2021 Hazardous Waste Scanning Project

File Form Naming Convention.

(*File_Type*).(*Program*).(*Site_Number*).(*YYYY-MM-DD*).(*File_Name*).pdf

Note 1: Each category is separated by a period "."
Note 2: Each word within category is separated by an underscore "_"

Specific File Naming Convention Label:

Report. HW. 915149. 1994-03-18. Feasability_Study .pdf

FINAL

FEASIBILITY STUDY REPORT

Prepared for:

SCOTT AVIATION
225 Erie Street
Lancaster, New York

Prepared by:

VERSAR, INC.
2010 Cabot Boulevard West
Langhorne, Pennsylvania 19047

March 18, 1994

FINAL

FEASIBILITY STUDY REPORT

OF

Prepared for:

SCOTT AVIATION
225 Erie Street
Lancaster, New York

Prepared by:

VERSAR, INC.
2010 Cabot Boulevard West
Langhorne, Pennsylvania 19047

March 18, 1994

CERTIFICATION

Pursuant to Section II (E) (4) of order on Consent Index No. B9-0377-91-06, entered into between the New York State Department of Environmental Conservation and Figgie International, the undersigned, a New York State licensed Professional Engineer with primary responsibility for performance of the Feasibility Study conducted at the Scott Aviation site in Lancaster, New York certifies that it was completed in accordance with the requirements of Consent Order B9-037791-06, Section IIE. All activities that comprised the Feasibility Study were performed in full accordance with the requirements of the Department approved workplan, Exhibit 2 of the referenced Consent Order.

3/16/94

Stephen M. Schwartz, P.E.

TABLE OF CONTENTS

TABLE OF CONTENTS
(Continued)

TABLE OF CONTENTS
(Continued)

Page

FIGURES

TABLES

APPENDICES

EXECUTIVE SUMMARY

Versar, Inc. conducted a Remedial Investigation/Feasibility Study (RI/FS) at Scott Aviation, Lancaster, Erie County, New York. The remedial investigation of the site was conducted during October and November 1992, with supplemental on-site work in August 1993. This document presents the basis and procedures used to identify, screen, and evaluate remedial action alternatives. The objective of this report is to provide sufficient information to select a cost-effective alternative that is protective of human health and the environment.

Based on the results of the site investigation the following areas of potential environmental concern were identified: (1) groundwater, and (2) subsurface soils. Based on the results of the *Standards, Criteria, and Guidances and Remedial Action Objectives Report*, August 1993, general response actions were identified for each of the above referenced operable units. For each operable unit, remedial technology types and process options were identified and screened with respect to implementability, effectiveness, and cost. The process options that passed initial screening were assembled into site-wide alternatives. The assembled alternatives were further evaluated with respect to seven evaluation criteria: (1) overall protectiveness, (2) compliance with ARARs, (3) long-term effectiveness, (4) reduction of toxicity, mobility, or volume, (5) short-term effectiveness, (6) implementability, and (7) cost. This evaluation process was initially carried out for each individual alternative and then a comparative analysis of each alternative with respect to the seven evaluation criteria was conducted.

Based on the above screening and evaluation procedure the following remedial action alternatives were determined to be the most feasible and cost-effective alternatives that provide adequate protection of human health and the environment and comply with SCGs:

- Removal of the contaminated soils from the general vicinity of the former underground storage tank (UST). The exact volumes to be excavated will be determined through the drilling and sampling of additional soil borings for further delineation of the horizontal and vertical extent of contamination at the source area.

- Treatment of excavated soils through either *ex situ* bioremediation or vapor extraction. A pilot scale bioremediation treatability study would be necessary to ensure that required treatment levels could be met. Ex-situ vapor extraction is an equally cost effective and well proven technology that can be implemented in a shorter time frame. Therefore, this latter technology is the preferred remedial alternative for the site.

- Relocation and redesign of the existing groundwater interception system to extract and treat or dispose of contaminated groundwater associated with possible residual subsurface soil contamination which may remain in the aquifer, subsequent to removal of the source area.

1.0 INTRODUCTION

1.1 Scope and Objective

This Feasibility Study (FS) Report presents the results of the development and screening of remedial alternatives for the Scott Aviation site and provides a detailed description of, and the rationale for selecting, the preferred remedial alternative. The FS Report has been prepared in accordance with the guidance provided by the U.S. Environmental Protection Agency document, *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA*, dated October 1988, and standard industry practices. The FS Report is presented in the following sections: (1) Background Information, (2) Identification and Screening of Technologies, (3) Development and Screening of Alternatives, (4) Detailed Analysis of Alternatives, and (5) Preferred Alternative.

1.2 Background Information

1.2.1 Site Description

Scott Aviation is a manufacturer of gas/vapor detection instruments, aviation products, and health and safety equipment. The facility is located approximately 7 miles east of Buffalo, in Lancaster, New York. Building No. 2 is a 43,000 square foot (approximate size) structure that was constructed in 1965. Used primarily for product development and manufacturing, Building No. 2 contains machine shops and an engineering laboratory. A concrete pad located west of Building No. 2 was used for the storage of metal cuttings and 55-gallon drums of cutting oils, lubricating oils, and solvents. A 3,000-gallon underground storage tank (UST) located beneath the concrete pad was used to store waste oil and spent chlorinated solvents produced during the manufacturing process.

1.2.2 Site History

In 1991, it was discovered that the 3,000-gallon underground tank had leaked. Subsequent field sampling revealed that the release had impacted on-site soils and groundwater west of Building No. 2. On June 4, 1992, Scott Aviation and the New York State Department of Environmental Conservation (NYSDEC) entered into an Administrative Order by Consent that required Scott Aviation to complete a Remedial Investigation and Feasibility Study (RI/FS).

Remedial investigation activities were initiated on October 26, 1992. The results of the RI are documented in a report entitled *Remedial Investigation Report*, dated November 1993. The *Risk Assessment*, August 1993, provides an assessment of the risks posed to human health and the environment. The *Standards, Criteria, and Guidances and Remedial Action Objectives Report*, August 1993, compares the contaminants of concern to Federal ARARs and State SCGs and develops a list of remedial action objectives for each medium of concern.

1.2.3 Site Assessment

The RI field activities were conducted initially during October and November 1992, with supplemental field work in August 1993. The RI consisted of a soil gas survey, the sampling and analysis of the surface water and stream sediments of the unnamed stream, the installation of two additional groundwater monitoring wells, the sampling and analysis of six monitoring wells (2 rounds), additional sampling and analysis of three of the monitoring wells, the installation of seven soil borings, the collection of ten subsurface soil samples, the collection of six surface soil samples, a residential well survey, a utilities survey, a habitat based assessment, and an air pathways analysis. A summary of activities and significant findings is presented in the following sections.

1.2.3.1 Groundwater

Groundwater investigation activities included the installation of two new monitoring wells and the sampling and analysis of groundwater from the two new wells and four existing wells. Initially in late 1992, two full rounds of groundwater sampling were conducted. Groundwater sampling revealed the presence of elevated levels of volatile organic compounds (VOCs) in the on-site and off-site monitoring wells in addition to the interception trench. The contaminants of potential concern included: 1,1-dichloroethane (DCA), chloroethane, 1,2-dichloroethylene (DCE), 1,1,1-trichloroethane (TCA), trichloroethylene (TCE), toluene, and vinyl chloride. Three of the wells were re-sampled in August 1993 to better define the extent of the groundwater plume. The plume appears to be moving very slowly in a west-northwesterly direction and extends from the former waste storage area approximately 100 feet to the west.

See pg. 2-10

Remedial investigation activities were initiated on October 26, 1992. The results of the RI are documented in a report entitled *Remedial Investigation Report*, dated November 1993. The *Risk Assessment*, August 1993, provides an assessment of the risks posed to human health and the environment. The *Standards, Criteria, and Guidances and Remedial Action Objectives Report*, August 1993, compares the contaminants of concern to Federal ARARs and State SCGs and develops a list of remedial action objectives for each medium of concern.

1.2.3 Site Assessment

The RI field activities were conducted initially during October and November 1992, with supplemental field work in August 1993. The RI consisted of a soil gas survey, the sampling and analysis of the surface water and stream sediments of the unnamed stream, the installation of two additional groundwater monitoring wells, the sampling and analysis of six monitoring wells (2 rounds), additional sampling and analysis of three of the monitoring wells, the installation of seven soil borings, the collection of ten subsurface soil samples, the collection of six surface soil samples, a residential well survey, a utilities survey, a habitat based assessment, and an air pathways analysis. A summary of activities and significant findings is presented in the following sections.

1.2.3.1 Groundwater

The installation of soil borings in the vicinity of the former UST indicated that the chlorinated solvent release had affected soil contamination to a depth proximal to the bedrock surface. TCE impacted groundwater originating from this source areas, therefore, migrates along both the upper and lower portions of the highly stratified sediments of the uppermost confined aquifer. This observation is significant in that any interception trench designed to extract contaminated groundwater form this aquifer must be capable of withdrawal whose zone of influence extend full to this underlying bedrock surface.

At the Scott Aviation site, an interception trench was installed in 1991 as an interim remedial measure (IRM). The trench was installed to penetrate only one to two feet below the top of the uppermost confined aquifer. This installation depth was intended to capture petroleum hydrocarbon type contaminants which typically have transport pathways along the top of the aquifer only. Subsequent groundwater sampling, however, revealed that the contaminants of concern were actually chlorinated solvents - contaminants having a density higher than water.

Groundwater investigation activities included the installation of two new monitoring wells and the sampling and analysis of groundwater from the two new wells and four existing wells. Initially in late 1992, two full rounds of groundwater sampling were conducted. Groundwater sampling revealed the presence of elevated levels of volatile organic compounds (VOCs) in the on-site and off-site monitoring wells in addition to the interception trench. The contaminants of potential concern included: 1,1-dichloroethane (DCA), chloroethane, 1,2-dichloroethylene (DCE), 1,1,1-trichloroethane (TCA), trichloroethylene (TCE), toluene, and vinyl chloride. Three of the wells were re-sampled in August 1993 to better define the extent of the groundwater plume. The plume appears to be moving very slowly in a west-northwesterly direction and extends from the former waste storage area approximately 100 feet to the west.

Successive rounds of groundwater sampling during the period 1991 to 1993 showed that TCE concentrations were consistently increasing in MW-4, the well located just downgradient of the interception trench, TCE concentration trends in this well indicate that contaminated groundwater may be bypassing the interception trench and flowing beneath its effective reach.

The TCE concentrations observed most recently (1993) in MW-4, located almost directly on the western site boundary, would suggest that the groundwater contaminant plume extends a slight distance off-site. However, the effects of TCE contamination do not appear to have reached MW-5 and MW-6 which are each located approximately 50 feet further downgradient than MW-4. well screens in MW-5 and MW-6 are set within one to two feet of the bedrock surface. The fact that TCE impact have not been recognized in these wells indicate that no dense non-aqueous phase liquids (DNAPLs) are migrating along the bedrock surface. Therefore, no additional groundwater monitoring wells or groundwater sampling has been scheduled to further evaluate this potential transport pathway.

1.2.3.2 Subsurface Soils

In order to investigate subsurface soils, six soil borings were advanced and ten subsurface soil samples were collected and analyzed. An additional boring was advanced to collect soil samples for bioremediation and thermal desportion treatability studies. This boring was drilled at a location near RP-5, a riser pipe at the east side of the existing groundwater interception trench. The subsurface soil sampling confirmed the presence of VOC contamination in the former waste storage area. Subsurface soil contaminants of concern included: 1,1-DCA, 1,2-DCE, 1,1,1-TCA, TCE, toluene, ethylbenzene, xylene, and 2-butanone. The subsurface soil contamination was found to extend vertically from an approximate depth of 2 feet to 18 feet and laterally from the former waste storage area to the western property boundary.

1.2.3.3 Surface Soils

A total of six surface soil samples were collected during the site investigations. The surface soil sampling results indicated that the lowlands located north of the former waste storage area have not been impacted. Based on the surface soil sampling results, it was concluded that there is no transport pathway between the former storage pad and the lowlands.

1.2.3.4 Surface Water and Sediments

Surface water and sediment samples were collected from three locations along the unnamed stream. Surface water and sediment analytical results indicated that site-related activities have not impacted the unnamed stream. This finding is consistent with hydrogeologic findings, which concluded that there is not a hydraulic relationship between surface water and groundwater.

1.2.4 Baseline Risk Assessment

A semi-quantitative risk assessment was conducted for the Scott Aviation site and documented in a report entitled *Risk Assessment*, August 1993. The risk assessment consisted of the identification of potential contaminants of concern and an evaluation of potential health risks associated with exposure to groundwater and subsurface soils. Volatile organic compounds and a limited number of metals were identified as potential contaminants of concern. Exposure pathways evaluated included the hypothetical future residential use of groundwater as a potable water source and commercial worker exposure to subsurface soils. Both exposure scenarios are considered possible, but highly unlikely. Exposure to site surface soils was not evaluated since surface soil concentrations were below background levels. There were no complete human exposure pathways identified for surface water and sediments.

Preliminary remediation goals (PRGs) were calculated using toxicity information obtained from IRIS and HEAST for hypothetical future on-site residents and construction workers. The PRGs were compared to maximum site concentrations to determine if site related compounds pose an unacceptable carcinogenic risk or noncarcinogenic hazard. The maximum concentration of vinyl chloride in groundwater was above the PRG for an acceptable carcinogenic risk (i.e., risk exceeded 10^{-4}) for the ingestion of groundwater by hypothetical future residential users. Dichloroethylene and dichloroethane concentrations in subsurface soil exceeded the PRG for the threshold hazard index (e.g., greater than 1.0) for dermal contact with subsurface soils for a hypothetical on-site construction worker. Although contaminant concentrations in soil and groundwater exceed PRGs, the exposure pathways evaluated are considered highly improbable. Based on poor aquifer characteristics and the availability of a public water supply, it is highly unlikely that a future on-site resident would utilize the uppermost confined aquifer as a source of potable water. Maximum contaminant concentrations in the subsurface soil were detected at maximum depths of 18 feet below grade, which is well below the top of the uppermost confined aquifer. Due to physical and structural constraints it is an unlikely scenario that excavations to these depths will occur in the future.

1.2.5 Standards, Criteria, and Guidances

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), requires that remedial cleanup actions comply with Federal and State environmental laws. Remedial cleanup actions must satisfy requirements that are applicable, or relevant and appropriate to the hazardous substances or to the circumstances of the release. Because the New York State Standards, Criteria and Guidelines (SCGs) include applicable and relevant or appropriate federal standards, references to environmental requirements or standards will be termed SCGs. SCGs for the Scott Aviation site were identified and documented in a report entitled, *Standards, Criteria, and Guidances and*

Remedial Action Objectives Report, August 1993. The following sections provide a summary of SCGs developed for groundwater and subsurface soils. Stream sediments, surface water, and surface soils have been eliminated from further consideration, because the site investigation and subsequent risk assessment revealed no evidence of site-related impacts to any of these media.

1.2.5.1 Groundwater

The only chemical-specific SCGs identified that are applicable to the Scott Aviation site are the NYSDEC Groundwater Quality Regulations (6 NYCRR Parts 700-705). In accordance with 6 NYCRR Part 701.15, the uppermost confined aquifer is classified as Class GA fresh groundwaters and the best usage is as a source of potable water supply. Maximum contaminant levels found in regulations promulgated under the Safe Drinking Water Act (40 CFR 141) and maximum concentration limits found in regulations promulgated under the Resource Conservation and Recovery Act (40 CFR 264) are relevant and appropriate but not applicable. On the state level, the Organic Chemical Action Steps for Drinking Water and Part 5 of the State Sanitary Code for Drinking Water Supplies are relevant and appropriate but not applicable since the aquifer investigated does not support any local drinking water supplies. The NYSDEC Groundwater Quality Regulations are at least as stringent and are sometimes more stringent than these standards. Other guidance values which are not promulgated regulations that should be considered include: Technical and Operations Guidance Series (TOGS) - 1.1.1 April 1987 - *Ambient Water Quality Standards and Guidance Values*; TOGS - 2.1.3 October 1993 - *Primary and Principal Aquifer Determinations*; Technical and Administrative Guidance Memorandum (TAGM) - *Determinations of Soil Cleanup Objectives and Cleanup Levels*, November 1992; and NYSDEC Draft Cleanup Policy and Guidelines, October 1991.

Each of the above mentioned SCGs were considered to determine appropriate action levels for groundwater at the Scott Aviation site. Since the NYSDEC Groundwater Quality Regulations are the only SCGs that are applicable to the site and are at least as stringent as, and sometimes more stringent than, all other standards, the concentrations of VOCs detected in the uppermost confined aquifer have been compared to NYSDEC Groundwater Quality Regulations (6 NYCRR Parts 700-705), effective date September 1, 1991.

1.2.5.2 Subsurface Soils

There are no promulgated State or Federal regulations regarding the cleanup of soil. Therefore, there are no applicable or relevant and appropriate chemical-specific SCGs for subsurface soils. The following SCGs were considered in the determination of soil cleanup action levels: Technical and Administrative Guidance Memorandum (TAGM) - *Determinations of Soil Cleanup Objectives and Cleanup Levels*, November 1992; NYSDEC Draft Cleanup Policy and Guidelines, October 1991; Proposed Resource Conservation and Recovery Act (RCRA) Corrective Action for Solid Waste Management Units at Hazardous Waste Management Facilities, July 1990; *RCRA Facility Investigation (RFI) Guidance Volume 1 of 4*, May 1989; and U.S. Environmental Protection Agency (U.S. EPA), *Determining Soil Response Action Levels Based on Potential Contaminant Migration to Groundwater: A Compendium of Examples*, October 1989.

Because there are no promulgated soil standards, standards based on the protection of human health and the protection of groundwater were both evaluated. In accordance with U.S EPA guidance (October 1989) and the NYSDEC TAGM (November 1992), water-soil equilibrium partition theory was used as a basis to determine soil cleanup action levels for the protection of groundwater. This method establishes an acceptable soil concentration based on the ability of organic carbon to adsorb contamination, using an acceptable water quality criteria.

The RFI Guidance (May 1989) provides health-based soil criteria for systemic toxicants and carcinogens based on the ingestion of contaminated soil. These guidelines are generally used for contaminated soil found from 0-2 feet below grade. Although the soil contamination at the Scott Aviation site is highest at depth greater than 2 feet, these standards were considered as a worst case scenario for risks to human health.

1.2.6 Remedial Action Objectives

Remedial action objectives (RAOs) define goals for the protection of human health and the environment on a media specific or operable unit specific basis. RAOs should set forth: (1) the contaminants of concern, (2) exposure pathways and receptors, and (3) appropriate remedial response. The following sections provide a brief summary of the RAOs developed for each of the operable units identified at the Scott Aviation site. The discussion is limited to groundwater and subsurface soil only, because previous data evaluations identified these media as the only media of concern at the site. A detailed discussion of RAOs is presented in *Standards, Criteria, and Guidances and Remedial Action Objectives Report*, August 1993.

1.2.6.1 Groundwater

Groundwater samples were collected from six monitoring wells screened in the uppermost confined aquifer during the Remedial Investigation. The sampling results and the comparison of data with background concentrations and SCGs suggested the following contaminants of concern needed to be evaluated: chloroethane, 1,1-dichloroethane, 1,2-dichloroethylene (total), 1,1,1-trichloroethane, trichloroethylene, toluene, and vinyl chloride. Potential exposure pathways for groundwater are ingestion of groundwater by a hypothetical resident. Currently, there are no receptors for the groundwater ingestion pathway, since the uppermost confined aquifer is not used as a source of potable water. Future receptors for this pathway are limited to a hypothetical on-site residential user of the uppermost confined aquifer; however, this scenario is unlikely because of the high turbidity and low yield potential of the aquifer. Based on the data analysis, the following remedial action objective for groundwater has been identified: Prevent ingestion of groundwater that exceeds NYSDEC groundwater quality standards.

1.2.6.2 Subsurface Soils

Subsurface soil samples were collected from six soil borings at various depths ranging from 0-2 feet to 16-18 feet. The results of the soil sampling and subsequent comparison with background levels and SCGs revealed the following list of soil contaminants of concern: 1,1-dichloroethane, 1,2-dichloroethylene (total), 1,1,1-trichloroethane, trichloroethylene, toluene, ethylbenzene, and xylene. Potential exposure pathways for subsurface soils are the ingestion/dermal contact of contaminated soils and the migration of contaminants from the subsurface soils to the uppermost confined aquifer. Potential receptors for the ingestion/dermal contact pathway include: an on-site worker (present and future), an on-site trespasser (present and future), and a hypothetical future on-site resident. Since the highest concentrations of soil contaminants were detected at a depth of 16-18 feet, the only likely dermal exposure scenario is for a future construction worker in a situation where excavation to that depth is required. Receptors for the migration of soil contaminants to the uppermost confined aquifer include all the receptors identified for groundwater. The following remedial action objective for subsurface soil has been identified: Prevent the ingestion and inhalation of and dermal contact with contaminated soils that pose an unreasonable risk to human health.

2.0 IDENTIFICATION AND SCREENING OF TECHNOLOGIES

2.1 Identification of Operable Units

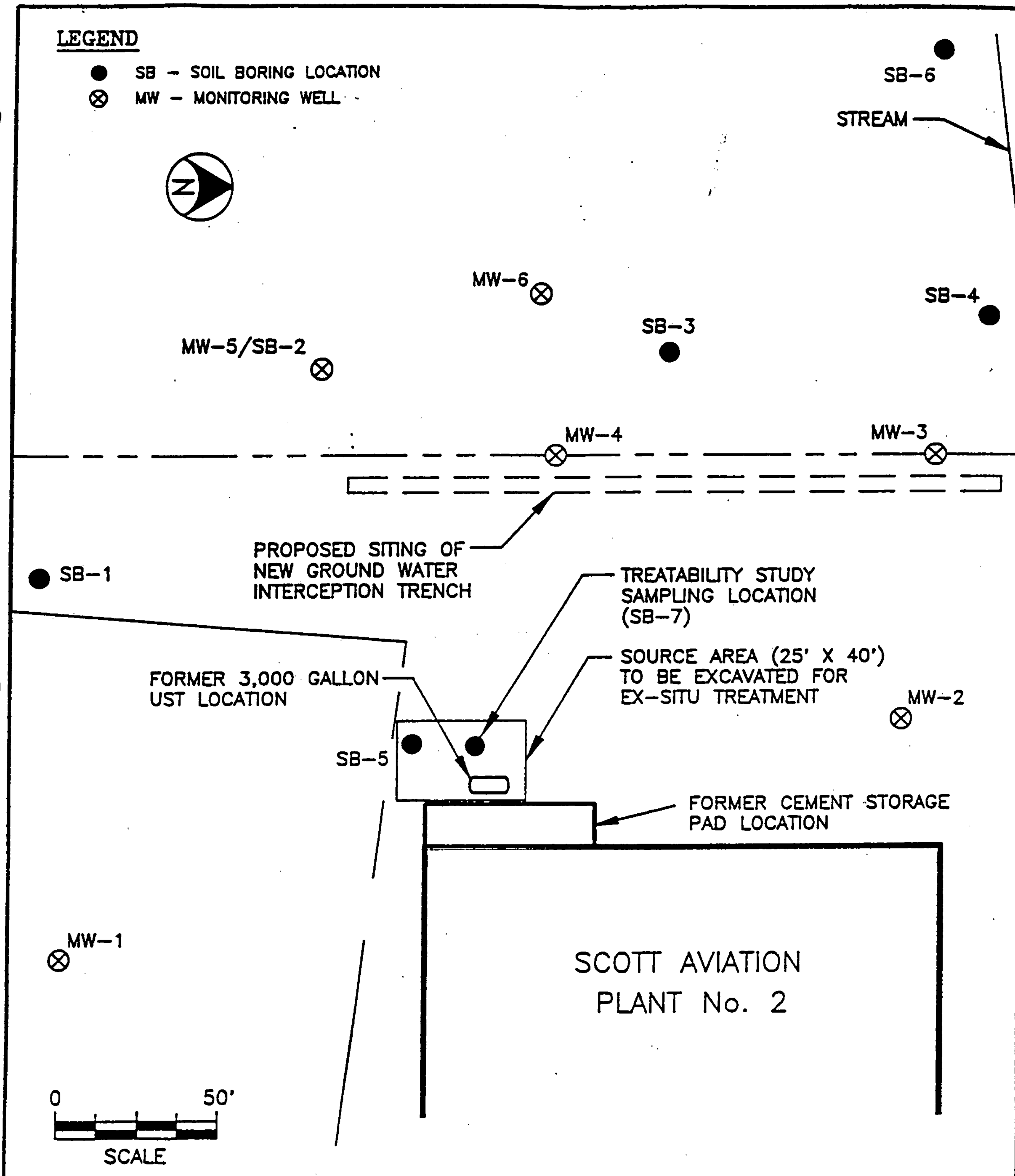
Operable units represent volumes or areas of media to which general response actions may be applied. Based on data obtained during the remedial investigation, the following operable units have been identified: (1) groundwater and (2) subsurface soils.

2.2 General Response Actions

General response actions (GRAs) are developed for each medium or operable unit defining potential treatment, resource recovery, and containment technologies that will satisfy the RAOs previously developed (*Standards, Criteria and Guidances and Remedial Action Objectives Report, August 1993*). For each GRA, the media-specific areas or volumes that they will be applied to should be defined. The areas or media are often refined as alternatives are assembled to reflect interactions between different media. The National Contingency Plan (NCP) requires that a "No Action" GRA be considered for each operable unit to determine a baseline to which other remedial actions can be compared.

2.2.1 Subsurface Soils

Subsurface soil sampling confirmed the presence of elevated levels of VOCs in on-site soils. The contaminants of concern include: 1,1-DCA, 1,2-DCE, 1,1,1-TCA, TCE, toluene, ethylbenzene, xylene, and 2-butanone. A former 3,000-gallon UST has been identified as the source of the contamination. It is estimated that the former UST location and surrounding media comprise a source area of approximately 1,000 ft^2 and extend to an approximate depth of 20 feet below grade. The source area was established based on the locations of soil boring SB-5, the treatability study soil boring (SB-7), and the former UST/waste storage pad (see Figure 1). This initial delineation of the source area was accomplished using all surface and subsurface soil analytical data presented in the final site Remedial Investigation Report (November 1993). The volume of soil contained within the source area is estimated to be 750 $yards^3$ (approximately 1,125 tons assuming 1.5 tons of soil/yd^3).



Versar INC.
2010 CABOT BLVD
LANGHORNE, PA 19047
(215) 741-4211

SCOTT AVIATION, LANCASTER, NY

FIGURE 1

LOCATION OF PROPOSED REMEDIAL ACTIONS
NOVEMBER – 1993

A more complete delineation of the source area is planned prior to final remedial design for the Scott Aviation site. A grid of soil borings will be advanced in the area between the former UST and the western property boundary. Soil samples acquired during delineation sampling will be screened with a photo-ionization detector (PID) prior to laboratory analysis. Based on field observations from previous sampling activities in the vicinity of the source area, a PID cut-off point of 50 ppm will be used to select those samples which are to be analyzed. The parameter list for sample analysis will include: TCE, 1,1,1-TCA, 1,1-DCA, 1,2-DCE, chloroethane and vinyl chloride. Based upon the analytical results, the volume of soil to be excavated may change.

Site specific technical considerations that must be taken into account during the evaluation of technologies include: the location of the existing interception trench with respect to the extent of contamination, the depth of soil contamination relative to the aquifer, space limitations, and structural concerns near the building.

The following GRAs will be evaluated:

- No Action
- Source Removal
- On-site Treatment
- Off-site Disposal

2.2.2 Groundwater

Elevated levels of VOCs, including DCA, chloroethane, DCE, TCA, TCE, toluene, and vinyl chloride, were detected in on-site and off-site monitoring wells and the on-site interception trench. The highest levels of contamination were detected in the on-site interception trench. Metals in groundwater were not identified as site-related contaminants of concern, but the evaluation of treatment technologies should take the presence of metals in suspended material (e.g., undissolved) into consideration. Hydraulic data indicates that the contaminant plume is moving very slowly in a westerly direction from the former waste storage pad/tank toward the property boundary. GRAs for the site will address the area between the source area and the ~~property boundary~~. The *SCGs and RAOs Report* indicated that in order to achieve RAOs for groundwater, the soils in the source area should be remediated and the interception trench should continue to be operated. Once

extent of contamination
Trench will collect GW from both on & off-site.

down gradient limit of GW contamination plume which is located between monitoring wells MW-2-3 and MW-6

A more complete delineation of the source area is planned prior to final remedial design for the Scott Aviation site. A grid of soil borings will be advanced in the area between the former UST and the western property boundary. Soil samples acquired during delineation sampling will be screened with a photo-ionization detector (PID) prior to laboratory analysis. Based on field observations from previous sampling activities in the vicinity of the source area, a PID cut-off point of 50 ppm will be used to select those samples which are to be analyzed. The parameter list for sample analysis will include: TCE, 1,1,1-TCA, 1,1-DCA, 1,2-DCE, chloroethane and vinyl chloride. Based upon the analytical results, the volume of soil to be excavated may change.

Site specific technical considerations that must be taken into account during the evaluation of technologies include: the location of the existing interception trench with respect to the extent of contamination, the depth of soil contamination relative to the aquifer, space limitations, and structural concerns near the building.

The following GRAs will be evaluated:

- No Action
- Source Removal
- On-site Treatment
- Off-site Disposal

2.2.2 Groundwater

Elevated levels of VOCs, including DCA, chloroethane, DCE, TCA, TCE, toluene, and vinyl chloride, were detected in on-site and off-site monitoring wells and the on-site interception trench. The highest levels of contamination were detected in the on-site interception trench. Metals in groundwater were not identified as site-related contaminants of concern, but the evaluation of treatment technologies should take the presence of metals in suspended material (e.g., undissolved) into consideration. Hydraulic data indicates that the contaminant plume is moving very slowly in a westerly direction from the former waste storage pad/tank toward the property boundary. GRAs for the site will address the area between the source area and the downgradient limit of the groundwater contaminant plume which is located between monitoring wells MW-4 and MW-6. The *SCGs and RAOs Report* indicated that in order to achieve RAOs for groundwater, the soils in the source area should be remediated and the interception trench should continue to be operated. Once the source of contamination is removed, no further leaching of contaminants to the groundwater is anticipated.

The following GRAs will be evaluated for this operable unit.

- No Action
- Treatment (on-site)
- Off-site Treatment/Disposal

2.3 Identification and Screening of Technology Types and Process Options

2.3.1 Identification and Screening of Technologies

In this section, the universe of potentially applicable technology types and process options will be identified for general response actions identified for the following operable units: groundwater and subsurface soils. The term "technology type" refers to general categories of technologies (e.g., chemical treatment), while the term "process option" refers to specific processes within each technology type (e.g., precipitation is the chemical treatment type). In this section, technology types and process options are initially reduced by evaluating them with respect to technical implementability.

2.3.1.1 Soils

A summary of GRAs, technology types, process options, and initial screening comments for the soil pathway is presented in Table 2-1. A detailed discussion of each of the technology types and corresponding process options identified is provided below.

<u>No Action</u> - The no action alternative will be carried through the detailed analysis to form a baseline of comparison.

<u>Source Removal</u> - The soils that have been contaminated as a result of the tank release have been identified as the source of the contamination. The maximum levels of soil contamination were detected at an approximate depth of 18 feet, which is well below the surface of the groundwater table. Therefore, the source area (i.e., the subsurface soils) is currently acting as a continuing source of contamination. The source removal option will consist of the removal or treatment of the contaminated subsurface soil. This option is potentially applicable, but will be addressed through specific treatment options.

the source of contamination is removed, no further leaching of contaminants to the groundwater is anticipated.

The following GRAs will be evaluated for this operable unit.

- No Action
- Treatment (on-site)
- Off-site Treatment/Disposal

2.3 Identification and Screening of Technology Types and Process Options

2.3.1 Identification and Screening of Technologies

In this section, the universe of potentially applicable technology types and process options will be identified for general response actions identified for the following operable units: groundwater and subsurface soils. The term "technology type" refers to general categories of technologies (e.g., chemical treatment), while the term "process option" refers to specific processes within each technology type (e.g., precipitation is the chemical treatment type). In this section, technology types and process options are initially reduced by evaluating them with respect to technical implementability.

2.3.1.1 Soils

A summary of GRAs, technology types, process options, and initial screening comments for the soil pathway is presented in Table 2-1. A detailed discussion of each of the technology types and corresponding process options identified is provided below.

<u>No Action</u> - The no action alternative will be carried through the detailed analysis to form a baseline of comparison.

<u>Source Removal</u> - The soils that have been contaminated as a result of the tank release have been identified as the source of the contamination. The maximum levels of soil contamination were detected at an approximate depth of 18 feet, which is well below the surface of the groundwater table. Therefore, the source area (i.e., the subsurface soils) is currently acting as a continuing source of contamination. The source removal option will consist of the removal or treatment of the contaminated subsurface soil. This option is potentially applicable, but will be addressed through specific treatment options.

TABLE 2-1
INITIAL SCREENING OF
TECHNOLOGIES FOR SOILS

SUBSURFACE SOIL GENERAL RESPONSE ACTIONS	TECHNOLOGY TYPES	PROCESS OPTIONS	DESCRIPTIONS	SCREENING COMMENTS
No Action	N/A	N/A	N/A	Potentially Applicable
Source Removal	Removal/Treatment	See On-site Treatment Options	The soils that have been contaminated as a result of the tank release will be excavated and treated using one of the on-site treatment technologies.	Potentially Applicable
On-site Treatment	Biological Treatment	In-situ Bioremediation	The contaminated media is treated through the use of microbial degradation by the introduction of bacterial strains and nutrients directly into the native soil column.	This process is not applicable due to the predominance of clay in on-site soils.
		Ex-situ Bioremediation	The contaminated media is excavated and treated through biological degradation in a reactor vessel or soil layer.	Potentially Applicable
	Physical Treatment	Soil Flushing	Organic and inorganic contaminants are separated from the soil using an in-situ washing solution (e.g., solvent, acid, surfactant).	This process is not applicable due to the predominance of clay in on-site soils.
		Soil Washing	Soils are excavated and treated in a soil washer in order to separate inorganic or organic contaminants from the soil.	This process is not applicable due to the predominance of clay in soils.
		Soil Vapor Extraction	This process consists of the in-situ extraction of volatile organic vapors from the contaminated soil.	This process is not applicable due to the predominance of clay in soils.
		Enhanced Permeability Extraction	This process combines pneumatic fracturing with the conventional vapor extraction process and has been found effective, under certain site-specific conditions, for the treatment of low permeability soils.	This process has not been well proven in the field and would require pilot scale studies to determine applicability. This option will not be retained.

