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ENVIRONMENTAL RESTORATION PROGRAM

DRAFT FINAL
(REVISED)

FEASIBILITY STUDY REPORT

SITE 6

109th AIRLIFT WING
NEW YORK AIR NATIONAL GUARD
SCHENECTADY AIR NATIONAL GUARD BASE
SCOTIA, NEW YORK

NOVEMBER 2003

Prepared for
AIR NATIONAL GUARD READINESS CENTER
ANDREWS AFB, MARYLAND 20762-5157

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Prepared By

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LIST OF ACRONYMS

ANEPTEK	ANEPTEK Corporation
ANG	Air National Guard
ARNG	Army National Guard
AWQC	Ambient Water Quality Concentrations
AUL	Activity Use Limits
bgs	Below Ground Surface
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CEUR	Civil Engineering
COC	Contaminants of Concern
COPC	Contaminants of Potential Concern
COPEC	Contaminants of Potential Ecological Concern
DAF	Dilution Attenuation Factor
DD	Decision Document
DO	Dissolved Oxygen
DPE	Department of Defense and Liability Act
DWQS	Drinking Water Quality Standards
ERP	Environmental Restoration Program
FS	Feasibility Study
FTA	Fire Training Area
FW	Fighter Wing
GA	NYSDEC Groundwater Standards
GRA	General Response Action
HRC	Hydrogen Release Compound
IAG	Interagency Agreement
ERP	Installation Restoration Program
mg/Kg	Milligrams per Kilogram
mg/L	Milligrams per Liter
MNA	Monitored Natural Attenuation
NYANG	New York Air National Guard
NYCRR	New York Code
NYSDEC	New York State Department of Environmental Conservation
O&M	Operation and Maintenance
ORP	Oxidation/Reduction Potential
PA	Preliminary Assessment
PAH	Polycyclic Aromatic Hydrocarbons
PID	Photoionization Detector
POL	Petroleum Lubricant and Oil
PP13	Priority Pollutant 13 Metals
PRG	Preliminary Remedial Goals
RAO	Remedial Action Objective
RI	Remedial Investigation
SI	Site Investigation
SSG	Soil Screening Guidance
SSL	Soil Screening Levels

List of Acronyms (continued)

SVE	Soil Vapor Extraction
SVOC	Semi-Volatile Organic Compounds
TAGM	Technical and Administrative Guideline Memorandum
TOC	Total Organic Carbon
TPH	Total Petroleum Hydrocarbons
TSDF	Treatment Storage Disposal Facility
UCL	Upper Concentration Limits
µg/kg	Micrograms per Kilogram
µg/L	Micrograms per Liter
UST	Underground Storage Tank
VOC	Volatile Organic Compound
VPH	Volatile Petroleum Hydrocarbons

EXECUTIVE SUMMARY

This document presents the Feasibility Study prepared for the Air National Guard for Environmental Restoration Program Site 6, Suspected Spill Area, at the New York Air National Guard 109th Airlift Wing, Schenectady ANG Base, Scotia, New York. This Feasibility Study, prepared by ANEPTEK Corporation, was performed under Contract Number DAHA90-93-D-0003, Delivery Order 0014.

This Feasibility Study provides the documentation for the identification of remedial technologies, formulation of remedial alternatives, evaluation of remedial alternatives, and selection of the proposed remedial action alternatives at Site 6.

A Remedial Investigation was conducted in 1998 and 1999 to investigate contamination at Sites 2, 3 and 6 at the Schenectady Air National Guard Base.

The Remedial Investigation concluded that No Further Action was required at Site 2. The New York State Department of Environmental Conservation concurred that No Further Action was warranted at ERP Site 2. A Decision Document (DD) has been submitted for that site (ANEPTEK, 2001), and accepted by the New York State Department of Environmental Conservation.

The Remedial Investigation concluded that Site 3 and Site 6 should progress to the Feasibility Study phase. Site 6 was a previously unknown area until sample results from locations up-gradient of Site 3 indicated groundwater contamination migrating from these areas. Further investigation of these areas revealed contaminated soils and groundwater. This up-gradient area was subsequently identified as Site 6, Suspected Spill Area. Investigative measures at Site 6 were limited due to the fact that this area was investigated late in the Remedial Investigative program, hence certain data gaps remained which needed to be addressed before the Feasibility Study could be completed. A Supplemental Data Collection program was performed at Site 6 to address these data gaps. Recently, additional sources of contamination were discovered within Site 3. These sources consisted of two 55 gallon drums and numerous paint cans which were buried near the southern end of Site 3. Citing the need for additional investigative measures based on this new information, the Air National Guard decided to omit Site 3 from this Feasibility Study. Additional investigative measures will be conducted in the future under a separate contract. Therefore, this Feasibility Study will only address Site 6.

At Site 6, soil and groundwater contamination was found in excess of the New York State Department of Environmental Conservation cleanup standards. To limit further migration of soil contaminants to groundwater, a Time Critical Removal Action was performed by ANEPTEK in April of 2002. Approximately 173 cubic yards of soil was excavated from three locations, transported under manifest, and disposed of off-site by thermal incineration. Subsequently, a Supplemental Data Collection was conducted by ANEPTEK at Site 6 in June of 2002. The Supplemental Data Collection was performed at the 109th Airlift Wing to address data gaps identified after the completion of the Remedial Investigation and to facilitate the completion of a Feasibility Study. Results from the Supplemental Data Collection revealed additional areas of soil and groundwater contamination at Site 6. The proposed remedial alternative for Site 6 – Soil is excavation, treatment and disposal. The proposed remedial alternative for Site 6-groundwater is Enhanced Bioremediation and monitoring.

1.0 INTRODUCTION

The U.S. Department of Defense (DOD) has initiated a remediation program for evaluating suspected problems associated with past waste disposal and spill sites at DOD facilities. As part of this program, the Air National Guard (ANG/CEVR) has entered into an Interagency Agreement (IAG) with the U.S. Army, the U.S. Air Force, and the U.S. Environmental Protection Agency (EPA). The purpose of this agreement is to oversee the implementation of the Environmental Restoration Program (ERP) for the New York Air National Guard (NYANG). Under this agreement, the ANG/CEVR manages the ERP and related activities.

In accordance with the goals and objective of the ERP, ANEPTEK Corporation (ANEPTEK) has been tasked by the ANG/CEVR to perform a Feasibility Study (FS) for Site 6 at the Schenectady ANG Base (the Base), Scotia, New York. This was performed in conjunction with the ERP activities being conducted at the 109th Airlift Wing (AW), Schenectady ANG Base, Scotia, New York, under Contract Number DAHA90-93-D-0003, Delivery Order 0014. This study was performed in accordance with the Federal guidelines of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) as amended by the Superfund Amendments Reauthorization Act (SARA).

1.1 Purpose and Organization of Report

Three ERP Sites were evaluated under a Remedial Investigation (RI), performed by ANEPTEK (September 2000): Site 2, the Drum Storage Area; Site 3, the Drum Burial Area; and Site 6, the Suspected Spill Area. Based upon the results of the RI, the New York State Department of Environmental Conservation (NYSDEC) concurred that No Further Action was warranted at ERP Site 2 (NYSDEC, 2000). A Decision Document (DD) has been submitted and accepted by the NYSDEC for that site (ANEPTEK, 2001). The R I concluded that a FS should be conducted on Site 3 and Site 6.

The purpose of this FS is to develop, screen and evaluate the remedial alternatives that are potentially capable of meeting the Remedial Action Objectives (RAOs) identified for the sites. The first step in the FS process is to identify the RAOs and General Response Actions (GRAs). RAOs consist of medium or site-specific goals for protecting human health and the environment. GRAs are actions that satisfy the RAOs.

Following the identification of RAOs and GRAs, the next step in the FS process is to identify and screen remedial technologies. In this step, a large population of potentially applicable technology types and process options are reduced by evaluating options with respect to technical implementability. The retained technologies are then combined to form remedial alternatives capable of meeting the RAOs applicable to each media type. These remedial alternatives are screened based on effectiveness, implementability, and cost. The purpose of this screening is to reduce the number of alternatives that must undergo a more thorough evaluation during the detailed analysis step. The final step in the FS process is the detailed analysis of remedial alternatives retained in the preliminary screening. The remedial alternatives are evaluated against nine CERCLA criteria developed by the US Environmental Protection Agency (EPA). These criteria are (EPA, 1988):

- Overall protection of human health and the environment

- Compliance with Applicable or Relevant and Appropriate Requirements (ARARs)
- Long-term effectiveness and permanence
- Reduction of toxicity, mobility, or volume
- Short-term effectiveness
- Implementability
- Cost
- State acceptance
- Community acceptance

This report is presented in six Sections. Section 1.0 provides an introduction and background information associated with the ERP Sites. Identification and screening of remedial technologies is discussed in Section 2.0. Section 3.0 discusses the development of remedial alternatives, while Section 4.0 details the analysis of remedial alternatives. Section 5.0 provides the remedial alternative selection, and Section 6.0 presents references that were used for this report.

During the performance of this Feasibility Study, ANEPTEK followed the Federal requirements specified under CERCLA, as documented in the United States Environmental Protection Agency (EPA) publication, titled, "*Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA*", Interim Final, October 1988 (EPA 1988). Additional guidance for the development of remedial objectives (cleanup levels) was obtained from New York State Department of Environmental Conservation (NYSDEC) publications. Groundwater criteria were obtained from the NYSDEC, Technical and Operational Guidance Series (TOGS), entitled, "*Ambient Water Quality Standards and Guidance Values, and Groundwater Effluent Limitations*", June 1998 (NYSDEC 1998).

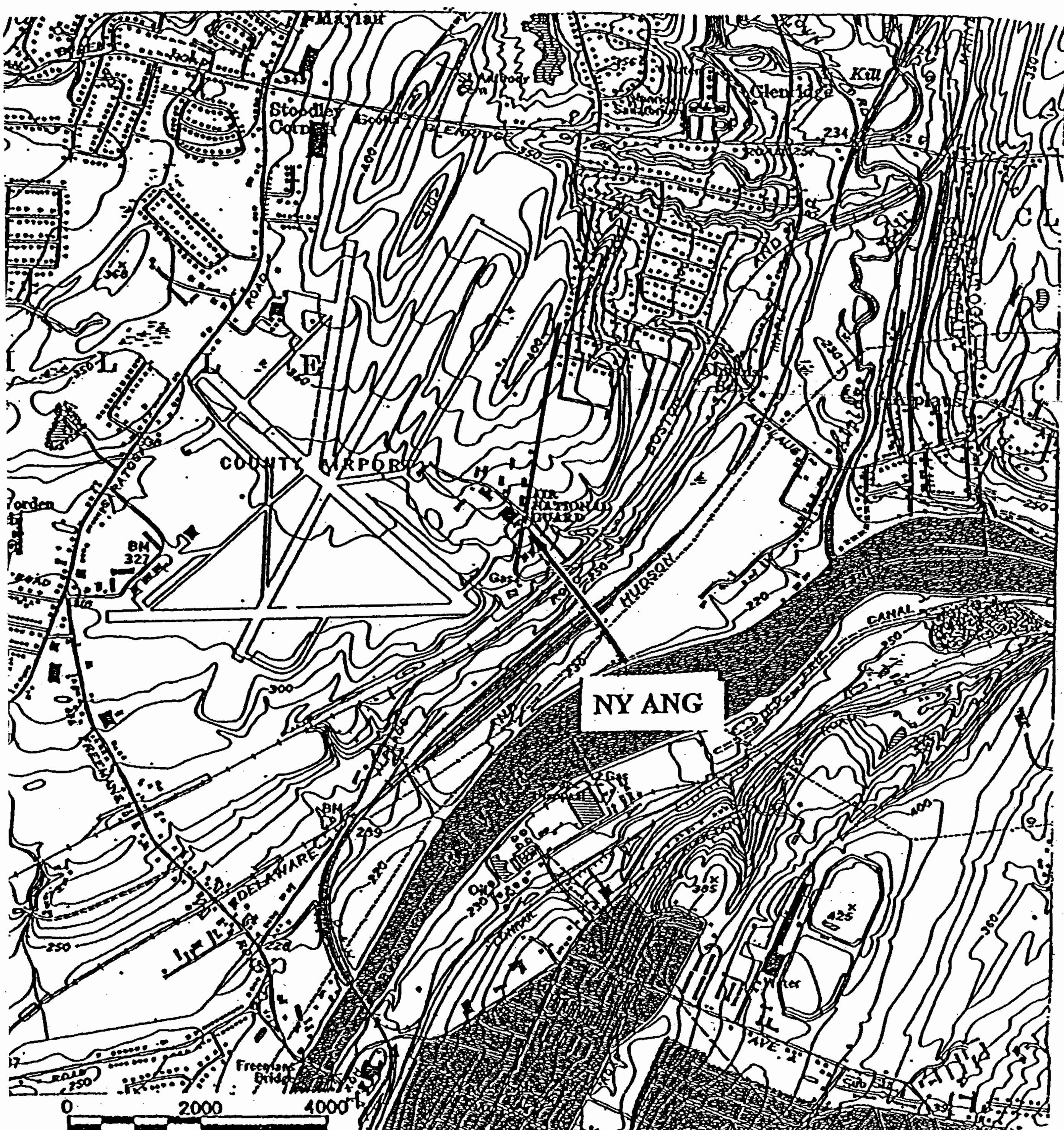
In the completion of this FS, the NYSDEC Drinking Water Quality Standards (DWQS) for the protection of a drinking water source were utilized. When a promulgated standard was not available, the corresponding guidance value was used. Soil contamination cleanup criteria were obtained from the NYSDEC, Technical and Administrative Guidance Memorandum (TAGM), entitled, *Determination of Soil Cleanup Objectives and Cleanup Levels*, January 1994 (NYSDEC 1994). Other soil criteria were obtained from *EPA Soil Screening Levels* (EPA 1996) and *Soil Screening Guidance* (EPA 1996). Development of remedial objectives was also facilitated by the risk assessments performed during the RI (ANEPTEK 2000), and the future use plans for the various sites anticipated by the ANG.

1.2 Background Information

1.2.1 Base Description and History

The 109th Airlift Wing is located on the eastern and southern portions of the Schenectady County Airport in Scotia, New York (Figure 1-1). The Base comprises approximately 106 acres (Figure 1-2). The land located to the north, east, and west of the Base is agricultural and residential.

South of the Base is the Mohawk River, a railway and commercial and residential properties. Prior to construction of the Base, the property was utilized as agricultural land. The Air National Guard authorized the formation of the 139th fighter squadron of the New York National Guard in November 1948. The unit was first located at the Scotia Naval Depot, which is about three miles to the west of the current base. By September of 1950, the permanent facilities for the unit were



Source: USGS Schenectady Quadrangle 7.5 Minute Series 1979 ABB Environmental Services

N	NEW YORK AIR NATIONAL GUARD BASE 109th AIRLIFT WING BASE LOCATION MAP SCOTIA, NEW YORK	ANEPTEK CORPORATION Analytic, Environmental and Process Technologies FIGURE: 1–1

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completed at the Schenectady County Airport. These facilities consisted of the present administration building, hangar, vehicle maintenance and various supply buildings.

Over the next fifty years, the Base operated an assortment of aircraft under numerous assignments. Aircraft operated from the Base included the P-47 Thunderbolt, T-6, B-26, C-47, P-51 Mustang, F-94 Starfire jets, the C-97A and C-97G Stratocruisers, and various models of the C-130 Hercules turboprop transports. In 1991, the unit's name changed to the 109th Airlift Wing and has since continued operations of the C-130H aircraft.

1.2.2 Previous Investigations/Remedial Actions

The following summarizes the investigative efforts and remedial actions performed at the Schenectady ANG Base. These investigative efforts included a Preliminary Assessment (PA), Site Investigation (SI), the RI, and a Supplemental Data Collection (SDC). The only remedial action conducted so far at Site 6 has been a Time Critical Removal Action (TCRA). Although ERP Site 6 is the only site currently evaluated for remedial alternatives, for historical clarity, this section also includes a brief summary of ERP activities at Sites 1 and 2. The locations of ERP Sites 1, 3, and 6 are shown in Figure 1-2.

1.2.2.1 Preliminary Assessment (PA)

A PA was performed at the Base by the U.S. Air Force Hazardous Materials Technology Center (HMTC) in 1988 (HMTC 1988). The PA included site visits, a review of existing environmental information, analysis of the Base records concerning the use and generation of hazardous materials/wastes, and Base personnel interviews. The PA identified two areas of concern: ERP Site 1, Former Fire Training Area; and ERP Site 2, Former Drum Storage Area.

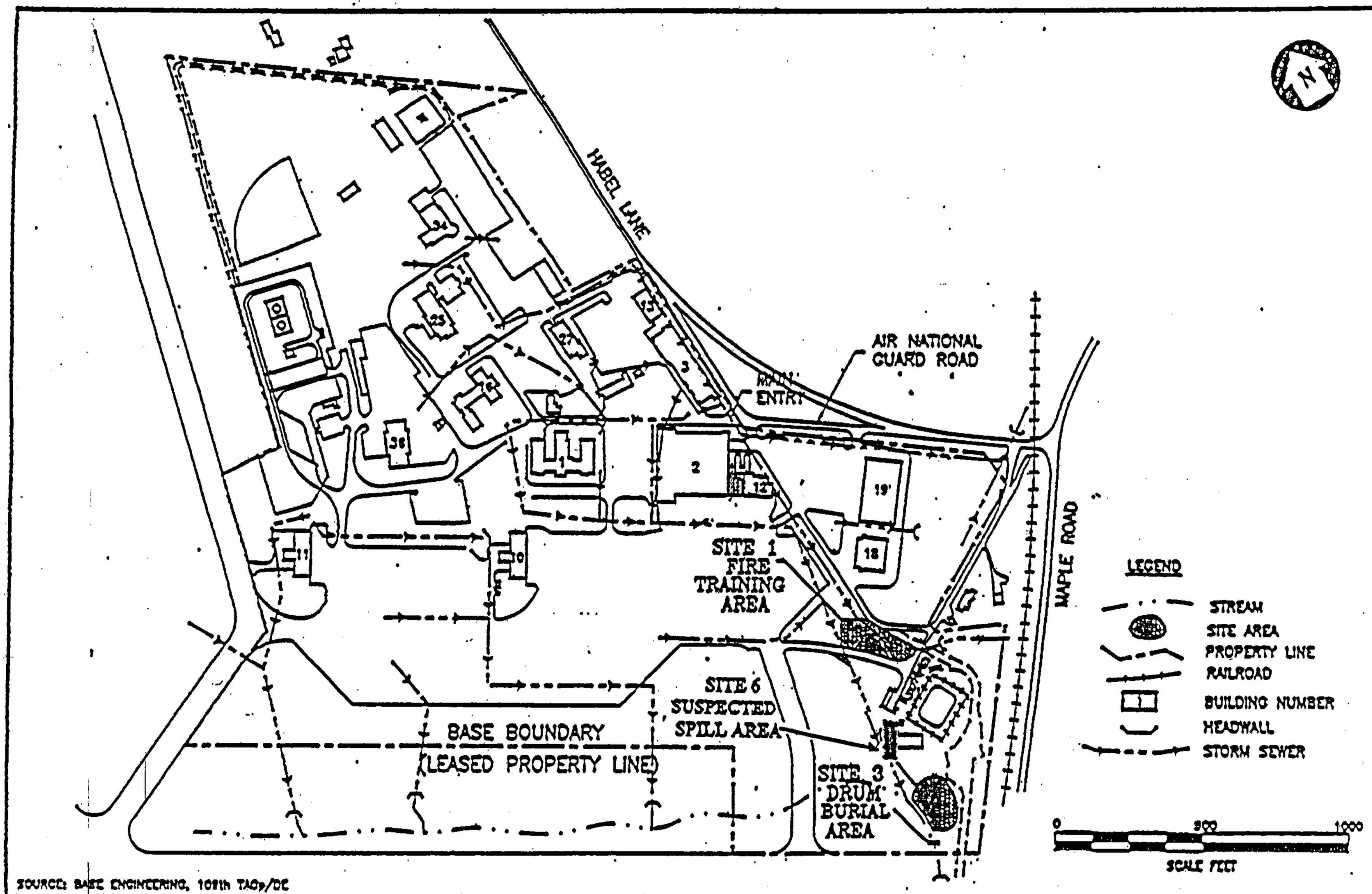
In April of 1990, a construction crew performing routine repairs to a gravel road located adjacent to the Base sewage treatment plant unearthed four metal drums. The drums, their contents and a small amount of associated soil were removed and the area was restored to its original grade. It was suspected that additional materials may have been buried at this location. Therefore, this area was identified as ERP Site 3 and included in the investigations conducted at the Base.

1.2.2.2 Site Investigation (SI)

An SI was completed at the Schenectady ANG Base, by ABB Environmental Services, Inc (ABB 1996). This investigation included ERP Sites 1, 2, and 3. The SI included geophysical surveys (magnetometer and ground penetrating radar), installation of groundwater monitoring wells, collection and analysis of surface soil and sediment samples, collection and analysis of surface water and groundwater samples, and aquifer testing. In the SI report, ABB recommended the delisting of ERP Sites 1 and 2, and further investigation of ERP Site 3. Although the NYSDEC agreed with the recommendation for ERP Site 1, it did not at that time concur with the delisting of ERP Site 2. Therefore, a follow-up RI was conducted for ERP Sites 2 and 3.

1.2.2.3 Remedial Investigation (RI)

In June of 1999, ANEPTEK completed the RI at the Schenectady ANG Base (ANEPTEK 2000). The RI initially included Sites 2 and 3. The RI field program was comprised of the installation of



NEW YORK AIR NATIONAL GUARD BASE

109th AIRLIFT WING

BASE MAP – ERP SITE LOCATIONS

SCOTIA, NEW YORK

ANEPTEK CORPORATION
Analytic, Environmental and Process Technologies

FIGURE: 1–2

C:\DRAW\SCHENECT\DISK1\BASE LOCATION

groundwater monitoring wells, in-situ aquifer testing and two rounds of groundwater sampling. The investigation at Site 3 also included the collection of soil and sediment samples, groundwater samples, and the excavation of 48 test pits to identify the type(s) and extent of buried debris and contamination. All samples were analyzed for volatile organic compounds, (VOCs), semi volatile organic compounds (SVOCs), Pesticides/Polychlorinated Biphenyl's (Pest/PCBs), herbicides, cyanide, propylene glycol, and metals.

During the early stages of the RI, chlorinated compounds were detected in the groundwater up gradient from Site 3. Later investigative efforts confirmed the earlier groundwater results, which led to the segregation of this up gradient location from Site 3, and its designation as Site 6.

The investigation at Site 6 consisted of the installation of both permanent and temporary groundwater monitoring wells, and two rounds of groundwater analysis. Additionally, 15 soil borings were performed at this site location. Soil from the borings was collected for chemical analysis. Based upon the results of the RI, and with concurrence from the ANG and NYSDEC, ANEPTEK recommended the delisting of ERP Site 2 and a follow-up Feasibility Study for ERP Sites 3 and 6.

