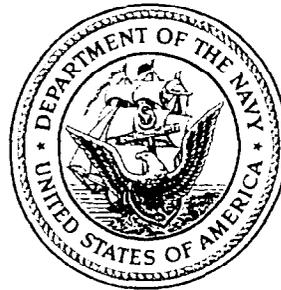


Summary Results Report
for
Pilot Study
Air Sparging/Vapor Extraction System
Naval Weapons Industrial Reserve
Plant (NWIRP)
Calverton, New York
Volume I



Northern Division
Naval Facilities Engineering Command
Contract Number N62472-90-D-1298
Contract Task Order 0223

June 1996

CF BRAUN ENGINEERING CORPORATION

**SUMMARY RESULTS REPORT
FOR
PILOT STUDY
AIR SPARGING/VAPOR EXTRACTION SYSTEM
NAVAL WEAPONS INDUSTRIAL RESERVE PLANT
CALVERTON, NEW YORK**

**COMPREHENSIVE LONG-TERM
ENVIRONMENTAL ACTION NAVY (CLEAN) CONTRACT**

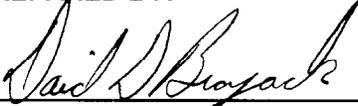
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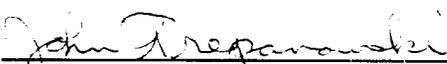
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EXECUTIVE SUMMARY

This report has been prepared to summarize and evaluate the results of a pilot-scale, Air Sparging/Soil Vapor Extraction (AS/SVE) System at Site 2 -- The Fire Training Area, Naval Weapons Industrial Reserve Plant (NWIRP) Calverton, New York. Authorization for the design and operation of this pilot-scale AS/SVE system by CF Braun through a master agreement with Brown & Root Environmental was provided under Contract Task Order 223 of Navy Clean Contract No. N62472-90-D-1298.

Fuel-and solvent-contaminated soils and groundwater were identified at the Fire Training Area during a recent RCRA Facility Investigation. In addition, a floating free product layer has been identified at the site. Because of the nature of the site soils (permeable sand) and type of contaminants present (primarily volatile and/or biodegradable organics) an air sparging and soil vapor extraction system was considered to be a potentially viable and cost effective option for remediating the site. As a result, this study was conducted.

The pilot study was constructed in June to August, 1995 and operated from August to December, 1995. The system consisted of three basic components: an air injection system, an air extraction system, and an offgas treatment system. Air was injected into an area which included the free product and the groundwater with the highest contaminant concentrations. The air was injected at a rate of 140 standard cubic feet per minute (SCFM). The air extraction system covered the area of contaminated soils, the free product, and the most contaminated groundwater. Air was extracted at a rate of approximately 200 SCFM. The extracted air was passed through two 1000-pound carbon units prior to discharge.

In general, a 30% to 70% reduction in organic concentrations were measured in the soils and groundwater during the trial. Variability in the soil data complicated this analysis. The reduction of organics in groundwater was initially in the range of 60% to 90%, however a partial rebound in volatile organic compound (VOC) and semi-volatile organic compound (SVOC) concentrations were noted after the trial ended.

The vapor extraction system removed 46 pounds and 8 pounds of target chlorinated and non-chlorinated VOCs, respectively. Based on carbon dioxide measurements, as much as 13,000 pounds of organics (as carbon) may have been destroyed by biological degradation during the trial.

Overall, the pilot-scale test was moderately successful in evaluating the AS/SVE technology. However, outstanding questions remain. These concerns are: can the AS/SVE remediate the free product plume; can the vacuum system remediate the VOCs and biodegradable SVOCs; and can the air sparging system remediate the groundwater. To address these concerns, it is recommended that the pilot trial be re-started and additional data be collected.

1.0 INTRODUCTION

This report has been prepared to summarize and evaluate the results of a pilot-scale, Air Sparging/Soil Vapor Extraction (AS/SVE) System at Site 2 - The Fire Training Area, Naval Weapons Industrial Reserve Plant (NWIRP) Calverton, New York. Authorization for the design and operation of this pilot-scale AS/SVE system by CF Braun through a master agreement with Brown & Root Environmental was provided under Contract Task Order 223 of Navy Clean Contract No. N62472-90-D-1298.

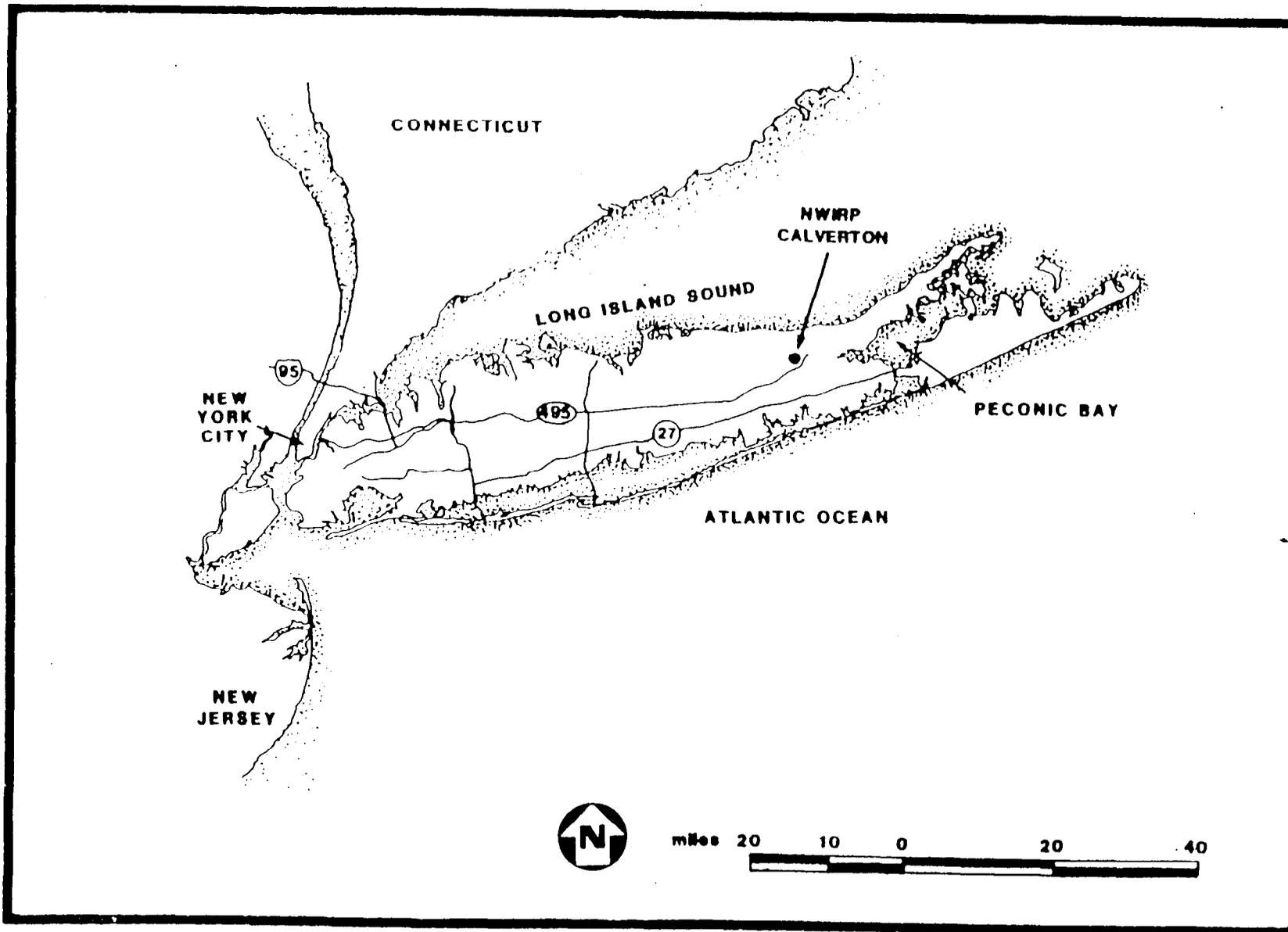
1.1 FACILITY LOCATION AND OPERATION

The NWIRP is located in the eastern section of Long Island, New York (Figure 1-1). The facility was constructed in the early 1950's for development, testing and retrofitting of Navy combat aircraft. The NWIRP Calverton has also been used to support the design and construction of Navy aircraft at the NWIRP Bethpage located in Bethpage, New York. Both the facilities were operated by the Northrop Grumman Corporation. Northrop Grumman vacated the NWIRP Calverton in February 1996.

1.2 SITE 2 - FIRE TRAINING AREA - RCRA FACILITY INVESTIGATION RESULTS

The fire training area is located in the south central portion of the NWIRP Calverton, (see Figure 1-2). Between 1952 and the mid-1990's, the Fire Training Area (Site 2) was used to train facility personnel in extinguishing potential flight-related activity fires. During the exercises, fuel would be floated on a water filled pit, and then ignited. These fuels may have been mixed with waste oils and solvents.

In 1992, a Site Investigation was completed at the site, (HNUS 1992) confirming the presence of petroleum and solvent contamination in the soils and groundwater. In addition, a free floating product layer was observed. Free-product recovery of fuels from this site has been an ongoing Northrop Grumman operation since the 1980's.

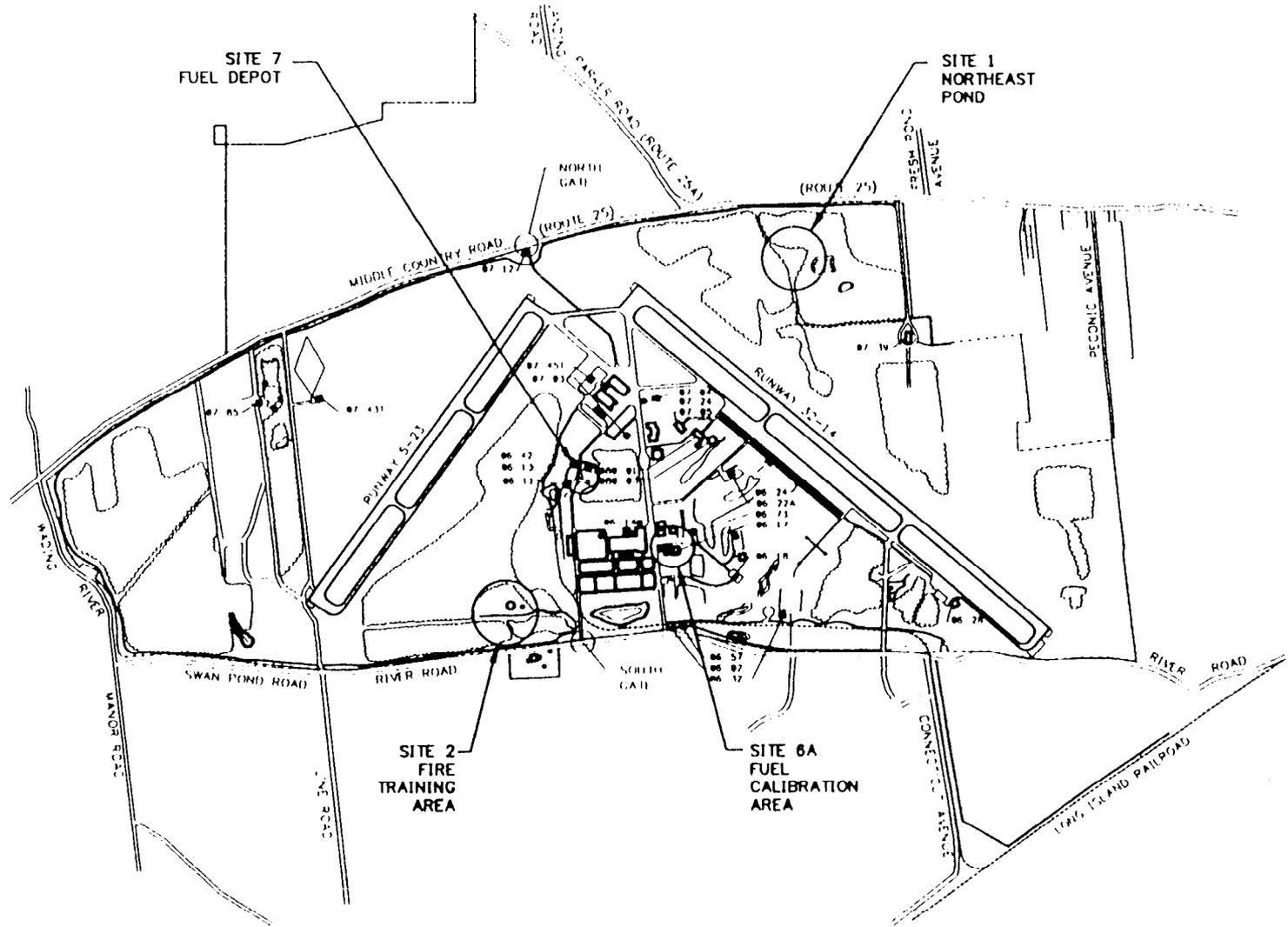


GENERAL LOCATION MAP
RFA - SAMPLING VISIT
NWIRP, CALVERTON, NEW YORK

FIGURE 1-1

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1-3



NOTE: NUMBERED BUILDINGS INDICATE LOCATIONS OF
CESSPOOLS/LEACHPITS TO BE INVESTIGATED
- TREE LINE

LOCATION OF SITES
REL - FIELD INVESTIGATION
NWIRP, CALVERTON, NEW YORK

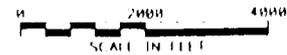


Figure 1-2

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In 1995, A RCRA Facility Investigation (RFI) was completed at the site (HNUS 1995). This study delineated the extent of soil and onsite groundwater contamination at the Fire Training Area. This testing found that soils and groundwater in the area of the fire training exercises were contaminated primarily with petroleum hydrocarbons and solvents. In addition, metals and polychlorinated biphenyl's (PCB's) were found; however, the concentrations and quantities of these compounds were considered to be minor when compared to the hydrocarbons and solvents. Relevant analytical data from the RFI for this site are presented in Appendix A and summarized as follows.

1.2.1 RFI Soil Results

Volatile organic compounds (VOCs) consisting primarily of chlorinated solvents and fuel-type compounds (benzene, toluene, ethyl benzene, and xylene) were detected at relatively high concentrations in the Site 2 soils, (e.g. 1,1,1-trichloroethane maximum: 9,900 ug/kg and xylene maximum: 85,000 ug/kg). Semi-volatile organic compounds (SVOCs, e.g. polynuclear aromatic hydrocarbons [PAH's] maximum: 43,100 ug/l) were also found as significant concentrations in the soils. PCBs and pesticides were detected at lower concentrations in the soils with maximum concentrations of 3,600 ug/kg and 30 ug/kg, respectively. See Appendix A - Figure 5-18 for additional data. The RFI concluded that the extent of soil contamination has been adequately defined at Site 2.

1.2.2 RFI Groundwater Results

The depth below ground surface to the groundwater aquifer underlying Site 2 ranges from approximately 12 feet in the area southeast of the fire training ring to a depth of approximately 19 feet in the area north of the fire training ring. The flow direction across Site 2, in this shallow, unconfined aquifer is to the south-southeast. Based on the results of shallow- and intermediate-depth monitoring wells, no measurable vertical hydraulic gradient exists at the site.

The groundwater contamination at Site 2 was found to be very similar to that observed in the site soils. VOCs, consisting primarily of chlorinated solvents and fuel-type compounds, were detected at relatively high concentrations in the Site 2 groundwater, (e.g. 1,1,1-trichloroethane maximum: 1,100 ug/l and toluene maximum: 320 ug/l). SVOCs, (e.g. PAH's maximum: 110 ug/l) were also found as in the groundwater. PCBs and pesticides were detected at lower concentrations in the groundwater with maximum concentrations of 18 ug/l and 0.65 ug/l,

respectively. A plot of iso-concentration contours for chlorinated and non-chlorinated VOCs in groundwater are presented in Figures 1-3 and 1-4, respectively. See Appendix A - Figure 5-20 for additional data. The RFI concluded that the extent of on site groundwater contamination has been adequately defined at Site 2.

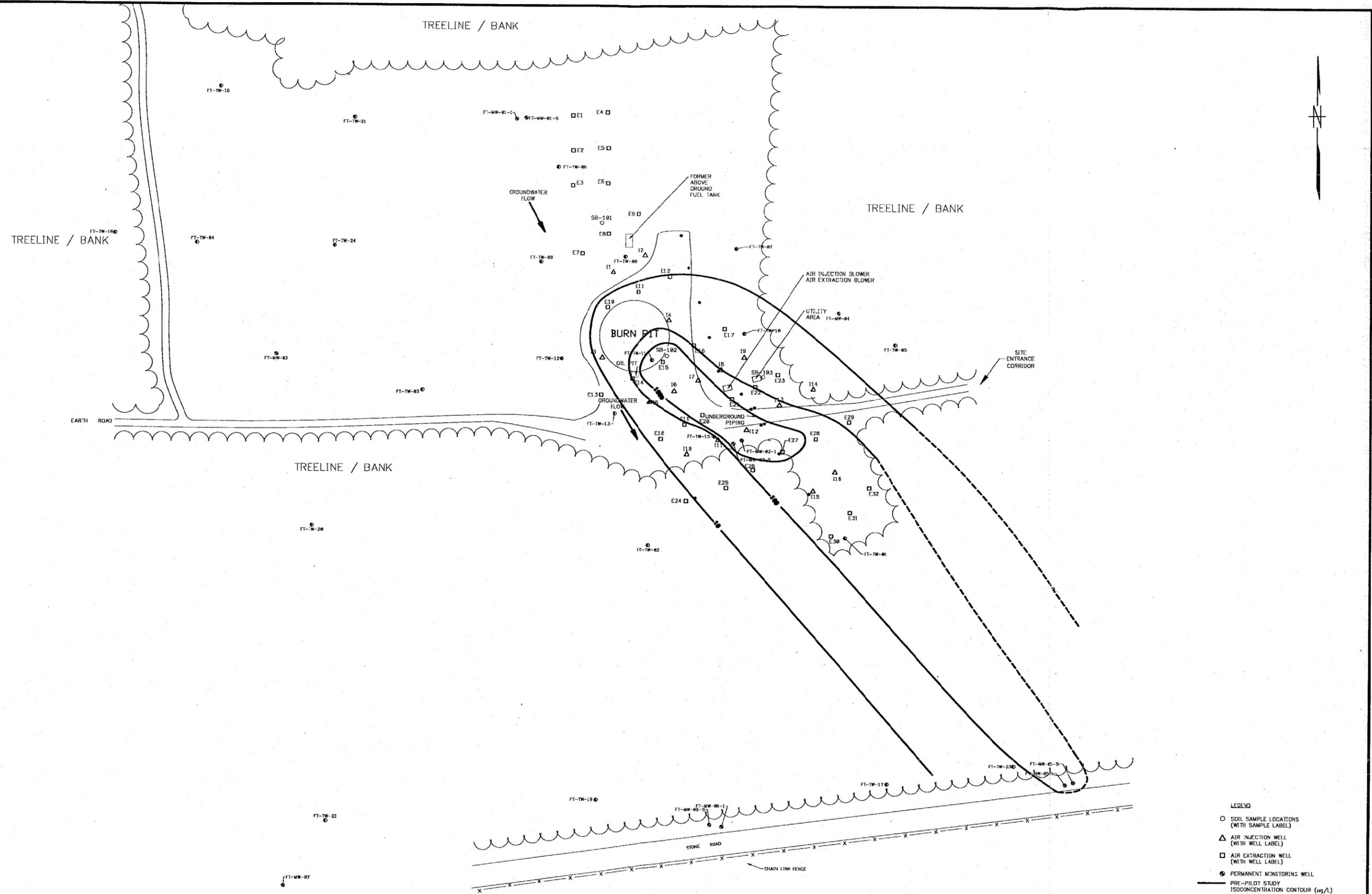
1.2.3 Floating Free Product

A floating free product layer was observed on the surface of the shallow aquifer at Site 2. In response to this layer, Northrop Grumman conducted free product removal for approximately a decade by manually bailing wells screened across the groundwater table. Free product recovery from this site totaled approximately 32.5 gallons in 1995. The approximate extent of the free product layer was better defined in May 1995. In general, the area of free product coincides with the area of the most contaminated groundwater.

