INSTALLATION RESTORATION PROGRAM

REMEDIAL INVESTIGATION REPORT
SITE 1, FIRE TRAINING AREA

VOLK FIELD AIR NATIONAL GUARD BASE,
CAMP DOUGLAS, WI

JULY 1990

VOLUME I

AIR NATIONAL GUARD

ENGINEERING-SCIENCE

ES

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The report covers the Remedial Investigation conducted on Site 1, Fire Training Area at Volk Field Air National Guard Base. The remedial work is described and the testing conducted after remediation to insure all contamination has been removed. The study was conducted under the Air National Guard's Installation Restoration Program.

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SITE 1, FIRE TRAINING AREA

VOLK FIELD AIR NATIONAL GUARD BASE
Camp Douglas, Wisconsin

VOLUME I

Submitted By

HAZARDOUS WASTE REMEDIAL ACTIONS PROGRAM
MARTIN MARIETTA ENERGY SYSTEMS
Oak Ridge, Tennessee

Submitted To

NATIONAL GUARD BUREAU
ANGSC/DER
Andrews AFB, Maryland

July 1990

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EXECUTIVE SUMMARY

On behalf of the U.S. National Guard Bureau (NGB) and as a part of the Installation Restoration Program (IRP), a Site Inspection / Remedial Investigation (SI/RI) was conducted at Volk Field Air National Guard Base, Camp Douglas, Wisconsin. The IRP SI/RI program included the investigation of eight potentially contaminated sites; seven at Volk Field and one at Hardwood Air-to-Ground Range. The eight sites investigated included:

- Site 1 - Fire Training Area
- Site 2 - Former Landfill C
- Site 3 - Chronic Fuel Spill
- Site 4 - Transformer Fluid Disposal Site
- Site 6 - JP-4 Spill Site
- Site 7 - Former Landfill A
- Site 9 - Former Landfill B
- Site 10 - Munitions Burial Ground (Hardwood Air-to-Ground Range)

The RI was conducted only at Site 1. An SI of Sites 2, 3, 4, 6, 7, 9, and 10 was conducted concurrently with the RI at Site 1. This document describes the activities undertaken and results obtained for the RI. Full details of the SI are contained in a separate document.

SITE 1

Fire training activities at Site 1 were conducted beginning in the 1940s and ending in 1980 (HMTC, 1984). During this time, it is estimated that as much as 266,500 gallons of fuels, waste oil, and solvents may have seeped into the ground at this site. The purpose of the RI at this site was to obtain site specific hydrogeological data and to collect samples of soil gas, soil, and groundwater to attempt to fully characterize the magnitude of contamination source and the extent that contaminants have migrated from the site. The methods used in the remedial investigations included:

- Soil Gas Survey;
- Soil Boring and Sampling;
- Monitoring Well Installation and Groundwater Sampling;
- Slug Tests and Aquifer Pumping Test;
- Chemical Analysis of Soil and Groundwater.

A soil gas survey was conducted at Site 1 to identify areas of possible soil and groundwater contamination through sampling and analysis of subsurface gases. The results from the soil gas survey were used to determine the locations for 15 soil borings and four groundwater monitoring wells. Soil samples for chemical analysis were collected at Site 1 to determine the extent of soil contamination at the site. The purpose of the four monitoring wells was to obtain hydrogeological and stratigraphic information. Groundwater in these wells and in seven other existing wells was sampled and analyzed for the presence of contaminants. Hydrogeologic data obtained from these wells were used to determine groundwater flow directions and gradients.

In order to determine aquifer characteristics an aquifer pumping test was conducted at Site 1. Wells at Site 1 and Site 9 were used as observation wells during this test. Slug tests were also performed at some of these wells. These tests provided estimates of the hydraulic conductivity which were used to estimate groundwater flow velocities at Site 1.

Site 1 soils were contaminated with volatile halogenated organics, volatile aromatic hydrocarbons, semi-volatile organics, petroleum hydrocarbons and lead. The primary contaminants identified in Site 1 soils were benzene, toluene, xylenes, ethylbenzene, trichloroethylene, tetrachloroethylene, naphthalene, and methylnaphthalene. Concentrations as high as 88,000 ug/kg were detected. The State of Wisconsin has no established soil cleanup criteria for organic contaminants.

Groundwater samples collected at Site 1 contained several organic and inorganic contaminants at levels exceeding Wisconsin Enforcement Standards and Preventive Action Limits. The maximum concentrations of contaminants which exceed Wisconsin Standards are listed below.

Groundwater Parameter	Groundwater Criteria: Enforcement Standard (μg/L)	Groundwater Criteria: Preventive Action Limit (μg/L)	Maximum Contaminant Concentration (μg/L)
Benzene	0.67	0.067	8,270
Toluene	343	68.6	3,950
1,1,1-Trichloroethane	200	40	60
Trichloroethylene	1.8	0.18	79
Xylenes	620	124	1,800
Lead	50	5	270
TDS	500	250	550

These findings indicate that significant groundwater contamination exists at Site 1.

Potential receptors for contaminants present at Site 1 include employees at Volk Field, visitors to the site, and nearby residents. Potential routes of human exposure include inhalation of contaminated air, ingestion of contaminated groundwater, surface water and soils, and dermal contact with contaminated soils.

The recommendations for additional IRP work at Site 1 are:

- Perform field investigation work to more fully define possible additional sources of contamination and the extent of horizontal and vertical contaminant migration from Site 1. This work includes a soil gas survey, soil borings, and installation of monitoring wells.
- Perform a Feasibility Study (FS) to determine the appropriate remedial action required to address the source contamination and groundwater contaminant migration at Site 1.
- Provide a temporary cap for the area of known soil contamination in Site 1 to reduce the vertical migration to groundwater of contaminants resulting from the infiltration of precipitation and direct run-on in this area.

These recommendations are discussed in Section 7 of this report.

SECTION 1
INTRODUCTION

The Department of Defense (DOD) has developed a program to identify and evaluate sites on DOD property where contamination may be present because of past spills or hazardous waste disposal practices, to control the migration of hazardous contaminants and to control hazards to health, welfare, or the environment that may result from contamination at these sites. This program is called the Installation Restoration Program (IRP). Under this program, Engineering-Science (ES) has entered into an agreement with Martin Marietta Energy Systems under General Order No. 18B-97387C, Task Order X-04 to conduct a Site Inspection/ Remedial Investigation (SI/RI) at Volk Field Air National Guard Base (ANGB) and Hardwood Air-to-Ground Range, Wisconsin.

The objective of the IRP for Volk Field is to confirm the presence of contamination and to evaluate the potential for migration of contaminants from seven sites at Volk Field ANGB and one site at Hardwood Air-to-Ground Range. The eight sites investigated included:

- Site 1 - Fire Training Area
- Site 2 - Former Landfill C
- Site 3 - Chronic Fuel Spill
- Site 4 - Transformer Fluid Disposal Site
- Site 6 - JP-4 Spill Site
- Site 7 - Former Landfill A
- Site 9 - Former Landfill B
- Site 10 - Munitions Burial Ground (Hardwood Air-to-Ground Range)

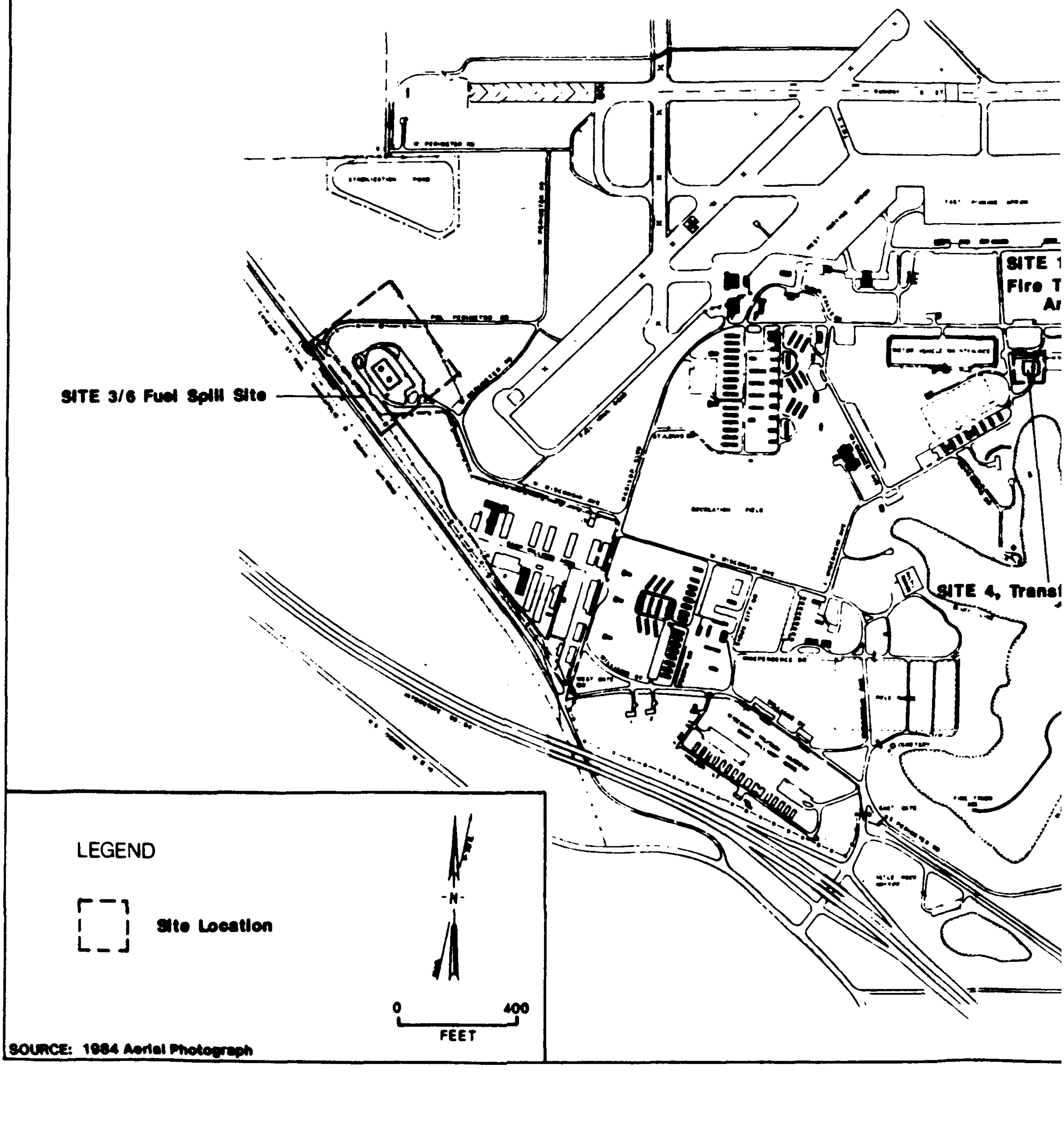
A Remedial Investigation (RI) was conducted at Site 1 concurrent with a Site Inspection (SI) of Sites 2, 3, 4, 6, 7, 9, and 10 (Figure 1.1) This report covers only the RI portion of the IRP SI/RI conducted at Volk Field. Full details of the SI are contained in a separate document (ES, 1988).

The purpose of the RI at Site 1 was to gather data to attempt to fully characterize the magnitude of the contamination source and the extent that

VOLK FIELD ANG

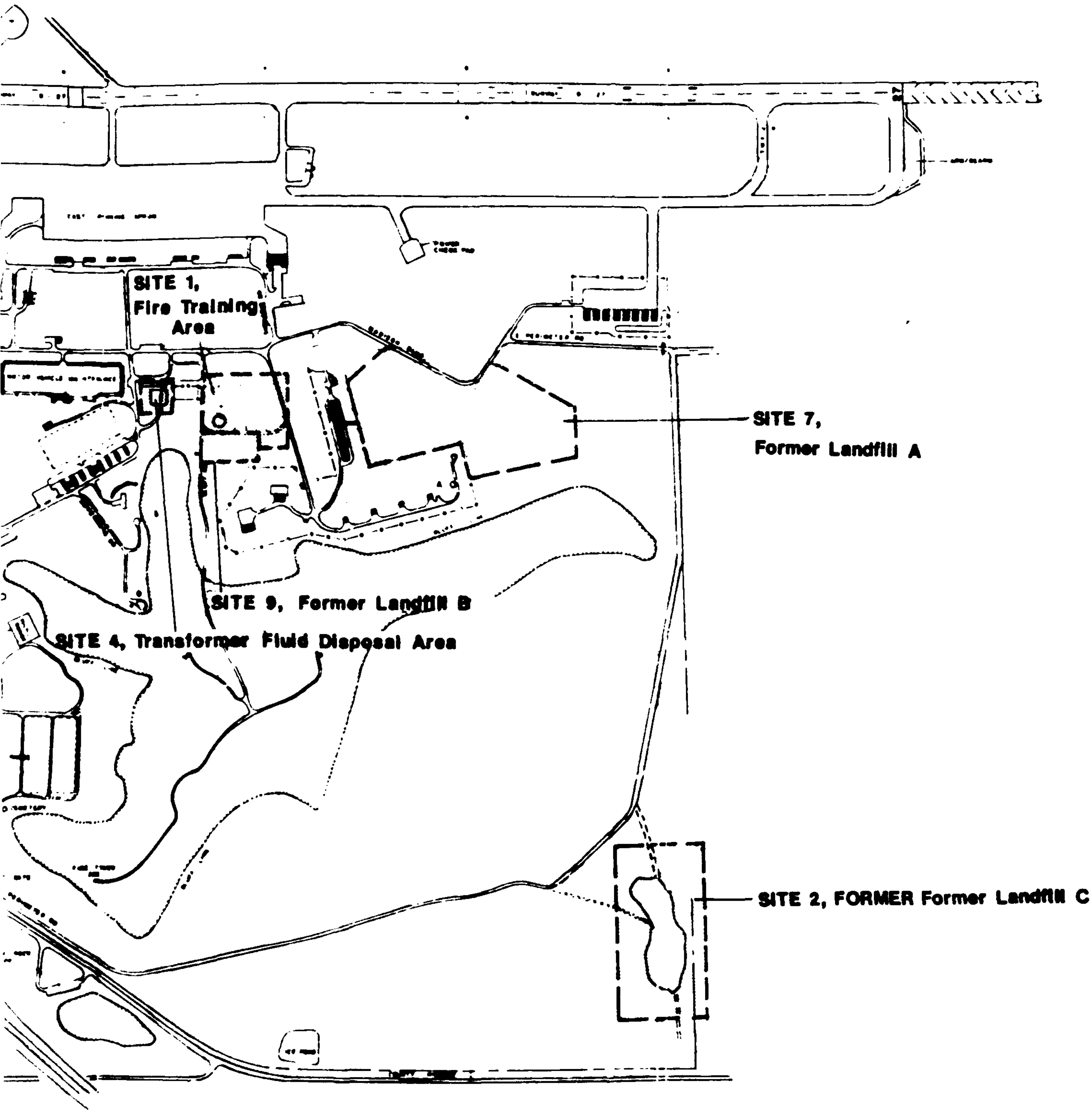
CAMP DOUGLAS,

SITE LOCATI



VOLK FIELD ANGB
CAMP DOUGLAS, WI.

'E LOCATIONS



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contaminants have migrated from the site. During the development of the RI scope, it was decided that a conservative approach would be used to characterize the extent of the contamination. Because of this approach, provisions were made within the project work plan to allow for additional field investigative work, if needed, during future tasks.

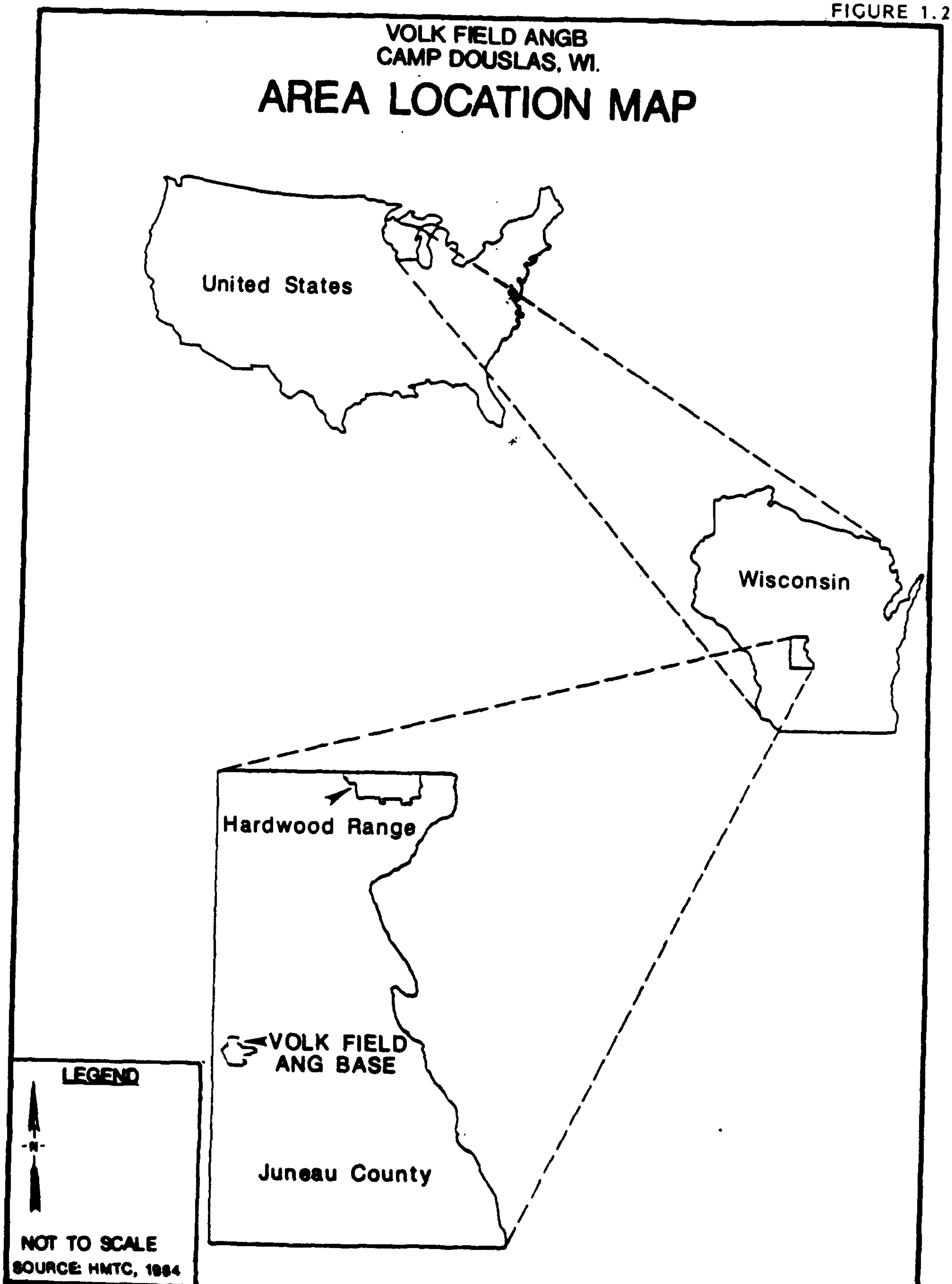
Section 1 of this report presents background information on Volk Field ANGB, a summary of the previous investigations conducted at Site 1 and the objectives of the RI. Section 2 presents a summary of the physical characteristics of the study area. Section 3 describes the field investigation program that was conducted from October 1987 through May 1988. Section 4 presents background information on the site, describes the field methods used and presents the results of the investigation as well as a discussion of the extent of contamination. Section 5 of this report describes the regulatory significance of the results. Section 6 is a baseline risk assessment based on available information for Site 1. Section 7 presents recommendations for future work. Section 8 presents the references used in this report. Section 9 is a fold out map of Volk Field showing the site location and survey data. Analytical data, boring logs, soil gas survey data, and aquifer test data are presented as appendices to the report.

1.1 BACKGROUND INFORMATION

Volk Field ANGB is located approximately 90 miles northwest of Madison, Wisconsin in Juneau County (Figure 1.2). The base is located in Township 17N and Range 2E. The installation (Figure 1.1) is one of four Field Training Sites (FTS) in the United States operated by the Air National Guard (ANG). The mission of the Volk Field ANGB is to provide an effective, realistic environment for military units to accomplish combat training. Located adjacent to Volk Field is Camp Williams which is the site of the Wisconsin Army National Guard State Maintenance Office. Also located at Camp Williams is the United States Property and Fiscal Office (USPFO) of the Wisconsin National Guard. Areas to the north and east of Volk Field are rural and agricultural lands. The town of Camp Douglas is located south and west of the base.

Volk Field ANGB was opened in 1886 as a training location for the Wisconsin National Guard. The base was referred to as Camp Douglas from that time until formally named Camp Williams in 1926. In 1947 Camp Williams expanded to include an airfield. This airfield has been utilized as a training location

FIGURE 1.2


VOLK FIELD ANGB
CAMP DOUSLAS, WI.
AREA LOCATION MAP
United States
Wisconsin
Hardwood Range
VOLK FIELD
ANG BASE
Juneau County
LEGEND
N
NOT TO SCALE
SOURCE: HMTC, 1984

for Air National Guard units since that time. Following execution of a lease arrangement with the Federal government in 1954, the facilities at Camp Williams were upgraded, including the addition of Hardwood Range. In 1957 the airfield portion of Camp Williams was officially renamed Volk Field. Since then Volk Field has been continuously upgraded to accommodate improved technologies and requirements of the visiting training units. As the number of ANG Field Training Sites has been reduced from eight to the present number of four, utilization of the facilities at Volk Field and associated Hardwood Range has increased significantly.

1.2 SUMMARY OF PREVIOUS INVESTIGATIONS AT SITE 1

Since 1980 at least three investigations by various organizations have been initiated at Site 1, Fire Training Area. The first investigation was initiated in the summer of 1981 by the Air National Guard Support Center (ANGSC) as a result of concerns over the potential for contamination and contaminant migration from this site. During this investigation, 16 shallow bore holes were drilled to approximately two feet below the water table. Wells were constructed in the boreholes using 4-inch diameter Schedule 40 PVC casing with glued fittings. The bottom two feet of this casing was perforated with 3/16-inch diameter holes to allow for water entry. The approximate locations of these wells are shown in Figure 1.3 (HMTC, 1984). The locations of some of these wells could not be determined during the RI field program and are shown on Figure 1.3 only to provide background information required when discussing analytical data from the 1981 report. Twelve water samples were collected in 1981 and analyzed by EPA Methods 601 and 602, and three samples were analyzed by EPA Method 624. The results of these analyses are provided in Table 1.1.

In 1984, the Hazardous Materials Technical Center of Rockville, Maryland, was contracted by the Air National Guard (ANG) to conduct a Base Records Search at Volk Field ANGB. In this report the background information on Volk Field ANGB, a summary of the 1981 investigation, and a complete description of the possible sources of contamination at Volk Field are presented. The records search identified 15 past disposal or spill sites at Volk Field ANGB. Of these 15 sites, 8 were ranked using the Air Force's Hazard Assessment Rating Methodology (HARM). According to this system, Site 1 was given the highest priority ranking.

In the summer of 1985, the Air Force Engineering and Services Laboratory (AFESL) of the Air Force Engineering and Services Center (AFESC), Tyndall

FICURE 1.3

VOLK FIELD ANGB
CAMP DOUGLAS, WI.

LOCATION OF WELLS INSTALLED DURING 1981 INVESTIGATION, SITE 1

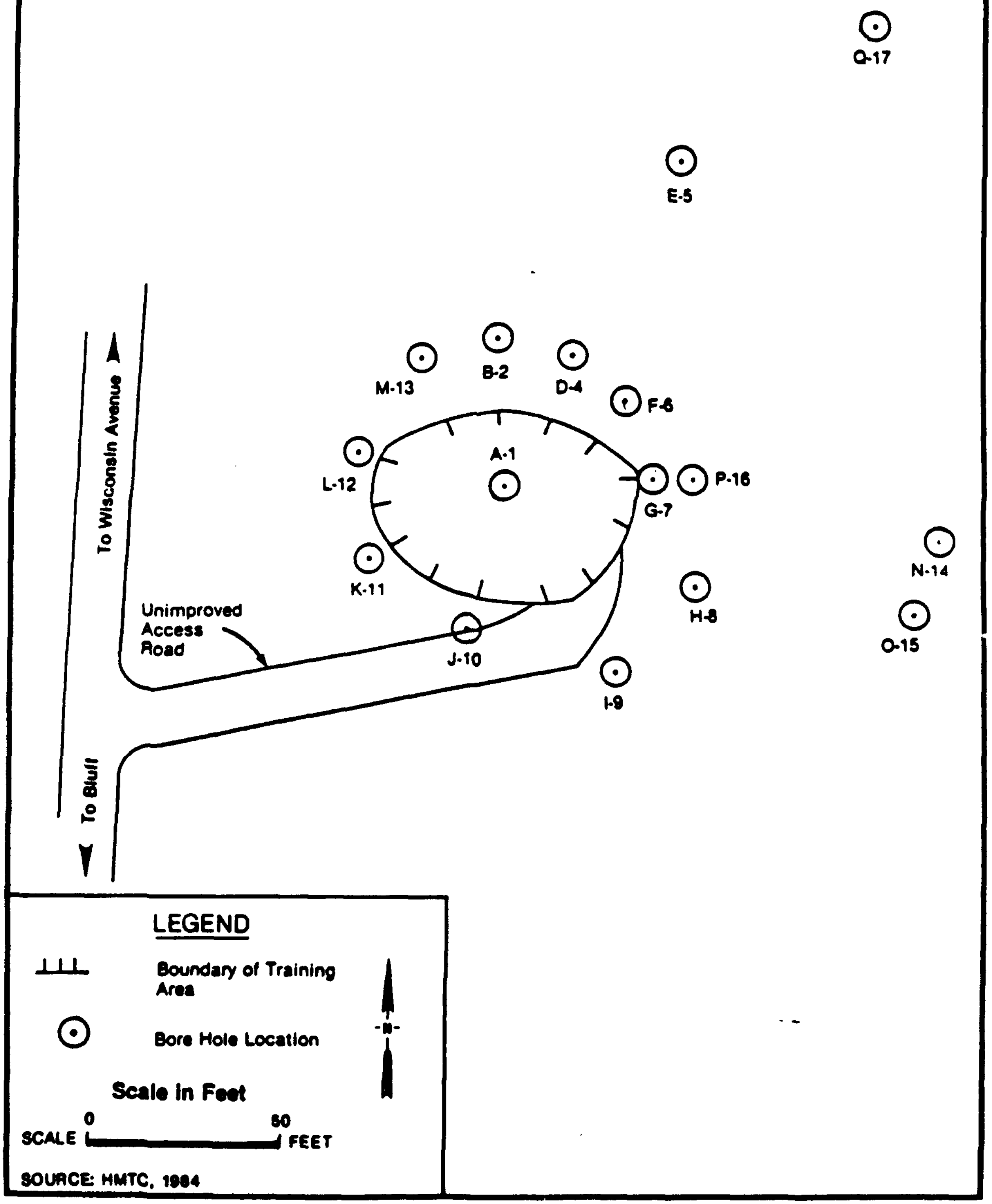


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TABLE 1.1
VOLK FIELD ANGB
CAMP DOUGLAS, WI
SUMMARY OF GROUNDWATER CHEMICAL ANALYSIS FOR
1981 INVESTIGATION, SITE 1

Borehole I.D. Number	Laboratory I.D. Number	EPA Method 601			EPA Method 602			EPA Method 624
		Chloroform	TCA[b] (μg/L)	TCE[c]	Benzene	Toluene (μg/L)	Ethylbenzene	
A-1[e]	AF 00019	2.3	<1.0	<1.0	4,500	2,700	270	--
B-2	AF 00020	2.3	<1.0	<1.0	<10	100	<10	--
D-4[e]	AF 00021	1.5	7.8	22	570	2,100	190	--
F-6[e]	AF 00022	1.1	39	100	14,000	8,000	950	--
G-7[e]	AF 00023	59	36	42	31,000	36,000	6,800	--
H-8[e]	AF 00024	130	<1.0	<1.0	1,900	5,700	200	--
J-10	AF 00030	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	--
K-11	AF 00025	1.3	<1.0	<1.0	<1.0	4.6	<1.0	--
L-12	AF 00026	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	--
N-14	AF 00027	50	<1.0	<1.0	8.5	<1.0	2.9	--
O-15	AF 00028	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	--
P-16	AF 00029	120	<10	<10	4,000	<50	1,000	--
E-5	Unknown	--	--	--	--	--	--	ND[d]
M-13	Unknown	--	--	--	--	--	--	ND[d]
Q-17	Unknown	--	--	--	--	--	--	ND[d]

a Source: HMTC, 1984.
b 1,1,1-Trichloroethane
c Trichloroethylene
d None of the parameters specified in EPA Method 624 were detected.
e Data should be considered qualitative.

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AFB, Florida, and U.S. EPA Environmental Research Laboratory, Edison, New Jersey, conducted a joint research project at Site 1. The primary objective of this joint effort was to demonstrate the full-scale feasibility of in-situ soil washing techniques. Towards this objective a field study at Site 1 was conducted to determine, if possible, the extent and type of contamination located there. The field work, conducted in May 1985, included the following activities:

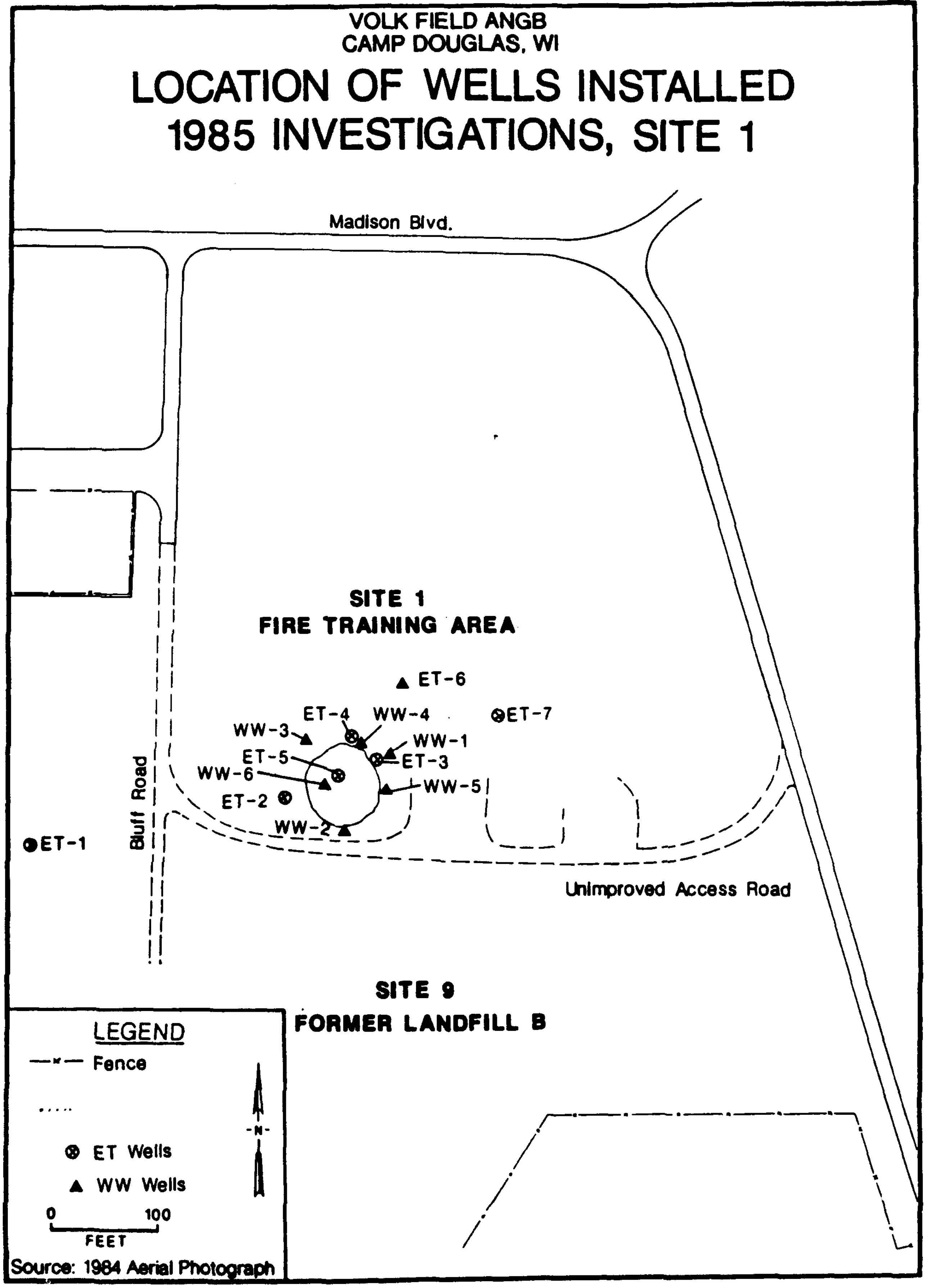
- Sampling of wells installed in 1981,
- Removal of Well G-7 (installed in 1981),
- Drilling and sampling of soils for chemical analysis of at least 16 boreholes,
- Installation of seven wells designated ET-1 through ET-7 (See Figure 1.4),
- Percolation tests in the area of the fire training pit,
- Wet sieve analysis of soil samples,
- Aquifer test using ET-1 as the pumped well, and
- Chemical analysis of soil gas obtained from water and soil samples by a portable gas chromatograph.

The information obtained from the field effort described above was used to evaluate the feasibility of using soil washing techniques to clean up contaminated soils at Site 1 (Nash, 1985). This evaluation involved the following investigative techniques:

- Pilot study to test effectiveness of various surfactants in cleaning soils,
- Installation of six 4-inch diameter water withdrawal wells, designated WW-1 through WW-6 (Figure 1.4),
- Aquifer test utilizing various combinations of the above wells,
- Treatment of pumped contaminated water.
- Electromagnetic survey to possibly identify contaminant plume.

Results of this study have been published and are available from AFESC.

Following the AFESC/USEPA joint effort, a research project was undertaken at Site 1 involving Radio Frequency (RF) Thermal Soil Decontamination (Personal Communication, Doug Downey 1988). The project involved soil sampling and chemical analysis, setup and operation of a pilot scale RF decontamination



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system, and follow-up soil sampling and analysis. Portions of this project were concurrent with, although independent of, the Remedial Investigation discussed in this report.

The field projects summarized above have been reviewed and an effort was made throughout the RI at Site 1 to utilize the information available. However, because of differing investigation objectives, limitations in the data often required that additional or more detailed data be gathered.

SECTION 2
PHYSICAL CHARACTERISTICS OF THE STUDY AREA

This section describes the physical characteristics of the area studied for the Remedial Investigation (RI) portion of the Installation Restoration Program (IRP) at Volk Field ANGB. Regional characteristics are discussed with primary emphasis placed on how movement of surface water and groundwater has influenced possible contaminant migration at Site 1, Fire Training Area. The information reported in this section was obtained by examining available literature and records, and by performing site specific activities such as soil borings and groundwater monitoring.

2.1 INSTALLATION DESCRIPTION

Volk Field consists of approximately 2,500 acres at a mean elevation of 905 feet above mean sea level. The air field at Volk Field consists of a main runway measuring 9,000 feet in length. Two inactive runways, 4,483 feet and 1,960 feet in length, are still present. The undeveloped portions of Volk Field are heavily wooded and used for various training exercises. The base is generally flat with semi-marshy areas located to the north of the air field and along the southeastern boundary of the base. The semi-marshy area to the south is separated from the developed portion of the base by a sandstone bluff that rises approximately 200 feet above the surrounding areas.

2.2 METEOROLOGY(1)

The climate in the area of Volk Field ANGB is generally classified as having wide and frequent variations in temperature. Typically, the winters are cold and humid, and summers are warm with moderate humidities. Occasionally during the summer there are periods of hot and humid weather which last up to a week. Table 2.1 is a summary of the temperature and precipitation in the study area. Table 2.2 provides dates of the first and last freezing temperatures for the study area. This data and the discussion below are based on information recorded in the period 1951

(1) The information presented in this section was prepared by the National Climatic Center, Asheville, North Carolina and was taken from a preprint of the Juneau County Soil Survey, to be published by the National Cooperative Soil Survey. Additional information was taken from the Installation Restoration Program - Record Search, Hazardous Materials Technical Center, 1984.

TABLE 2.1
VOLK FIELD ANGB, CAMP DOUGLAS, WI
SUMMARY OF TEMPERATURE AND PRECIPITATION DATA

	TEMPERATURE (°F)					PRECIPITATION (inches)				
				2 yrs in 10 will have			2 Yrs in 10 will have			
				Maximum Temperature	Minimum Temperature					
Month	Average Daily Maximum	Average Daily Minimum	Average	Higher than	Lower than	Average Precipitation	Less than	More than	Average No. of Days with 0.10 inch of Rainfall or more	Average Snowfall
January	25.8	4.1	15.0	47	-27	.25	.37	1.43	3	11.1
February	31.6	8.2	19.9	52	-23	1.12	.24	1.80	3	10.7
March	42.6	12.3	31.0	71	-14	2.13	.72	3.15	5	11.6
April	58.8	33.6	46.2	83	14	3.33	1.92	4.59	7	1.9
May	71.3	43.9	57.6	91	25	3.64	1.91	5.16	8	.0
June	79.7	53.1	66.4	94	35	3.88	2.41	5.20	8	.0
July	83.9	57.6	70.8	96	43	3.73	2.31	5.00	7	.0
August	81.7	55.6	68.7	95	37	4.39	1.90	6.51	8	.0
September	73.0	47.1	60.1	91	27	3.97	1.55	5.00	7	.0
October	62.6	37.5	50.1	83	15	7.40	.74	3.74	5	.1
November	45.7	25.2	35.5	67	-1	1.81	.62	2.7	4	3.7
December	31.3	12.5	21.9	56	-20	1.31	.65	1.87	4	12.6
Yearly:										
Average	57.3	33.1	45.3	--	--	--	--	--	--	--
Extreme	--	--	--	97	-30	--	--	--	--	--
Total	--	--	--	--	--	32.66	--	--	62	51.7

Data were recorded in the period 1951-81 at Mauston, Wisconsin.

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TABLE 2.2
VOLK FIELD ANGB
CAMP DOUGLAS, WI
FREEZE DATES IN SPRING AND FALL

Probability	Temperature		
	24°F or Lower	28°F or Lower	32°F or Lower
Last freezing temperature in spring:			
1 year in 10, later than:	May 2	May 18	May 31
2 years in 10, later than:	April 28	May 13	May 26
5 years in 10, later than:	April 20	May 3	May 17
First freezing temperature in fall:			
1 year in 10, earlier than:	September 16	September 3	August 18
2 years in 10, earlier than:	September 29	September 16	September 1
5 years in 10, earlier than:	October 24	October 11	September 28

Data were recorded in the period 1951-1981 at Mauston, Wisconsin.

through 1981 at Mauston, Wisconsin located approximately 15 miles southeast of Volk Field ANGB.

In winter, the average temperature is 19°F, and the average daily minimum temperature is 8°F. The lowest temperature on record, which occurred at Mauston on January 15, 1963, is -36°F. In summer, the average temperature is 69°F, and the average daily maximum temperature is 82°F. The highest recorded temperature, which occurred at Mauston on August 21, 1955, is 102°F.

The average annual precipitation is 33 inches. Of this, 23 inches or 70 percent, usually falls from April through September. In 2 years out of 10, the rainfall in April through September is less than 18 inches. The heaviest one-day rainfall during the period of record was 3.78 inches at Mauston on August 1, 1953. Thunderstorms occur on about 40 days each year, and most occur in the summer months.

The average seasonal snowfall is 52 inches, with the greatest snowfall at any one time during the period of record being 31 inches. On the average, 48 days of the year have at least 1 inch of snow on the ground. The number of such days varies greatly from year to year.

The average relative humidity in mid-afternoon is about 60 percent. Humidity is higher at night, and the average at dawn is about 80 percent. The sun shines 65 percent of the time in summer and 45 percent in winter. The prevailing wind is southerly in the summer and westerly in the winter. Windspeeds are highest in the spring and average 10 miles per hour.

2.3 SURFACE-WATER HYDROLOGY

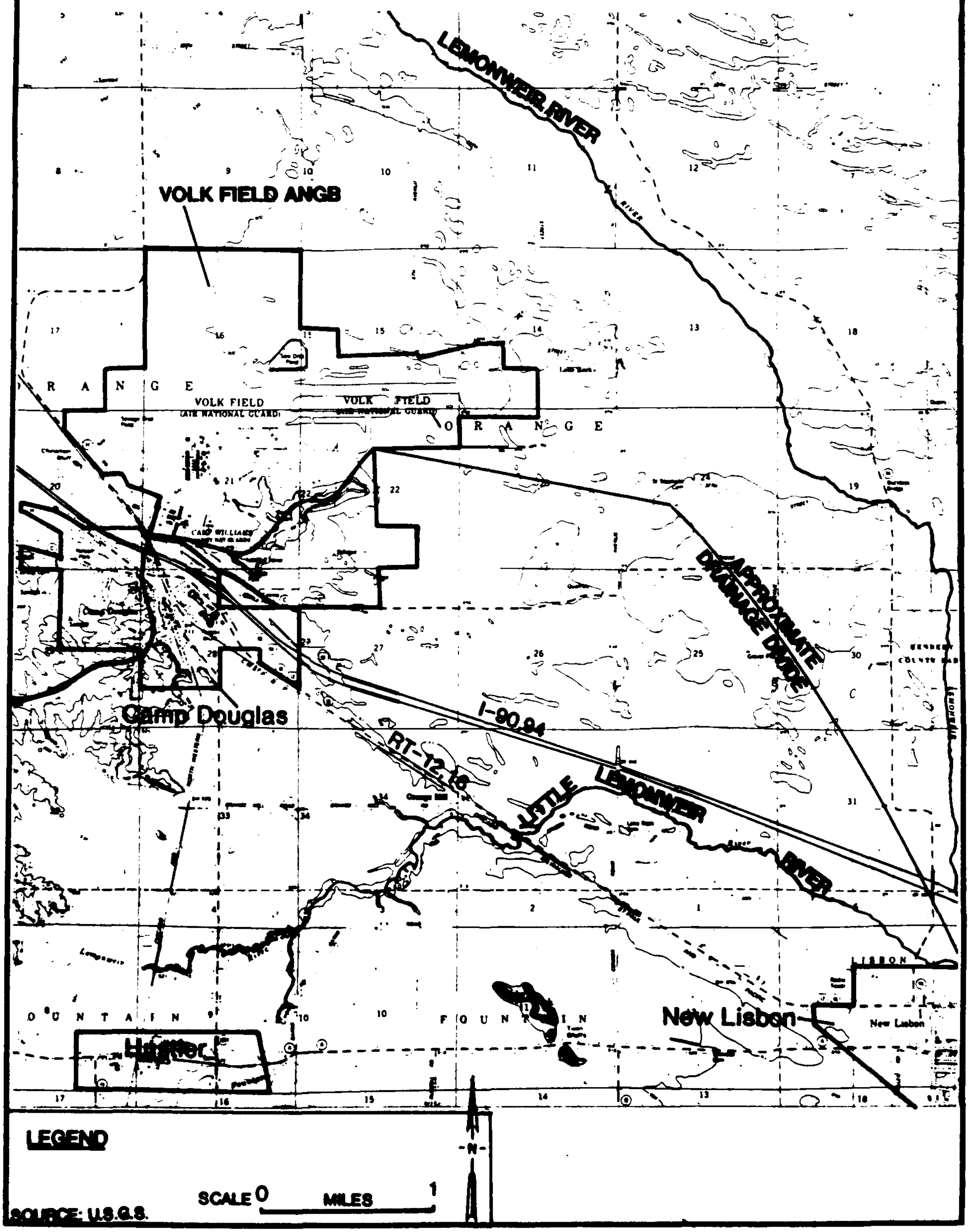
Volk Field ANGB is located within the drainage basin of the Lemonweir and Little Lemonweir Rivers (Figure 2.1). The Lemonweir River generally flows from northwest to southeast and is located approximately 3,700 feet northeast of the base boundary. The Little Lemonweir River is approximately 1.5 miles south of the base boundary and flows from west to east. It joins the Lemonweir River 4.5 miles s-outheast of Volk Field ANGB, at the town of New Lisbon. New Lisbon and Mauston are the only major communities on the Lemonweir River downstream of the base. Neither of these towns utilizes surface water for municipal water supplies.

Runoff at Volk Field is facilitated by a system of drainage ditches and is generally toward the south and east. These drainage ditches lead directly to either

FIGURE 2.1

VOLK FIELD ANGB
CAMP DOUGLAS, WI

MAJOR DRAINAGE BASINS



the Lemonweir River or the Little Lemonweir River. Figure 2.2 illustrates the directions of surface runoff at Volk Field.

2.4 GEOLOGY

Volk Field ANGB is located within the Wisconsin Central Plain Physiographic Province, a subsection of the Central Lowlands Physiographic Province of the United States. This part of the Central Plain is characterized by flat or gently undulating topography. Relief is generally low except for the sandstone buttes located near Volk Field. These buttes rise 100 to 300 feet above the surrounding lowlands.

2.4.1 Regional Geology

The geologic processes responsible for the formation of the rock units which comprise the Central Lowlands began during the Cambrian Period (600 million years ago). During the Cambrian Period differential uplift and subsidence occurred throughout Wisconsin and much of the North American Continent, causing the areas which subsided to become inundated by encroaching seas and the uplifted portions to be eroded. The uplifted areas were primarily composed of granite and undifferentiated igneous and metamorphic rocks.

North central Wisconsin was part of the uplifted area called the Wisconsin Arch. Along the flanks of this arch, ancient seas deposited sediments similar to those currently being deposited along the continental margins of the United States. Subsequent lithification (process of turning sediment into rock) created sandstone out of the ancient beach and shallow offshore sand deposits. A portion of these sandstone units are exposed in the bluffs surrounding Volk Field ANGB. These sandstones are Cambrian-aged and include from oldest to youngest the Mt. Simon, Eau Claire and Wonewoc Formations.

The process which exposed the Cambrian-aged sandstones at Volk Field was a final period of uplift along the Wisconsin Arch. This uplift occurred during the Permian Period (250 million years ago), initiating a long period of erosion which continues today. Beginning approximately 50 miles north of Volk Field ANGB and extending northward, this erosion has exposed the Precambrian-aged core of the Wisconsin Arch. Figure 2.3 is a generalized geologic map of Wisconsin which illustrates the location of the Precambrian rocks and the overlying younger sedimentary rocks. Also in Figure 2.3 is a diagram of an east-west oriented geologic

FIGURE 2.2

VOLK FIELD ANGB
CAMP DOUGLAS, WI.

SURFACE DRAINAGE

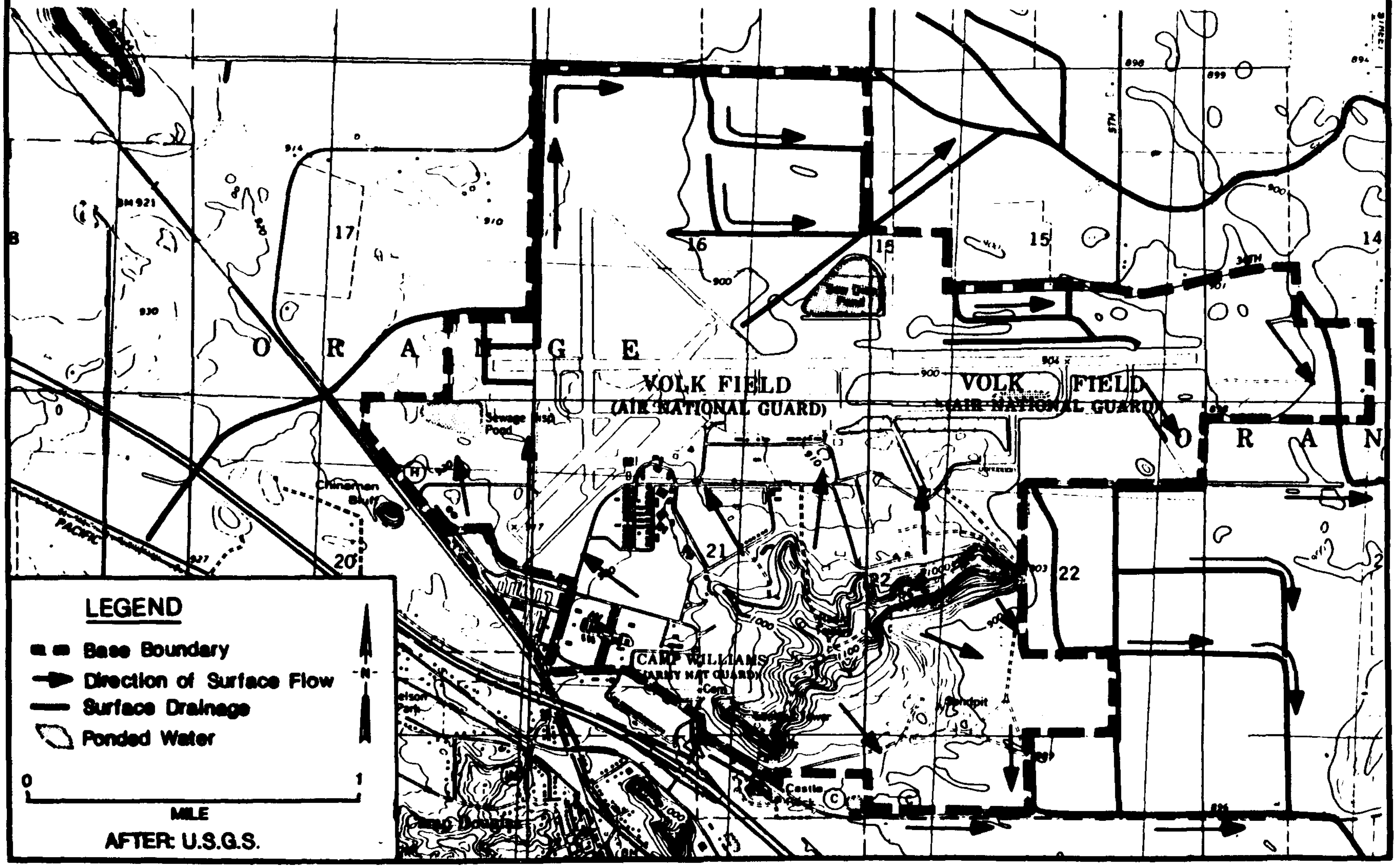
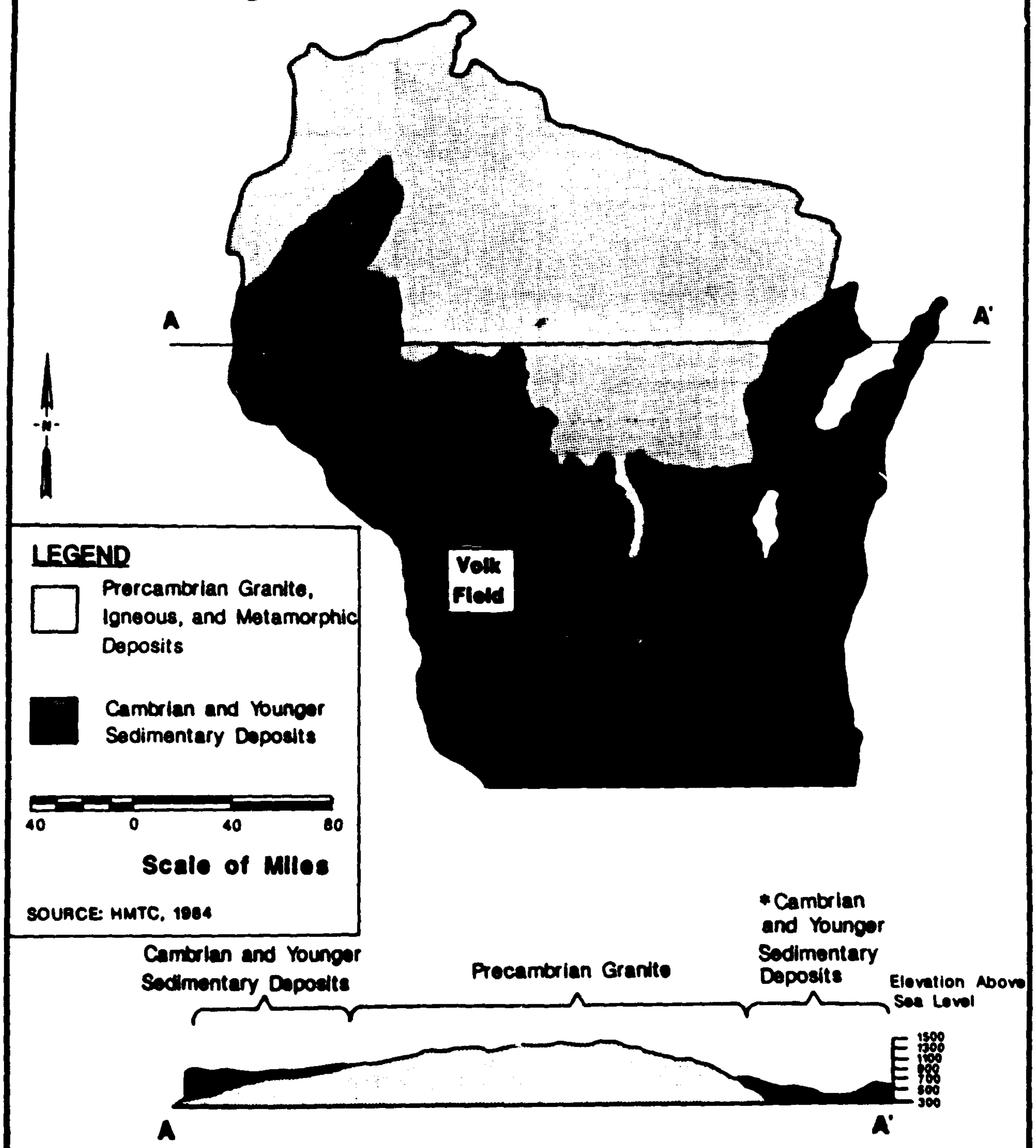


FIGURE 2.3

VOLK FIELD ANGB
CAMP DOUGLAS, WI.

GENERALIZED GEOLOGIC MAP AND GEOLOGIC CROSS-SECTION OF WISCONSIN



*Subdivisions denote orientations of bedding planes, only.

cross-section which illustrates the domed structure of the Wisconsin Arch and the position of the Cambrian and younger rocks along the flanks (HMTC, 1984).

Both the Precambrian-aged core (granites and undifferentiated igneous and metamorphic rocks) and the Cambrian-aged sedimentary sequences (sandstones) described above are significant when describing the site specific physical characteristics at Volk Field ANGB. The geologic history of these rock groups provide some indication as to their hydrogeologic characteristics (e.g. degree of fracturing). These characteristics are discussed in detail in the following subsections.

2.4.2 Local Geology

The geologic formations that directly underlie Volk Field ANGB are predominantly fine to coarse-grained sandstones with interbedded shale and overlying unconsolidated sand, silt, and minor amounts of clay, as described in Table 2.3. These sediments rest on top of the Precambrian-aged core mentioned above. The unconsolidated deposits in the vicinity of Volk Field ANGB are generally less than 40 feet thick. These deposits resulted from glaciers which developed during the Pleistocene Epoch (two million years ago). Although Volk Field ANGB was not directly covered by glaciers, it was located close enough to ice masses situated to the north and east to be covered by ice-related geologic deposits. When the glaciers began to retreat, large inland lakes were formed near the perimeters of the receding glaciers. Within these lakes, sand, silt, and clay were deposited from streams and rivers carrying melt water and sediment. Figure 2.4 illustrates the boundaries of the major glaciers relative to the present study areas and the locations of glacial lake sediments. The glacial lake sediments at Volk Field ANGB were deposited within a 1,800 square mile Pleistocene lake referred to as Lake Wisconsin. Volk Field ANGB is located near the western boundary of this ancient lake. Borehole logs for a well drilled near Volk Field ANGB (Camp Douglas Emergency Fire Well) are interpreted as encountering the unconsolidated sediments to a depth of 55 feet. These materials overlie the sandstone and shales to a depth of 250 feet below the ground surface. Below this, approximately 20 feet of Precambrian granite was encountered. No indication on the borehole log was provided as to the degree of fracturing. A copy of this log is included in Appendix B.

TABLE 2.3[1]
VOLK FIELD ANGB, CAMP DOUGLAS, WI
DESCRIPTIONS OF THE GEOLOGICAL FORMATIONS
IN THE STUDY AREA

Systems[2]	Formation	Age (Millions of Years)	Approximate Thickness (feet)	Description
Quaternary	Pleistocene Deposits	2	8-150	Unconsolidated sand and gravel deposits with interbedded silt and clay layers. Peat and much are commonly present at the surface in areas of poor drainage. Yields small to large volumes of ground water from the sand and gravel zones.
Cambrian	Wonewoc	580	100-400	Relatively thick, well-sorted quartz sandstone. Resistent to erosion, this unit therefore forms the cap rock to bluffs in the vicinity.
Cambrian	Eau Claire and Mt. Simon Sandstone	600	200-300	Fine to coarse grained sandstone with interbedded shale. Both the Eau Claire and Mt. Simon formations are below the ground water table in the vicinity of Volk Field ANG Base and, therefore, yield small to large volumes of water depending on the secondary porosity.

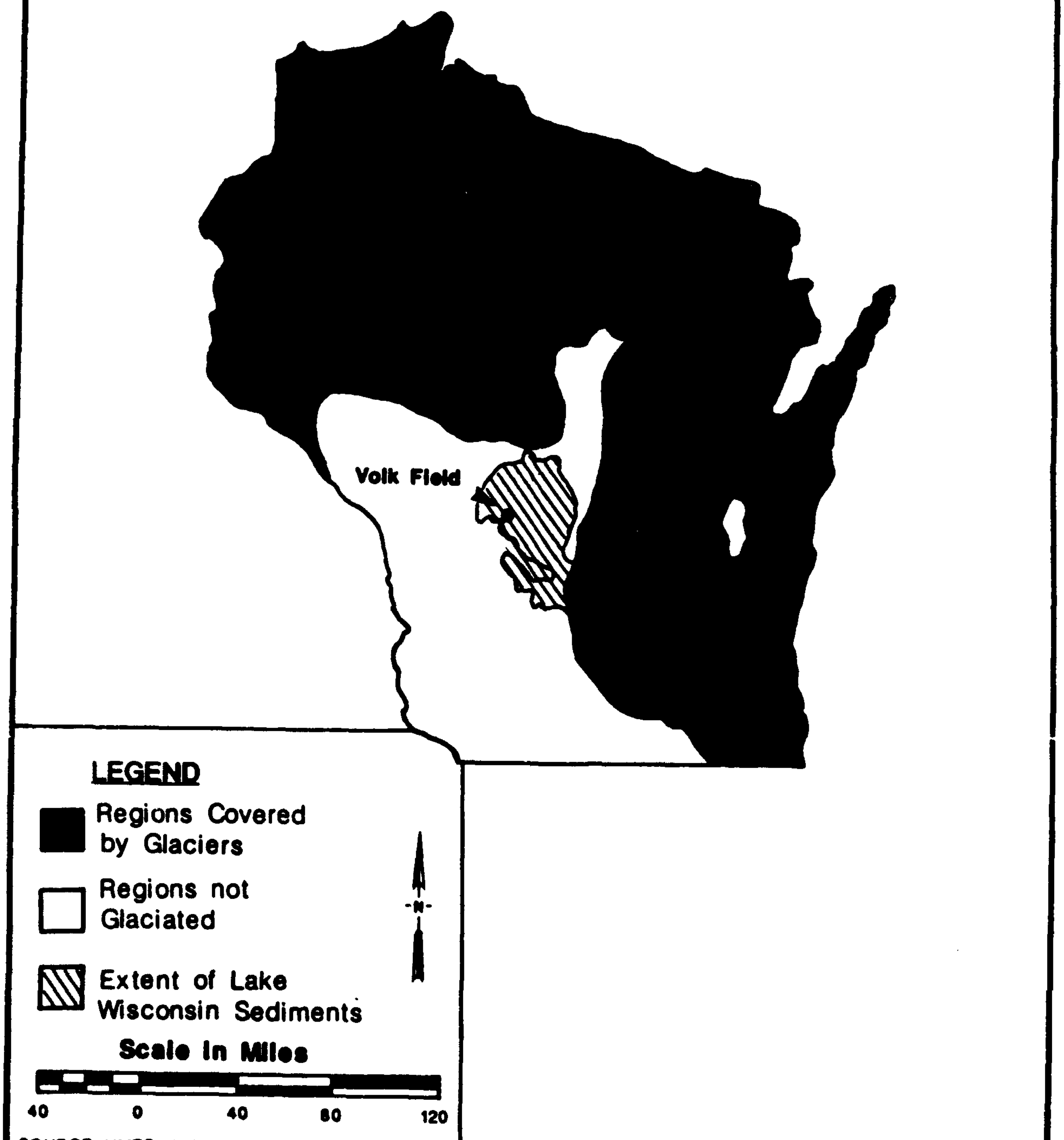
(1) After HMTC, 1984

(2) Precambrian not provided due to lack of data.

FIGURE 2.4

VOLK FIELD ANGB
CAMP DOUGLAS, WI

LIMITS OF GLACIAL ICE AND LAKE WISCONSIN SEDIMENTS



SOURCE: HMTC, 1984

Soil boring records (Appendix B) from Volk Field ANGB concur with the regional geologic conditions described above. A generalized stratigraphic sequence developed from boring logs is shown in Figure 2.5. At Volk Field, all borings encountered unconsolidated sands to a depth of approximately 15 feet below the ground surface. The unconsolidated materials are typically yellowish, fine to very fine, quartz sand with only a trace of silt-sized particles present. No accessory minerals were visible. At some locations, a clay or silty clay typically less than 5 feet in thickness was encountered. These clays are thought to be lake deposits (Lake Wisconsin). This clay was typically reddish brown, laminated and contained various amounts of silt. The clay laminae were often separated by thinner beds of unconsolidated very fine sand. These clay deposits were not found in borings at Site 1. Below these unconsolidated deposits, the Mt. Simon Formation sandstone was encountered (Lee Clayton, personal communication). In borings this sandstone is composed of material nearly indistinguishable from the above unconsolidated sands except in the degree of consolidation. This sandstone drills relatively easily and appears to be poorly cemented and extremely friable. The presence of fractures in this material could not be determined using mud rotary techniques, however, outcrops in the immediate area show vertical fracturing.

2.4.2.1 Soils

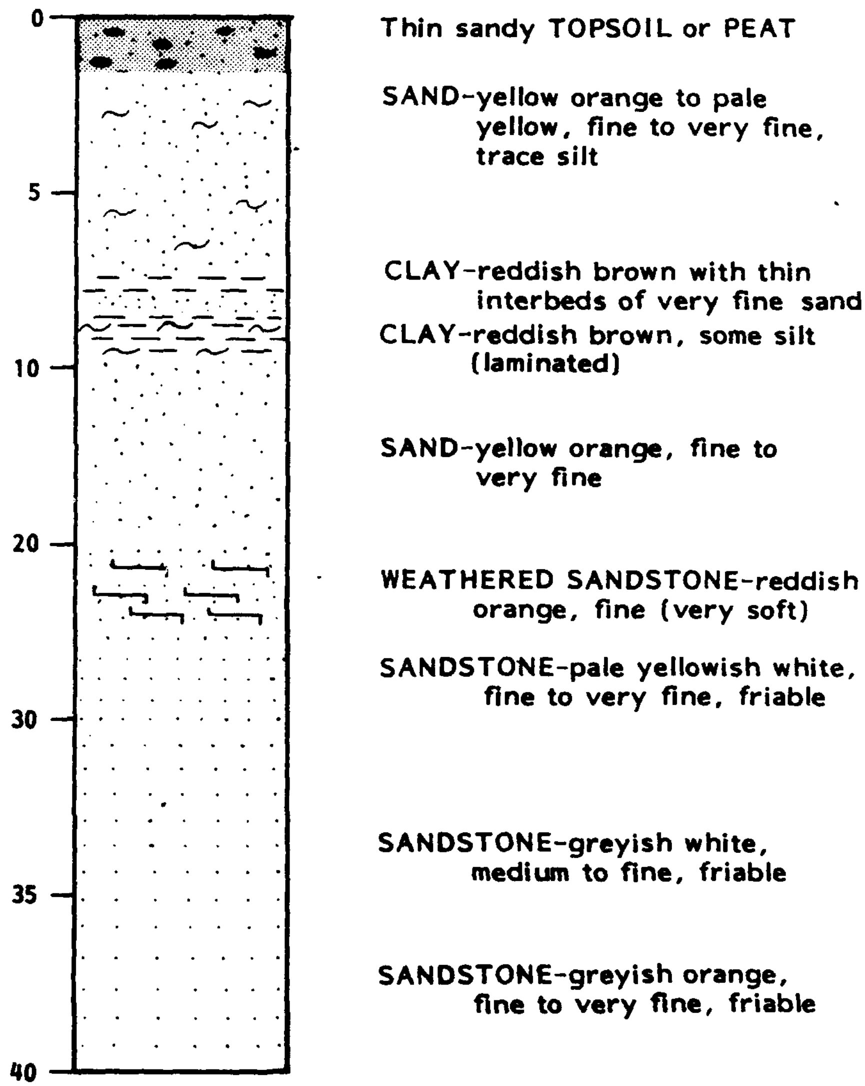
The soil types at Volk Field ANGB are generally classified as marshy, sandy soils. The soils generally consist of moderately to excessively drained soils with high permeabilities. These soils formed in outwash, lacustrine or aeolian deposits. In low-lying areas, poorly drained soils containing large amounts of organic matter can be found. These soils formed on outwash plains and in the basins of glacial lakes [Preprint of Soil Survey, Juneau County, Wisconsin, 1988].

A large portion of the soil at Volk Field ANGB is fine sand. The upper eight inches of this material is very fine with some organic matter making it slightly loamy. This soil is loose with no structure and is often wind blown. The subsoil consists of a loose, fine sand that is often yellow in color. There is no gravel in the subsoil and the amount of silt is extremely small. In other areas this subsoil is found below a surface soil that is yellowish-brown or gray in color and consists of fine sand containing a small amount of organic matter. This surface soil is found in thicknesses of approximately six inches with organics confined primarily to the upper one inch. This soil is also wind blown. In areas at the base of the sandstone buttes, a

FIGURE 2.5

VOLK FIELD ANGB
CAMP DOUGLAS, WI.

GENERALIZED STRATIGRAPHIC SEQUENCE



thin soil is present which is low in organic matter and containing fine sand and medium to large rock fragments derived from the nearby buttes.

In low-lying areas the soils are still generally sandy with a shallow peat (vegetable matter in various stages of decomposition), incorporated with varying amounts of mineral matter. The peat can be found to a depth of 30 inches below the ground surface. The subsoil is usually fine sand which is white in color and often stained with iron or slightly mottled. In areas where standing water occurs, the surface soil is a black organic rich muck with fine sand and silt sized particles (HMTC, 1984).

2.5 HYDROGEOLOGY

2.5.1 Regional Hydrogeology

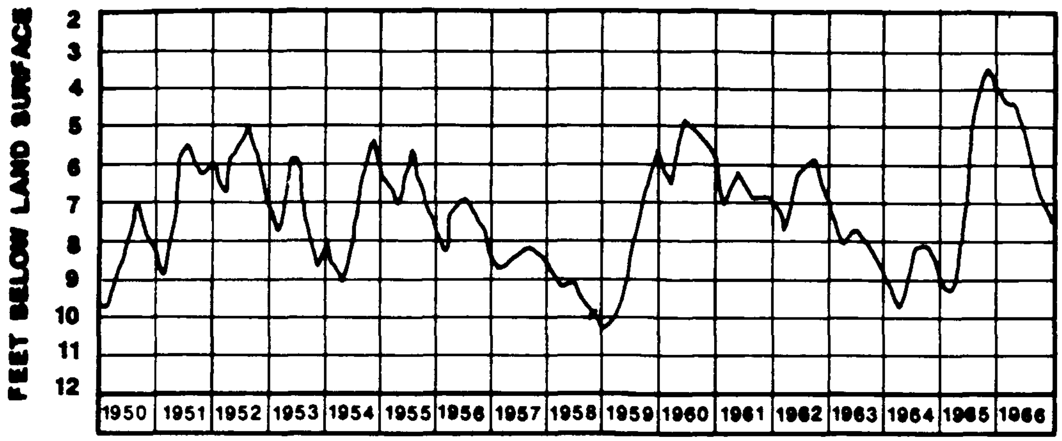
Groundwater is an important resource throughout Wisconsin. Water exists in both the unconsolidated Pleistocene-aged deposits and the underlying Cambrian-aged sandstone units and, presumably, in the Precambrian-aged metamorphic and igneous rocks that underlie the sedimentary sequence. The thicknesses of these units were provided in Section 2.4.2. Water in these deposits originates as recharge from precipitation and infiltration.

Groundwater within the Pleistocene-aged deposits is contained within the pore spaces between individual particles. Groundwater in the Cambrian-aged sandstone is also contained within the pore spaces and to a lesser extent in secondary fractures that developed after the rock was formed. Water within the deeper Pre-Cambrian units is likely to be almost exclusively within the secondary fractures and openings.

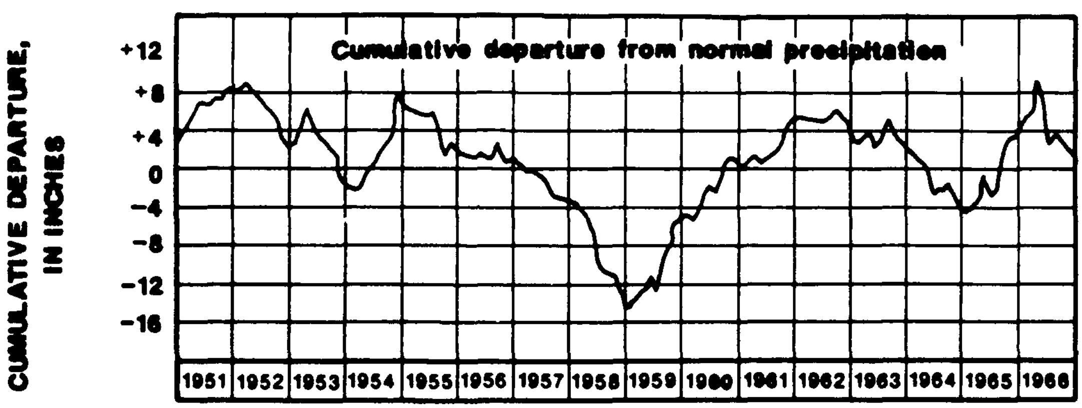
Recharge is by surface water infiltration derived from precipitation and snow melt. Depletion of this stored water, resulting in a lowering of the water table, is the result of natural discharge to streams and swamps, pumping from wells installed in the aquifers and from evapotranspiration (water removed by direct evaporation and by transpiration of plants). The effect of these processes on water levels in this area is demonstrated in Figure 2.6. The upper portion of Figure 2.6 shows the monthly measurements of the depth to the water table for a well located at Volk Field ANGB. This graph clearly shows a consistent rise of the groundwater table during early spring through June, as a result of snow melt and lack of vegetation activity, and then decreases during the summer months when vegetation activities are at a

VOLK FIELD ANGB
CAMP DOUGLAS, WI.

HISTORIC WATER TABLE ELEVATIONS AND MONTHLY PRECIPITATION DATA



Graph of monthly measurements of the depth to the groundwater table, observed in well W6 at Volk Field ANG Base from 1950 to 1966.



Graph of the cumulative departure from normal monthly precipitation, measured in Waushara County during the period 1952 to 1966.

SOURCE: HMTC, 1984

maximum. Long-term trends in the water levels can be attributed to variation in the total annual precipitation in the area as shown on the lower portion of Figure 2.6.

In Juneau County groundwater movement generally follows topography and drainage patterns. Flow is towards the Lemonweir River in the vicinity of Volk Field ANGB. Figure 2.7 shows a generalized groundwater contour map for Juneau County including Volk Field ANGB.

2.5.2 Site Hydrogeology

In the area of Volk Field ANGB the major aquifers are the unconsolidated sands deposits and the underlying Cambrian-aged sandstones. Most of the groundwater is derived from the deeper sandstone unit as the unconsolidated materials are generally less than 40 feet thick. Both aquifers generally have moderate yields of 500-1000 gpm (Golden Sands Resource Conservation and Development Area, 1981) of good quality water.

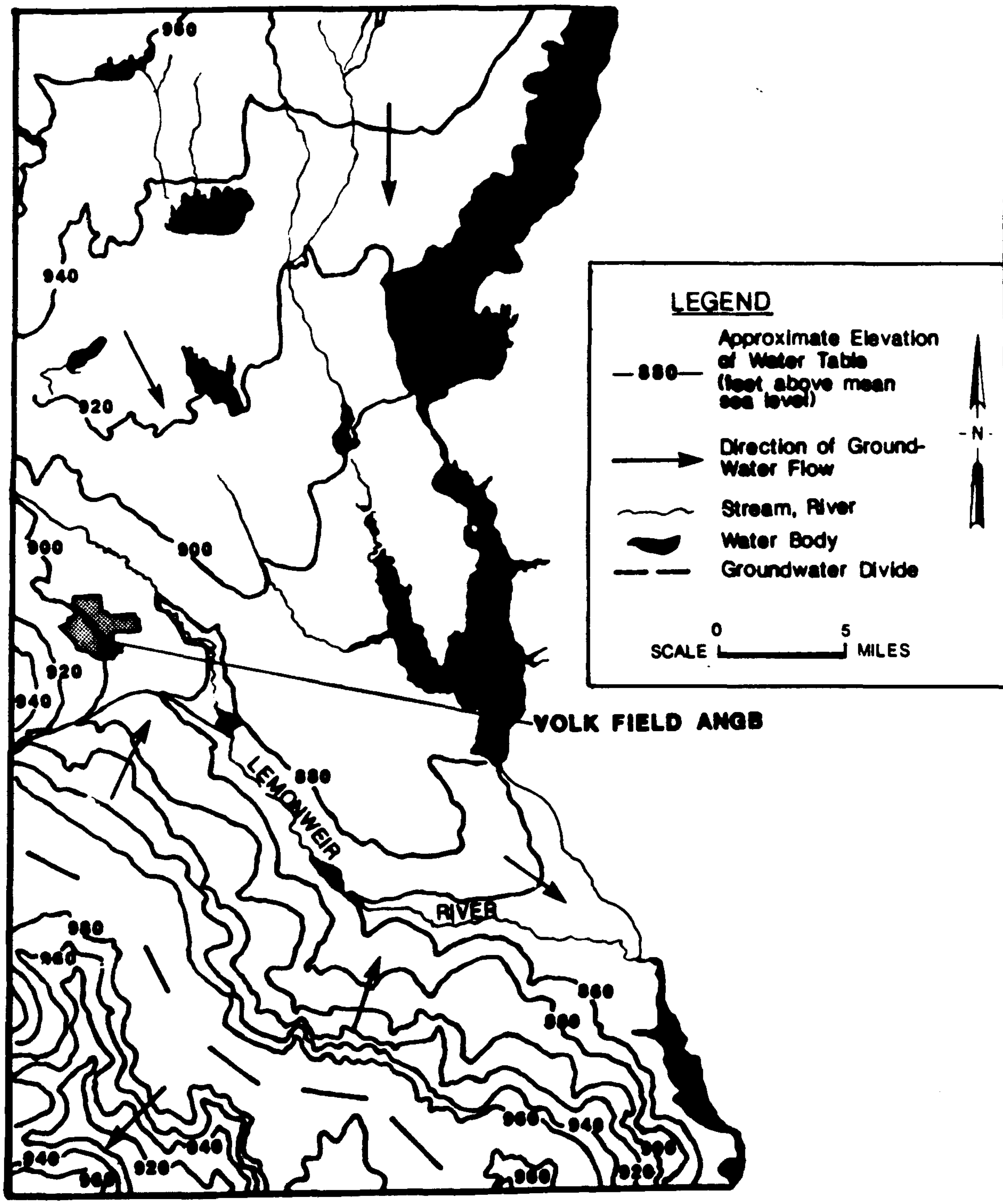
The well records examined for this study do not indicate the presence of any laterally extensive low permeability materials near the unconsolidated sand/sandstone contact. This suggests that the two sequences are hydraulically connected and that water is free to pass from one sequence to the other depending on the vertical gradient at a particular location. In the area around Volk Field, relatively thin clay or silty clay layers generally less than five feet thick, have been reported (Harloff, 1942). The clays are believed to be lacustrine deposits of historic Lake Wisconsin. The clays are described as being generally reddish in color and in places are found in thin layers and are locally carved. However, the clays are sometimes massive. The extent to which these clays affect groundwater conditions in the area is not known but appears to be of limited influence. Although not considered to act as a continuous confining layer, these clays may produce local perched water table conditions and local semi-confined aquifers (Harloff, 1942).

Groundwater flow for Volk Field ANGB is shown in Figure 2.8. Horizontal groundwater gradients in the area of the base range from 0.001 to 0.005 ft/ft. Groundwater flow corresponds to the regional flow pattern discussed in Section 2.5.1.

The hydraulic characteristics of materials underlying portions of Volk Field ANGB were determined from an aquifer pumping test conducted at Site 1. Data from this test indicate that the aquifer is unconfined with an apparent storage coefficient of 0.05 (non-dimensional). The apparent hydraulic conductivity is 800

VOLK FIELD ANGB
CAMP DOUGLAS, WI

GENERALIZED GROUNDWATER CONTOUR MAP OF JUNEAU COUNTY FOR SEPTEMBER, 1981



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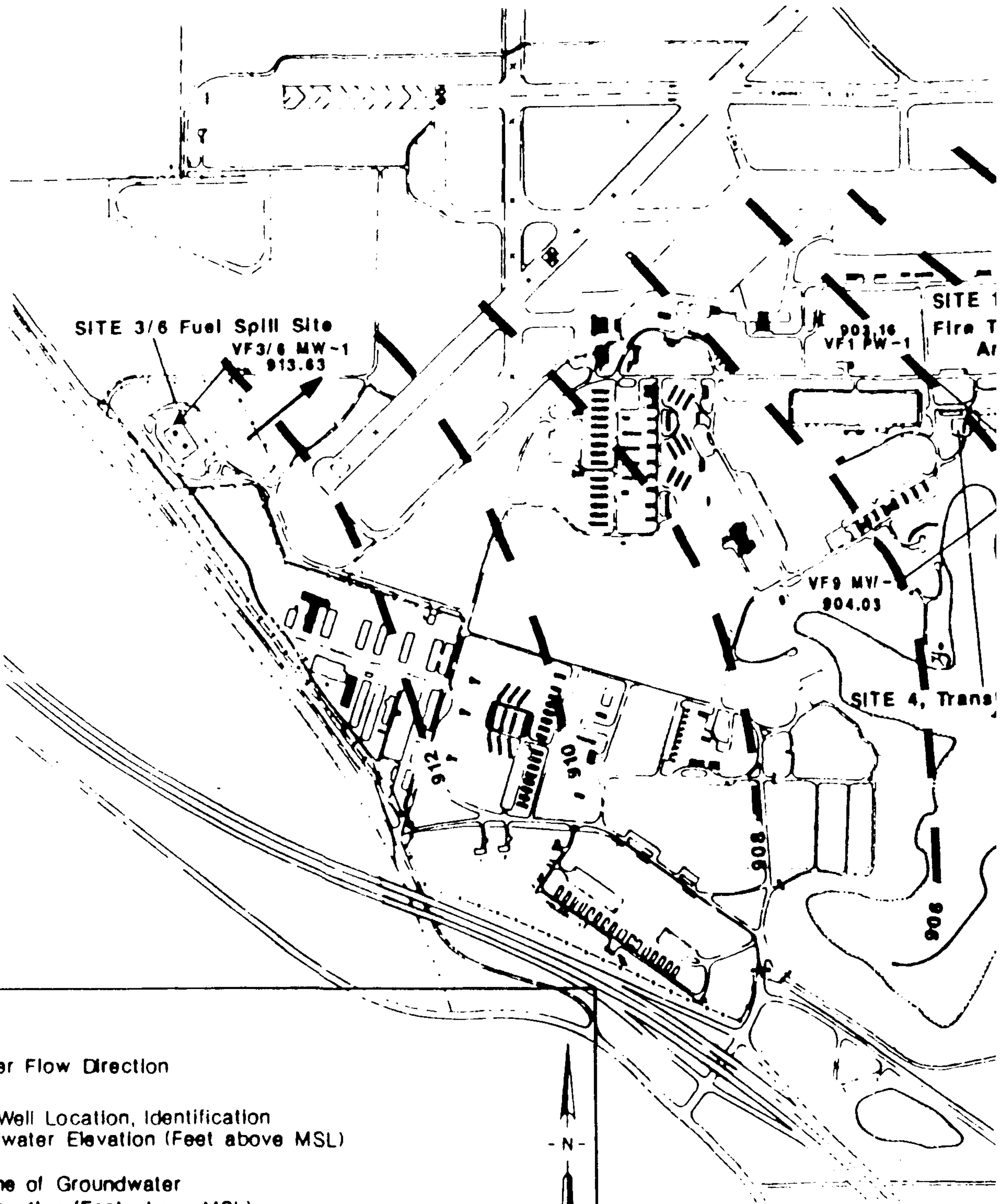
GROUNDWATER CONTOUR MA



LEGEND

Groundwater Flow Direction

VF9 MW-3 903.11 ▲ Monitoring Well Location, Identification and Groundwater Elevation (Feet above MSL)

Inferred Line of Groundwater Surface Elevation (Feet above MSL)

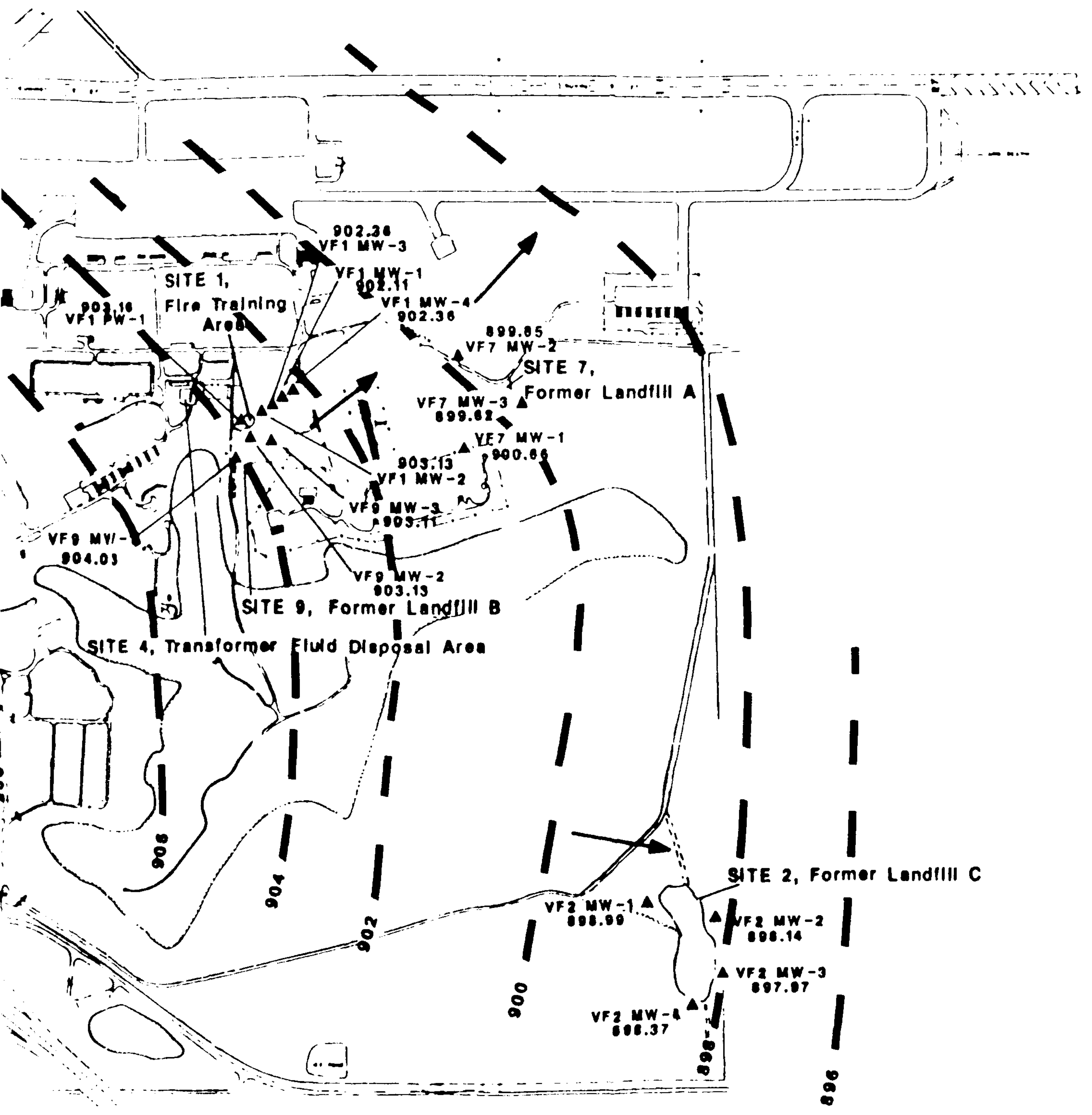
Source: 1984 Aerial Photograph

0 400 FEET

-N-

VOLK FIELD ANGB
CAMP DOUGLAS, WI.

NTOUR MAP FOR 22 APRIL 1988



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gallons per day per foot squared (3.8 cm x 10^{-2} cm/sec). A complete description of the aquifer tests conducted, data collected, and computed results are given in Appendix C and are summarized in Section 4.

2.5.2.1 Locations of Existing Wells

Volk Field ANGB has six wells located on the base that are, or were in the past, used for water supplies. Table 2.4 summarizes the available information on these wells. The location of the six wells at Volk Field ANGB is shown in Figure 2.9. Well construction records were examined for wells located near Volk Field ANGB. These records, obtained from the Wisconsin Geologic and Natural History Survey, do not provide sufficient information for location on a map. Because no public water supply exists in the vicinity of Volk Field ANGB and no surface water supplies are known to be used, it is reasonable to assume that all households and other structures containing running water are supplied by groundwater wells on the associated property.

TABLE 2.4
VOLK FIELD ANGB, CAMP DOUGLAS, WI
WATER SUPPLY WELL DETAILS

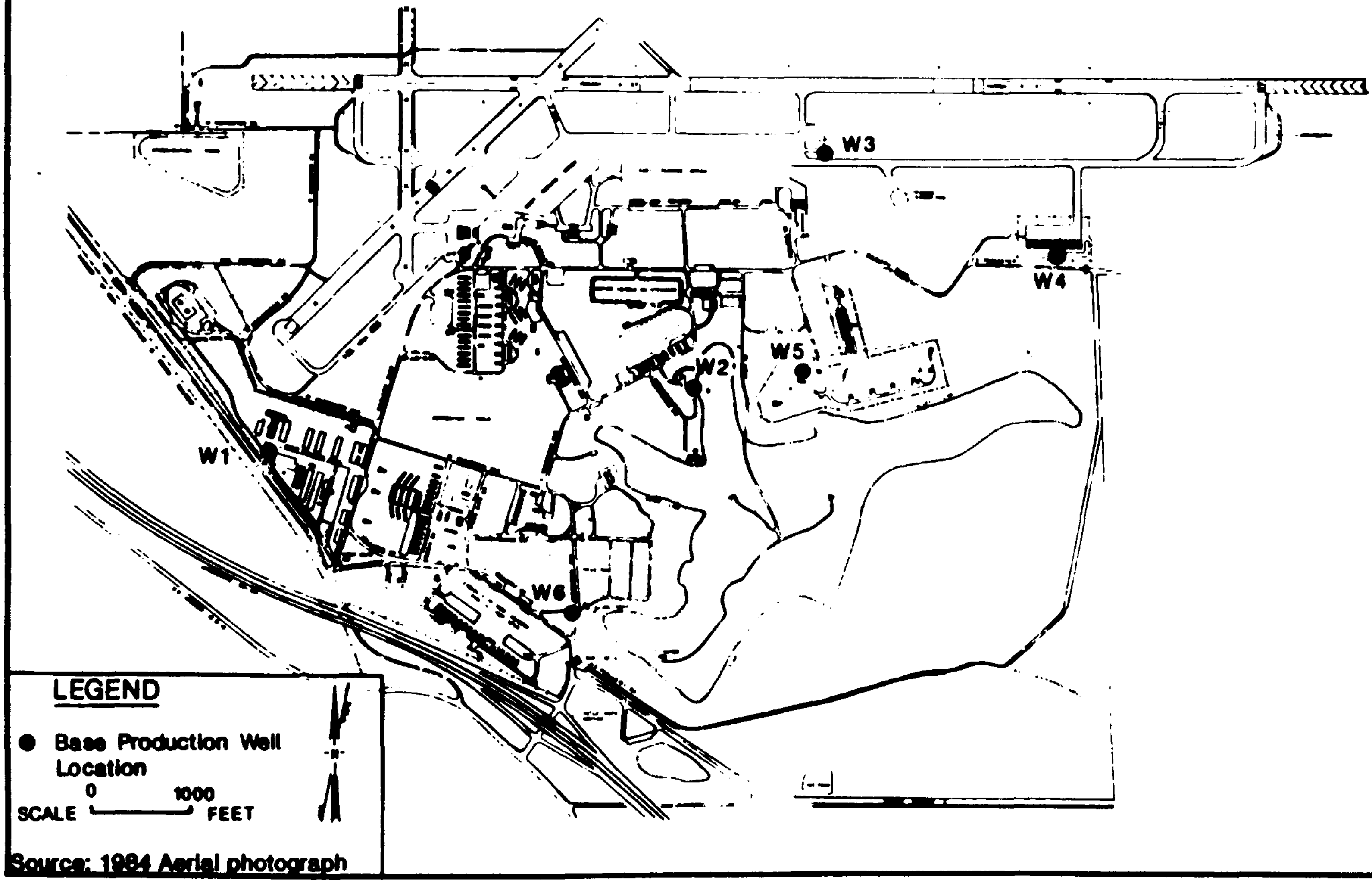
Well ID	Date Installed	Supply for	Location	Drill Method	Construction	Water Yield	Lithology
Well 1	1942	Main Base Supply	Bldg. 28	Rotary (?) 17-1/4"-80' 11 1/2"-303'	18" pipe, 0'-19.5' 12" pipe, 19.5'-80' Open hole 80'-303' Cement 0-80'	Water level = 16' Reported 842 gpm with "specific capacity = 30 gpm"	Sand, fine to medium, 0 to 7', Sandstone, fine to medium or fine to coarse, 7'-303' (Dresbach, mainly Eau Claire and cross bedding, 190'-240'.
Well 2	–	Main Base Supply	Bldg. 319	Rotary (?)	18" Casing, 0'-shallow depth 12" casing, 0'-80' 17 1/4 Hole, Grout 0'-80' 12" Open hole 80'-306'	Static = 74' Water level = 93' with 20' drawdown at 480 gpm.	–
Well 3	–	Supplemental used during summer.	25' south of Bldg. 934	–	–	–	–
Well 4	–	Supplemental used during summer.	Bldg. 950	–	–	–	–
Well 5	4/9/69	Munitions	Bldg. 916	Rotary 8 3/4" 0-80.5' 6" 80.5-282'	6" wrought iron to 80.5' open hole 80.5-282' Drill cutting backfill 0-26' Neat cement 26'-80.5'	Water level = 30.33' Water level = 32 while pumping 50 gpm for 24 hours.	Sand 0-26' Sandstone 26'-282'
Well 6	–	Not in use	290' north of Building 200 (?)	–	–	–	–

°°¹1181

FIGURE 2.9

VOLK FIELD ANGB
CAMP DOUGLAS, WI.

BASE PRODUCTION WELL LOCATIONS



SECTION 3
FIELD INVESTIGATION PROGRAM

The Installation Restoration Program (IRP) Remedial Investigation (RI) consisted of an investigation of the Fire Training Area (Site 1) at Volk Field ANGB. This section discusses the procedures and methodology used in the field program. The field program at Site 1 consisted of obtaining site specific hydrogeologic and geologic data and collecting samples of soil gas, soil, and groundwater for chemical analysis. The field work at Site 1 was accomplished concurrently with the Site Investigation (SI) field work at Sites 2, 3/6, 4, 7, 9 and 10.

3.1 PROGRAM IMPLEMENTATION

The field program was implemented on 5 October 1987 and completed on 7 May 1988. The soil gas survey was conducted between 11 November 1987 and 20 November 1987. Collection of soil samples and installation of monitoring wells was completed at various times between 7 December 1987 and 18 February 1988. Sampling of monitoring wells was completed between 1 March 1988 and 9 March 1988. Slug tests were conducted between 18 April 1988 and 22 April 1988. An aquifer test was conducted between 1 May 1988 and 7 May 1988.

3.2 CONTAMINANT SOURCE INVESTIGATION

Potential sources of contamination at Volk Field ANGB, including Site 1, were identified in the Records Search portion of the Installation Restoration Program performed by the Hazardous Materials Technical Center (HMTC, 1984). A discussion of the previous investigations conducted at Site 1 was provided in Section 1 of this report. Methods utilized for the remedial investigation at Site 1 included soil-gas monitoring, the installation of four monitoring wells and one pumping well, collecting groundwater samples from eleven wells, drilling fifteen soil borings and collecting forty-five soil samples for chemical analysis. In addition, eleven slug tests and an aquifer pumping test were performed at the site to determine the existing hydrogeologic conditions.

3.3 SOIL-GAS SURVEY

The soil gas survey was conducted to provide information on possible contaminant migration from the site. Results aided in locating soil borings and monitoring wells. Soil gas survey services were provided by EA Engineering Science and Technology, Inc. of Sparks, Maryland. A detailed description of the procedures, raw data and results related to this portion of the Volk Field ANGB investigation is provided in Section 4 and Appendix D. A brief discussion of the procedures used for the survey is provided in this subsection.

The soil gas survey was conducted by collecting soil gas samples through hollow steel probes installed at regularly spaced intervals throughout the site. The probes were mechanically driven to a depth of less than 14 feet into the ground. After installation, the probe was fitted with a vacuum pump which was used to evacuate the soil gas. Using a syringe needle, a small quantity of the soil gas was collected for immediate analysis in a HNu® 421 gas chromatograph with a flame ionization detector which was housed in an analytical field van on site. Analytical parameters included trichloroethylene (TCE), benzene, toluene, ethylbenzene and ortho-xylene.

Results of the field analysis were plotted on a scaled map of the area. In some cases, additional soil gas probes were installed to further define areas of potential contamination. The results of the soil gas survey indicated a possible area of contamination and was used in the determination of monitoring well and soil sampling locations.

3.4 SOIL BORING AND SAMPLING AND ABANDONMENT

3.4.1 Soil Boring and Sampling

Fifteen soil borings were drilled at Site 1 to gain lithological information and to obtain soil samples for chemical analysis. Borings were made in the fire training pit and surrounding area, or in areas identified during the soil gas survey as potentially having soil contamination. The locations of these borings and the results obtained are discussed in detail in Section 4.

Collection of the soil samples was made by advancing six- or four-inch inside diameter (I.D.) hollow-stem augers to the required sampling depth and driving a split-spoon sampler (ASTM-D-1586) into the undisturbed soils ahead of the drill bit. A 2.25-inch I.D. standard split spoon with stainless steel sleeves was used to collect soil samples. The borings were drilled to a depth of approximately 10 feet and three samples were taken from each boring. Soil samples for chemical analysis were obtained typically at the 0 feet, 3.5 feet and 8.5 feet below the ground surface. The presence of groundwater at approximately 10 feet below the ground surface negated the need for collection of soil samples from greater depths since groundwater samples were also collected at the site. After obtaining the soil sample, the sleeves were separated and the sample removed using a stainless steel knife. The samples were placed in stainless steel bowls. Soil samples analyzed for volatile organic compounds were packed into 40 mL vials with as little disturbance as possible. For the remaining sample parameters, the soil was homogenized thoroughly and then placed into the sample containers, utilizing a cut and quartering technique. The manner in which the soil samples were numbered, handled, packaged and shipped is similar to that for water samples and is described in detail in Section 3.7 of this report. Samples to be used for visual classification purposes were collected at intervals of 5 feet. Soils were classified visually with respect to type, grain size, mineralogy (when pertinent), color, moisture content and odor. These soil samples were placed in glass jars and stored for future reference. Organic vapors were monitored during drilling operations using an HNu® photoionization detector and recorded on the boring logs. Any additional notes or problems encountered were recorded in the field notebook.

All the soil borings were located on base maps with reference to U.S. Geological Survey benchmarks. The elevation of each boring was surveyed to nearest ± 0.1 foot. The horizontal location of each soil boring was surveyed to the nearest ± 1 foot.

3.4.2 Borehole Abandonment

Following completion of each borehole, the boring was abandoned to prevent rapid infiltration of surface water which might enhance possible contamination migration. The methodology consisted of grouting the borehole using a tremie hose. The hose was placed at the bottom of the borehole while grout was pumped into the borehole. The hose was slowly withdrawn as the borehole was filled. The mixture used consisted of approximately 100 pounds of Portland type-1 cement, 5 pounds of Quick Gel®-type bentonite and 6 gallons of water. This mixture was thoroughly mixed in a tub using a grout pump. After pumping into the borehole, the grout is allowed to settle and infiltrate the natural formation. The boreholes were later topped off with a similar mixture to make the boreholes flush with the ground surface.

3.5 MONITORING WELL CONSTRUCTION AND SAMPLING

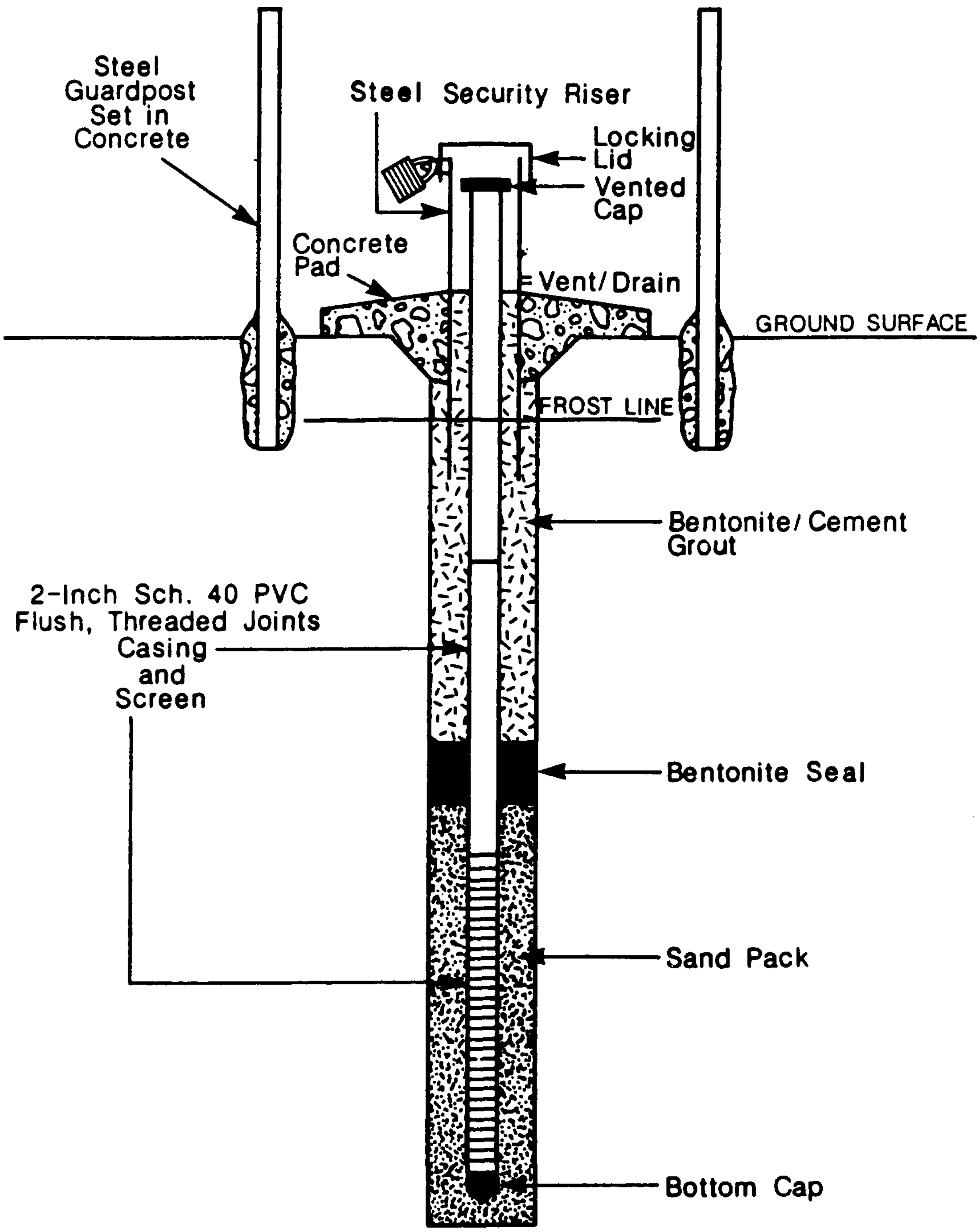
Four monitoring wells and one pumping well were installed at Site 1. These wells were installed using a technique utilizing 10-inch outer diameter (O.D.) (6.25-inch I.D.) hollow-stem augers while drilling in the unconsolidated sands and a 6-inch O.D. rotary bit after encountering the sandstone formation. While drilling the boring for the pumping well installed at Site 1, a 10-inch O.D. hollow stem auger was used to drill through the uppermost unconsolidated sediments. This auger was removed and a 10-inch I.D. conductor casing was driven into the top of the bedrock. At this point a 10-inch O.D. rotary bit was used to advance the hole to the required depth. Lithilogic samples were obtained using split-spoon samplers or gathered from cuttings discharged at the top of the hole. Where necessary, Quick Gel® bentonite was added to the drilling fluid to increase its cutting carrying capacity and to ensure that the borehole remained open.

The wells were completed using 2-inch diameter (6-inch diameter in the pumping well) Schedule 40 PVC casing and screen. The screen used was machine slotted with 0.010 slot size and all casings had threaded, flush joints. End caps were used on both ends of the casing. The casing and screen were set at the determined depth and a sand pack was placed in the annular space to a depth of two feet above the top of the screen. A two feet bentonite seal (1/4 inch pellets) was placed above the sand pack. The hole was then backfilled, using a tremie hose, to within a few feet of the surface with a cement bentonite grout. The procedure used to mix the grout was similar to that described for the soil boring abandonment (Section 3.4.2).

A 6-inch diameter (8-inch diameter in the pumping well) steel security riser with locking lid was concreted in place around the PVC well riser. Bumper posts were installed around each well riser. A schematic diagram of a typical monitoring well construction is shown on Figure 3.1. All risers were marked with well identification numbers. The monitoring well locations were located on base maps with reference to U.S. Geological Survey benchmarks. The elevations of all new wells were surveyed to the nearest ± 0.01 foot. The horizontal location of each monitoring well was surveyed to the nearest ± 1 foot. The wells were developed by pumping and, for the pumping well, by the airlift method.

VOLK FIELD ANGB
CAMP DOUGLAS, WI.

TYPICAL MONITORING WELL CONSTRUCTION



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3.5.1 Groundwater Sampling

Groundwater samples were collected from all the newly installed monitoring wells and the seven existing wells installed by AFESC in 1985. These wells are designated as ET-1 through ET-7. Prior to sampling each well, the water level depth was measured using an electronic water level indicator and the volume of water in each well was calculated. The wells were then purged of a minimum of five volumes of water using either a Teflon® bailer or a Keck pump. Water levels were checked prior to sampling to insure recovery to 95 percent of their original level. All sampling equipment was decontaminated prior to each use according to the methods described in Section 3.6. Temperature, conductivity, and pH were measured during well purging and also prior to sampling. The numbering system used to track the samples is presented in Section 3.7.

Groundwater samples collected were analyzed by the methods listed in Table 3.1 The target parameters for all the analytical methods utilized in the RI at Site 1 are also listed in this table. Results from the analyses are discussed in Section 4.

3.5.2 Well Abandonment

During the field program, eight monitoring wells which had been installed in 1981 by the Air National Guard Support Center (ANGSC) were abandoned. Abandonment was accomplished by pulling the well casing out of the ground and grouting the borehole following the procedures described in 3.4.2.

3.6 DECONTAMINATION PROCEDURES

Care was taken to prevent cross-contamination between sampling locations as well as between individual samples. The drill rig was decontaminated with high-pressure steam prior to its initial use at the base. Drill bits, augers, drill rods, split spoon samplers and other down-hole equipment were decontaminated prior to each use. The decontamination procedure consisted of the following:

- Rinse with high-pressure steam,
- Wash and scrub with biodegradable detergent solution,
- Rinse with high-pressure steam,
- Rinse with pesticide grade isopropyl alcohol,

TABLE 3.1
VOLK FIELD ANGB, CAMP DOUGLAS, WI
ANALYTICAL PARAMETERS AND METHODS

Parameter	Method	Reference
Halogenated Volatile Organics	SW 8010	3
(μg/kg - Soils)		
Benzyl Chloride		
Bis (2-Chloroethoxy) Methane		
Bis (2-Chloroisopropyl) Ether		
Bromobenzene		
Bromodichloromethane		
Bromoform		
Bromoethane		
Carbon Tetrachloride		
Chloroacetaldehyde		
Chloral		
Chlorobenzene		
Chloroethane		
Chloroform		
1-Chlorohexane		
2-Choroethyl Vinyl Ether		
Chloromethane		
Chloromethyl Methyl Ether		
Chlorotoluene		
Dibromochloromethane		
Dibromomethane		
1,2-Dichlorobenzene		
1,3-Dichlorobenzene		
1,4-Dichlorobenzene		
Dichlorodifluoromethane		
1,1-Dichloroethane		
1,2-Dichloroethane		
1,1-Dichloroethylene		
Trans-1,2-Dichloroethylene		
Dichloromethane		
1,2-Dichloropropane		
1,3-Dichloropropylene		
1,1,2,2-Tetrachloroethane		
1,1,1,2-Tetrachloroethane		
Tetrachloroethylene		
1,1,1-Trichloroethane		
1,1,2-Trichloroethane		
Trichloroethylene		
Trichlorofluoromethane		
Trichloropropane		
Vinyl Chloride		

TABLE 3.1 - Continued
VOLK FIELD ANGB, CAMP DOUGLAS, WI
ANALYTICAL PARAMETERS AND METHODS

Parameter	Method	Reference
Halogenated Volatile Organics	E 601	1
(µg/L - Water)		
Bromodichloromethane		
Bromoform		
Bromoethane		
Carbon Tetrachloride		
Chlorobenzene		
Chloroethane		
2-Chloroethyl Vinyl Ether		
Chloroform		
Chloromethane		
Dibromochloromethane		
1,2-Dichlorobenzene		
1,3-Dichlorobenzene		
1,4-Dichlorobenzene		
Dichlorodifluoromethane		
1,1-Dichloroethane		
1,2-Dichloroethane		
1,1-Dichloroethene		
Trans-1,2-Dichloroethene		
1,2-Dichloropropane		
cis-1,3-Dichloropropane		
Trans-1,3-Dichloropropene		
Methylene Chloride		
1,1,2,2-Tetrachloroethane		
Tetrachloroethene		
1,1,1-Trichloroethane		
1,1,1-Trichloroethane		
Trichloroethene		
Trichlorofluoromethane		
Vinyl Chloride		
Conductance	E 120.1	2
(umhos - Water)		
pH	E 150.1	2
(unitless - Water)		
Temperature	E 170.1	2
('C - Water)		

TABLE 3.1 - Continued
VOLK FIELD ANGB, CAMP DOUGLAS, WI
ANALYTICAL PARAMETERS AND METHODS

Parameter	Method	Reference
Aromatic Volatile Organics	SW 8020	3
(µg/kg - Soil) (µg/L - Water)		
Benzene		
Chlorobenzene		
1,2-Dichlorobenzene		
1,3-Dichlorobenzene		
1,4-Dichlorobenzene		
Ethyl Benzene		
Toluene		
Xylenes		
Metals		
(mg/L - Water)		
Lead	E 239.2	2
PCBs	SW 8080	3
(µg/L - Water) (mg/kg - Soil)		
PCB-1016		
PCB-1221		
PCB-1232		
PCB-1242		
PCB-1248		
PCB-1254		
PCB-1260		
Base/Neutral Acid Extractables	E 625	1
(µg/L - Water)		
1,3-Dichlorobenzene		
1,4-Dichlorobenzene		
Hexchloroethane		
Bis(2-chloroethyl)ether		
1,2-Dichlorobenzene		
N-Nitrosodiumethylamine		
Bis(2-chloroisopropyl)ether		
N-Nitrosodi-n-propyl amine		
Hexachlorobutadiene		
1,2,4-Trichlorobenzene		
Nitrobenzene		
Isophorone		
Nahpthalene		
Bis(2-chloroethyoxy)methane		
2-Chloronaphthalene		

TABLE 3.1 - Continued
VOLK FIELD ANGB, CAMP DOUGLAS, WI
ANALYTICAL PARAMETERS AND METHODS

Parameter	Method	Reference
Base/Neutral Acid Extractables ($\mu g/L$ - Water)(Continued)	E 625	1
Hexachlorocyclopentadiene		
Acenaphthylene		
Acenaphthene		
Dimethyl phthlate		
2,6-Dinitrotoluene		
Fluorene		
2,4-Dinitrotoluene		
Diethyl phthalate		
N-Nitrosodiphenylamine		
Hexachlorobenzene		
Phenanthrene		
Anthracene		
Dibutyl phthalate		
Fluoranthene		
4-Chlorophenyl phenyl ether		
Pyrene		
Butyl Benzyl phthalate		
Bis(2-ethylhexyl) phthalate		
Chrysene		
4-Bromophenyl phenyl ether		
Benzo(a)anthracene		
Di-n-octylphthalate		
Benzo(b)fluoranthene		
Benzo(k)fluoranthene		
Benzidine		
3,3'-Dichlorobenzidine		
Benzo(a)pyrene		
Indeno(1,2,3-cd)pyrene		
Dibenzo(a,h)anthracene		
Benzo(ghi)perylene		
Alpha-BHC		
Gamma-BHC		
Beta-BHC		
Heptachlor		
Delta-BHC		
Aldrin		
Heptachlor epoxide		
Endosulfan I		
Dieldrin		
4,4'-DDE		

TABLE 3.1 - Continued
VOLK FIELD ANGB, CAMP DOUGLAS, WI
ANALYTICAL PARAMETERS AND METHODS

Parameter	Method	Reference
Base/Neutral Acid Extractables	E 625	1
(µg/L - Water) (Continued)		
Endrin		
Endosulfan II		
4,4'-DDD		
4,4'-DDT		
Endosulfan Sulfate		
Endrin aldehyde		
Chlordane		
Toxaphene		
PCB-1016		
PCB-1221		
PCB-1232		
PCB-1242		
PCB-1248		
PCB-1254		
PCB-1260		
2-Chlorophenol		
2-Nitrophenol		
Phenol		
2,4-Dimethylphenol		
2,4-Dichlorophenol		
2,4,6-Trichlorophenol		
4-Chloro-3-methylphenol		
2,4-Dinitrophenol		
2-Methyl-4,6-Dinitrophenol		
Pentachlorophenol		
4-Nitrophenol		
Base/Neutral Acid Extractables	SW 8270	3
(mg/kg - Soil)		
1,3-Dichlorobenzene		
1,4-Dichlorobenzene		
Hexachloroethane		
Bis(2-Chloroethyl)ether		
1,2-Dichlorobenzene		
N-Nitrosodi-n-propyl amine		
Hexachlorobutadiene		
1,2,4-Trichlorobenzene		
Nitrobenzene		
Isophorone		
Naphthalene		

TABLE 3.1 - Continued
VOLK FIELD ANGB, CAMP DOUGLAS, WI
ANALYTICAL PARAMETERS AND METHODS

Parameter	Method	Reference
Base/Neutral Acid Extractables (mg/kg - Soil) (Continued)	SW 8270	3
Bis(2-chloroethyoxy)methane		
2-Chloronaphthalene		
Hexachlorocyclopentadiene		
Acenaphthlene		
Acenaphthene		
Dimethyl phthalate		
2,6-Dinitrotoluene		
Fluorene		
2,4-Dinitrotoluene		
Diethyl phthalate		
N-Nitrosodiphenylamine		
Hexachlorobenzene		
Phenanthrene		
Anthracene		
Dibutyl phthalate		
Fluoranthene		
4-Chlorophenyl phenyl ether		
Pyrene		
Butyl Benzyl phthalate		
Bis(2-ethylhexyl) phthalate		
Chrysene		
4-Bromophenyl phenyl ether		
Benzo(a)anthracene		
Di-n-octylphthalate		
Benzo(b)fluoranthene		
Benzo(k)fluoranthene		
Benzidine		
3,3'-Dichlorobenzidine		
Benzo(a)pyrene		
Ideno(1,2,3-cd)pyrene		
Dibenzo(a,h)anthrcene		
Benzo(ghi)perylene		
Benzyl Alcohol		
Acetophenone		
Aniline		
4-Aminobiphenyl		
4-Chloroaniline		
1-Chloronaphthalene		
Dibenzofuran		
p-Dimethylaminoazobenzene		

TABLE 3.1 - Continued
VOLK FIELD ANGB, CAMP DOUGLAS, WI
ANALYTICAL PARAMETERS AND METHODS

Parameter	Method	Reference
Base/Neutral Acid Extractables (mg/kg - Soil) (Continued)	SW 8270	3
7,12-Dimethylbenz(a)anthracene		
a-,a-Dimethylphenethylamine		
Diphenylamine		
1,2-Diphenylhydrazine		
Ethyl methanesulfonate		
3-Methylcholanthrene		
2-Methylnaphthalene		
1-Naphthylamine		
2-Naphthylamine		
2-Nitroaniline		
3-Nitroaniline		
4-Nitroaniline		
N-Nitroso-di-n-butylamine		
N-Nitrosopiperidine		
Pentachlorobenzene		
Pentachloronitrobenzene		
Phenacetin		
2-Picoline		
Pronamide		
1,2,4,5-Tetrachlorobenzene		
Alpha-BHC		
Gamma-BHC		
Beta-BHC		
Heptachlor		
Delta-BHC		
Aldrin		
Heptachlor epoxide		
Endosulfan I		
Dieldrin		
4,4'-DDE		
Endrin		
Endosulfan II		
4,4'-DDD		
4,4'DDT		
Endosulfan Sulfate		
Endrin aldehyde		
Endrin Ketone		
Chlordane		
Methoxychlor		
Toxaphene		

TABLE 3.1 - Continued
VOLK FIELD ANGB, CAMP DOUGLAS, WI
ANALYTICAL PARAMETERS AND METHODS

Parameter	Method	Reference
Base/Neutral Acid Extractables (mg/kg - Soil) (Continued)	SW 8270	3
Aroclor-1016		
Aroclor-1221		
Aroclor-1232		
Aroclor-1242		
Aroclor-1248		
Aroclor-1254		
Aroclor-1260		

References:

1. Methods for Organic Chemical Analysis of Municipal and Industrial Wastewater, EPA-600/4-82-057, USEPA Environmental Monitoring and Support Laboratory, July 1982.