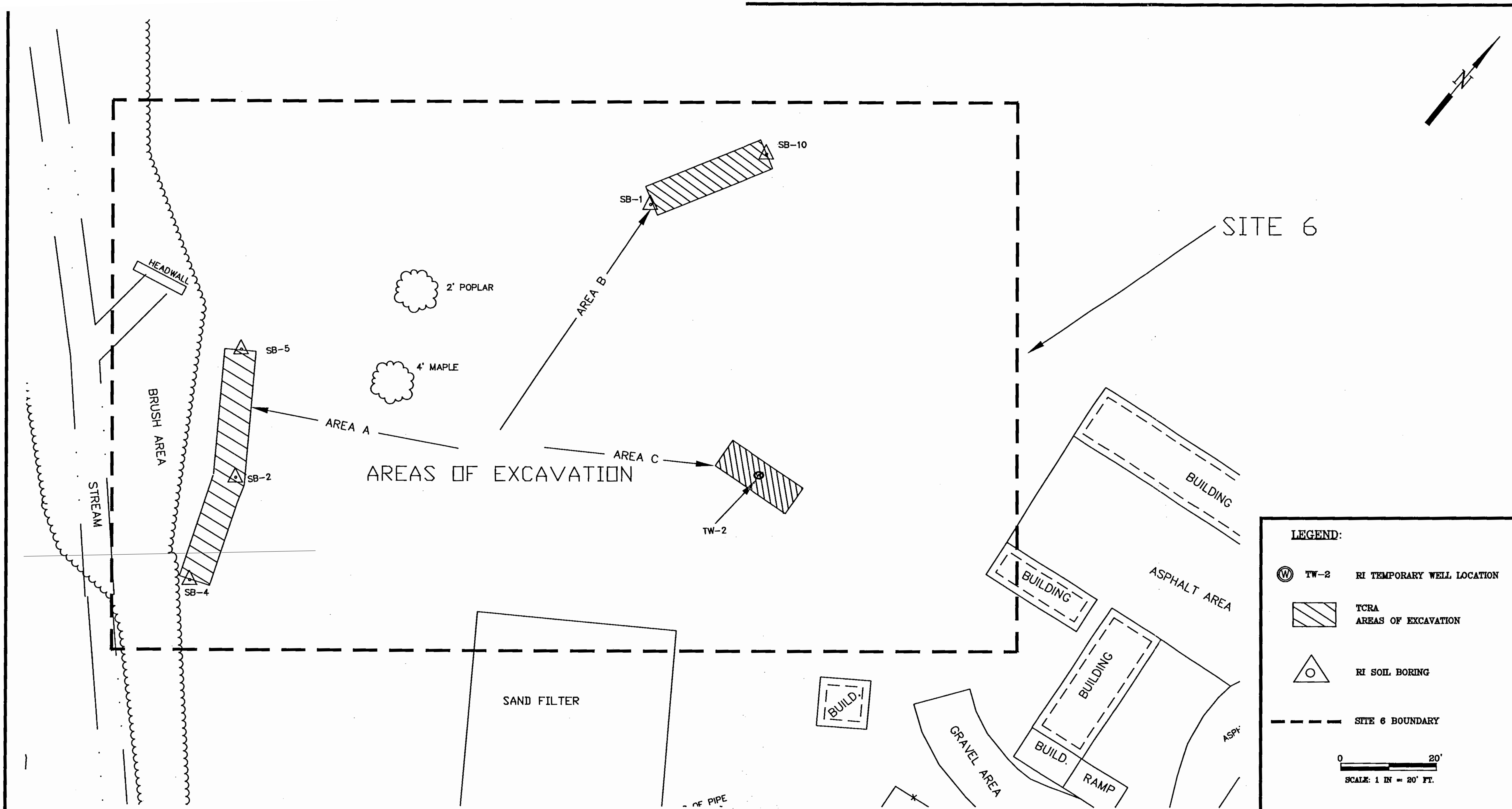
1.2.2.4 Time Critical Removal Action

Based on the results of the RI, three Areas of Concern (AOC), Areas A, B, and C, were identified. Excavation and off-site disposal were chosen as the remedial action (Draft Final FS, ANEPTEK, 2001). Aneptek was contracted by the ANG to conduct a TCRA at Site 6. The TCRA was conducted on April 22 to April 25, 2002 (TCRA Final Report, ANEPTEK, 2003). The areas of excavation were between soil boring (SB) SB-4 and SB-5 (Area A), between SB-1 and SB-10 (Area B), and centering on temporary well (TW) TW-2 (Area C). Excavated areas are shown in Figure 1-3. Soils were excavated from the ground surface to a depth of approximately 8 feet bgs. Approximately 173 cubic yards of soil were removed.

Soils were transported to EMSI in Hudson Falls, New York, for disposal by incineration. Confirmatory soil samples were collected from the sidewalls and floor of each excavation and submitted to an off-site laboratory for VOC analysis by EPA Method 8260B. Sample results are presented in Table 1-1. Confirmatory sampling locations and results for Areas A, B, and C are summarized in Figures 1-4, 1-5, and 1-6, respectively.

1.2.2.5 Supplemental Data Collection

As previously stated in Section 1.2.2.3, Site 6 was not originally identified as an ERP Site to be investigated during the RI. Based on results from the RI activities conducted at Site 3, it became apparent that groundwater at Site 3 was being impacted from point sources located up gradient and adjacent to Site 3. As this was realized near the end of the RI field program, the scope of work conducted at Site 6 was limited in nature. This resulted in a limited number of soil and groundwater sampling points with corresponding limited information about site contamination, contributing to a number of data gaps relating to the vertical and horizontal extent of soil and groundwater contamination and groundwater flow direction. The SDC field program included the installation of monitoring wells, temporary wells, and the collection of soil samples. The objective of the SDC was to address existing data gaps to facilitate the completion of the FS at Site 6.



NEW YORK AIR NATIONAL GUARD BASE
109th AIRLIFT WING
TCRA AREAS OF EXCAVATION–SITE 6
SCOTIA, NEW YORK

ANEPTEK CORPORATION
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FIGURE: 1–3

TABLE 1-1
SOIL SAMPLE RESULTS
SCHENECTADY ANGB - SITE 6 TCRA
SCOTIA, NEW YORK

ANALYTE	DETECTION LIMIT[1]	BCKGRND CONC.[2]	NYSDEC CLEANUP CONC.[3]	SAMPLE IDENTIFICATION									
				A-W-sidewall		A-N-bottom		A-N-sidewall		A-E-sidewall		A-S-bottom	
VOCs (ug/kg)													
Dichorodifluoromethane	NL	ND	NL	1.1	JL	1.1	JL	1.1	JL	1.2	JL	1.2	JL
cis-1,2-Dichloroethene	6	ND	NL	3.9	JQ	1.1	U	1.1	U	7.3		1.2	U
Chloroform	NL	ND	NL	1.1	U	1.1	U	1.1	U	1.2	U	1.2	U
Trichloroethene	6	ND	700	2.7	JQ	1.1	U	1.1	JQ	3.7	JQ	1.2	U
Benzene	NL	ND	NL	1.3	JQ	2.1	JQ	1.9	JQ	1.2	JQ	1.2	JQ
Tetrachoroethene	6	ND	1400	3200		130	U	400		1800		36	U
Toluene	1	5.4	1500	2.5	JQ	5.5		3.1	JQ	1.7	JQ	3.8	JQ
m,p-Xylene	6	ND	1200	1.1	U	1.3	JQ	1.1	U	1.2	U	0.8	JQ
4-Isopropyltoluene	NL	ND	NL	1.1	U	1.1	U	1.1	U	1.2	U	1.2	U
1,2,4-Trichlorobenzene	NL	ND	NL	1.1	U	1.1	U	1.1	U	1.2	U	1.2	U
Naphthalene	390	ND	13,000	1.1	U	1.1	U	1.1	U	1.2	U	1.2	U

ANALYTE	DETECTION LIMIT[1]	BCKGRND CONC.[2]	NYSDEC CLEANUP CONC.[3]	SAMPLE IDENTIFICATION									
				A-S-sidewall		B-N-bottom		B-S-D-bottom		B-N-sidewall		B-E-sidewall	
VOCs (ug/kg)													
Dichorodifluoromethane	NL	ND	NL	1.1	JL	1.2	JL	1.2	JL	1.1	JL	1.2	JL
cis-1,2-Dichloroethene	6	ND	NL	1.1	U	1.3	JQ	5.8	JQ, JF	1.1	U	4.9	JQ
Chloroform	NL	ND	NL	1.1	U	1.2	U	1.2	U	1.1	U	1.2	U
Trichloroethene	6	ND	700	2.1	JQ	1.3	JQ	8.6	JF	1.1	U	5.6	JQ, JM
Benzene	NL	ND	NL	2.7	JQ	1.2	U	1	JQ	1.1	U	1.1	JQ
Tetrachoroethene	6	ND	1400	240		1.2	U	1.2	U	1.1	U	1.2	U
Toluene	1	5.4	1500	13		1.2	U	2.6	JQ	1.2	JQ	3.4	JQ, JM
m,p-Xylene	6	ND	1200	1.1	U	1.2	U	1.2	U	1.1	U	1.2	U
4-Isopropyltoluene	NL	ND	NL	1.1	U	1.2	U	1.2	U	1.1	U	2.3	JQ
1,2,4-Trichlorobenzene	NL	ND	NL	1.1	U	1.2	U	1.2	U	1.1	U	1.2	JM
Naphthalene	390	ND	13,000	1.1	U	1.2	U	2.3	JQ	1.1	U	2.5	JQ

TABLE 1-1(Cont.)
SOIL SAMPLE RESULTS
SCHENECTADY ANGB - SITE 6 TCRA
SCOTIA, NEW YORK

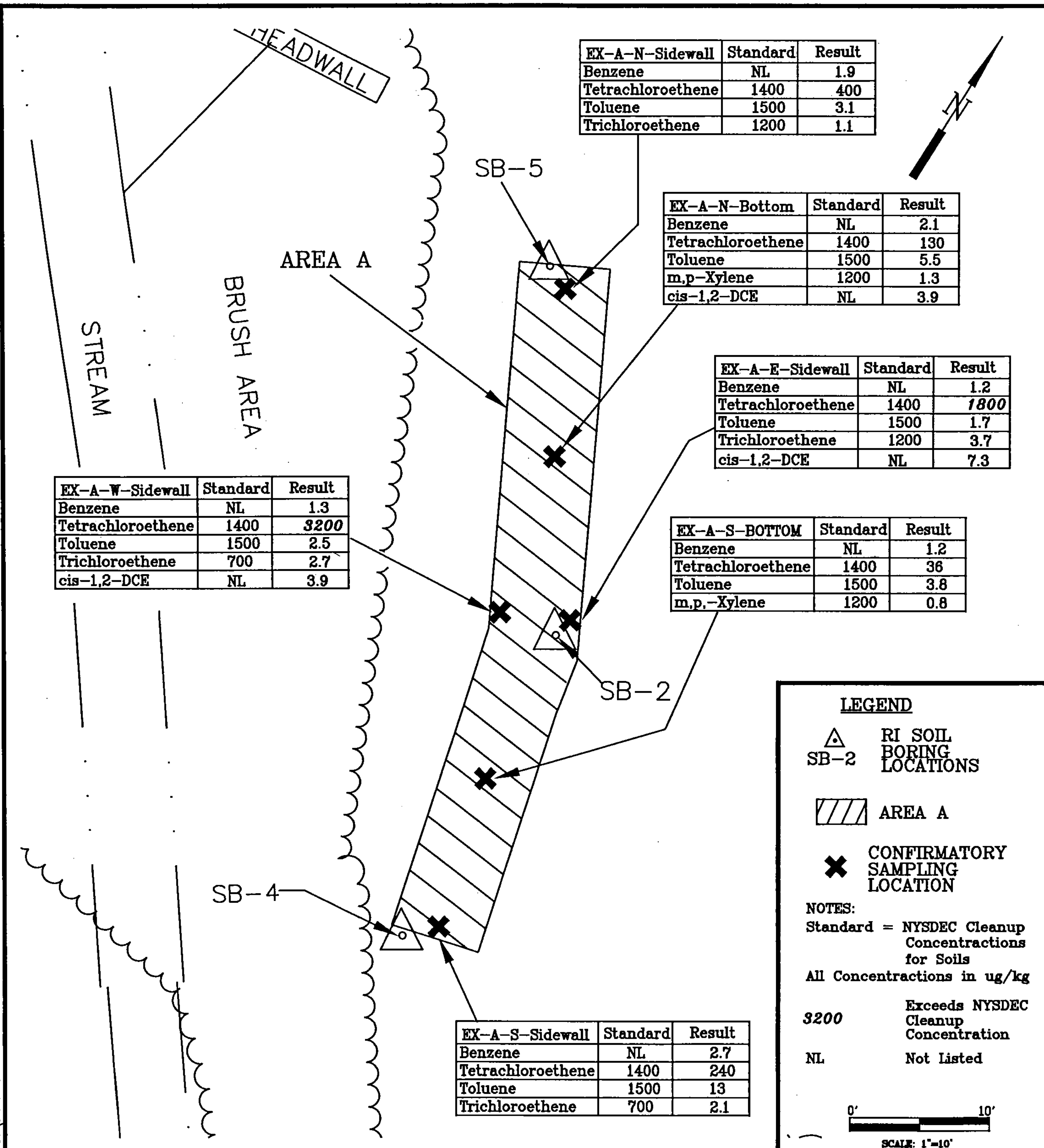
ANALYTE	DETECTION LIMIT[1]	BCKGRND CONC.[2]	NYSDEC CLEANUP CONC.[3]	SAMPLE IDENTIFICATION									
				B-S-sidewall		B-S-bottom		B-W-sidewall		C-E-bottom		C-S-sidewall	
VOCs (ug/kg)													
Dichorodifluoromethane	NL	ND	NL	1.2	JL	1.2	JL	1.2	JL	1.1	JL	1.2	JL
cis-1,2-Dichloroethene	6	ND	NL	1.2	U	20	JF	1.2	U	5.8		1.2	U
Chloroform	NL	ND	NL	1.2	U	1.2	U	1.2	U	1.1	U	1.2	U
Trichloroethene	6	ND	700	1.2	U	30	JF	1.2	U	20		1.3	JQ
Benzene	NL	ND	NL	1.2	U	1.2	JQ	1.2	U	4.9	JQ	1.2	JQ
Tetrachoroethene	6	ND	1400	1.2	U	1.2	U	1.2	U	1.1	U	1.2	U
Toluene	1	5.4	1,500	1.2	U	1.2	U	1.2	U	1.1	JF	1.7	JQ
m,p-Xylene	6	ND	1200	1.2	U	1.2	U	1.2	U	1.1	U	1.2	U
4-Isopropyltoluene	NL	ND	NL	1.2	U	1.2	U	1.2	U	1.1	U	1.2	U
1,2,4-Trichlorobenzene	NL	ND	NL	1.2	U	1.2	U	1.2	U	1.1	U	1.2	U
Naphthalene	390	ND	13,000	1.2	U	1.2	U	1.2	U	1.1	U	1.2	U

ANALYTE	DETECTION LIMIT[1]	BCKGRND CONC.[2]	NYSDEC CLEANUP CONC.[3]	SAMPLE IDENTIFICATION									
				C-W-sidewall		C-E-D-bottom		C-E-sidewall		C-W-bottom		C-N-sidewall	
VOCs (ug/kg)													
Dichorodifluoromethane	NL	ND	NL	1.1	JL	1.1	JL	1.1	JL	1.2	JL	1.2	JL
cis-1,2-Dichloroethene	6	ND	NL	46		3.6	JQ	1.3	JQ	6.9		1.2	JQ
Chloroform	NL	ND	NL	1.1	U	1.1	U	1.1	U	1.2	U	1.2	U
Trichloroethene	6	ND	700	91		13		5.8		19		12	
Benzene	NL	ND	NL	2.9	JQ	5.3	JQ	2	JQ	2.5	JQ	1.2	JQ
Tetrachoroethene	6	ND	1400	1.1	U	1.9	JQ	0.7	JQ	1.2	U	1.2	U
Toluene	1	5.4	1500	3	JQ	21	JF	5	JQ	2.5	JQ	1.3	JQ
m,p-Xylene	6	ND	1200	1.1	U	1.1	U	1.1	U	1.2	U	1.2	U
4-Isopropyltoluene	NL	ND	NL	1.1	U	1.1	U	1.1	U	1.2	U	1.2	U
1,2,4-Trichlorobenzene	NL	ND	NL	1.1	U	1.1	U	1.1	U	1.2	U	1.2	U
Naphthalene	390	ND	13,000	1.1	U	1.1	U	1.1	U	1.2	U	1.2	U

ABBREVIATIONS:
ug/kg - micrograms per kilogram
DWQS - Drinking Water Quality Stds.
MDL - Method Detection Limit
MS(D) - Matrix Spike (Duplicate)
NYSDEC - New York State Dept. of Environm'l Conservation
NL - Not Listed
RI - Remedial Investigation
RPD - Relative Percent Difference
VOC's - Volatile Organic Compounds

NOTES:
1) Contract Required Detection Limit (CRDL)
2) RI Background Sample Results
3) NYSDEC TAGM HWR-94-4046, Jan 24, 1994. Where applicable, the soil cleanup objectives were corrected for TOC levels. Where the GW based Soil Cleanup Objectives differed from the Recommended Soil Cleanup Objectives, the more stringent value was used.

DATA QUALIFIERS:
J - The analyte was positively identified; the associated value is the approx. concentration of analyte in the sample
JF - Field duplicate %RPD was high (greather than 50% for soils) for this compound
JL - The blank spike and/or blank spike duplicate % recoveries were not within the control limits of 60-140% for organics
JM - The MS and/or MSD % recoveries were not within the control limits for this compound
JQ - Estimate due to detection level below lowest calibration standard
U - Compound was analyzed for, but not detected



EX-A-N-Sidewall	Standard	Result
Benzene	NL	1.9
Tetrachloroethene	1400	400
Toluene	1500	3.1
Trichloroethene	1200	1.1

EX-A-N-Bottom	Standard	Result
Benzene	NL	2.1
Tetrachloroethene	1400	130
Toluene	1500	5.5
m,p-Xylene	1200	1.3
cis-1,2-DCE	NL	3.9

EX-A-E-Sidewall	Standard	Result
Benzene	NL	1.2
Tetrachloroethene	1400	*1800*
Toluene	1500	1.7
Trichloroethene	1200	3.7
cis-1,2-DCE	NL	7.3

EX-A-W-Sidewall	Standard	Result
Benzene	NL	1.3
Tetrachloroethene	1400	*3200*
Toluene	1500	2.5
Trichloroethene	700	2.7
cis-1,2-DCE	NL	3.9

EX-A-S-BOTTOM	Standard	Result
Benzene	NL	1.2
Tetrachloroethene	1400	36
Toluene	1500	3.8
m,p,-Xylene	1200	0.8

EX-A-S-Sidewall	Standard	Result
Benzene	NL	2.7
Tetrachloroethene	1400	240
Toluene	1500	13
Trichloroethene	700	2.1

LEGEND

SB-2 — RI SOIL BORING LOCATIONS

AREA A

CONFIRMATORY SAMPLING LOCATION

NOTES:

Standard = NYSDEC Cleanup Concentrations for Soils

All Concentractions in ug/kg

3200 — Exceeds NYSDEC Cleanup Concentration

NL — Not Listed

0' 10'

SCALE: 1"=10'

NEW YORK AIR NATIONAL GUARD BASE

109th AIRLIFT WING

CONFIRMATORY SAMPLING RESULTS SUMMARY-AREA A

SCOTIA, NEW YORK

ANEPTEK CORPORATION
Analytic, Environmental and Process Technologies

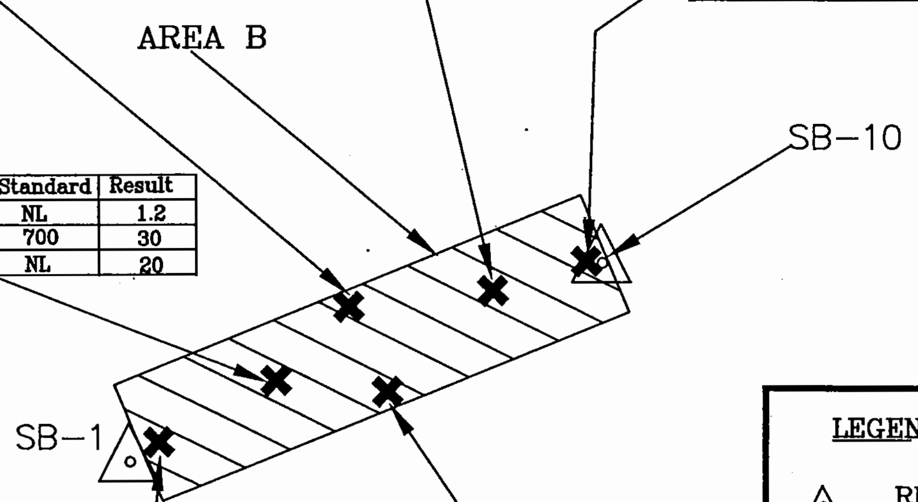
FIGURE: 1-4

C:\DRAW\STRATTON\DFT TCRA COMP REP FIG 4-2

EX-B-W-Sidewall	Standard	Result
Benzene	NL	ND
Toluene	1500	ND
Trichloroethene	700	ND
cis-1,2-DCE	NL	ND
Tetrachloroethene	NL	ND
m,p-Xlyene	NL	ND
Napthalene	13000	ND

EX-B-N-Bottom	Standard	Result
Trichloroethene	700	1.3
cis-1,2-DCE	NL	1.3

EX-B-N-Sidewall	Standard	Result
Toluene	1500	1.2



EX-B-S-Bottom	Standard	Result
Benzene	NL	1.2
Trichloroethene	700	30
cis-1,2-DCE	NL	20

EX-B-S-Sidewall	Standard	Result
Benzene	NL	ND
Toluene	1500	ND
Trichloroethene	700	ND
cis-1,2-DCE	NL	ND
Tetrachloroethene	NL	ND
m,p-Xlyene	NL	ND
Napthalene	13000	ND

EX-B-E-Sidewall	Standard	Result
Benzene	NL	1.1
Toluene	1500	3.4
Trichloroethene	700	5.6
cis-1,2-DCE	NL	4.9
4-Isopropyltoluene	NL	2.3
1,2,4-Trichlorobenzene	NL	1.2
Napthalene	13000	2.5

LEGEND

SB-1 RI SOIL BORING LOCATIONS

AREA B

CONFIRMATORY SAMPLING LOCATION

NOTES:
Standard = NYSDEC Cleanup Concentractions for Soils

All Concentractions in ug/kg

NL Not Listed

0' 10'
SCALE: 1"=10'

NEW YORK AIR NATIONAL GUARD BASE
109th AIRLIFT WING
CONFIRMATORY SAMPLING RESULTS SUMMARY-AREA B
SCOTIA, NEW YORK

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Analytic, Environmental and Process Technologies

FIGURE: 1-5

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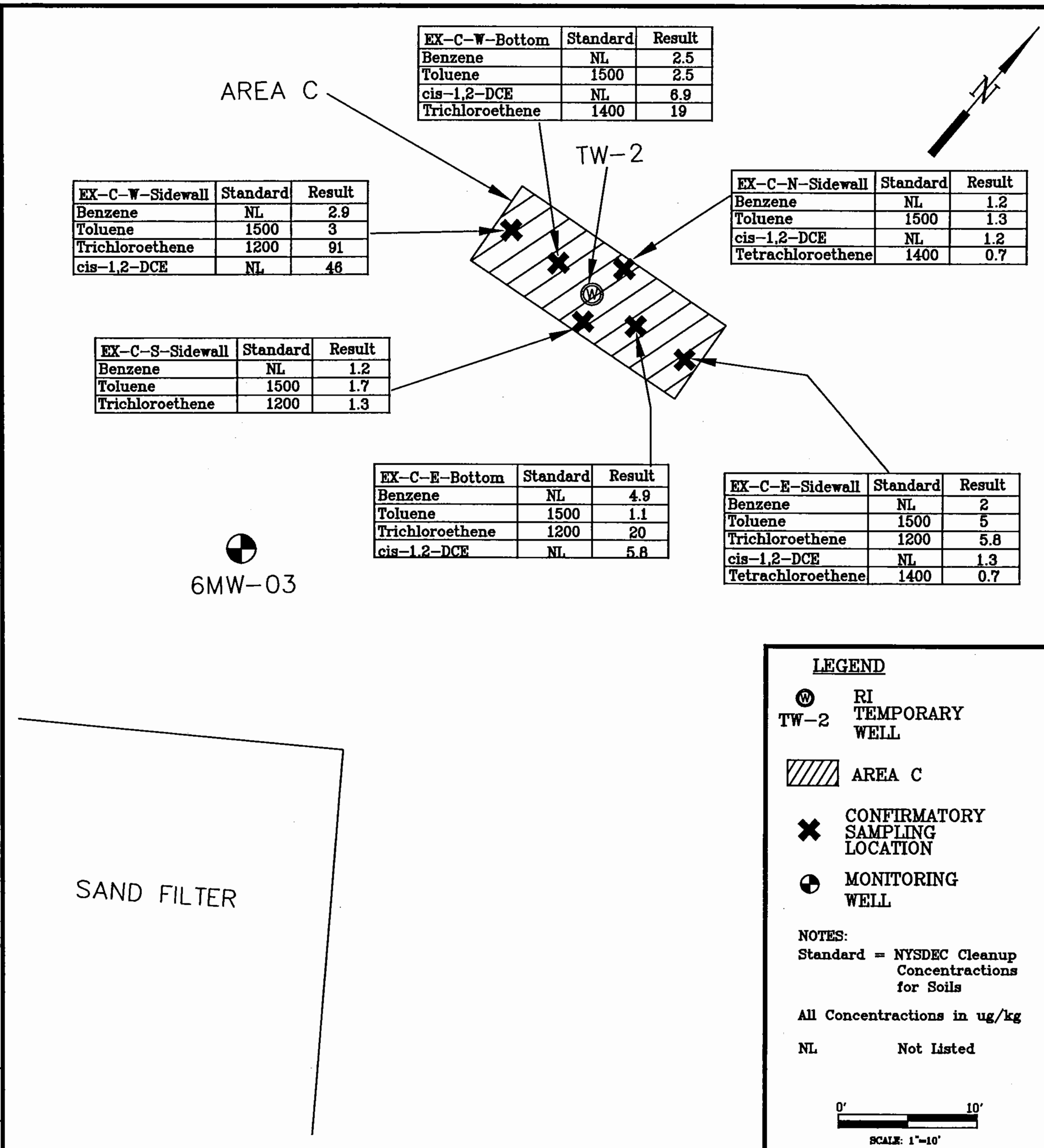

EX-C-W-Bottom	Standard	Result
Benzene	NL	2.5
Toluene	1500	2.5
cis-1,2-DCE	NL	6.9
Trichloroethene	1400	19

EX-C-W-Sidewall	Standard	Result
Benzene	NL	2.9
Toluene	1500	3
Trichloroethene	1200	91
cis-1,2-DCE	NL	46

EX-C-N-Sidewall	Standard	Result
Benzene	NL	1.2
Toluene	1500	1.3
cis-1,2-DCE	NL	1.2
Tetrachloroethene	1400	0.7

EX-C-S-Sidewall	Standard	Result
Benzene	NL	1.2
Toluene	1500	1.7
Trichloroethene	1200	1.3

EX-C-E-Bottom	Standard	Result
Benzene	NL	4.9
Toluene	1500	1.1
Trichloroethene	1200	20
cis-1,2-DCE	NL	5.8

EX-C-E-Sidewall	Standard	Result
Benzene	NL	2
Toluene	1500	5
Trichloroethene	1200	5.8
cis-1,2-DCE	NL	1.3
Tetrachloroethene	1400	0.7

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109th AIRLIFT WING
CONFIRMATORY SAMPLING RESULTS SUMMARY–AREA C
SCOTIA, NEW YORK

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FIGURE: 1–6

C:\DRAW\STRATTON\DISK1\TITLE BLOCK

1.2.3 Site Description

Site 6, the Suspected Spill Area, is the only ERP site addressed in this FS. A brief description of Site 6 is provided in the following paragraphs.