TABLE 2-1
INITIAL SCREENING OF
TECHNOLOGIES FOR SOILS (CONTINUED)

SUBSURFACE SOIL GENERAL RESPONSE ACTIONS	TECHNOLOGY TYPES	PROCESS OPTIONS	DESCRIPTIONS	SCREENING COMMENTS
		Vapor Extraction/Hot Air Injection/Chemical Oxidation	This process is a modification or enhancement of the conventional vapor extraction process and has been found effective for the treatment of low permeability soils, when coupled with enhancement of soil permeabilities.	This process has not been well proven in the field and would require pilot scale studies to determine applicability. This option will not be retained.
		Ex-situ Vapor Extraction	This process is similar to the conventional in-situ vapor extraction process, however the treatment is conducted in an above-grade treatment cell.	This process can accommodate the treatment of low permeability soil and is potentially applicable to the site.
	Thermal Treatment	Low Temperature Thermal Desorption	Volatile and semi-volatile organic compounds are vaporized through the application of heat. The process is typically conducted ex-situ.	Potentially Applicable
	Stabilization	Lime-based/Portland cement - based solidification	Soil is stabilized/solidified with a silicious material or portland cement	Based on the high water table, the presence of clays, and the organic nature of the waste, this option will not be retained.
		Vitrification	Wastes are converted into a glassy substance using high temperatures	This process is not applicable because it has not been well proven, is energy intensive, and may cause contaminants to migrate outside treatment area.
Excavation/Off-site Disposal	Off-site Treatment	RCRA Facility	Excavated soil will be transported to a RCRA facility for treatment and disposal.	Potentially Applicable

Biological Treatment

In Situ **Bioremediation** consists of the treatment of contaminated media through the use of microbial degradation. For *in situ* bioremediation, bacterial strains and nutrients are introduced directly into the native soil column. Aerobic degradation is typically the controlling process for *in situ* biological treatment. The process is applicable to the treatment of petroleum products, halogenated organics, and complex organic compounds. The effectiveness of bioremediation is highly dependent on site specific conditions such as extent and location of contamination and the physical properties of the soil. Bioremediation is best suited to soils with high permeability, neutral pH, and a moisture content of 50 to 75 percent. Low permeability soils, such as clays, limit achievable treatment levels due to sorption and poor mixing. Data from a bench scale treatability study performed have indicated that due to the high clay content of site soils, the uniform distribution of nutrients via air or aqueous injection needed to enhance natural microbial populations would be difficult, if not impossible, to achieve. This option will not be retained.

Ex Situ Bioremediation consists of the excavation of the contaminated soil and subsequent treatment through biological degradation in a reactor vessel or a soil layer of specified thickness. This technology has been demonstrated to be effective for the treatment of chlorinated hydrocarbons and will be retained for further evaluation.

Physical Treatment

Soil Flushing is an *in situ* aqueous based technology that uses a washing solution (e.g., acid, surfactant, or solvent) to separate organic and inorganic contaminants from soil. Typically, the area to be treated is flooded with the washing solution, and the elutriate is collected in a series of shallow wellpoints or subsurface drains. The elutriate is treated and/or recycled back into the soil. The performance of this technology is dependent on the amount of contact achieved between the flushing solution and the contaminants. The process is most effective in highly permeable soils. Contaminants in fine-grained soils, such as clay and silt, are very difficult to remove because of sorption. Based on split-spoon sampling and slug testing, these types of soils are common at the Scott Aviation site, particularly in the source area and contiguous with MW-4. This process will have limited effectiveness at the Scott Aviation site, due to the predominance of clays throughout the soil column. This option will not be retained.

Soil Washing is an *ex situ* process whereby soils are excavated and treated in a soil washer. As in soil flushing, the process consists of the separation of organic or inorganic contaminants from the soil using a washing solution. This process is also limited by the physical properties of the soil (i.e., it is best suited to highly permeable soils). Additionally, a residual washing solution is generated that will require further treatment. Due to the presence of silt and clay in site soils, both of which were frequently observed during split-spoon sampling and slug testing, this option will not be retained.

Soil Vapor Extraction is an *in situ* process that involves the extraction of volatile organic vapors from contaminated soil. A typical installation consists of a series of injection wells placed around the site perimeter and gas extraction wells placed in the center of the area. The contaminants are desorbed and volatilized from the soil. The contaminated air stream is collected and treated to remove VOCs. This process may also be enhanced to extract contaminated groundwater along with the air stream. The use of vapor extraction is typically limited to permeable unsaturated soils. However, a number of process variations have been demonstrated.

Enhanced Permeability Extraction, has been found effective for the treatment of low permeability soils. This process combines the vapor extraction process with pneumatic fracturing. Conductive channels are created within the vadose zone using pneumatic fracturing and thus increasing the surface area of the contaminated soil. However, the enhanced permeability extraction methodology is not well suited to the contaminant distribution in the soils at the Scott site, particularly in the source area where the highest concentrations of VOCs occur in the basal portions of the aquifer.

Another variation of the soil vapor extraction process consists of **Vapor Extraction, Hot Air Injection, and Chemical Oxidation**. As with Enhanced Permeability Extraction, this process is not likely to be effective in treating the high concentrations of VOCs which occur under saturated conditions near the base of the aquifer. The conventional soil vapor extraction process and the enhanced permeability extraction options will be eliminated from further consideration.

Ex situ Vapor Extraction operates principally the same as in situ soil vapor extraction, however, the volatile organic vapors are removed from the soil in an above-grade soil treatment cell. A typical installation consists of the excavation of the contaminated soil in lifts and subsequent placement in a lined treatment cell. A series of perforated pipes are placed on top of each lift. The pipes are connected through a series of manifolds to a blower, which draws the contaminated vapors through the soil pile. The contaminated air is generally treated with vapor phase granular activated carbon. This technology is very effective for the treatment of volatile organic compounds. Conditioning of the soil prior to treatment is required for soils with high clay content. This option is potentially applicable.

Thermal Treatment

Low Temperature Thermal Desorption is a process in which heat is used to vaporize volatile and semi-volatile organic compounds in soil or sludge. The contaminants are desorbed from the material being treated and collected in a separate chamber to be condensed and recovered or incinerated. This process has been well demonstrated for the treatment of a wide variety of volatile and semi-volatile organic compounds. The process can be conducted *in situ*, but is typically done *ex situ*. This option is potentially applicable.

Stabilization

Lime-based/Portland Cement-based Stabilization is a process in which contaminated soils are mixed with Portland cement or siliceous materials to form a granular or solid matrix. This process is effective for the treatment of metal cations, but high concentrations of sulfates and metallic anions may hamper solidification. This process has been demonstrated to be effective for the treatment of organics under certain controlled conditions, but generally, organics do not stabilize, impede setting, and decrease long-term stability. Long term stability and resistance to leaching is not well known for all waste types. Clays and lignins may also impede the setting time. If the water table is high, dewatering may be required. Based on the high water table at the site, the presence of clays, and the organic nature of the waste, this process will not be retained.

1. (Page 2-10) - insert in place of last sentence:

The installation of soil borings in the vicinity of the former UST indicated that the chlorinated solvent release had affected soil contamination to a depth proximal to the bedrock surface. TCE impacted groundwater originating from this source area, therefore, migrates along both the upper and lower portions of the highly stratified sediments of the uppermost confined aquifer. This observation is significant in that any interception trench designed to extract contaminated groundwater from this aquifer must be capable of withdrawals whose zone of influence extend fully to this underlying bedrock surface.

Should this be this section instead of pg 2-10? of pg 1-2

At the Scott Aviation site, an interception trench was installed in 1991 as an interim remedial measure (IRM). The trench was installed to penetrate only one to two feet below the top of the uppermost confined aquifer. This installation depth was intended to capture petroleum hydrocarbon type contaminants which typically have transport pathways along the top of the aquifer only. Subsequent groundwater sampling, however, revealed that the contaminants of concern were actually chlorinated solvents - contaminants having a density higher than water.

Successive rounds of groundwater sampling during the period 1991 to 1993 showed that TCE concentrations were consistently increasing in MW-4, the well located just downgradient of the interception trench. TCE concentration trends in this well indicate that contaminated groundwater may be bypassing the interception trench and flowing beneath its effective reach.

The TCE concentrations observed most recently (1993) in MW-4, located almost directly on the western site boundary, would suggest that the groundwater contaminant plume extends a slight distance off-site. However, the effects of TCE contamination do not appear to have reached MW-5 and MW-6 which are each located approximately 50 feet further downgradient than MW-4. Well screens in MW-5 and MW-6 are set to within one to two feet of the bedrock surface. The fact that TCE impacts have not been recognized in these wells indicate that no dense non-aqeous phase liquids (DNAPLs) are migrating along the bedrock surface. Therefore, no additional groundwater monitoring wells or groundwater sampling has been scheduled to further evaluate this potential transport pathway.

The low hydraulic conductivites at thte site are manifested in equivalently low well yields from existing monitoring wells. This observation was borne out by pre-sampling well purging results during the remedial investigation. Certain wells, notably MW-4, bailed dry following the removal of only two casing volumes, producing as little as 11 gallons of total fluids.

Physically, the extremely low well yields in the dense impermeable site soils means that the effective radius of the area being drained around these wells is measurable in terms of a few feet. Therefore, from a cost perspective, it becomes impractical to extract contaminated groundwater from the entire area underlain by the groundwater contaminant plume due to the sheer number of wells which would be required to accomplish this. A properly designed and installed interception trench is a much more effective means of removing and treating the requisite volumes of contaminated groundwater. Based on these considerations, the pumping option will not be retained.

Vitrification is a process which converts wastes into a stable glassy substance by the application of very high temperatures. The heat causes a melting effect that gradually works down through the soils. This process was originally used to stabilize radioactive wastes. This process has not been well demonstrated in the field, it is very energy intensive, and may cause contaminants to migrate to the outer boundary of the treatment area. Water in soils affects the operational time and increase costs. This process will not be retained.

Excavation/Off-site Treatment - The contaminated soil would be excavated and transported to an off-site treatment, storage, and disposal facility for ultimate treatment and disposal. This option is potentially applicable.

2.3.1.2 Groundwater

A summary of GRAs, technology types, process options, and initial screening comments for the groundwater pathway is presented in Table 2-2. A detailed discussion of each technology type and corresponding process options is provided below.

No Action - The no action alternative will be carried through the detailed analysis of alternatives to form a baseline of comparison.

Monitoring - Long-term groundwater monitoring will be conducted to determine if there have been any significant changes in the concentration and magnitude of groundwater contamination or groundwater flow pattern. This option is potentially applicable.

Groundwater Pumping - Groundwater pumping can be used to modify groundwater levels and flow direction, to prevent the migration of a plume (e.g., form a hydraulic barrier), or to extract contaminated groundwater (e.g., pump and treat). The same basic limitations and design requirements are applicable to the design of a hydraulic barrier or a pump and treat system. The effectiveness of groundwater pumping is dependent on the rate of flow and the pumping rate. The hydraulic conductivity in the area of concern is estimated to range from 6.7×10^{-5} to 1.6×10^{-4} cm/sec. Based on the low hydraulic conductivity, this option will not be retained.

Vitrification is a process which converts wastes into a stable glassy substance by the application of very high temperatures. The heat causes a melting effect that gradually works down through the soils. This process was originally used to stabilize radioactive wastes. This process has not been well demonstrated in the field, it is very energy intensive, and may cause contaminants to migrate to the outer boundary of the treatment area. Water in soils affects the operational time and increase costs. This process will not be retained.

Excavation/Off-site Treatment - The contaminated soil would be excavated and transported to an off-site treatment, storage, and disposal facility for ultimate treatment and disposal. This option is potentially applicable.

2.3.1.2 Groundwater

A summary of GRAs, technology types, process options, and initial screening comments for the groundwater pathway is presented in Table 2-2. A detailed discussion of each technology type and corresponding process options is provided below.

No Action - The no action alternative will be carried through the detailed analysis of alternatives to form a baseline of comparison.

Monitoring - Long-term groundwater monitoring will be conducted to determine if there have been any significant changes in the concentration and magnitude of groundwater contamination or groundwater flow pattern. This option is potentially applicable.

Groundwater Pumping - Groundwater pumping can be used to modify groundwater levels and flow direction, to prevent the migration of a plume (e.g., form a hydraulic barrier), or to extract contaminated groundwater (e.g., pump and treat). The same basic limitations and design requirements are applicable to the design of a hydraulic barrier or a pump and treat system. The effectiveness of groundwater pumping is dependent on the rate of flow and the pumping rate. The hydraulic conductivity in the area of concern is estimated to range from 6.7×10^{-5} to 1.6×10^{-4} cm/sec. The low hydraulic conductivities at the site are manifested in equivalently low well yields from existing monitoring wells. This observation was borne out by pre-sampling well purging results during the remedial investigation. Certain wells, notably MW-4, bailed dry following the removal of only two casing volumes, producing as little as 11 gallons of total fluids.

Physically, the extremely low well yields in the dense impermeable site soils means that the effective radius of the area being drained around these wells is measurable in terms of a few feet. Therefore, from a cost perspective, it becomes impractical to extract contaminated groundwater from the entire area underlain by the groundwater contaminant plume due to the sheer number of wells which would be required to accomplish this. A properly designed and installed interception trench is a much more effective means of removing and treating the requisite volumes of contaminated groundwater. based on these considerations, the pumping option will not be retained.

TABLE 2-2
INITIAL SCREENING OF TECHNOLOGIES FOR GROUND WATER

Shading indicates option has not been retained.

GROUNDWATER GENERAL RESPONSE ACTIONS	TECHNOLOGY TYPES	PROCESS OPTIONS	DESCRIPTIONS	SCREENING COMMENTS
No Action	N/A	N/A	N/A	Potentially Applicable
Institutional Controls	Monitoring	Monitoring	Ongoing monitoring of wells	Potentially Applicable
Collection/Containment	Ground Water Pumping	Extraction wells	Ground water pumping can be conducted to adjust water levels and prevent plume migration or extract contaminated groundwater.	This option is not applicable due to the low hydraulic conductivity measured at the site.
	Subsurface Drains	Interception Trench	A series of perforated pipes used to collect groundwater.	Potentially Applicable
Treatment (on-site)	Physical	Air Stripping	A mass transfer process where volatiles are evaporated into the air.	Potentially Applicable (pretreatment and off-gas treatment may be required)
		Carbon Adsorption	The adsorption of contaminants on activated carbon.	Potentially Applicable
	Biological	Aerobic	Degradation of organics using microorganisms in an aerobic environment.	Not recommended for the treatment of chlorinated compounds in water.
		Anaerobic	Degradation of organics using microorganisms in an anaerobic environment	Not well proven for the treatment of chlorinated compounds in water.
	Chemical	Chemical Precipitation	A pH adjustment process used to remove metals.	Potentially Applicable for pretreatment but not for the removal of organics.

Shading indicates option has not been retained.

TABLE 2-2
INITIAL SCREENING OF TECHNOLOGIES
FOR GROUND WATER (CONTINUED)

GROUNDWATER GENERAL RESPONSE ACTIONS	TECHNOLOGY TYPES	PROCESS OPTIONS	DESCRIPTIONS	SCREENING COMMENTS
		Oxidation/Reduction	A chemical reaction utilized to change the chemical form of a hazardous material.	Based on the potential formation of more toxic by-products, this option will not be retained.
Off-site Treatment/Disposal	Off-site Disposal	Discharge to POTW	Extracted water discharge to the local POTW.	Potentially Applicable
		Discharge to Stream	Extracted water discharged to the unnamed stream.	Potentially Applicable for treated ground water.
	Off-site Treatment	RCRA Facility	Extracted ground water will be transported to a RCRA facility for treatment and disposal.	Potentially Applicable

Subsurface Drains - Subsurface drains (e.g., interception trench) are used to collect contaminated groundwater and prevent groundwater migration. A trench is excavated to a depth below the groundwater table. A perforated collection pipe and sump are laid in the trench on a layer of crushed stone. The trench is then backfilled with soil. Groundwater flows into the trench and is diverted to the sump for removal. An interception trench is often used in place of pumping wells if the hydraulic conductivity of the aquifer is less than 10^{-5} cm/sec. An interception trench is currently in operation at the site. The FS will evaluate the effectiveness of this system and/or an alternate system if the selected soil remediation alternative requires it.

Physical Treatment

Air Stripping - Air stripping is a mass transfer process used to treat high volatility, low water soluble, aqueous organic wastes. The process operates by providing contact between the contaminated water and supplied air, which allows volatiles to diffuse from the liquid to the gaseous phase. The process produces the stripped effluent and contaminated off-gas, the latter which may require further treatment. The process is temperature dependent and the presence of suspended solids and dissolved iron and manganese may reduce process efficiency. Air stripping is an effective treatment technique for highly volatile contaminants such as vinyl chloride; therefore, this option will be retained for further analysis. Due to the presence of inorganics, pretreatment and/or post-treatment may be required with air stripping.

Carbon Adsorption - The activated carbon adsorption process is used to treat aqueous organic wastes with high molecular weight and boiling point and low solubility and polarity. The process can also be used to collect organics in gaseous waste streams. Adsorption is a process whereby molecules of a dissolved compound are collected and adhere on the surface of a solid. Granular activated carbon is used as an adsorbent because of its large surface area (e.g., 1,000 to 1,400 m^2/g). The efficiency of the process may be limited by high levels of iron and manganese in the groundwater and by high concentration organic waste streams. This process option is potentially applicable.

Biological Treatment

Aerobic Degradation - Aerobic biological treatment consists of the degradation of hydrocarbons by microorganisms in the presence of oxygen. Organic molecules are oxidized to carbon dioxide and water using oxygen as the terminal electron acceptor. The process can be conducted *in situ* or above grade in a reactor vessel. Aerobic degradation must be carried out in a carefully controlled environment because the process is highly dependent on the physiological state of the contaminants, microbial inhibition by chemicals in the waste, pH, and temperature. Biodegradation of chlorinated compounds can be accomplished with specially engineered organisms and carefully controlled conditions, but this process is not recommended for the treatment of chlorinated compounds in an aqueous medium. Additionally, the fate of vinyl chloride will be largely controlled by volatilization in an aerated system, thus limiting the effectiveness of aerobic biodegradation. This option will not be retained.

Anaerobic Degradation - The anaerobic degradation process is similar to aerobic treatment, except that organic material is reduced in the absence of oxygen. Anaerobic degradation can be accomplished *in situ*, but in order to achieve truly anaerobic conditions, the process must be conducted in an air-tight vessel. The system requires stable operating conditions and is subject to frequent upsets. This process is more effective than aerobic treatment for the treatment of chlorinated compounds, but has not been well proven in an aqueous medium. Based on the uncertainties associated with this process option, it will not be retained for further analysis.

Chemical Treatment

Chemical Precipitation - Chemical precipitation removes dissolved metals from aqueous waste streams through the adjustment of pH. In general, precipitates are settled, clarified, and filtered out of solution. The process must be optimized for the metals present in the waste stream and the sludge produced may require further treatment. This process option is potentially applicable as a pretreatment step, prior to further treatment for organics removal/destruction.

Oxidation/Reduction - Oxidation and reduction reactions are used to alter the chemical form of a compound to change the compound's toxicity, mobility, Don't add to every soil alternative discussion in Section 4.1.1 but put up front in Section 2.3.2

11. Continued:

A CAMU at the Scott Aviation facility will serve the purpose of allowing the excavation and treatment of contaminated soils, and their deposition on-site after treatment, without triggering the need for an actual RCRA authorized treatment, storage and disposal (TSD) facility permit. Normally, hazardous wastes at the site would require management at a TSD, if stored at the facility for over 90 days. However, NYSDEC as a RCRA authorized state can obviate the need for permits such as are required for a TSD facility, to allow for an accelerated time frame for remedial actions. Moreover, strict RCRA land ban rules could be appropiately adjusted by NYSDEC within the CAMU consistent with the site remedial objectives. This will allow for appropriate on-site treatment of the soil without triggering "placement" under RCRA's land ban rules. After treatment, the land ban rules will no longer apply because treatment will be to levels well below the land ban requirement.

The CAMU to be designated at the Scott Aviation site is depicted in Figure 1 and will include the following areas:

- Source area from which contaminated soils will be excavated
- Cell for treatment of contaminated soil
- Disposal area for treated soils (i.e. area where treated soils will be spread and regraded after meeting treatment standards).
- Groundwater interception trench
- Air stripper location

Once VOC contaminated soils have been treated to the clean-up criteria which have been established, they will be landspread in the vicinity of Building No. 2 and will then meet all applicable LDR criteria. A delisting petition will be submitted to NYSDEC for the delisting of the site from New York's Registry of Sites following the successful completion of soil remediation and the implementation of groundwater remediation. If the treatment goals are met, the delisting petition should be approved by NYSDEC.

There are no action-specific or location-specific SCGs that will prevent the implementation of this alternative.

stability, or solubility. The process requires controlled conditions (e.g., waste conditions must be well known). The process is applicable to the treatment of a variety of dilute aqueous waste streams containing organic and inorganic compounds. This process is not well suited to the treatment of chlorinated organic compounds. Pilot studies are advisable prior to implementation. Additionally, ultraviolet light may be needed to break down chlorinated compounds. Based on the limited volume of water to be treated and the potential for formation of more toxic by-products, this process option will not be retained.

Off-site Disposal - Two off-site disposal options have been identified: (1) discharge to the local Publicly Owned Treatment Works (POTW) and (2) discharge to the local unnamed stream. Discharge to the POTW will require the approval of the Buffalo Sewer Authority and the Erie County Department of Environment and Planning. This option is potentially applicable. Prior to the discharge of contaminated groundwater to the unnamed stream, a ~~National~~ State Pollutant Discharge Elimination System (NPDES) Permit may have to be obtained. The permit will establish discharge limitations, which will likely require that the groundwater be treated prior to discharge. This option is also applicable for the discharge of treated groundwater.

No permit required since order C.O. intent to meet SPDES Regs.

Need to correct basis

Off-site Treatment - Extracted groundwater, treated or untreated, would be shipped to a Resource Conservation and Recovery Act (RCRA) facility for ultimate treatment and disposal. Because the waste stream will be characterized as an F002 by RCRA requirements, the costs for disposal of treated groundwater will likely be the same as if untreated. This option would require waste characterization prior to disposal. This option is potentially applicable.

2.3.2 Waste Designation for Soil Treatment Levels and Land Disposal Restrictions

Because the soil at the site can not be treated in situ, it must be excavated and either transported off-site for disposal or treated ex situ on-site. Because of the regulatory implications, it is important to specifically characterize the soils under the appropriate RCRA designation.

To a large degree, hazardous waste designation under RCRA is a function not only of the types of contaminants involved, but also of the processes that stability, or solubility. The process requires controlled conditions (e.g., waste conditions must be well known). The process is applicable to the treatment of a variety of dilute aqueous waste streams containing organic and inorganic compounds. This process is not well suited to the treatment of chlorinated organic compounds. Pilot studies are advisable prior to implementation. Additionally, ultraviolet light may be needed to break down chlorinated compounds. Based on the limited volume of water to be treated and the potential for formation of more toxic by-products, this process option will not be retained.

Off-site Disposal - Two off-site disposal options have been identified: (1) discharge to the local Publicly Owned Treatment Works (POTW) and (2) discharge to the local unnamed stream. Discharge to the POTW will require the approval of the Buffalo Sewer Authority and the Erie County Department of Environment and Planning. This option is potentially applicable. Prior to the discharge of contaminated groundwater to the unnamed stream, a State Pollutant Discharge Elimination System (SPDES) Permit would not have to be obtained, although any waste water discharges would be required to meet any applicable substantive discharge requirements. The permit will establish discharge limitations, which will likely require that the groundwater be treated prior to discharge. This option is also applicable for the discharge of treated groundwater.

Off-site Treatment - Extracted groundwater, treated or untreated, would be shipped to a Resource Conservation and Recovery Act (RCRA) facility for ultimate treatment and disposal. Because the waste stream will be characterized as an F002 by RCRA requirements, the costs for disposal of treated groundwater will likely be the same as if untreated. This option would require waste characterization prior to disposal. This option is potentially applicable.

2.3.2 Waste Designation for Soil Treatment Levels and Land Disposal Restrictions

Because the soil at the site can not be treated in situ, it must be excavated and either transported off-site for disposal or treated ex situ on-site. Because of the regulatory implications, it is important to specifically characterize the soils under the appropriate RCRA designation.

originally generated the waste, and, in some cases, the concentrations of various substances within the raw products used in those processes. In the case of Scott Aviation, trichloroethylene is the primary contaminant of concern. According to the Remedial Investigation Report, trichlorethylene may have been used by Scott Aviation as a solvent, but this has not been definitively established, and little information exists regarding the percent by weight or volume of trichloroethylene in any such solvent products that may have been used at the facility. Consequently, the soil can be considered D040 (characteristic hazardous waste due to the presence of trichloroethylene as a toxic constituent) or F002 (listed hazardous waste constituting a spent halogenated solvent in which the original solvent contained, before use, a total of 10% or more by volume of trichloroethylene and other solvents listed in F001, F002, and F003).

Because the nature of the processes and the raw materials from which the waste was generated has not been established, it is arguable that the waste should be characterized as D040 and not as F002. In such a case, the RCRA land disposal restrictions (LDR) would not apply because EPA has not promulgated a LDR for D040. Thus, the contaminated soil could be excavated and sent off-site for disposal to an appropriate hazardous waste landfill without treatment.

However, if the wastes should be characterized as F002, several other considerations apply. First, the RCRA "contained-in" interpretation would apply to the contaminated soil. Thus, a listed hazardous waste (F002) is "contained-in" the soil, and, consequently, the contaminated soil must be managed as F002 as long as the soil "contains" F002. By long-standing EPA interpretation, neither the "derived-from" rule nor the "mixture" rule would apply because the soil itself is not considered a "solid waste" but rather an environmental medium. These EPA interpretations are documented at OSWR, Superfund LDR Guide No. 56, *Determining When Land Disposal Restrictions Are Applicable To CERCLA Response Actions* (July 1989), and in a letter dated June 19, 1989 from Jonathan Z. Cannon, EPA's then-acting Assistant Administrator for Solid and Hazardous Waste, to Thomas Jorling, then-Commissioner of DEC.

Delete

Under the "contained-in" rule, the main question is, at what concentration level can it be said that the soil at the site no longer "contains" F002. In this context, several considerations apply. First, in

5. Replace Paragraph 3, Page 2-16 with the following paragraph:

~~However~~, NYSDEC has made the determination with the concurrence of the NYSDOH that the level of 1.0 ppm is an appropriate treatment standard for trichcloroethylene under the Inactive Sites Program with regard to this site. This determination was made based on human health, environmental and technical practicability considerations derived from case histories where treatment of this contaminant has been successfully achieved under similar geologic and hydrogeologic conditions. The more stringent NYSDEC standard of 1.0 ppm should be applied to the Scott Aviation site.

OK

Also for health, environmental and technical practicability considerations, New York requires as a practical matter that total volatile organic compounds (VOCs) may not exceed 10 ppm. Consequently, the level of 10 ppm is adopted in the Feasibility Study as the treatment standard for total VOCs.

Using 1.0 ppm as the required treatment level for trichloroethylene and 10 ppm as the required treatment level for total VOCs, is thus fully consistent with RCRA ~~and its LDR requirements~~, as well as the requirements of NYSDEC and NYSDOH. Once the treatment levels have been achieved, the soils will no longer "contain" F002.

OK ~~Delete~~

the aforementioned EPA letter dated June 19, 1989, EPA takes the position that, until EPA specifies definitive guidance as to when, or at what levels, environmental media contaminated with listed hazardous wastes are no longer considered to contain that hazardous waste, the individual EPA regions, and EPA RCRA-authorized states should make such determinations on a case-by case basis. Although such guidance has not yet been promulgated, specific criteria have been established for trichloroethylene as a F002 waste.

Under the current land disposal regulations, where trichloroethylene is the hazardous constituent of concern in F002 waste, it must be treated to a level of 5.6 ppm before it may be land disposed. Recognizing that this LDR treatment requirement may pose problems in the treatment of contaminated soils, in the December 14, 1993 Federal Register EPA proposed to revise upward the treatment standard for trichloroethylene in soils to 6.0 ppm. Treating the soils to these levels should be sufficient to support an argument that they no longer "contain" F002 and that, consequently, they are no longer subject to the land ban.

However, NYSDEC has adopted the level of 3.0 ppm as the appropriate treatment standard for trichloroethylene under the Inactive Sites Program (Reference: Carborundum Corp., Site No. 932102, August 19, 1991) Because the site is located in New York, the more stringent New York standard of 3.0 ppm should be applied to the Scott Aviation site.

Using 3.0 ppm as the required treatment level is thus fully consistent with RCRA and its LDR requirements. Once the treatment level has been achieved, the soils will no longer "contain" F002.

For health-based reasons, New York also requires as a practical matter that vinyl chloride, a common break-down product of trichloroethylene, may not exceed the level of 0.5 ppm. Consequently, the level of 0.5 ppm is adopted in this Feasibility Study as the treatment standard for vinyl chloride in the soil.

Because the contaminated soils could be characterized as both F002 and D040, the more stringent standards applicable to F002 will be applied. Thus, once the contaminated soils are excavated, they will be either manifested as F002 wastes for appropriate off-site handling, or treated on-site to the levels herein specified and then used as fill on the Scott Aviation site. The

To a large degree, hazardous waste designation under RCRA is a function not only of the types of contaminants involved, but also of the processes that originally generated the waste, and, in some cases, the concentrations of various substances within the raw products used in those processes. In the case of Scott Aviation, trichloroethylene is the primary contaminant of concern. According to the Remedial Investigation Report, trichlorethylene may have been used by Scott Aviation as a solvent, but this has not been definitively established, and little information exists regarding the percent by weight or volume of trichloroethylene in any such solvent products that may have been used at the facility. Consequently, the soil can be considered D040 (characteristic hazardous waste due to the presence of trichloroethylene as a toxic constituent) or F002 (listed hazardous waste constituting a spent halogenated solvent in which the original solvent contained, before use, a total of 10% or more by volume of trichloroethylene and other solvents listed in F001, F002, and F003).

The wastes should be characterized as F002. The RCRA "contained-in" interpretation would apply to the contaminated soil. Thus, a listed hazardous waste (F002) is "contained-in" the soil, and, consequently, the contaminated soil must be managed as F002 as long as the soil "contains" F002. By long-standing EPA interpretation, neither the "derived-from" rule nor the "mixture" rule would apply because the soil itself is not considered a "solid waste" but rather , an environmental medium. These EPA interpretations are documented at OSWR, Superfund LDR Guide No. 56, *Determining When Land Disposal Restrictions Are Applicable To CERCLA Response Actions* (July 1989), and in a letter dated June 19, 1989 from Jonathan Z. Cannon, EPA's then-acting Assistant Administrator for Solid and Hazardous Waste, to Thomas Jorling, then-Commissioner of DEC.

Under the "contained-in" rule, the main question is, at what concentration level can it be said that the soil at the site no longer "contains" F002. In this context, several considerations apply. First, in the aforementioned EPA letter dated June 19, 1989, EPA takes the position that, until EPA specifies definitive guidance as to when, or at what levels, environmental media contaminated with listed hazardous wastes are no longer considered to contain that hazardous waste, the individual EPA regions, and EPA RCRA-authorized states should make such determinations on a case-by case basis. Although such guidance has not yet been promulgated, specific criteria have been established for trichloroethylene as a F002 waste.

A basis for the decision regarding how TCE contaminated soils at the Scott Aviation site should be defined and subsequently managed is established in a NYSDEC TAGM dated November 30, 1992 and entitled "Contained-in Criteria for Environmental Media. Under this NYSDEC TAGM, the facility will attempts to identify the source(s) of environmental media contamination. If it can conclusively be established that the hazardous constituents in the media did not come from the listed hazardous waste, or commercial chemical products, then the contaminated media need not be managed as a hazardous waste with the following qualification: The contaminated media may not exhibit one or more of the criteria identified in NYCRR Part 371, Section 3 or in the USEPA Toxicity Characteristic in 40 CFR 261.24. In the case of trichloroethylene (TCE) contaminated media, if concentrations in soil or in the leachate derived from such contaminated soils exceeds certain threshold values, then the contaminated media must be managed as a hazardous waste. Soils and leachates at the Scott Aviation site have been found to exceed the respective action levels of 6.4 ppm and 5 ppb for soil and soil derived leachate respectively.

However, NYSDEC has made the determination with the concurrence of the NYSDOH that the level of 1.0 ppm is an appropriate treatment standard for trichloroethylene under the Inactive Sites Program with regard to this site. This determination was made based on human health, environmental and technical practicability considerations derived from case histories where treatment of this contaminant has been successfully achieved under similar geologic and hydrogeologic conditions. The more stringent NYSDEC standard of 1.0 ppm should be applied to the Scott Aviation site.

Also for health, environmental and technical practicability considerations, New York requires as a practical matter that total volatile organic compounds (VOCs) may not exceed 10 ppm. Consequently, the level of 10 ppm is adopted in the Feasibility Study as the treatment standard for total VOCs.

Using 1.0 ppm as the required treatment level for trichloroethylene and 10 ppm as the required treatment level for total VOCs, is thus fully consistent with RCRA and its LDR requirements, as well as the requirements of

NYSDEC and NYSDOH. Once the treatment level has been achieved, the soils will no longer "contain" F002.

Because the contaminated soils could be characterized as both F002 and D040, the more stringent standards applicable to F002 will be applied. Thus, once the contaminated soils are excavated, they will be either manifested as F002 wastes for appropriate off-site handling, or treated on-site to the levels herein specified and then used as fill on the Scott Aviation site. The choice of remedy will depend upon the detailed evaluation of remedial alternatives in this Feasibility Study Report.

Remedial action objectives established for the Scott Aviation site include the following:

- Prevent the ingestion of groundwater that exceeds NYSDEC groundwater quality standards.
- Prevent the ingestion and inhalation of and dermal contact with contaminated soils that pose an unreasonable risk to human health.

Treatment levels of 3.0 ppm and 0.5 ppm respectively, for trichloroethylene and vinyl chloride, respectively will therefore be attained to ensure that these remedial action objectives are realized. revise

2.3.3 Evaluation of Remaining Technologies

In this section, the potentially applicable technology types and process options are evaluated in greater detail in order to select one representative process option for each technology type. During this step, process options are evaluated with respect to effectiveness, implementability, and cost. The effectiveness evaluation will focus on: (1) the effectiveness of handling the estimated volumes or areas of media and the ability to meet RAOs, (2) potential impacts to human health and the environment during the construction phase, and (3) the reliability of the process with respect to the contaminants of concern. The implementability evaluation will focus on determining the technical and administrative feasibility of implementing a process option. At this stage in the evaluation, costs will play a minor role. Each process option will be evaluated as to whether the costs are relatively high, medium, or low.

2.3.3.1 Soils

a. No Action

The no action alternative does not prevent the migration of soil contaminants to groundwater and does not strictly limit future dermal exposure scenarios. This option will be carried through the detailed analysis to form a baseline for comparison. There are no restrictions to the technical implementability of this option and costs are negligible.

choice of remedy will depend upon the detailed evaluation of remedial alternatives in this Feasibility Study Report.

Remedial action objectives established for the Scott Aviation site include the following:

- Prevent the ingestion of groundwater that exceeds NYSDEC groundwater quality standards.
- Prevent the ingestion and inhalation of and dermal contact with contaminated soils that pose an unreasonable risk to human health.

Treatment levels of 1.0 ppm and 10 ppm respectively, for trichloroethylene and total VOCs will therefore be attained to ensure that these remedial action objectives are realized. The RAO for contaminated soils it to prevent the ingestion and inhalation of and dermal contact with contaminated soils that pose an unacceptable risk to human health. As set forth in Section 3.1, soils must be treated to under 1.0 ppm for trichloroethylene and 10 ppm total VOCs. The treatment of these soils will be conducted within a corrective area management unit (CAMU), a relevant and appropriate requirement for the site. In the case of the Scott Aviation site to be designated by NYSDEC for use a hazardous waste management area during site remediation activities, and, if appropriated, for ultimate deposition of the treated soils.

A CAMU at the Scott Aviation facility will serve the purpose of allowing the excavation and treatment of contaminated soils, and their deposition on-site after treatment, without triggering the need for a RCRA authorized treatment, storage and disposal (TSD) facility permit. Normally hazardous wastes at the site would require management at a TSD, if stored at the facility for over 90 days. However, NYSDEC as a RCRA authorized state can obviate the need for permits such as are required for a TSD facility, to allow for an accelerated time frame for remedial actions. Moreover, strict RCRA land ban rules could be appropriately adjusted by NYSDEC within the CAMU consistent with the site remedial objectives. this will allow for appropriate on-site treatment of the soil without triggering "placement" under RCRA's land ban rules. After treatment, will be to levels well below the land ban requirement.