2. Methods for Chemical Analysis of Water and Wastes, EPA-600/4-79-020, USEPA Environmental Monitoring and Support Laboratory, Revised March 1983.

3. SW 846 Test Methods for Solid Waste, 3rd Edition, 1986.

- Rinse with distilled water; and
- Air dry.

Equipment utilized more than once at a boring location was cleaned at that location using the above procedure except that no high pressure rinses were used.

All sampling equipment was decontaminated before use at each sampling location by a detergent wash, a clean-water rinse, an isopropyl alcohol rinse, and a final deionized, organic-free water rinse. Bailers were allowed to air dry completely and were wrapped in aluminum foil for storage after decontamination. A new nylon bailer line was used at each well and then discarded.

3.7 SAMPLE NUMBERING SYSTEM

Each sample collected for analysis was assigned a unique identification number that described where the sample was collected. Each number consisted of a group of letters and numbers, separated by commas. The sample numbering system is presented in Table 3.2.

Field duplicates and blanks collected for quality assurance purposes were also assigned unique sample identifiers. The site number or well number was changed to a different numeral with no corresponding well or site location in the field. For example, a blind duplicate of the groundwater sample VF, 1-W2, GW-1, ES would be: VF, 1-W5, GW-1, ES. The well number is changed to 5 since only 4 wells actually exist. Records of all such quality assurance samples were kept in the field log books.

3.8 SAMPLE HANDLING, PACKAGING, AND SHIPMENT

All samples and duplicates were placed in pre-cleaned glass or plastic bottles for shipping to the laboratory. These bottles were supplied pre-cleaned according to EPA procedures by I-CHEM Research of Hayword, California. When required for a particular analysis, preservatives were added to the bottles immediately before sample collection. Each sample bottle was sealed by a Teflon®-lined cap that was taped shut using polyethylene tape to ensure it remained sealed during shipment. Individual bottles were then wrapped in bubble pack to prevent breakage during shipment. Individual sample bottles were labeled with the following information:

TABLE 3.2
VOLK FIELD ANGB
CAMP DOUGLAS, WISCONSIN
SAMPLE NUMBER SYSTEM

Project Identification:

VF (Volk Field)

Site Number:

1 (Fire Training Area)

Well Number (sequential):

W2 - Monitoring Well Number

B2 - Soil Boring Location

Sample Number:

GW1 - Groundwater Sample Number (sequential for each sampling event)

SS1 - Split-spoon Sample Number (sequential for each sampling event at a soil boring location)

Sample Destination:

ES - Engineering-Science Laboratory

OR - Oak Ridge National Laboratory

Example Sample Number:

VF, 1-W2, GW-1, ES

Volk Field Air National Guard Base, Camp Douglas, Wisconsin, Site 1, Fire Training Area, Monitoring Well MW-2, the first sampling event, v[illegible] sample being shipped to the Engineering-Science Laboratory in Berkeley, California.

- Project identifier;
- Sample identifier (as described above);
- Preservatives added (specific for analytical method);
- Date of sample collection;
- Time of sample collection; and
- Required analytical method (specific for each container).

Sample bottles were then placed into insulated shipping coolers, along with a sealed plastic bag containing ice.

A chain-of-custody form with the following information was completed and sealed inside each cooler in a waterproof envelope prior to shipping:

- Project identifier;
- Name and signature of person who collected the samples;
- Sample identifiers (for all samples in the cooler);
- Date and time of sample collection;
- Number of individual bottles for each sample; and
- Required analytical methods for each sample.

The coolers were shipped by overnight delivery to the ES Berkeley Laboratory. Copies of the completed chain-of-custody forms were obtained from the laboratory upon completion of the analytical effort and are presented in Appendix E.

Quality assurance (QA) samples were routinely included with shipments along with other samples. QA samples consisted of trip blanks (deionized, organic-free water in appropriate sample bottles), equipment wash blanks (deionized, organic-free water poured through a decontaminated bailer into appropriate sample bottles), and blind duplicates. The QA samples were marked with unique sample identifiers which made them indistinguishable from normal samples.

3.9 WATER LEVEL MEASUREMENTS

The level of water in each well at Site 1 was measured on four different dates within the same 8-hour period on each date. The water levels at Site 1 were measured to the nearest 0.01 feet using an electronic water level indicator referenced to a mark made on the top of the PVC riser. This mark was surveyed to the nearest 0.01 foot and referenced to an established datum. Four sets of water levels were taken at Site 1 and Site 9 during the course of the RI. This information is presented in detail in Section 4. Wells suspected of having free-floating product were checked periodically for product using an oil/ water interface probe. This instrument indicates the presence of product with thicknesses greater than 1/4 inch.

3.10 AQUIFER TESTING

Aquifer characteristics of Site 1 were determined by slug tests and by an aquifer pumping test. A brief discussion of each methodology is presented in the subsections below. A complete description of the tests with all the field data and interpretative plots are included as Appendix C. The results of these tests are also summarized in Section 4.

3.10.1 Slug Tests

Slug tests were performed on 11 monitoring wells located at Site 1. These tests were performed by causing an instantaneous change in the water levels of wells by the introduction and removal of a stainless-steel rod (slug). During the tests water levels and time intervals were recorded using an In-situ Hermit 1000® recorder with a pressure transducer submerged in the wells. The hydraulic conductivities of the materials immediately surrounding the wells were estimated, using an analytical method (Bouwer, 1987), from the rates at which water levels changed following the introduction and removal of the slug.

3.10.2 Aquifer Pumping Test

Prior to running the aquifer pumping test, a step drawdown test was run to determine a suitable pumping rate to be used during the pumping test. After allowing water levels to recover from the step drawdown test, water levels in wells at Sites 1 and 9 were recorded to establish static water levels.

The aquifer test consisted of pumping water from a six-inch pumping well, VF1 PW-1, at a known rate for 24 hours. Resulting changes in water level, or drawdowns, were measured in the pumping well and the closest observation well, ET-2, using the In-Situ Hermit 1000® with pressure tranducers in each well. In addition, Slope® water level indicators were used to measure the water levels in other monitoring wells located at Site 1 and at adjacent Site 9. Background wells, or wells that would not be affected by pumping in the vicinity of Sites 1 and 9, were monitored to determine whether a trend correction would be required. After pumping ceased, rates of recovery of water levels in these wells were measured for at least the next 12 hours or until water levels had reached equilibrium conditions. Hydraulic conductivity and the storage coefficient of the aquifer underlying Sites 1 and 9 were estimated from the time-rate of drawdown and recovery data using several analytical methods (see Appendix C, Section 1). A discussion of these data is presented in Section 4.

SECTION 4
INVESTIGATION RESULTS

Site 1, the Fire Training Area, was the only site investigated under the Remedial Investigation (RI). This section includes a discussion of the site background and history, RI field activities, and the results of the RI. Particular interest is given to the areal and vertical distribution of contaminants in the soil and groundwater at the site, as well as site characteristics which may promote contaminant migration.

4.1 BACKGROUND

4.1.1 Site Description

Site 1 is located approximately 600 feet southeast of the intersection of Madison Boulevard and Bluff Road (Figure 4.1). The Fire Training Area is located on essentially flat land covered by a gravel parking area, mowed grass and two stands of trees. The site slopes down gently to the north and northeast. South of the site, the slope rises towards the sandstone bluff located approximately 300 feet south of the fire training pit. Site 9, Former Landfill B is located between the Fire Training Area and this bluff. Site 9 has been investigated as part of the Site Inspection (SI) under the IRP.

Visible evidence of contamination at Site 1 is limited to the fire training pit. This pit lacks vegetation and is presently covered with approximately four inches of gravel. Reports completed by U.S. EPA and AFESC, indicate that originally the soil in the fire training pit was black and cohesive and had enough residual contamination to feel oily and to emit a fuel odor. Other features at Site 1 include a small (6 feet by 15 feet) concrete slab west of the pit, a lined lagoon northwest of the pit and numerous wells.

4.1.2 Site History

Activities at Site 1 began in the 1940s and ended in 1980. Table 4.1 provides a summary of these activities. The amount of fuels and solvents discharged at the fire training pit is not accurately known. However, examination of records (HMTC, 1984) provided some indication of the amounts and types of materials discharged.

VOLK FIELD ANGB
CAMP DOUGLAS, WI

PREVIOUS ACTIVITIES AT SITE 1 AND SITE 9

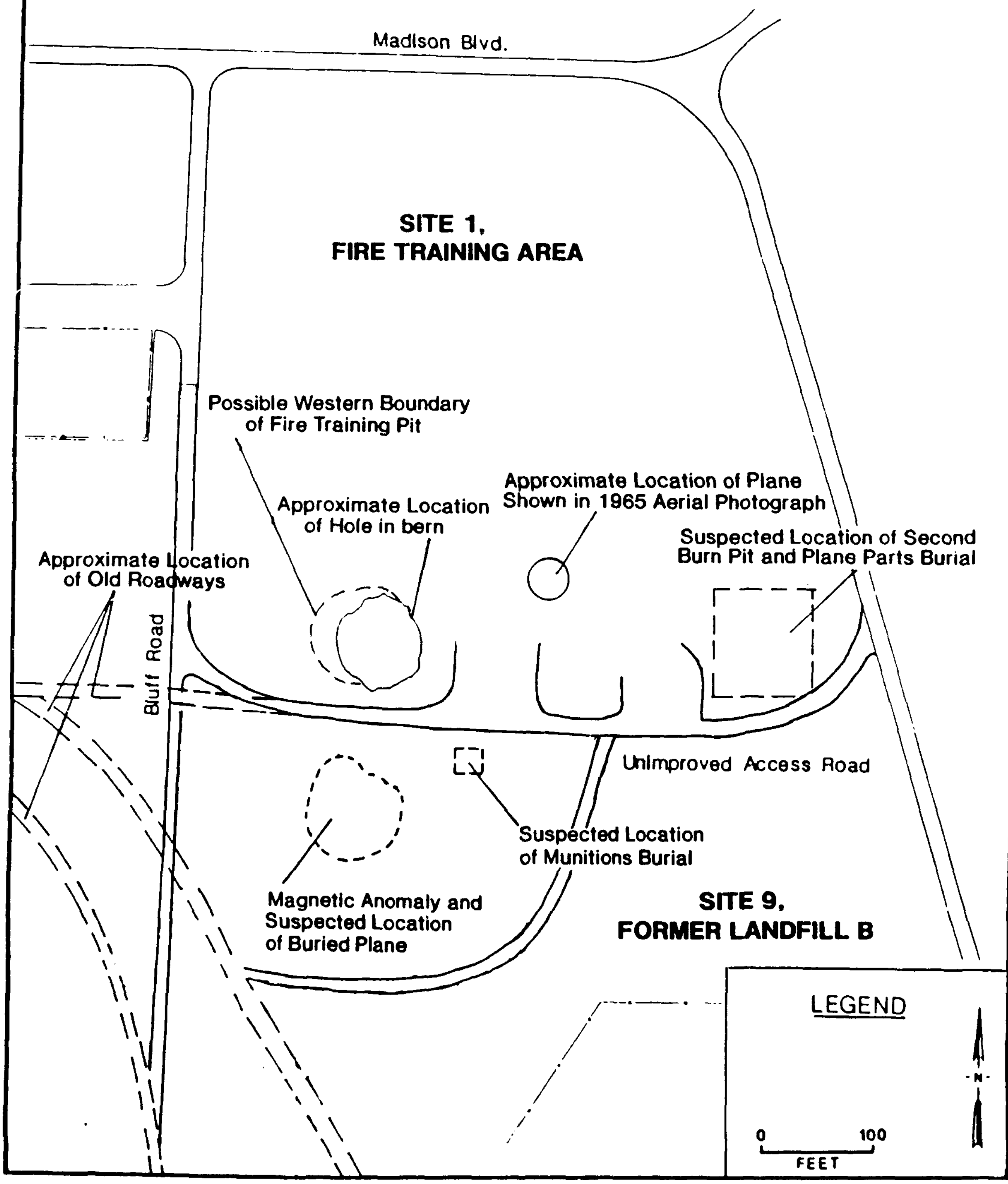

TABLE 4.1
VOLK FIELD ANGB
CAMP DOUGLAS, WI
SUMMARY OF MATERIALS RELEASED AT SITE 1[(1)]

Activity	Approximate Duration of Activity	Materials Discharged	Amount Discharged	Amount Burned	Amount Remaining
Fire training activities	1945-1980	Various fuels, solvents, transformer fluids (possibly containing PCBs), firefighting agents including halon, protein foam, bromochloromethane and aqueous film forming foam	Unknown	Unknown	Unknown
US Air Force firefighting training	1963-1970	Waste Fuels	25,000 gallons	Assume 70% = 17,500	7,500 gallons
Volk Field personnel firefighting training	1970-1973	95% JP-4, 5% mineral solvents and trichloroethylene (TCE)	250 gallons/exercise 20 times a year, for 3 years (14,250 gallons JP-4, 750 gallons solvents and TCE).	Assume 70% = 9,975 gallons JP-4, 525 gallons solvents and TCE	4,275 gallons, JP-4 225 gallons solvents and TCE
Volk Field personnel firefighting training	1973-1980	Fresh JP-4	250 gallons/exercise 20 times a year for 7 years (35,000 gallons)	Assume 70% = 24,500	10,500 gallons
Servicing of refueling equipment	1955-1968	JP-4 and AVGAS	20 trucks, 4 times a year 100-200 gallons/service (104,000 to 208,000 gallons)	None to very little	104,000 to 208,000 gallons

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TABLE 4.1 - Continued
VOLK FIELD ANGB
CAMP DOUGLAS, WI
SUMMARY OF MATERIALS RELEASED AT SITE 1[(1)]

Activity	Approximate Duration of Activity	Materials Discharged	Amount Discharged	Amount Burned	Amount Remaining
Servicing of refueling equipment	1968-1977	JP-4 and AVGAS	10 trucks 2 times a year 100-200 gallons/services (18,000 to 36,000 gallons)	None to very little	18,000 to 36,000 gallons

(1) The information used in providing this estimation was obtained from the HMTC, 1984 Record Search pg. IV-8 and IV-9.

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Prior to 1973, fire training activities used JP-4 mixed with other flammable materials which included, at various times, waste fuels, waste oils, solvents, and possibly some transformer fluids containing PCBs. Between 1973 and 1980, only clean, fresh JP-4 was used. It is estimated that 70 percent of the liquids were consumed in the fires and the remaining 30 percent infiltrated into the ground. In addition to fire training exercises, AVGAS refueling equipment were routinely serviced in this area. Servicing of this equipment resulted in the discharge of fuel to the ground. This fuel, estimated between 122,000 and 244,000 gallons, partially evaporated, but most probably seeped into the ground. Based on this information it is estimated that as much as 266,500 gallons of fuels, waste oils, and solvents may have seeped into the ground in this area.

The possibility exists that the discharge of fuels occurred at areas other than the presently located fire training pit at Site 1. The largest portions of the fuels that were released in this area resulted from the maintenance of refueling vehicles (HMTC, 1984). It has been reported by base personnel(1) that this activity was not limited to the fire training pit, but may have occurred at various locations along both sides of the unimproved access roads in this area. A 1965 aerial photograph shows that other access roads have existed at different locations in this area. Some of these historic access roads have been included on Figure 4.1. The 1965 photograph also shows an aircraft located to the east of the primary burn pit (Figure 4.1). It is possible that this aircraft was used for fire training activities at the location shown in Figure 4.1. or elsewhere in this area. Base personnel have indicated that an aircraft, not necessarily the one identified in the photograph, was used in fire training exercises at a burn pit located approximately 300 feet east of the primary fire training pit. Barrels filled with flammable materials were also used in activities at the second burn pit. Base personnel also indicated that portions of the plane used in fire training exercises were buried near this second burn pit. The majority of the plane was believed to be buried immediately south of the unimproved access road at Site 9, Former Landfill B (Figure 4.1). During the course of the Site Inspection (SI) at Site 9 a geophysical survey indicated the presence of a magnetic anomaly at the location shown (ES, 1988). This anomaly may be caused by the presence of the buried aircraft used in fire training activities. Another potential source of fuel

(1) The conversations with Base personnel referred to in the section have been summarized in an Engineering-Science correspondence to Mr. Carl Wheeler of HAZWRAP dated September 22, 1988.

contamination may exist from the burning of munitions in this area. Munition burning is thought to have occurred in a small pit at the approximate location shown in Figure 4.1. It is reasonable that fuel and/or solvents which may have been used to burn these munitions could have contributed to the contamiantion at Site 1, Fire Training Area. Other information regarding the location of sources of contamination were provided in the U.S. EPA and AFESC 1985 report. A figure from this report shows a possible western boundary of the Site 1 burn pit extending approximately 50 feet west of the boundary shown on Figure 4.1. Also shown on that figure is the location of a drain hole in a berm surrounding the pit. This hole is located on the east side of the pit and may have allowed fuel products to run off in this direction.

4.2 FIELD ACTIVITIES AND INVESTIGATION RESULTS

This section describes the field methods utilized to determine the magnitude and extent of contamination existing at Site 1. Table 4.2 summarizes the field program for the Remdial Investigation at Site 1.

4.2.1 Soil Gas Survey

The soil gas survey conducted at Site 1 encompassed approximately 2.5 acres and included 56 data collection points (Figure 4.2). The results of the soil gas survey (Table 4.3) indicated that contamination was present to the east and northeast of the fenced area surrounding the primary burn pit. Benzene, ethylbenzene, toluene and xylenes were detected in soil gas samples collected in this area. The highest concentration of these compounds was found at probe location VF-54 shown on Figure 4.2. The soil gas sample from this location contained benzene, toluene and ethylbenzene at concentrations of 250, 170 and 30 ppm, respectively. In addition to these compounds, unidentified compounds reported as toluene equivalents were present at a concentration of 2000 ppm. No trichloroethylene was identified in any of the soil gas samples, however, the detection limit for trichloroethylene in the soil gas analysis (1 ppm) was higher than the level of trichloroethylene found in the soil samples. The soil gas survey was considered when siting soil borings and monitoring wells installed at the site.

4.2.2 Soil Sampling

The RI at Site 1 included drilling 15 soil borings to a depth of 10 feet. Forty-five soil samples were collected for chemical analysis. Detailed results of the

TABLE 4.2
VOLK FIELD ANGB
CAMP DOUGLAS, WI
SITE 1, FIRE TRAINING AREA
SUMMARY OF THE FIELD PROGRAM

Field Activities	Media Sampling	Media Analysis
Conducted soil gas monitoring survey over approximately 2.5 acres Installed 4 monitoring wells; total footage drilled 195.5 ft.	Soil Gas	Benzene, toluene, ethylbenzene, trichloroethylene (TCE) and ortho-xylene
Sampled 11 monitoring wells Installed 1 pumping well; total footage drilled 37 feet Drilled 15 soil borings; total footage drilled 150 feet	Groundwater	Purgeable organics plus xylenes, base/neutral and acid extractable organics, PCBs, petroleum hydrocarbons, lead, and total dissolved solids
Sampled soil (45 samples) Performed 11 slug tests Performed 1 aquifer pumping test Abandoned 8 monitoring wells installed in 1981	Soil	Purgeable organics plus xylenes, base/neutral and acid extractable organics, PCBs, petroleum hydrocarbons, and lead

FIGURE 4.2

VOLK FIELD ANGB
CAMP DOUGLAS, WI.

SOIL GAS SURVEY LOCATIONS, SITE 1

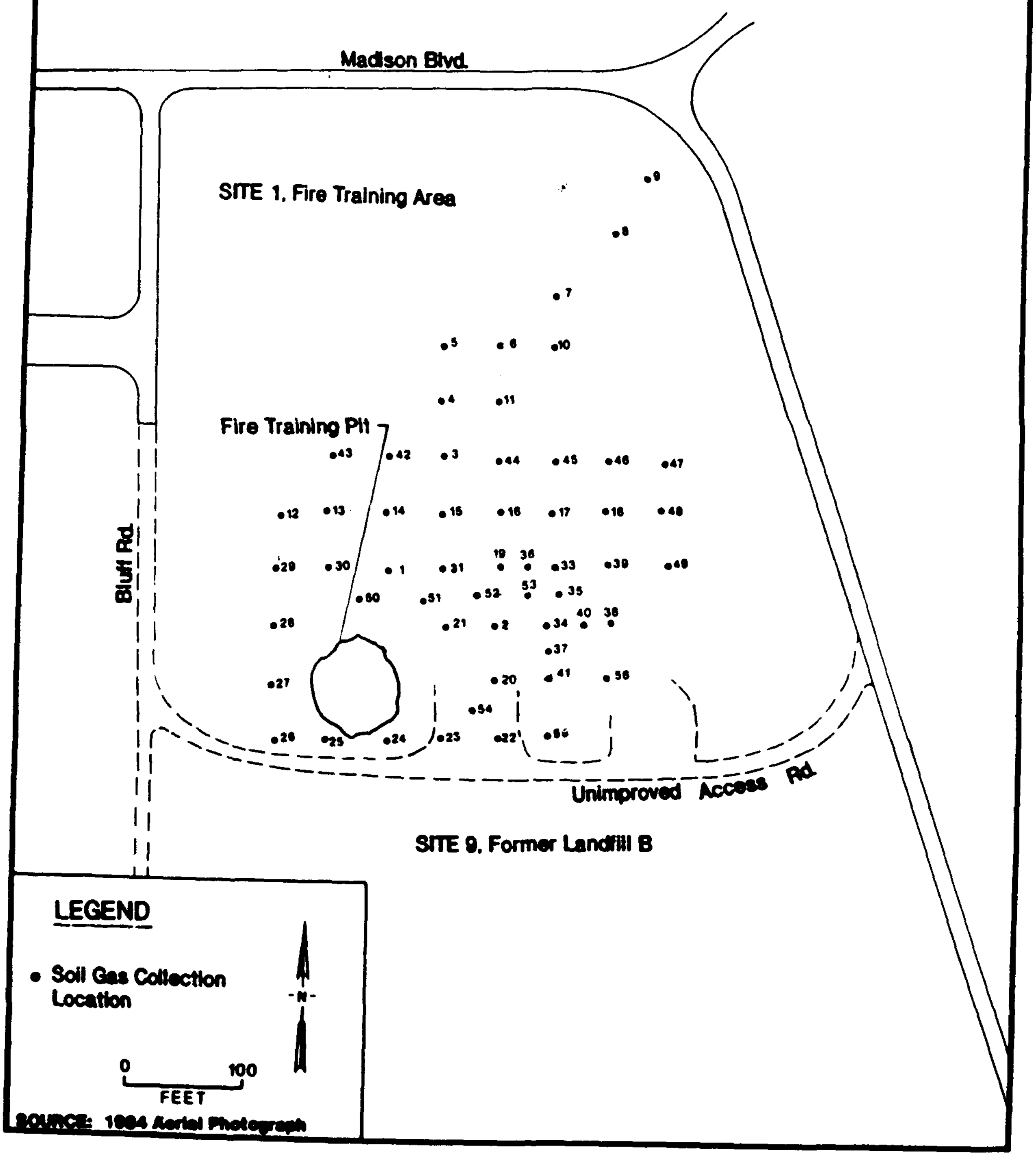


TABLE 4.3
VOLK FIELD ANGB
CAMP DOUGLAS, WI
SOIL GAS SURVEY RESULTS
SITE 1, FIRE TRAINING AREA

Sample	Sum of the Peaks Eluting Prior to Toluene (ppm toluene equivalents)	Benzene (ppm)	Toluene (ppm)	Ethylbenzene and Xylenes (ppm)	TCE (ppm)
VP-1, 6′	<0.5	<0.1	<0.1	<0.2	<0.4
VP-1, 9′	<0.5	<0.1	<0.1	<0.2	<0.4
VP-1, 12′			Water, No Sample		
VP-2, 3′	<0.5	<0.1	<0.1	<0.2	<0.4
VP-2, 6′	<0.5	<0.1	<0.1	<0.2	<0.4
VP-2, 9′	<0.5	<0.1	<0.1	<0.2	<0.4
VP-2, 12′	150	20	44	6	(a)
VP-3, 6′	<0.5	<0.1	<0.1	<0.2	<0.4
VP-3, 9′	<0.5	<0.1	<0.1	<0.2	<0.4
VP-3, 12′	5	<0.5	2	0.7	<0.4
VP-4, 11′			Water, No Sample		
VP-4, 9′			Water, No Sample		
VP-4, 6′	<0.5	<0.1	<0.1	<0.2	<0.4
VP-5, 6′	<0.5	<0.1	<0.1	<0.2	<0.4
VP-6, 6′	<0.5	<0.1	<0.1	<0.2	<0.4
VP-7, 6′			Water, No Sample		
VP-7, 4.5′	<0.5	<0.1	<0.1	<0.2	<0.4
VP-8, 6′			Water, No Sample		
VP-8, 4.5′	<0.5	<0.1	<0.1	<0.2	<0.4
VP-9, 5′	<0.5	<0.1	<0.1	<0.2	<0.4
VP-10, 5′	<0.5	<0.1	<0.1	<0.2	<0.4
VP-11, 6′	<0.5	<0.1	<0.1	<0.2	<0.4
VP-12, 4.5′	<0.5	<0.1	<0.1	<0.2	<0.4
VP-13, 4.5′	<0.5	<0.1	<0.1	<0.2	<0.4
VP-14, 6′	<0.5	<0.1	<0.1	<0.2	<0.4
VP-15, 6′	<0.5	<0.1	<0.1	<0.2	<0.4
VP-16, 6′	<0.5	<0.1	<0.1	<0.2	<0.4
VP-17, 6′	<0.5	<0.1	<0.1	<0.2	<0.4
VP-18, 8′	<0.5	<0.1	<0.1	<0.2	<0.4
VP-19, 9′	<0.5	<0.1	<0.1	<0.2	<0.4
VP-20, 10.5′	<0.5	<0.1	<0.1	<0.2	<0.4
VP-21, 9′	4,700	(a)	100	60	(a)
VP-22, 9′	<0.5	<0.1	<0.1	<0.2	<0.4
VP-23, 9′	<0.5	<0.1	<0.1	<0.2	<0.4
VP-24, 9′	<0.5	<0.1	<0.1	<0.2	<0.4
VP-25, 9′	<0.5	<0.1	<0.1	<0.2	<0.4
VP-26, 9′	<0.5	<0.1	<0.1	<0.2	<0.4

TABLE 4.3 - Continued
VOLK FIELD ANGB
CAMP DOUGLAS, WI
SOIL GAS SURVEY RESULTS
SITE 1, FIRE TRAINING AREA

Sample	Sum of the Peaks Eluting Prior to Toluene (ppm toluene equivalents)	Benzene (ppm)	Toluene (ppm)	Ethylbenzene and Xylenes (ppm)	TCE (ppm)
VP-27, 9′	<0.5	<0.1	<0.1	<0.2	<0.4
VP-28, 9′	<0.5	<0.1	<0.1	<0.2	<0.4
VP-29, 9′	<0.5	<0.1	<0.1	<0.2	<0.4
VP-30, 9′	<0.5	<0.1	<0.1	<0.2	<0.4
VP-31, 9′	<0.5	<0.1	<0.1	<0.2	<0.4
VP-32, 9′	1,500	(a)	70	90	(a)
VP-33, 9′	<0.5	<0.1	<0.1	<0.2	<0.4
VP-34, 9′	<0.5	<0.1	<0.1	<0.2	<0.4
VP-35, 9′	<0.5	<0.1	<0.1	<0.2	<0.4
VP-36, 9′	<0.5	<0.1	<0.1	<0.2	<0.4
VP-37, 9′	<0.5	<0.1	<0.1	<0.2	<0.4
VP-38, 9′	<0.5	<0.1	<0.1	<0.2	<0.4
VP-39, 9′	<0.5	<0.1	<0.1	<0.2	<0.4
VP-40, 9′	<0.5	<0.1	<0.1	<0.2	<0.4
VP-41, 9′	<0.5	<0.1	<0.1	<0.2	<0.4
VP-42, 3′	<0.5	<0.1	<0.1	<0.2	<0.4
VP-42, 6′	<0.5	<0.1	<0.1	<0.2	<0.4
VP-43, 6′	<0.5	<0.1	<0.1	<0.2	<0.4
VP-44, 6′	<0.5	<0.1	<0.1	<0.2	<0.4
VP-45, 6′	<0.5	<0.1	<0.1	<0.2	<0.4
VP-46, 6′	<0.5	<0.1	<0.1	<0.2	<0.4
VP-47, 6′	<0.5	<0.1	<0.1	<0.2	<0.4
VP-48, 6′	<0.5	<0.1	<0.1	<0.2	<0.4
VP-49, 6′	<0.5	<0.1	<0.1	<0.2	<0.4
VP-50, 6′	<1	<0.2	<0.2	<0.4	<1
VP-51, 6′	<1	<0.2	<0.2	<0.4	<1
VP-52, 6′	<0.5	<0.1	<0.1	<0.2	<0.4
VP-53, 6′	<0.5	<0.1	<0.1	<0.2	<0.4
VP-54, 9′	2,000	250	170	30	(a)
VP-55, 9′	<0.5	<0.1	<0.1	<0.2	<0.4
VP-56, 9′	<0.5	<0.1	<0.1	<0.2	<0.4

[a] Unable to qualitate from chromatogram.

chemical analyses are listed in Table 4.4 and depicted graphically on Figures 4.3, 4.4, and 4.5. The presence of groundwater at approximately 10 feet below the ground surface negated the need for collection of soil samples from greater depths since groundwater samples were collected at the site.

Purgeable halocarbons, volatile aromatic hydrocarbons, petroleum hydrocarbons, semi-volatile organics and lead were identified in soil samples collected at Site 1. Trichloroethylene and tetrachloroethylene were detected in soil samples from Borings VF1 B-1 and VF1 B-4, while only trichloroethylene was detected in soil samples from VF1 B-6 and VF1 B-11. The highest concentrations of trichloroethylene and tetrachloroethylene were found in soil sample VF1-B1-SS1-0.5 at levels of 33 μg/kg and 0.94 μg/kg, respectively. This boring is located within the primary burn pit. These solvents were probably mixed with JP-4 utilized in fire training exercises conducted in this area. Benzene, ethylbenzene, toluene and xylenes, purgeable aromatic hydrocarbons indicative of fuel contamination, were detected in soil samples from Borings VF1 B-1, VF1 B-4, VF1 B-5, VF1 B-6 and VF1 B-11. The highest concentrations of these compounds were found in Boring VF1 B-1. High concentrations of aromatic hydrocarbons were found throughout the depth of the boring. The maximum contaminant concentrations in this soil boring were 19,000 μg/kg of benzene, 17,000 μg/kg ethylbenzene, 5,700 μg/kg toluene and 83,000 μg/kg of xylenes. Contamination was present in this boring to a depth of 8.5 feet. Naphthalene and 2-methyl naphthalene, which are semi-volatile components of fuels, were detected in samples from Boring VF1 B-1 at maximum concentrations of 7,300 μg/kg and 15,000 μg/kg respectively.

Soil samples collected from Borings B-2, B-3, B-7, B-8, B-9, B-10, B-12, B-13, B-14 and B-15 did not contain quantifiable levels of volatile halogenated organic compounds or volatile aromatic hydrocarbons. Petroleum hydrocarbons were detected in surface samples collected at Borings B-2, B-3 and B-8 and at a depth of 3.5 feet in Boring B-9. Diethyl phthalate was found in Boring B-9 at a depth of 8.5 feet at a concentration just above the detection limit. This compound is a common plasticizer and its presence is not believed to be due to site contamination. Lead was detected in all but 11 soil samples at Site 1. The highest concentration of lead (77.5 mg/kg) was found in soil sample VF1-B6-SS1-0. Lead at this site is probably from the combustion of leaded fuels. Other soil samples which contained halogenated and non-halogenated organic compounds were obtained from soil borings located to the east of Boring VF1 B-1. At Borings VF1 B-6 and VF1 B-11

TABLE 4.4
VOLK FIELD ANGB
CAMP DOUGLAS, WI
SUMMARY OF CHEMICAL ANALYSES FOR SOIL SAMPLES - SITE 1, FIRE TRAINING AREA

SAMPLE IDENTIFIER	DATE SAMPLED	PURGEABLE HALOCARBONS SW8010(ug/Kg)			AROMATIC VOLATILE ORGANICS SW8020(ug/Kg)			PETROLEUM HYDROCARBONS E418.1(mg/Kg)		PCB'S SW8080 (ug/Kg)	BASE/NEUTRAL ACID EXTRACTABLES SW8270(mg/Kg)			LEAD E239.2 (mg/Kg)
		CHEM NAME	DL	Results	CHEM NAME	DL	Result	DL	Results	Results	CHEM NAME	DL	Results	
VF1-B1-SS1-0.5	01/26/88	TETRACHLOROETHYLENE	0.03	0.94	BENZENE	0.2	16,000	100	22,000	ND	2-METHYLNAPHTHALENE	0.66	9.7	5.7
		TRICHLOROETHENE	0.12	33	ETHYLBENZENE	0.2	17,000							
					TOLUENE	0.2	3,600							
					XYLENES	0.4	83,000							
VF1-B1-SS2-3.5	01/26/88	TETRACHLOROETHYLENE	0.03	0.70	BENZENE	0.2	6,500	100	8,600	ND	NAPHTHALENE	0.66	7.3	0.8
		TRICHLOROETHENE	0.12	17	ETHYLBENZENE	0.2	6,300				2-METHYLNAPHTHALENE	0.66	15	
					TOLUENE	0.2	2,000							
					XYLENES	0.4	31,000							
VF1-B1-SS3-8.5	01/26/88	TETRACHLOROETHYLENE	0.03	0.58	BENZENE	0.2	19,000	100	8,600	ND	NAPHTHALENE	6.6	7.3	0.6
		TRICHLOROETHENE	0.12	14	ETHYLBENZENE	0.2	15,000				2-METHYLNAPHTHALENE	6.6	14	
					TOLUENE	0.2	5,700							
					XYLENES	0.4	60,000							
VF1-B2-SS1-0.5	01/26/88	-------		ND	-------		ND	100	260	ND	-------		ND	1.8
VF1-B2-SS2-3.5	01/26/88	-------		ND	-------		ND	100	<100	ND	-------		ND	<0.5
VF1-B2-SS3-8.5	01/26/88	-------		ND	-------		ND	100	<100	ND	-------		ND	<0.5
VF1-B3-SS1-1.0	01/26/88	-------		ND	-------		ND	100	260	ND	-------		ND	1.7
VF1-B21-SS1-1.0 (duplicate of B3-SS1)	01/26/88	-------		ND	-------		ND	100	130	ND	-------		ND	1.6
VF1-B3-SS2-3.5	01/26/88	-------		ND	-------		ND	100	<100	ND	-------		ND	<0.5

TABLE 4.4 (CONTINUED)
VOLK FIELD ANGB
CAMP DOUGLAS, WI
SUMMARY OF CHEMICAL ANALYSES FOR SOIL SAMPLES - SITE 1, FIRE TRAINING AREA

SAMPLE IDENTIFIER	DATE SAMPLED	PURGEABLE HALOCARBONS SW8010(ug/Kg)			AROMATIC VOLATILE ORGANICS SW8020(ug/Kg)			PETROLEUM HYDROCARBONS E418.1(mg/Kg)		PCB'S SW8080 (ug/Kg)	BASE/NEUTRAL ACID EXTRACTABLES SW8270(mg/Kg)			LEAD E239.2 (mg/Kg)
		CHEM NAME	DL	Results	CHEM NAME	DL	Result	DL	Results	Results	CHEM NAME	DL	Results	
VF1-B3-SS3-8.5	01/26/88	-------		ND	-------		ND	100	<100	ND	-------		ND	<0.5
VF1-B4-SS1-0.5	01/26/88	TETRACHLOROETHYLENE	0.03	0.53	BENZENE	0.2	2,000	100	11,000	ND	-------		ND	62.0S
		TRICHLOROETHENE	0.12	8.0	ETHYLBENZENE	0.2	4,800							
					TOLUENE	0.2	2,500							
					XYLENES	0.4	9,800							
VF1-B22-SS1-0.5	01/26/88	TETRACHLOROETHYLENE	0.03	0.73	BENZENE	0.2	170	100	11,000	ND	-------		ND	85.0
(duplicate of B4-SS1)		TRICHLOROETHENE	0.12	41	ETHYLBENZENE	0.2	1,100							
					TOLUENE	0.2	1,000							
					XYLENES	0.4	15,000							
VF1-B4-SS2-3.5	01/26/88	-------		ND	-------		ND	100	220	ND	-------		ND	3.9
VF1-B4-SS3-8.5	01/26/88	-------		ND	BENZENE	0.2	41	100	1,500	ND	-------		ND	0.9
					ETHYLBENZENE	0.2	110							
					TOLUENE	0.2	51							
					XYLENES	0.4	190							
VF1-B5-SS1-0.0	01/27/88	-------		ND	-------		ND	100	280	ND	-------		ND	5.8
VF1-B5-SS2-3.5	01/27/88	-------		ND	-------		ND	100	600	ND	-------		ND	1.2
VF1-B5-SS3-10.0	01/27/88	-------		ND	BENZENE	0.2	110	100	420	ND	-------		ND	<0.5
					ETHYLBENZENE	0.2	360							
					TOLUENE	0.2	500							
					XYLENES	0.4	880							

TABLE 4.4 (CONTINUED)
VOLK FIELD ANGB
CAMP DOUGLAS, WI
SUMMARY OF CHEMICAL ANALYSES FOR SOIL SAMPLES - SITE 1, FIRE TRAINING AREA

SAMPLE IDENTIFIER	DATE SAMPLED	PURGEABLE HALOCARBONS SW8010(ug/Kg)			AROMATIC VOLATILE ORGANICS SW8020(ug/Kg)			PETROLEUM HYDROCARBONS E418.1(mg/Kg)		PCB'S SW8080 (ug/Kg)	BASE/NEUTRAL ACID EXTRACTABLES SW8270(mg/Kg)			LEAD E239.2 (mg/Kg)
		CHEM NAME	DL	Results	CHEM NAME	DL	Result	DL	Results	Results	CHEM NAME	DL	Results	
VF1-B6-SS1-0	01/27/88	-------		ND	BENZENE	0.2	120	100	830	ND	-------		ND	77.5
					ETHYLBENZENE	0.2	370							
					TOLUENE	0.2	800							
					XYLENES	0.4	2,200							
VF1-B6-SS2-3.5	01/27/88	TRICHLOROETHYLENE	0.12	5.7	BENZENE	0.2	1,200	100	3,000	ND	-------		ND	55.0
					ETHYLBENZENE	0.2	6,000							
					TOLUENE	0.2	2,600							
					XYLENES	0.4	25,000							
VF1-B6-SS3-8.5	01/27/88	TRICHLOROETHYLENE	0.12	8.6	BENZENE	0.2	970	100	3,200	ND	NAPHTHALENE	0.66	2.7	1.9
					ETHYLBENZENE	0.2	8,500				2-METHYLNAPHTHALENE	0.66	2.7	
					TOLUENE	0.2	1,800							
					XYLENES	0.4	84,000							
VF1-B7-SS1-0	01/27/88	-------		ND	-------		ND	100	<100	ND	-------		ND	1.8
VF1-B7-SS2-3.5	01/27/88	-------		ND	-------		ND	100	<100	ND	-------		ND	0.9
VF1-B7-SS3-8.5	01/27/88	-------		ND	-------		ND	100	<100	ND	-------		ND	<0.5
VF1-B8-SS1-0	01/28/88	-------		ND	-------		ND	100	160	ND	-------		ND	11.05
VF1-B8-SS2-3.5	01/28/88	-------		ND	-------		ND	100	<100	ND	-------		ND	0.5
VF1-B8-SS3-8.5	01/28/88	-------		ND	-------		ND	100	<100	ND	-------		ND	<0.5

TABLE 4.4 (CONTINUED)
VOLK FIELD ANGB
CAMP DOUGLAS, WI
SUMMARY OF CHEMICAL ANALYSES FOR SOIL SAMPLES - SITE 1, FIRE TRAINING AREA

SAMPLE IDENTIFIER	DATE SAMPLED	PURGEABLE HALOCARBONS SW8010(ug/Kg)			AROMATIC VOLATILE ORGANICS SW8020(ug/Kg)			PETROLEUM HYDROCARBONS E418.1(mg/Kg)		PCB'S SW8080 (ug/Kg)	BASE/NEUTRAL ACID EXTRACTABLES SW8270(mg/Kg)			LEAD E239.2 (mg/Kg)
		CHEM NAME	DL	Results	CHEM NAME	DL	Result	DL	Results	Results	CHEM NAME	DL	Results	
VF1-B9-SS1-0	01/28/88	-------		ND	-------		ND	100	<100	ND	-------		ND	2.3
VF1-B26-SS1-0 (duplicate of B9-SS1)	01/28/88	-------		ND	-------		ND	100	<100	ND	-------		ND	2.3
VF1-B9-SS2-3.5	01/28/88	-------		ND	-------		ND	100	100	ND	-------		ND	0.9
VF1-B9-SS3-8.5	01/28/88	-------		ND	-------		ND	100	<100	ND	DIETHYL PHTHALATE	0.66	1.0	<0.5
VF-B10-SS1-0.5	02/09/88	-------		ND	-------		ND	100	570	ND	-------		ND	4.4
VF-B10-SS2-3.5	02/09/88	-------		ND	-------		ND	100	<100	ND	-------		ND	1.0
VF-B10-SS3-8.5	02/09/88	-------		ND	-------		ND	100	<100	ND	-------		ND	<0.5
VF1-B11-SS1-1.0	02/09/88	-------		ND	-------		ND	100	<100	ND	-------		ND	1.8
VF1-B11-SS2-3.5	02/09/88	-------		ND	-------		ND	100	<100	ND	-------		ND	0.6
VF1-B11-SS3-8.5	02/09/88	TRICHLOROETHYLENE	0.12	3.3	BENZENE	0.2	15,000	100	2,900	ND	NAPHTHALENE	0.66	1.8	0.9
					ETHYLBENZENE	0.2	40,000				2-METHYLNAPHTHALENE	0.66	2.4	
					TOLUENE	0.2	37,000							
					XYLENES	0.4	88,000							
VF1-B12-SS1-1.0	02/09/88	-------		ND	-------		ND	100	<100	ND	-------		ND	2.2
VF1-B12-SS2-3.5	02/09/88	-------		ND	-------		ND	100	<100	ND	-------		ND	1.5

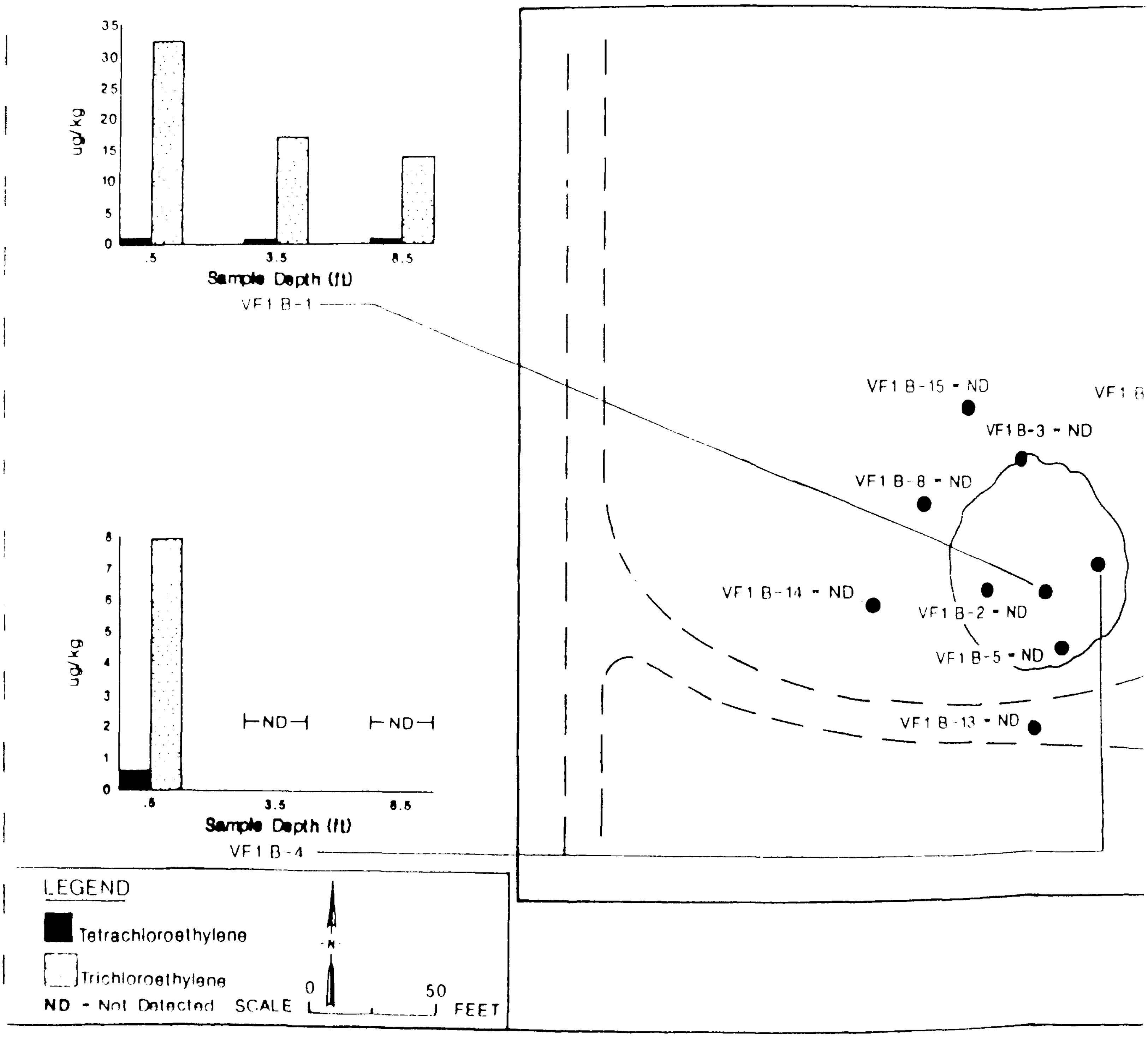
TABLE 4.4 (CONTINUED)
VOLK FIELD ANGB
CAMP DOUGLAS, WI
SUMMARY OF CHEMICAL ANALYSES FOR SOIL SAMPLES - SITE 1, FIRE TRAINING AREA

SAMPLE IDENTIFIER	DATE SAMPLED	PURGEABLE HALOCARBONS SW8010(ug/Kg)			AROMATIC VOLATILE ORGANICS SW8020(ug/Kg)			PETROLEUM HYDROCARBONS E418.1(mg/Kg)		PCB'S SW8080 (ug/Kg)	BASE/NEUTRAL ACID EXTRACTABLES SW8270(mg/Kg)			LEAD E239.2 (mg/Kg)
		CHEM NAME	DL	Results	CHEM NAME	DL	Result	DL	Results	Results	CHEM NAME	DL	Results	
VF1-B12-SS3-8.5	02/09/88	-------		ND	-------		ND	100	<100	ND	-------		ND	0.7
VF1-B13-SS1-1.5	02/09/88	-------		ND	-------		ND	100	<100	ND	-------		ND	0.8
VF1-B28-SS1-1.5 (duplicate of B13-SS1)	02/09/88	-------		ND	-------		ND	100	<100	ND	-------		ND	2.4
VF1-B13-SS2-3.5	02/10/88	-------		ND	-------		ND	100	<100	ND	-------		ND	0.6
VF1-B13-SS3-8.5	02/10/88	-------		ND	-------		ND	100	<100	ND	-------		ND	<0.5
VF1-B14-SS1-1.0	02/10/88	-------		ND	-------		ND	100	<100	ND	-------		ND	7.1
VF1-B14-SS2-3.5	02/10/88	-------		ND	-------		ND	100	<100	ND	-------		ND	1.0
VF1-B14-SS3-8.5	02/10/88	-------		ND	-------		ND	100	<100	ND	-------		ND	0.6
VF1-B15-SS1-0.5	02/10/88	-------		ND	-------		ND	100	<100	ND	-------		ND	1.7
VF1-B15-SS2-3.5	02/10/88	-------		ND	-------		ND	100	<100	ND	-------		ND	<0.5
VF1-B15-SS3-8.5	02/10/88	-------		ND	-------		ND	100	<100	ND	-------		ND	<0.5

ND - Not Detected
DL - Detection Limit
S - Reported value was determined by the method of Standard Additions

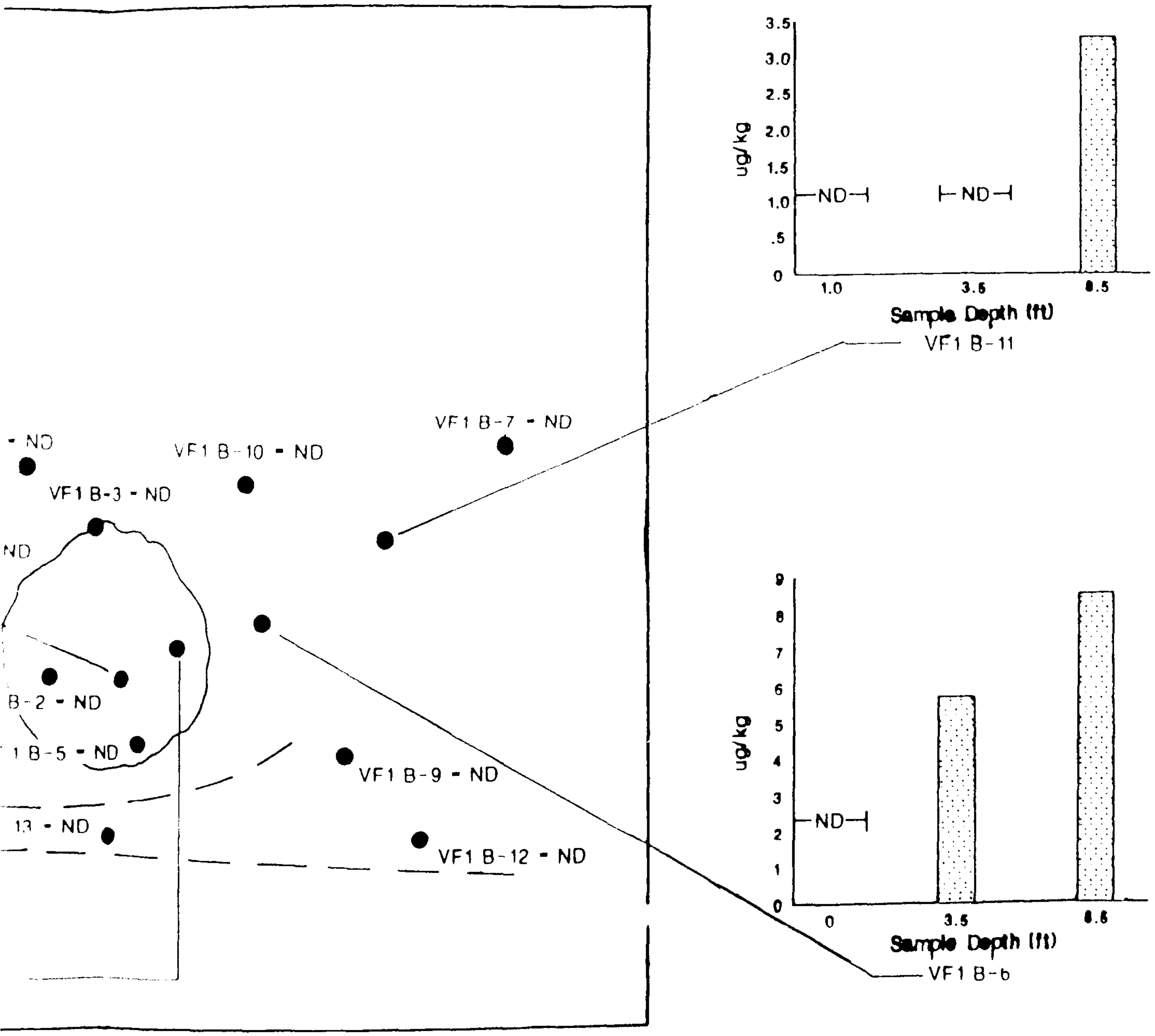
VOLK FIELD ANGB
CAMP DOUGLAS, WI.

SUMMARY OF SELECTED HALOGENATED CC



)LK FIELD ANGB
MP DOUGLAS, WI.

ENATED COMPOUNDS IN SOILS AT SITE 1



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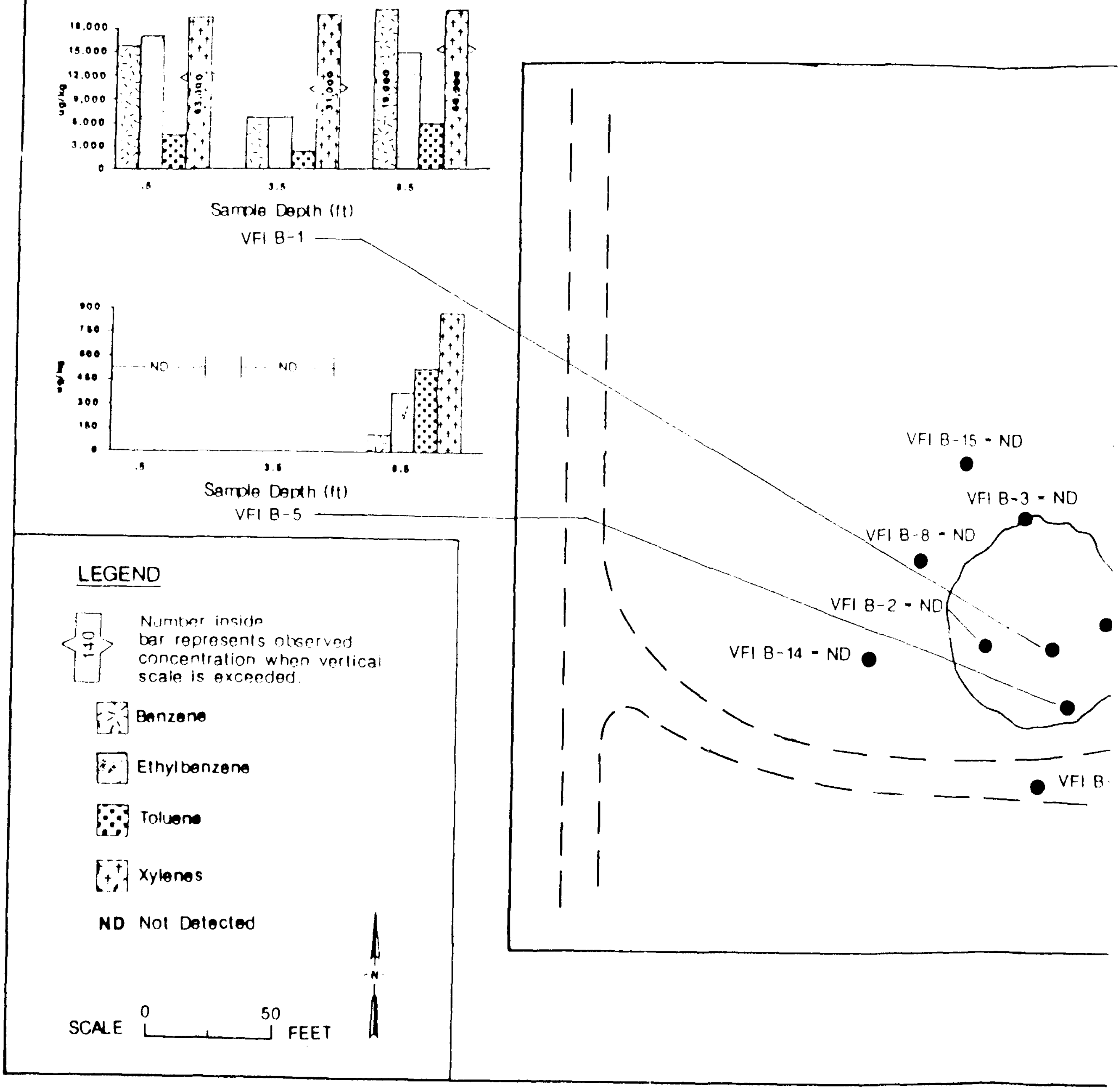
VOLK FIELD ANGB

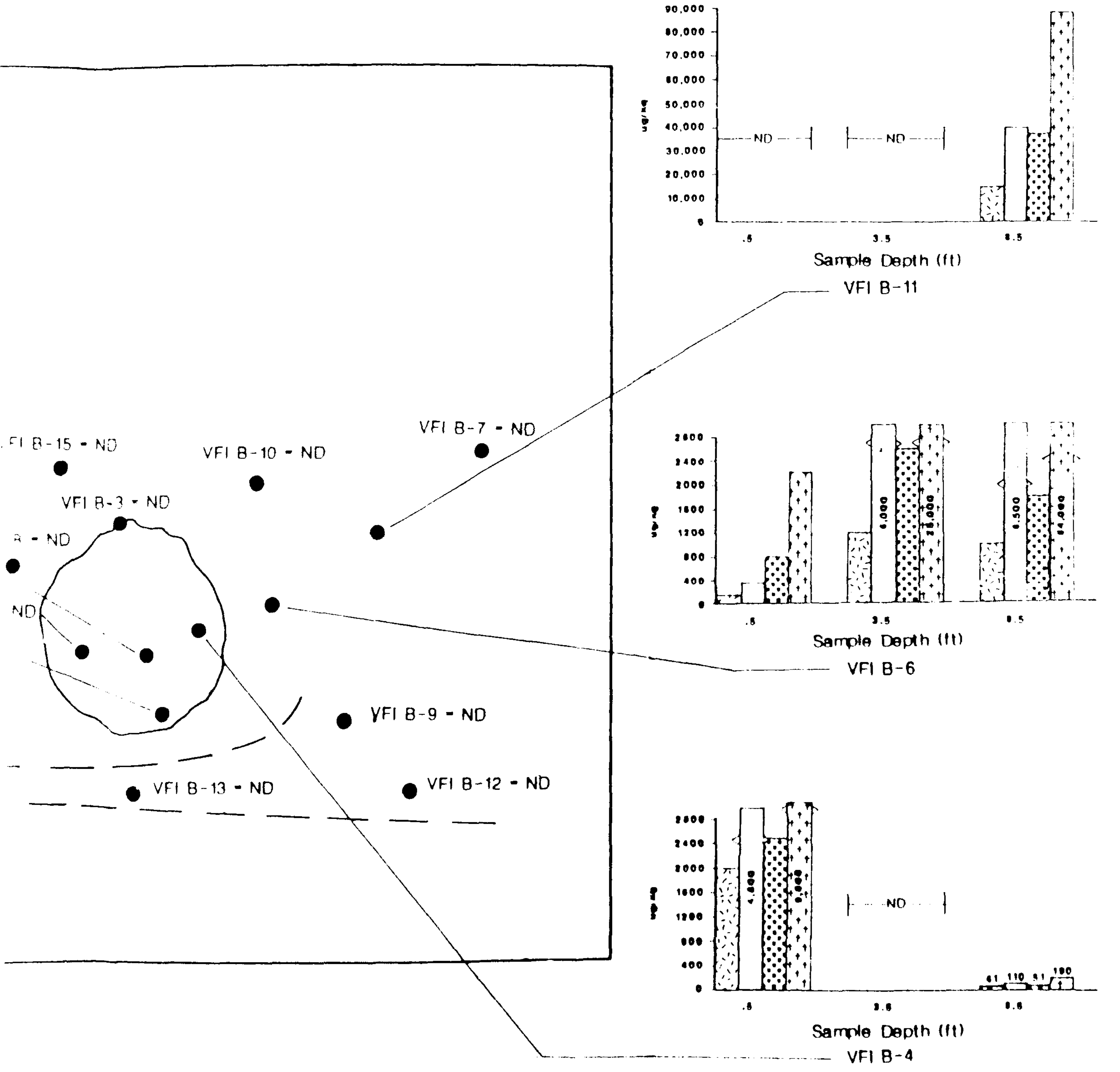
CAMP DOUGLAS, W

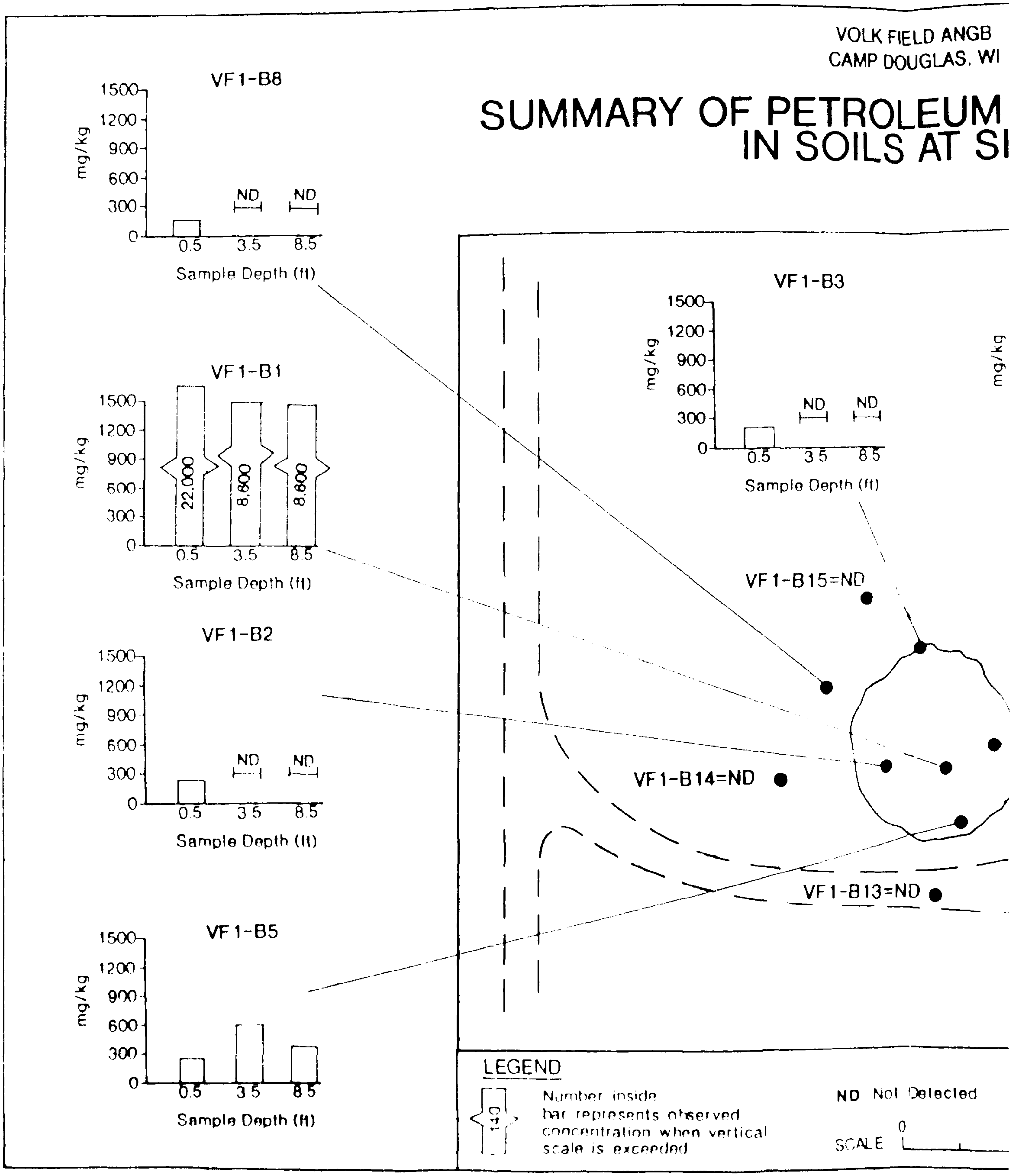
SUMMARY OF SELECTED VOLATILE ORGANIC



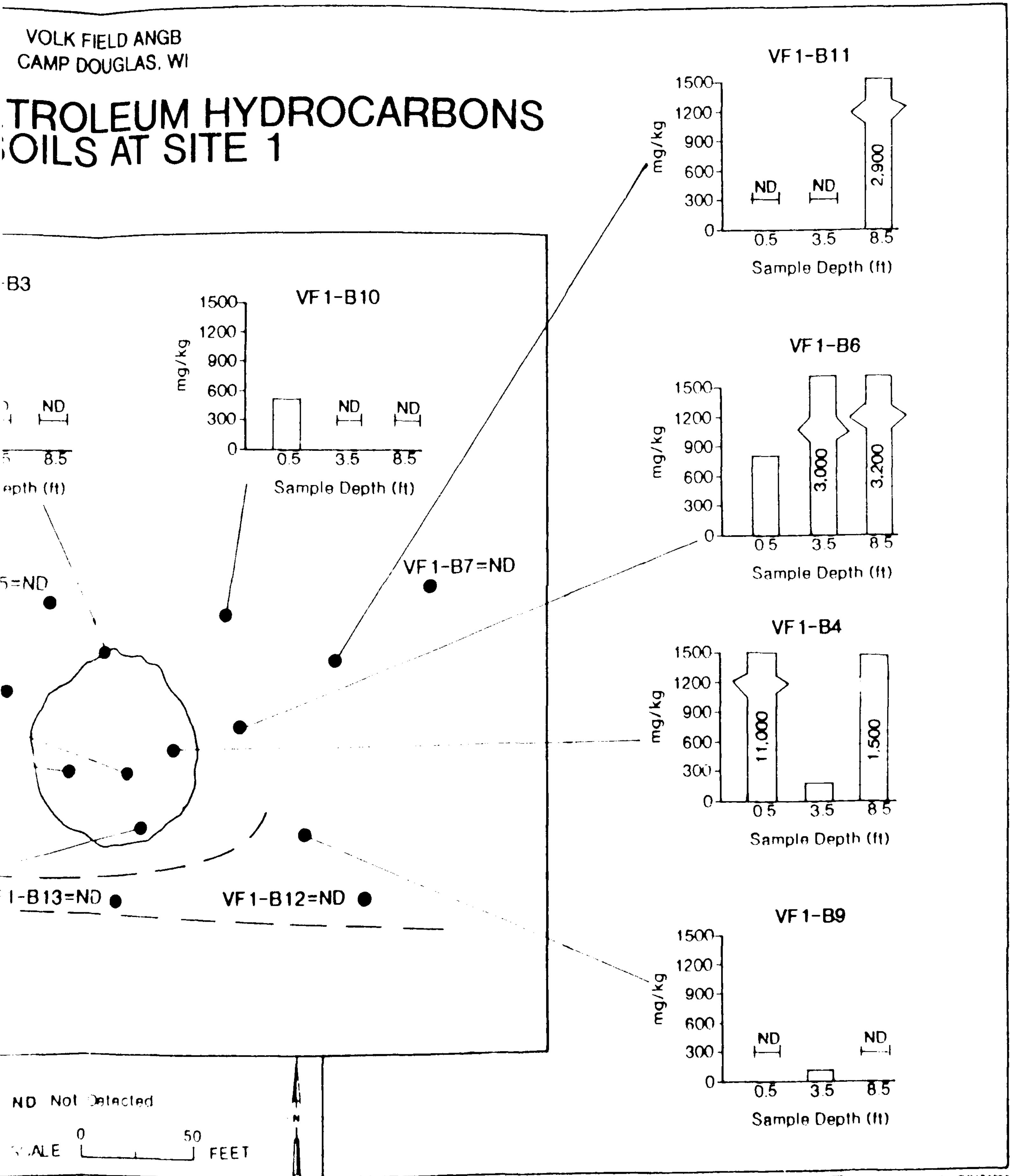
VOLK FIELD ANGB
CAMP DOUGLAS, WI.

…LE ORGANIC COMPOUNDS IN SOILS AT SITE 1





VOLK FIELD ANGB
CAMP DOUGLAS, WI
SUMMARY OF PETROLEUM
IN SOILS AT SI
VF1-B8
VF1-B1
VF1-B2
VF1-B5
VF1-B3
mg/kg
Sample Depth (ft)
0.5
3.5
8.5
ND
22,000
8,800
8,800
VF1-B15=ND
VF1-B14=ND
VF1-B13=ND
LEGEND
Number inside bar represents observed concentration when vertical scale is exceeded
140
ND Not Detected
SCALE
0



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the highest levels of contaminants were detected in soil samples collected from the deepest points. Contamination extends from the surface of the soil to the groundwater at Borings VF1 B-1, B-4, and B-6. At Boring VF1 B-11, contamination was only present at a depth of 8.5 feet. Analytical results for the soil samples are consistent with the soil gas results. The source of contamination at Site 1 is shown in Figure 4.6.

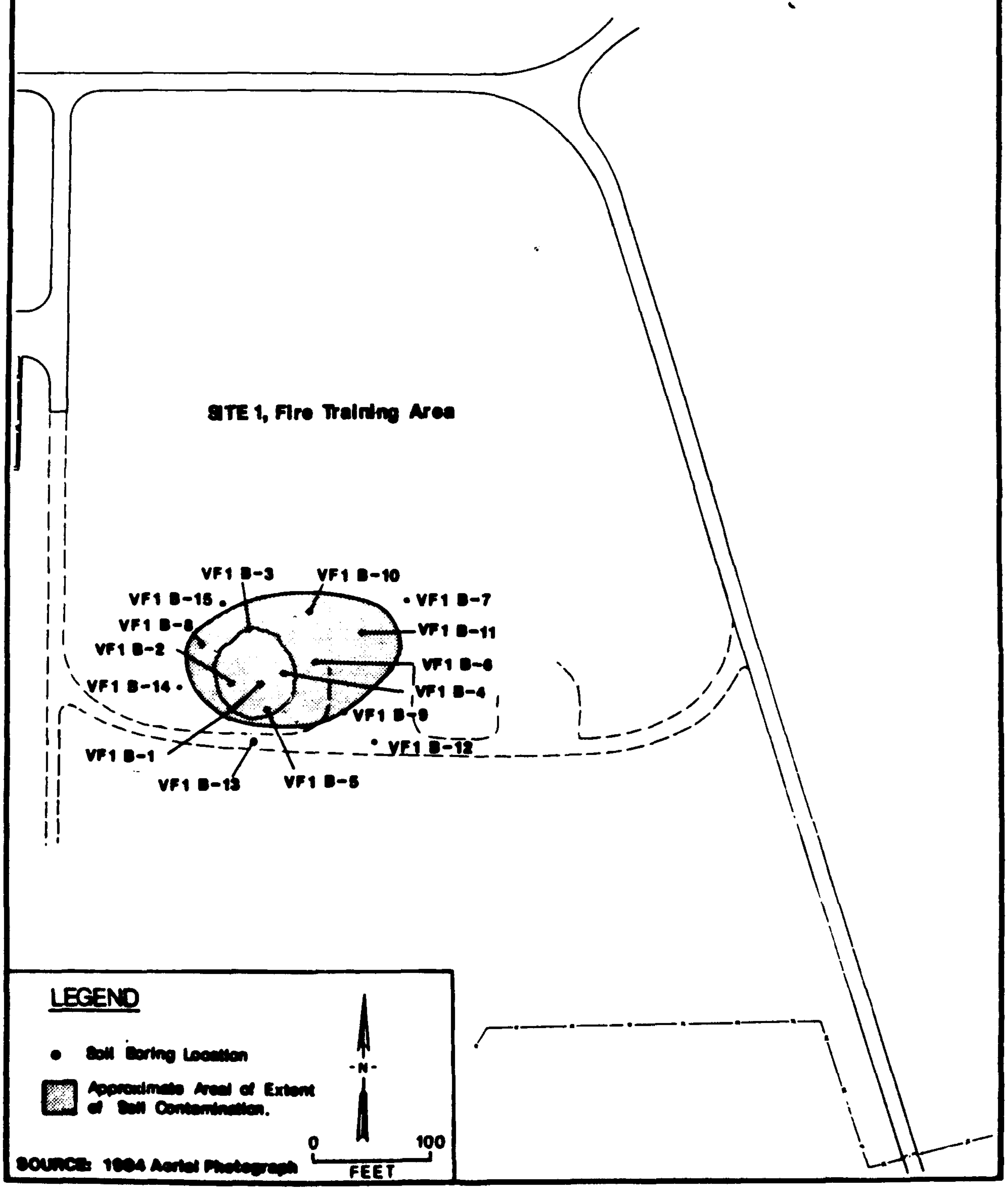
4.2.3 Groundwater

Four, two-inch diameter groundwater monitoring wells, designated VF1 MW-1, MW-2, MW-3 and MW-4, were installed at Site 1 as part of the RI. The locations of the four newly installed monitoring wells and the existing wells at Site 1 are shown in Figure 4.7. Table 4.5 lists the well construction details for these wells. The four wells were installed downgradient from the suspected area of contamination and were drilled using mud rotary methods. Drilling logs and well completion diagrams for the new and existing Site 1 wells are contained in Appendix B. Monitoring Well VF1 MW-1 was drilled to 23.5 feet and fine to very fine sand, yellowish-orange in color was encountered during drilling. Sandstone was encountered at 20 feet. Well VF1 MW-1 was screened from 6 to 21 feet and the depth to water in this well is approximately 9.9 feet. This well was installed as part of a well cluster with Monitoring Well VF1 MW-4 as the deep well. Monitoring Well VF1 MW-2 was drilled to 84 feet. During drilling, fine sand containing small amounts of silt was encountered. These materials ranged from yellowish-brown to yellowish-orange in color. Sandstone was encountered in the boring at approximately 12 feet. The screened interval in this well is from 21 feet to 31 feet. Monitoring Well VF1 MW-3 was drilled to a depth of 44 feet and was screened from 33 feet to 43 feet in sandstone. Fine to very fine sand containing trace amounts of silts were encountered during drilling. Sandstone was present at a depth of 12 feet in the boring. Materials ranged from greyish-brown at the soil's surface to yellowish-orange and yellowish-brown for the sandstone. Well VF1 MW-4, the deeper well installed adjacent to VF1 MW-1 was drilled to 44 feet and screened from 32.5 feet to 42.5 feet. In addition to the four monitoring wells, one six-inch diameter pumping well, VF1-PW-1, was installed at Site 1 (Figure 4.7). The pumping well was installed upgradient of the fire training pit to a depth of 34 feet with 15 feet of screen for use in the aquifer pumping test. During drilling of these wells, fine to very fine sand and sandstone was encountered. Materials ranged from yellowish-brown to yellowish-orange in color. The unconsolidated materials encountered

FIGURE 4.6

VOLK FIELD ANGB
CAMP DOUGLAS, WI.

APPROXIMATE AREAL EXTENT OF SOIL CONTAMINATION, SITE 1



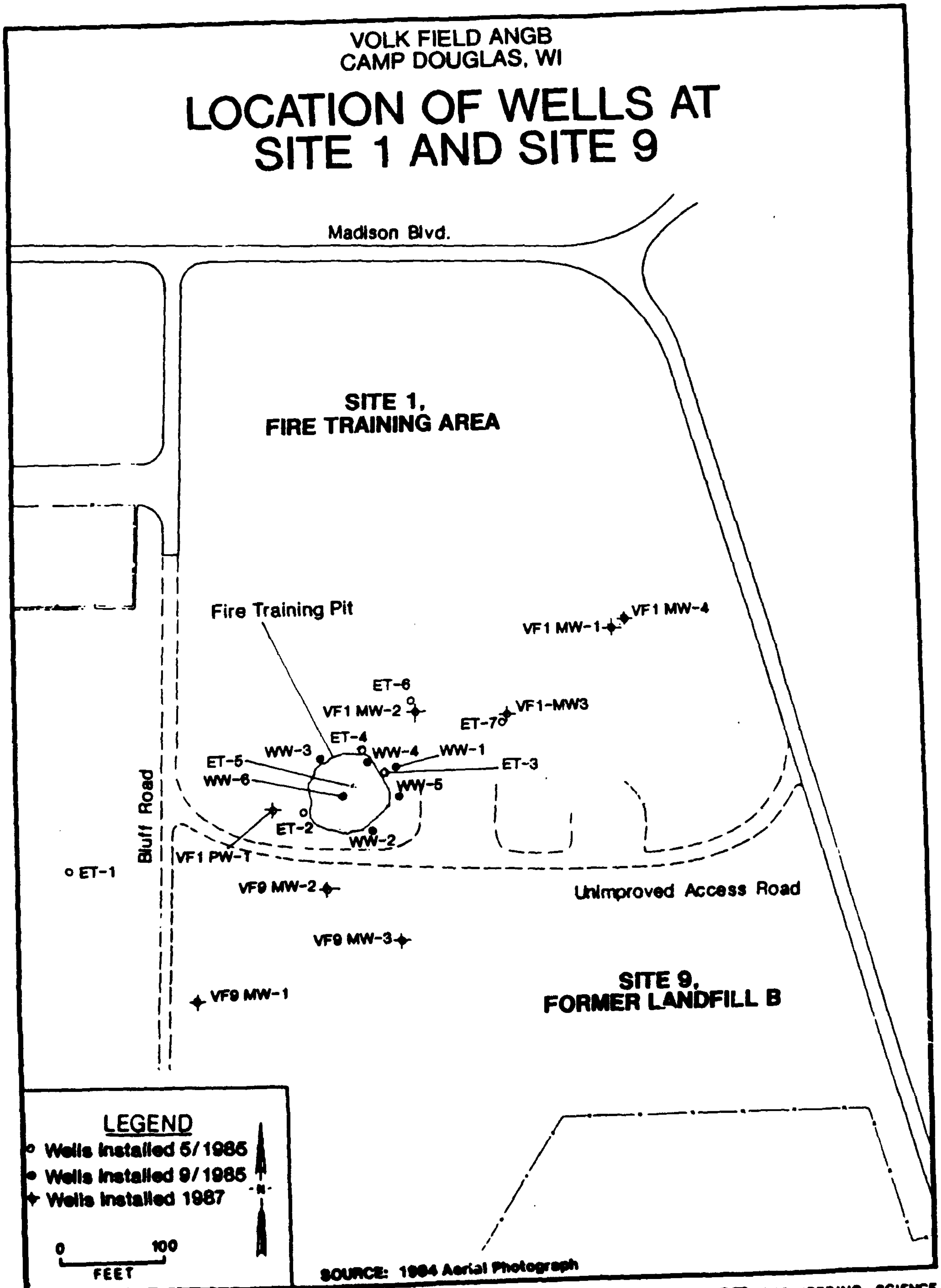


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TABLE 4.5
VOLK FIELD ANGB
CAMP DOUGLAS, WI
WELL CONSTRUCTION DETAILS SITE 1 AND SITE 9

Well No.	Approximate Land Surface Elevation (ft)	Top of Security Riser Elevation (ft)	Top of Casing Elevation (ft)	Borehole Depth (ft)	Well[1] Screen Interval (ft)	Depth to Water from Top of Casing (ft)	Water[2] Elevation (ft)	Approximate[1] Bedrock Depth (ft)	Approximate Bedrock Elevation (ft)
VF1 MW-1	911.2	912.51	912.34	23.5	6-21	9.93	902.41	20	891
VF1 MW-2	913.3	915.54	915.33	84.0	21-31	12.48	902.85	11	902
VF1 MW-3	913.3	915.18	914.85	44.0	33-43	12.09	902.76	12	901
VF1 MW-4	911.2	912.93	912.76	44.0	32.5-42.5	10.40	902.36	17	894
VF1 PW-1	917.4	919.83	919.64	37.0	19-34	16.48	903.16	9	908
VF9 MW-1	923.0	924.57	924.28	33.5	13.5-28.5	20.25	903.03	9	914
VF9 MW-2	919.5	920.52	920.40	29.0	9-24	17.27	903.13	13	907
VF9 MW-3	917.5	918.88	918.56	27.5	9-24	15.45	903.11	12	906
ET-1	920.7	922.45	922.35	25.0	19-23.5	18.55	903.80	9	912
ET-2	917.2	919.49	919.27	25.0	18-22.5	16.18	903.09	13	904
ET-3	915.4	917.61	917.43	25.0	10-19	14.46	902.97	11	904
ET-4	915.4	917.48	917.24	25.0	11-21	14.28	902.96	15	900
ET-5	916.7	918.91	918.65	25.0	10.5-19.5	15.77	902.88	13	904
ET-6	912.8	915.26	914.94	40.0	[3]20-25, 35-40	12.04	902.90	14	899
ET-7	913.8	--	915.76	20.0	8-18	13.05	902.71	18	896
WW-1	915.7	--	917.12	23.7	13-23	14.20	902.92	11	905
WW-2	917.6	--	919.27	30.1	15-30	16.22	903.05	11	907
WW-3	915.5	--	917.56	30.0	15-30	14.50	903.06	11	905
WW-4	915.5	--	917.19	30.0	15-30	14.20	902.99	20	896
WW-5	916.7	--	918.14	30.0	15-30	15.21	902.93	12	905
WW-6	916.4	--	919.13	30.4	15-30	16.09	903.04	12	904

(1) Measured to ground surface.
(2) Measured on 4/22/88.
(3) This well was installed with multiple screen intervals

during drilling are Pleistocene lake deposits. The sandstone encountered is the Mount Simons sandstone (Personal Communication, Clayton, 1988).

The hydraulic characteristics of the aquifer underlying Site 1 were estimated from the results of an aquifer pump test. The pumped well was VF1 PW-1 and the observation wells were VF1 MW-2, MW-2, MW-3, VF9 MW-2, MW-3, ET-2, ET-3, ET-4, ET-5, ET-6, WW-1, WW-2, WW-3, WW-4, WW-5, and WW-6. Transmissivity ranged from 11,900 gpd/ft to 18,900 gpd/ft and averaged 16,000 gpd/ft. Hydraulic conductivity ranged from 590 gpd/ft^2 (2.8 x 10^{-2} cm/sec) to 950 gpd/ft^2 (4.5 x 10^{-2} cm/sec) and averaged 800 gpd/ft^2 (3.8 x 10^{-2} cm/sec). The storage coefficient ranged from 0.008 (non-dimensional) to 0.07 and averaged 0.05. These results were obtained from analyses of drawdown and recovery data from the pumped and the observation wells using Boulton's method (Lohman, 1970), the Cooper-Jacob method (Bouwer, 1978), and the Theis recovery method (Bouwer, 1978). Results of the analyses of data from each well are given in Table 4.6. Complete descriptions of the test and of the analyses are given in Appendix C.

The storage coefficients estimated from the pump test data indicate that the aquifer is unconfined or semi-confined. This is supported by the lack of confining materials observed from drilling records for wells in the vicinity of Site 1. It was assumed that the unconsolidated sand and the friable sandstone units exhibited similar hydraulic characteristics and were treated in the analysis of the pump test data as one hydrologic unit. Wells used as pumping and observtion wells are screened across both units and there are no effective confining materials between the two units. Therefore, there is no reliable method of determining the hydraulic characteristics of each individual unit from the pump test data. The hydraulic characteristics given here are average values for the two units.

Hydraulic conductivities of materials in the vicinities of wells VF1 MW-1, MW-2, MW-3, ET-1, ET-2, ET-4, ET-5, ET-6, ET-7, WW-3, and WW-4 were also estimated from the results of slug tests conducted at each of these wells. The resulting hydraulic conductivities ranged from 7 gpd/ft^2 (3.3 x 10^{-4} cm/sec) to 96 gpd/ft^2 (4.5 x 10^{-3} cm/sec). These results were obtained from analyses of data collected during slug injection and slug withdrawal tests using the Bouwer-Rice method (Bouwer, 1978). There is no apparent correlation between slug test results for a well and the types of materials found in the vicinity of the well. Very low hydraulic conductivities estimated using slug test data from well ET-6 indicate that

TABLE 4.6
VOLK FIELD ANGB, CAMP DOUGLAS, WI
SITE 1, FIRE TRAINING AREA
AQUIFER TEST RESULTS

PUMP TEST RESULTS:

Well Identification	Transmissivity gpd/ft	Hydraulic Conductivity gpd/ft^2	Hydraulic Conductivity cm/sec	Storage Coefficient
VF1 PW-1	17,600	880	4.15×10^{-2}	--
VF1 MW-2	17,200	860	4.06×10^{-2}	0.05
VF1 MW-3	18,900	950	4.48×10^{-2}	0.04
VF9 MW-2	15,900	800	3.77×10^{-2}	0.03
VF9 MW-3	12,700	640	3.02×10^{-2}	0.03
ET-2	11,900	590	2.78×10^{-2}	0.008
ET-3	15,600	780	3.68×10^{-2}	0.05
ET-4	17,800	890	4.20×10^{-2}	0.05
ET-5	16,600	830	3.41×10^{-2}	0.05
ET-6	14,800	740	3.49×10^{-2}	0.07
WW-1	16,500	830	3.41×10^{-2}	0.06
WW-2	16,800	840	3.96×10^{-2}	0.05
WW-3	14,700	730	3.44×10^{-2}	0.03
WW-4	17,800	890	4.20×10^{-2}	0.06
WW-5	14,700	740	3.49×10^{-2}	0.07
WW-6	16,100	810	3.82×10^{-2}	0.04
Average	16,000	800	3.80×10^{-2}	0.05

SLUG TEST RESULTS:

Well Identification	Hydraulic Conductivity: Injection Analysis gpd/ft^2	Injection Analysis cm/sec	Removal Analysis gpd/ft^2	Removal Analysis cm/sec
VF1 MW-2	73	3.44×10^{-3}	94	4.43×10^{-3}
VF1 MW-3	72	3.40×10^{-3}	59	2.78×10^{-3}
VF1 MW-4	89	4.20×10^{-3}	88	4.15×10^{-3}
ET-1	38	1.79×10^{-3}	62	2.92×10^{-3}
ET-2	96	4.53×10^{-3}	67	3.16×10^{-3}
ET-4	44	2.07×10^{-3}	38	1.79×10^{-3}
ET-5	18	8.49×10^{-4}		
ET-6	7	3.30×10^{-4}	8	3.77×10^{-4}
ET-7	65	3.07×10^{-3}	73	3.44×10^{-3}
WW-3	66	3.11×10^{-3}	87	4.10×10^{-3}
WW-4	49	2.31×10^{-3}	48	2.26×10^{-3}

the screen in this well may be partially clogged. Results for each well are given in Table 4.6. A complete description of the tests and analyses is given in Appendix C.

There are two possible explanations for the differences in hydraulic conductivities estimated from the pump test data and from the slug test data. One explanation is that the pumping test, being of a longer duration, caused groundwater flow in fracture zones between wells. This would have the effect of increasing flow rates while decreasing the rate of drawdown, thus resulting in a higher estimated hydraulic conductivity.

Another explanation for the relatively high hydraulic conductivity estimated from the pump test data is that the vertical extent of the flow region was actually greater than that used in the analysis of the data (Figure 4.8). Hydraulic conductivity is determined in the analysis of pump test data by dividing the estimated transmissivity by the aquifer thickness. In the case of a very thick aquifer, such as that underlying Volk Field, the aquifer thickness used in the analysis is the thickness of the flow region at a sufficient distance from the well for the flow lines to be parallel. However, this thickness is not reliably estimated because the vertical extent of the flow region is not known. In the analysis of the pump test data, the aquifer thickness that was used was the distance from the static water table to the bottom of the screened interval of the pumped well. The use of this thickness was conservative from a risk perspective because it resulted in a higher estimated hydraulic conductivity and a faster estimated migration of contaminants from the site. If a thicker flow region had been used, the result would have been a lower hydraulic conductivity. However, this variability alone would not account for the differences between hydraulic conductivities estimated from slug test data and hydraulic conductivities estimated from pump test data.

The hydraulic conductivity used in the evaluation of the migration rate of groundwater from the site was based on estimates from the pump test data rather than from the slug test data for two reasons. First, the use of the higher value results in a faster contaminant migration and thus a more conservative estimate. Secondly, pump tests are in general a more reliable method for estimating hydraulic conductivity (Lohman, 1970; Bouwer, 1978).

Groundwater flows to the northeast with a hydraulic gradient of approximately 0.003 ft/ft. Table 4.7 shows the groundwater elevation for wells located at Site 1 and adjacent Site 9. The groundwater flow velocity in this area is estimated to be 1.6 ft/day. This estimate is based on a hydraulic conductivity of 800

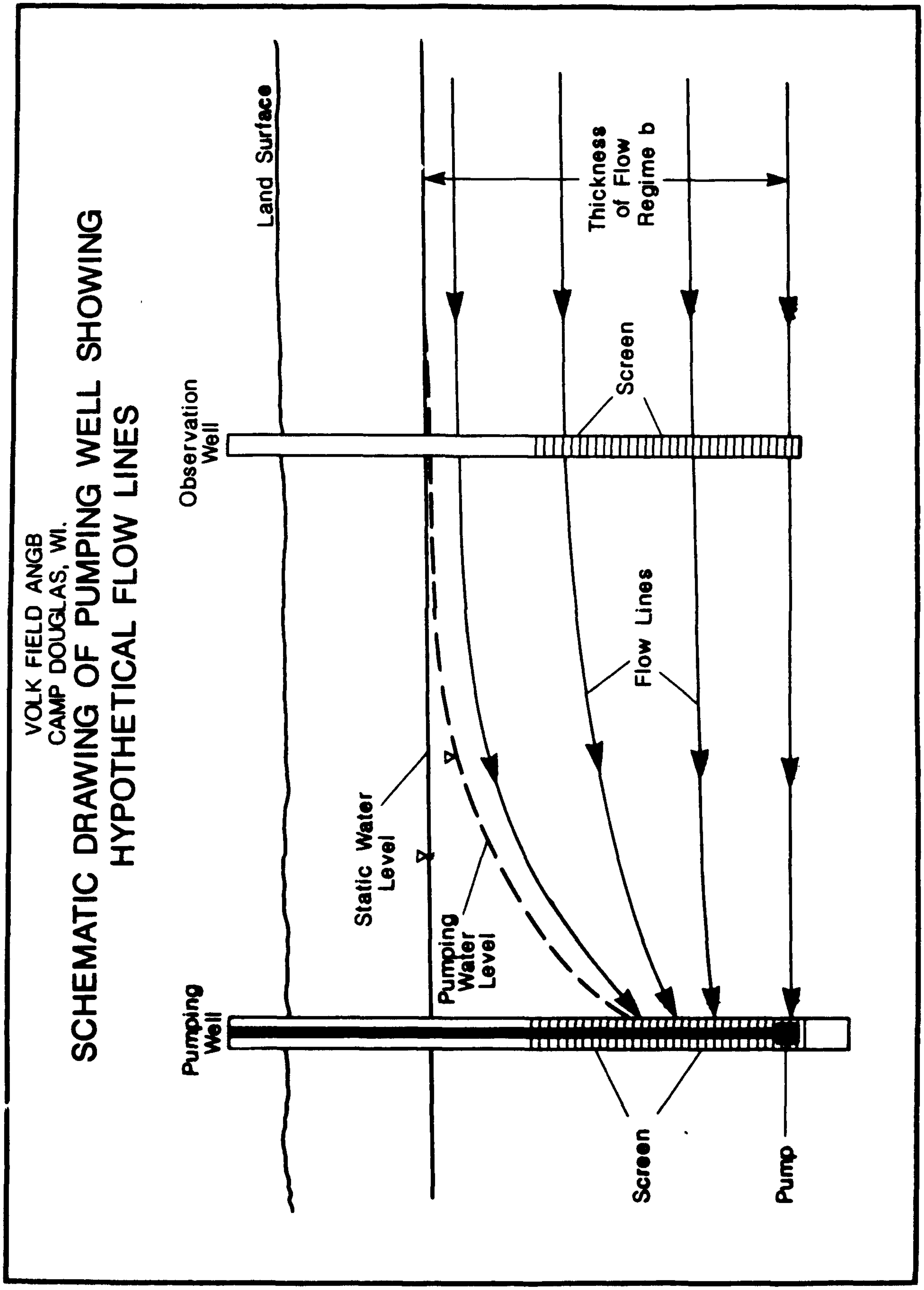
31-May-89 ELEVR1.WK1

TABLE 4.7
VOLK FIELD ANGB
CAMP DOUGLAS, WI
SUMMARY OF GROUNDWATER MEASUREMENTS

Well Identification	Top Of Casing Elevation (feet)	Depth to Water from Top of Casing (feet) Date: 3/1/88	4/22/88	5/3/88	7/8/88	4/5/89	Water Elevation (feet) Date: 3/1/88	4/22/88	5/3/88	7/8/88	4/5/89	Change in Water Elevation (feet)(2) 3/1/88 to 4/22/88	4/22/88 to 5/3/88	7/8/88 to 4/5/89	3/1/88 to 4/5/89
VF1 MW-1	912.34	10.22	9.93	9.94	11.13	10.82	902.12	902.41	902.40	901.21	901.52	0.29	-0.01	0.31	-0.60
VF1 MW-2	915.33	12.86	12.48	12.47	13.50	13.42	902.47	902.85	902.86	901.83	901.91	0.38	0.01	0.08	-0.56
VF1 MW-3	914.85	12.50	12.09	12.12	13.12	13.05	902.35	902.76	902.73	901.73	901.80	0.41	-0.03	0.07	-0.55
VF1 MW-4	912.76	10.67	10.40	10.42	11.40	11.35	902.09	902.36	902.34	901.36	901.41	0.27	-0.02	0.05	-0.68
VF1 PW-1	919.64	16.97	16.48	16.48	17.52	17.42	902.67	903.16	903.16	902.12	902.22	0.49	0.00	.10	-0.45
VF9 MW-1	924.28	20.85	20.25	20.26	21.32	21.36	903.43	904.03	904.02	902.97	902.92	0.60	-0.01	-0.05	-0.51
VF9 MW-2	920.40	17.75	17.27	17.28	18.30	18.25	902.65	903.13	903.12	902.10	902.15	0.48	-0.01	0.05	-0.50
VF9 PW-3	918.56	15.95	15.45	15.47	--	(1)16.42	902.61	903.11	903.09	--	902.14	0.50	-0.02	--	-0.47
ET-1	922.35	19.13	18.55	18.56	19.67	19.60	903.22	903.80	903.79	902.68	902.75	0.58	-0.01	0.07	-0.47
ET-2	919.27	16.20	16.18	16.19	17.22	17.14	903.07	903.09	903.08	902.05	902.13	0.02	-0.01	0.08	-0.94
ET-3	917.43	14.89	14.46	14.46	15.51	15.84	902.54	902.97	902.97	901.92	901.59	0.43	0.00	-0.33	-0.95
ET-4	917.24	14.80	14.28	14.28	15.33	15.23	902.44	902.96	902.96	901.91	902.01	0.52	0.00	0.10	-0.43
ET-5	918.65	16.08	15.77	15.66	17.76	(3)16.84	902.57	902.88	902.99	900.89	901.81	0.31	0.11	0.92	-0.76
ET-6	914.94	12.50	12.04	12.11	13.12	13.02	902.44	902.90	902.83	901.82	901.9[illegible]	0.46	-0.07	0.10	-0.52
ET-7	915.76	13.45	13.05	13.05	14.09	13.98	902.31	902.71	902.71	901.67	901.78	0.40	0.00	0.11	-0.53
MW-1	917.12	14.60	14.20	14.18	15.21	15.35	902.52	902.92	902.94	901.91	901.77	0.40	0.02	0.14	-0.75
MW-2	917.27	16.67	16.22	16.21	17.24	17.17	900.60	901.05	901.06	900.03	900.10	0.45	0.01	0.07	-0.50
MW-3	917.56	14.94	14.50	14.51	15.56	15.45	902.62	903.06	903.05	902.00	902.11	0.44	-0.01	0.11	-0.51
MW-4	917.19	14.62	14.20	14.20	15.25	15.16	902.57	902.99	902.99	901.94	901.59	0.42	0.00	-0.35	-0.98
MW-5	918.14	15.60	15.20	15.20	16.22	16.16	902.54	902.94	902.94	901.92	901.98	0.40	0.00	0.06	-0.56
MW-6	919.13	16.50	16.09	16.10	17.11	17.96	902.63	903.04	903.03	902.02	901.17	0.41	-0.01	-0.85	-1.46

(1) Not measured
(2) Negative numbers reflect a drop in water elevation.
(3) Possible measurement error.

FIGURE 4.8



VOLK FIELD ANGB
CAMP DOUGLAS, WI.
SCHEMATIC DRAWING OF PUMPING WELL SHOWING HYPOTHETICAL FLOW LINES

gpd/ft^2 (3.8 x 10^{-2} cm/sec), a hydraulic gradient of 0.003 ft/ft and a porosity of 0.2. The hydraulic gradient of .003 ft/ft was based on the groundwater elevations northeast of Site 1 provided in Section 2 of this report. Figure 4.9 shows a generalized groundwater contour map for Site 1 and adjacent Site 9. The relationship between groundwater elevation, the geology and screen intervals discussed above, and the contaminants discovered (discussed below) is presented in two hydrogeologic cross-sections. The locations of these sections are shown on Figure 4.10 and the cross-sections are shown on Figures 4.11 and 4.12.

Groundwater levels in wells at Sites 1 and 9 were measured on four occasions: 1 March 1988, 22 April 1988, 3 May 1988, and 8 July 1988. These water levels, the computed groundwater elevations, and the change in water elevation from one measurement event to the next are given in Table 4.7. Data collected on 22 April 1988 was used to develop the groundwater contour maps shown on Figures 2.8 and 4.9 since this represents the most complete set of data. On 22 April, 1988, groundwater in wells in the vicinity of Site 1 ranged in elevation from 902.36 to 903.80 feet above Mean Sea Level (MSL).

Groundwater samples were collected from the four newly installed wells, VF1 MW-1 through VF1 MW-4 and seven existing wells ET-1 through ET-7. The locations of these wells are shown on Figure 4.10. Groundwater samples collected from new and existing Site 1 monitoring wells were analyzed for:

- Purgeable Halocarbons;
- Volatile Aromatic Organics;
- PCBs;
- Semi-Volatile Organics (acid extractable and base/neutral);
- Petroleum Hydrocarbons;
- Lead; and
- Total Dissolved Solids.

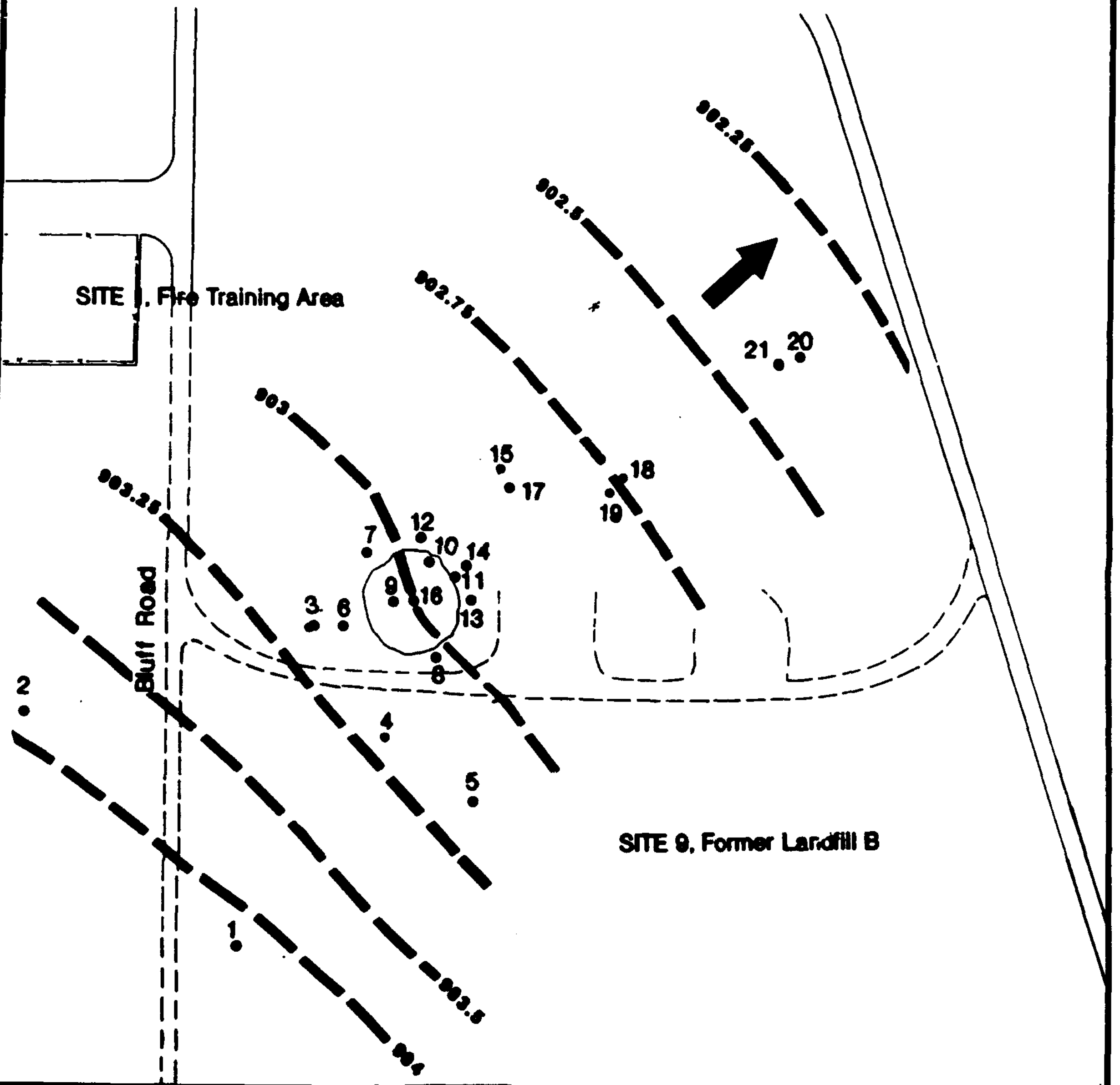
The results from these analyses are listed in Table 4.8. Temperature, pH and conductivity measurements for the groundwater samples were obtained in the field at the time of sampling and are listed in Table 4.9.

Contaminants detected in groundwater samples collected at Site 1 included halogenated volatile organics, volatile aromatic organics petroleum hydrocarbons, semi-volatile organics and lead. Lead was detected in all Site 1 groundwater

FIGURE 4.9

VOLK FIELD ANGB
CAMP DOUGLAS, WI.

GROUNDWATER CONTOUR MAP, SITE 1



LEGEND

Generalized Ground-Water Flow

903.00 Groundwater Elevation Measured 22 April 88

-N-

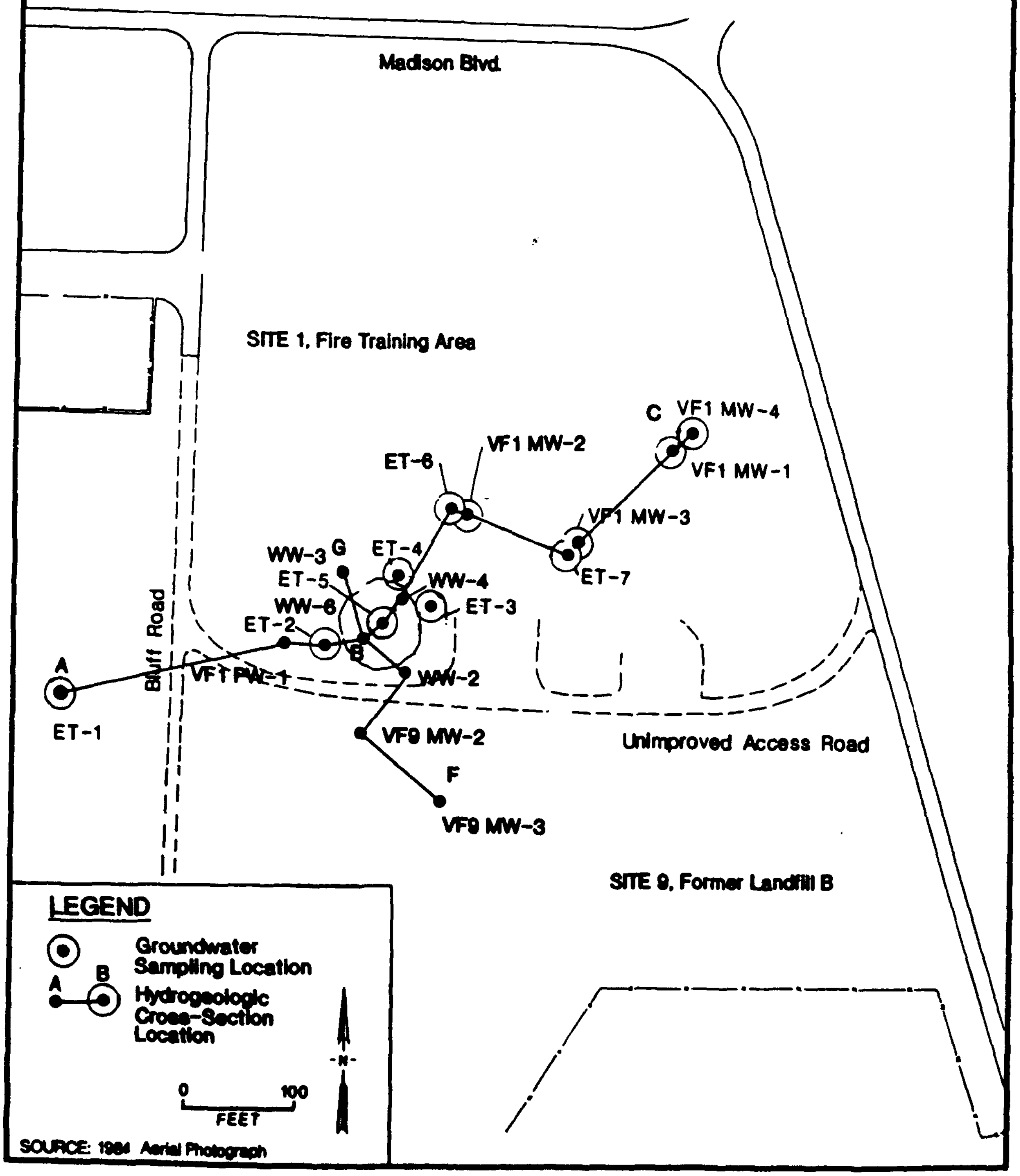
0 100
FEET

SOURCE: 1984 Aerial Photograph

CODE	WELL I.D.	GROUNDWATER ELEVATION (Above MSL)	CODE	WELL I.D.	GROUNDWATER ELEVATION (Above MSL)
1	VF9 MW-1	904.03	11	ET-3	902.97
2	ET-1	903.80	12	ET-4	902.96
3	VF1 PW-1	903.16	13	WW-5	902.93
4	VF9 MW-2	903.13	14	WW-1	902.92
5	VF9 MW-3	903.11	15	ET-6	902.90
6	ET-2	903.09	16	ET-5	902.88
7	WW-3	903.06	17	VF1 MW-2	902.85
8	WW-2	903.05	18	VF1 MW-3	902.76
9	WW-6	903.04	19	ET-7	902.71
10	WW-4	902.99	20	VF1 MW-4	902.36
			21	VF1 MW-1	902.41

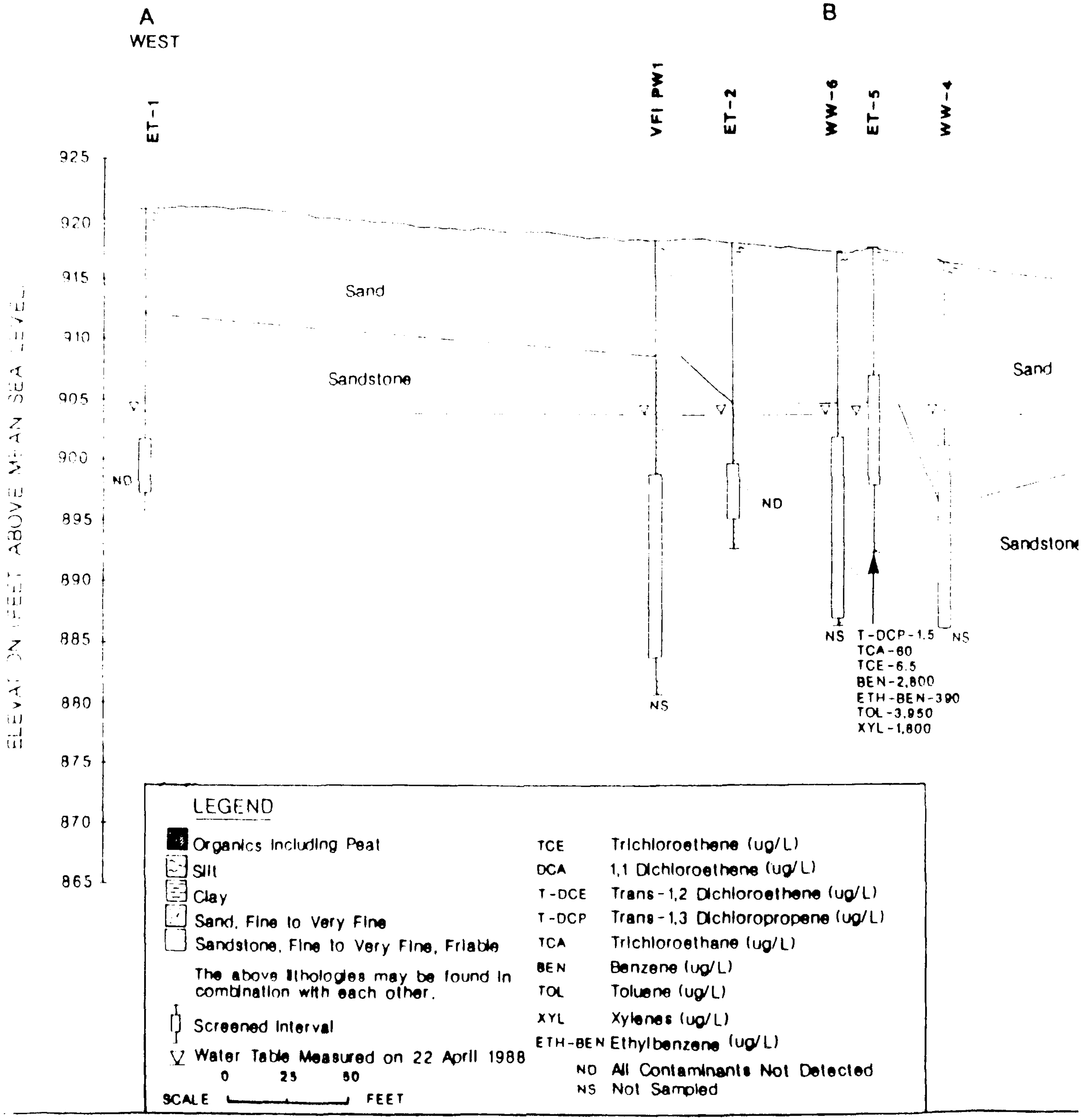
VOLK FIELD ANGB
CAMP DOUGLAS, WI.