1.2.3.1 Site 6-Suspected Spill Area

Site 6 is an approximately 0.20 acre area located northwest of the Base sewage treatment facility and north (up gradient) from Site 3 (see Figure 1-2). The area comprised by what is currently Site 6 was originally part of the Site 3 remedial investigation activities. During the early stages of the RI, chlorinated compounds were detected in the groundwater up gradient from Site 3. Later investigative efforts confirmed the earlier groundwater result, which eventually led to the segregation of this up gradient location from Site 3 and its designation as Site 6.

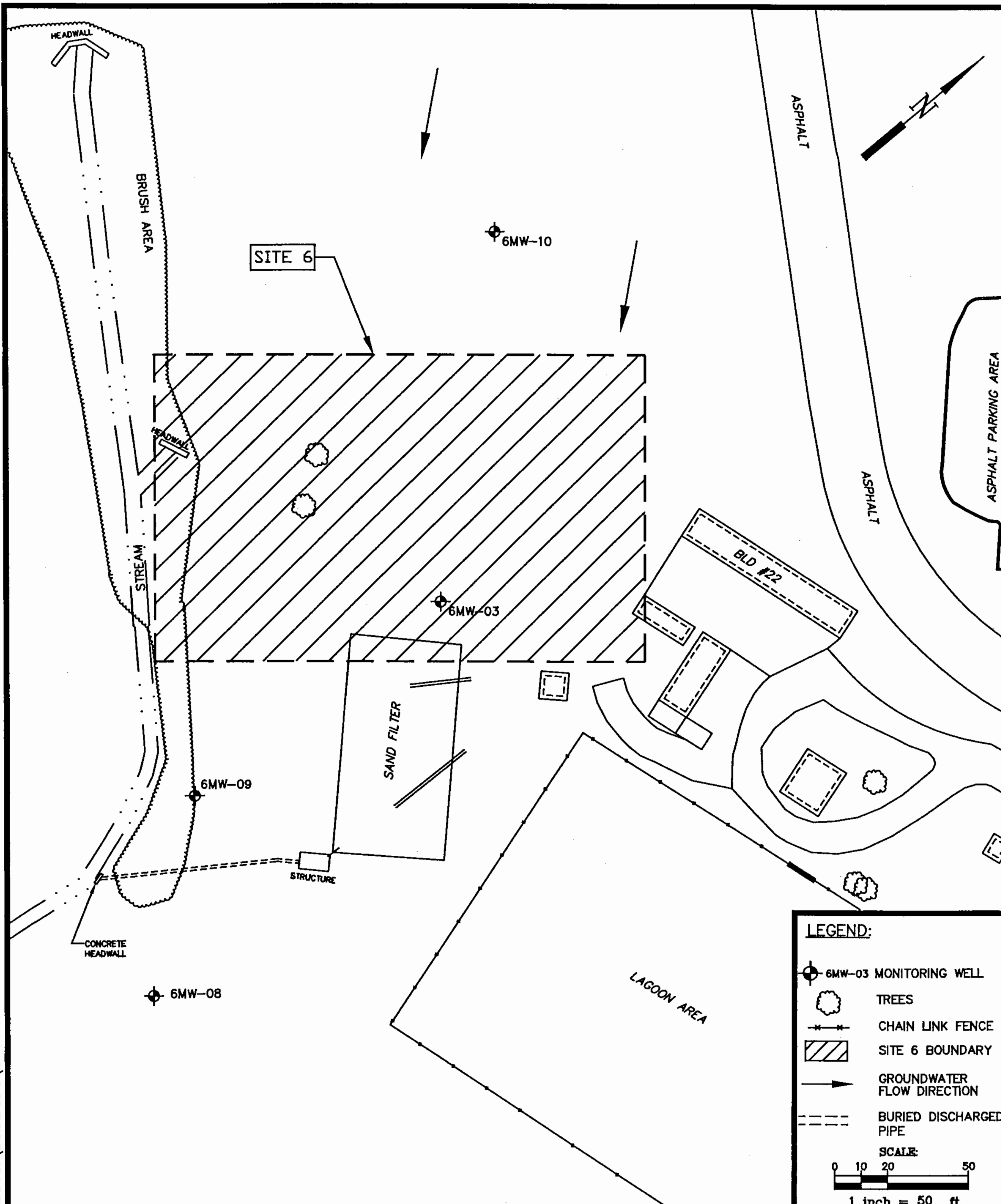
An analysis of the distribution of contaminants in the vicinity of Site 6 suggested that contamination may have been due to the past spillage and/or disposal of liquid solvents and fuel products in this area. However, due to the limited information available for this site, this assessment cannot be confirmed and further investigation, conducted under the SDC, of this site was performed. Overall, the RI and SDC revealed both soil and groundwater contamination in exceedance of the NYSDEC criteria for the protection of groundwater. Figure 1-7 presents a site map of Site 6.

1.3 Local Geology

Although this FS addresses only Site 6, Sites 3 and 6 are adjacent to each other. Therefore, given the relatively small areas encompassed by each site, the two sites share similar geologic and hydrogeologic characteristics. The majority of geological characteristics of Site 3 which were observed during the RI were also observed at Site 6 during the RI and SDC. Subsequently, general geologic observations from Site 3 are combined with those at Site 6 to give an overall picture of the local geology.

1.3.1 Surficial Geology

The overburden material at Site 6 consists mainly of a brownish to dark gray inorganic clayey silt with some fine to medium sand. The findings of the RI indicated that the thickness of the overburden soil ranges between four and eight feet below ground surface. (ANEPTEK, 2000). The thickest portion of the overburden was observed at the northern section of Site 6 while the overburden becomes increasing shallower towards the northern edge of Site 3. The overburden soils have a relatively high total organic carbon (TOC) content. The geometric mean of 5 samples (collected at Site 3 during the RI) resulted in a TOC concentration of 0.0184%. Groundwater is generally absent from the soil overburden.



NEW YORK AIR NATIONAL GUARD BASE
109th AIRLIFT WING
SITE MAP OF SITE 6-SUSPECTED SPILL AREA
SCOTIA, NEW YORK

ANEPTEK CORPORATION
Analytic, Environmental and Process Technologies

FIGURE: 1-7

C:\DRAW\STRATTON\DRAFTRI\SUSPECTED SPILL AREA

1.3.2 Bedrock Geology

During the RI, a single bore hole was advanced through bedrock to 100 feet below the ground surface at the northern boundary of Site 6. Highly fractured bedrock was encountered at a depth of approximately 9 feet. A hollow stem auger drill rig was used to reach a depth of approximately 22 feet, after which rock coring was required to reach the final depth of 100 feet. Although rock core samples were not collected prior to 22 feet below the ground surface, it is assumed that this bedrock interval is highly weathered and fractured, otherwise the hollow stem auger could not have been advanced to this depth. Rock core samples collected from 22 to 100 feet bgs possessed an average RQD of 94.2%.

The bedrock is described as a dark gray to bluish-black, moderately hard, thinly bedded shale. The bedrock is typically deeper at the northern portion of Site 6, becoming increasingly shallower towards the southern boundary of Site 3. The top of bedrock is interpreted as being located between 9 and 4 feet below the ground surface throughout the two sites.

The bedrock can be described as having two, distinct zones. The upper zone is a highly weathered and fractured zone that transitions to the overlying soil overburden. Numerous shallow borings advanced during the SI and RI revealed that the shale was highly fractured and weathered at the overburden-bedrock interface. The thickness of this weathered bedrock zone has been interpreted from groundwater monitoring well installations to be approximately 2 to 8 feet thick, with the greater thickness being located in the vicinity of Site 6 and the northern portion of Site 3. Groundwater was located primarily within this weathered bedrock zone.

Although the combined greatest thickness of the overburden and the weathered bedrock is less than 22 feet at the two sites, it should be noted that the deep bedrock test hole was to the northwest of Site 6. Further to the southeast, the depth to bedrock and thickness of the weathered bedrock zone decreases.

1.4 Hydrogeology

The hydrogeology of Site 6 is somewhat complicated. The interpreted complexity of the hydrogeology appears to be related to both the highly weathered and fractured nature of the shallow bedrock, the proximity of the surface drainage stream, the wastewater filter beds, and the wastewater treatment lagoon.

1.4.1 Groundwater Flow Directions

The general direction of local groundwater flow is toward the south-southeast with slight local variations in flow direction (Final SDC Report, ANEPTEK, 2003). This direction is consistent with findings presented in the RI report (Aneptek, September, 2000), and, to a lesser extent, as reported during a Site Investigation (ABB, 1996) conducted at Site 3 (adjacent to and downgradient of Site 6). Groundwater flow generally follows site topography with a slightly steeper gradient in the areas above the sand filters to a flatter terrain with less gradient in the sand filter area. Below the sand filter area to the east of monitoring well 6MW-08, site topography again reverts to a steeper gradient Figure 1-8 shows the general groundwater flow patterns at Site 6 based on results from the more recent SDC.

1.4.2 Groundwater Velocity

The groundwater flow velocity for Site 6 is relatively low. At Site 6, the average, groundwater velocity ranges from approximately 5.5 to 8.0 feet/year. These flow velocities were calculated using the geometric mean of the hydraulic conductivity obtained from slug tests conducted during the RI at each site and an assumed effective porosity of 15% (ANEPTEK 2000).

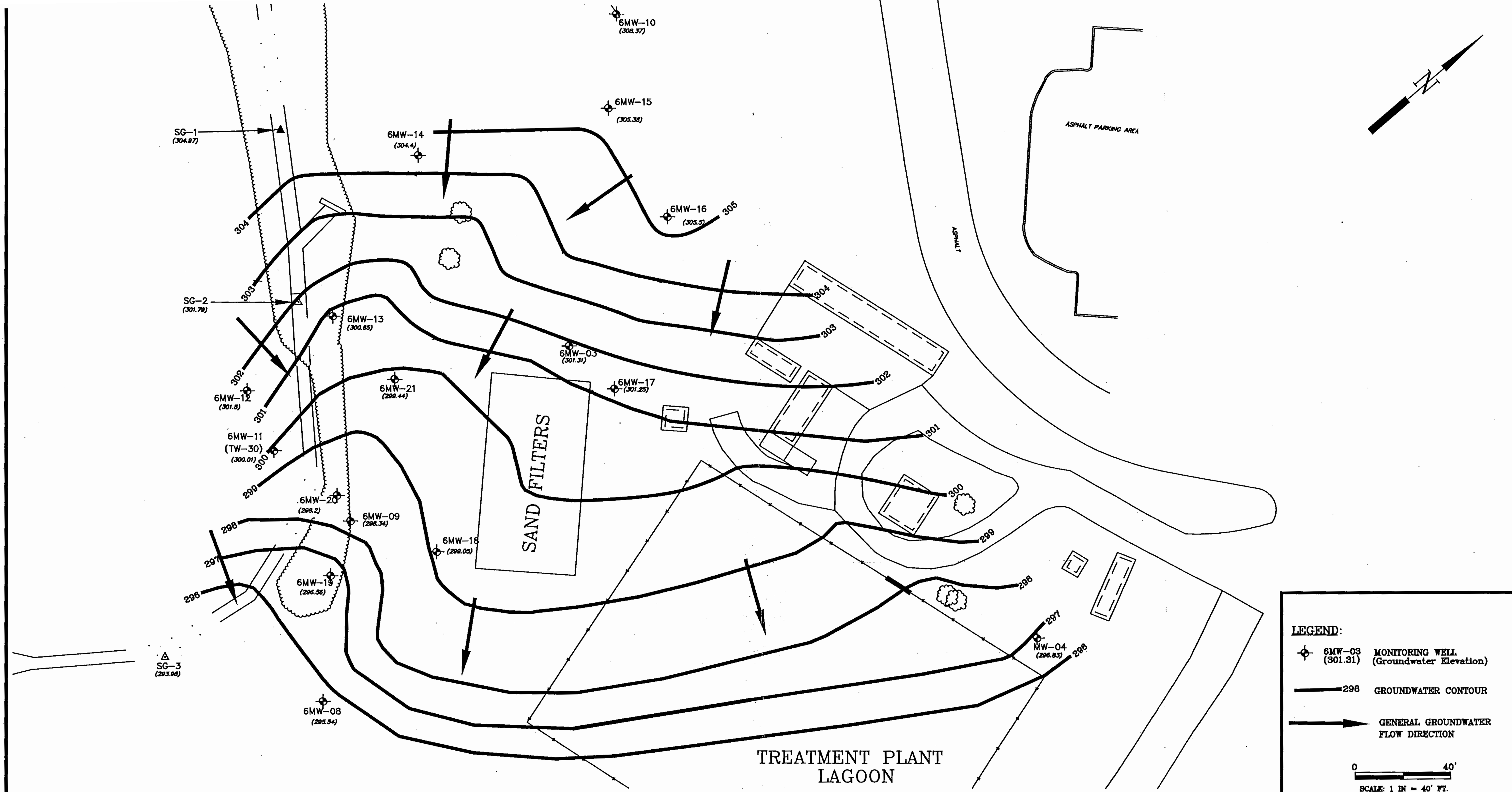
The range in groundwater velocity was obtained by varying the hydraulic gradient to reflect the change in observed gradients at the site. It should also be noted that there is a potential for the hydraulic conductivity to vary also. Normally, this might not be a major issue, with the geometric mean of the hydraulic conductivity being reflective of the average for a small site. However, the groundwater table appears to be generally at the interface between the overburden and the highly weathered and fractured bedrock. Therefore, it is possible for preferential flow of groundwater through fractured and/or weathered zones of higher hydraulic conductivity.

For example, of the three wells located within Site 6, the hydraulic conductivity of 6MW-10 was 2.72E-04 cm/sec while the values for 6MW-03 and 6MW-08 were 8.72E-06 and 8.46E-06 cm/sec, respectively. As a consequence, even though the geometric mean was taken as 2.72E-05 cm/sec, there is significant potential for preferential flow along the fracture zones. The variation in measured hydraulic conductivity is not uncharacteristic of fractured bedrock. As a result, the weathered, fractured bedrock aquifer should be considered to be non-homogeneous and anisotropic.

Using the highest hydraulic conductivity for Site 6, the groundwater velocity could range from 55 to 77 feet per year. Therefore, while average groundwater velocity appears to be relatively low, preferential, localized groundwater velocity in the weathered, fractured shallow bedrock could be an order of magnitude greater.

1.5 Nature and Extent of Contamination – Site 6

The results of the RI and the SDC were used to identify the contaminants of concern (COCs) and their locations Site 6 in order to delineate the source areas. This information was also used to assess possible migration pathways. This information was then used to assess the potential for migration of contaminants and exposure to potential human and environmental receptors. As previously stated, the SDC program was initiated in June of 2002 at Site 6 to further delineate soil and groundwater contamination and groundwater flow direction.



NEW YORK AIR NATIONAL GUARD BASE
109th AIRLIFT WING
GROUNDWATER FLOW DIRECTION–AUGUST 12 2002–SITE 6
SCOTIA, NEW YORK

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FIGURE: 1–8

The RI and SDC performed at Site 6 evaluated groundwater and soil for environmental quality and evidence of contamination by hazardous materials or hazardous waste. There is no surface water or sediment media related to Site 6. Groundwater and soil contamination that exceeded NYSDEC cleanup concentrations, EPA Maximum Contaminant Levels (MCLs) and EPA Soil Screening Levels (SSLs) were detected for these two media. Soil contamination was limited to subsurface locations. No areas of significant surface soil contamination or areas of vegetative stress were noted.

The results of the investigations and the Risk Assessment performed indicate that while two media (soil and groundwater) have contaminant levels that could pose a potential risk to either human health and/or the environment, no increase in risk to human health was found. As stated in the RI (ANEPTEK, 2000):

> *Based upon the results of the investigative activities conducted during this RI and incorporating the findings of the Risk Assessment, no risk to human health is associated with Site 6 soils and groundwater. These findings are based on the following criteria: COCs in soil were found in sub-surface soil samples, no receptors being identified down gradient of Site 6, the Site is located in a secure area, current land use is non-residential (and is expected to remain as such), and the contaminant pathway to human receptors is incomplete (e.g., soils are sub-surface and the aquifer underlying Site 6 is not used as a source for potable water).*

A summary of the Site 6 RI contaminants exceeding cleanup concentrations and/or guidance levels is provided in Table 1-2. Additional information is summarized below.

1.5.1 RI Results

Soil Contamination

Field Screening
Although field screening results are not accepted as validated data, the results are useful as indicators of potential contamination. Field screening results from the RI indicated potential soil contamination in two areas to be addressed in this FS, therefore they are being included for comparison purposes.

A total of 16 soil borings were advanced during the RI. Soil samples were screened in the field using a PID. Five of the samples, SB-1 (80 ppm), SB-2 (350 ppm), SB-6 (200 ppm), SB-8 (300 ppm), and SB-10 (200 ppm), registered significant readings when screened. Of these five locations, the areas incorporating borings SB-1, SB-2, and SB-10 were excavated during the TCRA. RI field screening results are presented in Table 1-3.

Analytical Results - Soils
Subsurface soil samples collected from Site 6 had elevated concentrations of two volatile organic compounds in excess of NYSDEC soil cleanup concentrations. Elevated concentrations of tetrachloroethene (PCE) and trichloroethene (TCE) were recorded at 3 of 10 and 2 of 10 sampling locations, respectively. These concentrations were also in excess of EPA Soil Screening Levels using a dilution attenuation factor of 20 times.

No semi-volatile organic compounds were detected in Site 6 soils at concentration in excess of

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1-18

Table 1-2 ERP Site 6 RI Analytical Summary

	Contaminant	Number Exceeding	Maximum Concentration	MCL	EPA SSL[1] DAF[2] = 20X	NYSDEC Soil /GW Criteria
Subsurface Soil	*VOCs (μg/Kg)*					
	PCE	3 of 10	8,600		60	1,400
	TCE	2 of 10	100		60	700
	Metals (mg/Kg)					
	Aluminum	8 of 10	19,800			12,026[3]
	Arsenic	7 of 10	16.5			7.5
	Beryllium	6 of 10	1.0			0.75[3]
	Cadmium	1 of 10	1.1			1
	Chromium	5 of 10	24.5		38.0	19.3[3]
	Copper	1 of 10	48.8			32.5[3]
	Iron	5 of 10	40,500			28,238[3]
	Manganese	2 of 10	888			649[3]
	Nickel	4 of 10	59.7			23.8[3]
	Potassium	8 of 10	2,280			1,580[3]
Groundwater	*VOCs (μg/L)*					
	Cis-1,2Dichloroethene	3 of 6	120	70		5
	PCE	1 of 6	16	5		5
	Vinyl Chloride	2 of 6	16	2		2
	SVOCs (μg/L)					
	2-Methylnaphthalene	6 of 6	35			5
	Acenapthene	6 of 6	40			20
	2,4 Dinitrophenol		26			1
	4 Nitrophenol		26			1
	Phenol	2 of 6	9			1
	Bis(ethylhexyl)Phthalate	4 of 6	12	6		5
	Metals (μg/L)					
	Magnesium	5 of 6	51,700			35,000
	Manganese	5 of 6	684			300
	Sodium	6 of 6	86,300			20,000
	Thallium	61 of 6	5	2		1

(1)SSL: Soil Screening Level (EPA 1996)
(2)DAF: Dilution Attenuation Factor
(3)Site Background Value

Table 1-3
RI Soil Boring
Field Screening Results

Site 6 RI	PID Response (ppm)				
Soil Boring	**0-2 Feet**	**2-4 Feet**	**4-6 Feet**	**6-8 Feet**	**8-10 Feet**
SB-1	0	0	40	18	80
SB-2	NS	NS	350	100	NA
SB-3	NS	10	NA	NA	NA
SB-4	NS	3	5	NA	NA
SB-5	2	2	NS	0	NA
SB-6	0	0	200	100	NA
SB-7	0	4	0	NA	NA
SB-8	0	0	300	NA	NA
SB-9	0	NS	NS	0	NA
SB-10	0	0	200	150	NA
SB-11	NS	NS	NA	NA	NA
SB-12	1	1	NA	NA	NA
SB-13	0	0	NA	NA	NA
SB-14	0	0	NA	NA	NA
SB-15	0	0	NA	NA	NA
SB-16	0	0	NA	NA	NA

NYSDEC cleanup concentrations or EPA Soil Screening Levels.

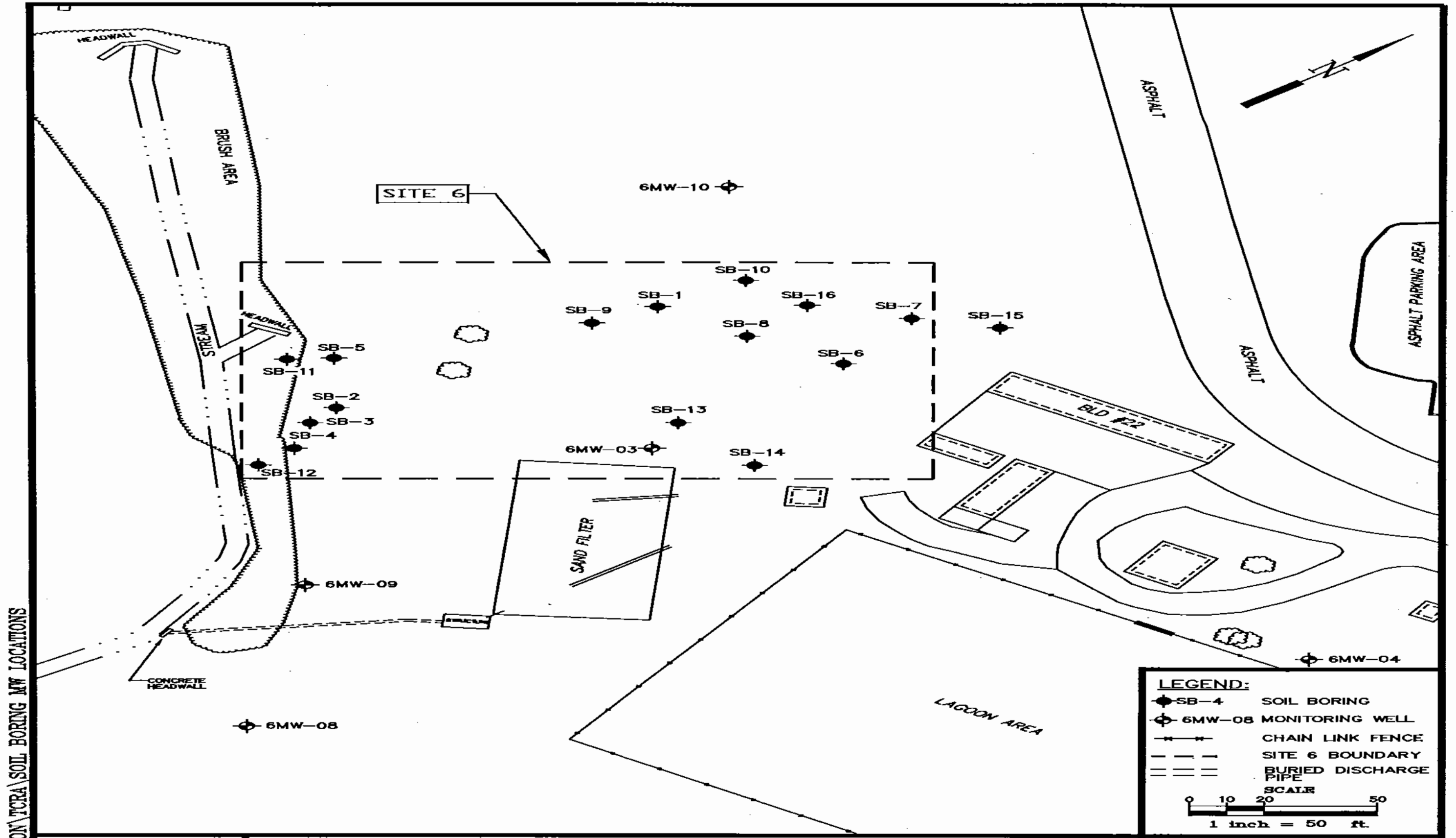
Metals were detected in Site 6 soils. Metals detected in excess of NYSDEC soil cleanup standards included aluminum, arsenic, beryllium, cadmium, chromium, copper, iron, manganese, nickel, potassium and zinc. However, none of these constituents was present in concentrations in excess of the EPA Soil Screening Levels using a dilution attenuation factor of 20 times. Refer to Section 1.6.2 for a discussion of the screening level comparison.