1.2.4 Summary of Site Contaminants

Based on observations made during the May 1995 - Existing Conditions Survey (CF Braun 1995a), and the results and conclusions reported in the RCRA Facility Investigation (HNUS, 1995), the site conditions can be divided into three general areas as follows.

1. Area north of the fire training ring, where contamination is limited to relatively low-level and sporadic soil contamination. Based on historical aerial photographs, limited fire training exercises may have been conducted in this area.
2. Area around the existing fire training ring, where the highest concentrations of soil and groundwater contamination were observed. This area also corresponds to the location of a measurable free product layer.
3. Area hydraulically downgradient of the fire training ring, where moderate concentrations of groundwater contamination and trace levels of free-product on the groundwater surface were observed.



- LEGEND
- SOIL SAMPLE LOCATIONS (WITH SAMPLE LABEL)
 - △ AIR INJECTION WELL (WITH WELL LABEL)
 - AIR EXTRACTION WELL (WITH WELL LABEL)
 - PERMANENT MONITORING WELL
 - PRE-PILOT STUDY ISOCHLORINATION CONTOUR (μg/L)

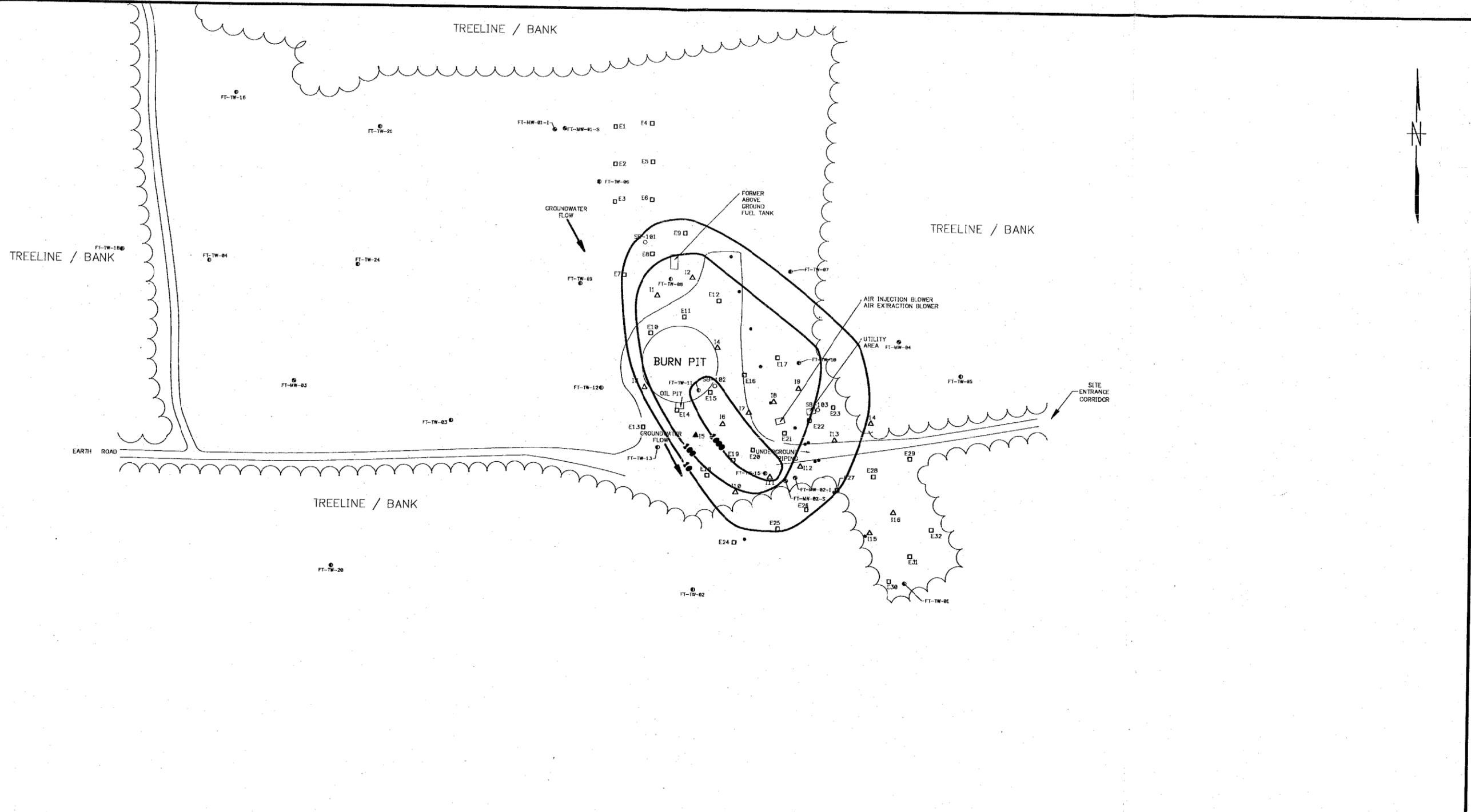


DRAWN	J.D'Alessandris	(05/21/96)
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DESIGN ENGINEER		
PROCESS ENGINEER		
PROJECT MANAGER	D. Brayack	
ENGINEERING MANAGER	S. Hughes	
CLIENT APPROVAL		

C.F. BRAUN

FOSTER PLAZA 7
891 ANDERSON DRIVE
PITTSBURGH, PA 15229

TITLE		TOTAL CHLORINATED VOCs - GROUNDWATER ISOCHLORINATION MAP (μg/L) PRE-PILOT STUDY CONDITIONS (AUGUST 1995)	
CLIENT	NWRP CALVERTON	CUSTOMER	CLEAN - CTO 223
SCALE	AS SHOWN	DATE	JUNE 1996
DRAWING NO.	4570/4570M02.DWG	SHEET	1 OF 1
FIGURE 1-3		SCALE	AS FILED



- LEGEND
- SOIL SAMPLE LOCATIONS (WITH SAMPLE LABEL)
 - △ AIR INJECTION WELL (WITH WELL LABEL)
 - AIR EXTRACTION WELL (WITH WELL LABEL)
 - PERMANENT MONITORING WELL
 - PRE-PILOT STUDY ISOCONCENTRATION CONTOUR (µg/L)



DRAWN	T.D. Alessandria	(05/23/96)
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TITLE		TOTAL NON-CHLORINATED VOCs - GROUNDWATER ISOCONCENTRATION MAP (µg/L) PRE-PILOT STUDY CONDITIONS (AUGUST 1996)	
CLIENT	NWRP CALVERTON	CONTRACT	CLEAN - CTO 223
SCALE	AS SHOWN	DATE	JUNE 1996
DRAWING NO.	4570/45700001.DWG	SHEET	1 OF 1
FIGURE NO.	FIGURE 1-4	DATE	06/05/96

1.2.5 Air Sparging/Soil Vapor Extraction Technology

Air Sparging/Soil Vapor Extraction (AS/SVE) consists of injecting air into the groundwater and extracting air from the unsaturated soils overlaying the groundwater. Collected off gas is treated using activated carbon prior to discharge to the atmosphere. The AS/SVE technology treats organic contaminants through two mechanisms, consisting of volatile compound stripping and stimulating natural micro-organisms to destroy biodegradable contaminants in place. Table 1-1 presents physical/chemical data on the primary contaminants of concern at the site.

Volatile compounds are stripped from both the soils and groundwater by contacting the contaminants with air. The relative rate at which compounds can be stripped from the soil and groundwater is based primarily on the vapor pressure and Henry's Law Constant of the compound and the air flow rate. The more volatile the compound, the faster the compound can be removed. Other factors such as the type of soil (sandy soils being better for the removal than clays) and the total organic content of the soil, (which changes the volatility of a compound) also affect removal rates.

Most organic compounds are biodegradable. However, biological degradation rates are highly variable and dependent on many factors including the presence or absence of oxygen, the density of micro-organisms, and the presence of nutrients and moisture. In some cases, toxins may be present which would inhibit biodegradation.

TABLE 1-1
CHEMICAL PROPERTIES
AS/SVE NWIRP CALVERTON

Parameter	Molecular Weight	Specific Gravity (20/4 C)	Water Solubility (mg/L)	Vapor Pressure (mm Hg @ 20 C)	Henry's Law Constant (atm - L/mol @ 20 C)
Vinyl Chloride	62.5	0.91	1.1×10^3	2.6×10^3	2.8×10^{-2}
Chloroethane	64.51	0.9	5.7×10^3	1.0×10^3	6.9×10^{-3}
1,1 - Dichloroethane	98.96	1.2	5.5×10^3	2.3×10^2	5.9×10^{-3}
Toluene	92.14	0.87	5.2×10^2	2.8×10^1	5.9×10^{-3}
Xylenes	106.17	0.86	1.87×10^2	1.0×10^1	4.2×10^{-3}
cis 1,2 - Dichloroethene	96.94	1.3	8.0×10^2	2.0×10^2	4.1×10^{-3}
1,1,1 - Trichloroethane	133.4	1.3	4.4×10^3	1.0×10^2	4.1×10^{-3}
2-Methylnaphthalene	142.2	1	2.6×10^1	1.0×10^1	5.0×10^{-4}
Fluorene	166.22	1.2	1.9×10^0	1.0×10^1	1.2×10^{-4}
4-Methylphenol	108.14	1	2.4×10^4	1.1×10^{-1}	3.9×10^{-7}
Phenol	94.11	1.1	8.0×10^4	3.5×10^{-1}	1.0×10^{-8}

NA: Not available.

2.0 SYSTEM CONSTRUCTION

The AS/SVE pilot system was constructed in June, July, and August 1995. The system was constructed in accordance with Work Plan for this project (CF Braun 1995b). In general, the system consisted of an air injection system, an air extraction system, and activated carbon units for treating the extraction system offgas.

The objective of the pilot study was to determine the effectiveness of AS/SVE in remediating site media in the source area. Specific goals of the study were to evaluate the reduction of :

- VOCs, SVOCs, PCBs and pesticides in the soils;
- VOCs, SVOCs, PCBs and pesticides in the shallow groundwater; and
- the quantity of floating free product.

The pilot study AS/SVE was designed to achieve this objective by providing a continuous circulation of air through the contaminated soil and groundwater to promote the accelerated volatilization and capture of VOCs and enhance aerobic degradation of biodegradable organics of concern. Samples of soil, groundwater, and air were collected to track the removals.

Specific design features of this pilot study AS/SVE system are summarized in the following sections. More details of the system construction are presented in the Work Plan.

2.1 AIR INJECTION/EXTRACTION SYSTEMS

2.1.1 Air Injection and Extraction Well Location and Spacing

The surveyed locations of the air injection and air extraction wells installed at Site 2 for the pilot study AS/SVE system are presented in Drawing 1, (see Appendix B for survey notes). A process and instrumentation diagram is presented in Drawing 2. Photographs of the system (from May 1996) are presented in Appendix M.

As illustrated in Drawing 1, the extraction well system consisted of one bank of six wells (E1 to E6) placed north of the fire training ring (burn pit) and six parallel rows of wells, each containing 3 to 7 wells. The air extraction well system was spaced over an approximate 2-acre area and encompasses all of the identified soil contamination, as well as the area of the free

product layer. The extraction well system area also encompasses the area of the most contaminated groundwater. Each row in the extraction system was oriented perpendicular to the groundwater flow.

The air injection well system was also located in five parallel rows, with each row containing 2 to 5 wells. The injection wells rows were also oriented perpendicular to the groundwater flow and were situated between the extraction well rows.

Spacing between alternating rows of injection and extraction wells was generally 40 feet. Wells along a particular row were normally spaced at 40-foot intervals. However, well spacing were more concentrated in areas of high soil and groundwater contamination, such as in the area immediately south of the fire training ring, (30-foot intervals). In addition, the location of individual wells and piping runs were adjusted in the field to maintain access through the area.

2.1.2 Air Injection Wells

The air injection system was designed to deliver an average of 8 to 9 standard cubic feet of air per minute (SCFM) through each of the 16 injection wells for a total of 140 SCFM. The design system pressure was a maximum of 5 pounds per square inch (PSI).

The air injection well design called for 1-foot long well screens to be installed at a depth of 5 to 9 feet below the groundwater table. Actual well construction data for the 16 air injection wells are presented in Table 2-1 and on Drawing 1 and indicate full compliance with the requirements on 15 of the 16 wells. On one well (I15), the screen was installed to a depth of 9.3 to 10.3 feet below the groundwater table. Additional discussion on the injection well installation is summarized below. Injection well boring logs and construction sheets are provided in Appendices C and D, respectively.

TABLE 2-1

AIR INJECTION WELL DATA
AS/SVE - NWIRP CALVERTON

	Ground	Well Stick-Up	Screen Bottom	Water Table	Water Column
Well ID	Elevation (ft)	(ft-ags)	(ft-bgs)	(ft-bgs)	Depth (ft)*
I1**	58.97	0.40	26.0	19.4	6.6
I2**	58.94	0.52	26.0	19.5	6.5
I3	56.38	0.51	21.8	16.7	5.2
I4	55.89	0.48	22.8	16.3	6.5
I5	55.13	0.55	23.2	15.7	7.5
I6	54.62	1.39	23.3	15.2	8.1
I7	54.46	1.47	23.6	15.2	8.4
I8	54.30	1.53	22.8	14.9	7.9
I9	54.20	0.61	23.2	14.9	8.3
I10	54.36	0.46	23.7	15.0	8.7
I11	53.83	0.91	23.7	14.4	9.3
I12**	53.01	0.43	22.5	13.7	8.8
I13**	53.00	1.21	22.5	13.3	9.3
I14**	54.57	1.10	21.9	15.3	6.6
I15	50.99	0.48	22.4	12.1	10.3
I16**	51.28	1.19	20.0	12.0	8.1

* Measured from bottom of well screen.

** Injection well depth modified following installation.

Following drilling and installation of the injection wells, the static water levels in wells I1 and I2 were measured to be only 3.4 feet and 3.8 feet deep, respectively. As a result, these injection wells were re-drilled at a nearby location. The water columns in the re-drilled wells were measured to be 6.6 feet and 6.5 feet, respectively.

The depth of water in wells I12, I13, I14, I15 and I16 were originally measured to be 9.8 feet, 10.1 feet, 8.4 feet, 10.3 feet, and 10.5 feet (from bottom of well), respectively. Since the well grout had not fully set at the time these measurements were taken, the well casings for injection wells I12, I13, I14 and I16 were raised to reduce the water column in these wells to 8.8 feet, 9.3 feet, 6.6 feet and 8.1 feet, respectively. Efforts to raise the well casing on injection well I15 failed because the grout had already set.

2.1.3 Air extraction wells

The air extraction system was designed to remove approximately 6 SCFM of air from the ground at each of the 32 extraction wells, for a total of approximately 200 SCFM. Design specifications for the 32 air extraction wells used at the site are illustrated on Drawing 1. In compliance with the design, the screened interval for each of the 32 air extraction wells was installed between 4 and 8 feet below the ground surface. Extraction well boring logs and construction sheets are provided in Appendices E and F, respectively.

20' by 20' sheets of plastic were placed on the surface at each air extraction well to enhance the area of influence for each well and to minimize direct precipitation infiltration into the wells. Most of these sheets were installed as specified. However, several sheets placed in the wooded areas were not fully spread out and an anchor trench was not used. These modifications were taken in order to minimize the impact on area vegetation.

2.1.4 Air Injection Blower

Based on the physical properties of the subsurface contaminants identified at the Fire Training Area and the oxygen requirements for biological degradation, an air injection rate of between 6 and 10 CFM was applied through each of the 16 air injection wells. A 5 horsepower, Roots air injection blower with an air delivery capacity of approximately 108 actual cubic feet per minute (ACFM) at 4.5 psig (which is approximately 140 SCFM) was used to produce the required air flow.

The air injection blower controls included an interlock with the air extraction blower to preclude operation of the injection blower, when the extraction blower was not operating based on tripping of automatic pressure, temperature, or pressure switches. In addition, a high temperature switch and a high pressure switch on the air discharge would automatically shutdown the injection blower down if the air discharge temperature exceeded 350 F or the pressure exceeded 4.75 PSI.

2.1.5 Air Extraction Blower

A 5 horsepower Roots vacuum blower was used to collect air through the extraction wells at approximately 1.5 times the air injection rate. The Roots blower was operated at an air extraction rate of approximately 260 ACFM (which is approximately 200 SCFM) and 5" Hg vacuum.

The extraction blower controls included a high moisture level switch in the secondary moisture separator, a high temperature switch (350 F), a high discharge air pressure switch (1 PSI), and a high vacuum pressure switch (5" Hg).

2.1.6 Blower Housing Unit

A temporary blower housing unit was specified in the work plan to cover the two blowers. The temporary structure was eliminated because the two blowers were constructed for outdoor use, and therefore the buildings were not necessary to protect the equipment. Other considerations which would indicate the need for a structure include security and noise control. Because access to the site is restricted and remote from other activities at the facility, neither of these factors were considered critical for the operation.

2.2 AIR TRANSFER PIPING AND CONTROL SYSTEMS

2.2.1 Piping and Air Flow Control Valves

Air flow calculations were performed during system design to determine optimal pipe sizes throughout the air transfer network. Four-inch diameter PVC piping was used for main header near the air injection and air extraction blowers. Two-inch diameter PVC piping was used for some of the remote headers and all of the branches to the separate banks of air injection and air extraction wells. Piping sizes are presented in Drawing 2.

For the air injection wells, a 2-inch PVC ball valve was used to regulate air flow into each of the injection pointed. Air flow from the air extraction wells was regulated by 2-inch PVC ball valves located at the connections between the air extraction header and each row of 3 to 7 air extraction wells. Valve locations are presented on Drawing 2.

10-foot sections of 3-inch, carbon steel piping were installed at the air exhaust ports of the air injection and air extraction blowers to dissipate heat. This piping was aligned along a horizontal plane instead of the specified vertical plane because the blower housing unit and the additional steel pipe support points provided by the housing unit were eliminated from the system.

2.2.2 Moisture/ Condensate Control

Liquid condensate was formed in the air extraction piping, particularly following periods of rain and/or during periods of low ambient air temperatures. This condensate was collected in a 55-gallon primary moisture separator and a 10-gallon secondary moisture separator located in series immediately preceding the air extraction blower. Condensate was also removed from the air extraction lines by opening 1/4-inch drain plugs located at low points along the above-ground piping network. The locations of the moisture separators and the drain plugs are illustrated on Drawings 1 and 2.

The 55-gallon primary moisture separator was part of the original design. But because it was not available at the time of startup, it was not installed during the original construction in August. During the first two weeks of operation no moisture was observed in the system. However, at the end of September, as the ambient air temperatures decreased and several rain events occurred, moisture started accumulating in the system. At that time, based on a high water level in the secondary moisture separator, the blowers automatically shut down. As a result of the shutdown, the primary moisture separator was added to the system as originally specified and drain taps were installed at low points in the piping.

2.3 ELECTRICAL SYSTEMS

A electrical wiring diagram for the pilot scale AS/SVE system at the Fire Training Area was included with the project work plan. As indicated on Drawing 2, system shut down switches were included for excessive line pressures in the air injection and air extraction systems,

excessive temperatures in the air injection and air extraction systems and excessive condensate collection in the air extraction system. Also, an interlock was provided between the air injection and air extraction systems.

2.4 AIR TREATMENT SYSTEM

VOCs that were removed by the air extraction wells were treated by activated carbon. The contaminated air stream was passed through two, 1000-pound vapor-phase treatment units connected in series (Drawing 2). The first carbon unit was removed from the treatment train when contaminant breakthrough was detected at the unit's effluent port. The second carbon unit in the treatment series was then moved to the first position and a fresh carbon unit was placed in the second position of the air treatment train. Three, 1000-pound carbon units were used to treat the extracted air during the 4-month AS/SVE operating period.