HYDROGEOLOGIC CROSS-SECTION AND GROUNDWATER SAMPLING LOCATIONS, SITE 1, FIRE TRAINING AREA



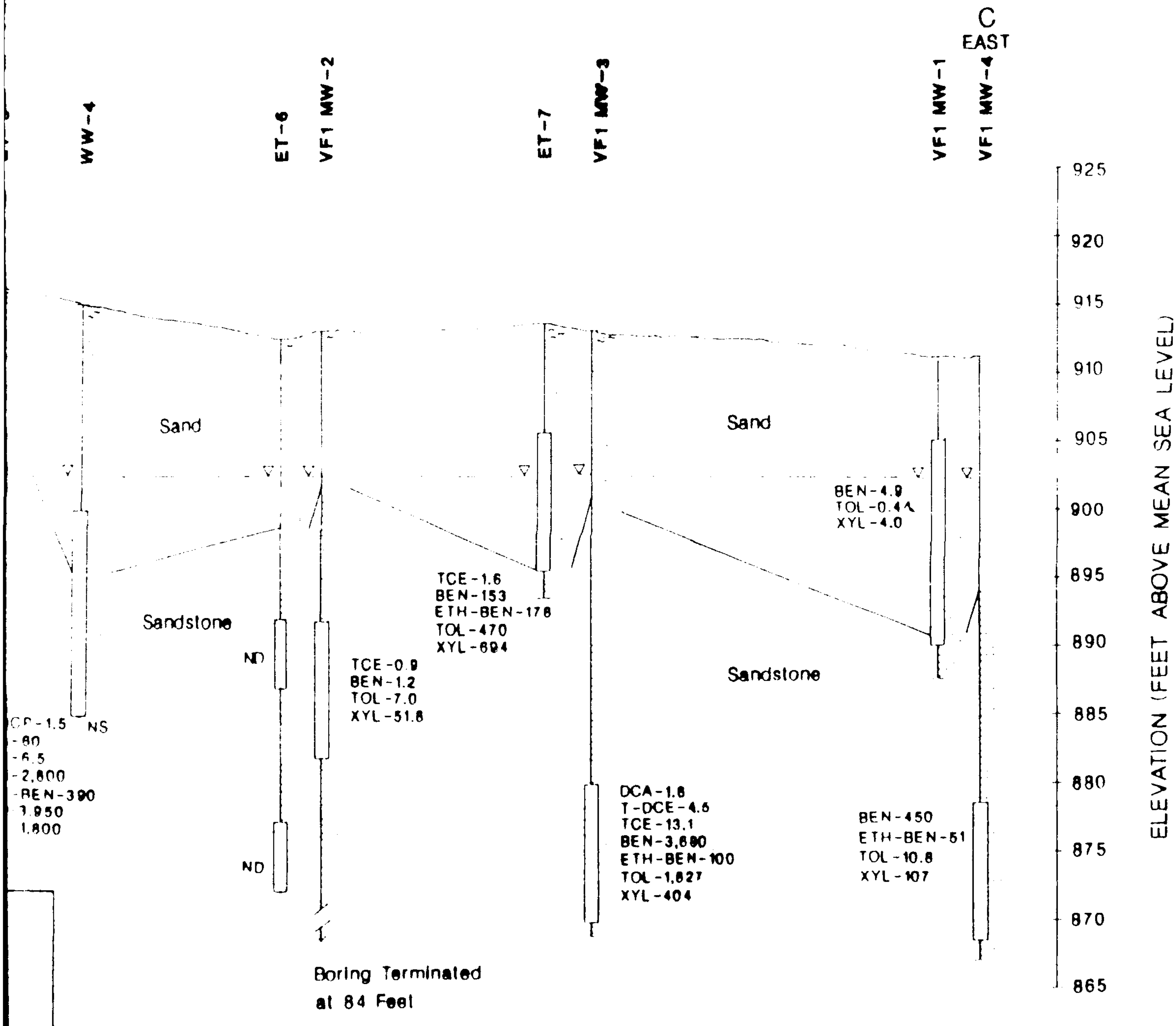
VOLK FIELD ANGB
CAMP DOUGLAS, WI

HYDROGEOLOGIC CROSS-SECTION A-B-C



VOLK FIELD ANGB
CAMP DOUGLAS, WI.

...ON A-B-C AND CONTAMINANT DISTRIBUTION



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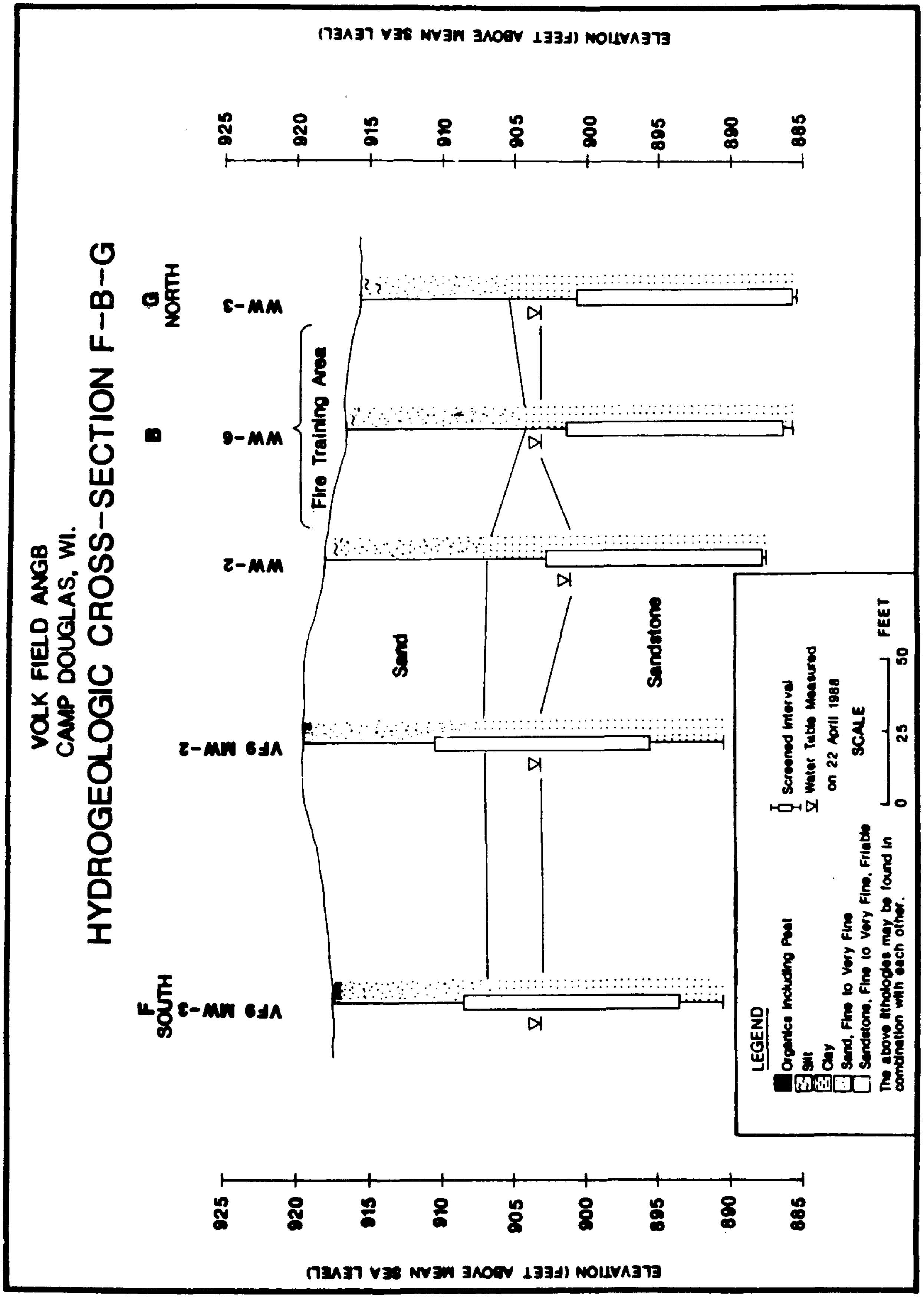
VOLK FIELD ANGB
CAMP DOUGLAS, WI.
HYDROGEOLOGIC CROSS-SECTION F-B-G
F SOUTH
B
G NORTH
VF9 MW-3
VF9 MW-2
WW-2
WW-6
WW-3
Fire Training Area
Sand
Sandstone
ELEVATION (FEET ABOVE MEAN SEA LEVEL)
925
920
915
910
905
900
895
890
885
LEGEND
Organics Including Peat
Silt
Clay
Sand, Fine to Very Fine
Sandstone, Fine to Very Fine, Friable
The above lithologies may be found in combination with each other.
Screened Interval
Water Table Measured on 22 April 1988
SCALE
0
25
50
FEET

TABLE 4.8
VOLK FIELD ANGB
CAMP DOUGLAS, WI
SUMMARY OF CHEMICAL ANALYSES FOR GROUNDWATER SAMPLES - SITE 1, FIRE TRAINING AREA

SAMPLE IDENTIFIER	DATE SAMPLED	PURGEABLE HALOCARBONS E601(ug/L)			AROMATIC VOLATILE ORGANICS SW8020(ug/L)			PETROLEUM HYDROCARBONS E418.1(mg/L)		TOTAL DISSOLVED SOLIDS E160.1(mg/L)		PCB'S SW8080 (ug/L)	BASE/NEUTRALS ACID EXTRACTABLES E625(ug/L)			LEAD E239.2 (mg/L)
		CHEM NAME	DL	Results	CHEM NAME	DL	Results	DL	Results	DL	Results	Results	CHEM NAME	DL	Results	Results
VF-1-W1-GW1-ES	03/04/88	-------		ND	BENZENE	0.2	4.9	1	<1	10	129	ND	NAPHTHALENE	2	2.3	0.010
					TOLUENE	0.2	0.44						BIS(2-ETHYLHEXYL)PHTHALATE	3	9.0	
					XYLENES	0.4	4.0									
VF-1-W2-GW1-ES	03/08/88	TRICHLOROETHENE	0.12	0.9	BENZENE	0.2	1.2	1	<1	10	82.0	ND	-------		ND	0.005
					TOLUENE	0.2	7.0									
					XYLENES	0.4	51.8									
VF-1-W3-GW1-ES	03/06/88	1,1-DICHLOROETHANE	0.07	1.6	BENZENE	0.2	3,680	1	1.6	10	215	ND	NAPHTHALENE	2	11	0.005W
		TRANS-1,2-DICHLOROETHENE	0.10	4.5	ETHYLBENZENE	0.2	100						PHENOL	2	11	
		TRICHLOROETHENE	0.12	13.1	TOLUENE	0.2	1,827						2,4-DIMETHYLPHENOL	3	4	
					XYLENES	0.4	404									
VF-1-W4-GW1-ES	03/04/88	-------		ND	BENZENE	0.2	450	1	<1	10	550	ND	NAPHTHALENE	2	19	0.006
					ETHYLBENZENE	0.2	51									
					TOLUENE	0.2	10.8									
					XYLENES	0.4	107									
VF-1-W5-GW1-ES (duplicate of 1-W1)	03/04/88	-------		ND	BENZENE	0.2	4.5	1	<1	10	164	ND	-------		ND	0.020
					XYLENES	0.4	4.7									
VF-ET1-GW1-ES	03/08/88	-------		ND	-------		ND	1	<1	10	89.0	ND	-------		ND	0.033
VF-ET2-GW1-ES	03/08/88	-------		ND	-------		ND	1	<1	10	57.0	ND	-------		ND	0.025

TABLE 4.8 (CONTINUED)
VOLK FIELD ANGB
CAMP DOUGLAS, WI
SUMMARY OF CHEMICAL ANALYSES FOR GROUNDWATER SAMPLES - SITE 1, FIRE TRAINING AREA

SAMPLE IDENTIFIER	DATE SAMPLED	PURGEABLE HALOCARBONS E601(ug/L)			AROMATIC VOLATILE ORGANICS SW8020(ug/L)			PETROLEUM HYDROCARBONS E418.1(mg/L)		TOTAL DISSOLVED SOLIDS E160.1(mg/L)		PCB'S SW8080 (ug/L)	BASE/NEUTRALS ACID EXTRACTABLES E625(ug/L)			LEAD E239.2 (mg/L)
		CHEM NAME	DL	Results	CHEM NAME	DL	Results	DL	Results	DL	Results	Results	CHEM NAME	DL	Results	Results
VF-ET3-GW1-ES	03/08/88	1,1-DICHLOROETHANE	0.07	12	BENZENE	0.2	8,270	1	26	10	220	ND	NAPHTHALENE	2	51	0.085
		TRANS-1,3-DICHLOROPROPENE	0.34	10	ETHYLBENZENE	0.2	535						BIS(2-ETHYLHEXYL)PHTHALATE	3	28	
		TRICHLOROETHENE	0.12	79	TOLUENE	0.2	12,700						PHENOL	2	27	
					XYLENES	0.4	1,740						PENTACHLOROPHENOL	4	76	
VF-ET4-GW1-ES	03/09/88	TRICHLOROETHENE	0.12	0.7	BENZENE	0.2	29	1	18	10	191	ND	NAPHTHALENE	2	55	0.053
					ETHYLBENZENE	0.2	166						FLUORENE	2	3	
					TOLUENE	0.2	40						BIS(2-ETHYLHEXYL)PHTHALATE	3	1,100	
					XYLENES	0.4	900									
VF-ET5-GW1-ES	03/09/88	TRANS-1,3-DICHLOROPROPENE	0.34	1.5	BENZENE	0.2	2,800	1	110	10	382	ND	NAPHTHALENE	2	38	0.270
		1,1,1-TRICHLOROETHANE	0.03	60	ETHYLBENZENE	0.2	390						PHENOL	2	28	
		TRICHLOROETHENE	0.12	6.5	TOLUENE	0.2	3,950									
					XYLENES	0.4	1,800									
VF-ET6-GW1-ES	03/09/88	....		ND	....		ND	1	<1	10	43.0	ND	....		ND	0.009
VF-ET7-GW1-ES	03/09/88	TRICHLOROETHENE	0.12	1.6	BENZENE	0.2	153	1	<1	10	109	ND	NAPHTHALENE	2	26	0.007
					ETHYLBENZENE	0.2	178						PHENOL	2	3	
					TOLUENE	0.2	470						PENTACHLOROPHENOL	4	5	
					XYLENES	0.4	694									

ND - Not Detected DL - Detection Limit
W - Post digestion spike for Furnace AA analysis out of control limits (85-115%), while sample absorbance is less than 50% of spike absorbance.

TABLE 4.9
VOLK FIELD ANGB
CAMP DOUGLAS, WI
GROUNDWATER SAMPLING FIELD MEASUREMENTS
SITE 1, FIRE TRAINING AREA

Sample Identifier	Date Collected	pH	Specific Conductance (umhos/cm)	Temp (C)
VF-1-W1-GW1-ES[a]	3/4/88	5.8	150	7.7
VF-1-W2-GW1-ES	3/8/88	6.0	146	10.3
VF-1-W3-GW1-ES	3/6/88	6.8	375	11.7
VF-1-W4-GW1-ES	3/4/88	6.4	875	9.9
VF-ET1-GW1-ES	3/8/88	6.5	65	9.0
VF-ET2-GW1-ES	3/8/88	5.3	93	9.4
VF-ET3-GW1-ES	3/8/88	6.6	500	9.8
VF-ET4-GW1-ES	3/9/88	6.3	250	9.9
VF-ET5-GW1-ES	3/9/88	6.6	675	11.0
VF-ET6-GW1-ES	3/9/88	5.9	68	10.2
VF-ET7-GW1-ES	3/9/88	6.4	250	8.2

[a] A blind duplicate sample was collected and labeled VF-1-W5-GW1-ES.

samples. Only Wells ET-3 and ET-5 which contained 0.085 and 0.270 mg/L of lead respectively contained lead levels significantly higher than the background concentrations observed in upgradient wells. Lead in these groundwater sample may have originated from leaded fuels spread on the ground in this area. Eight of the eleven groundwater samples collected from Site 1 wells contained elevated levels of one or more organic contaminants. No organic contamination was detected in the groundwater samples obtained from Site 1 wells ET-1, ET-2 or ET-6. Well ET-1 served as the upgradient well for Site 1. The absence of organic contaminants from groundwater samples obtained from this well indicates that organic contamination is not migrating onto the site from a source upgradient of Site 1 well ET-1. The absence of organic contamination in Well ET-6 and relatively low concentration in VF-1 MW-3 is attributed to these wells being north of the source of contamination.

In general well ET-3 is the most contaminated well sampled at Site 1. The location of this well is shown in Figure 4.10. Detectable volatile halogenated organics include 1,1-dichloroethane, 1,3-dichloropropylene and trichloroethylene at concentrations of 12 μg/L, 10 μg/L and 79 μg/L respectively. Detected aromatic hydrocarbons include benzene, ethylbenzene, toluene, and xylenes at concentrations of 270 μg/L, 535 μg/L, 12,700 μg/L and 1,740 μg/L respectively. The concentration of petroleum hydrocarbons in this sample was 26 mg/L. However, no free product was observed. In addition to these contaminants, several semi-volatile contaminants were detected in this groundwater sample. Naphthalene, bis(2-ethylhexyl) phthalate, phenol and pentachlorophenol were detected at concentrations of 51 μg/L, 28 μg/L, 27 μg/L and 76 μg/L respectively. All of the compounds identified in this sample could have originated from liquids used in fire training exercises conducted in this area with the exception of pentachlorophenol and bis(2-ethylhexyl) phthalate. Pentachlorophenol is a wood preservative and its source at this site is not known. Bis(2-ethylhexyl) phthalate is a common plasticizer which may have been introduced during sampling or analysis.

The groundwater sample from Well ET-5 contained the same compounds found in Well ET-3 except for the absence of pentachlorophenol, bis(2-ethylhexyl) phthalate, and 1,1 dichloroethane. Also, trichloroethane was detected in this sample at concentration of 60 μg/L. The concentrations of the volatile aromatic and halogenated compounds in this sample were less than the levels detected in Well ET-3 but were still high. Benzene, ethylbenzene, toluene and xylenes were detected at concentrations of 2,800 μg/L, 390 μg/L, 3,950 μg/L, and 1,800 μg/L respectively. Wells ET-3 and ET-5 are located in the area having the highest level of soil contamination. The high level of soil contamination in this area provides a continuous source for groundwater contamination. Both of these wells are screened to intercept the water table and capture any free product which may be present. The groundwater sample from Well ET-5 contained 110 mg/L of petroleum hydrocarbons. However, no free product was detected at this well but the bailer and downhole instruments showed evidence of a floating product. The groundwater samples collected from these wells contained higher levels of benzene and toluene than soil samples collected in this area. Well ET-4 also contained elevated levels of volatile halocarbons, purgeable aromatics and semi-volatile organics but at concentrations lower than those observed in Site 1 Wells ET-3 and ET-5 with the exception of bis(2-ethylhexyl)phthalate which was present at a concentration of 1,100 μg/L. The source of the high concentration of this compound is not known but it was most likely introduced during sampling or analysis. The presence of this compound is not felt to be indicative of environmental contamination. Well ET-4 is also screened to intercept the top of the aquifer but is located cross-gradient to the contaminant source.

Analytical data obtained from two well clusters located downgradient of the contaminant source indicate that higher levels of contamination are present in the deeper wells. This could be due to volatilization of contaminants from the groundwater surface and enhanced biodegradation. Another possible explanation is that the infiltration of clean rainwater can reduce the contaminant levels present in the upper portion of the aquifer. The contaminant plume at Site 1 has reached Monitoring Wells VF1 MW-1 and VF1 MW-4, the wells furthest from the contaminant source. The groundwater samples collected from Monitoring Wells VF1 MW-1 and VF1 MW-4 did not contain measurable levels of halogenated compounds. However, benzene, toluene, xylenes, and naphthalene were detected in groundwater samples obtained from both of these wells. The shallow monitoring well, VF1 MW-1 contained bis(2-ethylhexyl)phthalate at a concentration of 9 μg/L. The detection of this compound is believed to be caused by sampling or analytical procedures rather than site contamination. Benzene, toluene and xylenes were detected in Monitoring Well VF1 MW-1 at concentrations of 4.9 μg/L, 0.44 μg/L and 4.0 μg/L respectively. The deeper well at this location, VF1 MW-4, contained 450 μg/L benzene, 51 μg/L ethylbenzene, 10.8 μg/L toluene, and 107 μg/L xylenes. Naphthalene was also detected in this well at 19 μg/L.

The concentration of total dissolved solids (TDS) in the Site 1 monitoring wells ranged from 43 mg/L to 550 mg/L. Concentrations of TDS below 100 mg/L are believed to reflect background levels. The concentrations of TDS in upgradient Well ET-1 and Well ET-2 were less than 100 mg/L. Groundwater samples collected at Site 1 which contained TDS concentrations in excess of 100 mg/L also contained high levels of organic contaminants. Groundwater samples which contained over 100 mg/L TDS also contained significant levels of organic contaminants.

All the groundwater samples collected from Site 1 monitoring wells contained detectable levels of lead. Lead was detected in upgradient Well ET-1 at a concentration of 0.033 mg/L. The highest concentration of lead (0.270 mg/L) was detected in Well ET-5. One bailer rinsate sample collected during the groundwater sampling program at Volk Field ANGB contained lead at a concentration of 0.007 mg/L. Lead in groundwater samples at this level are not believed to be indicative of contamination.

In addition to the groundwater analysis from the monitoring wells at Site 1, three groundwater samples were obtained for chemical analysis from Base Production Wells 3, 4 and 5 (Figure 4.13). These samples were collected on 7 July 1988 and analyzed for purgeable halocarbons and aromatic volatile organics. The results of these analyses are provided in Table 4.10. Methylene chloride was found in both the groundwater samples and trip blanks and was not identified in any other soil or groundwater samples collected at Volk Field ANGB. It is suspected to be a lab contaminant and is not felt to be indicative of contamination. As the well construction details of these three wells are not known, it is not possible to rule out the possibility that the contaminant plume from Site 1 has reached these locations.

FIGURE 4.13

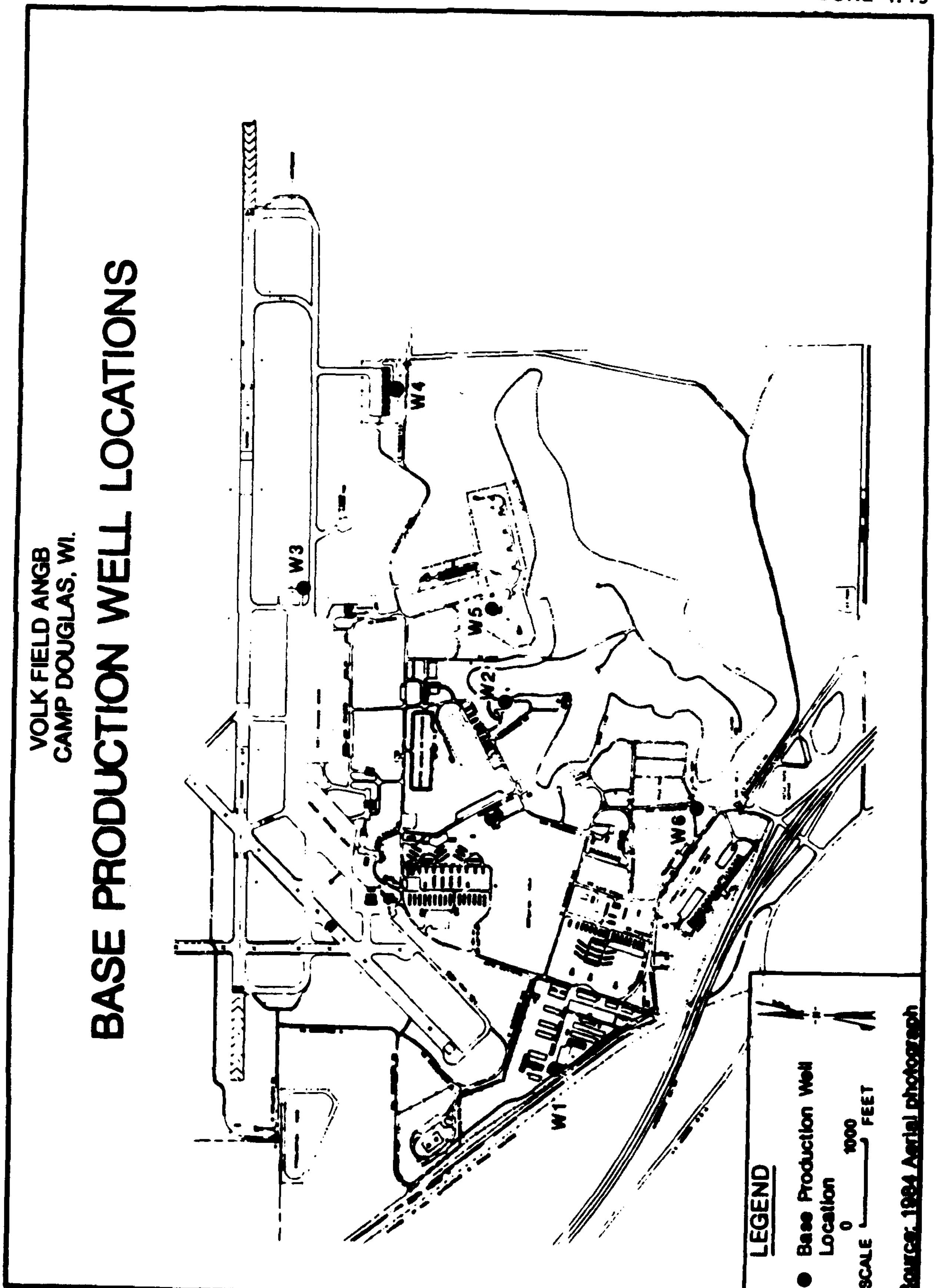
VOLK FIELD ANGB
CAMP DOUGLAS, WI.
BASE PRODUCTION WELL LOCATIONS
W1
W2
W3
W4
W5
W6
LEGEND
Base Production Well Location
SCALE
0
1000
FEET
Source: 1984 Aerial photograph

TABLE 4.10
VOLK FIELD ANGB
CAMP DOUGLAS, WI
SUMMARY OF CHEMICAL ANALYSES FOR
BASE PRODUCTION WELLS

Base Production Well	Purgeable Halocarbons E601 (μg/L)	Volatile Aromatic Hydrocarbons E602 (μg/L)
3	Methylene Chloride 1.5	ND
4	Methylene Chloride 1.9	ND
5	Methylene Chloride 1.7	ND
Trip blank	Methylene Chloride 5.6	ND

SECTION 5
REGULATORY SIGNIFICANCE OF RESULTS

In this section, criteria for evaluating the significance of the results presented in Section 4 are developed and contaminant levels at each site are compared to regulatory criteria. In subsection 5.1 Applicable, Relevant and Appropriate Regulations (ARARs) are developed and in subsection 5.2 the analytical results from Site 1 are compared to these ARARs.

5.1 CRITERIA FOR DETERMINING SIGNIFICANCE OF RESULTS

The presence of contaminants in the environment due to past materials handling or waste disposal practices does not mean the contaminants pose an unacceptable threat to human health or the environment. To ensure that resources for further investigation and remedial actions are efficiently committed, priorities must be established based on estimates of risk to human health and the environment. The objective of this subsection is to present criteria for determining the significance of the results presented in Section 4 in order that more accurate estimates of risk can be made. Applicable regulatory standards and guidelines were used as the criteria for determining significance of the results.

Section 121 of the Superfund Amendments Reauthorization Act (SARA) establishes cleanup standards for superfund sites. This act sets forth the need for appropriate remedial actions, consistent with the National Contingency Plan (NCP), that provide a cost effective response. The degree of cleanup specified in subsection (d) of 121 of SARA is "to achieve applicable or relevant and appropriate standards (ARARs) under other federal or state laws". "Applicable" standards must be legally applicable to the hazardous substance or pollutant of concern. "Relevant and appropriate" standards must be based on the circumstances presented by the release or threatened release. The USEPA has identified three categories of ARARs:

- Chemical Specific;
- Location Specific, i.e., wetlands limitations or historic sites; and
- Action Specific, i.e., performance and design standards.

The evaluation of the significance of results for the site investigations considered chemical specific ARARs.

At present, USEPA considers drinking water Maximum Contaminant Levels (MCL), Maximum Contaminant Level Goals (MCLG), Federal Ambient Water Quality Criteria (WQC), National Ambient Air Quality Standards (NAAQS), and promulgated state environmental standards to be potential ARARs for ambient concentrations.

5.1.1 Criteria for Groundwater

The State of Wisconsin has developed groundwater quality criteria to protect human health. Chapter NR 140 of the Administrative Code of the Wisconsin Department of Natural Resources lists enforcement standards and preventive action limits for substances of public health and public welfare concern. Enforcement standards are those which are legally enforceable as under Wisconsin law. The preventative action limits are concentrations, when found in groundwater, that trigger actions to assure or prevent the concentrations from reaching enforcement standards. Table 5.1 lists the Enforcement Standards and Preventive Action Limits (PAL) for compounds detected in the groundwater at Volk Field ANGB. For all substances that have carcinogenic, mutagenic, or teratogenic properties or interactive effects, the preventive action limit is 10 percent of the enforcement standard. Other compounds that are of public health concern have preventive action limits that are 20 percent of the enforcement standard.

In addition to State of Wisconsin criteria, the USEPA has proposed additional MCLs and has established or proposed Recommended Maximum Contaminant Levels (RMCL) for several compounds detected at Volk Field ANGB. Table 5.1 contains MCL, MCLG, WQC, as well as proposed MCL and MCLG for contaminants detected at Volk Field ANGB.

5.1.2 Criteria for Soils

5.1.2.1 Organic Compounds

Organic compounds identified in soil samples collected during the Remedial Investigation at Site 1 included the volatile organics trichloroethylene, tetrachloroethylene, benzene, ethylbenzene, xylenes, and toluene; and the semi-volatile compounds naphthalene, methylnaphthalene, diethyl phthalate and petroleum hydrocarbons. Table 5.2 lists the maximum concentrations of compounds detected in the soil and water at Site 1, Fire Training Area. Table 5.3 presents their physical and chemical properties. The State of Wisconsin does not currently regulate specific compounds in soils, however, guidelines have been set for volatile organic

TABLE 5.1
VOLK FIELD ANGB, CAMP DOUGLAS, WI
APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS, STANDARDS, AND CRITERIA FOR THE ORGANIC CONTAMINANTS DETECTED

Indicator Chemical	Safe Drinking Water Act[1]		Water Quality Criteria[2]		Clean Air Act[3]	Wisconsin[4]	Wisconsin Ground Water Quality Standards (mg/L)[5]		
	MCL (μg/L)	MCLG (μg/L)	Drinking Water and Organisms (μg/L)	Drinking Water Only (μg/L)	NAAQs (mg/m^3)	Standards (mg/m^3)	Air Quality Action Limit (μg/L)	Preventive Standard (μg/L)	Enforcement TLV/420[6] (mg/m^3)
Bisethylhexyl Phthalate	–	–	15,000	21,000	–	–	–	–	0.0119
Benzene	5	0	0.66	0.67	–	–	0.067	0.67	0.00714
Ethylbenzene	–	–	1,400	2,400	–	–	–	–	1.036
Fluoranthene	–	–	–	–	–	–	–	–	–
Lead	50	–	50.0	5.0	0.0015	0.0015	5	50	0.000119
Phenol	–	–	3,500	3,500	–	–	–	–	0.0452
Toluene	–	–	14,300	15,000	–	–	68.6	343	0.893
1,1,1-Trichlorethane	200	200	18,400	19,000	–	–	4	20	4.52
Trichloroethene	5	0	2.7	2.8	–	–	18	18	0.643
Methylnapthalene	–	–	–	–	–	–	–	–	–
Napthalene	–	–	–	–	–	–	–	–	0.119
Pentachlorophenol	–	–	1,010	1,010	–	–	–	–	0.00119
Xylene	–	–	–	–	–	–	124	620	1.04
Tetrachloroethane	–	–	0.8	0.88	–	–	0.1	1	0.798
Trans-1,3-Dichloropropene	–	–	*87.0*	87	–	–	–	–	0.0119
2,4-Dimethyl Phenol	–	–	400	400	–	–	–	–	–
Diethyl Phthalate	–	–	350,000	434,000	–	–	–	-	0.0119
1,1-Dichloroethane	–	–	–a	–a	–	–	0.05	0.5	1.43
1,2-Dichloroethylene	–	–	–a	–a	–	–	0.024	0.24	1.88

(1) Source: 40 CFR 141; last amendment 52 FR 25712, July 8, 1987.
(2) Source: Federal Register, Vol. 50, No. 145, July 29, 1985; Vol. 45, No. 231, Nov. 28, 1980.
(3) Source: 40 CFR 50; last amendment 52 FR 24663, July 1, 1987.
(4) Source: Wisconsin Administrative Code NR 404; last amendment and recodification on October 1, 1986.
(5) Source: *Wisconsin Administrative Code, NR 140.10. Register, May 1986, No. 365.*
(6) Source: ACGIH, 1987-88 except for benzene and lead. The values for benzene and lead are based on recent OSHA PELs of 3 and 0.05 mg/m3, respectively.

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TABLE 5.2
VOLK FIELD ANGB, CAMP DOUGLAS, WI
MAXIMUM CONTAMINANT CONCENTRATIONS AT SITE 1
AND APPLICABLE CRITERIA

Parameter	Most Appropriate Drinking Water Criteria (μg/L) ENF. STD./PAL	Criteria Source	Site 1 Groundwater (μg/L)	Site 1 Soils (μg/kg)
Benzene	0.67/0.067	1	8,270	19,000
Bis(2 Ethylhexyl)Phthalate	15,000	2	1,100	--
1,1-Dichloroethane	--		12	--
1,2-Dichloroethene	--		4.5	--
1,3-Dichloropropene	87	2	10.0	--
Diethyl Phthalate	350,000	2	--	2,000
2,4-Dimethylphenol	400	2	24.0	--
Ethylbenzene	1,400	2	535	40,000
Fluorene	--		3.0	--
2-Methylnaphthalene	--		-	15,000
Naphthalene	--		55	7,300
Pentachlorophenol	1,010	2	76	--
Phenol	3,500	2	28	--
Tetrachloroethylene	1/0.1	1	--	0.94
Toluene	343/68.6	1	3,950	37,000
1,1,1-Trichloroethane	200/40	1	60	--
Trichloroethylene	1.8/.18	1	79	41
Xylenes	620/124	1	1,800	88,000
Petroleum Hydrocarbons	--		110(3)	22,000(3)
Lead	50/5	1	270	85(4)
TDS	500/250	1	550	--

1 = Source: Wisconsin Administrative Code, NR 140.10 Register, May 1986, No. 365.
2 = Source: Federal Register, Vol. 50, No. 145, July 29, 1985; Vol. 45, No. 231, Nov. 28, 1980.
(3) = mg/L
(4) = mg/kg

compounds. The State of Wisconsin recommends that for volatile organic compounds, organic vapor concentrations in the soil should be less than 10 ppm as measured with an organic vapor analyzer or photoionization detection instrument.

Volatile and semi-volatile organic compounds are low molecular weight compounds typically used as solvents, fuel additives and raw materials. The majority of these compounds do not occur naturally, and their presence is usually associated with spills or leaks. Volatile and semi-volatile compounds are moderately to highly soluble. The compound with the highest solubility detected at Site 1 was phenol. Vapor pressures and Henry's Law values, which indicate how readily a compound will volatilize, were highest for 1,2-dichloroethylene. This compound will volatilize readily from soils and groundwater and is not expected to persist in the environment. Organic carbon partition coefficients indicate that while some compounds will adsorb strongly (i.e., ethylhexyl phthalate, K_{oc} = 62,000), others will not (i.e., phenol, K_{oc} = 14). The data in Table 5.3 indicate that the volatile compounds are in general quite mobile in the environment and are, therefore, of primary concern at sites where groundwater is withdrawn nearby for drinking water. These same properties make volatile organic compounds more available, in general, for degradation processes such as biodegradation. The semi-volatile organic compounds vary in their mobilities and persistence in the environment. Semi-volatile compounds with high solubilities and low organic carbon coefficients such as phenol and dimethyl phenol are expected to be very mobile. However, the relatively insoluble compounds such as ethylhexyl phthalate, pentachlorophenol and naphthalene, are expected to be less mobile and more persistent.

Wisconsin or EPA criteria do not exist for petroleum hydrocarbons in soils. Organic compounds which constitute most of the petroleum hydrocarbons are generally of low toxicity. The primary health risk is associated with chronic exposures through ingestion of contaminated food and water. Most compounds measured as petroleum hydrocarbons are relatively persistent in the environment. Biodegradation is the main elimination mechanism, but rates are fairly low, especially for cyclic or aromatic hydrocarbons (American Petroleum Institute, 1986). Complete biodegradation of petroleum hydrocarbons may require years or even decades.

The potential for migration of petroleum hydrocarbons is moderate to low. Most of the hydrocarbons have negligible water solubilites, low vapor pressures, and high sorption coefficients. For example, n-decane ($C_{10}H_{22}$), a medium molecular

TABLE 5.3
VOLK FIELD ANGB, CAMP DOUGLAS, WI
PHYSICAL AND CHEMICAL PROPERTIES OF CONTAMINANTS DETECTED AT SITE 1

Contaminant	CAS Number	Concentration Soil (ug/Kg)	Concentration Ground Water (ug/L)	Water Solubility (mg/L)(20°C)	Vapor Pressure mmHg (20°C)	Henry's Law Constant	Koc (mg/L)	Density g/cm3 (20°C)	Overall Half-Life Range (Days)1,2 Air	Overall Half-Life Range (Days)1,2 Surface Water
Benzene	73-43-2	19,000	8,270	1.75E+03	9.52E+01	5.43E-03	83	0.8765	6.0	1-6.0
Bis(2-Ethylhexyl)phthalate	117-81-7	–	1,100	4.00E-01	6.20E-08	2.50E-07	62,000	0.9861	NR	NR
1,1-Dichloroethane	75-34-3	–	12	5.50E+03	1.82E+02	5.70E-03	30	1.175	NR	NR
1,2-Dichloroethylene	540-59-0	–	4.5	6.30E+03	3.24E+02	1.54E-01	59	1.214	2.0	1.0-6.0
1,3-Dichloropropylene	542-75-6	–	10	2.80E+03	2.50E+01	NR	48	NR	NR	1.0
2,4-Dimethylphenol	105-67-9	–	4	1.48E+03	6.70E-02	6.70E-06	96	0.965	NR	NR
Ethylbenzene	100-41-4	17,000	535	1.52E+02	7.00E+00	7.90E-03	1100	0.867	1.46	1.5-7.5
Fluorene	86-73-7	–	3	1.90E+00	7.10E-04	NR	7300	NR	5.5	1.0-2.0
2-Methylnaphthalene	–	15,000	–	NR	NR	NR	NR	0.994	NR	NR
Naphthalene	91-20-3	7,300	55	3.00E+01	1.00E+00	4.82E-04	962	1.145	NR	NR
Pentachlorophenol	87-86-5	–	76	1.40E+01	1.10E-04	2.80E-06	53,000	1.978	21.0	5.0
Phenol	108-95-2	–	28	9.30E+04	3.41E-01	7.00E-07	14	1.0576	0.62-9.0	0.62-9.0
Tetrachloroethylene	127-18-4	0.94	–	1.50E+02	1.78E+01	2.27E-02	364	1.625	47	1-30
Toluene	108-88-3	5,700	12,700	5.33+02	2.81+01	6.61E-03	300	0.8669	1.3	0.17
1,1,1-Trichloroethane	71-55-6	–	60	1.50E+03	1.23E+02	2.76E-02	152	1.325	803-1752	0.14-7.0
Trichloroethylene	79-01-6	33	79	1.10E+03	5.79E+01	8.92E-03	126	1.462	3.7	1.0-90.0
Xylene	1330-20-7	83,000	1,800	1.98E+02	1.00E+01	4.94E-03	240	0.8602	0.5	1.5-9.0
Lead	7439-92-1	77,500	270	Variable	NA	NA	NR	–	4.8	Persistent

NR - Not Reported
NA - Not Applicable.

1 - Source: USEPA, 1986
2 - Overall half-life takes into account all physical, chemical and biological removal processes.

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weight hydrocarbon, has a water solubility of only 0.009 mg/L and a vapor pressure of 2.7 mm Hg at 20°C (Vershuren, 1983). Its overall soil sorption coefficient (K_{oc}) can be estimated from its solubility (S, in mg/L) using the following equation (Lyman and others, 1982):

$$\text{Log } K_{oc} = -0.55 (\text{Log } S) + 3.64$$

The log K_{oc} of n-decane is thus estimated to be 4.77, indicating a high ratio of amounts adsorbed to amounts dissolved. Other petroleum hydrocarbons are even less soluble in water and should adsorb more strongly than n-decane. The generally high sorption potential associated with petroleum hydrocarbons is the primary reason for concluding their mobility is low. Further, volatile and other organic contaminants will generally have lower mobilities when found in association with petroleum hydrocarbons, due to sorption or partitioning of these compounds into the petroleum hydrocarbons coating the soil grains.

5.1.2.2 Metals

Lead was the only metal analyzed for in soil samples collected at Site 1 during the investigations. No Federal or State of Wisconsin standards exist for metals in soils. To evaluate the significance of lead, its normal background level must be considered. The concentration of lead in uncontaminated soils across the U.S. ranges from 2 to 2,000 mg/kg with an average value of 10 mg/kg (EPA SW-874, 1980). Lead is not degradable through biological or chemical actions, and can be considered persistent in the environment. Dissolved lead can be present in free-ion form (Pb^{2+}), in hydroxy complex form, and as carbonate or sulfite ion pairs. Lead is also readily adsorbed to organic and inorganic sediment surfaces. The ratio of lead levels in suspended solids to lead in dissolved form varies from 4:1 in rural streams to 27:1 in urban streams (USPHS, 1988). This ratio is likely to be higher in groundwaters where lead can come into contact with a large matrix surface area in aquifer pore spaces. Above a pH of 5.4, lead dissolved concentrations are controlled by $PbCO_3$ and $Pb_2(OH)_2CO_3$ complexes. The mobility of lead is generally quite low in soil systems due to its adsorption by clay minerals and organic matter. The mobility of lead in soils is influenced by the pH of the pore fluid. Lead is generally more readily soluble at low pHs and is therefore more mobile.

5.2 COMPARISON OF RESULTS TO ARARS

In this subsection the results presented in Section 4 are compared to the ARARs developed in Section 5.1.

5.2.1 Soil Contamination

Soil samples collected at Site 1 contained several organic contaminants including benzene, ethylbenzene, toluene, xylenes, trichloroethylene, tetrachloroethylene, naphthalene, methylnaphthalene, diethylphthalate, and petroleum hydrocarbons. As discussed in Section 5.1, the State of Wisconsin does not currently regulate specific compounds in soils but it is felt that the extremely high levels of benzene, ethylbenzene, toluene and xylenes present are indicative of significant contamination. The lead concentration in one surface soil sample exceeds the average reported lead concentration for uncontaminated soils. However, the concentration was within the range listed for uncontaminated soils and is, therefore, not considered significant.

5.2.2 Groundwater Contamination

Groundwater samples collected at Site 1 contained several organic and inorganic contaminants at levels exceeding Wisconsin Enforcement Standards and Preventive Action Limits. The maximum concentrations of contaminants which exceed Wisconsin Standards are listed below:

Groundwater Parameter	Groundwater Criteria: Enforcement Standard (μg/L)	Groundwater Criteria: Preventive Action Limit (μg/L)	Maximum Contaminant Concentration (μg/L)
Benzene	0.67	0.067	8,270
Toluene	343	68.6	3,950
1,1,1-Trichloroethane	200	40	60
Trichloroethylene	1.8	0.18	79
Xylenes	620	124	1,800
Lead	50	5	270
TDS	500	250	550

These findings indicate that significant groundwater contamination exists at Site 1.

SECTION 6
PUBLIC HEALTH EVALUATION

6.1 OBJECTIVE

The primary objective of this section is to provide a baseline public health evaluation of the Fire Training Area (Site 1) at Volk Field Air National Guard Base in Camp Douglas, Wisconsin. This evaluation is intended to reflect the potential health risks associated with the site under existing conditions. The baseline evaluation was conducted in accordance with the guidelines and methodology set forth in the USEPA Superfund Public Health Evaluation Manual (EPA, 1986a). The following steps were involved in conducting the evaluation:

- Step 1: Selection of indicator chemicals
- Step 2: Identification of complete pathways of exposure
- Step 3: Estimation of exposure point concentrations
- Step 4: Identification of ARARS (Applicable or Relevant and Appropriate Requirements and Standards)
- Step 5: Estimation of exposure point intakes
- Step 6: Assessment of risk

6.1.1 Selection of Indicator Chemicals

If more than 10 to 15 chemicals are detected in environmental media at a site, the first step in the Public Health Evaluation process is the selection of indicator chemicals. This step serves to reduce the number of chemicals carried through the risk assessment to a manageable number.

Normally the selection of indicator chemicals entails computation of representative concentrations of each compound detected in each environmental medium on site, assignment of a relative rank based on toxicity and concentration for each compound detected in each environmental medium on site, and evaluation of relevant physical and chemical properties of the top-ranked compounds. Since only 18 compounds were detected in the groundwater and soil samples taken from the Fire Training Area at Volk Field (hereafter referred to as Site 1), the ranking procedure was not employed in the selection of indicator chemicals for Site 1. The compounds detected included benzene, toluene, xylenes, ethylbenzene, 1,1,1-trichloroethane, trichloroethene, 1,1-dichloroethane, trans-1,2-dichloroethene, trans-1,3-dichloropropene, methyl- naphthalene, naphthalene, fluorene, bis(2-ethyhexyl) phthalate, phenol, 2,4-dimethylphenol, pentachlorophenol, lead, and tetrachloroethene. The following compounds were selected as indicator chemicals based on their detected concentrations, pervasiveness at the site, toxicity, and persistence:

- benzene
- ethylbenzene
- lead
- phenol
- toluene
- trichloroethene
- naphthalene
- xylenes
- tetrachloroethene

The indicator chemicals along with some relevant physical, chemical, and toxicologic properties are shown in Table 6.1.

6.1.1.1 Identification of Complete Pathways of Exposure

Once it has been established that environmental media on site or in the vicinity of the site have been contaminated, it is necessary to identify complete pathways of exposure. A complete pathway of exposure consists of the following elements:

- a release source and mechanism for chemical release
- a transport medium
- a point of potential human exposure
- a route of human exposure (oral, dermal, inhalation)
- a human receptor

TABLE 6.1
VOLK FIELD ANGB, CAMP DOUGLAS, WISCONSIN
INDICATOR CHEMICALS AND SOME RELEVANT PHYSICAL PROPERTIES[1]

Chemical	CAS Number	Toxicity Class	Water Solubility (mg/L)	Vapor Pressure (mm/Hg)	Henry's Law Constant (atm-m^3/mol.)	K_{oc} (ml/g)
Benzene	71-43-2	C	1,750	95.2	5.59E-03	83
Ethylbenzene	101-41-4	NC	152	7.00	6.43E-03	1100
Lead	7439-92-1	NC	Variable	NA	NA	NR
Phenol	108-95-2	NC	93,000	0.341	4.54E-07	14.2
Toluene	108-88-3	NC	535	28.1	6.37E-03	300
Trichloroethene	79-01-6	C	1,100	57.9	9.10E-03	126
Naphthalene[2]	91-20-3	NR	30	10.0	NR	NR
Xylenes	1330-20-07	NC	198	10.0	7.04E-03	240
Tetrachloroethylene	127-18-4	C	150	17.8	2.59E-02	364

(1) Source: EPA, 1986a
(2) Source: Verschueren, 1983; RTECS, 1986

C = carcinogen
NC = non-carcinogen
NR = not reported
NA = not applicable

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If any one of these elements is absent, the pathway is not complete and human exposure cannot occur.

At Site 1, and at Volk Field in general, contaminated soils and groundwater have been identified as potential release sources. Potential release mechanisms include volatilization of organic compounds, fugitive dust generation, site leaching, tracking, site runoff, and groundwater seepage. An integrated qualitative analysis of release sources, mechanisms for release, and probability of release for potential contaminants at Site 1 is shown in Table 6.2.

Once source and release mechanisms were identified, the next step in the analysis was to identify potential exposure points, receptors, and routes of exposure.

Potential primary exposure points include the site itself, residences northeast of the site, residences north of the site, Volk Field water supply wells northeast of the site, and the Lemonweir River and its tributaries. Figure 6.1 shows these features and generalized groundwater flow direction.

Since soils and groundwater in the vicinity of Site 1 are contaminated, the site itself is a potential exposure point. Due to the fact that prevailing winds in the vicinity of Volk Field are from the south for most of the year, locations downwind of the site are potential exposure points for pathways in which air is the transport medium. Volk Field water supply wells W-3 and W-4, are located 2,000 feet north and 2,900 feet northeast, respectively from the site (see Figure 6.1). Since groundwater is known to flow in a northeasterly direction, these water supply wells are downgradient of Site 1 and are therefore potential exposure points. Private residences in the area are known to be supplied by groundwater wells, and therefore represent potential exposure points. The nearest private residences are located 6000 feet northeast of the site. The Lemonweir River and its tributaries are potential exposure points since it is the nearest body of surface water which potentially could be contaminated via surface runoff from the site and groundwater seepage.

Potential primary receptors are those individuals who might have access to an exposure point. For Site 1, potential receptors include employees at Volk Field, visitors to the site, and nearby residents.

Primary routes of human exposure include inhalation of potentially contaminated air, ingestion of potentially contaminated groundwater, surface water and soils, and dermal contact with potentially contaminated soils and surface water.

TABLE 6.2
VOLK FIELD ANGB, CAMP DOUGLAS, WISCONSIN
QUALITATIVE RELEASE SOURCE MECHANISMS
SITE 1: FIRE TRAINING AREA

Transport Medium	Potential Release Source	Release Mechanism	Release Timeframe[2]	Release Probability/Amount
Air	Contaminated soils	Volatilization	C	Probability is moderate; amounts are expected to be low; HNu® readings taken in the breathing zone during field investigations did not exceed 4 ppm.
	Contaminated surface soils	Fugitive dust generation	E	Low for lead; the fire training pit has been covered with a 4 inch layer of sand and gravel; low for organics due to volatilization.
Groundwater	Contaminated soils	Site leaching	C	High probability; moderate to high concentrations have been detected in soils and groundwater.
Soils	Contaminated soils; groundwater	Site leaching	C	High probability; moderate to high concentrations have been detected in soils and groundwater.
	Contaminated surface soils	Tracking[1]	E	Moderate probability; amounts would be low.
Surface water	Contaminated surface soils	Site runoff	E	Very low; site is basically flat and nearest surface water (a tributary of the Lemonweir River) is greater than 1/2 mile from the site (see Figure 6.1). The Lemonweir River is greater than 2 miles from the site.
	Contaminated groundwater	Groundwater seepage	C	Low; nearest surface water is 1/2 mile from the site.

(1) "Tracking" refers to dispersal of soils via shoes/feet.
(2) C = Continuous, E = Episodic.

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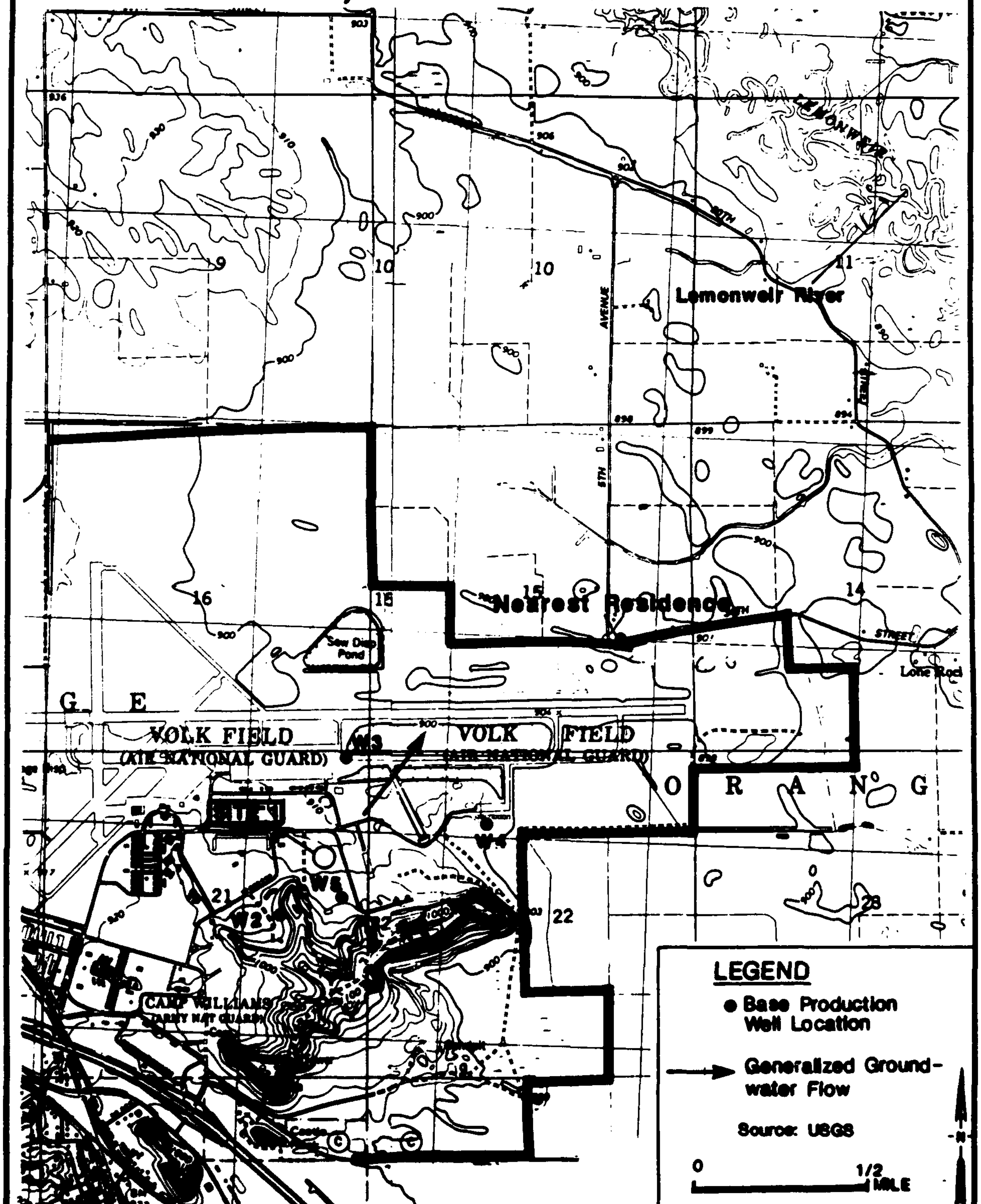
FIGURE 6.1

VOLK FIELD ANGB
CAMP DOUGLAS, WI

BASE PRODUCTION WELLS, NEAREST RESIDENCE, AND LEMONWEIR RIVER



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In general, organic compounds are readily absorbed via the lungs (inhalation) and gastrointestinal tract (oral). Absorption of compounds across the skin (dermal) is generally less extensive, particularly where metals are concerned. In the following assessment, absorption of organic compounds via the skin and gastrointestinal tract is considered to be 100 percent of the exposure concentration. Gastrointestinal and dermal absorption of lead are considered to be 40 percent and 1 percent of the exposure concentration, respectively. These percentages of absorption for lead reflect human data which have been reviewed extensively by USEPA and the scientific community (see the Ambient Air Quality Criterion Document for Lead, USEPA, 1987).

Sources, release mechanisms, transport media, exposure points, receptors, and routes of exposure were integrated to form complete pathways. A matrix of potential exposure pathways associated with Site 1 at Volk Field is presented in Table 6.3. Of the pathways listed in the table, only the following are considered to be complete:

- inhalation of volatile compounds released from contaminated soils
- incidental ingestion of soil on site
- dermal exposure to soils on site
- ingestion of groundwater

It was necessary to consider whether inhalation of airborne contaminants via fugitive dust generation was a complete pathway since Site 1 is unvegetated and since lead was detected in soil samples. However, the pathway was dismissed as incomplete since the site is known to have been covered with a four inch layer of sand and gravel (Nash, 1985).

Pathways involving surface water as a transport medium and the Lemonweir River as an exposure point were dismissed for the following reasons: the Lemonweir river and its tributaries are greater than 1/2 mile from Site 1; and the slope of the terrain between the site and the nearest tributary of the Lemonweir River is less than one percent, contamination via surface runoff seems unlikely. Additionally, contamination of the river by groundwater seepage was considered to be possible but was dismissed as insignificant due to 1) the distance from the site to the river, 2) the small gradient between the site and the river, and 3) the large volume of mixing.

TABLE 6.3
VOLK FIELD ANGB, CAMP DOUGLAS, WISCONSIN
MATRIX OF POTENTIAL EXPOSURE PATHWAYS
SITE 1: FIRE TRAINING AREA

Transport Medium	Release Source/ Mechanism	Primary Exposure Points	Primary Receptors	Number of People Primary Routes of Exposure	Pathway Potentially Exposed	Completion Possible	Probability of Pathway Completion
Air	Contaminated soils/ volatilization	Locations north of the site; on site.	Residents north of the site; employees on site.	Inhalation	1500	Yes	Probable: volatile organic compounds have been detected in surface soils, photoionization detector readings of 4 ppm have been detected in the breathing zone during drilling activities in winter, and an odor is present at the site.
	Contaminated soils/ fugitive dust generation	Locations north of the site; on site.	Residents north of the site; employees on site.	Inhalation	1500	Yes	Low for lead; unlikely for other compounds due to volatilization; fire training pit has been covered with a 4-inch layer of gravel and sand.
Groundwater	Contaminated soils/ site leaching	Residences northeast of the site.	Residents northeast of the site.	Oral	100	Yes	Probable: the extent to which the contaminant plume may have migrated off-site is currently unknown. Contaminants have been detected in downgradient wells furthest from the site.
		Water supply wells northeast of the site (W-3, W-4)	Employees on site.	Oral	1400	Yes	None; contaminants have not been detected in these water supply wells.
Soils	Contaminated soils/ groundwater/site leaching/tracking	On-site	Employees on site; nearby residents; trespassers.	Oral, Dermal	1500	Yes	Low to moderate; clothing will minimize potential for dermal exposure; incidental oral exposure could occur.
Surface Water	Contaminated soils and groundwater/ surface runoff, groundwater seepage	Lemonweir River	Individuals who might swim in the river.	Oral, Dermal	100	Yes	Unlikely; the site is flat and the river is more than 2 miles from the site.

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6.1.1.2 Estimation of Exposure Point Concentrations

Where possible, concentrations of indicator chemicals were calculated for each exposure point associated with a potentially complete pathway. Both best estimates and maximum estimates were calculated. The best estimate is the arithmetic mean of all detected concentrations. The maximum estimate is the highest value detected. For offbase private wells, the concentrations at the most distant downgradient base wells were used to determine the best estimate and maximum estimate.

6.1.1.3 Exposure via Air

As discussed previously, air emissions are likely to occur due to the presence of volatile organic compounds in soils at the site. The concentrations of indicator chemicals detected in the top 10 feet of soil sampled at Site 1 are shown in Table 6.4. Insufficient information was obtained during the investigation to calculate emission rates, and hence concentrations in air. Estimates of air concentrations which may be present due to volatilization of contaminants from soils can be calculated using results obtained from flux box experiments. A flux box is a device used for the capture and measurement of volatile compounds released from soils. No flux box measurements were made at Volk Field. These procedures would have allowed for an estimate of emission rates from soils, and could have been used in combination with dispersion modeling to make estimates of concentrations in air.

6.1.1.4 Exposure via Groundwater

Indicator chemicals were detected in samples of groundwater taken from monitoring wells which were installed in the vicinity of Site 1. Since contaminants were detected in the furthest downgradient wells, MW-1 and MW-4, the extent of contamination is unknown. As mentioned previously, groundwater flows in a northeasterly direction. Therefore, potential exposure points include water supply wells for Volk Field (W-3 and W-4) and nearby residences northeast of the site. Ideally, concentrations for these exposure points should be determined from samples taken at the exposure point. Indicator chemicals were not detected in base production wells W-3 and W-4 during a recent round of sampling. However, there are no sampling data for nearby residential wells. Whether or not the contaminant plume has reached (or even passed) the nearby residences is unknown, and since sampling data from residential wells are unavailable, the concentrations of indicator chemicals in monitoring Wells MW-1 and MW-4 are taken to represent the

TABLE 6.4
VOLK FIELD ANGB, CAMP DOUGLAS, WISCONSIN
CONCENTRATIONS IN TOP TEN FEET OF SOIL

Indicator Chemical	Best Estimate Concentration[1] (µg/kg)	Maximum Concentration[2] (µg/kg)
Benzene	5,550	16,000
Ethylbenzene	9,050	40,000
Lead	9,380	85,000
Phenol	ND	ND
Toluene	5,230	37,000
Trichloroethene	16	41
Naphthalene	5,000	7,000
Xylenes	36,300	88,000
Tetrachloroethene	0.7	0.9

ND = not detected
(1) Arithmetic mean of all detectable concentrations
(2) The highest value detected

concentrations in the nearby residential wells. These concentrations are shown in Table 6.5.

6.1.1.5 Exposure via Soils

Exposure may occur via incidental ingestion of soils on site or by way of dermal contact with soils on Site 1. Potential receptors include employees at Volk Field, any visitors who might visit Volk Field, and nearby residents who might walk onto the site. Children were not considered to be receptors since a small child between the ages of 2 and 6 (ages when pica is displayed) is not likely to play at a military installation. Concentrations of indicator chemicals in surface soils at Site 1 are shown in Table 6.6. Only samples taken from the top 24 inches of soil were considered when calculating these values since human contact with soil is most likely to involve only surface soils.

6.1.1.6 Identification of ARARS and Comparison with Exposure Point Concentrations

Section 121 of the Superfund Amendment and Reauthorization Act (SARA) establishes cleanup criteria for superfund sites. This section sets forth the need for appropriate remedial actions, consistent with the National Contingency Plan (NCP), that provide a cost effective response. Subsection (d) of section 121 stipulates that cleanup should "achieve applicable or relevant and appropriate standards under other federal or state laws". "Applicable standards" are those requirements, criteria or limitations promulgated under Federal or State laws which specifically address a hazardous substance, pollutant, contaminant, remedial action location, or other circumstance at a CERCLA site. "Relevant and Appropriate Standards" refers to those cleanup or control standards and other substantive environmental protection requirements, criteria, or limitations promulgated under Federal or State laws that, while not "Applicable", address problems or situations sufficiently similar to those encountered at a CERCLA site that their use is well suited to the site under consideration. The USEPA has identified three categories of ARARS: chemical-specific, location-specific, and action-specific. Chemical-specific ARARS were considered in this evaluation.

At present, USEPA considers drinking water Maximum Contaminant Levels (MCLs), Maximum Contaminant Level Goals (MCLGs), Federal Ambient Water Quality Criteria, National Ambient Air Quality Standards (NAAQS) and State environmental standards to be ARARS for ambient concentrations. Table 6.7 lists

TABLE 6.5
VOLK FIELD ANGB, CAMP DOUGLAS, WISCONSIN
CONCENTRATIONS IN GROUNDWATER[1]

Indicator Chemical	Best Estimate Concentration[2] (μg/L)	Maximum Concentration[3] (μg/L)
Benzene	227	450
Ethylbenzene	51	51
Lead	8	10
Phenol	ND	ND
Toluene	5.62	10.8
Trichloroethene	ND	ND
Naphthalene	10.6	19
Xylenes	55.5	107
Tetrachloroethene	ND	ND

(1) Wells MW-1 and MW-4 are furthest downgradient wells; concentrations in these wells are taken to represent exposure point concentrations in Volk Field water supply wells and water supply wells for nearby residences.

(2) Arithmetic mean of all detected concentrations

(3) Highest value detected

TABLE 6.6
VOLK FIELD ANGB, CAMP DOUGLAS, WISCONSIN
CONCENTRATIONS IN SURFACE SOILS[(1)]

Indicator Chemical	Best Estimate Concentration[(2)] (μg/kg)	Maximum Concentration[(3)] (μg/kg)
Benzene	4,570	16,000
Ethylbenzene	5,820	17,000
Lead	21,600	85,000
Phenol	ND	ND
Toluene	1,960	17,000
Trichloroethene	27	41
Naphthalene	ND	ND
Xylenes	27,500	83,000
Tetrachloroethene	0.7	0.9

(1) Concentrations detected in the top 24 inches of soil

Samples:

VF1-B1-SS1-0.5	VF1-B6-SS1-0	VF1-B26-SS1-0
VF1-B2-SS1-05	VF1-B7-SS1-0	VF1-B10-SS1-0.5
VF1-B4-SS1-0.5	VF1-B8-SS1-0	VF1-B15-SS1-0.5
VF1-B22-SS1-0.5	VF1-B9-SS1-0	

(2) Arithmetic mean of all detected concentrations

(3) Maximum value of all detected concentrations

TABLE 6.7
VOLK FIELD ANGB, CAMP DOUGLAS, WISCONSIN
APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS, STANDARDS, AND CRITERIA FOR THE INDICATOR CHEMICALS

Indicator Chemical	Safe[1] Drinking Water Act MCL (μg/L)	Safe[1] Drinking Water Act MCLG (μg/L)	Drinking Water and Organisms (μg/L)	Water Quality Criteria[2] Drinking Water Only (μg/L)	Clean Air[1] Act NAAQs ($\mu g/m^3$)	Wisconsin Air[4] Quality Standards ($\mu g/m^3$)	Wisconsin Ground Water[5] Quality Standards Preventive Action Limit (μg/L)	Wisconsin Ground Water[5] Quality Standards Enforcement Standard (μg/L)	TLV/420[6] ($\mu g/m^3$)
Benzene	5	0	0(0.66)[7]	0(0.67)[7]	--	--	0.067	0.67	7.14
Ethylbenzene	--	--	1,400	2,400	--	--	--	--	1,036
Lead	50	--	50	50	1.5 (90 days)	1.5 (90 days)	5.0	50	0.119
Phenol	--	--	3,500	3,500	--	--	--	--	45.2
Toluene	--	--	14,300	15,000	--	--	68.6	343	893
Trichloroethene	5	0	0(2.7)[7]	0(2.8)[7]	--	--	0.018	0.018	643
Naphthalene	--	--	--	--	--	--	--	--	119
Xylenes	--	--	--	--	--	--	124	620	1,040
Tetrachloroethene	--	--	0(0.80)[7]	0(0.88)[7]	--	--	0.1	0.1	798

(1) Source: 40 CFR 141; last amendment 52FR25712, July 8, 1987.
(2) Source: Federal Register, Vol. 50, No. 145, July 29, 1985; Vol. 45, No. 231, Nov. 28, 1980.
(3) Source: 40 CFR50; last amendment 52 FR 24663, July 1, 1987.
(4) Source: Wisconsin Administrative Code NR 404; last amendment and recodification on October 1, 1986.
(5) Source: Wisconsin Administrative Code, NR 140.10. Register, May 1986, No. 365.
(6) Source: ACGIH, 1988-1989 except for benzene and lead. The values for benzene and lead are based on OSHA PELs of 3 and 0.05 mg/m3, respectively.
(7) The concentration given in parentheses for potential carcinogens corresponds to a risk of 1 cancer per 1 million exposed persons.

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ARARs for each of the indicator chemicals associated with Site 1 at Volk Field. Since none of the indicator chemicals at the site except lead have ARARS for air, TLV/420 is listed under "other criteria". Threshold Limit Values (TLVs) divided by 420 are criteria used commonly by USEPA to assess exposure of general populations via air. The TLV is a time-weighted average which is based on occupational exposure for 8 hours per day, 5 days per week. Division by 420 converts occupational exposure to continuous exposure (24 hr/day, 7 days/week).

6.1.1.7 Groundwater

Both maximum (450 μg/L) and best estimate (227 μg/L) concentrations of benzene detected in groundwater samples drawn from wells MW-1 and MW-4 exceed the MCL of 5 μg/L and Wisconsin Groundwater Quality Standards of 0.067 μg/L (Preventive Action Limit) and 0.67 μg/L (Enforcement Standard). Both maximum (10 μg/L) and best estimates (8 μg/L) of lead in groundwater exceed the Wisconsin Preventive Action Limit of 5 μg/L. The maximum concentration of xylenes (107 μg/L) detected in groundwater samples from MW-1 and MW-4 is very close to the Wisconsin Preventive Action Limit. Of course, since no indicator chemicals were detected in base-production wells W-3 and W-4, water from these wells is in compliance with available standards.

6.1.1.8 Soils

There are no ARARS for compounds in soils. The USEPA (1980) cites an average of 10 ppm and a range of 2-200 ppm as concentrations of lead which can be found in typical soils in the United States.

6.1.1.9 Air

Insufficient information was available to predict reliably the concentrations of indicator chemicals in the air which would be likely to occur at primary exposure points.

6.1.1.10 Estimation of Exposure Point Intakes

In order to assess potential adverse health effects associated with Site 1, human intake was estimated from exposure point concentrations. Intake (absorbed dose) is expressed as the amount of a chemical taken into the body per unit body weight per unit time and is calculated separately for each environmental medium. Once calculated, intakes for each medium were summed to yield total dermal and oral intakes for each potential receptor. Normally whenever there are complete air pathways, total inhalation intakes are also calculated. However, since there is insufficient information with which to estimate concentrations of the indictor chemicals which might be present in air, it is not possible to quantify intakes via inhalation for this assessment. However, one should bear in mind that air pathways will contribute to overall exposure and, hence, risk.

The methodologies employed in estimating these intakes are discussed in exposure assessment guidance documents (EPA, 1984, 1985, 1986b) and the public health evaluation manual (EPA, 1986a).

Estimation of chronic daily intake via ingestion of groundwater is shown in Table 6.8. Both maximum and best estimate values have been calculated for nearby residents. Chronic daily intake (CDI) is calculated by multiplying the appropriate concentration by a human intake factor (HIF). For all groups, the HIF assumes that an adult weighs 70 kg and drinks 2 liters of water per day, and that 100 percent of the organic compounds and 40 percent of the lead are absorbed by the gastrointestinal tract. Chronic Daily Intake for employees on site and visitors to the site is zero for all of the indicator chemicals since no indicator chemicals were detected in base production Wells W-3 and W-4.

Estimation of exposure point intake via ingestion of soils at Site 1 are presented in Table 6.9. Adults ingest soil during routine daily activities which involve hand-to-mouth contact. Values for both employees on site and visitors to the site are given. For this pathway, values for nearby residents and visitors are the same since nearby residents can be visitors to the site. Both maximum and best estimates of chronic daily intake were obtained by multiplying the appropriate exposure point concentration by a human intake factor. The HIFs for both employees and visitors on site assume that an adult weighs 70 kg and ingests 25 mg of soil per day. Both HIF values assume that 100 percent of the organic chemicals and 1 percent of the lead are adsorbed through the skin. The HIF for employees assumes daily exposure while the HIF for visitors assumes exposure only three times per year.

Estimation of exposure point intakes via dermal contact with soils at Site 1 is shown in Table 6.10. Both maximum and best estimates of chronic daily intake for both employees on site and visitors to the site were obtained by multiplying the appropriate exposure point concentration by the appropriate human intake factor. The values for visitors also apply to nearby residents since nearby residents can be visitors to the site. The HIFs for both visitors and employees assumes the following:

TABLE 6.8
VOLK FIELD ANGB, CAMP DOUGLAS, WISCONSIN
ESTIMATION OF EXPOSURE POINT INTAKE VIA
INGESTION OF GROUND WATER ON NEARBY RESIDENTS

Indicator Chemical	Best Estimate Concentration (μg/L)	Maximum Concentration (μg/L)	HIF[1] (L/kg/day)	Chronic Daily Intake[2] (ug/kg/day)	
				Best Estimate	Maximum Estimate
Benzene	227	450	0.029	6.58	13.1
Ethylbenzene	51	51	0.029	1.48	1.48
Lead	8	10	0.0114	0.091	0.29
Phenol	ND	ND	0.029	ND	ND
Toluene	5.62	10.8	0.029	0.163	0.313
Trichloroethene	ND	ND	0.029	ND	ND
Naphthalene	10.6	19	0.029	0.307	0.551
Xylenes	55.5	107	0.029	1.61	3.1
Tetrachloroethene	ND	ND	0.029	ND	ND

ND = Not detected.
(1) Human Intake Factor: Assumes that an adult weighs 70 kg and drinks 2 liters per day; assumes 100% absorption for organic compounds and 40% absorption for lead.
(2) Chronic Daily Intake = Concentration x HIF.

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TABLE 6.9
VOLK FIELD ANGB, CAMP DOUGLAS, WISCONSIN
ESTIMATION OF EXPOSURE POINT INTAKE VIA
INGESTION OF SURFACE SOILS

Indicator Chemical	Best Estimate Concentration (μg/kg)	Maximum Concentration (μg/kg)	HIF(1) (kg soil/kg body weight/day)		Chronic Daily Intake(2) (μg/kg/day)			
					Employees on Site		Visitors(3)	
			Employees On-Site	Visitors On-Site(3)	Best Estimate	Maximum Estimate	Best Estimate	Maximum Estimate
Benzene	4,570	16,000	.000254	.00000294	1.16	4.06	0.0134	0.042
Ethylbenzene	5,820	17,000	.000254	.00000294	1.48	4.32	0.0171	0.050
Lead	21,600	85,000	.000102	.00000118	2.20	8.67	0.0255	0.100
Phenol	ND	ND	.000254	.00000294	0	0	0	0
Toluene	1,960	17,000	.000254	.00000294	0.497	4.32	0.0058	0.050
Trichloroethene	27	41	.000254	.00000294	0.007	0.0104	0.00008	0.00012
Naphthalene	ND	ND	.000254	.00000294	0	0	0	0
Xylenes	27,500	83,000	.000254	.00000294	6.98	21.1	0.0809	0.244
Tetrachloroethene	0.7	0.9	.000254	.00000294	0.00018	0.00023	0.000002	0.000003

ND = Not detected.

(1) = Human Intake Factor: for employees on site, assumes exposure 260 days/year (5 days/week); for visitors, assumes exposure 3 days/year; assumes a body weight of 70 kg and incidental ingestion of 25 mg of soil per day; assumes 100% absorption for organic compounds and 40% absorption for lead.

(2) Chronic Daily Intake = Concentration x HIF.

(3) Includes nearby residents.

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TABLE 6.10
VOLK FIELD ANGB, CAMP DOUGLAS, WISCONSIN
ESTIMATION OF EXPOSURE POINT INTAKE VIA DERMAL CONTACT WITH SOILS ON SITE

Indicator Chemical	Best Estimate Concentration (μg chemical/μg soil)	Maximum Concentration (μg chemical/μg soil)	HIF[1] (μg soil/kg body wt/day)		Chronic Daily Intake[1] (μg contaminant/kg body wt/day)[2]			
					Employees on Site		Visitors[3]	
			Employees On-Site	Visitors On-Site[3]	Best Estimate	Maximum Estimate	Best Estimate	Maximum Estimate
Benzene	0.00000457	0.000016	512,000	5,900	2.34	8.19	0.0269	0.0944
Ethylbenzene	0.00000582	0.0000017	512,000	5,900	2.98	0.87	0.0343	0.0100
Lead	0.0000216	0.000085	5,120	59	0.111	0.435	0.00127	0.00502
Phenol	ND	ND	512,000	5,900	0	0	0	0
Toluene	0.00000196	0.0000017	512,000	5,900	1.00	0.870	0.0116	0.0100
Trichloroethene	0.000000027	0.000000041	512,000	5,900	0.0138	0.0210	0.000159	0.000242
Naphthalene	ND	ND	512,000	5,900	0	0	0	0
Xylenes	0.0000275	0.000083	512,000	5,900	14.1	42.5	0.162	0.489
Tetrachloroethene	0.0000000007	0.0000000009	512,000	5,900	0.000358	0.000461	0.00000413	0.000005
31								

ND = Not detected.

(1) = Human Intake Factor: Assumes that an individual weights 70 kg and has a surface area of 18,150 cm2; assumes that the amount of soil which adheres to the skin is 2.77 mg/cm2 per contact; assumes one contact per day; assumes 100% absorption for organic compounds and 1% absorption for lead; assumes that employees on site are exposed 260 days per year (5/7 days per week) and that visitors are exposed 3 days per year.

(2) Chronic Daily Intake = Concentration x HIF.

(3) Includes nearby residents.

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- an adult weighs 70 kg and has a surface area of 18,150 cm^2
- the amount of soil which adheres to the skin is 2.77 mg/cm^2 per contact
- one contact per day
- adsorption is 100 percent for organic compounds and 1 percent for lead

For employees on site, the HIF assumes exposure on 260 days per year (5/7 days per week). For visitors, the HIF assumes exposure on three days per year.

6.1.1.11 Calculation of Total Route-Specific Chronic Daily Intake

The primary receptors of concern in this evaluation include employees on site, visitors to the site, and nearby residents. All of these receptors are considered to be potentially exposed via incidental ingestion of soils, dermal exposure to soils, and inhalation of volatilized airborne contaminants. Only nearby residents are potentially exposed via ingestion of groundwater. As mentioned previously, it was not possible to quantify exposure via inhalation since reliable estimates of concentrations of indicator chemicals in air could not be calculated from the available information. Tables 6.11 and 6.12 summarize best estimate and maximum estimate values, respectively, of chronic daily intake for each of the primary receptors.

The estimates of chronic daily intake shown in Tables 6.11 and 6.12 were used to generate total route-specific chronic daily intakes (oral, dermal) for each receptor. Total route-specific chronic daily intakes are shown in Tables 6.13 (best estimates) and 6.14 (maximum estimates).

6.1.2 Toxicity Assessment

For purposes of public health evaluation, USEPA (1986a) uses three values with which to characterize the toxicity of a given compound. These include:

- The acceptable intake for chronic exposure (AIC)
- The acceptable intake for subchronic exposure (AIS)
- The carcinogenic potency factor

The AIC for a compound is ideally based on a chronic study where the test animal or human population was exposed to the compound of interest over the major portion of the lifespan. The AIS is ideally based on studies involving subchronic exposure, i.e., exposure for approximately 10 percent of the lifespan.

TABLE 6.11
VOLK FIELD ANGB,
CAMP DOUGLAS, WI
SUMMARY OF CHRONIC INTAKE
(BEST ESTIMATE)

Receptor/ Indicator Chemical	Ingestion of Groundwater CDI (μg/kg/day)	Ingestion of Soils CDI (μg/kg/day)	Dermal Contact with Soils CDI (μg/kg/day)	Volatilization (μg/kg/day)
Employees On Site				
Benzene	0	1.16	2.34	*
Ethylbenzene	0	1.48	2.98	*
Lead	0	2.20	0.111	*
Phenol	0	0	0	*
Toluene	0	0.497	1.00	*
Trichloroethene	0	0.007	0.0138	*
Naphthalene	0	0	0	*
Xylenes	0	6.98	14.1	*
Tetrachloroethene	0	0.00018	0.000358	*
Visitors On Site				
Benzene	0	0.0134	0.0269	*
Ethylbenzene	0	0.0171	0.0343	*
Lead	0	0.0255	0.00127	*
Phenol	0	0	0	*
Toluene	0	0.0058	0.0116	*
Trichloroethene	0	0.00008	0.000159	*
Naphthalene	0	0	0	*
Xylenes	0	0.0809	0.162	*
Tetrachloroethene	0	0.000002	0.00000413	*
Nearby Residents N - NE of the Site				
Benzene	6.58	0.0134	0.0269	*
Ethylbenzene	1.48	0.0171	0.0343	*
Lead	0.0912	0.0255	0.00127	*
Phenol	0	0	0	*
Toluene	0.163	0.0058	0.0116	*
Trichloroethene	0	0.00008	0.000159	*
Naphthalene	0.307	0	0	*
Xylenes	1.61	0.0809	0.162	*
Tetrachloroethene	0	0.000002	0.00000413	*

* Not quantified.

TABLE 6.12
VOLK FIELD ANGB,
CAMP DOUGLAS, WI
SUMMARY OF CHRONIC INTAKE
(MAXIMUM ESTIMATE)

Receptor/ Indicator Chemical	Ingestion of Ground Water CDI (μg/kg/day)	Ingestion of Soils CDI (μg/kg/day)	Dermal Contact with Soils CDI (μg/kg/day)	Volatization (μg/kg/day)
Employees On Site				
Benzene	0	4.06	8.19	*
Ethylbenzene	0	4.32	0.870	*
Lead	0	8.67	0.435	*
Phenol	0	0	0	*
Toluene	0	4.32	0.870	*
Trichloroethene	0	0.0104	0.021	*
Naphthalene	0	0	0	*
Xylene	0	21.1	42.5	*
Tetrachloroethene	0	0.00023	0.000461	*
Visitors On Site				
Benzene	0	0.042	0.0944	*
Ethylbenzene	0	0.050	0.0100	*
Lead	0	0.100	0.00502	*
Phenol	0	0	0	*
Toluene	0	0.050	0.0100	*
Trichloroethene	0	0.00012	0.000242	*
Naphthalene	0	0	0	*
Xylene	0	0.244	0.489	*
Tetrachloroethene	0	0.000003	0.0000053	*
Nearby Residents N - NE of the Site				
Benzene	13.1	0.042	0.0944	*
Ethylbenzene	1.48	0.050	0.0100	*
Lead	0.290	0.100	0.00502	*
Phenol	0	0	0	*
Toluene	0.313	0.050	0.0100	*
Trichloroethene	0	0.00012	0.000242	*
Naphthalene	0.551	0	0	*
Xylene	3.10	0.244	0.489	*
Tetrachloroethene	0	0.000003	0.0000053	*

* Not quantified.

TABLE 6.13
VOLK FIELD ANGB
CAMP DOUGLAS, WI
BEST ESTIMATES OFTOTAL ROUTE-SPECIFIC CDIS

Exposure Point/ Indicator Chemical	Total Oral CDI (μg/kg/day)	Total Dermal CDI (μg/kg/day)	Total Inhalation CDI (μg/kg/day)
Employees On Site			
Benzene	1.16	2.34	*
Ethylbenzene	1.48	2.98	*
Lead	2.20	0.111	*
Phenol	0	0	*
Toluene	0.497	1.00	*
Trichloroethene	0.007	0.0138	*
Naphthalene	0	0	*
Xylenes	6.98	14.1	*
Tetrachloroethene	0.00018	0.000358	*
Visitors On Site			
Benzene	0.0134	0.0269	*
Ethylbenzene	0.0171	0.0343	*
Lead	0.0255	0.00127	*
Phenol	0	0	*
Toluene	0.0058	0.0116	*
Trichloroethene	0.00008	0.000159	*
Naphthalene	0	0	*
Xylenes	0.0809	0.162	*
Tetrachloroethene	0.000002	0.00000413	*
Nearby Residents N - NE of the Site			
Benzene	6.59	0.0269	*
Ethylbenzene	1.50	0.0343	*
Lead	0.117	0.00127	*
Phenol	0	0	*
Toluene	0.169	0.0116	*
Trichloroethene	0.00008	0.000159	*
Naphthalene	0.307	0	*
Xylenes	1.69	0.162	*
Tetrachloroethene	0.000002	0.00000413	*

* Not quantified.

TABLE 6.14
VOLK FIELD ANGB
CAMP DOUGLAS, WI
MAXIMUM ESTIMATES OF TOTAL ROUTE-SPECIFIC CDIS

Exposure Point/ Indicator Chemical	Total Oral CDI (μg/kg/day)	Total Dermal CDI (μg/kg/day)	Total Inhalation CDI (μg/kg/day)
Employees On Site			
Benzene	4.06	8.19	*
Ethylbenzene	4.32	0.87	*
Lead	8.67	0.435	*
Phenol	0	0	*
Toluene	4.32	0.87	*
Trichloroethene	0.0104	0.0210	*
Naphthalene	0.00023	0	*
Xylenes	21.1	42.5	*
Tetrachloroethene	0.00023	0.000461	*
Visitors On Site			
Benzene	0.047	0.0944	*
Ethylbenzene	0.050	0.0100	*
Lead	0.100	0.00502	*
Phenol	0	0	*
Toluene	0.050	0.0100	*
Trichloroethene	0.00012	0.000242	*
Naphthalene	0	0	*
Xylenes	0.244	0.489	*
Tetrachloroethene	0.00000265	0.0000053	*
Nearby Residents N - NE of the Site			
Benzene	13.1	0.0944	*
Ethylbenzene	1.53	0.0100	*
Lead	0.39	0.00502	*
Phenol	0	0	*
Toluene	0.363	0.0100	*
Trichloroethene	0.00012	0.000242	*
Naphthalene	0.551	0	*
Xylenes	3.34	0.489	*
Tetrachloroethene	0.00000265	0.0000053	*

* Not quantified.

If animal studies are used as the basis for an AIS and AIC, a No-Effect-Level (NOEL), No-Observed-Adverse-Effect-Level (NOAEL) or Lowest-Observed-Adverse-Effect-Level (LOAEL) is determined from the most appropriate study, and is subsequently divided by a series of uncertainty factors to arrive at an AIS or AIC for humans. The uncertainty factors reflect uncertainties associated with interspecific extrapolation, sensitive subgroups within a population, using a LOAEL to approximate a NOAEL if a NOEL or NOAEL was not determined, and for using subchronic data to estimate chronic exposure when chronic data are not available.

Carcinogenic potency factors are derived only for compounds which have been shown to cause an increased incidence of tumors in either human or animal studies.

The potency factor is an upper 95 percent confidence limit on lifetime risk and is determined by low-dose extrapolation modeling of human or animal data. When an animal study is used, the final potency factor is adjusted to account for extrapolation of animal data to humans. If the studies used to derive the potency factor were conducted for less than the lifespan of the animal (or human), the final potency factor is adjusted to reflect risk associated with lifetime exposure.

Subchronic exposure was not considered in the evaluation of Site 1 since the primary concern is potential lifetime risk. Therefore only AICs and carcinogenic potency factors were used in the following evaluation.

Available AIC values and carcinogenic potency factors for the indicator chemicals are presented in Table 6.15. For oral exposure, either a potency factor or an AIC is available for all of the indicator chemicals. Available values for inhalation are given even though intake of indicator chemicals via inhalation has not been quantified for this evaluation. Acceptable intake levels and carcinogenic potency factors have not been derived for dermal exposure.

6.1.3 Risk Characterization

In this phase of the public health evaluation, estimated chronic daily intakes are compared with AICs and potency factors to characterize risk. Carcinogenic and noncarcinogenic effects are considered separately.

6.1.3.1 Noncarcinogenic Effects

To assess the overall potential for noncarcinogenic effects associated with exposure to multiple chemicals, a hazard index approach has been developed by

TABLE 6.15
VOLK FIELD ANGB, CAMP DOUGLAS, WISCONSIN
CRITICAL TOXICITY VALUES(1)

Indicator Chemical	CAG Group[2]	Acceptable Intake Oral (μg/kg/day)	Chronic (μg/kg/day) Inhalation	Carcinogenic Potency Factor (μg/kg/day)	
				Oral	Inhalation
Benzene	A	None	None	52	26
Ethylbenzene	D	100	None	None	None
Lead	D	1.40	0.430	None	None
Phenol	D	35.7	20	None	None
Toluene	D	300	1,500	None	None
Trichloroethene	B2	None	None	11	4.60
Naphthalene	D	400[3]	None	None	None
Xylenes	D	10	400	None	None
Tetrachloroethene	B2	20	None	51	1.70

(1) Source of Data is U.S. EPA, 1986, unless otherwise referenced.

(2) CAG = U.S. EPA Carcinogen Assessment Group; CAG Groups are assigned as follows:

A	=	known human carcinogen
B1, B2	=	probable human carcinogen
C	=	limited evidence of carcinogenicity
D	=	insufficient evidence of carcinogenicity
E	=	evidence which supports lack of carcinogenicity

(3) Source = Health and Environmental Effects Profile on Naphthalene (EPA, 1986; ECAO-CIN-P192

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USEPA. This approach assumes that multiple sub-threshold exposures may result in an adverse effect and that the magnitude of the adverse effect will be proportional to the sum of the ratios of the sub-threshold exposures to acceptable exposures. This is expressed as:

$$\text{Hazard Index} = \text{Sum}\ (E_1/RL_1 + \cdots + E_i/RL_i)$$

where: E_i = Exposure level (chronic daily intake) of the ith toxicant

RL_i = Reference level (AIC) of the ith toxicant

Thus if any single toxicant is present at levels which exceed the reference level for that toxicant, then the hazard index will exceed unity. A hazard index greater than one indicates a potential hazard to human health.

The assumption of dose additivity reflected in the hazard index is best applied to compounds that induce the same effect by the same mechanism. Applying the hazard index to cases where the known compounds do not induce the same effect may overestimate risk. The hazard index is not a mathematic prediction of incidence or severity of effects. It is simply a numeric index which is designed to aid in identifying potential exposure problems. In cases where AIC values are not available for all noncarcinogenic compounds, the hazard index may not be reflective of the actual hazard at the site. Results should thus be carefully examined and the lack of AIC data should be considered.

Table 6.16 presents the ratios of oral CDI:AIC for each chemical by receptor. Ratios are available for all receptors for oral exposure. Since inhalation exposure to noncarcinogenic compounds was not quantified, there are no inhalation CDI:AIC ratios for any of the receptors. Thus the total hazard index for all routes of exposure for each receptor is due solely to oral exposure. The hazard index for each receptor is presented in Table 6.17. Hazard indices less than one indicate that potential health hazards associated with noncarcinogenic indicator chemicals at Site 1 are unlikely to exist for visitors and nearby residents under current conditions. However, the contribution of risk incurred due to inhalation of volatile compounds would have to be quantified before one could conclude that the hazard index is actually less than one for these receptors. Both the best estimate and maximum estimate of hazard indices for employees on site exceed unity. These values are due primarily to the incidental ingestion of lead in soils, and indicate a potential threat to the health of these receptors.

TABLE 6.16
VOLK FIELD ANGB
CAMP DOUGLAS, WI
CALCULATION OF CHRONIC HAZARD INDEX

Receptor/ Indicator Chemical	Oral AIC (µg/kg/day)	Oral CDI (µg/kg/day)		Oral CDI:AIC	
		Best Estimate	Maximum Estimate	Best Estimate	Maximum Estimate
Employees On Site					
Benzene	--	1.16	4.06	--	--
Ethylbenzene	100	1.48	4.32	0.0148	0.0432
Lead	1.40	2.20	8.67	1.57	6.19
Phenol	35.7	0	0	--	--
Toluene	300	0.497	4.32	0.00166	0.0144
Trichloroethene	--	0.007	0.0104	--	--
Naphthalene	400	0	0	--	--
Xylenes	10	8.59	24.2	0.859	2.42
Tetrachloroethene	20	0.00018	0.00023	0.000009	0.0000115
Visitors On Site					
Benzene	--	0.0134	0.0470	--	--
Ethylbenzene	100	0.0171	0.050	0.000171	0.0005
Lead	1.40	0.0255	0.100	0.0182	0.0714
Phenol	35.7	0	0	--	--
Toluene	300	0.0058	0.050	0.0000192	0.000167
Trichloroethene	--	0.00008	0.000121	--	--
Naphthalene	400	--	--	--	--
Xylenes	10	0.0809	0.244	0.00809	0.0244
Tetrachloroethene	20	0.000002	0.00000254	0.000000103	0.000000133
Nearby Residents N - NE of the Site					
Benzene	--	6.58	13.1	--	--
Ethylbenzene	100	1.50	1.53	0.015	0.0153
Lead	1.40	0.117	0.39	0.0836	0.279
Phenol	35.7	0	0	--	--
Toluene	300	0.169	0.363	0.000563	0.00121
Trichloroethene	--	0.0000794	0.000121	--	--
Naphthalene	400	0.307	0.551	0.000768	0.00138
Xylene	10	1.69	3.34	0.169	0.334
Tetrachloroethene	20	0.00000206	0.00000265	0.000000103	0.000000133

TABLE 6.17
VOLK FIELD ANGB
CAMP DOUGLAS, WI
SUMMARY OF HAZARD INDEX VALUES[1]

Receptor	Summary of CDI:AIC Ratios	
	Best Estimate	Maximum Estimate
Employees On Site	2.44	8.66
Visitors On Site	0.0265	0.0965
Nearby Residents N-NE of the Site	0.269	0.631

(1) These values reflect oral exposure only since only oral pathways were quantified for Site 1; inhalation of volatile organics is a viable pathway but was not quantified due to insufficient data. These estimates are based on theoretical calculations and represent worst case conditions.

6.1.3.2 Potential Carcinogenic Effects

For potential carcinogens, risk is estimated as a probability of developing cancer as a result of lifetime exposure. At low doses, risk associated with a given carcinogen is described by:

Risk = Dose x Carcinogenic Potency Factor

where:

Dose = chronic daily intake (μg/kg/day)

Carcinogenic potency factor = the upper 95 percent confidence limit on the risk of developing cancer over a lifetime

For purposes of public health evaluation, USEPA assumes that the risks associated with exposure to multiple carcinogens are additive. That is to say:

$$\text{Risk} = \text{SUM}_1\ (\text{CDI}_1 \text{ x Potency Factor}_1) + \cdots + (\text{CDI}_i \text{ x Potency Factor}_i)$$

where i = the ith carcinogenic indicator chemical.

Risk addition is valid when the following assumptions are met:

- doses are low
- no synergistic or antagonistic interactions occur
- similar endpoints are evaluated

For purposes of this evaluation it is also assumed that cancer risk due to routes of exposure is additive.

Table 6.18 shows the estimated cancer risks due to oral exposure for each receptor. These values are calculated only for the carcinogenic indicator chemicals: benzene, trichloroethene, and tetrachloroethene. These compounds are also considered to be carcinogenic via inhalation. However, since the intake of these compounds via inhalation cannot be quantified, the contribution of inhalation intake to overall carcinogenic risk cannot be quantified. Thus, the overall quantifiable risk of developing cancer which is potentially associated with Site 1 at Volk Field is estimated solely from oral exposure.

The chemical-specific risk values due to oral exposure have been summed to estimate total quantifiable carcinogenic risk for each receptor. These values are presented in Table 6.19. These values indicate risks of three to seven cancers in 10,000 individuals for nearby residents, six in 100,000 to two in 10,000 cancers for employees on site, and one to two cancers in one million for visitors to the site. The

TABLE 6.18
VOLK FIELD ANGB
CAMP DOUGLAS, WI
CALCULATION OF RISK DUE TO CARCINOGENS[1]

Receptor/ Indicator Chemical	Carcinogenic Potency Factor $(\mu g/kg/day)^{-1}$	Oral CDI (μg/kg/day) Best Estimate	Oral CDI (μg/kg/day) Maximum Estimate	Quantifiable Risk Best Estimate	Quantifiable Risk Maximum Estimate
Employees On Site					
Benzene	0.000052	1.16	4.06	.0000603	0.000211
Ethylbenzene	--	1.48	4.32	--	--
Lead	--	2.20	8.67	--	--
Phenol	--	0	0	--	--
Toluene	--	0.497	4.32	--	--
Trichloroethene	0.000011	0.00687	0.0104	0.0000000756	0.0000000114
Naphthalene	--	0	0	--	--
Xylenes	--	6.98	21.1	--	--
Tetrachloroethene	0.000051	0.000178	0.000229	0.00000000908	0.0000000117
Visitors On Site					
Benzene	0.000052	0.0134	0.047	0.000000697	0.00000244
Ethylbenzene	--	0.0171	0.050	--	--
Lead	--	0.0255	0.100	--	--
Phenol	--	0	0	--	--
Toluene	--	0.00576	0.05	--	--
Trichloroethene	0.000011	0.0000794	0.000121	0.000000000873	0.00000000133
Naphthalene	--	0	0	--	--
Xylenes	--	0.0809	0.244	--	--
Tetrachloroethene	0.000051	0.00000206	0.00000265	0.000000000105	0.000000000135
Nearby Residents N - NE of the Site					
Benzene	0.000052	6.59	13.1	0.000343	0.000681
Ethylbenzene	--	1.50	1.53	--	--
Lead	--	0.117	0.394	--	--
Phenol	--	0	0	--	--
Toluene	--	0.169	0.363	--	--
Trichloroethene	0.000011	0.0000794	0.000121	0.000000000873	0.00000000133
Naphthalene	--	0.307	0.551	--	--
Xylenes	--	0.0000169	3.34	--	--

(1) These values reflect oral exposure only since only oral pathways were quantified for Site 1; inhalation of volatile organics is a viable pathway but was not quantified due to insufficient data.

TABLE 6.19
VOLK FIELD ANGB
CAMP DOUGLAS, WI
TOTAL QUANTIFIABLE CARCINOGENIC RISK[1]

	Risk Expressed as Cancer Cases per 1 Million Exposed	
Receptor	Best Estimate	Maximum Estimate
Employees On Site	60.4	211
Visitors On Site	0.698	2.44
Nearby Residents N-NE of the Site	343	681

(1) These values reflect oral exposure only since only oral pathways were quantified for Site 1; inhalation of volatile organics is a viable pathway but was not quantified due to insufficient data. These values are theoretical and represent worst case estimates.

risks for nearby residents and employees on site are unacceptable under current EPA guidelines (one in 100,000 to one in one million cancers). The high risk for these receptors is due primarily to benzene in drinking water (nearby residents only) and soils (employees and nearby residents). The risks to visitors are within acceptable limits so long as inhalation exposure does not contribute significantly to the overall risk incurred.

6.2 SUMMARY AND CONCLUSIONS

A baseline public health evaluation was conducted for the Fire Training area (Site 1) at Volk Field Air National Guard Base, Camp Douglas, Wisconsin. This evaluation was conducted in accordance with the guidelines and methodology set forth in the USEPA Superfund Public Health Evaluation Manual (EPA, 1986a), and is intended to reflect the potential health risks associated with the site under existing conditions. The steps involved in the evaluation include the following: selection of indicator chemicals, identification of complete pathways of exposure, estimation of exposure point concentrations, identification of ARARs (Applicable or Relevant and Appropriate Requirements and Standards), estimation of exposure point intakes, and assessment of risk.

Indicator chemicals are selected in order to limit the number of chemicals which are carried through the public health evaluation to a manageable number. Based on their detected concentrations, pervasiveness at the site, toxicity, and persistence, the following compounds were chosen as indicator chemicals for Site 1 at Volk Field:

- benzene
- ethylbenzene
- lead
- phenol
- toluene
- trichloroethene
- naphthalene
- xylene
- tetrachloroethene

Once indicator chemicals were chosen, it was necessary to identify complete pathways of exposure. A complete pathway of exposure consists of the following elements: a release source and mechanism for chemical release, a transport medium, a point of potential human exposure (exposure point), a route of human exposure, and a human receptor. If any one of these elements is missing, then the pathway is incomplete, and human exposure cannot occur. The following complete pathways were identified for Site 1 at Volk Field:

- Inhalation of volatile compounds release from contaminated soils.
- Incidental ingestion of soil on site.
- Dermal exposure to soil on site.
- Ingestion of groundwater.

Potential receptors for these pathways include base employees, visitors to the base, and nearby residents. Employees and visitors (nearby residents may be visitors) may come into contact with soils at Site 1. Since groundwater in the vicinity of Volk Field is known to flow in a northeasterly direction, individuals who use water supply wells that are located northeast of Site 1 are potential receptors. Individuals in this category include base employees and visitors who drink from water supply wells W-3 and W-4, and nearby offbase residents located northeast of the site. Since the prevailing winds in the vicinity of Volk Field are from the south, nearby residents north of the base are potential receptors for the air pathway.

Once complete pathways of exposure were identified, the next step in the evaluation was the calculation of exposure point concentrations for each medium; i.e., concentrations to which human receptors are likely to be exposed at the point of contact. Where possible, concentrations of indicator chemicals were calculated for each exposure point associated with a potentially complete pathway. Both best estimates (average of all detected concentrations) and maximum estimates (the highest concentration detected) were calculated.

For groundwater, exposure point concentrations for nearby residents were calculated from concentrations of indicator chemicals detected in wells MW-1 and MW-4. The concentrations of indicator chemicals in these wells were taken to represent exposure point concentrations since MW-1 and MW-4 are the furthest downgradient wells, since the extent to which the plume has migrated from the site is unknown, and since sampling data from private wells are not currently available.

Exposure point concentrations were taken to be zero for base production wells since no indicator chemicals were detected in these wells during a recent round of sampling.

Exposure point concentrations of indicator chemicals in soils were calculated from samples taken from the top 24 inches of soil. Samples taken at depths greater than 24 inches were not included in the estimates of exposure point concentrations since human contact is most likely to involve only surface soils.

Once calculated, exposure point concentrations were compared with ARARs (Applicable or Relevant and Appropriate Requirements and Standards). ARARs for Volk Field included the available MCLs, MCLGs, Water Quality Criteria, and Wisconsin groundwater Quality Standards for each indicator chemical. For groundwater drawn from Wells MW-1 and MW-4, both maximum (450 μg/L) and best estimate (227 μg/L) concentrations of benzene exceed the MCL of 5 μg/L and the Wisconsin groundwater Quality Standards of 0.067 μg/L (Preventive Action Limit) and 0.67 μg/L (Enforcement Standard). Both maximum (10 μg/L) and best estimates (8 μg/L) of lead in groundwater from the above mentioned wells exceed the Wisconsin Preventive Action Limit of 5 μg/L. The maximum concentration of xylene (107 μg/L) detected in groundwater is very close to the Wisconsin Preventive Action Limit. There are no ARARs for compounds in soils.

If ARARs had been available for all of the indicator chemicals in all media of concern, the public health evaluation would have been complete at this point. However, since ARARs were not available for all media, it was necessary to calculate human intakes from the available exposure point concentrations. These values were used in conjunction with toxicity data to characterize risk.

Human intake (absorbed dose) is referred to as "chronic daily intake" (CDI) and is expressed as the amount of chemical taken into the body per unit body weight per day, over the duration of a lifetime. When conducting a public health evaluation, CDI is calculated for each chemical, exposure medium, route of exposure, and receptor. Once calculated, the chemical-specific CDIs for each medium are summed to yield total oral, dermal, and inhalation CDIs for each receptor. Total oral and dermal CDIs were calculated for each chemical and receptor associated with Site 1 at Volk Field. Inhalation CDIs were not calculated since there was insufficient information with which to calculate exposure point concentrations in air.

In order to characterize the risks associated with potential exposure to contaminants at Site 1, Volk Field, the above route-specific CDIs were compared with toxicity values which have been derived by EPA. In this characterization, carcinogenic and noncarcinogenic effects were considered separately.

For noncarcinogenic compounds, route-specific CDIs were compared with toxicity values known as AICs (Acceptable Chronic Intake). AICs are route and chemical-specific reference doses which represent the maximum amount of a compound which can safely be absorbed into the body over a liftime. To assess noncarcinogenic risks, ratios of CDI to AIC were calculated for each indicator chemical, route of exposure, and receptor. These ratios were then summed across chemicals and routes of exposure to yield a hazard index for each receptor. A hazard index of less than one indicates that no risk is likely to be incurred by a receptor. A hazard index which is greater than one indicates that adverse health effects associated with exposure may possibly be incurred over the lifespan of the exposed receptor. Hazard indices for receptors associated with Site 1 at Volk Field range from 2.44 to 8.66 for employees onsite, 0.0265 to 0.0965 for visitors to the site, and 0.269 to 0.631 for nearby residents. The lower value of the range is the hazard index which was calculated from average estimates of CDI. The upper value of the range is the hazard index calculated from maximum estimates of CDI. Since it was not possible to quantify human intake associated with inhalation of indicator chemicals, and since AIC values do not exist for dermal exposure, these hazard indices are based solely on oral exposure. Hazard indices less than one indicate that potential health hazards associated with noncarcinogenic indicator chemicals at Site 1 are unlikely to exist for visitors and nearby residents under current conditions. However, the contribution of risk incurred due to inhalation of volatile compounds would have to be quantified before one could conclude that the hazard index is actually less than one for these receptors. Both the best estimate and maximum hazard index for employees on-site exceed unity. These values are due primarily to the incidental ingestion of lead in soils, and indicate the existence of a potential threat to health for these receptors.

For carcinogenic compounds, route-specific CDIs were multiplied by route and chemical-specific potency factors to obtain the risk of developing cancer over a lifetime for each chemical and route of exposure. Since route-specific CDIs were available only for oral exposure, and since EPA has not derived potency factors for dermal exposure, risks were calculated only for oral exposure. The risks associated with oral exposure for each indicator chemical were then added to yield an overall risk for each receptor. Based on the available data, best estimate, and maximum estimates of overall quantifiable risk are 60.4 and 211 cancers per one million exposed persons (for employees on site), 0.698 and 2.44 cancers per one million exposed persons (for visitors to the site), and 343 and 6.81 cancers per one million exposed persons (for nearby residents). In other words, the risks of developing cancer are three to seven cancers in 10,000 individuals for nearby residents, six in 100,000 to two in 10,000 cancers for employees onsite, and one to two cancers in one million for visitors to the site. The risks for nearby residents and employees onsite are unacceptable under current EPA guidelines (one in 100,000 to one in one million cancers). The high risk for these receptors is due primarily to benzene in drinking water (nearby residents only) and soils (employees and nearby residents). The risks to visitors are within acceptable limits so long as inhalation exposure does not contribute significantly to the overall risk incurred.

SECTION 7
RECOMMENDATIONS

In this section, recommendations based upon consideration of the Investigation Results (Section 4), Regulatory Significance of Results (Section 5), and the Public Health Evaluation (Section 6) are presented.

7.1 RECOMMENDATIONS

As discussed in Section 4.1.1, information was obtained after the completion of the field work indicating that fire training and fuel disposal activities may have occurred in areas other than the identified fire training pit at Site 1. Additional investigative work is required to identify all the sources of contamination at Site 1. Also the extent of the contaminant plume migrating from Site 1 should be determined.

Following the completion of this work, a feasibility study (FS) should be prepared for Site 1 that will provide the basis for selection of a remedial response that will cost-effectively mitigate and minimize threats to, and provide adequate protection of, public health, welfare, and the environment. The FS should address the potential responses by operable unit. Operable units are defined in the National Contingency Plan (NCP) as discrete parts of the entire response action that decrease a release, threat of release, or pathway of exposure. Operable units of Site 1 are:

- Remediation of source contamination, and
- Remediation of contaminated groundwater migrating from Site 1.

The recommended components for the follow-on investigation are described by operable unit in the following paragraphs.

7.1.1 Contamination Source at Site 1

To better define the source of contamination at Site 1 a soil gas survey should be conducted to the south and east of the presently located fire training pit. Prior to conducting this survey an effort should be made to meet with base personnel who possess knowledge of past activities at the Fire Training Area. The purpose of this meeting will be to ascertain the areas in which the discharge of fuels may have occurred in the past. Based on the results of this meeting, the area of the soil gas survey will be determined. Soil borings and soil sampling should be performed in areas of suspected contamination. The soil samples should be screened for volatile organic contaminants using an organic vapor analyzer (or similar instrument) and selected for chemical analysis based on these measurements.