Analytical Results - Groundwater

Several SVOCs were detected in Site 6 groundwater in concentrations in excess of NYSDEC Drinking Water Quality Standards. These included 2-methylnaphthalene, acenapthene, 4-nitrophenol, 2,4-dinitrophenol, and phenol. Of these, only bis-2 (ethylhexyl) phthalate exceeded Federal Maximum Contaminant Levels.

Only four metals (inorganics) were detected in Site 6 groundwater at levels that exceeded NYSDEC Drinking Water Quality Standards. These were magnesium, manganese, sodium, and thallium. Of these, only thallium also exceeded the Federal Maximum Contaminant Levels.

Site 6 RI soil boring and monitoring well locations are shown on Figure 1-9.



NEW YORK AIR NATIONAL GUARD BASE
109th AIRLIFT WING
RI SOIL BORING/MONITORING WELL LOCATIONS – SITE 6
SCOTIA, NEW YORK

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FIGURE: 1–9

C:\DRAW\STRATTON\YCRA\SOIL BORING MW LOCATIONS

1.5.2 SDC Results

Analytical Results - Soils
A total of twelve confirmatory subsurface soil samples were submitted for laboratory analysis. This number does not include two duplicate samples collected for QA/QC purposes. The samples are identified by the soil boring from which they were collected followed by the depth of the sample interval bgs. Of the fourteen samples collected, three contained chlorinated VOCs at concentrations exceeding their respective NYSDEC Cleanup Concentrations. TCE was detected in SB-19 7-8 at a concentration of 2,800 µg/kg, above the cleanup concentration of 700µg/kg. PCE was detected in SB-25 5-6 and SB-26 5-6 at concentrations of 14,000µg/kg and 20,000µg/kg, respectively. The cleanup concentration for PCE is 1,400µg/kg. These compounds were also detected at low concentrations in several other samples. No SVOCs were detected above NYSDEC cleanup concentrations.

Several inorganic analytes were detected above their respective NYSDEC cleanup concentrations. Arsenic, beryllium, chromium, iron, nickel, and potassium were detected in several samples above their respective cleanup concentrations.

Groundwater
As previously stated, screening data is not considered validated data. However, screening results of samples collected from temporary wells (TWs) installed during the SDC, as well as screening data from data points (monitoring wells, microwells, and TWs) installed as part of the RI, provided pertinent information which is incorporated into this FS.

Laboratory Gas Chromatograph (GC) Screening Results
A total of 36 groundwater samples were collected and submitted to an off-site laboratory for GC screening. Samples were screened for VOCs using EPA Method 8260. Twenty three of these samples were collected from temporary well points which were installed during the SDC. The remaining thirteen samples were collected from sampling points which were installed as part of the field program during the RI. The RI locations included four groundwater monitoring wells, 6MW-03, 6MW-08, 6MW-09, and 6MW-10, seven temporary wells, TW-1, TW-3, TW-7, TW-9, TW-12, TW-15, and TW-16, and two microwells, MIC-C, and MIC-D. Of the 36 samples collected, 19 contained one or more VOCs which exceeded its respective NYSDEC drinking water standard. The predominant compounds detected included cis-1,2-DCE, PCE, and TCE. Vinyl chloride was detected above its respective regulatory standard in 5 of the samples collected. All groundwater GC screening results are presented in Table 1-4.

Analytical Results
SDC groundwater sampling locations and an estimate of the extent of groundwater contamination is shown in Figure 1-13. PCE, TCE, and cis-1,2 DCE were detected in several groundwater samples at Site 6 in excess of NYSDEC Drinking Water Quality Standards (DWQS). PCE and TCE were detected at concentrations that exceeded Federal Maximum Contaminant Levels.

A summary of the soil and groundwater contaminants detected during the SDC exceeding cleanup concentrations and/or guidance levels is provided in Table 1-5. All SDC sampling locations are shown in Figure 1-10.

TABLE - 1-4
GROUNDWATER SAMPLE RESULTS-SITE 6 SDC
GC SCREENING
SCHENECTADY ANGB

ANALYTE	DETECTION LIMITS[1]	NY STATE DWQS[2]	SAMPLE NUMBERS						
			TW-1	TW-3	TW-7	TW-9	TW-12	TW-15	TW-16
VOCs (ug/L)									
cis-1,2,-Dichloroethene	5	5	4.9	ND	1.61	278	61.6	22.1	ND
Tetrachloroethene	5	5	ND	ND	ND	335	4.09	28.1	ND
trans-1,2-Dichloroethene	5	5	ND	ND	ND	1.79	ND	ND	ND
Trichloroethene	5	5	1.22	ND	ND	[illegible]	12.7	3.06	ND
Vinyl Chloride	5	2	ND	ND	ND	1.09	ND	ND	ND

ANALYTE	DETECTION LIMITS[1]	NY STATE DWQS[2]	SAMPLE NUMBERS						
			TW-17	TW-18	TW-19	TW-20	TW-21	TW-22	TW-23
VOCs (ug/L)									
1,2,3-Trichlorobenzene	5	5	ND	ND	1.16	ND	ND	ND	ND
1,2-Dichlorobenzene	5	3	ND	ND	ND	ND	ND	ND	1.22
cis-1,2,-Dichloroethene	5	5	28.6	4.37	23.4	1.12	139	812	227
Naphthalene	5	10	ND	ND	1.28	ND	ND	ND	ND
Tetrachloroethene	5	5	ND	ND	ND	ND	ND	560	ND
trans-1,2-Dichloroethene	5	5	ND	ND	ND	ND	ND	3.23	1.26
Trichloroethene	5	5	ND	ND	51	ND	3.03	37.8	1.89
Vinyl Chloride	5	2	44.1	ND	ND	ND	11	ND	708

TABLE -1-4 (CONT)
GROUNDWATER SAMPLE RESULTS-SITE 6 SDC
GC SCREENING
SCHENECTADY ANGB
SCOTIA, NEW YORK

ANALYTE	DETECTION LIMITS[1]	NY STATE DWQS[2]	SAMPLE NUMBERS						
			TW-24	TW-25	TW-26	TW-27	TW-28	TW-29	
VOCs (ug/L)									
1,2,3-Trichlorobenzene	5	5	ND	ND	ND	1.09	ND	2.23	
1,2,4-Trichlorobenzene	5	5	ND	ND	ND	ND	ND	2.04	
4-Isopropyltoluene	5	4	ND	ND	ND	ND	ND	1.25	
Acetone	5	NL	ND	ND	ND	ND	ND	19.8	
cis-1,2,-Dichloroethene	5	5	162	20.3	34.6	67.5	ND	ND	
Hexachlorobutadiene	5	0.5	ND	ND	ND	ND	ND	2.92	
n-Butylbenzene	5	5	ND	ND	ND	ND	ND	1.56	
Naphthalene	5	10	ND	ND	ND	1.15	ND	2.31	
sec-Butylbenzene	5	5	ND	ND	ND	ND	ND	1.59	
Trichloroethene	5	5	7.6	ND	ND	3.53	ND	ND	
Vinyl Chloride	5	2	ND	40.3	ND	[illegible]	ND	ND	

ANALYTE	DETECTION LIMITS[1]	NY STATE DWQS[2]	SAMPLE NUMBERS						
			TW-30	TW-31	TW-32	TW-33	TW-34	TW-35	TW-36
VOCs (ug/L)									
cis-1,2,-Dichloroethene	5	5	ND	1.41	[illegible]	ND	ND	ND	ND
Hexachlorobutadiene	5	0.5	ND	1.61	ND	ND	ND	ND	ND
Naphthalene	5	10	1.86	1.22	1.21	ND	ND	ND	ND

TABLE - 1-4 (CONT)
GROUNDWATER SAMPLE RESULTS-SITE 6 SDC
GC SCREENING
SCHENECTADY ANGB
SCOTIA, NEW YORK

ANALYTE	DETECTION LIMITS[1]	NY STATE DWQS[2]	SAMPLE NUMBERS						
			TW-37	TW-38	TW-39	6MW-03	6MW-08	6MW-09	6MW-10
VOCs (ug/L)									
cis-1,2,-Dichloroethene	5	5	21.6	ND	102	313	ND	36.7	ND
Tetrachloroethene	5	5	63	ND	336	ND	ND	14.7	ND
trans-1,2-Dichloroethene	5	5	ND	ND	1.09	ND	ND	ND	ND
Trichloroethene	5	5	13.6	ND	[illegible]	ND	ND	3.83	ND

ANALYTE	DETECTION LIMITS[1]	NY STATE DWQS[3]	SAMPLE NUMBERS	
			MIC-C	MIC-D
VOCs (ug/L)				
cis-1,2,-Dichloroethene	5	5	2.25	ND

ABBREVIATIONS:

ug/L- micrograms per liter
DWQS - Drinking Water Quality Standards
NL - Not Listed
ND - Not Detected
TW - Temporary Well
MW - Monitoring Well
MCL - Maximum Contaminant Level
NYSDEC - New York State Department of Environmental Conservation
VOCs - Volatile Organic Compounds

NOTES:

[1] Contract Required Detection Limit for Organics (CDRL)
[2] NYSDEC Water Quality Standards and Guidance Values, June 1998.
Sample screened only for the compunds listed.

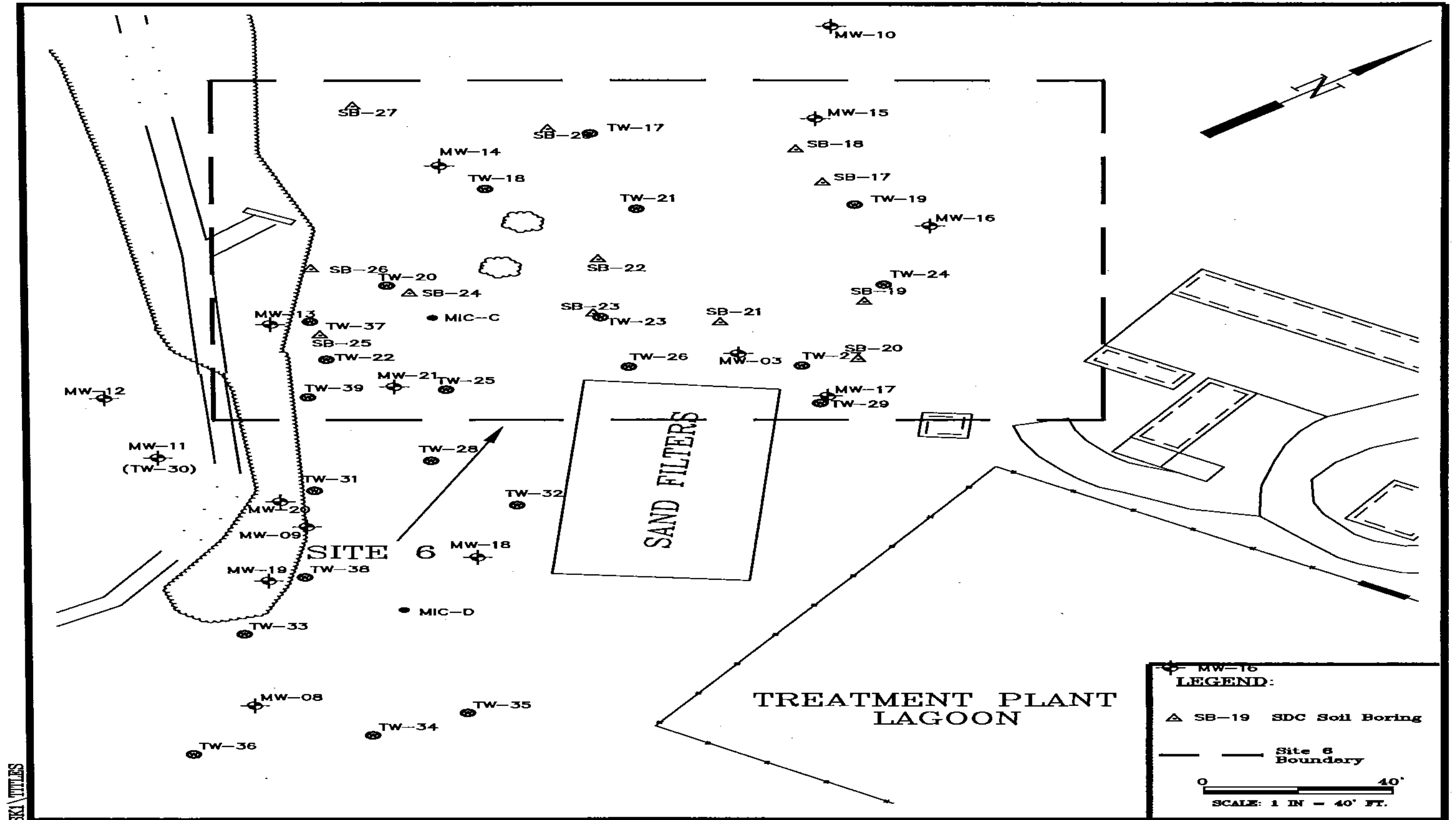
DATA QUALIFIERS:

(shaded) Indicates concentation that exceeds State or Federal regulatory limits.

Table 1-5 – ERP Site 6 SDC Analytical Summary

	Contaminant	Number Exceeding	Maximum Concentration	MCL	EPA SSL[1] DAF[2] = 20X	NYSDEC Soil /GW Criteria
Subsurface Soil	*VOCs (μg/Kg)*					
	PCE	2 of 12	20,000		60	1,400
	TCE	1 of 12	2,800		60	700
	Metals (mg/Kg)					
	Aluminum	10 of 12	27,700			12,026[3]
	Arsenic	10 of 12	15.3			7.5
	Beryllium	10 of 12	1.5			0.7[3]
	Chromium	12 of 12	32.6		38.0	19.3
	Copper	10 of 12	54.7			32.5[3]
	Iron	9 of 12	40,500			28,238[3]
	Manganese	7 of 12	1,060			649[3]
	Nickel	12 of 12	68.8			23.8[3]
	Potassium	12 of 12	2,650			1,580[3]
Groundwater[3]	*VOCs (μg/L)*					
	Cis-1,2Dichloroethene	8 of 15	71	70		5
	PCE	5 of 15	3,700	5		5
	Trichloroethene	4 of 15	48	5		5
	Vinyl Chloride	2 of 15	6.5	2		2
	SVOCs					
	All Samples Non-Detect					
	Metals, Total (μg/L)					
	Antimony	5 of 30	13.7	6		3
	Arsenic	1 of 30	26.8	50		25
	Chromium	1 of 30	55.7	100		50
	Cobalt	8 of 30	57.6			5
	Iron	24 of 30	78,000			300
	Lead	1 of 30	50.1	15		25
	Magnesium	11 of 30	68,400			35,000
	Manganese	20 of 30	5150			300
	Nickel	1 of 30	130	100		100
	Sodium	25 of 30	162,000			20,000

(1) SSL: Soil Screening Level (EPA 1996)
(2) DAF: Dilution Attenuation Factor
(3) Includes two rounds of sampling



NEW YORK AIR NATIONAL GUARD BASE
109th AIRLIFT WING
SDC
SAMPLING LOCATIONS
SCOTIA, NEW YORK

ANEPTEK CORPORATION
Analytic, Environmental and Process Technologies

FIGURE: 1-10

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1.5.2.1 Site 6 Summary

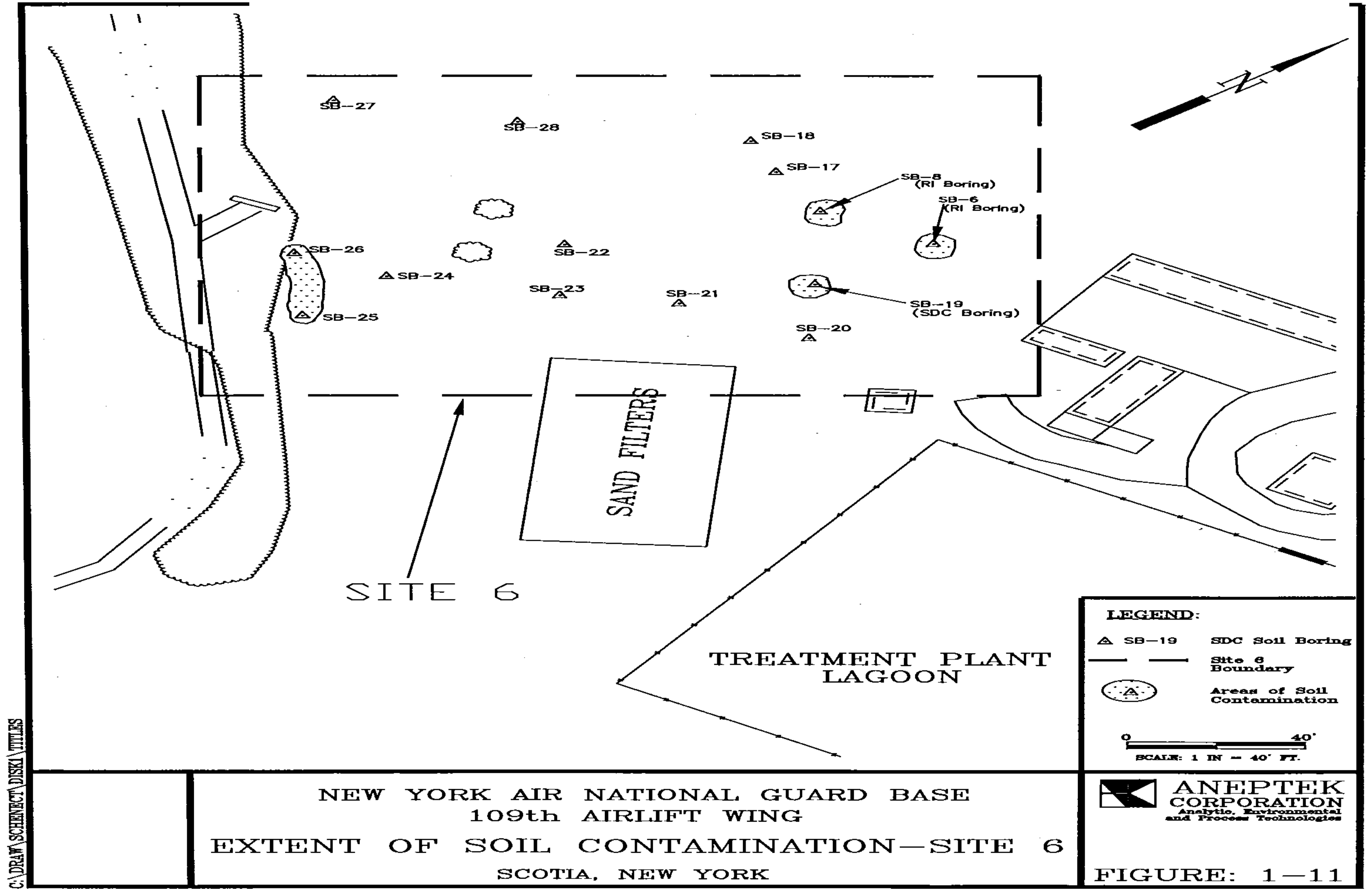
The following section presents a summary of the extent of soil and groundwater contamination present at Site 6. Information obtained during the performance of the RI and the TCRA was incorporated with information from the SDC in formulating the extent of contamination.

Extent of Soil Contamination

The extent of soil contamination at Site 6 is based on confirmatory subsurface soil sampling results from the SDC, confirmatory sample results from the TCRA conducted at Site 6 prior to the implementation of the SDC, and confirmatory and soil screening sampling results from the RI. Sampling results indicate that while the majority of Site 6 is generally free of soil contamination, isolated areas of VOC contamination above regulatory clean up standards were identified. Sample results from SDC soil borings SB-19, SB-25, and SB-26, all reported elevated levels of chlorinated VOCs. Sample SB-19, collected from the 7-8 ft bgs interval, contained TCE at a concentration of 2,800 ug/kg, exceeding the cleanup concentration of 700 ug/kg. Samples SB-25 and SB-26, both collected from the 5 to 6 ft bgs interval, contained PCE at concentrations of 14,000 and 20,000 ug/kg, respectively. These concentrations are an order of magnitude greater than the cleanup concentration of 1,400 ug/kg. In addition, borings SB-25 and SB-26 are located just to the east and west of the limits of excavation conducted at Area A during the TCRA (Section 3.5). Confirmatory soil samples collected from the east and west sidewalls at Area A during the TCRA also contained PCE at levels of 1,800 and 3,200 ug/kg, respectively (Figure 3-6). Boring SB-19 is located to the just northwest limit of excavation at TCRA Area C, although confirmatory sample results from Area C were all below regulatory cleanup standards. In addition, during performance of the RI, PID field screening headspace results reported a reading of 200 ppm from the 4-6 foot bgs interval from SB-6, and a reading of 300 ppm in the 4-6 foot interval of SB-8. Analytical results from SDC soil boring SB-17, located approximately 20 feet to the north west of SB-8, reported low levels of contamination and no exceedances of cleanup concentrations. RI analytical results from soil borings SB-15 and SB-16, located 40 to 50 feet north of SB-6 reported non-detect for VOCs. GC screening results from RI soil boring SB-7, located between SB-15 and SB-16, were non-detect for VOCs. SDC groundwater sampling results for 6MW-16 were non-detect for VOCs. The extent of soil contamination at Site 6, based on data results from the RI and SDC field programs, is presented in Figure 1-11.

Extent of Groundwater Contamination

The extent of groundwater contamination at Site 6 is based on data results from the RI and SDC field programs, including screening and confirmatory sample results. In review of these results, there appears to be a central, localized area within which levels of groundwater contamination are, at a minimum, at least 5 μg/L. This is the regulatory drinking water standard for the majority of the chlorinated VOCs detected. Based on data gathered to date, the dimensions of this area are approximately 200 feet long and between 100 to 140 feet wide. This area extends north to south from TW-17 and TW-19 to 6MW-09, and west to east from 6MW-13 to TW-27. Located within this central area are pockets of isolated contamination with concentrations ranging from a minimum of 50 μg/L to a maximum of 3700 μg/L (6MW-13, June 2002 SDC sampling event). The highest concentrations were detected in the south southwest corner of Site 6, ranging from 6MW-13 to the west to TW-9 and TW-



SB-27
SB-28
SB-18
SB-17
SB-8 (RI Boring)
SB-6 (RI Boring)
SB-26
SB-22
SB-24
SB-23
SB-21
SB-19 (SDC Boring)
SB-25
SB-20
SAND FILTERS
SITE 6
TREATMENT PLANT LAGOON
LEGEND:
SB-19 SDC Soil Boring
Site 6 Boundary
Areas of Soil Contamination
0 40'
SCALE: 1 IN = 40' FT.
NEW YORK AIR NATIONAL GUARD BASE
109th AIRLIFT WING
EXTENT OF SOIL CONTAMINATION—SITE 6
SCOTIA, NEW YORK
ANEPTEK CORPORATION
Analytic, Environmental and Process Technologies
FIGURE: 1—11
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12 to the east, although localized groundwater "hot spots" were detected throughout the site. The extent of groundwater contamination at Site 6 is presented in Figure 1-12

The results of the RI and SDC indicate that there is contamination in soil and groundwater at levels above NYSDEC cleanup concentrations and several Federal standards or guidance levels. The remedial options evaluated in this FS are for soil and groundwater contamination. The following section describes the potential impact.