3.0 SYSTEM OPERATION RESULTS

3.1 SYSTEM OBJECTIVES AND SUMMARY OF OPERATION

The pilot study was designed to operate continuously from August 1995, for a period of approximately four months, to December 1995, at which time cold weather would force its shutdown. Continuous operation of the pilot scale AS/SVE system began on August 31, 1995 and ended on December 18, 1995. Specific exceptions to the continuous operation are as follows.

- The system was shutdown on a monthly basis, for approximately 24 hours each, to allow for collection of groundwater samples from 3 air injection wells and blower oil changes. This was a normal scheduled shutdown.
- During the first monthly inspection on September 27, 1995, the system was found to be shutdown because of a high moisture level in the secondary moisture separator. Based on interviews with facility personnel and an evaluation of the power use, the system was believed to have been down for a period of approximately one week prior to this date. The system was restarted on September 29, 1995.
- During the last monthly inspection on December 17, 1995, significant quantities of ice were noted throughout the air extraction piping. Cold weather approximately 1/2 to 1 week prior to this date is believed to have triggered the restrictions.

3.2 AIR INJECTION AND AIR EXTRACTION WELL BALANCING

3.2.1 Air Extraction Well Flowrate Balancing

The flow rate from each air extraction well was originally targeted to be 6 SCFM, with a variance of plus or minus 2 SCFM. During system startup and after initial balancing of air flow rates, the air flow rates for each bank were measured to range from 6 to 8 ACFM on a per well basis, (see Table 3-1). After approximately one month of operation, the average air flow rate for each bank was noted to have drifted, with a new average flowrate range of 4 to 15 ACFM on a per well basis. During this period measurement for well cluster E30 to E32, there was no

TABLE 3-1

**AIR EXTRACTION AND INJECTION FLOW RATES (ACFM)
AS/SVE - NWIRP CALVERTON**

Sample Date	8/31/95	09/07/95	10/04/95	10/04/95	10/12/95	10/12/95	10/25/95	10/25/95	11/20/95
	SOD	SOD	SOD	EOD	SOD	EOD	SOD	EOD	SOD
Measured Extraction Blower Header	262	262	96*		87*		87*	87*	
Extraction Well Bank Measurements (calculated average per well)									
E1 - E6	7	7	4	5	6	5	5	3	3
E7 - E9	7	9	5	6	8	6	7	9	11
E10 - E12	7	7	15	9	10	9	9	5	7
E13 - E16	7	7	5	6	7	7	7	8	9
E17	7	7	9	8	9	11	13	13	13
E19 - E23	8	6	11	9	11	12	11	11	11
E18 and E 24 - E29	6	6	5	8	5	6	5	3	3
E30 - E32	7	8	0	0	1	4	4	3	4
Calculated Extraction Air Flow	217	218	207	199	218	229	227	196	209
Individual Extraction Wells Measurements									
E1		2	4			7		7	
E2		7							
E4		8	9			10		10	
E7			5						
E10	5	4	11			8		8	
E12	8	4							
E13			5			9		9	
E15	5	5							
E18	4	4				4		4	
E19	9	7	14			13		13	
E20						8		8	
E22						13		13	
E23		9				14		14	
E24	4	5				4		4	
E25		7	10						
E26			13						
E28						7		7	
E29		9	2			10		10	
E30		9				12		12	
E31		7				5		5	
E32						4		4	

TABLE 3-1 (Continued)
AIR EXTRACTION AND INJECTION FLOW RATES (ACFM)
AS/SVE - NWIRP CALVERTON

Monitoring Date	8/31/95		9/7/95		10/4/95		10/12/95		10/25/95		11/22/95	
	SOD	EOD	SOD	EOD	SOD	EOD	SOD	EOD	SOD	EOD	SOD	EOD
Measured Injection Blower Header		157	157	157	153		131		140		140	140
Individual Injection Well Measurements												
I1	4	2	2	4	4	3	4	4	4	4	5	5
I2	4	3	4	3	3	2	4	4	2	4	8	5
I3	9	6	6	8	9	10	10	10	10	10	10	9
I4	11	7	9	9	12	11	8	8	9	8	10	9
I5	7	5	5	9	9	10	11	11	12	9	4	9
I6	2	22	34	9	33	13	13	13	11	11	11	9
I7	7	8	5	10	13	10	9	9	10	9	7	9
I8	8	6	6	9	11	10	9	9	13	4	9	9
I9	13	13	16	9	4	9	7	7	8	2	2	9
I10	2	0	1	7	13	9	4	8	9	11	7	10
I11	0	0	1	4	8	11	11	11	11	11	13	11
I12	0	0	1	3	2	10	11	11	10	12	13	11
I13	2	1	2	4	5	11	4	7	5	8	11	10
I14	4	5	7	9	11	11	11	11	13	11	11	9
I15	0	0	1	0	1	3	4	4	2	5	11	1
I16	13	20	27	10	9	11	19	19	13	9		9
Calculated Injection Air Flow	86	98	127	106	148	142	137	143	142	128	132	143

* Measurement point was moved with the inclusion of the primary moisture separator. Measurements at this location after this date are not believed to be as accurate as the original measuring point.

SOD: Start of Day Measurement

EOD: End of Day Measurement. Difference between SOD and EOD would reflect changes made to the system during the day.

measurable air flow rate with available instruments, although a slight vacuum was noted in the piping, indicating that some air flow was occurring. Condensate collecting at low points in the line is believed to have inhibited the flow. The flowrates were readjusted at this point, and drainage taps were installed to improve condensate removal. The adjusted air flow rates were then maintained for the balance of the pilot study, with no need for additional balancing.

3.2.2 Air Injection Well Flowrate Balancing

The air injection rate for each well was originally targeted to be 8 SCFM, with a variance of plus or minus 2 SCFM. During system startup, the actual measured air flow rates for each injection well was measured to range from no measurable flow in three wells to a high of 22 ACFM, (see Table 3-1). Wells located near the free-product area were noted to be the more difficult to adjust and control.

By the end of the first week of operation, the air flow rate distribution had improved on its own and individual wells were adjustable from 1 ACFM to 10 ACFM. After one month of operation, the air distribution continued to stabilize, with the range adjusted to 2 to 11 ACFM. Similar air distribution was then maintained throughout the balance of the pilot test.

3.3 SAMPLE RESULTS

3.3.1 Soil Samples

Soils samples were collected during the pilot study to evaluate the effectiveness of AS/SVE in reducing the concentration of VOCs, SVOC, PCBs, pesticides, and petroleum hydrocarbons (TPH) in soils. Shallow (at a depth of 1 to 2 feet below ground surface) and deep (at the water table - 14 to 22 feet below grade surface) soil samples were collected at three locations, (soil borings SB101, SB102, and SB103, see Drawing 1). The shallow samples were collected on a monthly basis, where as the deep samples were collected prior to the start of the test and at system shutdown. A stake was placed at each sample location. All soil samples were collected within 2.5 feet of this stake. Chain-of-custody records, sample log sheets, and soil boring log sheets are presented in Appendices G, H, and I. Raw analytical data sheets are presented in Appendix J.

The results of the testing are summarized in Table 3-2. Based on this data, except for a few low concentration detections of methylene chloride and tetrachloroethene in the pre-study

TABLE 3-2

SOIL RESULTS (ug/kg)
AS/SVE - NWIRP CALVERTON

SB101 (NORTHWEST OF TRAINING RING)

Sample Date	MDLs	STARs	7/31/95	9/28/95	10/25/95	11/21/95	12/20/95	7/31/95	12/20/95
Sample Depth (feet)		Memo 1	0002	0002	0002	0002	0002	2022	2022
TCL Volatiles									
Acetone	7			--	--	--			
2-Butanone	7			--	--	--			
Ethylbenzene	1			--	--	--			
Methylene Chloride	2		5	--	--	--	5 J	3 J	3 J
4-Methyl - 2-Pentanone	3			--	--	--			
1,1-Dichloroethane	1			--	--	--			
1,1-Dichloroethene	2			--	--	--			
Tetrachloroethene	1		11	--	--	--			
Trichloroethene	1			--	--	--			
1,1,1-Trichloroethane	1			--	--	--			
Toluene	1			--	--	--			
Total Xylenes	1			--	--	--			
TCL Semivolatiles									
Acenaphthene	33	>100,000	140	130 J		170 J	170 J		
Dibenzofuran	24		42	67 J		58 J	63 J		
Fluorene	28	>100,000	110	140 J		160 J	160 J		
Phenanthrene	33		1,400	1,300 J	120 J		1,400		

TABLE 3-2 (Continued)
 SOIL RESULTS (ug/kg)
 AS/SVE - NWIRP CALVERTON

SB101 (NORTHWEST OF TRAINING RING)

Sample Date	MDLs	STARS	7/31/95	9/28/95	10/25/95	11/21/95	12/20/95	7/31/95	12/20/95
Sample Depth (feet)		Memo 1	0002	0002	0002	0002	0002	2022	2022
Anthracene	33	>100,000	270	240 J		240 J	280 J		
Carbazole	33		190	210 J		220 J	220 J		
Fluoranthene	33	>100,000	2,100	2,500	220 J		1,800		
Pyrene	67	>100,000	2,300	2,200	150 J		1,600		
Butylbenzylphthalate	67		88	90 J		84 J	94 J		
Di-n-butylphthalate	33								
Di-n-octylphthalate	67						130 J		130 J
Diethylphthalate	67					160 J			
Benzo(a)anthracene	33	220	1,300	1,200	99 J		890		
Dibenz(a, h)anthracene	67	14		270 J		260 J	180 J		
Diethylphthalate	67								
bis(2-Ethylhexyl)phthalate	67			100 J	180 J				
Chrysene	33		1,500	1,400	99 J		960		
Benzo(b)fluoranthene	67	220	2,100	2,300	130 J	1,400	1,200		
Benzo(k)fluoranthene	133	220	790			530	390		
Benzo(a)pyrene	67	61	1,600	1,300	89 J	970	960		
Indeno(1,2,3-cd)pyrene	67		920	890		620	940		
Benzo(g,h,i)perylene	67		1,100	900		760	1,200		
2-Methylnaphthalene	33			62 J		160 J	37 J		
4-Methylphenol	100								
Naphthalene	33	300,000				1,200			
Acenaphthylene	33	>100,000							
Total Semivolatile Compounds			15,950	15,299	1,087	6,992	12,674	0	130

TABLE 3-2 (Continued)
 SOIL RESULTS (ug/kg)
 AS/SVE - NWIRP CALVERTON

SB101 (NORTHWEST OF TRAINING RING)

Sample Date	MDLs	STARS	7/31/95	9/28/95	10/25/95	11/21/95	12/20/95	7/31/95	12/20/95
Sample Depth (feet)		Memo 1	0002	0002	0002	0002	0002	2022	2022
TCL Pesticides									
PCB-1260	200		900	300	200	600	1		
PCB-1254	200								
Endosulfan II	10					10			
Endosulfan Sulfate	30						11 J		
Heptachlor Epoxide	10						4 J		
Total Petroleum Hydrocarbons(mg/kg)			600	--	--	--	900		7 J

SB102 (ADJACENT TO SOUTHEAST SECTION OF THE FIRE TRAINING RING)

Sample Date	MDLs	STARS	7/31/95	9/28/95	10/25/95	11/21/95	12/22/95	7/31/95	12/22/95
Sample Depth (feet)		Memo 1	0002	0002	0002	0002	0002	2022	1517
TCL Volatiles									
Acetone	7			--	--	--			
2-Butanone	7			--	--	--		34	
Ethylbenzene	1			--	--	--		4 J	1,600
Methylene Chloride	2		2 J	--	--	--	2 J	3 J	
4-Methyl - 2-Pentanone	3			--	--	--		3 J	
1,1-Dichloroethane	1			--	--	--		3 J	
1,1-Dichloroethene	2			--	--	--			
Tetrachloroethene	1		2 J	--	--	--			210 J
Trichloroethene	1			--	--	--			

TABLE 3-2 (Continued)
 SOIL RESULTS (ug/kg)
 AS/SVE - NWIRP CALVERTON

SB102 (ADJACENT TO SOUTHEAST SECTION OF THE FIRE TRAINING RING)

Sample Date	MDLs	STARS	7/31/95	9/28/95	10/25/95	11/21/95	12/22/95	7/31/95	12/22/95
Sample Depth (feet)		Memo 1	0002	0002	0002	0002	0002	2022	1517
1,1,1-Trichloroethane	1			--	--	--			
Toluene	1			--	--	--		15	4,400
Total Xylenes	1		6	--	--	--		33	13,000
TCL Semivolatiles									
Acenaphthene	33	>100,000		940 J					770 J
Dibenzofuran	24			1,200 J	840				700 J
Fluorene	28	>100,000		1,300 J					
Phenanthrene	33		190 J	1,900 J	2,100		160 J	150 J	2,600
Anthracene	33	>100,000	47 J	560 J	340 J				
Carbazole	33			420 J					
Fluoranthene	33	>100,000	420	3,300 J	2,600		230 J	120 J	2,100
Pyrene	67	>100,000	410	3,000 J	1,500		240 J	110 J	1,700 J
Butylbenzylphthalate	67			1,800 J	2,100				710 J
Di-n-butylphthalate	33			490 J					
Di-n-octylphthalate	67						140 J		
Diethylphthalate	67								
Benzo(a)anthracene	33	220	270 J	1,500 J	880		100 J		550 J
Dibenz(a, h)anthracene	67	14			230 J				4,900 B
Diethylphthalate	67								
bis(2-Ethylhexyl)phthalate	67			3,900	4,200		130 J		
Chrysene	33		320 J	1,800 J	900		120 J	46 J	600 J
1,2 Dichlorobenzene	33								700 J
Benzo(b)fluoranthene	67	220	430	3,000 J	1,100				520 J
Benzo(k)fluoranthene	133	220	160 J		350				

TABLE 3-2 (Continued)
SOIL RESULTS (ug/kg)
AS/SVE - NWIRP CALVERTON

SB102 (ADJACENT TO SOUTHEAST SECTION OF THE FIRE TRAINING RING)

Sample Date	MDLs	STARS	7/31/95	9/28/95	10/25/95	11/21/95	12/22/95	7/31/95	12/22/95
Sample Depth (feet)		Memo 1	0002	0002	0002	0002	0002	2022	1517
Benzo(a)pyrene	67	61	310 J	1,600 J	820				
Indeno(1,2,3-cd)pyrene	67		190 J	730 J	830				
Benzo(g,h,i)perylene	67		220 J	760 J	800				
2-Methylnaphthalene	33		36 J	6,000 J	3,100			93 J	11,000
4-Methylphenol	100							130 J	
Isophorone	67								3,000
Naphthalene	33	300,000		2,300 J					3,800
Acenaphthylene	33	>100,000		450 J					
Total Semivolatile Compounds			3,003	36,950	22,690	0	1,120	649	33,650
TCL Pesticides									
PCB-1260	200		160 J			200 J		60 J	1,000
PCB-1254	200			500	600				
Endosulfan II	10								
DDD	10								10
Endrin Aldehyde	10								18 J
Total Petroleum Hydrocarbons(mg/kg)			360	--	--	--	90	1,000	23,000

TABLE 3-2 (Continued)
 SOIL RESULTS (ug/kg)
 AS/SVE - NWIRP CALVERTON

SB103 (DIRECTLY EAST OF UTILITY AREA)

Sample Date	MDLs	STARS	7/31/95	9/28/95	10/25/95	11/21/95	12/20/95	7/31/95	12/20/95
Sample Depth (feet)		Memo 1	0002	0002	0002	0002	0002	1416	1416
TCL Volatiles									
Acetone	7			--	--	--			
2-Butanone	7			--	--	--		200	
Ethylbenzene	1			--	--	--		2,300 D	1,200
Methylene Chloride	2			--	--	--			
4-Methyl - 2-Pentanone	3			--	--	--			
1,1-Dichloroethane	1			--	--	--		150	
1,1-Dichloroethene	2			--	--	--		1,200	
Tetrachloroethene	1			--	--	--		170	
Trichloroethene	1			--	--	--		120	
1,1,1-Trichloroethane	1			--	--	--		5,300 D	1,300
Toluene	1			--	--	--		6,600 D	3,000
Total Xylenes	1			--	--	--		19,000 D	11,000
TCL Semivolatiles									
Acenaphthene	33	>100,000		56 J					
Dibenzofuran	24			41		1,600 J			260 J
Fluorene	28	>100,000		94 J		1,600 J			660 J
Phenanthrene	33			200 J				1,400 J	310 J
Anthracene	33	>100,000		63 J					
Carbazole	33			84 J					
Fluorene	33	>100,000						1,500 J	
Fluoranthene	33	>100,000		380				1,200 J	
Pyrene	67	>100,000		420					
Butylbenzylphthalate	67			140 J		940 J		1,500 J	550 J
Di-n-butylphthalate	33							1,300 J	260 J

TABLE 3-2 (Continued)
 SOIL RESULTS (ug/kg)
 AS/SVE - NWIRP CALVERTON

SB103 (DIRECTLY EAST OF UTILITY AREA)

Sample Date	MDLs	STARS	7/31/95	9/28/95	10/25/95	11/21/95	12/20/95	7/31/95	12/20/95
Sample Depth (feet)		Memo 1	0002	0002	0002	0002	0002	1416	1416
Di-n-octylphthalate	67								630 J
Diethylphthalate	67								
Benzo(a)anthracene	33	220		170 J					
Dibenz(a, h)anthracene	67	14							
Diethylphthalate	67								
bis(2-Ethylhexyl)phthalate	67			430	200 J		150 J		1,100 J
Chrysene	33			230 J					
Benzo(b)flouranthene	67	220		380					
Benzo(k)flouranthene	133	220							
Benzo(a)pyrene	67	61		200 J					
Indeno(1,2,3-cd)pyrene	67			100 J					
Benzo(g,h,i)perylene	67			120 J					
2-Methylnaphthalene	33			65 J		15,000		72,000 D	8,700
Isophorone	67								1,200 J
4-Methylphenol	100								
Naphthalene	33	300,000				6,400		42,000	2,500
Acenaphthylene	33	>100,000							
Total Semivolatile Cpds			0	3,173	200	25,540	150	120,900	16,170
TCL Pesticides									
Beta BHC	10								2
PCB-1260	200			130 J	100 J				
PCB-1254	200			140 J		500		200 J	
Endosulfan II	10								

TABLE 3-2 (Continued)
 SOIL RESULTS (ug/kg)
 AS/SVE - NWIRP CALVERTON

SB103 (DIRECTLY EAST OF UTILITY AREA)

Sample Date	MDLs	STARS	7/31/95	9/28/95	10/25/95	11/21/95	12/20/95	7/31/95	12/20/95
Sample Depth (feet)		Memo 1	0002	0002	0002	0002	0002	1416	1416
Total Petroleum Hydrocarbons(mg/kg)			600	--	--	--		22,000	7,000 J

-- Sample not collected
 Blank Chemical not detected above Method Detection Limit (MDL)
 J Estimated value
 D Analysis of a diluted sample
 STARS Memo 1 STARS Memo #1, Petroleum-Contaminated Soil Guidance Policy, New York State Department of Environmental Conservation, Division of Spills Management, August 1992. Presented for SVOCs only. VOCs may be subject to more stringent site-specific requirements for protection of groundwater. > 100,000 indicates that a criteria is present, but that the standard is greater than 100,000 ug/kg

samples, VOCs were not detected in the shallow soil samples. For the deep samples (water table), no significant concentrations of VOCs were detected in the soils in soil boring SB101.

For soil boring SB102, VOCs in soils totaled approximately 95 ug/kg at a depth of 20 to 22 feet below ground surface prior to the test and 19,210 ug/kg at a depth of 15 to 17 feet below ground surface at the end of the test. Despite being at the same location (horizontally), this data is not considered comparable because of the difference in the sample depth (feet below ground surface). Since the contamination at this site is concentrated near the groundwater surface (at a depth of 14 to 15 feet below ground surface) and is associated with a floating free product layer, then samples collected from several feet below the groundwater table would not be as impacted as those soils which are more shallow.