7.1.2 Contaminant Migration From Site 1

To further define the vertical extent of contamination, additional monitoring wells are needed at the site. The horizontal extent of contaminant migration will be further defined by the installation of wells along the estimated leading edge of the contaminant plume. Monitoring wells should also be installed in any new area of contamination identified. Shallow monitoring well should be installed so that free-floating product, if present, may be detected. The location and construction details of these proposed monitoring wells will be determined based on conditions encountered during the field investigation.

Groundwater samples should be collected from selected existing and all the additional Site 1 wells. In order to better define potential health risks at Volk Field ANGB, the five base production wells, which are used for potable water, should be sampled and analyzed for appropriate parameters. An examination of base production wells W-3, W-4, and W-5 should be completed to determine construction details if accurate records for these wells are not available. The static groundwater elevation at these three wells should be determined to better define groundwater flow directions northeast of Site 1.

7.1.3 Removal Actions

In accordance with the NCP, removal actions include appropriate actions that will minimize the migration of hazardous substances into the soil or groundwater. The high levels of contamination in the soils at Site 1 provide a continuous source of groundwater contamination beneath the site. A temporary cap should be placed over these contaminated soils so as to reduce surface water infiltration at the site and a temporary fence installed around this area.

In addition to minimizing further degradation of the groundwater this cover will reduce the amount of potential volatile contaminants in the ambient air at Site

1. The potential exposure to the public could also be reduced by fencing the immediate area of contamination. The effectiveness of these measures in reducing the potential threat to human health via inhalation could be monitored using Flux Boxes located immediately outside the proposed fenced-off area.

SECTION 8
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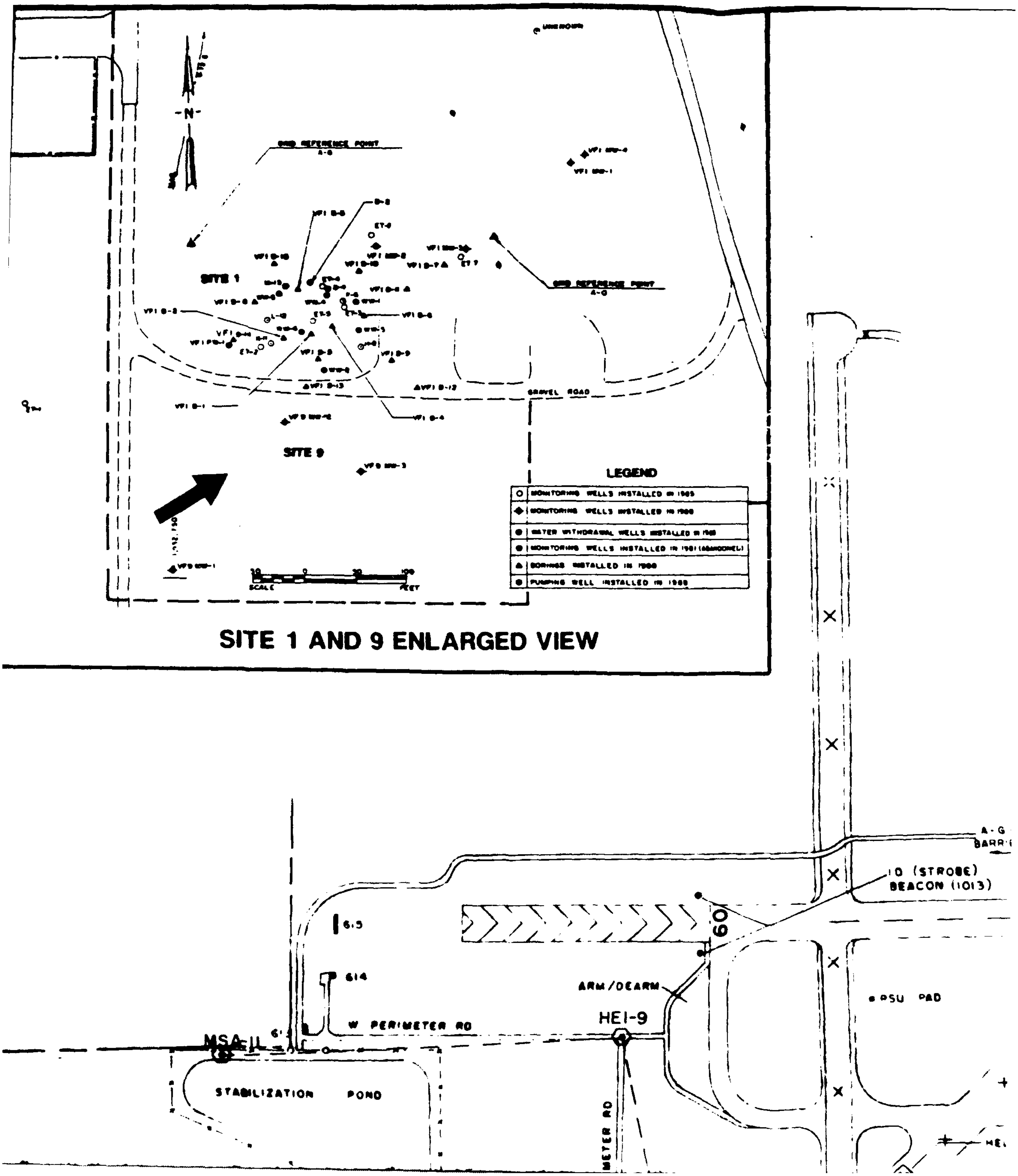
SECTION 9
SITE MAP OF VOLK FIELD ANGB



N
GRID REFERENCE POINT
SITE 1
SITE 9
GRAVEL ROAD
LEGEND
SITE 1 AND 9 ENLARGED VIEW
10 (STROBE)
BEACON (1013)
615
614
ARM/DEARM
HEI-9
W PERIMETER RD
MSA-IL
STABILIZATION POND
PSU PAD
METER RD
60

HORIZONTAL CONTROL POINTS

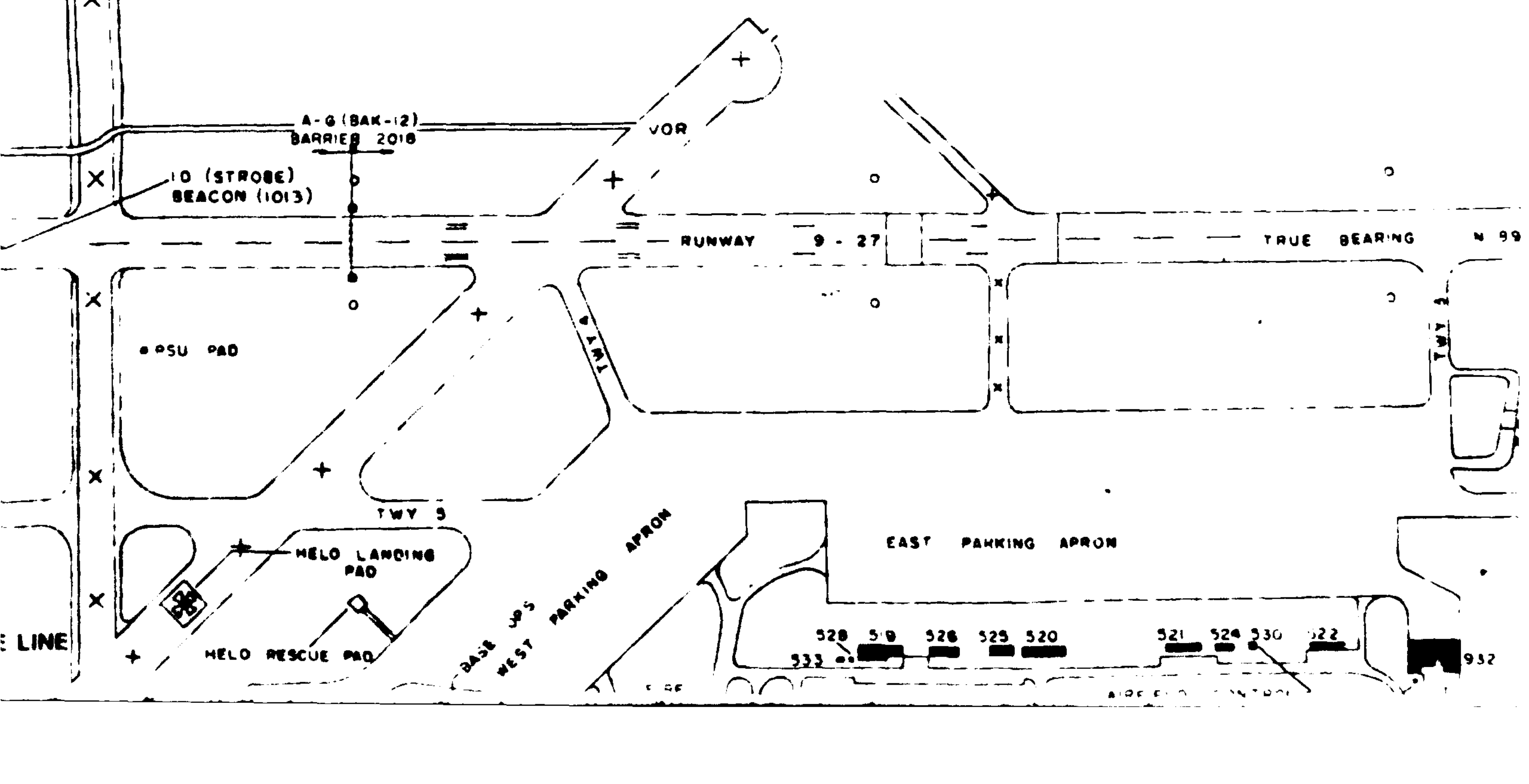
POINTS SET BY MID-STATE ASSOCIATES, BARABOO, WISCONSIN (1984)

POINT	NORTH COORDINATE	EAST COORDINATE	DESCRIPTION
MSA-205	701,177.95	1,935,375.30	3/8" PIN
MSA-204	701,695.58	1,935,903.96	3/8" PIN
MSA-203	703,659.59	1,936,217.18	3/8" PIN
MSA-11	706,286.18	1,926,909.57	3/4" PIN

POINTS SET BY HANSON ENGINEERS INC., SPRINGFIELD, ILLINOIS (1987)

POINT	NORTH COORDINATE	EAST COORDINATE	DESCRIPTION
HEI-1	705,105.62	1,936,164.51	1"*2" STAKE
HEI-2	705,118.94	1,934,906.15	NAIL & WASHER
HEI-3	704,715.18	1,934,606.17	1"*2" STAKE
HEI-4	704,404.34	1,934,703.26	5/8" PIN
HEI-5	704,182.63	1,933,442.73	NAIL & WASHER
HEI-6	705,035.91	1,933,154.69	NAIL & WASHER
HEI-7	705,019.23	1,929,880.82	NAIL & WASHER
HEI-8	703,446.47	1,929,130.58	BRASS DISK
HEI-9	706,390.49	1,928,506.36	NAIL & WASHER

COORDINATES SHOWN ARE GRID COORDINATES BASED ON THE WISCONSIN STATE PLANE COORDINATE SYSTEM GROUND TO GRID FACTOR 0.9999300.



34)

(1987)

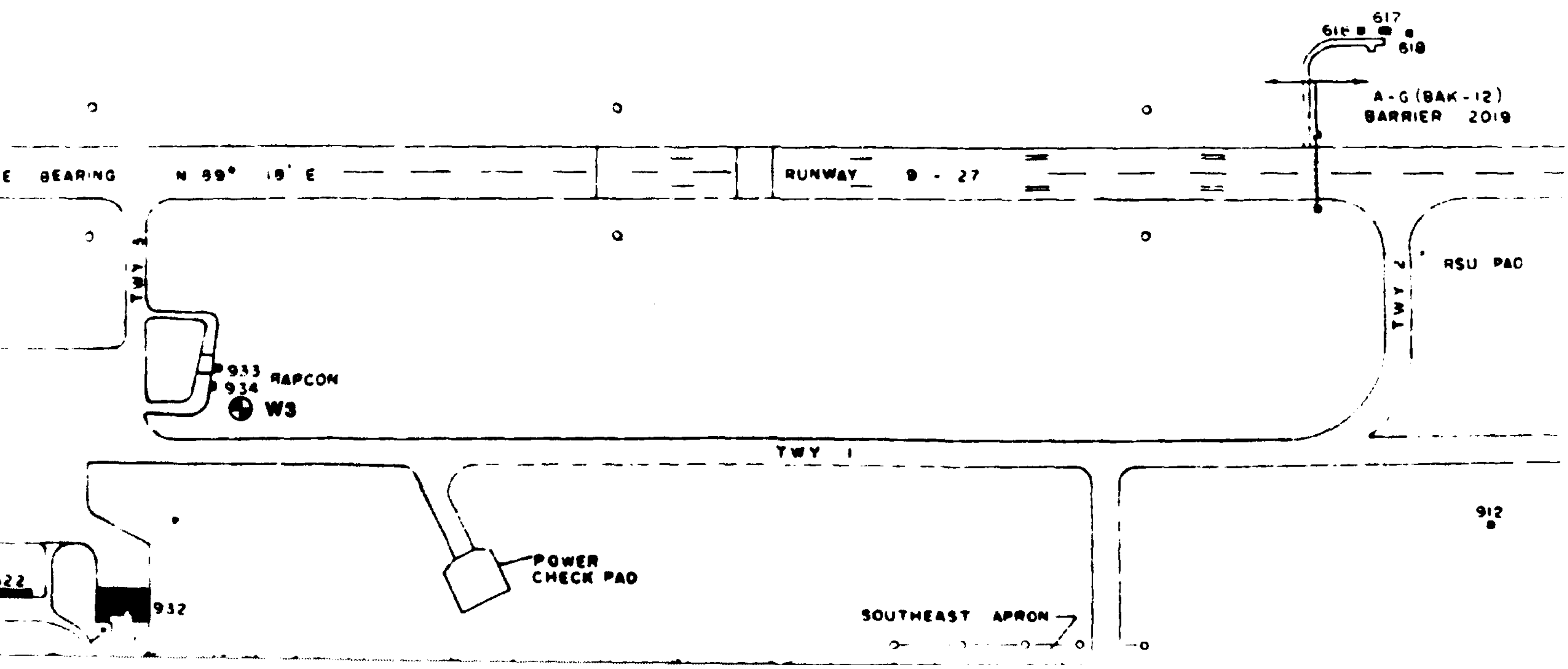
IN STATE

SITE GRID REFERENCE POINTS

POINT	NORTH COORD.	EAST COORD.	DESCRIPTION
SITES 1, 4, 9			
A-0	704.599.57	1.933.065.59	STAKE
A-6	704.592.97	1.932.766.21	STAKE
SITE 2			
16+54.7N . 10E	700.577.40	1.936.197.16	5/8" PIN
20N . 10E	700.901.52	1.936.078.10	5/8" PIN
SITE 7			
400N . 100E	704.404.52	1.934.103.41	STAKE
400N . 700E	704.404.34	1.934.703.26	5/8" PIN
SITE 3/6, POL AREA			
A-0	704.578.20	1.927.416.21	STAKE
A-5	704.765.53	1.927.250.96	STAKE

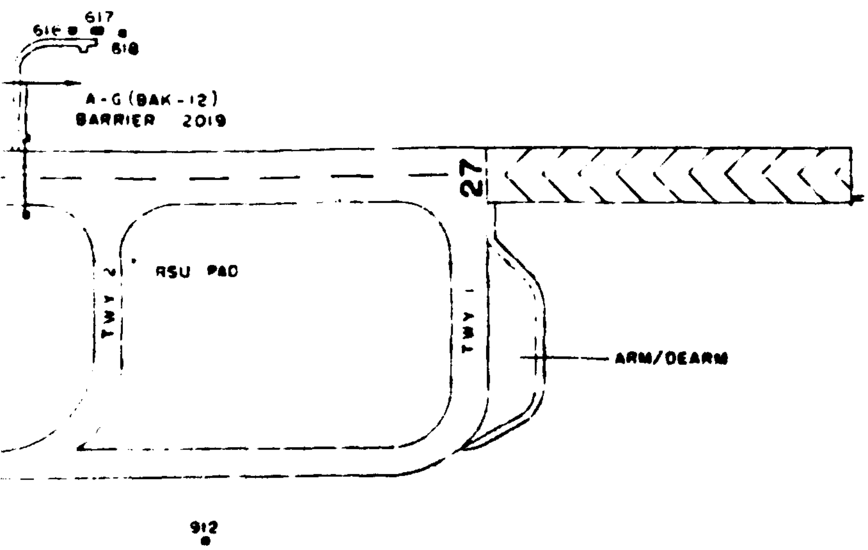
THESE POINTS WERE USED FOR ESTABLISHING

INDIVIDUAL SITE GEOPHYSICAL GRIDS



POINTS

:OORD.	DESCRIPTION
165.59	STAKE
'66.21	STAKE
97.16	5/8" PIN
178.10	5/8" PIN
03.41	STAKE
'03.26	5/8" PIN
16.21	STAKE
'50.96	STAKE



WELL AND BORING INFORMATIC

SITE 1 FIRE TRAININ

WELL NO	NORTH COORDINATE	EAST COORDINATE	GROUND EL.	TO
(MONITORING WELLS INSTALLED IN 1985)				
ET-1	704.430.30	1.932.600.32	920.7	9
ET-2	704.486.05	1.932.835.33	917.2	9
ET-3	704.526.98	1.932.916.68	9'5.4	9
ET-4	704.547.38	1.932.896.17	915.4	9
ET-5	704.512.13	1.932.886.02	916.7	9
ET-7	704.579.31	1.933.032.90	913.8	
ET-6	704.601.42	1.932.943.86	912.8	9
(MONITORING WELLS INSTALLED IN 1988)				
VF1 MW-1	704.675.21	1.933.142.95	911.2	9
VF1 MW-2	704.589.98	1.932.948.32	913.3	9
VF1 MW-3	704.587.36	1.933.037.52	913.3	9
VF1 MW-4	704.683.81	1.933.156.80	911.2	9
(WATER WITHDRAWAL WELLS INSTALLED IN 1985)				
WW-1	704.531.88	1.932.928.21	915.7	
WW-2	704.461.89	1.932.896.85	917.6	
WW-3	704.539.82	1.932.853.35	915.5	
WW-4	704.538.47	1.952.899.43	915.5	
WW-5	704.502.95	1.932.931.28	916.7	
WW-6	704.501.02	1.932.874.84	916.4	
(MONITORING WELLS INSTALLED IN 1981)				
B-2	704.551.84	1.932.882.68	915.8	
D-4	704.545.41	1.932.899.85	915.6	
F-6	704.532.14	1.932.915.78	915.6	
H-8	704.486.26	1.932.933.04	917.3	
K-11	704.489.39	1.932.845.44	917.3	
L-12	704.513.28	1.932.841.88	917.0	
M-13	704.547.38	1.932.858.90	915.5	
UNKNOWN WELL	704.809.92	1.933.108.98	909.1	
(PUMPING WELL INSTALLED IN 1988)				
VF1 PW-1	704.488.04	1.932.805.03	917.4	9

(SITE BORING LOCATIONS DRILLED IN 1988)

BORING NO	NORTH COORDINATE	EAST COORDINATE	GROUND EL.
VF1 B-1	704.499.10	1.932.884.41	917.0
VF1 B-2	704.494.93	1.932.857.72	917.0
VF1 B-3	704.544.06	1.932.871.33	915.4
VF1 B-4	704.506.66	1.932.905.10	917.1
VF1 B-5	704.473.93	1.932.891.37	917.1
VF1 B-6	704.517.34	1.932.936.07	916.3
VF1 B-7	704.570.87	1.933.016.59	913.5
VF1 B-8	704.531.61	1.932.830.09	916.3
VF1 B-9	704.472.09	1.932.964.31	916.8
VF1 B-10	704.564.08	1.932.931.60	914.1
VF1 B-11	704.544.57	1.932.979.39	914.6
VF1 B-12	704.443.93	1.932.989.41	917.6
VF1 B-13	704.445.03	1.932.879.33	917.9
VF1 B-14	704.492.81	1.932.809.17	917.3
VF1 B-15	704.571.96	1.932.849.15	914.5

SITE 2 FORMER LANI

WELL NO.	NORTH COORDINATE	EAST COORDINATE	GROUND EL.	TOP (EL
VF2 MW-1	701.135 61	1.935.810.84	900 5	901.

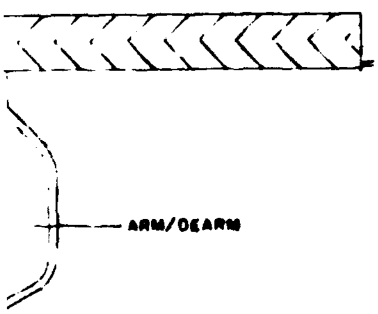
WELL AND BORING INFORMATION

SITE 1 FIRE TRAINING AREA

WELL NO	NORTH COORDINATE	EAST COORDINATE	GROUND EL.	TOP CASE EL.	TOP PIPE EL.
(MONITORING WELLS INSTALLED IN 1985)					
ET-1	704.430.30	1.932.600.32	920.7	922.45	922.35
ET-2	704.486.05	1.932.835.33	917.2	919.49	919.27
ET-3	704.526.98	1.932.916.68	915.4	917.61	917.43
ET-4	704.547.38	1.932.896.17	915.4	917.48	917.24
ET-5	704.512.13	1.932.886.02	916.7	918.91	918.55
ET-7	704.579.31	1.933.032.90	913.8	NONE	915.76
ET-6	704.601.42	1.932.943.86	912.8	915.26	914.94
(MONITORING WELLS INSTALLED IN 1988)					
VF1 MW-1	704.675.21	1.933.142.95	911.2	912.51	912.34
VF1 MW-2	704.589.98	1.932.948.32	913.3	915.54	915.33
VF1 MW-3	704.587.36	1.933.037.52	913.3	915.18	914.85
VF1 MW-4	704.683.81	1.933.156.80	911.2	912.93	912.76
(WATER WITHDRAWAL WELLS INSTALLED IN 1985)					
WW-1	704.531.88	1.932.928.21	915.7	NONE	917.12
WW-2	704.461.69	1.932.896.85	917.6	NONE	919.27
WW-3	704.539.82	1.932.853.35	915.5	NONE	917.56
WW-4	704.538.47	1.952.899.43	915.5	NONE	917.19
WW-5	704.502.95	1.932.931.28	916.7	NONE	918.14
WW-6	704.501.02	1.932.874.84	916.4	NONE	919 13
(MONITORING WELLS INSTALLED IN 1981)					
B-2	704.551.84	1.932.882.68	915.8	ABANDONED	
D-4	704.545.41	1.932.899.85	915.6	ABANDONED	
F-6	704.532.14	1.932.915.78	915.8	ABANDONED	
H-8	704.486.26	1.932.933.04	917.3	ABANDONED	
K-11	704.489.39	1.932.845.44	917.3	ABANDONED	
L-12	704.513.28	1.932.841.88	917.0	ABANDONED	
M-13	704.547.38	1.932.858.90	915.5	ABANDONED	
UNKNOWN WELL	704.809.92	1.933.108.98	909.1	ABANDONED	
(PUMPING WELL INSTALLED IN 1988)					
VF1 PW-1	704.488.04	1.932.805.03	917.4	919.83	919.64

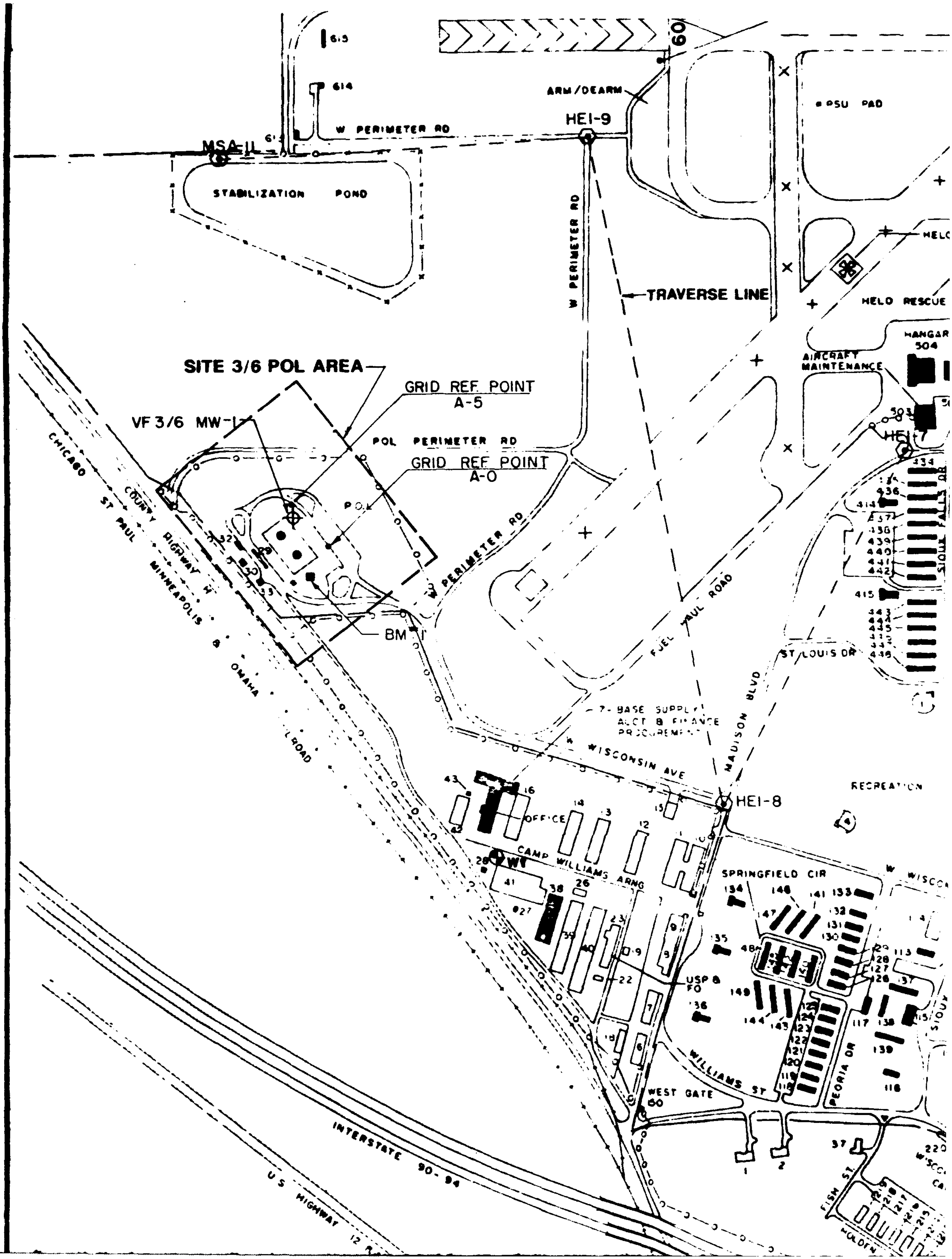
(SITE BORING LOCATIONS DRILLED IN 1988)

BORING NO	NORTH COORDINATE	EAST COORDINATE	GROUND EL.
VF1 B-1	704.499.10	1.932.884.41	917.0
VF1 B-2	704.494.93	1.932.857.72	917.0
VF1 B-3	704.544.06	1.932.871.33	915.4
VF1 B-4	704.506.66	1.932.905.10	917.1
VF1 B-5	704.473.93	1.932.891.37	917.1
VF1 B-6	704.517.34	1.932.936.07	916.3
VF1 B-7	704.570.87	1.933.016.59	913.5
VF1 B-8	704.531.61	1.932.830.09	916.3
VF1 B-9	704.472.09	1.932.964.31	916.8
VF1 B-10	704.564.08	1.932.931.60	914.1
VF1 B-11	704.544.57	1.932.979.39	914.6
VF1 B-12	704.443.93	1.932.989.41	917.6
VF1 B-13	704.445.03	1.932.879.33	917.9
VF1 B-14	704.492.81	1.932.809.17	917.3
VF1 B-15	704.571.96	1.932.849.15	914.5

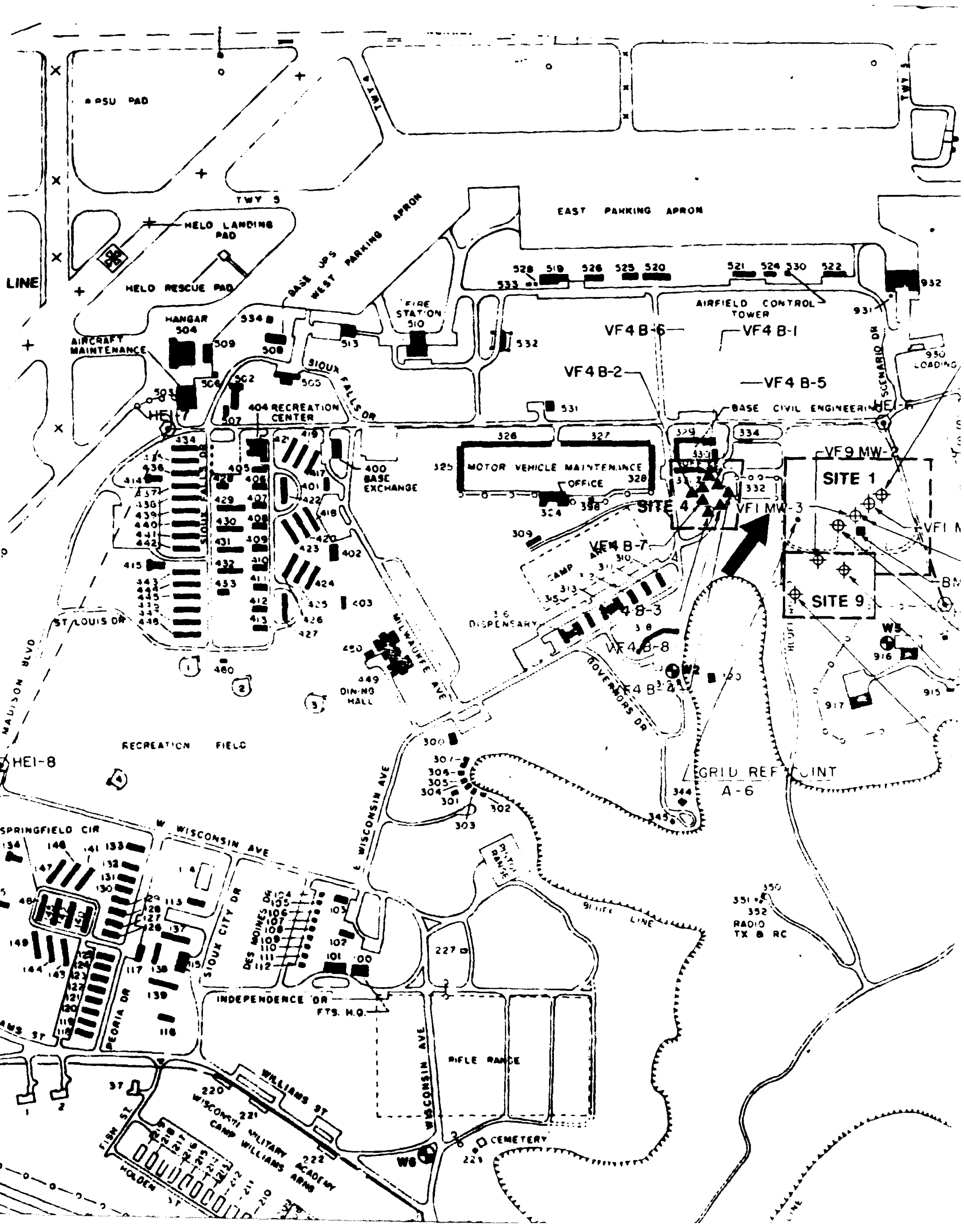


SITE 2 FORMER LANDFILL C

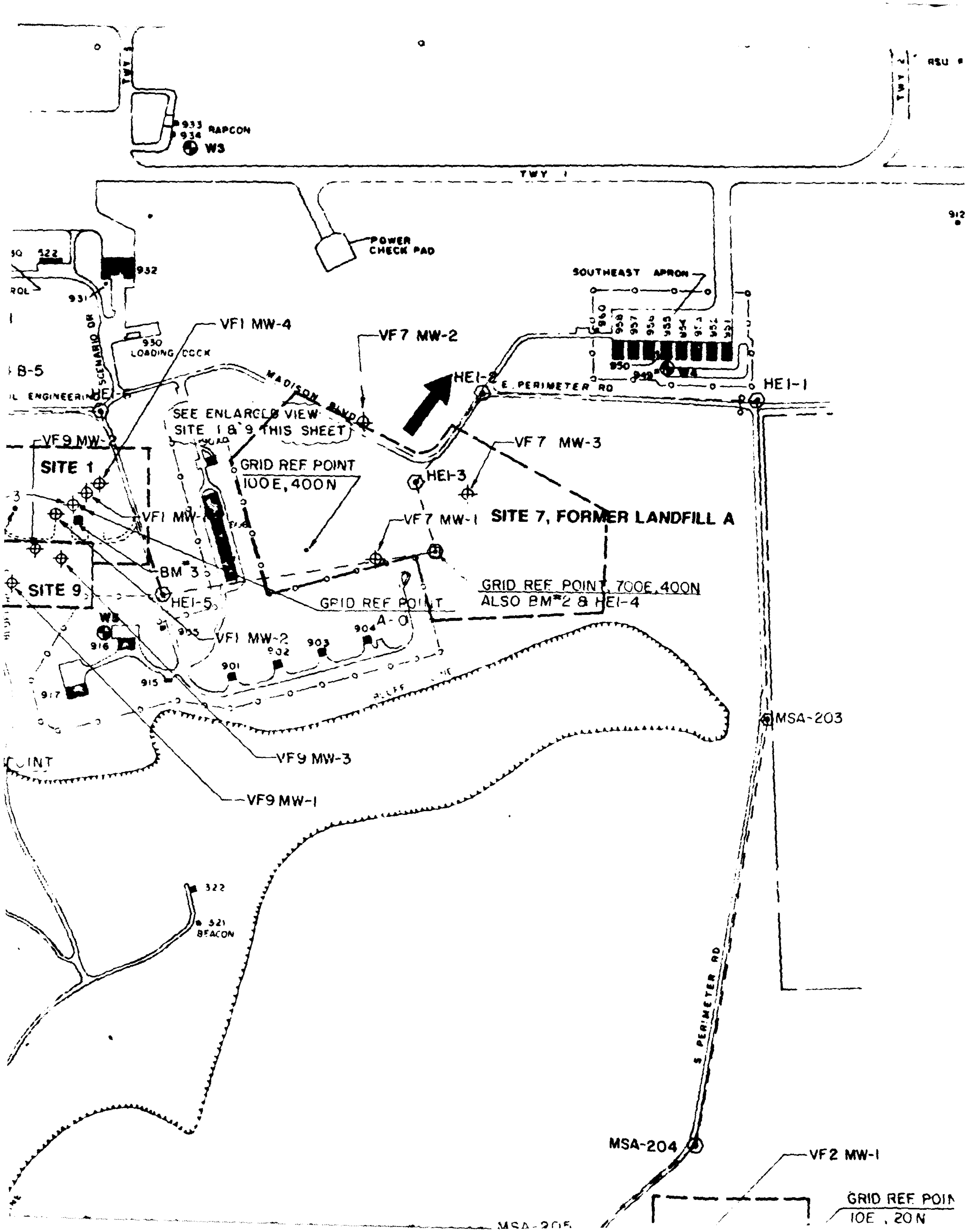
WELL NO.	NORTH COORDINATE	EAST COORDINATE	GROUND EL.	TOP CASE EL.	TOP PIPE EL.	WATER EL. 4/22/88
VF2 MW-1	701.135.61	1.935.810.84	900.5	901.74	901.53	[illegible]



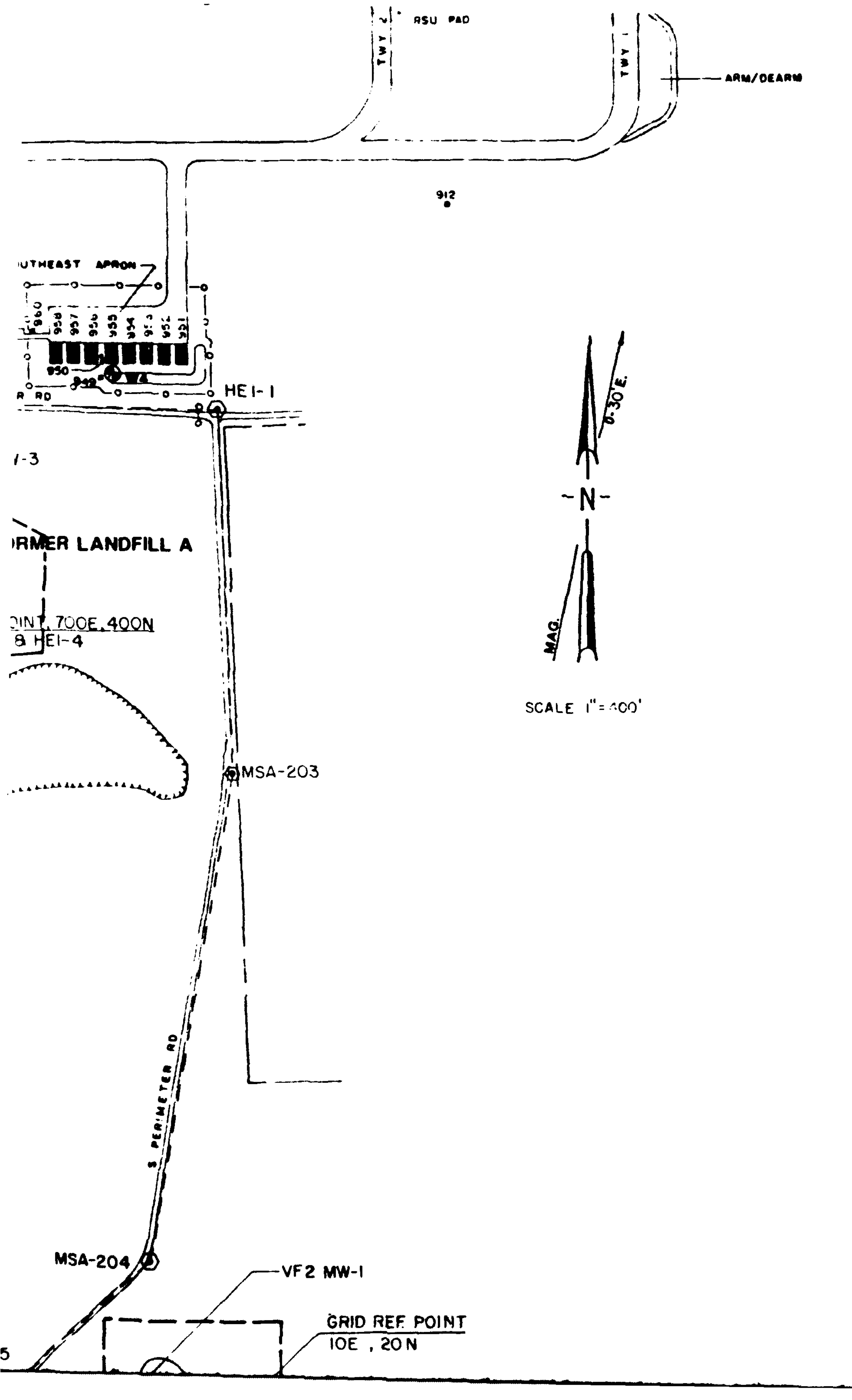
SITE 3/6 POL AREA
GRID REF. POINT A-5
GRID REF. POINT A-0
VF 3/6 MW-1
MSA-1L
HEI-9
HEI-8
HEI-7
BM-1
TRAVERSE LINE
STABILIZATION POND
W PERIMETER RD
POL PERIMETER RD
ARM/DEARM
PSU PAD
HELO RESCUE
HANGAR 504
AIRCRAFT MAINTENANCE
FUEL HAUL ROAD
MADISON BLVD
ST LOUIS DR
W WISCONSIN AVE
CAMP WILLIAMS ARNG
SPRINGFIELD CIR
WILLIAMS ST
PEORIA DR
WEST GATE
RECREATION
OFFICE
USP & FO
CHICAGO ST PAUL MINNEAPOLIS & OMAHA RAILROAD
COUNTY HIGHWAY
INTERSTATE 90-94
U S HIGHWAY 12
FISH ST
HOLDEN
7- BASE SUPPLY ACCT & FINANCE PROCUREMENT



APSU PAD
TWY 5
TWY 4
EAST PARKING APRON
HELO LANDING PAD
HELO RESCUE PAD
BASE OPS
WEST PARKING APRON
LINE
HANGAR 504
AIRCRAFT MAINTENANCE
FIRE STATION 510
AIRFIELD CONTROL TOWER
VF4 B-6
VF4 B-1
VF4 B-2
VF4 B-5
VF4 B-7
VF4 B-3
VF4 B-8
BASE CIVIL ENGINEERING
SIOUX FALLS DR
RECREATION CENTER
MOTOR VEHICLE MAINTENANCE
OFFICE
BASE EXCHANGE
SITE 1
SITE 4
SITE 9
VF9 MW-2
VF1 MW-3
HEI-7
HEI-8
ST LOUIS DR
MADISON BLVD
DISPENSARY
CAMP AVE
DINING HALL
MILWAUKEE AVE
GOVERNORS DR
SCENARIO DR
RECREATION FIELD
GRID REF POINT A-6
E WISCONSIN AVE
W WISCONSIN AVE
SPRINGFIELD CIR
SIOUX CITY DR
DES MOINES DR
PEORIA DR
RADIO TX & RC
INDEPENDENCE DR
FTS. H.Q.
RIFLE RANGE
WISCONSIN AVE
WILLIAMS ST
WISCONSIN MILITARY ACADEMY
CAMP WILLIAMS ARMS
CEMETERY
HOLDEN ST
FISH ST
W5
W6
W2



TWY 1
933 RAPCON
934
W3
POWER CHECK PAD
SOUTHEAST APRON
912
932
931
930 LOADING DOCK
SCENARIO DR
B-5
ENGINEERING
VF1 MW-4
VF7 MW-2
HEI-2
E. PERIMETER RD
HEI-1
MADISON BLVD
HEI-6
SEE ENLARGED VIEW SITE 1 & 9 THIS SHEET
VF9 MW-2
SITE 1
GRID REF POINT 100E, 400N
HEI-3
VF7 MW-3
VF1 MW-1
VF7 MW-1
SITE 7, FORMER LANDFILL A
BM#3
SITE 9
HEI-5
GRID REF POINT
GRID REF POINT, 700E, 400N ALSO BM#2 & HEI-4
A-0
W5
916
905
VF1 MW-2
904
903
902
901
917
915
MSA-203
VF9 MW-3
VF9 MW-1
322
321 BEACON
S PERIMETER RD
MSA-204
VF2 MW-1
GRID REF POIN
10E, 20N



VF1 B-9	704.
VF1 B-10	704.
VF1 B-11	704.
VF1 B-12	704.
VF1 B-13	704.
VF1 B-14	704.
VF1 B-15	704.

WELL NO.	NORTH COORDINAT
VF2 MW-1	701,135.6
VF2 MW-2	701,037.2
VF2 MW-3	700,657.0
VF2 MW-4	700,382.4

(SITE BORING LOCATIO

BORING . NO	NO COORD
VF4 B-1	704.7
VF4 B-2	704.7
VF4 B-3	704.6
VF4 B-4	704.7
VF4 B-5	704.7
VF4 B-6	704.7
VF4 B-7	704.6
VF4 B-8	704.6

WELL NO (MONITORING	NO COORD WELLS INST
VF7 MW-1	704.3
VF7 MW-2	704.9
VF7 MW-3	704.6

(MONITORING WELLS IN

WELL NO	NO COORD
VF9 MW-1	704.2
VF9 MW-2	704.4
VF9 MW-3	704.3

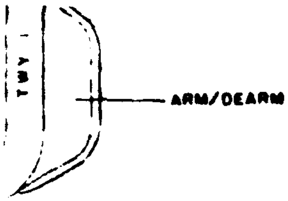
WELL NO (MONITORING WELL	NO COORD INSTAL
VF3/6 MW-1	704.7

PRIMARY BENCHMARK: TOP (
INC. , BARABOO , WISCONS
COORDINATES N. 700,814.4

HANSON ENGINEERS
SITE BENCHMARKS: BM#1 F
COMPO

BM#2
700

BM#3
25' S



VF1 B-9	704.472.09	1.932.964.31	916.8
VF1 B-10	704.564.08	1.932.931.60	914.1
VF1 B-11	704.544.57	1.932.979.39	914.6
VF1 B-12	704.443.93	1.932.989.41	917.6
VF1 B-13	704.445.03	1.932.879.33	917.9
VF1 B-14	704.492.81	1.932.809.17	917.3
VF1 B-15	704.571.96	1.932.849.15	914.5

SITE 2 FORMER LANDFILL C

WELL NO.	NORTH COORDINATE	EAST COORDINATE	GROUND EL.	TOP CASE EL.	TOP PIPE EL.	WATER EL. 4/22/88
VF2 MW-1	701.135.61	1.935.810.84	900.5	901.74	901.53	898.99
VF2 MW-2	701.037.26	1.936.327.33	896.9	898.07	897.69	898.14
VF2 MW-3	700.657.06	1.936.356.63	897.1	899.08	898.67	897.97
VF2 MW-4	700.382.44	1.936.183.51	896.8	898.61	898.38	898.08

0-30 E.

SITE 4 TRANSFORMER FLUID DISPOSAL SITE

(SITE BORING LOCATIONS DRILLED IN 1988)

BORING . NO	NORTH COORDINATE	EAST COORDINATE	GROUND EL.
VF4 B-1	704.759.41	1.932.360.78	915.0
VF4 B-2	704.707.56	1.932.317.42	918.4
VF4 B-3	704.654.92	1.932.361.19	918.9
VF4 B-4	704.720.60	1.932.440.43	915.5
VF4 B-5	704.744.22	1.932.404.95	914.8
VF4 B-6	704.731.41	1.932.344.63	916.7
VF4 B-7	704.674.21	1.932.338.18	918.7
VF4 B-8	704.676.31	1.932.408.24	916.9

SITE 7 FORMER LANDFILL A

(MONITORING WELLS INSTALLED IN 1983)

WELL NO	NORTH COORDINATE	EAST COORDINATE	GROUND EL.	TOP CASE EL.	TOP PIPE EL.	WATER EL. 4/22/88
VF7 MW-1	704.345.08	1.934.428.61	923.8	925.62	924.72	900.66
VF7 MW-2	704.990.47	1.934.359.21	916.1	917.45	917.26	899.85
VF7 MW-3	704.671.17	1.934.847.71	913.8	915.63	915.33	899.62

= 400'

SITE 9 FORMER LANDFILL B

(MONITORING WELLS INSTALLED IN 1988)

WELL NO	NORTH COORDINATE	EAST COORDINATE	GROUND EL.	TOP CASE EL.	TOP PIPE EL.	WATER EL. 4/22/88
VF9 MW-1	704.257.37	1.932.747.99	923.0	924.57	924.28	904.03
VF9 MW-2	704.408.71	1.932.858.76	919.5	920.52	920.40	903.13
VF9 MW-3	704.358.15	1.932.932.61	917.5	918.88	918.56	903.11

SITE 3/6 , POL AREA

(MONITORING WELL INSTALLED IN 1988)

WELL NO	NORTH COORDINATE	EAST COORDINATE	GROUND EL.	TOP CASE EL.	TOP PIPE EL.	WATER EL. 4/22/88
VF3/6 MW-1	704.708.59	1.927.256.71	920.9	922.56	922.40	913.63

BENCHMARKS

PRIMARY BENCHMARK: TOP OF 3/4" IRON PIN SET BY MID-STATE ASSOCIATES INC. , BARABOO , WISCONSIN - LOCATED AT SITE #2 AREA AT STATE PLANE COORDINATES N. 700,814.49 E. 1.936.061.95 ELEVATION 903.62

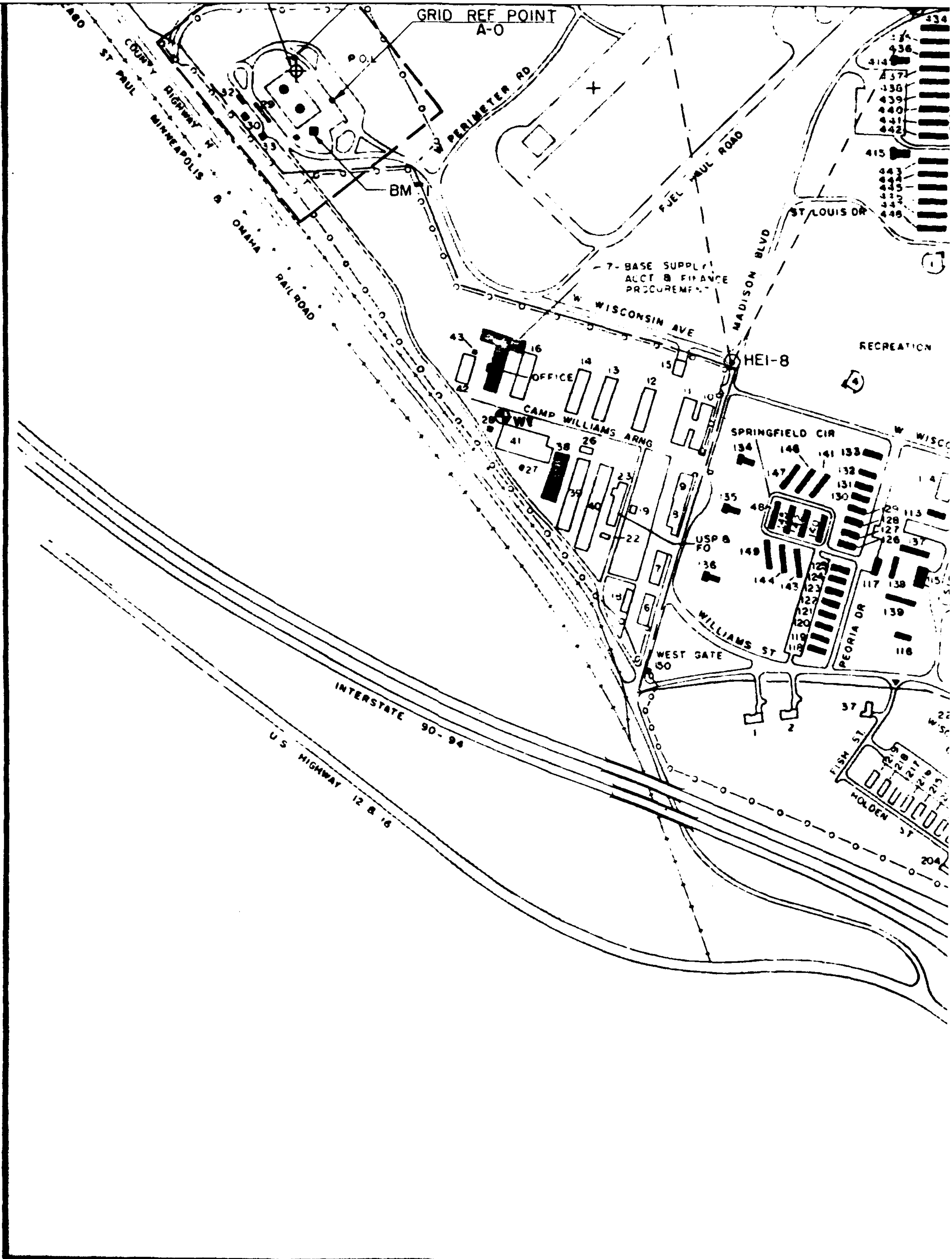
HANSON ENGINEERS SITE BENCHMARKS:

BM#1 RAILROAD SPIKE IN 36" TREE INSIDE OF FENCED COMPOUND AREA OF SITE 3/6 . POL AREA EL. 923.39

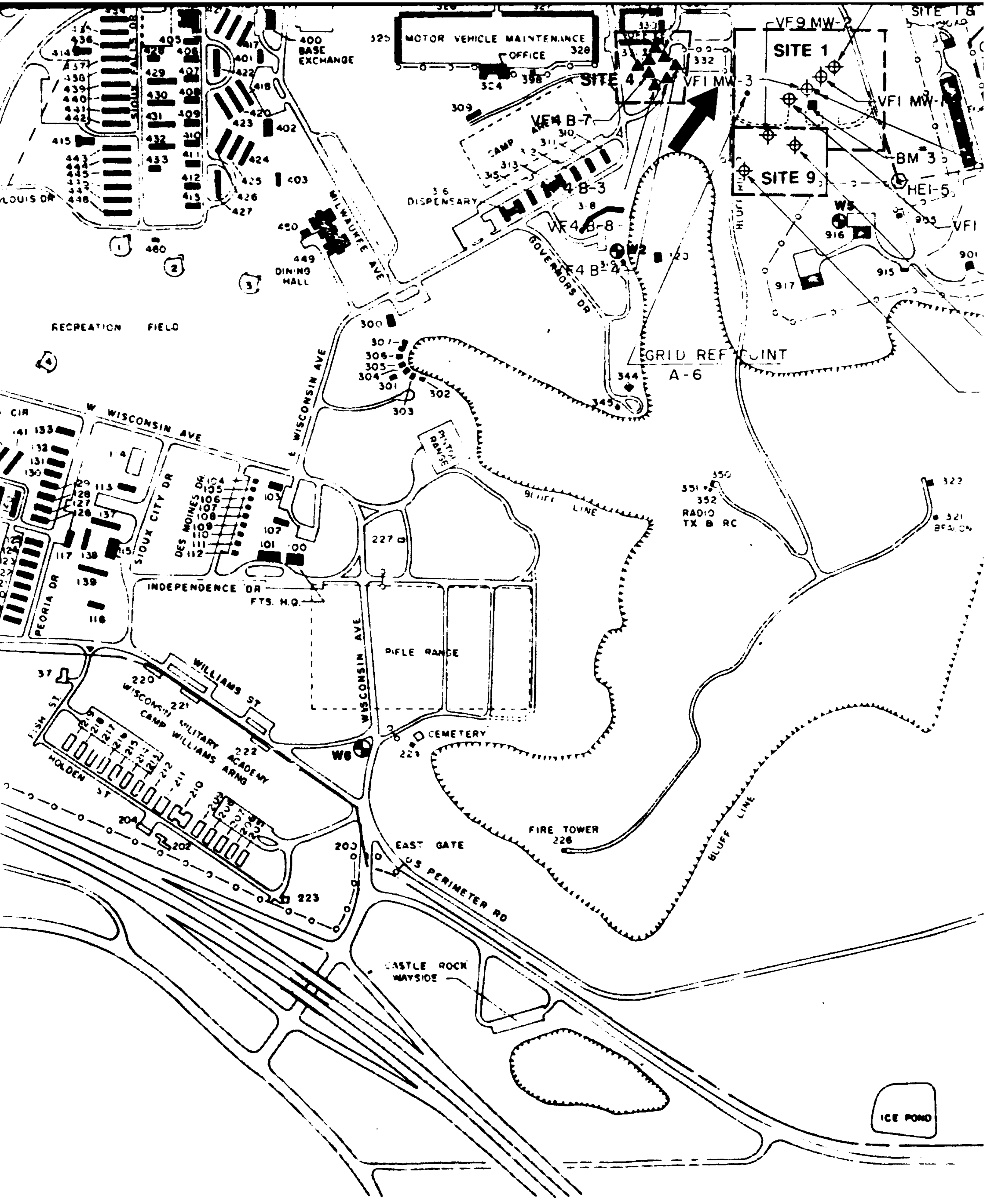
BM#2 TOP OF 5/8" IRON PIN AT SITE GRID COORDINATES 700E . 400N OF SITE #7 EL. 921.52

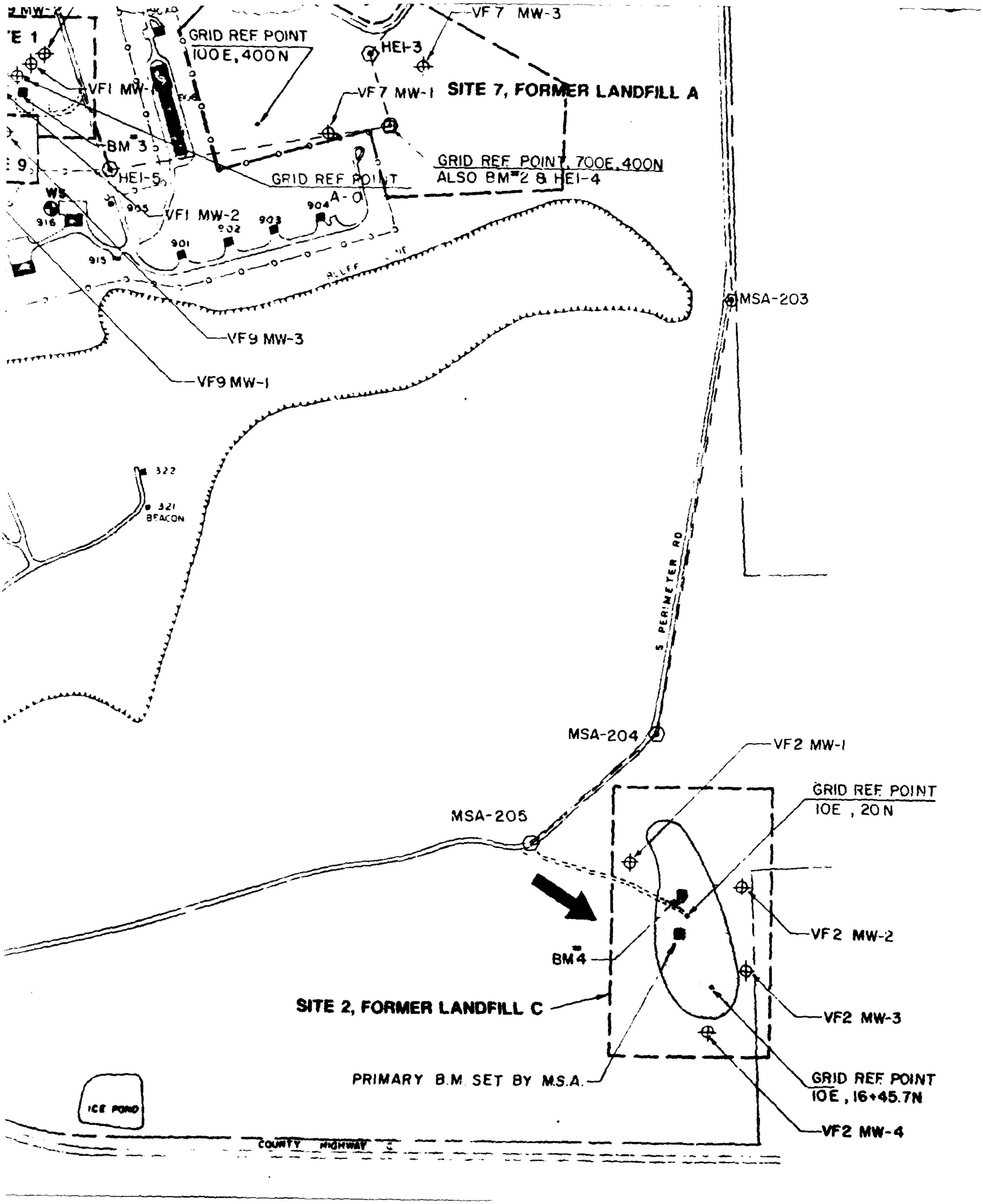
BM#3 RAILROAD SPIKE IN POWER POLE APPPROXIMATELY 25' SOUTH OF SITE GRID POINT A-0 OF SITE #1 EL. 914.92

BM#4 RAILROAD SPIKE IN 12" TREE AT SITE GRID COORDINATES

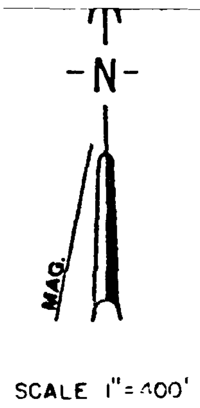


GRID REF POINT
A-0
P.O.L.
BM-1
W PERIMETER RD
FUEL HAUL ROAD
ST LOUIS DR
MADISON BLVD
7- BASE SUPPLY
ACCT & FINANCE
PROCUREMENT
W WISCONSIN AVE
HEI-8
RECREATION
OFFICE
CAMP WILLIAMS ARNG
SPRINGFIELD CIR
USP & FO
WILLIAMS ST
PEORIA DR
WEST GATE
FISH ST
HOLDEN ST
COUNTY HIGHWAY N
ST PAUL
MINNEAPOLIS & OMAHA
RAILROAD
INTERSTATE 90-94
U S HIGHWAY 12 & 16


MOTOR VEHICLE MAINTENANCE
OFFICE
400 BASE EXCHANGE
SITE 4
SITE 1
SITE 9
SITE 18
VF9 MW-2
VF1 MW-3
VF1 MW-1
VF4 B-7
VF4 B-3
VF4 B-8
VF4 B-4
BM 3
HEI-5
W5
W2
W6
CAMP
DISPENSARY
MILWAUKEE AVE
GOVERNORS DR
449 DINING HALL
RECREATION FIELD
GRID REF POINT A-6
W WISCONSIN AVE
E WISCONSIN AVE
SIOUX CITY DR
DES MOINES DR
PEORIA DR
INDEPENDENCE DR
FTS. H.Q.
RIFLE RANGE
WISCONSIN AVE
BLUFF LINE
RADIO TX & RC
BEACON
WILLIAMS ST
WISCONSIN MILITARY ACADEMY CAMP WILLIAMS ARNG
HOLDEN ST
CEMETERY
FIRE TOWER
EAST GATE
PERIMETER RD
CASTLE ROCK WAYSIDE
ICE POND



VF7 MW-3
GRID REF POINT
100E, 400N
HEI-3
SITE 7, FORMER LANDFILL A
VF1 MW-
VF7 MW-1
BM#3
GRID REF POINT, 700E, 400N
ALSO BM#2 & HEI-4
HEI-5
GRID REF POINT
A-0
WS
916
905
VF1 MW-2
904
903
902
901
915
VF9 MW-3
VF9 MW-1
MSA-203
322
321
BEACON
S PERIMETER RD
MSA-204
VF2 MW-1
GRID REF POINT
10E, 20N
MSA-205
VF2 MW-2
BM#4
SITE 2, FORMER LANDFILL C
VF2 MW-3
PRIMARY B.M. SET BY M.S.A.
GRID REF POINT
10E, 16+45.7N
VF2 MW-4
ICE POND
COUNTY HIGHWAY



[illegible]	[illegible]	[illegible]
VF4 B-2	704.707.56	1.932.31
VF4 B-3	704.654.92	1.932.36
VF4 B-4	704.720.60	1.932.44
VF4 B-5	704.744.22	1.932.40
VF4 B-6	704.731.41	1.932.34
VF4 B-7	704.674.21	1.932.33
VF4 B-8	704.676.31	1.932.40

SITE 7 I

WELL NO	NORTH COORDINATE	EAST COORDINAT
(MONITORING WELLS INSTALLED IN 1988)		
VF7 MW-1	704.345.08	1.934.42
VF7 MW-2	704.990.47	1.934.35
VF7 MW-3	704.671.17	1.934.847

SITE 9 F

(MONITORING WELLS INSTALLED IN 1988

WELL NO	NORTH COORDINATE	EAST COORDINAT
VF9 MW-1	704.257.37	1.932.747
VF9 MW-2	704.408.71	1.932.858
VF9 MW-3	704.358.15	1.932.932

SITE 3/6 , POL A

WELL NO	NORTH COORDINATE	EAST COORDINAT
(MONITORING WELL INSTALLED IN 1988)		
VF3/6 MW-1	704.708.58	1.927.256

BENCH

PRIMARY BENCHMARK: TOP OF 3/4" IRON PIN
INC. , BARABOO , WISCONSIN - LOCATED AT
COORDINATES N. 700,814.49 E. 1.936.061 9'

HANSON ENGINEERS SITE BENCHMARKS:

BM#1 RAILROAD SPIKE IN
COMPOUND AREA OF SITE

BM#2 TOP OF 5/8" IRON
700E , 400N OF SITE #7

BM#3 RAILROAD SPIKE IN
25' SOUTH OF SITE GRID

BM#4 RAILROAD SPIKE IN
21N , 10E OF SITE #2

LEGEND

- ▲ BORINGS INSTALLED IN 1988
- MONITORING WELLS INSTALLED IN 1988
- ■ BENCHMARK
- HORIZONTAL CONTROL POINT
- • SITE GRID REFERENCE POINT
- GROUNDWATER FLOW DIRECTION
- BASE PRODUCTION WELLS

MONITOR

CAM

DESIGNED
CHECKED
DRAWN JA / GR
CHECKED GR

[illegible]	[illegible]	[illegible]	[illegible]
VF4 B-2	704.707.56	1.932.317.42	918.4
VF4 B-3	704.654.92	1.932.361.19	918.9
VF4 B-4	704.720.60	1.932.440.43	915.5
VF4 B-5	704.744.22	1.932.404.95	914.8
VF4 B-6	704.731.41	1.932.344.63	916.7
VF4 B-7	704.674.21	1.932.338.18	918.7
VF4 B-8	704.676.31	1.932.408.24	916.9

SITE 7 FORMER LANDFILL A

WELL NO	NORTH COORDINATE	EAST COORDINATE	GROUND EL.	TOP CASE EL.	TOP PIPE EL.	WATER EL. 4/22/88
(MONITORING WELLS INSTALLED IN 1988)						
VF7 MW-1	704.345.08	1.934.428.61	923.8	925.62	924.72	900.66
VF7 MW-2	704.990.47	1.934.359.21	916.1	917.45	917.26	899.85
VF7 MW-3	704.671.17	1.934.847.71	913.8	915.63	915.33	899.62

SITE 9 FORMER LANDFILL B

(MONITORING WELLS INSTALLED IN 1988)

WELL NO	NORTH COORDINATE	EAST COORDINATE	GROUND EL.	TOP CASE EL.	TOP PIPE EL.	WATER EL. 4/22/88
VF9 MW-1	704.257.37	1.932.747.99	923.0	924.57	924.28	904.03
VF9 MW-2	704.408.71	1.932.858.76	919.5	920.52	920.40	903.13
VF9 MW-3	704.358.15	1.932.932.61	917.5	918.88	918.56	903.11

SITE 3/6 , POL AREA

WELL NO	NORTH COORDINATE	EAST COORDINATE	GROUND EL.	TOP CASE EL.	TOP PIPE EL.	WATER EL. 4/22/88
(MONITORING WELL INSTALLED IN 1988)						
VF3/6 MW-1	704.708.59	1.927.256.71	920.9	922.56	922.40	913.63

BENCHMARKS

PRIMARY BENCHMARK: TOP OF 3/4" IRON PIN SET BY MID-STATE ASSOCIATES INC. , BARABOO , WISCONSIN - LOCATED AT SITE #2 AREA AT STATE PLANE COORDINATES N. 700,814.49 E. 1,936,061.95 ELEVATION 903.62

HANSON ENGINEERS SITE BENCHMARKS:

BM#1 RAILROAD SPIKE IN 36" TREE INSIDE OF FENCED COMPOUND AREA OF SITE 3/6 . POL AREA EL. 923.39

BM#2 TOP OF 5/8" IRON PIN AT SITE GRID COORDINATES 700E , 400N OF SITE #7 EL. 921.52

BM#3 RAILROAD SPIKE IN POWER POLE APPROXIMATELY 25' SOUTH OF SITE GRID POINT A-0 OF SITE #1 EL. 914.92

BM#4 RAILROAD SPIKE IN 12" TREE AT SITE GRID COORDINATES 21N , 10E OF SITE #2 EL. 905.68

LEGEND

- BORINGS INSTALLED IN 1988
- MONITORING WELLS INSTALLED IN 1988
- BENCHMARK
- HORIZONTAL CONTROL POINT
- SITE GRID REFERENCE POINT
- GROUNDWATER FLOW DIRECTION
- BASE PRODUCTION WELLS

MONITOR WELL SURVEY INFORMATION
VOLK FIELD
CAMP DOUGLAS WISCONSIN

DESIGNED
CHECKED
DRAWN JA / GR
CHECKED GR

HANSON ENGINEERS INCORPORATED
SPRINGFIELD, PEORIA & ROCKFORD, ILLINOIS

FILE NO. 87S5014

DATE 4/25/88

APPENDIX A
GLOSSARY OF TERMS

SECTION A.1
INTRODUCTION

Numerous terms and abbreviations are used in the report that may be unfamiliar to some readers. The pages that follow provide a reference list of selected terms and abbreviations to aid the reader.

SECTION A.2

DEFINITIONS, NOMENCLATURE AND UNITS OF MEASUREMENT

AA: Atomic Absorption, an instrumental analytical method for quantitation of metallic elements.

ACIDS: Chemical compounds that yield hydrogen ions in an aqueous solution.

ACIDIC: Refers to water having a pH value of less than 7, aqueous solutions containing dissolved acids.

ADSORPTION: The attachment of dissolved matter to the surface of solids through weak chemical interactions which are usually reversible.

AEOLIAN: Applied to the erosive action of the wind, and to deposits which are due to the transporting action of the wind.

Ag: Chemical symbol for silver.

ALKALINE: Refers to water having a pH value of more than 7, aqueous solutions containing dissolved bases.

ALLUVIAL: Pertaining to or composed of alluvium or deposited by a stream or running water.

ALLUVIUM: Materials eroded, transported and deposited by streams.

ALLUVIAL FAN: A fan-shaped deposit formed by a stream either where it issues from a narrow mountain valley into a plain or broad valley, or where a tributary stream joins a main stream.

ANG: Air National Guard.

ANION: A negatively charged ion in solution.

AQUIFER: A geologic formation, group of formations, or part of a formation that is capable of yielding useable quantities of water to a well or spring.

AROMATICS: Organic chemical compounds having a stable six-carbon ring as their basic structure, such as benzene, toluene, and xylenes.

ARTESIAN: A condition of confined aquifers in which water levels in wells rise above the top of the aquifer.

As: Chemical symbol for arsenic.

Ba: Chemical symbol for barium.

BASE: Chemical compounds that yield hydroxide ions in aqueous solution.

BEDROCK: Any solid rock in place; may be exposed at the surface of the earth or overlain by unconsolidated material.

BIOACCUMULATION: Refers to tendency of some chemical elements or compounds to become concentrated in the tissues of living organisms as a result of chronic exposures, mainly ingestion and inhalation.

BIODEGRADABLE: Refers to organic compounds that are broken down into simpler chemical compounds or elements by natural microorganisms in the environment.

Ca: Chemical symbol for calcium.

$CaCO_3$: Chemical symbol for calcium carbonate.

CARBONATE ROCKS: A rock consisting chiefly of carbonate minerals, such as limestone and dolomite.

CATION: A positively charged ion in solution.

Cd: Chemical symbol for cadmium.

CN: Chemical symbol for cyanide.

CONFINED AQUIFER: An aquifer bounded above and below by impermeable strata or geologic units of distinctly lower permeability than that of the aquifer itself.

CONFINING STRATA: A strata of impermeable or distinctly less permeable material stratigraphically adjacent to one or more aquifers.

CONFINING UNIT: A low-permeability layer which restricts the movement of groundwater.

CONTAMINANT: As defined by section 104(a)(2) of CERCLA, shall include, but not be limited to, any element, substance, compound, or mixture, including disease-causing agents, which after release into the environment and upon exposure, ingestion, inhalation, or assimilation into any organism, either directly from the environment or indirectly by ingestion through food chains, will or may reasonably be anticipated to cause death, disease, behavioral abnormalities, cancer, genetic mutation, physiological malfunction (including malfunctions in reproduction) or physical deformation, in such organisms or their offspring.

Cr: Chemical symbol for chromium.

Cu: Chemical symbol for copper.

DARCY'S LAW: An equation describing the flow of fluids in porous media based on the assumption that the flow is laminar and that inertia can be neglected.

DENSITY: Physical property of materials equal to mass per unit volume.

DISCHARGE: The process involved in the draining or seepage of water out of a groundwater aquifer.

DOD: Department of Defense.

DOWNGRADIENT: A direction that is hydraulically downslope; the direction in which groundwater flows.

DRAINAGE BASIN: The land area from which all surface runoff drains into one stream channel or system of channels, or to a lake reservoir, or other body of water.

DRAW-DOWN: The difference between the static water level and the water level in a well that is pumped.

EP: Extraction Procedure, a US EPA standard laboratory procedure for simulating leachate generation.

EPA: U.S. Environmental Protection Agency.

EFFECTIVE POROSITY: The amount of interconnected pore space in an aquifer that is available for water transmission.

EROSION: The wearing away of land surface by wind, water, or chemical processes.

ES: Engineering-Science, Inc.

EVAPOTRANSPIRATION: Loss of water from a land area through transpiration of plants and evaporation from the soil.

FAA: Federal Aviation Administration.

FAULT: A fracture in rock along which the adjacent rock surfaces have been displaced.

Fe: Chemical symbol for iron.

FLOW LINES (PATHS): Lines indicating the direction of groundwater movement.

GAL/DAY/FT: Gallons per day per foot. Units used to define transmissivity.

GC: Gas chromatograph, an analytical laboratory instrument used for the quantitation and identification of organic compounds.

GC/MS: Gas chromatograph/mass spectrophotometer, an analytical laboratory instrument used for the quantitation and identification of organic compounds.

GAINING STREAM: A stream or reach of stream whose flow is being increased by the inflow of groundwater.

GROUNDWATER: Water beneath the land surface in the saturated zone.

HALIDES: Refers to the salts of halogen elements, or the anions formed by halogens in aqueous solution.

HALOGEN: Refers to any one of a group of chemical elements including fluorine, chlorine, bromine, and iodine.

HALOGENATED ORGANIC: Refers to any organic compound that contains one or more halogens as a substituent group.

HARDNESS: A property of water causing formation of an insoluble residue when the water is used with soap.

HARM: Hazard Assessment Rating Methodology.

HAZARDOUS WASTE: A solid or liquid waste that, because of its quantity, concentration, or physical, chemical, or infectious characteristics may:

> (a) cause, or significantly contribute to, an increase in mortality or an increase in serious irreversible or incapacitating reversible illness; or
>
> (b) pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported or disposed of, or otherwise managed.

HEAVY METALS: Metal elements, including the transition elements, with atomic weight greater than 50. Many of these elements are required for plant and animal nutrition in trace concentrations, but are toxic at higher concentrations.

HNu® Meter: An instrument that uses a photoionization detector to measure organic vapors.

HOMOGENEITY: In reference to an aquifer, the aquifer is homogeneous if its hydrologic properties are identical everywhere.

Hg: Chemical symbol for mercury.

HYDRAULIC CONDUCTIVITY: The rate of flow of liquid through a unit cross section of porous media under a unit hydraulic gradient, at the prevailing temperature.

HYDRAULIC GRADIENT: The change in static head per unit of direction in a given direction.

HYDROCARBONS: Organic chemical compounds composed of hydrogen and carbon atoms. Hydrocarbons may be straight chain, cyclic, branched chain, aromatic, or polycyclic, depending upon arrangement of carbon atoms. Halogenated hydrocarbons are hydrocarbons in which one or more hydrogen atoms has been replaced by a halogen atom.

ICAP: Induction-Coupled Argon Plasma, an instrumental analytical method for quantitation of metal elements.

IGNEOUS ROCKS: Rocks that are solidified from molten or partly molten material.

INFILTRATION: The movement of water through land surface into the ground.

IRP: Installation Restoration Program.

ISOTROPY: In reference to an aquifer, the aquifer is isotropic if all significant properties of the aquifer are independent of direction.

JP-4: Jet propulsion fuel number four (contains kerosene and gasoline fractions, used in most military jet aircraft).

LEACHING: The process by which soluble materials in soils or a landfill dissolve in water. The resulting leachate may percolate down into lower layers or, in a secure landfill, is collected for treatment.

LITHOLOGY: The description of the physical character of rocks and soil.

LOAM: A permeable soil composed of a friable mixture of relatively equal proportions of clay, silt, and sand particles, and usually containing organic matter (humus) with a minor amount of gravel.

LOSING STREAM: A stream or reach of a stream that is losing water to the ground.

µg/g: Micrograms (10-6 grams) per gram, equals one part per million.

µg/L: Micrograms (10-6 grams) per liter.

mg/L: Milligrams (10-3 grams) per liter.

MIGRATION (Contaminant): The movement of contaminants through pathways (groundwater, surface water, soil, and air).

Mn: Chemical symbol for manganese.

msl: Mean Sea Level.

Ni: Chemical symbol for nickel.

NOAA: National Oceanic and Atmospheric Administration (USDC).

ORDNANCE: Any form of artillery, weapons, or ammunition used in warfare.

ORGANIC: Refers to chemical compounds having carbon atoms as their main skeletal structure. Most organic chemicals are created by living organisms or from their remains (such as fossil fuels) and occur naturally in the environment; other organic chemicals are man-made.

ORNL: Oak Ridge National Laboratory.

OUTCROP: Zone or area where a geologic unit or formation occurs at or near land surface. "Outcrop area" is an important factor in studies of aquifers as this zone usually corresponds to the point where significant recharge occurs. Occasionally, this term is used as an intransitive verb: "Where the unit crops out....."

Pb: Chemical symbol for lead.

PCBs: Polychlorinated biphenyls, liquid halogenated polycyclic organic compounds commonly used as insulating and cooling fluids in electrical equipment. Commercial mixtures of PCBs are referred to as Arochlors.

PD-680: A petroleum distillate used as a safety cleaning solvent. Two types of PD-680 solvent have been used: Type I, having a flash point of 100°F; and Type II, having a flashpoint of 140°F.

PERCHED WATER TABLE: Unconfined groundwater separated from an underlying water table by an unsaturated zone.

PERCOLATION: Movement of moisture by gravity or hydrostatic pressure through interstices of unsaturated rock or soil.

PERMEABILITY: The capacity of a porous rock, sediment, or soil for transmitting a fluid without impairment of the structure of the medium: it is a measure of the relative ease of the fluid flow under unequal pressure.

PESTICIDE: A chemical agent used to destroy pests, includes specialty groups known as herbicides, fungicides, insecticides, rodenticides, etc.

pH: A measure of the acidic or alkaline nature of aqueous solutions, specifically the negative logarithm of the hydrogen ion concentration.

POLYCYCLIC COMPOUND: An organic compound in which the carbon atoms are arranged into two or more six-carbon rings, usually aromatic in nature.

POTENTIOMETRIC SURFACE: An imaginary surface that is coincident with the elevation to which water from a pumped or nonpumped aquifer would rise in a well hydraulically connected to that aquifer.

ppb: Parts per billion by weight.

ppm: Parts per million by weight.

PRECIPITATION: Rainfall and snowfall.

QUATERNARY: The second period of the Cenozoic geologic era, following the Tertiary, and including the last 2-3 million years.

QA/QC: Quality assurance and quality control.

RCRA: Resource Conservation and Recovery Act.

RECEPTORS: Individuals or groups of organisms or resources that are potentially affected by a contamination source.

RECHARGE AREA: The part of an aquifer that receives water by infiltration from surface water, precipitation, or an overlying aquifer. Recharge areas may be natural or manmade.

RECHARGE: The addition of water to the zone of saturation by natural or artificial processes.

SARA: Superfund Amendments and Reauthorization Act of 1986.

SATURATED ZONE: That part of the earth's crust in which all voids are filled with water.

SCS: Soil Conservation Service (USDA).

Se: Chemical symbol for selenium.

SEDIMENTARY ROCKS: Rocks formed by the consolidation of loose sediments that have accumulated in layers.

SPECIFIC CAPACITY: The discharge of water from a well per unit of drawdown, commonly expressed in gpm/ft.

SPECIFIC YIELD: The change that occurs in the amount of water in storage per unit area of an unconfined aquifer as a result of a unit change in static head.

STATIC HEAD: In an aquifer the height above a standard datum that water will rise in a tightly cased well.

STATIC WATER ELEVATION: The elevation to which water from a nonpumped aquifer would rise in a well hydraulically layers separated vertically from other layers.

STATIC WATER LEVEL: The level of water in a well that is not being affected by withdrawal of groundwater.

STORAGE COEFFICIENT: The volume of water an aquifer releases from or takes into storage per unit surface area of an aquifer per unit change in head. The storage coefficient is essentially equal to specific yield for an unconfined aquifer.

STRATA: Distinguishable horizontal layers separated vertically from other layers.

SURFACE WATER: All water exposed at the ground surface, including streams, rivers, ponds, and lakes.

TCA: Trichloroethane, a solvent and suspected carcinogen.

TCE: Trichloroethylene, a solvent and suspected carcinogen.

TDS: Total Dissolved Solids.

TOC: Total Organic Carbon.

TOH: Total Organic Halides.

TOXICITY: The ability of a material to produce injury or disease upon exposure, ingestion, inhalation, or assimilation by a living organism.

TRACE METALS: Metal elements that occur in low abundances in natural materials.

TRANSMISSIVITY: A measure of an aquifer's capability to yield water; the rate at which water is transmitted through a unit width of aquifer under a unit hydraulic gradient.

TRANSPIRATION: The process by which water absorbed by plants, usually through the roots, is evaporated into the atmosphere from the plant surface.

UNCONFINED AQUIFER: An aquifer that has a water table. The aquifer is not overlain by a confining unit.

UP-GRADIENT: In the direction of increasing hydraulic head; the direction opposite to the prevailing flow of groundwater.

USAF: United States Air Force.

USDA: United States Department of Agriculture.

USDC: United States Department of Commerce.

USGS: United States Geological Survey.

WATER TABLE: Surface of a body of unconfined groundwater at which the pressure is equal to that of the atmosphere.

WETLAND: An area subject to permanent or prolonged inundation or saturation that exhibits plant communities adapted to this environment.

Zn: Chemical symbol for zinc.

APPENDIX B

TABLE OF CONTENTS

SOIL BORINGS AND MONITORING WELL LOGS

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(1) Code to Sample ID Column on Soil Boring Record:

- *** A sample was taken for chemical analysis.**
- **** A sample was taken for chemical analysis and a duplicate sample was sent to Engineering-Science.**
- ***** A sample was taken for chemical analysis and a duplicate sample was sent to the Oak Ridge Laboratory.**

(2) **The sample identification used for samples obtained for lithological descriptions are not included on the drilling records. These samples were labeled and retained for inspection at a later date if desired. The sample identification consists of three parts: the well ID, VF1 MW1; the split spoon number which is numbered consecutively for each well, SS-1; and the sample depth which corresponds to the depth indicated on the drilling record by the sampler blows. An example of a complete sample identification is VF1 MW-1, SS1, 0'.**

SOIL BORINGS

ENGINEERING-SCIENCE

DRILLING RECORD

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WELL/BORING ID: VF1 B-1	**DRILLING STARTED:** 1/26/88
LOCATION: Volk Field ANGB Camp Douglas, Wisconsin	**DRILLING COMPLETED:** 1/26/88
PROJECT NO: AT077	**DRILLING METHOD:** 6.25 inch I.D. Hollow Stem Auger
DRILLER: Exploration Technology, Inc.	**SAMPLING METHOD:** Split Spoon
LOGGER:	**STATIC WATER LEVEL:** Dry
GEOLOGIST: R. L. Allen	**WATER LEVEL DATE:**
	WATER LEVEL DATUM:

DEPTH IN FEET BELOW LS.	SAMPLER BLOWS	PERCENT RECOVERY	SAMPLE ID	SAMPLE DESCRIPTION	NOTES
0	21-24-23		*	Sand, dusky yellow brown to moderate yellow brown, fine to very fine, trace silt	VF1, B-1, SS-1, 0.5' has petroleum odor
5	2-2-4		*	Sand, yellow orange, very fine, trace silt	VF1, B-1, SS-2, 3.5', HNu reading -- 110 ppm in SS-2, 4 ppm in breathing zone
10	5-13-29		*		VF1, B-1, SS-3, 8.5', HNu reading -- 160 ppm in SS-3
				Boring Terminated at 10.0'	

ENGINEERING-SCIENCE

DRILLING RECORD

WELL/BORING ID: VF1 B-2	**DRILLING STARTED:** 1/26/88
LOCATION: Volk Field ANGB Camp Douglas, Wisconsin	**DRILLING COMPLETED:** 1/26/88
PROJECT NO: AT077	**DRILLING METHOD:** 6.25 inch I.D. Hollow Stem Auger
DRILLER: Exploration Technology, Inc.	**SAMPLING METHOD:** Split Spoon
LOGGER:	**STATIC WATER LEVEL:** Dry
GEOLOGIST: R. L. Allen	**WATER LEVEL DATE:**
	WATER LEVEL DATUM:

DEPTH IN FEET BELOW LS.	SAMPLER BLOWS	PERCENT RECOVERY	SAMPLE ID	SAMPLE DESCRIPTION	NOTES
0	32-27-19		*	Sand, yellow orange, fine to very fine, trace silt	VF1, B-2, SS-1, 0.5', HNu reading -- 8 ppm in SS-1
5	5-7-9		*		VF1, B-2, SS-2, 3.5', HNu reading -- 18 ppm in SS-2
10	10-20-50/4"		*	Sand, dark yellowish orange, fine to very fine (partially weathered sandstone)	VF1, B-2, SS-3, 8.5'
				Boring Terminated at 10.0'	

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ENGINEERING-SCIENCE

DRILLING RECORD

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WELL/BORING ID: VF1 B-3	**DRILLING STARTED:** 1/26/88
LOCATION: Volk Field ANGB Camp Douglas, Wisconsin	**DRILLING COMPLETED:** 1/26/88
PROJECT NO: AT077	**DRILLING METHOD:** 6.25 inch I.D. Hollow Stem Auger
DRILLER: Exploration Technology, Inc.	**SAMPLING METHOD:** Split Spoon
LOGGER:	**STATIC WATER LEVEL:** Dry
GEOLOGIST: R. L. Allen	**WATER LEVEL DATE:**
	WATER LEVEL DATUM:

DEPTH IN FEET BELOW LS.	SAMPLER BLOWS	PERCENT RECOVERY	SAMPLE ID	SAMPLE DESCRIPTION	NOTES
0	39-25-14		**	Sand, dusky yellow brown, fine to very fine, trace silt	VF1, B-3, SS-1, 1.0'
5	3-4-6		*	Sand, yellow orange, fine to very fine	VF1, B-3, SS-2, 3.5'
10	8-18-50		*	Sand, rusty red to pale yellow orange (possible partially weathered sand-stone)	VF1, B-3, SS-3, 8.5'
				Boring Terminated at 10.0'	

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ENGINEERING-SCIENCE

DRILLING RECORD

WELL/BORING ID: VF1 B-4	DRILLING STARTED: 1/26/88
LOCATION: Volk Field ANGB Camp Douglas, Wisconsin	DRILLING COMPLETED: 1/26/88
PROJECT NO: AT077	DRILLING METHOD: 6.25 inch I.D. Hollow Stem Auger
DRILLER: Exploration Technology, Inc.	SAMPLING METHOD: Split Spoon
LOGGER:	STATIC WATER LEVEL: Dry
GEOLOGIST: R. L. Allen	WATER LEVEL DATE:
	WATER LEVEL DATUM:

DEPTH IN FEET BELOW LS.	SAMPLER BLOWS	PERCENT RECOVERY	SAMPLE ID	SAMPLE DESCRIPTION	NOTES
0	29-43-23		**	Sand, greyish black to dusky yellowish brown, fine to very fine, trace silt	VF1, B-4, SS-1, 0.5', HNu reading -- 90 ppm in SS-1, 4 ppm in breathing zone
5	4-6-9		*		VF-1, B-4, SS-2, 3.5;, HNu reading 60 ppm in auger, 60 ppm in SS-2,
10	4-7-12		*	Sand, pale yellowish orange, fine to very fine, trace silt	VF1, B-4, SS-3, 8.5', HNu reading 30 ppm in SS-3
				Boring Terminated at 10.0'	

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ENGINEERING-SCIENCE

DRILLING RECORD

WELL/BORING ID: VF1 B-5	DRILLING STARTED: 1/27/88
LOCATION: Volk Field ANGB Camp Douglas, Wisconsin	DRILLING COMPLETED: 1/27/88
PROJECT NO: AT077	DRILLING METHOD: 6.25 inch I.D. Hollow Stem Auger
DRILLER: Exploration Technology, Inc	SAMPLING METHOD: Split Spoon
LOGGER:	STATIC WATER LEVEL: Dry
GEOLOGIST: R. L. Allen	WATER LEVEL DATE:
	WATER LEVEL DATUM:

DEPTH IN FEET BELOW LS.	SAMPLER BLOWS	PERCENT RECOVERY	SAMPLE ID	SAMPLE DESCRIPTION	NOTES
0	60-57-22 19-21-18		***	Top soil, 0.0' to 0.5' Sand, dusky yellow brown to greyish orange, fine to very fine, trace silt	VF1, B-5, SS-1, 1.0'
5	4-5-6		*	Sand, yellowish orange, fine to very fine, trace silt	VF1, B-5, SS-2, 3.5'
10	6-9-20		*		VF1, B-5, SS-3, 10.0'
				Boring Terminated at 10.0'	

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DRILLING RECORD

WELL/BORING ID: VF1 B-6	**DRILLING STARTED:** 1/27/88
LOCATION: Volk Field ANGB Camp Douglas, Wisconsin	**DRILLING COMPLETED:** 1/27/88
PROJECT NO: AT077	**DRILLING METHOD:** 6.25 inch I.D. Hollow Stem Auger
DRILLER: Exploration Technology, Inc.	**SAMPLING METHOD:** Split Spoon
LOGGER:	**STATIC WATER LEVEL:** Dry
GEOLOGIST: R. L. Allen	**WATER LEVEL DATE:**
	WATER LEVEL DATUM:

DEPTH IN FEET BELOW LS.	SAMPLER BLOWS	PERCENT RECOVERY	SAMPLE ID	SAMPLE DESCRIPTION	NOTES
0	31-45-54		***	Sand, dusky yellowish brown to greyish yellow, fine to very fine	VF1, B-6, SS-1, 0' HNu reading -- 130 ppm in SS-1
5	1-1-3		*		VF1, B-6, SS-2, 3.5', HNu reading -- 200 ppm in SS-2
10	4-9-31		*	Sand, pale greyish orange, fine to very fine	VF1, B-6, SS-3, 8.5", HNu reading -- 130 ppm in SS-3
				Boring Terminated at 10.0'	

ENGINEERING-SCIENCE
DRILLING RECORD

WELL/BORING ID: VF1 B-7	**DRILLING STARTED:** 1/27/88
LOCATION: Volk Field ANGB Camp Douglas, Wisconsin	**DRILLING COMPLETED:** 1/27/88
PROJECT NO: AT077	**DRILLING METHOD:** 6.25 inch I.D. Hollow Stem Auger
DRILLER: Exploration Technology, Inc.	**SAMPLING METHOD:** Split Spoon
LOGGER:	**STATIC WATER LEVEL:** Dry
GEOLOGIST: R. L. Allen	**WATER LEVEL DATE:**
	WATER LEVEL DATUM:

DEPTH IN FEET BELOW LS.	SAMPLER BLOWS	PERCENT RECOVERY	SAMPLE ID	SAMPLE DESCRIPTION	NOTES
0	22-17-10		***	Sand, moderate yellowish brown, fine to very fine	VF1, B-7, SS-1, 0'
5	4-6-7		*	Sand, pale yellowish orange, fine to very fine	VF1, B-7, SS-2, 3.5'
10	6-14-21		*		VF1, B-7, SS-3, 8.5'
				Boring Terminated at 10.0'	

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ENGINEERING-SCIENCE

DRILLING RECORD

WELL/BORING ID: VF1 B-8	**DRILLING STARTED:** 1/28/88
LOCATION: Volk Field ANGB Camp Douglas, Wisconsin	**DRILLING COMPLETED:** 1/28/88
PROJECT NO: AT077	**DRILLING METHOD:** 4.25 inch I.D. Hollow Stem Auger
DRILLER: Exploration Technology, Inc.	**SAMPLING METHOD:** Split Spoon
LOGGER:	**STATIC WATER LEVEL:** Dry
GEOLOGIST: R. L. Allen	**WATER LEVEL DATE:**
	WATER LEVEL DATUM:

DEPTH IN FEET BELOW LS.	SAMPLER BLOWS	PERCENT RECOVERY	SAMPLE ID	SAMPLE DESCRIPTION	NOTES
0	28-35-42		*	Top soil, 0.0' to 0.5' Sand, dusky yellowish brown to moderate brown, fine to very fine	VF1, B-8, SS-1, 0'
5	4-6-7		*	Sand, yellowish orange, fine to very fine	VF1, B-8, SS-2, 3.5'
10	8-30-70		*	Sand, yellowish orange with rust staining, fine to very fine (partially weathered sandstone)	VF1, B-8, SS-3, 8.5', HNu reading -- 6.5 ppm in SS-3
				Boring Terminated at 10.0'	

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ENGINEERING-SCIENCE

DRILLING RECORD

WELL/BORING ID: VF1 B-9	**DRILLING STARTED:** 1/28/88
LOCATION: Volk Field ANGB Camp Douglas, Wisconsin	**DRILLING COMPLETED:** 1/28/88
PROJECT NO: AT077	**DRILLING METHOD:** 4.25 inch I.D. Hollow Stem Auger
DRILLER: Exploration Technology, Inc.	**SAMPLING METHOD:** Split Spoon
LOGGER:	**STATIC WATER LEVEL:** Dry
GEOLOGIST: R. L. Allen	**WATER LEVEL DATE:**
	WATER LEVEL DATUM:

DEPTH IN FEET BELOW LS.	SAMPLER BLOWS	PERCENT RECOVERY	SAMPLE ID	SAMPLE DESCRIPTION	NOTES
0	43-57/5"		**	Sand, dark yellowish brown, fine to very fine	VF1, B-9, SS-1, 0'
5	4-7-8		*	Sand, yellowish orange, fine to very fine	VF1, B-9, SS-2, 3.5', HNu reading -- 7 ppm in SS-2
10	4-8-10		*		VF1, B-9, SS-3, 3.5', HNu reading -- 8.5 ppm in SS-3
				Boring Terminated at 10.0'	

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ENGINEERING-SCIENCE

DRILLING RECORD

WELL/BORING ID: VF1 B-10	**DRILLING STARTED:** 2/9/88
LOCATION: Volk Field ANGB Camp Douglas, Wisconsin	**DRILLING COMPLETED:** 2/9/88
PROJECT NO: AT077	**DRILLING METHOD:** 4.25 inch I.D. Hollow Stem Auger
DRILLER: Exploration Technology, Inc.	**SAMPLING METHOD:** Split Spoon
LOGGER:	**STATIC WATER LEVEL:** Dry
GEOLOGIST: R. L. Allen	**WATER LEVEL DATE:**
	WATER LEVEL DATUM:

DEPTH IN FEET BELOW LS.	SAMPLER BLOWS	PERCENT RECOVERY	SAMPLE ID	SAMPLE DESCRIPTION	NOTES
0	31-25-17		**	Sand, dark yellowish orange fine to very fine	VF1, B-10, SS-1, 0.5'
5	4-8-8		*		VF1, B-10, SS-2, 3.5'
10	7-29-50/5"		*	Sand, pale yellowish orange and layers of dark greyish brown and rusty brown (possible partially weathered sandstone)	VF1, B-10, SS-3, 8.5'
				Boring Terminated at 10.0'	

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ENGINEERING-SCIENCE

DRILLING RECORD

WELL/BORING ID: VF1 B-11	DRILLING STARTED: 2/9/88
LOCATION: Volk Field ANGB Camp Douglas, Wisconsin	DRILLING COMPLETED: 2/9/88
PROJECT NO: AT077	DRILLING METHOD: 4.25 inch I.D. Hollow Stem Auger
DRILLER: Exploration Technology, Inc.	SAMPLING METHOD: Split Spoon
LOGGER:	STATIC WATER LEVEL: Dry
GEOLOGIST: R. L. Allen	WATER LEVEL DATE:
	WATER LEVEL DATUM:

DEPTH IN FEET BELOW LS.	SAMPLER BLOWS	PERCENT RECOVERY	SAMPLE ID	SAMPLE DESCRIPTION	NOTES
0	100-100		*	Sand, dark brown, little silt, little clay	VF1, B-11, SS-1, 1.0'
5	5-8-10		*	Sand, yellowish orange, fine to very fine	VF1, B-11, SS-2, 3.5'
10	5-8-13		*	Sand, yellowish orange to grayish pink with layers of greyish black, fine to very fine	VF1, B-11, SS-3, 8.5', HNu reading -- 50 ppm in SS-3
				Boring Terminated at 10.0'	

ENGINEERING-SCIENCE

DRILLING RECORD

WELL/BORING ID: VF1 B-12	**DRILLING STARTED:** 2/9/88
LOCATION: Volk Field ANGB Camp Douglas, Wisconsin	**DRILLING COMPLETED:** 2/9/88
PROJECT NO: AT077	**DRILLING METHOD:** 4.25 inch I.D. Hollow Stem Auger
DRILLER: Exploration Technology, Inc.	**SAMPLING METHOD:** Split Spoon
LOGGER:	**STATIC WATER LEVEL:** Dry
GEOLOGIST: R. L. Allen	**WATER LEVEL DATE:**
	WATER LEVEL DATUM:

DEPTH IN FEET BELOW LS.	SAMPLER BLOWS	PERCENT RECOVERY	SAMPLE ID	SAMPLE DESCRIPTION	NOTES
0	44-66-6		*	Sand, yellowish orange, fine to very fine	VF1, B-12, SS-1, 1.5'
5	16-17-18		*		VF1, B-12, SS-2, 3.5'
10	4-7-8		*		VF1, B-12, SS-3, 8.5'
				Boring Terminated at 10.0'	

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DRILLING RECORD

WELL/BORING ID: VF1 B-13	**DRILLING STARTED:** 2/9/88
LOCATION: Volk Field ANGB Camp Douglas, Wisconsin	**DRILLING COMPLETED:** 2/10/88
PROJECT NO: AT077	**DRILLING METHOD:** 4.25 inch I.D. Hollow Stem Auger
DRILLER: Exploration Technology, Inc.	**SAMPLING METHOD:** Split Spoon
LOGGER:	**STATIC WATER LEVEL:** Dry
GEOLOGIST: R. L. Allen	**WATER LEVEL DATE:**
	WATER LEVEL DATUM:

DEPTH IN FEET BELOW LS.	SAMPLER BLOWS	PERCENT RECOVERY	SAMPLE ID	SAMPLE DESCRIPTION	NOTES
0	44-65-71		**	Sand, yellow orange, fine to very fine	VF1, B-13, SS-1, 1.0'
5	19-22-22		*		VF1, B-13, SS-2, 3.5'
10	5-8-11		*	Sand, pale yellowish orange, fine to very fine	VF1, B-13, SS-3, 8.5'
				Boring Terminated at 10.0'	

ENGINEERING-SCIENCE

DRILLING RECORD

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WELL/BORING ID: VF1 B-14	**DRILLING STARTED:** 2/10/88
LOCATION: Volk Field ANGB Camp Douglas, Wisconsin	**DRILLING COMPLETED:** 2/10/88
PROJECT NO: AT077	**DRILLING METHOD:** 4.25 inch I.D. Hollow Stem Auger
DRILLER: Exploration Technology, Inc.	**SAMPLING METHOD:** Split Spoon
LOGGER:	**STATIC WATER LEVEL:** Dry
GEOLOGIST: R. L. Allen	**WATER LEVEL DATE:**
	WATER LEVEL DATUM:

DEPTH IN FEET BELOW LS.	SAMPLER BLOWS	PERCENT RECOVERY	SAMPLE ID	SAMPLE DESCRIPTION	NOTES
0	26-34-22 25-38-40		***	Sand, dark greyish brown, little silt, little clay to 2.0'	VF1, B-14, SS-1, 1.0'
5	3-3-5		*	Sand, moderate brown, fine to very fine	VF1, B-14, SS-2, 3.5'
10	8-22-50		*	Sand, pale yellow orange, fine to very fine, (possible partially weathered sand-stone)	VF1, B-14, SS-3, 8.5'
				Boring Terminated at 10.0'	

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ENGINEERING-SCIENCE

DRILLING RECORD

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WELL/BORING ID: VF1 B-15	**DRILLING STARTED:** 2/10/88
LOCATION: Volk Field ANGB Camp Douglas, Wisconsin	**DRILLING COMPLETED:** 2/10/88
PROJECT NO: AT077	**DRILLING METHOD:** 4.25 inch I.D. Hollow Stem Auger
DRILLER: Exploration Technology, Inc.	**SAMPLING METHOD:** Split Spoon
LOGGER:	**STATIC WATER LEVEL:** Dry
GEOLOGIST: R. L. Allen	**WATER LEVEL DATE:**
	WATER LEVEL DATUM:

DEPTH IN FEET BELOW LS.	SAMPLER BLOWS	PERCENT RECOVERY	SAMPLE ID	SAMPLE DESCRIPTION	NOTES
0	3-4-6		***	Sand, yellowish orange, fine to very fine, trace silt	VF1, B-15, SS-1, 0.5'
5	2-2-2		*		VF1, B-15, SS-2, 3.5'
10	8-22-50		*	Sand, yellowish orange, fine to very fine, (possible partially weathered sandstone)	VF1, B-15, SS-3, 8.5'
				Boring Terminated at 10.0'	

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PRODUCTION WELL

ENGINEERING-SCIENCE
DRILLING RECORD

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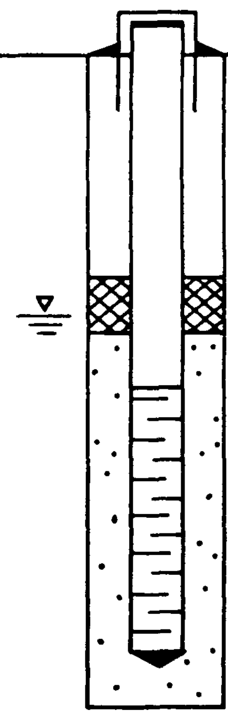
WELL/BORING ID: VF1 PW-1	DRILLING STARTED: 2/13/88
LOCATION: Volk Field ANGB, Camp Douglas, WI	DRILLING COMPLETED: 2/13/88
PROJECT NO: AT077	DRILLING METHOD: 10 inch Mud Rotary
DRILLER: Exploration Technology, Inc.	SAMPLING METHOD: Split Spoon/Grab
LOGGER:	STATIC WATER LEVEL: 903.16
GEOLOGIST: R.S. Bonner	WATER LEVEL DATE: 4/22/88
	WATER LEVEL DATUM: MSL

DEPTH IN FEET BELOW LS.	SAMPLER BLOWS	PERCENT RECOVERY	SAMPLE DESCRIPTION	LITHOLOGY	WELL CONSTRUCTION
0	25-20-7		SAND-moderate brown, medium to fine, trace silt		
	3-3-4		SAND-greyish orange, fine to very fine		
10	8-26-50/4"		SAND-yellowish orange to pale yellowish orange, fine to very fine (sandstone)		
	50/3"				
20					
30					
			Boring Terminated at 37.0'		
40					

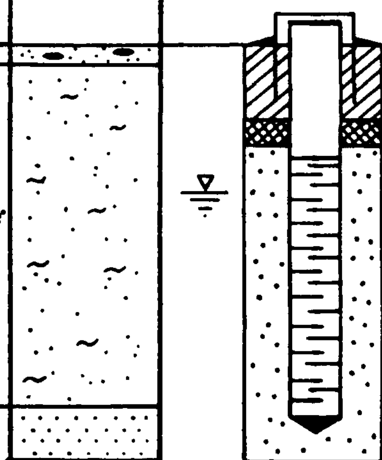


MONITORING WELLS

ENGINEERING-SCIENCE
DRILLING RECORD

WELL/BORING ID: VF1 MW-1	DRILLING STARTED: 12/22/87
LOCATION: Volk Field ANGB, Camp Douglas, WI	DRILLING COMPLETED: 12/22/87
PROJECT NO: AT077	DRILLING METHOD: 6.25 inch I.D.HSA 5.9 inch Rotary Wash
DRILLER: Exploration Technology, Inc.	SAMPLING METHOD: Split Spoon
LOGGER:	STATIC WATER LEVEL: 902.41
GEOLOGIST: R.L. Allen	WATER LEVEL DATE: 4/22/88
	WATER LEVEL DATUM: MSL

DEPTH IN FEET BELOW LS.	SAMPLER BLOWS	PERCENT RECOVERY	SAMPLE DESCRIPTION	LITHOLOGY	WELL CONSTRUCTION
0	3-3-3		SAND-dark greyish-brown, fine to very fine, (organics)		
	3-5-5				
10	3-5-9		SAND-dark yellowish orange to pale yellowish orange, fine to very fine, trace silt		
	3-7-12				
20	50/1"		SAND-pale yellowish-orange, fine to very fine (possible sandstone)		
			Boring Terminated at 23.5'		
30					

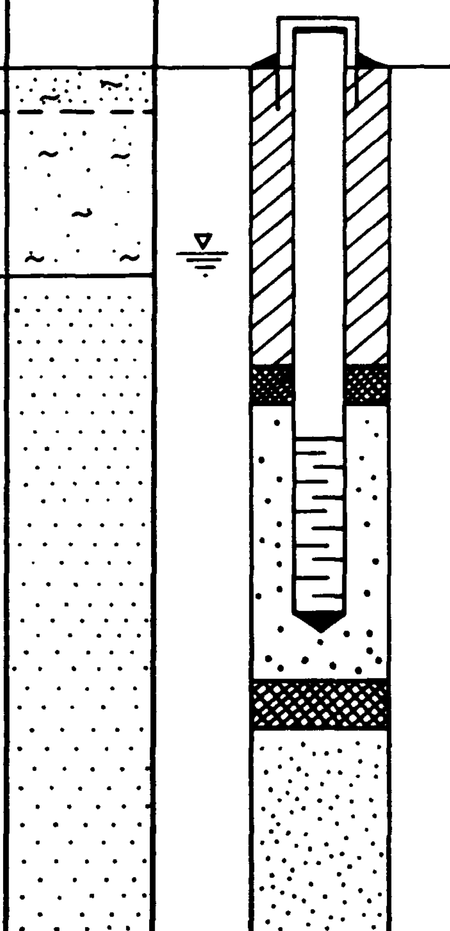


ENGINEERING-SCIENCE
DRILLING RECORD

WELL/BORING ID: VF1 MW-2	DRILLING STARTED: 1/30/88
LOCATION: Volk Field ANGB, Camp Douglas, WI	DRILLING COMPLETED: 1/31/88
PROJECT NO: AT077	DRILLING METHOD: 6.25 inch I.D. HSA 7.9 inch Rotary Wash
DRILLER: Exploration Technology, Inc.	SAMPLING METHOD: Split Spoon/Grab
LOGGER:	STATIC WATER LEVEL: 902.85
GEOLOGIST: R.S. Bonner	WATER LEVEL DATE: 4/22/88
	WATER LEVEL DATUM: MSL

DEPTH IN FEET BELOW LS.	SAMPLER BLOWS	PERCENT RECOVERY	SAMPLE DESCRIPTION
0	13-13-8		SAND-moderate, yellowish brown, medium to fine, little silt
	2-2-3		SAND-greyish orange, fine to very fine, trace silt
10	3-4-8		
	100/4"		SAND-greyish orange to pale yellowish orange, fine to very fine (sandstone)
20	100/5"		
	100/5"		
30			
40			
50			

LITHOLOGY / WELL CONSTRUCTION



ENGINEERING-SCIENCE
DRILLING RECORD

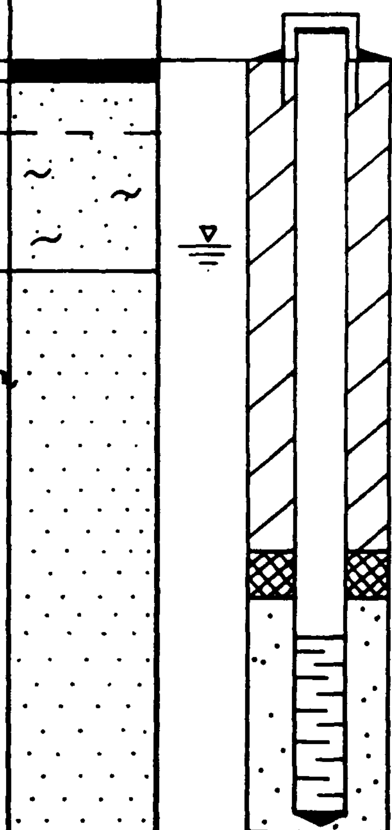
WELL/BORING ID: VF1 MW-2	DRILLING STARTED: 1/30/88
LOCATION: Volk Field ANGB, Camp Douglas, WI	DRILLING COMPLETED: 1/31/88
PROJECT NO: AT077	DRILLING METHOD: 6.25 inch I.D. HSA 7.9 inch Rotary Wash
DRILLER: Exploration Technology, Inc.	SAMPLING METHOD: Split Spoon/Grab
LOGGER:	STATIC WATER LEVEL: 902.85
GEOLOGIST: R.S. Bonner	WATER LEVEL DATE: 4/22/88
	WATER LEVEL DATUM: MSL

DEPTH IN FEET BELOW LS.	SAMPLER BLOWS	PERCENT RECOVERY	SAMPLE DESCRIPTION	LITHOLOGY	WELL CONSTRUCTION
50					
60					
70					
80					
			Boring Terminated at 84.0'		
90					

ENGINEERING-SCIENCE
DRILLING RECORD

WELL/BORING ID: VF1 MW-3	DRILLING STARTED: 2/1/88
LOCATION: Volk Field ANGB, Camp Douglas, WI	DRILLING COMPLETED: 2/1/88
PROJECT NO: AT077	DRILLING METHOD: 6.25 inch I.D. HSA 7.9 inch Rotary Wash
DRILLER: Exploration Technology, Inc.	SAMPLING METHOD: Split Spoon/Grab
LOGGER:	STATIC WATER LEVEL: 902.76
GEOLOGIST: R.L. Allen	WATER LEVEL DATE: 4/22/88
	WATER LEVEL DATUM: MSL

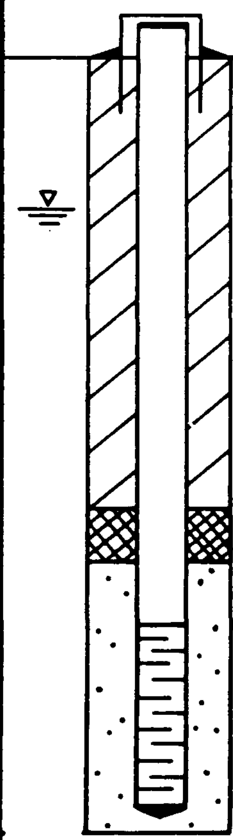
DEPTH IN FEET BELOW LS.	SAMPLER BLOWS	PERCENT RECOVERY	SAMPLE DESCRIPTION	LITHOLOGY	WELL CONSTRUCTION
0	12-7-5		TOPSOIL		
	3-4-4		SAND-greyish red, fine to very fine.		
10	8-4-4		SAND-yellowish orange, fine to very fine, trace silt.		
	12-53-100/4"		SAND-pale yellowish orange to pale yellowish brown, fine to very fine. (sandstone)		
20	50/4"				
	50/2"				
30					
40					
			Boring terminated at 44.0'		
50					



ENGINEERING-SCIENCE
DRILLING RECORD

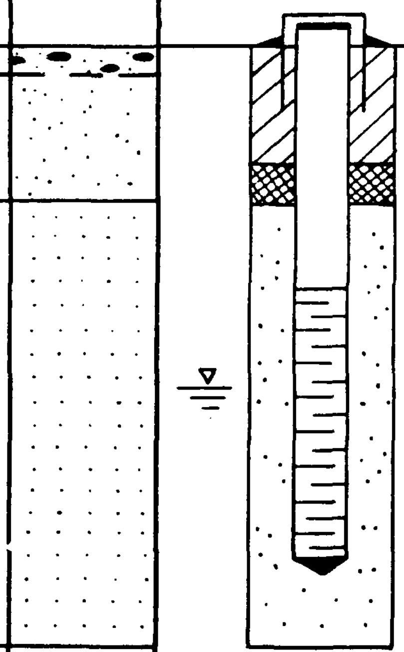
WELL/BORING ID: VF1 MW-4	DRILLING STARTED: 2/2/88
LOCATION: Volk Field ANGB, Camp Douglas, WI	DRILLING COMPLETED: 2/2/88
PROJECT NO: AT077	DRILLING METHOD: 6.25 inch I.D. HSA 7.9 inch Rotary Wash
DRILLER: Exploration Technology, Inc.	SAMPLING METHOD: Split Spoon/Grab
LOGGER:	STATIC WATER LEVEL: 902.36
GEOLOGIST: R.L. Allen	WATER LEVEL DATE: 4/22/88
	WATER LEVEL DATUM: MSL

DEPTH IN FEET BELOW LS.	SAMPLER BLOWS	PERCENT RECOVERY	SAMPLE DESCRIPTION	LITHOLOGY	WELL CONSTRUCTION
0	23-12-9		SAND-moderate yellowish brown to dark yellowish orange, fine to very fine		
	3-5-5				
10	3-4-5				
	6-10-11				
20	50/3"		SAND-pale yellow orange, fine to very fine (sandstone)		
30					
40					
			Boring Terminated at 44.0'		
50					



ENGINEERING-SCIENCE
DRILLING RECORD

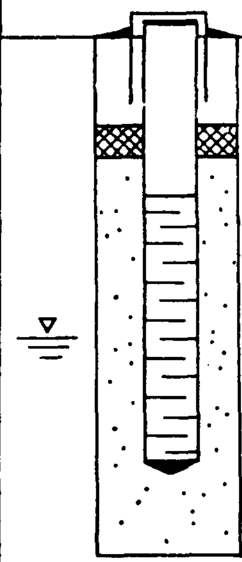
WELL/BORING ID: VF9 MW-1	DRILLING STARTED: 12/17/87
LOCATION: Volk Field ANGB, Camp Douglas, WI	DRILLING COMPLETED: 12/18/87
PROJECT NO: AT077	DRILLING METHOD: 6.25 inch I.D. HSA 5.9 inch Rotary Wash
DRILLER: Exploration Technology, Inc.	SAMPLING METHOD: Split Spoon
LOGGER:	STATIC WATER LEVEL: 904.03
GEOLOGIST: R.L. Allen	WATER LEVEL DATE: 4/22/88
	WATER LEVEL DATUM: MSL



DEPTH IN FEET BELOW LS.	SAMPLER BLOWS	PERCENT RECOVERY	SAMPLE DESCRIPTION	LITHOLOGY	WELL CONSTRUCTION
0	1-3-3		SAND-grey, fine to very fine (organics)		
	3-5-7				
			SAND-yellow orange and rusty streaks, fine to very fine		
10	100/6"				
	100/5"		SAND-pale yellow orange, fine to very fine, (sandstone)		
20	100/6"				
	100/3"				
30					
			Boring Terminated at 33.5'		
40					

ENGINEERING-SCIENCE
DRILLING RECORD

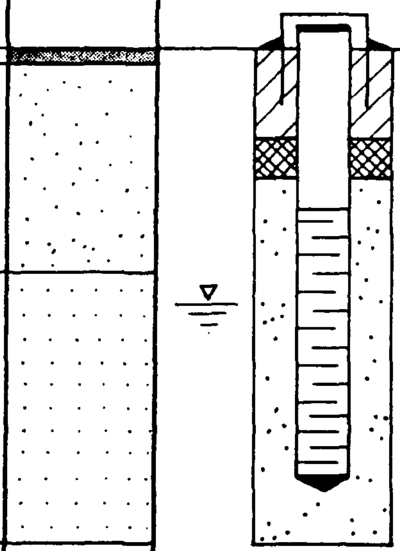
WELL/BORING ID: VF9 MW-2	DRILLING STARTED: 12/20/87
LOCATION: Volk Field ANGB, Camp Douglas, WI	DRILLING COMPLETED: 12/20/87
PROJECT NO: AT077	DRILLING METHOD: 6.25 inch I.D. HSA 5.9 inch Rotary Wash
DRILLER: Exploration Technology, Inc.	SAMPLING METHOD: Split Spoon
LOGGER:	STATIC WATER LEVEL: 903.13
GEOLOGIST: R.S. Bonner/R.L. Allen	WATER LEVEL DATE: 4/22/88
	WATER LEVEL DATUM: MSL

DEPTH IN FEET BELOW LS.	SAMPLER BLOWS	PERCENT RECOVERY	SAMPLE DESCRIPTION	LITHOLOGY	WELL CONSTRUCTION
0	3-4-4		TOPSOIL		
	3-5-6		SAND-dark yellowish brown to dark yellowish orange (laminated), fine to very fine		
10	7-11-11				
	100/4"		SAND-yellowish orange fine to very fine, (sandstone)		
20	50/2"				
30			Boring Terminated at 29.0'		

ENGINEERING-SCIENCE
DRILLING RECORD

WELL/BORING ID: VF9 MW-3	DRILLING STARTED: 12/21/87
LOCATION: Volk Field ANGB, Camp Douglas, WI	DRILLING COMPLETED: 12/21/87
PROJECT NO: AT077	DRILLING METHOD: 6.25 inch I.D. HSA 5.9 inch Rotary Wash
DRILLER: Exploration Technology, Inc.	SAMPLING METHOD: Split Spoon
LOGGER:	STATIC WATER LEVEL: 903.11
GEOLOGIST: R.L. Allen	WATER LEVEL DATE: 4/22/88
	WATER LEVEL DATUM: MSL

DEPTH IN FEET BELOW LS.	SAMPLER BLOWS	PERCENT RECOVERY	SAMPLE DESCRIPTION	LITHOLOGY	WELL CONSTRUCTION
0	2-2-3		TOPSOIL		
	4-4-6		SAND-yellow, orange and rusty, fine to very fine		
10	4-6-8				
	50/3"		SAND-pale yellow orange, fine to very fine, (sandstone)		
20	50/1"				
			Boring Terminated at 27.5'		
30					



EXPLORATION TECHNOLOGY, INC. WELLS

EXPLORATION TECHNOLOGY INC.