Contaminant Fate and Transport Summary

The following discussion assesses the contaminant fate and transport pathways for Site 6. More detailed discussion of the Risk Assessment provided in the Remedial Investigation Report (ANEPTEK, 2000). Additional information is also available in the TCRA Completion Report (ANEPTEK, January, 2003), and the SDC Technical Memorandum (ANEPTEK, August, 2003).

Once a compound is released into the environment, numerous physical, chemical, and biological processes may affect the degree to which the compound will migrate, the migration pathway the compound will follow and the ultimate destination or fate of that compound. The degree to which any of these processes will effect the contaminant migration is highly dependent upon the compounds chemical properties, as well as many site-specific properties. From the Fate and Transport Study performed as part of the RI, the dominant processes were determined to include:

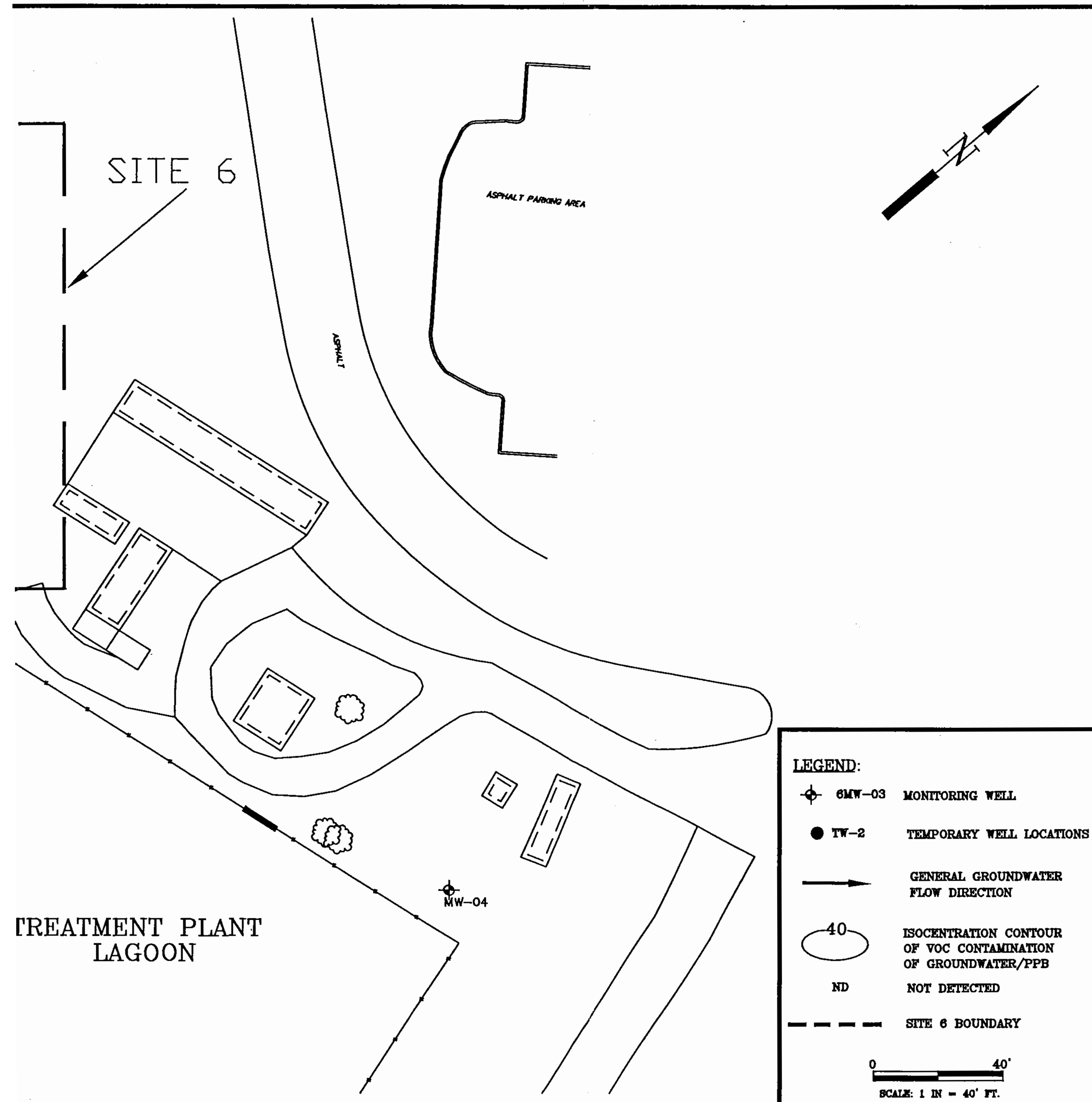
- *Sorption* of contaminants within the relatively high TOC, silty-clayey soil
- *Dispersion* and *Dilution* of the contaminants within the fractured bedrock aquifer
- *Particle Migration* of metals and semi-volatile organic compounds
- *Volatilization* of volatile organic compounds from soil and groundwater

An evaluation of the migration potential and possible pathways for contaminants at the two sites was developed and is presented below.

1.5.3 Contaminant Migration

Groundwater contamination occurs almost wholly from the slow leaching of overlying contaminated soils during precipitation. Overall, a slow rate of contaminant leaching from the soil followed by dilution and mixing at the intersections of fractures within the bedrock aquifer would reduce the contaminant concentrations to below the NYSDEC criteria slightly down gradient from the site location.

Surface water and receptor contamination can also occur through runoff, wind blown soil, and direct contact with the contaminated material. Depending upon the site topography and other restrictions, such as access control, impoundment of surface water, etc. the degree to which the contaminants can migrate along those pathways may be limited.



: NATIONAL GUARD BASE
AIRLIFT WING
ER CONTAMINATION–SITE 6
'A, NEW YORK

ANEPTEK CORPORATION
Analytic, Environmental and Process Technologies

FIGURE: 1–12

1.5.4 Site Conceptual Model

1.5.4.1 Current Land Use

Both an industrial exposure and a rural residential exposure scenario were considered during the Tier 1 risk assessment. However, it is anticipated that the use of Site 6 will remain industrial for the foreseeable future. The current land use considered in the Tier 1 risk assessment are restricted access industrial, and the current land use in the area immediately surrounding the sites is industrial. Current land use types in areas surrounding the Schenectady County Airport includes agricultural, residential, and commercial uses.

1.5.4.2 Future Land Use

Future land use of the area is expected to remain restricted access industrial. The immediate location Site 6 includes a wastewater treatment plant. The plant includes an aerated, wastewater treatment lagoon, and effluent filtration beds. As a result, it is unlikely that ANG use other than industrial for the sites will occur in the near future. In addition, the future land use of the area immediately surrounding Site 6 is expected to remain industrial. This includes the continued use of the Schenectady County Airport and the commercial railroad that abuts the properties.

1.5.4.3 Exposure Pathways

Under an industrial scenario, exposure to soil were deemed relevant to the worker in this Tier 1 risk assessment. For soil, the exposure pathways considered were incidental ingestion, dermal absorption, and inhalation of volatile chemicals and particles emitted from the soil. This would potentially occur as workers intermittently accessed the properties while discharging their work related duties.

Under the rural residential exposure scenario, exposure to soil and groundwater were deemed relevant to the resident in this Tier 1 risk assessment. For soils, the exposure pathways considered were incidental ingestion, dermal absorption, and inhalation of volatile chemicals and particles emitted from soil.

For groundwater, the exposure pathways considered were ingestion of groundwater as drinking water and inhalation of volatile chemicals emitted into the home during household use of groundwater (e.g., showering, laundering, dish washing).

1.5.5 Site 6

1.5.5.1 Subsurface Soil

Compounds in subsurface soil were identified during the RI and SDC that were in excess of NYSDEC cleanup concentrations and EPA Soil Screening Guidance.

1.5.4 Site Conceptual Model

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1.5.5 Site 6

1.5.5.1 Subsurface Soil

Compounds in subsurface soil were identified during the RI and SDC that were in excess of NYSDEC cleanup concentrations and EPA Soil Screening Guidance.

1-32

1.5.5.1.1 VOCs

Two VOCs, PCE and TCE, were identified in the subsurface soil at Site 6 at concentrations that exceeded NYSDEC soil cleanup concentrations. These compounds have the potential to migrate from the soils to groundwater with infiltrating precipitation, snowmelt, or runoff. Therefore, the primary route of migration for these compounds is to the groundwater.

An evaluation of the retardation factor was made for these compounds. Five soil samples were collected at Site 3 during the RI and analyzed for total organic carbon (TOC). Given the close proximity of Site 6 to Site 3, it is assumed that soils are homogenous between the two sites. The concentrations ranged from 0.013 % to 0.04 % with a geometric mean of 0.0184 %. The porosity of the soil was assumed to be 0.40 and the dry, bulk density was taken as 1.6 grams per cubic centimeter. Given these parameters, the calculated retardation factor for PCE was 28, the retardation factor for TCE was 10.28 (refer to Attachment C).

These compounds exceeded the EPA soil screening guidance levels assuming that there is a dilution attenuation factor of 20 (see Table 1-5). This indicates that there is potential for migration of contaminants from Site 6 subsurface soils to groundwater.

1.5.5.1.2 Metals

In samples collected during both the RI and SDC, several metals were identified in Site 6 subsurface soils that were present in excess of NYSDEC soil cleanup standards. The most prominent of these being iron, manganese, magnesium, and sodium, inorganics which have been prevalent the majority of soil samples collected during the RI, SDC, and SI (ABB, October 1996). Other metals detected in soils included arsenic, beryllium, nickel, and potassium. Although these other metals were detected in soil samples, they were not detected in groundwater samples. The majority of the metals detected were at concentrations close to background concentrations, which, for most of the metals, drives the NYSDEC standards This would indicate that there does not appear to be a migration of metals to groundwater at Site 6.

1.5.5.2 Groundwater

1.5.5.2.1 VOCs

Four VOCs were detected in exceedance of regulatory standards in Site 6 groundwater during the RI and SDC. These included PCE, TCE, cis-1,2-DCE, and vinyl chloride. These compounds were present in concentrations that exceeded NYSDEC DWQS and Federal MCLs for drinking water.

1.5.5.2.2 SVOCs

In samples collected during the RI, several SVOCs were detected in Site 6 groundwater in excess of NYSDEC DWQS. These included 2-methylnaphthalene, acenaphtene, 2,4 dinitrophenol, 4 nitrophenol, phenol, and bis-2 (ethyl hexyl) phthalate (see Table 1-2). In samples collected during the SDC, only bis-2 (ethyl hexyl) phthalate was detected at concentrations below its respective NYSDEC DWQS.

The source of these contaminants is not known. A review of the soils for Site 6 does not indicate that any of these compounds are present in the soils. The retardation factors for these compounds were calculated. Partitioning coefficient data was not available for all of the compounds. However, a review of the retardation values calculated for several of these compounds suggests that they do not travel very far in groundwater. Retardation factors for 2-methylnapthalene, acenapthene, and bis-2, (ethylhexyl) phthalate all exceeded 300 (refer to Attachment C).

1.5.5.2.3 Metals

Several metals were detected in Site 6 groundwater at levels above NYSDEC DWQS. These included iron, magnesium, manganese, sodium. Some metals which were detected in groundwater during the RI were not detected in groundwater samples collected during the SDC, and vise versa, even though the same wells were sampled during both field programs. These metals include thallium, antimony, chromium, and cobalt. In addition, some metals were detected during one sampling round and not detected during the second.

1.5.5.3 Site 6 Summary

Soils
There does not appear to be a pathway for, or risk posed by, the soils at Site 6. This statement is based on the fact that the soil contamination is subsurface, the present and future land use is industrial, and the site is located within a controlled area. However, it does appear that residual chlorinated VOC subsurface soil contamination continues to impact Site 6 groundwater. Therefore, remedial actions associated with the exceedance of NYSDEC soil cleanup standards is investigated as part of this FS.

Groundwater
Evaluation of the contaminants in the groundwater at Site 6 and the contaminants potentially in the soil at Site 6 indicate that the source for the contaminants in the groundwater at Site 6 is residual subsurface soil contamination. Therefore, remedial actions associated with the exceedance of NYSDEC Drinking Water Quality Standards is investigated as part of this FS.

1.6 Tier 1 Risk Assessment Summary

The following section provides a summary of the Tier 1 Risk Assessment prepared for Site 6. The Risk Assessment was originally included with the RI report (ANEPTEK, 2000), and does not include data from the more recent SDC. The purpose of the Risk Assessment was to determine if contaminants were present at the site locations at concentrations that exceeded levels that pose an adverse effect to human health and the environment.

It should be noted that the risk assessment performed is designed to be conservative. That is, in lieu of a full, base line risk assessment, the concentrations detected are compared against prepared standards. These standards may be regulatory limits or guidance levels. The threshold, therefore, is set somewhat lower for remedial action than might otherwise be if the full base line risk assessment was employed. This factor was taken into account when developing and evaluating remedial alternatives.

1.6.1 Action Levels

The following information and source material were used to develop the site-specific action levels used in the performance of the Risk assessment:

- All values used to screen exposure via direct contact (i.e., ingestion of contaminated media, dermal contact with contaminated media, and inhalation of vapors and particles emitted from contaminated media) were taken from the Region IX EPA Preliminary Remedial Goals (PRG). The PRGs combine current EPA toxicity values with standard exposure factors to estimate contaminant concentrations that are protective of humans, over a lifetime.

- Values to screen soil for protection of groundwater (i.e., ingestion of groundwater contaminated by constituents migrating from soil) were taken from EPA's Soil Screening Guidance (SSG). The SSG was developed by the EPA to standardize and accelerate the evaluation of contaminated soils with future residential land use. The SSG provides a methodology for calculating risk-based, site-specific, soil screening levels (SSLs). As part of the Tier 1 risk assessment, the SSLs may be used to identify areas in need of further investigation. The SSG addresses contaminant dilution in groundwater by the incorporation of a dilution attenuation factor (DAF) in the evaluation process. A DAF of 1 corresponds to no contaminant dilution or attenuation (i.e., the concentration of soil leachate equals the concentration of the contaminant at the receptor well). The EPA has selected a DAF of 20, as protective for contaminated soil sources up to 0.5 acres (minimum) in size.

- For soil, values were taken from the NYSDEC document entitled *Technical and Administrative Guidance Memorandum (TAGM) 4046*. In accordance with this TAGM, the soil values were adjusted using the average total organic carbon content from the background soil study.

- For groundwater, values were taken from the NYSDEC document entitled *Ambient Water Quality Standards and Guidance Values and Groundwater Effluent Limitations*. To be consistent with Tier 1 risk assessment methods, the values used were for water class GA, type H(WS). Therefore, the values used provide for protection of sources of drinking water (groundwater). In addition, federal MCLs were compiled and used as screening criteria.

1.6.2 Screening Level Comparison

The Tier 1 risk assessment's screening level comparison is a systematic process in which the sample results are compared to the risk-based and background-based screening levels. As a result of this comparison, chemicals that are chemicals of potential concern (COPC) or chemicals of potential ecological concern (COPEC) are identified. If no chemicals of potential concern or chemicals of potential ecological concern are identified for a site, then there is no unacceptable risk, and a no further action may be appropriate for the site. However, if chemicals of potential concern or chemicals of potential ecological concern are identified, then there may be unacceptable risk to either human health or the environment or both. In this case, either further tier evaluation or interim action or both may be appropriate for the site.

Unlike the screen against risk-based criteria discussed above, the screen against regulatory values does not result in the development of a list of COPCs or COPECs. Screening against such regulatory values, if they are based upon ARARs, results in a list of contaminants of concern (COCs) that must be addressed, and for which remedial action must be taken.

1.6.3 Conclusion

In this Tier 1 risk assessment, an analyte was selected as a COPC if it was detected at a maximum concentration that exceeded the selected action level and the background concentration. If an analyte's concentration exceeded the selected action level, but was less than the calculated background concentration, then it was not selected as a COPC. Following these guidelines, the dominant COPCs are as follows:

<u>Site 6</u>
- Soil - volatile organic compounds and inorganic chemicals (metals).
- Groundwater - volatile organic compounds and inorganic chemicals (metals).

The Tier 1 risk assessment could not conclude that no further action is appropriate at Site 6. However, the Tier 1 risk assessment could also not conclude that remedial action is required. As discussed in the ASTM guidance, because contaminants of potential concern were identified, an evaluation needs to be performed to determine which of the following conditions exists:

1) **<u>Is Remediation to the Tier 1 action levels possible</u>?** In this case, alternatives based on the Tier 1 action levels should be considered. This should include considerations of combinations of remedial technologies, natural attenuation, and institutional controls (ASTM 1998).

2) **<u>Is Remediation to Tier 1 risk-based screening level not possible</u>?** In this case, either interim remedial actions or a further risk assessment may be appropriate. In the former, the goal would be to conduct a partial remedial action to correct easily addressable concerns so that immediate risks are reduced. However, additional risk assessments may be appropriate after these actions are implemented. In the latter, the goal would be to refine the action levels so that information about the concerns at the sites can be refined.

2.0 IDENTIFICATION AND SCREENING OF TECHNOLOGIES

2.1 Introduction

This section describes the identification and screening of technology types and process options that will be used to formulate remedial alternatives. Section 2.2 presents the development of the RAOs, which summarizes the environmental media affected, pertinent contaminants, and exposure pathways. It also develops the preliminary remedial goals to be used in the FS. Section 2.3 presents the general response actions that were developed. It includes an estimate of the area and/or volume of each environmental media that is addressed. Section 2.4 describes the identification of appropriate technologies, and the screening and evaluation of those remedial technologies followed by the selection of representative technologies.

2.2 Remedial Action Objectives

RAOs are developed first in the FS. These objectives are goals that apply to each media or operable unit that will allow protection of human health and the environment. These objectives focus on the contaminant, the exposure route, and the potential receptors.

For protection of human health, remedial objectives should be developed that identify both a contaminant level and an exposure route. Protection of human health may be achieved by implementing measures that restrict exposure to the contaminant. Therefore, an appropriate remedial alternative may be developed and implemented that does not restore the site to background conditions. For protection of environmental receptors, remedial objectives are developed that identify the environmental medium and target cleanup concentrations. Protection of environmental receptors usually involves protecting a resource such as surface water, aquatic life, or groundwater. These resources may not be as effectively protected by measures that solely restrict access.

A review of the contaminants present, the exposure routes, and potential receptors at Site 6 indicates that site soil and groundwater may require remedial action. Site 6 is anticipated to remain as industrial type operational area for the foreseeable future. The human receptors will be limited to workers whose potential exposure will be relatively limited and whose activities can be controlled. Therefore, remedial action objectives for Site 6 soils were developed to be protective of human health. Remedial action objectives for Site 6 groundwater were developed to be protective of human health and the environment. A summary of the identified media, contaminant, and goals is provided in Table 2-1.

Table 2-1
Remedial Action Objectives, Media and Contaminants

Location	Media	Contaminant	Remedial Action Objective
Site 6	**Subsurface Soil**	PCE	Remediate soil below NYSDEC Cleanup Concentrations
		TCE	Remediate soil below NYSDEC Cleanup Concentrations
		Aluminum(2)	N/A Present at or near background concentrations

Table 2-1 (Cont.)

		Arsenic(2)	N/A Present at or near background concentrations
		Beryllium(2)	N/A Present at or near background concentrations
		Chromium(2)	N/A Present at or near background concentrations
		Copper(2)	N/A Present at or near background concentrations
		Iron(2)	N/A Present at or near background concentrations
		Manganese(2)	N/A Present at or near background concentrations
		Mercury(2)	N/A Present at or near background concentrations
		Nickel(2)	N/A Present at or near background concentrations
		Potassium(2)	N/A Present at or near background concentrations
		Zinc(2)	N/A Present at or near background concentrations
Site 6	**Groundwater**	PCE	Remediate below NYSDEC DWQS
		TCE	Remediate below NYSDEC DWQS
		Cis-1,2-DCE	Remediate below NYSDEC DWQS
		Vinyl Chloride	Remediate below NYSDEC DWQS
		Antimony(2)	N/A Due to current and ongoing airport operations
		Arsenic(2)	N/A Due to current and ongoing airport operations
		Cobalt(2)	N/A Due to current and ongoing airport operations
		Chromium(2)	N/A Due to current and ongoing airport operations
		Iron(2)	N/A Due to current and ongoing airport operations
		Lead(2)	N/A Due to current and ongoing airport operations
		Magnesium(2)	N/A Due to current and ongoing airport operations
		Manganese(2)	N/A Due to current and ongoing airport operations
		Nickel(2)	N/A Due to current and ongoing airport operations
		Sodium(2)	N/A Due to current and ongoing airport operations

2.2.1 Remedial Action Objectives: Site 6

Human Health:

There were no human health exposure risks identified with Site 6 soil for the industrial scenario.

Environmental Protection:

Prevent continued migration of contaminants from subsurface soil to groundwater. PCE and TCE were identified in Site 6 soils as exceeding the EPA Soil Screening Level concentrations using a Dilution Attenuation Factor of 20X. PCE was detected at a concentration of 20,000 µg/Kg compared to the DAF 20X level of 60 µg/Kg, TCE was detected at a concentration of 2,800 µg/Kg compared to the DAF 20X level of 60 µg/Kg.

2.3 General Response Actions

General response actions (GRAs) are medium-specific activities that allow implementation of the remedial action objectives. General response actions for soil can include institutional controls, treatment, excavation, disposal, and containment. These actions can be employed by themselves or in combinations to meet the remedial action goals. Also identified during this process are the areas and/or volumes of contamination that may exist for each medium, and to which the general response actions may be applied.

Provided below are the general response actions and estimated areas and/or volumes of contamination that have been identified for Site 6. It should be noted that the areas and volumes of contamination that have been identified as requiring remedial action at each of the sites are an estimate. The information collected during the RI and SDC investigations is generally not sufficient for design and construction cost estimating purposes. However, they are of the appropriate magnitude to allow comparative evaluation during the FS.

2.3.1 Site 6 - Soil

Based on comparisons between soil and groundwater sampling results, it is apparent that the Site 6 subsurface soils are the source of the chlorinated VOC contaminated groundwater at the site. Therefore, general response actions were identified for these soils. The volume of contaminated soil to be addressed lies in the vicinities of SDC soil borings SB-19, SB-25, and SB-26. These areas had a laboratory detection of PCE or TCE in excess of EPA Soil Screening Levels using a Dilution Attenuation Factor of 20 times. In addition, volumes of contaminated soils for the areas of RI soil borings SB-6 and SB-8 were also calculated based on the soil screening results from the RI (Table 1-9). The estimated dimensions (based on an average depth of 8 feet bgs) and total areas of these five locations are as follows:

- SB-25 to SB-26 -- approximately 39 x 12 x 8 = 139 cu/yds
- SB-6 - approximately 13 x 10 x 8 = 39 cu/yds
- SB-8 - approximately 13 x 10 x 8 = 39 cu/yds
- SB-19 - approximately 11 x 10 x 8 = 33 cu/yds

An excavated volume of approximately 325 cu/yds of contaminated soil was estimated (assuming a bulking factor of 30 percent -- refer to Attachment A).

As stated, these volumes are only estimates base on the small area of each location where a sample was collected, the actual volume of soil which may need to be excavated from each location cannot be accurately calculated at this time. Soils will need to be continually screened in the field during the excavation to ascertain the limits of contamination.

The following GRAs were identified as being potentially applicable for Site 6 soil.

General Response Actions: No Action
Institutional Controls
Ex-situ Treatment
In-situ Treatment

2.3.2 Site 6 – Groundwater

Based on comparisons between soil and groundwater sampling results, it is apparent that groundwater at Site 6 is being impacted by chlorinated VOC contaminated subsurface soils. Therefore, general response actions were identified for groundwater.

The following GRAs were identified as being potentially applicable for Site 6 groundwater.

General Response Actions: No Action
Institutional Controls
In-situ Treatment

2.4 Identification and Screening of Technology Types

The first step in the development of remedial alternatives that will address the remedial goals and general response actions is to identify and then screen the possible, available remedial technologies. The selection and screening of technologies are driven by two factors. These include the medium that is contaminated and the nature of the contaminants in the particular medium.

Section 2.4.1 identifies the most likely remedial technologies potentially suitable for remediating the types of contaminants and environmental media found at Site 6. Although there may be other more innovative and relatively new technologies capable of achieving the same objectives, the purpose of this process is to identify technologies that are proven to be effective and are readily available. Section 2.4.2 screens the technologies to select the representative technologies that will be used in the development of remedial alternatives. A representative technology may consist of only one technology or option, or it may be comprised of several technologies.