The CAMU to be designated at the Scott Aviation site is depicted in Figure 1 and will include the following areas:

- Source area from which contaminated soils will be excavated
- Cell for treatment of contaminated soil
- Disposal area for treated soils (i.e. area where treated soils will be spread and regraded after meeting treatment standards).
- Groundwater interception trench
- Air stripper location

Once VOC contaminated soils have been treated to the clean-up criteria which have been established, they will be landspread in the vicinity of Building No. 2 and will then meet all applicable LDR criteria. A delisting petition will be submitted to NYSDEC for the delisting of the site from New York's Registry of Sites following the successful completion of soil remediation and the implementation of groundwater remediation. If the treatment goals are met, the delisting petition should be approved by NYSDEC.

Treatment levels of 1.0 ppm and 10 ppm respectively, for trichloroethylene and total VOCs will be therefore be attained to ensure that these remedial action objectives are realized. The RAO for contaminated soils is to prevent the ingestion and inhalation of and dermal contact with contaminated soils that pose unacceptable risk to human health. As set forth in Section 3.1, soil must be treat to under 1.0 ppm of trichloroethylene and 10 ppm for total VOCs. The treatment of these soils will be conducted within a corrective area management unit (CAMU), a relevant and appropriate requirement for the site. In the case of the Scott Aviation site, a CAMU is an area on the Scott Aviation site to be designated by NYSDEC for use as a hazardous waste management area during site remediation activities, and if appropriate, for ultimate deposition of the treated soils.

There are no action-specific or location-specific SCGs that will prevent the implementation of this alternative.

2.3.3 Evaluation of Remaining Technologies

In this section, the potentially applicable technology types and process options are evaluated in greater detail in order to select one representative process option for each technology type. During this step, process options are evaluated with respect to effectiveness, implementability, and cost. The effectiveness evaluation will focus on: (1) the effectiveness of handling the estimated volumes or areas of media and the ability to meet RAOs, (2) potential impacts to human health and the environment during the construction phase, and (3) the reliability of the process with respect to the contaminants of concern. The implementability evaluation will focus on determining the technical and administrative feasibility of implementing a process option. At this stage in the evaluation, costs will play a minor role. Each process option will be evaluated as to whether the costs are relatively high, medium, or low.

2.3.3.1 Soils

a. No Action

The no action alternative does not prevent the migration of soil contaminants to groundwater and does not strictly limit future dermal exposure scenarios. This option will be carried through the detailed analysis to form a baseline for comparison. There are no restrictions to the technical implementability of this option and costs are negligible.

b. Source Removal

A complete delineation of the contaminant source area to be accomplished through additional soil borings and vertical soil quality profiling will provide a basis for calculating the exact volume of soils which need to be extracted for on-site treatment or off-site disposal. Source removal and subsequent treatment will eliminate the remaining source of the contaminants and prevent the migration of soil contaminants to groundwater and future dermal exposure scenarios. Based on the depth of soil contamination (i.e., 20 feet below grade) and the relationship between soil material and the aquifer, the excavation of contaminated soil will have some technical limitations. These limitations include but are not limited to: ensuring the structural stability of the excavation and the building, dewatering the excavation, preventing groundwater migration, securing specialized equipment to excavate to a depth of 20 feet, controlling emissions and stormwater, and maintaining a security system around the perimeter of the excavation. These limitations may have some effect on design costs and the total time to implement but are not insurmountable. Additionally, subsequent treatment options may be limited by space constraints. The overall effectiveness, implementability, and cost will be evaluated with respect to the individual treatment options.

c. Low Temperature Thermal Desorption

Treatability studies were conducted to evaluate the effectiveness of two *ex situ* treatment options: low-temperature thermal desorption and bioremediation. IT Corporation was subcontracted to perform six bench scale thermal desorption treatability tests on soils collected from the Scott Aviation site. Based on the results of the bench scale treatability studies, IT concluded that low temperature thermal desorption would be an effective treatment technology for soils at the Scott Aviation site. The treatability studies indicated that some pre-treatment and post-treatment steps may be required, based on the nature of the soil material and the contaminants of concern. Specifically, due to the high clay content of the soil at the site, measures to reduce soil moisture and specimen size may be required prior to the feed. Permits and/or an emission control system may be required. This option is subject to the technical limitations outlined in the preceding paragraph (e.g., space limitations, etc.), but can be implemented at the site.

Costs associated with this technology are moderate to high. This option will be carried through the analysis.

d. **Ex situ Bioremediation**

Bench scale bioremediation treatability studies of the contaminated soil from the Scott Aviation site were conducted by Biotrol, Inc. The results of the Biotrol study indicated that the contaminants of concern are amenable to bioremediation. Based on information collected during the treatability study, Biotrol has proposed an ex situ methanogenic (aerobic) bioremediation process, which utilizes methane as the primary food source for bacteria that degrade chlorinated solvents. The ex situ application of the methanogenic bioremediation technology is an innovative treatment technology and will require pilot scale testing prior to full scale implementation. The duration of this study would be approximately 8 weeks. Air permits may be required for the implementation of this option. Costs for this option are moderate. This option will be carried through the analysis.

e. **Ex situ Vapor Extraction**

Soil vapor extraction is a well proven treatment technology for the removal of volatile organic compounds from soil. Due to the high clay content of on-site soils, in situ vapor extraction techniques would be difficult to implement and may not be effective. However, ex situ vapor extraction, which will allow for the conditioning of soils prior to treatment, is considered a very effective method of treatment for the contaminants of concern and site specific conditions. Air permits may be required for the implementation of this option. Costs for this option are moderate. This option will be carried through the analysis.

f. **Off-site Disposal**

Excavation of contaminated soils and disposal at an off-site treatment, storage, and disposal facility is an effective method of achieving RAOs. However, this option may increase long-term liability where disposal is in a landfill in the U.S. In addition, the land disposal restriction in the U.S make such landfilling problematic. The same technical limitations which apply to soil removal and treatment apply to soil removal and disposal, including but not limited to: ensuring the structural stability of the excavation and the building, dewatering the excavation, preventing groundwater migration, Costs associated with this technology are moderate to high. This option will be carried through the analysis.

d. **Ex situ Bioremediation**

Bench scale bioremediation treatability studies of the contaminated soil from the Scott Aviation site were conducted by Biotrol, Inc. The results of the Biotrol study indicated that the contaminants of concern are amenable to bioremediation. Based on information collected during the treatability study, Biotrol has proposed an ex situ methanogenic (aerobic) bioremediation process, which utilizes methane as the primary food source for bacteria that degrade chlorinated solvents. The ex situ application of the methanogenic bioremediation technology is an innovative treatment technology and will require pilot scale testing prior to full scale implementation. The duration of this study would be approximately 8 weeks. Air permits may be required for the implementation of this option. Costs for this option are moderate. This option will be carried through the analysis.

e. **Ex situ Vapor Extraction**

Soil vapor extraction is a well proven treatment technology for the removal of volatile organic compounds from soil. Due to the high clay content of on-site soils, in situ vapor extraction techniques would be difficult to implement and may not be effective. However, ex situ vapor extraction, which will allow for the conditioning of soils prior to treatment, is considered a very effective method of treatment for the contaminants of concern and site specific conditions. Costs for this option are moderate. This option will be carried through the analysis.

f. **Off-site Disposal**

Excavation of contaminated soils and disposal at an off-site treatment, storage, and disposal facility is an effective method of achieving RAOs. However, this option may increase long-term liability where disposal is in a landfill in the U.S. In addition, the land disposal restriction in the U.S make such landfilling problematic. The same technical limitations which apply to soil removal and treatment apply to soil removal and disposal, including but not limited to: ensuring the structural stability of the excavation and the building, dewatering the excavation, preventing groundwater migration, providing specialized equipment to excavate to a depth of 20 feet, controlling emissions and stormwater, and maintaining a security system around the perimeter of the excavation. Contaminated soils at the site characterized as F002 waste would be excavated and manifested and transported accordingly. Under this waste classification, there are three viable off-site disposal options (1) disposal in a Canadian landfill (e.g., Stablex landfill, Quebec, Canada), (2) disposal at an incinerator within the United States, and (3) off-site treatment and disposal at a U.S. landfill. Since the costs for incineration are significantly higher than those associated with landfilling, the former option will not be carried throug thee anaylsis. There are three hazardous waste landfills located proximate to the site, Chemical Waste's Model City Landfill, Buffalo, New York, Laidlaw's Sarnia Landfill, Ontario, Canada and Stablex, Ontario, Canada. Costs for this option are moderate to high. This option will be retained for analysis.

A summary of the soil evaluation criteria is presented in Table 2-3. Based on the above evaluation of technologies, the following process options will be retained for further analysis: no action, source removal, *ex situ* bioremediation, low-temperature thermal desorption, ex situ vapor extraction, and off-site disposal.

2.3.3.2 Groundwater

a. No Action

The no action alternative addresses the remedial action objective for groundwater because it is highly unlikely that any groundwater that may be impacted by the release will ever be ingested, although there is no guarantee that no one will ever ingest it. There are no technical restrictions on the implementability of this option and costs are negligible. This alternative will be carried through the detailed analysis to form a baseline for comparison.

b. Source Removal

The removal of the source of contamination (i.e., contaminated soils) will not strictly prevent the ingestion of groundwater, but will decrease the length of time required to meet NYSDEC groundwater criteria through natural attenuation. The overall effectiveness, implementability, and cost of this

TABLE 2-3
SUMMARY OF SOIL EVALUATION CRITERIA

SUBSURFACE SOIL GENERAL RESPONSE ACTIONS	TECHNOLOGY TYPES	PROCESS OPTIONS	EFFECTIVENESS	IMPLEMENTABILITY	COST
No Action	N/A	N/A	Does not absolutely protect against future ingestion.	Technically Implementable.	None
Source Removal	Removal/Treatment	See treatment/disposal options	See treatment/disposal options	See treatment/disposal options	See treatment/ disposal options
On-site Treatment	Biological Treatment	Ex-situ bioremediation	Treatability testing data has demonstrated that this is an effective means of treating site-related contaminants.	Technically implementable, but requires pilot scale studies.	Moderate
	Thermal Treatment	Low-Temperature Thermal Desorption	Treatability studies conducted on on-site soils indicated that this is an effective treatment method for site-related contaminants.	Technically implementable	Moderate to high
	Physical Treatment	Ex-situ Vapor Extraction	Effective for treatment of volatile organic compounds.	Technically implementable, but additional data will be required prior to full-scale implementation.	Moderate
Excavation/Disposal	Off-site Treatment and/or land disposal	RCRA Facility in U.S.; approved Canadian facility.	Effective and reliable.	Technically implementable, but disposal options restricted by land disposal restrictions in U.S.	Moderate to high transportation and disposal costs

option is evaluated in greater detail with respect to soils in Section 2.3.2.1.

c. **Groundwater Monitoring**

Groundwater monitoring alone does not affect waste characteristics and does not prevent the ingestion of groundwater. This option is considered a useful tool, however, if the no action/limited action option is selected. This option is technically implementable, and capital, operations and maintenance costs are low. This option will be retained.

d. **Interception Trench**

An interception trench is an effective means of groundwater flow containment and collection in low permeability aquifers. This option, coupled with treatment, can be very effective. This option is technically implementable, capital costs are moderate, and operations and maintenance costs are low. An interception trench is currently in operation at the site. However, based on the lateral extent of the groundwater contamination at the site, the existing trench probably should be abandoned and replaced with a downgradient interception trench. The new interception trench could be located along the western property border.

e. **Air Stripping**

Air stripping is an effective method of treating high volatility organic compounds. This process option is technically implementable but may require treatment of the off-gas. The effectiveness of this option may be limited by the presence of dissolved metals in the groundwater but can easily be handled through the use of pretreatment (e.g., metal precipitation). Costs for this option are moderate. This option will meet RAOs and will be carried through the detailed analysis.

f. **Carbon Adsorption**

Carbon Adsorption is an effective means of treating volatile organic compounds. This technology may be limited by the presence of vinyl chloride in the groundwater. Vinyl chloride has a very low adsorption capacity. The effectiveness of this technology will be dependent on the influent concentration of vinyl chloride and the desired effluent concentration. The effluent concentration is dependent on the final method of disposal (e.g., discharge to the POTW or discharge to the stream). Costs for this alternative are moderate. This option will be retained for further evaluation.

g. Metals Precipitation

Metals precipitation is an effective method of removing dissolved metals from aqueous wastes. Although metals removal is not the goal of the groundwater remediation, the presence of metals may interfere with the operation of the selected remedial treatment process. This process is easily implementable. Based on inorganic data collected to date, it is not believed that pretreatment will be required; therefore, this option will not be retained. If required, it will be evaluated during the remediation design phase.

h. Discharge to POTW

The discharge of untreated wastewater to the local POTW does not alter waste characteristics but will meet RAOs for groundwater. The Buffalo Sewer Authority stated that in order for Scott Aviation to discharge contaminated groundwater into the sanitary sewer system, the approval of the Buffalo Sewer Authority (BSA) and the Erie County Department of Environment and Planning (ECDEP) must be obtained. In order to obtain approval, Scott Aviation must submit a report to the BSA indicating the volume of the discharge, the constituents of concern, the contaminant concentrations, and the discharge location. The BSA indicated that the groundwater must typically be below RCRA land disposal restriction Toxicity Characteristic Leaching Procedure (TCLP) standards or below 5 parts per million of total VOCs. Capital costs for this option are low and operations and maintenance costs are low. Based on the level of contaminants detected on-site, the direct discharge of groundwater to the POTW without pre-treatment is not a viable option. However, this option may be effective for the discharge of treated groundwater and will be retained.

i. Discharge to the Stream

The discharge of untreated wastewater to the unnamed stream will not alter waste characteristics, but will meet RAOs for groundwater. Implementation of this alternative may require a National Pollutant Discharge Elimination System (NPDES) Permit and will likely require treatment prior to disposal. The procurement of a NPDES Permit could be a lengthy process, but if the discharge is pursuant to a RD/RA consent order, permitting requirements may be minimized. However, based on the volume of groundwater requiring treatment, this alternative is not anticipated to be cost effective. This option will not be retained.

j. Off-site Treatment and Disposal

The off-site treatment of contaminated groundwater at a RCRA facility is an effective and reliable method of meeting RAOs. This option is technically and administratively implementable. Costs for this option are moderate. This option will be retained for analysis.

A summary of the evaluation criteria is presented in Table 2-4. Based on the above evaluation the following process options will be evaluated further: no action, groundwater monitoring, interception trench, air stripping, carbon adsorption, discharge to POTW, and disposal at a RCRA facility.

TABLE 2-4
SUMMARY OF GROUNDWATER EVALUATION CRITERIA

GROUNDWATER GENERAL RESPONSE ACTIONS	TECHNOLOGY TYPES	PROCESS OPTIONS	EFFECTIVENESS	IMPLEMENTABILITY	COST
No Action	N/A	N/A	Does not absolutely protect against future ingestion.	Technically implementable.	None
Source Removal	See Table 2-3	See Table 2-3	N/A	N/A	N/A
Institutional Controls	Monitoring	Monitoring	Does not alter waste characteristics.	Technically implementable.	Low capital, Low O&M
Collection/Containment	Subsurface Drains	Interception Trench	Effective method of flow interception/ collection; does not alter waste characteristics	Technically implementable.	Moderate capital, low O&M
Treatment (on-site)	Physical	Air Stripping	Effective treatment method for VOCs.	Technically implementable, but may require air pollution control.	Moderate
		Carbon Absorption	Effective treatment method for site-related VOCs, with the possible exception of vinyl chloride.	Technically implementable, but may be limited by presence of vinyl chloride	Moderate
	Chemical	Chemical Precipitation	Effective and reliable method for the removal of dissolved metals from aqueous wastes.	Easily implementable. Requires additional treatment for organics.	Moderate
Off-site Treatment/Disposal	Off-site Disposal	Discharge to POTW	Does not alter waste characteristics.	May require treatment prior to discharge.	Low capital, low O&M

TABLE 2-4
SUMMARY OF GROUNDWATER EVALUATION CRITERIA (CONTINUED)

GROUNDWATER GENERAL RESPONSE ACTIONS	TECHNOLOGY TYPES	PROCESS OPTIONS	EFFECTIVENESS	IMPLEMENTABILITY	COST
		Discharge to the unnamed stream	Does not alter waste characteristics	Treatment may be required prior to discharge. A NPDES permit may be required prior to discharge.	Low to moderate
	Off-site Treatment	RCRA Facility	Effective and reliable.	Technically implementable.	Moderate to high

3.0 DEVELOPMENT AND SCREENING OF ALTERNATIVES

In this section, the general response actions and process options developed for each operable unit are combined to form remedial action alternatives for the site as a whole. The goal of this process is to develop a list of alternatives that will be carried through the detailed analysis of alternatives. The descriptions of the alternatives will include information on (1) system size and configuration, (2) estimated time to meet RAOs, (3) required permits, and (4) spatial requirements. Due to the limited number of process options retained for analysis, each of the remedial alternatives will be carried through the detailed analysis.

The remedial alternatives developed for the Scott Aviation site generally address the removal and subsequent treatment/disposal of the source of contamination (i.e., soils in the vicinity of the former waste storage area) and the interception and subsequent processing of contaminated groundwater.

3.1 Description of Soil Alternatives

Five remedial action alternatives have been identified for soils: Alternative 1S - No Action, Alternative 2S - Thermal Treatment, Alternative 3S - *Ex situ* Bioremediation, and Alternative 4S - Off-site Treatment/Disposal and Alternative 5S - Ex situ Vapor Extraction. With the exception of the no action alternative, the remedial alternatives for soil each consist of the excavation of soil from the source area followed by treatment and/or disposal. One of the goals of soil remediation is to prevent the migration of contaminants from soil to groundwater that will result in groundwater concentrations in excess of NYSDEC groundwater quality criteria. Therefore, one of the ways to evaluate the effectiveness of the soil remediation is to review long-term groundwater monitoring data. Another goal of soil remediation is to prevent ingestion and inhalation of and dermal contact with contaminated soils that pose an unacceptable risk to human health. The final remediation goal will be to reduce the concentration of volatile organic compounds in soils from the source area to less than 3 ppm. The elements that are common to Alternatives 2S, 3S, and 4S are described below, and the specifics of each alternative are discussed in the following sections.

Alternatives 2S, 3S, 4S, and 5S will each consist of excavation to approximately 20 feet of all soil materials contained within the source area.

The volume of material to be treated is estimated to be 750 $yards^3$; assuming a conservative estimate of 1.5 $tons/yd^3$, this volume corresponds to approximately 1,125 tons of soil. A design volume of 1,200 tons will be assumed, pending a more complete delineation of the source area soon to be accomplished through a grid of soil borings and additional sampling. There are a number of technical and administrative concerns with an excavation of this size that must be considered:

- The excavation will require shoring for both worker safety and structural stability.
- The aquifer may need to be dewatered during excavation activities.
- Specialized equipment will be required to excavate to a depth of 20 feet.
- Security fencing must be installed around the perimeter of the excavation to prevent unauthorized access.
- An area for staging and treating excavated soils will need to be constructed.
- An emission control and/or monitoring system may be required.

Since groundwater elevations rise to an approximate depth of 5 feet below grade, groundwater from the excavation may need to be pumped out and treated. However, the installation of sheet piling during excavation activities will minimize the infiltration of groundwater. Any groundwater removed from the excavation will be treated with one of the groundwater treatment options to be evaluated.

Once excavation activities have been completed, the excavation will be filled with [crushed stone] permeable soil and topped with clay. The permeable soil will assist in increasing the conductivity of the aquifer, thus expediting groundwater remediation. The clay layer will reduce infiltration, reducing the volume of groundwater requiring treatment.

3.1.1 Alternative 1S - No Action

The no action alternative will be evaluated as required by the National Contingency Plan (NCP). Under this alternative no remedial measures would be implemented to mitigate site conditions. Current remedial activities, such as the operation of the interception trench, would be discontinued. This alternative does not meet RAOs, but will be carried through the detailed

analysis to form a baseline of comparison in the absence of further remedial action. There are no permits required to implement this alternative, and the time and costs to implement are negligible.

3.1.2 Alternative 2S - Low Temperature Thermal Desorption

Alternative 2 will consist of the excavation of soils from the source area and subsequent off-site treatment by low temperature thermal desorption. Preremedial activities will include construction of a staging area and a treatment pad. Based on the results of the treatability studies, pretreatment (e.g., soil homogenization) and post-treatment (off-gas treatment) may be required, but there are no technical or administrative barriers to the

Revise the third to last sentence under Section 3.1.2 to read .... will no longer contain F002 wastes, and it will be spread in the area adjacent to Building No. 2. Because this area will be part of the CAMU designated for the site, no further regulatory requirements will apply.

Insert the following sentence after the one which begins with Based on the results of ....

* Soil will be analyzed following treatment to ensure that it is under the criteria of 1.0 ppm for trichloroethylene and 10 ppm for total VOCs.

3.1.3 Alternative 3S - Bioremediation

Alternative 3S will consist of the excavation of soils in the source area and *ex situ* bioremediation. A number of *ex situ* bioremediation methods exist (e.g., bioreactor, bio-cell). Bench scale bioremediation treatability studies of the contaminated soil from the Scott Aviation site were conducted by Biotrol, Inc. The results of the bench scale studies indicate that the contaminants of concern can be degraded to levels prescribed by the RAOs. Based on information collected during the treatability study, Biotrol has proposed an ex situ methanogenic (aerobic) bioremediation process, which utilizes methane as the primary food source for bacteria that degrade chlorinated solvents. The ex situ application of the methanogenic bioremediation technology is an innovative treatment technology and will require pilot scale testing prior to full scale implementation. Biotrol's methanogenic bioremediation technology for the ex situ treatment of water contaminated with halogenated hydrocarbons was accepted in the Superfund

analysis to form a baseline of comparison in the absence of further remedial action. There are no permits required to implement this alternative, and the time and costs to implement are negligible.

3.1.2 Alternative 2S - Low Temperature Thermal Desorption

Alternative 2 will consist of the excavation of soils from the source area and subsequent treatment by low temperature thermal desorption. Preremedial activities will include construction of a staging area and a treatment pad. Based on the results of the treatability studies, pretreatment (e.g., soil homogenization) and post-treatment (off-gas treatment) may be required, but there are no technical or administrative barriers to the implementation of this system. Soil will be analyzed following treatment to ensure that it is under the criteria of 3.0 ppm for trichloroethylene and 0.5 ppm for vinyl chloride. In addition, soil will meet all applicable LDR criteria. After these levels are attained, the treated soil will no longer "contain" F002 wastes, and it will be spread on the ground surface in the open area of the site north of the unnamed tributary and covered with a layer of clay. The operation of the low temperature thermal desorption system may require an air permit. It is estimated that this alternative will achieve RAOs in 6 to 12 months.

3.1.3 Alternative 3S - Bioremediation

Alternative 3S will consist of the excavation of soils in the source area and *ex situ* bioremediation. A number of *ex situ* bioremediation methods exist (e.g., bioreactor, bio-cell). Bench scale bioremediation treatability studies of the contaminated soil from the Scott Aviation site were conducted by Biotrol, Inc. The results of the bench scale studies indicate that the contaminants of concern can be degraded to levels prescribed by the RAOs. Based on information collected during the treatability study, Biotrol has proposed an ex situ methanogenic (aerobic) bioremediation process, which utilizes methane as the primary food source for bacteria that degrade chlorinated solvents. The ex situ application of the methanogenic bioremediation technology is an innovative treatment technology and will require pilot scale testing prior to full scale implementation. Biotrol's methanogenic bioremediation technology for the ex situ treatment of water contaminated with halogenated hydrocarbons was accepted in the Superfund

analysis to form a baseline of comparison in the absence of further remedial action. There are no permits required to implement this alternative, and the time and costs to implement are negligible.

3.1.2 Alternative 2S - Low Temperature Thermal Desorption

Alternative 2 will consist of the excavation of soils from the source area and subsequent off-site treatment by low temperature thermal desorption. Preremedial activities will include construction of a staging area and a treatment pad. Based on the results of the treatability studies, pretreatment (e.g., soil homogenization) and post-treatment (off-gas treatment) may be required, but there are no technical or administrative barriers to the

Revise the third to last sentence under Section 3.1.2 to read .... will no longer contain F002 wastes, and it will be spread in the area adjacent to Building No. 2. Because this area will be part of the CAMU designated for the site, no further regulatory requirements will apply.

Insert the following sentence after the one which begins with Based on the results of ....

Soil will be analyzed following treatment to ensure that it is under the criteria of 1.0 ppm for trichloroethylene and 10 ppm for total VOCs.

3.1.3 Alternative 3S - Bioremediation

Alternative 3S will consist of the excavation of soils in the source area and *ex situ* bioremediation. A number of *ex situ* bioremediation methods exist (e.g., bioreactor, bio-cell). Bench scale bioremediation treatability studies of the contaminated soil from the Scott Aviation site were conducted by Biotrol, Inc. The results of the bench scale studies indicate that the contaminants of concern can be degraded to levels prescribed by the RAOs. Based on information collected during the treatability study, Biotrol has proposed an ex situ methanogenic (aerobic) bioremediation process, which utilizes methane as the primary food source for bacteria that degrade chlorinated solvents. The ex situ application of the methanogenic bioremediation technology is an innovative treatment technology and will require pilot scale testing prior to full scale implementation. Biotrol's methanogenic bioremediation technology for the ex situ treatment of water contaminated with halogenated hydrocarbons was accepted in the Superfund

analysis to form a baseline of comparison in the absence of further remedial action. There are no permits required to implement this alternative, and the time and costs to implement are negligible.

3.1.2 Alternative 2S - Low Temperature Thermal Desorption

Alternative 2 will consist of the excavation of soils from the source area and subsequent on-site treatment by low temperature thermal desorption. Preremedial activities will include construction of a staging area and a treatment pad. Based on the results of the treatability studies, pretreatment (e.g., soil homogenization) and post-treatment (off-gas treatment) may be required, but there are no technical or administrative barriers to the implementation of this system. Soil will be analyzed following treatment to ensure that it is under the criteria of 1.0 ppm for trichloroethylene and 10 ppm for total VOCs. In addition, soil will meet all applicable LDR criteria. After these levels are attained, the treated soil will no longer "contain" F002 wastes, and it will be spread in the area adjacent to Building No. 2. The treated soils will be covered with clean fill and then revegated. Because this area will be part of the CAMU designated for the site, no further regulatory requirements will apply. The operation of the low temperature thermal desorption system may require an air permit. It is estimated that this alternative will achieve RAOs in 6 to 12 months.

3.1.3 Alternative 3S - Bioremediation

Alternative 3S will consist of the excavation of soils in the source area and *ex situ* bioremediation. A number of *ex situ* bioremediation methods exist (e.g., bioreactor, bio-cell). Bench scale bioremediation treatability studies of the contaminated soil from the Scott Aviation site were conducted by Biotrol, Inc. The results of the bench scale studies indicate that the contaminants of concern can be degraded to levels prescribed by the RAOs. Based on information collected during the treatability study, Biotrol has proposed an ex situ methanogenic (aerobic) bioremediation process, which utilizes methane as the primary food source for bacteria that degrade chlorinated solvents. The ex situ application of the methanogenic bioremediation technology is an innovative treatment technology and will require pilot scale testing prior to full scale implementation. Biotrol's methanogenic bioremediation technology for the ex situ treatment of water

Innovative Technology Evaluation (SITE) Emerging Technology Program in July 1990. Biotrol reports that bench-scale and pilot-scale studies have demonstrated the full scale applicability of this technology for treating groundwater. This technology has not been demonstrated for the treatment of soils contaminated with chlorinated hydrocarbons. A pilot scale bioremediation treatability study would need to be conducted at the Scott Aviation facility before this technology could be considered a viable alternative.

If the results of the pilot scale study were to indicate that this technology can be effectively implemented on a full scale basis, bioremediation activities could commence. If the pilot scale study dictates that this technology is not applicable an alternate remedial action alternative would be implemented. Specification of design parameters, would be dependent on the results of the pilot scale study. In general, preremediation activities would include the construction of a soil staging area and a treatment pad. Because the soil to be excavated would have a high clay content and high moisture content, conditioning of the soil will likely

Page 3-4, Paragraph 2, Replace last 3 sentences with:

If the treated soil meet the criteria of 1.0 ppm for trichloroethylene and 10 ppm for total VOCs, the soil will no longer "contain" F002 wastes. Consequently, it will be spread on the ground surface in the area adjacent to Building No. 2. Because this area will be part of the CAMU designated for the site, no further regulatory requirements will apply. The ex-situ bioremediation system is estimated to be implementable within a 12 to 18 month period.

→ covered with 6" clay layer

3.1.4 Alternative 4S - Off-site Disposal

Alternative 4S will consist of the excavation of contaminated soil and off-site disposal at an approved treatment, storage, and disposal facility. The off-site disposal of soil must comply with all RCRA requirements including waste characterization and manifesting. Since it has been determined that the contaminated soil can be characterized as both a D040 and F002, the excavated soils will be manifested under the more stringent classification as an F002 waste. Under this waste classification, there are three viable off-site disposal options (1) disposal in a Canadian landfill (e.g., Stablex landfill, Quebec, Canada), (2) disposal at an incinerator within the United States, and (3) off-site treatment and disposal at a U.S. Landfill. Since the costs for

Innovative Technology Evaluation (SITE) Emerging Technology Program in July 1990. Biotrol reports that bench-scale and pilot-scale studies have demonstrated the full scale applicability of this technology for treating groundwater. This technology has not been demonstrated for the treatment of soils contaminated with chlorinated hydrocarbons. A pilot scale bioremediation treatability study would need to be conducted at the Scott Aviation facility before this technology could be considered a viable alternative.

If the results of the pilot scale study were to indicate that this technology can be effectively implemented on a full scale basis, bioremediation activities could commence. If the pilot scale study dictates that this technology is not applicable an alternate remedial action alternative would be implemented. Specification of design parameters, would be dependent on the results of the pilot scale study. In general, preremediation activities would include the construction of a soil staging area and a treatment pad. Because the soil to be excavated would have a high clay content and high moisture content, conditioning of the soil will likely be required prior to initiating treatment activities. [redacted].

3.1.4 Alternative 4S - Off-site Disposal

Alternative 4S will consist of the excavation of contaminated soil and off-site disposal at an approved treatment, storage, and disposal facility. The off-site disposal of soil must comply with all RCRA requirements including waste characterization and manifesting. Since it has been determined that the contaminated soil can be characterized as both a D040 and F002, the excavated soils will be manifested under the more stringent classification as an F002 waste. Under this waste classification, there are three viable off-site disposal options (1) disposal in a Canadian landfill (e.g., Stablex landfill, Quebec, Canada), (2) disposal at an incinerator within the United States, and (3) off-site treatment and disposal at a U.S. Landfill. Since the costs for incineration are significantly higher than those associated with landfilling, the latter will be evaluated as the disposal option of choice. This alternative is anticipated to take 3 to 6 months to implement.

3.1.5 Alternative 5S - Ex situ Vapor Extraction

Alternative 5S will consist of the excavation of soils from the source area and subsequent treatment by ex situ vapor extraction. Prior to commencing soil excavation activities a soil staging area and a treatment cell, consisting of a perimeter berm and an impermeable liner, will be constructed. Once preremediation activities are complete, the soil will be excavated in lifts, conditioned (e.g., mechanically broken apart), and placed in the treatment cell. Because the soils will be excavated from the saturated

Page 3-5, Paragraph 1, insert the following text after the ~~3rd~~ 4th sentence:

*Soil conditioning operations will be conducted within an enclosed structure, during which time VOC and fugitive dust emissions will be monitored. VOC and particulate discharges from this unit will meet applicable air regulations and ambient air levels.

Page 3-5, Paragraph 1, 5th to last sentence

Soil will be analyzed following treatment to ensure that it is under the criteria of 1.0 ppm for trichloroethylene and 10.0 ppm for total VOCs.

After these levels are attained, the soil no longer "contain" F002 wastes, and it will be spead on the ground surface in the area adjacent to Building No. 2. Because this area will be part of the CAMU designated for the site, no further regulatory requirements will apply.

and LEAVE IN

3.2 Description of Groundwater Alternatives

Four remedial action alternatives have been identified for groundwater: Alternative 1G - No Action, Alternative 2G - Air Stripping, Alternative 3G, Carbon Adsorption, and Alternative 4G - Off-site Disposal. With the exception of Alternative 1G, each of the alternatives will consist of the collection of groundwater in an interception trench followed by treatment and/or disposal and long-term monitoring of groundwater. The RAO for groundwater is to prevent the ingestion of groundwater that does not meet NYSDEC groundwater quality standards. Although it is unlikely that the groundwater will ever be incineration are significantly higher than those associated with landfilling, the latter will be evaluated as the disposal option of choice. This alternative is anticipated to take 3 to 6 months to implement.

3.1.5 Alternative 5S - Ex situ Vapor Extraction

Alternative 5S will consist of the excavation of soils from the source area and subsequent treatment by ex situ vapor extraction. Prior to commencing soil excavation activities a soil staging area and a treatment cell, consisting of a perimeter berm and an impermeable liner, will be constructed. Once preremediation activities are complete, the soil will be excavated in lifts, conditioned (e.g., mechanically broken apart), and placed in the treatment cell. Because the soils will be excavated from the saturated zone of the aquifer, further soil conditioning will likely be required to handle excess moisture. A series of perforated pipes will be placed horizontally on top of each lift. The pipes will be connected through a series of manifolds to a blower, which will draw air through the soil pile. Once the pile is completed, it will be covered with plastic. Off-gas from the soil pile will be treated with a vapor phase carbon adsorption system. Soil will be analyzed following treatment to ensure that it is under the criteria of 3.0 ppm for trichloroethylene and 0.5 ppm for vinyl chloride. In addition, soil will meet all applicable LDR criteria. After these levels are attained, the soil will no longer "contain" F002 wastes, and it will be spread on the ground surface in the open area of the site north of the unnamed tributary and covered with a layer of clay. Operation of the soil treatment system may require an air permit. It is estimated that this alternative will achieve RAOs in 3 to 6 months.

3.2 Description of Groundwater Alternatives

Four remedial action alternatives have been identified for groundwater: Alternative 1G - No Action, Alternative 2G - Air Stripping, Alternative 3G, Carbon Adsorption, and Alternative 4G - Off-site Disposal. With the exception of Alternative 1G, each of the alternatives will consist of the collection of groundwater in an interception trench followed by treatment and/or disposal and long-term monitoring of groundwater. The RAO for groundwater is to prevent the ingestion of groundwater that does not meet NYSDEC groundwater quality standards. Although it is unlikely that the groundwater will ever be contaminated with halogenated hydrocarbons was accepted in the Superfund Innovative Technology Evaluation (SITE) Emerging Technology Program in July 1990. Biotrol reports that bench-scale and pilot-scale studies have demonstrated the full scale applicability of this technology for treating groundwater. This technology has not been demonstrated for the treatment of soils contaminated with chlorinated hydrocarbons. A pilot scale bioremediation treatability study would need to be conducted at the Scott Aviation facility before this technology could be considered a viable alternative.

If the results of the pilot scale study were to indicate that this technology can be effectively implemented on a full scale basis, bioremediation activities could commence. If the pilot scale study dictates that this technology is not applicable an alternate remedial action alternative would be implemented. Specification of design parameters, would be dependent on the results of the pilot scale study. In general, preremediation activities would include the construction of a soil staging area and a treatment pad. Because the soil to be excavated would have a high clay content and high moisture content, conditioning of the soil will likely be required prior to initiating treatment activities. If the treated soil meet the criteria of 1.0 ppm for trichlorethylene and 10 ppm for total VOCs, the soil will no longer "contain" F002 wastes. Consequently, it will be spread on the ground surface in the area adjacent to Building No. 2. The treated soils will be covered with clean fill and then revegated. Because this area will be part of the CAMU designated for the site, no further regulatory requirements will apply. The *ex situ* bioremediation system is estimated to be implementable within a 12 to 18 month period.