LOG OF TEST BORING

Project: Well Installation
Location: Vallfield-Camp Douglas, Wisconsin

Boring No. ET-1
Surface Elevation
Job No. 810611
Sheet 1 of 1

SAMPLE No.	Type	Recovery	Moisture	N	Depth	VISUAL CLASSIFICATION and Remarks
						Fine Brown SAND, Some Silt
1	SS	14"	M	11		Medium Dense, Reddish Brown Fine SAND
2	SS	12"	M	23	5	Medium, Yellowish White SAND
3	SS	13"	M	50		
4	SS	11"	M	[illegible]	10	White Weathered SANDSTONE
5	SS	3"	M	[illegible]	15	
6	SS	1"	M	[illegible]	20	
7	SS	4"	M	[illegible]	25	End Boring at 25'
					30	Well installed at 23.5'

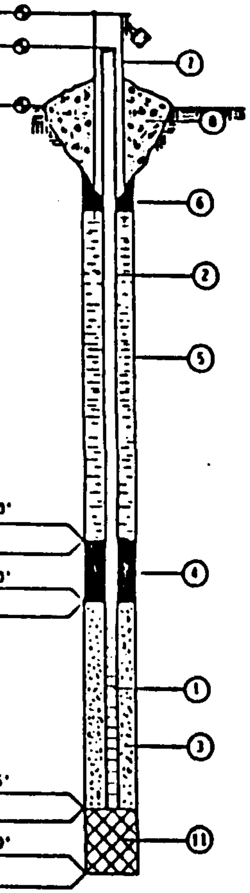
SOIL PROPERTIES: (no entries)

WATER LEVEL OBSERVATIONS

While Drilling
Upon Completion of Drilling
Time After Drilling 1/2 hour
Depth to Water 15.5'
Depth to Cave in

GENERAL NOTES

Start 5/7/85 Complete 5/7/85
Crew Chief MG Rig 9920
Drilling Method



EXPLORATION TECHNOLOGY INC.

MONITORING WELL CONSTRUCTION INFORMATION

JOB NO. 810611
BORING/WELL NO. ET-1
DATE 5/7/85
CHIEF/UNIT MG/9920

1. SCREEN TYPE SCH 40 PVC
   SLOTTED LENGTH 4.5 ft.
   SLOT SIZE 0.010"
   SCREEN DIAMETER 2 in.
2. SOLID PIPE TYPE SCH 40 PVC
   SOLID PIPE LENGTH 20.5 ft.
   JOINT TYPE SLIP/GLUED/(THREADED)
3. TYPE OF BACKFILL AROUND SCREEN #30 Flint Sand
4. TYPE OF LOWER SEAL (IF INSTALLED) Bentonite Pellets
5. TYPE OF BACKFILL Bentonite Spoils
   HOW INSTALLED - TREMIE (FROM SURFACE)
6. TYPE OF SURFACE SEAL (IF INSTALLED) Granular Bentonite
7. PROTECTIVE CASING (YES) NO
   LOCKING (YES) NO
8. CONCRETE SEAL YES (NO)
9. DRILLING METHOD 3 1/4" Hollow Stem Auger
10. ADDITIVES USED (IF ANY) None
11. TYPE OF BACKFILL Natural Sand

WATER LEVEL 15.5' DATE 5/7/85

*ALL DEPTHS MEASURED FROM GROUND SURFACE.

LOG OF TEST BORING

EXPLORATION TECHNOLOGY INC.

Project: Well Installation
Location: Volkfield-Camp Douglas, Wisconsin
Boring No.: ET-2
Surface Elevation:
Job No.: 810611
Sheet 1 of 1

SAMPLE No.	Type	Recovery	Moisture	N	Depth	VISUAL CLASSIFICATION and Remarks
						Brown Fine SAND, Some Silt
1	SS	18"	M	10		Medium Dense, Reddish Brown Fine SAND
2	SS	18"	M	11	5	
3	SS	18"	M	32		Rusty White Weathered SANDSTONE
4	SS	18"	M	68	10	
5	SS	7"	W	[illegible]	15	SANDSTONE, Very Dense
6	SS	11"	W	[illegible]	20	
7	SS	8"	W	[illegible]	25	End Boring at 25' Installed well at 22.5'

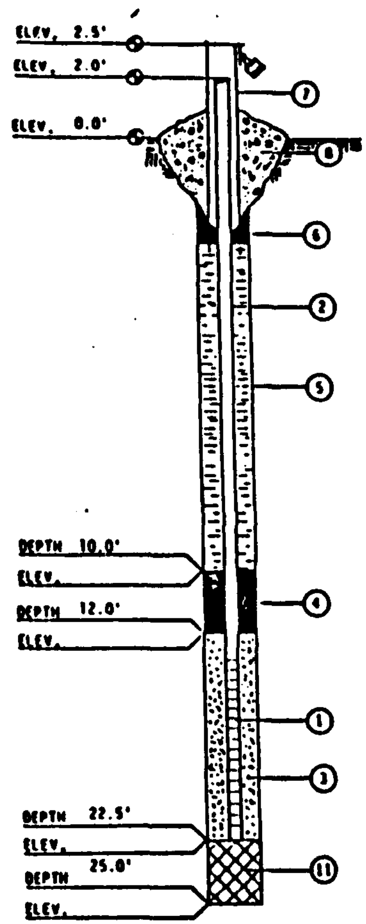
SOIL PROPERTIES: (no entries)

WATER LEVEL OBSERVATIONS

While Drilling
Upon Completion of Drilling
Time After Drilling: 1/4 hour
Depth to Water: 13.3'
Depth to Cave in

GENERAL NOTES

Start 5/7/85 Complete 5/7/85
Crew Chief MG Rig 9920
Drilling Method



EXPLORATION TECHNOLOGY INC.

MONITORING WELL CONSTRUCTION INFORMATION

JOB NO. 810611
BORING/WELL NO. ET-2
DATE 5/7/85
CHIEF/UNIT MG/9920

1. SCREEN TYPE SCH 40 PVC
   SLOTTED LENGTH 4.5 ft.
   SLOT SIZE 0.010"
   SCREEN DIAMETER 2.0 in.
2. SOLID PIPE TYPE SCH 40 PVC
   SOLID PIPE LENGTH 19.5 ft.
   JOINT TYPE SLIP/GLUED/THREADED (circled: THREADED)
3. TYPE OF BACKFILL AROUND SCREEN #30 Flint Sand
4. TYPE OF LOWER SEAL (IF INSTALLED) Bentonite Pellets
5. TYPE OF BACKFILL Bentonite Smalls (Sand)
   HOW INSTALLED - TREMIE / FROM SURFACE (circled: FROM SURFACE)
6. TYPE OF SURFACE SEAL (IF INSTALLED) Granular Bentonite
7. PROTECTIVE CASING YES NO (circled: YES)
   LOCKING YES NO (circled: YES)
8. CONCRETE SEAL YES NO (circled: NO)
9. DRILLING METHOD 3 1/4" Hollow Stem Auger
10. ADDITIVES USED (IF ANY) None
11. TYPE OF BACKFILL Natural Sand

WATER LEVEL 13.3' DATE 5/7/85

*ALL DEPTHS MEASURED FROM GROUND SURFACE.

LOG OF TEST BORING

EXPLORATION TECHNOLOGY INC.

Project: Well Installation
Location: Volkfield-Camp Douglas, Wisconsin

Boring No. ET-3
Surface Elevation
Job No. 810611
Sheet 1 of 1

SAMPLE No.	Type	Recovery	Moisture	N	Depth	VISUAL CLASSIFICATION and Remarks
						Dark Brown SAND, Some Silt
1	SS	10"	M	11		Medium Dense, Reddish Brown Fine SAND, Trace of Silt
2	SS	16"	M	15	5	
3	SS	14"	M	15		Rusty White Weathered SANDSTONE Sample smells of Airplane Fuel
4	SS	16"	M	48	10	Drill Hard at 11.5'
5	SS	5"	M	[illegible]	15	
6	SS	6"	W	[illegible]	20	Sandstone, Dirty White Gray in Color
7	SS	5"	W	[illegible]	25	End Boring at 25'
					30	Installed well at 19'

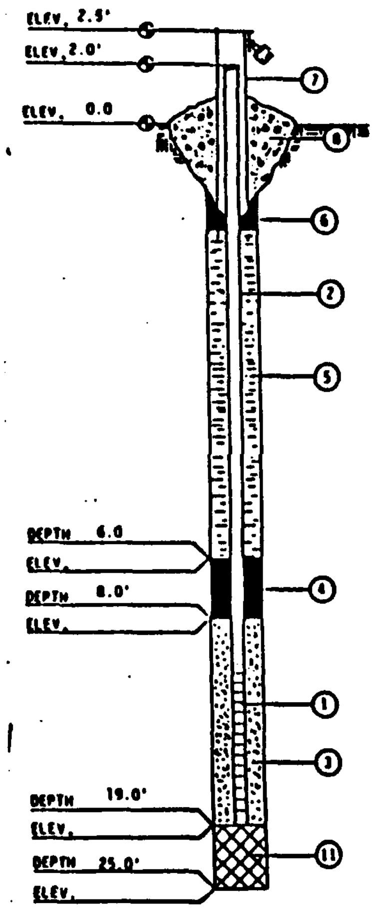
SOIL PROPERTIES

WATER LEVEL OBSERVATIONS

While Drilling
Upon Completion of Drilling
Time After Drilling: 1/4 hour
Depth to Water: 11.3'
Depth to Cave in

GENERAL NOTES

Start 5/7/85 Complete 5/7/85
Crew Chief MG Rig 9920
Drilling Method



EXPLORATION TECHNOLOGY INC.

MONITORING WELL CONSTRUCTION INFORMATION

JOB NO. 810611
BORING/WELL NO. ET-3
DATE 5/7/85
CHIEF/UNIT MG/9920

1. SCREEN TYPE SCH 40 PVC
   SLOTTED LENGTH 9.0 ft.
   SLOT SIZE 0.010"
   SCREEN DIAMETER 2.0 in.
2. SOLID PIPE TYPE SCH 40 PVC
   SOLID PIPE LENGTH 12.0 ft.
   JOINT TYPE SLIP/GLUED (THREADED)
3. TYPE OF BACKFILL AROUND SCREEN #30 Flint Sand
4. TYPE OF LOWER SEAL (IF INSTALLED) Bentonite Pellets
5. TYPE OF BACKFILL Bentonite Spoils
   HOW INSTALLED - TREMIE (FROM SURFACE)
6. TYPE OF SURFACE SEAL (IF INSTALLED) Granular Bentonite
7. PROTECTIVE CASING (YES) NO
   LOCKING (YES) NO
8. CONCRETE SEAL YES (NO)
9. DRILLING METHOD 3 1/4" Hollow Stem Auger
10. ADDITIVES USED (IF ANY) None
11. TYPE OF BACKFILL Natural Sand

WATER LEVEL 11.3' DATE 5/7/85

*ALL DEPTHS MEASURED FROM GROUND SURFACE.

EXPLORATION TECHNOLOGY INC.

LOG OF TEST BORING

Project: Well Installation
Location: Volkfield-Camp Douglas, Wisconsin

Boring No.: ET-4
Surface Elevation:
Job No.: 810611
Sheet 1 of 1

SAMPLE No.	Type	Recovery	Moisture	N
1	SS	18"	M	9
2	SS	18"	M	12
3	SS	18"	M	15
4	SS	18"	M	31
5	SS	6"	W	100/[illegible]
6	SS	3"	W	100/[illegible]
7	SS	6"	W	100/[illegible]

VISUAL CLASSIFICATION and Remarks

- Dark Brown Fine SAND, Some Silt
- Medium Dense, Reddish Brown Fine SAND
- Rusty White Weathered SANDSTONE
- Green, Gray White In Color. Smells of Fuel
- End Boring at 25'

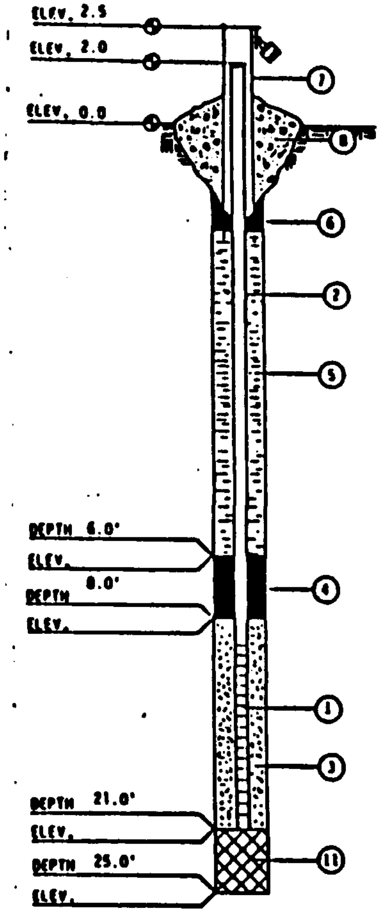
SOIL PROPERTIES: (blank)

WATER LEVEL OBSERVATIONS

While Drilling:
Upon Completion of Drilling:
Time After Drilling: 3 hours
Depth to Water: 11.0'
Depth to Cave In:

GENERAL NOTES

Start 6/8/85 Complete 6/8/85
Crew Chief MG Rig 9920
Drilling Method



EXPLORATION TECHNOLOGY INC.

MONITORING WELL CONSTRUCTION INFORMATION

JOB NO. 810611
BORING/WELL NO. ET-4
DATE 5/8/85
CHIEF/UNIT MG/9920

1. SCREEN TYPE SCH 40 PVC
   SLOTTED LENGTH 10.0 ft.
   SLOT SIZE 0.010"
   SCREEN DIAMETER 2.0 in.
2. SOLID PIPE TYPE SCH 40 PVC
   SOLID PIPE LENGTH 23.0 ft.
   JOINT TYPE SLIP/GLUED (THREADED)
3. TYPE OF BACKFILL AROUND SCREEN #30 Flint Sand
4. TYPE OF LOWER SEAL (IF INSTALLED) Bentonite Pellets
5. TYPE OF BACKFILL Bentonite Grout
   HOW INSTALLED - TREMIE (FROM SURFACE)
6. TYPE OF SURFACE SEAL (IF INSTALLED) Granular Bentonite
7. PROTECTIVE CASING (YES) NO
   LOCKING (YES) NO
8. CONCRETE SEAL YES (NO)
9. DRILLING METHOD 3 1/4" Hollow Stem Auger
10. ADDITIVES USED (IF ANY) None
11. TYPE OF BACKFILL Natural Sand

WATER LEVEL 11.0' DATE 5/8/85

*ALL DEPTHS MEASURED FROM GROUND SURFACE.

LOG OF TEST BORING

EXPLORATION TECHNOLOGY INC.

Project: Well Installation
Location: Volkfield-Camp Douglas, Wisconsin

Boring No. ET-5
Surface Elevation
Job No. 810611
Sheet 1 of 1

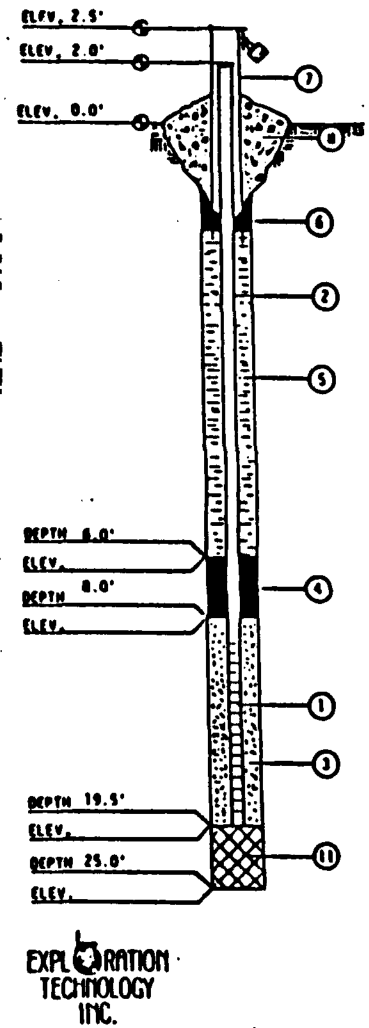
SAMPLE No.	Type	Recovery	Moisture	N	Depth	VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES				
1	SS	18"	M	8		Dark Brown SAND, Trace Silt					
						Medium Dense, Light Brown Fine SAND					
2	SS	18"	M	12	5	Smell of Fuel					
3	SS	18"	M	16							
4	SS	18"	M	41	10	White Weathered SANDSTONE					
5	SS	7"	M	115/2	15	Fuel Odor					
6	SS	5"	M	100/3	20	Greenish Gray in Color					
7	SS	4"	M	100/3	25	End Boring at 25'					
					30	Installed well at 19.5'					
					35						
					40						

WATER LEVEL OBSERVATIONS

While Drilling
Upon Completion of Drilling
Time After Drilling 1 hour
Depth to Water 11.2'
Depth to Cave in

GENERAL NOTES

Start 5/8/85 Complete 5/8/85
Crew Chief MG Rig 9920
Drilling Method



EXPLORATION TECHNOLOGY INC.

MONITORING WELL CONSTRUCTION INFORMATION

JOB NO. 810611
BORING/WELL NO. ET-5
DATE 5/8/85
CHIEF/UNIT MG/9920

1. SCREEN TYPE SCH 40 PVC
   SLOTTED LENGTH 9.0 ft.
   SLOT SIZE 0.010"
   SCREEN DIAMETER 2.0 in.
2. SOLID PIPE TYPE SCH 40 PVC
   SOLID PIPE LENGTH 12.5 ft.
   JOINT TYPE SLIP/GLUED (THREADED)
3. TYPE OF BACKFILL AROUND SCREEN
   #30 Flint Sand
4. TYPE OF LOWER SEAL (IF INSTALLED)
   Bentonite Pellets
5. TYPE OF BACKFILL Bentonite & Spoils
   HOW INSTALLED - TREMIE (FROM SURFACE)
6. TYPE OF SURFACE SEAL (IF INSTALLED)
   Granular Bentonite
7. PROTECTIVE CASING (YES) NO
   LOCKING (YES) NO
8. CONCRETE SEAL YES (NO)
9. DRILLING METHOD 3 1/4" Hollow Stem Auger
10. ADDITIVES USED (IF ANY)
    None
11. TYPE OF BACKFILL Natural Sand

WATER LEVEL 11.3' DATE 5/8/85

*ALL DEPTHS MEASURED FROM GROUND SURFACE.

EXPLORATION TECHNOLOGY INC.

LOG OF TEST BORING

Project: Well Installation
Location: Volkfield-Camp Douglas, Wisconsin

Boring No. ET-6
Surface Elevation
Job No. 810611
Sheet 1 of 1

SAMPLE No.	Type	Recovery "	Moisture	N	Depth	VISUAL CLASSIFICATION and Remarks
						Dark Brown Fine SAND, Trace of Silt
1	SS	18"	M	9		Medium Dense, Reddish Brown Fine SAND
2	SS	18"	M	8	5	Light Gray White in Color
3	SS	12"	M	23		
4	SS	16"	M	42	10	Yellow White Weathered SANDSTONE
5	SS	5"	W	[illegible]	15	
6	SS	NR		[illegible]	20	
7	SS	4"	W	[illegible]	25	
8	SS	NR		[illegible]	30	Wash Sample
9	SS	NR		[illegible]	35	Wash Sample
						Installed well at 40'
10	SS	1"	W	[illegible]	40	End Boring at 40'

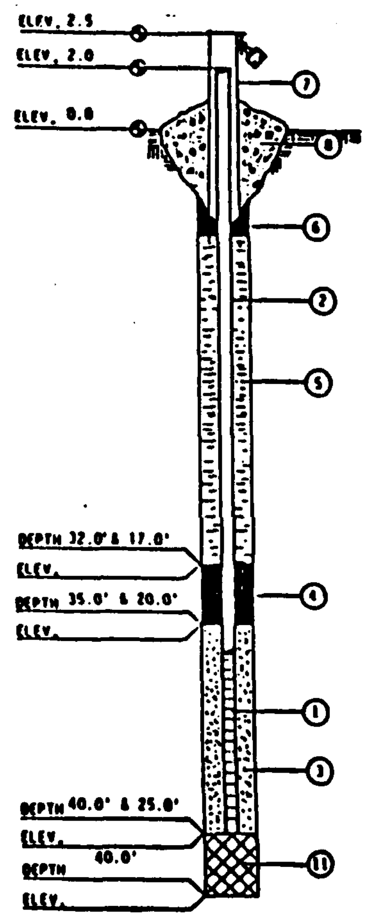
SOIL PROPERTIES: (blank)

WATER LEVEL OBSERVATIONS

While Drilling
Upon Completion of Drilling
Time After Drilling 1/2 hour
Depth to Water 12'
Depth to Cave in

GENERAL NOTES

Start 5/9/85 Complete 5/9/85
Crew Chief MG Rig 9920
Drilling Method



EXPLORATION TECHNOLOGY INC.

MONITORING WELL CONSTRUCTION INFORMATION

JOB NO. 810611
BORING/WELL NO. ET-6
DATE 5/9/85
CHIEF/UNIT MG/9920

1. SCREEN TYPE SCH 40 PVC
   SLOTTED LENGTH 9.0 ft.
   SLOT SIZE 0.010"
   SCREEN DIAMETER 2.0 in.
2. SOLID PIPE TYPE SCH 40 PVC
   SOLID PIPE LENGTH 33.0 ft.
   JOINT TYPE SLIP/GLUED THREADED
3. TYPE OF BACKFILL AROUND SCREEN #30 Flint Sand
4. TYPE OF LOWER SEAL (IF INSTALLED) Bentonite Pellets
5. TYPE OF BACKFILL Bentonite & Spoils
   HOW INSTALLED - TREMIE / (FROM SURFACE)
6. TYPE OF SURFACE SEAL (IF INSTALLED) Granular Bentonite
7. PROTECTIVE CASING (YES) NO
   LOCKING (YES) ; NO
8. CONCRETE SEAL YES (NO)
9. DRILLING METHOD 3 7/8" Mud rotary
10. ADDITIVES USED (IF ANY) Powder Bentonite
11. TYPE OF BACKFILL

WATER LEVEL 12.0' DATE 5/9/85

*ALL DEPTHS MEASURED FROM GROUND SURFACE.

EXPLORATION TECHNOLOGY INC.

LOG OF TEST BORING

Project: Well Installation
Location: Volk Field-Camp Douglas, Wisconsin

Boring No. ET-7
Surface Elevation
Job No. 810611
Sheet 1 of 1

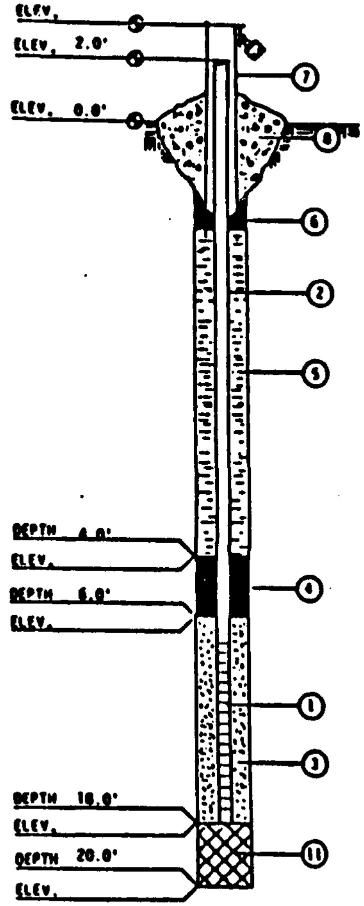
SAMPLE No.	Type	Recovery	Moisture	N	Depth	VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES qu	w	LL	PL	D
					0–10	Earth DRILLED					
1	SS	18	W	22	10	Gray-White Medium Dense to Dense SANDSTONE					
2	SS	18"	W	56	15						
3	SS	6"	W	100/	20	End Boring at 20' Installed well at 10.0'					

WATER LEVEL OBSERVATIONS

While Drilling
Upon Completion of Drilling
Time After Drilling 1/4 hour
Depth to Water 10.1'
Depth to Cave in

GENERAL NOTES

Start 5/9/85 Complete 5/9/85
Crew Chief MG Rig 9920
Drilling Method



EXPLORATION TECHNOLOGY INC.

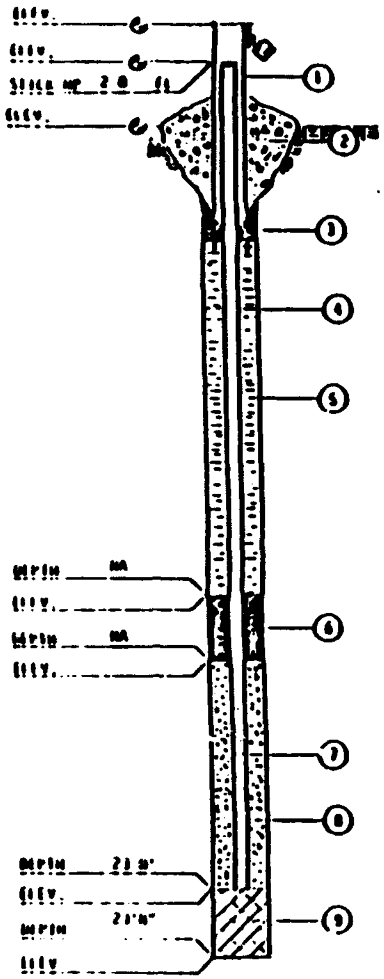
MONITORING WELL CONSTRUCTION INFORMATION

JOB NO. 810611
BORING/WELL NO. ET-7
DATE 5/9/85
CHIEF/UNIT MG/9920

1. SCREEN TYPE SCH 40 PVC
   SLOTTED LENGTH 10.0 ft.
   SLOT SIZE 0.010"
   SCREEN DIAMETER 2.0 in.
2. SOLID PIPE TYPE SCH 40 PVC
   SOLID PIPE LENGTH 10 ft.
   JOINT TYPE SLIP/GLUED/(THREADED)
3. TYPE OF BACKFILL AROUND SCREEN #30 Flint Sand
4. TYPE OF LOWER SEAL (IF INSTALLED) Bentonite Pellets
5. TYPE OF BACKFILL Bentonite Smalls
   HOW INSTALLED - TREMIE (FROM SURFACE)
6. TYPE OF SURFACE SEAL (IF INSTALLED) Granular Bentonite
7. PROTECTIVE CASING YES (NO)
   LOCKING YES (NO)
8. CONCRETE SEAL YES (NO)
9. DRILLING METHOD 3 1/4" Hollow Stem Auger
10. ADDITIVES USED (IF ANY) None
11. TYPE OF BACKFILL Natural Sand

WATER LEVEL 10.1 DATE 5/9/85

*ALL DEPTHS MEASURED FROM GROUND SURFACE.



EXPLORATION TECHNOLOGY INC.

MONITORING WELL CONSTRUCTION INFORMATION

JOB NO. 810009

BORING/WELL NO. MW1

DATE 9/10/85

CHIEF/UNIT LS/9110

1. PROTECTIVE CASING YES (NO)
   LOCKING YES (NO)
2. CONCRETE SEAL YES (NO)
3. TYPE OF SURFACE SEAL (IF INSTALLED) None
4. SOLID PIPE TYPE SCH 40 PVC
   SOLID PIPE LENGTH 15.0 ft.
   JOINT TYPE SLIP/GLUED (THREADED)
5. TYPE OF BACKFILL Cutting from Boring
   HOW INSTALLED - TREMIE & (POUR SURFACE)
6. TYPE OF LOWER SEAL (IF INSTALLED) NA
7. SCREEN TYPE SCH 40 PVC 4"
   SCREEN LENGTH 10.0'
   SLOT-SIZE 0.010" LENGTH 8.4 ft.
   SCREEN DIAMETER 4.0 in.
8. TYPE OF BACKFILL AROUND SCREEN Flint Sand #30
9. TYPE OF BACKFILL Cave in from Hole
10. DRILLING METHOD Auger & Wash Bore 5 7/8"
11. ADDITIVES USED (IF ANY) Bentonite

WATER LEVEL 12.5' DATE 9/10/85

*ALL DEPTHS MEASURED FROM GROUND SURFACE.

EXPLORATION TECHNOLOGY INC.

LOG OF TEST BORING

Project Volk Field-Mason Hanger

Location Camp Douglas, Wisconsin

Boring No. MW1

Surface Elevation

Job No. 810009

Sheet 1 of 1

No.	Type	Recovery	Moisture	N	Depth	VISUAL CLASSIFICATION and Remarks	Qu	W	LL	PL	D
						3" Crushed ROCK					
						Dark Brown Fine to Medium SAND, Little to Trace of Silt					
1	SS	10"	M	23	5	Medium Dense Light Brown Fine to Medium Sand					
						Odor in Soil					
2	SS	10"	M	22	10	White Color					
3	SS	4"	W	[illegible]	15	Hard SANDSTONE					
4	SS	2"	W	[illegible]	20	-					
5	SS		W	[illegible]	25	End Boring at 23'8"					
						Install 23' well					
					30						
					35						
					40						

WATER LEVEL OBSERVATIONS

While Drilling 12.5'

Upon Completion of Drilling

Time After Drilling 1 hour

Depth to Water 12.5'

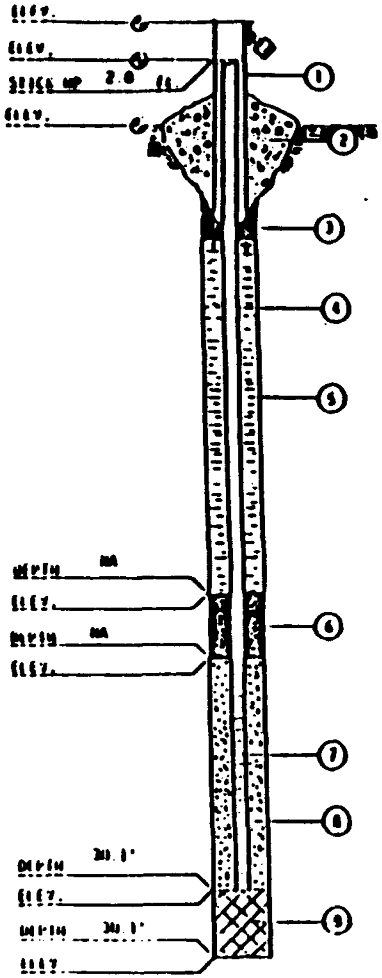
Depth to Cave in

GENERAL NOTES

Start 9/9/85 Complete 9/9/85

Crew Chief LS Rig 9110

Drilling Method



EXPLORATION TECHNOLOGY INC.

MONITORING WELL CONSTRUCTION INFORMATION

JOB NO. 810809

BORING/WELL NO. MW2

DATE 9/10/85

CHIEF/UNIT LS/9110

1. PROTECTIVE CASING YES (NO)
   LOCKING YES (NO)
2. CONCRETE SEAL YES (NO)
3. TYPE OF SURFACE SEAL (IF INSTALLED) None
4. SOLID PIPE TYPE SCH 40 PVC
   SOLID PIPE LENGTH 17.1 ft.
   JOINT TYPE SLIP/GLUED/(THREADED)
5. TYPE OF BACKFILL Cutting from Hole
   HOW INSTALLED - ~~TREMIE~~ (FROM SURFACE)
6. TYPE OF LOWER SEAL (IF INSTALLED) None
7. SCREEN TYPE SCH 40 PVC
   SCREEN LENGTH 15.0
   SLOT-SIZE 0.010" LENGTH 12.6 ft.
   SCREEN DIAMETER 4.0 in.
8. TYPE OF BACKFILL AROUND SCREEN #30 Flint Sand
9. TYPE OF BACKFILL NA
10. DRILLING METHOD Auger & Wash Bore 5-7/8" Bit
11. ADDITIVES USED (IF ANY) Bentonite

WATER LEVEL 14.5' DATE 9/10/85

*ALL DEPTHS MEASURED FROM GROUND SURFACE.

LOG OF TEST BORING

EXPLORATION TECHNOLOGY INC.

Project: Volk Field-Mason Hangar

Location: Camp Douglas, Wisconsin

Boring No. MW2

Surface Elevation

Job No. 810809

Sheet 1 of 1

SAMPLE No.	Type	Recovery	Moisture	N	Depth	VISUAL CLASSIFICATION and Remarks
						Medium Dense, Dark Brown Fine to Medium SAND, Some to Little Silt
1	SS	18"	M	17	5	Medium Dense, Light Brown Fine to Medium SAND
2	SS	18"	M	22	10	White & Rust Brown Colored Seams
3	SS		M	100/2"	15	Hard SANDSTONE Light Brown to White Color
4	SS		M	100/2"	20	
5	SS		M	100/2"	25	
6	SS		M	100/2"	30	End Boring at 30.1'
					35	Install 30' Well-4"
					40	

SOIL PROPERTIES: (columns blank)

WATER LEVEL OBSERVATIONS

While Drilling 14'

Upon Completion of Drilling

Time After Drilling 1 hour

Depth to Water 14.5'

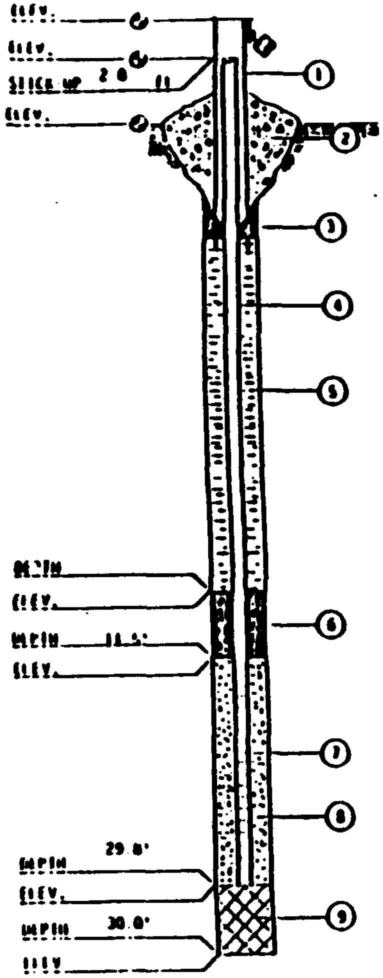
Depth to Cave in

GENERAL NOTES

Start 9/14/85 Complete 9/14/85

Crew Chief LS Rig 9100

Drilling Method



EXPLORATION TECHNOLOGY INC.

MONITORING WELL CONSTRUCTION INFORMATION

JOB NO. 810809

BORING/WELL NO. MW3

DATE 9/11/85

CHIEF/UNIT LS/9110

1. PROTECTIVE CASING YES (NO)

   LOCKING YES (NO)

2. CONCRETE SEAL YES (NO)

3. TYPE OF SURFACE SEAL (IF INSTALLED) None

4. SOLID PIPE TYPE SCH 40 PVC

   SOLID PIPE LENGTH 16.9 ft.

   JOINT TYPE SLIP/GLUED (THREADED)

5. TYPE OF BACKFILL Cuttings from Boring

   HOW INSTALLED - ~~TREMIE~~ (FROM SURFACE)

6. TYPE OF LOWER SEAL (IF INSTALLED) 4 NA

7. SCREEN TYPE SCH 40 PVC

   SCREEN LENGTH 10.0

   SLOT-SIZE 0.010" LENGTH 12.6 ft.

   SCREEN DIAMETER 4.0 in.

8. TYPE OF BACKFILL AROUND SCREEN Flint Sand

9. TYPE OF BACKFILL Stuff in of Boring

10. DRILLING METHOD Auger & Wash Bore 5 7/8"

11. ADDITIVES USED (IF ANY) Bentonite

WATER LEVEL 12.8' DATE 9/11/85

*ALL DEPTHS MEASURED FROM GROUND SURFACE.

EXPLORATION TECHNOLOGY INC.

LOG OF TEST BORING

Project: Volk Field-Mason Hanger

Location: Camp Douglas, Wisconsin

Boring No. MW3

Surface Elevation 810809

Job No.

Sheet 1 of 1

No.	Type	Recovery	Moisture	N	Depth	Visual Classification and Remarks
						*Brown to Light Brown Color
1	SS	18"	M	8	5	Loose Light Brown to White Fine to Medium SAND
2	SS	18"	M	54		Rust Brown & White Colored Seams
2	SS	18"	M	54	10	
3	SS	6"	M	100/[illegible]	15	Hard, Rust Brown & White Fine to Medium SANDSTONE
4	SS		W	100/[illegible]	20	
5	SS		W	100/[illegible]	25	
6	SS		W	100/[illegible]	30	End Boring at 30'
						*Loose Dark Brown Fine to Medium SAND, Some to Little Silt.
					35	
					40	

SOIL PROPERTIES

WATER LEVEL OBSERVATIONS

While Drilling 13.4'

Upon Completion of Drilling

Time After Drilling 1 hour

Depth to Water 12.5'

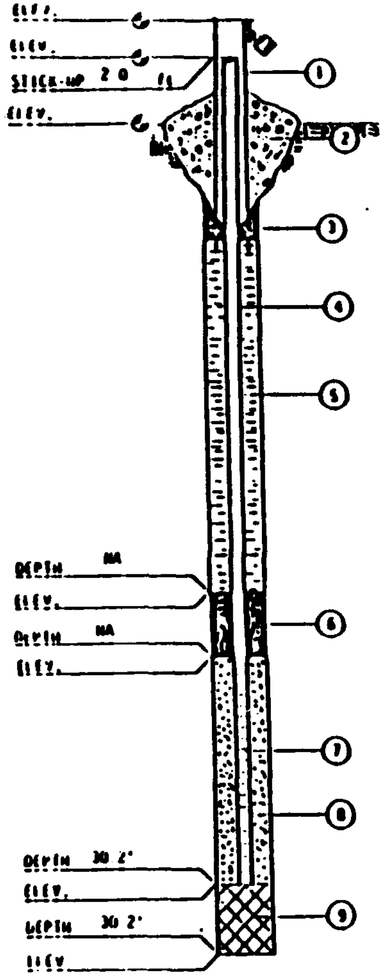
Depth to Cave In

GENERAL NOTES

Start 9/10/85 Complete 9/10/85

Crew Chief LS Rig 9110

Drilling Method



EXPLORATION TECHNOLOGY INC.

MONITORING WELL CONSTRUCTION INFORMATION

JOB NO. 810AN5

BORING/WELL NO. VAM

DATE 9/11/85

CHIEF/UNIT LS/9110

1. PROTECTIVE CASING YES (NO)
   LOCKING YES (NO)
2. CONCRETE SEAL YES (NO)
3. TYPE OF SURFACE SEAL (IF INSTALLED) None
4. SOLID PIPE TYPE SCH 40 PVC
   SOLID PIPE LENGTH 17.2 ft.
   JOINT TYPE SLIP/GLUE/(THREADED)
5. TYPE OF BACKFILL Cutting from Hole
   HOW INSTALLED - TREMIE / (FROM SURFACE)
6. TYPE OF LOWER SEAL (IF INSTALLED) None
7. SCREEN TYPE SCH 40 PVC
   SCREEN LENGTH 15.0'
   SLOT-SIZE 0.010" LENGTH 12.8 ft.
   SCREEN DIAMETER 4.0 in.
8. TYPE OF BACKFILL AROUND SCREEN Flint Sand #30
9. TYPE OF BACKFILL None
10. DRILLING METHOD Auger & Wash Bore 5 7/8"
11. ADDITIVES USED (IF ANY) Bentonite

WATER LEVEL 13.5' DATE 9/11/85

*ALL DEPTHS MEASURED FROM GROUND SURFACE.

EXPLORATION TECHNOLOGY INC.

LOG OF TEST BORING

Project: Volk Field-Mason Hanger
Location: Camp Douglas, Wisconsin

Boring No. VAM
Surface Elevation
Job No. 810AN5
Sheet 1 of 1

No.	Type	Recovery	Moisture	N	Depth	Visual Classification and Remarks
						Medium Dense, Brown Fine to Medium SAND, Little Silt
1	SS	18"	M	10	5	Medium Dense, Light Brown Fine to Medium SAND, Trace of Silt
2	SS		M	18	10	White & Rust Brown Colored Seams
3	SS	6"	W		15	More Gray Color, Strong Odor in Water & Soil
4	SS	2"	W	100/.5	20	
5	SS	1"	W	100/.5	25	
6	SS		W	100/.2	30	End Boring at 30'
					35	Install 4" 30' Well
					40	

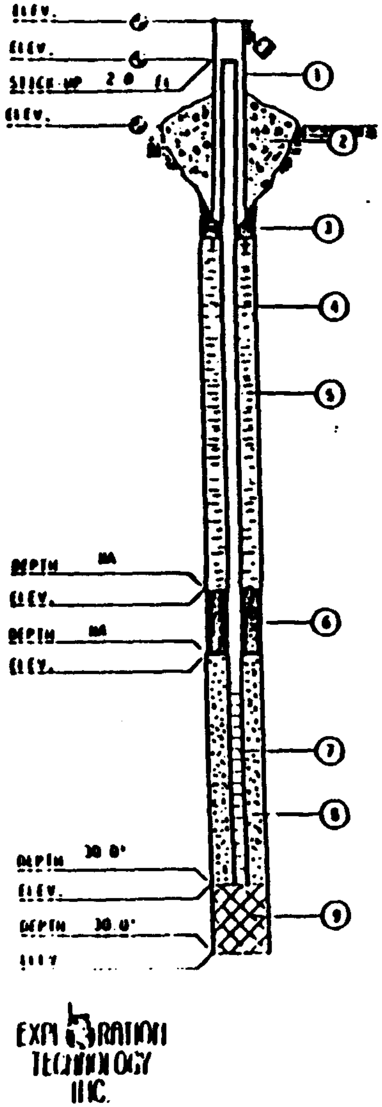
SOIL PROPERTIES: qu | W | LL | PL | D

WATER LEVEL OBSERVATIONS

While Drilling 12.5'
Upon Completion of Drilling
Time After Drilling 1 hour
Depth to Water 13.5'
Depth to Cave In

GENERAL NOTES

Start 9/11/85 Complete 9/11/
Crew Chief LS Rig 9110
Drilling Method



MONITORING WELL CONSTRUCTION INFORMATION

JOB NO. 810809

BORING/WELL NO. MW5

DATE 9/12/85

CHIEF/UNIT LS/9110

1. PROTECTIVE CASING YES (NO)
   LOCKING YES (NO)
2. CONCRETE SEAL YES (NO)
3. TYPE OF SURFACE SEAL (IF INSTALLED) None
4. SOLID PIPE TYPE SCH 40 PVC
   SOLID PIPE LENGTH 17.0 ft.
   JOINT TYPE SLIP/GLUE/(THREADED)
5. TYPE OF BACKFILL Cutting from Boring
   HOW INSTALLED - TREMIE (FROM SURFACE)
6. TYPE OF LOWER SEAL (IF INSTALLED) None
7. SCREEN TYPE SCH 40 PVC
   SCREEN LENGTH 15.0'
   SLOT-SIZE 0.010" LENGTH 12.8 ft.
   SCREEN DIAMETER 4.0 in.
8. TYPE OF BACKFILL AROUND SCREEN #30 Flint Sand
9. TYPE OF BACKFILL None
10. DRILLING METHOD Auger & Wash Bore
11. ADDITIVES USED (IF ANY) Bentonite

WATER LEVEL 13.2' DATE 9/12/85

*ALL DEPTHS MEASURED FROM GROUND SURFACE.

EXPLORATION TECHNOLOGY INC.

LOG OF TEST BORING

Project: Volk Field-Nelson Hangar

Location: Camp Douglas, Wisconsin

Boring No. MW5

Surface Elevation

Job No. 810809

Sheet 1 of 1

Sample No.	Type	Recovery	Moisture	N	Depth	Visual Classification and Remarks
						*
1	SS	10"	M	9	5	Loose, Brown Fine to Medium SAND, Trace of Silt. Slight Odor in Soil, Light Brown to White Color
2	SS	10"	M	14	10	
3	SS	6"	W	100/5	15	Hard Fine to Medium SAND, SANDSTONE. 2" Gray Medium to Coarse Sand Seam. Gray Color
4	SS	4"	W	100/3	20	
5	SS	3"	W	100/3	25	
6	SS	1"	W	100/3	30	End Boring at 30'. Install 30' Well-4". *Loose Brown Fine to Medium SAND, Occasional Seams of Dark Brown Color Marbled in Little Silt

SOIL PROPERTIES: Qu | W | LL | PL | D (no entries)

WATER LEVEL OBSERVATIONS

While Drilling 13.0'

Upon Completion of Drilling

Time After Drilling 1 hour

Depth to Water 13.2'

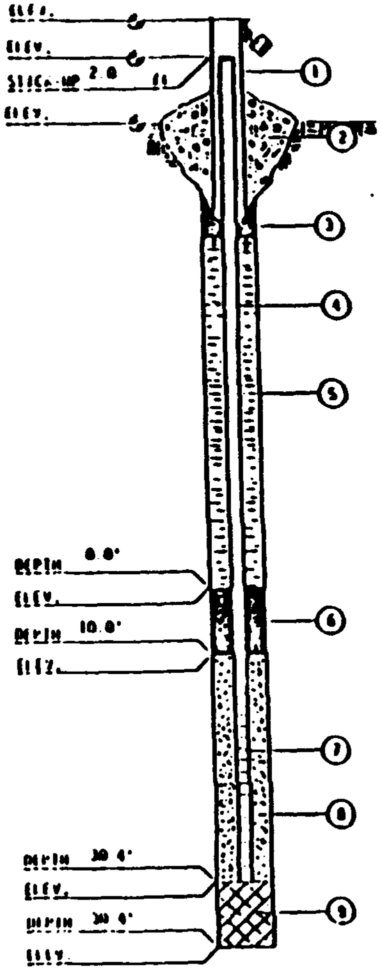
Depth to Cave in

GENERAL NOTES

Start 9/11/85 Complete 9/11/85

Crew Chief LS Rig 9110

Drilling Method



EXPLORATION TECHNOLOGY INC.

MONITORING WELL CONSTRUCTION INFORMATION

JOB NO. 810409

BORING/WELL NO. 1A6

DATE 9/12/85

CHIEF/UNIT LS/9110

1. PROTECTIVE CASING YES (NO)
   LOCKING YES (NO)
2. CONCRETE SEAL YES (NO)
3. TYPE OF SURFACE SEAL (IF INSTALLED) Bentonite
4. SOLID PIPE TYPE SCH 40 PVC
   SOLID PIPE LENGTH 17.4 ft.
   JOINT TYPE SLIP/GLUED (THREADED)
5. TYPE OF BACKFILL Bentonite Grout
   HOW INSTALLED (TREMIE) FROM SURFACE
6. TYPE OF LOWER SEAL (IF INSTALLED) Bentonite Grout
7. SCREEN TYPE SCH 40 PVC
   SCREEN LENGTH 15.0'
   SLOT-SIZE 0.010" LENGTH 12.8 ft.
   SCREEN DIAMETER 4.0 in.
8. TYPE OF BACKFILL AROUND SCREEN #30 Flint Sand
9. TYPE OF BACKFILL None
10. DRILLING METHOD Auger & Wash Bore
11. ADDITIVES USED (IF ANY) Bentonite

WATER LEVEL 14.0' DATE 9/12/85

*ALL DEPTHS MEASURED FROM GROUND SURFACE.

EXPLORATION TECHNOLOGY INC.

LOG OF TEST BORING

Project Volk Field-Mason Hanger

Location Camp Douglas, Wisconsin

Boring No. 1A6
Surface Elevation
Job No. 810409
Sheet 1 of 1

SAMPLE No.	Type	Recovery	Moisture	N	Depth	VISUAL CLASSIFICATION and Remarks
						Medium Dense, Dark Brown Fine to Medium SAND, Little Silt
1	SS	18"	M	12	5	Medium Dense, Brown to Light Brown Fine to Medium SAND
2	SS	18"	M	37	10	Strong Odor. Light Brown Color-Occasional Thin Seams of Dark Gray Color
3	SS	6"	M	110/6	15	Hard Fine to Medium Brown SAND
4	SS	3"	W	100/	20	
5	SS		W	100/	25	
6	SS	1"	W	100/	30	End Boring at 30.4'. Install 30.4' Well-4"
					35	
					40	

SOIL PROPERTIES: Qu | W | LL | PL | D

WATER LEVEL OBSERVATIONS

While Drilling 14'
Upon Completion of Drilling
Time After Drilling 1 hour
Depth to Water 14.0' To 00TT
Depth to Cave in

GENERAL NOTES

Start 9/12/85 Complete 9/12/85
Crew Chief LS Rig 9100
Drilling Method

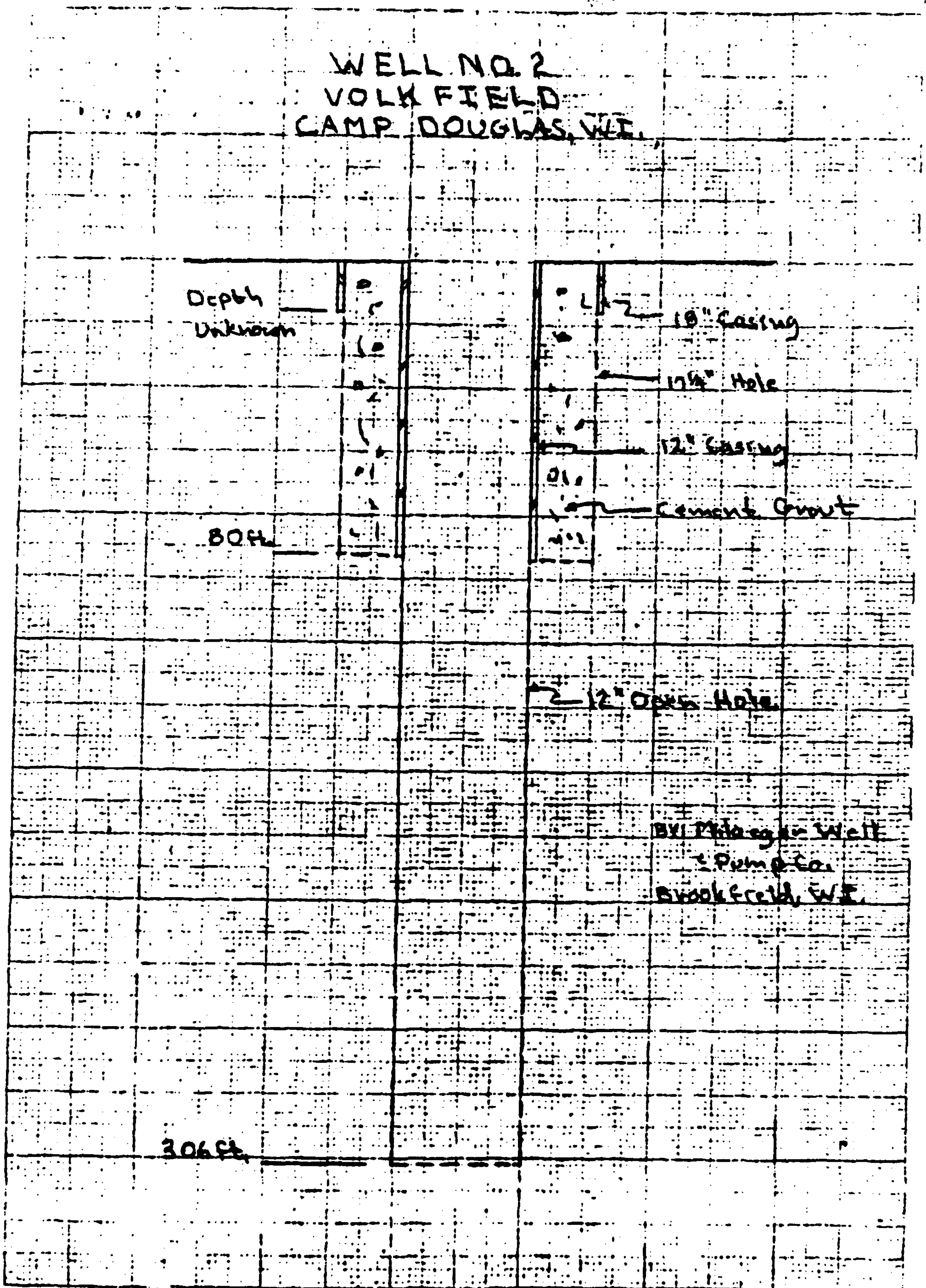
DEPARTMENT OF NATURAL RESOURCES
PRIVATE WATER SUPPLY WELLS

Camp Williams Well, Camp Douglas, Wis.
NW¼, NE¼, Sec. 26 T.17 N., R.sE.
M.H. Baley, Driller, 1942
Samples examined by F.T. Thwaites
Nos. 114315-114375

Volk Field ANGB Well 1

Formation	Base	Depth	Thickness	Description	Construction
S	7	0-7	7	Sand, fine to medium, yellow-brown	
		7-15	8	Sandstone, fine to medium, yellow-gray	18" pipe
		15-30	15	Sandstone, fine to medium, light yellow-gray	16 water 19.5
		30-40	10	Sandstone, fine to medium, light gray	
		40-45	5	Sandstone, medium to fine, light yellow-gray	
		45-60	15	Sandstone, fine to medium, light gray	17½" hole
		60-65	5	Sandstone, fine, light gray	12" pipe cemented
		65-85	20	Sandstone, fine to medium, light gray	80
		85-90	5	Sandstone, fine to medium, light yellow-gray	
		90-95	5	Sandstone, medium to fine, light yellow-gray	
		95-120	25	Sandstone, fine to medium, light gray	
		120-125	5	Sandstone, fine to coarse, light gray	11½" hole
D		125-140	15	Sandstone, fine to medium, light gray	
R E		140-145	5	Sandstone, fine to coarse, light gray	
S B A C		145-175	30	Sandstone, fine to medium, light gray	
H		175-180	5	Sandstone, fine, light gray	
		180-195	15	Sandstone, fine to medium, light gray	
		195-210	15	Sandstone, fine to coarse, light gray	
		210-220	10	Sandstone, fine to medium, light gray	
		220-230	10	Sandstone, fine to coarse, light gray	
		230-235	5	Sandstone, medium to fine, light gray	
		235-245	10	Sandstone, fine to medium, light gray	
		245-250	5	Sandstone, fine, light gray	
		250-260	10	Sandstone, coarse to fine, light gray	
		260-285	25	Sandstone, fine to medium, light gray	
		285-290	5	Sandstone, fine to coarse, light gray	
		290-295	5	Sandstone, coarse to fine, light gray	
	296	295-303	8	Sandstone, silty to coarse, light gray	

Formations: Surface; Dresbach, mainly Eau Claire Cross bedding reported 190-240
Tested at 842 g.p.m. specific capacity = 30 g.p.m.


WELL NO. 2
VOLK FIELD
CAMP DOUGLAS, WI.
Depth Unknown
18" Casing
17¾" Hole
12" Casing
Cement Grout
80 ft.
12" Open Hole
& Pump Co.
Brookfield, WI.
306 ft.

STATE OF WISCONSIN

DEPARTMENT OF RESOURCE DEVELOPMENT

LL CONSTRUCTOR'S REPORT

Wel (

COUNTY: Juneau

CHECK ONE: ☑ Town ☐ Village ☐ City

NAME: Orange

LOCATION (Number and Street or ¼ section, section, township and range. Also give subdivision name, lot and block numbers when available.)
SW¼ Sec 22 T17N R2E

OWNER AT TIME OF DRILLING: Volk Field

OWNER'S COMPLETE MAIL ADDRESS: Camp Douglas Wisconsin

Distance in feet from well to nearest: Record answer in appropriate block)	BUILDING	SANITARY SEWER C. I.	SANITARY SEWER TILE	FLOOR DRAIN C. I.	FLOOR DRAIN TILE	FOUNDATION DRAIN SEWER CONNECTED	FOUNDATION DRAIN INDEPENDENT	WASTE WATER DRAIN C. I.	WASTE WATER DRAIN TILE
	in Building								

AR WATER DRAIN C. I.	AR WATER DRAIN TILE	SEPTIC TANK	PRIVY	SEEPAGE PIT	ABSORPTION FIELD	BARN	SILO	ABANDONED WELL	SINK HOLE

ER POLLUTION SOURCES (Give description such as dump, quarry, drainage well, stream, pond, lake, etc.)

Well is intended to supply water for: Munitions building

DRILLHOLE Rotary

Dia. (in.)	From (ft.)	To (ft.)	Dia. (in.)	From (ft.)	To (ft.)
3/4	Surface	80½			
	80	282			

CASING, LINER, CURBING, AND SCREEN

Dia. (in.)	Kind and Weight	From (ft.)	To (ft.)
	Wrought Iron New 15.97 Plain end	Surface	80½

10. FORMATIONS

Kind	From (ft.)	To (ft.)
Sand	Surface	26
Sandstone	26	282

GROUT OR OTHER SEALING MATERIAL

Kind	From (ft.)	To (ft.)
drill cuttings	Surface	26
neat cement	26	80½

Well construction completed on April 9, 1969

MISCELLANEOUS DATA

d test: 24 Hrs. at 50 GPM

Well is terminated 12" inches ☒ above ☐ below final grade

th from surface to normal water level 30' 4" ft.

Well disinfected upon completion ☒ Yes ☐ No

th to water level when pumping 82' ft.

Well sealed watertight upon completion ☒ Yes ☐ No

er sample sent to Madison, Wis. laboratory on: April 9, 1969

opinion concerning other pollution hazards, information concerning difficulties encountered, and data relating to nearby s, screens, seals, type of casing joints, method of finishing the well, amount of cement used in grouting, blasting, sub- ice pumprooms, access pits, etc., should be given on reverse side.

ATURE: [signature] Registered Well Driller

COMPLETE MAIL ADDRESS: 578 Water Ave. Hillsboro Wis.

Please do not write in space below

ORM TEST RESULT	GAS — 24 HRS.	GAS — 48 HRS.	CONFIRMED	REMARKS

UNIVERSITY OF WISCONSIN GEOLOGICAL & NATURAL HISTORY SURVEY 2 Log No. H237-Ju-114
1815 University Avenue, Madison, Wisconsin 53706

Well name Camp Douglas Emergency Fire Well
Town of Orange
Owner.... Department of Natural Resources
Address.. Box 7921
Madison, WI 53707
Driller.. Ace Well Drilling, Inc.
Engineer.

County: Juneau
Completed... 9/3/76
Field check.
Altitude.... 898' ETM
Use......... Fire protection
Static w.l.. 3'
Spec. cap... 7.2 GPM/ft

R. 2 E.
T. 17 N.
Sec. 26

Quad. Mauston 15'

Drill Hole						Casing & Liner Pipe or Curbing							
Dia.	from	to	Dia.	from	to	Dia.	Wgt.& Kind	from	to	Dia.	Wgt.& Kind	from	to
17"	0	50'				14"	new steel 0.313 ASTM A53 Gr B U.S.P.	+20"	53'				
$13\frac{1}{4}$"	50'	270'											

Drilling method: Rotary
Samples from 0 to 270' Rec'd: 1/27/77

Studied by: R. M. Peters

Grout	from	to
Puddled Clay	0	50'

Issued: 1/12/82

Formations: Surface, Alluvium, Elk Mound Group, Precambrian

Remarks: Well tested for 4 hours at 1000 GPM with 139 feet of drawdown.
DNR Permanent Well #80205 and Juneau Co. Miscellaneous #5.

LOG OF WELL:

	Depths	Graphic Section	Rock Type	Color	Grain Size Mode	Grain Size Range	Miscellaneous Characteristics
SUR	0-5		Sand	Lt bn gy & bk	M	Vfn/VC	Little soil, silt.
0'	5-10		〃	〃	〃	〃	Same.
A	10-15		〃	Rd bn&yl bn	C	〃	Mch dolic clay. Ltl silt. Tr glaucic silica-cemented sandstone.
L	15-20		〃	Yl bn&rd bn	〃	〃	Mch dolomitic clay. Ltl silt, caved sand. Trace Fn glauconite.
L	20-25		〃	Rd bn&yl bn	〃	〃	Same but no caved sand.
U	25-30		〃	〃	〃	〃	Much dolomitic clay, caved sand. Little silt.
V	30-35		〃	Pl brown	M	Vfn/C	Little soil, silt.
I	35-40		〃	〃	〃	〃	Same.
U	40-45		〃	〃	〃	Vfn/VC	〃
M	45-50		〃	Pl yellow	C	〃	Trace red brown dolomitic clay.
55'	50-55		〃	〃	〃	〃	Same plus trace M glauconite.
	55-60		Sandstone	V pl brown	M	〃	Rounded. Trace caved soil, silt, white siliceous shale.
	60-65		〃	〃	〃	〃	Rounded. Trace silt. Vfn/Fn glauconite.
E	65-70		〃	〃	〃	〃	Same plus trace caved soil.
L	70-75		〃	〃	〃	〃	Same but no soil.
K	75-80		〃	Pl yellow	C	〃	Rounded. Trace silt, silica cement, caved soil.
	80-85		〃	〃	〃	〃	Same.
	85-90		〃	〃	〃	〃	〃
M	90-95		〃	〃	〃	〃	Rounded. Trace silt, silica cement.
O	95-100		〃	〃	〃	〃	Rounded. Trace silt.
U	100-105		〃	〃	〃	〃	Same.
N	105-110		〃	〃	〃	〃	Rounded. Trace silt. Vfn glauconite.
	110-115		〃	〃	〃	〃	Rounded. Trace silt.
D	115-120		〃	〃	〃	〃	Rounded. Trace silt, white siliceous shale, silica cement.
	120-125		〃	〃	〃	〃	Rounded. Trace silt, white siliceous shale.
	125-130		〃	〃	〃	〃	Rnd. Little white siliceous shale. Trace silt, silica cement.
	130-135		〃	〃	〃	〃	Rounded. Trace silt, white siliceous shale.
	135-140		〃	Yl pink	〃	〃	Same.
	140-145		〃	〃	〃	〃	Rounded. Trace silica cement, white siliceous shale, silt.
	145-150		〃	〃	〃	〃	Rounded. Trace silt.
	150-155		〃	〃	〃	〃	Rounded.
	155-160		NO SAMPLE. Driller reports same as preceding intervals.				

Well name: Camp Douglas Emergency Fire Well

	Depths	Graphic Section	Rock Type	Color	Grain Size Mode	Grain Size Range	Miscellaneous Characteristics
	160-165		NO SAMPLE. Driller reports same as following intervals.				
E	165-170		Sandstone	Yellow	C	Vfn/VC	Rounded. Trace silica cement, white siliceous shale, silt.
L	170-175		NO SAMPLE. Driller reports same as following intervals.				
K	175-180		Sandstone	Yellow	C	Vfn/VC	Rounded. Trace silica cement, white siliceous shale.
	180-185		"	"	"	"	Rounded. Trace white siliceous shale.
	185-190		"	"	"	"	Same plus trace silica cement.
M	190-195		"	"	"	"	Rounded. Trace white siliceous shale.
O	195-200		"	Pl yellow	"	"	Rounded. Trace silt.
U	200-205		"	"	"	"	Rounded. Trace silt, white siliceous shale.
	205-210		"	"	"	"	Same.
N	210-215		"	"	"	"	Rounded. Trace silica cement, silt, white siliceous shale.
D	215-220		"	V pl brown	"	"	Rounded. Trace silica cement, silt.
	220-225		"	"	"	"	Same.
	225-230		"	"	"	"	Rounded. Trace silt.
	230-235		"	"	"	"	Same.
	235-240		"	"	"	"	Rounded. Trace silica cement, silt.
	240-245		"	"	"	"	Same.
	245-250		"	"	"	"	"
200	250-255		"	"	"	"	"
P€	*255-260		Granite	Mxd strg bn	Fn?	—	Wea but' hd. Qtz, altered biot, pnk feld. Mch cvd snd. Ltl saprolite. Tr cvd sil-cem ss.
	*260-265		"	"	"	—	Same plus trace pyrite.
15'	*265-270		"	"	"	—	Same but trace saprolite and no pyrite.

*Samples contain many steel drill bit fragments and are discolored by the rust from them.

DUPLICATE SAMPLE.

Depths	Graphic Section	Rock Type	Color	Grain Size Mode	Grain Size Range	Miscellaneous Characteristics
225-230		Sandstone	Pl yellow	C	Vfn/VC	Rounded. Trace silica cement, white siliceous shale, silt.

SAMPLES WITH MISSING BAG TAGS.

Depths	Graphic Section	Rock Type	Color	Grain Size Mode	Grain Size Range	Miscellaneous Characteristics
A		Sandstone	Yellow	C	Vfn/VC	Rounded. Trace silica cement, white siliceous shale.
B		Sandstone	Yellow	C	Vfn/VC	Rounded. Trace white siliceous shale.

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APPENDIX C
AQUIFER TESTING

TABLE OF CONTENTS

SECTION C.1
AQUIFER PUMPING TEST AT SITES 1 AND 9

A 24-hour aquifer pumping test was performed during the period 5 May to 7 May 1988 in the vicinity of Sites 1 and 9 at Volk Field ANGB. The purpose of the test was to determine the hydraulic characteristics of the aquifer underlying Sites 1 and 9.

Hydraulic characteristics that were estimated from the aquifer pumping tests are hydraulic conductivity, transmissivity, and storage coefficient. Hydraulic conductivity is the coefficient that relates groundwater flow through an aquifer to the hydraulic gradient and the cross-sectional area. This relation is expressed by Darcy's Law:

$$q = KiA$$

where:

- q is the volumetric flow rate, in gallons per day (gpd);
- K is the hydraulic conductivity, in gallons per day per foot squared (gpd/ft^2);
- i is the hydraulic gradient, in feet per foot (ft/ft); and
- A is the cross-sectional area through which flow occurs, perpendicular to the direction of flow, in square feet (ft^2).

Transmissivity is the hydraulic conductivity times the thickness of the aquifer. For an aquifer test in which the pumped well does not penetrate the thickness of the aquifer, the thickness b of the flow regime, at a distance from the pumped well where the flow lines are parallel (Figure C.1), may be used such that

$$T = Kb$$

where:

- T is the transmissivity, in gallons per day per foot (gpd/ft); and
- b is the thickness of the flow regime, in feet (ft).

The storage coefficient is defined as the volume of water yielded per unit horizontal area per unit drop in potentiometric head in a confined aquifer or per unit drop in water level in an unconfined aquifer. The storage coefficient is termed specific yield for an unconfined aquifer (Bouwer, 1978).

Well VF1 PW-1 was the pumped well used during the aquifer pumping test. A step test was performed on 4 May from 12:50 until 15:00 to determine the discharge rate that could be used without breaking suction on the pump. The pumping test began at 06:45 Central Daylight Time (CDT) on 5 May and pumping lasted until 06:45 CDT on 6 May. The average pumping rate was 15.7 gallons per minute. Water from the well was discharged into a trench constructed approximately 25 feet north-northwest of the pumped well. The trench is roughly 57 feet long, 16 feet wide and 3 feet deep with sides sloped at a ratio of 1:1. The trench was lined prior to the test with two layers of 6 mil black plastic. During the pumping test the water in the trench was allowed to aerate and then was pumped through approximately 600 feet of two inch plastic hose into the sanitary sewer drain adjacent to the Base CE compound (Building 331).

Twenty wells in Sites 1 and 9 were used as observation wells. Their identification, construction data, and distances from the pumped well are listed in Table C.1. The location of the observation wells and the pumped well are shown in Figure C.2.

Water levels in the pumped well and in the observation wells were recorded prior to, during, and following the aquifer pumping test. Water levels in the pumped well, VF1 PW-1, and in one observation well, ET-2, were monitored using pressure transducers submersed in the wells and a computerized water level recorder. Water levels in the other wells were measured using hand-held water level indicators and recorded by hand. Significant changes in water levels (drawdowns) ranging from 0.10 feet to 0.85 feet were observed in 15 observation wells. Water level changes in five observation wells were negligible. Computed drawdowns in the pumped well were corrected to allow for dewatering of the unconfined aquifer using a method given by Lohman (1970). Dewatering effects were negligible at the observation wells. Methods used to compute drawdown are given in Section C.1.1. The data indicate a delayed yield response and were analyzed by Boulton's method (see Section C.1.2). The data were also compared to type curves for an aquifer pumped by a partially penetrating well. However, the data best matched the delayed yield type curve. Furthermore, comparison of the data to the delayed yield type curve and the partially penetrating well type curve result in equivalent values of estimated transmissivity because the two type curves are equivalent for the relatively late time periods at which most of the data were collected. The Cooper-Jacob drawdown analysis and the Theis recovery analysis were also used to estimate transmissivity using data from the observation wells and the pumped well (see Section C.1.3).

The apparent hydraulic conductivity of the aquifer underlying Sites 1 and 9 ranges from 550 to 1090 gallons per day per foot squared (gpd/ft^2). These values are estimated using the range in apparent transmissivities given above divided by the distance (b) measured from the static water table to the bottom of the screened interval of the pumped well, which is approximately 20 feet. In using this value for b, the assumption is made that flow into the well is horizontal at the bottom of the screen and parallel to the cone of depression of the water table at the top of the flow regime (Figure C.2). While this assumption does not account for divergence of the flow lines downward from the screened interval, the resulting estimated hydraulic conductivity is conservatively higher than it would be if a larger value of b were used. This is conservative since the velocity of contaminated water leaving the site, and the distance it has traveled, is proportional to the hydraulic conductivity.

The apparent storage coefficient of the aquifer underlying Sites 1 and 9 ranges from 0.008 to 0.07 (unitless). The Boulton delayed yield analysis (see Section C.1.2) was used with data from the observation wells to estimate late time storage coefficients, or specific yields. The range of storage coefficients indicates that the aquifer is unconfined (Freeze and Cherry, 1979). The Boulton analysis may also be used to determine an early-time storage coefficient that is characteristic of an aquifer before delayed yield effects become apparent. However, there is insufficient data from this aquifer test to estimate an early-time storage coefficient.

It was assumed that the unconsolidated sand and the friable sandstone layers comprising the aquifer underlying Sites 1 and 9 would have similar hydraulic characteristics. Though this may not strictly be the case, there is no reliable method for determining the hydraulic characteristics of each individual layer from the data because the two layers are in direct hydraulic connection and because the pumped well and observation wells are close to or intersect the interface between the two layers.

The estimated hydraulic characteristics determined using data from each of the observation wells and from the pumped well are summarized in Table C.1. The methods used to analyze the pumping test data are described in Sections C.1.1 through C.1.3.

C.1.1 Drawdown Computations

Water levels observed prior to, during and after the aquifer pumping test at Sites 1 and 9 were used to compute changes in water levels, or drawdowns, that resulted from pumping the pumped well, VF1 PW-1. The observed water levels in the pumped well and 20 observation wells and the computed drawdowns are provided in Section C.1.5.

Water levels observed in four wells, VF1 MW-1, VF1 MW-4, VF9 MW-1 and ET-1, were not affected by pumping but were used to determine whether the water level was changing as a result of a regional variation, or trend, during the period of the test. The water levels for these wells are given in Tables C.3, C.6, C.7, and C.10 in Section C.1.5 and are shown in Figure C.2B. There was no significant trend in the regional water level, thus no trend correction was made to the water level data to determine drawdowns.

A correction was made in computing drawdown in the pumped well, VF1 PW-1, to account for dewatering of the aquifer. The corrected drawdown is given by (Lohman, 1970):

$$s' = s - (s^2/2b)$$

where:

- s is the observed change in water level (drawdown), in feet;
- s′ is the corrected drawdown, in feet; and
- b is the saturated height of the water table above the bottom of the screen in the vicinity of the well prior to pumping, in feet.

Dewatering effects in the observation wells were negligible.

C.1.2 Boulton Analyses of Pumping Test Data

Boulton's analysis (Lohman, 1970) for unconfined aquifers with delayed yield was used to estimate the hydraulic characteristics of the aquifer underlying Sites 1 and 9 using data from the observation wells. Log-log plots of drawdown versus time since pumping began were compared to a type curve for wells pumping from an unconfined aquifer exhibiting delayed yield effects. A match point was placed on each plot corresponding to the point on the type curve at which each non-dimensional axis value was equal to unity (for example, see Figure C.3. The nonequilibrium equations used to determine transmissivity and storage coefficient using this method are

$$T = \frac{114.6\,Q\,W(u)}{s} \qquad \text{(Equation 1)}$$

and

$$S = \frac{T u t}{2690 r^2} \qquad \text{(Equation 2)}$$

where:

T = the transmissivity, in gallons per day per foot (gpd/ft);

Q = the average pumping rate, in gallons per minute (gpm);

s = the drawdown at the matchpoint, in feet (ft);

t = the time since pumping began at the matchpoint, in minutes (min);

S = the late-time storage coefficient, or specific yield, of the aquifer (non-dimensional);

r = the distance from the observation well to the pumped well, in feet;

u = the reciprocal of the non-dimensional late-time x-axis value of the delayed yield type curve corresponding to the match point; and

W(u) = the non-dimensional y-axis value of the delayed yield type curve corresponding to the match point.

By the curve matching method, Equation 1 is used to estimate transmissivity, which is then used to estimate the storage coefficient using Equation 2. Log-log plots of drawdown versus time since pumping began for the observation wells are shown in Figures C.3 through C.17. The scale used in these figures is intended to be the same as that used in Lohman's reproduction of the Boulton type curve (Lohman, 1970, Plate 8).

C.1.3 Straight-Line Analyses of Pumping Test Data

The Cooper-Jacob method and the Theis recovery method (Bouwer, 1978) were used to determine the apparent hydraulic characteristics of the aquifer underlying Sites 1 and 9 using data from the observation wells and the pumped well. By the Cooper-Jacob method, drawdowns during the aquifer pumping test are plotted on an arithmetic axis, while time since pumping began is plotted on a logarithmic axis (see Figure C.18). By the Theis recovery method, residual drawdown is plotted on an arithmetic axis against the ratio $\Delta t/\Delta t'$ on a logarithmic axis. The term Δt is time since pumping began and the term $\Delta t'$ is the time since pumping ceased (see Figure C.19). A best-fitting straight line is then drawn through the data points which theoretically should be linear. For both methods, the nonequilibrium equation used to calculate estimated transmissivity is

$$T = \frac{264Q1}{\Delta s} \qquad \text{(Equation 3)}$$

where:

T = the transmissivity, in gallons per day per foot (gpd/ft);

Q = the average pumping rate, in gallons per minute (gpm);

s = the change in drawdown, in feet, during one log cycle of the linear portion of Δt for the Cooper-Jacob method and of the linear portion of $\Delta t'$ for the Theis recovery method.

Plots of drawdown versus Δt and residual drawdown versus $\Delta t/\Delta t'$ used in these methods are shown in Figures C.18 through C.42. Data from observation wells VF1 MW-2, VF1 MW-3, VF9 MW-3, ET-3, ET-6, WW-1, and WW-5 were not analyzed by the Theis recovery method because linear portions of the plotted data were not identifiable.

The storage coefficient cannot be estimated using the Cooper-Jacob or Theis recovery methods.

C.1.4 Figures Used for Pumping Test Analyses

Figures C.3 through C.42 were used in the analyses of the aquifer pumping test data. Figures C.3 through C.17 were used for the Boulton Delayed Yield analyses, and Figures C.18 through C.42 were used for the Straight-Line Analyses. Computed drawdown and elapsed time data used to construct these figures are given in Tables C.2 through C.22.

C.1.5 Water Level Data and Computed Drawdowns for Aquifer Pumping Test

Observed water levels and computed drawdowns are given in Tables C.2 through C.22. In these tables, The column headings have the following meaning:

Date:	Date of reading.
Time:	Time of reading, Central Daylight Time (CDT).
Δt:	Time from start of pumping, in minutes.
$\Delta t'$:	Time since pumping stopped, in minutes.
Depth to Water:	Depth to water below the measuring point, in feet.
s:	Drawdown in the well, in feet. Drawdown is computed by subtracting the depth to water measured prior to the pumping test (Assumed Static Water Level) from the depth to water during and following the aquifer test.
$s^2/2b$:	A correction to account for dewatering of the aquifer system, in feet. The saturated height of the water table above the bottom of the screen in the vicinity of the well prior to pumping is represented by b. The value of b is 20

	feet. This correction is used for the pumped well only. Dewatering effects in observation wells were negligible.
s′:	The drawdown in the well corrected for the effects of dewatering, in feet. This drawdown is used for the pumped well.
Total Discharge: (pumped well only)	Reading on flow meter, in gallons.
Flow Rate: (pumped well only)	Average flow rate in gallons per minute, between the previous reading and current reading of flow meter. Flow rate is computed by dividing the difference between two subsequent total discharge readings by the corresponding difference in Δt.
Remarks:	Any pertinent remarks.

TABLES C.1 THROUGH C.22

TABLE C.1
VOLK FIELD ANGB, CAMP DOUGLAS, WI
PUMPING TEST WELL DATA AND RESULTS SUMMARY

Well I.D.	Depth to Water on 5/5/88 (1) (ft.)	Elevation of Measuring Point (ft.)	Water Table Elevation (ft.)	Length of Screen (ft.)	Screened Interval Elevations (ft.)	Screen Diameter (inches)	Distance from Pumping Well (ft.)	Method of Analysis	Apparent Transmissivity (gpd/ft.)	Apparent Hydraulic Conductivity (gpd/sq.ft.)	Apparent Storage Coefficient
VF1 PW-1 (2)	16.54	919.64	903.10	15	883 - 898	6.0	--	Cooper-Jacob	19,700	990	N.A. (3)
								Theis Recovery	15,400	770	N.A.
VF1 MW-1	9.98	912.34	902.36	15	890 - 905	2.0	386.3	None (4)	--	--	--
VF1 MW-2	12.51	915.33	902.82	10	882 - 892	2.0	175.0	Boulton	16,400	820	0.05
								Cooper-Jacob	18,000	900	N.A.
VF1 MW-3	12.13	914.85	902.72	10	870 - 880	2.0	252.8	Boulton	18,000	900	0.04
								Cooper-Jacob	19,700	990	N.A.
VF1 MW-4	10.44	912.76	902.32	10	869 - 879	2.0	402.6	None	--	--	--
VF9 MW-1	20.31	924.28	903.97	15	895 - 910	2.0	237.6	None	--	--	--
VF9 MW-2	17.33	920.40	903.07	15	896 - 911	2.0	95.8	Boulton	15,000	750	0.03
								Cooper-Jacob	14,800	740	N.A.
								Theis Recovery	18,000	900	N.A.
VF9 MW-3	15.51	918.56	903.05	15	894 - 909	2.0	182.1	Boulton	12,000	600	0.03
								Cooper-Jacob	13,400	670	N.A.
ET-1	18.61	922.35	903.74	4.5	897 - 902	2.0	212.7	None	--	--	--
ET-2	16.22	919.27	903.05	4.5	895 - 899	2.0	30.4	Boulton	12,000	600	0.008
								Cooper-Jacob	12,600	630	N.A.
								Theis Recovery	11,000	550	N.A.
ET-3	14.51	917.43	902.92	9	896 - 905	2.0	118.3	Boulton	13,800	690	0.05
								Cooper-Jacob	17,300	870	N.A.
ET-4	14.33	917.24	902.91	10	894 - 904	2.0	108.8	Boulton	13,800	690	0.05
								Cooper-Jacob	18,800	940	N.A.
								Theis Recovery	20,700	1,040	N.A.
ET-5	15.71	918.65	902.94	9	897 - 906	2.0	84.5	Boulton	13,800	690	0.05
								Cooper-Jacob	15,400	770	N.A.
								Theis Recovery	20,700	1,040	N.A.

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TABLE C.1--Continued
VOLK FIELD ANGB, CAMP DOUGLAS, WI
PUMPING TEST WELL DATA AND RESULTS SUMMARY

Well I.D.	Depth to Water on 5/5/88 (ft.)[1]	Elevation of Measuring Point (ft.)	Water Table Elevation (ft.)	Length of Screen (ft.)	Screened Interval Elevations (ft.)	Screen Diameter (inches)	Distance from Pumping Well (ft.)	Method of Analysis	Apparent Transmissivity (gpd/ft.)	Apparent Hydraulic Conductivity (gpd/sq.ft.)	Apparent Storage Coefficient
ET-6	12.14	915.76	903.62	5	873 - 878	2.0	179.3	Boulton	12,900	650	0.07
								Cooper-Jacob	16,600	830	N.A.
ET-7	13.09	914.94	901.85	10	896 - 906	2.0	245.5	None	--	--	—
WW-1	14.22	917.12	902.90	10	893 - 903	4.0	130.8	Boulton	15,000	750	0.06
								Cooper-Jacob	18,000	900	N.A.
WW-2	16.27	919.27	903.00	15	888 - 903	4.0	95.5	Boulton	13,800	690	0.05
								Cooper-Jacob	15,900	800	N.A.
								Theis Recovery	20,700	1,040	N.A.
WW-3	14.57	917.56	902.99	15	886 - 901	4.0	70.8	Boulton	13,800	690	0.03
								Cooper-Jacob	15,400	770	N.A.
								Theis Recovery	20,700	1,040	N.A.
WW-4	14.26	917.19	902.93	15	886 - 901	4.90	107.0	Boulton	15,000	750	0.06
								Cooper-Jacob	16,600	830	N.A.
								Theis Recovery	21,800	1,090	N.A.
WW-5	15.23	918.14	902.91	15	887 - 902	4.0	127.1	Boulton	15,000	750	0.07
								Cooper-Jacob	14,300	720	N.A.
WW-6	16.14	919.13	902.99	15	886 - 901	4.0	71.0	Boulton	15,000	750	0.04
								Cooper-Jacob	15,900	800	N.A.
								Theis Recovery	17,300	870	N.A.
								Average:	16,100	800	0.05

(1) Measured to top of well casing on 5 May 1988.

(2) Pumped Well.

(3) Not applicable: no reliable method for estimating storage coefficient by this method.

(4) Data not analyzed because drawdown was negligible.

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TABLE C.2

VOLK FIELD ANGB

WATER LEVEL DATA AND DRAWDOWN COMPUTATIONS
FOR WELL VF1 PW-1

Date	Time (CDT)	Δt (min)	Δt' (min)	Δt / Δt'	Depth To Water (ft)	Drawdown s (ft)	$\frac{s^2}{2b}$ (ft)	s' (ft)	Total Discharge (gal)	Flow Rate (gpm)	Remarks
5/03/88	11:49:00				16.48						
	18:30:00				16.48						
5/04/88	09:03:00				16.48						
	12:35:00				16.52						
	12:50:00				16.50				23862.1		Pump On - Step Test
	12:51:00				21.06						
	12:52:00				22.04						
	12:53:00				22.27				23895.8	11.23	
	12:54:00				22.36				23907.0	11.20	
	12:55:00				22.41						
	12:56:00				22.39						
	12:57:00				22.41						
	12:58:00				22.44						
	12:59:00				22.44						
	13:00:00				22.44				23974.4	11.23	
	13:01:00				22.52						
	13:02:00				22.49						
	13:03:00				22.52						
	13:04:00				22.49						
	13:05:00				22.47						
	13:06:00				22.49						
	13:07:00				22.53						
	13:08:00				22.50						
	13:09:00				22.52						
	13:10:00				22.50						
	13:11:00				22.55						
	13:12:00				22.58						
	13:13:00				22.53						
	13:14:00				22.57						
	13:15:00				22.57						
	13:16:00				22.58						
	13:17:00				22.50						
	13:18:00				22.58						
	13:19:00				22.60						
	13:20:00				22.57				24198.2	11.19	Increase Discharge
	13:21:00				23.98				24213.2	15.00	
	13:22:00				24.45						
	13:23:00				24.61				24242.0	14.40	
	13:24:00				24.67				24256.4	14.40	
	13:25:00				24.61				24270.9	14.50	

TABLE C.2
(CONTINUED)
VOLK FIELD ANGB

WATER LEVEL DATA AND DRAWDOWN COMPUTATIONS
FOR WELL VF1 PW-1

Date	Time (CDT)	Δt (min)	Δt' (min)	Δt/Δt'	Depth To Water (ft)	Drawdown s (ft)	$\frac{s^2}{2b}$ (ft)	s' (ft)	Total Discharge (gal)	Flow Rate (gpm)	Remarks
5/04/88	13:26:00				24.66						
(continued)	13:27:00				24.64				24300.1	14.60	
	13:28:00				24.63						
	13:29:00				24.70				24329.2	14.55	
	13:30:00				24.69				24343.8	14.60	
	13:31:00				24.74						
	13:32:00				24.69						
	13:33:00				24.69						
	13:34:00				24.74						
	13:35:00				24.69						
	13:36:00				24.66						
	13:37:00				24.67						
	13:38:00				24.69						
	13:39:00				24.64						
	13:40:00				24.70						
	13:41:00				24.72						
	13:42:00				24.72						
	13:43:00				24.72						
	13:44:00				24.78						
	13:45:00				24.77						
	13:46:00				24.69						
	13:47:00				24.74						
	13:48:00				24.75						
	13:49:00				24.75						
	13:50:00				24.80				24634.8	14.55	Increase Discharge
	13:51:00				25.73				24651.2	16.40	
	13:52:00				26.05				24668.2	17.00	
	13:53:00				26.10				24684.7	16.50	
	13:54:00				26.16				24701.2	16.50	
	13:55:00				26.15				24718.0	16.80	
	13:56:00				26.16						
	13:57:00				26.16						
	13:58:00				26.18						
	13:59:00				26.15						
	14:00:00				26.19						
	14:01:00				26.19						
	14:02:00				26.19						
	14:03:00				26.16						
	14:04:00				26.23						
	14:05:00				26.21				24884.6	16.66	

TABLE C.2
(CONTINUED)
VOLK FIELD ANGB

WATER LEVEL DATA AND DRAWDOWN COMPUTATIONS
FOR WELL VF1 PW-1

Date	Time (CDT)	Δt (min)	Δt' (min)	Δt / Δt'	Depth To Water (ft)	Drawdown s (ft)	$\frac{s^2}{2b}$ (ft)	s' (ft)	Total Discharge (gal)	Flow Rate (gpm)	Remarks
5/04/88	14:06:00				26.21						
(continued)	14:07:00				26.18						
	14:08:00				26.21						
	14:09:00				26.27						
	14:10:00				26.24						
	14:11:00				26.26						
	14:12:00				26.19						
	14:13:00				26.23						
	14:14:00				26.27						
	14:15:00				26.27				25051.1	16.65	
	14:16:00				26.27						
	14:17:00				26.23						
	14:18:00				26.27						
	14:19:00				26.21						
	14:20:00				26.34				25134.5	16.68	Increase Discharge
	14:21:00				27.65				25153.8	19.30	
	14:22:00				28.14				25173.5	19.70	
	14:23:00				28.40						
	14:24:00				28.52				25212.5	19.50	
	14:25:00				28.55						
	14:26:00				28.57						
	14:27:00				28.57				25271.4	19.63	
	14:28:00				28.57						
	14:29:00				28.55						
	14:30:00				28.57				25329.8	19.47	
	14:31:00				28.60						
	14:32:00				28.57						
	14:33:00				28.59						
	14:34:00				28.57						
	14:35:00				28.55						
	14:36:00				28.60						
	14:37:00				28.59						
	14:38:00				28.57						
	14:39:00				28.57						
	14:40:00				28.59						
	14:41:00				28.55						
	14:42:00				28.60						
	14:43:00				28.60						
	14:44:00				28.63						
	14:45:00				28.63						

TABLE C.2
(CONTINUED)
VOLK FIELD ANGB

WATER LEVEL DATA AND DRAWDOWN COMPUTATIONS
FOR WELL VF1 PW-1

Date	Time (CDT)	Δt (min)	Δt' (min)	Δt / Δt'	Depth To Water (ft)	Drawdown s (ft)	$\frac{s^2}{2b}$ (ft)	s' (ft)	Total Discharge (gal)	Flow Rate (gpm)	Remarks
5/04/88	14:46:00				28.62						
(continued)	14:47:00				28.67						
	14:48:00				28.62						
	14:49:00				28.62						
	14:50:00				28.63						
	14:51:00				28.63						
	14:52:00				28.63						
	14:53:00				28.65						
	14:54:00				28.67						
	14:55:00				28.62						
	14:56:00				28.63						
	14:57:00				28.62						
	14:58:00				28.62						
	14:59:00				28.65						
	15:00:00				28.63				25917.1	19.58	Pump Off
	17:16:00				16.62						
	19:00:00				16.57						
	20:00:00				16.55						
	21:00:00				16.53						
	22:00:00				16.52						
	23:00:00				16.52						
5/05/88	06:33:00				16.54						Assumed Static Water Level
	06:45:00	0.00							25917.1	19.58	Pump On
	06:45:01	0.01			16.65	0.11	0.00	0.11			(Begin Aquifer
	06:45:02	0.03			16.84	0.30	0.00	0.30			Pumping Test)
	06:45:03	0.05			16.90	0.36	0.00	0.36			
	06:45:04	0.07			16.97	0.43	0.00	0.43			
	06:45:05	0.08			17.03	0.49	0.01	0.48			
	06:45:06	0.10			17.11	0.57	0.01	0.56			
	06:45:07	0.12			17.16	0.62	0.01	0.61			
	06:45:08	0.13			17.27	0.73	0.01	0.72			
	06:45:09	0.15			17.32	0.78	0.02	0.76			
	06:45:10	0.17			17.38	0.84	0.02	0.82			
	06:45:11	0.18			17.47	0.93	0.02	0.91			
	06:45:12	0.20			17.51	0.97	0.02	0.95			
	06:45:13	0.22			17.59	1.05	0.03	1.02			
	06:45:14	0.23			17.65	1.11	0.03	1.08			
	06:45:15	0.25			17.68	1.14	0.03	1.11			
	06:45:16	0.27			17.76	1.22	0.04	1.18			
	06:45:17	0.28			17.84	1.30	0.04	1.26			

TABLE C.2
(CONTINUED)
VOLK FIELD ANGB

WATER LEVEL DATA AND DRAWDOWN COMPUTATIONS
FOR WELL VF1 PW-1

Date	Time (CDT)	Δt (min)	Δt' (min)	Δt / Δt'	Depth To Water (ft)	Drawdown s (ft)	$\frac{s^2}{2b}$ (ft)	s' (ft)	Total Discharge (gal)	Flow Rate (gpm)	Remarks
5/05/88	06:45:18	0.30			17.87	1.33	0.04	1.29			
(continued)	06:45:19	0.32			17.95	1.41	0.05	1.36			
	06:45:20	0.33			17.97	1.43	0.05	1.38			
	06:45:25	0.42			18.22	1.68	0.07	1.61			
	06:45:30	0.50			18.41	1.87	0.09	1.78	25920.5	6.80	
	06:45:35	0.58			18.57	2.03	0.10	1.93			
	06:45:40	0.67			18.73	2.19	0.12	2.07			
	06:45:45	0.75			18.88	2.34	0.14	2.20			
	06:45:55	0.92			19.12	2.58	0.17	2.41			
	06:46:00	1.00			19.22	2.68	0.18	2.50			
	06:46:05	1.08			19.31	2.77	0.19	2.58			
	06:46:10	1.17			19.38	2.84	0.20	2.64			
	06:46:15	1.25			19.49	2.95	0.22	2.73			
	06:46:20	1.33			19.53	2.99	0.22	2.77			
	06:46:25	1.42			19.58	3.04	0.23	2.81			
	06:46:30	1.50			19.61	3.07	0.24	2.83			
	06:46:35	1.58			19.63	3.09	0.24	2.85			
	06:46:40	1.67			19.68	3.14	0.25	2.89			
	06:46:45	1.75			19.90	3.36	0.28	3.08			
	06:46:50	1.83			20.15	3.61	0.33	3.28			
	06:46:55	1.92			20.42	3.88	0.38	3.50			
	06:47:00	2.00			20.58	4.04	0.41	3.63	25931.5	7.33	Adjusted Discharge Up
	06:47:30	2.50			21.64	5.10	0.65	4.45			
	06:48:00	3.00			22.35	5.81	0.84	4.97	25943.5	12.00	Adjusted Discharge Up
	06:48:30	3.50			23.02	6.48	1.05	5.43			
	06:49:00	4.00			23.91	7.37	1.36	6.01	25957.7	14.20	
	06:49:30	4.50			24.75	8.21	1.69	6.52			
	06:50:00	5.00			25.27	8.73	1.91	6.82			
	06:50:30	5.50			25.49	8.95	2.00	6.95			
	06:51:00	6.00			25.66	9.12	2.08	7.04			Adjusted Discharge Down
	06:51:30	6.50			25.66	9.12	2.08	7.04			
	06:52:00	7.00			25.41	8.87	1.97	6.90	26006.7	16.33	
	06:52:30	7.50			25.09	8.55	1.83	6.72			
	06:53:00	8.00			24.94	8.40	1.76	6.64	26021.4	14.70	Adjusted Discharge Up
	06:53:30	8.50			24.82	8.28	1.71	6.57			
	06:54:00	9.00			24.78	8.24	1.70	6.54			Adjusted Discharge Up
	06:54:30	9.50			24.75	8.21	1.69	6.52			
	06:55:00	10.00			24.75	8.21	1.69	6.52	26050.4	14.50	Adjusted Discharge Up
	06:56:00	11.00			24.73	8.19	1.68	6.51	26065.6	15.20	Adjusted Discharge Up
	06:57:00	12.00			25.22	8.68	1.88	6.80			

TABLE C.2
(CONTINUED)
VOLK FIELD ANGB

WATER LEVEL DATA AND DRAWDOWN COMPUTATIONS
FOR WELL VF1 PW-1

Date	Time (CDT)	Δt (min)	Δt' (min)	Δt / Δt'	Depth To Water (ft)	Drawdown s (ft)	$\frac{s^2}{2b}$ (ft)	s' (ft)	Total Discharge (gal)	Flow Rate (gpm)	Remarks
5/05/88	06:59:00	14.00			25.33	8.79	1.93	6.86			
(continued)	07:01:00	16.00			25.35	8.81	1.94	6.87			
	07:03:00	18.00			25.36	8.82	1.94	6.88			
	07:05:00	20.00			25.35	8.81	1.94	6.87			
	07:07:00	22.00			25.36	8.82	1.94	6.88			Adjusted Discharge Up
	07:09:00	24.00			25.63	9.09	2.07	7.02	26268.0	15.57	
	07:11:00	26.00			25.65	9.11	2.07	7.04			
	07:13:00	28.00			25.66	9.12	2.08	7.04			
	07:15:00	30.00			25.63	9.09	2.07	7.02	26363.0	15.83	
	07:17:00	32.00			25.70	9.16	2.10	7.06			
	07:19:00	34.00			25.71	9.17	2.10	7.07			
	07:21:00	36.00			25.70	9.16	2.10	7.06			
	07:23:00	38.00			25.76	9.22	2.13	7.09			
	07:25:00	40.00			25.71	9.17	2.10	7.07			
	07:27:00	42.00			25.76	9.22	2.13	7.09	26553.2	15.85	
	07:29:00	44.00			25.74	9.20	2.12	7.08			
	07:31:00	46.00			25.76	9.22	2.13	7.09			
	07:33:00	48.00			25.76	9.22	2.13	7.09			
	07:35:00	50.00			25.79	9.25	2.14	7.11			
	07:37:00	52.00			25.81	9.27	2.15	7.12			
	07:39:00	54.00			25.81	9.27	2.15	7.12			
	07:41:00	56.00			25.78	9.24	2.13	7.11			
	07:43:00	58.00			25.81	9.27	2.15	7.12			
	07:45:00	60.00			25.82	9.28	2.15	7.13	26838.0	15.82	
	07:47:00	62.00			25.82	9.28	2.15	7.13			
	07:49:00	64.00			25.81	9.27	2.15	7.12			
	07:51:00	66.00			25.82	9.28	2.15	7.13			
	07:53:00	68.00			25.85	9.31	2.17	7.14			
	07:55:00	70.00			25.81	9.27	2.15	7.12			
	07:57:00	72.00			25.85	9.31	2.17	7.14	27027.8	15.82	
	07:59:00	74.00			25.84	9.30	2.16	7.14			
	08:01:00	76.00			25.85	9.31	2.17	7.14			
	08:03:00	78.00			25.87	9.33	2.18	7.15			
	08:05:00	80.00			25.84	9.30	2.16	7.14			
	08:07:00	82.00			25.87	9.33	2.18	7.15			
	08:09:00	84.00			25.84	9.30	2.16	7.14			
	08:11:00	86.00			25.87	9.33	2.18	7.15	27248.3	15.75	
	08:13:00	88.00			25.84	9.30	2.16	7.14			
	08:15:00	90.00			25.84	9.30	2.16	7.14			
	08:17:00	92.00			25.85	9.31	2.17	7.14			

TABLE C.2
(CONTINUED)
VOLK FIELD ANGB

WATER LEVEL DATA AND DRAWDOWN COMPUTATIONS
FOR WELL VF1 PW-1

Date	Time (CDT)	Δt (min)	Δt' (min)	Δt / Δt'	Depth To Water (ft)	Drawdown s (ft)	$\frac{s^2}{2b}$ (ft)	s' (ft)	Total Discharge (gal)	Flow Rate (gpm)	Remarks
5/05/88	08:19:00	94.00			25.82	9.28	2.15	7.13			
(continued)	08:21:00	96.00			25.89	9.35	2.19	7.16			
	08:23:00	98.00			25.82	9.28	2.15	7.13			
	08:25:00	100.00			25.85	9.31	2.17	7.14			
	08:35:00	110.00			25.92	9.38	2.20	7.18	27627.1	15.78	
	08:45:00	120.00			25.85	9.31	2.17	7.14			
	08:55:00	130.00			25.85	9.31	2.17	7.14			
	09:05:00	140.00			25.92	9.38	2.20	7.18			
	09:15:00	150.00			25.90	9.36	2.19	7.17			
	09:25:00	160.00			25.90	9.36	2.19	7.17			
	09:35:00	170.00			25.95	9.41	2.21	7.20			
	09:45:00	180.00			25.98	9.44	2.23	7.21			
	09:55:00	190.00			25.97	9.43	2.22	7.21			
	10:05:00	200.00			25.98	9.44	2.23	7.21			
	10:15:00	210.00			25.97	9.43	2.22	7.21			
	10:25:00	220.00			25.98	9.44	2.23	7.21			
	10:35:00	230.00			26.01	9.47	2.24	7.23			
	10:45:00	240.00			26.03	9.49	2.25	7.24	29673.6	15.74	
	10:55:00	250.00			26.08	9.54	2.28	7.26			
	11:05:00	260.00			26.03	9.49	2.25	7.24			
	11:15:00	270.00			26.06	9.52	2.27	7.25			
	11:25:00	280.00			26.03	9.49	2.25	7.24			
	11:35:00	290.00			26.06	9.52	2.27	7.25			
	11:45:00	300.00			26.06	9.52	2.27	7.25	30620.2	15.78	
	11:55:00	310.00			26.04	9.50	2.26	7.24			
	12:05:00	320.00			26.08	9.54	2.28	7.26			
	12:15:00	330.00			26.01	9.47	2.24	7.23			
	12:25:00	340.00			26.03	9.49	2.25	7.24			
	12:35:00	350.00			26.04	9.50	2.26	7.24			
	12:45:00	360.00			26.01	9.47	2.24	7.23	31565.2	15.75	
	12:55:00	370.00			26.03	9.49	2.25	7.24			
	13:05:00	380.00			26.06	9.52	2.27	7.25			
	13:15:00	390.00			26.08	9.54	2.28	7.26			
	13:25:00	400.00			26.04	9.50	2.26	7.24			
	13:35:00	410.00			26.04	9.50	2.26	7.24			
	13:45:00	420.00			26.09	9.55	2.28	7.27	32506.5	15.69	
	13:55:00	430.00			26.09	9.55	2.28	7.27			
	14:05:00	440.00			26.09	9.55	2.28	7.27			
	14:15:00	450.00			26.04	9.50	2.26	7.24			
	14:25:00	460.00			26.09	9.55	2.28	7.27			

TABLE C.2
(CONTINUED)
VOLK FIELD ANGB

WATER LEVEL DATA AND DRAWDOWN COMPUTATIONS
FOR WELL VF1 PW-1

Date	Time (CDT)	Δt (min)	Δt' (min)	Δt / Δt'	Depth To Water (ft)	Drawdown s (ft)	$\frac{s^2}{2b}$ (ft)	s' (ft)	Total Discharge (gal)	Flow Rate (gpm)	Remarks
5/05/88	14:35:00	470.00			26.08	9.54	2.28	7.26			
(continued)	14:45:00	480.00			26.06	9.52	2.27	7.25	33447.0	15.67	
	14:55:00	490.00			26.09	9.55	2.28	7.27			
	15:05:00	500.00			26.06	9.52	2.27	7.25			
	15:15:00	510.00			26.11	9.57	2.29	7.28			
	15:25:00	520.00			26.04	9.50	2.26	7.24			
	15:35:00	530.00			26.09	9.55	2.28	7.27			
	15:45:00	540.00			26.11	9.57	2.29	7.28			
	15:55:00	550.00			26.12	9.58	2.29	7.29			
	16:05:00	560.00			26.19	9.65	2.33	7.32			
	16:15:00	570.00			26.16	9.62	2.31	7.31			
	16:25:00	580.00			26.19	9.65	2.33	7.32			
	16:35:00	590.00			26.14	9.60	2.30	7.30			
	16:45:00	600.00			26.14	9.60	2.30	7.30			
	16:55:00	610.00			26.19	9.65	2.33	7.32			
	17:05:00	620.00			26.17	9.63	2.32	7.31			
	17:15:00	630.00			26.17	9.63	2.32	7.31			
	17:25:00	640.00			26.19	9.65	2.33	7.32			
	17:35:00	650.00			26.16	9.62	2.31	7.31			
	17:45:00	660.00			26.19	9.65	2.33	7.32	36274.7	15.71	
	17:55:00	670.00			26.23	9.69	2.35	7.34			
	18:05:00	680.00			26.22	9.68	2.34	7.34			
	18:15:00	690.00			26.22	9.68	2.34	7.34			
	18:25:00	700.00			26.19	9.65	2.33	7.32			
	18:35:00	710.00			26.19	9.65	2.33	7.32			
	18:45:00	720.00			26.23	9.69	2.35	7.34			
	18:55:00	730.00			26.22	9.68	2.34	7.34			
	19:05:00	740.00			26.20	9.66	2.33	7.33			
	19:15:00	750.00			26.20	9.66	2.33	7.33			
	19:25:00	760.00			26.20	9.66	2.33	7.33			
	19:35:00	770.00			26.17	9.63	2.32	7.31			
	19:45:00	780.00			26.19	9.65	2.33	7.32	38161.0	15.72	
	19:55:00	790.00			26.19	9.65	2.33	7.32			
	20:05:00	800.00			26.19	9.65	2.33	7.32			
	20:15:00	810.00			26.17	9.63	2.32	7.31			
	20:25:00	820.00			26.20	9.66	2.33	7.33			
	20:35:00	830.00			26.17	9.63	2.32	7.31			
	20:45:00	840.00			26.19	9.65	2.33	7.32			
	20:55:00	850.00			26.20	9.66	2.33	7.33			
	21:05:00	860.00			26.20	9.66	2.33	7.33			