2.4.1 Identification of Potentially Applicable Remedial Technologies

Technologies that are normally employed in remedial alternatives are those that are likely to be effective in achieving a permanent or temporary solution to the contamination and skilled personnel are available and capable of implementing the technology. For soil and groundwater contaminated chlorinated compounds, there are a number of accepted and proven mitigative technologies. A brief description for each technology and rationale for the selection for possible use in a remedial alternative is provided below.

2.4.1.1 No Action - Soil and Groundwater

Under the no action GRA, the current state of soil and groundwater contamination would not be altered. The no action GRA is carried through to provide a baseline for comparison to other technologies.

2.4.1.2 Institutional Controls – Soil and Groundwater

Institutional controls are a set of possible actions that can reduce the exposure and risk at a site. These controls achieve this by limiting access to the site and the contaminants.

2.4.1.2.1 Fencing – Soil and Groundwater

Institutional controls can include fencing. Construction of fencing around a contaminated site would limit the potential exposure by possible receptors. The fencing could be combined with warning signs to inform of any potential hazard. Note that the entire base is fenced, and only authorized personnel are allowed entry to the Site 6 area.

2.4.1.2.2 Access Restrictions – Soil and Groundwater

Access may be controlled by imposing use restrictions. Future use of the property would be limited to certain activities. Construction of playgrounds, schools, homes, etc. would not be permitted. Also, future use of groundwater could be limited. Control would terminate, however, if NYANG relinquished control of the property, since deed restrictions are not a preferred alternative of USAF or ANG.

2.4.1.3 Ex-Situ Treatment Technologies – Soil and Groundwater

There are several options for remediating contaminated soils and groundwater that involve removal of the contaminated media from the subsurface. For soils, an advantage to these technologies is that they allow determination of remaining soil contaminant concentrations as the contaminated soil is removed, thereby assuring restoration to background conditions, and resulting in a permanent solution. This technology also has the advantage that the contaminated soil can be removed in a relatively short period of time, thereby accelerating the remedial process. Typically, no long-term operation and maintenance costs are incurred.

2.4.1.3.1 Excavation and Off-Site Treatment/Disposal - Soil

This technology relies on the removal of the contaminated soil by excavation. The removed soil is shipped under manifest to a licensed Treatment, Storage, and/or Disposal Facility (TSDF). This technology may have several sub-components depending upon the nature and concentrations of contamination and the appropriate disposal method. The contaminated soil may be buried in a permitted landfill, detoxified by incineration, or cleaned by soil washing or thermal desorption. Given the composition of the soil (silty-clayey till), recycling by asphalt batching is not an option.

The final disposal option can be evaluated during the detailed evaluation of alternatives. However, the final disposition of off-site disposal may be irrelevant, except for cost, and the assurance that any future liability is avoided. Although initial costs may be relatively high, there is usually a much lower long-term operation and maintenance (O&M) cost than is typically associated with other alternatives. This technology can result in a permanent solution that achieves background conditions if clean backfill is used to fill the excavation.

2.4.1.3.2 Excavation and On-Site Treatment/Disposal - Soil

An alternative to off-site disposal is on-site treatment of the excavated soil. On-site treatment options may include biological treatment (land farming), chemical oxidation, soil washing, thermal oxidation and thermal desorption. Removal of the soils has the same advantages discussed above for excavation and off-site disposal. However, on-site treatment of the contaminated soils can result in significant costs savings. In addition, disposal costs, transportation costs, and potential future liability may be eliminated. Also treated soils may be backfilled into the excavation upon achieving the appropriate clean up levels, thereby saving costs for purchase and transport of clean fill material.

An advantage to aboveground biotreatment and/or aeration compared to in-situ bioventing or SVE is that air, nutrients, and water can be applied to the soils more effectively. Soils can also be mixed and measured for residual contamination more effectively. Although chlorinated compounds are not readily amenable to land farming, they can be volatilized during the aboveground mixing process. This treatment option will require a relatively large area for system set-up, operations and maintenance.

An advantage to chemical oxidation, over biological oxidation is reliability, reduced cost of O&M, rapid treatment and the destruction of chlorinated organics. Chemical oxidation will also require less space and can be performed concurrently with the excavation process. The rapid treatment by chemical oxidation will allow the contractor to return the treated soil back to its place of origin in a shorter time frame, restoring the site and reducing the liability of an open excavation.

2.4.1.3.3 Pump and Treat – Groundwater

Ex-situ treatment of groundwater is a much more involved process than soils and is often a long term solution. The most typical application of this sort is a pump and treat system in which contaminated groundwater is pumped from the leading edge of the plume, treated through air stripping or carbon filters, and returned to the aquifer at an up-gradient location or discharged into an approved location.

2.4.1.4 In-Situ Treatment Technologies - Soil and Groundwater

In-situ technologies remediate the soil or groundwater without excavating it. These technologies are generally less intrusive and lower cost. The time required to achieve the cleanup goals is typically longer than for ex-situ technologies, however.

2.4.1.4.1 Soil Vapor Extraction - Soil

Soil vapor extraction (SVE) is normally employed for the removal of volatile organic compounds (VOCs) located within the soil matrix in the unsaturated (vadose) zone. This technology is targeted at removing these VOCs from the soil matrix by mass transfer from the soil to the soil gas. During operation, this technology extracts contaminated air from the soil and replaces it with cleaner air. Additional contaminants adsorbed to the soil then transfer to the cleaner air, which is subsequently removed in a continuous process.

2.4.1.4.2 Bioventing - Soil

Bioventing is typically used for the remediation of petroleum-contaminated soils. It is similar to soil vapor extraction, the exception being that a lower volume of air is usually extracted/injected. The purpose of this technology is to oxygenate the vadose zone, stimulating indigenous microorganism that may biodegrade the soil contaminants. Unlike SVE, the goal of bioventing is to minimize the amount of volatilization and vapor extraction. This technology is more appropriate for sites with contaminants that may not be highly volatile, but are biodegradable under aerobic conditions. Therefore, this technology is best suited for petroleum hydrocarbons (fuels, oil etc.) and is less applicable for chlorinated organics (e.g. PCE, TCE etc.).

2.4.1.4.3 Bio-Sparging – Groundwater

Bio-sparging is an in situ technology in which air is injected through a contaminated aquifer. Injected air traverses horizontally and vertically in channels through the soil column, creating an underground stripper that removes contaminants by volatilization. This injected air helps to flush (bubble) the contaminants up into the unsaturated zone where a vapor extraction system is usually implemented in conjunction with air sparging to remove the generated vapor phase contamination. This technology is designed to operate at high flow rates to maintain increased contact between ground water and soil and strip more ground water by sparging. Oxygen added to contaminated ground water and vadose zone soils can also enhance biodegradation of contaminants below and above the water table. Air sparging has a medium to long duration which may last, generally, up to a few years.

2.4.1.4.4 Chemical Oxidation – Groundwater

Chemical oxidation converts hazardous contaminants to non-hazardous or less toxic compounds that are more stable, less mobile, and/or inert. The chemical oxidants most commonly employed to date include peroxide, ozone, and permanganate. These oxidants have been able to cause the rapid and complete chemical destruction of many toxic organic chemicals; other organics are amenable to partial degradation as an aid to subsequent bioremediation. In general the oxidants have been capable of achieving high treatment efficiencies (*e.g.*, > 90 percent) for unsaturated aliphatic (*e.g.*, trichloroethylene [TCE]) and aromatic compounds (*e.g.*, benzene), with very fast reaction rates (90 percent destruction in minutes). Field applications have clearly affirmed that matching the oxidant and *in situ* delivery system to the contaminants of concern (COCs) and the site conditions is the key to successful implementation and achieving performance goals.

2.4.1.4.5 Enhanced Bioremediation – Groundwater

Enhanced bioremediation is a process in which indigenous or inoculated micro-organisms (e.g., fungi, bacteria, and other microbes) degrade (metabolize) organic contaminants found in soil and/or ground water, converting them to innocuous end products. Nutrients, oxygen, or other amendments may be used to enhance bioremediation and contaminant desorption from subsurface materials.

2.4.1.4.6 Monitored Natural Attenuation – Soil and Groundwater

This technology/process allows contaminants in soil and groundwater to naturally diminish over time. Contaminant reduction is achieved by flushing of the contaminants by infiltrating precipitation, volatilization through the unsaturated vadose zone, and *In-Situ* biodegradation.

Depending upon the solubility of the contaminant, infiltrating water can solubilize and remove contaminants adsorbed to the soil particles. These contaminants would then be transported to the groundwater table. However, if the concentrations are low enough, negative impacts to groundwater quality may be minimal.

Volatilization of the contaminants may occur if the overlying soils are relatively permeable, and the contaminants are relatively volatile. Over time, the contaminant absorbed to the soil particles will partition to the air within the soil matrix. If the contaminant has a low vapor density and the soil temperatures are warmed, the contaminant can migrate upward into the atmosphere.

In-Situ biodegradation of the adsorbed contaminants can also occur. If soil contaminant concentrations do not saturate the soil pore spaces, microorganisms can grow within the soil matrix and use the organic contaminants as growth substrate. If oxygen is capable of diffusing through the overburden soil to the contaminants, aerobic biodegradation may occur. Additionally, several anaerobic biological processes have been linked to the degradation of organic contaminants, including chlorinated compounds: iron reduction, methanogenesis, nitrate reduction, and sulfate reduction.

Critical factors for natural attenuation to occur include permeable soils, a relatively shallow depth from the ground surface, a water table below the zone of contamination, volatile contaminants, biodegradable contaminants, and the presence of microorganisms. A Fate and Transport Study completed with the RI concluded that the contaminants at Sites 3 and 6 are, and will likely continue to be strongly sorbed by the overburden soil, slowly leaching over time to the groundwater (ANEPTEK 2000). Although an evaluation of natural attenuation parameters has not yet been performed, the presence of the 1,2-DCE and vinyl chloride (PCE and TCE breakdown products) in the soil and groundwater at Site 6 indicates that *In-Situ* degradation of chlorinated VOCs is possible.

2.4.1.4.7 Stabilization - Soil

Stabilization technologies are used to minimize the migration of contaminants in soil. The stabilization of contaminated soils thereby can be used to minimize the risk posed by those soils. The stabilization of contaminants in soils is achieved by mixing a stabilizing agent such as lime, cement, clay or a similar material to retain contaminants in the soil. The addition of these materials either forms an encapsulating matrix or forms a bond with the contaminant itself.

While stabilization is typically employed for heavy metals and asbestos it can also be effective at stabilizing relatively low concentrations of petroleum hydrocarbons and chlorinated compounds. Since heavy metals and relatively low concentrations of petroleum and chlorinated compounds have been detected in one or more of the sites this technology may be potentially useful for incorporation in a remedial alternative.

2.4.1.4.8 Capping - Low Permeability Cover – Soil and Groundwater

The technology consists of placing a low permeability cover over the area of contaminated soil at the ground surface. The cover may be constructed of a geomembrane, geotextile, or soil, in combination, or alone. This technology also does not treat the contaminated soils. However, it is used to reduce the risk posed by the presence of the contaminated soils by covering the contaminated soils with a low permeable cover and providing a barrier. This can prevent direct exposure to possible receptors.

Construction of a low permeability cover can also reduce the continued migration of contaminants from the soil to another media such as air or groundwater. In particular, placing a low permeability cover over contaminated soils eliminates or sharply reduces the amount of infiltrating water that could flow through the soils and thereby leach out contaminants to the groundwater. Placement of a cover may also allow soils with higher levels of contaminants to remain in place without any further action.

Critical factors for this technology to be effective are the presence of the contaminants above the groundwater table, the tendency of the contaminants to remain immobilized in the soil matrix, and an appropriate future use of the site that allows a constructed cover. These factors appear to be applicable at both Sites 3 and 6. Therefore, this option may be appropriate.

2.4.2 Selection of Representative Technologies

A review and assessment of the suitability of the remedial technologies described previously in Section 2.4.1 was performed in order to select the optimum technologies for remedial alternative formulation. Although all of the described technologies selected in Section 2.4.1 have some level of applicability, some were determined to be more appropriate based upon site limitations, the mix of contaminants present, and possible implementation concerns. The remaining RAO is the remediation of approximately 174 cubic yards of chlorinated VOCs (PCE and TCE) contaminated soil at Site 6. The screening of the remedial technologies for the soil at Site 6 is summarized in Table 2-2, technologies for the remediation of groundwater are summarized in Table 2-3.

2.4.2.1 Technologies Eliminated

A brief rationale for the affected media and the technologies eliminated is provided below.

2.4.2.1.1 Soil Vapor Extraction - Soil

The critical variables for the evaluation of SVE are the volatility of the contaminants, the permeability of the soils and the depth to groundwater. The identified contaminants in the soil at the sites include those with moderate to high volatilization potential, although some of the petroleum hydrocarbons have relatively low volatilization factors. Yet, due to the relatively low intrinsic permeability of the site soils (silty-clayey till), and the shallow groundwater present at both site

ess Option Screening
– Site 6, Soil

ffectiveness	Implementability	Cost	Pass Primary Screen?	Secondary Screening Comments
ıtion not controlled or diation objectives may not	Readily implementable.	No Cost.	No	Retained per CERCLA
r risk by restricting future ıdwater use. Remediation not be achieved.	Readily implementable.	Capital – L No O&M Costs	Yes	Retained
s to contaminated area.	Readily implementable. Facility fencing currently exists around base.	Capital – L O&M - L	Yes	Retained
ımination from area. esponsibility for material	Readily implementable.	Capital – M No O&M Costs	No	Off-site land disposal without prior treatment is not a preferred alternative of the ANG.
ımination from area. are thermally destroyed.	Readily implementable.	Capital – H No O&M Costs	Yes	Retained
ımination from area. are chemically removed	Not Readily implementable. Few off-site soil washing facilities exist. Total yardage of material is insufficient to warrant on-site mobilization.	Capital – H No O&M Costs	No	
ımination from area. are thermally destroyed neration, but lower	Readily implementable.	Capital – H No O&M Costs	Yes	Retained
Given the composition of layey till), recycling by g is not an option.	Readily implementable	Capital – M No O&M Costs	No	Not effective.
ımination from area. are removed from the soil. aced back in excavation.	Not Readily implementable. Total yardage of material is insufficient to warrant on-site mobilization	Capital – H No O&M Costs	No	High mobilization costs require large volume of material to reduce unit cost.

Table 2-2 (Cont.)

Remedial Technology and Process Option Screening
Schenectady ANG Base – Site 6, Soil

General Response Action	Remedial Technology Type	Process Option	Description	Effectiveness	Implementability	Cost	Pass Primary Screen?	Secondary Screening Comments
		Excavation and chemical oxidation	Excavation of contaminated material, onsite chemical treatment, replacement of cleaned soil in excavation.	Removes contamination from area. Contaminants are removed from the soil. Clean soil is placed back in excavation.	Not Readily implementable. Total yardage of material is insufficient to warrant on-site mobilization	Capital – H No O&M Costs	No	High mobilization costs require large volume of material to reduce unit cost.
		Excavation and soil washing	Excavation of contaminated material, onsite soil washing, replacement of cleaned soil in excavation.	Removes contamination from area. Contaminants are chemically removed from the soil. Clean soil is placed back in excavation.	Not Readily implementable. Total yardage of material is insufficient to warrant on-site mobilization.	Capital – H No O&M Costs	No	High mobilization costs require large volume of material to reduce unit cost.
		Thermal oxidation	Excavation of contaminated material, onsite thermal treatment, replacement of cleaned soil in excavation.	Removes contamination from area. Contaminants are removed from the soil. Clean soil is placed back in excavation.	Not Readily implementable. Total yardage of material is insufficient to warrant on-site mobilization	Capital – H No O&M Costs	No	High mobilization costs require large volume of material to reduce unit cost.
		Thermal desorption	Excavation of contaminated material, onsite thermal treatment, replacement of cleaned soil in excavation.	Removes contamination from area. Contaminants are removed from the soil. Clean soil is placed back in excavation.	Not Readily implementable. Total yardage of material is insufficient to warrant on-site mobilization	Capital – H No O&M Costs	No	High mobilization costs require large volume of material to reduce unit cost.
In-situ Treatment	Stabilization	Low permeable cover	Placing a low permeability cover over the area of contaminated soil at the ground surface. The cover may be constructed of a geomembrane, geotextile, or soil.	Effective in covering material and limiting infiltration from the surface, but not in removing contamination.	Readily implementable	Capital – M O&M – M	No	High cost. No guarantee migration of contaminants from soil to groundwater will not occur.
		Stabilization	The stabilization of contaminants in soils is achieved by mixing a stabilizing agent such as lime, cement, clay or a similar material to retain contaminants in the soil.	Effective in stabilizing material, but not in removing contamination.	Readily implementable	Capital – M O&M – M	No	Not a preferred alternative of the ANG.
	In-situ Biological Treatment	Bioventing	This technology is targeted at removing these VOCs from the soil matrix by mass transfer from the soil to the soil gas. Lower volume than SVE.	Not effective on chlorinated compounds (PCE, TCE).	Readily implementable	Capital – M O&M – M	No	
	In-situ Physical/ Chemical Treatment	Soil Vapor Extraction	This technology is targeted at removing these VOCs from the soil matrix by mass transfer from the soil to the soil gas	Not effective on chlorinated compounds (PCE, TCE).	Readily implementable	Capital – M O&M – M	No	
		Monitored Natural Attenuation	This allows natural degradation of components to occur. Monitoring is performed to ensure no migration and measure progress.	Potentially effective, but much slower than other alternatives.	Readily implementable	Capital – L O&M – M	Yes	Retained

Remedial Technology and Process Option Screening
Schenectady ANG Base – Site 6, Groundwater

General Response Action	Remedial Technology Type	Process Option	Description	Effectiveness	Implementability	Cost	Pass Primary Screen?	Secondary Screening Comments
No Action	None	None	No further actions to address contaminated soil. Natural attenuation may occur, but no monitoring activities will be conducted to measure effectiveness. Under CERCLA, No Action is considered a baseline alternative to compare the effectiveness and cost of other technologies/alternatives.	Soil contamination not controlled or treated. Remediation objectives may not be achieved.	Readily implementable.	No Cost.	No	Retained per CERCLA
Institutional Controls	Access and Use Restrictions	Use Restrictions	Use of property will be restricted administratively. Control would terminate if base passes from control of NYANG, since deed restrictions are not an option to USAF or ANG.	Reduces further risk by restricting future land and groundwater use. Remediation objectives may not be achieved.	Readily implementable.	Capital – L No O&M Costs	Yes	Retained
		Fences	Security fences installed around potentially contaminated areas to limit access.	Restricts access to contaminated area.	Readily implementable. Facility fencing currently exists around base.	Capital – L O&M - L	Yes	Retained
Ex-situ Treatment and Disposal	Pump and Treat System	Pump and treat contaminated groundwater using air stripping	Contaminated groundwater is pumped from aquifer. Contaminants are partitioned from the groundwater by greatly increasing the surface area of the contaminated water exposed to air. Contaminants volatilize to atmosphere.	Removes contamination from groundwater. Effective on VOCs.	Readily implementable.	Capital – M O&M - H	No	High cost of O&M.
		Pump and treat contaminated groundwater using carbon filters	Contaminated groundwater is pumped from aquifer and passed through activated carbon filter(s). Filtered water is returned to aquifer or discharged to appropriate area.	Removes contamination from groundwater. Contaminants are captured by carbon filter(s). Effective on VOCs.	Readily implementable.	Capital – M O&M - H	No	High cost of O&M.
In-situ Treatment	Stabilization	Low permeable cover	Placing a low permeability cover over the area of contaminated soil at the ground surface. The cover may be constructed of a geomembrane, geotextile, or soil.	Effective in covering material and limiting infiltration from the surface to groundwater, but not in removing contamination.	Readily implementable	Capital – M O&M – M	No	High cost. No guarantee migration of contaminants from soil to groundwater will not occur.
	In-situ Biological Treatment	Bio-Sparging	This technology is targeted at removing these VOCs from the groundwater by mass transfer from the groundwater to the soil gas to the atmosphere.	Not effective on chlorinated compounds (PCE, TCE).	Readily implementable	Capital – M O&M – M	No	
		Enhanced Bioremediation	Indigenous micro-organisims metabolize organic contaminants in groundwater converting them to innocuous end products. Chemical additives (such as HRC®) used to enhance bioremediation and contaminant desorption.	Effective on chlorinated compounds (PCE, TCE).	Readily implementable	Capital – M O&M – M	Yes	Retained
	In-situ Physical/ Chemical Treatment	Chemical Oxidation	Chemical oxidation converts hazardous contaminants to non-hazardous or less toxic compounds.	Effective on chlorinated compounds (PCE, TCE).	Readily implementable	Capital – M O&M – M	No	Requirement for large quzntities of hazardous oxidizers due to oxidant demand, unproductive oxidant consumption of fomation, oxidants pose hazardous risk to workers.
		Monitored Natural Attenuation	This allows natural degradation of components to occur. Monitoring is performed to ensure no migration and measure progress.	Potentially effective, but much slower than other alternatives.	Readily implementable	Capital – L O&M – M	Yes	Retained

locations, the effectiveness of SVE will be dramatically reduced. Therefore, SVE is not a viable remedial technology.

2.4.2.1.2 Bioventing - Soil

The critical factors for the evaluation of this technology are biodegradability of the contaminants, permeability of the soils, and the presence of indigenous microorganisms. The predominant contaminants at Site 6 are chlorinated VOCs, which are not considered to be readily biodegradable under aerobic conditions. Therefore, bioventing is not an appropriate remedial technology.

2.4.2.1.3 Stabilization/Capping – Soil and Groundwater

While this technology could potentially reduce the risks at the sites, it provides less certainty than other technologies. Although the contaminants might be stabilized and prevented from migration into groundwater or to human or environmental receptors, the contaminants would remain on-site. Therefore, the site would not be restored to background concentrations, and limitations to future site use would be required. It is also likely that the stabilized soil would need to be protected by a low permeability cover to minimize degradation of the stabilized matrix. This is not a preferred remedial option by the ANG. Therefore, it is eliminated from use at these sites.

2.4.2.1.4 Excavation & On-Site Treatment - Soil

Although the on-site treatment of excavated soils will likely reduce the concentrations of organic contaminants, the concentrations of inorganic contaminants will not be significantly affected. This would require the additional treatment by stabilization (and possible need for a low permeability cover) to produce a soil that could be left at the site location. Treatment by stabilization would require the implementation of institutional controls or restricted site use. Therefore, this option is not recommended for use locations with elevated metals in the soils. Since Site 6 possesses metals contaminated soil, the treatment option was eliminated as a potential representative technology.

2.4.2.2 Technologies Retained

The technologies that were retained for use in developing remedial alternatives are provided below. This list of technologies was determined to be the most practical types of technologies for application at this site. One or more of these technologies will be subsequently used, either alone, or in combination with another technology to develop an alternative appropriate for the medium of concern.

No Action

No action is retained to provide a baseline for comparison to other technologies.

Institutional Controls

Fencing/Access Restrictions

locations, the effectiveness of SVE will be dramatically reduced. Therefore, SVE is not a viable remedial technology.

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The critical factors for the evaluation of this technology are biodegradability of the contaminants, permeability of the soils, and the presence of indigenous microorganisms. The predominant contaminants at Site 6 are chlorinated VOCs, which are not considered to be readily biodegradable under aerobic conditions. Therefore, bioventing is not an appropriate remedial technology.

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Although the on-site treatment of excavated soils will likely reduce the concentrations of organic contaminants, the concentrations of inorganic contaminants will not be significantly affected. This would require the additional treatment by stabilization (and possible need for a low permeability cover) to produce a soil that could be left at the site location. Treatment by stabilization would require the implementation of institutional controls or restricted site use. Therefore, this option is not recommended for use locations with elevated metals in the soils. Since Site 6 possesses metals contaminated soil, the treatment option was eliminated as a potential representative technology.

2.4.2.2 Technologies Retained

The technologies that were retained for use in developing remedial alternatives are provided below. This list of technologies was determined to be the most practical types of technologies for application at this site. One or more of these technologies will be subsequently used, either alone, or in combination with another technology to develop an alternative appropriate for the medium of concern.

No Action

No action is retained to provide a baseline for comparison to other technologies.

Institutional Controls

Fencing/Access Restrictions

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Fencing and other access restrictions are a low-cost, effective away of controlling risk by limiting the receptors. Although the contamination remains on the site, this alternative is retained, since it is protective of human health.

Ex-Situ Technologies - Soil

Excavation, Treatment, and Disposal

Excavation, Treatment and Off-site Disposal is retained as for further evaluation since it is responsive to removing the contamination, protecting human health, and offering a final solution.

In-Situ Technologies – Soil and Groundwater

Natural Attenuation and Monitoring

The presence of PCE and TCE breakdown products at the site indicate that natural attenuation is feasible. This technology will be retained for further evaluation.