3.1.4 Alternative 4S - Off-site Disposal

Alternative 4S will consist of the excavation of contaminated soil and off-site disposal at an approved treatment, storage, and disposal facility. The off-site disposal of soil must comply with all RCRA requirements including waste characterization and manifesting. Since it has been determined that the contaminated soil can be characterized as both a D040 and F002, the excavated soils will be manifested under the more stringent classification as an F002 waste. Under this waste classification, there are three viable off-site disposal options (1) disposal in a Canadian landfill (e.g., Stablex landfill, Quebec, Canada), (2) disposal at an incinerator within the United States, and (3) off-site treatment and disposal at a U.S. Landfill. Since the costs for incineration are significantly higher than those associated with landfilling, the latter will be evaluated as the disposal option of choice. This alternative is anticipated to take 3 to 6 months to implement.

3.1.5 Alternative 5S - Ex situ Vapor Extraction

Alternative 5S will consist of the excavation of soils from the source area and subsequent treatment by ex situ vapor extraction. Prior to commencing soil excavation activities a soil staging area and a treatment cell, consisting of a perimeter berm and an impermeable liner, will be constructed. Once preremediation activities are complete, the soil will be excavated in lifts, conditioned (e.g., mechanically broken apart), and placed in the treatment cell. Because the soils will be excavated from the saturated zone of the aquifer, further soil conditioning will likely be required to handle excess moisture. Soil conditioning operations will be conducted within an enclosed structure, during which time VOC and fugitive dust emissions will be monitored. VOC and particulate discharges from this unit will meet applicable air regulations and ambient air levels. A series of perforated pipes will be placed horizontally on top of each lift. The pipes will be connected through a series of manifolds to a blower, which will draw air through the soil pile. Once the pile is completed, it will be covered with plastic. Off-gas from the soil pile will be treated with a vapor phase carbon adsorption system. Soil will be analyzed following treatment to ensure that it is under the criteria of 1.0 ppm for trichloroethylene and 10 ppm for total VOCs. In addition, soil will meet all applicable LDR criteria. After these levels are attained, the soil will no longer "contain" F002 wastes, and it will be spread on the ground surface in the area adjacent to Building No. 2. The treated soils will be covered with clean fill and then revegated. Because this area will be part of the CAMU designated for the site, no further regulatory requirements will apply. It is estimated that this alternative will achieve RAOs in 3 to 6 months.

3.2 Description of Groundwater Alternatives

Four remedial action alternatives have been identified for groundwater: Alternative 1G - No Action, Alternative 2G - Air Stripping, Alternative 3G, Carbon Adsorption, and Alternative 4G - Off-site Disposal. With the exception of Alternative 1G, each of the alternatives will consist of the collection of groundwater in an interception trench followed by treatment and/or disposal and long-term monitoring of groundwater. The RAO for groundwater is to prevent the ingestion of groundwater that does not meet NYSDEC groundwater quality standards. Although it is unlikely that the groundwater will ever be ingested by anyone, theoretically, a goal of the groundwater remediation is to reduce groundwater concentrations to levels set forth by the NYSDEC groundwater quality standards. From a practical standpoint, groundwater collection/treatment systems have historically been found to reach a point of equilibrium, whereby further reduction of contaminant concentrations becomes unfeasible. Therefore, the effectiveness of the groundwater collection/treatment system, if selected, will be evaluated on the basis of groundwater monitoring data.

An evaluation of VOC concentrations versus time in groundwater samples collected from outside of the existing interception trench indicates that the this containment system may not be working at 100% efficiency (i.e part of the plume is passing beneath the stagnation point (effective zone of capture) of the present trench system). It has been determined that the existing interception trench should be replaced by a new system, closer to the western site property boundary and capable of intercepting groundwater from the top of the aquifer to the bedrock surface. Therefore, Alternatives 2G, 3G, and 4G will each consist of the in-place abandonment of the existing trench and the design and construction of a new interception trench. The existing interception trench will be inactivated by pumping out and disposing of all residual wastewater, followed by the injection of a cement slurry into the trench piping to seal off flow in the system.

The new interception trench will be located along the western property boundary and will be installed to a sufficient depth so that when pumped, the stagnation point extends to the bedrock surface at approximately 25 feet below grade. The trench will be approximately 200 feet long and will be installed at a depth to be determined via groundwater modelling in the remedial design phase. Based on hydraulic conductivity data collected in the vicinity of MW-4 and MW-3, it is estimated that the trench will yield between 4,000 gallons per day (gpd) and 10,000 gpd. In order to allow for a comparison between alternatives, a conservative design flow rate of 7.5 gallons per minute (gpm) will be assumed. Based on solute transport calculations, accounting for retardation, surface water infiltration, and soil partitioning, it is estimated that groundwater collection/treatment will take approximately 10 years to achieve RAOs. The design flow rate and required treatment duration estimates will be refined during the remedial design phase.

Alternatives 2G, 3G, and 4G will also consist of long-term groundwater monitoring. Existing monitoring wells MW-4 and MW-3 will be monitored on a semi-annual basis along with the new interception trench. The monitoring will consist of the sampling and analysis of the wells and the trench for priority pollutant VOCs. The results of the groundwater monitoring will be used to assess the long-term effectiveness of the interception trench and remediation system.

Alternatives 2G and 3G will consist of the discharge of treated groundwater to the Buffalo Sewer Authority (BSA). Prior to discharge to the BSA, approval from the BSA and the Erie County Department of Environment and Planning must be obtained.

3.2.1 Alternative 1G - No Action

The no action alternative will be evaluated as required by the National Contingency Plan (NCP). Under this alternative no remedial measures would be implemented to mitigate groundwater site conditions. Current remedial activities, such as the operation of the interception trench, would be discontinued. This alternative would probably meet the groundwater RAO, if coupled with excavation of contaminated soils that are the source of the groundwater contamination. This alternative will be carried through the detailed analysis to form a baseline of comparison in the absence of further remedial action. There are no permits required to implement this alternative, and the time to implement is negligible.

3.2.2 Alternative 2G - Air Stripping

Groundwater from the interception trench system will be pumped to an on-site packed tower air stripper and the treated effluent will be discharged to the sanitary sewer. For this alternative, a pretreatment step may be required to prevent fouling of the air stripper with dissolved iron and manganese, but

Page 3-7, Paragraph 3

Delete last half of sentence: (Off-gas from the air stripper may require further treatment,) and an air quality permit may be required.

effluent to the BSA will require prior approval.

regarding the anticipated volume of contaminated soils to be excavated and treated, it is estimated that the air stripping system will be operated for 10

Alternatives 2G, 3G, and 4G will also consist of long-term groundwater monitoring. Existing monitoring wells MW-4 and MW-3 will be monitored on a semi-annual basis along with the new interception trench. The monitoring will consist of the sampling and analysis of the wells and the trench for priority pollutant VOCs. The results of the groundwater monitoring will be used to assess the long-term effectiveness of the interception trench and remediation system.

Alternatives 2G and 3G will consist of the discharge of treated groundwater to the Buffalo Sewer Authority (BSA). Prior to discharge to the BSA, approval from the BSA and the Erie County Department of Environment and Planning must be obtained.

3.2.1 Alternative 1G - No Action

The no action alternative will be evaluated as required by the National Contingency Plan (NCP). Under this alternative no remedial measures would be implemented to mitigate groundwater site conditions. Current remedial activities, such as the operation of the interception trench, would be discontinued. This alternative would probably meet the groundwater RAO, if coupled with excavation of contaminated soils that are the source of the groundwater contamination. This alternative will be carried through the detailed analysis to form a baseline of comparison in the absence of further remedial action. There are no permits required to implement this alternative, and the time to implement is negligible.

3.2.2 Alternative 2G - Air Stripping

Groundwater from the interception trench system will be pumped to an on-site packed tower air stripper and the treated effluent will be discharged to the sanitary sewer. For this alternative, a pretreatment step may be required to prevent fouling of the air stripper with dissolved iron and manganese, but it is a well demonstrated technology that can be easily implemented at the site. Off-gas from the air stripper may require further treatment, and an air quality permit may be required. If off-gas treatment is required, a vapor phase carbon adsorption system will be installed. The discharge of treated effluent to the BSA will require prior approval. Based on present assumptions regarding the anticipated volume of contaminated soils to be excavated and treated, it is estimated that the air stripping system will be operated for 10 alternatives, a conservative design flow rate of 7.5 gallons per minute (gpm) will be assumed. Based on solute transport calculations, accounting for retardation, surface water infiltration, and soil partitioning, it is estimated that groundwater collection/treatment will take approximately 10 years to achieve RAOs. The design flow rate and required treatment duration estimates will be refined during the remedial design phase.

Alternatives 2G, 3G, and 4G will also consist of long-term groundwater monitoring. Existing monitoring wells MW-4 and MW-3 will be monitored on a semi-annual basis along with the new interception trench. The monitoring will consist of the sampling and analysis of the wells and the trench for priority pollutant VOCs. The results of the groundwater monitoring will be used to assess the long-term effectiveness of the interception trench and remediation system.

Alternatives 2G and 3G will consist of the discharge of treated groundwater to the Buffalo Sewer Authority (BSA). Prior to discharge to the BSA, approval from the BSA and the Erie County Department of Environment and Planning must be obtained.

3.2.1 Alternative 1G - No Action

The no action alternative will be evaluated as required by the National Contingency Plan (NCP). Under this alternative no remedial measures would be implemented to mitigate groundwater site conditions. Current remedial activities, such as the operation of the interception trench, would be discontinued. This alternative would probably meet the groundwater RAO, if coupled with excavation of contaminated soils that are the source of the groundwater contamination. This alternative will be carried through the detailed analysis to form a baseline of comparison in the absence of further remedial action. There are no permits required to implement this alternative, and the time to implement is negligible.

3.2.2 Alternative 2G - Air Stripping

Groundwater from the interception trench system will be pumped to an on-site packed tower air stripper and the treated effluent will be discharged to the sanitary sewer. For this alternative, a pretreatment step may be required to prevent fouling of the air stripper with dissolved iron and manganese, but it is a well demonstrated technology that can be easily implemented at the site. Off-gas from the air stripper may require further treatment. If off-gas treatment is required, a vapor phase carbon adsorption system will be installed. The discharge of treated effluent to the BSA will require prior approval. Based on present assumptions regarding the anticipated volume of contaminated soils to be excavated and treated, it is estimated that the air stripping system will be operated for 10 years. It is anticipated that this figure may be adjusted downward, depending on the actual volumes which are removed and a final estimate of any residual soil contamination remaining following excavation.

3.2.3 Alternative 3G - Carbon Adsorption

Alternative 3G will consist of the treatment of groundwater from the interception trench with an on-site carbon adsorption system. This treatment option may also be limited by the presence of vinyl chloride in the groundwater. Vinyl chloride has a very low adsorption capacity. However, the concentrations of vinyl chloride detected in on-site groundwater were below 1 ppm, which may be acceptable to the BSA. The discharge of treated effluent will require the approval of the BSA and the ECDEP. It is estimated that this system will be operated for 10 years.

3.2.4 Alternative 4G - Off-site Treatment

Alternative 4G will consist of the off-site disposal of the groundwater collected from the interception trench at a RCRA facility. Groundwater currently being pumped from the interim trench is shipped to the CECOS International treatment facility, in Niagara Falls, New York. Based on the proximity of this facility and economic disposal rates, this facility will be retained as the preferred RCRA disposal facility. It is estimated that this alternative would be operational for a period of 10 years.

4.0 DETAILED ANALYSIS OF ALTERNATIVES

In this section, the remedial action alternatives selected for further evaluation are first individually evaluated against seven evaluation criteria, and then a comparative analysis of alternatives is conducted. CERCLA requires that, to the maximum extent practical, remedial action alternatives must (1) be protective of human health and the environment, (2) attain ARARs (e.g., SCGs), (3) be cost-effective, (4) utilize permanent solutions and alternative treatment technologies, and (5) reduce toxicity, mobility, or volume. The purpose of the detailed analysis of alternatives is to determine which remedial action alternative is most appropriate for the site.

4.1 Individual Analysis of Alternatives

The individual analysis of alternatives consists of the analysis of each of the remedial action alternatives selected for further evaluation against the following evaluation criteria (1) overall protection of human health and the environment, (2) compliance with applicable and relevant and appropriate SCGs, (3) long-term effectiveness and permanence, (4) reduction of toxicity, mobility, or volume, (5) short-term effectiveness, (6) implementability, and (7) cost. A brief description of each of the evaluation criteria is presented in Table 4-1. In accordance with the NYSDEC Technical and Administrative Guidance Memorandum - Selection of Remedial Actions at Inactive Hazardous Waste Sites, May 1, 1990, a series of worksheets were used to evaluate the relative feasibility of each alternative with respect to the evaluation criteria. Copies of the worksheets are presented in Appendix A.

4.1.1 Remedial Action Alternatives for Soils

4.1.1.1 Alternative 1S - No Action

Overall Protectiveness

This alternative does not offer adequate protection of human health and the environment. Specifically, the risks for a hypothetical future on-site resident are above acceptable levels.

Compliance With SCGs

The no action alternative does not comply with chemical-specific SCGs or achieve remedial action objectives. As set forth in Section 3.1, soils must

Table 4-1
Description of Evaluation Criteria
Used for the
Detailed Analysis of Alternatives

Evaluation Criteria	Description
Overall Protection of Human Health and the Environment	Assessment against this criterion describes how the alternative achieves and/or maintains protection of human health and the environment (e.g., does the alternative prevent exposure to contaminated media?).
Compliance with Standards, Criteria, and Guidances (SCGs)	Assessment against this criterion describes how the alternative achieves or exceeds compliance with SCGs, as well as, remedial action objectives.
Long-term Effectiveness and Permanence	Assessment against this criterion evaluates the long-term effectiveness of the alternative in terms of the maintenance of human health (e.g., magnitude of residual risk). The selection of a remedy that provides a permanent solution is statutorily preferred.
Reduction of Toxicity, Mobility, or Volume	Assessment against this criterion evaluates the effectiveness of the remedial technology in terms of the reduction in toxicity, mobility, and volume of contaminated material.
Short-Term Effectiveness	Assessment against this criterion describes the relative effectiveness of the alternative in protecting human health and the environment during the construction phase (e.g., will site controls be required to prevent fugitive emissions?).
Implementability	Assessment against this criterion evaluates the technical and administrative feasibility of the remedial alternative.
Cost	Assessment against this criterion evaluates the capital and operation and maintenance costs of the remedial alternative. Costs are typically provided to an accuracy of +50 percent to -30 percent.

Page 4-3, Paragraph 1, Sentence 1 - revise to read:

* ...be treated to under 1.0 ppm for trichloroethylene and 10 ppm for total VOCs, so that they no longer "contain" F002 wastes. Consequently, it will be spread on the ground surface in the area adjacent to Building No. 2. covered with a clay layer. Because this area will be part of the CAMU designated for the site, no further regulatory requirements will apply.

oil soils asures niting

the implementation of this alternative.

Long-term Effectiveness and Permanence

This alternative is not anticipated to be effective on a long-term basis. If the soil in the source area is not removed, it may act as a continuing source of groundwater contamination. This alternative does not meet the statutory preference for a permanent solution.

Reduction of Toxicity, Mobility, or Volume

The no action alternative will not directly reduce the toxicity, mobility, or volume of contaminated soil. Some reduction in the volume and toxicity of the soil will occur over time through natural degradation and migration to groundwater, but it will result in an increase in the volume of contaminated groundwater.

Short-term Effectiveness

This alternative does not pose any additional risks to on-site workers or the surrounding community during the implementation phase. However, this option does not achieve RAOs and does not reduce potential risks to human health and the environment.

Implementability

There are no technical or administrative restrictions on the implementability of this alternative.

Cost

The costs for this alternative are relatively low, being limited to the quarterly monitoring of the six existing groundwater monitoring wells. Total operation and maintenance costs shown in Table 4-11 are based on a 10 year duration of monitoring[1].

This alternative will result in the removal and on-site treatment (i.e., low temperature thermal desorption) of all contaminated soils within the be treated to under 3.0 ppm for trichloroethylene and 0.5 ppm for vinyl chloride, so that they no longer "contain" F002 wastes.* In addition, soil will meet all applicable LDR criteria. Under the no action alternative, soils in excess of site-specific RAOs would remain on-site with no further measures to prevent dermal contact or the migration of contaminants from soil to groundwater. There are no location-specific or action-specific SCGs limiting the implementation of this alternative.

Long-term Effectiveness and Permanence

This alternative is not anticipated to be effective on a long-term basis. If the soil in the source area is not removed, it may act as a continuing source of groundwater contamination. This alternative does not meet the statutory preference for a permanent solution.

Reduction of Toxicity, Mobility, or Volume

The no action alternative will not directly reduce the toxicity, mobility, or volume of contaminated soil. Some reduction in the volume and toxicity of the soil will occur over time through natural degradation and migration to groundwater, but it will result in an increase in the volume of contaminated groundwater.

Short-term Effectiveness

This alternative does not pose any additional risks to on-site workers or the surrounding community during the implementation phase. However, this option does not achieve RAOs and does not reduce potential risks to human health and the environment.

Implementability

There are no technical or administrative restrictions on the implementability of this alternative.

Cost

The costs for this alternative are negligible.

4.1.1.2 Alternative 2S - Low Temperature Thermal Desorption

Overall Protectiveness

This alternative will result in the removal and on-site treatment (i.e., low temperature thermal desorption) of all contaminated soils within the be treated to under 1.0 ppm for trichloroethylene and 10 ppm for total VOCs, so that they no longer "contain" F002 wastes. Consequently, it will be spread on the ground surface in the area adjacent to Building No. 2. The treated soils will be covered with clean fill and then revegated. Because this area will be part of the CAMU designated for the site, no further regulatory requirements will apply.

Long-term Effectiveness and Permanence

This alternative is not anticipated to be effective on a long-term basis. If the soil in the source area is not removed, it may act as a continuing source of groundwater contamination. This alternative does not meet the statutory preference for a permanent solution.

Reduction of Toxicity, Mobility, or Volume

The no action alternative will not directly reduce the toxicity, mobility, or volume of contaminated soil. Some reduction in the volume and toxicity of the soil will occur over time through natural degradation and migration to groundwater, but it will result in an increase in the volume of contaminated groundwater.

Short-term Effectiveness

This alternative does not pose any additional risks to on-site workers or the surrounding community during the implementation phase. However, this option does not achieve RAOs and does not reduce potential risks to human health and the environment.

Implementability

There are no technical or administrative restrictions on the implementability of this alternative.

Cost

The costs for this alternative are relatively low, being limited to the quarterly monitoring of the six existing groundwater monitoring wells. Total operation and maintenance cost shown in Table 4-11 are based on a 10 year duration of monitoring.

source area. Soil contamination in the former tank area extends to bedrock but tapers to a one to two foot thick layer at the top of the uppermost confined aquifer as the western property line is approached. Following delineation and removal of the source area, some residual soil contamination may remain in soil at the top of this aquifer near the site boundary (i.e. in the vicinity of MW-4). The residual contamination is limited to a very thin stratigraphic section occurring at a depth of about 10 feet below grade and is, therefore, not directly accessible for human contact. It is anticipated that contaminant levels in these residually contaminated soils will decline to RAOs as groundwater moving through the top of the aquifer desorbs these VOCs and is removed through a relocated and redesigned interception trench system. Future risks to human health under this remedial alternative are anticipated to be within acceptable ranges.

Compliance With SCGs

Insert the following text in Section 4.1.1 under the Compliance with SCGs section for each soil remediation alternative discussed in the text.

The RAO for contaminated soils is to prevent the ingestion and inhalation of and dermal contact with contaminated soils that pose an unaccaeptable risk to human health. As set forth in Section 3.1, soils must be treated to under 1.0 ppm for trichloroethylene and 10 ppm for total VOCs. The treatment of these soils will be conducted within a corrective area management unit (CAMU), a relevant and appropriate requirement for the site. In the case of the Scott Aviation site, a CAMU is an area on the Scott Aviation site to be designated by NYSDEC for use as a hazardous waste management area during site remediation activities, and, if appropriate, for ultimate deposition of the treated soils.

o human
ppm
l will
removal
the
lition,
ırce to
ide the
7.
ht the
nay be

required.

Long-term Effectiveness and Permanence

Alternative 2S was rated very high with respect to long-term effectiveness and permanence. This alternative utilizes an on-site treatment method, that is considered a permanent remedy. The selection of an alternative that provides a permanent solution is statutorily preferred. A small quantity of residual soil contamination will remain on-site, but this

source area. Soil contamination in the former tank area extends to bedrock but tapers to a one to two foot thick layer at the top of the uppermost confined aquifer as the western property line is approached. Following delineation and removal of the source area, some residual soil contamination may remain in soil at the top of this aquifer near the site boundary (i.e. in the vicinity of MW-4). The residual contamination is limited to a very thin stratigraphic section occurring at a depth of about 10 feet below grade and is, therefore, not directly accessible for human contact. It is anticipated that contaminant levels in these residually contaminated soils will decline to RAOs as groundwater moving through the top of the aquifer desorbs these VOCs and is removed through a relocated and redesigned interception trench system. Future risks to human health under this remedial alternative are anticipated to be within acceptable ranges.

Compliance With SCGs

The RAO for soils is to prevent the ingestion and inhalation of and dermal contact with contaminated soils that pose an unacceptable risk to human health. As set forth in Section 3.1 soils must be treated to under 3.0 ppm for trichloroethylene and 0.5 ppm for vinyl chloride. In addition, soil will meet all applicable LDR criteria. This alternative will result in the removal and treatment of contaminated soils in the source area, thus preventing the ingestion and inhalation of and dermal contact with such soils. In addition, it will prevent the further migration of soil contaminants from the source to groundwater. Low levels of residual contamination found in areas outside the source area are not anticipated to pose a threat to groundwater quality. There are no action-specific or location-specific SCGs that will prevent the implementation of this alternative. However, an air discharge permit may be required.

Long-term Effectiveness and Permanence

Alternative 2S was rated very high with respect to long-term effectiveness and permanence. This alternative utilizes an on-site treatment method, that is considered a permanent remedy. The selection of an alternative that provides a permanent solution is statutorily preferred. A small quantity of residual soil contamination will remain on-site, but this

4.1.1.2 Alternative 2S - Low Temperature Thermal Desorption

Overall Protectiveness

This alternative will result in the removal and on-site treatment (i.e., low temperature thermal desorption) of all contaminated soils within the source area. Soil contamination in the former tank area extends to bedrock but tapers to a one to two foot thick layer at the top of the uppermost confined aquifer as the western property line is approached. Following delineation and removal of the source area, some residual soil contamination may remain in soil at the top of this aquifer near the site boundary (i.e. in the vicinity of MW-4). The residual contamination is limited to a very thin stratigraphic section occurring at a depth of about 10 feet below grade and is, therefore, not directly accessible for human contact. It is anticipated that contaminant levels in these residually contaminated soils will decline to RAOs as groundwater moving through the top of the aquifer desorbs these VOCs and is removed through a relocated and redesigned interception trench system. Future risks to human health under this remedial alternative are anticipated to be within acceptable ranges.

Compliance With SCGs

The RAO for soils is to prevent the ingestion and inhalation of and dermal contact with contaminated soils that pose an unacceptable risk to human health. As set forth in Section 3.1, soils must be treated to under 1.0 ppm for trichloroethylene and 10 ppm for total VOCs. In addition, soil will meet all applicable LDR criteria. This alternative will result in the removal and treatment of contaminated soils in the source area, thus preventing the ingestion and inhalation of and dermal contact with such soils. In addition, it will prevent the further migration of soil contaminants from the source to groundwater. Low levels of residual contamination found in areas outside the source area are not anticipated to pose a threat to groundwater quality. There are no action-specific or location-specific SCGs that will prevent the implementation of this alternative.

Long-term Effectiveness and Permanence

Alternative 2S was rated very high with respect to long-term effectiveness and permanence. This alternative utilizes an on-site treatment method, that is considered a permanent remedy. The selection of an alternative that provides a permanent solution is statutorily preferred. A small quantity of residual soil contamination will remain on-site, but this material is not anticipated to pose a threat to human health and the environment. The treated soil will be analyzed to determine if it is under the criteria of 1.0 ppm for trichloroethylene and 10 for total VOCs. In addition, the soil will meet all applicable LDRs. If these criteria are met, the soils will be regraded at an on-site location; otherwise it should be disposed of off-site. In either case, the treated residual soil will not pose any unacceptable risks to human health or the environment. It is estimated that this alternative can be fully implemented in 6 to 12 months and there will be no operation and maintenance requirements for soils.

Reduction of Toxicity, Mobility, or Volume

Alternative 2S will result in a significant reduction in the toxicity, mobility, and volume of contaminated soil at the site. The soils located within the source area will be removed and treated on-site by low temperature thermal desorption. This method of treatment will result in a permanent reduction in the toxicity, mobility, and volume of the soils treated. The treated soil will be regraded on-site if it no longer "contains" F002, as set forth above, otherwise, it will be disposed of at an off-site facility.

Short-term Effectiveness

The excavation of the soil and subsequent treatment by on-site low temperature thermal desorption may result in the emission of fugitive dust and gaseous phase VOCs. In order to ensure the continued protection of the surrounding community, measures will be implemented to control these potential site emissions (e.g., dust suppression, air monitoring). There are no anticipated short-term risks that can not be controlled.

material is not anticipated to pose a threat to human health and the environment. The treated soil will be analyzed to determine if it is under the criteria of 3.0 ppm for trichloroethylene and 0.5 for vinyl chloride. In addition, the soil will meet all applicable LDRs. If these criteria are met, the soils will be regraded at an on-site location; otherwise it should be disposed of off-site. In either case, the treated residual soil will not pose any unacceptable risks to human health or the environment. It is estimated that this alternative can be fully implemented in 6 to 12 months and there will be no operation and maintenance requirements for soils.

Reduction of Toxicity, Mobility, or Volume

Alternative 2S will result in a significant reduction in the toxicity, mobility, and volume of contaminated soil at the site. The soils located within the source area will be removed and treated on-site by low temperature thermal desorption. This method of treatment will result in a permanent reduction in the toxicity, mobility, and volume of the soils treated. The treated soil will be regraded on-site if it no longer "contains" F002, as set forth above, otherwise, it will be disposed of at an off-site facility.

Short-term Effectiveness

The excavation of the soil and subsequent treatment by on-site low temperature thermal desorption may result in the emission of fugitive dust and gaseous phase VOCs. In order to ensure the continued protection of the surrounding community, measures will be implemented to control these potential site emissions (e.g., dust suppression, air monitoring). There are no anticipated short-term risks that can not be controlled.

Implementability

There are no insurmountable technical or administrative constraints preventing the implementation of this alternative. However, there are a number of technical constraints that must be taken into consideration. Specifically, the excavation may require shoring for both worker safety and structural stability; the excavation may need to be dewatered; specialized equipment will be required to excavate to a depth of 20 feet; and limited space is available at the site. These technical constraints can easily be determined during the design phase. Low temperature thermal desorption is a

Implementability

There are no insurmountable technical or administrative constraints preventing the implementation of this alternative. However, there are a number of technical constraints that must be taken into consideration. Specifically, the excavation may require shoring for both worker safety and structural stability; the excavation may need to be dewatered; specialized equipment will be required to excavate to a depth of 20 feet; and limited space is available at the site. These technical constraints can easily be determined during the design phase. Low temperature thermal desorption is a

source area. Soil contamination in the former tank area extends to bedrock but tapers to a one to two foot thick layer at the top of the uppermost confined aquifer as the western property line is approached. Following delineation and removal of the source area, some residual soil contamination may remain in soil at the top of this aquifer near the site boundary (i.e. in the vicinity of MW-4). The residual contamination is limited to a very thin stratigraphic section occurring at a depth of about 10 feet below grade and is, therefore, not directly accessible for human contact. It is anticipated that contaminant levels in these residually contaminated soils will decline to RAOs as groundwater moving through the top of the aquifer desorbs these VOCs and is removed through a relocated and redesigned interception trench system. Future risks to human health under this remedial alternative are anticipated to be within acceptable ranges.

The area where residual soil contamination may remain is located at and up to 50 feet west of the property line between Scott Aviation and Quick Cut Rubber and Gasket. Although the depth of this residual contamination would generally prevent direct exposure, it is possible that certain construction activities could result in contact with these soils. A temporary deed restriction may be required for this off-site area, depending on the final location selected for the groundwater interception trench and the extent to which associated groudwater withdrawals flush out this residual contamination.

well proven, commercially available technology; therefore, no difficulties are anticipated in the implementation of this system.

Cost

The total costs associated with Alternative 2S - Low Temperature Thermal Desorption are estimated to be $521,850.00 (+50% to -30%). This includes the

cc Insert the following sentence after sentence no. 1:

cc * The implementation of the bioremediation alternative would necessitate the establishment of a specific RAO for vinyl chloride. This is due to the fact that vinyl chloride is produced during the process of microbial degradation of trichloroethylene.

de ... nal ... d

cc ... yd^3 of

so ... the primary cost factors associated with the soil excavation (i.e., ≈ $36,000) is the requirement to drive sheet piling to prevent sloughing (e.g., caving in). The soil removed will be hauled to the treatment area, which will be located on the north side of the unnamed stream. The excavation will be backfilled with a permeable soil and restored to grade. Due to the presence of clay in the soil it has been assumed that soil conditioning will be required prior to initiating treatment.* Costs for soil conditioning are based on the mechanical mixing of contaminated soil with sand at a ratio of 2 parts soil to 1 part sand. A treatment cell consisting

o ... cted.

o * Soil conditioning operations will be conducted within an enclosed structure, during which time VOC and fugitive dust emissions will be monitored. VOC and particulate discharges from this unit will meet applicable air regulations and ambient air levels.

... l be ... total ... stem

are estimated to be $270.000.00. A summary of the individual cost components are summarized in Table 4-2.

4.1.1.3 Alternative 3S - Bioremediation

Overall Protectiveness

Alternative 3S is very similar to Alternative 2S, in that it will result in the removal and on-site treatment of all contaminated soils within the source area.* Some residual soil contamination will remain outside the source area, but these areas are not directly accessible for human contact due to their limited distribution in the underlying confined aquifer. (2) Therefore, future risks to human health under this remedial alternative are anticipated to be within acceptable ranges.

well proven, commercially available technology; therefore, no difficulties are anticipated in the implementation of this system.

Cost

The total costs associated with Alternative 2S - Low Temperature Thermal Desorption are estimated to be $521,850.00 (+50% to -30%). This includes the costs for pilot testing, soil excavation and backfilling, limited soil conditioning, the construction of a treatment cell, low temperature thermal desorption, sampling and monitoring, and engineering, administration, and contingency fees. The cost estimate was based on the excavation of 800 yd^3 of soil from the source area. One of the primary cost factors associated with the soil excavation (i.e., ≈ $36,000) is the requirement to drive sheet piling to prevent sloughing (e.g., caving in). The soil removed will be hauled to the treatment area, which will be located on the north side of the unnamed stream. The excavation will be backfilled with a permeable soil and restored to grade. Due to the presence of clay in the soil it has been assumed that soil conditioning will be required prior to initiating treatment.* Costs for soil conditioning are based on the mechanical mixing of contaminated soil with sand at a ratio of 2 parts soil to 1 part sand. A treatment cell consisting of a synthetic liner underlain by a 0.5 foot sand layer will be constructed. The pilot study costs are based on additional data acquisition that will be required prior to full scale system design. Based on vendor data, the total costs including equipment and labor to operate the thermal desorption system are estimated to be $270.000.00. A summary of the individual cost components are summarized in Table 4-2.

4.1.1.3 Alternative 3S - Bioremediation

Overall Protectiveness

Alternative 3S is very similar to Alternative 2S, in that it will result in the removal and on-site treatment of all contaminated soils within the source area.* Some residual soil contamination will remain outside the source area, but these areas are not directly accessible for human contact due to their limited distribution in the underlying confined aquifer. (2) Therefore, future risks to human health under this remedial alternative are anticipated to be within acceptable ranges.

well proven, commercially available technology; therefore, no difficulties are anticipated in the implementation of this system.

Cost

The total costs associated with Alternative 2S - Low Temperature Thermal Desorption are estimated to be $521,850.00 (+50% to -30%). This includes the costs for pilot testing, soil excavation and backfilling, limited soil conditioning, the construction of a treatment cell, low temperature thermal desorption, sampling and monitoring, and engineering, administration, and contingency fees. The cost estimate was based on the excavation of 800 yd^3 of soil from the source area. One of the primary cost factors associated with the soil excavation (i.e., ≈ $36,000) is the requirement to drive sheet piling to prevent sloughing (e.g., caving in). The soil removed will be hauled to the treatment area, which will be located on the north side of the unnamed stream. The excavation will be backfilled with a permeable soil and restored to grade. Due to the presence of clay in the soil it has been assumed that soil conditioning will be required prior to initiating treatment. Soil conditioning operations will be conducted within an enclosed structure, during which time VOC and fugitive dust emissions will be monitored. VOC and particulate discharges from this unit will meet applicable air regulations and ambient air levels. Costs for soil conditioning are based on the mechanical mixing of contaminated soil with sand at a ratio of 2 parts soil to 1 part sand. A treatment cell consisting of a synthetic liner underlain by a 0.5 foot sand layer will be constructed. The pilot study costs are based on additional data acquisition that will be required prior to full scale system design. Based on vendor data, the total costs including equipment and labor to operate the thermal desorption system are estimated to be $270.000.00. A summary of the individual cost components are summarized in Table 4-2.

4.1.1.3 Alternative 3S - Bioremediation

Overall Protectiveness

Alternative 3S is very similar to Alternative 2S, in that it will result in the removal and on-site treatment of all contaminated soils within the source area. Some residual soil contamination will remain outside the source area, but these areas are not directly accessible for human contact due to their limited distribution in the underlying confined aquifer. This alternative will result in the removal and on-site treatment (e.g. low temperature thermal desorption) of all the contaminated soils within the source area. Soil contamination in the former tank area extends to bedrock but tapers to a one to two foot thick layer at the top of the uppermost confined aquifer as the western property line is approached. Following delineation and removal of the source area, some residual soil contamination may remain in soil at the top of this aquifer near the site boundary (i.e. in the vicinity of MW-4). The residual contamination is limited to a very thin stratigraphic section occurring at a depth of about 10 feet below grade and is, therefore, not directly accessible for human contact. It is anticipated that contaminant levels in these residually contaminated soils will decline to RAOs as groundwater moving through the top of the aquifer desorbs these VOCs and is removed through a relocated and redesigned interception trench system. Future risks to human health under this remedial alternative are anticipated to be within acceptable ranges.

The area where residual soil contamination may remain is located at and up to 50 feet west of the property line between Scott Aviation and Quick Cut Rubber and Gasket. Although the depth of this residual contamination would generally prevent direct exposure, it is possible that certain construction activities could result in contact with these soils. A temporary deed restriction may be required for this off-site area, depending on the final location selected for the groundwater interception trench and the extent to which associated groundwater withdrawals flush out this residual contamination. Therefore, future risks to human health under this remedial alternative are anticipated to be within acceptable ranges.

TABLE 4-2
COST ESTIMATE FOR ALTERNATIVE
2S - THERMAL DESORPTION[1]

TASK	QUANTITY		UNIT COST ($)		TOTAL COST ($)
PILOT TESTING			LUMP SUM		$10,000.00
SOIL EXCAVATION[2]	800	CY	$13.50	/CY	$10,800.00
BACKFILLING/TAMPING	800	CY	$4.00	/CY	$3,200.00
SHEET PILING	3250	SF	$11.00	/SF	$35,750.00
SOIL CONDITIONING[3]	800	CY	$15.00	/CY	$12,000.00
TREATMENT CELL[4]	7500	SF	LUMP SUM		$22,000.00
THERMAL DESORPTION	1200	TONS	$225.00	/TON	$270,000.00
SAMPLING/MONITORING	40	SAMPLE	$225.00	/SAMPLE	$9,000.00
SUBTOTAL					$372,750.00
ENGINEERING AND ADMINSTRATION (20%)					$74,550.00
CONTINGENCY (20%)					$74,550.00
TOTAL ESTIMATED COST[1]					$521,850.00

1 Costs are accurate to +50% to -30%
2 Includes all labor and equipment for excavation and subsequent on-site hauling
3 Includes all labor and equipment for mechanical mixing of soil
4 Includes costs for synthetic liner, sand liner, and synthetic cover

soil to groundwater will be addressed under the groundwater alternatives. Therefore, future risks to human health under this remedial alternative are anticipated to be within acceptable ranges.