TABLE C.2
(CONTINUED)
VOLK FIELD ANGB

WATER LEVEL DATA AND DRAWDOWN COMPUTATIONS
FOR WELL VF1 PW-1

Date	Time (CDT)	Δt (min)	Δt' (min)	Δt / Δt'	Depth To Water (ft)	Drawdown s (ft)	$\frac{s^2}{2b}$ (ft)	s' (ft)	Total Discharge (gal)	Flow Rate (gpm)	Remarks
5/05/88	21:15:00	870.00			26.25	9.71	2.36	7.35			
(continued)	21:25:00	880.00			26.23	9.69	2.35	7.34			
	21:35:00	890.00			26.23	9.69	2.35	7.34			
	21:45:00	900.00			26.25	9.71	2.36	7.35			
	21:55:00	910.00			26.22	9.68	2.34	7.34			
	22:05:00	920.00			26.25	9.71	2.36	7.35			
	22:15:00	930.00			26.20	9.66	2.33	7.33			
	22:25:00	940.00			26.22	9.68	2.34	7.34			
	22:35:00	950.00			26.23	9.69	2.35	7.34			
	22:45:00	960.00			26.23	9.69	2.35	7.34			
	22:55:00	970.00			26.27	9.73	2.37	7.36			
	23:05:00	980.00			26.22	9.68	2.34	7.34			
	23:15:00	990.00			26.23	9.69	2.35	7.34			
	23:25:00	1000.00			26.22	9.68	2.34	7.34			
	23:35:00	1010.00			26.22	9.68	2.34	7.34			
	23:45:00	1020.00			26.27	9.73	2.37	7.36	41928.9	15.70	
	23:55:00	1030.00			26.25	9.71	2.36	7.35			
5/06/88	00:05:00	1040.00			26.27	9.73	2.37	7.36			
	00:15:00	1050.00			26.25	9.71	2.36	7.35			
	00:25:00	1060.00			26.25	9.71	2.36	7.35			
	00:35:00	1070.00			26.23	9.69	2.35	7.34			
	00:45:00	1080.00			26.27	9.73	2.37	7.36			
	00:55:00	1090.00			26.25	9.71	2.36	7.35			
	01:05:00	1100.00			26.27	9.73	2.37	7.36			
	01:15:00	1110.00			26.25	9.71	2.36	7.35			
	01:25:00	1120.00			26.27	9.73	2.37	7.36			
	01:35:00	1130.00			26.27	9.73	2.37	7.36			
	01:45:00	1140.00			26.27	9.73	2.37	7.36			
	01:55:00	1150.00			26.28	9.74	2.37	7.37			
	02:05:00	1160.00			26.25	9.71	2.36	7.35	44125.9	15.69	
	02:15:00	1170.00			26.28	9.74	2.37	7.37			
	02:25:00	1180.00			26.27	9.73	2.37	7.36			
	02:35:00	1190.00			26.28	9.74	2.37	7.37			
	02:45:00	1200.00			26.28	9.74	2.37	7.37			
	02:55:00	1210.00			26.28	9.74	2.37	7.37			
	03:05:00	1220.00			26.31	9.77	2.39	7.38			
	03:15:00	1230.00			26.30	9.76	2.38	7.38			
	03:25:00	1240.00			26.33	9.79	2.40	7.39			
	03:35:00	1250.00			26.33	9.79	2.40	7.39			
	03:45:00	1260.00			26.35	9.81	2.41	7.40			

TABLE C.2
(CONTINUED)
VOLK FIELD ANGB

WATER LEVEL DATA AND DRAWDOWN COMPUTATIONS
FOR WELL VF1 PW-1

Date	Time (CDT)	Δt (min)	Δt' (min)	Δt / Δt'	Depth To Water (ft)	Drawdown s (ft)	$\frac{s^2}{2b}$ (ft)	s' (ft)	Total Discharge (gal)	Flow Rate (gpm)	Remarks
5/06/88	03:55:00	1270.00			26.33	9.79	2.40	7.39			
(continued)	04:05:00	1280.00			26.35	9.81	2.41	7.40			
	04:15:00	1290.00			26.31	9.77	2.39	7.38			
	04:25:00	1300.00			26.31	9.77	2.39	7.38			
	04:35:00	1310.00			26.33	9.79	2.40	7.39			
	04:45:00	1320.00			26.33	9.79	2.40	7.39			
	04:55:00	1330.00			26.28	9.74	2.37	7.37			
	05:05:00	1340.00			26.30	9.76	2.38	7.38			
	05:15:00	1350.00			26.33	9.79	2.40	7.39			
	05:25:00	1360.00			26.33	9.79	2.40	7.39			
	05:35:00	1370.00			26.31	9.77	2.39	7.38			
	05:45:00	1380.00			26.30	9.76	2.38	7.38			
	05:55:00	1390.00			26.31	9.77	2.39	7.38			
	06:05:00	1400.00			26.33	9.79	2.40	7.39			
	06:15:00	1410.00			26.33	9.79	2.40	7.39			
	06:25:00	1420.00			26.33	9.79	2.40	7.39			
	06:35:00	1430.00			26.36	9.82	2.41	7.41			
	06:45:00	1440.00							48515.3	15.68	Pump Off
	06:45:00	1440.00	0.00	436362.6	26.15	9.61	2.31	7.30			(Average flow rate for
	06:45:00	1440.00	0.01	218181.8	26.07	9.53	2.27	7.26			pump test = 15.7 gpm)
	06:45:00	1440.00	0.01	145454.9	26.04	9.50	2.26	7.24			
	06:45:00	1440.01	0.01	108271.2	26.01	9.47	2.24	7.23			
	06:45:01	1440.01	0.02	86747.6	25.98	9.44	2.23	7.21			
	06:45:01	1440.01	0.02	72000.7	25.91	9.37	2.19	7.18			
	06:45:01	1440.02	0.02	61803.3	25.88	9.34	2.18	7.16			
	06:45:01	1440.02	0.03	54136.1	25.83	9.29	2.16	7.13			
	06:45:01	1440.02	0.03	48000.8	25.79	9.25	2.14	7.11			
	06:45:02	1440.03	0.03	43244.0	25.74	9.20	2.12	7.08			
	06:45:03	1440.04	0.05	28800.9	25.56	9.02	2.03	6.99			
	06:45:04	1440.06	0.07	21622.5	25.39	8.85	1.96	6.89			
	06:45:05	1440.08	0.08	17287.8	25.20	8.66	1.87	6.79			
	06:45:06	1440.09	0.10	14400.9	25.04	8.50	1.81	6.69			
	06:45:07	1440.11	0.12	12350.9	24.87	8.33	1.73	6.60			
	06:45:08	1440.13	0.13	10803.7	24.71	8.17	1.67	6.50			
	06:45:09	1440.14	0.15	9601.0	24.53	7.99	1.60	6.39			
	06:45:10	1440.16	0.17	8644.4	24.39	7.85	1.54	6.31			
	06:45:11	1440.18	0.18	7856.9	24.23	7.69	1.48	6.21			
	06:45:12	1440.19	0.20	7201.0	24.08	7.54	1.42	6.12			
	06:45:13	1440.21	0.22	6649.2	23.93	7.39	1.37	6.02			
	06:45:14	1440.23	0.23	6173.3	23.79	7.25	1.31	5.94			

TABLE C.2
(CONTINUED)
VOLK FIELD ANGB

WATER LEVEL DATA AND DRAWDOWN COMPUTATIONS
FOR WELL VF1 PW-1

Date	Time (CDT)	Δt (min)	Δt' (min)	$\frac{\Delta t}{\Delta t'}$	Depth To Water (ft)	Drawdown s (ft)	$\frac{s^2}{2b}$ (ft)	s' (ft)	Total Discharge (gal)	Flow Rate (gpm)	Remarks
5/06/88	06:45:15	1440.24	0.25	5761.0	23.65	7.11	1.26	5.85			
(continued)	06:45:16	1440.26	0.27	5402.3	23.52	6.98	1.22	5.76			
	06:45:17	1440.28	0.28	5083.9	23.39	6.85	1.17	5.68			
	06:45:18	1440.29	0.30	4801.0	23.25	6.71	1.13	5.58			
	06:45:19	1440.31	0.32	4549.3	23.12	6.58	1.08	5.50			
	06:45:20	1440.33	0.33	4321.4	23.01	6.47	1.05	5.42			
	06:45:25	1440.41	0.42	3456.7	22.43	5.89	0.87	5.02			
	06:45:30	1440.49	0.50	2881.0	21.92	5.38	0.72	4.66			
	06:45:35	1440.58	0.58	2469.7	21.43	4.89	0.60	4.29			
	06:45:40	1440.66	0.67	2160.9	20.99	4.45	0.50	3.95			
	06:45:45	1440.74	0.75	1921.0	20.61	4.07	0.41	3.66			
	06:45:50	1440.83	0.83	1729.1	20.24	3.70	0.34	3.36			
	06:45:55	1440.91	0.92	1571.8	19.94	3.40	0.29	3.11			
	06:46:00	1440.99	1.00	1441.0	19.66	3.12	0.24	2.88			
	06:46:05	1441.08	1.08	1330.3	19.40	2.86	0.20	2.66			
	06:46:10	1441.16	1.17	1235.2	19.18	2.64	0.17	2.47			
	06:46:15	1441.24	1.25	1153.0	18.97	2.43	0.15	2.28			
	06:46:20	1441.33	1.33	1081.0	18.80	2.26	0.13	2.13			
	06:46:25	1441.41	1.42	1017.5	18.63	2.09	0.11	1.98			
	06:46:30	1441.49	1.50	961.0	18.48	1.94	0.09	1.85			
	06:46:35	1441.58	1.58	910.5	18.36	1.82	0.08	1.74			
	06:46:40	1441.66	1.67	865.0	18.25	1.71	0.07	1.64			
	06:46:45	1441.74	1.75	823.9	18.13	1.59	0.06	1.53			
	06:46:50	1441.83	1.83	786.5	18.04	1.50	0.06	1.44			
	06:46:55	1441.91	1.92	752.3	17.96	1.42	0.05	1.37			
	06:47:00	1441.99	2.00	721.0	17.88	1.34	0.04	1.30			
	06:47:30	1442.49	2.50	577.0	17.56	1.02	0.03	0.99			
	06:48:00	1442.99	3.00	481.0	17.39	0.85	0.02	0.83			
	06:48:30	1443.49	3.50	412.4	17.30	0.76	0.01	0.75			
	06:49:00	1443.99	4.00	361.0	17.25	0.71	0.01	0.70			
	06:49:30	1444.49	4.50	321.0	17.22	0.68	0.01	0.67			
	06:50:00	1444.99	5.00	289.0	17.20	0.66	0.01	0.65			
	06:50:30	1445.49	5.50	262.8	17.18	0.64	0.01	0.63			
	06:51:00	1445.99	6.00	241.0	17.18	0.64	0.01	0.63			
	06:51:30	1446.49	6.50	222.5	17.17	0.63	0.01	0.62			
	06:52:00	1446.99	7.00	206.7	17.17	0.63	0.01	0.62			
	06:52:30	1447.49	7.50	193.0	17.15	0.61	0.01	0.60			
	06:53:00	1447.99	8.00	181.0	17.15	0.61	0.01	0.60			
	06:53:30	1448.49	8.50	170.4	17.15	0.61	0.01	0.60			
	06:54:00	1448.99	9.00	161.0	17.14	0.60	0.01	0.59			

TABLE C.2
(CONTINUED)
VOLK FIELD ANGB

WATER LEVEL DATA AND DRAWDOWN COMPUTATIONS
FOR WELL VF1 PW-1

Date	Time (CDT)	Δt (min)	Δt' (min)	Δt / Δt'	Depth To Water (ft)	Drawdown s (ft)	$\frac{s^2}{2b}$ (ft)	s' (ft)	Total Discharge (gal)	Flow Rate (gpm)	Remarks
5/06/88	06:54:30	1449.49	9.50	152.6	17.14	0.60	0.01	0.59			
(continued)	06:55:00	1449.99	10.00	145.0	17.14	0.60	0.01	0.59			
	06:57:00	1451.99	12.00	121.0	17.12	0.58	0.01	0.57			
	06:59:00	1453.99	14.00	103.9	17.12	0.58	0.01	0.57			
	07:01:00	1455.99	16.00	91.0	17.11	0.57	0.01	0.56			
	07:03:00	1457.99	18.00	81.0	17.09	0.55	0.01	0.54			
	07:05:00	1459.99	20.00	73.0	17.09	0.55	0.01	0.54			
	07:07:00	1461.99	22.00	66.5	17.07	0.53	0.01	0.52			
	07:09:00	1463.99	24.00	61.0	17.07	0.53	0.01	0.52			
	07:11:00	1465.99	26.00	56.4	17.06	0.52	0.01	0.51			
	07:13:00	1467.99	28.00	52.4	17.06	0.52	0.01	0.51			
	07:15:00	1469.99	30.00	49.0	17.04	0.50	0.01	0.49			
	07:17:00	1471.99	32.00	46.0	17.04	0.50	0.01	0.49			
	07:19:00	1473.99	34.00	43.4	17.04	0.50	0.01	0.49			
	07:21:00	1475.99	36.00	41.0	17.03	0.49	0.01	0.48			
	07:23:00	1477.99	38.00	38.9	17.03	0.49	0.01	0.48			
	07:25:00	1479.99	40.00	37.0	17.03	0.49	0.01	0.48			
	07:27:00	1481.99	42.00	35.3	17.03	0.49	0.01	0.48			
	07:29:00	1483.99	44.00	33.7	17.03	0.49	0.01	0.48			
	07:31:00	1485.99	46.00	32.3	17.01	0.47	0.01	0.46			
	07:33:00	1487.99	48.00	31.0	17.01	0.47	0.01	0.46			
	07:35:00	1489.99	50.00	29.8	17.01	0.47	0.01	0.46			
	07:37:00	1491.99	52.00	28.7	16.99	0.45	0.01	0.44			
	07:39:00	1493.99	54.00	27.7	16.99	0.45	0.01	0.44			
	07:41:00	1495.99	56.00	26.7	16.99	0.45	0.01	0.44			
	07:43:00	1497.99	58.00	25.8	16.99	0.45	0.01	0.44			
	07:45:00	1499.99	60.00	25.0	16.98	0.44	0.00	0.44			
	07:47:00	1501.99	62.00	24.2	16.98	0.44	0.00	0.44			
	07:49:00	1503.99	64.00	23.5	16.98	0.44	0.00	0.44			
	07:51:00	1505.99	66.00	22.8	16.98	0.44	0.00	0.44			
	07:53:00	1507.99	68.00	22.2	16.98	0.44	0.00	0.44			
	07:55:00	1509.99	70.00	21.6	16.98	0.44	0.00	0.44			
	07:57:00	1511.99	72.00	21.0	16.98	0.44	0.00	0.44			
	07:59:00	1513.99	74.00	20.5	16.96	0.42	0.00	0.42			
	08:01:00	1515.99	76.00	19.9	16.96	0.42	0.00	0.42			
	08:03:00	1517.99	78.00	19.5	16.96	0.42	0.00	0.42			
	08:05:00	1519.99	80.00	19.0	16.96	0.42	0.00	0.42			
	08:07:00	1521.99	82.00	18.6	16.96	0.42	0.00	0.42			
	08:09:00	1523.99	84.00	18.1	16.96	0.42	0.00	0.42			
	08:11:00	1525.99	86.00	17.7	16.96	0.42	0.00	0.42			

TABLE C.2
(CONTINUED)
VOLK FIELD ANGB

WATER LEVEL DATA AND DRAWDOWN COMPUTATIONS
FOR WELL VF1 PW-1

Date	Time (CDT)	Δt (min)	Δt' (min)	Δt / Δt'	Depth To Water (ft)	Drawdown s (ft)	$\frac{s^2}{2b}$ (ft)	s' (ft)	Total Discharge (gal)	Flow Rate (gpm)	Remarks
5/06/88	08:13:00	1527.99	88.00	17.4	16.96	0.42	0.00	0.42			
(continued)	08:15:00	1529.99	90.00	17.0	16.95	0.41	0.00	0.41			
	08:17:00	1531.99	92.00	16.7	16.95	0.41	0.00	0.41			
	08:19:00	1533.99	94.00	16.3	16.95	0.41	0.00	0.41			
	08:21:00	1535.99	96.00	16.0	16.95	0.41	0.00	0.41			
	08:23:00	1537.99	98.00	15.7	16.95	0.41	0.00	0.41			
	08:25:00	1539.99	100.00	15.4	16.95	0.41	0.00	0.41			
	08:35:00	1549.99	110.00	14.1	16.93	0.39	0.00	0.39			
	08:45:00	1559.99	120.00	13.0	16.92	0.38	0.00	0.38			
	08:55:00	1569.99	130.00	12.1	16.90	0.36	0.00	0.36			
	09:05:00	1579.99	140.00	11.3	16.88	0.34	0.00	0.34			
	09:15:00	1589.99	150.00	10.6	16.87	0.33	0.00	0.33			
	09:25:00	1599.99	160.00	10.0	16.87	0.33	0.00	0.33			
	09:35:00	1609.99	170.00	9.5	16.85	0.31	0.00	0.31			
	09:45:00	1619.99	180.00	9.0	16.84	0.30	0.00	0.30			
	09:55:00	1629.99	190.00	8.6	16.84	0.30	0.00	0.30			
	10:05:00	1639.99	200.00	8.2	16.84	0.30	0.00	0.30			
	10:15:00	1649.99	210.00	7.9	16.82	0.28	0.00	0.28			
	10:25:00	1659.99	220.00	7.5	16.82	0.28	0.00	0.28			
	10:35:00	1669.99	230.00	7.3	16.80	0.26	0.00	0.26			
	10:45:00	1679.99	240.00	7.0	16.80	0.26	0.00	0.26			
	10:55:00	1689.99	250.00	6.8	16.80	0.26	0.00	0.26			
	11:05:00	1699.99	260.00	6.5	16.79	0.25	0.00	0.25			
	11:15:00	1709.99	270.00	6.3	16.79	0.25	0.00	0.25			
	11:25:00	1719.99	280.00	6.1	16.77	0.23	0.00	0.23			
	11:35:00	1729.99	290.00	6.0	16.77	0.23	0.00	0.23			
	11:45:00	1739.99	300.00	5.8	16.77	0.23	0.00	0.23			
	11:55:00	1749.99	310.00	5.6	16.76	0.22	0.00	0.22			
	12:05:00	1759.99	320.00	5.5	16.76	0.22	0.00	0.22			
	12:15:00	1769.99	330.00	5.4	16.76	0.22	0.00	0.22			
	12:25:00	1779.99	340.00	5.2	16.74	0.20	0.00	0.20			
	12:35:00	1789.99	350.00	5.1	16.74	0.20	0.00	0.20			
	12:45:00	1799.99	360.00	5.0	16.74	0.20	0.00	0.20			
	12:55:00	1809.99	370.00	4.9	16.73	0.19	0.00	0.19			
	13:05:00	1819.99	380.00	4.8	16.73	0.19	0.00	0.19			
	13:15:00	1829.99	390.00	4.7	16.71	0.17	0.00	0.17			
	13:25:00	1839.99	400.00	4.6	16.71	0.17	0.00	0.17			
	13:35:00	1849.99	410.00	4.5	16.71	0.17	0.00	0.17			
	13:45:00	1859.99	420.00	4.4	16.71	0.17	0.00	0.17			
	13:55:00	1869.99	430.00	4.3	16.71	0.17	0.00	0.17			

TABLE C.2
(CONTINUED)
VOLK FIELD ANGB

WATER LEVEL DATA AND DRAWDOWN COMPUTATIONS
FOR WELL VF1 PW-1

Date	Time (CDT)	Δt (min)	Δt' (min)	Δt / Δt'	Depth To Water (ft)	Drawdown s (ft)	$\frac{s^2}{2b}$ (ft)	s' (ft)	Total Discharge (gal)	Flow Rate (gpm)	Remarks
5/06/88	14:05:00	1879.99	440.00	4.3	16.69	0.15	0.00	0.15			
(continued)	14:15:00	1889.99	450.00	4.2	16.69	0.15	0.00	0.15			
	14:25:00	1899.99	460.00	4.1	16.69	0.15	0.00	0.15			
	14:35:00	1909.99	470.00	4.1	16.69	0.15	0.00	0.15			
	14:45:00	1919.99	480.00	4.0	16.69	0.15	0.00	0.15			
	16:45:00	2039.99	600.00	3.4	16.68	0.14	0.00	0.14			
	17:45:00	2099.99	660.00	3.2	16.69	0.15	0.00	0.15			
	18:45:00	2159.99	720.00	3.0	16.68	0.14	0.00	0.14			
	19:47:00	2221.99	782.00	2.8	16.65	0.11	0.00	0.11			
5/07/88	09:06:00	3020.99	1581.00	1.9	16.62	0.08	0.00	0.08			

TABLE C.3

VOLK FIELD ANGB

WATER LEVEL DATA AND DRAWDOWN COMPUTATIONS
FOR WELL VF1 MW-1

Date	Time (CDT)	Δt (min)	Δt' (min)	Δt / Δt'	Depth To Water (feet)	Drawdowns (feet)	Remarks
5/3/88	13:27:00				9.94		
5/4/88	17:58:00				9.94		
5/5/88	06:08:00				9.98		Assumed Static Water Level
	06:45:00	0.0					Pump On
	08:27:00	102.0			10.01	0.03	
	09:16:00	151.0			10.01	0.03	
	09:53:00	188.0			9.99	0.01	
	10:34:00	229.0			10.00	0.02	
	11:36:00	291.0			9.99	0.01	
	12:50:00	365.0			9.99	0.01	
	13:50:00	425.0			10.00	0.02	
	14:40:00	475.0			9.99	0.01	
	15:40:00	535.0			9.99	0.01	
	16:41:00	596.0			9.99	0.01	
	18:17:00	692.0			10.01	0.03	
	19:33:00	768.0			10.05	0.07	
	21:29:00	884.0			9.99	0.01	
5/6/88	00:08:00	1043.0			9.98	0.00	
	02:02:00	1157.0			10.01	0.03	
	04:33:00	1308.0			10.01	0.03	
	06:26:00	1421.0			10.02	0.04	
	06:45:00	1440.0	0.0				Pump Off
	07:17:00	1472.0	32.0	46.0	10.02	0.04	
	07:53:00	1508.0	68.0	22.2	10.02	0.04	
	08:37:00	1552.0	112.0	13.9	10.03	0.05	
	09:24:00	1599.0	159.0	10.1	10.00	0.02	
	10:27:00	1662.0	222.0	7.5	10.01	0.03	
	12:13:00	1768.0	328.0	5.4	10.00	0.02	
	13:19:00	1834.0	394.0	4.7	10.00	0.02	
	15:45:00	1980.0	540.0	3.7	10.00	0.02	
	17:07:00	2062.0	622.0	3.3	10.00	0.02	
	19:08:00	2183.0	743.0	2.9	10.00	0.02	
5/7/88	09:27:00	3042.0	1602.0	1.9	10.00	0.02	

TABLE C.4

VOLK FIELD ANGB

WATER LEVEL DATA AND DRAWDOWN COMPUTATIONS
FOR WELL VF1 MW-2

Date	Time (CDT)	Δt (min)	Δt' (min)	Δt / Δt'	Depth To Water (feet)	Drawdown s (feet)	Remarks
5/3/88	13:15:00				12.47		
5/4/88	12:49:00				12.49		
5/5/88	06:12:00				12.51		Assumed Static Water Level
	06:45:00	0.0					Pump On
	07:51:00	66.0			12.55	0.04	
	08:15:00	90.0			12.54	0.03	
	09:48:00	183.0			12.56	0.05	
	10:30:00	225.0			12.56	0.05	
	11:32:00	287.0			12.57	0.06	
	12:43:00	358.0			12.57	0.06	
	13:45:00	420.0			12.57	0.06	
	14:35:00	470.0			12.58	0.07	
	15:35:00	530.0			12.58	0.07	
	16:35:00	590.0			12.59	0.08	
	18:12:00	687.0			12.60	0.09	
	19:26:00	761.0			12.63	0.12	
	21:24:00	879.0			12.62	0.11	
5/6/88	00:03:00	1038.0			12.61	0.10	
	01:59:00	1154.0			12.63	0.12	
	04:30:00	1305.0			12.64	0.13	
	06:24:00	1419.0			12.65	0.14	
	06:45:00	1440.0	0.0				PUMP OFF
	07:14:30	1469.5	29.5	49.8	12.64	0.13	
	07:28:00	1483.0	43.0	34.5	12.64	0.13	
	07:50:00	1505.0	65.0	23.2	12.62	0.11	
	08:34:00	1549.0	109.0	14.2	12.63	0.12	
	09:21:30	1596.5	156.5	10.2	12.61	0.10	
	10:24:30	1659.5	219.5	7.6	12.60	0.09	
	12:10:30	1765.5	325.5	5.4	12.59	0.08	
	13:16:00	1831.0	391.0	4.7	12.58	0.07	
	15:06:00	1941.0	501.0	3.9	12.57	0.06	
	17:04:00	2059.0	619.0	3.3	12.56	0.05	
	19:04:00	2179.0	739.0	2.9	12.56	0.05	
5/7/88	09:23:00	3038.0	1598.0	1.9	12.55	0.04	

TABLE C.5

VOLK FIELD ANGB

WATER LEVEL DATA AND DRAWDOWN COMPUTATIONS
FOR WELL VF1 MW-3

Date	Time (CDT)	Δt (min)	Δt' (min)	Δt / Δt'	Depth To Water (feet)	Drawdown s (feet)	Remarks
5/3/88	13:24:00				12.12		
5/4/88	18:01:00				12.12		
5/5/88	06:08:00				12.13		Assumed Static Water Level
	06:45:00	0.0					Pump On
	07:53:00	68.0			12.17	0.04	
	08:10:00	85.0			12.17	0.04	
	09:15:00	150.0			12.16	0.03	
	09:51:00	186.0			12.16	0.03	
	10:33:00	228.0			12.16	0.03	
	11:34:00	289.0			12.17	0.04	
	12:47:00	362.0			12.16	0.03	
	13:48:00	423.0			12.17	0.04	
	14:39:00	474.0			12.17	0.04	
	15:38:00	533.0			12.17	0.04	
	16:39:00	594.0			12.18	0.05	
	18:15:00	690.0			12.19	0.06	
	19:30:00	765.0			12.19	0.06	
	21:27:00	882.0			12.19	0.06	
5/6/88	00:06:00	1041.0			12.20	0.07	
	0[illegible] 1:00	1156.0			12.21	0.08	
	04:33:00	1308.0			12.23	0.10	
	06:25:00	1420.0			12.22	0.09	
	06:45:00	1440.0	0.0				PUMP OFF
	07:18:30	1473.5	33.5	44.0	12.22	0.09	
	07:51:30	1506.5	66.5	22.7	12.21	0.08	
	08:36:00	1551.0	111.0	14.0	12.21	0.08	
	09:23:30	1598.5	158.5	10.1	12.20	0.07	
	10:25:30	1660.5	220.5	7.5	12.20	0.07	
	12:12:00	1767.0	327.0	5.4	12.18	0.05	
	13:18:00	1833.0	393.0	4.7	12.19	0.06	
	15:10:00	1945.0	505.0	3.9	12.17	0.04	
	17:07:00	2062.0	622.0	3.3	12.20	0.07	
	19:09:00	2184.0	744.0	2.9	12.19	0.06	
5/7/88	09:26:00	3041.0	1601.0	1.9	12.19	0.06	

TABLE C.6

VOLK FIELD ANGB

WATER LEVEL DATA AND DRAWDOWN COMPUTATIONS
FOR WELL VF1 MW-4

Date	Time (CDT)	Δt (min)	Δt' (min)	Δt / Δt'	Depth To Water (feet)	Drawdown s (feet)	Remarks
5/3/88	13:29:00				10.42		
5/4/88	17:55:00				10.41		
5/5/88	06:05:00				10.44		Assumed Static Water Level
	06:45:00	0.0					Pump On
	08:06:00	81.0			10.44	0.00	
	08:25:00	100.0			10.44	0.00	
	09:17:00	152.0			10.43	-0.01	
	09:54:00	189.0			10.44	0.00	
	10:35:00	230.0			10.44	0.00	
	11:37:00	292.0			10.43	-0.01	
	12:51:00	366.0			10.43	-0.01	
	13:51:00	426.0			10.43	-0.01	
	14:42:00	477.0			10.43	-0.01	
	15:41:00	536.0			10.43	-0.01	
	16:41:00	596.0			10.44	0.00	
	18:18:00	693.0			10.44	0.00	
	19:34:00	769.0			10.44	0.00	
	21:30:00	885.0			10.46	0.02	
5/6/88	00:07:00	1042.0			10.45	0.01	
	02:03:00	1158.0			10.46	0.02	
	04:35:00	1310.0			10.46	0.02	
	06:27:00	1422.0			10.47	0.03	
	06:45:00	1440.0	0.0				PUMP OFF
	07:17:30	1472.5	32.5	45.3	10.47	0.03	
	07:54:00	1509.0	69.0	21.9	10.47	0.03	
	08:38:00	1553.0	113.0	13.7	10.47	0.03	
	09:25:00	1600.0	160.0	10.0	10.47	0.03	
	10:27:30	1662.5	222.5	7.5	10.45	0.01	
	12:13:30	1768.5	328.5	5.4	10.45	0.01	
	13:19:00	1834.0	394.0	4.7	10.45	0.01	
	15:13:00	1948.0	508.0	3.8	10.43	-0.01	
	17:08:00	2063.0	623.0	3.3	10.45	0.01	
	19:08:00	2183.0	743.0	2.9	10.45	0.01	
5/7/88	09:27:00	3042.0	1602.0	1.9	10.45	0.01	

TABLE C.7

VOLK FIELD ANGB

WATER LEVEL DATA AND DRAWDOWN COMPUTATIONS
FOR WELL VF9 MW-1

Date	Time (CDT)	Δt (min)	Δt' (min)	Δt / Δt'	Depth To Water (feet)	Drawdown s (feet)	Remarks
5/3/88	15:25:00				20.30		
5/4/88	18:01:00				20.27		
5/5/88	06:10:00				20.31		Assumed Static Water Level
	06:45:00	0.0					Pump On
	07:28:00	43.0			20.30	-0.01	
	07:54:00	69.0			20.30	-0.01	
	08:10:00	85.0			20.31	0.00	
	08:29:00	104.0			20.31	0.00	
	09:07:00	142.0			20.32	0.01	
	09:43:00	178.0			20.31	0.00	
	10:33:00	228.0			20.31	0.00	
	11:29:00	284.0			20.31	0.00	
	12:40:00	355.0			20.31	0.00	
	13:43:00	418.0			20.31	0.00	
	14:39:00	474.0			20.30	-0.01	
	15:53:00	548.0			20.33	0.02	
	16:33:00	588.0			20.30	-0.01	
	17:55:00	670.0			20.31	0.00	
	19:09:00	744.0			20.32	0.01	
	20:39:00	834.0			20.37	0.06	
	23:48:00	1023.0			20.34	0.03	
5/6/88	01:32:00	1127.0			20.34	0.03	
	04:12:00	1287.0			20.36	0.05	
	06:07:00	1402.0			20.35	0.04	
	06:45:00	1440.0	0.0				PUMP OFF
	07:00:00	1455.0	15.0	97.0	20.35	0.04	
	07:10:00	1465.0	25.0	58.6	20.35	0.04	
	07:24:00	1479.0	39.0	37.9	20.35	0.04	
	07:48:00	1503.0	63.0	23.9	20.34	0.03	
	09:48:00	1623.0	183.0	8.9	20.34	0.03	
	10:33:00	1668.0	228.0	7.3	20.33	0.02	
	12:17:00	1772.0	332.0	5.3	20.33	0.02	
	13:24:00	1839.0	399.0	4.6	20.32	0.01	
	15:19:30	1954.5	514.5	3.8	20.32	0.01	
	16:51:00	2046.0	606.0	3.4	20.33	0.02	
	18:52:00	2167.0	727.0	3.0	20.35	0.04	
5/7/88	09:08:00	3023.0	1583.00	1.9	20.32	0.01	

TABLE C.8

VOLK FIELD ANGB

WATER LEVEL DATA AND DRAWDOWN COMPUTATIONS
FOR WELL VF9 MW-2

Date	Time (CDT)	Δt (min)	Δt' (min)	Δt / Δt'	Depth To Water (feet)	Drawdown s (feet)	Remarks
5/3/88	11:47:00				17.28		
5/4/88	18:27:00				17.33		
5/5/88	06:13:00				17.33		Assumed Static Water Level
	06:45:00	0.0					Pump On
	07:21:00	36.0			17.40	0.07	
	07:35:00	50.0			17.41	0.08	
	07:53:00	68.0			17.42	0.09	
	08:12:00	87.0			17.42	0.09	
	08:31:00	106.0			17.43	0.10	
	09:08:00	143.0			17.45	0.12	
	09:45:00	180.0			17.46	0.13	
	10:37:00	232.0			17.48	0.15	
	11:33:00	288.0			17.50	0.17	
	12:44:00	359.0			17.51	0.18	
	13:46:00	421.0			17.52	0.19	
	14:45:00	480.0			17.53	0.20	
	15:56:00	551.0			17.56	0.23	
	16:37:00	592.0			17.55	0.22	
	17:53:00	668.0			17.56	0.23	
	19:07:00	742.0			17.58	0.25	
	20:37:00	832.0			17.60	0.27	
	23:47:00	1022.0			17.61	0.28	
5/6/88	01:33:00	1128.0			17.61	0.28	
	04:14:00	1289.0			17.66	0.33	
	06:10:00	1405.0			17.67	0.34	
	06:45:00	1440.0	0.0				PUMP OFF
	06:47:00	1442.0	2.0	721.0	17.68	0.35	
	06:50:00	1445.0	5.0	289.0	17.66	0.33	
	06:51:00	1446.0	6.0	241.0	17.66	0.33	
	06:53:00	1448.0	8.0	181.0	17.65	0.32	
	06:54:00	1449.0	9.0	161.0	17.65	0.32	
	06:57:00	1452.0	12.0	121.0	17.63	0.30	
	07:02:00	1457.0	17.0	85.7	17.63	0.30	
	07:05:00	1460.0	20.0	73.0	17.62	0.29	
	07:12:00	1467.0	27.0	54.3	17.63	0.30	
	07:20:00	1475.0	35.0	42.1	17.62	0.29	

TABLE C.8
(CONTINUED)
VOLK FIELD ANGB

WATER LEVEL DATA AND DRAWDOWN COMPUTATIONS
FOR WELL VF9 MW-2

Date	Time (CDT)	Δt (min)	Δt' (min)	Δt / Δt'	Depth To Water (feet)	Drawdown s (feet)	Remarks
5/6/88	07:43:00	1498.0	58.0	25.8	17.60	0.27	
(continued)	08:22:00	1537.0	97.00	15.8	17.59	0.26	
	09:10:00	1585.0	145.00	10.9	17.57	0.24	
	10:34:00	1669.0	229.00	7.3	17.53	0.20	
	12:19:00	1774.0	334.00	5.3	17.50	0.17	
	13:25:30	1840.5	400.50	4.6	17.48	0.15	
	15:22:00	1957.0	517.00	3.8	17.44	0.11	
	16:53:00	2048.0	608.00	3.4	17.43	0.10	
	18:53:00	2168.0	728.00	3.0	17.44	0.11	
5/7/88	09:11:00	3026.0	1586.00	1.9	17.41	0.08	

TABLE C.9

VOLK FIELD ANGB

WATER LEVEL DATA AND DRAWDOWN COMPUTATIONS
FOR WELL VF9 MW-3

Date	Time (CDT)	Δt (min)	Δt' (min)	Δt / Δt'	Depth To Water (feet)	Drawdown s (feet)	Remarks
5/3/88	12:19:00				15.47		
5/4/88	18:16:00				15.49		
5/5/88	06:25:00				15.51		Assumed Static Water Level
	06:45:00	0.0					Pump On
	07:30:00	45.0			15.50	-0.01	
	08:01:00	76.0			15.55	0.04	
	08:13:00	88.0			15.55	0.04	
	08:33:00	108.0			15.55	0.04	
	09:10:00	145.0			15.56	0.05	
	09:45:00	180.0			15.56	0.05	
	10:40:00	235.0			15.57	0.06	
	11:34:00	289.0			15.57	0.06	
	12:59:00	374.0			15.58	0.07	
	13:48:00	423.0			15.57	0.06	
	14:45:00	480.0			15.58	0.07	
	15:57:00	552.0			15.59	0.08	
	16:38:00	593.0			15.59	0.08	
	18:01:00	676.0			15.60	0.09	
	19:15:00	750.0			15.61	0.10	
	21:06:00	861.0			15.63	0.12	
	23:52:00	1027.0			15.63	0.12	
5/6/88	01:34:00	1129.0			15.65	0.14	
	04:15:00	1290.0			15.71	0.20	
	06:11:00	1406.0			15.70	0.19	
	06:45:00	1440.0	0.0				PUMP OFF
	06:56:00	1451.0	11.0	131.9	15.68	0.17	
	07:04:00	1459.0	19.0	76.8	15.66	0.15	
	07:18:00	1473.0	33.0	44.6	15.66	0.15	
	07:51:00	1506.0	66.0	22.8	15.66	0.15	
	09:10:30	1585.5	145.5	10.9	15.63	0.12	
	10:35:30	1670.5	230.5	7.2	15.62	0.11	
	12:19:30	1774.5	334.5	5.3	15.60	0.09	
	13:26:30	1841.5	401.5	4.6	15.59	0.08	
	15:23:30	1958.5	518.5	3.8	15.57	0.06	
	16:54:00	2049.0	609.0	3.4	15.59	0.08	
	18:54:00	2169.0	729.0	3.0	15.58	0.07	
5/7/88	09:12:00	3027.0	1587.0	1.9	15.58	0.07	

TABLE C.10

VOLK FIELD ANGB

WATER LEVEL DATA AND DRAWDOWN COMPUTATIONS
FOR WELL ET-1

Date	Time (CDT)	Δt (min)	Δt' (min)	Δt / Δt'	Depth To Water (feet)	Drawdown s (feet)	Remarks
5/3/88	11:25:00				18.56		
5/3/88	19:43:00				18.64		
5/4/88	08:45:00				18.55		
5/4/88	17:57:00				18.58		
5/5/88	06:07:00				18.61		Assumed Static Water Level
5/5/88	06:45:00	0.0					Pump On
	07:25:00	40.0			18.61	0.00	
	07:52:00	67.0			18.62	0.01	
	08:07:00	82.0			18.63	0.02	
	08:26:00	101.0			18.63	0.02	
	09:01:00	136.0			18.63	0.02	
	09:40:00	175.0			18.64	0.03	
	10:30:00	225.0			18.65	0.04	
	11:28:00	283.0			18.63	0.02	
	12:37:00	352.0			18.64	0.03	
	13:40:00	415.0			18.64	0.03	
	14:37:00	472.0			18.60	-0.01	
	15:49:00	544.0			18.69	0.08	
	16:30:00	585.0			18.63	0.02	
	17:57:00	672.0			18.63	0.02	
	19:10:00	745.0			18.63	0.02	
	20:42:00	837.0			18.68	0.07	
	23:50:00	1025.0			18.65	0.04	
5/6/88	01:29:00	1124.0			18.66	0.05	
	04:10:00	1285.0			18.69	0.08	
	06:07:00	1402.0			18.70	0.09	
	06:45:00	1440.0	0.0				Pump Off
	06:59:00	1454.0	14.0	103.9	18.68	0.08	
	07:08:00	1463.0	23.0	63.6	18.69	0.07	
	07:22:00	1477.0	37.0	39.9	18.68	0.06	
	07:46:00	1501.0	61.0	24.6	18.67	0.04	
	09:06:00	1581.0	141.0	11.2	18.65	0.04	
	10:31:00	1666.0	226.0	7.4	18.65	0.04	
	12:16:00	1771.0	331.0	5.4	18.65	0.02	
	13:23:00	1838.0	398.0	4.6	18.63	0.02	
	15:17:00	1952.0	512.0	3.8	18.63	0.02	
	16:48:00	2043.0	603.0	3.4	18.64	0.03	
	18:48:00	2163.0	723.0	3.0	18.65	0.04	
5/7/88	09:08:00	3023.0	1583.0	1.9	18.68	0.07	

TABLE C.11

VOLK FIELD ANGB

WATER LEVEL DATA AND DRAWDOWN COMPUTATIONS
FOR WELL ET-2

Date	Time (CDT)	Δt (min)	Δt' (min)	Δt / Δt'	Depth To Water (feet)	Drawdown s (feet)	Remarks
5/03/88	11:53:00				16.19		
	15:58:00				16.18		
	19:47:00				16.18		
5/4/88	08:58:00				16.16		
	09:30:00				16.19		
	11:16:00				16.18		
	12:38:00				16.21		
	12:50:00				16.16		Start Step Test: Well PW1
	12:51:00				16.25		
	12:52:00				16.27		
	12:53:00				16.27		
	12:54:00				16.28		
	12:55:00				16.28		
	12:56:00				16.28		
	12:57:00				16.32		
	12:58:00				16.33		
	12:59:00				16.36		
	13:00:00				16.35		
	13:01:00				16.36		
	13:02:00				16.35		
	13:03:00				16.36		
	13:04:00				16.36		
	13:05:00				16.36		
	13:06:00				16.40		
	13:07:00				16.38		
	13:08:00				16.38		
	13:09:00				16.38		
	13:10:00				16.35		
	13:11:00				16.36		
	13:12:00				16.38		
	13:13:00				16.40		
	13:14:00				16.41		
	13:15:00				16.40		
	13:16:00				16.40		
	13:17:00				16.36		
	13:18:00				16.35		
	13:19:00				16.38		
	13:20:00				16.40		
	13:21:00				16.41		
	13:22:00				16.41		

TABLE C.11
(CONTINUED)
VOLK FIELD ANGB

WATER LEVEL DATA AND DRAWDOWN COMPUTATIONS
FOR WELL ET-2

Date	Time (CDT)	Δt (min)	Δt' (min)	Δt / Δt'	Depth To Water (feet)	Drawdown s (feet)	Remarks
5/4/88	13:23:00				16.41		
(continued)	13:24:00				16.41		
	13:25:00				16.40		
	13:26:00				16.44		
	13:27:00				16.47		
	13:28:00				16.49		
	13:29:00				16.51		
	13:30:00				16.51		
	13:31:00				16.49		
	13:32:00				16.49		
	13:33:00				16.51		
	13:34:00				16.49		
	13:35:00				16.46		
	13:36:00				16.43		
	13:37:00				16.47		
	13:38:00				16.49		
	13:39:00				16.49		
	13:40:00				16.52		
	13:41:00				16.51		
	13:42:00				16.47		
	13:43:00				16.47		
	13:44:00				16.47		
	13:45:00				16.49		
	13:46:00				16.51		
	13:47:00				16.51		
	13:48:00				16.51		
	13:49:00				16.52		
	13:50:00				16.51		
	13:51:00				16.54		
	13:52:00				16.52		
	13:53:00				16.54		
	13:54:00				16.54		
	13:55:00				16.54		
	13:56:00				16.55		
	13:57:00				16.54		
	13:58:00				16.55		
	13:59:00				16.57		
	14:00:00				16.59		
	14:01:00				16.59		
	14:02:00				16.59		

TABLE C.11
(CONTINUED)
VOLK FIELD ANGB

WATER LEVEL DATA AND DRAWDOWN COMPUTATIONS
FOR WELL ET-2

Date	Time (CDT)	Δt (min)	Δt' (min)	Δt / Δt'	Depth To Water (feet)	Drawdown s (feet)	Remarks
5/4/88	14:03:00				16.57		
(continued)	14:04:00				16.59		
	14:05:00				16.59		
	14:06:00				16.57		
	14:07:00				16.57		
	14:08:00				16.59		
	14:09:00				16.59		
	14:10:00				16.60		
	14:11:00				16.59		
	14:12:00				16.57		
	14:13:00				16.55		
	14:14:00				16.55		
	14:15:00				16.54		
	14:16:00				16.54		
	14:17:00				16.55		
	14:18:00				16.59		
	14:19:00				16.59		
	14:20:00				16.57		
	14:21:00				16.60		
	14:22:00				16.60		
	14:23:00				16.60		
	14:24:00				16.60		
	14:25:00				16.60		
	14:26:00				16.60		
	14:27:00				16.63		
	14:28:00				16.62		
	14:29:00				16.65		
	14:30:00				16.65		
	14:31:00				16.65		
	14:32:00				16.65		
	14:33:00				16.65		
	14:34:00				16.66		
	14:35:00				16.66		
	14:36:00				16.68		
	14:37:00				16.66		
	14:38:00				16.66		
	14:39:00				16.66		
	14:40:00				16.66		
	14:41:00				16.65		
	14:42:00				16.65		

TABLE C.11
(CONTINUED)
VOLK FIELD ANGB

WATER LEVEL DATA AND DRAWDOWN COMPUTATIONS
FOR WELL ET-2

Date	Time (CDT)	Δt (min)	Δt' (min)	Δt / Δt'	Depth To Water (feet)	Drawdown s (feet)	Remarks
5/4/88	14:43:00				16.66		
(continued)	14:44:00				16.66		
	14:45:00				16.65		
	14:46:00				16.65		
	14:47:00				16.68		
	14:48:00				16.70		
	14:49:00				16.70		
	14:50:00				16.70		
	14:51:00				16.70		
	14:52:00				16.70		
	14:53:00				16.70		
	14:54:00				16.68		
	14:55:00				16.68		
	14:56:00				16.68		
	14:57:00				16.70		
	14:58:00				16.70		
	14:59:00				16.70		
	15:00:00				16.70		Stop Step Test: Well PW1
	18:10:00				16.30		
	18:52:00				16.27		
	19:00:00				16.27		
	20:00:00				16.23		
	21:00:00				16.25		
	22:00:00				16.23		
	23:00:00				16.22		
5/05/88	00:00:00				16.22		
	01:00:00				16.20		
	02:00:00				16.20		
	03:00:00				16.20		
	04:00:00				16.20		
	05:00:00				16.19		
	06:00:00				16.19		
	06:45:00	0.00			16.23	0.01	Pump On
	06:45:00	0.00			16.23	0.01	
	06:45:00	0.01			16.23	0.01	
	06:45:01	0.01			16.23	0.01	
	06:45:01	0.01			16.23	0.01	
	06:45:01	0.02			16.23	0.01	
	06:45:01	0.02			16.25	0.03	
	06:45:01	0.02			16.25	0.03	

TABLE C.11
(CONTINUED)
VOLK FIELD ANGB

WATER LEVEL DATA AND DRAWDOWN COMPUTATIONS
FOR WELL ET-2

Date	Time (CDT)	Δt (min)	Δt' (min)	Δt / Δt'	Depth To Water (feet)	Drawdown s (feet)	Remarks
5/5/88	06:45:02	0.03			16.23	0.01	
(continued)	06:45:02	0.03			16.25	0.03	
	06:45:02	0.03			16.23	0.01	
	06:45:03	0.05			16.23	0.01	
	06:45:04	0.07			16.23	0.01	
	06:45:05	0.08			16.23	0.01	
	06:45:06	0.10			16.23	0.01	
	06:45:07	0.12			16.23	0.01	
	06:45:08	0.13			16.23	0.01	
	06:45:09	0.15			16.23	0.01	
	06:45:10	0.17			16.23	0.01	
	06:45:11	0.18			16.23	0.01	
	06:45:12	0.20			16.25	0.03	
	06:45:13	0.22			16.23	0.01	
	06:45:14	0.23			16.25	0.03	
	06:45:15	0.25			16.23	0.01	
	06:45:16	0.27			16.23	0.01	
	06:45:17	0.28			16.25	0.03	
	06:45:18	0.30			16.25	0.03	
	06:45:19	0.32			16.25	0.03	
	06:45:20	0.33			16.25	0.03	
	06:45:25	0.42			16.25	0.03	
	06:45:30	0.50			16.25	0.03	
	06:45:35	0.58			16.26	0.04	
	06:45:40	0.67			16.26	0.04	
	06:45:45	0.75			16.26	0.04	
	06:45:50	0.83			16.26	0.04	
	06:45:55	0.92			16.26	0.04	
	06:46:00	1.00			16.28	0.06	
	06:46:05	1.08			16.28	0.06	
	06:46:10	1.17			16.28	0.06	
	06:46:15	1.25			16.28	0.06	
	06:46:20	1.33			16.28	0.06	
	06:46:25	1.42			16.28	0.06	
	06:46:30	1.50			16.29	0.07	
	06:46:35	1.58			16.29	0.07	
	06:46:40	1.67			16.29	0.07	
	06:46:45	1.75			16.29	0.07	
	06:46:50	1.83			16.29	0.07	
	06:46:55	1.92			16.29	0.07	

TABLE C.11
(CONTINUED)
VOLK FIELD ANGB

WATER LEVEL DATA AND DRAWDOWN COMPUTATIONS
FOR WELL ET-2

Date	Time (CDT)	Δt (min)	Δt' (min)	Δt / Δt'	Depth To Water (feet)	Drawdown s (feet)	Remarks
5/5/88	06:47:00	2.00			16.29	0.07	
(continued)	06:47:30	2.50			16.33	0.11	
	06:48:00	3.00			16.34	0.12	
	06:48:30	3.50			16.36	0.14	
	06:49:00	4.00			16.37	0.15	
	06:49:30	4.50			16.39	0.17	
	06:50:00	5.00			16.41	0.19	
	06:50:30	5.50			16.42	0.20	
	06:51:00	6.00			16.42	0.20	
	06:51:30	6.50			16.44	0.22	
	06:52:00	7.00			16.44	0.22	
	06:52:30	7.50			16.44	0.22	
	06:53:00	8.00			16.44	0.22	
	06:53:30	8.50			16.44	0.22	
	06:54:00	9.00			16.44	0.22	
	06:54:30	9.50			16.44	0.22	
	06:55:00	10.00			16.44	0.22	
	06:57:00	12.00			16.48	0.26	
	06:59:00	14.00			16.50	0.28	
	07:01:00	16.00			16.50	0.28	
	07:03:00	18.00			16.52	0.30	
	07:05:00	20.00			16.52	0.30	
	07:07:00	22.00			16.53	0.31	
	07:09:00	24.00			16.53	0.31	
	07:11:00	26.00			16.55	0.33	
	07:13:00	28.00			16.56	0.34	
	07:15:00	30.00			16.56	0.34	
	07:17:00	32.00			16.58	0.36	
	07:19:00	34.00			16.58	0.36	
	07:21:00	36.00			16.60	0.38	
	07:23:00	38.00			16.61	0.39	
	07:25:00	40.00			16.61	0.39	
	07:27:00	42.00			16.61	0.39	
	07:29:00	44.00			16.63	0.41	
	07:31:00	46.00			16.63	0.41	
	07:33:00	48.00			16.64	0.42	
	07:35:00	50.00			16.64	0.42	
	07:37:00	52.00			16.66	0.44	
	07:39:00	54.00			16.66	0.44	
	07:41:00	56.00			16.66	0.44	

TABLE C.11
(CONTINUED)
VOLK FIELD ANGB

WATER LEVEL DATA AND DRAWDOWN COMPUTATIONS
FOR WELL ET-2

Date	Time (CDT)	Δt (min)	Δt' (min)	Δt / Δt'	Depth To Water (feet)	Drawdown s (feet)	Remarks
5/5/88	07:43:00	58.00			16.67	0.45	
(continued)	07:45:00	60.00			16.67	0.45	
	07:47:00	62.00			16.67	0.45	
	07:49:00	64.00			16.67	0.45	
	07:51:00	66.00			16.69	0.47	
	07:53:00	68.00			16.69	0.47	
	07:55:00	70.00			16.69	0.47	
	07:57:00	72.00			16.69	0.47	
	07:59:00	74.00			16.69	0.47	
	08:01:00	76.00			16.71	0.49	
	08:03:00	78.00			16.71	0.49	
	08:05:00	80.00			16.72	0.50	
	08:07:00	82.00			16.72	0.50	
	08:09:00	84.00			16.72	0.50	
	08:11:00	86.00			16.72	0.50	
	08:13:00	88.00			16.72	0.50	
	08:15:00	90.00			16.72	0.50	
	08:17:00	92.00			16.74	0.52	
	08:19:00	94.00			16.74	0.52	
	08:21:00	96.00			16.74	0.52	
	08:23:00	98.00			16.74	0.52	
	08:25:00	100.00			16.74	0.52	
	08:35:00	110.00			16.75	0.53	
	08:45:00	120.00			16.77	0.55	
	08:55:00	130.00			16.79	0.57	
	09:05:00	140.00			16.79	0.57	
	09:15:00	150.00			16.80	0.58	
	09:25:00	160.00			16.80	0.58	
	09:35:00	170.00			16.82	0.60	
	09:45:00	180.00			16.83	0.61	
	09:55:00	190.00			16.82	0.60	
	10:05:00	200.00			16.83	0.61	
	10:15:00	210.00			16.85	0.63	
	10:25:00	220.00			16.85	0.63	
	10:35:00	230.00			16.85	0.63	
	10:45:00	240.00			16.86	0.64	
	10:55:00	250.00			16.86	0.64	
	11:05:00	260.00			16.85	0.63	
	11:15:00	270.00			16.86	0.64	
	11:25:00	280.00			16.86	0.64	

TABLE C.11
(CONTINUED)
VOLK FIELD ANGB

WATER LEVEL DATA AND DRAWDOWN COMPUTATIONS
FOR WELL ET-2

Date	Time (CDT)	Δt (min)	Δt' (min)	Δt / Δt'	Depth To Water (feet)	Drawdown s (feet)	Remarks
5/5/88	11:35:00	290.00			16.90	0.68	
(continued)	11:45:00	300.00			16.90	0.68	
	11:55:00	310.00			16.86	0.64	
	12:05:00	320.00			16.90	0.68	
	12:15:00	330.00			16.90	0.68	
	12:25:00	340.00			16.90	0.68	
	12:35:00	350.00			16.90	0.68	
	12:45:00	360.00			16.91	0.69	
	12:55:00	370.00			16.90	0.68	
	13:05:00	380.00			16.91	0.69	
	13:15:00	390.00			16.93	0.71	
	13:25:00	400.00			16.91	0.69	
	13:35:00	410.00			16.91	0.69	
	13:45:00	420.00			16.93	0.71	
	13:55:00	430.00			16.94	0.72	
	14:05:00	440.00			16.93	0.71	
	14:15:00	450.00			16.93	0.71	
	14:25:00	460.00			16.94	0.72	
	14:35:00	470.00			16.93	0.71	
	14:45:00	480.00			16.94	0.72	
	14:55:00	490.00			16.91	0.69	
	15:05:00	500.00			16.91	0.69	
	15:15:00	510.00			16.93	0.71	
	15:25:00	520.00			16.93	0.71	
	15:35:00	530.00			16.93	0.71	
	15:45:00	540.00			16.94	0.72	
	15:55:00	550.00			16.93	0.71	
	16:05:00	560.00			16.94	0.72	
	16:15:00	570.00			16.94	0.72	
	16:25:00	580.00			16.94	0.72	
	16:35:00	590.00			16.94	0.72	
	16:45:00	600.00			16.94	0.72	
	16:55:00	610.00			16.94	0.72	
	17:05:00	620.00			16.94	0.72	
	17:15:00	630.00			16.94	0.72	
	17:25:00	640.00			16.94	0.72	
	17:35:00	650.00			16.94	0.72	
	17:45:00	660.00			16.94	0.72	
	17:55:00	670.00			16.96	0.74	
	18:05:00	680.00			16.96	0.74	

TABLE C.11
(CONTINUED)
VOLK FIELD ANGB

WATER LEVEL DATA AND DRAWDOWN COMPUTATIONS
FOR WELL ET-2

Date	Time (CDT)	Δt (min)	Δt' (min)	Δt / Δt'	Depth To Water (feet)	Drawdown s (feet)	Remarks
5/5/88	18:15:00	690.00			16.96	0.74	
(continued)	18:25:00	700.00			16.96	0.74	
	18:35:00	710.00			16.96	0.74	
	18:45:00	720.00			16.96	0.74	
	18:55:00	730.00			16.94	0.72	
	19:05:00	740.00			16.93	0.71	
	19:15:00	750.00			16.94	0.72	
	19:25:00	760.00			16.94	0.72	
	19:35:00	770.00			16.94	0.72	
	19:45:00	780.00			16.94	0.72	
	19:55:00	790.00			16.94	0.72	
	20:05:00	800.00			16.94	0.72	
	20:15:00	810.00			16.94	0.72	
	20:25:00	820.00			16.94	0.72	
	20:35:00	830.00			16.94	0.72	
	20:45:00	840.00			16.94	0.72	
	20:55:00	850.00			16.96	0.74	
	21:05:00	860.00			16.96	0.74	
	21:15:00	870.00			16.96	0.74	
	21:25:00	880.00			16.96	0.74	
	21:35:00	890.00			16.96	0.74	
	21:45:00	900.00			16.98	0.76	
	21:55:00	910.00			16.96	0.74	
	22:05:00	920.00			16.98	0.76	
	22:15:00	930.00			16.98	0.76	
	22:25:00	940.00			16.98	0.76	
	22:35:00	950.00			16.98	0.76	
	22:45:00	960.00			16.99	0.77	
	22:55:00	970.00			16.98	0.76	
	23:05:00	980.00			16.98	0.76	
	23:15:00	990.00			16.98	0.76	
	23:25:00	1000.00			16.99	0.77	
	23:35:00	1010.00			16.99	0.77	
	23:45:00	1020.00			16.98	0.76	
	23:55:00	1030.00			16.98	0.76	
5/06/88	00:05:00	1040.00			16.99	0.77	
	00:15:00	1050.00			16.98	0.76	
	00:25:00	1060.00			16.99	0.77	
	00:35:00	1070.00			16.99	0.77	
	00:45:00	1080.00			16.99	0.77	

TABLE C.11
(CONTINUED)
VOLK FIELD ANGB

WATER LEVEL DATA AND DRAWDOWN COMPUTATIONS
FOR WELL ET-2

Date	Time (CDT)	Δt (min)	Δt' (min)	Δt / Δt'	Depth To Water (feet)	Drawdowns (feet)	Remarks
5/06/88	00:55:00	1090.00			17.01	0.79	
(continued)	01:05:00	1100.00			16.99	0.77	
	01:15:00	1110.00			16.99	0.77	
	01:25:00	1120.00			16.99	0.77	
	01:35:00	1130.00			17.01	0.79	
	01:45:00	1140.00			17.01	0.79	
	01:55:00	1150.00			17.01	0.79	
	02:05:00	1160.00			17.01	0.79	
	02:15:00	1170.00			17.01	0.79	
	02:25:00	1180.00			17.02	0.80	
	02:35:00	1190.00			17.02	0.80	
	02:45:00	1200.00			17.04	0.82	
	02:55:00	1210.00			17.04	0.82	
	03:05:00	1220.00			17.04	0.82	
	03:15:00	1230.00			17.04	0.82	
	03:25:00	1240.00			17.04	0.82	
	03:35:00	1250.00			17.04	0.82	
	03:45:00	1260.00			17.05	0.83	
	03:55:00	1270.00			17.04	0.82	
	04:05:00	1280.00			17.04	0.82	
	04:15:00	1290.00			17.04	0.82	
	04:25:00	1300.00			17.04	0.82	
	04:35:00	1310.00			17.04	0.82	
	04:45:00	1320.00			17.04	0.82	
	04:55:00	1330.00			17.04	0.82	
	05:05:00	1340.00			17.04	0.82	
	05:15:00	1350.00			17.04	0.82	
	05:25:00	1360.00			17.04	0.82	
	05:35:00	1370.00			17.04	0.82	
	05:45:00	1380.00			17.04	0.82	
	05:55:00	1390.00			17.04	0.82	
	06:05:00	1400.00			17.05	0.83	
	06:15:00	1410.00			17.05	0.83	
	06:25:00	1420.00			17.05	0.83	
	06:35:00	1430.00			17.07	0.85	
	06:45:00	1440.00					Pump Off
	06:45:00	1440.00	0.0	436363.6	17.09	0.87	
	06:45:00	1440.00	0.0	218182.3	17.07	0.85	
	06:45:00	1440.01	0.0	145455.2	17.07	0.85	
	06:45:01	1440.01	0.0	108271.4	17.07	0.85	

TABLE C.11
(CONTINUED)
VOLK FIELD ANGB

WATER LEVEL DATA AND DRAWDOWN COMPUTATIONS
FOR WELL ET-2

Date	Time (CDT)	Δt (min)	Δt' (min)	Δt / Δt'	Depth To Water (feet)	Drawdown s (feet)	Remarks
5/06/88	06:45:01	1440.01	0.0	86747.8	17.07	0.85	
(continued)	06:45:01	1440.02	0.0	72000.8	17.09	0.87	
	06:45:01	1440.02	0.0	61803.4	17.09	0.87	
	06:45:01	1440.02	0.0	54136.2	17.07	0.85	
	06:45:02	1440.03	0.0	48000.9	17.07	0.85	
	06:45:02	1440.03	0.0	43244.1	17.09	0.87	
	06:45:03	1440.05	0.1	28800.9	17.07	0.85	
	06:45:04	1440.06	0.1	21622.6	17.07	0.85	
	06:45:05	1440.08	0.1	17287.9	17.07	0.85	
	06:45:06	1440.10	0.1	14401.0	17.07	0.85	
	06:45:07	1440.11	0.1	12350.9	17.07	0.85	
	06:45:08	1440.13	0.1	10803.7	17.07	0.85	
	06:45:09	1440.15	0.2	9601.0	17.07	0.85	
	06:45:10	1440.16	0.2	8644.4	17.07	0.85	
	06:45:11	1440.18	0.2	7857.0	17.07	0.85	
	06:45:12	1440.20	0.2	7201.0	17.07	0.85	
	06:45:13	1440.21	0.2	6649.2	17.05	0.83	
	06:45:14	1440.23	0.2	6173.3	17.07	0.85	
	06:45:15	1440.25	0.3	5761.0	17.05	0.83	
	06:45:16	1440.26	0.3	5402.3	17.05	0.83	
	06:45:17	1440.28	0.3	5083.9	17.05	0.83	
	06:45:18	1440.30	0.3	4801.0	17.05	0.83	
	06:45:19	1440.31	0.3	4549.3	17.05	0.83	
	06:45:20	1440.33	0.3	4321.4	17.05	0.83	
	06:45:25	1440.41	0.4	3456.7	17.04	0.82	
	06:45:30	1440.50	0.5	2881.0	17.04	0.82	
	06:45:35	1440.58	0.6	2469.7	17.02	0.80	
	06:45:40	1440.66	0.7	2160.9	17.02	0.80	
	06:45:45	1440.75	0.8	1921.0	17.01	0.79	
	06:45:50	1440.83	0.8	1729.1	17.01	0.79	
	06:45:55	1440.91	0.9	1571.8	16.99	0.77	
	06:46:00	1441.00	1.0	1441.0	16.98	0.76	
	06:46:05	1441.08	1.1	1330.3	16.98	0.76	
	06:46:10	1441.16	1.2	1235.2	16.98	0.76	
	06:46:15	1441.25	1.3	1153.0	16.98	0.76	
	06:46:20	1441.33	1.3	1081.0	16.96	0.74	
	06:46:25	1441.41	1.4	1017.5	16.96	0.74	
	06:46:30	1441.50	1.5	961.0	16.94	0.72	
	06:46:35	1441.58	1.6	910.5	16.94	0.72	
	06:46:40	1441.66	1.7	865.0	16.94	0.72	

TABLE C.11
(CONTINUED)
VOLK FIELD ANGB

WATER LEVEL DATA AND DRAWDOWN COMPUTATIONS
FOR WELL ET-2

Date	Time (CDT)	Δt (min)	Δt' (min)	Δt / Δt'	Depth To Water (feet)	Drawdown s (feet)	Remarks
5/06/88	06:46:45	1441.75	1.8	823.9	16.94	0.72	
(continued)	06:46:50	1441.83	1.8	786.5	16.93	0.71	
	06:46:55	1441.91	1.9	752.3	16.93	0.71	
	06:47:00	1442.00	2.0	721.0	16.93	0.71	
	06:47:30	1442.50	2.5	577.0	16.91	0.69	
	06:48:00	1443.00	3.0	481.0	16.90	0.68	
	06:48:30	1443.50	3.5	412.4	16.90	0.68	
	06:49:00	1444.00	4.0	361.0	16.88	0.66	
	06:49:30	1444.50	4.5	321.0	16.88	0.66	
	06:50:00	1445.00	5.0	289.0	16.88	0.66	
	06:50:30	1445.50	5.5	262.8	16.86	0.64	
	06:51:00	1446.00	6.0	241.0	16.86	0.64	
	06:51:30	1446.50	6.5	222.5	16.86	0.64	
	06:52:00	1447.00	7.0	206.7	16.86	0.64	
	06:52:30	1447.50	7.5	193.0	16.85	0.63	
	06:53:00	1448.00	8..	181.0	16.85	0.63	
	06:53:30	1448.50	8.5	170.4	16.85	0.63	
	06:54:00	1449.00	9.0	161.0	16.85	0.63	
	06:54:30	1449.50	9.5	152.6	16.83	0.61	
	06:55:00	1450.00	10.0	145.0	16.83	0.61	
	06:57:00	1452.00	12.0	121.0	16.83	0.61	
	06:59:00	1454.00	14.0	103.9	16.83	0.61	
	07:01:00	1456.00	16.0	91.0	16.82	0.60	
	07:03:00	1458.00	18.0	81.0	16.80	0.58	
	07:05:00	1460.00	20.0	73.0	16.80	0.58	
	07:07:00	1462.00	22.0	66.5	16.80	0.58	
	07:09:00	1464.00	24.0	61.0	16.79	0 57	
	07:11:00	1466.00	26.0	56.4	16.79	0.57	
	07:13:00	1468.00	28.0	52.4	16.79	0.57	
	07:15:00	1470.00	30.0	49.0	16.77	0.55	
	07:17:00	1472.00	32.0	46.0	16.77	0.55	
	07:19:00	1474.00	34.0	43.4	16.75	0.53	
	07:21:00	1476.00	36.0	41.0	16.75	0.53	
	07:23:00	1478.00	38.0	38.9	16.75	0.53	
	07:25:00	1480.00	40.0	37.0	16.75	0.53	
	07:27:00	1482.00	42.0	35.3	16.75	0.53	
	07:29:00	1484.00	44.0	33.7	16.75	0.53	
	07:31:00	1486.00	46.0	32.3	16.74	0.52	
	07:33:00	1488.00	48.0	31.0	16.74	0.52	
	07:35:00	1490.00	50.0	29.8	16.74	0.52	

TABLE C.11
(CONTINUED)
VOLK FIELD ANGB

WATER LEVEL DATA AND DRAWDOWN COMPUTATIONS
FOR WELL ET-2

Date	Time (CDT)	Δt (min)	Δt' (min)	Δt / Δt'	Depth To Water (feet)	Drawdown s (feet)	Remarks
5/06/88	07:37:00	1492.00	52.0	28.7	16.74	0.52	
(continued)	07:39:00	1494.00	54.0	27.7	16.74	0.52	
	07:41:00	1496.00	56.0	26.7	16.72	0.50	
	07:43:00	1498.00	58.0	25.8	16.72	0.50	
	07:45:00	1500.00	60.0	25.0	16.72	0.50	
	07:47:00	1502.00	62.0	24.2	16.72	0.50	
	07:49:00	1504.00	64.0	23.5	16.71	0.49	
	07:51:00	1506.00	66.0	22.8	16.71	0.49	
	07:53:00	1508.00	68.0	22.2	16.71	0.49	
	07:55:00	1510.00	70.0	21.6	16.71	0.49	
	07:57:00	1512.00	72.0	21.0	16.72	0.50	
	07:59:00	1514.00	74.0	20.5	16.71	0.49	
	08:01:00	1516.00	76.0	19.9	16.71	0.49	
	08:03:00	1518.00	78.0	19.5	16.71	0.49	
	08:05:00	1520.00	80.0	19.0	16.71	0.49	
	08:07:00	1522.00	82.0	18.6	16.71	0.49	
	08:09:00	1524.00	84.0	18.1	16.71	0.49	
	08:11:00	1526.00	86.0	17.7	16.69	0.47	
	08:13:00	1528.00	88.0	17.4	16.69	0.47	
	08:15:00	1530.00	90.0	17.0	16.69	0.47	
	08:17:00	1532.00	92.0	16.7	16.69	0.47	
	08:19:00	1534.00	94.0	16.3	16.69	0.47	
	08:21:00	1536.00	96.0	16.0	16.69	0.47	
	08:23:00	1538.00	98.0	15.7	16.69	0.47	
	08:25:00	1540.00	100.0	15.4	16.69	0.47	
	08:35:00	1550.00	110.0	14.1	16.67	0.45	
	08:45:00	1560.00	120.0	13.0	16.67	0.45	
	08:55:00	1570.00	130.0	12.1	16.66	0.44	
	09:05:00	1580.00	140.0	11.3	16.64	0.42	
	09:15:00	1590.00	150.0	10.6	16.63	0.41	
	09:25:00	1600.00	160.0	10.0	16.61	0.39	
	09:35:00	1610.00	170.0	9.5	16.63	0.41	
	09:45:00	1620.00	180.0	9.0	16.60	0.38	
	09:55:00	1630.00	190.0	8.6	16.60	0.38	
	10:05:00	1640.00	200.0	8.2	16.60	0.38	
	10:15:00	1650.00	210.0	7.9	16.60	0.38	
	10:25:00	1660.00	220.0	7.5	16.58	0.36	
	10:35:00	1670.00	230.0	7.3	16.56	0.34	
	10:45:00	1680.00	240.0	7.0	16.55	0.33	
	10:55:00	1690.00	250.0	6.8	16.56	0.34	

TABLE C.11
(CONTINUED)
VOLK FIELD ANGB

WATER LEVEL DATA AND DRAWDOWN COMPUTATIONS
FOR WELL ET-2

Date	Time (CDT)	Δt (min)	Δt' (min)	Δt / Δt'	Depth To Water (feet)	Drawdown s (feet)	Remarks
5/06/88	11:05:00	1700.00	260.0	6.5	16.55	0.33	
(continued)	11:15:00	1710.00	270.0	6.3	16.53	0.31	
	11:25:00	1720.00	280.0	6.1	16.55	0.33	
	11:35:00	1730.00	290.0	6.0	16.53	0.31	
	11:45:00	1740.00	300.0	5.8	16.53	0.31	
	11:55:00	1750.00	310.0	5.6	16.50	0.28	
	12:05:00	1760.00	320.0	5.5	16.52	0.30	
	12:15:00	1770.00	330.0	5.4	16.50	0.28	
	12:25:00	1780.00	340.0	5.2	16.50	0.28	
	12:35:00	1790.00	350.0	5.1	16.48	0.26	
	12:45:00	1800.00	360.0	5.0	16.50	0.28	
	12:55:00	1810.00	370.0	4.9	16.48	0.26	
	13:05:00	1820.00	380.0	4.8	16.50	0.28	
	13:15:00	1830.00	390.0	4.7	16.47	0.25	
	13:25:00	1840.00	400.0	4.6	16.48	0.26	
	13:35:00	1850.00	410.0	4.5	16.45	0.23	
	13:45:00	1860.00	420.0	4.4	16.48	0.26	
	13:55:00	1870.00	430.0	4.3	16.48	0.26	
	14:05:00	1880.00	440.0	4.3	16.45	0.23	
	14:15:00	1890.00	450.0	4.2	45	0.23	
	14:25:00	1900.00	460.0	4.1	16.45	0.23	
	14:35:00	1910.00	470.0	4.1	16.45	0.23	
	14:45:00	1920.00	480.0	4.0	16.41	0.19	
	16:46:00	2041.00	601.00	3.4	16.38	0.16	
	17:46:00	2101.00	661.00	3.2	16.40	0.18	
	18:47:00	2162.00	722.00	3.0	16.38	0.16	
	19:47:00	2222.00	782.00	2.8	16.38	0.16	
5/07/88	09:05:00	3020.00	1580.00	1.9	16.33	0.11	

TABLE C.12

VOLK FIELD ANGB

WATER LEVEL DATA AND DRAWDOWN COMPUTATIONS
FOR WELL ET-3

Date	Time (CDT)	Δt (min)	Δt' (min)	$\frac{\Delta t}{\Delta t'}$	Depth To Water (feet)	Drawdown s (feet)	Remarks
5/4/88	18:10:00				14.39		
5/5/88	06:17:00				14.51		Assumed Static Water Level
5/5/88	06:45:00	0.0					Pump On
	07:45:00	60.0			14.56	0.05	
	08:30:00	105.0			14.59	0.08	
	09:08:00	143.0			14.58	0.07	
	09:44:00	179.0			14.59	0.08	
	10:26:00	221.0			14.60	0.09	
	11:28:00	283.0			14.60	0.09	
	12:38:00	353.0			14.61	0.10	
	13:41:00	416.0			14.62	0.11	
	14:31:00	466.0			14.62	0.11	
	15:31:00	526.0			14.63	0.12	
	16:31:00	586.0			14.64	0.13	
	18:10:00	685.0			14.68	0.17	
	19:23:00	758.0			14.66	0.15	
	21:20:00	875.0			14.68	0.17	
5/6/88	00:00:00	1035.0			14.69	0.18	
	01:56:00	1151.0			14.69	0.18	
	04:26:00	1301.0			14.72	0.21	
	06:20:00	1415.0			14.73	0.22	
	06:45:00	1440.0	0.0				Pump Off
	06:49:00	1444.0	4.0	361.0	14.70	0.20	
	06:55:00	1450.0	10.0	145.0	14.71	0.19	
	07:04:00	1459.0	19.0	76.8	14.7	0.18	
	07:10:30	1465.5	25.5	57.5	14.69	0.18	
	07:23:30	1478.5	38.5	38.4	14.69	0.17	
	07:47:00	1502.0	62.0	24.2	14.68	0.17	
	08:09:00	1524.0	84.0	18.1	14.68	0.15	
	08:30:00	1545.0	105.0	14.7	14.66	0.15	
	09:19:30	1594.5	154.5	10.3	14.66	0.15	
	10:22:30	1657.5	217.5	7.6	14.55	0.04	
	12:09:00	1764.0	324.0	5.4	14.52	0.01	
	13:14:00	1829.0	389.0	4.7	14.51	0.00	
	15:02:00	1937.0	497.0	3.9	14.59	0.08	
	17:00:00	2055.0	615.0	3.3	14.61	0.10	
	19:03:00	2178.0	738.0	3.0	14.59	0.08	
5/7/88	09:21:00	3036.0	1596.0	1.9	14.58	0.07	

TABLE C.13

VOLK FIELD ANGB

WATER LEVEL DATA AND DRAWDOWN COMPUTATIONS
FOR WELL ET-4

Date	Time (CDT)	Δt (min)	Δt' (min)	Δt / Δt'	Depth To Water (feet)	Drawdown s (feet)	Remarks
5/3/88	12:49:00				14.28		
5/4/88	18:07:00				14.33		
5/5/88	06:14:00				14.33		Assumed Static Water Level
5/5/88	06:45:00	0.0					Pump On
	07:43:00	58.0			14.37	0.04	
	08:35:00	110.0			14.41	0.08	
	09:06:00	141.0			14.42	0.09	
	09:40:00	175.0			14.42	0.09	
	10:23:00	218.0			14.43	0.10	
	11:25:00	280.0			14.43	0.10	
	12:35:00	350.0			14.45	0.12	
	13:39:00	414.0			14.45	0.12	
	14:28:00	463.0			14.46	0.13	
	15:28:00	523.0			14.47	0.14	
	16:29:00	584.0			14.48	0.15	
	18:07:00	682.0			14.50	0.17	
	19:21:00	756.0			14.52	0.19	
	21:18:00	873.0			14.51	0.18	
	23:58:00	1033.0			14.52	0.19	
5/6/88	01:54:00	1149.0			14.54	0.21	
	04:25:00	1300.0			14.57	0.24	
	06:18:00	1413.0			14.57	0.24	
	06:45:00	1440.0	0.0				Pump Off
	06:48:00	1443.0	3.0	481.0	14.56	0.22	
	06:54:00	1449.0	9.0	161.0	14.55	0.22	
	07:03:30	1458.5	18.5	78.8	14.55	0.21	
	07:09:30	1464.5	24.5	59.8	14.54	0.20	
	07:24:30	1479.5	39.5	37.5	14.53	0.19	
	07:46:00	1501.0	61.0	24.6	14.52	0.19	
	08:07:00	1522.0	82.0	18.6	14.52	0.18	
	08:28:00	1543.0	103.0	15.0	14.51	0.18	
	09:18:00	1593.0	153.0	10.4	14.51	0.18	
	10:19:00	1654.0	214.0	7.7	14.49	0.16	
	12:08:00	1763.0	323.0	5.5	14.46	0.13	
	13:13:00	1828.0	388.0	4.7	14.44	0.11	
	14:58:00	1933.0	493.0	3.9	14.45	0.12	
	16:59:00	2054.0	614.0	3.3	14.44	0.11	
	19:00:00	2175.0	735.0	3.0	14.42	0.09	
5/7/88	09:19:00	3034.0	1594.0	1.9	14.39	0.06	

TABLE C.14

VOLK FIELD ANGB

WATER LEVEL DATA AND DRAWDOWN COMPUTATIONS
FOR WELL ET-5

Date	Time (CDT)	Δt (min)	Δt' (min)	$\frac{\Delta t}{\Delta t'}$	Depth To Water (feet)	Drawdown s (feet)	Remarks
5/3/88	12:07:00				15.66		
5/4/88	09:11:00				1[illegible].66		
5/5/88	06:25:00				15.71		Assumed Static Water Level
	06:45:00	0.0					Pump On
	07:21:00	36.0			15.77	0.06	
	07:34:00	49.0			15.79	0.08	
	08:05:00	80.0			15.80	0.09	
	08:27:00	102.0			15.81	0.10	
	09:03:00	138.0			15.83	0.12	
	09:44:00	179.0			15.82	0.11	
	10:26:00	221.0			15.83	0.12	
	11:27:00	282.0			15.86	0.15	
	12:37:00	352.0			15.85	0.14	
	13:43:00	418.0			15.89	0.18	
	14:32:00	467.0			15.90	0.19	
	15:40:00	535.0			15.92	0.21	
	16:07:00	562.0			15.90	0.19	
	16:45:00	600.0			15.92	0.21	
	18:05:00	680.0			15.94	0.23	
	19:18:00	753.0			15.94	0.23	
	20:16:00	811.0			15.97	0.26	
	23:57:00	1032.0			15.97	0.26	
5/6/88	01:52:00	1147.0			15.98	0.27	
	04:23:00	1298.0			16.02	0.31	
	06:15:00	1410.0			16.02	0.31	
	06:45:00	1440.0	0.0				PUMP OFF
	06:47:00	1442.0	2.0	721.0	16.02	0.31	
	06:52:30	1447.5	7.5	193.0	16.00	0.29	
	06:57:30	1452.5	12.5	116.2	16.01	0.30	
	06:59:30	1454.5	14.5	100.3	16.00	0.29	
	07:02:00	1457.0	17.0	85.7	16.00	0.29	
	07:08:00	1463.0	23.0	63.6	15.99	0.28	
	07:20:00	1475.0	35.0	42.1	15.96	0.25	
	07:26:00	1481.0	41.0	36.1	15.97	0.26	
	07:44:30	1499.5	59.5	25.2	15.96	0.25	
	08:03:00	1518.0	78.0	19.5	15.94	0.23	

TABLE C.14
(CONTINUED)
VOLK FIELD ANGB

WATER LEVEL DATA AND DRAWDOWN COMPUTATIONS
FOR WELL ET-5

Date	Time (CDT)	Δt (min)	Δt' (min)	Δt / Δt'	Depth To Water (feet)	Drawdown s (feet)	Remarks
5/16/88	08:27:00	1542.0	102.0	15.1	15.93	0.22	
(continued)	09:16:30	1591.5	151.5	10.5	15.91	0.20	
	10:15:00	1650.0	210.0	7.9	15.88	0.17	
	12:07:00	1762.0	322.0	5.5	15.83	0.12	
	13:11:30	1826.5	386.5	4.7	15.81	0.10	
	14:54:00	1929.0	489.0	3.9	15.80	0.09	
	16:58:00	2053.0	613.0	3.3	15.79	0.08	
	18:58:00	2173.0	733.0	3.0	15.82	0.11	
5/7/88	09:16:00	3031.0	1591.0	1.9	15.77	0.06	

TABLE C.15

VOLK FIELD ANGB

WATER LEVEL DATA AND DRAWDOWN COMPUTATIONS
FOR WELL ET-6

Date	Time (CDT)	Δt (min)	Δt' (min)	Δt / Δt'	Depth To Water (feet)	Drawdown s (feet)	Remarks
5/3/88	13:20:00				12.11		
5/4/88	18:04:00				12.11		
5/5/88	06:11:00				12.14		Assumed Static Water Level
	06:45:00	0.0					Pump On
	07:52:00	67.0			12.17	0.03	
	08:14:00	89.0			12.16	0.02	
	09:12:00	147.0			12.16	0.02	
	09:50:00	185.0			12.18	0.04	
	10:32:00	227.0			12.18	0.04	
	11:33:00	288.0			12.19	0.05	
	12:44:00	359.0			12.19	0.05	
	13:46:00	421.0			12.19	0.05	
	14:36:00	471.0			12.20	0.06	
	15:36:00	531.0			12.20	0.06	
	16:36:00	591.0			12.21	0.07	
	18:13:00	688.0			12.22	0.08	
	19:28:00	763.0			12.22	0.08	
	21:25:00	880.0			12.21	0.07	
5/6/88	00:05:00	1040.0			12.23	0.09	
	01:59:00	1154.0			12.24	0.10	
	04:30:00	1305.0			12.25	0.11	
	06:24:00	1419.0			12.26	0.12	
	06:45:00	1440.0	0.0				PUMP OFF
	07:15:00	1470.0	30.0	49.0	12.25	0.10	
	07:28:30	1483.5	43.5	34.1	12.24	0.09	
	07:50:30	1505.5	65.5	23.0	12.23	0.09	
	08:34:00	1549.0	109.0	14.2	12.23	0.09	
	09:22:00	1597.0	157.0	10.2	12.21	0.07	
	10:25:00	1660.0	220.0	7.5	12.20	0.06	
	12:11:00	1766.0	326.0	5.4	12.20	0.06	
	13:16:30	1831.5	391.5	4.7	12.19	0.05	
	15:02:00	1937.0	497.0	3.9	12.19	0.05	
	17:05:00	2060.0	620.0	3.3	12.22	0.08	
	19:05:00	2180.0	740.0	2.9	12.21	0.07	
5/7/88	09:25:00	3040.0	1600.0	1.9	12.19	0.05	

TABLE C.16

VOLK FIELD ANGB

WATER LEVEL DATA AND DRAWDOWN COMPUTATIONS
FOR WELL ET-7

Date	Time (CDT)	Δt (min)	Δt' (min)	Δt / Δt'	Depth To Water (feet)	Drawdown s (feet)	Remarks
5/3/88	13:23:00				13.05		
5/4/88	18:03:00				13.07		
5/5/88	06:10:00				13.09		Assumed Static Water Level
	06:45:00	0.0					Pump On
	07:55:00	70.0			13.12	0.03	
	08:12:00	87.0			13.14	0.05	
	09:14:00	149.0			13.14	0.05	
	09:52:00	187.0			13.13	0.04	
	10:33:00	228.0			13.12	0.03	
	11:35:00	290.0			13.12	0.03	
	12:49:00	364.0			13.11	0.02	
	13:47:00	422.0			13.11	0.02	
	14:38:00	473.0			13.12	0.02	
	15:37:00	532.0			13.11	0.03	
	16:38:00	593.0			13.12	0.02	
	18:14:00	689.0			13.15	0.03	
	19:29:00	764.0			13.18	0.06	
	21:26:00	881.0			13.14	0.09	
5/6/88	00:06:00	1041.0			13.13	0.05	
	02:00:00	1155.0			13.15	0.04	
	04:33:00	1308.0			13.17	0.08	
	06:25:00	1420.0			13.18	0.09	
	06:45:00	1440.0	0.0				PUMP OFF
	07:16:00	1471.0	31.0	47.5	13.17	0.08	
	07:52:00	1507.0	67.0	22.5	13.17	0.07	
	08:35:00	1550.0	110.0	14.1	13.17	0.07	
	09:23:00	1598.0	158.0	10.1	13.16	0.06	
	10:26:00	1661.0	221.0	7.5	13.15	0.06	
	12:12:00	1767.0	327.0	5.4	13.15	0.05	
	13:17:30	1832.5	392.5	4.7	13.14	0.02	
	15:09:00	1944.0	504.0	3.9	13.11	0.03	
	17:07:00	2062.0	622.0	3.3	13.12	0.03	
	19:07:00	2182.0	742.0	2.9	13.15	0.06	
5/7/88	09:25:00	3040.0	1600.0	1.9	13.11	0.02	

TABLE C.17

VOLK FIELD ANGB

WATER LEVEL DATA AND DRAWDOWN COMPUTATIONS
FOR WELL WW-1

Date	Time (CDT)	Δt (min)	Δt' (min)	Δt / Δt'	Depth To Water (feet)	Drawdown s (feet)	Remarks
5/3/88	12:37:00				14.18		
5/4/88	18:12:00				14.22		
5/5/88	06:18:00				14.22		Assumed Static Water Level
	06:45:00	0.0					Pump On
	07:47:00	62.0			14.29	0.07	
	08:17:00	92.0			14.30	0.08	
	09:09:00	144.0			14.30	0.08	
	09:45:00	180.0			14.29	0.07	
	10:28:00	223.0			14.30	0.08	
	11:29:00	284.0			14.29	0.07	
	12:39:00	354.0			14.31	0.09	
	13:42:00	417.0			14.31	0.09	
	14:32:00	467.0			14.32	0.10	
	15:32:00	527.0			14.32	0.10	
	16:32:00	587.0			14.33	0.11	
	18:11:00	686.0			14.35	0.13	
	19:25:00	760.0			14.35	0.13	
	20:21:00	816.0			14.36	0.14	
5/6/88	00:01:00	1036.0			14.38	0.16	
	01:57:00	1152.0			14.37	0.15	
	04:28:00	1303.0			14.41	0.19	
	06:22:00	1417.0			14.42	0.20	
	06:45:00	1440.0	0.0				PUMP OFF
	06:50:00	1445.0	5.0	289.0	14.41	0.19	
	06:55:30	1450.5	10.5	138.1	14.40	0.18	
	07:05:00	1460.0	20.0	73.0	14.40	0.18	
	07:23:00	1478.0	38.0	38.9	14.39	0.17	
	07:47:30	1502.5	62.5	24.0	14.38	0.16	
	07:56:00	1511.0	71.0	21.3	14.38	0.15	
	08:31:00	1546.0	106.0	14.6	14.37	0.14	
	09:20:00	1595.0	155.0	10.3	14.36	0.13	
	10:23:00	1658.0	218.0	7.6	14.35	0.11	
	12:09:00	1764.0	324.0	5.4	14.33	0.11	
	13:14:30	1829.5	389.5	4.7	14.32	0.10	
	15:03:00	1938.0	498.0	3.9	14.32	0.10	
	17:01:00	2056.0	616.0	3.3	14.31	0.09	
5/7/88	09:01:00	3016.0	1576.0	1.9	14.30	0.08	

TABLE C.18

VOLK FIELD ANGB

WATER LEVEL DATA AND DRAWDOWN COMPUTATIONS
FOR WELL WW-2

Date	Time (CDT)	Δt (min)	Δt' (min)	Δt / Δt'	Depth To Water (feet)	Drawdown s (feet)	Remarks
5/3/88	12:12:00				16.21		
5/4/88	18:17:00				16.27		
5/5/88	06:22:00				16.27		Assumed Static Water Level
	06:45:00	0.0					Pump On
	07:20:00	35.0			16.34	0.07	
	07:23:00	38.0			16.35	0.08	
	08:08:00	83.0			16.35	0.08	
	08:24:00	99.0			16.36	0.09	
	09:05:00	140.0			16.37	0.10	
	09:45:00	180.0			16.39	0.12	
	10:24:00	219.0			16.40	0.13	
	11:23:00	278.0			16.41	0.14	
	12:35:00	350.0			16.42	0.15	
	13:40:00	415.0			16.44	0.17	
	14:29:00	464.0			16.45	0.18	
	15:30:00	525.0			16.47	0.20	
	16:05:00	560.0			16.46	0.19	
	16:43:00	598.0			16.47	0.20	
	18:03:00	678.0			16.50	0.23	
	19:16:00	751.0			16.49	0.22	
	21:13:00	868.0			16.53	0.26	
	23:55:00	1030.0			16.53	0.26	
5/6/88	01:49:00	1144.0			16.53	0.26	
	04:21:00	1296.0			16.57	0.30	
	06:12:00	1407.0			16.58	0.31	
	06:45:00	1440.0	0.0				Pump Off
	06:45:30	1440.5	0.5	2881.0	16.55	0.28	
	06:51:00	1446.0	6.0	241.0	16.54	0.27	
	06:56:30	1451.5	11.5	126.2	16.55	0.28	
	07:00:30	1455.5	15.5	93.9	16.55	0.28	
	07:07:00	1462.0	22.0	66.5	16.54	0.27	
	07:12:00	1467.0	27.0	54.3	16.53	0.26	
	07:21:30	1476.5	36.5	40.5	16.52	0.25	
	07:27:00	1482.0	42.0	35.3	16.52	0.25	
	07:49:00	1504.0	64.0	23.5	16.50	0.23	
	08:06:00	1521.0	81.0	18.8	16.49	0.22	

TABLE C.18
(CONTINUED)
VOLK FIELD ANGB

WATER LEVEL DATA AND DRAWDOWN COMPUTATIONS
FOR WELL MW-2

Date	Time (CDT)	Δt (min)	Δt' (min)	Δt / Δt'	Depth To Water (feet)	Drawdowns (feet)	Remarks
5/7/88	08:24:00	1539.0	99.0	15.5	16.48	0.21	
	09:15:30	1590.5	150.5	10.6	16.47	0.20	
	10:10:00	1645.0	205.0	8.0	16.47	0.20	
	12:05:00	1760.0	320.0	5.5	16.40	0.13	
	13:10:00	1825.0	385.0	4.7	16.38	0.11	
	14:50:00	1925.0	485.0	4.0	16.39	0.12	
	16:55:00	2050.0	610.0	3.4	16.38	0.11	
	18:56:00	2171.0	731.0	3.0	16.35	0.08	
	09:13:00	3028.0	1588.0	1.9	16.32	0.05	

TABLE C.19

VOLK FIELD ANGB

WATER LEVEL DATA AND DRAWDOWN COMPUTATIONS
FOR WELL WW-3

Date	Time (CDT)	Δt (min)	Δt' (min)	Δt / Δt'	Depth To Water (feet)	Drawdown s (feet)	Remarks
5/3/88	12:59:00				14.51		
5/4/88	18:25:00				14.57		
5/5/88	06:30:00				14.57		Assumed Static Water Level
	06:45:00	0.0					Pump On
	07:18:00	33.0			14.66	0.15	
	07:36:00	51.0			14.68	0.17	
	08:04:00	79.0			14.69	0.18	
	08:28:00	103.0			14.70	0.19	
	09:04:00	139.0			14.71	0.20	
	09:48:00	183.0			14.73	0.22	
	10:28:00	223.0			14.74	0.23	
	11:30:00	285.0			14.76	0.25	
	12:38:00	353.0			14.79	0.28	
	13:44:00	419.0			14.81	0.30	
	14:33:00	468.0			14.82	0.31	
	15:34:00	529.0			14.84	0.33	
	16:08:00	563.0			14.83	0.32	
	16:46:00	601.0			14.84	0.33	
	18:06:00	681.0			14.87	0.36	
	19:20:00	755.0			14.87	0.36	
	21:17:00	872.0			14.90	0.39	
	23:57:00	1032.0			14.90	0.39	
5/6/88	01:53:00	1148.0			14.91	0.40	
	04:23:00	1298.0			14.94	0.43	
	06:16:00	1411.0			14.95	0.44	
	06:45:00	1440.0	0.0				Pump Off
	06:48:00	1443.0	3.0	481.0	14.91	0.40	
	06:53:00	1448.0	8.0	181.0	14.90	0.39	
	06:58:30	1453.5	13.5	107.7	14.90	0.39	
	07:03:00	1458.0	18.0	81.0	14.90	0.39	
	07:09:00	1464.0	24.0	61.0	14.89	0.38	
	07:13:30	1468.5	28.5	51.5	14.88	0.37	
	07:19:30	1474.5	34.5	42.7	14.87	0.36	
	07:25:00	1480.0	40.0	37.0	14.87	0.36	
	07:45:30	1500.5	60.5	24.8	14.84	0.33	
	08:05:00	1520.0	80.0	19.0	14.82	0.31	

TABLE C.19
(CONTINUED)
VOLK FIELD ANGB

WATER LEVEL DATA AND DRAWDOWN COMPUTATIONS
FOR WELL WW-3

Date	Time (CDT)	Δt (min)	Δt' (min)	Δt / Δt'	Depth To Water (feet)	Drawdown s (feet)	Remarks
5/6/88	08:28:00	1543.0	103.0	15.0	14.82	0.31	
(continued)	09:17:30	1592.5	152.5	10.4	14.80	0.29	
	10:17:00	1652.0	212.0	7.8	14.77	0.26	
	12:07:30	1762.5	322.5	5.5	14.70	0.19	
	13:12:00	1827.0	387.0	4.7	14.70	0.19	
	14:56:00	1931.0	491.0	3.9	14.68	0.17	
	16:59:00	2054.0	614.0	3.3	14.68	0.17	
	18:59:00	2174.0	734.0	3.0	14.66	0.15	
5/7/88	09:18:00	3033.0	1593.0	1.9	14.62	0.11	

TABLE C.20

VOLK FIELD ANGB

WATER LEVEL DATA AND DRAWDOWN COMPUTATIONS
FOR WELL WW-4

Date	Time (CDT)	Δt (min)	Δt' (min)	Δt / Δt'	Depth To Water (feet)	Drawdown s (feet)	Remarks
5/3/88	12:43:00				14.20		
5/4/88	18:08:00				14.26		
5/5/88	06:15:00				14.26		Assumed Static Water Level
	06:45:00	0.0					Pump On
	07:42:00	57.0			14.32	0.06	
	08:32:00	107.0			14.36	0.10	
	09:08:00	143.0			14.36	0.10	
	09:42:00	177.0			14.36	0.10	
	10:25:00	220.0			14.36	0.10	
	11:26:00	281.0			14.37	0.11	
	12:37:00	352.0			14.38	0.12	
	13:40:00	415.0			14.39	0.13	
	14:30:00	465.0			14.39	0.13	
	15:29:00	524.0			14.40	0.14	
	16:30:00	585.0			14.41	0.15	
	18:08:00	683.0			14.43	0.17	
	19:22:00	757.0			14.43	0.17	
	21:19:00	874.0			14.47	0.21	
	23:59:00	1034.0			14.45	0.19	
5/6/88	01:55:00	1150.0			14.47	0.21	
	04:25:00	1300.0			14.50	0.24	
	06:19:00	1414.0			14.50	0.24	
	06:45:00	1440.0	0.0				Pump Off
	06:49:00	1444.0	4.0	361.0	14.48	0.22	
	06:54:30	1449.5	9.5	152.6	14.47	0.21	
	07:04:00	1459.0	19.0	76.8	14.47	0.21	
	07:10:00	1465.0	25.0	58.6	14.47	0.21	
	07:24:00	1479.0	39.0	37.9	14.46	0.20	
	07:46:30	1501.5	61.5	24.4	14.45	0.19	
	08:08:00	1523.0	83.0	18.3	14.43	0.17	
	08:29:00	1544.0	104.0	14.8	14.42	0.16	
	09:19:00	1594.0	154.0	10.4	14.41	0.15	
	10:20:30	1655.5	215.5	7.7	14.40	0.14	
	12:08:30	1763.5	323.5	5.5	14.37	0.11	
	13:13:30	1828.5	388.5	4.7	14.36	0.10	
	14:59:00	1934.0	494.0	3.9	14.34	0.08	
	17:00:00	2055.0	615.0	3.3	14.36	0.10	
	19:06:00	2181.0	741.0	2.9	14.35	0.09	
5/7/88	09:20:00	3035.0	1595.0	1.9	14.32	0.06	

TABLE C.21

VOLK FIELD ANGB

WATER LEVEL DATA AND DRAWDOWN COMPUTATIONS
FOR WELL WW-5

Date	Time (CDT)	Δt (min)	Δt' (min)	Δt / Δt'	Depth To Water (feet)	Drawdown s (feet)	Remarks
5/3/88	12:27:00				15.20		
5/4/88	18:13:00				15.21		
5/5/88	06:20:00				15.23		Assumed Static Water Level
	06:45:00	0.0					Pump On
	07:49:00	64.0			15.31	0.08	
	08:19:00	94.0			15.30	0.07	
	09:10:00	145.0			15.32	0.09	
	09:46:00	181.0			15.31	0.08	
	10:29:00	224.0			15.31	0.08	
	11:30:00	285.0			15.31	0.08	
	12:40:00	355.0			15.32	0.09	
	13:43:00	418.0			15.32	0.09	
	14:33:00	468.0			15.33	0.10	
	15:33:00	528.0			15.32	0.09	
	16:34:00	589.0			15.35	0.12	
	19:24:00	759.0			15.37	0.14	
	21:22:00	877.0			15.40	0.17	
5/6/88	00:03:00	1038.0			15.38	0.15	
	01:58:00	1153.0			15.39	0.16	
	04:28:00	1303.0			15.41	0.18	
	06:23:00	1418.0			15.42	0.19	
	06:45:00	1440.0	0.0				Pump Off
	06:50:30	1445.5	5.5	262.8	15.41	0.18	
	06:56:00	1451.0	11.0	131.9	15.41	0.18	
	07:06:00	1461.0	21.0	69.6	15.40	0.17	
	07:11:30	1466.5	26.5	55.3	15.39	0.16	
	07:22:00	1477.0	37.0	39.9	15.39	0.16	
	07:48:00	1503.0	63.0	23.9	15.37	0.14	
	07:57:00	1512.0	72.0	21.0	15.40	0.17	
	08:32:00	1547.0	107.0	14.5	15.40	0.17	
	09:20:30	1595.5	155.5	10.3	15.37	0.14	
	10:23:30	1658.5	218.5	7.6	15.35	0.12	
	12:10:00	1765.0	325.0	5.4	15.32	0.09	
	13:15:00	1830.0	390.0	4.7	15.33	0.10	
	15:04:30	1939.5	499.5	3.9	15.32	0.09	
	17:00:00	2055.0	615.0	3.3	15.32	0.09	
	19:03:00	2178.0	738.0	3.0	15.32	0.09	
5/7/88	09:22:00	3037.0	1597.0	1.9	15.28	0.05	

TABLE C.22

VOLK FIELD ANGB

WATER LEVEL DATA AND DRAWDOWN COMPUTATIONS
FOR WELL WW-6

Date	Time (CDT)	Δt (min)	Δt' (min)	Δt / Δt'	Depth To Water (feet)	Drawdown s (feet)	Remarks
5/3/88	12:01:00				16.10		
5/4/88	18:22:00				16.13		
5/5/88	06:24:00				16.14		Assumed Static Water Level
	06:45:00	0.0					Pump On
	07:19:00	34.0			16.24	0.10	
	07:30:00	45.0			16.25	0.11	
	08:07:00	82.0			16.26	0.12	
	08:26:00	101.0			16.27	0.13	
	09:01:00	136.0			16.29	0.15	
	09:42:00	177.0			16.30	0.16	
	10:25:00	220.0			16.31	0.17	
	11:25:00	280.0			16.34	0.20	
	12:36:00	351.0			16.36	0.22	
	13:42:00	417.0			16.38	0.24	
	14:31:00	466.0			16.40	0.26	
	15:31:00	526.0			16.41	0.27	
	16:07:00	562.0			16.40	0.26	
	16:45:00	600.0			16.41	0.27	
	18:04:00	679.0			16.44	0.30	
	19:17:00	752.0			16.44	0.30	
	21:15:00	870.0			16.47	0.33	
	23:56:00	1031.0			16.47	0.33	
5/6/88	01:51:00	1146.0			16.50	0.36	
	04:22:00	1297.0			16.51	0.37	
	06:14:00	1409.0			16.52	0.38	
	06:45:00	1440.0	0.0				PUMP OFF
	06:47:00	1442.0	2.0	721.0	16.51	0.37	
	06:52:00	1447.0	7.0	206.7	16.49	0.35	
	06:57:00	1452.0	12.0	121.0	16.48	0.34	
	06:59:00	1454.0	14.0	103.9	16.47	0.33	
	07:01:30	1456.5	16.5	88.3	16.46	0.32	
	07:07:30	1462.5	22.5	65.0	16.46	0.32	
	07:13:00	1468.0	28.0	52.4	16.46	0.32	
	07:21:00	1476.0	36.0	41.0	16.45	0.31	
	07:26:30	1481.5	41.5	35.7	16.44	0.30	
	07:44:00	1499.0	59.0	25.4	16.42	0.28	

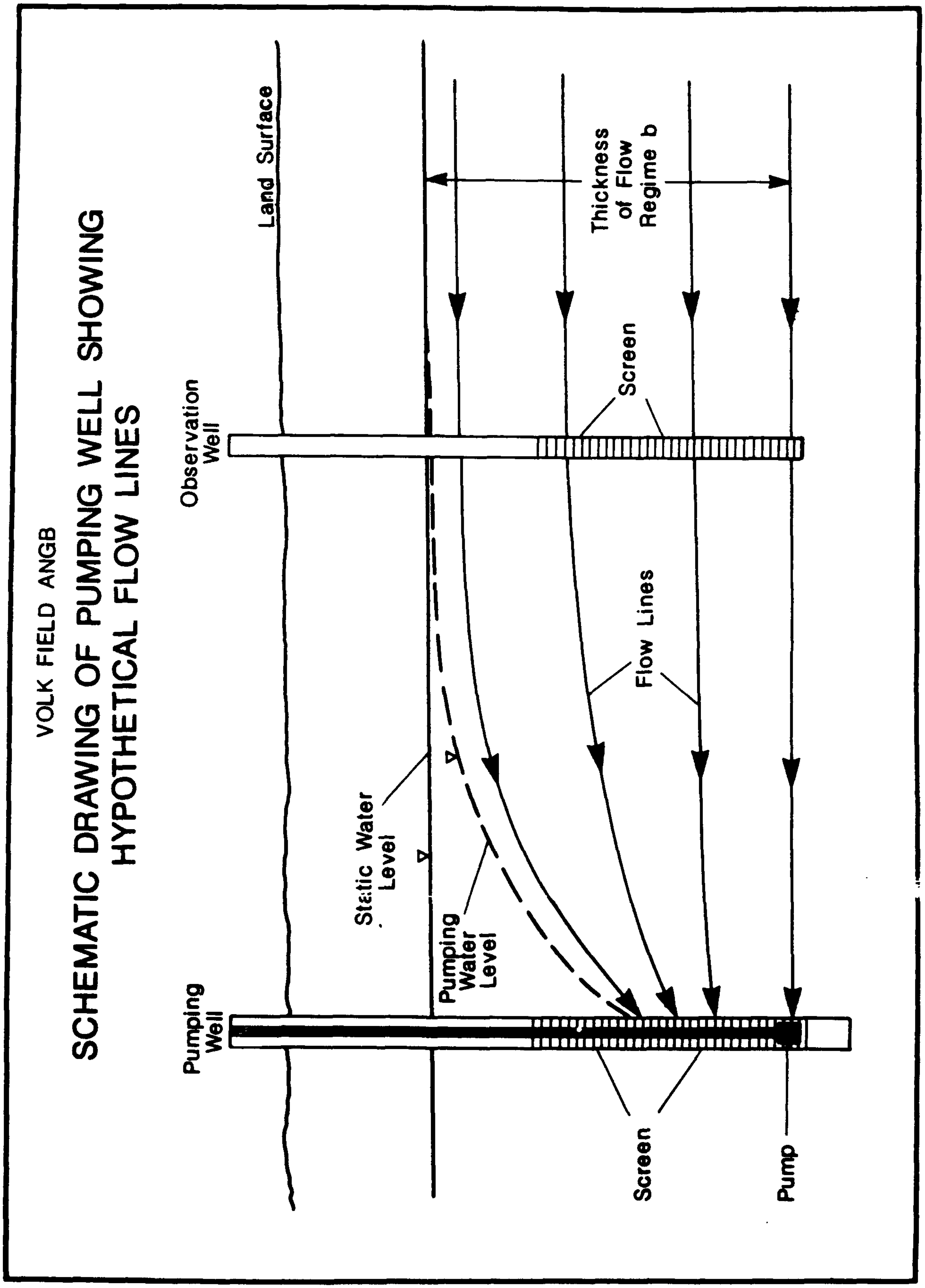
TABLE C.22
(CONTINUED)
VOLK FIELD ANGB

WATER LEVEL DATA AND DRAWDOWN COMPUTATIONS
FOR WELL WW-6

Date	Time (CDT)	Δt (min)	Δt' (min)	Δt / Δt'	Depth To Water (feet)	Drawdown s (feet)	Remarks
5/6/88	08:04:00	1519.0	79.0	19.2	16.40	0.26	
(continued)	08:20:00	1535.0	95.0	16.2	16.40	0.26	
	09:16:00	1591.0	151.0	10.5	16.37	0.23	
	10:12:30	1647.5	207.5	7.9	16.35	0.21	
	12:06:00	1761.0	321.0	5.5	16.30	0.16	
	13:11:00	1826.0	386.0	4.7	16.27	0.13	
	14:50:00	1925.0	485.0	4.0	16.32	0.18	
	16:56:00	2051.0	611.0	3.4	16.27	0.13	
	18:58:00	2173.0	733.0	3.0	16.29	0.15	
5/7/88	09:15:00	3030.0	1590.00	1.9	16.19	0.05	

FIGURES C.1 THROUGH C.42

FIGURE C.1

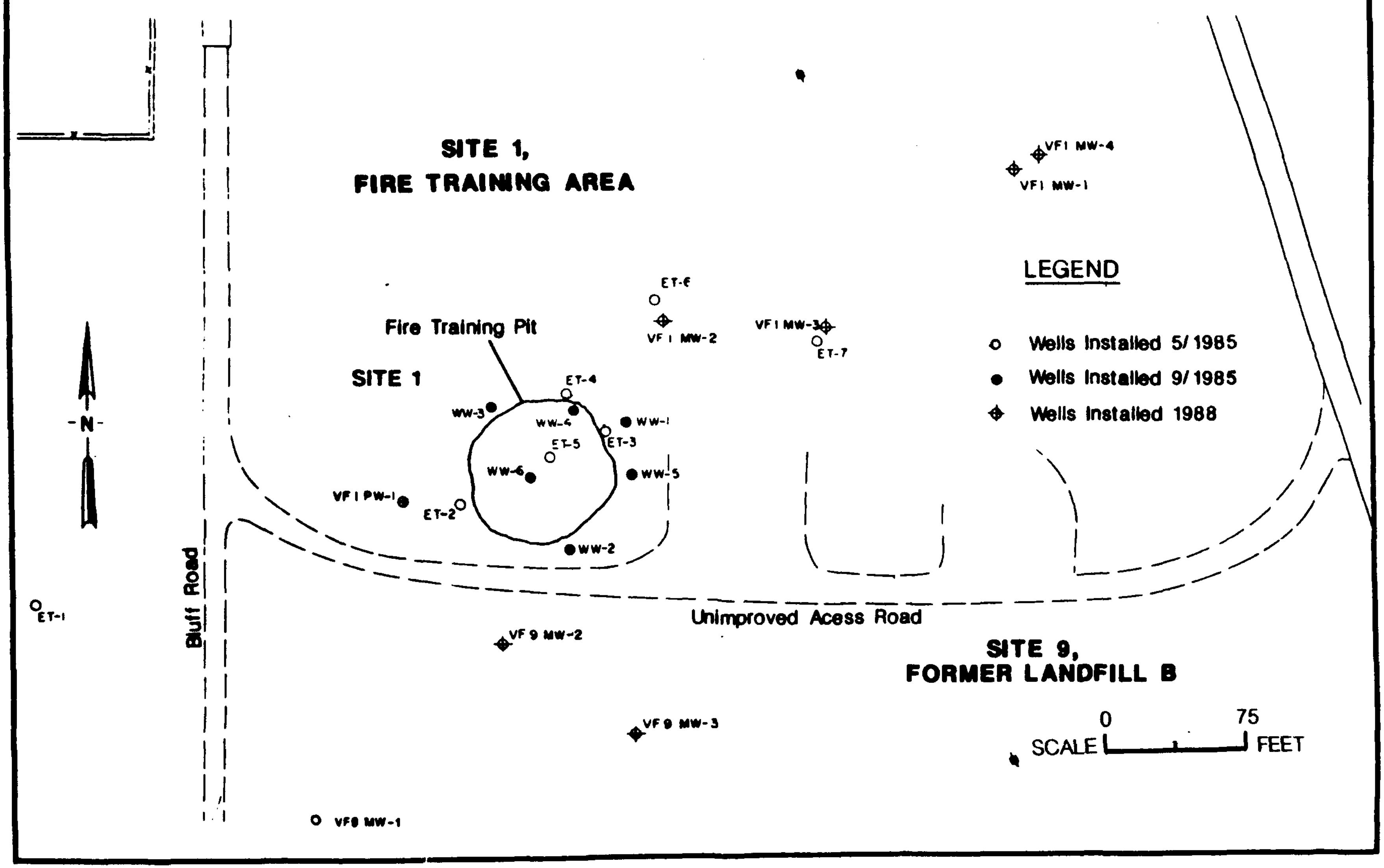


VOLK FIELD ANGB
SCHEMATIC DRAWING OF PUMPING WELL SHOWING
HYPOTHETICAL FLOW LINES
Land Surface
Pumping Well
Observation Well
Static Water Level
Pumping Water Level
Screen
Screen
Flow Lines
Thickness of Flow Regime b
Pump