For soil boring SB103, samples were collected at the same depth (14 to 16 feet below ground surface) and total VOCs in soils were measured to decrease from 35,040 ug/kg prior to the trial to 16,500 ug/kg at the end of the trial. This decrease may be attributable to the operation of the air sparging system. However, because only two data points were collected and a consistent trend was not identified in other soil samples, this data is not conclusive.

Also presented in Table 3-2 are individual and total SVOC concentrations. In general low to moderate concentrations of PAHs and phthalates were detected in each of the samples. For comparison, the New York State Department of Environmental Conservation STARS Memo # 1, which presents guidance for petroleum spills, is presented.

For sample locations SB101-0002, SB102-0002, SB102-1517, and on one sample event for sample SB103-0002, guidance concentrations developed under the STARS memo were exceeded for several PAHs, including benzo(a) anthracene, dibenz (a,h) anthracene, benzo (b) flouranthene, benzo (k) flouranthene, and/or benzo (a) pyrene. However, the STARS memo criteria for each of these parameters is very low, with the criteria ranging from 60 to 220 ug/kg and the maximum concentration of PAHs in the soil samples was only 2,100 ug/kg. In general, a downward trend in the concentration of these chemicals was noted during the trial. However there is insufficient data to confirm this trend.

PCBs and pesticides were detected at maximum concentrations of 1,000 ug/kg and 18 ug/kg, respectively. These concentrations are expected to be near or less than potential action limits for the site. No observable trend is obvious from this data.

Total petroleum hydrocarbon (TPH) data collected during the test were only partially conclusive. For three of the samples, the TPH concentration in soils was measured to decrease by an average of approximately 75% during the trial. However, for soil sample SB101-0002, the concentration was measured to increase during the trial by 50% (600 to 900 mg/kg). This increase may be attributable to normal variance in soil concentrations. Soil sample SB101-2022, was not measured to have a significant concentration of TPH and no significant change in concentration was noted during the trial. As previously discussed, soil sample SB102-2022 and SB102-1517 were measured at different depths and therefore the TPH results can not be directly compared.

3.3.2 Groundwater Samples:

Groundwater samples were collected during the pilot study to evaluate the effectiveness of AS/SVE in reducing the concentration of VOCs, SVOC, PCBs, and pesticides in groundwater. The groundwater samples were collected from one permanent monitoring well (GW02) screened across the water table (with a 10-foot long well screen) and three air injection wells (IW06, IW13, IW16) screened at a depth of 8 to 9 feet below the groundwater table (with a 1-foot long well screen). Monitoring well GW02 represents the most contaminated monitoring well at Site 2. The groundwater sample locations are indicated on Drawing 1. Chain-of-custody records and sample log sheets are presented in Appendices G and H. Raw analytical data sheets are presented in Appendix J.

Analytical results for samples collected from well GW02 are presented in Table 3-3 and are plotted as a function of time in Figure 3-1. Based on this testing, the concentration of chlorinated and non-chlorinated VOCs decreased by approximately 90% and 60% during the operation of the trial, respectively (using 11/21/96 or Day 100). One month after the system was shutdown (1/23/96 or Day 160), the concentration of chlorinated and non-chlorinated VOCs were measured to increase by 140% and 36%, respectively, from the concentrations recorded two months earlier. This increase indicates a partial rebound in VOC concentrations. A similar decrease and rebound in SVOC concentrations was also noted in this well, especially if bis(2-ethylhexyl) phthalate (a common laboratory contaminant) was not included in the analysis. PCBs and pesticides were noted at low concentrations in this well, with no obvious trend resulting from the performance of the pilot test.

TABLE 3-3

GROUNDWATER RESULTS (ug/L)
 PERMANENT MONITORING WELL GW02
 AS/SVE - NWIRP CALVERTON

Sample Date	MDLs	8/16/95	9/28/95	10/26/95	11/21/95	12/19/95	1/23/96
TCL Volatiles							
Acetone	6	52		16 J	17 J	--	280
2-Butanone	3	140	40		3 J	--	100
Benzene	1	8		1 J		--	
Ethylbenzene	2	13	13	12	10	--	
Vinyl Chloride	2	25				--	
Methylene Chloride	2					--	
4-Methyl - 2-Pentanone	5	15	19	8 J		--	
Carbon Disulfide	3			48		--	
Chloroethane	3	420 D	21	20	17	--	40 J
1,1-Dichloroethane	2	200	39	36	24	--	69
1,1-Dichloroethene	1	8		6	1 J	--	
cis 1,2-Dichloroethene	2	220	18	21	14	--	53
1,2-Dichloroethane	2	2 J				--	
Tetrachloroethene	1	12	5	12	12	--	37 J
Trichloroethene	1	2 J		1 J	1 J	--	
1,1,1-Trichloroethane	1	59	20	41	26	--	29 J
Toluene	2	250	78	75	62	--	94
2 Hexanone	7	15	21			--	
Total Xylenes	1	110	120	120	100	--	140
Total Chlorinated VOCs		948	103	137	95	--	228
Total Non Chlorinated VOCs*		411	254	264	172	--	234

TABLE 3-3 (Continued)
GROUNDWATER RESULTS
PERMANENT MONITORING WELL - GW02
AS/SVE NWIRP CALVERTON, NEW YORK

Sample Date	MDLs	8/16/95	9/28/95	10/26/95	11/21/95	12/19/95	1/23/96
TCL Semivolatiles							
Phenol	1	35	22	8 J			
2-Methylphenol	2	23	13	7 J			
2,4-Dimethylphenol	1	38	17		23		36 J
1,4-Dichlorobenzene	1	2 J					
1,2-Dichlorobenzene	1	5 J	3 J	3 J		4 J	
1,2,4 Trichlorobenzene	1		2 J	3 J	4 J	1 J	
Acenaphthene	1						26 J
Dibenzofuran	1						
Fluorene	1	5		1 J	2 J	3 J	39 J
Phenanthrene	1	4 J			2 J	1 J	
Anthracene	1						
Carbazole	1				8 J		
Fluoranthene	1	5 J			1 J		
Pyrene	1	4 J	2 J	2 J	2 J	1 J	
Butylbenzylphthalate	2						
Di-n-butylphthalate	1			1 J	1 J	2 J	
Benzo(a)anthracene	1						
bis(2-Ethylhexyl)phthalate	2	5 J	5	4 J	160	36	43 J
Chrysene	1						
Benzo(b)fluoranthene	2						
Benzo(k)fluoranthene	2						
Benzo(a)pyrene	2						
Indeno(1,2,3-cd)pyrene	2						

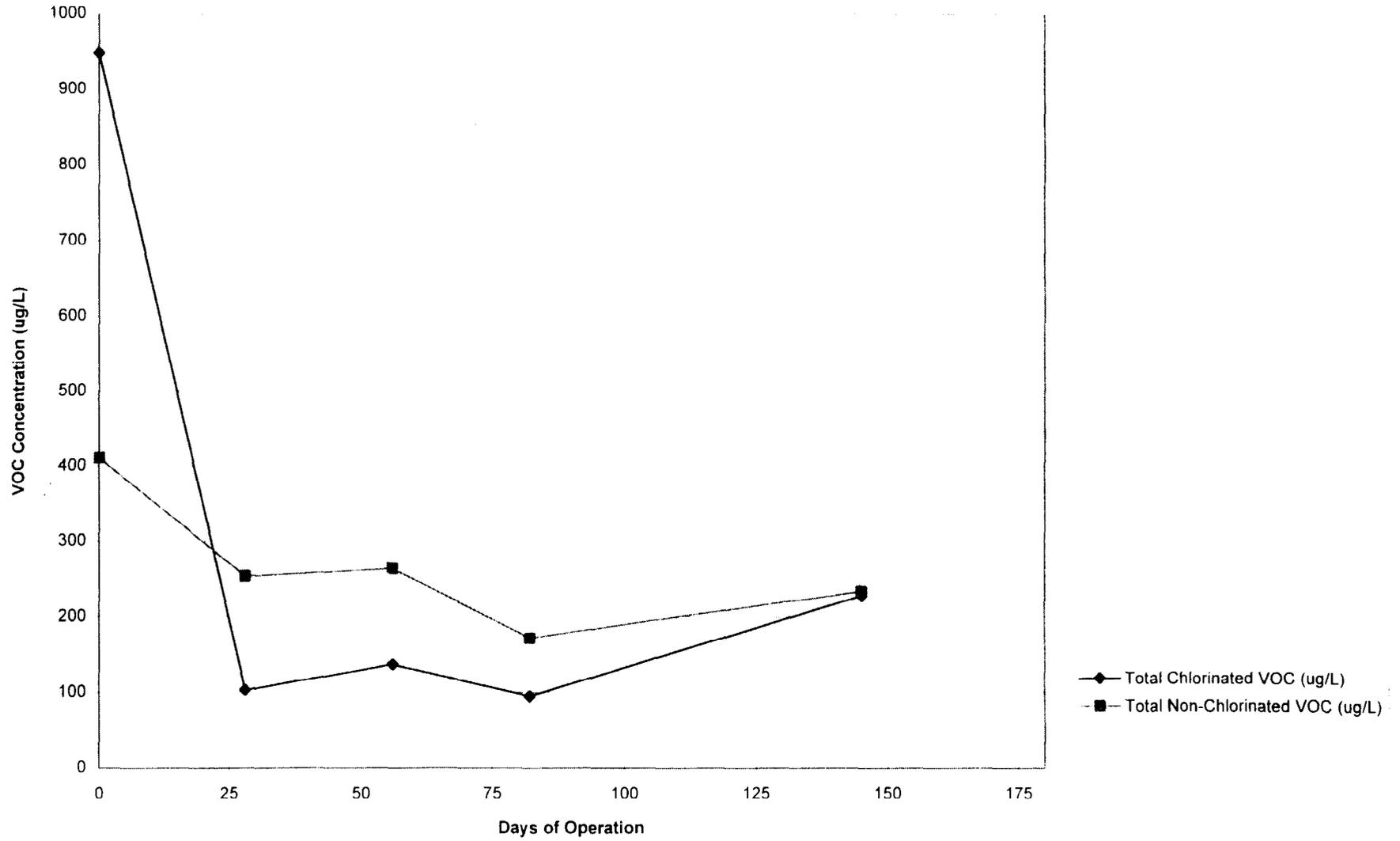
TABLE 3-3 (Continued)
GROUNDWATER RESULTS
PERMANENT MONITORING WELL - GW02
AS/SVE NWIRP CALVERTON, NEW YORK

Sample Date	MDLs	8/16/95	9/28/95	10/26/95	11/21/95	12/19/95	1/23/96
Benzo(g,h,i)perylene	2						
2-Methylnaphthalene	1	19	36	58	87	55	20 J
4-Methylphenol	2	250 D	91	17		7 J	72 J
Naphthalene	1	45	51	63	67	35	16 J
Isophorone	1					8 J	
Total Semivolatile VOCs		440	242	167	357	153	252
PCB-1260	1	26	10	9	8	2.6 J	20
Endosulfan I	0.01	0.04 J		0.009 J			
Endosulfan II	0.3			0.34			0.46
Alpha BHC	0.01			0.007 J		0.03 J	
Gamma BHC-Lindane	0.02					0.05 J	0.05
Dieldrin	0.01			0.08			0.08
Heptachlor							0.04
Aldrin							0.02
Nitrate Nitrogen		--					
Nitrite Nitrogen		--					

-- Sample not collected
Blank Chemical not detected above Method Detection Limit(MDL)
J Estimated value
D Analysis of a diluted sample
* Totals do not include acetone and 2-butanone, which are likely to be laboratory contaminants.

FIGURE 3-1

VOC CONCENTRATION VERSUS TIME
PERMANENT MONITORING WELL GW02
AS/SVE - NWIRP CALVERTON



Analytical results for the three injection wells are presented in Table 3-4 and plotted as a function of time in Figures 3-2, 3-3, and 3-4. The results of this testing are not as clear as for the permanent monitoring well. For injection well IW06, no significant concentration of VOCs was detected. For injection well I13, the concentration of chlorinated VOCs was initially at a relatively low level (11 ug/l) and then increased to 65 ug/l after two months into the trial. Finally, by the end of the trial, the concentration had decreased to 43 ug/l. The initial increase in VOCs is believed to have resulted from the blending of more shallow and contaminated groundwater (at water table) with groundwater at the screened depth (8 to 9 feet below the groundwater table). It is uncertain as to whether the decrease noted during the last month of operation was significant.

For injection well IW16, an almost identical, but more pronounced trend was observed. The chlorinated VOC concentration initially decreased during the first month, and then increased over the next two months, and finally decreased during the last month of operation.

Iso-concentration contours maps were prepared for VOCs in the groundwater for both the pre-pilot study and the post-pilot study. Figures 1-3 and 1-4 present the pre-study maps for the chlorinated and non-chlorinated VOCs, respectively. These maps are based on a combination of permanent monitoring data, temporary monitoring well data, and soil gas data from the RFI and RFI Addendums for this site. The RFI data was supplemented with groundwater data collected in July and August 1995.

Figures 3-5 and 3-6 present estimated post-study maps for the chlorinated and non-chlorinated VOCs, respectively. The data base for the post-study conditions was more limited, and consists of VOC data for Monitoring Well MW-02 and Air Injection Wells I6, I13, and I16. To estimate the groundwater concentrations outside of these specific well points, average chlorinated and non-chlorinated VOC concentration reductions of 76% and 43% (from MW-02) were applied to the RFI data.

TABLE 3-4

GROUNDWATER RESULTS (ug/L)
AIR INJECTION WELLS IW06, IW13 and IW16
AS/SVE - NWIRP CALVERTON

IW06

Sample Date	MDLs	8/16/95	9/28/95	10/26/95	11/21/95	12/19/95
TCL Volatiles						
Acetone	6	10 J				
2-Butanone	3		27			
Total Chlorinated VOCs		0	0	0	0	0
Total Non-Chlorinated VOCs		0	0	0	0	0
Nitrate Nitrogen**		--	20000	@	13200	
Nitrite Nitrogen**		--		@		

IW13

Sample Date	MDLs	8/16/95	9/28/95	10/26/95	11/21/95	12/19/95
TCL Volatiles						
Acetone	6	10 J				
2-Butanone	3		23			
1,1-Dichloroethane	2			7	13	12
1,1-Dichloroethene	1			5	2 J	
Tetrachloroethene	1	4 J	2 J	4 J	2 J	2 J
Trichloroethene	1	2 J	2 J	11	8	7
1,1,1-Trichloroethane	1	5 J	5	38	34	22
Total Chlorinated VOCs		11	9	65	59	43
Total Non Chlorinated VOCs		0	0	0	0	0

TABLE 3-4 (Continued)
GROUNDWATER RESULTS (ug/L)
AIR INJECTION WELLS IW06, IW13 and IW16
AS/SVE -NWIRP CALVERTON

Sample Date	MDLs	IW16				
		8/16/95	9/28/95	10/26/95	11/21/95	12/19/95
TCL Volatiles						
Acetone	6	28		16 J		
2-Butanone	3	7 J	35	13		
Ethylbenzene	2			3 J	10	
Methylene Chloride	2	4 J				
4-Methyl - 2-Pentanone	5				6 J	
Chloroethane	3	22		94	100	16
1,1-Dichloroethane	2	85	57	170	300 D	210
1,1-Dichloroethene	1	12		6	15	2 J
cis 1,2-Dichloroethene	2			3 J	7	2 J
Tetrachloroethene	1	4 J	2 J	1 J		
Trichloroethene	1	9	5 J	3 J	1 J	2 J
1,1,1-Trichloroethane	1	120	33	37	170	85
Toluene	2	11		8	5	
Total Xylenes	1	10		13	35	8
Total Chlorinated VOCs		256	97	314	593	317
Total Non-Chlorinated VOCs		21	0	14	36	8

- @ Sample broken in transit
- Sample not collected
- Blank Chemical not detected above Method Detection Limit(MDL).
- J Estimated value
- D Analysis of a diluted sample
- ** Nitrate/Nitrite parameters not collected for IW13 and IW16