Enhanced Bioremediation

The presence of PCE and TCE breakdown products at the site indicate that natural attenuation is feasible. The addition of chemical additives to the already occurring natural attenuation will considerably shorten the duration of bioremediation. This technology will be retained for further evaluation.

3.0 DEVELOPMENT AND SCREENING OF ALTERNATIVES

Following selection of the optimal practical remedial technologies, remedial alternatives were developed for Site 6. These alternatives were developed using general response actions. This was accomplished using one or more of the selected remedial technologies. The goal was to develop potential remedial alternatives that are capable of achieving the remedial action objectives.

<u>Site 6</u>
A total of five remedial alternatives were developed for both Site 6 soil and groundwater. The remedial alternatives are listed below and are briefly described in the following paragraphs.

Alternative 6-1: No Action – Soil and Groundwater

Alternative 6-2: Institutional Controls – Soil and Groundwater

Alternative 6-3: Excavation, Treatment (Incineration/Thermal Desorption) and Off-Site Disposal - Soil

Alternative 6-4: Natural Attenuation and Monitoring –Soil and Groundwater

Alternative 6-5: Enhanced Bioremediation - Groundwater

3.1 Development of Remedial Alternatives

Alternatives developed in Section 2 are evaluated in this section against the short-and long-term aspects of three broad criteria: effectiveness, implementability, and cost. Because the purpose of the screening evaluation is to reduce the number of alternatives that will undergo a more thorough and extensive analysis, alternatives will be evaluated more generally in this phase than during the detailed analysis.

The three criteria used in the screening of the alternatives in this section are defined in the following sections.

3.1.1 Effectiveness Evaluation

A key aspect of the screening evaluation is the effectiveness of each alternative in protecting human health and the environment. Each alternative is evaluated as to its effectiveness in providing protection and the reductions in toxicity, mobility, or volume that it will achieve. Both short- and long-term components of effectiveness are evaluated; short-term referring to the construction and implementation period, and long-term referring to the period after the remedial action is complete. Reduction of toxicity, mobility, or volume refers to changes in one or more characteristics of the hazardous substances or contaminated media by the use of treatment that decreases the inherent threats or risks associated with the hazardous material.

3.1.2 Implementability Evaluation

Implementability, as a measure of both the technical and administrative feasibility of constructing, operating, and maintaining a remedial action alternative, is used during screening to evaluate the combinations of process options with respect to conditions at a specific site. Technical feasibility refers to the ability to construct, reliably operate, and meet technology-specific regulations for process options until a remedial action is complete; it also includes operation, maintenance, replacement, and monitoring of technical components of an alternative, if required, into the future after the remedial action is complete. Administrative feasibility refers to the ability to obtain approvals from other offices and agencies; the availability of treatment, storage, and disposal services and capacity; and the requirements for, and availability of, specific equipment and technical specialists.

3.1.3 Cost Evaluation

The cost of implementing the remedial alternative is the final factor considered in the screening process. Since this section includes a general analysis based on media-specific categories, no cost figures are presented in this section. The cost analysis in this section is a relative cost comparison of the alternatives. All lifecycle costs (e.g., capital and O&M costs) are considered in this evaluation.

3.2 Screening of Remedial Alternatives for Site 6 Soil and Groundwater

The following sections describe the screening of the remedial alternatives specific to Site 6 soil and groundwater. Contamination exists at the Site 6 area in soils that exceed NYSDEC cleanup concentrations, and in Site 6 groundwater that exceed NYSDEC DWQS. Additionally, using EPA soil screening level guidance and assuming a dilution attenuation factor of 20 times, there is a potential for contaminants to migrate into groundwater.

3.2.1 No Action Alternative

The no-action alternative provides a baseline for comparing other alternatives. Because no remedial activities would be implemented with the no-action alternative, long-term human health and environmental risks for the site essentially would be the same as those identified in the baseline risk assessment.

3.2.1.1 Effectiveness

Under the no action alternative, there would be no reduction in volume of contaminated soil or in its potential for migration. The no action alternative is not effective.

3.2.1.2 Implementability

There are no actions to implement under this alternative.

3.2.1.3 Cost

There is no cost associated with this alternative.

3.2.2 Institutional Controls Alternative – Soil and Groundwater

Under this alternative, there would be some institutional controls placed in the area. There would also have to be assurances that the property would remain secured and non-residential. However, no additional fencing installation or warning signs would be needed as this is already a secured area.

3.2.2.1 Effectiveness

Under the institutional controls alternative there would be no reduction in volume of contaminated soil or in its potential for migration. Access to subsurface soil and groundwater would be controlled by administrative means.

3.2.2.2 Implementability

Since the site is under the control of the NYANG, this alternative is readily implementable.

3.2.2.3 Cost

The cost associated with this alternative is minimal, primarily consisting of posting limits on uses of the site and imposing restrictions on future uses of the site.

3.2.3 Excavation, Treatment and Off-Site Disposal Alternative - Soil

The contaminants exceeding the NYSDEC soil cleanup concentrations and EPA soil screening level guidance levels at the 20X dilution attenuation factor appear to be limited to a zone of soil in the weathered bedrock at the southern portion of the site.

This alternative would eliminate soil contamination in excess of the NYSDEC soil cleanup concentrations. Any vegetation would be cleared in the immediate area and the soils would be excavated to a depth of approximately seven (7) feet below the ground surface. Field screening will be performed on the excavation sidewalls and bottom to monitor this process. The contaminated soil/weathered bedrock will be excavated and placed into lined, approved roll off containers.

Upon receiving acceptable field screening results, a soil confirmation program will be implemented. With "clean" confirmation established, the excavations will be back filled with confirmed clean material from the excavation and off-site pea gravel and sand material and restored to original grade with topsoil. The excavated areas will be seeded to reestablish vegetation. This alternative would restore the site to background conditions. This alternative would not require any limitations on the use or activities at this site location.

The excavated soil would be transported to an off-site treatment, storage and disposal facility

(TSDF) for thermal treatment prior to disposal. In this way, the contamination would be destroyed or inerted prior to disposal.

3.2.3.1 Effectiveness

Under this alternative, contaminated soil would be excavated, treated and disposed of off-site. Critical factors for this alternative include the depth of contaminated soil and the availability of TSDFs for the contaminated soil. The depth to the groundwater table at Site 6 is approximately 8 feet below the ground surface From this perspective, excavation would be a cost-effective approach to site remediation. Overall, this alternative is effective.

3.2.3.2 Implementability

All technologies implemented under this alternative are proven and established. The contamination is fairly shallow (less than ten feet bgs), and the excavation of the soil should not be difficult. Also, TSDFs are readily available. Due to the limited volume of soil, even though the cost is relatively high, the overall project cost is not excessive. This alternative is readily implementable.

3.2.3.3 Cost

The cost for this alternative is moderate (approx. $61,000). The cost could rise if additional contaminated soil is identified, and the volume of soil to be treated increases. Transport, treatment and disposal of the contaminated soil is the largest component of the cost for this alternative.

3.2.4 Natural Attenuation with Monitoring Alternative – Soil and Groundwater

This alternative relies on the natural attenuation of the chlorinated solvents. Since it is a strictly natural process, the main component of this alternative is the monitoring of the area and preparation of periodic reports on the progress of the attenuation.

3.2.4.1 Effectiveness

Under this alternative, natural attenuation would be allowed to progress and would be monitored. The presence of PCE and TCE breakdown products at the site indicate that natural attenuation is feasible. The time-frame for reduction of the soil and groundwater concentrations to less than NYSDEC standards has not been determined. Overall, this alternative is potentially effective.

3.2.4.2 Implementability

This alternative relies on sampling and analysis to demonstrate the effectiveness. Monitoring wells to be used under this alternative have already been installed. This alternative is readily implementable.

3.2.4.3 Cost

The cost for this alternative is moderate (between $10,000 and $100,000). The cost could rise if additional monitoring wells are required. The primary component of cost for this alternative is the annual monitoring requirement, extended for thirty years, however, if after a period of time the results indicate contaminants are being attenuated, this time frame may be shortened pending NYSDEC approval.

3.2.5 Enhanced Bioremediation - Groundwater

3.2.5.1 Effectiveness

Under this alternative, natural attenuation would be accelerated through the introduction of chemical additives. Monitoring the progress of this alternative would be included. The presence of PCE and TCE breakdown products at the site indicate that natural attenuation is occuring. The time-frame for reduction of groundwater concentrations to less than NYSDEC DWQS has not been determined. Overall, this alternative is potentially effective.

3.2.5.2 Implementability

This alternative relies on introduction of the chemical additives to the groundwater. Using existing site monitoring wells in conjunction with additional injection wells would make this alternative very time and cost effective. Additional sampling and analysis will need to be conducted to demonstrate the effectiveness. This alternative is readily implementable.

3.2.5.3 Cost

Cost for this alternative is approximately $353,463, based on sampling 4 wells for two years on a quarterly basis. This cost includes QA/QC samples. The cost for this alternative is high. The cost could rise if additional monitoring wells are required. The primary component of cost for this alternative is the annual monitoring requirement, extended for thirty years, however, if after a period of time the results indicate contaminants are being attenuated, this time frame may be shortened pending NYSDEC approval.

4.0 DETAILED ANALYSIS OF ALTERNATIVES

4.1 Introduction

The alternatives developed in Section 3.0 are analyzed and evaluated in this section. The purpose of this analysis is to assess the merits of each alternative to facilitate the selection of the most appropriate remedial alternative by decision-makers. Section 4.2 briefly describes the assessment criteria. Section 4.3 provides an analysis of each alternative. Section 4.4 provides a comparative analysis of the alternatives to one another.

4.2 Assessment Criteria

The evaluation involves comparing the alternatives against a set of nine criteria (EPA, 1988). The nine criteria are grouped into three categories: threshold, balancing, and modifying. The five remedial alternatives that were developed were evaluated against the nine criteria, listed below:

<u>Threshold Criteria</u>
- Overall Protection of Human Health and the Environment
- Compliance with ARARs

<u>Balancing Criteria</u>
- Long-term Effectiveness and Permanence
- Reduction of Toxicity, Mobility, or Volume Through Treatment
- Short-term Effectiveness
- Implementability
- Cost

<u>Modifying Criteria</u>
- State Acceptance
- Community Acceptance

These criteria are described in detail in the following paragraphs:

4.2.1 Threshold Criteria

Threshold criteria must be met or complied with by the remedial action. These criteria include the following:

4.2.1.1 Overall Protection of Human Health and the Environment

This criterion is used to evaluate how well the alternative will be protective of human health and the environment. It specifically looks at how the risks through each pathway are eliminated, reduced, or controlled through the proposed remedial measures.

4.2.3 Modifying Criteria

State and community acceptance of the proposed remedial action is an important component in the selection process. The proposed remedy will be reviewed by the state and community representatives, and their concerns will be addressed prior to implementation. The following are termed modifying criteria:

4.2.3.1 State Acceptance

This criterion reflects the state's (or support agency's) apparent preferences among or concerns about alternatives.

4.2.3.2 Community Acceptance

This criterion reflects the community's apparent preferences among or concerns about alternatives.

4.3 Individual Analysis of Alternatives

The following pages detail the relative merits of the proposed remedial alternatives for Site 6. Each of the remedial alternatives is evaluated in the form of a brief paragraph describing the remedial alternative's ability to satisfy each of the requisite criteria.

4.3.1 Alternative 6-1: No Action – Soil and Groundwater

Overall Protection of Human Health and the Environment: This alternative would employ no active measures at the site. Because any contaminated soils and groundwater exist below the ground surface, no direct surface exposure will occur. This alternative does not eliminate the potential for soil contamination to leach to groundwater, nor does it address the present groundwater contamination. Therefore, this alternative is ranked **low**, in regard to this criterion.

Compliance with ARARs: Because this alternative does not remove or treat the contaminated soil or groundwater, the concentrations of contaminants in the soil and groundwater that are above NYSDEC cleanup concentrations and DWQS will continue to exist until they are attenuated by flushing, etc. Therefore, this alternative is scored **low** in meeting the requirements of this criterion.

Long-term Effectiveness and Permanence: No action will be taken. Contamination in the soil will continue to leach out of the soil and contaminate groundwater. As a result, this alternative will not have long-term effectiveness. Because of the potential for contribution to groundwater contamination, this alternative is ranked **low** in regard to this criterion.

Reduction of Toxicity, Mobility, or Volume Through Treatment: This alternative does not involve treatment of the contaminants. As a result, it is ranked **low** for this criterion.

Short-term Effectiveness: This alternative will not involve excavation of the soil or treatment of groundwater. Therefore, there will be no impact to human health, or the environment, as a result of the implementation of this alternative. This alternative ranks **high** in meeting the objectives of this criterion.

Implementability: There is nothing to implement for this alternative. Therefore, it is ranked **high** against this criterion.

Cost: Costs for each alternative are developed in Attachment B. There are no costs associated with this alternative. Therefore, the comparison of this alternative against this criterion results in a **high** ranking.

State Acceptance: Since this alternative leaves the contamination in place at levels exceeding the NYSDEC regulatory standards for soil and groundwater, it is unlikely to receive state support. Therefore, this alternative is ranked **low** against this criterion.

Community Acceptance: Since this alternative leaves the contamination in place at levels exceeding the NYSDEC regulatory standards for soil and groundwater, it is unlikely to receive community support. Therefore, this alternative is ranked **low** against this criterion.

4.3.2 Alternative 6-2: Institutional Controls – Soil and Groundwater

Overall Protection of Human Health and the Environment: This alternative would employ no active measures at the site. Because contaminated soils and groundwater exist below the ground surface, no direct surface exposure will occur. This alternative does not eliminate the potential for soil contamination to leach to groundwater. Institutional controls would be put in place to limit access to subsurface soils and groundwater. Therefore, this alternative is ranked **moderate**, in regard to this criterion.

Compliance with ARARs: Because this alternative does not remove or treat the contaminated soil or groundwater, the concentrations of contaminants that are above NYSDEC cleanup concentrations and DWQS will continue to exist until they are attenuated by flushing, etc. Therefore, this alternative is scored **low** in meeting the requirements of this criterion.

Long-term Effectiveness and Permanence: No action will be taken. Contamination in the soil may continue to leach out of the soil and into the groundwater. As a result, this alternative will not have long-term effectiveness. Control would terminate if NYANG relinquished control of the property, since deed restrictions are not a preferred alternative of USAF or ANG. Because of the potential for contribution to groundwater contamination, this alternative is ranked **low** in regard to this criterion.

Reduction of Toxicity, Mobility, or Volume Through Treatment: This alternative does not involve treatment of the contaminants. As a result, it is ranked **low** for this criterion.

Short-term Effectiveness: This alternative will not involve excavation of the soil or treatment of groundwater. Therefore, there will be no impact to human health, or the environment, as a result of the implementation of this alternative. This alternative ranks **high** in meeting the objectives of this criterion.

Implementability: Since the facility is fully overseen by the NYANG, institutional controls will be easily enacted. Therefore, it is ranked **high** against this criterion.

Cost: Costs for each alternative are developed in Attachment B. There are minimal costs (approximately $2,000) associated with this alternative. Therefore, the comparison of this alternative against this criterion results in a **high** ranking.

State Acceptance: Since this alternative leaves the contamination in place at levels exceeding the NYSDEC soil and groundwater regulatory standards, it is unlikely to receive state support. Therefore, this alternative is ranked **low** against this criterion.

Community Acceptance: Since this alternative leaves the contamination in place at levels exceeding the NYSDEC soil and groundwater regulatory standards, it is unlikely to receive community support. Therefore, this alternative is ranked **low** against this criterion.

4.3.3 Alternative 6-3: Excavation, Treatment and Off-Site Disposal - Soil

Overall Protection of Human Health and the Environment: This alternative would potentially eliminate the contaminants from the soil. The remaining soil or clean backfill would not contribute contaminants to the site groundwater. Therefore, this alternative would be highly protective and is rated **high** when compared to this criterion.

Compliance with ARARs: Excavation of contaminated site soils would comply with NYSDEC soil cleanup concentrations. Soil environmental quality would be restored to background conditions. Therefore, this alternative is ranked **high** against the requirements of this criterion.

Long-term Effectiveness and Permanence: Because the contaminated soil is removed from the site, implementation of this alternative should provide long-term effectiveness and be a permanent remedy for the site. Therefore, this alternative is ranked **high** when compared to the requirements of this criterion.

Reduction of Toxicity, Mobility, or Volume, Through Treatment: This alternative involves treatment of the contaminants. Contaminants will be permanently destroyed prior to disposal. Therefore, it is ranked **high** when compared to the objectives of this criterion.

Short-term Effectiveness: There is the potential for exposure to workers during excavation of the soils. This exposure can be kept to a minimum using appropriate excavation and safety procedures. Nonetheless, it is ranked **moderate** when evaluated against this criterion.

Implementability: The equipment and procedures to implement this alternative are readily available. The soil excavation depths are relatively shallow and the volume of soil to be excavated is relatively small. Administrative actions to support the alternative are not expected to be difficult or extensive. Therefore, this alternative is ranked **high** against the evaluation criteria for this criterion.

Cost: The excavation, transport, off-site treatment (incineration) and disposal of the contaminated soils would involve capital cost. The actual cost will depend upon the actual volume of contaminated soil. The cost incurred should be a capital cost, with no additional operation, maintenance, or monitoring costs. Costs for each alternative are developed in Attachment B. The estimated cost for this alternative is $61,040. Therefore, it is ranked as **moderate**, when compared to this evaluation criterion.

State Acceptance: Since this alternative removes and treats the contamination at the site, there is a high probability of state support. Therefore, this alternative is ranked **high** against this criterion.

Community Acceptance: Since this alternative removes and treats the contamination at the site, there is a high probability of community support. Therefore, this alternative is ranked **high** against this criterion.

4.3.4 Alternative 6-4: Natural Attenuation with Monitoring – Soil and Groundwater

Overall Protection of Human Health and the Environment: This alternative would employ no active measures at the site. Groundwater would continue to be monitored to assess whether any contamination in the soils was continuing to contribute contamination to site groundwater. Because any contaminated soils exist below the ground surface, no direct surface exposure will occur. Therefore, this alternative is ranked **moderate**, in regard to this criterion.

Compliance with ARARs: Because this alternative does not remove or treat the contaminated soil, the concentrations of contaminants in the soil that are above NYSDEC cleanup concentrations will continue to exist unless they are attenuated by flushing, etc. Therefore, this alternative is scored **low** in meeting the requirements of this criterion.

Long-term Effectiveness and Permanence: Contamination in the soil may continue to leach out of the soil and contaminate groundwater. As a result, this alternative may not have long-term effectiveness. Additionally, the time-frame over which natural attenuation may be expected to occur is relatively long. Because of the potential for contribution to groundwater contamination, this alternative is ranked **low** in regard to this criterion.

Reduction of Toxicity, Mobility, or Volume Through Treatment: This alternative does not involve treatment of the contaminants. As a result, it is ranked **low** for this criterion.

Short-term Effectiveness: This alternative will not involve excavation of the soil. Activities would be limited to sampling of existing wells. Therefore, there will be no impact to human health, or the environment, as a result of the implementation of this alternative. This alternative ranks **high** in meeting the objectives of this criterion.

Implementability: Since only the installation of one or more additional monitoring wells would be required, along with additional groundwater sampling and analysis, this alternative can be easily implemented. Therefore, it is ranked **high** against this criterion.

Cost: The costs for this alternative are limited to the construction of one or more groundwater monitoring wells, and periodic sampling, analysis, and report preparation. Costs for each alternative are developed in Attachment B. The overall costs for this alternative are estimated to be $94,000 (Table B-4). Therefore, the comparison of this alternative against this criterion results in a **moderate** ranking.

State Acceptance: Since this alternative leaves the contamination in place at levels exceeding the NYSDEC cleanup concentrations for soils (with subsequent continued impact to groundwater), it is unlikely to receive state support. Therefore, this alternative is ranked **low** against this criterion.

Community Acceptance: Since this alternative leaves the contamination in place at levels exceeding the NYSDEC cleanup concentrations for soils (with subsequent continued impact to groundwater), it is unlikely to receive community support. Therefore, this alternative is ranked **low** against this criterion.

4.3.5 Alternative 6-5: Enhanced Bioremediation - Groundwater

Overall Protection of Human Health and the Environment: This alternative would potentially reduce the contaminants from the groundwater to NYSDEC DWQS levels. The chemical reaction induced by the addition of additives would not contribute contaminants to the site groundwater. Therefore, this alternative would be highly protective and is rated **high** when compared to this criterion.

Compliance with ARARs: Groundwater quality would be restored to background conditions/NYSDEC DWQS. Therefore, this alternative is ranked **high** against the requirements of this criterion.

Long-term Effectiveness and Permanence: Because the contaminated soil would have been removed from the site, implementation of this alternative should provide long-term effectiveness and be a permanent remedy for the site. Therefore, this alternative is ranked **high** when compared to the requirements of this criterion.

Reduction of Toxicity, Mobility, or Volume, Through Treatment: This alternative involves treatment of the contaminants. Contaminants will be permanently destroyed in-situ. Therefore, it is ranked **high** when compared to the objectives of this criterion.

Short-term Effectiveness: There is the potential for chemical exposure to workers during application of the additives to the groundwater. This exposure can be kept to a minimum using appropriate personal protective equipment and safety procedures. Therefore, it is ranked **moderate** when evaluated against this criterion.

Implementability: The equipment and procedures to implement this alternative are readily available. Depths to groundwater are relatively shallow and the volume of contaminated groundwater to be treated is confined to a relatively small area. In addition, existing monitoring wells are already in place. Administrative actions to support the alternative are not expected to be difficult or extensive. Therefore, this alternative is ranked **high** against the evaluation criteria for this criterion.

Cost: Implementing this alternative would involve capital cost and monitoring costs. The actual cost will depend upon the amount of additive needed to treat the groundwater, drilling equipment needed to introduce the additive to the groundwater, installing any additional monitoring wells, labor costs, and monitoring costs. The estimated cost for this alternative is $353,463. Therefore, it is ranked as **low**, when compared to this evaluation criterion.

State Acceptance: Since this alternative removes and treats the groundwater contamination at the site, there is a high probability of state support. Therefore, this alternative is ranked **high** against this criterion.

Community Acceptance: Since this alternative removes and treats the groundwater contamination at the site, there is a high probability of community support. Therefore, this alternative is ranked **high** against this criterion.

4.4 Comparative Analysis

In order to provide a quantitative method of comparison, a numerical ranking was assigned to each criterion, for each alternative. For a comparative assessment, numerical values of **3** (high), **2** (moderate) and **1** (low) are assigned to each of the rankings, respectively. By summing the numerical score for all of the evaluation criteria, the remedial alternative that provides the most potential advantages for that media may be determined. This would be reflected by the alternative with the highest numerical score.

Soils
The numerical comparison ranking for the Site 6 remedial alternative for soils indicates that there is a relatively minor difference between Alternatives 6-1, 6-2 and 6-4. These alternatives all rank comparatively low because they all leave the soil contamination in place. Only Alternative 6-3, Excavation, Treatment, and Disposal is ranked highly for the two threshold criteria – *Protection of Human Health and the Environment* and *Compliance with ARARs*. It also ranks well for the balancing criteria and the modifying criteria. Therefore, the selected remedial alternative for soils is Alternative 6-3, Excavation, Treatment, and Disposal. The cost for Alternative 6-3, approximately $61,040, is moderate. It is anticipated that competitive procurement of the transport and disposal of the soil will result in lower costs.

Groundwater

The numerical comparison ranking for the Site 6 remedial alternative for groundwater indicates that there is a relatively minor difference between Alternatives 6-1, 6-2 and 6-4. These alternatives all rank comparatively low because they do not treat the present groundwater contamination. Only Alternative 6-5, Enhanced Bioremediation, is ranked highly for the two threshold criteria – *Protection of Human Health and the Environment* and *Compliance with ARARs*. It also ranks well for the balancing criteria and the modifying criteria. Therefore, the selected remedial alternative for groundwater is Alternative 6-5, Enhanced Bioremediation. The cost for Alternative 6-5, approximately $353,463, is high primarily due to the present cost worth of the groundwater monitoring extended out for 30 years. Based on monitoring results, this time frame could be shortened considerably, thereby reducing the overall cost. It is also anticipated that competitive procurement of the subcontractors necessary for implementation will result in lower costs.