FIGURE C.2

VOLK FIELD ANGB

LOCATION OF WELLS AT SITE 1 AND SITE 9



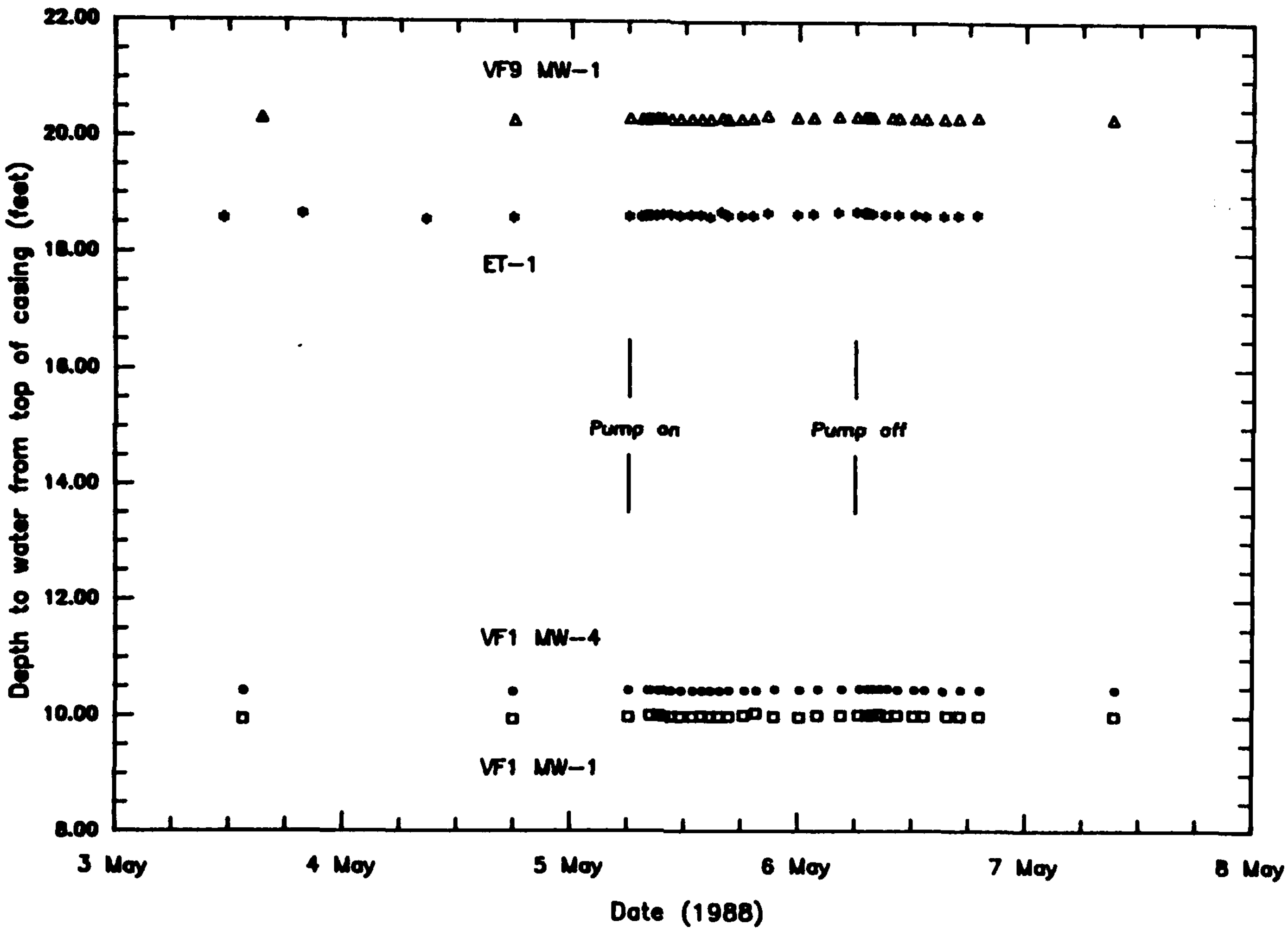


FIGURE 2B Water Levels in Unaffected Wells Before, During, and After Pumping Test

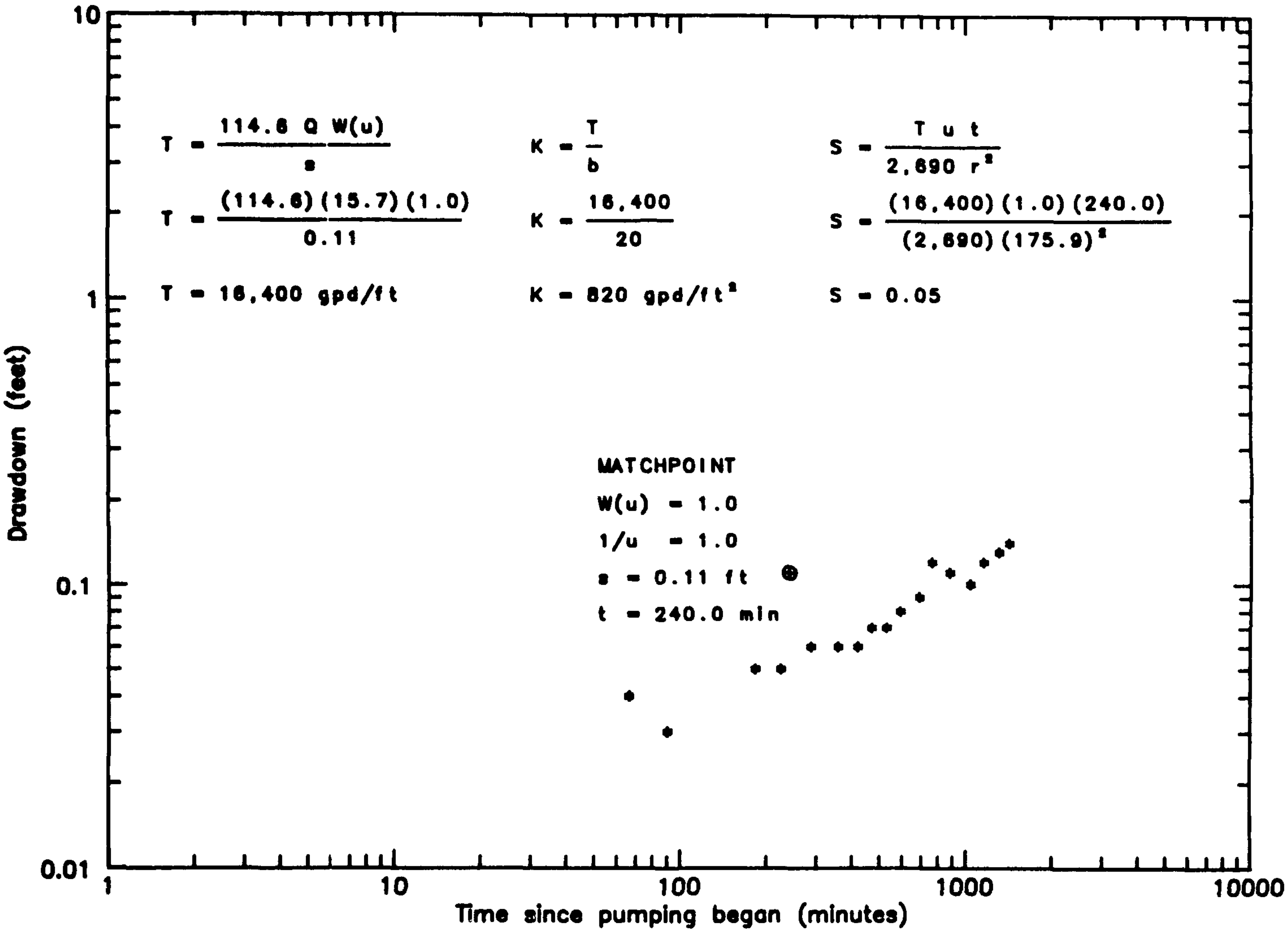


FIGURE C.3 Boulton Nonequilibrium Analysis Using Data from Well VF1 MW-2

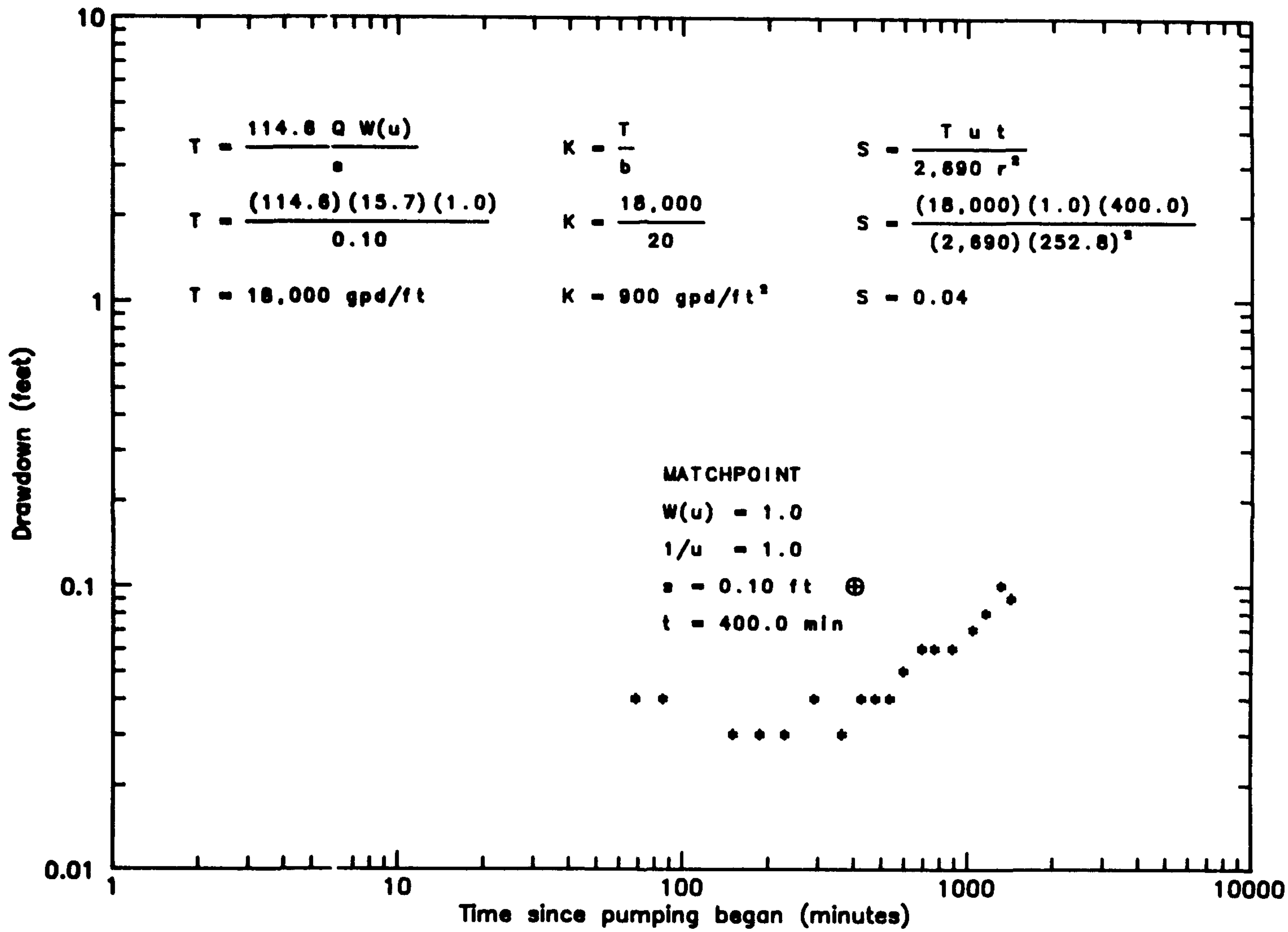


FIGURE C.4 Boulton Nonequilibrium Analysis Using Data from Well VF1 MW-3

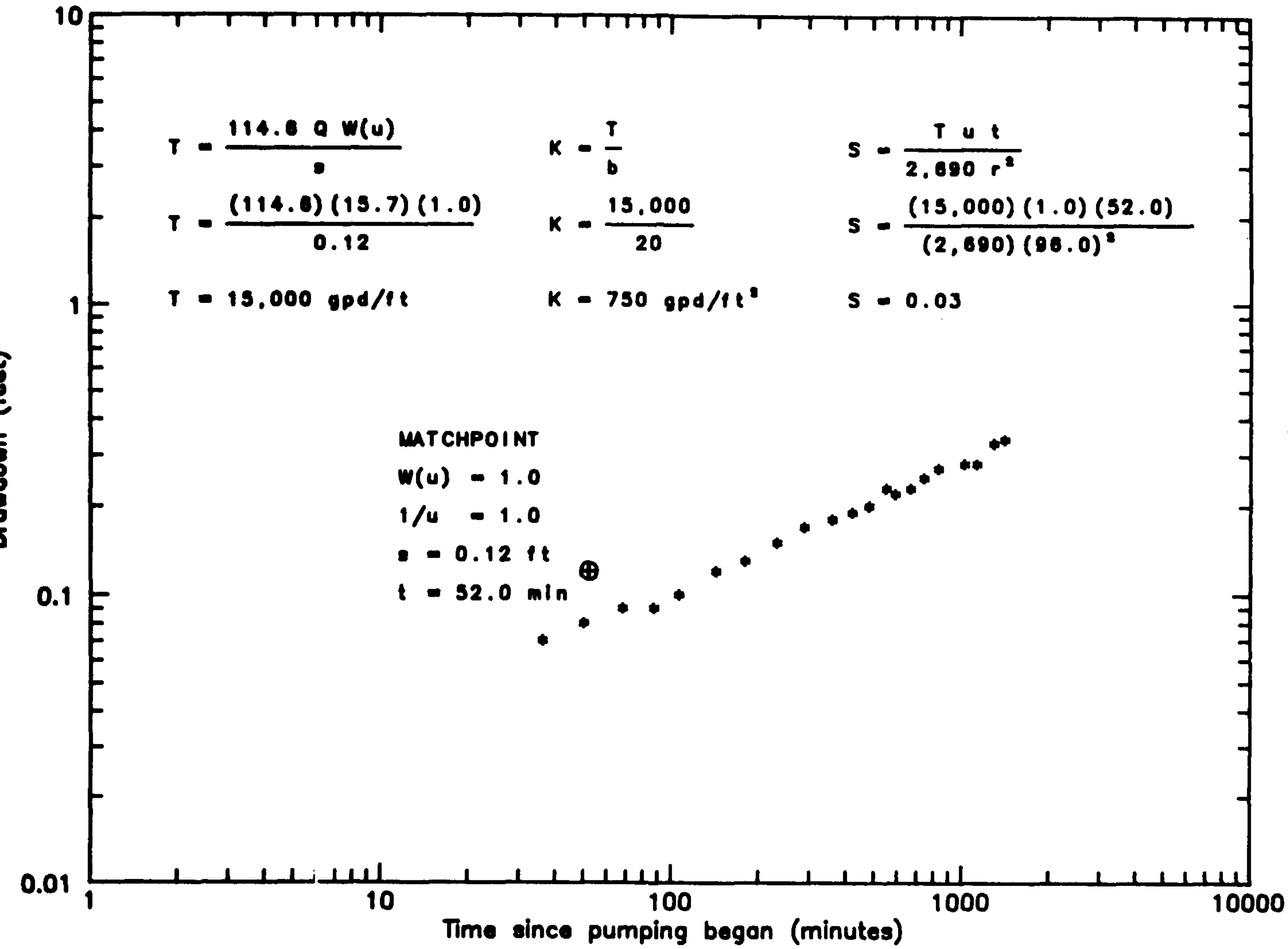


FIGURE C.5 Boulton Nonequilibrium Analysis Using Data from Well VF9 MW-2

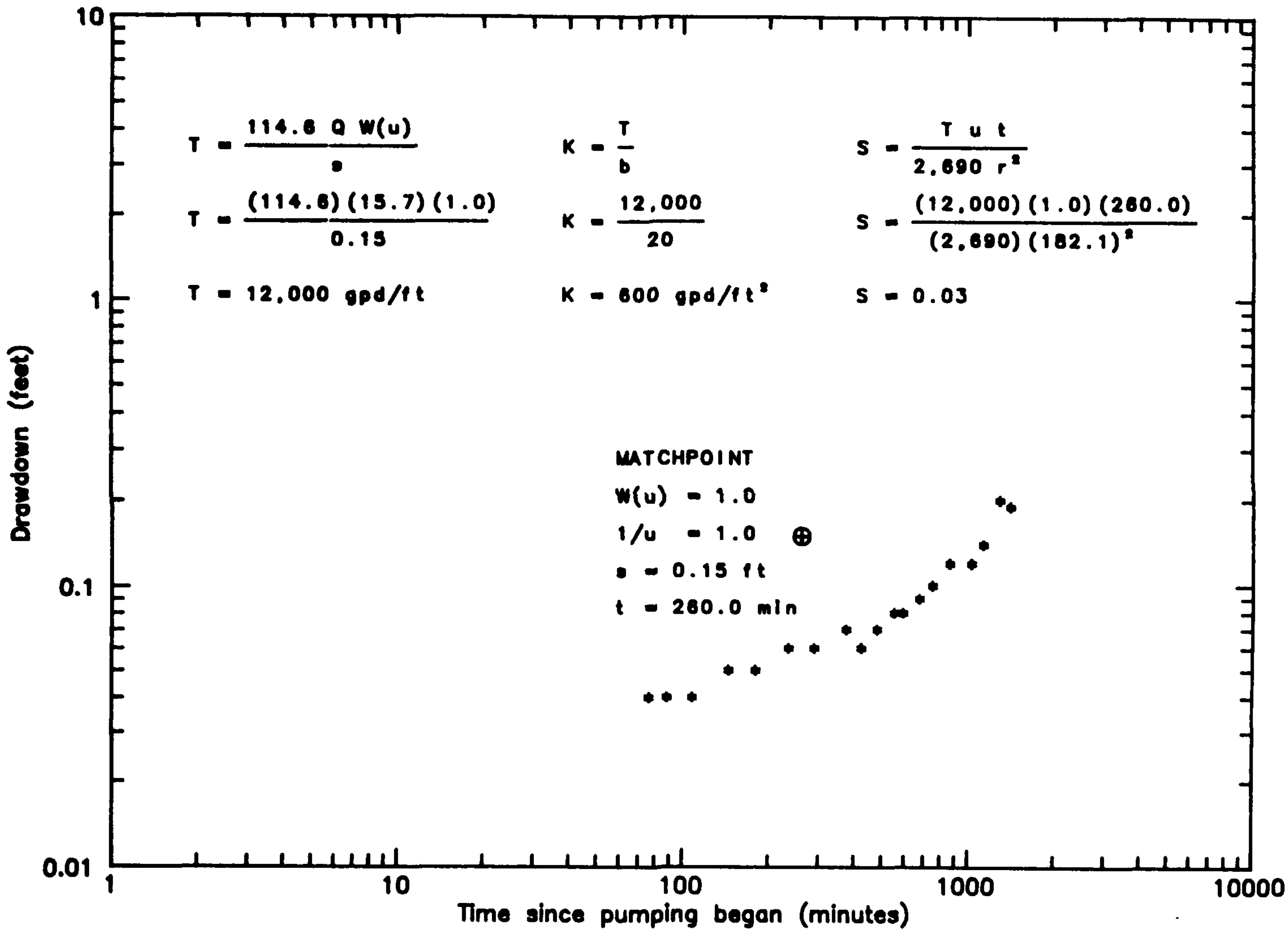


FIGURE C.6 Boulton Nonequilibrium Analysis Using Data from Well VF9 MW–3

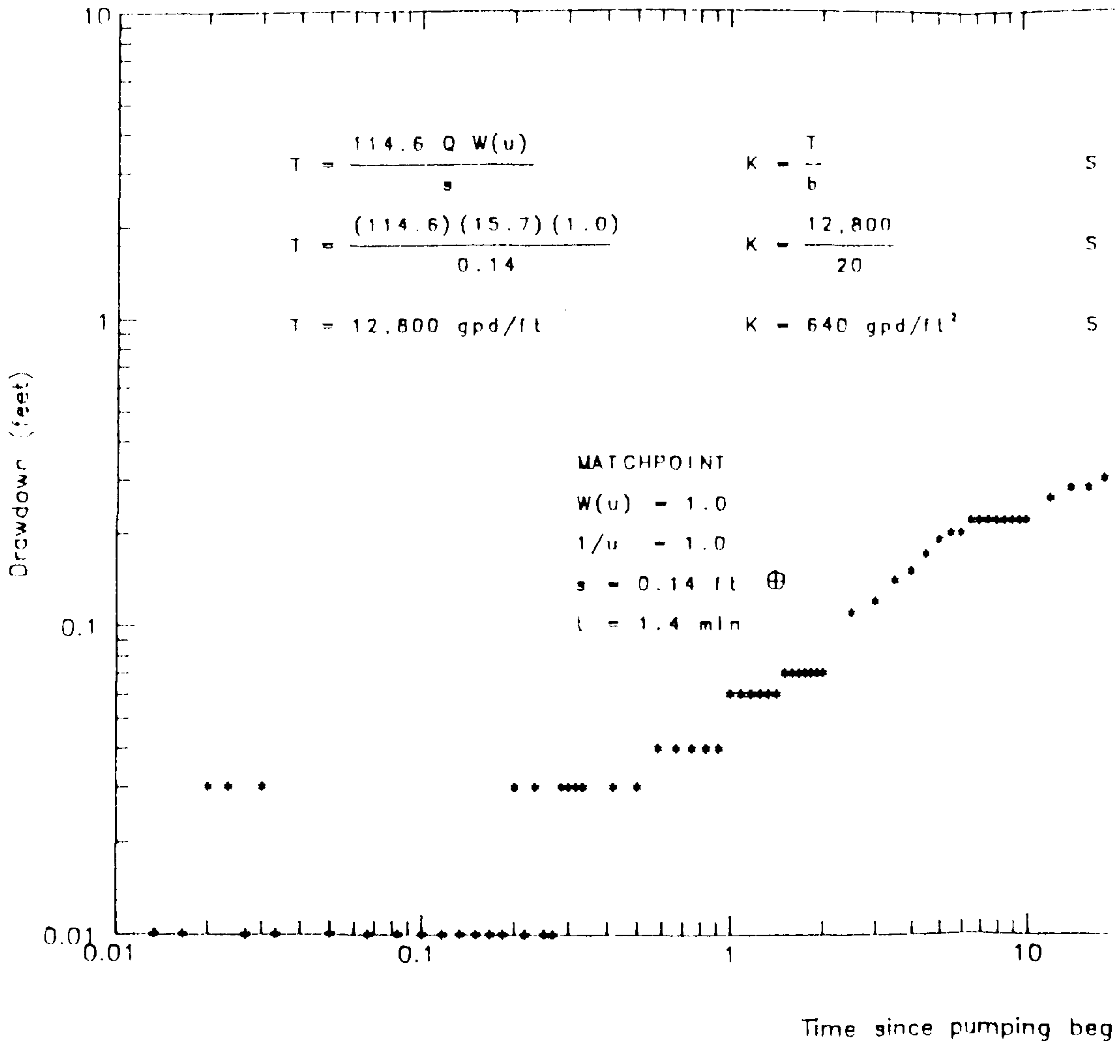
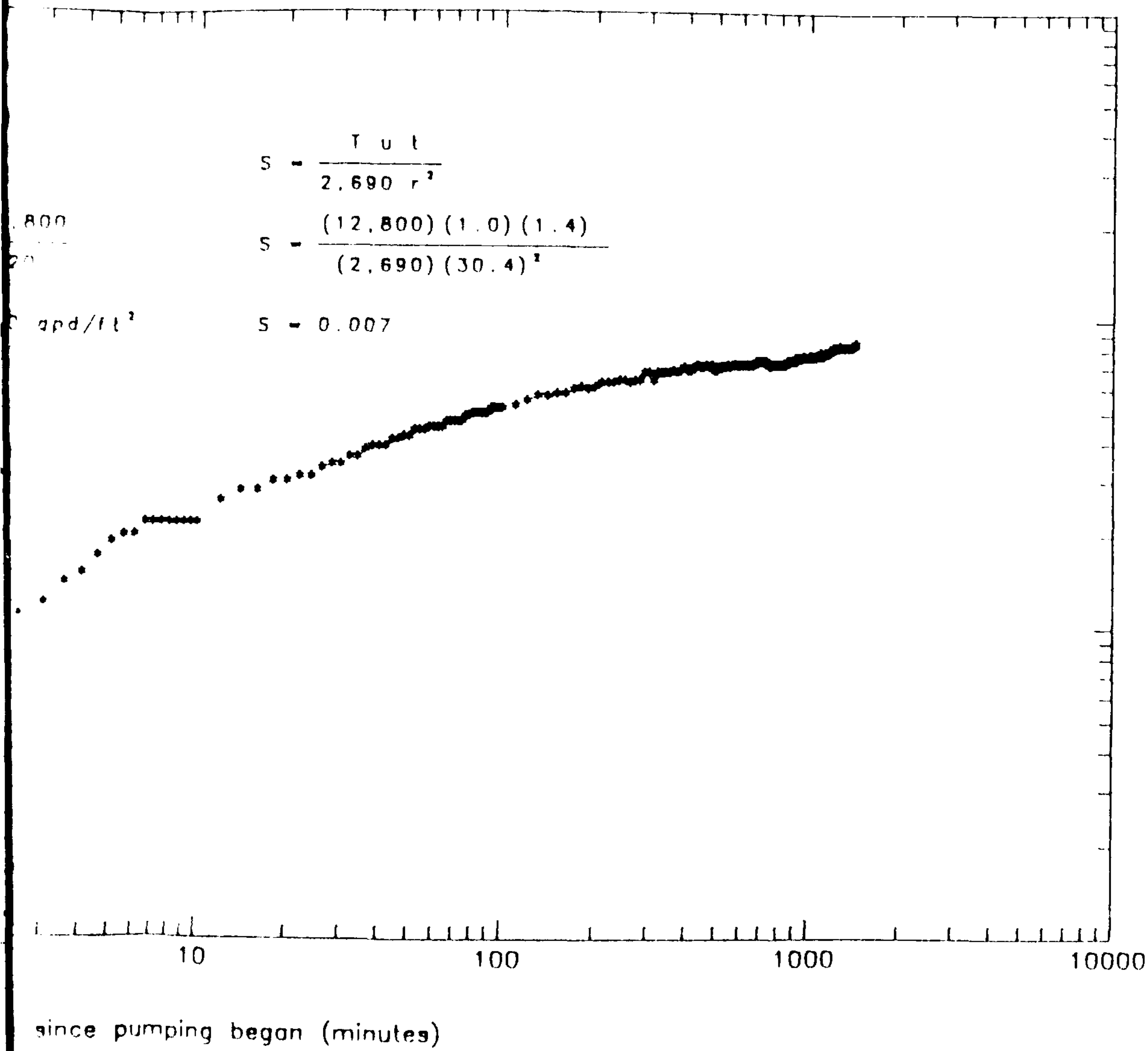