FIGURE 3-2

VOC CONCENTRATION VERSUS TIME
AIR INJECTION WELL IW06
AS/SVE - NWIRP CALVERTON

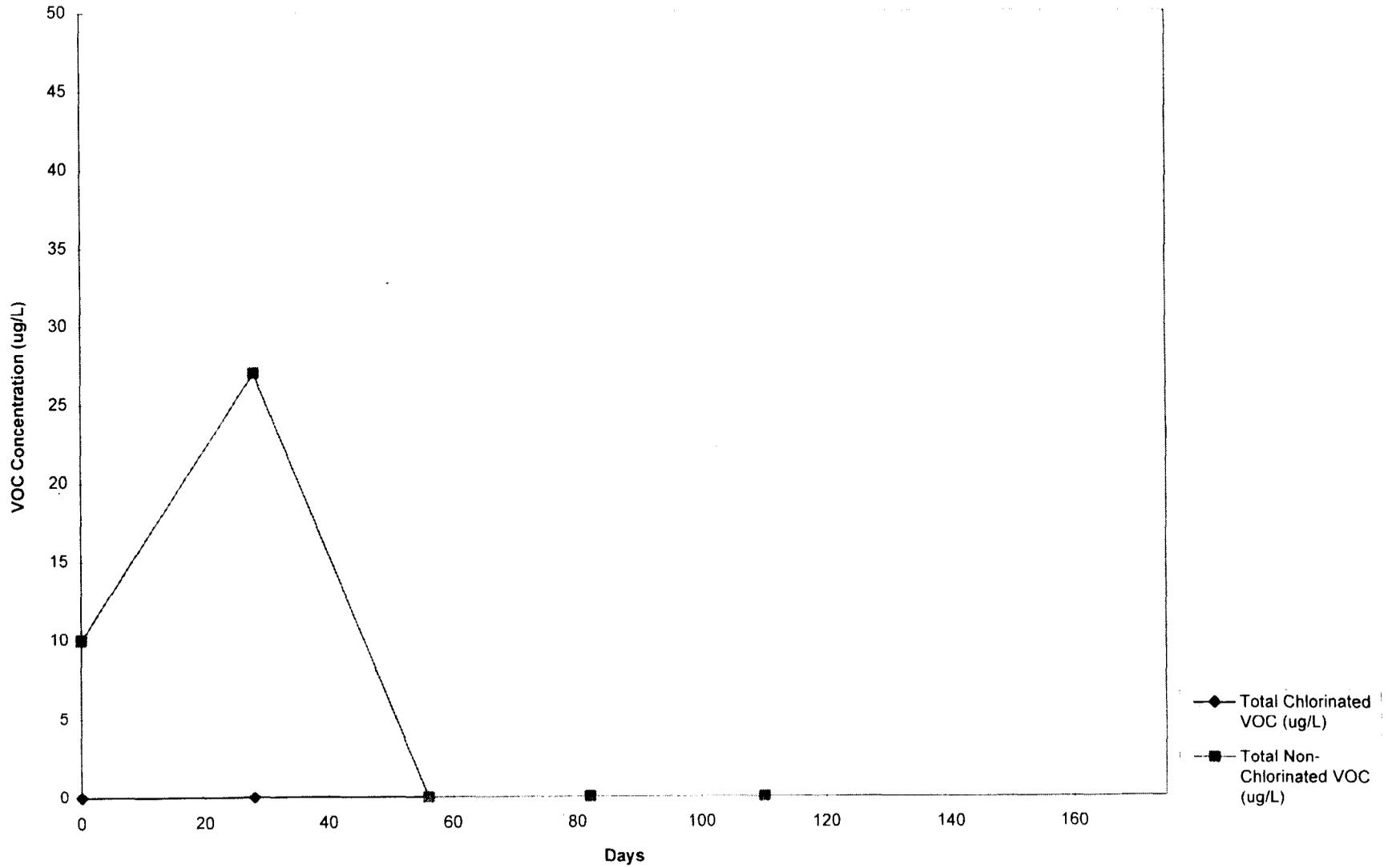


FIGURE 3-3

VOC CONCENTRATION VERSUS TIME
AIR INJECTION WELL IW13
AS/SVE - NWIRP CALVERTON

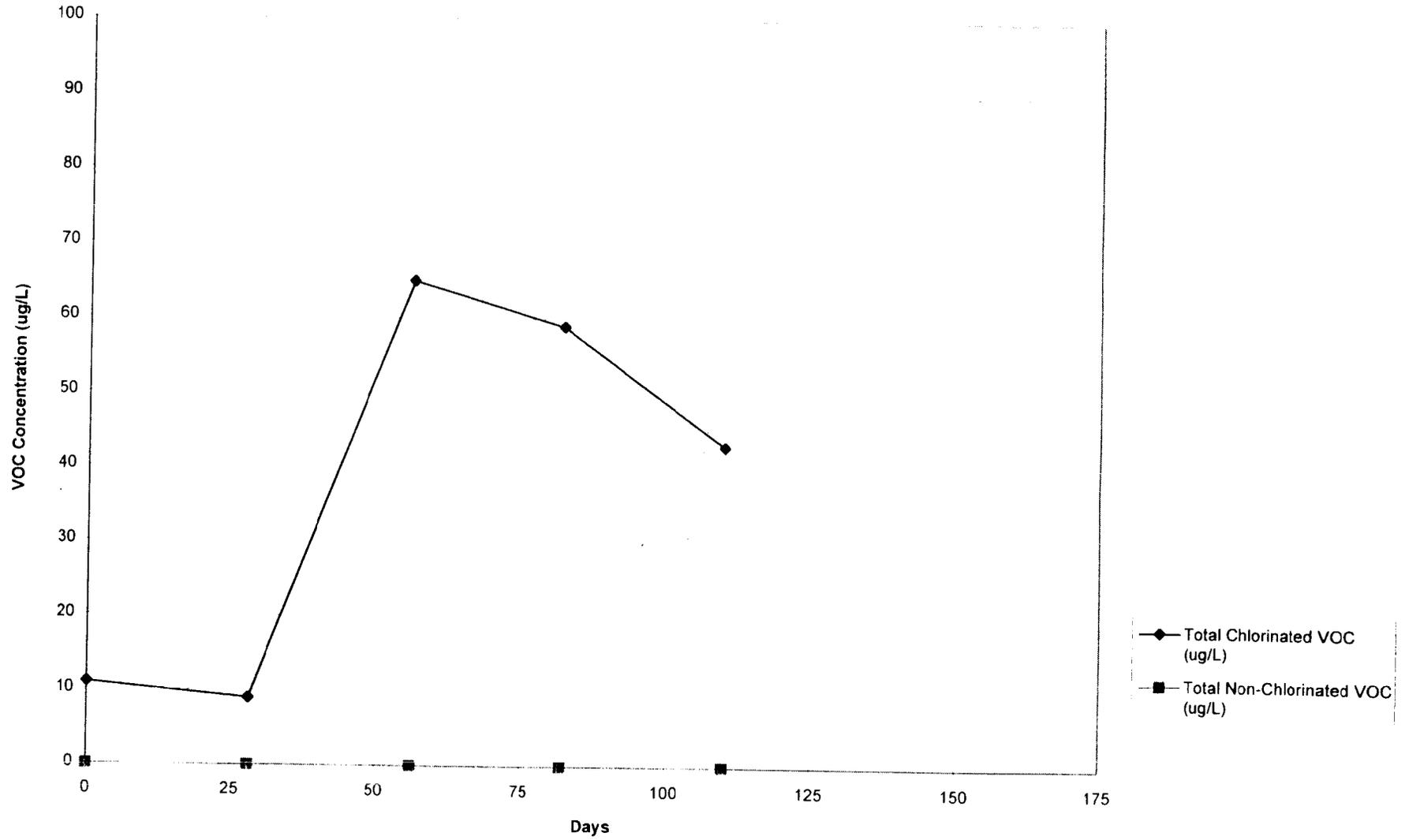
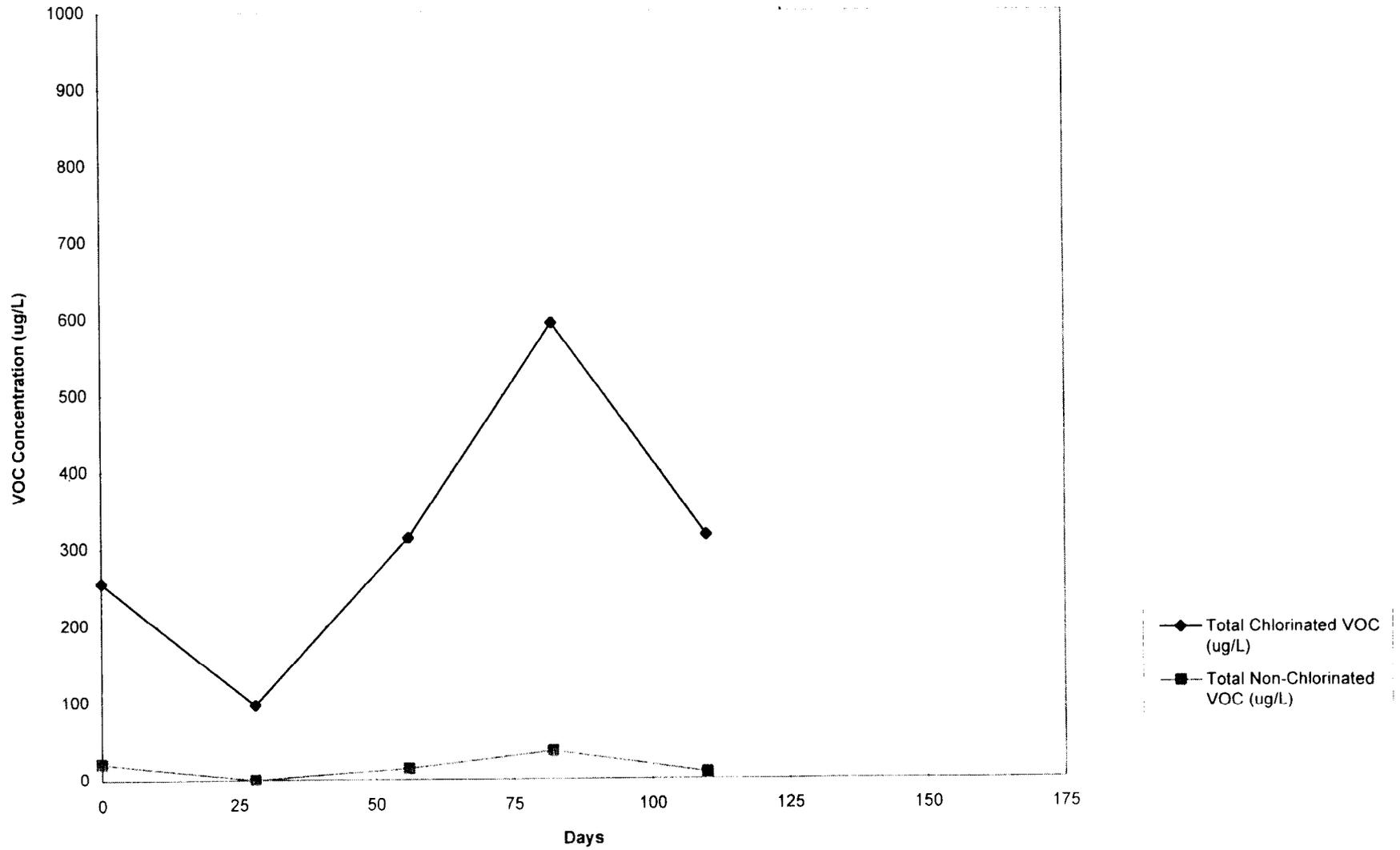
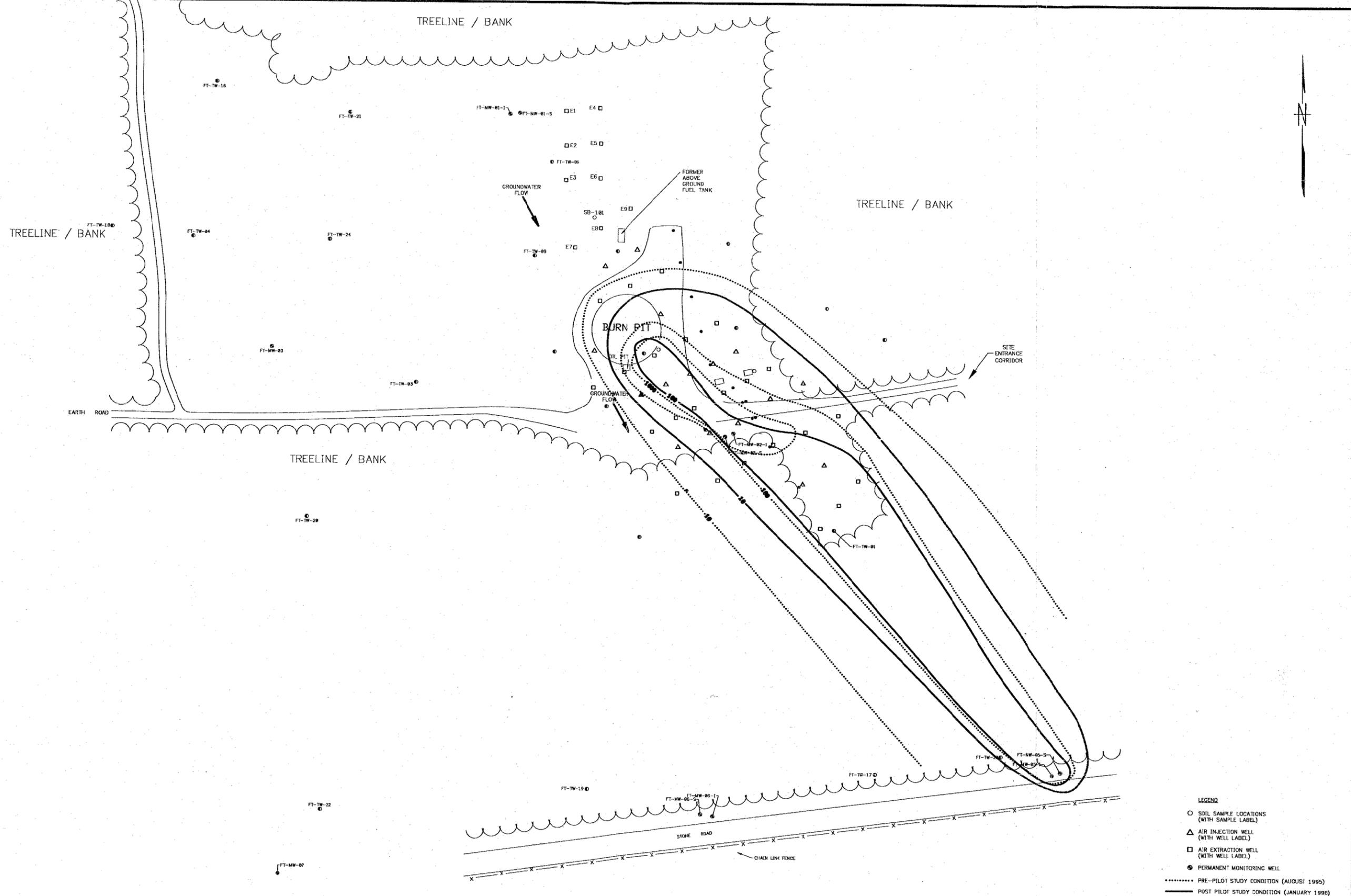


FIGURE 3-4

VOC CONCENTRATION VERSUS TIME
AIR INJECTION WELL IW16
AS/SVE - NWIRP CALVERTON





- LEGEND**
- SOIL SAMPLE LOCATIONS (WITH SAMPLE LABEL)
 - △ AIR INJECTION WELL (WITH WELL LABEL)
 - AIR EXTRACTION WELL (WITH WELL LABEL)
 - PERMANENT MONITORING WELL
 - PRE-PILOT STUDY CONDITION (AUGUST 1995)
 - POST PILOT STUDY CONDITION (JANUARY 1996)



DRAWN	T. D'Alencandris	(05/23/96)
CHECKED		
DESIGN ENGINEER	C. Farkas	
PROCESS ENGINEER		
PROJECT MANAGER	D. Brayack	
ENGINEERING MANAGER	S. Hughes	
CLIENT APPROVAL		

C.F. BRAUN

PETER PLAZA 7
88 ANDERSON DRIVE
PITTSBURGH, PA 15228

FILE		TOTAL CHLORINATED VOCs - GROUNDWATER	
CONTRACT		ISOCONCENTRATION MAP (ug/L)	
CLIENT		PRE- & POST PILOT STUDY CONDITIONS	
CLIENT	HWRP CALVERTON	CONTRACT	CLEAN - CTD 223
SCALE	AS SHOWN	DATE	JUNE 1998
DRAWING NO.	FIGURE 3-6	AS FILE NAME	4578/4578CM84.DWG
REV.		REV.	

3.3.3 Air Results:

Air monitoring was conducted during the trial to present an independent estimate of the quantity of VOCs being extracted from the soils and groundwater. The air monitoring consisted of measuring VOCs in the air stream from the North Field, (FT-AS00-16, an area where low-level and sporadic detections of VOCs were noted) and from the combined extracted air (carbon unit influent - FT-AS00-01). The carbon unit effluent air (FT-AS00-02) was also analyzed for VOCs to evaluate the carbon removal efficiencies and break through times. The fixed-base laboratory air monitoring results are presented in Table 3-5. The sample locations are illustrated on Drawing 1. Chain-of-custody records and sample log sheets are presented in Appendices G and H. Raw analytical data sheets are presented in Appendix J.

As indicated by the data in Table 3-5, Figure 3-7, and Figure 3-8, for the carbon unit influent air samples (FT-AS00-01), the total chlorinated and non-chlorinated VOC concentrations entering the carbon treatment units steadily decreased during the trial. In all five sample events, the total chlorinated VOC concentrations exceeded the total non-chlorinated VOC concentrations by a factor of approximately five. Based on air flow rates and measured VOC concentrations, the soil vapor extraction system removed approximately 46 pounds of target chlorinated-VOCs and 8 pounds of target non-chlorinated VOCs, (See Appendix K for calculations).

The analytical results for air samples collected from the carbon unit effluent (FT-AS00-02) indicate that most of the volatilized contaminants were removed by the vapor-phase carbon units during the trial. However, after two months of operation, breakthrough of 1,1,1-trichloroethane and 1,1-dichloroethane were noted, indicating a carbon usage rate of approximately 1000 pounds per month during initial system operation. A fresh carbon unit was attached to the treatment train on November 21, 1995.

According to the work plan, real-time field monitoring of the air extraction stream was to be performed using an organic vapor analyzer (OVA). However, during the startup of the system, it was determined that the OVA could not provide usable readings, for upon attaching the OVA to the sample port the meter reading would rapidly increase to several hundred parts per million (ppm) and then the unit would flameout. Based on later tests, it is suspected that the flameout resulted from a low oxygen concentration in the extracted air.

TABLE 3-5

AIR MONITORING RESULTS (ug/m³)
 VAPOR EXTRACTION AIR STREAM
 AS/SVE - NWIRP CALVERTON

AIR SAMPLE FT-AS00-01

Monitoring Date	MDLs	9/1/95	9/7/95	9/29/95	10/25/95	11/20/95
Vinyl Chloride	0.6	170	49	38		
Chloroethane	0.6	4,600	2,200 D	1,900	12 D	150
Chloromethane			6	19		
Acetone	2.0	140	100	41	66 D	35
2-Butanone	2.0	29				
Carbon Disulfide	2.0	6	30	19	14 D	24
Methylene Chloride	1.9	11	30		30 D	
1,1-Dichloroethane	0.9	8,600	8,000 D	10,000	4,200 D	1,800
1,2 Dichloroethane	0.9	5		11		
1,1-Dichloroethene	0.9	87	100	94	6 D	16
trans-1,2-Dichloroethene	0.9	10	15	10		
cis 1,2-Dichloroethene	0.9	990	820 D	940	500 D	300
1,1,1-Trichloroethane	1.0	9,700	11,000 D	15,000	12,000 D	7,000
Benzene	0.7	67	68	70	34 D	35
Trichloroethene	1.0	440	340	270	140 D	120
Toluene	0.8	2,700	2,200 D	2,500	1,100 D	400
1,1,2-Trichloroethane	1.0	45	53	56		
Tetrachloroethene	1.0	920	650	1,000	530 D	550
Ethyl Benzene	1.0	310	230	220	290 D	180
1,4-Dichlorobenzene	3.0			4 J		
m/p-Xylene	1.0	1,200	670	870	1,400 D	860
o-Xylene	1.0	700	490	660	1,000 D	660
Total Chlorinated VOCs*		26,007	23,573	29,612	17,528	10,056
Total Non-Chlorinated VOCs*		5,152	3,788	4,380	3,904	2,194

TABLE 3-5 (Continued)
 AIR MONITORING RESULTS (ug/m³)
 AS/SVE NWIRP CALVERTON

AIR SAMPLE FT-AS00-02

Monitoring Date	MDLs	9/1/95		9/7/95	9/29/95	10/25/95	11/20/95
Vinyl Chloride	0.6	5	D	37	17		
Chloroethane	0.6			270	D 1,300	62	D 190
Chloromethane					1	J	
Acetone	2.0	120	D	120	60		38
2-Butanone	2.0	91	D	7	15		
Carbon Disulfide	2.0			7			18
Methylene Chloride	1.9	40	D	120	12		
Chloroform	1.0			9			
1,1-Dichloroethane	0.9			5	78	15,000	D
1,2 Dichloroethane	0.9						4,000
1,1-Dichloroethene	0.9			1	J	63	D 60
trans-1,2-Dichloroethene	0.9						6
cis 1,2-Dichloroethene	0.9			1	J	480	D 610
1,1,1-Trichloroethane	1.0			13		21,000	D 13,000
Benzene	0.7			1	J 1	5	D 19
Trichloroethene	1.0			2	J 2	25	D 100
Toluene	0.8	27	D	33	24	190	D 200
Tetrachloroethene	1.0			7	J 23	41	D 110
Ethyl Benzene	1.0			7	1	J	8
1,4-Dichlorobenzene	3.0			8			
m/p-Xylene	1.0	7	D	29	5		12
o-Xylene	1.0			17	2	J	6
Styrene	0.9			3	J		
Total Chlorinated VOCs*		5		353	1,421	36,671	18,076
Total Non-Chlorinated VOCs*		34		97	33	195	263

TABLE 3-5 (Continued)
 AIR MONITORING RESULTS (ug/m³)
 AS/SVE NWIRP CALVERTON

AIR SAMPLE FT-AS00-16

Monitoring Date	MDLs	10/25/95	11/20/95
Vinyl Chloride	0.6		
Chloroethane	0.6		
Chloromethane			
Acetone	2.0		36
2-Butanone	2.0		56
Carbon Disulfide	2.0		9
Methylene Chloride	1.9		8
Chloroform	1.0		
1,1-Dichloroethane	0.9	160 D	2 J
1,2 Dichloroethane	0.9		
1,1-Dichloroethene	0.9		1 J
trans-1,2-Dichloroethene	0.9		
cis 1,2-Dichloroethene	0.9		2 J
1,1,1-Trichloroethane	1.0	320 D	10
Benzene	0.7		3 J
Trichloroethene	1.0		2 J
Toluene	0.8	290 D	36
1,1,2-Trichloroethane	1.0		
Tetrachloroethene	1.0		15
Ethyl Benzene	1.0		2 J
1,4-Dichlorobenzene	3.0		
m/p-Xylene	1.0		6
o-Xylene	1.0		2 J
Styrene	0.9		2 J

- Total non-chlorinated VOCs values do not include acetone, 2-butanone and total chlorinated VOCs do not include methylene chloride because of possible laboratory contamination.
- Blank Chemical not detected above Method Detection Limit (MDL).
- J Estimated value.
- D Analysis of a diluted sample.
- Note - The planned air to be collected in December 1995 were not collected. The system was shut down approximately 1.5 weeks early because of unanticipated cold weather.