Compliance With SCGs

Insert the following text in Section 4.1.1 under the Compliance with SCGs section for each soil remediation alternative discussed in the text.

The RAO for contaminated soils is to prevent the ingestion and inhalation of and dermal contact with contaminated soils that pose an unaccaeptable risk to human health. As set forth in Section 3.1, soils must be treated to under 1.0 ppm for trichloroethylene and 10 ppm for total VOCs. The treatment of these soils will be conducted within a corrective area management unit (CAMU), a relevant and appropriate requirement for the site. In the case of the Scott Aviation site, a CAMU is an area on the Scott Aviation site to be designated by NYSDEC for use as a hazardous waste management area during site remediation activities, and, if appropriate, for ultimate deposition of the treated soils.

Implementation of this alternative must comply with any applicable RCRA requirements.

Long-term Effectiveness and Permanence

This alternative received an average rating for long-term effectiveness and permanence. This alternative will effectively remove the contaminated soils from the source area, thus reducing long-term risks; however, on-site treatment methods are preferred over off-site methods. A small quantity of residual soil contamination will remain on-site, but this material is not anticipated to pose a threat to human health and the environment. No treated residual will be left on-site, but the excavated soil will be disposed of in a landfill. It is estimated that this alternative can be fully implemented in 3 to 6 months and there will be no operation and maintenance requirements for soils.

Reduction of Toxicity, Mobility, or Volume

Alternative 4S will result in the reduction in the toxicity and mobility of the soils within the source area through off-site treatment techniques. The treated residual will be disposed of at an off-site facility (e.g., RCRA

soil to groundwater will be addressed under the groundwater alternatives. Therefore, future risks to human health under this remedial alternative are anticipated to be within acceptable ranges.

Compliance With SCGs

As set forth in Section 3.1, soils must be treated to under 3.0 ppm for trichloroethylene and 0.5 ppm for vinyl chloride. In addition, soil will meet all applicable LDR criteria. The RAO for soils is to prevent ingestion and inhalation of and dermal contact with contaminated soils that pose and unacceptable risk to human health. This alternative will result in the removal and off-site treatment of contaminated soils in the source area, thus preventing the migration of contaminants to the groundwater. Low levels of residual contamination found in areas outside the source area are not anticipated to pose a threat to groundwater quality, as groundwater control measures will be implemented. There are no action-specific or location-specific SCGs that will prevent the implementation of this alternative. Implementation of this alternative must comply with any applicable RCRA requirements.

Long-term Effectiveness and Permanence

This alternative received an average rating for long-term effectiveness and permanence. This alternative will effectively remove the contaminated soils from the source area, thus reducing long-term risks; however, on-site treatment methods are preferred over off-site methods. A small quantity of residual soil contamination will remain on-site, but this material is not anticipated to pose a threat to human health and the environment. No treated residual will be left on-site, but the excavated soil will be disposed of in a landfill. It is estimated that this alternative can be fully implemented in 3 to 6 months and there will be no operation and maintenance requirements for soils.

Reduction of Toxicity, Mobility, or Volume

Alternative 4S will result in the reduction in the toxicity and mobility of the soils within the source area through off-site treatment techniques. The treated residual will be disposed of at an off-site facility (e.g., RCRA

permanent reduction in the toxicity, and mobility of the soils treated. The volume of soil may actually increase, due to the need for soil conditioning prior to treatment. *Ex situ* bioremediation has been shown to consistently work well for soils contaminated with petroleum hydrocarbons. The treatment of halogenated organics has also been successful in situations where under carefully controlled conditions, the desired treatment efficiencies were attained. A pilot scale bioremediation treatability study would have to be conducted at the Scott Aviation facility, if this technology were to be considered for implementation. This *ex situ* field test will evaluate the efficiency with which nutrients can be uniformly distributed through the fine-grained soils native to this site. The successful distribution of nutrients in the contaminated soils will enhance the existing microbial populations converting the chlorinated hydrocarbons into non-hazardous by-products. The treated soil will be regraded on-site if it no longer "contains" F002 wastes; as set forth above, otherwise it will be disposed of at an off-site facility.

Short-term Effectiveness

The excavation of the soil and subsequent treatment by on-site bioremediation may result in the emission of fugitive dust and gaseous phase VOCs. In order to ensure the continued protection of the surrounding community, measures will be implemented to control these potential site emissions (e.g., dust suppression, air monitoring). There are no anticipated short-term risks that can not be controlled.

Implementability

There are no technical or administrative constraints that will prevent the implementation of this alternative. However, there are a number of technical constraints that must be taken into consideration during the excavation and treatment steps. Technical issues that may arise in the excavation phase include: shoring the excavation for structural stability and worker safety; dewatering the excavation; introduction of specialized equipment to excavate to a depth of 20 feet; and space limitations at the site. These technical constraints can be controlled during the design phase. *Ex situ* bioremediation, using a methanogenic process, is [commercially available] an innovative technology that will require pilot scale studies

source area. Soil contamination in the former tank area extends to bedrock but tapers to a one to two foot thick layer at the top of the uppermost confined aquifer as the western property line is approached. Following delineation and removal of the source area, some residual soil contamination may remain in soil at the top of this aquifer near the site boundary (i.e. in the vicinity of MW-4). The residual contamination is limited to a very thin stratigraphic section occurring at a depth of about 10 feet below grade and is, therefore, not directly accessible for human contact. It is anticipated that contaminant levels in these residually contaminated soils will decline to RAOs as groundwater moving through the top of the aquifer desorbs these VOCs and is removed through a relocated and redesigned interception trench system. Future risks to human health under this remedial alternative are anticipated to be within acceptable ranges.

The area where residual soil contamination may remain is located at and up to 50 feet west of the property line between Scott Aviation and Quick Cut Rubber and Gasket. Although the depth of this residual contamination would generally prevent direct exposure, it is possible that certain construction activities could result in contact with these soils. A temporary deed restriction may be required for this off-site area, depending on the final location selected for the groundwater interception trench and the extent to which associated groudwater withdrawals flush out this residual contamination.

prior to implementation. Properly designed and operated, bioremediation is an effective treatment method.

Cost

The total costs associated with Alternative 3S - Ex Situ Bioremediation are estimated to be $480,550.00 (+50% to -30%). This includes the costs for a pilot scale study, soil excavation and backfilling, soil conditioning, the construction of a treatment cell, ex situ bioremediation, sampling and monitoring, and engineering, administration, and contingency fees. The cost estimate was based on the excavation of 800 yd^3 of soil from the source area. One of the primary cost factors associated with the soil excavation (i.e., ≈ $36,000) is the requirement to drive sheet piling to prevent sloughing (e.g., caving in). The soil removed will be hauled to the treatment area, which will be located on the north side of the unnamed stream. The excavation will be backfilled with permeable soil and restored to grade. Due to the presence of clay in the soil it has been assumed that soil conditioning will be required prior to initiating treatment. Costs for soil conditioning are based on the mechanical mixing of contaminated soil with sand at a ratio of 1 part soil to 1 part sand. A treatment cell consisting of a synthetic liner underlain by a 0.5 foot sand layer will be constructed. The completed cell will be covered completely with a synthetic material. Due to the innovative nature of this treatment technology, a pilot scale treatability study will be required to determine the feasibility of implementing this option on a full scale basis. Based on vendor data, the total costs including equipment and labor to operate the ex situ bioremediation system are estimated to be $90,000.00. Sampling requirements for this technology are anticipated to be more rigorous than those for the other alternatives. A summary of the individual cost components are summarized in Table 4-3.

4.1.1.4 Alternative 4S - Off-site Disposal

Overall Protectiveness

Alternative 4S will result in the removal and off-site treatment of all contaminated soils within the source area. Some residual soil contamination will remain outside the source area, but these areas are not directly accessible to human contact.* The potential migration of contaminants from prior to implementation. Properly designed and operated, bioremediation is an effective treatment method.

Cost

The total costs associated with Alternative 3S - Ex Situ Bioremediation are estimated to be $480,550.00 (+50% to -30%). This includes the costs for a pilot scale study, soil excavation and backfilling, soil conditioning, the construction of a treatment cell, ex situ bioremediation, sampling and monitoring, and engineering, administration, and contingency fees. The cost estimate was based on the excavation of 800 yd^3 of soil from the source area. One of the primary cost factors associated with the soil excavation (i.e., ≈ $36,000) is the requirement to drive sheet piling to prevent sloughing (e.g., caving in). The soil removed will be hauled to the treatment area, which will be located on the north side of the unnamed stream. The excavation will be backfilled with permeable soil and restored to grade. Due to the presence of clay in the soil it has been assumed that soil conditioning will be required prior to initiating treatment. Costs for soil conditioning are based on the mechanical mixing of contaminated soil with sand at a ratio of 1 part soil to 1 part sand. A treatment cell consisting of a synthetic liner underlain by a 0.5 foot sand layer will be constructed. The completed cell will be covered completely with a synthetic material. Due to the innovative nature of this treatment technology, a pilot scale treatability study will be required to determine the feasibility of implementing this option on a full scale basis. Based on vendor data, the total costs including equipment and labor to operate the ex situ bioremediation system are estimated to be $90,000.00. Sampling requirements for this technology are anticipated to be more rigorous than those for the other alternatives. A summary of the individual cost components are summarized in Table 4-3.

4.1.1.4 Alternative 4S - Off-site Disposal

Overall Protectiveness

Alternative 4S will result in the removal and off-site treatment of all contaminated soils within the source area. Some residual soil contamination will remain outside the source area, but these areas are not directly accessible to human contact due to their limited distribution in the underlying confined aquifer. The potential migration of contaminants from

TABLE 4-3
COST ESTIMATE FOR ALTERNATIVE
3S - EX-SITU BIOREMEDIATION[1]

TASK	QUANTITY		UNIT COST ($)		TOTAL COST ($)
PILOT STUDY			LUMP SUM		$50,000.00
SOIL EXCAVATION[2]	800	CY	$13.50	/CY	$10,800.00
BACKFILLING/TAMPING	800	CY	$4.00	/CY	$3,200.00
SHEET PILING	3250	SF	$11.00	/SF	$35,750.00
SOIL CONDITIONING[3]	800	CY	$30.00	/CY	$24,000.00
TREATMENT CELL[4]	20000	SF	LUMP SUM		$107,000.00
EX-SITU BIOREMEDIATION	1200	TONS	$75.00	/TON	$90,000.00
SAMPLING/MONITORING	100	SAMPLE	$225.00	/SAMPLE	$22,500.00
SUBTOTAL					$343,250.00
ENGINEERING AND ADMINISTRATION (20%)					$68,650.00
CONTINGENCY (20%)					$68,650.00
TOTAL ESTIMATED COSTS[1]					$480,550.00

1 Costs are accurate to +50% to -30%
2 Includes all labor and equipment for excavation and subsequent on-site hauling
3 Includes all labor and equipment for mechanical mixing of soil
4 Includes costs for synthetic liner, sand liner, and synthetic cover

Compliance With SCGs

Insert the following text in Section 4.1.1 under the Compliance with SCGs section for each soil remediation alternative discussed in the text.

The RAO for contaminated soils is to prevent the ingestion and inhalation of and dermal contact with contaminated soils that pose an unaccaeptable risk to human health. As set forth in Section 3.1, soils must be treated to under 1.0 ppm for trichloroethylene and 10 ppm for total VOCs. The treatment of these soils will be conducted within a corrective area management unit (CAMU), a relevant and appropriate requirement for the site. In the case of the Scott Aviation site, a CAMU is an area on the Scott Aviation site to be designated by NYSDEC for use as a hazardous waste management area during site remediation activities, and, if appropriate, for ultimate deposition of the treated soils.

alternative. However, an air discharge permit may be required.

Long-term Effectiveness and Permanence

Alternative 3S was rated high with respect to long-term effectiveness and permanence for the same basic reasons that Alternative 2S was rated high, assuming that pilot scale testing of this option is successful. This alternative utilizes an on-site destructive treatment method that is considered a permanent remedy; an alternative that provides a permanent solution is statutorily preferred. A small quantity of residual soil contamination will remain on-site, but this material is not anticipated to pose a threat to human health and the environment. The treated soil will be analyzed to ensure that it no longer "contains" F002 wastes and can be regraded on site; otherwise it will disposed of at an off-site facility. In either case, the treated residual will not pose any unacceptable risks to human health or the environment. It is estimated that this alternative can be fully implemented in 12 to 18 months and that there will be no operation and maintenance requirements for soils.

Reduction of Toxicity, Mobility, or Volume

Alternative 3S is anticipated to result in the reduction in the toxicity, mobility, and volume of contaminated soil at the site. The soils located within the source area will be removed and treated on-site using *ex situ* bioremediation. This method of treatment is anticipated to result in a

Compliance With SCGs

As set forth in Section 3.1, soils must be treated to under 3.0 ppm for trichloroethylene and 0.5 ppm for vinyl chloride. In addition, soil will meet all applicable LDR criteria. The RAO for soils is to prevent ingestion and inhalation of and dermal contact with contaminated soils that pose an unacceptable risk to human health. This alternative will result in the removal and treatment of contaminated soils in the source area, thus preventing the migration of contaminants to the groundwater. Low levels of residual contamination found in areas outside the source area are not anticipated to pose a threat to groundwater quality. Further, groundwater control measures are expected to be implemented. There are no action-specific or location-specific SCGs that will prevent the implementation of this alternative. However, an air discharge permit may be required.

Long-term Effectiveness and Permanence

Alternative 3S was rated high with respect to long-term effectiveness and permanence for the same basic reasons that Alternative 2S was rated high, assuming that pilot scale testing of this option is successful. This alternative utilizes an on-site destructive treatment method that is considered a permanent remedy; an alternative that provides a permanent solution is statutorily preferred. A small quantity of residual soil contamination will remain on-site, but this material is not anticipated to pose a threat to human health and the environment. The treated soil will be analyzed to ensure that it no longer "contains" F002 wastes and can be regraded on site; otherwise it will disposed of at an off-site facility. In either case, the treated residual will not pose any unacceptable risks to human health or the environment. It is estimated that this alternative can be fully implemented in 12 to 18 months and that there will be no operation and maintenance requirements for soils.

Reduction of Toxicity, Mobility, or Volume

Alternative 3S is anticipated to result in the reduction in the toxicity, mobility, and volume of contaminated soil at the site. The soils located within the source area will be removed and treated on-site using *ex situ* bioremediation. This method of treatment is anticipated to result in a soil to groundwater will be addressed under the groundwater alternatives. Therefore, future risks to human health under this remedial alternative are anticipated to be within acceptable ranges. This alternative will result in the removal and on-site treatment (e.g. low temperature thermal desorption) of all the contaminated soils within the source area. Soil contamination in the former tank area extends to bedrock but tapers to a one to two foot thick layer at the top of the uppermost confined aquifer as the western property line is approached. Following delineation and removal of the source area, some residual soil contamination may remain in soil at the top of this aquifer near the site boundary (i.e. in the vicinity of MW-4). The residual contamination is limited to a very thin stratigraphic section occurring at a depth of about 10 feet below grade and is, therefore, not directly accessible for human contact.

It is anticipated that contaminant levels in these residually contaminated soils will decline to RAOs as groundwater moving through the top of the aquifer desorbs these VOCs and is removed through a relocated and redesigned interception trench system. The area where residual soil contamination may remain is located at and up to 50 feet west of the property line between Scott Aviation and Quick Cut Rubber and Gasket. Although the depth of this residual contamination would generally prevent direct exposure, it is possible that certain construction activities could result in contact with these soils. A temporary deed restriction may be required for this off-site area, depending on the final location selected for the groundwater interception trench and the extent to which associated groundwater withdrawals flush out this residual contamination. Future risks to human health under this remedial alternative are anticipated to be within acceptable ranges.

Compliance With SCGs

As set forth in Section 3.1, soils must be treated to under 1.0 ppm for trichloroethylene and 10 ppm for total VOCs. In addition, soil will meet all applicable LDR criteria. The RAO for soils is to prevent ingestion and inhalation of and dermal contact with contaminated soils that pose and unacceptable risk to human health. This alternative will result in the removal and off-site treatment of contaminated soils in the source area, thus preventing the migration of contaminants to the groundwater. Low levels of residual contamination found in areas outside the source area are not anticipated to pose a threat to groundwater quality, as groundwater control measures will be implemented. There are no action-specific or location-specific SCGs that will prevent the implementation of this alternative. Implementation of this alternative must comply with any applicable RCRA requirements.

Long-term Effectiveness and Permanence

This alternative received an average rating for long-term effectiveness and permanence. This alternative will effectively remove the contaminated soils from the source area, thus reducing long-term risks; however, on-site treatment methods are preferred over off-site methods. A small quantity of residual soil contamination will remain on-site, but this material is not anticipated to pose a threat to human health and the environment. No treated residual will be left on-site, but the excavated soil will be disposed of in a landfill. It is estimated that this alternative can be fully implemented in 3 to 6 months and there will be no operation and maintenance requirements for soils.

Reduction of Toxicity, Mobility, or Volume

Alternative 4S will result in the reduction in the toxicity and mobility of the soils within the source area through off-site treatment techniques. The treated residual will be disposed of at an off-site facility (e.g., RCRA

landfill), which is less desirable than the on-site management of treated residual.

Short-term Effectiveness

The implementation of this alternative may result in the emission of fugitive dust and VOCs, but these emissions can be easily controlled. This alternative can be implemented in a relatively short period of time. No short-term impacts to on-site workers and the surrounding community are anticipated that can not be controlled.

Implementability

Of the three off-site disposal alternatives, only one is practical relative to implementability-landfilling at a Canadian facility. Based on information acquired from proximate Canadian landfill sites, soils "containing" F002 wastes at the concentrations encountered at the Scott Aviation site fall within their acceptance criteria and may be landfilled without prior treatment. Also, under present Canadian regulations, following disposal of F002 wastes at these landfills, Scott Aviation would generally no longer be liable in the future for the wastes.

Land disposal at a U.S. facility would require that soils only be treated to under 5.6 ppm for trichloroethylene under the "contained in" criteria. Since on-site treatment would reduce trichloroethylene concentrations in soils to under 3.0 ppm, the latter alternative is preferable because it is more protective of health and the environment. Land disposal at a U.S, facility is therefore eliminated from further consideration.

Off-site disposal via incineration is clearly the least cost effective remedial alternative for the Scott Aviation site. The existence of other alternatives which meet remedial criteria but are far less costly eliminate off-site incineration and disposal from further consideration.

There are no technical or administrative constraints that will prevent the implementation of this alternative of land disposal in an approved Canadian facility. However, a number of technical constraints must be taken into consideration during excavation, specifically, shoring the excavation for both worker safety and structural stability; dewatering the excavation;

landfill), which is less desirable than the on-site management of treated residual.

Short-term Effectiveness

The implementation of this alternative may result in the emission of fugitive dust and VOCs, but these emissions can be easily controlled. This alternative can be implemented in a relatively short period of time. No short-term impacts to on-site workers and the surrounding community are anticipated that can not be controlled.

Implementability

Of the three off-site disposal alternatives, only one is practical relative to implementability-landfilling at a Canadian facility. Based on information acquired from proximate Canadian landfill sites, soils "containing" F002 wastes at the concentrations encountered at the Scott Aviation site fall within their acceptance criteria and may be landfilled without prior treatment. Also, under present Canadian regulations, following disposal of F002 wastes at these landfills, Scott Aviation would generally no longer be liable in the future for the wastes.

Land disposal at a U.S. facility would require that soils only be treated to under 5.6 ppm for trichloroethylene under the LDR criteria. Since on-site treatment would reduce trichloroethylene concentrations in soils to under 1.0 ppm, the latter alternative is preferable because it is more protective of health and the environment. Land disposal at a U.S. facility is therefore eliminated from further consideration.

Off-site disposal via incineration is clearly the least cost effective remedial alternative for the Scott Aviation site. The existence of other alternatives which meet remedial criteria but are far less costly eliminate off-site incineration and disposal from further consideration.

There are no technical or administrative constraints that will prevent the implementation of this alternative of land disposal in an approved Canadian facility. However, a number of technical constraints must be taken into consideration during excavation, specifically, shoring the excavation for both worker safety and structural stability; dewatering the excavation;

source area.* Soil contamination in the former tank area extends to bedrock but tapers to a one to two foot thick layer at the top of the uppermost confined aquifer as the western property line is approached. Following delineation and removal of the source area, some residual soil contamination may remain in soil at the top of this aquifer near the site boundary (i.e. in the vicinity of MW-4). The residual contamination is limited to a very thin stratigraphic section occurring at a depth of about 10 feet below grade and is, therefore, not directly accessible for human contact. It is anticipated that contaminant levels in these residually contaminated soils will decline to RAOs as groundwater moving through the top of the aquifer desorbs these VOCs and is removed through a relocated and redesigned interception trench system. Future risks to human health under this remedial alternative are anticipated to be within acceptable ranges.

The area where residual soil contamination may remain is located at and up to 50 feet west of the property line between Scott Aviation and Quick Cut Rubber and Gasket. Although the depth of this residual contamination would generally prevent direct exposure, it is possible that certain construction activities could result in contact with these soils. A temporary deed restriction may be required for this off-site area, depending on the final location selected for the groundwater interception trench and the extent to which associated groudwater withdrawals flush out this residual contamination.

and introducing specialized equipment to excavate to a depth of 20 feet. These technical constraints can easily be controlled during the design phase.

Cost

The total costs associated with Alternative 4S - Off-site Disposal are estimated to be $524,650.00 (+50% to -30%). This includes the costs for soil excavation and backfilling, sampling/profiling, transportation and disposal, and engineering, administration, and contingency fees. The cost estimate was based on the excavation of 800 yd^3 of soil from the source area. One of the primary cost factors associated with the soil excavation (i.e., ≈ $36,000) is the requirement to drive sheeting piling to prevent sloughing (e.g., caving in). The excavated soil will be shipped off-site to either the Chemical Waste Management landfill in Model City, New York or the Stablex landfill in Ontario, Canada. The total disposal costs including transportation are estimated to be $300,000.00. A summary of the individual cost components are summarized in Table 4-4.

4.1.1.5 Alternative 5S - Ex Situ Vapor Extraction

Overall Protectiveness

Alternative 5S will result in the removal and on-site treatment of all contaminated soils within the source area. Some residual soil contamination will remain outside the source area, but these areas are not directly accessible for human contact. Therefore future risks to human health under

Insert the following text in Section 4.1.1 under the Compliance with SCGs section for each soil remediation alternative discussed in the text.

The RAO for contaminated soils is to prevent the ingestion and inhalation of and dermal contact with contaminated soils that pose an unaccaeptable risk to human health. As set forth in Section 3.1, soils must be treated to under 1.0 ppm for trichloroethylene and 10 ppm for total VOCs. The treatment of these soils will be conducted within a corrective area management unit (CAMU), a relevant and appropriate requirement for the site. In the case of the Scott Aviation site, a CAMU is an area on the Scott Aviation site to be designated by NYSDEC for use as a hazardous waste management area during site remediation activities, and, if appropriate, for ultimate deposition of the treated soils.

and introducing specialized equipment to excavate to a depth of 20 feet. These technical constraints can easily be controlled during the design phase.

Cost

The total costs associated with Alternative 4S - Off-site Disposal are estimated to be $524,650.00 (+50% to -30%). This includes the costs for soil excavation and backfilling, sampling/profiling, transportation and disposal, and engineering, administration, and contingency fees. The cost estimate was based on the excavation of 800 yd^3 of soil from the source area. One of the primary cost factors associated with the soil excavation (i.e., ≈ $36,000) is the requirement to drive sheeting piling to prevent sloughing (e.g., caving in). The excavated soil will be shipped off-site to either the Chemical Waste Management landfill in Model City, New York or the Stablex landfill in Ontario, Canada. The total disposal costs including transportation are estimated to be $300,000.00. A summary of the individual cost components are summarized in Table 4-4.

4.1.1.5 Alternative 5S - Ex Situ Vapor Extraction

Overall Protectiveness

Alternative 5S will result in the removal and on-site treatment of all contaminated soils within the source area. Some residual soil contamination will remain outside the source area, but these areas are not directly accessible for human contact. *Therefore future risks to human health under this remediation scenario are anticipated to be within acceptable ranges.

Compliance With SCGs

As set forth in Section 3.1, soils must be treated to under 3.0 ppm for trichloroethylene and 0.5 ppm for vinyl chloride. In addition, soil will meet all applicable LDR criteria. The RAO for soils is to prevent ingestion and inhalation of and dermal contact with contaminated soils that pose an unacceptable risk to human health. This alternative will result in the removal and treatment of contaminated soils in the source area, thus preventing the migration of contaminants to the groundwater. Low levels of residual contamination found in areas outside the source area are not anticipated to pose a threat to groundwater quality. Further, groundwater

and introducing specialized equipment to excavate to a depth of 20 feet. These technical constraints can easily be controlled during the design phase.

Cost

The total costs associated with Alternative 4S - Off-site Disposal are estimated to be $524,650.00 (+50% to -30%). This includes the costs for soil excavation and backfilling, sampling/profiling, transportation and disposal, and engineering, administration, and contingency fees. The cost estimate was based on the excavation of 800 yd^3 of soil from the source area. One of the primary cost factors associated with the soil excavation (i.e., ≈ $36,000) is the requirement to drive sheeting piling to prevent sloughing (e.g., caving in). The excavated soil will be shipped off-site to either the Chemical Waste Management landfill in Model City, New York or the Stablex landfill in Ontario, Canada. The total disposal costs including transportation are estimated to be $300,000.00. A summary of the individual cost components are summarized in Table 4-4.

4.1.1.5 Alternative 5S - Ex Situ Vapor Extraction

Overall Protectiveness

Alternative 5S will result in the removal and on-site treatment of all contaminated soils within the source area. Some residual soil contamination will remain outside the source area, but these areas are not directly accessible for human contact due to their limited distribution in the underlying confined aquifer. This alternative will result in the removal and on-site treatment (e.g. low temperature thermal desorption) of all the contaminated soils within the source area. Soil contamination in the former tank area extends to bedrock but tapers to a one to two foot thick layer at the top of the uppermost confined aquifer as the western property line is approached. Following delineation and removal of the source area, some residual soil contamination may remain in soil at the top of this aquifer near the site boundary (i.e. in the vicinity of MW-4). The residual contamination is limited to a very thin stratigraphic section occurring at a depth of about 10 feet below grade and is, therefore, not directly accessible for human contact. It is anticipated that contaminant levels in these residually contaminated soils will decline to RAOs as groundwater moving through the top of the aquifer desorbs these VOCs and is removed through a relocated and redesigned interception trench system. Future risks to human health under this remedial alternative are anticipated to be within acceptable ranges.

The area where residual soil contamination may remain is located at and up to 50 feet west of the property line between Scott Aviation and Quick Cut Rubber and Gasket. Although the depth of this residual contamination would generally prevent direct exposure, it is possible that certain construction activities could result in contact with these soils. A temporary deed restriction may be required for this off-site area, depending on the final location selected for the groundwater interception trench and the extent to which associated groundwater withdrawals flush out this residual contamination. Therefore future risks to human health under this remediation scenario are anticipated to be within acceptable ranges.

Compliance With SCGs

As set forth in Section 3.1, soils must be treated to under 1.0 ppm for trichloroethylene and 10 ppm for total VOCs. In addition, soil will meet all applicable LDR criteria. The RAO for soils is to prevent ingestion and inhalation of and dermal contact with contaminated soils that pose an unacceptable risk to human health. This alternative will result in the removal and treatment of contaminated soils in the source area, thus preventing the migration of contaminants to the groundwater. Low levels of residual contamination found in areas outside the source area are not anticipated to pose a threat to groundwater quality. Further, groundwater

TABLE 4-4
COST ESTIMATE FOR ALTERNATIVE
4S - OFF-SITE DISPOSAL[1]

TASK	QUANTITY		UNIT COST ($)		TOTAL COST ($)
SOIL EXCAVATION[2]	800	CY	$13.50	/CY	$10,800.00
BACKFILLING/TAMPING	800	CY	$4.00	/CY	$3,200.00
SHEET PILING	3250	SF	$11.00	/SF	$35,750.00
OFF-SITE DISPOSAL	1200	TONS	$250.00	/TON	$300,000.00
SAMPLING/PROFILING	25	SAMPLE	$1,000.00	/SAMPLE	$25,000.00
SUBTOTAL					$374,750.00
ENGINEERING AND ADMINISTRATION (20%)					$74,950.00
CONTINGENCY (20%)					$74,950.00
TOTAL ESTIMATED COSTS					$524,650.00

1 Costs are accurate to +50% to -30%
2 Includes all labor and equipment for excavation and subsequent on-site hauling
3 Includes all labor and equipment for mechanical mixing of soil
4 Includes costs for synthetic liner, sand liner, and synthetic cover

control measures are expected to be implemented. There are no action-specific or location-specific SCGs that will prevent the implementation of this alternative. However, an air discharge permit may be required.

Long-term Effectiveness and Permanence

Alternative 5S was rated very high with respect to long-term effectiveness and permanence for the same basic reasons that Alternatives 2S and 3S were rated high. This alternative utilizes an on-site physical treatment method that is considered a permanent remedy; an alternative that provides a permanent solution is statutorily preferred. A small quantity of residual soil contamination will remain on-site, but this material will not pose an unacceptable threat to human health and the environment. The treated soil will be analyzed to ensure that it no longer "contains" F002 wastes and can be regraded on-site; otherwise it will be disposed of at an off-site facility. In either case, the treated residual will not pose any unacceptable risks to human health or the environment. It is estimated that this alternative can be fully implemented in 3 to 6 months and that there will be no operation and maintenance requirements for soils.

Reduction of Toxicity, Mobility, or Volume

Alternative 5S is anticipated to result in the reduction in the toxicity and mobility of contaminated soil at the site. The soils located within the source area will be removed and treated on-site using *ex situ* vapor extraction. This method of treatment is anticipated to result in a permanent reduction in the toxicity and mobility of the soils treated. The volume of soils to be treated will increase due to the need for soil conditioning, which require the mechanical mixing of native soils with another medium (e.g., sand). The treated soil will be disposed of on-site if it does not exhibit the characteristic of a hazardous waste, as defined by RCRA regulations (e.g., toxicity, reactivity), otherwise it will be disposed of at an off-site facility.

Short-term Effectiveness

Page 4-16 - Strike last paragraph and replace with:

The excavation of the soils, mechanical conditioning and subsequent treatment by ex-situ vapor extraction will likely result in the emission of fugitive dust and gaseous phase VOCs, since this alternative is a short term, high intensity stripping of these contaminants. In order to ensure the continued protection of the surrounding community, air treatment facilitities will be required. There are no anticipated short term risks that cannot be controlled during this process.

control measures are expected to be implemented. There are no action-specific or location-specific SCGs that will prevent the implementation of this alternative.

Long-term Effectiveness and Permanence

Alternative 5S was rated very high with respect to long-term effectiveness and permanence for the same basic reasons that Alternatives 2S and 3S were rated high. This alternative utilizes an on-site physical treatment method that is considered a permanent remedy; an alternative that provides a permanent solution is statutorily preferred. A small quantity of residual soil contamination will remain on-site, but this material will not pose an unacceptable threat to human health and the environment. The treated soil will be analyzed to ensure that it no longer "contains" F002 wastes and can be regraded on-site; otherwise it will be disposed of at an off-site facility. In either case, the treated residual will not pose any unacceptable risks to human health or the environment. It is estimated that this alternative can be fully implemented in 3 to 6 months and that there will be no operation and maintenance requirements for soils.

Reduction of Toxicity, Mobility, or Volume

Alternative 5S is anticipated to result in the reduction in the toxicity and mobility of contaminated soil at the site. The soils located within the source area will be removed and treated on-site using *ex situ* vapor extraction. This method of treatment is anticipated to result in a permanent reduction in the toxicity and mobility of the soils treated. The volume of soils to be treated will increase due to the need for soil conditioning, which require the mechanical mixing of native soils with another medium (e.g., sand). The treated soil will be disposed of on-site if it does not exhibit the characteristic of a hazardous waste, as defined by RCRA regulations (e.g., toxicity, reactivity), otherwise it will be disposed of at an off-site facility.

Short-term Effectiveness

The excavation for the soils, mechanical conditioning and subsequent treatment by ex-situ vapor extraction will likely result in the emission of fugitive dust and gaseous phase VOCs, since this alternative is a short term, measures will be implemented to control these potential site emissions (e.g., dust suppression, air monitoring). There are no anticipated short-term risks that can not be controlled.

Implementability

There are no technical or administrative constraints that will prevent the implementation of this alternative. However, there are a number of technical constraints that must be taken into consideration during the excavation and treatment steps. Technical issues that may arise in the excavation phase include: shoring the excavation for structural stability and worker safety; dewatering the excavation; introduction of specialized equipment to excavate to a depth of 20 feet; and space limitations at the site. These technical constraints can be controlled during the design phase. Other technical considerations include the high clay content and high moisture content of the soils to be treated. Because of these factors, soil conditioning (e.g., mechanical mixing, aeration) will be required to ensure the efficiency of the system. Treatability testing for ex situ vapor extraction have not been conducted, therefore, in order to evaluate the effectiveness of this alternative further site data must be collected and evaluated. Ex situ vapor extraction is a commercially available, well demonstrated technology.

Cost

The total costs associated with Alternative 5S - Ex Situ Vapor Extraction are estimated to be $489,650.00 (+50% to -30%). This includes the costs for pilot scale testing, soil excavation and backfilling, soil conditioning, the construction of a treatment cell, ex situ vapor extraction, sampling and monitoring, and engineering, administration, and contingency fees. The cost estimate was based on the excavation of 800 yd^3 of soil from the source area. One of the primary cost factors associated with the soil excavation (i.e., ≈ $36,000) is the requirement to drive sheet piling to prevent sloughing (e.g., caving in). The soil removed will be hauled to the treatment area, which will be located on the north side of the unnamed stream. The excavation will be backfilled with permeable soil and restored to grade. Due to the presence of clay in the soil it has been assumed that soil conditioning will be required high intensity stripping of these contaminants. In order to ensure the continued protection for the surrounding community, air treatment facilities will be required. There are no anticipated short term risks that cannot be controlled during this process.

Implementability

There are no technical or administrative constraints that will prevent the implementation of this alternative. However, there are a number of technical constraints that must be taken into consideration during the excavation and treatment steps. Technical issues that may arise in the excavation phase include: shoring the excavation for structural stability and worker safety; dewatering the excavation; introduction of specialized equipment to excavate to a depth of 20 feet; and space limitations at the site. These technical constraints can be controlled during the design phase. Other technical considerations include the high clay content and high moisture content of the soils to be treated. Because of these factors, soil conditioning (e.g., mechanical mixing, aeration) will be required to ensure the efficiency of the system. Treatability testing for ex situ vapor extraction have not been conducted, therefore, in order to evaluate the effectiveness of this alternative further site data must be collected and evaluated. Ex situ vapor extraction is a commercially available, well demonstrated technology.