The evaluations and the results of the evaluations for Site 6 soils and groundwater are summarized in Table 4-1and Table 4-2, respectively.

le 4-1
Ranking of Remedial Alternatives
6 Soil

	Alternative 6-3		Alternative 6-4	
	Excavation, Treatment & Disposal		*Natural Attenuation & Monitoring*	
/ ?	***Description***	***Rank/ Score***	***Description***	***Rank/ Score***
2	This alternative would potentially eliminate the contaminants from the soil. The remaining soil or clean backfill would not contribute contaminants to the site groundwater.	High/3	Groundwater would continue to be monitored to assess whether any contamination in the soils was continuing to contribute contamination to site groundwater. Because any contaminated soils exist below the ground surface, no direct surface exposure will occur.	Mod./2
.	Excavation of contaminated site soils would comply with NYSDEC soil cleanup concentrations.	High/3	Contamination in excess of NYSDEC cleanup standards remains in place until natural attenuation succeeds.	Low/1
	Contaminated soil is removed from the site.	High/3	Contamination in excess of NYSDEC cleanup standards remains in place until natural attenuation succeeds.	Low/1
	Soil is treated and permanently destroyed prior to disposal.	High/3	No treatment performed.	Low/1
;	Involves excavation of soil, potential exposure to workers. Employ proper protective equipment to minimize hazard.	Mod./2	No disturbance of soil. No excavation.	High/3
	All equipment is readily available. Excavation will be relatively shallow. Readily implementable.	High/3	Only requires periodic sampling. Readily implementable.	High/3
	$61,040	Mod./2	$94,000	Mod./2
	Contamination is removed and treated. Acceptance is likely.	High/3	Since contamination is left in place, unlikely.	Low/1
	Contamination is removed and treated. Acceptance is likely.	High/3	Since contamination is left in place, unlikely.	Low/1
i	**SELECTED ALTERNATIVE**	**High/25**		**Low/15**

Table 4-2
Comparison and Comparative Ranking of Remedial Alternatives
Site 6 Groundwater

Remedial Alternative	**Alternative 6-1 Groundwater**		**Alternative 6-2 Groundwater**		**Alternative 6-3 Groundwater**	**Alternative 6-4 Groundwater**		**Alternative 6-5 Groundwater**	
	No Action		***Institutional Controls***		***Excavation, Treatment & Disposal***	***Natural Attenuation & Monitoring***		***Enhanced Bioremediation***	
Detailed Evaluation Criteria	***Description***	***Rank/ Score***	***Description***	***Rank/ Score***	***N/A***	***Description***	***Rank/ Score***	***Description***	***Rank/ Score***
Protection of Human Health & Environment	No actions taken. Contamination remains in place. Leaching potential remains.	Low/1	Institutional controls would be put in place to limit access to subsurface soils and groundwater. Control would terminate, however, if NYANG relinquished control of the property, since deed restrictions are not a preferred alternative of USAF or ANG.	Mod./2		Groundwater would continue to be monitored to assess whether any contamination in the soils was continuing to contribute contamination to site groundwater. Because any contaminated soils exist below the ground surface, no direct surface exposure will occur.	Mod./2	Addition of chemical release compounds into the groundwater, initiating accelerated bioremediation. This alternative would potentially eliminate chlorinated VOC contaminants from the groundwater. The additive chemical compounds would not contribute contaminants to the site groundwater.	High/3
Overall Compliance with ARARs	Contamination in excess of NYSDEC cleanup standards remains in place.	Low/1	Contamination in excess of NYSDEC cleanup standards remains in place.	Low/1		Contamination in excess of NYSDEC cleanup standards remains in place until natural attenuation succeeds.	Low/1	Significant reduction in chlorinated VOC contaminants in groundwater is expected. Levels could potentially be reduced to NYSDEC DWQS	High/3
Long-Term Effectiveness & Permanence	Contamination remains in place. Leaching potential remains.	Low/1	Contamination remains in place. Leaching potential remains.	Low/1		Contamination in excess of NYSDEC cleanup standards remains in place until natural attenuation succeeds.	Low/1	Chlorinated VOC contaminants would be permanantly remediated.	High/3
Reduction of Toxicity, Etc. by Treatment	No treatment performed.	Low/1	No treatment performed.	Low/1		No treatment performed.	Low/1	Reduction of toxicity of chlorinated VOCs nearly 100%	High/3
Short-term Effectiveness of the Measure	No disturbance of soil. No excavation.	High/3	No disturbance of soil. No excavation.	High/3		No disturbance of soil. No excavation.	High/3	Involves potential chemical exposure to workers. Initiate safety training and employ proper protective equipment to minimize hazard.	Mod./2
Implementability of the Measure	Nothing to implement.	High/3	Facility under NYANG control. Readily implementable.	High/3		Only requires periodic sampling. Readily implementable.	High/3	All equipment is readily available. No major logistic issues, relatively easy, proven application.	High/3
Project Life Cycle Cost of the Measure	Zero	High/3	$2,000	High/3		$94,000	Mod./2	$353,463	Low/1
State Acceptance	Since contamination is left in place, unlikely.	Low/1	Since contamination is left in place, unlikely.	Low/1		Since contamination is left in place, unlikely.	Low/1	Contamination is treated and permanantly removed. Acceptance is likely.	High/3
Community Acceptance	Since contamination is left in place, unlikely.	Low/1	Since contamination is left in place, unlikely.	Low/1		Since contamination is left in place, unlikely.	Low/1	Contamination is treated and permanantly removed. Acceptance is likely.	High/3
Remedial Alternative Overall Rank/Total Score		**Low/15**		**Low/16**			**Low/15**	**SELECTED ALTERNATIVE**	**High/24**

5.0 REMEDIAL ALTERNATIVE SELECTION SUMMARY

The recommended remedial alternative is identified and briefly discussed in this section. The development and selection of the remedial alternative is detailed in Section 4.

5.1 Site 6

5.1.1 Soil

The remedial alternative that is recommended for implementation for soils at Site 6 is Alternative 6-3 – Excavation and Treatment followed by Off-site Disposal. Under this alternative, contaminated soil will be excavated to a depth of approximately seven (7) feet below the ground surface. The area will be slightly over-excavated and approximately 3 feet of contaminated soil/weathered bedrock at the bottom will be excavated and placed into lined, approved roll off containers.

Field screening will be performed on the excavation sidewalls and bottom to monitor the excavation process. Upon receiving acceptable field screening results, a soil confirmation program will be implemented. With "clean" confirmation established, the excavations will be back filled with excavated clean material and off-site pea gravel and sand material and restored to original grade with topsoil. The excavated areas will be seeded to reestablish vegetation. This alternative would restore the site to background conditions.

The excavated contaminated soil will be transported to a thermal treatment facility (incineration or thermal desorption) where it will be treated. The treated residue will be disposed of in a licensed landfill facility.

5.1.2 Groundwater

The remedial alternative that is recommended for implementation at Site 6 for groundwater is Alternative 6-5 – Enhanced Bioremediation using HRC® with subsequent groundwater monitoring. Under this alternative, a number of temporary well points would be laid out in a grid pattern which would provide optimum dispersal of the HRC® to the groundwater. Well points would be installed using a mobile drill rig equipped with HSAs and would be advanced into the top two to three feet of weathered bedrock. Groundwater samples would then be collected from selected existing monitoring wells and analyzed for VOCs per EPA Method 8260. These samples results would serve as baseline parameters. Following the installation of the temporary wells, HRC® would be introduced to the groundwater. Following a pre-determined period of time, groundwater samples would again be collected from the baseline wells, analyzed for VOCs, and the results compared to the baseline results, thus giving an indication as to the effectiveness of the bioremediation. Groundwater monitoring would then continue quarterly for a minimum of 2 years. If after 2 years groundwater sampling results report no exceedances for VOCs, sampling would be terminated and a Decision Document would be submitted to the NYSDEC recommending No Further Action for Site 6.

5.0 REMEDIAL ALTERNATIVE SELECTION SUMMARY

The recommended remedial alternative is identified and briefly discussed in this section. The development and selection of the remedial alternative is detailed in Section 4.

5.1 Site 6

5.1.1 Soil

The remedial alternative that is recommended for implementation for soils at Site 6 is Alternative 6-3 – Excavation and Treatment followed by Off-site Disposal. Under this alternative, contaminated soil will be excavated to a depth of approximately seven (7) feet below the ground surface. The area will be slightly over-excavated and approximately 3 feet of contaminated soil/weathered bedrock at the bottom will be excavated and placed into lined, approved roll off containers.

Field screening will be performed on the excavation sidewalls and bottom to monitor the excavation process. Upon receiving acceptable field screening results, a soil confirmation program will be implemented. With "clean" confirmation established, the excavations will be back filled with excavated clean material and off-site pea gravel and sand material and restored to original grade with topsoil. The excavated areas will be seeded to reestablish vegetation. This alternative would restore the site to background conditions.

The excavated contaminated soil will be transported to a thermal treatment facility (incineration or thermal desorption) where it will be treated. The treated residue will be disposed of in a licensed landfill facility.

5.1.2 Groundwater

The remedial alternative that is recommended for implementation at Site 6 for groundwater is Alternative 6-5 – Enhanced Bioremediation using HRC® with subsequent groundwater monitoring. Under this alternative, a number of temporary well points would be laid out in a grid pattern which would provide optimum dispersal of the HRC® to the groundwater. Well points would be installed using a mobile drill rig equipped with HSAs and would be advanced into the top two to three feet of weathered bedrock. Groundwater samples would then be collected from selected existing monitoring wells and analyzed for VOCs per EPA Method 8260. These samples results would serve as baseline parameters. Following the installation of the temporary wells, HRC® would be introduced to the groundwater. Following a pre-determined period of time, groundwater samples would again be collected from the baseline wells, analyzed for VOCs, and the results compared to the baseline results, thus giving an indication as to the effectiveness of the bioremediation. Groundwater monitoring would then continue quarterly for a minimum of 2 years. If after 2 years groundwater sampling results report no exceedances for VOCs, sampling would be terminated and a Decision Document would be submitted to the NYSDEC recommending No Further Action for Site 6.

5-1

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ATTACHMENT A

CONTAMINATED SOIL VOLUME ESTIMATE

Contaminated Soil Volume Estimate

Four separate areas would be excavated. The following is an estimate of the volume of soil from each area. To ensure all the contaminated soil is removed, these volumes may increase based on field screening conducted during the excavations. The four areas are shown in Figure A-1.

Site 6

Area No. 1

Affected contaminated soil is 8 feet thick.
Affected contaminated soil area is 39 feet long.
Affected contaminated soil width is 12 feet wide.

In-Place Volume (V) = Length (L) x Width (W) x Depth (D)

= (39 feet) (12 feet) (8 feet)

= 3,744 cubic feet / 27 cubic feet / cubic yard

= **139 cubic yards**

Assume bulking factor of 30%

Excavated Volume = In-Place Volume x bulking factor

= 139 cubic yards x 1.3

= 180.7 cubic yards ≈ **181 cubic yards**

Area No. 2

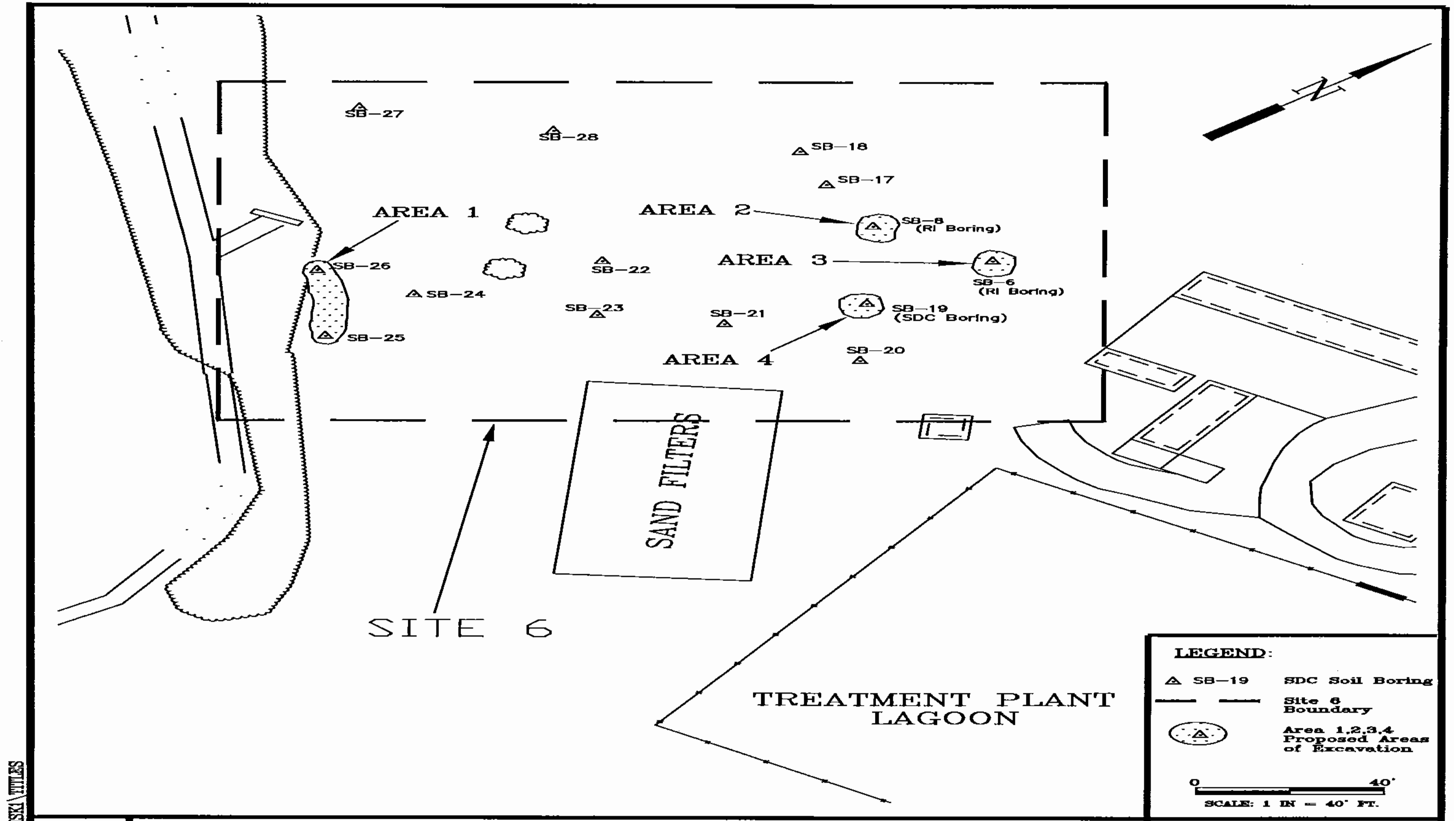
Affected contaminated soil is 8 feet thick.
Affected contaminated soil area is 13 feet long.
Affected contaminated soil width is 10 feet wide.

In-Place Volume (V) = Length (L) x Width (W) x Depth (D)

= (13 feet) (10 feet) (8 feet)

=1,040 cubic feet / 27 cubic feet / cubic yard

= **39 cubic yards**



NEW YORK AIR NATIONAL GUARD BASE
109th AIRLIFT WING
PROPOSED AREAS OF EXCAVATION—SITE 6
SCOTIA, NEW YORK

ANEPTEK CORPORATION
Analytic, Environmental and Process Technologies

FIGURE: A-1

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Assume bulking factor of 30%

Excavated Volume = In-Place Volume x bulking factor

= 39 cubic yards x 1.3

= **50 cubic yards**

Area No. 3

Affected contaminated soil is 4 feet thick.
Affected contaminated soil area is 13 feet long.
Affected contaminated soil width is 15 feet wide.

In-Place Volume (V) = Length (L) x Width (W) x Depth (D)

= (13 feet) (10 feet) (8 feet)

= 1,040 cubic feet / 27 cubic feet / cubic yard

= 39 cubic yards

Assume bulking factor of 30%

Excavated Volume = In-Place Volume x bulking factor

= 39 cubic yards x 1.3

= **50 cubic yards**

Area No. 4

Affected contaminated soil is 8 feet thick.
Affected contaminated soil area is 50 feet long.
Affected contaminated soil width is 15 feet wide.

In-Place Volume (V) = Length (L) x Width (W) x Depth (D)

= (11 feet) (10 feet) (8 feet)

= 880 cubic feet / 27 cubic feet / cubic yard

= 32.6 cubic yards = **33 cubic yards**

Assume bulking factor of 30%

Excavated Volume = In-Place Volume x bulking factor

= 33 cubic yards x 1.3

= 43 cubic yards

The total estimated soil to be excavated from all four areas is **324 cubic yards**.

ATTACHMENT B

REMEDIAL ALTERNATIVES COST ESTIMATION

Table B-1: Cost Estimate for Alternative 6-1 – No Action - Soil and Groundwater

There are no costs associated with the no action alternative.

Total Cost: $0

Table B-2: Cost Estimate for Alternative 6-2 – Institutional Controls - Soil and Groundwater

The costs for this alternative consist of developing and implementing appropriate institutional controls.

Capital Cost: $2,000

Annual Operation and Maintenance Cost: $0/Year

Present Worth Cost: Capital + O&M (13.7648) = $2,000 + ($0) (13.7648) = **$2,000**

Present worth based upon 6% interest rate and 30 year life cycle (normally required under CERCLA).

Component	Unit Cost	Units	Direct Cost	Mark Up	Total
Office					
Project Manager	$110/Hour	8	$880	$220	$1100
Staff Scientist	$60/Hour	12	$720	$180	$900
Annual Total (w/o O&P)					**$2,000**

Table B-3: Cost Estimate for Alternative 6-3 – Excavation/Treatment and Disposal - Soil

This alternative consists of excavating and removing the contaminated soil. The soil will be treated and disposed of offsite. It is comprised of capital costs only, since the groundwater monitoring requirement is addressed under Alternative 6-5.

Capital Cost: $61,040

Annual Operation and Maintenance Cost: None

Present Worth Cost: Capital + O&M (13.7648) = $61,040 + $0 (13.7648) = **$61,040**
Present worth based upon 6% interest rate and 30-year life cycle (normally required under CERCLA). Assumes only one sampling period per year. Depending upon regulatory requirements this may be increased.

Capital Component	Unit Cost	Units	Direct Cost	Mark Up	Total
Mobilization	$500	LS	$500	N/A	$500
Erosion Control	$1,500	LS	$1,500	$300	$1,800
Hydraulic Excavator/Crew	$145/Hour	30	$4,350	$1,088	$5,438
Equip/Covers/Permits/Etc.	$2,500	LS	$2,500	$500	$3,000
Laborer (2)	$35/Hour	60	$2,100	$425	$2,525
Clean Fill Off-Site/Place	$10/CY	150	$1,500	$300	$1,800
Clean Fill On-Site/Place	$5/CY	250	$1250	$250	$1,500
Site Restoration	$1,500	LS	$1,500	$300	$1,800
Sampling & Analysis	$6,000	LS	$6,000	$1,200	$7,200
Transport and Disposal	$50/ton[1]	486[2]	$24,300	$29,160	$29,160
Project Manager	$110/Hour	8	$880	$220	$1,100
Geotechnical Engineer	$95/Hour	12	$1,140	$285	$1,425
On-Site Staff Engineer	$70/Hour	38	$2,660	$532	$3,192
Expenses/Travel/Etc.	$500	LS	$500	$100	$600
Capital Total (w/o O&P)					**$61,040**

(1) To EMSI, Hudson Falls, NY
(2) Based on 324 cy and an assumed soil density of 1.5 tons/cy.

Note: Applicable taxes and fees not included.

Table B-4: Cost Estimate for Alternative 6-4 – Monitored Natural Attenuation - Soil and Groundwater

The costs for this alternative consist of groundwater monitoring annually for three or four of the existing, groundwater monitoring wells. Installation of additional wells is not included.

Capital Cost: None

Annual Operation and Maintenance Cost: $6,807/Year

Present Worth Cost: Capital + O&M (13.7648) = $0 + ($6,807) (13.7648) = **$93,697**

Present worth based upon 6% interest rate and 30 year life cycle (normally required under CERCLA).

Assumes only one sampling period per year. Depending upon regulatory requirements this may be increased. Also assumes limited number of samples, including quality control/quality assurance samples.

Component	Unit Cost	Units	Direct Cost	Mark Up	Total
Groundwater Samples					
VOCs	$150/Each	4	$ 760	$152	$912
Field Crew (1 Day)					
Staff Scientist	$60/Hour	10	$600	$150	$750
Field Technician	$45/Hour	10	$450	$113	$563
Equipment/Tvl/Exp	$250	LS	$250	$50	$300
Office (Report & Plan)					
Project Manager	$110/Hour	4	$440	$110	$550
Staff Scientist	$60/Hour	8	$480	$120	$600
Expenses	$50	LS	$50	$10	$60
Annual Total (w/o O&P)					**$6,807**

Table B-5: Cost Estimate for Alternative 6-5 – Enhanced Bioremediation and Monitoring - Groundwater

The costs for this alternative consist of HRC® application and groundwater monitoring for 2 years for four of the existing, groundwater monitoring wells. Installation of additional wells is not included.

Capital Cost: $91,217

Annual Operation and Maintenance Cost: $13,931

Present Worth Cost: Capital + O&M (13.7648) = $91,217 + $19,052 (13.7648) = **$353,463**

Present worth based upon 6% interest rate and 30 year life cycle (normally required under CERCLA). Based on sampling 4 wells each quarter for 2 years. Depending upon regulatory requirements this may be increased. Also assumes limited number of samples, including quality control/quality assurance samples.

Enhanced Bioremediation

Capital Component	Unit Cost	Units	Direct Cost	Mark Up	Total
Mobilization	$200	LS	$200	N/A	$200
Drill Rig/Crew (2)	$1,700/Day	11	$18,700	$2,898	$21,598
HRC® Material	$35,659	LS	$35,659	$5,527	$41,186
HRC® Technician	$10,000	LS	$6,000	$1,550	$11,550
Project Manager	$89.25/Hr	110	$9,817	N/A	$9,817
Environmental Tech	$44.34/Hr	110	$4,877	N/A	$4,877
Expenses/Travel/Etc.	$1,210	LS	$1,120	$36	$1,246
Capital Total (w/o O&P)					**$91,217.00**

Groundwater Monitoring

Component	Unit Cost	Units	Direct Cost	Mark Up	Total
Groundwater Samples[1]					
VOCs	$150/Each	56	$8,400	$1,302	$9,702
Field Crew (1 Day)					
Field Technician	$450/Day	8	$3,600	NA	$7,200
Equipment/Tvl/Exp	$261/Event	4	$1,044	$31	$2,150
Annual Total (w/o O&P)					**$19,052**

Notes: 1. Based on quarterly sampling of 4 wells each sampling event for 2 years, includes QA/QC samples (7 samples total each event).

ATTACHMENT C

TRANSPORT RETARDATION FACTOR CALCULATIONS

TRANSPORT RETARDATION FACTOR CALCULATIONS

Introduction

This attachment develops the transport retardation factors utilized in the Contaminant Fate and Transport section (1.5) of the FS.

Basis

Transport of organic compounds in soil and groundwater can be retarded by elevated organic carbon in the soil/aquifer. The retardation factor can be determined from the following equations.

$$K_p = K_{oc} f_{oc} \qquad Rf = 1 + (\rho_b K_p)/\theta$$

Kp = Organic carbon partitioning factor.

Koc = Octanol/Water partioning coefficient (ml/g).

f_{oc} = Organic carbon fraction of the soil (TOC %).

R_f = Retardation factor.

ρ_b = Dry bulk density of the soil (g/cm^3).

θ = Porosity.

A retardation factor of 1.0 implies that the compound will move with groundwater given that it is dissolved into the water phase. Therefore, the analyses suggest that these compounds are not very mobile in the site soils due to the relatively high total organic carbon fraction.

Site 6 Subsurface Soil

Volatile Organic Compounds

An evaluation of the retardation factor was made for these compounds. The soil dry bulk density, porosity, and total organic carbon content of the soils were the same as those used at Site 3 for the retardation factor calculations for benzene, toluene, ethyl benzene, and xylene.

Compound	Koc	Kp	Rf
PCE	364	6.70	27.8
TCE	126	2.32	10.28

Site 6 Groundwater

SVOCs

SVOCs were detected in Site 6 groundwater in excess of NYSDEC Drinking Water Quality Standards during the RI. These included 2-methylnaphthalene, acenaphtene, 2,4 dinitrophenol, 4-nitrophenol, phenol, and bis-2,(ethyl hexyl) phthalate which were detected during the RI, these compounds were not detected during the more recent SDC. There is only one published Federal Maximum Contaminant Level compound standard for these compounds and that was exceeded also, for bis-2,(ethyl hexyl) phthalate (Table 1-2).

The source of these contaminants is not known. A review of the soils for Site 6 does not indicate that any of these compounds are present in the soils. The retardation factors for these compounds were calculated. Partitioning coefficient data was not available for all of the compounds. However, a review of the retardation values calculated for several of these compounds suggests that they do not travel very far in groundwater.

Compound	**Koc**	**Kp**	**Rf**
2-Methylnaphthalene	8,500	156.4	627
Acenaphthene	4,600	84.6	339
Bis-2,(ethylhexyl) phthalate	5,900	108.6	435