FIGURE 3-7

CHLORINATED VOC, COMBINED EXTRACTION SYSTEM
CONCENTRATION AND LOADING VERSUS TIME
AS/SVE - NWIRP CALVERTON

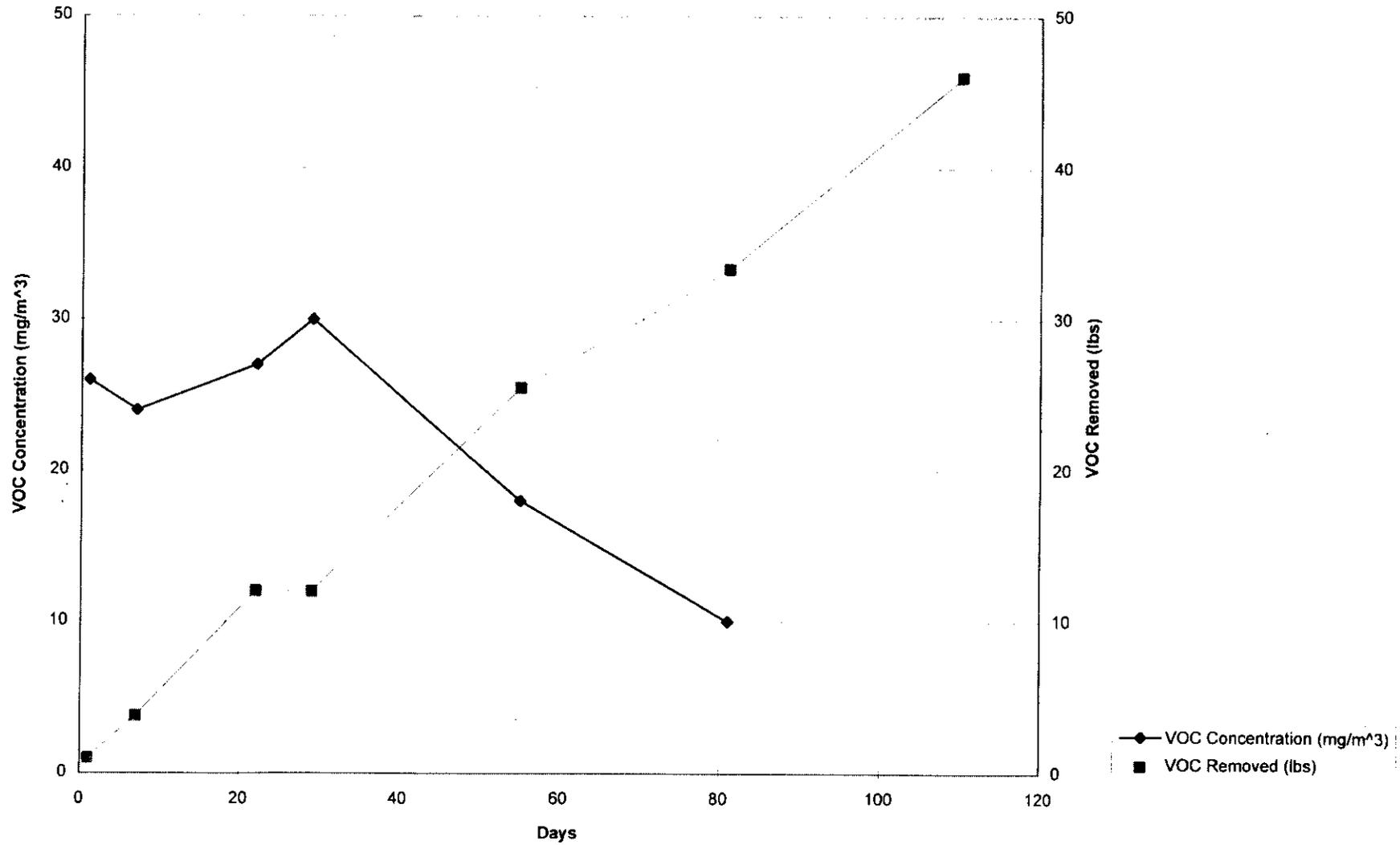
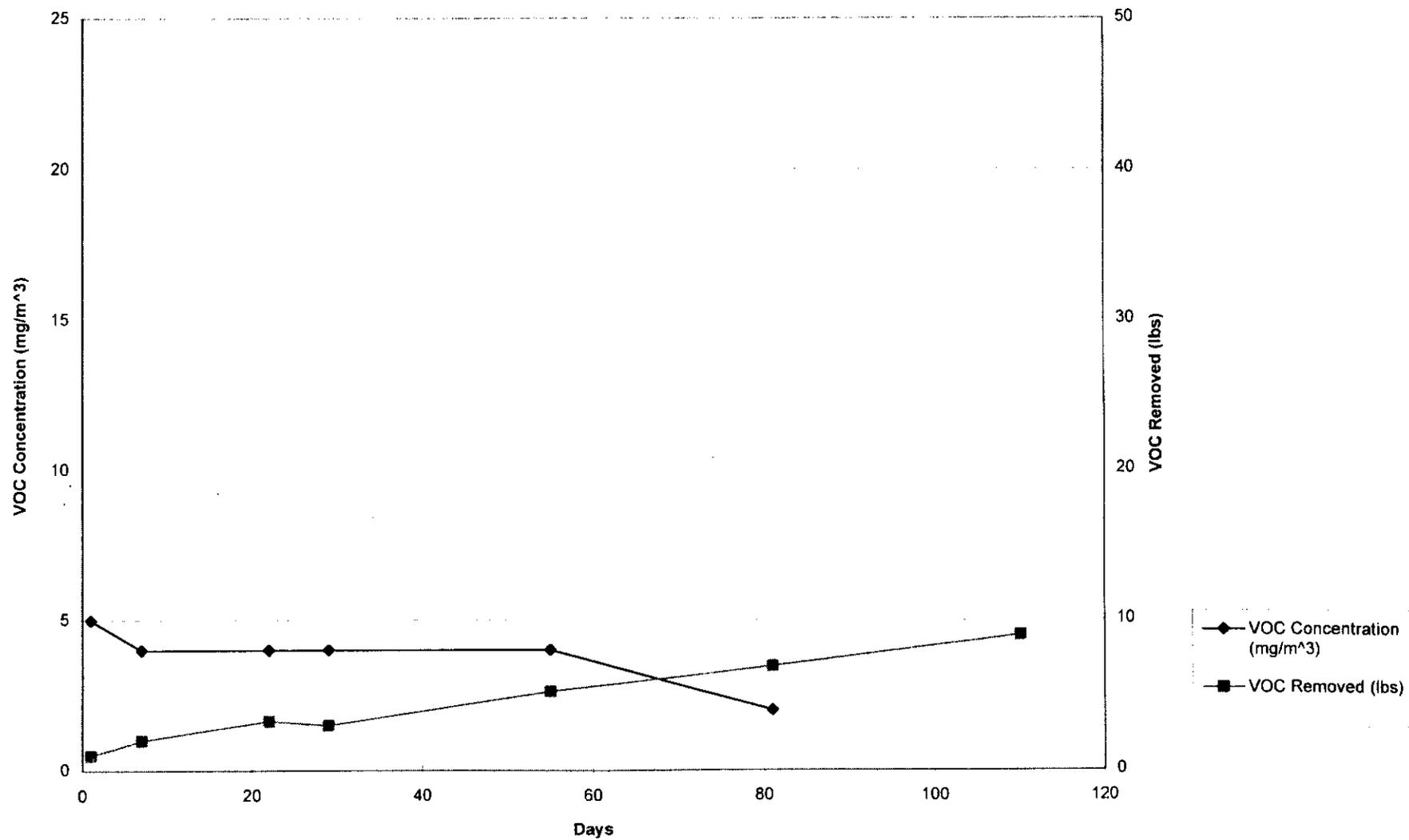


FIGURE 3-8

NON-CHLORINATED VOC, COMBINED EXTRACTION SYSTEM
CONCENTRATION AND LOADING VERSUS TIME
AS/SVE - NWIRP CALVERTON



As a result of problems with the OVA, Draeger tubes were then used for real-time monitoring. Draeger tube analysis was conducted for toluene, total petroleum hydrocarbons, oxygen, carbon dioxide, and 1,1,1 trichloroethane. The Draeger tube sampling procedure is provided in Appendix L. Draeger tube samples were collected in line by attaching a sample tap/tygon tube to the sample point and then withdrawing the pre-determined volume of air through the tube into the pump as per the sample procedure. For sampling on vacuum lines, a 1/4-inch diameter by 6-inch long piece of tygon tube was used to minimize the effects of stagnant air in the tube (5 ml) versus volume of the sample (100 to 500 ml).

The Draeger tube air monitoring results are presented in Table 3-6, and plotted in Figure 3-9 and Figure 3-10. In general, the toluene, total petroleum hydrocarbon, oxygen, and carbon dioxide tests provided consistent and reasonably reliable results. Only the 1,1,1-trichloroethane tests did not provide acceptable results. The problem with the 1,1,1-trichloroethane tests is evidenced by lack of detection for this chemical with the Draeger tubes, while positive and significant detections were measured in the fixed-base laboratory testing.

Based on carbon dioxide and oxygen analysis, atmospheric oxygen was being consumed and carbon dioxide was being formed in the soils and/or groundwater. These results are a reasonable indication of biological degradation of organics in subsurface media. Based on an average measured carbon dioxide concentration of 1.2%, a total of approximately 13,000 pounds of organics (as C) were extracted from the soils during the test, (See Appendix K for calculations). Additional discussion of the carbon dioxide and oxygen data is presented in Section 3.7.

3.4 SYSTEM SHUTDOWN

The AS/SVE system operation was scheduled to be ended in mid- to late-December. On December 18, 1995, when the system was to be shut down, excessive frozen moisture was observed in the extraction piping. A vacuum relief valve was observed to have opened, thereby protecting the blower. Since the extraction wells were located 4 to 8 feet above the groundwater table and 20' by 20 foot plastic sheets covered each extraction well, this moisture is believed to have resulted from relatively warm saturated air from the soils and groundwater condensing in the cold non-insulated extraction piping. No condensation was noted in the injection piping.

TABLE 3-6

AIR RESULTS (ppm) - DRAEGER TUBE ANALYSIS
AS/SVE - NWIRP CALVERTON

ACTIVATED CARBON SYSTEM

Monitoring Location	Entering Activated Carbon System					Between Activated Carbon Units				
Monitoring Date	9/1/95	9/7/95	9/29/95	10/25/95	11/20/95	9/1/95	9/7/95	9/29/95	10/25/95	11/20/95
Toluene	35	40	4	2	7					5
Total Petroleum Hydrocarbons	35	30	25	20	20	13	5	20	15	20
1,1,1 Trichloroethane				--		--	--	--	--	--
Oxygen	--	19%	14%	15%	--	--	--	--	--	--
Carbon Dioxide	--	1%	3%	1%	0.5%	--	--	--	--	--

EXTRACTION WELL SYSTEM

Monitoring Location	Well Series E19 - E23					Well E20				
Monitoring Date	9/1/95	9/7/95	9/29/95	10/25/95	11/20/95	9/1/95	9/7/95	9/29/95	10/25/95	11/20/95
Toluene	--	--	--	--	--	--	--	--	--	--
Total Petroleum Hydrocarbons	--	40	20	20	10	--	130	30	--	--
1,1,1 Trichloroethane	--	--	--	--	--	--	--	--	--	--
Oxygen	--	17%	14%	--	14%	--	16%	15%	--	15%
Carbon Dioxide	--	2%	2%	3%	0.5%	--	2%	2%	2%	0.8%

TABLE 3-6 (Continued)
AIR RESULTS (ppm) - DRAEGER TUBE ANALYSIS
AS/SVE - NWIRP CALVERTON

ACTIVATED CARBON SYSTEM

Monitoring Location	Exiting Activated Carbon System				
	9/1/95	9/7/95	9/29/95	10/25/95	11/20/95
Toluene	--	--	--	--	
Total Petroleum Hydrocarbons	5			7	20
1,1,1 Trichloroethane	--	--	--	--	--
Oxygen	--	--	--	--	--
Carbon Dioxide	--	--	--	--	--

EXTRACTION SYSTEM

Monitoring Location	Well E22				
	9/1/95	9/7/95	9/29/95	10/25/95	11/20/95
Toluene	--	--	--	--	--
Total Petroleum Hydrocarbons	--	20	8	--	10
1,1,1 Trichloroethane	--	--	--	--	--
Oxygen	--	15%	16%	--	15%
Carbon Dioxide	--	2%	2%	2%	0.8%

-- Measurement not collected
 Blank Non-detectable concentration

NOTE: Draeger tube air monitoring was not conducted in December. Operation of the air sparging system was terminated approximately 1.5 weeks early because of unanticipated cold weather.

FIGURE 3-9

CARBON DIOXIDE, COMBINED EXTRACTION SYSTEM
CONCENTRATION AND LOADING VERSUS TIME
AS/SVE - NWIRP CALVERTON

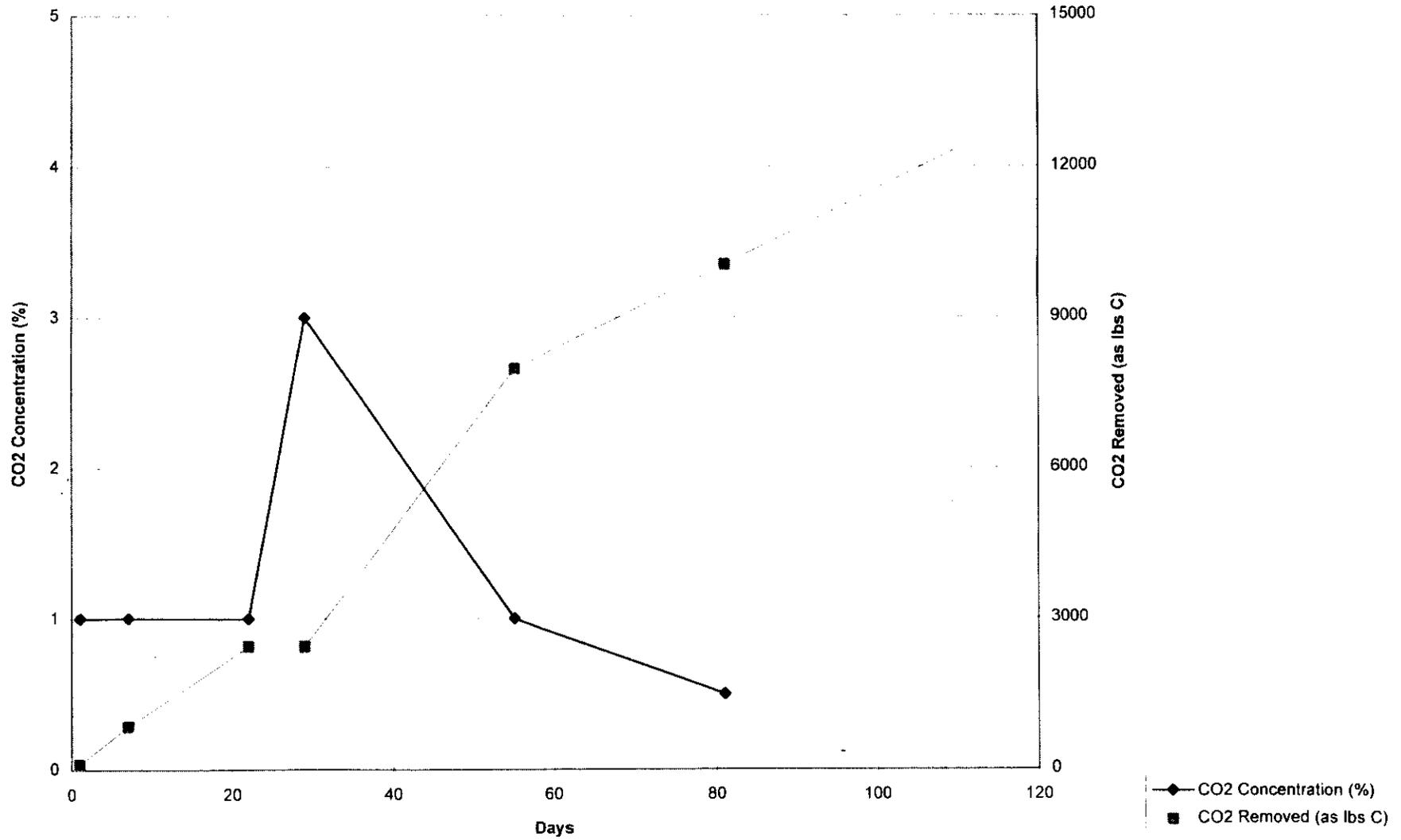
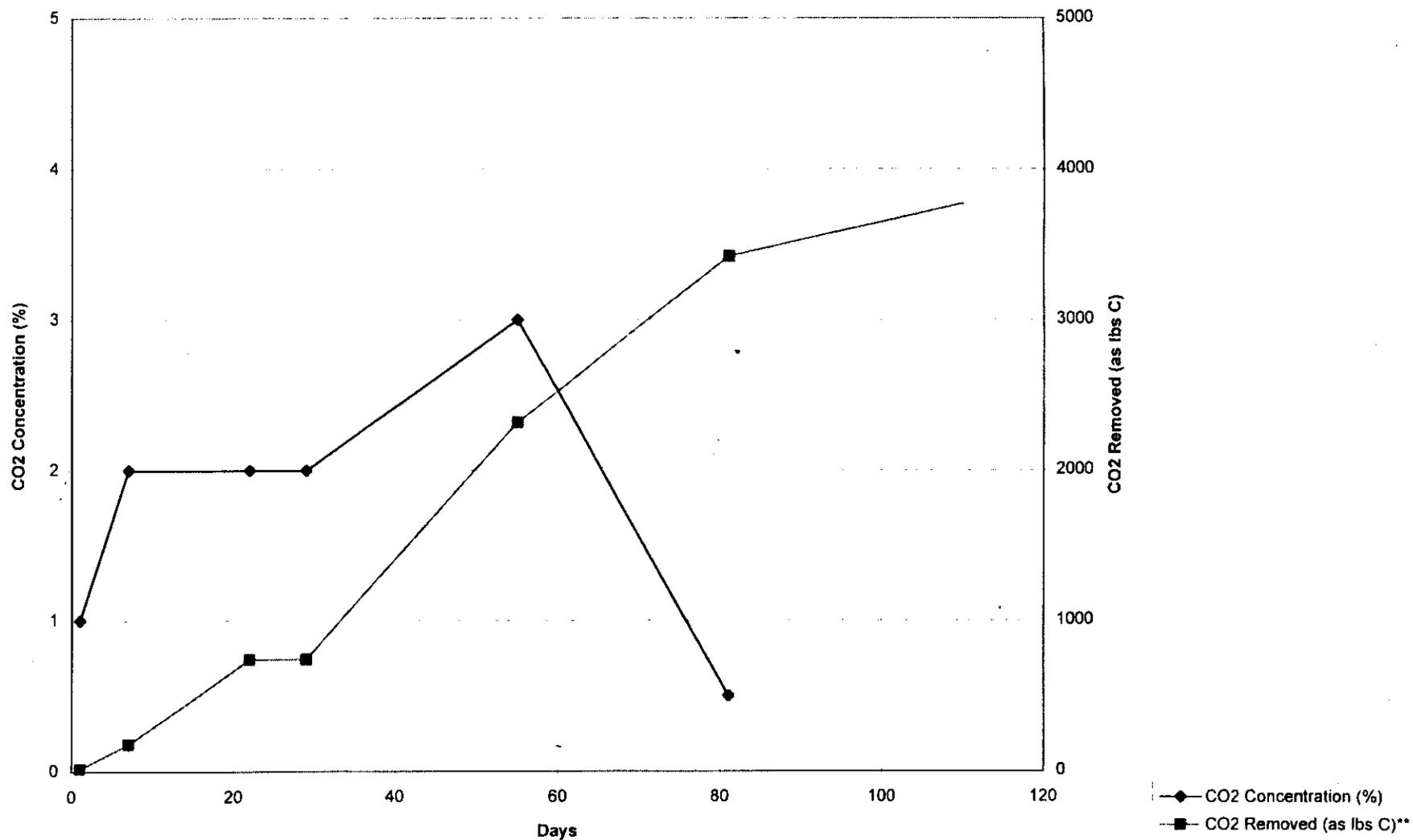


FIGURE 3-10

CARBON DIOXIDE, AIR EXTRACTION WELLS E19 - E23
CONCENTRATION AND LOADING VERSUS TIME
AS/SVE - NWIRP CALVERTON



Specific winterization activities included: draining the two moisture separators and all air extraction lines of liquid condensate and removing all 1/4-inch drainage plugs to allow drainage of melted condensate; changing the oil in the air injection and air extraction blowers; covering the blowers with plastic sheeting; turning off the main electric breakers at the Fire Training Area; removing the three activated carbon canisters from the site; and returning the carbon units to Calgon Carbon for regeneration.