Cost

The total costs associated with Alternative 5S - Ex Situ Vapor Extraction are estimated to be $489,650.00 (+50% to -30%). This includes the costs for pilot scale testing, soil excavation and backfilling, soil conditioning, the construction of a treatment cell, ex situ vapor extraction, sampling and monitoring, and engineering, administration, and contingency fees. The cost estimate was based on the excavation of 800 yd^3 of soil from the source area. One of the primary cost factors associated with the soil excavation (i.e., ≈ $36,000) is the requirement to drive sheet piling to prevent sloughing (e.g., caving in). The soil removed will be hauled to the treatment area, which will be located on the north side of the unnamed stream. The excavation will be backfilled with permeable soil and restored to grade. Due to the presence of clay in the soil it has been assumed that soil conditioning will be required prior to initiating treatment. Costs for soil conditioning are based on the mechanical mixing of contaminated soil with sand at a ratio of 1 part soil to 1 part sand. A treatment cell consisting of a synthetic liner underlain by a 0.5 foot sand layer will be constructed. The completed cell will be covered completely with a synthetic material. The pilot study costs are based on additional data acquisition that will be required prior to full scale system design. Based on vendor data, the total costs including equipment and labor to operate the ex situ vapor extraction system are estimated to be $150,000.00. Sampling requirements for this technology are anticipated to be much less rigorous than those for ex situ bioremediation. A summary of the individual cost components are summarized in Table 4-5.

4.1.2 Remedial Alternatives for Groundwater

4.1.2.1 Alternative 1G - No Action

Overall Protectiveness

The no action alternative will not provide any protection against exposure to contaminated groundwater for hypothetical future residents. However, due to the availability of a public water supply and the low yield of the aquifer, future use of the uppermost confined aquifer as a source of drinking water is considered highly unlikely.

Compliance With ARARs

The no action alternative does not comply with applicable chemical-specific SCGs. Specifically, concentrations of certain contaminants found in the groundwater exceed the NYSDEC groundwater quality standards. Based on the poor yield characteristics of the aquifer, a waiver from these requirements may be warranted if future deed restrictions were imposed.

Long-term Effectiveness and Permanence

By itself, this alternative is not anticipated to be effective on a long-term basis and would not immediately meet the statutory preference for a permanent remedy. Under this alternative, the contaminated groundwater would not be remediated, except for natural attenuation. However, when coupled with soil excavation of the source of groundwater contamination, over time the groundwater would be expected to reach regulatory levels. Although, low

TABLE 4-5
COST ESTIMATE FOR ALTERNATIVE
5S - EX-SITU VAPOR EXTRACTION

TASK	QUANTITY		UNIT COST ($)		TOTAL COST ($)
PILOT TESTING			LUMP SUM		$10,000.00
SOIL EXCAVATION(1)	800	CY	$13.50	/CY	$10,800.00
BACKFILLING/TAMPING	800	CY	$4.00	/CY	$3,200.00
SHEET PILING	3250	SF	$11.00	/SF	$35,750.00
SOIL CONDITIONING(2)	800	CY	$30.00	/CY	$24,000.00
TREATMENT CELL(3)	20000	SF	LUMP SUM		$107,000.00
EX-SITU VAPOR EXTRACTION(4)	1200	TONS	$125.00	/TON	$150,000.00
SAMPLING/MONITORING	40	SAMPLE	$225.00	/SAMPLE	$9,000.00
SUBTOTAL					$349,750.00
ENGINEERING AND ADMINISTRATION (20%)					$69,950.00
CONTINGENCY (20%)					$69,950.00
TOTAL ESTIMATED COSTS					$489,650.00

1 Costs are accurate to +50% to -30%
2 Includes all labor and equipment for excavation and subsequent on-site hauling
3 Includes all labor and equipment for mechanical mixing of soil
4 Includes costs for synthetic liner, sand liner, and synthetic cover

levels of residual contamination remaining in the on-site soils may migrate to groundwater, the level of contamination in groundwater would be expected to decrease as a result of the removal of soil contamination at the source.

Reduction of Toxicity, Mobility, or Volume

The no action alternative will not directly reduce the toxicity, mobility, or volume of contaminated groundwater. The toxicity of the contamination may be reduced to some degree through natural attenuation, especially when coupled with soil excavation at the source.

Short-term Effectiveness

There are no significant short-term risks that will be posed to on-site workers or the surrounding community under the no action alternative. The only potential risks to human health posed by this alternative are for a hypothetical future resident in the unlikely event that the groundwater is used as a drinking water source.

Implementability

There are no technical barriers to implementation of this alternative.

Cost

The costs associated with this alternative are negligible. LONG TERM monitoring Costs,

4.1.2.2 Alternative 2G - Air Stripping

Overall Protectiveness

Alternative 2G will result in the collection and on-site treatment of the contaminated groundwater downgradient of the former source area. After completion of remedial activities, risks to human health via exposure to groundwater are anticipated to be within acceptable levels, and any potential migration of residual soil contamination to the groundwater will be addressed. The goal of the groundwater treatment system will be to remediate groundwater to the levels set forth in the NYSDEC groundwater quality standards.

Compliance With SCGs

Alternative 2G is consistent with applicable chemical-specific SCGs. Specifically, this alternative will collect and treat groundwater to the target levels set forth by the NYSDEC groundwater quality standards. Operation of the air stripper may require air emission controls (e.g., an afterburner or activated carbon) and an air quality permit, and the discharge of treated groundwater will require the approval of the BSA and the ECDEP.

Long-term Effectiveness and Permanence

Alternative 2G was rated high with respect to long-term effectiveness and permanence because this alternative utilizes an on-site treatment method and provides a permanent remedy. It is anticipated that this alternative will need to be operated for a period of 10 years. Following completion of remediation, it is anticipated that no untreated groundwater will remain on-site. The air stripper may require off-gas treatment. Operation and maintenance requirements for this alternative will include long-term groundwater monitoring and maintenance of the interception trench and air stripping system. Maintenance requirements for these treatment systems are considered minimal.

Reduction of Toxicity, Mobility, or Volume

Alternative 2S - Air Stripping will reduce the toxicity, mobility, and volume of contaminated groundwater through on-site treatment. Air stripping is one of the most effective methods of treating vinyl chloride, which was detected on-site. This treatment technology relies on the transfer of contaminants from one physical state to another (i.e., water to air). Therefore, the off-gas from the air stripper may require further treatment (e.g., by an afterburner or granular activated carbon) to prevent an unacceptable increase in air emissions.

Short-term Effectiveness

Small quantities of fugitive dust and VOC emissions may be generated during the excavation of the interception trench. These emissions can be controlled by dust suppression methods and/or air monitoring. No short-term risks to on-site workers and the surrounding community are anticipated that can not be controlled.

target levels set forth by the NYSDEC groundwater quality standards. Operation of the air stripper may require air emission controls (e.g., an afterburner or activated carbon) and the discharge of treated groundwater will require the approval of the BSA and the ECDEP.

Long-term Effectiveness and Permanence

Alternative 2G was rated high with respect to long-term effectiveness and permanence because this alternative utilizes an on-site treatment method and provides a permanent remedy. It is anticipated that this alternative will need to be operated for a period of 10 years. Following completion of remediation, it is anticipated that no untreated groundwater will remain on-site. The air stripper may require off-gas treatment. Operation and maintenance requirements for this alternative will include long-term groundwater monitoring and maintenance of the interception trench and air stripping system. Maintenance requirements for these treatment systems are considered minimal.

Reduction of Toxicity, Mobility, or Volume

Alternative 2S - Air Stripping will reduce the toxicity, mobility, and volume of contaminated groundwater through on-site treatment. Air stripping is one of the most effective methods of treating vinyl chloride, which was detected on-site. This treatment technology relies on the transfer of contaminants from one physical state to another (i.e., water to air). Therefore, the off-gas from the air stripper may require further treatment (e.g., by an afterburner or granular activated carbon) to prevent an unacceptable increase in air emissions.

Short-term Effectiveness

Small quantities of fugitive dust and VOC emissions may be generated during the excavation of the interception trench. These emissions can be controlled by dust suppression methods and/or air monitoring. No short-term risks to on-site workers and the surrounding community are anticipated that can not be controlled.

Implementability

There are no technical or administrative constraints on the implementability of this alternative. An interception trench is an effective method of collecting groundwater in a low permeability aquifer, and air stripping is a commercially available, well demonstrated, technology commonly used for the treatment of highly volatile organic compounds. Air stripping is particularly effective for the treatment of vinyl chloride. The existing groundwater monitoring wells will be utilized for the long-term monitoring. Required coordination with the BSA and ECDEP should present no problems.

Cost

The present worth cost for air stripping with no off-gas treatment, assuming a 10-year life and a 5% interest rate, is estimated to be $399,126.00 (+50 to -30%); the present worth cost for air stripping followed by vapor phase carbon adsorption is estimated to be $598,700.00(+50% to -30%). This cost estimate includes the costs associated with the closure of the existing interception trench, installation of a new interception trench, air stripping, discharge to the POTW, and groundwater monitoring. The existing interception trench will be pumped out and filled with concrete. Capital costs for the construction of the new interception trench including excavation, installation of piping, bedding, and a sump/pump, and backfilling are estimated to be $126,650.00. The primary cost factor associated with the installation of the trench is the requirement to drive sheet piling to prevent sloughing during the excavation of the trench.

The capital costs for an air stripping tower and associated appurtenances are estimated to be $35,000 (+50% to -30%). Operations and maintenance costs for electrical consumption and replacement parts is estimated to be $5,000 per year, based on a design flow rate of 7.5 gpm. Based on a total influent VOC concentration of 100 ppm and assuming a removal efficiency of 95%, it is estimated that approximately 0.35 lbs/hour of VOCs will be discharged to the atmosphere. Based on this atmospheric discharge rate, it is anticipated that off-gas treatment will be required. The capital costs of air stripping followed by vapor phase carbon adsorption are estimated to be approximately two times the cost for air stripping alone (CDM 1990) or approximately $70,000

(+50% to -30%). Operation and maintenance costs for the air stripping followed by vapor phase carbon adsorption are typically four times the cost of air stripping alone (CDM 1990) or $20,000 per year (+50% to -30%). Additionally, the costs for discharge of treated groundwater to the sanitary sewer are estimated to be $5,000 per year.

In order to evaluate the effectiveness of the system semi-annual groundwater monitoring will be conducted. Each sampling event will consist of the collection of three samples (two from existing monitoring wells and one from the trench) and the subsequent analysis for priority pollutant VOCs. Annual costs for the groundwater monitoring are estimated to be $3,600.00. Summaries of the cost components for air stripping and air stripping with off-gas treatment are presented in Tables 4-6 and 4-7 respectively.

4.1.2.3 Alternative 3G - Carbon Adsorption

Overall Protectiveness

Alternative 3G will consist of the collection of groundwater via an interception trench and the subsequent on-site treatment via carbon adsorption. Once remedial activities are completed, risks associated with exposure to groundwater are anticipated to be well within acceptable levels. Additionally, any potential migration of residual soil contamination to groundwater will be adequately controlled. The goal of the treatment system will be to remediate groundwater to levels prescribed by the NYSDEC groundwater quality standards. ← needs to be stated clearly in RAO's (provide table of COC & appropriate standards)

Compliance with SCGs

Alternative 3G meets chemical-specific SCGs and RAOs through the treatment of groundwater to levels set forth by the NYSDEC groundwater quality standards. The only action-specific requirement for this option will be the requirement to obtain the approval of the BSA and ECDEP prior to discharge to the sanitary sewer system.

Long-term Effectiveness and Permanence

Alternative 3G is considered effective on a long-term basis and provides a permanent site remedy, consistent with the statutory preference for a

TABLE 4-6
COST ESTIMATE FOR ALTERNATIVE
2G - AIR STRIPPING[1]

TREATMENT COMPONENT	TYPE OF COST	QUANTITY	UNIT COST ($)	CAPITAL COSTS ($)	ANNUAL O&M COSTS ($)
CLOSURE OF EXISTING INTERCEPTION TRENCH					
	CAPITAL		LUMP SUM	$4,000.00	
INSTALLATION OF NEW INTERCEPTION TRENCH					
	CAPITAL				
EXCAVATION		700 CY	13.5 /CY	$9,450.00	
SHEETING		10000 SF	10.5 /SF	$105,000.00	
TRENCH[2]		200 LF	$55.00 /LF	$11,000.00	
SUMP/PUMP			LUMP SUM	$1,200.00	
	O&M	1 YR	$2,500.00 /YR		$2,500.00
AIR STRIPPER					
	CAPITAL		LUMP SUM	$35,000.00	
	O&M	1 YR	$5,000.00 /YR		$5,000.00
GROUNWATER MONITORING					
	CAPITAL		LUMP SUM	$1,500.00	
	O&M	6 SAMPLES	$600.00 /SAMPLE		$3,600.00
DISCHARGE TO POTW					
	CAPITAL		LUMP SUM	$2,500.00	
	O&M	1 YR	$5,000.00		$5,000.00
SUBTOTAL				$169,650.00	$16,100.00
ENGINEERING AND ADMINISTRATION				$33,930.00	$2,415.00
CONTINGENCY				$33,930.00	$2,415.00
TOTAL ESTIMATED COSTS				$237,510.00	$20,930.00
PRESENT WORTH COST[3]					$399,125.91

[1]Costs are accurate to +50% to -30%
[2]Includes all labor and material costs for the trench piping, bedding material, and backfilling
[3]Present worth costs based on 10 year life and a 5% interest rate

TABLE 4-7
COST ESTIMATE FOR ALTERNATIVE
2G - AIR STRIPPING WITH OFF-GAS TREATMENT[1]

TREATMENT COMPONENT	TYPE OF COST	QUANTITY	UNIT COST ($)	CAPITAL COSTS ($)	ANNUAL O&M COSTS ($)
CLOSURE OF EXISTING INTERCEPTION TRENCH					
	CAPITAL		LUMP SUM	$4,000.00	
INSTALLATION OF NEW INTERCEPTION TRENCH					
	CAPITAL				
EXCAVATION		700 CY	13.5 /CY	$9,450.00	
SHEETING		10000 SF	10.5 /SF	$105,000.00	
TRENCH[2]		200 LF	$55.00 /LF	$11,000.00	
SUMP/PUMP			LUMP SUM	$1,200.00	
	O&M	1 YR	$2,500.00 /YR		$2,500.00
AIR STRIPPER					
	CAPITAL		LUMP SUM	$35,000.00	
	O&M	1 YR	$5,000.00 /YR		$5,000.00
GRANULAR ACTIVATED CARBON					
	CAPITAL		LUMP SUM	$35,000.00	
	O&M	1 YR	$15,000.00 /YR		$5,000.00
GROUNWATER MONITORING					
	CAPITAL		LUMP SUM	$1,500.00	
	O&M	6 SAMPLES	$600.00 /SAMPLE		$3,600.00
DISCHARGE TO POTW					
	CAPITAL		LUMP SUM	$2,500.00	
	O&M	1 YR	$5,000.00		$5,000.00
SUBTOTAL				$204,650.00	$31,100.00
ENGINEERING AND ADMINISTRATION				$40,930.00	$4,665.00
CONTINGENCY				$40,930.00	$4,665.00
TOTAL ESTIMATED COSTS				$286,510.00	$40,430.00
PRESENT WORTH COST[3]					$598,699.74

[1] Costs are accurate to +50% to -30%
[2] Includes all labor and material costs for the trench piping, bedding material, and backfilling
[3] Present worth costs based on 10 year life and a 5% interest rate

permanent solution. The anticipated period of operation for this alternative is 10 years. The target treatment level for remediating groundwater is the NYSDEC groundwater quality standards; therefore, no contaminated groundwater will remain on-site. Operation and maintenance requirements for this alternative include long-term groundwater monitoring, and maintenance and operation of the interception trench and the carbon adsorption system. Operation of the carbon adsorption system is anticipated to be relatively labor intensive because spent activated carbon will require routine replacement.

Reduction of Toxicity, Mobility, or Volume

Alternative 3G will reduce the toxicity, mobility, and volume of groundwater contamination through on-site treatment. It will generate contaminated spent activated carbon, but this material can be properly treated off-site, through carbon regeneration processes.

Short-term Effectiveness

Excavation of the interception trench may result in some minor emissions of fugitive dust and VOCs, emissions that can easily be controlled. There are no uncontrollable risks to the surrounding community presented by the implementation of this alternative.

Implementability

There are no technical or administrative constraints to limit the implementability of this alternative. An interception trench is an effective method of collecting groundwater in a low permeability aquifer and carbon adsorption is a commercially available, well demonstrated technology commonly used for the treatment of volatile organic compounds. The use of carbon adsorption at the site will be limited by the presence of vinyl chloride in groundwater. Carbon adsorption is not an effective method of treating vinyl chloride; however, the levels of vinyl chloride detected on-site are estimated to be below those levels required for approval to discharge to the sanitary sewer. Existing groundwater monitoring wells will be utilized for the long-term monitoring. Required coordination with the BSA and ECDEP should present no problems.

Cost

The present worth cost of liquid phase granular activated carbon treatment, assuming a 10-year life at 5% interest, is $722,674.00 (+50% to -30% accuracy). This cost estimate includes the costs associated with the closure of the existing interception trench, installation of a new interception trench, granular activated carbon treatment, discharge to the POTW, and groundwater monitoring. The existing interception trench will be pumped out and filled with concrete. Capital costs for the construction of the new interception trench including excavation, installation of piping, bedding, and a sump/pump, and backfilling are estimated to be $126,650.00. The primary cost factor associated with the installation of the trench is the requirement to drive sheet piling to prevent sloughing during the excavation of the trench.

Based on a design flow rate of 7.5 gpm and an average (over the lifetime of the system) influent concentration of 100 ppm total VOCs, the usage of two 1,800-pound granular activated carbon (GAC) cylinders operated in series is recommended. Based on the design conditions and assuming .15 pounds adsorbed per pound of GAC, one of the GAC cylinders would require replacement approximately every 30 days. The capital cost for a dual mounted GAC treatment system, including delivery costs, is approximately $51,000. The estimated cost of replacing one GAC unit is $2,900, or an approximate annual operating cost of $35,000. The costs for discharge of treated groundwater to the sanitary sewer are estimated to be $5,000 per year.

In order to evaluate the effectiveness of the system semi-annual groundwater monitoring will be conducted. Each sampling event will consist of the collection of three samples (two from existing monitoring wells and one from the trench) to be analyzed for priority pollutant VOCs. Annual costs for the groundwater monitoring are estimated to be $3,600.00. A summary of the cost components is presented in Table 4-8.

4.1.2.4 Alternative 4G - Off-site Treatment

Overall Protectiveness

Alternative 4G will consist of the collection of contaminated groundwater with an interception trench and the subsequent treatment/disposal of the

TABLE 4-8
COST ESTIMATE FOR ALTERNATIVE
3G - GRANULAR ACTIVATED CARBON[1]

TREATMENT COMPONENT	TYPE OF COST	QUANTITY	UNIT COST ($)	CAPITAL COSTS ($)	ANNUAL O&M COSTS ($)
CLOSURE OF EXISTING INTERCEPTION TRENCH					
	CAPITAL		LUMP SUM	$4,000.00	
INSTALLATION OF NEW INTERCEPTION TRENCH					
	CAPITAL				
EXCAVATION		700 CY	13.5 /CY	$9,450.00	
SHEETING		10000 SF	10.5 /SF	$105,000.00	
TRENCH[2]		200 LF	$55.00 /LF	$11,000.00	
SUMP/PUMP			LUMP SUM	$1,200.00	
	O&M	1 YR	$2,500.00 /YR		$2,500.00
GRANULAR ACTIVATED CARBON					
	CAPITAL		LUMP SUM	$51,000.00	
	O&M	1 YR	$35,000.00 /YR		$35,000.00
GROUNWATER MONITORING					
	CAPITAL		LUMP SUM	$1,500.00	
	O&M	6 SAMPLES	$600.00 /SAMPLE		$3,600.00
DISCHARGE TO POTW					
	CAPITAL		LUMP SUM	$2,500.00	
	O&M	1 YR	$5,000.00		$5,000.00
SUBTOTAL				$185,650.00	$46,100.00
ENGINEERING AND ADMINISTRATION				$37,130.00	$6,915.00
CONTINGENCY				$37,130.00	$6,915.00
TOTAL ESTIMATED COSTS				$259,910.00	$59,930.00
PRESENT WORTH COST[3]					$722,473.57

[1] Costs are accurate to +50% to -30%
[2] Includes all labor and material costs for the trench piping, bedding material, and backfilling
[3] Present worth costs based on 10 year life and a 5% interest rate

groundwater at a RCRA facility. The remedial objective of the collection/off-site treatment system will be to remediate groundwater to the levels prescribed by the NYSDEC groundwater quality standards. Attainment of this remedial objective will assure protection of human health and the environment in the unlikely event that the groundwater is used as a drinking water source in the future.

Compliance With SCGs

Alternative 4G will meet RAOs and chemical specific SCGs through the collection and off-site treatment of groundwater to levels consistent with the NYSDEC groundwater quality standards. The only action-specific requirements for this alternative is that off-site treatment and disposal activities comply with RCRA requirements (e.g., manifesting, waste characterization).

Long-term Effectiveness and Permanence

Alternative 4G is an effective method of removing contaminated groundwater from the site; however, on-site treatment technologies are generally preferred. It is anticipated that this alternative will be implemented for a period of 10 years. Long-term operation and maintenance requirements for this alternative will include long-term groundwater monitoring and maintenance of the interception trench.

Reduction of Toxicity, Mobility, or Volume

Alternative 4G will reduce the toxicity, mobility, and volume of contaminated groundwater through off-site treatment methods.

Short-term Effectiveness

No short-term risks to on-site workers and the surrounding community are anticipated that can not be controlled. Small quantities of fugitive dust and VOCs generated during the excavation of the trench can be easily controlled.

Implementability

There are no technical or administrative constraints to limit the implementation of this alternative. An interception trench is an effective method of collecting groundwater in a low permeability aquifer. Currently, contaminated groundwater is being collected from an interim trench and shipped off-site to the CECOS International facility for treatment. Existing groundwater monitoring wells will be utilized for the long-term monitoring.

Cost

The present worth cost of this alternative, assuming a 10-year life and a 5% interest rate, is estimated at $10.8 million. This cost estimate includes the costs associated with the closure of the existing interception trench, installation of a new interception trench, off-site disposal, and groundwater monitoring. The existing interception trench will be pumped out and filled with concrete. Capital costs for the construction of the new interception trench including excavation, installation of piping, bedding, a sump/pump, and backfilling are estimated to be $126,650.00. The primary cost factor associated with the installation of the trench is the requirement to drive sheet piling to prevent sloughing during the excavation of the trench.

Costs for disposal of untreated groundwater at the CECOS International facility are estimated to be $0.27/gallon. Based upon a design groundwater collection rate of 7.5 gpm, the annual off-site disposal costs are estimated to be $1.1 million (+50% to -30%). In order to evaluate the effectiveness of the system semi-annual groundwater monitoring will be conducted. Each sampling event will consist of the collection of three samples (two from existing monitoring wells and one from the trench) to be analyzed for priority pollutant VOCs. Annual costs for the groundwater monitoring are estimated to be $3,600.00. A summary of the cost components is presented in Table 4-9.

4.2 Comparative Analysis of Alternatives

A comparative analysis of alternatives is conducted to evaluate the relative performance of each alternative with respect to the seven evaluation criteria and to determine the advantages and disadvantages of each alternative. The outcome provides the rationale for selection of a preferred alternative.

4.2.1 Comparison of Alternatives for Soils

4.2.1.1 Overall Protectiveness

Alternative 1S does not provide adequate protection of human health and the environment. Specifically, risks for a hypothetical future on-site

TABLE 4-9
COST ESTIMATE FOR ALTERNATIVE
4G - OFF-SITE DISPOSAL[1]

TREATMENT COMPONENT	TYPE OF COST	QUANTITY	UNIT COST ($)	CAPITAL COSTS ($)	ANNUAL O&M COSTS ($)
CLOSURE OF EXISTING INTERCEPTION TRENCH					
	CAPITAL		LUMP SUM	$4,000.00	
INSTALLATION OF NEW INTERCEPTION TRENCH					
	CAPITAL				
EXCAVATION		700 CY	13.5 /CY	$9,450.00	
SHEETING		10000 SF	10.5 /SF	$105,000.00	
TRENCH[2]		200 LF	$55.00 /LF	$11,000.00	
SUMP/PUMP			LUMP SUM	$1,200.00	
	O&M	1 YR	$2,500.00 /YR		$2,500.00
OFF-SITE DISPOSAL					
	CAPITAL		LUMP SUM	$1,500.00	
	O&M	3.9 MGAL/YR	$.27 /GAL		$1,053,000.00
GROUNWATER MONITORING					
	CAPITAL		LUMP SUM	$1,500.00	
	O&M	6 SAMPLES	$600.00 /SAMPLE		$3,600.00
SUBTOTAL				$133,650.00	$1,059,100.00
ENGINEERING AND ADMINISTRATION				$26,730.00	$158,865.00
CONTINGENCY				$26,730.00	$158,865.00
TOTAL ESTIMATED COSTS				$187,110.00	$1,376,830.00
PRESENT WORTH COST[3]					$10,818,626.30

[1] Costs are accurate to +50% to -30%
[2] Includes all labor and material costs for the trench piping, bedding material, and backfilling
[3] Present worth costs based on 10 year life and a 5% interest rate

resident are above acceptable levels. Alternatives 2S, 3S, 4S, and 5S each provide an equal level of protection to human health and the environment. Each of these alternatives will result in the removal of soils from the source area and subsequent treatment of the excavated material. Removal of the source area will minimize the threat of migration of soil contamination to groundwater. Future risks to human health are anticipated to be within acceptable ranges.

4.2.1.2 Compliance With SCGs

As set forth in Section 3.1, soils must be treated to under 3.0 ppm for trichloroethylene and 0.5 ppm for vinyl chloride. In addition, soil will meet all applicable LDR criteria. The objective of the RAO is to prevent the ingestion and inhalation of and dermal contact with contaminated soils that pose an unacceptable risk to human health. The no action alternative will not meet this objective. Alternatives 2S, 3S, 4S, and 5S will each result in the removal and treatment of the source area, thus reducing the potential for the migration of soil contaminants to groundwater. An air quality permit may be required for the implementation of alternatives 2S, 3S, and 5S. Alternative 4S must comply with RCRA requirements. Alternatives 2S, 3S, 4S, and 5S are each anticipated to comply with location-specific SCGs.

4.2.1.3 Long-term Effectiveness and Permanence

Alternatives 2S, 3S, and 5S were rated the highest with respect to long-term effectiveness and permanence. Each of these alternatives utilize on-site, destructive treatment technologies to achieve RAOs. Thermal desorption, ex situ vapor extraction, and *ex situ* bioremediation are each considered permanent remedies and consistent with the statutory preference for the selection of a permanent remedy. Alternative 4S - Off-site Treatment/Disposal is also considered a permanent remedy, but Alternatives 2S, 3S, and 5S are preferable, since they utilize on-site treatment methods. Although Alternatives 2S, 3S, and 5S each utilize permanent on-site treatment technologies, Alternative 2S (thermal desorption) and Alternative 5S (ex situ vapor extraction), may be considered by some sources to be more reliable and effective treatment technologies than bioremediation under certain field conditions. A pilot scale bioremediation treatability study would need to be conducted at the Scott Aviation facility to determine the effectiveness of resident are above acceptable levels. Alternatives 2S, 3S, 4S, and 5S each provide an equal level of protection to human health and the environment. Each of these alternatives will result in the removal of soils from the source area and subsequent treatment of the excavated material. Removal of the source area will minimize the threat of migration of soil contamination to groundwater. Future risks to human health are anticipated to be within acceptable ranges.

4.2.1.2 Compliance With SCGs

As set forth in Section 3.1, soils must be treated to under 1.0 ppm for trichloroethylene and 10 ppm for total VOCs. In addition, soil will meet all applicable LDR criteria. The objective of the RAO is to prevent the ingestion and inhalation of and dermal contact with contaminated soils that pose an unacceptable risk to human health. The no action alternative will not meet this objective. Alternatives 2S, 3S, 4S, and 5S will each result in the removal and treatment of the source area, thus reducing the potential for the migration of soil contaminants to groundwater. An air quality permit may be required for the implementation of alternatives 2S, 3S, and 5S. Alternative 4S must comply with RCRA requirements. Alternatives 2S, 3S, 4S, and 5S are each anticipated to comply with location-specific SCGs.

4.2.1.3 Long-term Effectiveness and Permanence

Alternatives 2S, 3S, and 5S were rated the highest with respect to long-term effectiveness and permanence. Each of these alternatives utilize on-site, destructive treatment technologies to achieve RAOs. Thermal desorption, ex situ vapor extraction, and *ex situ* bioremediation are each considered permanent remedies and consistent with the statutory preference for the selection of a permanent remedy. Alternative 4S - Off-site Treatment/Disposal is also considered a permanent remedy, but Alternatives 2S, 3S, and 5S are preferable, since they utilize on-site treatment methods. Although Alternatives 2S, 3S, and 5S each utilize permanent on-site treatment technologies, Alternative 2S (thermal desorption) and Alternative 5S (ex situ vapor extraction), may be considered by some sources to be more reliable and effective treatment technologies than bioremediation under certain field conditions. A pilot scale bioremediation treatability study would need to be conducted at the Scott Aviation facility to determine the effectiveness of this technology under existing site specific conditions. Alternative 1S is not an effective method of controlling potential site risks.

4.2.1.4 Reduction of Toxicity, Mobility, or Volume

Alternatives 2S, 3S, 4S, and 5S will each result in the reduction of the toxicity, and mobility of contaminated soil. Alternatives 3S and 5S may increase the volume of soil depending on the need for soil conditioning prior to treatment. Alternatives 2S and 5S are currently rated slightly higher than Alternatives 3S and 4S. However, Alternative 3S could rate highest if a pilot scale treatability was successfully conducted at the site. When effective, *ex situ* bioremediation will permanently reduce the toxicity and mobility of contaminated soil. Alternative 4S will rely on the management of residual waste that will occur at an off-site facility as opposed to on-site treatment and management. The no action alternative may result in a minor reduction of the toxicity and volume of contaminated soil due to degradation and migration, but the migration of soil contaminants will result in an overall increase in the volume of contaminated groundwater.

4.2.1.5 Short-term Effectiveness

With respect to short-term effectiveness Alternative 1S is ranked the highest because this alternative will not result in any intrusive activities that may expose the surrounding community to risks. Alternatives 2S, 3S, and 5S have the highest potential for short-term risks to the surrounding community and on-site workers. Alternatives 2S, 3S, 4S, and 5S will each require the excavation of contaminated soils, which may result in the generation of fugitive dust and VOC emissions. Additionally, the on-site operation of the treatment systems for Alternatives 2S, 3S, and 5S may result in the generation of additional air emissions. The potential short-term risks posed by each of the alternatives can be easily controlled by on-site control measures. Therefore, short-term risks are not considered to be a limiting factor.

4.2.1.6 Implementability

Alternative 1S is technically implementable but does not achieve RAOs. Alternatives 2S, 3S, 4S, and 5S are each technically and administratively feasible options. In the absence of pilot scale treatability study data for this technology under existing site specific conditions. Alternative 1S is not an effective method of controlling potential site risks.

4.2.1.4 Reduction of Toxicity, Mobility, or Volume

Alternatives 2S, 3S, 4S, and 5S will each result in the reduction of the toxicity, and mobility of contaminated soil. Alternatives 3S and 5S may increase the volume of soil depending on the need for soil conditioning prior to treatment. Alternatives 2S and 5S are currently rated slightly higher than Alternatives 3S and 4S. However, Alternative 3S could rate highest if a pilot scale treatability was successfully conducted at the site. When effective, *ex situ* bioremediation will permanently reduce the toxicity and mobility of contaminated soil. Alternative 4S will rely on the management of residual waste that will occur at an off-site facility as opposed to on-site treatment and management. The no action alternative may result in a minor reduction of the toxicity and volume of contaminated soil due to degradation and migration, but the migration of soil contaminants will result in an overall increase in the volume of contaminated groundwater.

4.2.1.5 Short-term Effectiveness

With respect to short-term effectiveness Alternative 1S is ranked the highest because this alternative will not result in any intrusive activities that may expose the surrounding community to risks. Alternatives 2S, 3S, and 5S have the highest potential for short-term risks to the surrounding community and on-site workers. Alternatives 2S, 3S, 4S, and 5S will each require the excavation of contaminated soils, which may result in the generation of fugitive dust and VOC emissions. Additionally, the on-site operation of the treatment systems for Alternatives 2S, 3S, and 5S may result in the generation of additional air emissions. The potential short-term risks posed by each of the alternatives can be easily controlled by on-site control measures. Therefore, short-term risks are not considered to be a limiting factor.

4.2.1.6 Implementability

Alternative 1S is technically implementable but does not achieve RAOs. Alternatives 2S, 3S, 4S, and 5S are each technically and administratively feasible options. The implementation of the bioremediation alternative would

Alternative 3S, Alternatives 2S and 5S are presently rated slightly higher. Thermal desorption, an in-vessel treatment method, is more readily controlled, and may be a more effective and reliable technology. Ex situ vapor extraction is a very reliable treatment technology, but the effectiveness of the system is dependent on the ability to condition soils to meet design parameters. Bench scale bioremediation treatability data generated from the treatment of chlorinated solvent contaminated soil samples at the Scott Aviation site suggest [illegible] may prove to be an equally successful treatment

*The implementation of the bioremediation alternative would necessitate the establishment of a specific RAO for vinyl chloride. This is due to the fact that vinyl chloride is produced during the process of microbial degradation of trichloroethylene. This disadvantage is unique to this particular alternative; all other alternatives utilize volatilization to remediate the soil, do not produce vinyl chloride through degradation, and therefore, would not require a specific RAP for this compound.

[illegible]ating [illegible]ative

The costs associated with Alternative 1S are negligible, but this alternative is not considered cost-effective because it does not achieve RAOs. The costs for Alternatives 2S through 5S are all comparable, ranging from a low of $480,000 to a high of $525,000. Alternative 3S results in the lowest estimated cost and Alternative 2S in the highest cost. However, the costs for Alternatives 3S and 5S are nearly identical, as are the costs for Alternatives 4S and 2S. Due to the extremely low variability of costs for the ex situ treatment technologies (i.e., differential cost < $45,000), all four alternatives are considered essentially equal, with Alternatives 3S and 5S rated slightly higher with respect to cost effectiveness. A comparison of the costs for the soil treatment alternatives is presented in Table 4-10.

4.2.1.8 Summary of Evaluation Criteria for Soils

With the exception of the evaluation criterion for short-term effectiveness, Alternative 1S is rated much lower than the other three alternatives on all evaluation criteria. Alternatives 2S, 3S, 4S, and 5S received comparable ratings with respect to all evaluation criteria. Alternatives 2S and 5S were rated slightly higher than Alternatives 4S and 3S with respect to long-term effectiveness and permanence, implementability, and reduction of toxicity, mobility, and volume. The technical feasibility of

Alternative 3S, Alternatives 2S and 5S are presently rated slightly higher. Thermal desorption, an in-vessel treatment method, is more readily controlled, and may be a more effective and reliable technology. Ex situ vapor extraction is a very reliable treatment technology, but the effectiveness of the system is dependent on the ability to condition soils to meet design parameters. Bench scale bioremediation treatability data generated from the treatment of chlorinated solvent contaminated soil samples at the Scott Aviation site suggest that this technology may prove to be an equally successful treatment alternative at this location.* A pilot scale bioremediation treatability study, if conducted at the Scott Aviation site, could modify the final rating for Alternative 3S. Alternative 4S also rates slightly lower than Alternative 2S with respect to implementability. Off-site treatment is subject to uncertainties associated with coordination with an off-site facility.

4.2.1.7 Cost

The costs associated with Alternative 1S are negligible, but this alternative is not considered cost-effective because it does not achieve RAOs. The costs for Alternatives 2S through 5S are all comparable, ranging from a low of $480,000 to a high of $525,000. Alternative 3S results in the lowest estimated cost and Alternative 2S in the highest cost. However, the costs for Alternatives 3S and 5S are nearly identical, as are the costs for Alternatives 4S and 2S. Due to the extremely low variability of costs for the ex situ treatment technologies (i.e., differential cost < $45,000), all four alternatives are considered essentially equal, with Alternatives 3S and 5S rated slightly higher with respect to cost effectiveness. A comparison of the costs for the soil treatment alternatives is presented in Table 4-10.