3.5 RADIUS OF INFLUENCE

One indirect objective of the pilot trial was to evaluate the effective radius of the injection and extraction well points. The evaluation consisted of preliminary tests during system startup and more detailed measurements at the end of the test period.

The objective of determining a radius of influence for the extraction wells were not fully met, because at the time of the testing, the extraction blower piping was mostly plugged with frozen condensate. However, preliminary tests were conducted during system startup in August 1995. These tests consisted of operating only one extraction well in a given area at a rate of 6 to 8 ACFM. Groundwater table monitoring wells and nearby extraction wells were then sealed and pressure (vacuum) readings were made with and without the air extraction well operating. Measurable vacuums were noted in wells up to 17 feet away. No measurable vacuums were observed in the wells 25 to 40 feet away. However, it must be noted that the lack of a measurable vacuum is not an indication that the extraction well did not capture air from this distance.

The tests on the air injection wells was more definitive. The field measurements recorded for the injection well radius of influence tests are summarized in Table 3-7. Based on the location of nearby wells which could be used for observation, air injection wells I-8, I13 and I-14 were selected for the testing. Air was injected into each of these wells at measured flow rates and pressures. Clusters of air extraction and Northrop Grumman monitoring wells surrounding each of the air injection points were monitored to detect changes in air pressure and water level induced by the injected air. The maximum distance between one of the air injection points and a monitoring point in which a pressure change or water level change was detected would be a positive indication of the radius of influence.

TABLE 3-7

RADIUS OF INFLUENCE TESTING
AS/SVE - NWIRP CALVERTON

Air Injected into Well I-8

Air Injection Data		Air Detection Data		
		Well ID	E17	DN
		Distance from Well I-8 (ft)	46	13
Volume (ft ³ /min)	Header Pressure (psi)	Detected Pressures (psi)		
< 1	1.4		0.000	0.001
< 1	2.2		0.000	0.001
1.1	2.9		0.000	0.001
4.4	3.1		0.000	0.005
11	3.6+**		0.001	0.012
17	3.6+**		0.002	0.023
33	3.6+**		0.003	0.036

Air Injected Into Well I-14

Air Injection Data		Air Detection Data			
		Well ID	DV	DO	DX
		Distance from Well I-14 (ft)	37	37	12
Volume (ft ³ /min)	Header Pressure (psi)	Detected Pressure (psi)			
12	1.9		0.000	0.000	0.001
3	---		---	---	0.001
9	---		---	---	0.003
13	---		---	---	0.004

Air Injected into Wells I-13 and I-14

Air Injection Data		Water Level Data			
		Well ID	DV	DO	DX
		Distance from Well I-14 (ft)	37	37	12
Volume (ft ³ /min)	Header Pressure (psi)	Detected Water Level Increase (in.)			
20	---		+5	---	---
39	---		+7	---	---

** Actual well pressures exceed maximum detection limits of the monitoring equipment

--- Measurement not recorded

As indicated by the data in Table 3-7, air injected into the ground at well I-8 at rates of 11 CFM and 17 CFM induced measurable pressure changes in an air extraction well located approximately 46 feet away. These air injection rates are slightly higher than the 6 to 10 CFM applied to air injection wells during the trial. For injection wells I-13 and I-14, air injection rates of 20 CFM and 39 CFM induced 5-inch and 7-inch water level increases in Grumman well DV located approximately 37 feet from the air injection point.

3.6 FREE PRODUCT LAYER

During the pilot testing, one objective was to evaluate the impact that the AS/SVE would have on the floating free product at the site. Northrop Grumman has been conducting floating free product recovery by bailing wells screened across the groundwater table. The product thicknesses and free product recovered were recorded by Northrop Grumman prior to and during the trial. This data for 1993 to 1995 is summarized in Table 3-8.

Based on the free product data, there is a preliminary indication that the free product layer thickness, and to an extent, the horizontal limits increased following AS/SVE start-up on August 31, 1995. For example, the average free product thickness for the eight months prior to the trial was 0.09 feet, and during the trial, the average free product thickness increased to 0.31 feet. For similar periods (September to December) in 1993 and 1994, the average free product thicknesses were 0.09 and 0.04 feet, respectively.

In addition, for individual wells, the average free product layer thickness measured in well DM increased from 0.07 feet in July 1995 to 1.12 feet in September 1995. For the time period of January 1993 to August 1995, the highest monthly average free product thickness measured in this well was 0.13 feet. Similarly, the average free product thickness measured in Northrop Grumman well DV increased from 0.02 feet in July 1995 to 0.90 feet in September 1995. For the time period of January 1993 to August 1995, the highest monthly average free product layer measured in this well was 0.05 feet. However, from the spring/summer of 1995 to the fall of 1995, the aquifer depth across the site generally appears to have fallen. Varying water tables commonly result in changes in free product thicknesses.

In addition, Grumman measured free product thicknesses at the Fuel Depot during this same period. The average free product thicknesses at the Fuel Depot increased from 0.11 feet in August 1995 to 0.39 feet and 0.67 feet in September and October 1995, respectively.

TABLE 3-8

FREE PRODUCT DATA
AS/SVE NWIRP CALVERTON

Month/ Year	Average Free-Product Thickness (feet)										Free Product Removed (gallons)
	DG (01)	DH (02)	DF (03)	DM (07)	DN (08)	DV (09)	DP (10)	DR (12)	DS (13)	Aver.	
01/93	0.01	0.03	0	0.1	0.04	0	0	0.04	0.1	0.04	0.15
02/93	0	0	0	0.1	0	0	0	0.01	0.01	0.01	0.05
05/93	0.06	0.04	0	0.03	0	0	0	0.01	0.02	0.02	0.1
06/93	0.13	0.01	0	0	0.01	0	0	0.01	0	0.02	0.1
07/93	0.06	0	0	0	0	0	0	0.01	0	0.01	0
08/93	0.13	0.02	0	0	0	0	0	0.01	0	0.02	0.15
09/93	0.15	0.17	0	0	0	0.01	0	0.01	0	0.04	0.55
10/93	0.17	0.7	0	0	0.01	0.01	0	0	0.18	0.12	2.25
11/93	0.16	0.68	0	0	0.01	0.01	0	0.02	0.32	0.13	1.5
12/93	0.04	0.11	0	0.1	0.01	0.05	0	0.06	0.08	0.05	0.25
Average (1993)	0.09	0.18	0	0.03	0.01	0.01	0	0.02	0.07	0.04	5.1
02/94	0	0	0	0.13	0	0	0	0	0.06	0.02	0.1
03/94	0.02	0	0	0.07	0	0	0	0	0	0.01	0.5
04/94	0	0	0	0.02	0.01	0	0	0	0	0	0.05
05/94	0	0	0	0.01	0.01	0	0	0	0	0	0
06/94	0	0	0	0	0.01	0	0	0	0	0	0
07/94	0.01	0	0	0	0	0	0	0	0	0	0
08/94	0.05	0.02	0	0	0.01	0	0	0	0	0.01	0.10
09/94	0.01	0.06	0	0	0	0.02	0	0	0	0.01	0.8
10/94	0	0.05	0	0.01	0	0	0	0	0.01	0.01	2.3
11/94	0.04	0.2	0	0.01	0	0.02	0	0.01	0.25	0.06	2.0
12/94	0	0.08	0	0.01	0.01	0	0	0.38	0.25	0.08	3.5
Average (1994)	0.01	0.04	0	0.02	0	0	0	0.04	0.05	0.02	9.44

TABLE 3-8 (Continued)
 FREE PRODUCT DATA
 AS/SVE NWIRP CALVERTON

Month/ Year	Average Free-Product Thickness (feet)										Free Product Removed (gallons)
	DG (01)	DH (02)	DF (03)	DM (07)	DN (08)	DV (09)	DP (10)	DR (12)	DS (13)	Aver.	
01/95	0	0.01	0	0.14	0.02	0	0	0.015	0.03	0.02	0.65
02/95	0	0	0	0.04	0	0	0	0	0.01	0.01	0.2
03/95	0	0	0	0.10	0.01	0	0	0	0.03	0.02	0.1
04/95	0.01	0.01	0	0.04	0	0.01	0	0	0.02	0.01	0
05/95	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	-
06/95	0.02	0.06	0	0.02	0.01	0.05	0	0.98	0.69	0.20	2.5
07/95	0.06	0.25	0	0.07	0.01	0.02	0	0.48	0.73	0.18	9.25
08/95	0.03	0.09	0.02	0.01	0	0.05	0	0.22	1.01	0.16	5.25
Average (1995)	0.02	0.06	0.00	0.06	0.01	0.02	0.00	0.24	0.36	0.09	17.95
Start of Pilot Test (08/31/95)											
09/95	0.04	0.05	0.05	1.12	0.05	0.9	0.68	0.07	0.91	0.43	5.5
10/95	0.33	0	0.02	0.87	0.05	0.82	0.47	0.09	0.84	0.39	6.5
11/95	0	0.25	0.03	0.68	0.02	0.61	0.37	0.34	0.51	0.31	5.5
12/95	0.15	0.05	0	0.15	0	0.2	0	0.25	0.2	0.11	0.5
Average (1995)	0.13	0.09	0.03	0.71	0.03	0.63	0.38	0.19	0.62	0.31	18

3.7 BIOLOGICAL DEGRADATION

An initial evaluation of the biological degradation potential at the site included the testing of the site soils for the presence of natural micro-organisms and the availability of macro nutrients needed for biological growth (nitrogen and phosphorous). Bacterial counts, nitrate/nitrite, and phosphorous results are presented in Table 3-9.

The bacterial count data indicates that a large natural biological population is present in the site soils. Based on this population, it is likely that natural degradation of the organics is occurring. This data also indicates that sufficient phosphorous is available for biological growth. However, the soils contained no measurable concentration of nitrates/nitrites, which indicates that the system may be nutrient limited.

Prior to the trial, natural biological degradation of the organics at depth at the site would be expected to be primarily under anaerobic conditions (in the absence of oxygen), since natural mechanisms for providing the oxygen (such as precipitation and diffusion) are potentially low (See Appendix K). Anaerobic degradation of hydrocarbons and chlorinated solvents is well documented. However, the destruction rate of an anaerobic system is typically less than that of a similar aerobic system. As a result, one of the advantages of the AS/SVE system is that it can accelerate the natural degradation of organics in place by providing oxygen needed for aerobic degradation.

To evaluate the biological degradation rate of organics, the presence of carbon dioxide at concentrations greater than the normal atmosphere (approximately 0.04%) and a deficiency in oxygen in the offgas are generally used. One other potential source of carbon dioxide is limestone which is not present at the site. Reduced forms of iron are present at the site and could potentially compete for the oxygen, as a result, carbon dioxide would generally be a better indication of degradation rates.

Draeger tubes were used to measure carbon dioxide and oxygen in the combined extracted air as well as on individual wells. This data is presented in Table 3-6. The data on the combined extracted air indicates that the carbon dioxide concentration increased during the first month of operation to a maximum concentration of 3% on September 29, 1995 and then decreased to 0.5% by November 25, 1995. This trend may be an indication of air and water temperatures affecting the biological degradation rate.

TABLE 3-9

SOIL RESULTS
 BIOLOGICAL PARAMETERS - SOIL BORINGS SB101, SB102 and SB103
 AS/SVE - NWIRP CALVERTON

SB101 (NORTHWEST OF FIRE TRAINING RING)

Sample Date	7/31/95	9/28/95	10/25/95	11/21/95	12/20/95	7/31/95	12/20/95
Sample Depth (feet)	0002	0002	0002	0002	0002	2022	2022
Pseudomonas aeruginosa		--	--	--			
Heterotrophic Plate Count (cfu/g)	200000	--	--	--		10000	
Total Kjeldahl Nitrogen (mg/kg)	--	--	--	--			
Total Phosphorus (mg/kg)	--	--	--	--		17	
Moisture (% by wt.)	3.3	2.5	9.9	10.4		4.9	

SB102 (ADJACENT TO SOUTHEAST SECTION OF FIRE TRAINING RING)

Sample Date	7/31/95	9/28/95	10/25/95	11/21/95	12/20/95	7/31/95	12/20/95
Sample Depth (feet)	0002	0002	0002	0002	0002	2022	1517
Pseudomonas aeruginosa		--	--	--			
Heterotrophic Plate Count (cfu/g)	5400000	--	--	--		830000	
Total Kjeldahl Nitrogen (mg/kg)	--	--	--	--			
Total Phosphorus (mg/kg)	--	--	--	--		41	
Moisture (% by wt.)	3.7	5.3	13.0	10.8		20.7	

SB103 (DIRECTLY EAST OF THE UTILITY AREA)

Sample Date	7/31/95	9/28/95	10/25/95	11/21/95	12/20/95	7/31/95	12/20/95
Sample Depth (feet)	0002	0002	0002	0002	0002	1416	1416
Pseudomonas aeruginosa		--	--	--			
Heterotrophic Plate Count (cfu/g)	24000	--	--	--		2000	
Total Kjeldahl Nitrogen (mg/kg)	--	--	--	--			
Total Phosphorus (mg/kg)	--	--	--	--		33	
Moisture (% by wt.)	5	3.6	12.8	7.4		10.5	

-- Measurement not collected
 Blank Chemical not detected above Method Detection Limit(MDL).

The carbon dioxide concentrations in well cluster E19-E23, which is located near the center of the free product plume, was measured to be higher than the combined system initially. The concentration peaked on October 25, 1995 at 3% and then decreased to 1% by November 20, 1995.

As part of the biological evaluation, a portion of the site was established as a test cell to evaluate potential benefits of adding nitrogen. On September 28, 1995 a urea solution was applied to the surface of one half of the test cell. The other half was used as a control. Both areas contained similar levels of free product, soil, and groundwater contamination. Air injection and extraction rates were also maintained. For this test, extraction well E20 is located in the center of the area where Urea was applied, and extraction well is located in the center of the control cell. Well E20 and E22 both exhibited nearly identical carbon dioxide results, and no noticeable increase in carbon dioxide was observed after the application of the urea. Similar to the combined extracted air, a decrease in carbon dioxide concentration was noted to occur after a peak concentration in September and October 1995.

3.8 CHEMICAL SPECIFIC REMOVALS

Table 3-10 presents the Henry's Law Constant, the vapor pressure, the change in concentration in the permanent groundwater monitoring well (GW02) during the trial, and the quantity of VOCs removed by the vapor extraction system for select chemicals. These chemicals represent the highest concentration of chemicals in groundwater within the general classifications of chlorinated VOCs (vinyl chloride, chloroethane, 1,1-dichloroethane, 1,2-dichloroethene, and 1,1,1-trichloroethane), non-chlorinated VOCs (toluene and xylene), polynuclear aromatic hydrocarbons (fluorene), and other SVOCs (2-methylnaphthalene, 4-methylphenol, and phenol). These chemicals are arranged in order of decreasing Henry's Law Constants, (where high Henry's Law Constants indicates that the chemical is volatile).

Chemicals with the greatest reductions in groundwater concentration include vinyl chloride (>92%), chloroethane, (90%), and phenol (>97%). Both vinyl chloride and chloroethane are relatively volatile, and measurable quantities of these chemicals were observed in the vapor extraction system. Phenol is not a volatile compound, however it is relatively biodegradable.

The concentration of other VOCs including toluene, 1,1 dichloroethane, 1,2 dichloroethene, and 1,1,1-trichloroethane were reduced in the groundwater by 51 to 76%. Xylene, which has a

Henry's Law Constant similar to these compounds, was noted to increase in concentration in the groundwater by 27% during the trial even though a similar quantity was collected in the vapor extraction system. 2-Methylnaphthalene and fluorene were measured to increase in concentration by 5% and 680% respectively, whereas 4-methylphenol was measured to decrease in concentration by 71%. These SVOCs were not measured in the offgas system.

TABLE 3-10

CHEMICAL SPECIFIC REMOVALS
AS/SVE NWIRP CALVERTON

Parameter	Henry's Law Constant (atm-L/mol @ 20 C)	Vapor Pressure (mm Hg @ 20 C)	Change in MW02 Concentration During Trial (%)	VOC Collected by Extraction System During Trial (lbs)
Vinyl Chloride	2.8×10^{-2}	2.6×10^3	>92	0.09
Chloroethane	6.9×10^{-3}	1.0×10^3	90	3.3
Toluene	5.9×10^{-3}	2.8×10^1	62	3.3
1,1 - Dichloroethane	5.9×10^{-3}	2.3×10^2	66	12.5
Xylenes	4.2×10^{-3}	1.0×10^1	-27	1.5
cis 1,2 - Dichloroethene	4.1×10^{-3}	2.0×10^2	76	1.4
1,1,1 - Trichloroethane	4.1×10^{-3}	1.0×10^2	51	22.4
2-Methylnaphthalene	5.0×10^{-4}	1.0×10^1	-5	NM
Fluorene	1.2×10^{-4}	1.0×10^1	-680	NM
4-Methylphenol	3.9×10^{-7}	1.1×10^{-1}	71	NM
Phenol	1.3×10^{-8}	3.5×10^{-1}	>97	NM

NM: Not measured.

4.0 CONCLUSIONS

The conclusions and recommendations developed during the pilot study are summarized as follows.

1. The pilot study was partially successful in reducing the concentration of organics in groundwater, with chlorinated and non-chlorinated VOC reductions totaling 90% and 60% during the operation of the study, respectively. Similar reductions in SVOCs was also noted. No significant reductions in PCBs or pesticides were observed. One month after the end of the trial, a partial rebound in VOC and SVOC concentrations were noted.
2. For soil samples, reductions in organics was variable. For comparable sample locations and depths, VOCs and/or SVOCs were measured to decrease in three sample locations by 30% to 90%. The 90% reduction occurred for both the VOCs and SVOCs and in the most contaminated sample location. However, the concentration of organics was also measured to increase in one location by approximately 50%.
3. Based on fixed-base laboratory results, approximately 46 pounds of target chlorinated VOCs and 8 pound of target non-chlorinated VOCs were removed from the by the Soil Vapor extraction system during the trial.
4. Based on carbon dioxide measurements, the vapor extraction system also removed approximately 13,000 pounds of organics (measured as carbon).
5. Based on free-product measurements, the operation of the AS/SVE system may have liberated soil-bound free product. However, variable water table elevations during the trial may be a primary cause of the thickness increases noted.
6. Overall, the operation of the pilot trial over approximately 4 months appears to have reduced the concentration of VOCs and SVOCs by approximately 30 to 70%. However, the system needs to be operated for a longer period of time to better define the effectiveness of the system.