4.2.1.8 Summary of Evaluation Criteria for Soils

With the exception of the evaluation criterion for short-term effectiveness, Alternative 1S is rated much lower than the other three alternatives on all evaluation criteria. Alternatives 2S, 3S, 4S, and 5S received comparable ratings with respect to all evaluation criteria. Alternatives 2S and 5S were rated slightly higher than Alternatives 4S and 3S with respect to long-term effectiveness and permanence, implementability, and reduction of toxicity, mobility, and volume. The technical feasibility of

necessitate the establishment of a specific RAO for vinyl chloride. This is due to the fact that vinyl chloride is produced during the process of microbial degradation of trichloroethylene. In the absence of pilot scale treatability study data for Alternative 3S, Alternatives 2S and 5S are presently rated slightly higher. Thermal desorption, an in-vessel treatment method, is more readily controlled, and may be a more effective and reliable technology. Ex situ vapor extraction is a very reliable treatment technology, but the effectiveness of the system is dependent on the ability to condition soils to meet design parameters. Bench scale bioremediation treatability data generated from the treatment of chlorinated solvent contaminated soil samples at the Scott Aviation site suggest that this technology may prove to be an equally successful treatment alternative at this location. The implementation of the bioremediation alternative would necessitate the establishment of a specific RAO for vinyl chloride. This is due to the fact that vinyl chloride is produced during the process of microbial degradation of trichloroethylene. This disadvantage is unique to this particular alternative; all other alternative utilize volatilization to remediate the soil, do not produce vinyl chloride through degradation, and therefore, would not require a specific RAP for this compound. A pilot scale bioremediation treatability study, if conducted at the Scott Aviation site, could modify the final rating for Alternative 3S. Alternative 4S also rates slightly lower than Alternative 2S with respect to implementability. Off-site treatment is subject to uncertainties associated with coordination with an off-site facility.

4.2.1.7 Cost

The costs associated with Alternative 1S are negligible, but this alternative is not considered cost-effective because it does not achieve RAOs. The costs for Alternatives 2S through 5S are all comparable, ranging from a low of $480,000 to a high of $525,000. Alternative 3S results in the lowest estimated cost and Alternative 2S in the highest cost. However, the costs for Alternatives 3S and 5S are nearly identical, as are the costs for Alternatives 4S and 2S. Due to the extremely low variability of costs for the ex situ treatment technologies (i.e., differential cost < $45,000), those alternatives are considered essentially equal, with Alternatives 3S and 5S rated slightly higher with respect to cost effectiveness. Treatment costs for all alternatives under consideration are presently based on an assumed soil volume of 1200 tons. However, as more detailed source definition is established and the volumes to be treated increase, the cost differential between off-site disposal options and on-site ex-situ treatment also increases, favoring the latter treatment scenarios. A final cost-benefit determination will be made following the implementation of a soil boring program at the site designed to assess the precise volume of soils to be excavated for treatment. Should treatment volumes significantly exceed the estimated 1200 tons of contaminated soils, then the ex-situ alternatives will be preferable. However, if volumes to be excavated are less than or equal to the presently assumed tonnage, the off-site disposal option remains a viable solution. A comparison of the costs for the soil treatment alternatives is presented in Table 4-10.

4.2.1.8 Summary of Evaluation Criteria for Soils

With the exception of the evaluation criterion for short-term effectiveness, Alternative 1S is rated much lower than the other three alternatives on all evaluation criteria. Alternatives 2S, 3S, 4S, and 5S received comparable ratings with respect to all evaluation criteria. Alternatives 2S and 5S were rated slightly higher than Alternatives 4S and 3S with respect to long-term effectiveness and permanence, implementability, and reduction of toxicity, mobility, and volume. The technical feasibility of

TABLE 4-10
COMPARISON OF COSTS
FOR SOIL ALTERNATIVES

ALTERNATIVE	RANGE OF COSTS [1]
1S - No Action	Negligible
2S - Low Temperature Thermal Desorption	$521,850.00
3S - *Ex situ* Bioremediation	$480,550.00
4S - Off-site Treatment/Disposal	$524,650.00
5S - Ex situ Vapor Extraction	$489,650.00

1 Costs are accurate to +50% to -30%

Alternative 2S is considered slightly higher than Alternatives 3S, 4S, and 5S, but Alternatives 3S, 4S, and 5S are each considered technically feasible technology types. Alternatives 3S and 5S are ranked highest with respect to cost-effectiveness. Preliminary vendor data has indicated that ex situ bioremediation may be effective under the site-specific conditions at Scott Aviation. A follow-up evaluation of initial data developed with respect to this alternative would involve the performance of a pilot scale bioremediation treatability study at the facility.

4.2.2 Comparison of Alternatives for Groundwater

4.2.2.1 Overall Protectiveness

Alternative 1G does not provide adequate protection of human health and the environment. Specifically, this alternative does not protect a hypothetical future resident from exposure to contaminated groundwater. When Alternative 1G is coupled with excavation of contaminated soils in the source area, groundwater could, over time, reach regulatory levels through dilution. However, residual contamination in on-site soils may continue to migrate to groundwater. Alternatives 2G, 3G, and 4G each provide an equal level of protection to human health and the environment by collecting groundwater and treating to the target levels set forth by the NYSDEC groundwater quality standards. Additionally, long-term monitoring will be conducted to determine any changes in the nature and extent of contamination and to evaluate the effectiveness of the treatment system.

4.2.2.2 Compliance With SCGs

Alternatives 2G, 3G, and 4G, each comply with chemical-specific SCGs, by treating groundwater to the target levels prescribed by the NYSDEC groundwater quality standards. Alternative 1G does not meet chemical-specific SCGs. However, based on the poor yield characteristics of the aquifer and the availability of a public water supply, a waiver from these requirements may be warranted.

4.2.2.3 Long-term Effectiveness and Permanence

Alternatives 2G and 3G were rated highest with respect to long-term effectiveness and permanence because both alternatives rely on-site treatment technologies. Alternatives 2G, 3G, and 4G are considered permanent remedies;

however, on-site treatment methods are preferred over off-site methods. Alternative 2G (air stripping) is considered more effective than alternative 3G (carbon adsorption) for treating the contaminants of concern (i.e., vinyl chloride), but both alternatives are considered effective treatment options. Alternative 1G may be effective on a long term basis, if coupled with excavation of contaminated soils at the source.

4.2.2.4 Reduction of Toxicity, Mobility, or Volume

Alternatives 2G, 3G, and 4G will reduce the toxicity, mobility, and volume of contaminated groundwater through collection and treatment. Alternative 2G is anticipated to result in a higher reduction in toxicity, since air stripping is the most effective method for the treatment of vinyl chloride. Alternatives 2G and 3G will each generate a residual waste stream (i.e., contaminated air and granular activated carbon, respectively), but the waste streams can be adequately controlled.

4.2.2.5 Short-term Effectiveness

The no action alternative is rated the highest with respect to short-term effectiveness, because this alternative will not result in any additional intrusive activities that may increase short-term risks. The remaining three alternatives are considered equal with respect to this criterion. The excavation of the interception trench may result in the generation of some fugitive emissions, but these potential emissions can be easily controlled.

4.2.2.6 Implementability

Alternative 1G is technically feasible, but it may not be administratively feasible since it does not necessarily comply with SCGs. Alternatives 2G, 3G, and 4G are technically and administratively feasible options, but Alternative 2G was rated the highest for this criterion. Carbon adsorption and air stripping are both commercially available processes that are effective for the treatment of volatile organic compounds, but carbon adsorption is not as effective for the treatment of vinyl chloride. Vinyl chloride has been detected in groundwater on-site, but the levels of vinyl chloride are estimated to be lower in concentration than the criteria for discharge to the sanitary sewer. Off-site treatment is subject to uncertainties associated with coordination with an off-site facility.

4.2.2.7 Cost

The costs associated with Alternative 1G are negligible; however, this alternative alone does not meet chemical-specific SCGs and is a feasible option only if coupled with excavation of contaminated soils at the source. Alternative 4G is not economically feasible. Alternative 2G is much more cost-effective than Alternative 3G if the air stripping system does not require off-gas treatment. However, even if off-gas treatment is required, air stripping is slightly less expensive than granular-activated carbon treatment. A comparison of costs for groundwater alternatives is presented in Table 4-11.

4.2.2.8 Summary of Evaluation Criteria for Groundwater

With the exception of the evaluation criterion for short-term effectiveness, Alternative 1G is rated lower than the other three alternatives for each of the evaluation criteria unless it is done in conjunction with soil excavation at the source of the contamination. Even then, it is unclear whether over time groundwater will meet regulatory standards through dilution. Alternatives 2G, 3G, and 4G received comparable ratings with respect to all the evaluation criteria except cost. Alternative 2G was rated slightly higher than Alternatives 4G and 3G with respect to long-term effectiveness and permanence, implementability, and reduction of toxicity, mobility, and volume. The primary reason for this is that low concentrations of vinyl chloride have been detected in on-site groundwater and air stripping is the most reliable treatment technology for vinyl chloride. However, based on the relatively low levels of vinyl chloride detected, carbon adsorption is anticipated to be an acceptable remedial alternative. With respect to cost, although Alternative 1G is certainly cost-effective, it may not be administratively feasible. Alternative 4G is cost prohibitive. Air stripping was generally found to be a more cost-effective option than carbon adsorption. However, if off-gas treatment is required, the costs of air stripping and carbon adsorption are comparable, although air stripping followed by off-gas treatment is still anticipated to cost less than carbon adsorption.

TABLE 4-11
COMPARISON OF COSTS
FOR GROUNDWATER ALTERNATIVES

Alternative	Capital Costs[1]	Annual Operating Costs[1]	Present Worth Cost [1,2]
Alternative 1G - No Action	Negligible	Negligible	Negligible
Alternative 2G - Air Stripping	$237,510.00	$20,930.00	$399,126.00
Alternative 2G - Air Stripping w/ Vapor Phase GAC	$286,510.00	$40,430.00	$598,700.00
Alternative 3G - Carbon Adsorption	$259,910.00	$59,930.00	$722,474.00
Alternative 4G - Off-site Treatment	$187,110.00	$1,376,830.00	$10,818,626.00

1 Costs are accurate to +50% to -30%

2 Present worth based on 10 year life and 5% interest rate

[1]Table 4-11 will be modified to reflect preparation and revision of a site groundwater monitoring program, and annual operating costs of $16K/year.

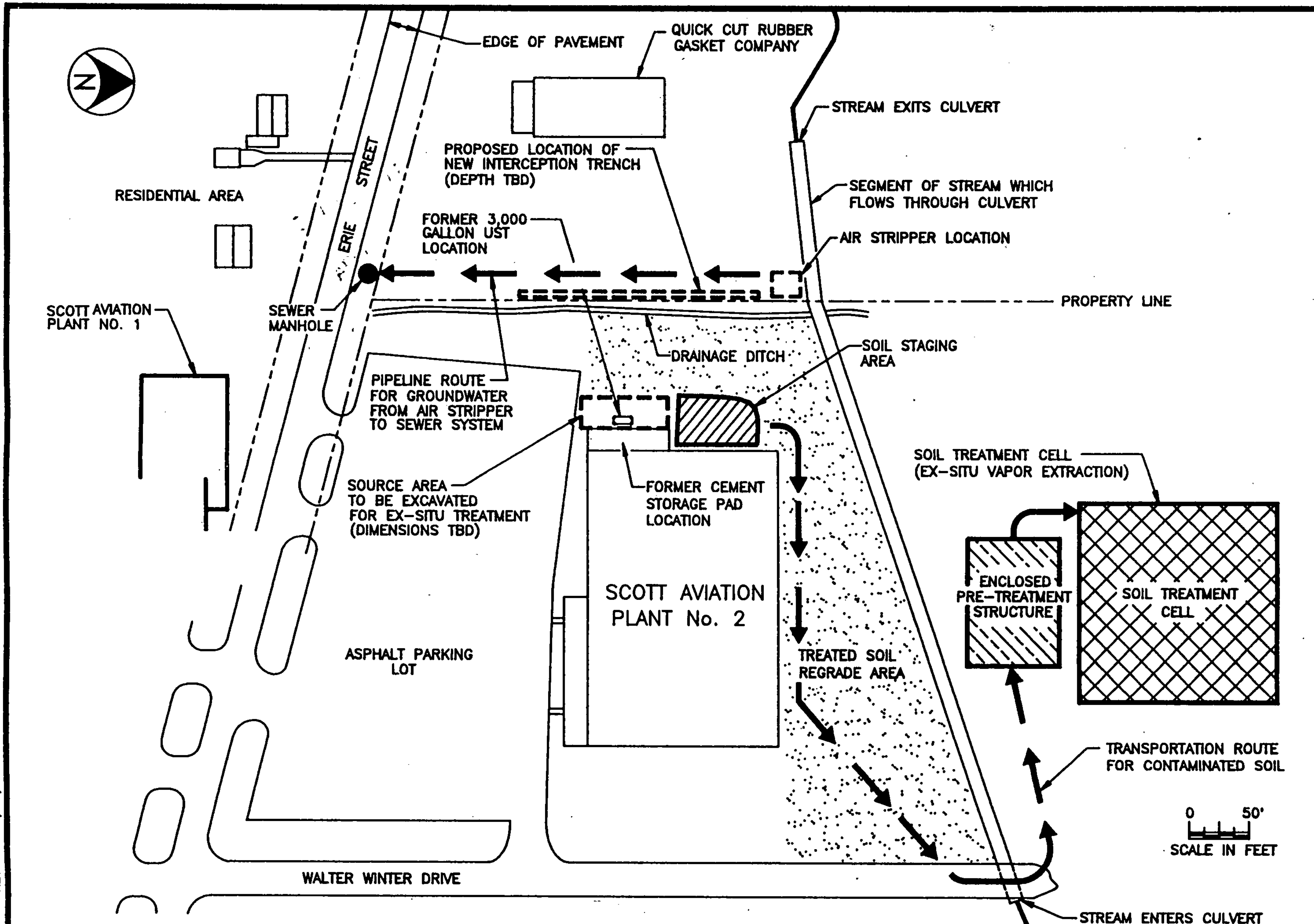
TABLE 4-11
COMPARISON OF COSTS
FOR GROUNDWATER ALTERNATIVES

Alternative	Capital Costs[1]	Annual Operating Costs[1]	Present Worth Cost [1,2]
Alternative 1G - No Action	$5,000.00	$16,000.00	$128,547.76
Alternative 2G - Air Stripping	$237,510.00	$20,930.00	$399,126.00
Alternative 2G - Air Stripping w/ Vapor Phase GAC	$286,510.00	$40,430.00	$598,700.00
Alternative 3G - Carbon Adsorption	$259,910.00	$59,930.00	$722,474.00
Alternative 4G - Off-site Treatment	$187,110.00	$1,376,830.00	$10,818,626.00

COMPARISON OF COSTS FOR SOIL ALTERNATIVES

Alternative	Capital Cost[1]	Annual Operating Cost[1]	Present Worth Cost[1]
Alternative 1S - No Action	Negligible	$0.00	$0.00
Alternative 2S - Low Temperature Thermal Desorption	$521,850.00[3]	$0.00	$521,850.00
Alternative 3S - *Ex situ* Bioremediation	$480,550.00[3]	$0.00	$480,550.00
Alternative 4S - Off-site Treatment/ Disposal	$524,650.00[3]	$0.00	$524,650.00
Alternative 5S - Ex situ Vapor Extraction	$489,650.00[3]	$0.00	$489,650.00

1 Costs are accurate to +50% to -30%
2 Present worth based on 10 year life and 5% interest rate
3 Cost includes both capital and annual operating costs



REVISED: 07/08/94

L9406100\SCOTT

Versar INC.
2010 CABOT BLVD
LANGHORNE, PA 19047
(215) 741-4211

SCOTT AVIATION, LANCASTER, NY

FIGURE 1

SOIL & GROUNDWATER TREATMENT SYSTEM LOCATION MAP
JUNE – 1994

DATE:	6/29/94
DESIGNED BY:	E. ASHTON
SCALE:	AS NOTED
PROJ. NO.:	1324.014

5.0 SELECTION OF THE PREFERRED ALTERNATIVE

This section presents recommendations for the preferred remedial action at the Scott Aviation site based on the results of the Remedial Investigation /Feasibility Study conducted at the site. Based on the results of the remedial investigation, the following operable units were identified and evaluated with respect to remedial action alternatives (1) on-site soils, and (2) groundwater.

Based on a comparative analysis of the seven critical evaluation criteria, the following remedial action alternatives are recommended for implementation at the Scott Aviation site.

Soils

Based on a comparative analysis of alternatives either Alternative 3S, on-site *ex situ* bioremediation, or Alternative 5S, on-site ex situ vapor extraction, are the preferred alternatives. There are some uncertainties associated with the effectiveness of ex situ bioremediation, but the results of the bench scale bioremediation studies have indicated that this technology is effective for the Scott Aviation site. A follow-up evaluation of initial data developed with respect to this alternative would involve the performance of a pilot scale bioremediation treatability study at the facility. Although bioremediation might be successfully achieved, ex-situ soil vapor extraction can be implemented within a shorter time frame, and requires only limited additional data acquisition relative to site-specific field parameters. The ex-situ soil vapor extraction alternative complies with SCGs, achieves remedial action objectives, is protective of human health and the environment, meets the statutory preference for a permanent remedy, is technically and administratively implementable, and reduces the toxicity, mobility, and volume of contaminated soil. Based on the implementation time factor, ex-situ soil vapor extraction is the preferred alternative over bioremediation. The exact volume of soil to be excavated for treatment will be determined through additional soil borings and sample analyses scheduled to be conducted at the site.

Groundwater

Based on the comparative analysis of alternatives, Alternatives 2G and 3G were both identified as technically, administratively and economically feasible treatment options. These alternatives both involve abandonment of the existing interception trench, construction of a new interception trench, discharge of treated groundwater to the sanitary sewer, and long-term groundwater monitoring. The two alternatives differ in that Alternative 2G relies on an air stripping system to treat the contaminated groundwater and Alternative 3G relies on a carbon adsorption system for the treatment of contaminated groundwater. Both of these remedial alternatives are effective treatment technologies that comply with SCGs, will protect human health and the environment, and reduce the toxicity, mobility, and volume of contaminants. Costs for Alternative 2G were evaluated based on two options (1) an air stripping system with no off-gas treatment and (2) an air stripping system with off-gas treatment. If off-gas treatment is not required, Alternative 2G is more cost-effective than Alternative 3G. However, if the operation of the air stripper requires off-gas treatment, the costs associated with Alternatives 2G and 3G are similar. Based on the feasibility study analysis, Alternative 2G is the preferred alternative. However, since alternative 3G also complies with the evaluation criteria and the costs are comparable to Alternative 2G, it is recommended that a more detailed evaluation of the technical and economic merits of air stripping versus carbon adsorption be conducted during the remedial design phase.

6.0 REFERENCES

Medlar, Steve, "Granular Activated Carbon Adsorption, Process, Performance, Design," Rutgers University Course, 1990.

"Air Stripping and Adsorption Technologies," Camp, Dresser & McKee (CDM), 1990

United States Environmental Protection Agency. March 1990. *Basics of Pump-and-Treat Ground-Water Remediation Technology*. Robert S. Kerr Research Laboratory, Ada, OK.

United States Environmental Protection Agency. 1987. *A Compendium of Technologies Used in the Treatment of Hazardous Wastes*. Office of Research and Development.

United States Environmental Protection Agency. 1988. *CERCLA Compliance with Other Laws Manual*. Interim Final. Office of Emergency and Remedial Response.

United States Environmental Protection Agency. 1989. *CERCLA Compliance with Other Laws Manual: Part II. Clean Air Act and Other Environmental Statutes and State Requirements*. Interim Final. Office of Emergency and Remedial Response.

United States Environmental Protection Agency. 1990. *Code of Federal Regulations Title 40, Parts 260 to 299*.

United States Environmental Protection Agency. 1987. *Compendium of Costs of Remedial Technologies at Hazardous Waste Sites*. Office of Research and Development.

United States Environmental Protection Agency. 1982. *Costs of Remedial Response Actions at Uncontrolled Hazardous Waste Sites*. Office of Research and Development.

United States Environmental Protection Agency. 1988. *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA*. Interim Final.

U.S.E.P.A. December 1988. *Guidance on Remedial Actions for Contaminated Groundwater at Superfund Sites*. Office of Emergency and Remedial Response, Washington, D.C.

U.S.E.P.A. 1988. *Guide to Treatment Technologies for Hazardous Wastes at Superfund Sites*. Office of Environmental Engineering and Technology Demonstration.

U.S.E.P.A. August 1987. *Proceedings: Second International Conference on New Frontiers for Hazardous Waste Management*. Hazardous Waste Engineering Research Laboratory, Cincinnati, OH.

U.S.E.P.A. 1987. *Remedial Action Costing Procedures Manual*. Office Solid Waste and Emergency Response.

U.S.E.P.A. September 1989. *Seminar Publication - Corrective Action Technologies and Applications.*

U.S.E.P.A. 1986a. *Superfund Public Health Evaluation Manual.* Office of Emergency and Remedial Response, US EPA, Washington, DC.

U.S.E.P.A. 1988. *Superfund Exposure Assessment Manual.* Office of Remedial Response, US EPA, Washington, DC.

U.S.E.P.A. 1986. *Superfund Treatment Technologies: A Vendor Inventory.*

U.S.E.P.A. 1989a. *Risk Assessment Guidance (RAGS) for Superfund: Volume I Human Health Evaluation Manual (Part A).* Office of Emergency and Remedial Response, US EPA, Washington, DC.

U.S.E.P.A. 1989d. *Determining Soil Response Action Levels Based on Potential Contaminant Migration to Groundwater: A Compendium of Examples.* Office of Emergency and Remedial Response. SOCEM. pp. 21-26.

U.S.E.P.A. 1992. *The Superfund Innovative Technology Evaluation Program: Technology Profiles*, Office of Solid Waste and Emergency Response, Washington, DC.

Versar, *Remedial Investigation Report*, Scott Aviation, Lancaster, New York, August 1993.

Versar, *Standards, Criteria, and Guidances and Remedial Action Objectives Report*, Scott Aviation, Lancaster, New York, August 1993.

Versar, *Risk Assessment Report*, Scott Aviation, Lancaster, New York, August 1993.

Appendix A

Worksheets for Analysis of Alternatives

Worksheet 1
Compliance with Applicable or Relevant and Appropriate State Standards Criteria and Guidelines (SCGs)

Alternative 1S-No Action

Analysis Factor	Basis	Score		
Compliance with chemical-specific SCGs	Meets chemical specific SCGs, such as ground water standards.	Yes No	____ 0	4 0
Compliance with action-specific SCGs	Meets SCGs, such as technology standards for incineration.	Yes No	3 ____	3 0
Compliance with location-specific SCGs	Meets location-specific SCGs, such as Freshwater Wetlands Act.	Yes No	3 ____	3 0
Total Score			6	

Worksheet 2
Protection of Human Health
and the Environment

Alternative 1S-No Action

Analysis Factor	Basis	Score		
Use of site after remediation.	Unrestricted use of the land and water (if yes go to end).	Yes		20
		No	0	0
Human health and the environment after remediation	Is the exposure to contaminants via air route acceptable?	Yes	3	3
		No		0
	Is the exposure to contaminants via groundwater/surface water acceptable?	Yes		4
		No	0	0
	Is the exposure to contaminants via sediments/soils acceptable?	Yes		3
		No	0	0
Magnitude of residual public health risks after remediation.	Health risk	≤1E-6		5
		≤1E-5	2	2
Magnitude of residual environmental risks after remediation.	Acceptable			5
	Slightly less than acceptable			3
	Significant risk still exists		0	0
Total Score			5	

Worksheet 3
Short-Term Effectiveness

Alternative 1S-No Action

Analysis Factor	Basis	Score		
Protection of community during remedial action.	Are there significant short-term risks to the community that must be addressed? (if no go to next factor)	Yes No	____ 4	0 4
	Can the risk be easily controlled?	Yes No	____ ____	1 0
	Does the mitigative effort to control risk impact the community?	Yes No	____ ____	0 2
Environmental Impacts	Are there significant short-term risks to the environment to be addressed? (if no, go to next factor)	Yes No	____ 4	0 4
	Are the available mitigative measures reliable to minimize potential impacts?	Yes No	____ ____	3 0
Time to implement remedy	What is the time required to implement the remedy?	<2 yrs. >2 yrs.	1 ____	1 0
	Required duration of the mitigative effort to control short-term risk.	<2 yrs. >2 yrs.	1 ____	1 0
Total Score		10		

Worksheet 4
Long-Term Effectiveness and Permanence

Alternative 1S-No Action

Analysis Factor	Basis	Score
Treatment method	On-site treatment Off-site treatment Off-site land disposal	____ 3 ____ 1 0 0
Permanence of the remedial alternative	Will the remedy be classified as permanent?	Yes ____ 3 No 0 0
Lifetime of remedial action(s).	Duration of the effectiveness of remedy	25-30 yr. ____ 3 20-25 yr. ____ 2 15-20 yr. ____ 1 <15 yr. 0 0
Quantity and nature of waste or residual left at the site after remediation.	Quantity of untreated waste left on-site.	None ____ 3 < 25% ____ 2 25-50% ____ 1 > 50% 0 0
	Is there treated residual left at the site? (if no, go to next factor)	Yes ____ 0 No ____ 2 N/A
	Is the treated residual toxic?	Yes ____ 0 No ____ 1
	Is the treated residual mobile?	Yes ____ 0 No ____ 1
Adequacy and reliability of controls.	Operation and maintenance requirements.	< 5 yr. 1 1 > 5 yr. ____ 0
	Are environmental controls required as a part of the remedy?	Yes ____ 0 No 1 1
	Degree of confidence that controls can adequately handle potential problems (if applicable)	High ____ 1 Low 0 0
	Relative degree of long-term monitoring required.	Minimal ____ 2 Moderate ____ 1 Extensive 0 0
Total Score		2

Worksheet 5 Reduction of Toxicity, Mobility, or Volume		
Alternative 1S-No Action		
Analysis Factor	**Basis**	**Score**
Volume of waste reduced	Quantity of waste destroyed or treated	99-100% ____ 8 90-99% ____ 7 80-89% ____ 6 60-79% ____ 4 40-59% ____ 2 20-39% ____ 1 < 20% __0__ 0
	Are there untreated or concentrated wastes produced as a result of treatment?	Yes ____ 0 No ____ 2 N/A
	After remediation, how is the untreated or residual waste disposed of?	Off-site disposal ____ 0 on-site disposal ____ 1 Off-site treatment ____ 2
Reduction in mobility (if applicable)	Quantity of waste immobilized after treatment.	90-100% ____ 2 60-89% ____ 1 < 60% __0__ 0
	Method of immobilization	Contain-ment ____ 0 Treat-ment ____ 3
Irreversibility of remedy	Completely irreversible Irreversible for most constituents Irreversible for a few constituents Reversible for most constituents	____ 5 ____ 3 ____ 2 __0__ 0
Total Score		0

Worksheet 6
Implementability

Alternative 1S-No Action

Analysis Factor	Basis	Score	
Technical Feasibility			
Ability to construct	Not difficult/no uncertainties	3	3
	Somewhat difficult/no uncertainties		2
	Very difficult/significant uncertainties		1
Reliability of technology	Very reliable		3
	Somewhat reliable		2
		N/A	
Delays due to mechanical problems	Unlikely	2	2
	Somewhat likely		1
Need for future remedial action	None anticipated		2
	Some action may be required	1	1
Administrative Feasibility			
Coordination with other agencies	Minimal coordination		2
	Coordination required is normal		1
	Extensive coordination	0	0
Availability of Services and Materials			
Availability of prospective technologies	Is the technology commercially available?	Yes 1	1
		No	0
	Will competitive bids be obtained?	Yes	1
		No 0	0
	Is the equipment/specialists readily available?	Yes	1
		No 0	0
Total Score		9	

Worksheet 1 Compliance with Applicable or Relevant and Appropriate State Standards Criteria and Guidelines (SCGs)		
Alternative 2S- Thermal Dersorption		
Analysis Factor	Basis	Score
Compliance with chemical-specific SCGs	Meets chemical specific SCGs, such as ground water standards.	Yes 4 4 No ___ 0
Compliance with action-specific SCGs	Meets SCGs, such as technology standards for incineration.	Yes 3 3 No ___ 0
Compliance with location-specific SCGs	Meets location-specific SCGs, such as Freshwater Wetlands Act.	Yes 3 3 No ___ 0
Total Score		10

Worksheet 2
Protection of Human Health
and the Environment

Alternative 2S- Thermal Dersorption

Analysis Factor	Basis	Score		
Use of site after remediation.	Unrestricted use of the land and water (if yes go to end).	Yes		20
		No	0	0
Human health and the environment after remediation	Is the exposure to contaminants via air route acceptable?	Yes	3	3
		No		0
	Is the exposure to contaminants via groundwater/surface water acceptable?	Yes	4	4
		No		0
	Is the exposure to contaminants via sediments/soils acceptable?	Yes	3	3
		No		0
Magnitude of residual public health risks after remediation.	Health risk	≤1E-6	5	5
		≤1E-5		2
Magnitude of residual environmental risks after remediation.	Acceptable		5	5
	Slightly less than acceptable			3
	Significant risk still exists			0
Total Score			20	

Worksheet 3
Short-Term Effectiveness

Alternative 2S- Thermal Dersorption

Analysis Factor	Basis	Score		
Protection of community during remedial action.	Are there significant short-term risks to the community that must be addressed? (if no go to next factor)	Yes No	0 ____	0 4
	Can the risk be easily controlled?	Yes No	1 ____	1 0
	Does the mitigative effort to control risk impact the community?	Yes No	____ 2	0 2
Environmental Impacts	Are there significant short-term risks to the environment to be addressed? (if no, go to next factor)	Yes No	____ 4	0 4
	Are the available mitigative measures reliable to minimize potential impacts?	Yes No	____ ____	3 0
Time to implement remedy	What is the time required to implement the remedy?	<2 yrs. >2 yrs.	1 ____	1 0
	Required duration of the mitigative effort to control short-term risk.	<2 yrs. >2 yrs.	1 ____	1 0
Total Score		9		

Worksheet 4
Long-Term Effectiveness and Permanence

Alternative 2S- Thermal Desorption

Analysis Factor	Basis	Score		
Treatment method	On-site treatment		3	3
	Off-site treatment			1
	Off-site land disposal			0
Permanence of the remedial alternative	Will the remedy be classified as permanent?	Yes	3	3
		No		0
Lifetime of remedial action(s).	Duration of the effectiveness of remedy	25-30 yr.	3	3
		20-25 yr.		2
		15-20 yr.		1
		<15 yr.		0
Quantity and nature of waste or residual left at the site after remediation.	Quantity of untreated waste left on-site.	None		3
		< 25%	2	2
		25-50%		1
		> 50%		0
	Is there treated residual left at the site? (if no, go to next factor)	Yes	0	0
		No		2
	Is the treated residual toxic?	Yes		0
		No	1	1
	Is the treated residual mobile?	Yes		0
		No	1	1
Adequacy and reliability of controls.	Operation and maintenance requirements.	< 5 yr.	1	1
		> 5 yr.		0
	Are environmental controls required as a part of the remedy?	Yes	0	0
		No		1
	Degree of confidence that controls can adequately handle potential problems (if applicable)	High	1	1
		Low		0
	Relative degree of long-term monitoring required.	Minimal	2	2
		Moderate		1
		Extensive		0
Total Score		17		

Worksheet 5 Reduction of Toxicity, Mobility, or Volume		
Alternative 2S- Thermal Dersorption		
Analysis Factor	**Basis**	**Score**
Volume of waste reduced	Quantity of waste destroyed or treated	99-100% ____ 8 90-99% __7__ 7 80-89% ____ 6 60-79% ____ 4 40-59% ____ 2 20-39% ____ 1 < 20% ____ 0
	Are there untreated or concentrated wastes produced as a result of treatment?	Yes __0__ 0 No ____ 2
	After remediation, how is the untreated or residual waste disposed of?	Off-site disposal ____ 0 on-site disposal __1__ 1 Off-site treatment ____ 2
Reduction in mobility (if applicable)	Quantity of waste immobilized after treatment.	90-100% __2__ 2 60-89% ____ 1 < 60% ____ 0
	Method of immobilization	Contain-ment ____ 0 Treat-ment __3__ 3
Irreversibility of remedy	Completely irreversible Irreversible for most constituents Irreversible for a few constituents Reversible for most constituents	__5__ 5 ____ 3 ____ 2 ____ 0
Total Score		18

Worksheet 6 Implementability		
Alternative 2S- Thermal Dersorption		
Analysis Factor	**Basis**	**Score**
Technical Feasibility		
Ability to construct	Not difficult/no uncertainties Somewhat difficult/no uncertainties Very difficult/significant uncertainties	____ 3 2 2 ____ 1
Reliability of technology	Very reliable Somewhat reliable	3 3 ____ 2
Delays due to mechanical problems	Unlikely Somewhat likely	____ 2 1 1
Need for future remedial action	None anticipated Some action may be required	2 2 ____ 1
Administrative Feasibility		
Coordination with other agencies	Minimal coordination Coordination required is normal Extensive coordination	2 2 ____ 1 ____ 0
Availability of Services and Materials		
Availability of prospective technologies	Is the technology commercially available?	Yes 1 1 No ____ 0
	Will competitive bids be obtained?	Yes 1 1 No ____ 0
	Is the equipment/specialists readily available?	Yes 1 1 No ____ 0
Total Score		13

Worksheet 1
Compliance with Applicable or Relevant and Appropriate
State Standards Criteria and Guidelines (SCGs)

Alternative 3S Ex-situ Bioremediation

Analysis Factor	Basis	Score
Compliance with chemical-specific SCGs	Meets chemical specific SCGs, such as ground water standards.	Yes 4 4 No ___ 0
Compliance with action-specific SCGs	Meets SCGs, such as technology standards for incineration.	Yes 3 3 No ___ 0
Compliance with location-specific SCGs	Meets location-specific SCGs, such as Freshwater Wetlands Act.	Yes 3 3 No ___ 0
Total Score		10

Worksheet 2
Protection of Human Health
and the Environment

Alternative 3S Ex-situ Bioremediation

Analysis Factor	Basis	Score		
Use of site after remediation.	Unrestricted use of the land and water (if yes go to end).	Yes		20
		No	0	0
Human health and the environment after remediation	Is the exposure to contaminants via air route acceptable?	Yes	3	3
		No		0
	Is the exposure to contaminants via groundwater/surface water acceptable?	Yes	4	4
		No		0
	Is the exposure to contaminants via sediments/soils acceptable?	Yes	3	3
		No		0
Magnitude of residual public health risks after remediation.	Health risk	≤1E-6	5	5
		≤1E-5		2
Magnitude of residual environmental risks after remediation.	Acceptable		5	5
	Slightly less than acceptable			3
	Significant risk still exists			0
Total Score		20		

Worksheet 3
Short-Term Effectiveness

Alternative 3S Ex-situ Bioremediation

Analysis Factor	Basis	Score		
Protection of community during remedial action.	Are there significant short-term risks to the community that must be addressed? (if no go to next factor)	Yes No	0 ___	0 4
	Can the risk be easily controlled?	Yes No	1 ___	1 0
	Does the mitigative effort to control risk impact the community?	Yes No	___ 2	0 2
Environmental Impacts	Are there significant short-term risks to the environment to be addressed? (if no, go to next factor)	Yes No	___ 4	0 4
	Are the available mitigative measures reliable to minimize potential impacts?	Yes No	___ ___	3 0
Time to implement remedy	What is the time required to implement the remedy?	<2 yrs. >2 yrs.	1 ___	1 0
	Required duration of the mitigative effort to control short-term risk.	<2 yrs. >2 yrs.	1 ___	1 0
Total Score		9		

Worksheet 4
Long-Term Effectiveness and Permanence

Alternative 3S Ex-situ Bioremediation

Analysis Factor	Basis	Score		
Treatment method	On-site treatment		3	3
	Off-site treatment			1
	Off-site land disposal			0
Permanence of the remedial alternative	Will the remedy be classified as permanent?	Yes	3	3
		No		0
Lifetime of remedial action(s).	Duration of the effectiveness of remedy	25-30 yr.	3	3
		20-25 yr.		2
		15-20 yr.		1
		<15 yr.		0
Quantity and nature of waste or residual left at the site after remediation.	Quantity of untreated waste left on-site.	None		3
		< 25%	2	2
		25-50%		1
		> 50%		0
	Is there treated residual left at the site? (if no, go to next factor)	Yes	0	0
		No		2
	Is the treated residual toxic?	Yes		0
		No	1	1
	Is the treated residual mobile?	Yes		0
		No	1	1
Adequacy and reliability of controls.	Operation and maintenance requirements.	< 5 yr.	1	1
		> 5 yr.		0
	Are environmental controls required as a part of the remedy?	Yes	0	0
		No		1
	Degree of confidence that controls can adequately handle potential problems (if applicable)	High	1	1
		Low		0
	Relative degree of long-term monitoring required.	Minimal	2	2
		Moderate		1
		Extensive		0
Total Score		17		

Worksheet 5
Reduction of Toxicity, Mobility, or Volume

Alternative 3S Ex-situ Bioremediation

Analysis Factor	Basis	Score		
Volume of waste reduced	Quantity of waste destroyed or treated	99-100%	____	8
		90-99%	7	7
		80-89%	____	6
		60-79%	____	4
		40-59%	____	2
		20-39%	____	1
		< 20%	____	0
	Are there untreated or concentrated wastes produced as a result of treatment?	Yes	0	0
		No	____	2
	After remediation, how is the untreated or residual waste disposed of?	Off-site disposal	____	0
		on-site disposal	1	1
		Off-site treatment	____	2
Reduction in mobility (if applicable)	Quantity of waste immobilized after treatment.	90-100%	2	2
		60-89%	____	1
		< 60%	____	0
	Method of immobilization	Contain-ment	____	0
		Treat-ment	3	3
Irreversibility of remedy	Completely irreversible		5	5
	Irreversible for most constituents		____	3
	Irreversible for a few constituents		____	2
	Reversible for most constituents		____	0
Total Score		18		

Worksheet 6 Implementability		
Alternative 3S Ex-situ Bioremediation		
Analysis Factor	**Basis**	**Score**
Technical Feasibility		
Ability to construct	Not difficult/no uncertainties Somewhat difficult/no uncertainties Very difficult/significant uncertainties	____ 3 2 2 ____ 1
Reliability of technology	Very reliable Somewhat reliable	____ 3 2 2
Delays due to mechanical problems	Unlikely Somewhat likely	____ 2 1 1
Need for future remedial action	None anticipated Some action may be required	2 2 ____ 1
Administrative Feasibility		
Coordination with other agencies	Minimal coordination Coordination required is normal Extensive coordination	2 2 ____ 1 ____ 0
Availability of Services and Materials		
Availability of prospective technologies	Is the technology commercially available?	Yes 1 1 No ____ 0
	Will competitive bids be obtained?	Yes 1 1 No ____ 0
	Is the equipment/specialists readily available?	Yes 1 1 No ____ 0
Total Score		12

Worksheet 1
Compliance with Applicable or Relevant and Appropriate State Standards Criteria and Guidelines (SCGs)

Alternative 4S- Off-Site Treatment/Disposal

Analysis Factor	Basis	Score
Compliance with chemical-specific SCGs	Meets chemical specific SCGs, such as ground water standards.	Yes 4 4 No ___ 0
Compliance with action-specific SCGs	Meets SCGs, such as technology standards for incineration.	Yes 3 3 No ___ 0
Compliance with location-specific SCGs	Meets location-specific SCGs, such as Freshwater Wetlands Act.	Yes 3 3 No ___ 0
Total Score		10

Worksheet 2
Protection of Human Health
and the Environment

Alternative 4S- Off-Site Treatment/Disposal

Analysis Factor	Basis	Score		
Use of site after remediation.	Unrestricted use of the land and water (if yes go to end).	Yes No	____ 0	20 0
Human health and the environment after remediation	Is the exposure to contaminants via air route acceptable?	Yes No	3 ____	3 0
	Is the exposure to contaminants via groundwater/surface water acceptable?	Yes No	4 ____	4 0
	Is the exposure to contaminants via sediments/soils acceptable?	Yes No	3 ____	3 0
Magnitude of residual public health risks after remediation.	Health risk	≤1E-6 ≤1E-5	5 ____	5 2
Magnitude of residual environmental risks after remediation.	Acceptable		5	5
	Slightly less than acceptable		____	3
	Significant risk still exists		____	0
Total Score			20	

Worksheet 3
Short-Term Effectiveness

Alternative 4S- Off-Site Treatment/Disposal

Analysis Factor	Basis	Score		
Protection of community during remedial action.	Are there significant short-term risks to the community that must be addressed? (if no go to next factor)	Yes No	0 ___	0 4
	Can the risk be easily controlled?	Yes No	1 ___	1 0
	Does the mitigative effort to control risk impact the community?	Yes No	___ 2	0 2
Environmental Impacts	Are there significant short-term risks to the environment to be addressed? (if no, go to next factor)	Yes No	___ 4	0 4
	Are the available mitigative measures reliable to minimize potential impacts?	Yes No	___ ___	3 0
Time to implement remedy	What is the time required to implement the remedy?	<2 yrs. >2 yrs.	1 ___	1 0
	Required duration of the mitigative effort to control short-term risk.	<2 yrs. >2 yrs.	1 ___	1 0
Total Score		9		

Worksheet 4
Long-Term Effectiveness and Permanence

Alternative 4S- Off-Site Treatment/Disposal

Analysis Factor	Basis	Score		
Treatment method	On-site treatment			3
	Off-site treatment		1	1
	Off-site land disposal			0
Permanence of the remedial alternative	Will the remedy be classified as permanent?	Yes	3	3
		No		0
Lifetime of remedial action(s).	Duration of the effectiveness of remedy	25-30 yr.	3	3
		20-25 yr.		2
		15-20 yr.		1
		<15 yr.		0
Quantity and nature of waste or residual left at the site after remediation.	Quantity of untreated waste left on-site.	None		3
		< 25%	2	2
		25-50%		1
		> 50%		0
	Is there treated residual left at the site? (if no, go to next factor)	Yes		0
		No	2	2
	Is the treated residual toxic?	Yes		0
		No		1
	Is the treated residual mobile?	Yes		0
		No		1
Adequacy and reliability of controls.	Operation and maintenance requirements.	< 5 yr.	1	1
		> 5 yr.		0
	Are environmental controls required as a part of the remedy?	Yes	0	0
		No		1
	Degree of confidence that controls can adequately handle potential problems (if applicable)	High	1	1
		Low		0
	Relative degree of long-term monitoring required.	Minimal	2	2
		Moderate		1
		Extensive		0
Total Score			15	

Worksheet 5
Reduction of Toxicity, Mobility, or Volume

Alternative 4S- Off-Site Treatment/Disposal

Analysis Factor	Basis	Score		
Volume of waste reduced	Quantity of waste destroyed or treated	99-100%		8
		90-99%		7
		80-89%		6
		60-79%		4
		40-59%		2
		20-39%		1
		< 20%	0	0
	Are there untreated or concentrated wastes produced as a result of treatment?	Yes	0	0
		No		2
	After remediation, how is the untreated or residual waste disposed of?	Off-site disposal	0	0
		on-site disposal		1
		Off-site treatment		2
Reduction in mobility (if applicable)	Quantity of waste immobilized after treatment.	90-100%	2	2
		60-89%		1
		< 60%		0
	Method of immobilization	Containment		0
		Treatment	3	3
Irreversibility of remedy	Completely irreversible		5	5
	Irreversible for most constituents			3
	Irreversible for a few constituents			2
	Reversible for most constituents			0
Total Score		10		

Worksheet 6 Implementability		
Alternative 4S- Off-Site Treatment/Disposal		
Analysis Factor	**Basis**	**Score**
Technical Feasibility		
Ability to construct	Not difficult/no uncertainties Somewhat difficult/no uncertainties Very difficult/significant uncertainties	____ 3 2 2 ____ 1
Reliability of technology	Very reliable Somewhat reliable	3 3 ____ 2
Delays due to mechanical problems	Unlikely Somewhat likely	____ 2 1 1
Need for future remedial action	None anticipated Some action may be required	2 2 ____ 1
Administrative Feasibility		
Coordination with other agencies	Minimal coordination Coordination required is normal Extensive coordination	____ 2 ____ 1 0 0
Availability of Services and Materials		
Availability of prospective technologies	Is the technology commercially available?	Yes 1 1 No ____ 0
	Will competitive bids be obtained?	Yes 1 1 No ____ 0
	Is the equipment/specialists readily available?	Yes 1 1 No ____ 0
Total Score		11

Worksheet 1
Compliance with Applicable or Relevant and Appropriate State Standards Criteria and Guidelines (SCGs)

Alternative 5S Ex-situ Vapor Extraction

Analysis Factor	Basis	Score
Compliance with chemical-specific SCGs	Meets chemical specific SCGs, such as ground water standards.	Yes 4 4 No 0
Compliance with action-specific SCGs	Meets SCGs, such as technology standards for incineration.	Yes 3 3 No 0
Compliance with location-specific SCGs	Meets location-specific SCGs, such as Freshwater Wetlands Act.	Yes 3 3 No 0
Total Score		10

Worksheet 2
Protection of Human Health
and the Environment

Alternative 5S Ex-situ Vapor Extraction

Analysis Factor	Basis	Score		
Use of site after remediation.	Unrestricted use of the land and water (if yes go to end).	Yes No	____ 0	20 0
Human health and the environment after remediation	Is the exposure to contaminants via air route acceptable?	Yes No	3 ____	3 0
	Is the exposure to contaminants via groundwater/surface water acceptable?	Yes No	4 ____	4 0
	Is the exposure to contaminants via sediments/soils acceptable?	Yes No	3 ____	3 0
Magnitude of residual public health risks after remediation.	Health risk	≤1E-6 ≤1E-5	5 ____	5 2
Magnitude of residual environmental risks after remediation.	Acceptable		5	5
	Slightly less than acceptable		____	3
	Significant risk still exists		____	0
Total Score			20	

Worksheet 3
Short-Term Effectiveness

Alternative 5S Ex-situ Vapor Extraction

Analysis Factor	Basis	Score		
Protection of community during remedial action.	Are there significant short-term risks to the community that must be addressed? (if no go to next factor)	Yes No	0 ____	0 4
	Can the risk be easily controlled?	Yes No	1 ____	1 0
	Does the mitigative effort to control risk impact the community?	Yes No	____ 2	0 2
Environmental Impacts	Are there significant short-term risks to the environment to be addressed? (if no, go to next factor)	Yes No	____ 4	0 4
	Are the available mitigative measures reliable to minimize potential impacts?	Yes No	____ ____	3 0
Time to implement remedy	What is the time required to implement the remedy?	<2 yrs. >2 yrs.	1 ____	1 0
	Required duration of the mitigative effort to control short-term risk.	<2 yrs. >2 yrs.	1 ____	1 0
Total Score			9	

Worksheet 4
Long-Term Effectiveness and Permanence

Alternative 5S Ex-situ Vapor Extraction

Analysis Factor	Basis	Score		
Treatment method	On-site treatment Off-site treatment Off-site land disposal		3 	3 1 0
Permanence of the remedial alternative	Will the remedy be classified as permanent?	Yes No	3 	3 0
Lifetime of remedial action(s).	Duration of the effectiveness of remedy	25-30 yr. 20-25 yr. 15-20 yr. <15 yr.	3 	3 2 1 0
Quantity and nature of waste or residual left at the site after remediation.	Quantity of untreated waste left on-site.	None < 25% 25-50% > 50%	 2 	3 2 1 0
	Is there treated residual left at the site? (if no, go to next factor)	Yes No	0 	0 2
	Is the treated residual toxic?	Yes No	 1	0 1
	Is the treated residual mobile?	Yes No	 1	0 1
Adequacy and reliability of controls.	Operation and maintenance requirements.	< 5 yr. > 5 yr.	1 	1 0
	Are environmental controls required as a part of the remedy?	Yes No	0 	0 1
	Degree of confidence that controls can adequately handle potential problems (if applicable)	High Low	1 	1 0
	Relative degree of long-term monitoring required.	Minimal Moderate Extensive	2 	2 1 0
Total Score		17		

Worksheet 5
Reduction of Toxicity, Mobility, or Volume

Alternative 5S Ex-situ Vapor Extraction

Analysis Factor	Basis	Score		
Volume of waste reduced	Quantity of waste destroyed or treated	99-100%	____	8
		90-99%	7	7
		80-89%	____	6
		60-79%	____	4
		40-59%	____	2
		20-39%	____	1
		< 20%	____	0
	Are there untreated or concentrated wastes produced as a result of treatment?	Yes	0	0
		No	____	2
	After remediation, how is the untreated or residual waste disposed of?	Off-site disposal	____	0
		on-site disposal	1	1
		Off-site treatment	____	2
Reduction in mobility (if applicable)	Quantity of waste immobilized after treatment.	90-100%	2	2
		60-89%	____	1
		< 60%	____	0
	Method of immobilization	Containment	____	0
		Treatment	3	3
Irreversibility of remedy	Completely irreversible		5	5
	Irreversible for most constituents		____	3
	Irreversible for a few constituents		____	2
	Reversible for most constituents		____	0
Total Score		18		

Worksheet 1
Compliance with Applicable or Relevant and Appropriate State Standards Criteria and Guidelines (SCGs)

Alternative 1G- No Action

Analysis Factor	Basis	Score		
Compliance with chemical-specific SCGs	Meets chemical specific SCGs, such as ground water standards.	Yes No	 0	4 0
Compliance with action-specific SCGs	Meets SCGs, such as technology standards for incineration.	Yes No	3 	3 0
Compliance with location-specific SCGs	Meets location-specific SCGs, such as Freshwater Wetlands Act.	Yes No	3 	3 0
Total Score			6	

Worksheet 2 Protection of Human Health and the Environment		
Alternative 1G- No Action		
Analysis Factor	**Basis**	**Score**
Use of site after remediation.	Unrestricted use of the land and water (if yes go to end).	Yes ____ 20 No __0__ 0
Human health and the environment after remediation	Is the exposure to contaminants via air route acceptable?	Yes __3__ 3 No ____ 0
	Is the exposure to contaminants via groundwater/surface water acceptable?	Yes ____ 4 No __0__ 0
	Is the exposure to contaminants via sediments/soils acceptable?	Yes ____ 3 No __0__ 0
Magnitude of residual public health risks after remediation.	Health risk	≤1E-6 ____ 5 ≤1E-5 __2__ 2
Magnitude of residual environmental risks after remediation.	Acceptable	____ 5
	Slightly less than acceptable	____ 3
	Significant risk still exists	__0__ 0
Total Score		5

Worksheet 3
Short-Term Effectiveness

Alternative <u>1G- No Action</u>

Analysis Factor	Basis	Score		
Protection of community during remedial action.	Are there significant short-term risks to the community that must be addressed? (if no go to next factor)	Yes No	 4	0 4
	Can the risk be easily controlled?	Yes No		1 0
	Does the mitigative effort to control risk impact the community?	Yes No		0 2
Environmental Impacts	Are there significant short-term risks to the environment to be addressed? (if no, go to next factor)	Yes No	 4	0 4
	Are the available mitigative measures reliable to minimize potential impacts?	Yes No		3 0
Time to implement remedy	What is the time required to implement the remedy?	<2 yrs. >2 yrs.	1 	1 0
	Required duration of the mitigative effort to control short-term risk.	<2 yrs. >2 yrs.	1 	1 0
Total Score		10		

Worksheet 4
Long-Term Effectiveness and Permanence

Alternative 1G- No Action

Analysis Factor	Basis	Score
Treatment method	On-site treatment Off-site treatment Off-site land disposal	____ 3 ____ 1 0 0
Permanence of the remedial alternative	Will the remedy be classified as permanent?	Yes ____ 3 No 0 0
Lifetime of remedial action(s).	Duration of the effectiveness of remedy	25-30 yr. ____ 3 20-25 yr. ____ 2 15-20 yr. ____ 1 <15 yr. 0 0
Quantity and nature of waste or residual left at the site after remediation.	Quantity of untreated waste left on-site.	None ____ 3 < 25% ____ 2 25-50% ____ 1 > 50% 0 0
	Is there treated residual left at the site? (if no, go to next factor)	Yes ____ 0 No 2 2
	Is the treated residual toxic?	Yes ____ 0 No ____ 1
	Is the treated residual mobile?	Yes ____ 0 No ____ 1
Adequacy and reliability of controls.	Operation and maintenance requirements.	< 5 yr. 1 1 > 5 yr. ____ 0
	Are environmental controls required as a part of the remedy?	Yes 1 0 No ____ 1
	Degree of confidence that controls can adequately handle potential problems (if applicable)	High ____ 1 Low 0 0
	Relative degree of long-term monitoring required.	Minimal 2 2 Moderate ____ 1 Extensive ____ 0
Total Score		6

Worksheet 5 Reduction of Toxicity, Mobility, or Volume		
Alternative 1G- No Action		
Analysis Factor	**Basis**	**Score**
Volume of waste reduced	Quantity of waste destroyed or treated	99-100% ____ 8 90-99% ____ 7 80-89% ____ 6 60-79% ____ 4 40-59% ____ 2 20-39% ____ 1 < 20% __0__ 0
	Are there untreated or concentrated wastes produced as a result of treatment?	Yes ____ 0 No ____ 2 N/A
	After remediation, how is the untreated or residual waste disposed of?	Off-site disposal ____ 0 on-site disposal ____ 1 Off-site treatment ____ 2
Reduction in mobility (if applicable)	Quantity of waste immobilized after treatment.	90-100% ____ 2 60-89% ____ 1 < 60% __0__ 0
	Method of immobilization	Contain-ment ____ 0 Treat-ment ____ 3
Irreversibility of remedy	Completely irreversible Irreversible for most constituents Irreversible for a few constituents Reversible for most constituents	____ 5 ____ 3 ____ 2 __0__ 0
Total Score		0

Worksheet 6
Implementability

Alternative 1G- No Action

Analysis Factor	Basis	Score	
Technical Feasibility			
Ability to construct	Not difficult/no uncertainties	3	3
	Somewhat difficult/no uncertainties		2
	Very difficult/significant uncertainties		1
Reliability of technology	Very reliable		3
	Somewhat reliable	N/A	2
Delays due to mechanical problems	Unlikely	2	2
	Somewhat likely		1
Need for future remedial action	None anticipated		2
	Some action may be required	1	1
Administrative Feasibility			
Coordination with other agencies	Minimal coordination		2
	Coordination required is normal	1	1
	Extensive coordination		0
Availability of Services and Materials			
Availability of prospective technologies	Is the technology commercially available?	Yes 1	1
		No	0
	Will competitive bids be obtained?	Yes	1
		No	0
	Is the equipment/specialists readily available?	Yes	1
		No	0
Total Score		8	

Worksheet 1
Compliance with Applicable or Relevant and Appropriate
State Standards Criteria and Guidelines (SCGs)

Alternative 2G- Air Stripping

Analysis Factor	Basis	Score
Compliance with chemical-specific SCGs	Meets chemical specific SCGs, such as ground water standards.	Yes 4 4 No ___ 0
Compliance with action-specific SCGs	Meets SCGs, such as technology standards for incineration.	Yes 3 3 No ___ 0
Compliance with location-specific SCGs	Meets location-specific SCGs, such as Freshwater Wetlands Act.	Yes 3 3 No ___ 0
Total Score		10

Worksheet 2
Protection of Human Health
and the Environment

Alternative 2G- Air Stripping

Analysis Factor	Basis	Score		
Use of site after remediation.	Unrestricted use of the land and water (if yes go to end).	Yes		20
		No	0	0
Human health and the environment after remediation	Is the exposure to contaminants via air route acceptable?	Yes	3	3
		No		0
	Is the exposure to contaminants via groundwater/surface water acceptable?	Yes	4	4
		No		0
	Is the exposure to contaminants via sediments/soils acceptable?	Yes	3	3
		No		0
Magnitude of residual public health risks after remediation.	Health risk	≤1E-6	5	5
		≤1E-5		2
Magnitude of residual environmental risks after remediation.	Acceptable		5	5
	Slightly less than acceptable			3
	Significant risk still exists			0
Total Score			20	

Worksheet 3
Short-Term Effectiveness

Alternative 2G- Air Stripping

Analysis Factor	Basis	Score		
Protection of community during remedial action.	Are there significant short-term risks to the community that must be addressed? (if no go to next factor)	Yes No	0 ____	0 4
	Can the risk be easily controlled?	Yes No	1 ____	1 0
	Does the mitigative effort to control risk impact the community?	Yes No	____ 2	0 2
Environmental Impacts	Are there significant short-term risks to the environment to be addressed? (if no, go to next factor)	Yes No	____ 4	0 4
	Are the available mitigative measures reliable to minimize potential impacts?	Yes No	____ ____	3 0
Time to implement remedy	What is the time required to implement the remedy?	<2 yrs. >2 yrs.	____ 0	1 0
	Required duration of the mitigative effort to control short-term risk.	<2 yrs. >2 yrs.	1 ____	1 0
Total Score			8	

Worksheet 4
Long-Term Effectiveness and Permanence

Alternative 2G- Air Stripping

Analysis Factor	Basis	Score		
Treatment method	On-site treatment		3	3
	Off-site treatment			1
	Off-site land disposal			0
Permanence of the remedial alternative	Will the remedy be classified as permanent?	Yes	3	3
		No		0
Lifetime of remedial action(s).	Duration of the effectiveness of remedy	25-30 yr.	3	3
		20-25 yr.		2
		15-20 yr.		1
		<15 yr.		0
Quantity and nature of waste or residual left at the site after remediation.	Quantity of untreated waste left on-site.	None		3
		< 25%	2	2
		25-50%		1
		> 50%		0
	Is there treated residual left at the site? (if no, go to next factor)	Yes		0
		No	2	2
	Is the treated residual toxic?	Yes		0
		No		1
	Is the treated residual mobile?	Yes		0
		No		1
Adequacy and reliability of controls.	Operation and maintenance requirements.	< 5 yr.		1
		> 5 yr.	0	0
	Are environmental controls required as a part of the remedy?	Yes	0	0
		No		1
	Degree of confidence that controls can adequately handle potential problems (if applicable)	High	1	1
		Low		0
	Relative degree of long-term monitoring required.	Minimal		2
		Moderate	1	1
		Extensive		0
Total Score			15	

Worksheet 5
Reduction of Toxicity, Mobility, or Volume

Alternative 2G- Air Stripping

Analysis Factor	Basis	Score		
Volume of waste reduced	Quantity of waste destroyed or treated	99-100%	8	8
		90-99%		7
		80-89%		6
		60-79%		4
		40-59%		2
		20-39%		1
		< 20%		0
	Are there untreated or concentrated wastes produced as a result of treatment?	Yes	0	0
		No		2
	After remediation, how is the untreated or residual waste disposed of?	Off-site disposal		0
		on-site disposal		1
		Off-site treatment	2	2
Reduction in mobility (if applicable)	Quantity of waste immobilized after treatment.	90-100%	2	2
		60-89%		1
		< 60%		0
	Method of immobilization	Containment		0
		Treatment	3	3
Irreversibility of remedy	Completely irreversible		5	5
	Irreversible for most constituents			3
	Irreversible for a few constituents			2
	Reversible for most constituents			0
Total Score			20	

Worksheet 6
Implementability

Alternative 2G- Air Stripping

Analysis Factor	Basis	Score	
Technical Feasibility			
Ability to construct	Not difficult/no uncertainties	3	3
	Somewhat difficult/no uncertainties		2
	Very difficult/significant uncertainties		1
Reliability of technology	Very reliable	3	3
	Somewhat reliable		2
Delays due to mechanical problems	Unlikely		2
	Somewhat likely	1	1
Need for future remedial action	None anticipated	2	2
	Some action may be required		1
Administrative Feasibility			
Coordination with other agencies	Minimal coordination		2
	Coordination required is normal	1	1
	Extensive coordination		0
Availability of Services and Materials			
Availability of prospective technologies	Is the technology commercially available?	Yes 1	1
		No	0
	Will competitive bids be obtained?	Yes 1	1
		No	0
	Is the equipment/specialists readily available?	Yes 1	1
		No	0
Total Score		13	

Worksheet 1
Compliance with Applicable or Relevant and Appropriate State Standards Criteria and Guidelines (SCGs)

Alternative 3G- Carbon Adsorption

Analysis Factor	Basis	Score
Compliance with chemical-specific SCGs	Meets chemical specific SCGs, such as ground water standards.	Yes 4 4 No ___ 0
Compliance with action-specific SCGs	Meets SCGs, such as technology standards for incineration.	Yes 3 3 No ___ 0
Compliance with location-specific SCGs	Meets location-specific SCGs, such as Freshwater Wetlands Act.	Yes 3 3 No ___ 0
Total Score		10

Worksheet 2 Protection of Human Health and the Environment		
Alternative 3G- Carbon Adsorption		
Analysis Factor	**Basis**	**Score**
Use of site after remediation.	Unrestricted use of the land and water (if yes go to end).	Yes ______ 20 No __0__ 0
Human health and the environment after remediation	Is the exposure to contaminants via air route acceptable?	Yes __3__ 3 No ______ 0
	Is the exposure to contaminants via groundwater/surface water acceptable?	Yes __4__ 4 No ______ 0
	Is the exposure to contaminants via sediments/soils acceptable?	Yes __3__ 3 No ______ 0
Magnitude of residual public health risks after remediation.	Health risk	≤1E-6 __5__ 5 ≤1E-5 ______ 2
Magnitude of residual environmental risks after remediation.	Acceptable	__5__ 5
	Slightly less than acceptable	______ 3
	Significant risk still exists	______ 0
Total Score		20

Worksheet 3 Short-Term Effectiveness		
Alternative 3G- Carbon Adsorption		
Analysis Factor	**Basis**	**Score**
Protection of community during remedial action.	Are there significant short-term risks to the community that must be addressed? (if no go to next factor)	Yes 0 — 0 No ___ — 4
	Can the risk be easily controlled?	Yes 1 — 1 No ___ — 0
	Does the mitigative effort to control risk impact the community?	Yes ___ — 0 No 2 — 2
Environmental Impacts	Are there significant short-term risks to the environment to be addressed? (if no, go to next factor)	Yes ___ — 0 No 4 — 4
	Are the available mitigative measures reliable to minimize potential impacts?	Yes ___ — 3 No ___ — 0
Time to implement remedy	What is the time required to implement the remedy?	<2 yrs. ___ — 1 >2 yrs. 0 — 0
	Required duration of the mitigative effort to control short-term risk.	<2 yrs. 1 — 1 >2 yrs. ___ — 0
Total Score		8

Worksheet 4
Long-Term Effectiveness and Permanence

Alternative 3G- Carbon Adsorption

Analysis Factor	Basis	Score		
Treatment method	On-site treatment		3	3
	Off-site treatment			1
	Off-site land disposal			0
Permanence of the remedial alternative	Will the remedy be classified as permanent?	Yes	3	3
		No		0
Lifetime of remedial action(s).	Duration of the effectiveness of remedy	25-30 yr.	3	3
		20-25 yr.		2
		15-20 yr.		1
		<15 yr.		0
Quantity and nature of waste or residual left at the site after remediation.	Quantity of untreated waste left on-site.	None		3
		< 25%	2	2
		25-50%		1
		> 50%		0
	Is there treated residual left at the site? (if no, go to next factor)	Yes		0
		No	2	2
	Is the treated residual toxic?	Yes		0
		No		1
	Is the treated residual mobile?	Yes		0
		No		1
Adequacy and reliability of controls.	Operation and maintenance requirements.	< 5 yr.		1
		> 5 yr.	0	0
	Are environmental controls required as a part of the remedy?	Yes	0	0
		No		1
	Degree of confidence that controls can adequately handle potential problems (if applicable)	High	1	1
		Low		0
	Relative degree of long-term monitoring required.	Minimal		2
		Moderate	1	1
		Extensive		0
Total Score		15		

Worksheet 5 Reduction of Toxicity, Mobility, or Volume		
Alternative 3G- Carbon Adsorption		
Analysis Factor	**Basis**	**Score**
Volume of waste reduced	Quantity of waste destroyed or treated	99-100% __8__ 8 90-99% ____ 7 80-89% ____ 6 60-79% ____ 4 40-59% ____ 2 20-39% ____ 1 < 20% ____ 0
	Are there untreated or concentrated wastes produced as a result of treatment?	Yes __0__ 0 No ____ 2
	After remediation, how is the untreated or residual waste disposed of?	Off-site disposal __0__ 0 on-site disposal ____ 1 Off-site treatment ____ 2
Reduction in mobility (if applicable)	Quantity of waste immobilized after treatment.	90-100% __2__ 2 60-89% ____ 1 < 60% ____ 0
	Method of immobilization	Contain-ment ____ 0 Treat-ment __3__ 3
Irreversibility of remedy	Completely irreversible Irreversible for most constituents Irreversible for a few constituents Reversible for most constituents	____ 5 __3__ 3 ____ 2 ____ 0
Total Score		16

Worksheet 6
Implementability

Alternative 3G- Carbon Adsorption

Analysis Factor	Basis	Score
Technical Feasibility		
Ability to construct	Not difficult/no uncertainties Somewhat difficult/no uncertainties Very difficult/significant uncertainties	____ 3 2 2 ____ 1
Reliability of technology	Very reliable Somewhat reliable	____ 3 2 2
Delays due to mechanical problems	Unlikely Somewhat likely	____ 2 1 1
Need for future remedial action	None anticipated Some action may be required	2 2 ____ 1
Administrative Feasibility		
Coordination with other agencies	Minimal coordination Coordination required is normal Extensive coordination	____ 2 1 1 ____ 0
Availability of Services and Materials		
Availability of prospective technologies	Is the technology commercially available?	Yes 1 1 No ____ 0
	Will competitive bids be obtained?	Yes 1 1 No ____ 0
	Is the equipment/specialists readily available?	Yes 1 1 No ____ 0
Total Score		11

Worksheet 1 Compliance with Applicable or Relevant and Appropriate State Standards Criteria and Guidelines (SCGs)		
Alternative 4G- Off-site Treatment		
Analysis Factor	Basis	Score
Compliance with chemical-specific SCGs	Meets chemical specific SCGs, such as ground water standards.	Yes __4__ 4 No _____ 0
Compliance with action-specific SCGs	Meets SCGs, such as technology standards for incineration.	Yes __3__ 3 No _____ 0
Compliance with location-specific SCGs	Meets location-specific SCGs, such as Freshwater Wetlands Act.	Yes __3__ 3 No _____ 0
Total Score		10

Worksheet 2
Protection of Human Health and the Environment

Alternative 4G- Off-site Treatment

Analysis Factor	Basis	Score		
Use of site after remediation.	Unrestricted use of the land and water (if yes go to end).	Yes	____	20
		No	0	0
Human health and the environment after remediation	Is the exposure to contaminants via air route acceptable?	Yes	3	3
		No	____	0
	Is the exposure to contaminants via groundwater/surface water acceptable?	Yes	4	4
		No	____	0
	Is the exposure to contaminants via sediments/soils acceptable?	Yes	3	3
		No	____	0
Magnitude of residual public health risks after remediation.	Health risk	≤1E-6	5	5
		≤1E-5	____	2
Magnitude of residual environmental risks after remediation.	Acceptable		5	5
	Slightly less than acceptable		____	3
	Significant risk still exists		____	0
Total Score			20	

Worksheet 3
Short-Term Effectiveness

Alternative 4G- Off-site Treatment

Analysis Factor	Basis	Score		
Protection of community during remedial action.	Are there significant short-term risks to the community that must be addressed? (if no go to next factor)	Yes No	0 	0 4
	Can the risk be easily controlled?	Yes No	1 	1 0
	Does the mitigative effort to control risk impact the community?	Yes No	 2	0 2
Environmental Impacts	Are there significant short-term risks to the environment to be addressed? (if no., go to next factor)	Yes No	 4	0 4
	Are the available mitigative measures reliable to minimize potential impacts?	Yes No		3 0
Time to implement remedy	What is the time required to implement the remedy?	<2 yrs. >2 yrs.	 0	1 0
	Required duration of the mitigative effort to control short-term risk.	<2 yrs. >2 yrs.	1 	1 0
Total Score		8		

Worksheet 4
Long-Term Effectiveness and Permanence

Alternative 4G- Off-site Treatment

Analysis Factor	Basis		Score	
Treatment method	On-site treatment			3
	Off-site treatment		1	1
	Off-site land disposal			0
Permanence of the remedial alternative	Will the remedy be classified as permanent?	Yes	3	3
		No		0
Lifetime of remedial action(s).	Duration of the effectiveness of remedy	25-30 yr.		3
		20-25 yr.	2	2
		15-20 yr.		1
		<15 yr.		0
Quantity and nature of waste or residual left at the site after remediation.	Quantity of untreated waste left on-site.	None		3
		< 25%	2	2
		25-50%		1
		> 50%		0
	Is there treated residual left at the site? (if no, go to next factor)	Yes		0
		No	2	2
	Is the treated residual toxic?	Yes		0
		No		1
	Is the treated residual mobile?	Yes		0
		No		1
Adequacy and reliability of controls.	Operation and maintenance requirements.	< 5 yr.		1
		> 5 yr.	0	0
	Are environmental controls required as a part of the remedy?	Yes	0	0
		No		1
	Degree of confidence that controls can adequately handle potential problems (if applicable)	High	1	1
		Low		0
	Relative degree of long-term monitoring required.	Minimal		2
		Moderate	1	1
		Extensive		0
Total Score			10	

Worksheet 5
Reduction of Toxicity, Mobility, or Volume

Alternative 4G- Off-site Treatment

Analysis Factor	Basis	Score		
Volume of waste reduced	Quantity of waste destroyed or treated	99-100%	8	8
		90-99%		7
		80-89%		6
		60-79%		4
		40-59%		2
		20-39%		1
		< 20%		0
	Are there untreated or concentrated wastes produced as a result of treatment?	Yes		0
		No	2	2
	After remediation, how is the untreated or residual waste disposed of?	Off-site disposal		0
		on-site disposal		1
		Off-site treatment		2
Reduction in mobility (if applicable)	Quantity of waste immobilized after treatment.	90-100%	2	2
		60-89%		1
		< 60%		0
	Method of immobilization	Contain-ment		0
		Treat-ment	3	3
Irreversibility of remedy	Completely irreversible			5
	Irreversible for most constituents		3	3
	Irreversible for a few constituents			2
	Reversible for most constituents			0
Total Score		18		

Worksheet 6
Implementability

Alternative 4G- Off-site Treatment

Analysis Factor	Basis	Score	
Technical Feasibility			
Ability to construct	Not difficult/no uncertainties	____	3
	Somewhat difficult/no uncertainties	2	2
	Very difficult/significant uncertainties	____	1
Reliability of technology	Very reliable	____	3
	Somewhat reliable	2	2
Delays due to mechanical problems	Unlikely	2	2
	Somewhat likely	____	1
Need for future remedial action	None anticipated	2	2
	Some action may be required	____	1
Administrative Feasibility			
Coordination with other agencies	Minimal coordination	____	2
	Coordination required is normal	1	1
	Extensive coordination	____	0
Availability of Services and Materials			
Availability of prospective technologies	Is the technology commercially available?	Yes 1	1
		No ____	0
	Will competitive bids be obtained?	Yes 1	1
		No ____	0
	Is the equipment/specialists readily available?	Yes 1	1
		No ____	0
Total Score		12	