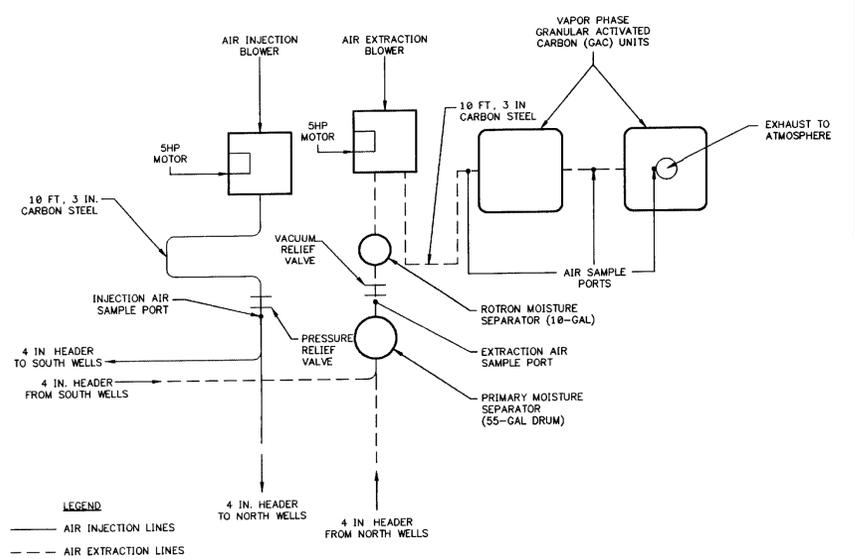
5.0 FUTURE EFFORTS

Potential future efforts to be considered at this site during the re-start of the pilot study are discussed as follows.

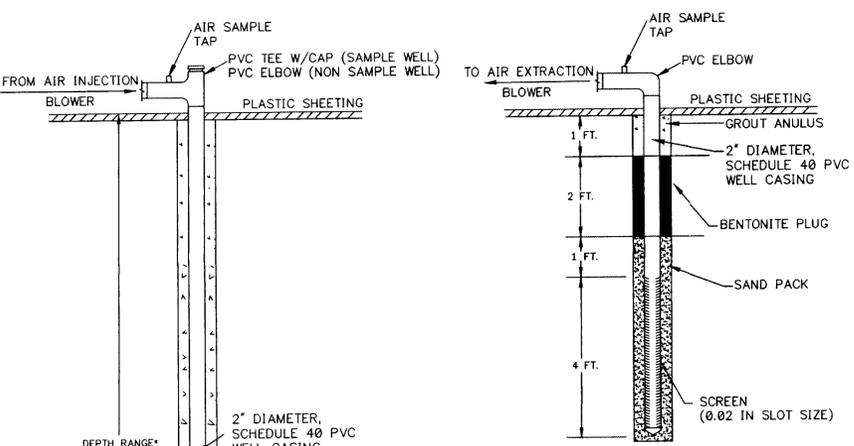
1. Continue monitoring the quality of groundwater in the permanent monitoring well and three injection wells. This data would be used to determine an approximate rate at which groundwater remediation is occurring.
2. Continue monitoring the extracted air from the combined system for VOCs and carbon dioxide. This data will be used to estimate the rate at which organics are being volatilized or converted to carbon dioxide. Also this data can be used to determine the need for the air extraction system and/or future air pollution controls.
3. Collect background carbon dioxide results to determine if the carbon dioxide concentrations measured are indicative of contaminant destruction or natural mechanisms.
4. Collect air samples from the E1 to E6 Well Series (North Field) to evaluate the need for future VOC treatment.
5. Collect air samples from the E18 to E23 Well Series, Well E20, and Well E22 and analyze them for carbon dioxide to evaluate effects that nitrogen addition has on this area (from the fall of 1995).
6. Complete the vacuum extraction radius of influence tests. Add piezometers to better measure the impacts of the system at the vacuum well screened depth.
7. Collect additional data on the free product thicknesses at the Fire Training Area to determine longer term effects from the air injection system.
8. Collect and analyze additional soil samples to better define the changes in contaminant concentrations.

REFERENCES

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2. HNUS, 1995. RCRA Facility Investigation NWIRP, Calverton, New York, Comprehensive Long-Term Environmental Action Navy (CLEAN) Program, Prepared by Halliburton NUS, Contract Number N62472-90-D-1298, Contract Task Order 0138, August.
3. CF Braun, 1995a. Existing Condition Survey NWIRP, Calverton, New York, Comprehensive Long-Term Environmental Action Navy (CLEAN) Program, Prepared by CF Braun through a Master Agreement with Brown & Root Environmental, Contract Number N62472-90-D-1298, Contract Task Order 0223, June.
4. CF Braun, 1995b. Pilot-Scale Air Sparging/Soil Vapor Extraction System Work Plan NWIRP, Calverton, New York, Comprehensive Long-Term Environmental Action Navy (CLEAN) Program, Prepared by CF Braun through a Master Agreement with Brown & Root Environmental, Contract Number N62472-90-D-1298, Contract Task Order 0223, July.



BLOWER LAYOUT
NOT TO SCALE

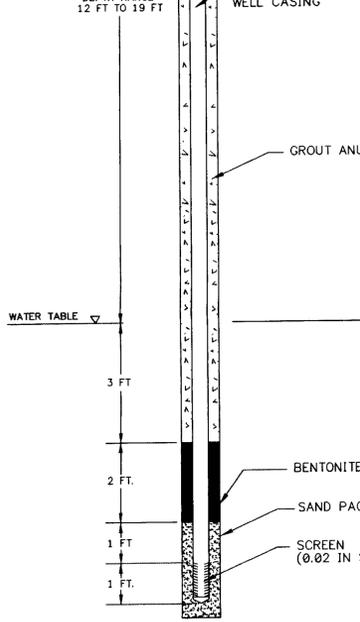


AIR EXTRACTION WELL DETAIL (TYPICAL)
NOT TO SCALE

TABLE 1

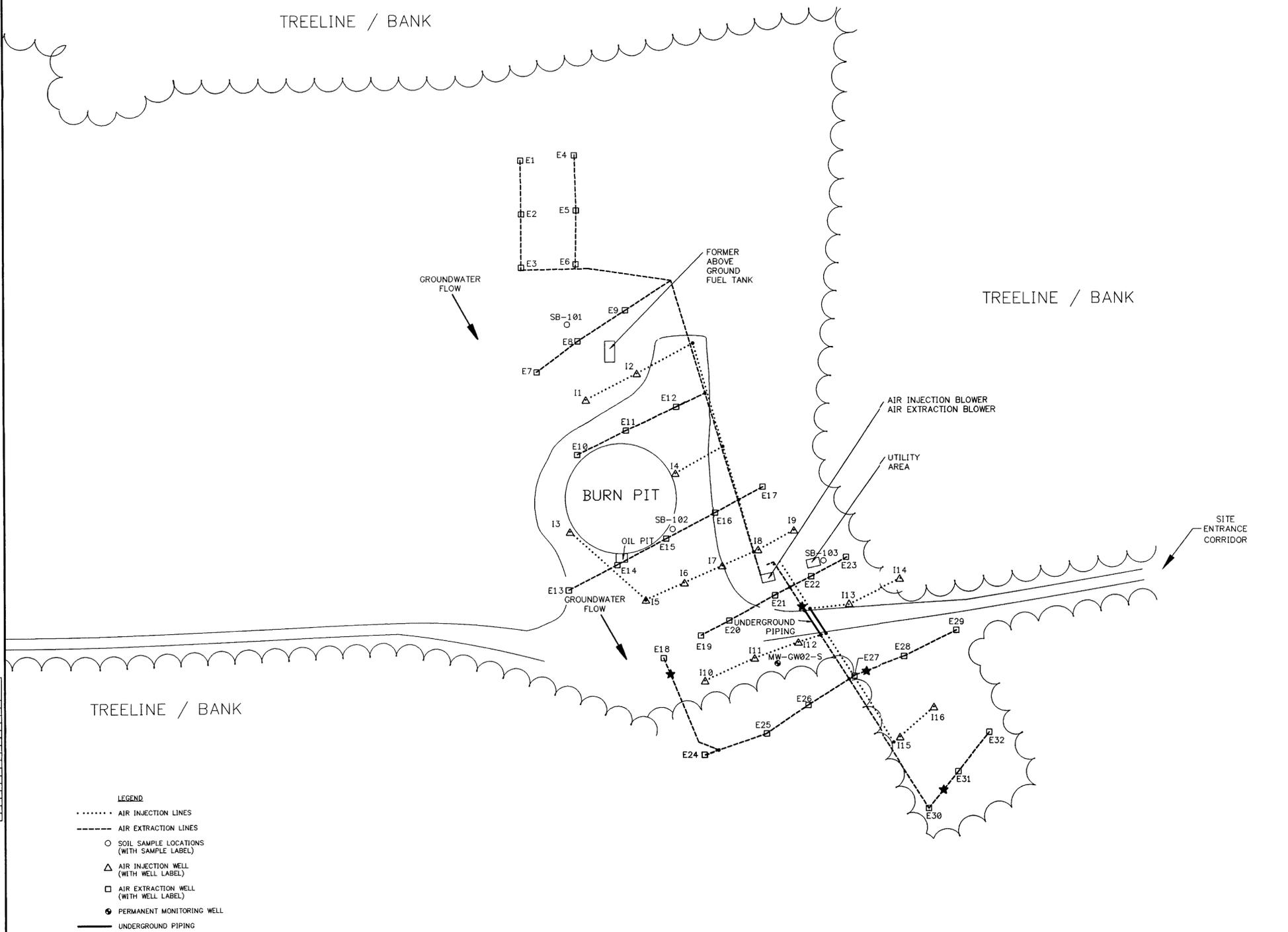
WELL ID	GROUND ELEVATION (FT)	WELL STICK-UP (FT-AGS)	SCREEN BOTTOM (FT-BGS)	WATER TABLE (FT-BGS)	WATER COLUMN DEPTH (FT)*
I1**	56.97	0.48	26.0	19.4	6.6
I2**	56.94	0.52	26.0	19.5	6.5
I3	56.38	0.51	21.8	16.7	5.2
I4	55.89	0.48	22.8	16.3	6.5
I5	55.13	0.55	23.2	15.7	7.5
I6	54.62	1.39	23.3	15.2	8.1
I7	54.46	1.47	23.6	15.2	8.4
I8	54.30	1.53	22.8	14.9	7.9
I9	54.28	0.61	23.2	14.9	8.3
I10	54.36	0.46	23.7	15.0	8.7
I11	53.85	0.91	23.7	14.4	9.3
I12**	53.01	0.43	23.5	13.7	8.8
I13**	53.00	1.21	23.5	13.3	9.3
I14**	54.57	1.10	21.9	15.3	6.6
I15	50.99	0.46	22.4	12.1	10.3
I16**	51.28	1.19	20.0	12.0	8.1

** INJECTION WELL DEPTH READJUSTED FOLLOWING WELL INSTALLATION (SEE SECTION 3.2)
* TO BOTTOM OF SCREEN

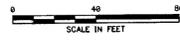
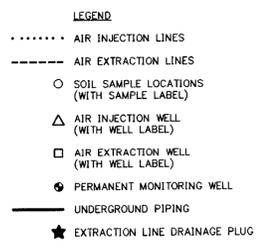


AIR INJECTION WELL DETAIL (TYPICAL)
NOT TO SCALE

* SPECIFIC DEPTH FOR EACH INJECTION WELL VARIES WITH DEPTH TO WATER TABLE. (SEE TABLE 1 ABOVE)



TREELINE / BANK



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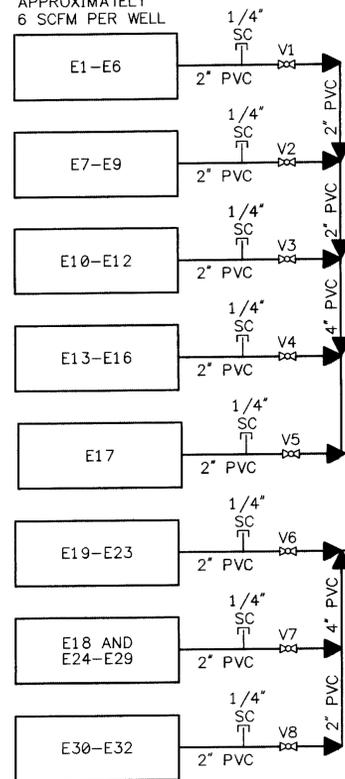
ACAD: K:\CAD0\5563\5563D011.DWG 06/24/96 DGB

DRAWN	M. BATES	(03/25/96)
CHECKED		
DESIGN ENGINEER	C. FARKOS	
PROCESS ENGINEER		
PROJECT MANAGER	D. Brayack	
ENGINEERING MANAGER	S. Hughes	
CLIENT APPROVAL		

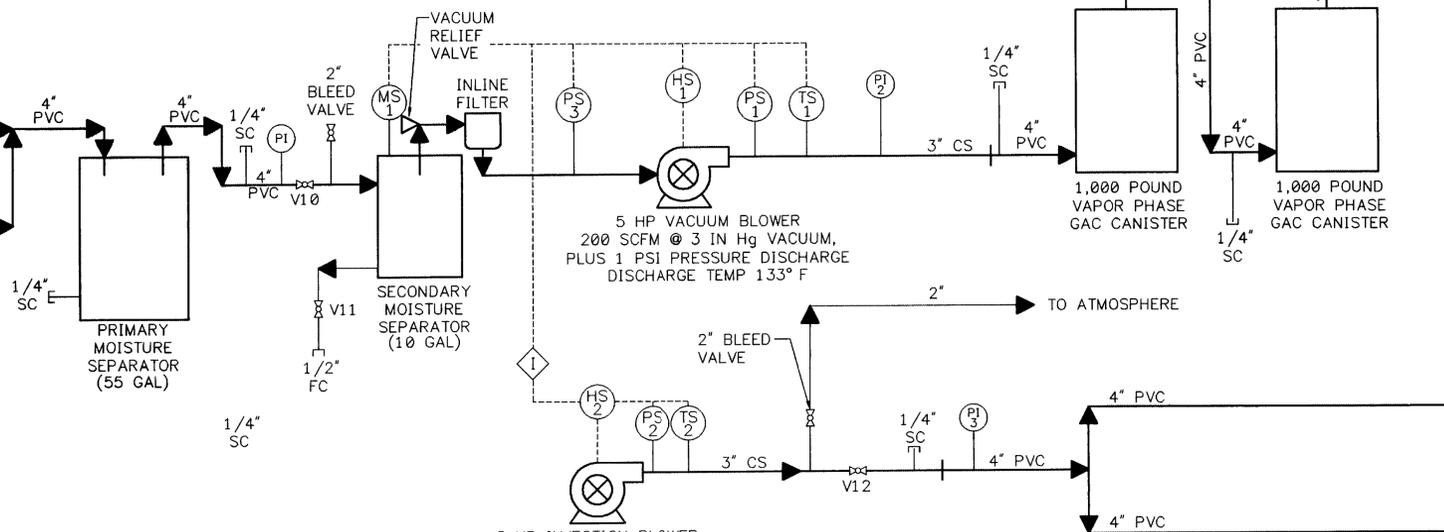
C.F. BRAUN
FOSTER PLAZA 7
661 ANDERSON DRIVE
PITTSBURGH, PA 15228

TITLE		AS/SVE CONSTRUCTION DETAIL AS/SVE PILOT-SCALE SYSTEM FIRE TRAINING AREA NWIRP, CALVERTON, NEW YORK	
CLIENT	NWIRP CALVERTON	CONTRACT	CLEAN - CTO 223
SCALE	AS SHOWN	DATE	MARCH 1996
DRAWING NO.	DRAWING 1	SHEET	1 OF 1
ACFILE NAME	5563/5563D011.DWG	REV.	0

EXTRACTION WELLS -
APPROXIMATELY
6 SCFM PER WELL



AIR EXTRACTION SYSTEM



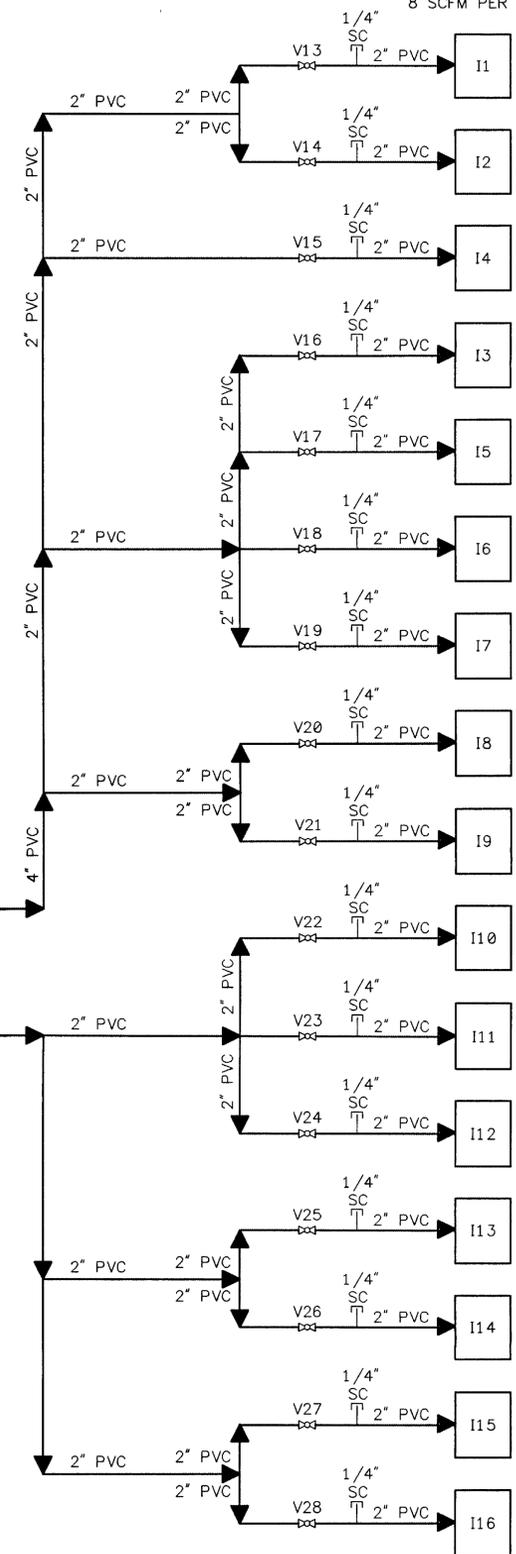
5 HP INJECTION BLOWER
140 SCFM @ 5 PSI
PRESSURE DISCHARGE
DISCHARGE TEMP 148° F

AIR INJECTION SYSTEM

LEGEND

- HS - HAND SWITCH
- V - VALVE
- GAC - GRANULATED ACTIVATED CARBON
- PI - PRESSURE INDICATOR
- SC - SAMPLE CONNECTION
- FC - FLUSH CONNECTION
- PS - PRESSURE SWITCH
- TS - TEMPERATURE SWITCH
- MS - MOISTURE SENSOR
- CS - CARBON STEEL
- PVC - POLYVINYL CHLORIDE
- E - EXTRACTION WELL
- I - INJECTION WELL
- ∩ - BALL VALVE

AIR INJECTION WELLS -
APPROXIMATELY
8 SCFM PER WELL



DRAWN	M. Bates	(83/2/96)
CHECKED		
DESIGN ENGINEER	C. Farkos	
PROCESS ENGINEER		
PROJECT MANAGER	D. Broysack	
ENGINEERING MANAGER	S. Hughes	
CLIENT APPROVAL		

C.F. BRAUN

FOSTER PLAZA 7
461 ANDERSON DRIVE
PITTSBURGH, PA 15228

TITLE		PROCESS & INSTRUMENT DIAGRAM AS/SVE PILOT SCALE SYSTEM NWIRP, CALVERTON, NEW YORK	
CLIENT	NWIRP CALVERTON	CONTRACT	CLEAN - CTO 223
SCALE	AS SHOWN	DATE	JUNE 1996
DRAWING NO.	DRAWING 2	ACFILE NAME	5563/AIR.DWG
		SHEET	1 OF 1
		REV	0