FIGURE C.7 Boulton Nonequilibrium Analy



…ilibrium Analysis Using Data from Well ET-2

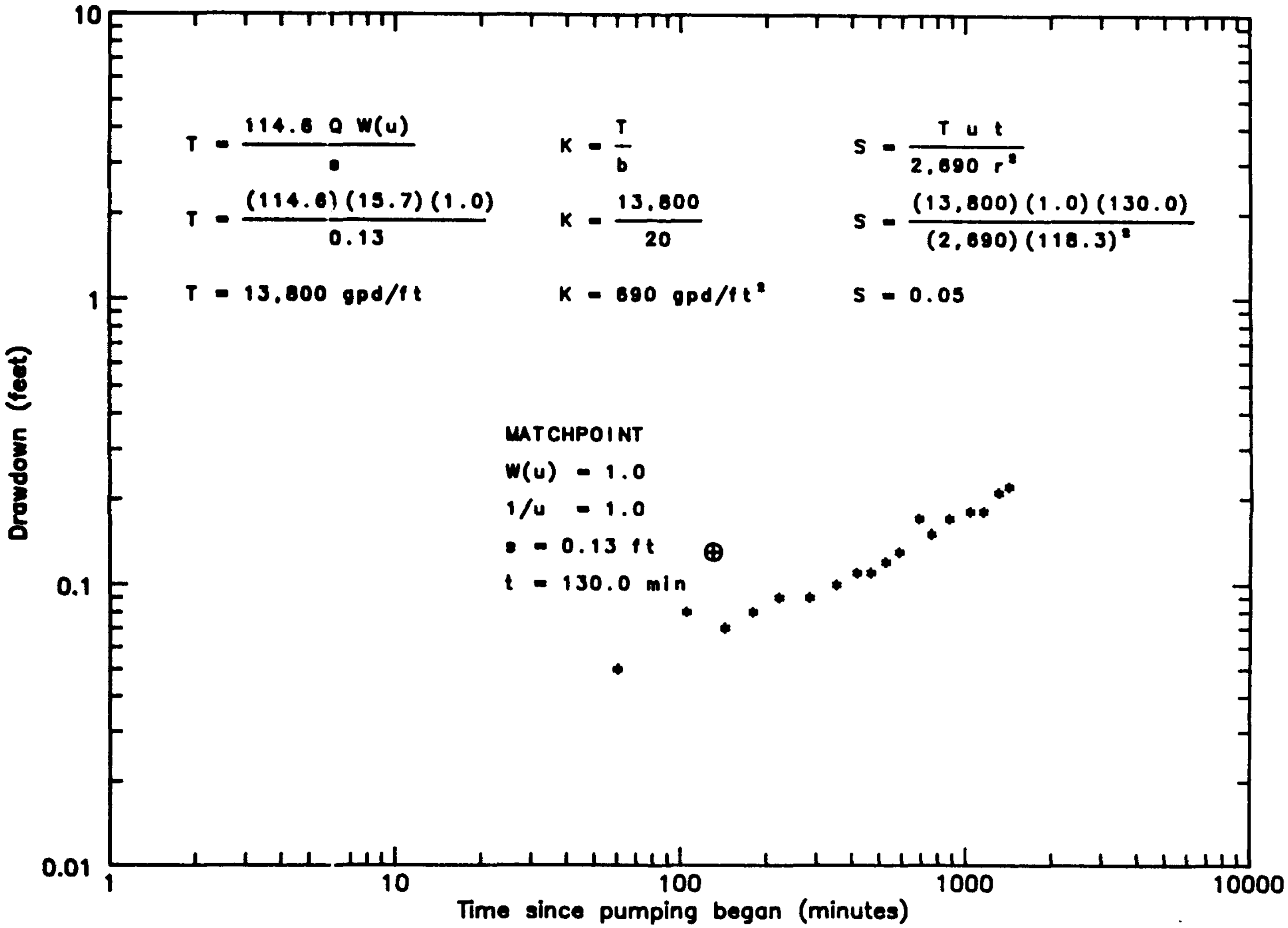


FIGURE C.8 Boulton Nonequilibrium Analysis Using Data from Well ET-3

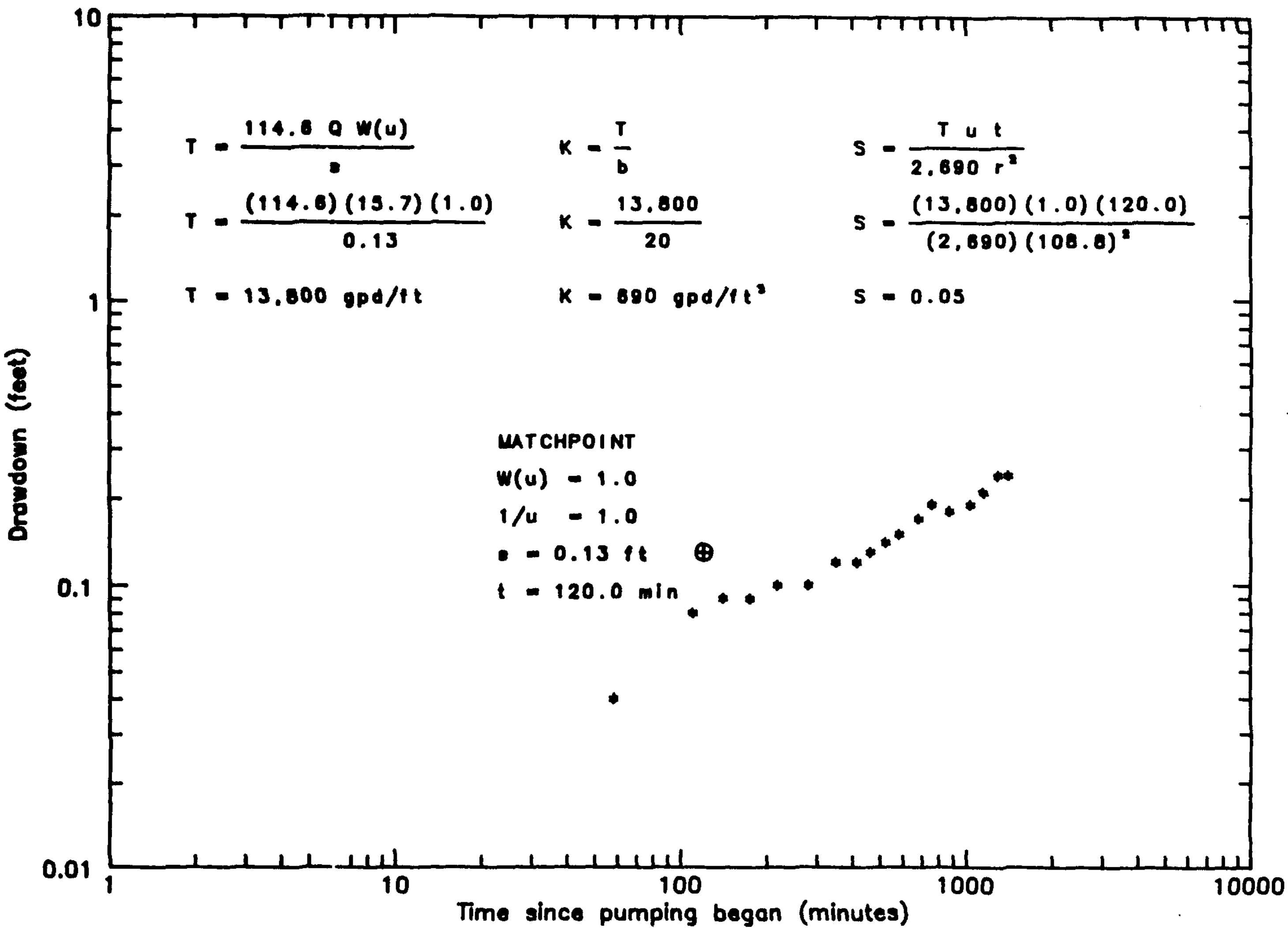


FIGURE C.9 Boulton Nonequilibrium Analysis Using Data from Well ET-4

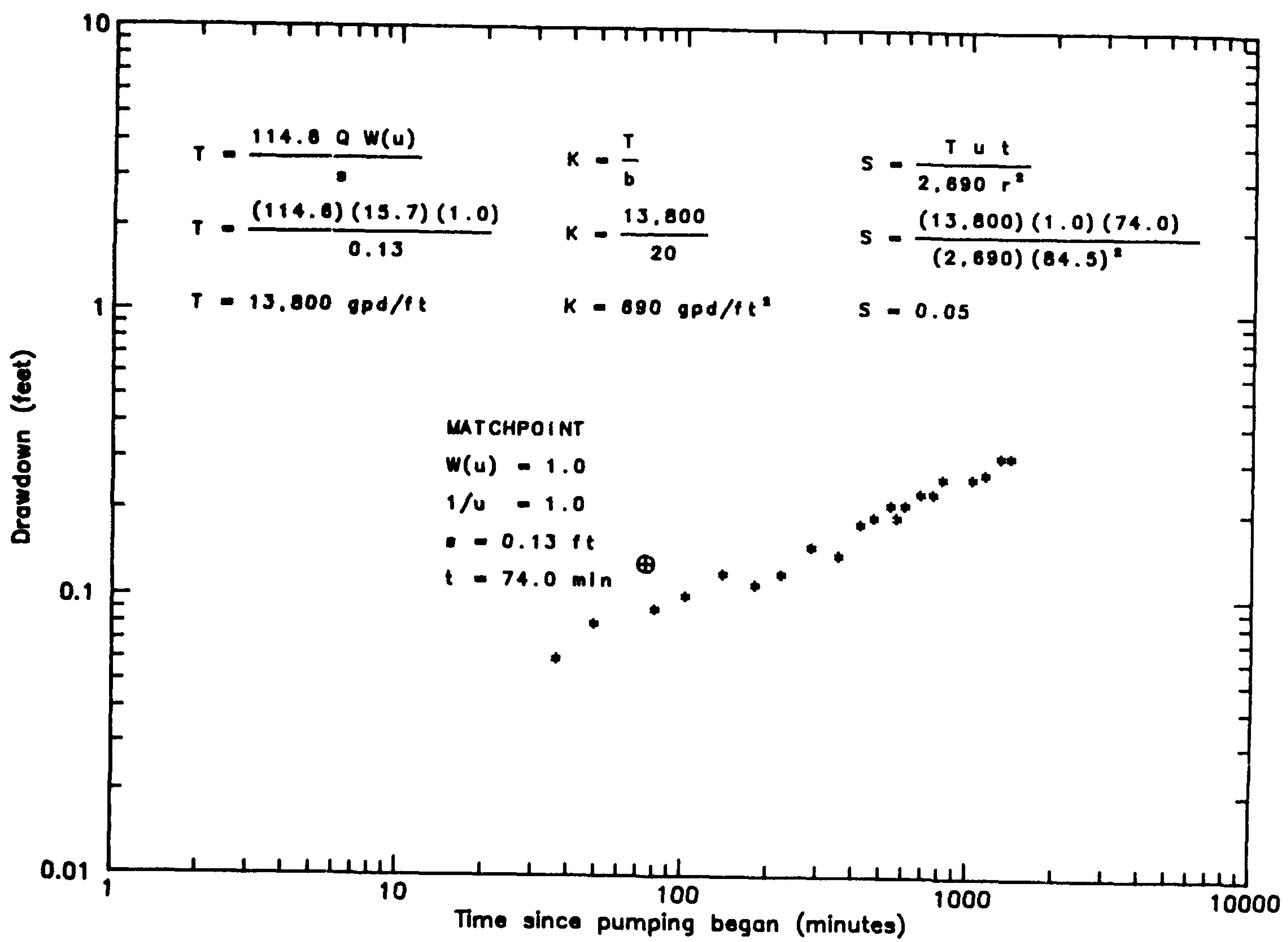


FIGURE C.10 Boulton Nonequilibrium Analysis Using Data from Well ET-5

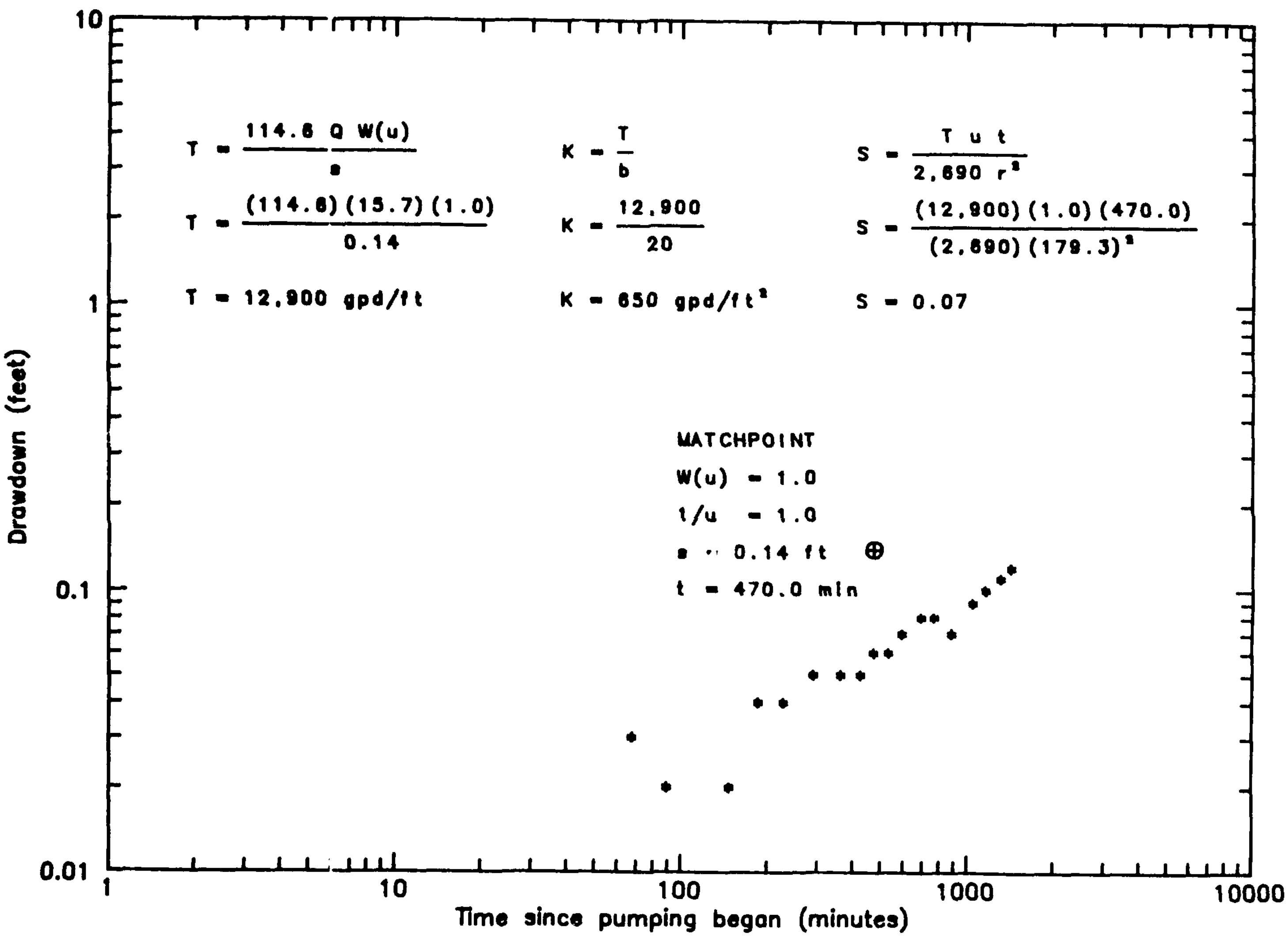


FIGURE C.11 Boulton Nonequilibrium Analysis Using Data from Well ET–6

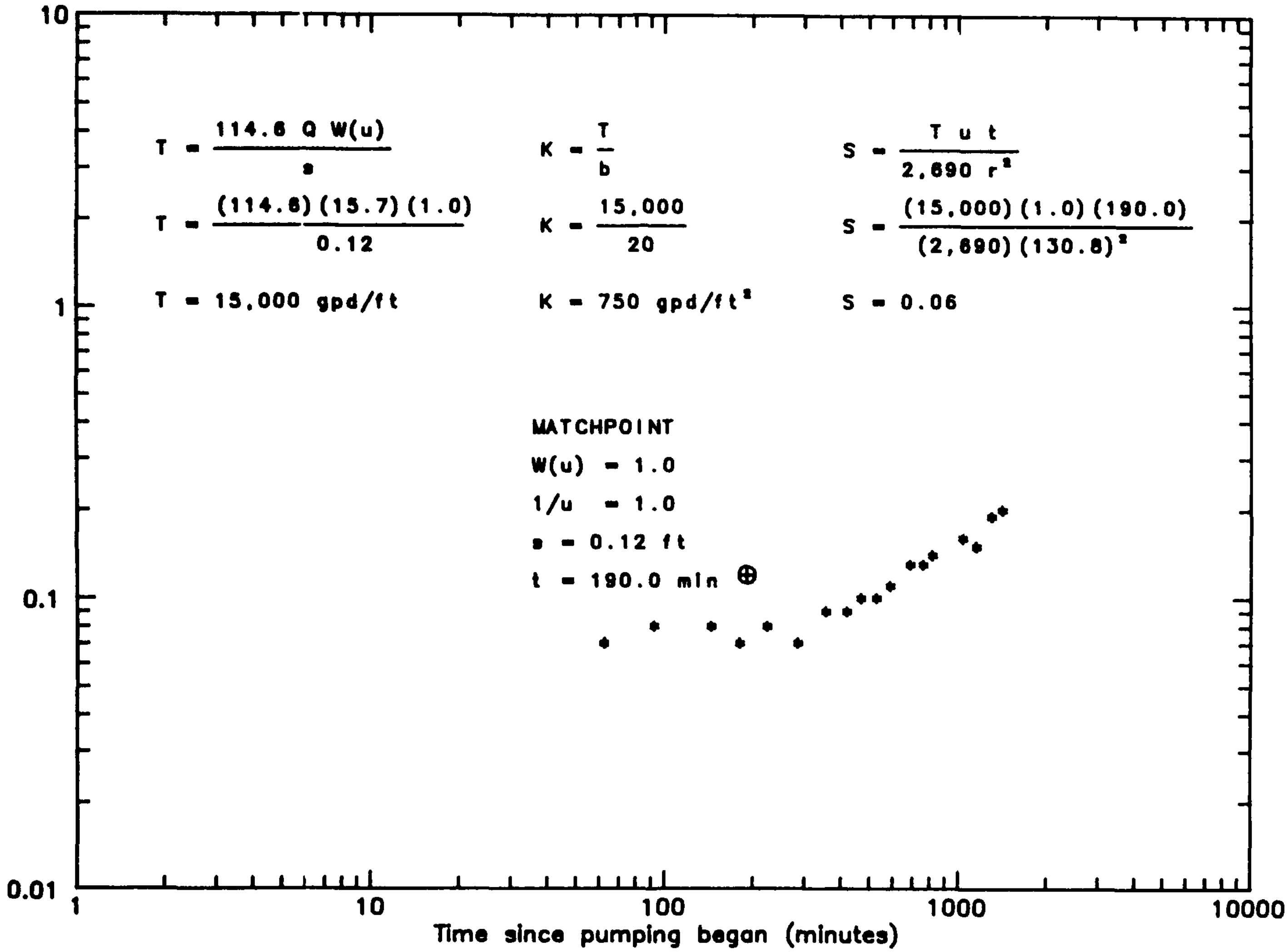


FIGURE C.12 Boulton Nonequilibrium Analysis Using Data from Well WW-1

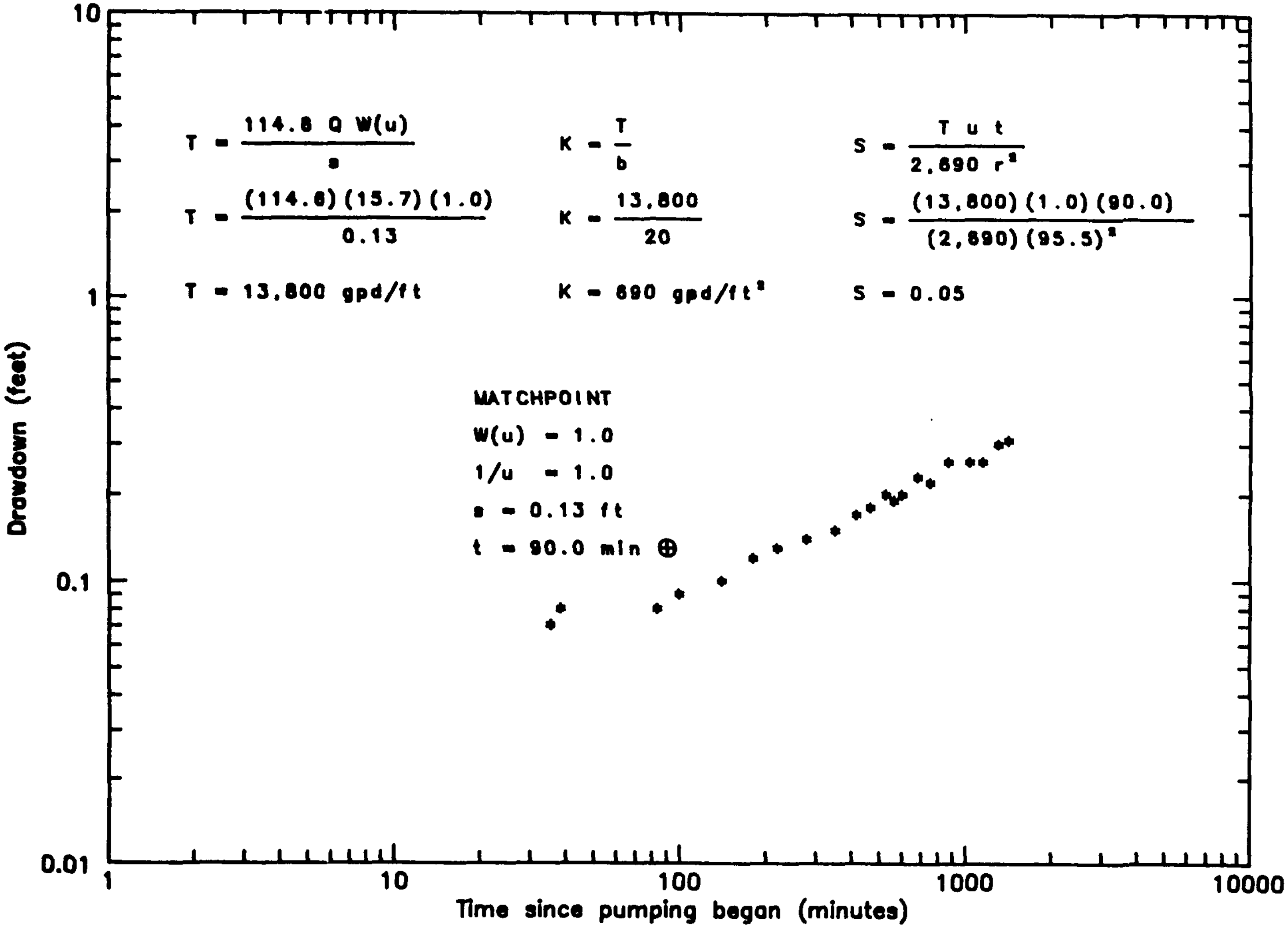


FIGURE C.13 Boulton Nonequilibrium Analysis Using Data from Well WW–2

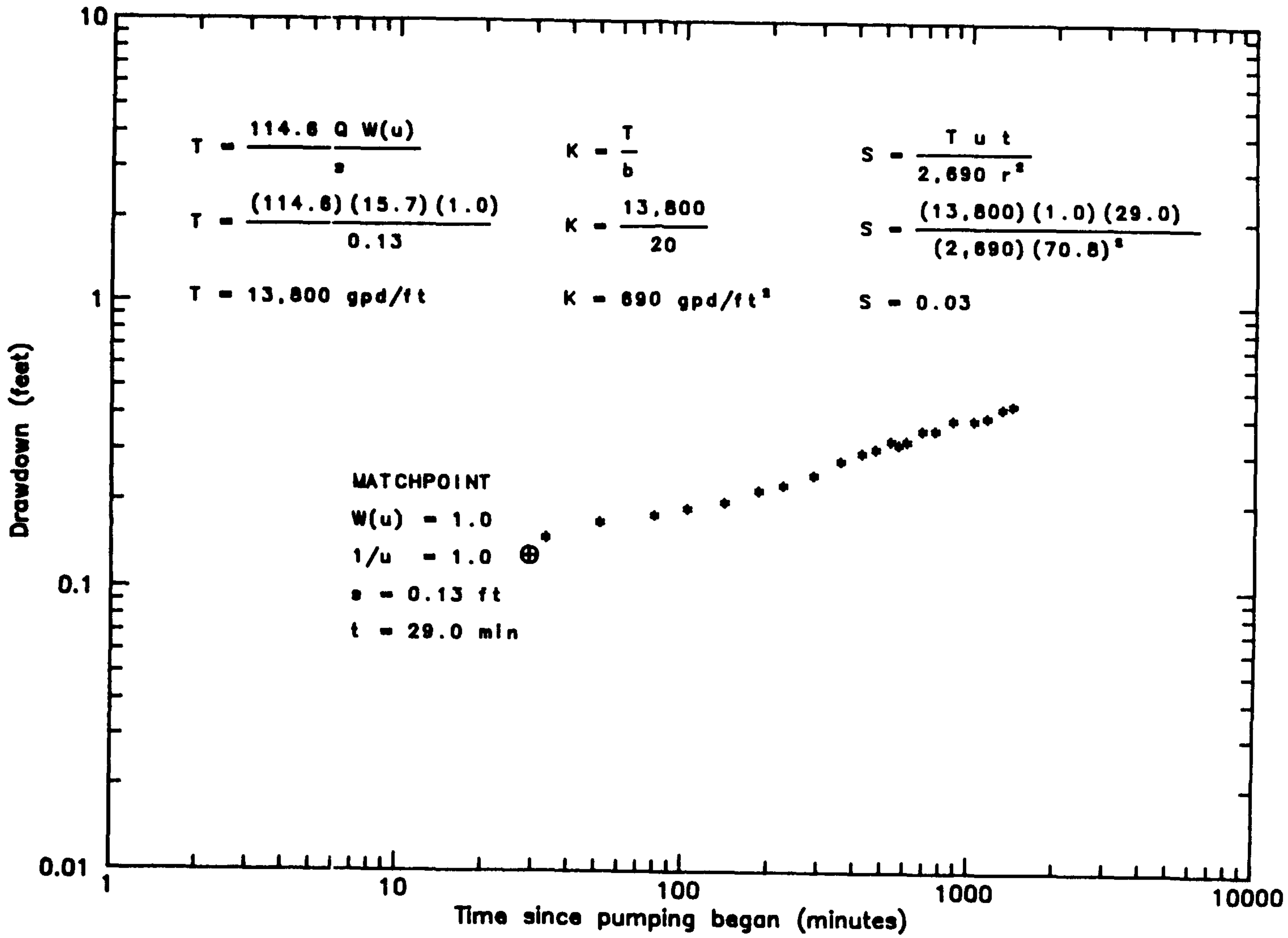


FIGURE C.14 Boulton Nonequilibrium Analysis Using Data from Well WW–3

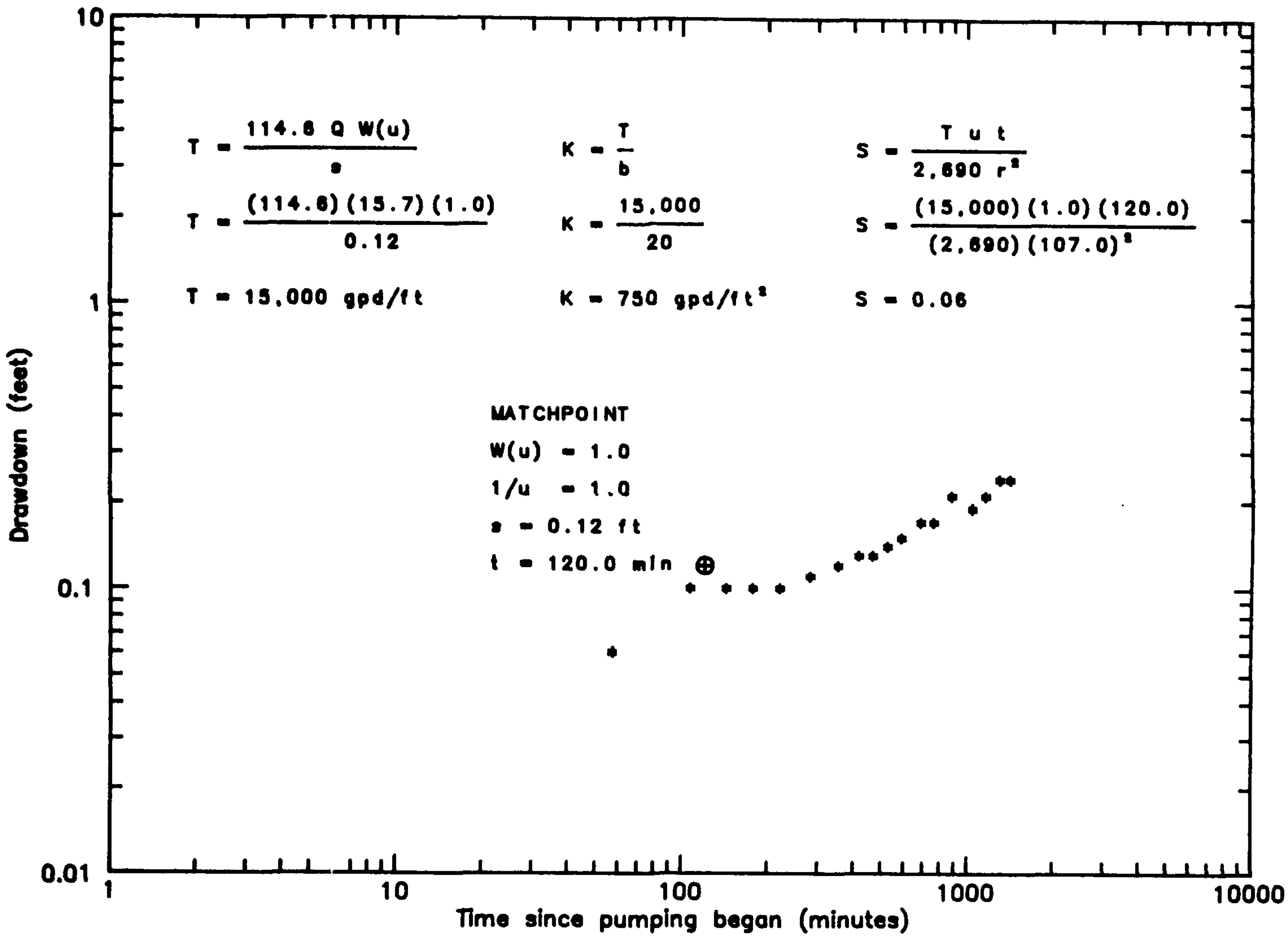


FIGURE C.15 Boulton Nonequilibrium Analysis Using Data from Well WW-4

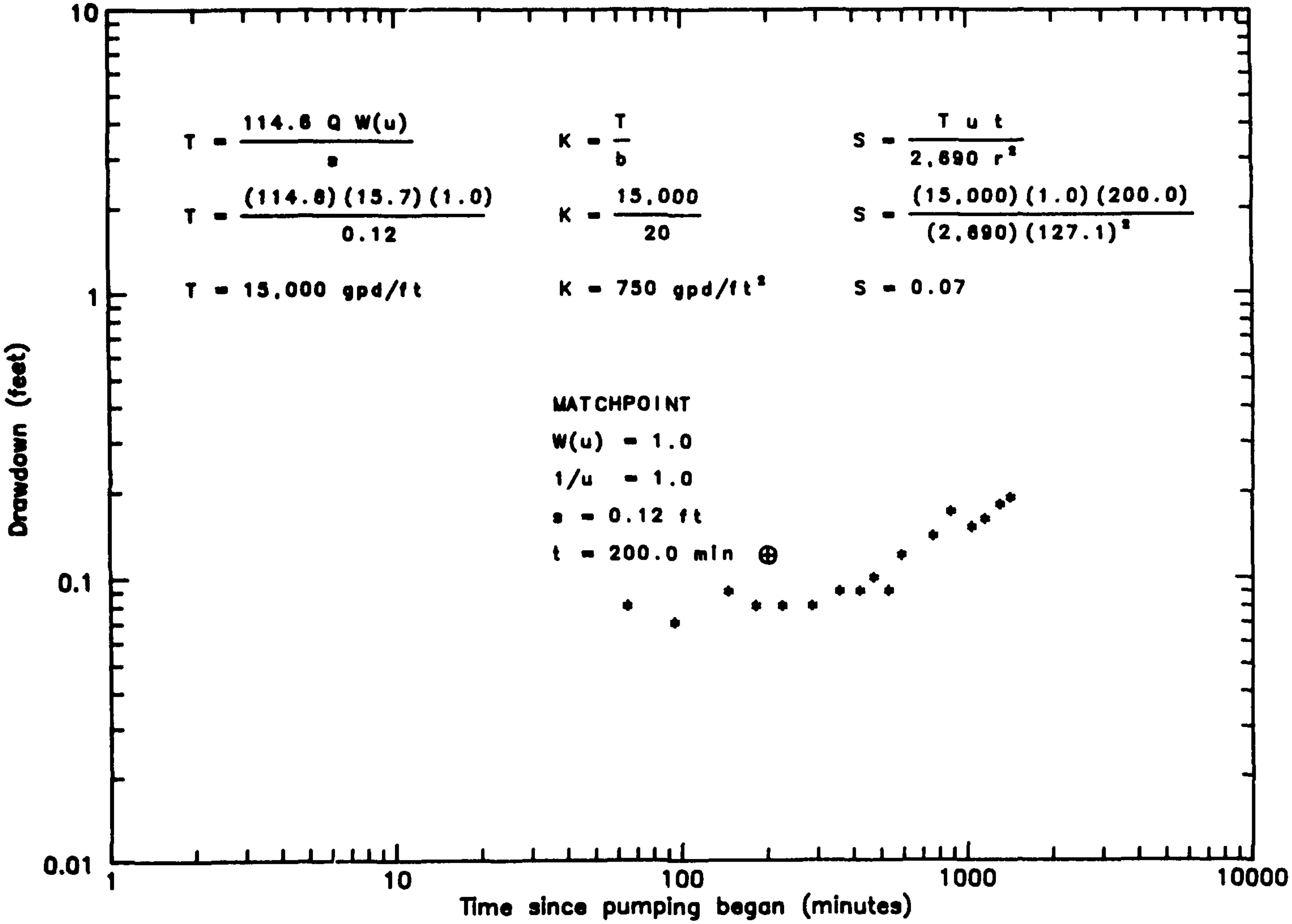


FIGURE C.16 Boulton Nonequilibrium Analysis Using Data from Well WW–5

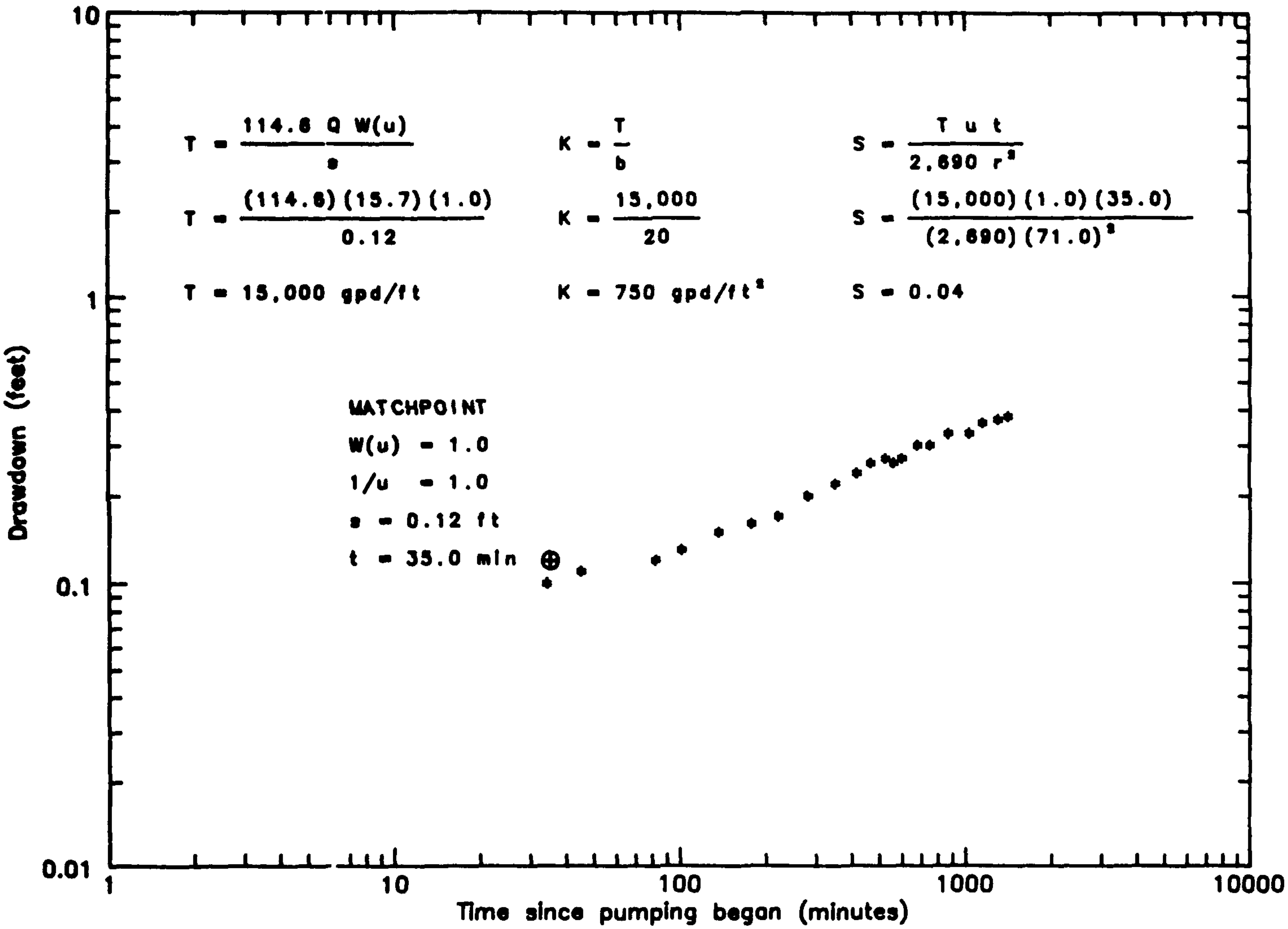


FIGURE C.17 Boulton Nonequilibrium Analysis Using Data from Well WW-6

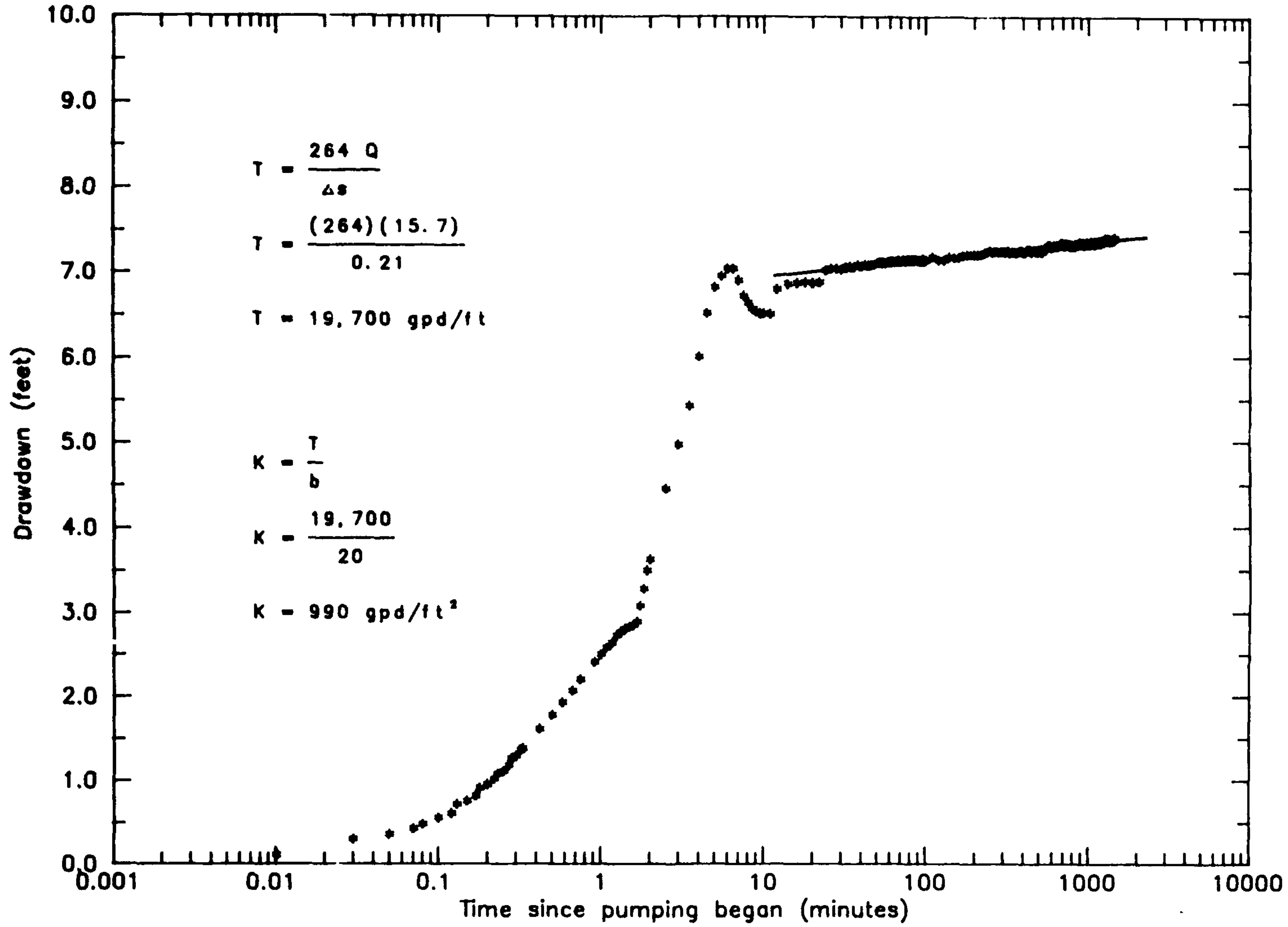


FIGURE C.18 Cooper–Jacob Nonequilibrium Analysis Using Data from Well VF1 PW–1

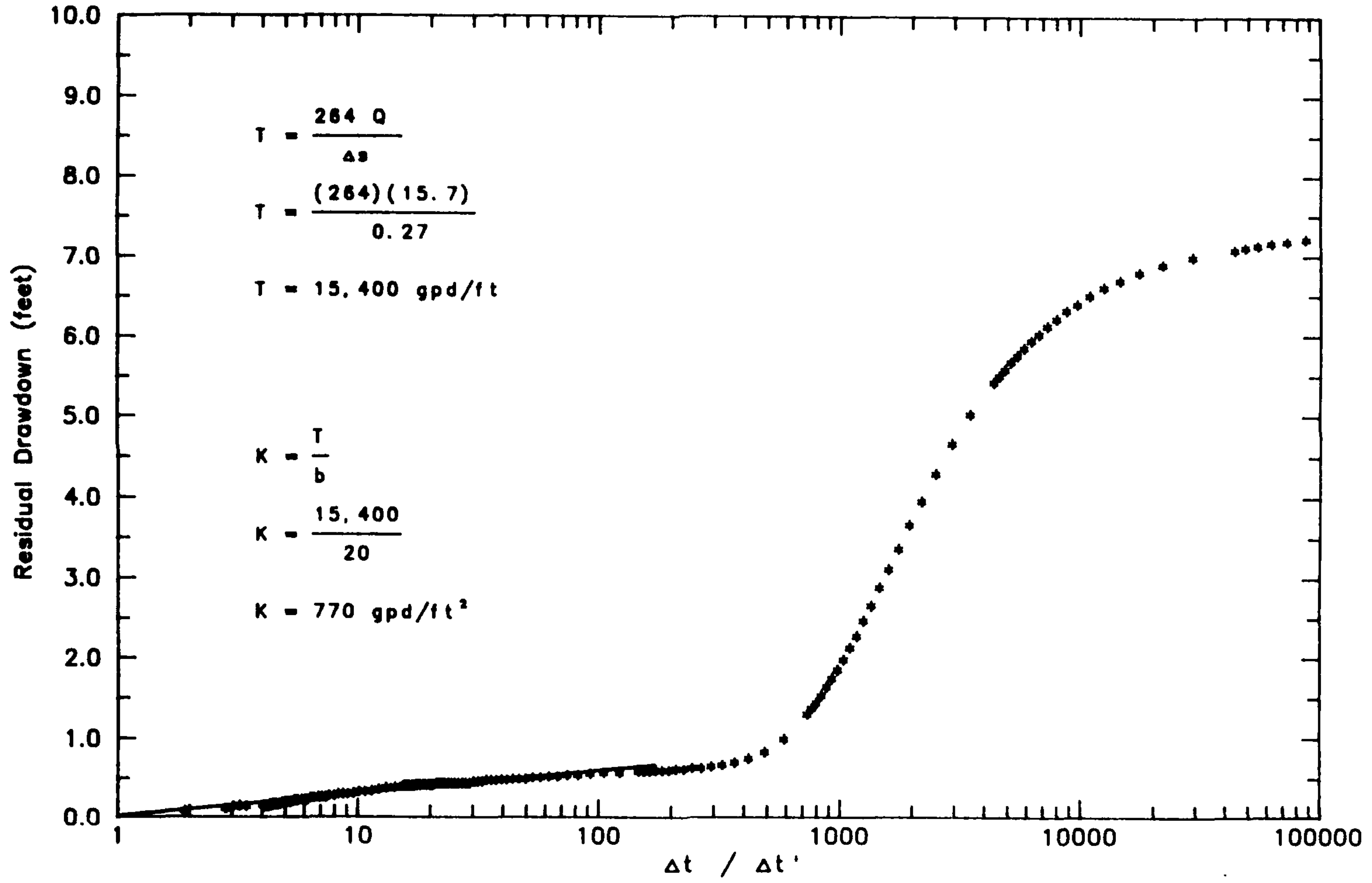


FIGURE C.19 Theis Recovery Analysis Using Data from Well VF1 PW--1

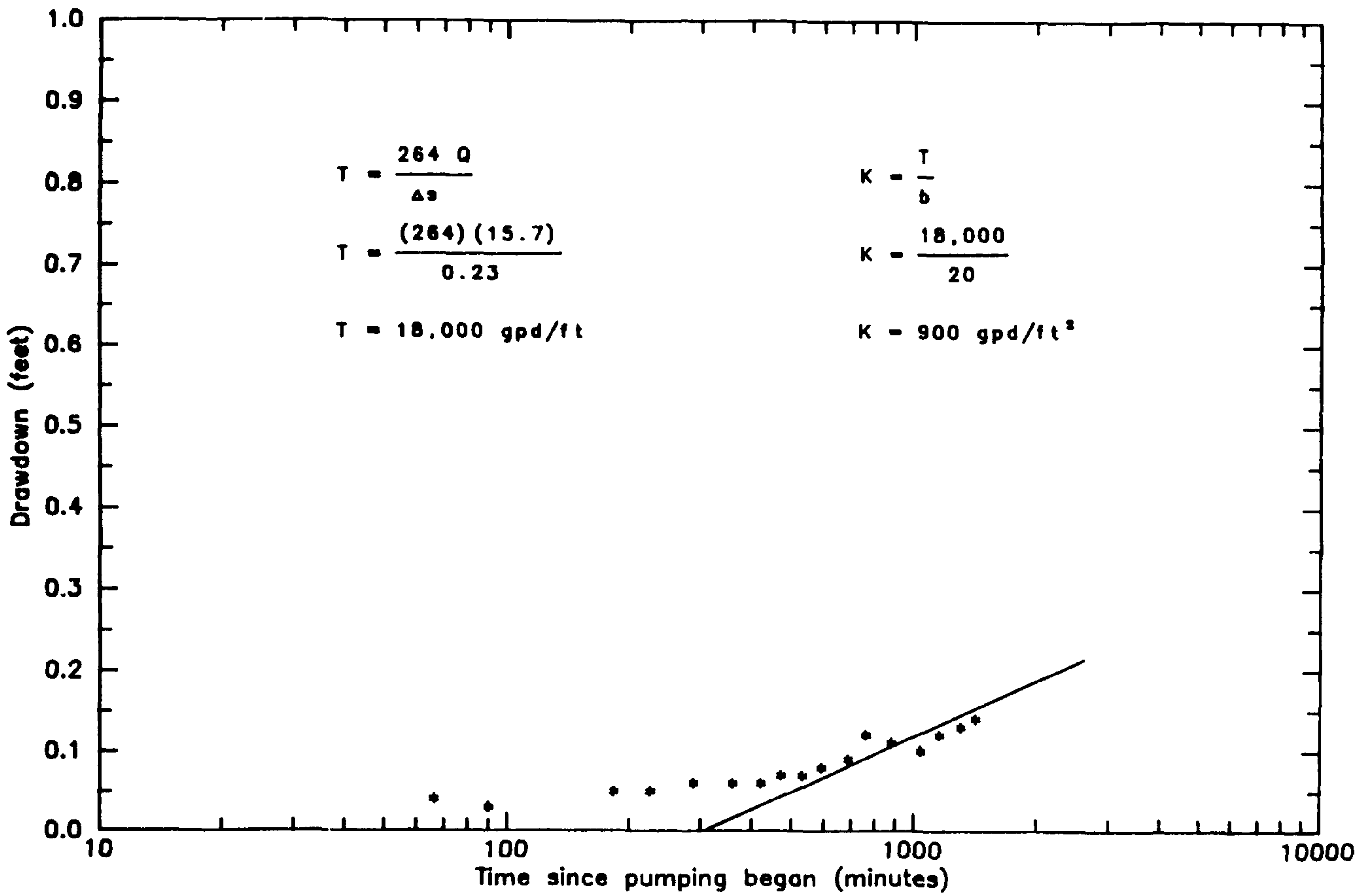


FIGURE C.20 Cooper–Jacob Nonequilibrium Analysis Using Data from Well VF1 MW–2

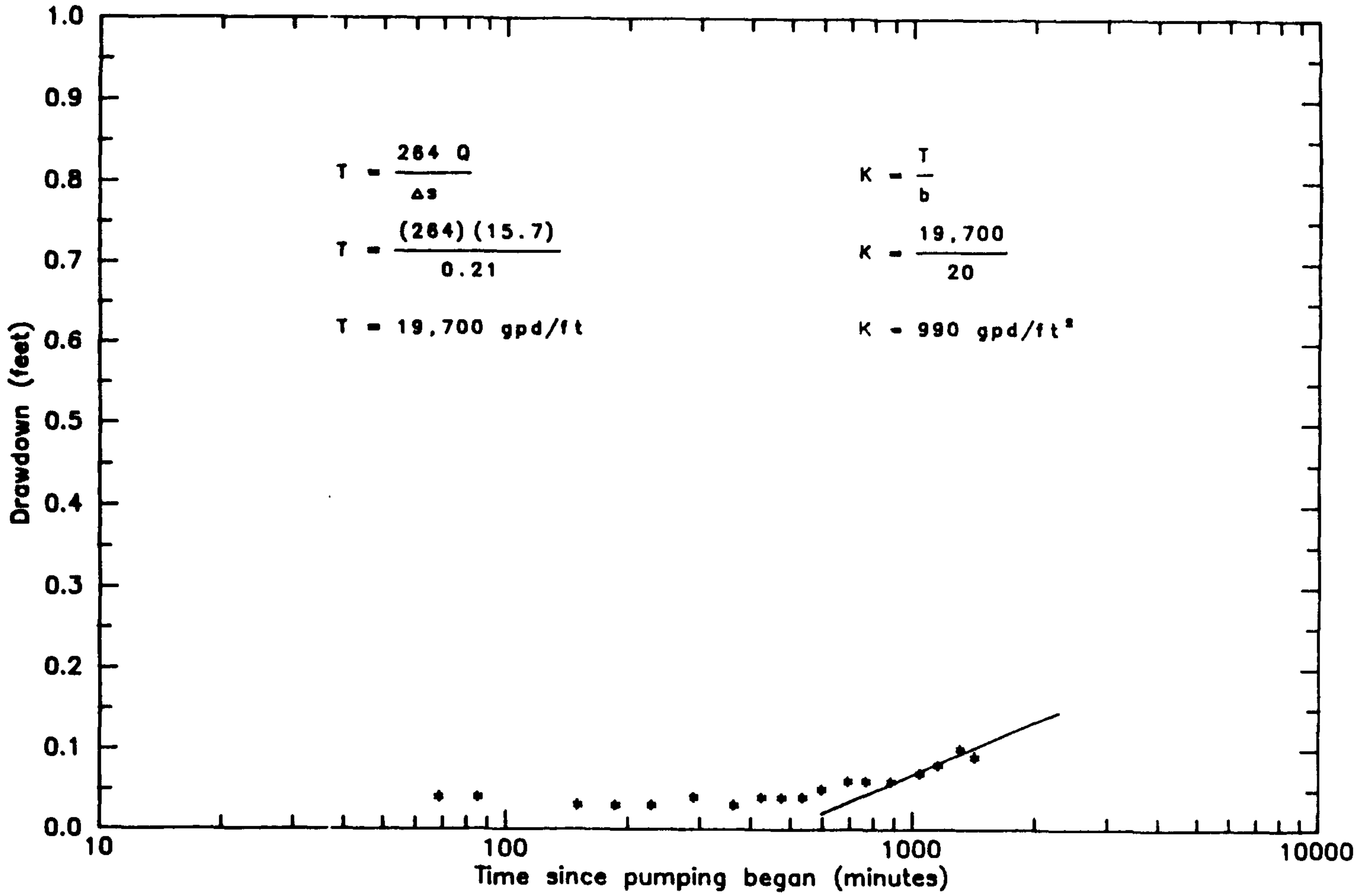


FIGURE C.21 Cooper–Jacob Nonequilibrium Analysis Using Data from Well VF1 MW–3

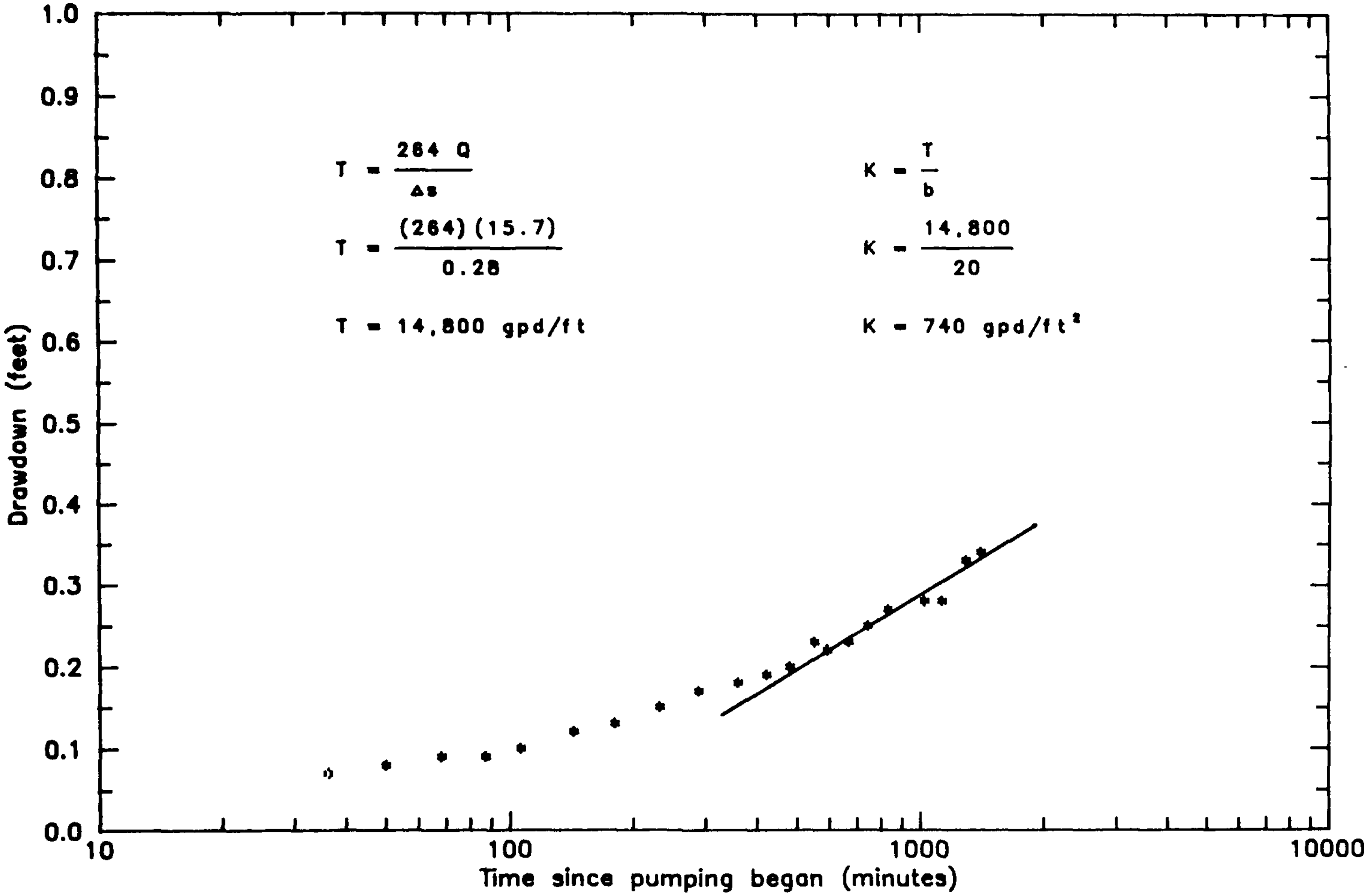


FIGURE C.22 Cooper–Jacob Nonequilibrium Analysis Using Data from Well VF9 MW–2

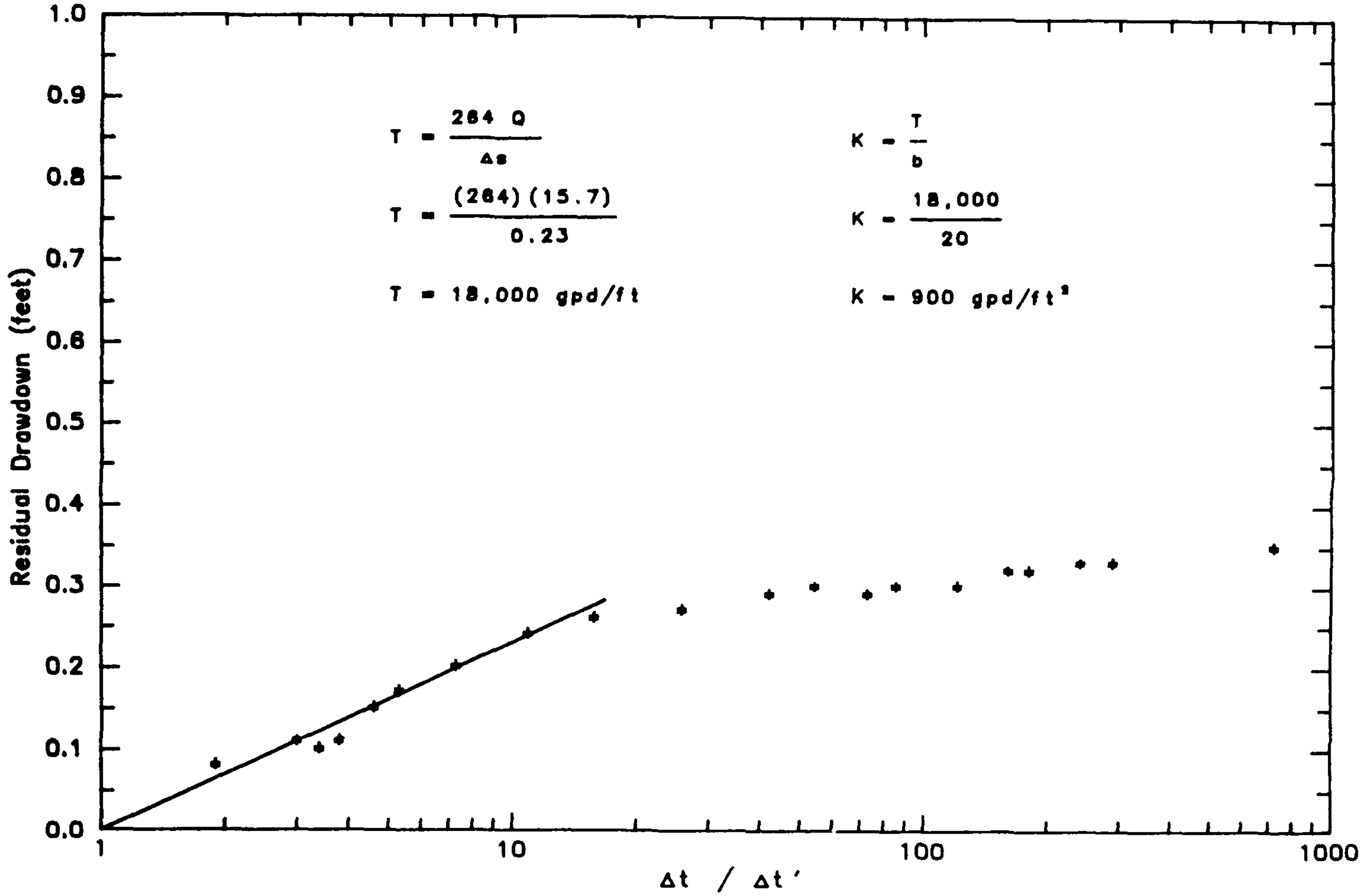


FIGURE C.23 Theis Recovery Analysis Using Data from Well VF9 MW–2

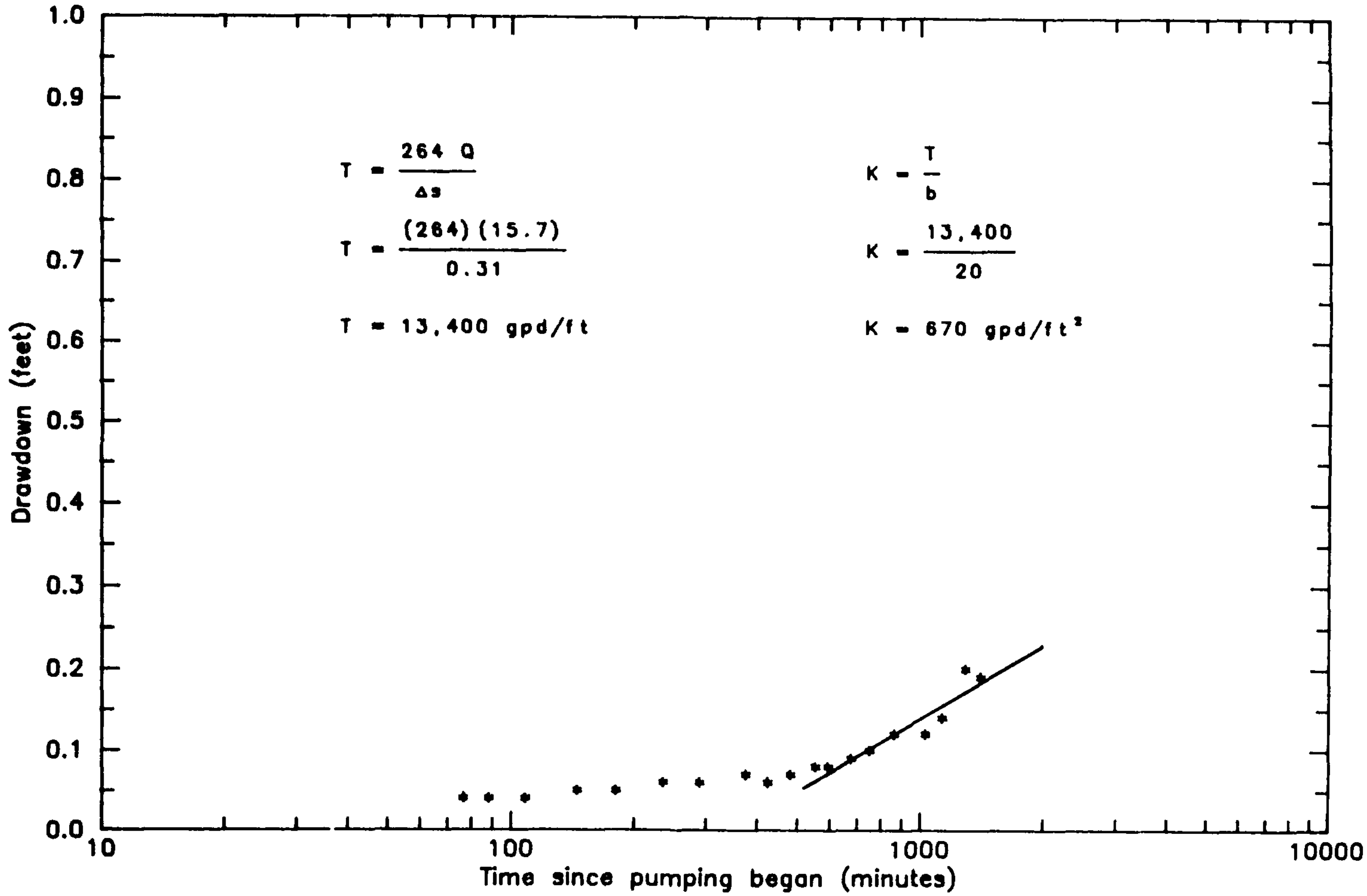


FIGURE C.24 Cooper–Jacob Nonequilibrium Analysis Using Data from Well VF9 MW–3

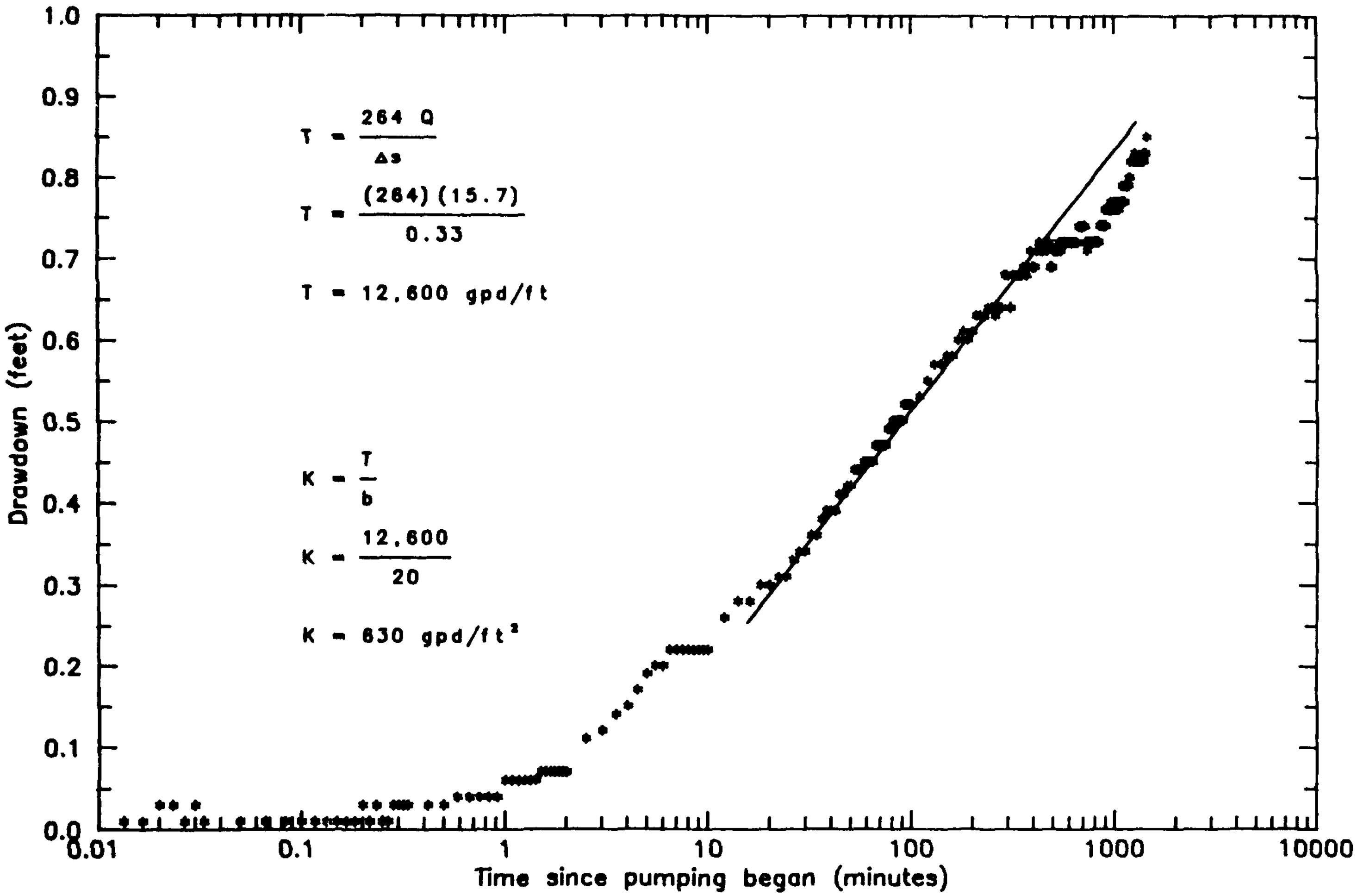


FIGURE C.25 Cooper–Jacob Nonequilibrium Analysis Using Data from Well ET–2

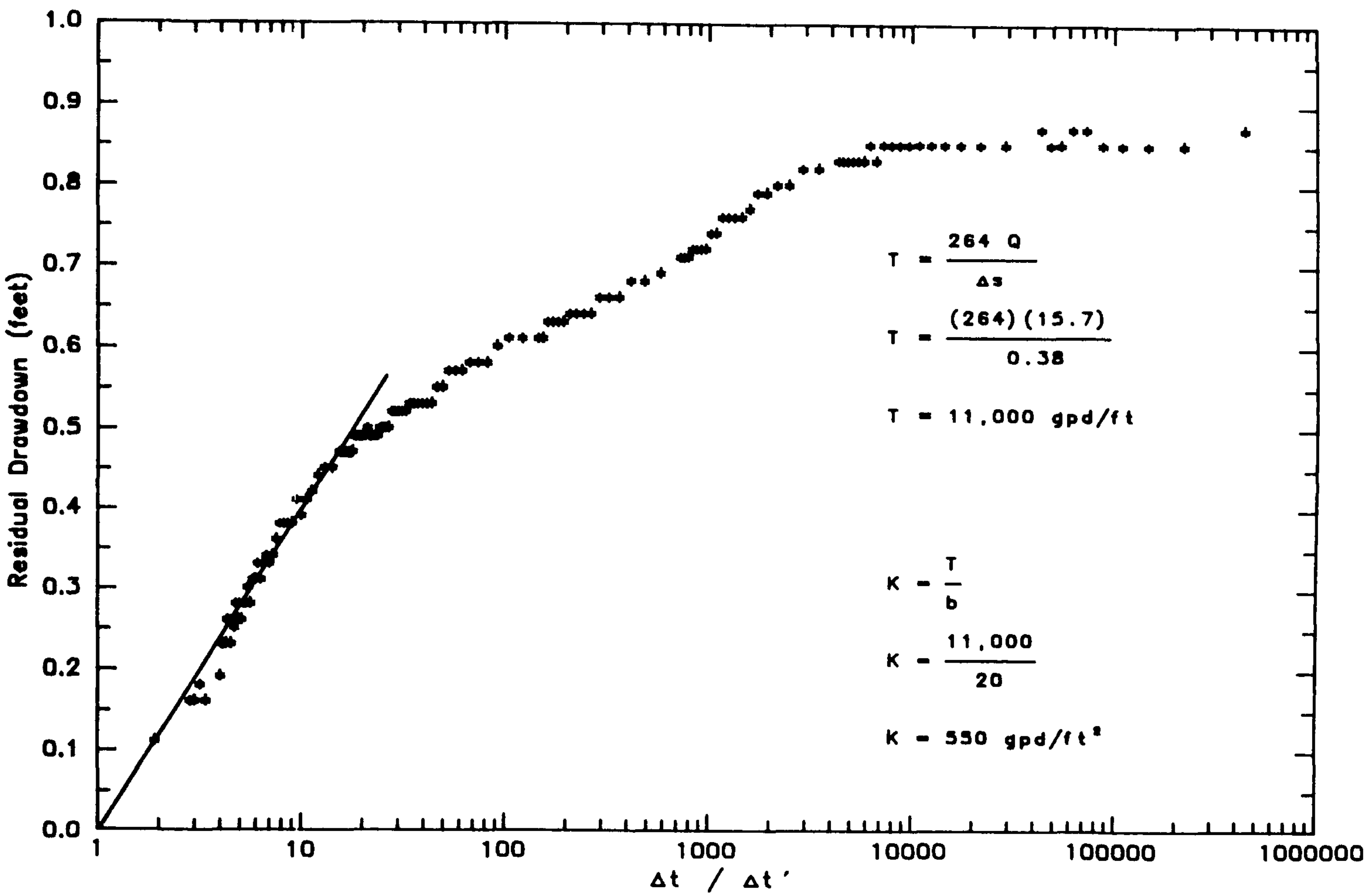


FIGURE C.26 Theis Recovery Analysis Using Data from Well ET-2

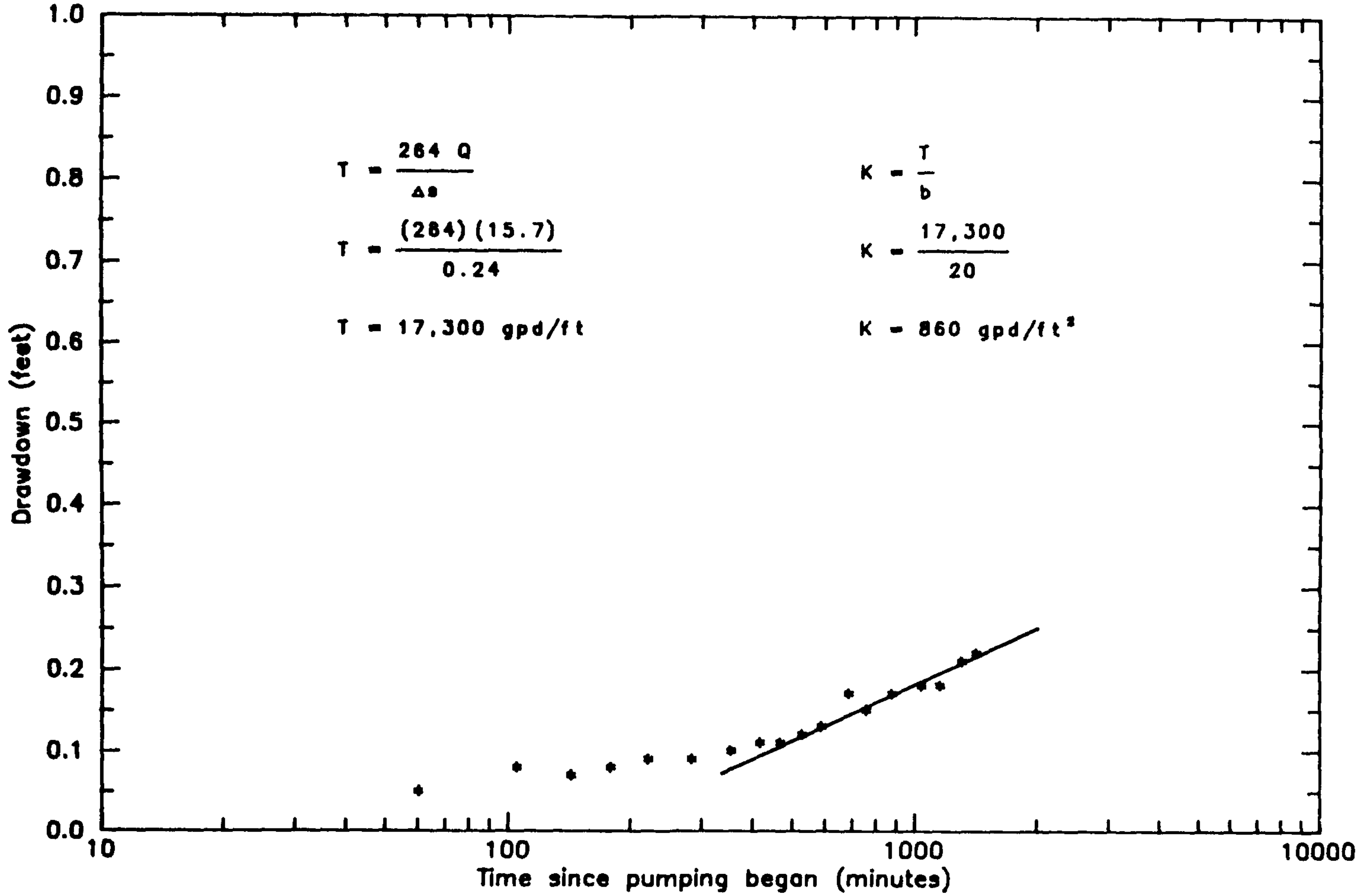


FIGURE C.27 Cooper–Jacob Nonequilibrium Analysis Using Data from Well ET–3

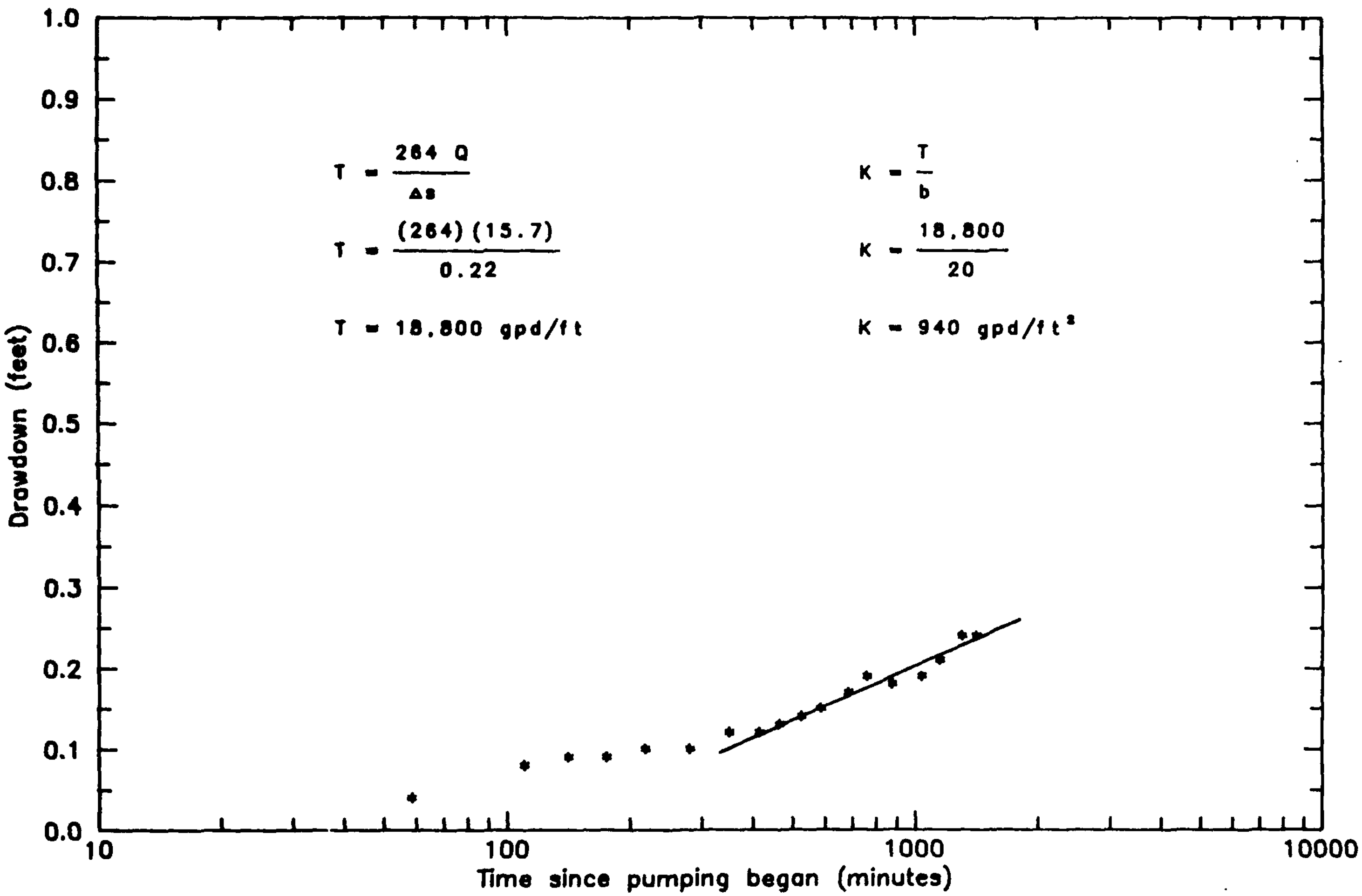


FIGURE C.28 Cooper–Jacob Nonequilibrium Analysis Using Data from Well ET–4

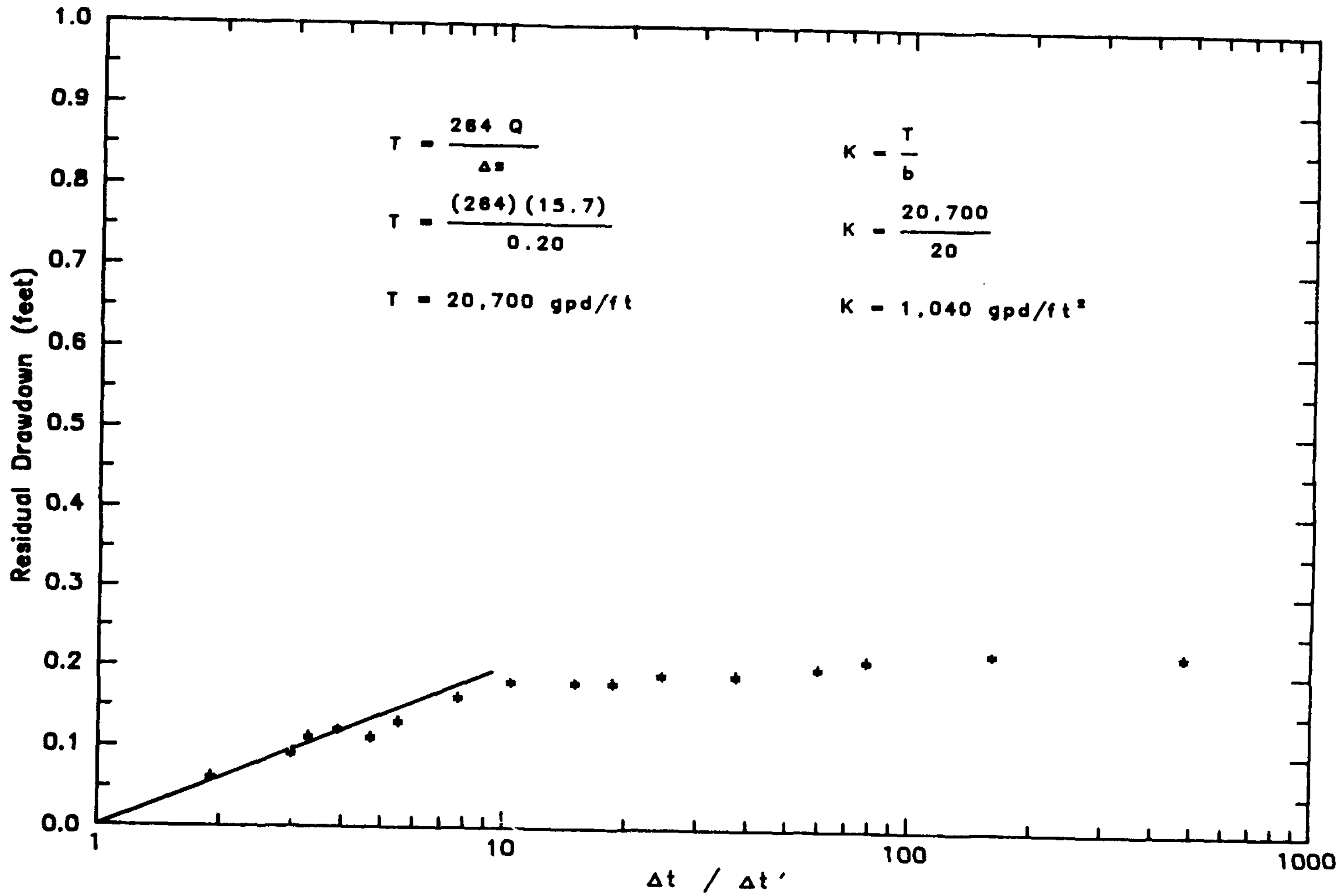


FIGURE C.29 Theis Recovery Analysis Using Data from Well ET-4

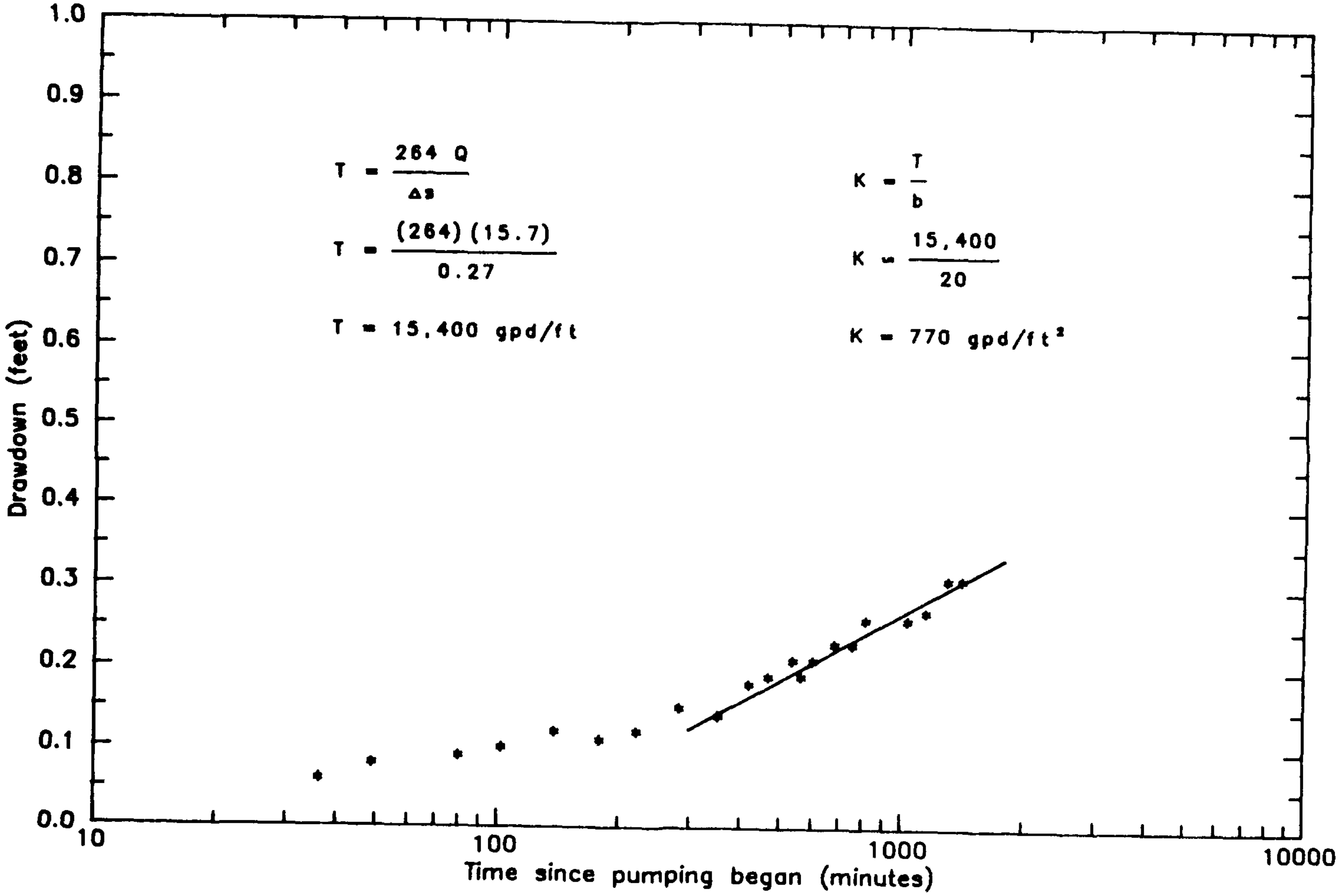


FIGURE C.30 Cooper–Jacob Nonequilibrium Analysis Using Data from Well ET–5

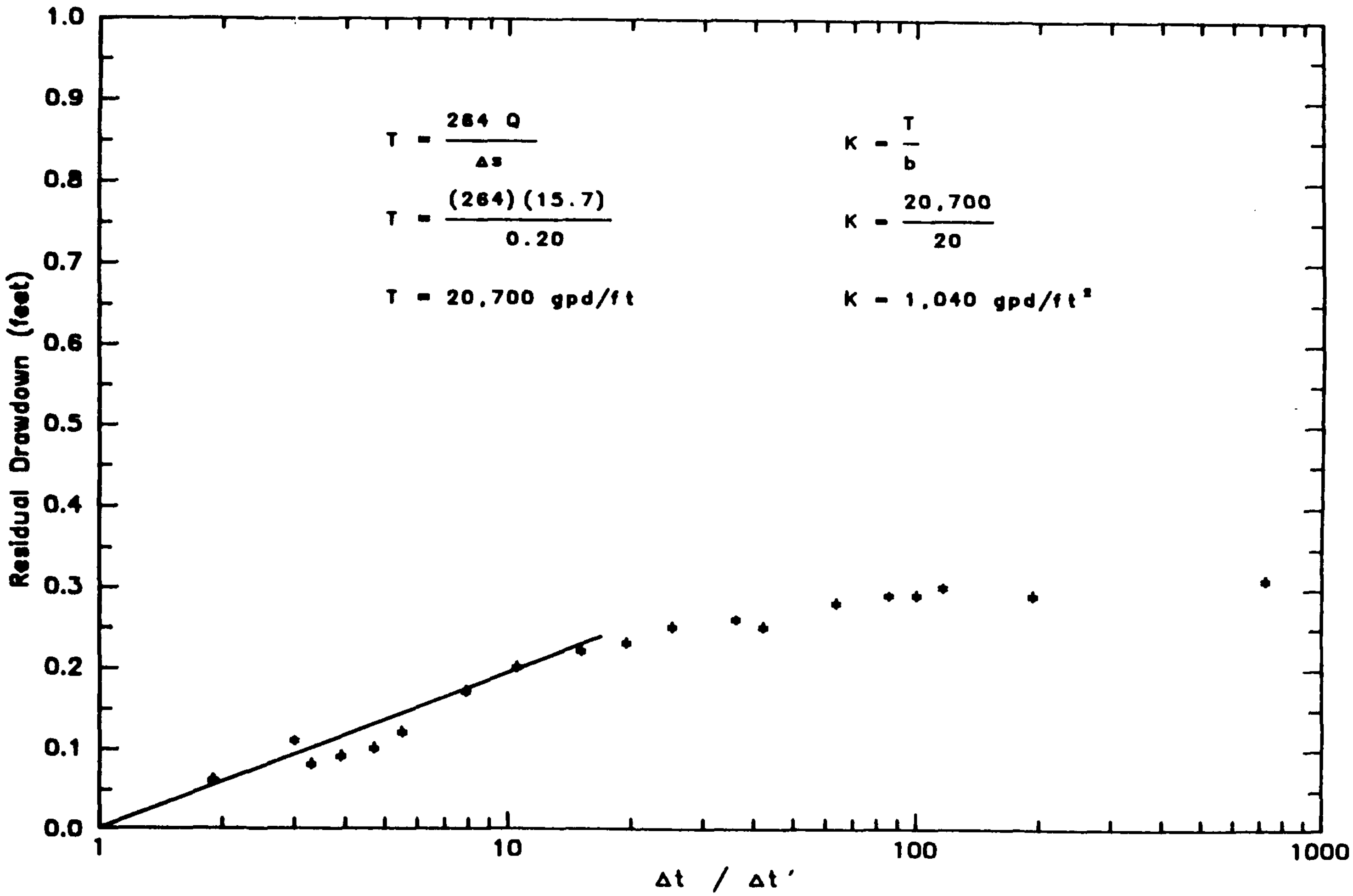


FIGURE C.31 Theis Recovery Analysis Using Data from Well ET–5

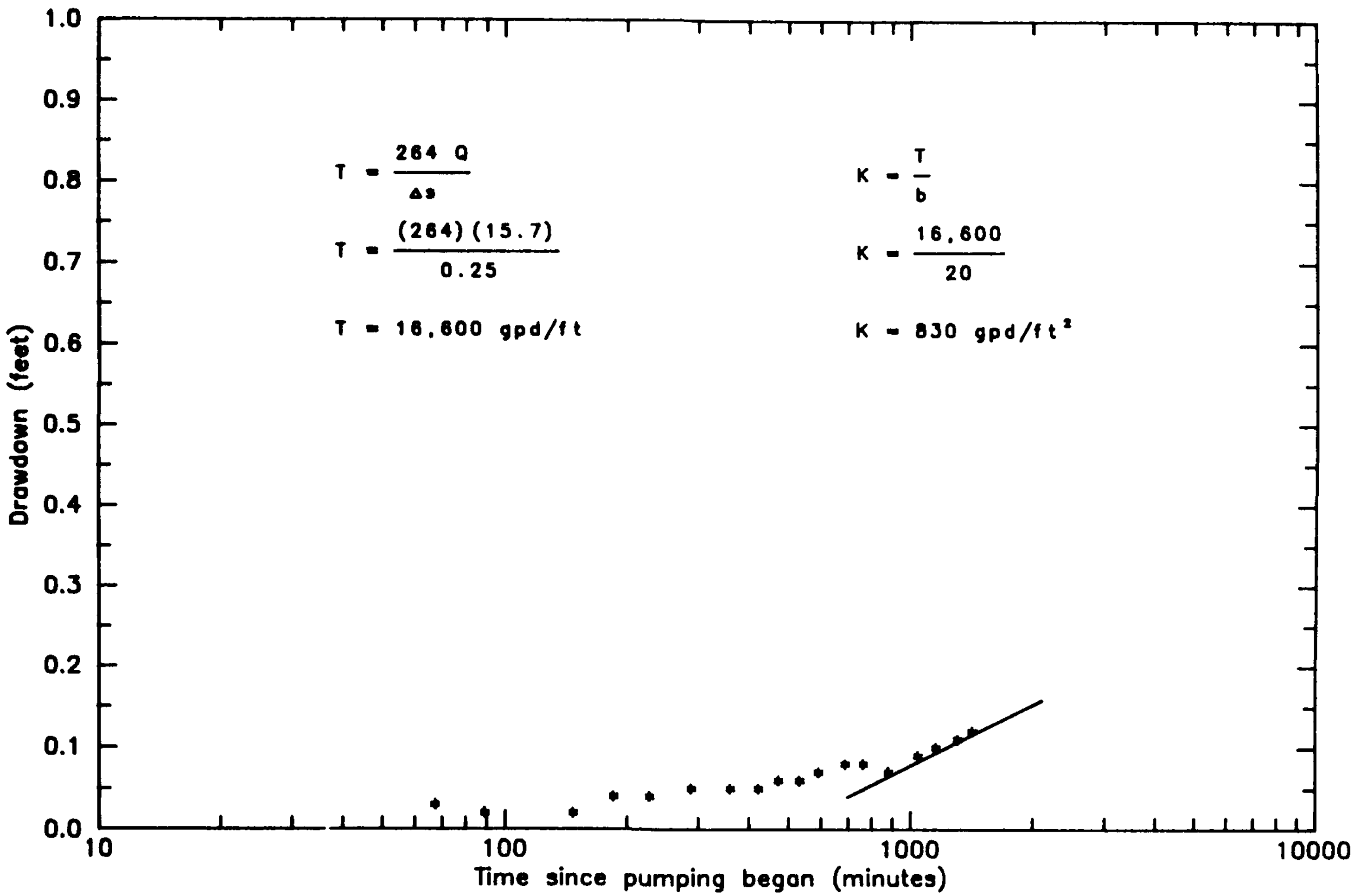


FIGURE C.32 Cooper–Jacob Nonequilibrium Analysis Using Data from Well ET–6

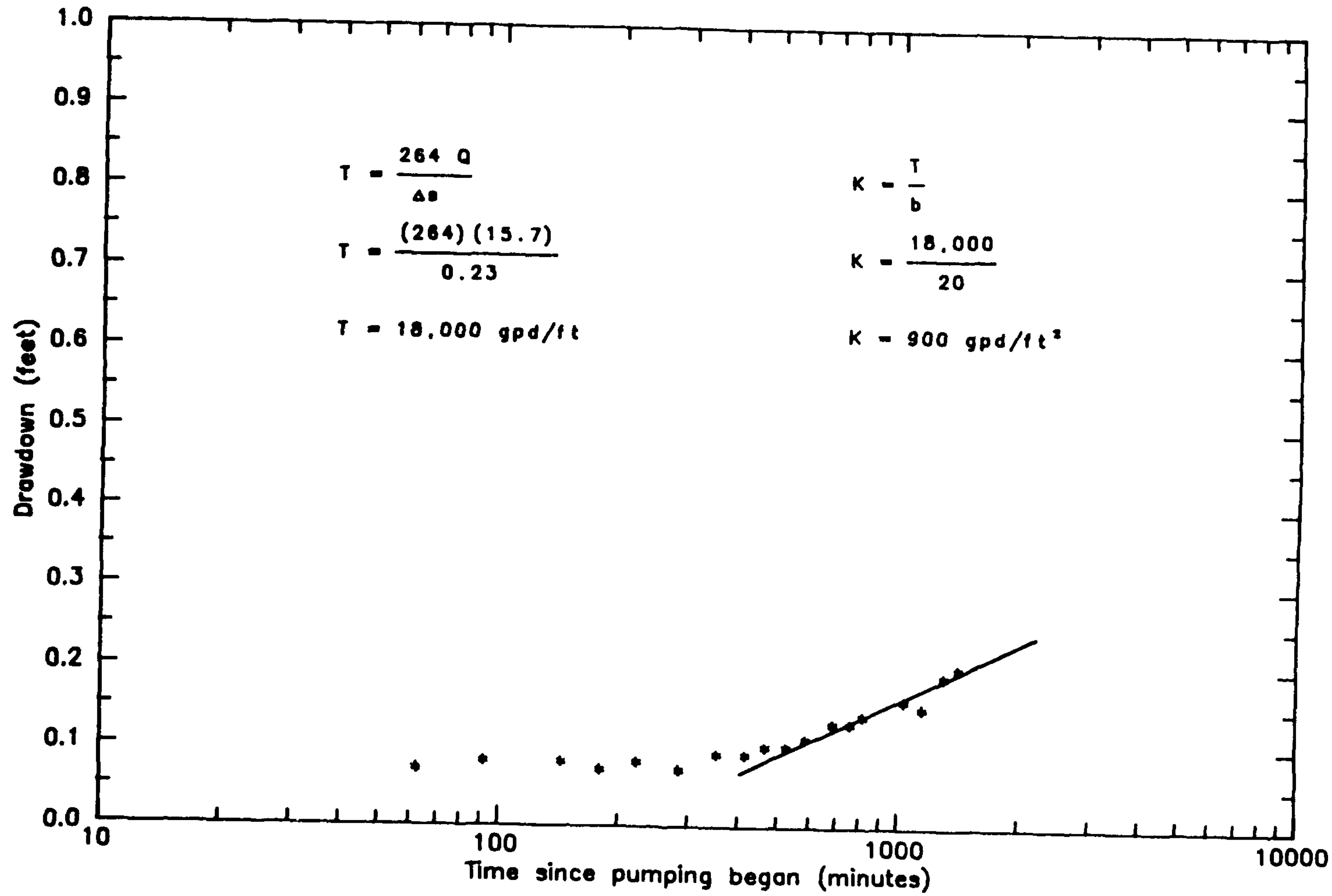


FIGURE C.33 Cooper–Jacob Nonequilibrium Analysis Using Data from Well WW–1

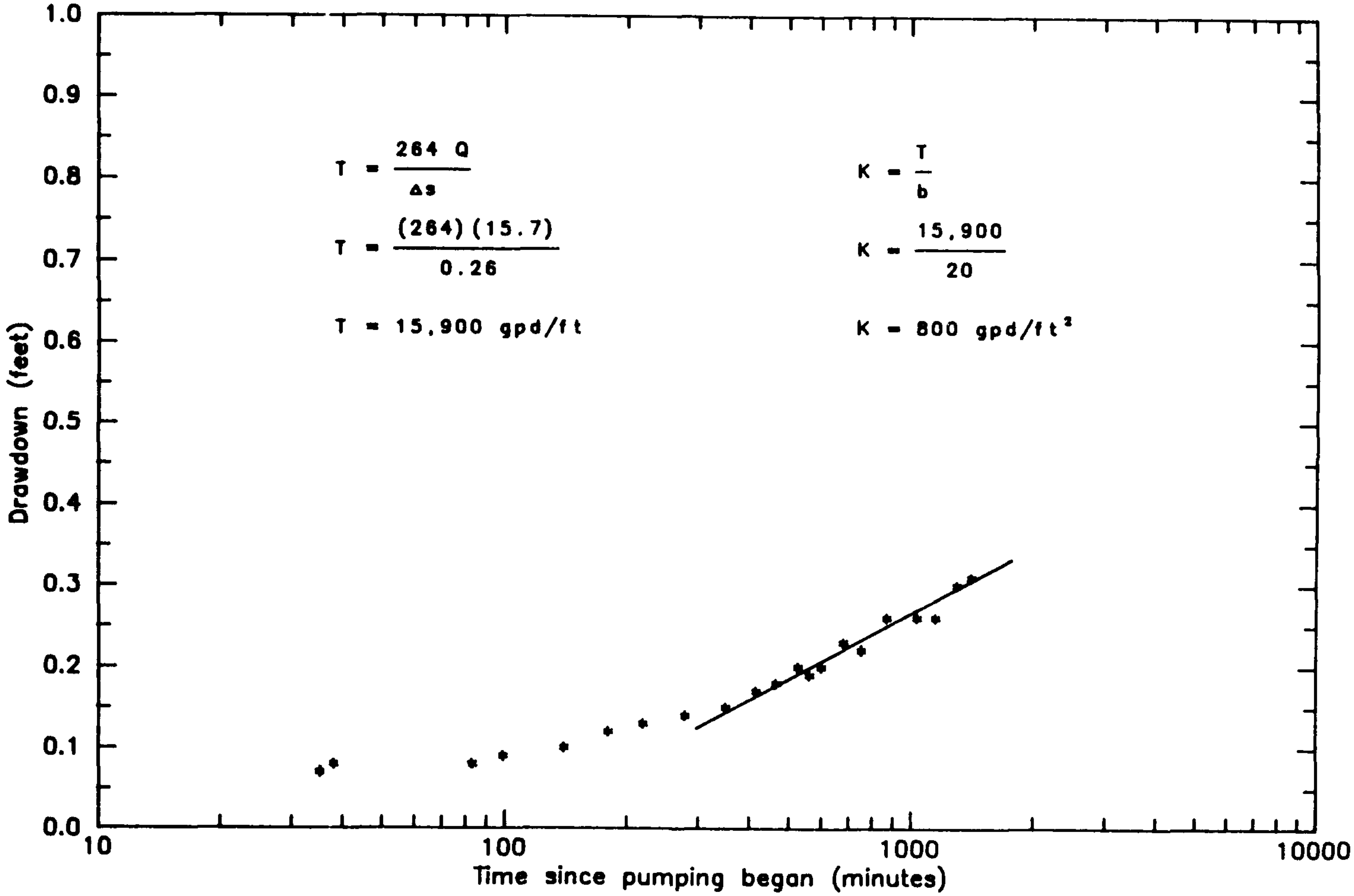


FIGURE C.34 Cooper–Jacob Nonequilibrium Analysis Using Data from Well WW–2

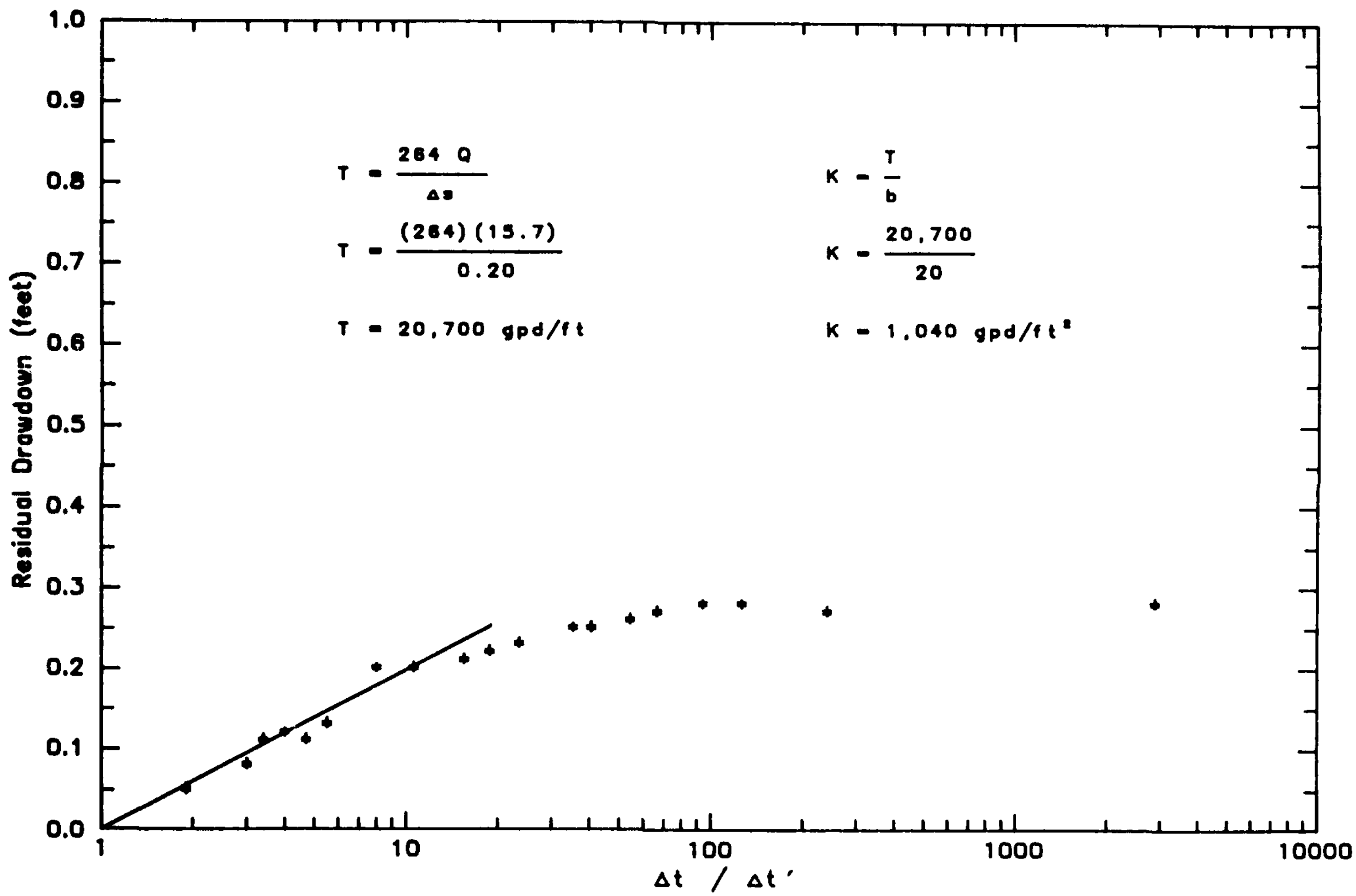


FIGURE C.35 Theis Recovery Analysis Using Data from Well WW–2

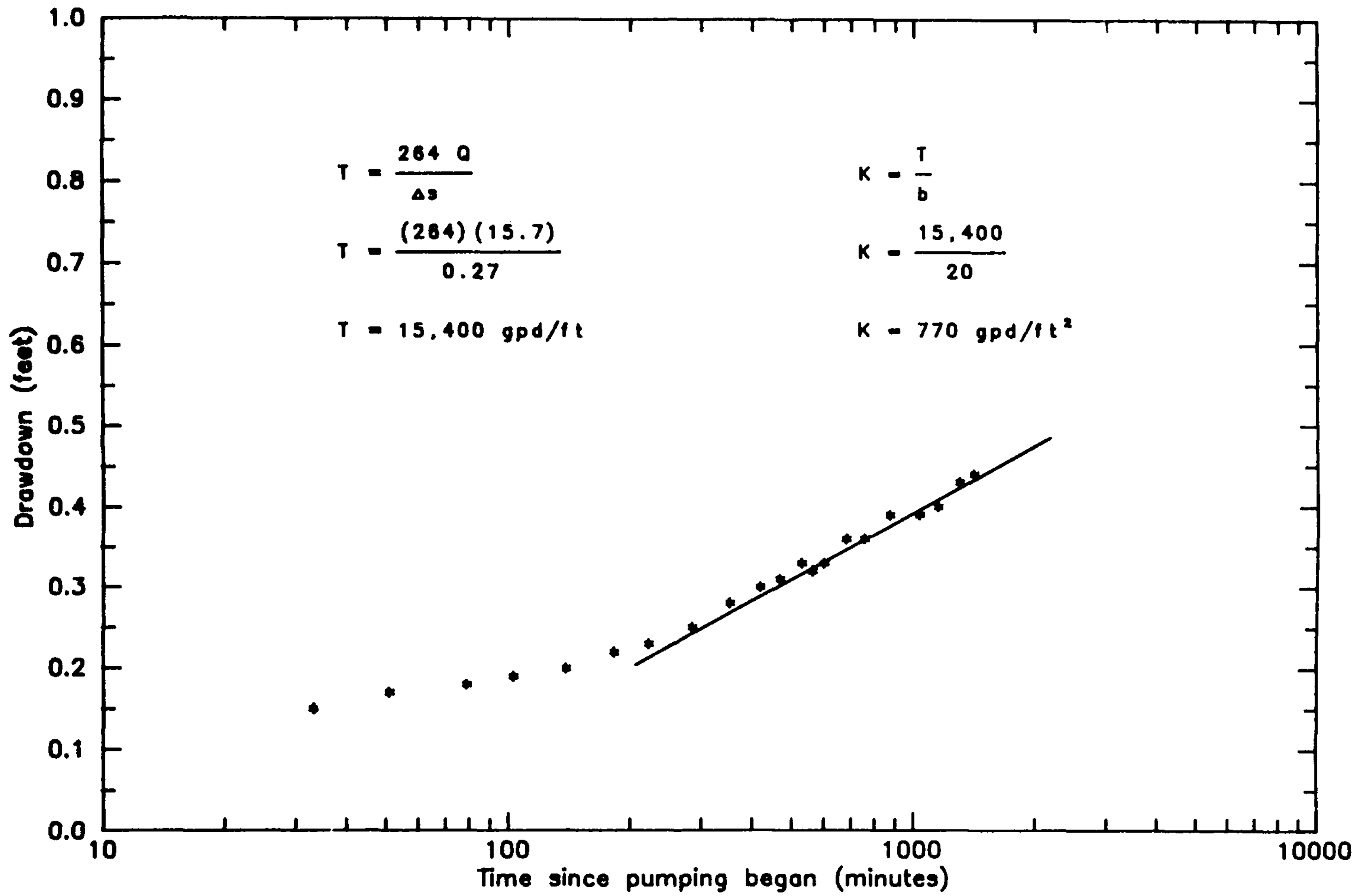


FIGURE C.36 Cooper–Jacob Nonequilibrium Analysis Using Data from Well WW–3

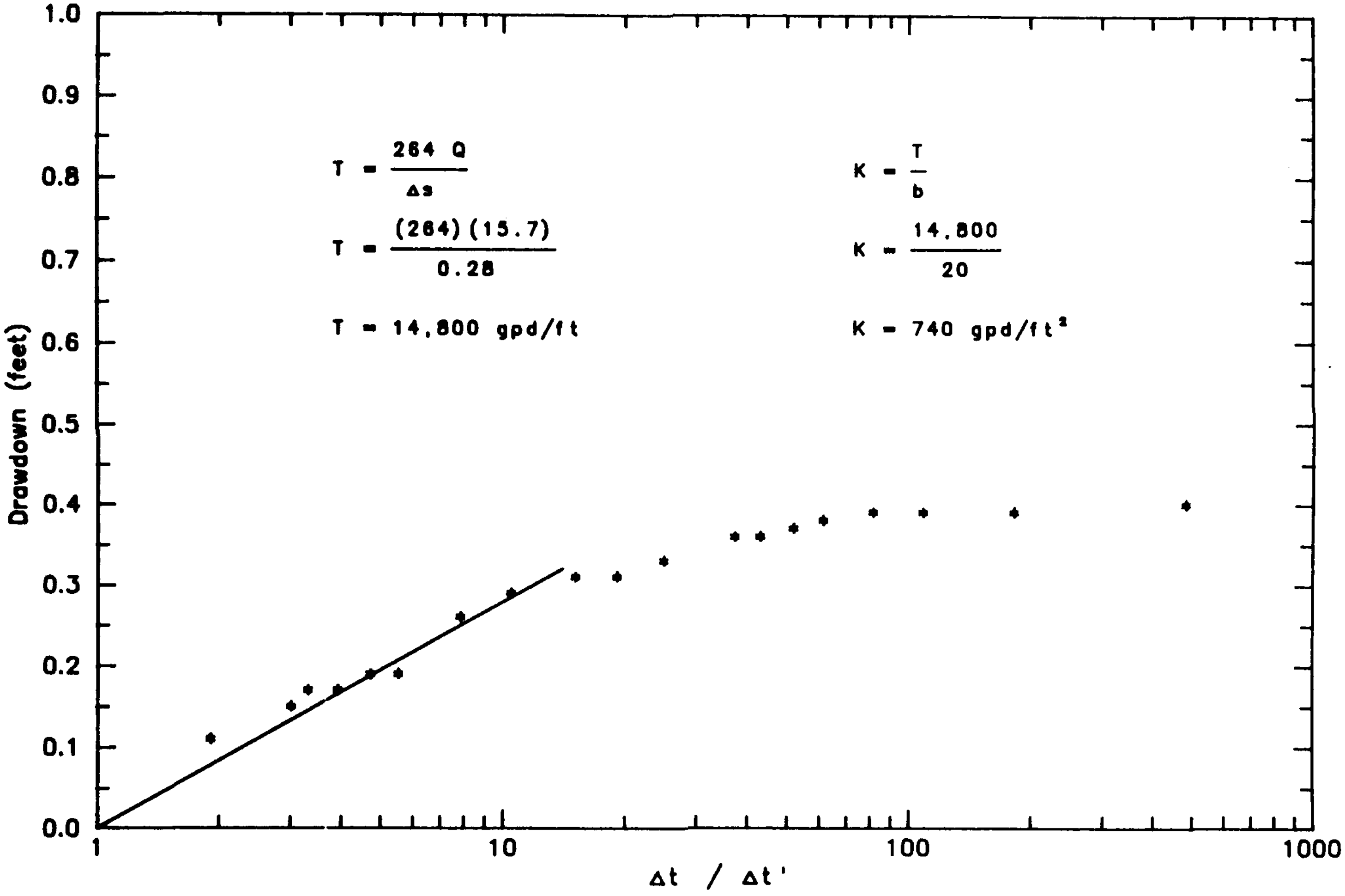


FIGURE C.37 Theis Recovery Analysis Using Data from Well WW–3

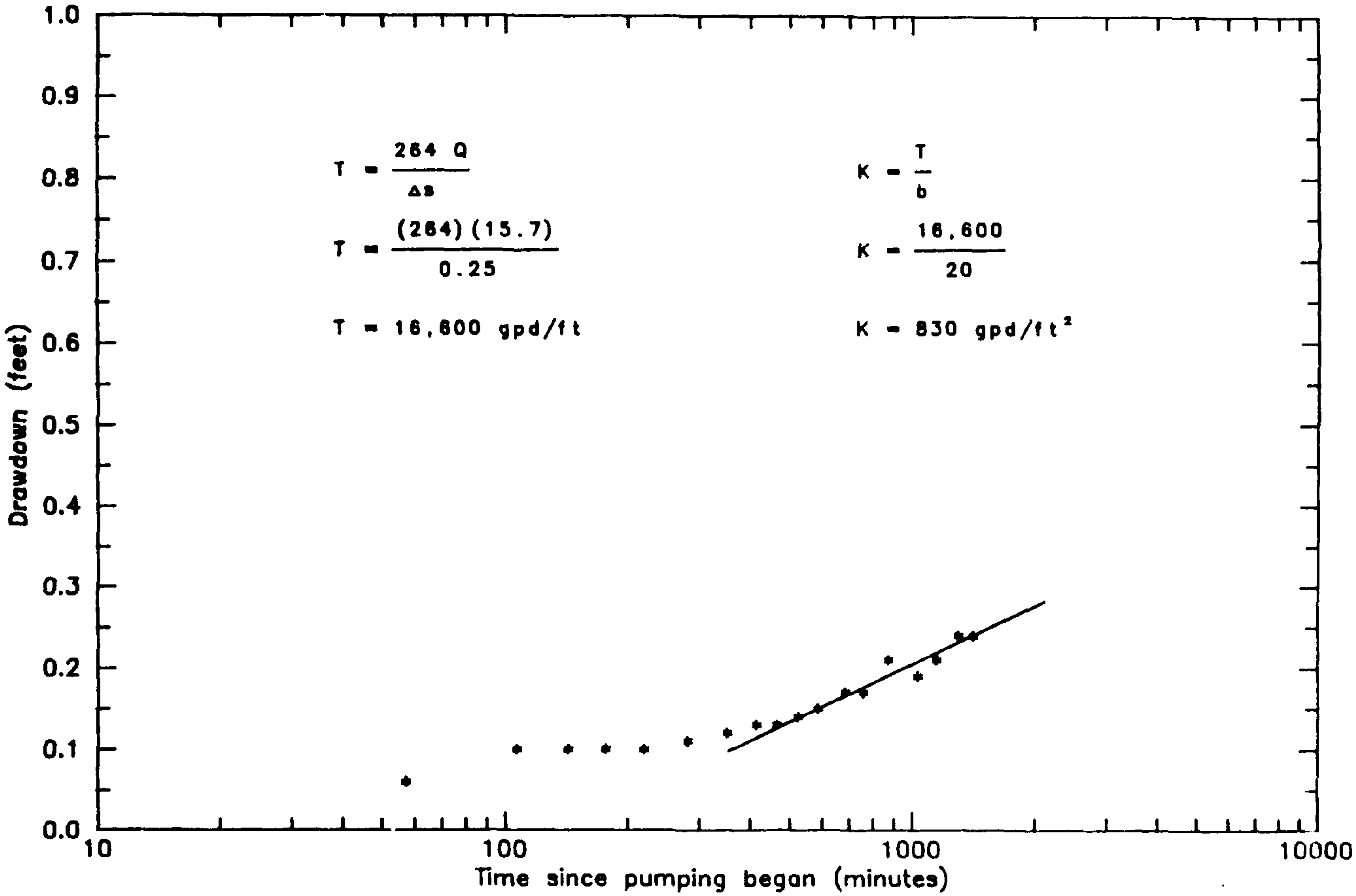


FIGURE C.38 Cooper–Jacob Nonequilibrium Analysis Using Data from Well WW–4

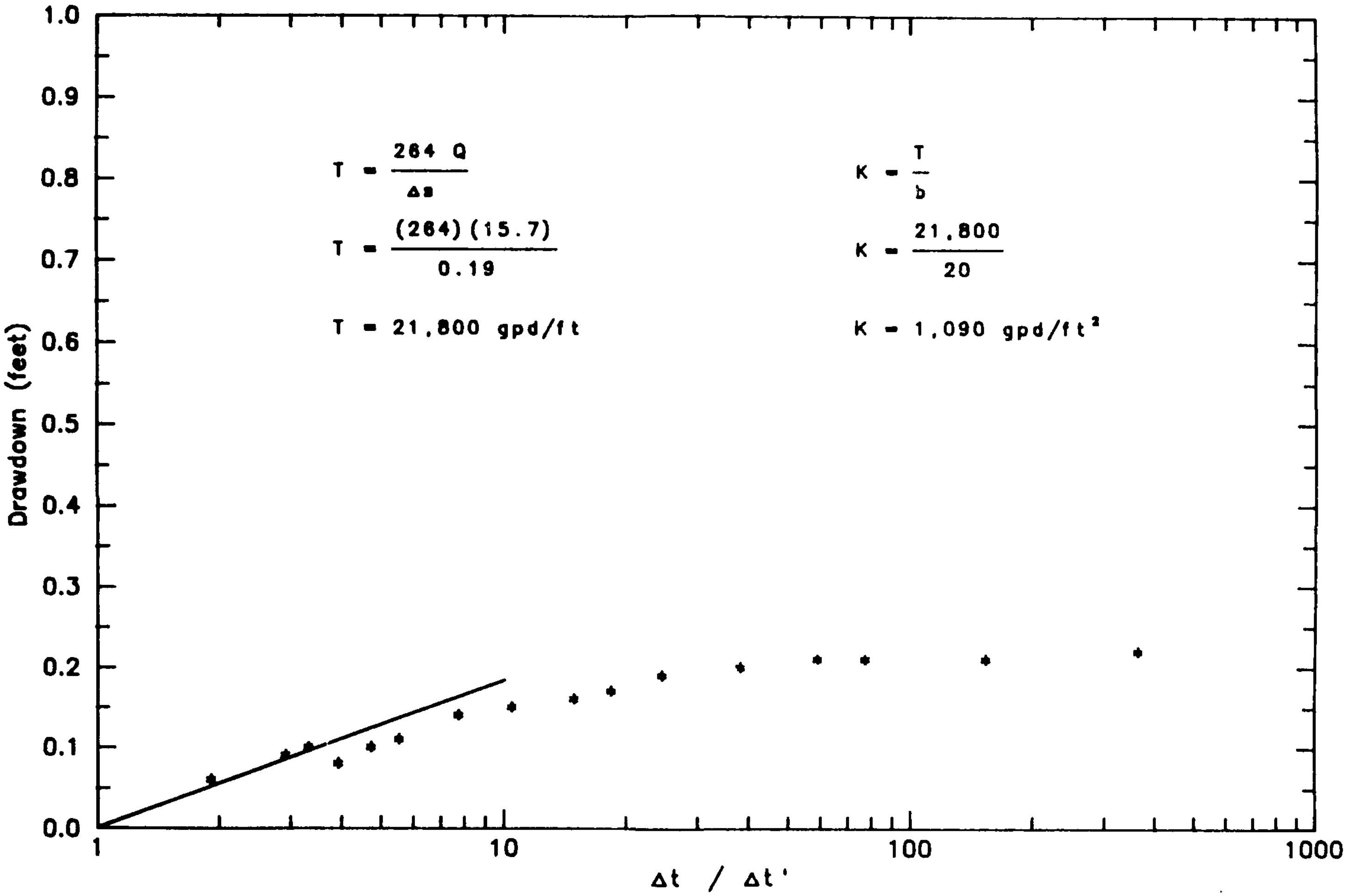


FIGURE C.39 Theis Recovery Analysis Using Data from Well WW-4

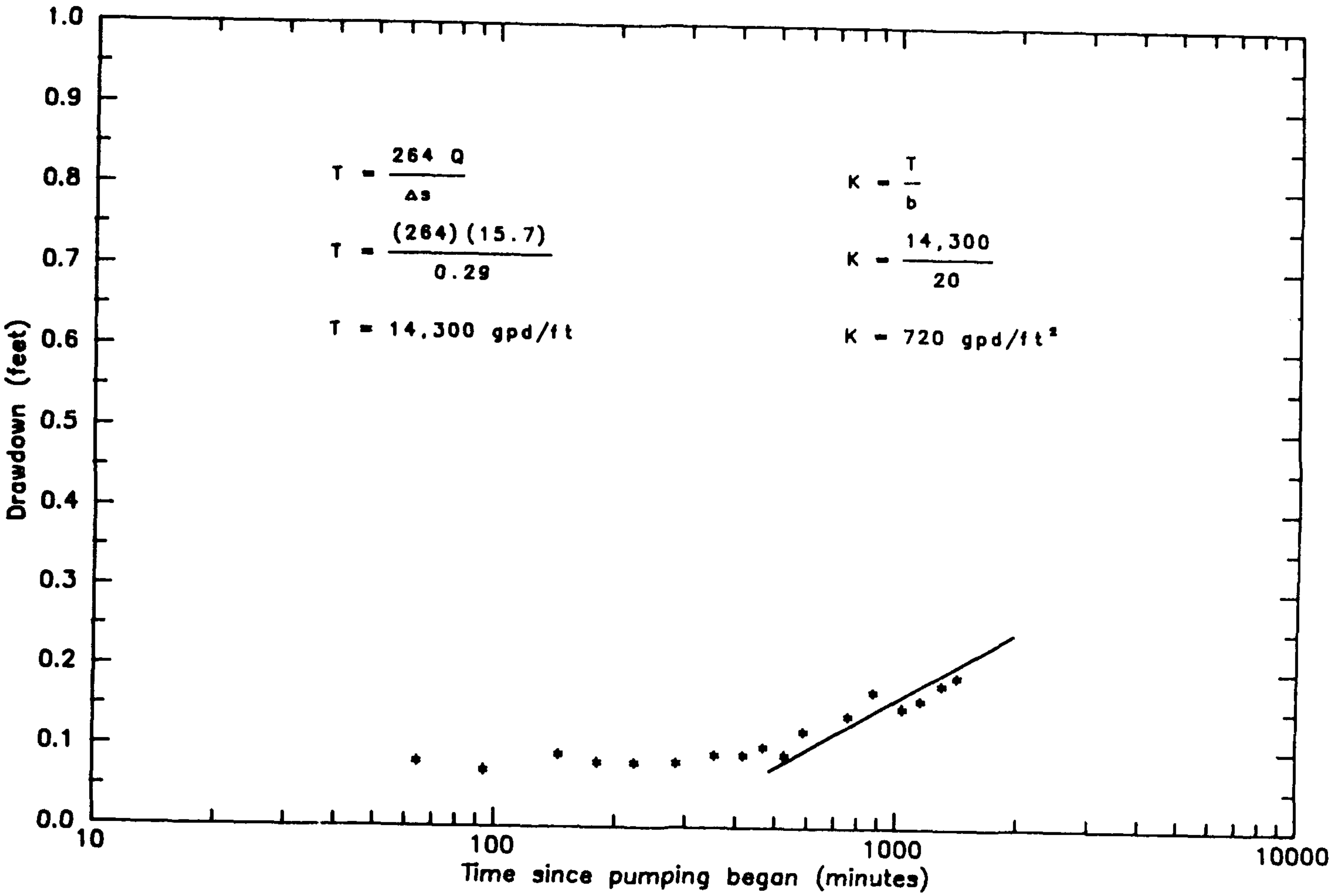


FIGURE C.40 Cooper–Jacob Nonequilibrium Analysis Using Data from Well WW–5

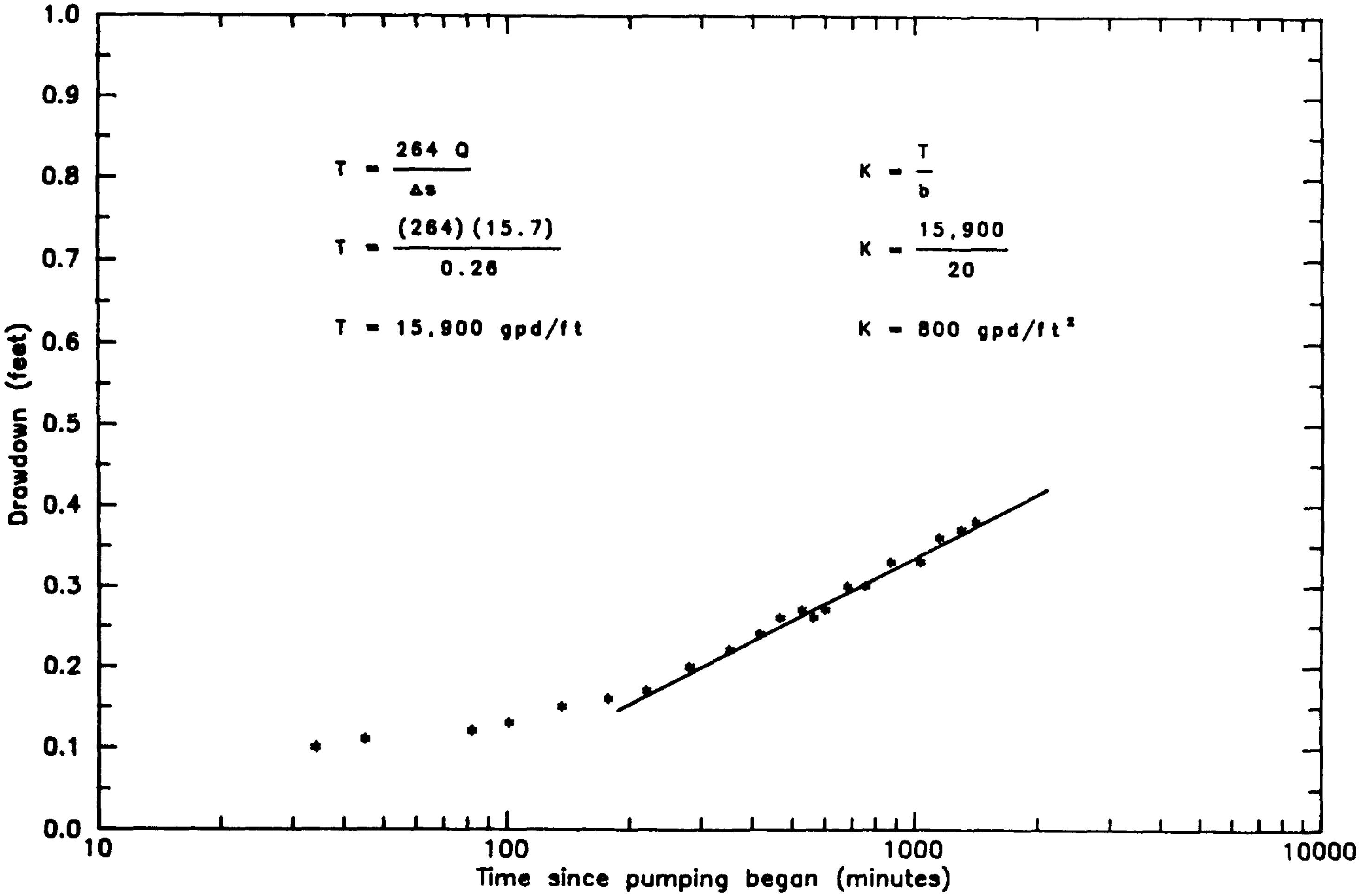


FIGURE C.41 Cooper–Jacob Nonequilibrium Analysis Using Data from Well WW–6

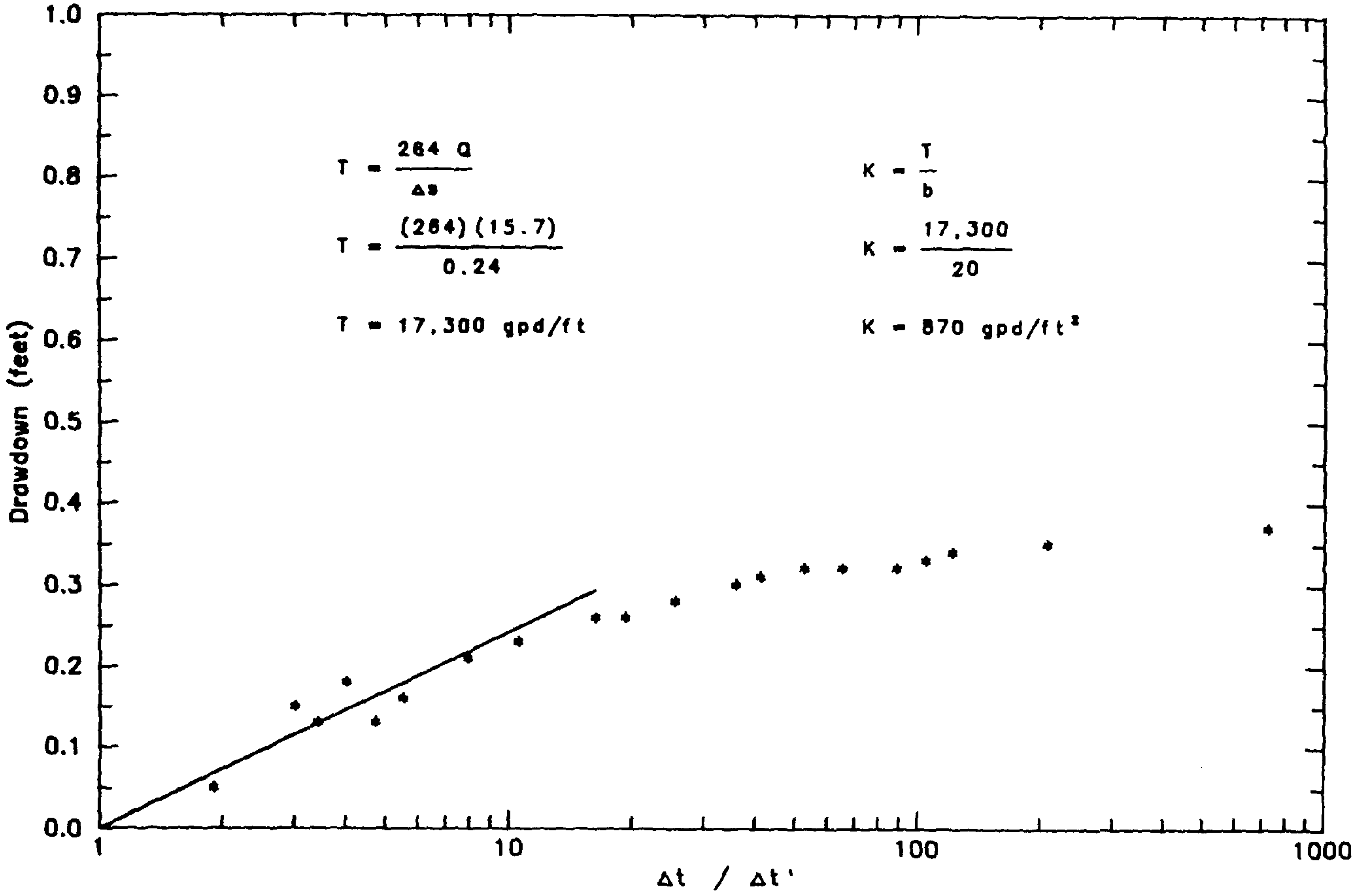


FIGURE C.42 Theis Recovery Analysis Using Data from Well WW-6

SECTION C.2
SLUG TEST ANALYSES AT SITE 1

Eleven slug tests were conducted at Site 1, Volk Field ANGB, to estimate the hydraulic conductivity in the vicinity of monitoring wells. Slug tests are a rapid means of evaluating hydraulic conductivity but are limited to measuring this characteristic in the immediate vicinity of the well. Slug tests were performed at Wells VF1 MW-2, VF1 MW-3, VF1 MW-4, ET-1, ET-2, ET-4, ET-5, ET-6, ET-7, WW-3, and WW-4.

Slug testing was performed by rapidly lowering a 1.25 inch outer diameter (OD) solid stainless-steel cylinder, or slug, into each well while monitoring changes in water level using a transducer submersed in the well attached to a computerized recorder capable of measuring and recording rapid changes. Upon introduction of the slug, the water rose to a level above the static, pre-test water level. After monitoring the water level as it returned to the static water level, the slug was rapidly removed and the water level was again monitored until it returned to static water level. The rate at which the water level changed following injection and removal of the slug is related to the hydraulic conductivity of the media surrounding the well. A slug removal test was not performed at Well ET-5 due to equipment malfunctions.

Water level data and computed water level changes are given in Section C.2.1. The slug test data was analyzed using the procedures developed by *Bouwer and Rice (Bouwer, 1978)* for slug tests in unconfined aquifers. Using this method, positive values of the change in water level, y, observed following the injection or removal of the slug are plotted on a log axis while the time since injection or removal of the slug is plotted on an arithmetic axis. A straight-line portion of the resulting curve is identified and projected back to time zero. The equation used to determine hydraulic conductivity is then:

$$K = \frac{37.4 r_c^2 \ln(R_e/r_w) \ln(Y_o/y_t)}{L_e t} \qquad \text{(Equation 4)}$$

where:

- K = hydraulic conductivity, in gallons per day per square foot (qpd/ft^2);
- r_c = radius of the well casing, in inches (in);
- R_e = effective radial distance over which the change in water level is dissipated, in inches (in);
- r_w = radius of the borehole, in inches (in);
- Y_o = change in water level at time zero projected back from straight-line portion of curve, in feet (ft);
- y_t = change in water level, in feet, on straight-line portion of curve at time t, in minutes (min); and
- L_e = height of screened section of well through which ground water enters, in feet (ft).

The distance over which the change in water level is dissipated, R_e, is related to the well and aquifer geometry by the empirical equation:

$$\ln (R_e/r_w) = \left[\frac{1.1}{\ln\left(\frac{12\,L_w}{r_w}\right)} + \frac{A + B \ln\ [(H-L_w)/r_w]}{\frac{12\,L_e}{r_w}} \right]^{-1}$$

Where L_w is the height of the static water table above the bottom of the screened interval, in feet; A and B are empirical functions of L_e/r_w that can be found using a figure given by *Bouwer (1978, Figure 5.11)*; and H is the height of the water table above impermeable bedrock, in feet. If the term $\ln\ [(H - L_w)/r_w]$ is greater than 6, a value of 6 should be used for this term. This condition requires a value for H no less than 188 feet. Though the depth to impermeable bedrock is not precisely known for each well tested, it is assumed that H is consistently greater than 188 feet, and 6 is used for the above term in determining $\ln(R_e/r_w)$.

Values of L_e, L_w, r_c, r_w, A, B and $\ln(R_e/r_w)$, used for each well are given in Table C.23 along with values of y_o, y_t, t, and K determined from both injection and removal analyses. Plots of log y versus t used to determine Y_o, Y_t, t are shown in Figures C.43 through C.63.

Apparent hydraulic conductivities in the vicinities of the wells tested using the slug test method range from 7 gpd/ft^2 to 96 gpd/ft^2.

C.2.1 Slug Test Water Level Data and Computed Water Level Changes at Site 1

Observed water levels for wells at Site 1 which were slug tested and computed water level changes are given in Table C.24 through C.35. In these tables, the column headings have the following meaning:

t = time since injection or removal of slug, in minutes (min). The same values of t are used for both injection and removal because the recording intervals are preset by the water level recording device.

Depth to Water = The depth to water from the top of casing, in feet (ft); and

y = The change in water level following injection or removal of the slug, in feet (ft). The change in water level is the depth to water subtracted from the depth to water prior to the test (initial water level) for the injection test, and the initial water level subtracted from the depth to water for the removal test.

REFERENCES

Bouwer, H., 1987. *Groundwater Hydrology*: McGraw-Hill, Inc.

Freeze, R.A., and J.A. Cherry, 1979. *Groundwater*: Prentice-Hall, Inc.

Lohman, S.W., 1970. *Groundwater Hydraulics*: U.S. Geological Survey Professional Paper 708.

TABLES C.23 THROUGH C.34

TABLE C.23
VOLK FIELD ANGB
SLUG TEST ANALYSES SUMMARY

Well I.D.	Depth to Water Table(1) (ft)	Screened Interval(1) (ft)	Le (ft)	Lw (ft)	Screen Radius (rc) (inches)	Borehole Radius (rw) (inches)	A	B	ln(Re/rw)	Injection Analysis yo (ft)	Injection Analysis yt (ft)	Injection Analysis t (min)	Injection Analysis K (gpd/ sq ft)	Removal Analysis yo (ft)	Removal Analysis yt (ft)	Removal Analysis t (min)	Removal Analysis K (gpd/ sq ft)
VF1 MW-2	12.47	23.0 - 33.0	10.0	20.6	1.00	4.00	2.5	0.3	2.44	3.00	0.054	0.5	73	9.00	0.052	0.5	94
VF1 MW-3	12.10	34.5 - 44.5	10.0	32.4	1.00	4.00	2.5	0.3	2.61	3.16	0.080	0.5	72	3.35	0.160	0.5	59
VF1 MW-4	10.38	34.1 - 44.1	10.0	33.7	1.00	4.00	2.5	0.3	2.62	3.72	0.040	0.5	89	5.25	0.059	0.5	88
ET-1	18.58	20.7 - 25.2	4.5	6.6	1.00	3.50	2.0	0.3	1.67	2.05	0.520	0.5	38	1.41	0.039	0.8	62
ET-2	16.16	20.1 - 24.6	4.5	8.4	1.00	3.50	2.0	0.3	1.74	2.14	0.079	0.5	96	1.23	0.030	0.8	67
ET-4	14.34	12.8 - 22.8	8.5	8.5	1.00	3.50	2.5	0.3	2.11	1.90	0.042	0.8	44	2.40	0.017	1.2	38
ET-5	15.77	12.5 - 21.5	5.7	5.7	1.00	3.50	2.2	0.3	1.74	1.10	0.158	1.2	18				
ET-6	12.21	37.1 - 42.1	10.0	29.9	1.00	3.50	2.1	0.3	2.15	3.02	1.070	1.5	7	3.00	0.955	1.5	8
		22.1 - 27.1															
ET-7	13.05	10.0 - 20.0	6.9	6.9	1.00	3.50	2.3	0.3	1.92	1.07	0.047	0.5	65	4.42	0.016	0.8	73
WW-3	14.51	17.1 - 32.1	15.0	17.6	2.00	3.00	3.4	0.6	2.66	0.90	0.076	1.0	66	1.00	0.038	1.0	87
WW-4	14.20	16.7 - 31.7	15.0	17.5	2.00	3.00	3.4	0.6	2.66	0.88	0.140	1.0	49	0.88	0.146	1.0	48

(1) Measured from top of casing.

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TABLE C.24

VOLK FIELD ANGB

SLUG TEST DATA AND WATER LEVEL CHANGE COMPUTATIONS
FOR WELL VF1 MW-2

INITIAL WATER LEVEL: 12.47 FEET BELOW TOP OF CASING

	INJECTION TEST		REMOVAL TEST	
DATE:	4-21-88		4-21-88	
TIME: (CDT)	9:09		9:20	
t (min)	Depth to Water (ft)	y (ft)	Depth to Water (ft)	y (ft)
0.0000	12.43	0.04	12.43	-0.04
0.0033	12.45	0.02	12.43	-0.04
0.0066	12.45	0.02	12.43	-0.04
0.0099	12.45	0.02	12.43	-0.04
0.0133	12.45	0.02	12.43	-0.04
0.0166	12.43	0.04	12.45	-0.02
0.0200	12.43	0.04	12.45	-0.02
0.0233	12.42	0.05	16.08	3.61
0.0266	9.73	2.74	14.35	1.88
0.0300	6.16	6.31	15.92	3.45
0.0333	3.06	9.41	15.70	3.23
0.0500	14.54	-2.07	13.70	1.23
0.0666	10.15	2.32	14.90	2.43
0.0833	10.93	1.54	15.41	2.94
0.1000	11.12	1.35	14.87	2.40
0.1166	11.29	1.18	15.20	2.73
0.1333	11.45	1.02	14.76	2.29
0.1500	11.59	0.88	14.59	2.12
0.1666	11.70	0.77	14.62	2.15
0.1833	11.80	0.67	14.22	1.75
0.2000	11.89	0.58	13.91	1.44
0.2166	11.97	0.50	13.67	1.20
0.2333	12.02	0.45	13.61	1.14
0.2500	12.09	0.38	13.29	0.82
0.2666	12.13	0.34	13.04	0.57
0.2833	12.16	0.31	12.91	0.44
0.3000	12.20	0.27	12.85	0.38
0.3166	12.23	0.24	12.80	0.33
0.3333	12.26	0.21	12.75	0.28
0.4167	12.34	0.13	12.48	0.01
0.5000	12.39	0.08	12.43	-0.04
0.5833	12.40	0.07	12.40	-0.07
0.6667	12.40	0.07	12.40	-0.07
0.7500	12.42	0.05	12.39	-0.08
0.8333	12.42	0.05	12.39	-0.08
0.9167	12.42	0.05	12.39	-0.08
1.0000	12.42	0.05	12.39	-0.08

TABLE C.24
(CONTINUED)
VOLK FIELD ANGB

SLUG TEST DATA AND WATER LEVEL CHANGE COMPUTATIONS
FOR WELL VF1 MW-2

INITIAL WATER LEVEL: 12.47 FEET BELOW TOP OF CASING

	INJECTION TEST		REMOVAL TEST	
DATE:	4-21-88		4-21-88	
TIME: (CDT)	9:09		9:20	
t (min)	Depth to Water (ft)	y (ft)	Depth to Water (ft)	y (ft)
1.0833	12.42	0.05	12.39	-0.08
1.1667	12.42	0.05	12.39	-0.08
1.2500	12.43	0.04	12.39	-0.08
1.3333	12.43	0.04	12.39	-0.08
1.4166	12.43	0.04	12.39	-0.08
1.5000	12.43	0.04	12.39	-0.08
1.5833	12.43	0.04	12.39	-0.08
1.6667	12.43	0.04	12.39	-0.08
1.7500	12.43	0.04	12.39	-0.08
1.8333	12.43	0.04	12.39	-0.08
1.9167	12.43	0.04	12.39	-0.08
2.0000	12.43	0.04	12.39	-0.08
2.5000	12.43	0.04	12.37	-0.10
3.0000	12.43	0.04	12.39	-0.08
3.5000	12.43	0.04	12.39	-0.08
4.0000	12.43	0.04	12.39	-0.08
4.5000	12.43	0.04	12.39	-0.08
5.0000	12.43	0.04	12.37	-0.10
5.5000	12.43	0.04	12.39	-0.08
6.0000	12.43	0.04	12.37	-0.10
6.5000	12.43	0.04	12.39	-0.08
7.0000	12.43	0.04	12.39	-0.08
7.5000	12.43	0.04	12.39	-0.08
8.0000	12.43	0.04	12.39	-0.08
8.5000	12.43	0.04	12.37	-0.10
9.0000	12.43	0.04	12.37	-0.10
9.5000	12.43	0.04	12.39	-0.08
10.0000	12.43	0.04	12.37	-0.10

TABLE C.25

VOLK FIELD ANGB

SLUG TEST DATA AND WATER LEVEL CHANGE COMPUTATIONS
FOR WELL VF1 MW-3

INITIAL WATER LEVEL: 12.08 FEET BELOW TOP OF CASING

	INJECTION TEST		REMOVAL TEST	
DATE:	4-21-88		4-21-88	
TIME: (CDT)	13:06		13:17	
t (min)	Depth to Water (ft)	y (ft)	Depth to Water (ft)	y (ft)
0.0000	12.04	0.04	12.04	-0.04
0.0033	12.06	0.02	12.04	-0.04
0.0066	12.06	0.02	12.04	-0.04
0.0099	12.06	0.02	12.04	-0.04
0.0133	12.06	0.02	13.96	1.88
0.0166	12.04	0.04	14.69	2.61
0.0200	12.04	0.04	14.18	2.10
0.0233	12.04	0.04	12.96	0.88
0.0266	12.04	0.04	10.40	-1.68
0.0300	8.69	3.39	9.53	-2.55
0.0333	4.90	7.18	12.20	0.12
0.0500	8.91	3.17	12.42	0.34
0.0666	8.97	3.11	13.31	1.23
0.0833	10.46	1.62	14.42	2.34
0.1000	10.60	1.48	14.21	2.13
0.1166	10.79	1.29	13.98	1.90
0.1333	10.95	1.13	14.23	2.15
0.1500	11.09	0.99	14.13	2.05
0.1666	11.20	0.88	13.98	1.90
0.1833	11.31	0.77	13.93	1.85
0.2000	11.39	0.69	13.61	1.53
0.2166	11.47	0.61	13.12	1.04
0.2333	11.55	0.53	12.93	0.85
0.2500	11.60	0.48	12.82	0.74
0.2666	11.66	0.42	12.72	0.64
0.2833	11.71	0.37	12.68	0.60
0.3000	11.74	0.34	12.63	0.55
0.3166	11.79	0.29	12.58	0.50
0.3333	11.81	0.27	12.53	0.45
0.4167	11.92	0.16	12.31	0.23
0.5000	11.98	0.10	12.23	0.15
0.5833	12.01	0.07	12.19	0.11
0.6667	12.03	0.05	12.17	0.09
0.7500	12.03	0.05	12.15	0.07
0.8333	12.04	0.04	12.15	0.07
0.9167	12.04	0.04	12.14	0.06
1.0000	12.04	0.04	12.14	0.06

TABLE C.25
(CONTINUED)
VOLK FIELD ANGB

SLUG TEST DATA AND WATER LEVEL CHANGE COMPUTATIONS
FOR WELL VF1 MW-3

INITIAL WATER LEVEL: 12.08 FEET BELOW TOP OF CASING

	INJECTION TEST		REMOVAL TEST	
DATE:	4-21-88		4-21-88	
TIME: (CDT)	13:06		13:17	
t (min)	Depth to Water (ft)	y (ft)	Depth to Water (ft)	y (ft)
1.0833	12.04	0.04	12.14	0.06
1.1667	12.04	0.04	12.14	0.06
1.2500	12.04	0.04	12.11	0.03
1.3333	12.04	0.04	12.11	0.03
1.4166	12.04	0.04	12.11	0.03
1.5000	12.04	0.04	12.11	0.03
1.5833	12.04	0.04	12.11	0.03
1.6667	12.04	0.04	12.09	0.01
1.7500	12.04	0.04	12.08	0.00
1.8333	12.04	0.04	12.08	0.00
1.9167	12.04	0.04	12.08	0.00
2.0000	12.04	0.04	12.09	0.01
2.5000	12.04	0.04	12.08	0.00
3.0000	12.04	0.04	12.08	0.00
3.5000	12.04	0.04	12.08	0.00
4.0000	12.04	0.04	12.08	0.00
4.5000	12.04	0.04	12.08	0.00
5.0000	12.04	0.04	12.08	0.00
5.5000	12.04	0.04	12.08	0.00
6.0000	12.04	0.04	12.08	0.00
6.5000	12.04	0.04	12.06	-0.02
7.0000	12.04	0.04	12.06	-0.02
7.5000	12.04	0.04	12.06	-0.02
8.0000	12.04	0.04	12.06	-0.02
8.5000	12.04	0.04	12.06	-0.02
9.0000	12.04	0.04	12.06	-0.02
9.5000	12.04	0.04	12.08	0.00
10.0000	12.04	0.04	12.08	0.00

TABLE C.26

VOLK FIELD ANGB

SLUG TEST DATA AND WATER LEVEL CHANGE COMPUTATIONS
FOR WELL VF1 MW-4

INITIAL WATER LEVEL: 10.38 FEET BELOW TOP OF CASING

	INJECTION TEST		REMOVAL TEST	
DATE:	4-20-88		4-20-88	
TIME: (CDT)	16:27		16:37	
t (min)	Depth to Water (ft)	y (ft)	Depth to Water (ft)	y (ft)
0.0000	10.36	0.02	10.38	0.00
0.0033	10.36	0.02	10.38	0.00
0.0066	10.36	0.02	10.38	0.00
0.0099	10.36	0.02	10.38	0.00
0.0133	10.36	0.02	10.38	0.00
0.0166	10.36	0.02	10.38	0.00
0.0200	10.33	0.05	10.38	0.00
0.0233	10.31	0.07	10.38	0.00
0.0266	8.85	1.53	11.42	1.04
0.0300	7.38	3.00	11.91	1.53
0.0333	8.09	2.29	11.78	1.40
0.0500	12.89	-2.51	11.37	0.99
0.0666	7.83	2.55	12.04	1.66
0.0833	8.62	1.76	12.66	2.28
0.1000	8.87	1.51	12.58	2.20
0.1166	9.09	1.29	12.24	1.86
0.1333	9.27	1.11	11.97	1.59
0.1500	9.44	0.94	11.72	1.34
0.1666	9.57	0.81	11.52	1.14
0.1833	9.68	0.70	11.36	0.98
0.2000	9.79	0.59	11.21	0.83
0.2166	9.87	0.51	11.09	0.71
0.2333	9.93	0.45	10.99	0.61
0.2500	10.00	0.38	10.90	0.52
0.2666	10.04	0.34	10.83	0.45
0.2833	10.09	0.29	10.77	0.39
0.3000	10.14	0.24	10.71	0.33
0.3166	10.17	0.21	10.66	0.28
0.3333	10.19	0.19	10.63	0.25
0.4167	10.28	0.10	10.50	0.12
0.5000	10.33	0.05	10.44	0.06
0.5833	10.34	0.04	10.41	0.03
0.6667	10.36	0.02	10.39	0.01
0.7500	10.36	0.02	10.39	0.01
0.8333	10.36	0.02	10.38	0.00
0.9167	10.36	0.02	10.38	0.00
1.0000	10.36	0.02	10.38	0.00

TABLE C.26
(CONTINUED)
VOLK FIELD ANGB

SLUG TEST DATA AND WATER LEVEL CHANGE COMPUTATIONS
FOR WELL VF1 MW-4

INITIAL WATER LEVEL: 10.38 FEET BELOW TOP OF CASING

	INJECTION TEST		REMOVAL TEST	
DATE:	4-20-88		4-20-88	
TIME: (CDT)	16:27		16:37	
t (min)	Depth to Water (ft)	y (ft)	Depth to Water (ft)	y (ft)
1.0833	10.36	0.02	10.38	0.00
1.1667	10.38	0.00	10.39	0.01
1.2500	10.38	0.00	10.39	0.01
1.3333	10.38	0.00	10.39	0.01
1.4166	10.38	0.00	10.39	0.01
1.5000	10.38	0.00	10.38	0.00
1.5833	10.38	0.00	10.38	0.00
1.6667	10.38	0.00	10.38	0.00
1.7500	10.38	0.00	10.38	0.00
1.8333	10.38	0.00	10.38	0.00
1.9167	10.38	0.00	10.38	0.00
2.0000	10.38	0.00	10.38	0.00
2.5000	10.36	0.02	10.38	0.00
3.0000	10.36	0.02	10.38	0.00
3.5000	10.38	0.00	10.38	0.00
4.0000	10.36	0.02	10.38	0.00
4.5000	10.36	0.02	10.36	-0.02
5.0000	10.36	0.02	10.38	0.00
5.5000	10.36	0.02	10.38	0.00
6.0000	10.38	0.00	10.38	0.00
6.5000	10.38	0.00	10.36	-0.02
7.0000	10.38	0.00	10.36	-0.02
7.5000	10.38	0.00	10.36	-0.02
8.0000	10.39	-0.01	10.36	-0.02
8.5000	10.38	0.00	10.38	0.00
9.0000	10.38	0.00	10.38	0.00
9.5000	10.38	0.00	10.38	0.00
10.0000	10.38	0.00	10.38	0.00

TABLE C.27

VOLK FIELD ANGB

SLUG TEST DATA AND WATER LEVEL CHANGE COMPUTATIONS
FOR WELL ET-1

INITIAL WATER LEVEL: 18.58 FEET BELOW TOP OF CASING

	INJECTION TEST		REMOVAL TEST	
DATE:	4-19-88		4-19-88	
TIME: (CDT)	16:29		16:43	
t (min)	Depth to Water (ft)	y (ft)	Depth to Water (ft)	y (ft)
0.0000	18.56	0.02	18.61	0.03
0.0033	18.54	0.04	18.61	0.03
0.0066	11.94	6.64	18.61	0.03
0.0099	30.31	-11.73	20.13	1.55
0.0133	16.01	2.57	18.72	0.14
0.0166	17.69	0.89	20.33	1.75
0.0200	17.15	1.43	19.98	1.40
0.0233	16.79	1.79	19.97	1.39
0.0266	17.01	1.57	19.94	1.36
0.0300	16.85	1.73	19.89	1.31
0.0333	16.88	1.70	19.86	1.28
0.0500	17.10	1.48	19.75	1.17
0.0666	17.29	1.29	19.64	1.06
0.0833	17.45	1.13	19.57	0.99
0.1000	17.58	1.00	19.49	0.91
0.1166	17.70	0.88	19.43	0.85
0.1333	17.80	0.78	19.37	0.79
0.1500	17.89	0.69	19.30	0.72
0.1666	17.97	0.61	19.26	0.68
0.1833	18.04	0.54	19.21	0.63
0.2000	18.10	0.48	19.16	0.58
0.2166	18.16	0.42	19.11	0.53
0.2333	18.20	0.38	19.08	0.50
0.2500	18.24	0.34	19.05	0.47
0.2666	18.29	0.29	19.02	0.44
0.2833	18.32	0.26	18.99	0.41
0.3000	18.35	0.23	18.96	0.38
0.3166	18.37	0.21	18.92	0.34
0.3333	18.40	0.18	18.91	0.33
0.4167	18.48	0.10	18.80	0.22
0.5000	18.53	0.05	18.73	0.15
0.5833	18.56	0.02	18.69	0.11
0.6667	18.58	0.00	18.65	0.07
0.7500	18.59	-0.01	18.64	0.06
0.8333	18.59	-0.01	18.62	0.04
0.9167	18.61	-0.03	18.62	0.04
1.0000	18.61	-0.03	18.61	0.03

TABLE C.27
(CONTINUED)
VOLK FIELD ANGB

SLUG TEST DATA AND WATER LEVEL CHANGE COMPUTATIONS
FOR WELL ET-1

INITIAL WATER LEVEL: 18.58 FEET BELOW TOP OF CASING

	INJECTION TEST		REMOVAL TEST	
DATE:	4-19-88		4-19-88	
TIME: (CDT)	16:29		16:43	
t (min)	Depth to Water (ft)	y (ft)	Depth to Water (ft)	y (ft)
1.0833	18.61	-0.03	18.61	0.03
1.1667	18.61	-0.03	18.61	0.03
1.2500	18.61	-0.03	18.61	0.03
1.3333	18.59	-0.01	18.61	0.03
1.4166	18.59	-0.01	18.59	0.01
1.5000	18.59	-0.01	18.61	0.03
1.5833	18.61	-0.03	18.61	0.03
1.6667	18.59	-0.01	18.61	0.03
1.7500	18.61	-0.03	18.61	0.03
1.8333	18.61	-0.03	18.61	0.03
1.9167	18.61	-0.03	18.61	0.03
2.0000	18.61	-0.03	18.61	0.03
2.5000	18.61	-0.03	18.59	0.01
3.0000	18.61	-0.03	18.61	0.03
3.5000	18.62	-0.04	18.61	0.03
4.0000	18.61	-0.03	18.61	0.03
4.5000	18.61	-0.03	18.61	0.03
5.0000	18.62	-0.04	18.59	0.01
5.5000	18.61	-0.03	18.58	0.00
6.0000	18.61	-0.03	18.58	0.00
6.5000	18.61	-0.03	18.58	0.00
7.0000	18.61	-0.03	18.58	0.00
7.5000	18.61	-0.03	18.58	0.00
8.0000	18.61	-0.03	18.58	0.00
8.5000	18.61	-0.03	18.58	0.00
9.0000	18.61	-0.03	18.58	0.00
9.5000	18.61	-0.03	18.58	0.00
10.0000	18.61	-0.03	18.58	0.00

TABLE C.28

VOLK FIELD ANGB

SLUG TEST DATA AND WATER LEVEL CHANGE COMPUTATIONS
FOR WELL ET-2

INITIAL WATER LEVEL: 16.16 FEET BELOW TOP OF CASING

	INJECTION TEST		REMOVAL TEST	
DATE:	4-21-88		4-21-88	
TIME: (CDT)	13:54		14:05	
t (min)	Depth to Water (ft)	y (ft)	Depth to Water (ft)	y (ft)
0.0000	16.16	0.00	16.17	0.01
0.0033	16.17	-0.01	16.17	0.01
0.0066	16.17	-0.01	16.17	0.01
0.0099	16.17	-0.01	16.17	0.01
0.0133	16.16	0.00	16.17	0.01
0.0166	16.17	-0.01	16.42	0.26
0.0200	16.17	-0.01	16.79	0.63
0.0233	16.14	0.02	16.61	0.45
0.0266	16.20	-0.04	17.50	1.34
0.0300	16.19	-0.03	17.26	1.10
0.0333	16.19	-0.03	17.25	1.09
0.0500	21.97	-5.81	17.14	0.98
0.0666	14.86	1.30	17.07	0.91
0.0833	14.94	1.22	17.01	0.85
0.1000	15.03	1.13	16.93	0.77
0.1166	15.16	1.00	16.87	0.71
0.1333	15.27	0.89	16.82	0.66
0.1500	15.36	0.80	16.77	0.61
0.1666	15.44	0.72	16.73	0.57
0.1833	15.52	0.64	16.69	0.53
0.2000	15.60	0.56	16.65	0.49
0.2166	15.65	0.51	16.61	0.45
0.2333	15.70	0.46	16.58	0.42
0.2500	15.74	0.42	16.55	0.39
0.2666	15.79	0.37	16.54	0.38
0.2833	15.82	0.34	16.50	0.34
0.3000	15.87	0.29	16.47	0.31
0.3166	15.89	0.27	16.46	0.30
0.3333	15.92	0.24	16.42	0.26
0.4167	16.01	0.15	16.35	0.19
0.5000	16.08	0.08	16.30	0.14
0.5833	16.12	0.04	16.25	0.09
0.6667	16.14	0.02	16.22	0.06
0.7500	16.14	0.02	16.20	0.04
0.8333	16.16	0.00	16.19	0.03
0.9167	16.16	0.00	16.19	0.03
1.0000	16.16	0.00	16.17	0.01

TABLE C.28
(CONTINUED)
VOLK FIELD ANGB

SLUG TEST DATA AND WATER LEVEL CHANGE COMPUTATIONS
FOR WELL ET-2

INITIAL WATER LEVEL: 16.16 FEET BELOW TOP OF CASING

	INJECTION TEST		REMOVAL TEST	
DATE:	4-21-88		4-21-88	
TIME: (CDT)	13:54		14:05	
t (min)	Depth to Water (ft)	y (ft)	Depth to Water (ft)	y (ft)
1.0833	16.16	0.00	16.17	0.01
1.1667	16.16	0.00	16.17	0.01
1.2500	16.16	0.00	16.17	0.01
1.3333	16.16	0.00	16.16	0.00
1.4166	16.17	-0.01	16.16	0.00
1.5000	16.16	0.00	16.16	0.00
1.5833	16.16	0.00	16.16	0.00
1.6667	16.17	-0.01	16.16	0.00
1.7500	16.17	-0.01	16.16	0.00
1.8333	16.16	0.00	16.16	0.00
1.9167	16.17	-0.01	16.16	0.00
2.0000	16.16	0.00	16.16	0.00
2.5000	16.16	0.00	16.14	-0.02
3.0000	16.16	0.00	16.16	0.00
3.5000	16.14	0.02	16.14	-0.02
4.0000	16.14	0.02	16.14	-0.02
4.5000	16.14	0.02	16.14	-0.02
5.0000	16.14	0.02	16.14	-0.02
5.5000	16.14	0.02	16.14	-0.02
6.0000	16.14	0.02	16.14	-0.02
6.5000	16.16	0.00	16.14	-0.02
7.0000	16.16	0.00	16.14	-0.02
7.5000	16.17	-0.01	16.14	-0.02
8.0000	16.17	-0.01	16.14	-0.02
8.5000	16.17	-0.01	16.16	0.00
9.0000	16.17	-0.01	16.14	-0.02
9.5000	16.17	-0.01	16.14	-0.02
10.0000	16.17	-0.01	16.14	-0.02

TABLE C.29

VOLK FIELD ANGB

SLUG TEST DATA AND WATER LEVEL CHANGE COMPUTATIONS
FOR WELL ET-4

INITIAL WATER LEVEL: 14.34 FEET BELOW TOP OF CASING

	INJECTION TEST		REMOVAL TEST	
DATE:	4-21-88		4-21-88	
TIME: (CDT)	15:21		15:33	
t (min)	Depth to Water (ft)	y (ft)	Depth to Water (ft)	y (ft)
0.0000	14.35	-0.01	14.34	0.00
0.0033	14.37	-0.03	14.35	0.01
0.0066	14.37	-0.03	14.35	0.01
0.0099	14.37	-0.03	14.35	0.01
0.0133	14.37	-0.03	14.35	0.01
0.0166	14.35	-0.01	14.35	0.01
0.0200	14.37	-0.03	14.35	0.01
0.0233	14.37	-0.03	16.38	2.04
0.0266	14.37	-0.03	15.82	1.48
0.0300	14.37	-0.03	15.57	1.23
0.0333	14.37	-0.03	15.89	1.55
0.0500	11.25	3.09	16.55	2.21
0.0666	11.63	2.71	16.33	1.99
0.0833	12.09	2.25	16.16	1.82
0.1000	12.58	1.76	16.01	1.67
0.1166	12.80	1.54	15.89	1.55
0.1333	13.02	1.32	15.78	1.44
0.1500	13.19	1.15	15.67	1.33
0.1666	13.34	1.00	15.57	1.23
0.1833	13.45	0.89	15.49	1.15
0.2000	13.56	0.78	15.35	1.01
0.2166	13.64	0.70	15.33	0.99
0.2333	13.70	0.64	15.25	0.91
0.2500	13.78	0.56	15.19	0.85
0.2666	13.83	0.51	15.13	0.79
0.2833	13.88	0.46	15.08	0.74
0.3000	13.91	0.43	15.03	0.69
0.3166	13.96	0.38	14.98	0.64
0.3333	13.99	0.35	14.94	0.60
0.4167	14.10	0.24	14.76	0.42
0.5000	14.18	0.16	14.65	0.31
0.5833	14.22	0.12	14.56	0.22
0.6667	14.26	0.08	14.51	0.17
0.7500	14.29	0.05	14.46	0.12
0.8333	14.30	0.04	14.43	0.09
0.9167	14.32	0.02	14.41	0.07
1.0000	14.32	0.02	14.40	0.06

TABLE C.29
(CONTINUED)
VOLK FIELD ANGB

SLUG TEST DATA AND WATER LEVEL CHANGE COMPUTATIONS
FOR WELL ET-4

INITIAL WATER LEVEL: 14.34 FEET BELOW TOP OF CASING

	INJECTION TEST		REMOVAL TEST	
DATE:	4-21-88		4-21-88	
TIME: (CDT)	15:21		15:33	
t (min)	Depth to Water (ft)	y (ft)	Depth to Water (ft)	y (ft)
1.0833	14.32	0.02	14.38	0.04
1.1667	14.34	0.00	14.37	0.03
1.2500	14.34	0.00	14.37	0.03
1.3333	14.34	0.00	14.35	0.01
1.4166	14.34	0.00	14.35	0.01
1.5000	14.34	0.00	14.35	0.01
1.5833	14.34	0.00	14.35	0.01
1.6667	14.34	0.00	14.35	0.01
1.7500	14.34	0.00	14.35	0.01
1.8333	14.35	-0.01	14.35	0.01
1.9167	14.35	-0.01	14.35	0.01
2.0000	14.35	-0.01	14.35	0.01
2.5000	14.35	-0.01	14.34	0.00
3.0000	14.35	-0.01	14.34	0.00
3.5000	14.35	-0.01	14.34	0.00
4.0000	14.35	-0.01	14.34	0.00
4.5000	14.34	0.00	14.32	-0.02
5.0000	14.34	0.00	14.34	0.00
5.5000	14.35	-0.01	14.34	0.00
6.0000	14.35	-0.01	14.34	0.00
6.5000	14.34	0.00	14.34	0.00
7.0000	14.35	-0.01	14.32	-0.02
7.5000	14.35	-0.01	14.32	-0.02
8.0000	14.35	-0.01	14.34	0.00
8.5000	14.35	-0.01	14.34	0.00
9.0000	14.35	-0.01	14.34	0.00
9.5000	14.34	0.00	14.34	0.00
10.0000	14.34	0.00	14.35	0.01

TABLE C.30

VOLK FIELD ANGB

SLUG TEST DATA AND WATER LEVEL CHANGE COMPUTATIONS
FOR WELL ET-5

INITIAL WATER LEVEL: 15.77 FEET BELOW TOP OF CASING

	INJECTION TEST		REMOVAL TEST	
DATE:	4-22-88		--	
TIME: (CDT)	09:41		--	
t (min)	Depth to Water (ft)	y (ft)	Depth to Water (ft)	y (ft)
0.0000	15.73	0.04		
0.0033	15.73	0.04		
0.0066	15.73	0.04		
0.0099	15.73	0.04		
0.0133	15.73	0.04		
0.0166	15.73	0.04		
0.0200	15.73	0.04		
0.0233	15.73	0.04		
0.0266	15.73	0.04		
0.0300	15.73	0.04		
0.0333	15.69	0.08		
0.0500	13.60	2.17		
0.0666	13.86	1.91		
0.0833	14.26	1.51		
0.1000	14.51	1.26		
0.1166	14.67	1.10		
0.1333	14.77	1.00		
0.1500	14.83	0.94		
0.1666	14.88	0.89		
0.1833	14.93	0.84		
0.2000	14.94	0.83		
0.2166	14.97	0.80		
0.2333	15.00	0.77		
0.2500	15.04	0.73		
0.2666	15.05	0.72		
0.2833	15.07	0.70		
0.3000	15.10	0.67		
0.3166	15.12	0.65		
0.3333	15.13	0.64		
0.4167	15.21	0.56		
0.5000	15.27	0.50		
0.5833	15.34	0.43		
0.6667	15.39	0.38		
0.7500	15.43	0.34		
0.8333	15.48	0.29		
0.9167	15.51	0.26		
1.0000	15.54	0.23		

TABLE C.30
(CONTINUED)
VOLK FIELD ANGB

SLUG TEST DATA AND WATER LEVEL CHANGE COMPUTATIONS
FOR WELL ET-5

INITIAL WATER LEVEL: 15.77 FEET BELOW TOP OF CASING

	INJECTION TEST		REMOVAL TEST	
DATE:	4-22-88		--	
TIME: (CDT)	09:41		--	
t (min)	Depth to Water (ft)	y (ft)	Depth to Water (ft)	y (ft)
1.0833	15.56	0.21		
1.1667	15.59	0.18		
1.2500	15.61	0.16		
1.3333	15.62	0.15		
1.4166	15.64	0.13		
1.5000	15.64	0.13		
1.5833	15.65	0.12		
1.6667	15.65	0.12		
1.7500	15.67	0.10		
1.8333	15.67	0.10		
1.9167	15.67	0.10		
2.0000	15.69	0.08		
2.5000	15.69	0.08		
3.0000	15.70	0.07		
3.5000	15.72	0.05		
4.0000	15.72	0.05		
4.5000	15.72	0.05		
5.0000	15.72	0.05		
5.5000	15.73	0.04		
6.0000	15.73	0.04		
6.5000	15.73	0.04		
7.0000	15.73	0.04		
7.5000	15.73	0.04		
8.0000	15.73	0.04		
8.5000	15.73	0.04		
9.0000	15.73	0.04		
9.5000	15.73	0.04		
10.0000	15.73	0.04		

TABLE C.31

VOLK FIELD ANGB

SLUG TEST DATA AND WATER LEVEL CHANGE COMPUTATIONS
FOR WELL ET-6

INITIAL WATER LEVEL: 12.21 FEET BELOW TOP OF CASING

	INJECTION TEST		REMOVAL TEST	
DATE:	4-21-88		4-21-88	
TIME: (CDT)	09:45		09:56	
t (min)	Depth to Water (ft)	y (ft)	Depth to Water (ft)	y (ft)
0.0000	12.21	0.00	12.17	-0.04
0.0033	12.22	-0.01	12.17	-0.04
0.0066	12.22	-0.01	12.17	-0.04
0.0099	12.22	-0.01	12.17	-0.04
0.0133	12.22	-0.01	12.17	-0.04
0.0166	12.22	-0.01	12.17	-0.04
0.0200	12.22	-0.01	12.14	-0.07
0.0233	12.22	-0.01	14.12	1.91
0.0266	12.22	-0.01	16.01	3.80
0.0300	12.22	-0.01	15.06	2.85
0.0333	12.22	-0.01	13.93	1.72
0.0500	12.25	-0.04	14.56	2.35
0.0666	9.58	2.63	13.80	1.59
0.0833	8.25	3.96	15.45	3.24
0.1000	1.50	10.71	15.34	3.13
0.1166	8.67	3.54	15.28	3.07
0.1333	9.37	2.84	15.23	3.02
0.1500	9.42	2.79	15.10	2.89
0.1666	9.45	2.76	15.07	2.86
0.1833	9.48	2.73	15.01	2.80
0.2000	9.53	2.68	14.96	2.75
0.2166	9.56	2.65	14.91	2.70
0.2333	9.58	2.63	14.87	2.66
0.2500	9.61	2.60	14.90	2.69
0.2666	9.64	2.57	14.85	2.64
0.2833	9.66	2.55	14.74	2.53
0.3000	9.69	2.52	14.69	2.48
0.3166	9.72	2.49	14.66	2.45
0.3333	9.75	2.46	14.63	2.42
0.4167	9.86	2.35	14.42	2.21
0.5000	9.97	2.24	14.26	2.05
0.5833	10.08	2.13	14.12	1.91
0.6667	10.16	2.05	13.99	1.78
0.7500	10.26	1.95	13.87	1.66
0.8333	10.34	1.87	13.77	1.56
0.9167	10.42	1.79	13.68	1.47
1.0000	10.49	1.72	13.58	1.37

TABLE C.31
(CONTINUED)
VOLK FIELD ANGB

SLUG TEST DATA AND WATER LEVEL CHANGE COMPUTATIONS
FOR WELL ET-6

INITIAL WATER LEVEL: 12.21 FEET BELOW TOP OF CASING

	INJECTION TEST		REMOVAL TEST	
DATE:	4-21-88		4-21-88	
TIME: (CDT)	09:45		09:56	
t (min)	Depth to Water (ft)	y (ft)	Depth to Water (ft)	y (ft)
1.0833	10.56	1.65	13.50	1.29
1.1667	10.62	1.59	13.42	1.21
1.2500	10.68	1.53	13.35	1.14
1.3333	10.75	1.46	13.28	1.07
1.4166	10.80	1.41	13.22	1.01
1.5000	10.86	1.35	13.16	0.95
1.5833	10.91	1.30	13.11	0.90
1.6667	10.95	1.26	13.06	0.85
1.7500	11.00	1.21	13.01	0.80
1.8333	11.05	1.16	12.97	0.76
1.9167	11.10	1.11	12.92	0.71
2.0000	11.13	1.08	12.89	0.68
2.5000	11.33	0.88	12.68	0.47
3.0000	11.51	0.70	12.55	0.34
3.5000	11.63	0.58	12.46	0.25
4.0000	11.75	0.46	12.40	0.19
4.5000	11.83	0.38	12.35	0.14
5.0000	11.89	0.32	12.32	0.11
5.5000	11.94	0.27	12.28	0.07
6.0000	11.98	0.23	12.27	0.06
6.5000	12.03	0.18	12.27	0.06
7.0000	12.06	0.15	12.27	0.06
7.5000	12.08	0.13	12.25	0.04
8.0000	12.09	0.12	12.25	0.04
8.5000	12.11	0.10	12.24	0.03
9.0000	12.13	0.08	12.24	0.03
9.5000	12.14	0.07	12.24	0.03
10.0000	12.16	0.05	12.24	0.03

TABLE C.32

VOLK FIELD ANGB

SLUG TEST DATA AND WATER LEVEL CHANGE COMPUTATIONS
FOR WELL ET-7

INITIAL WATER LEVEL: 13.05 FEET BELOW TOP OF CASING

	INJECTION TEST		REMOVAL TEST	
DATE:	4-21-88		4-21-88	
TIME: (CDT)	12:26		12:37	
t (min)	Depth to Water (ft)	y (ft)	Depth to Water (ft)	y (ft)
0.0000	13.06	-0.01	13.05	0.00
0.0033	13.06	-0.01	13.05	0.00
0.0066	13.06	-0.01	13.06	0.01
0.0099	13.06	-0.01	13.05	0.00
0.0133	13.06	-0.01	13.05	0.00
0.0166	12.98	0.07	13.05	0.00
0.0200	13.05	0.00	15.01	1.96
0.0233	13.05	0.00	14.11	1.06
0.0266	13.05	0.00	13.71	0.66
0.0300	11.59	1.46	14.07	1.02
0.0333	11.87	1.18	14.53	1.48
0.0500	7.25	5.80	14.64	1.59
0.0666	11.87	1.18	14.49	1.44
0.0833	12.05	1.00	15.26	2.21
0.1000	12.24	0.81	15.17	2.12
0.1166	12.38	0.67	14.98	1.93
0.1333	12.49	0.56	15.20	2.15
0.1500	12.57	0.48	15.33	2.28
0.1666	12.63	0.42	15.48	2.43
0.1833	12.70	0.35	14.96	1.91
0.2000	12.73	0.32	14.82	1.77
0.2166	12.78	0.27	14.72	1.67
0.2333	12.79	0.26	14.66	1.61
0.2500	12.82	0.23	14.61	1.56
0.2666	12.86	0.19	14.57	1.52
0.2833	12.87	0.18	14.50	1.45
0.3000	12.89	0.16	14.47	1.42
0.3166	12.90	0.15	14.44	1.39
0.3333	12.92	0.13	14.41	1.36
0.4167	12.95	0.10	14.28	1.23
0.5000	12.97	0.08	14.20	1.15
0.5833	13.00	0.05	14.15	1.10
0.6667	13.01	0.04	13.09	0.04
0.7500	13.03	0.02	13.08	0.03
0.8333	13.03	0.02	13.06	0.01
0.9167	13.03	0.02	13.05	0.00
1.0000	13.05	0.00	13.05	0.00

TABLE C.32
(CONTINUED)
VOLK FIELD ANGB

SLUG TEST DATA AND WATER LEVEL CHANGE COMPUTATIONS
FOR WELL ET-7

INITIAL WATER LEVEL: 13.05 FEET BELOW TOP OF CASING

	INJECTION TEST		REMOVAL TEST	
DATE:	4-21-88		4-21-88	
TIME: (CDT)	12:26		12:37	
t (min)	Depth to Water (ft)	y (ft)	Depth to Water (ft)	y (ft)
1.0833	13.05	0.00	13.03	-0.02
1.1667	13.05	0.00	13.03	-0.02
1.2500	13.05	0.00	13.03	-0.02
1.3333	13.05	0.00	13.03	-0.02
1.4166	13.05	0.00	13.03	-0.02
1.5000	13.05	0.00	13.03	-0.02
1.5833	13.05	0.00	13.03	-0.02
1.6667	13.05	0.00	13.01	-0.04
1.7500	13.05	0.00	13.03	-0.02
1.8333	13.05	0.00	13.03	-0.02
1.9167	13.05	0.00	13.03	-0.02
2.0000	13.05	0.00	13.03	-0.02
2.5000	13.05	0.00	13.01	-0.04
3.0000	13.05	0.00	13.01	-0.04
3.5000	13.03	0.02	13.01	-0.04
4.0000	13.05	0.00	13.01	-0.04
4.5000	13.05	0.00	13.01	-0.04
5.0000	13.05	0.00	13.01	-0.04
5.5000	13.05	0.00	13.01	-0.04
6.0000	13.05	0.00	13.01	-0.04
6.5000	13.05	0.00	13.01	-0.04
7.0000	13.05	0.00	13.01	-0.04
7.5000	13.03	0.02	13.01	-0.04
8.0000	13.03	0.02	13.00	-0.05
8.5000	13.03	0.02	13.01	-0.04
9.0000	13.03	0.02	13.00	-0.05
9.5000	13.05	0.00	13.00	-0.05
10.0000	13.03	0.02	13.00	-0.05

TABLE C.33

VOLK FIELD ANGB

SLUG TEST DATA AND WATER LEVEL CHANGE COMPUTATIONS
FOR WELL MW-3

INITIAL WATER LEVEL: 14.51 FEET BELOW TOP OF CASING

	INJECTION TEST		REMOVAL TEST	
DATE:	4-21-88		4-21-88	
TIME: (CDT)	14:23		14:34	
t (min)	Depth to Water (ft)	y (ft)	Depth to Water (ft)	y (ft)
0.0000	14.49	0.02	14.49	-0.02
0.0033	14.49	0.02	14.51	0.00
0.0066	14.49	0.02	14.51	0.00
0.0099	14.49	0.02	14.51	0.00
0.0133	14.49	0.02	14.51	0.00
0.0166	14.49	0.02	14.51	0.00
0.0200	14.49	0.02	14.62	0.11
0.0233	13.84	0.67	14.95	0.44
0.0266	13.51	1.00	14.70	0.19
0.0300	12.62	1.89	14.58	0.07
0.0333	15.87	-1.36	14.58	0.07
0.0500	12.89	1.62	14.90	0.39
0.0666	14.05	0.46	15.22	0.71
0.0833	13.86	0.65	15.23	0.72
0.1000	13.82	0.69	15.19	0.68
0.1166	13.86	0.65	15.15	0.64
0.1333	13.89	0.62	15.12	0.61
0.1500	13.92	0.59	15.09	0.58
0.1666	13.93	0.58	15.06	0.55
0.1833	13.95	0.56	15.03	0.52
0.2000	13.98	0.53	15.00	0.49
0.2166	14.01	0.50	14.98	0.47
0.2333	14.03	0.48	14.96	0.45
0.2500	14.05	0.46	14.93	0.42
0.2666	14.06	0.45	14.92	0.41
0.2833	14.08	0.43	14.89	0.38
0.3000	14.09	0.42	14.87	0.36
0.3166	14.11	0.40	14.85	0.34
0.3333	14.14	0.37	14.84	0.33
0.4167	14.20	0.31	14.77	0.26
0.5000	14.25	0.26	14.73	0.22
0.5833	14.28	0.23	14.68	0.17
0.6667	14.32	0.19	14.65	0.14
0.7500	14.35	0.16	14.62	0.11
0.8333	14.38	0.13	14.60	0.09
0.9167	14.39	0.12	14.58	0.07
1.0000	14.41	0.10	14.57	0.06

TABLE C.33
(CONTINUED)
VOLK FIELD ANGB

SLUG TEST DATA AND WATER LEVEL CHANGE COMPUTATIONS
FOR WELL WW-3

INITIAL WATER LEVEL: 14.51 FEET BELOW TOP OF CASING

	INJECTION TEST		REMOVAL TEST	
DATE:	4-21-88		4-21-88	
TIME: (CDT)	14:23		14:34	
t (min)	Depth to Water (ft)	y (ft)	Depth to Water (ft)	y (ft)
1.0833	14.43	0.08	14.55	0.04
1.1667	14.44	0.07	14.55	0.04
1.2500	14.44	0.07	14.55	0.04
1.3333	14.46	0.05	14.54	0.03
1.4166	14.46	0.05	14.54	0.03
1.5000	14.47	0.04	14.52	0.01
1.5833	14.47	0.04	14.52	0.01
1.6667	14.47	0.04	14.52	0.01
1.7500	14.47	0.04	14.52	0.01
1.8333	14.47	0.04	14.52	0.01
1.9167	14.47	0.04	14.52	0.01
2.0000	14.47	0.04	14.52	0.01
2.5000	14.49	0.02	14.51	0.00
3.0000	14.49	0.02	14.51	0.00
3.5000	14.49	0.02	14.49	-0.02
4.0000	14.51	0.00	14.51	0.00
4.5000	14.49	0.02	14.49	-0.02
5.0000	14.51	0.00	14.49	-0.02
5.5000	14.51	0.00	14.49	-0.02
6.0000	14.51	0.00	14.49	-0.02
6.5000	14.51	0.00	14.51	0.00
7.0000	14.51	0.00	14.51	0.00
7.5000	14.51	0.00	14.51	0.00
8.0000	14.51	0.00	14.51	0.00
8.5000	14.51	0.00	14.51	0.00
9.0000	14.51	0.00	14.51	0.00
9.5000	14.51	0.00	14.51	0.00
10.0000	14.51	0.00	14.49	-0.02

TABLE C.34

VOLK FIELD ANGB

SLUG TEST DATA AND WATER LEVEL CHANGE COMPUTATIONS
FOR WELL WW-4

INITIAL WATER LEVEL: 14.2 FEET BELOW TOP OF CASING

	INJECTION TEST		REMOVAL TEST	
DATE:	4-21-88		4-21-88	
TIME: (CDT)	14:55		15:06	
t (min)	Depth to Water (ft)	y (ft)	Depth to Water (ft)	y (ft)
0.0000	14.21	-0.01	14.21	0.01
0.0033	14.21	-0.01	14.21	0.01
0.0066	14.21	-0.01	14.21	0.01
0.0099	14.21	-0.01	14.21	0.01
0.0133	14.21	-0.01	14.21	0.01
0.0166	14.21	-0.01	14.91	0.71
0.0200	14.21	-0.01	14.58	0.38
0.0233	14.21	-0.01	14.32	0.12
0.0266	14.21	-0.01	14.26	0.06
0.0300	14.21	-0.01	14.48	0.28
0.0333	14.05	0.15	14.43	0.23
0.0500	13.15	1.05	14.92	0.72
0.0666	12.56	1.64	14.99	0.79
0.0833	12.63	1.57	14.96	0.76
0.1000	13.62	0.58	14.94	0.74
0.1166	13.53	0.67	14.91	0.71
0.1333	13.50	0.70	14.89	0.69
0.1500	13.53	0.67	14.86	0.66
0.1666	13.55	0.65	14.86	0.66
0.1833	13.58	0.62	14.83	0.63
0.2000	13.59	0.61	14.81	0.61
0.2166	13.61	0.59	14.80	0.60
0.2333	13.62	0.58	14.78	0.58
0.2500	13.64	0.56	14.77	0.57
0.2666	13.66	0.54	14.75	0.55
0.2833	13.67	0.53	14.73	0.53
0.3000	13.69	0.51	14.72	0.52
0.3166	13.70	0.50	14.70	0.50
0.3333	13.72	0.48	14.69	0.49
0.4167	13.78	0.42	14.62	0.42
0.5000	13.83	0.37	14.58	0.38
0.5833	13.88	0.32	14.53	0.33
0.6667	13.93	0.27	14.50	0.30
0.7500	13.96	0.24	14.46	0.26
0.8333	13.97	0.23	14.43	0.23
0.9167	14.01	0.19	14.42	0.22
1.0000	14.02	0.18	14.39	0.19

TABLE C.34
(CONTINUED)
VOLK FIELD ANGB

SLUG TEST DATA AND WATER LEVEL CHANGE COMPUTATIONS
FOR WELL WW-4

INITIAL WATER LEVEL: 14.2 FEET BELOW TOP OF CASING

	INJECTION TEST		REMOVAL TEST	
DATE:	4-21-88		4-21-88	
TIME: (CDT)	14:55		15:06	
t (min)	Depth to Water (ft)	y (ft)	Depth to Water (ft)	y (ft)
1.0833	14.04	0.16	14.37	0.17
1.1667	14.05	0.15	14.35	0.15
1.2500	14.07	0.13	14.34	0.14
1.3333	14.08	0.12	14.32	0.12
1.4166	14.10	0.10	14.31	0.11
1.5000	14.10	0.10	14.31	0.11
1.5833	14.12	0.08	14.29	0.09
1.6667	14.12	0.08	14.29	0.09
1.7500	14.13	0.07	14.27	0.07
1.8333	14.13	0.07	14.27	0.07
1.9167	14.15	0.05	14.27	0.07
2.0000	14.15	0.05	14.27	0.07
2.5000	14.16	0.04	14.24	0.04
3.0000	14.18	0.02	14.23	0.03
3.5000	14.20	0.00	14.23	0.03
4.0000	14.20	0.00	14.21	0.01
4.5000	14.20	0.00	14.21	0.01
5.0000	14.21	-0.01	14.21	0.01
5.5000	14.20	0.00	14.21	0.01
6.0000	14.20	0.00	14.21	0.01
6.5000	14.21	-0.01	14.23	0.03
7.0000	14.21	-0.01	14.21	0.01
7.5000	14.21	-0.01	14.21	0.01
8.0000	14.20	0.00	14.21	0.01
8.5000	14.21	-0.01	14.21	0.01
9.0000	14.20	0.00	14.21	0.01
9.5000	14.21	-0.01	14.21	0.01
10.0000	14.20	0.00	14.21	0.01

FIGURES C.43 THROUGH C.63

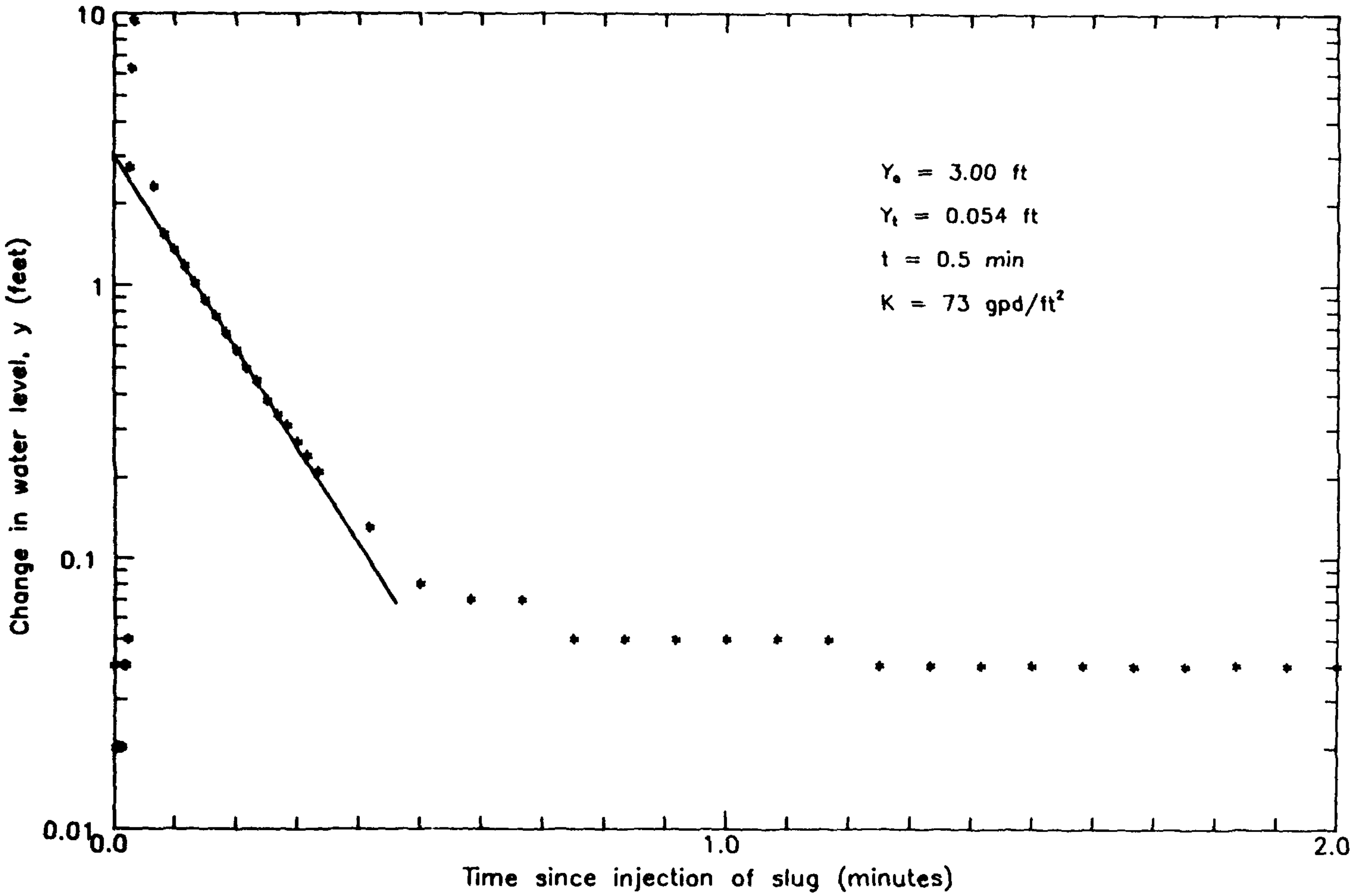


FIGURE C.43 Slug Injection Test Analysis Using Data from Well VF1 MW–2

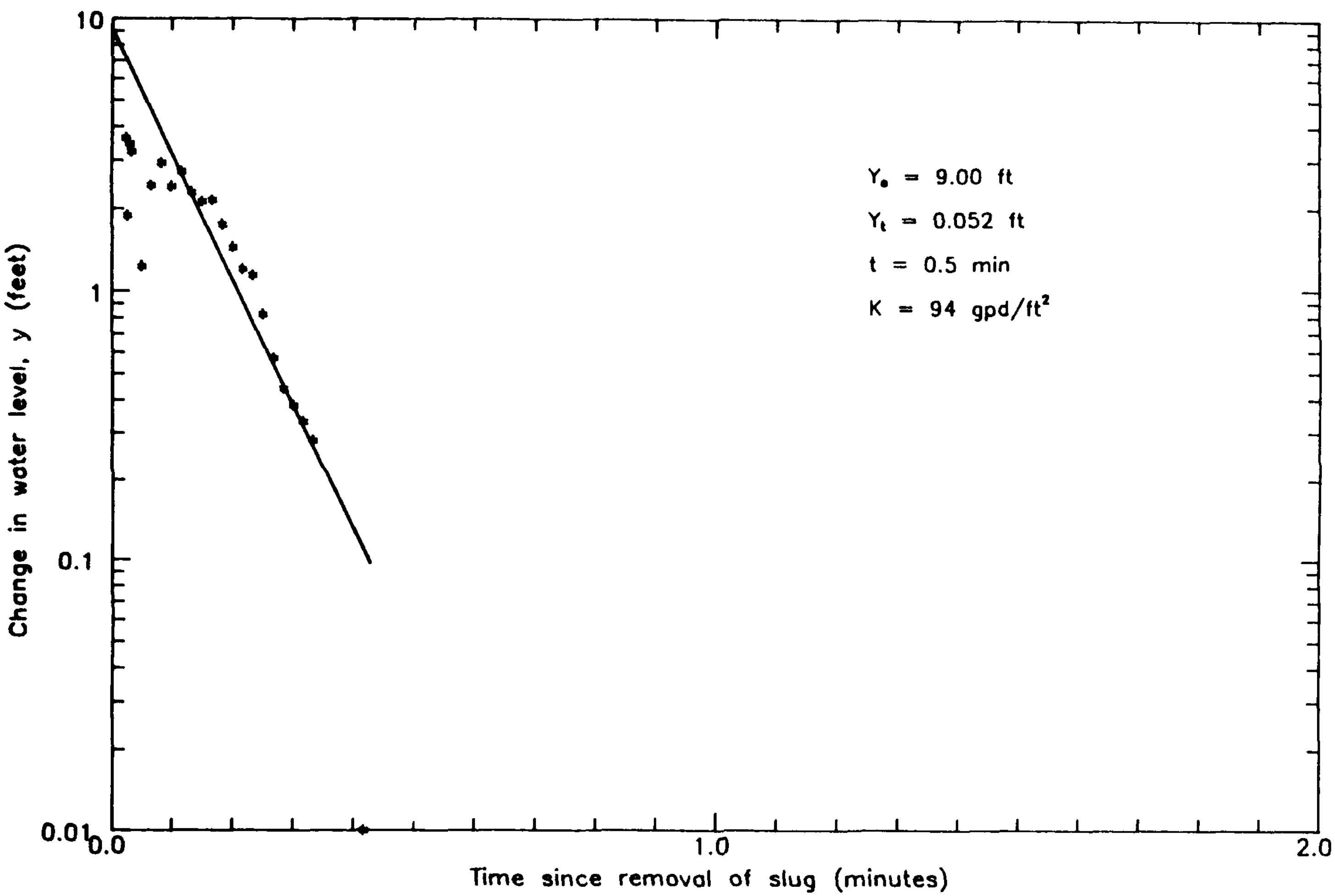


FIGURE C.44 Slug Removal Test Analysis Using Data from Well VF1 MW-2

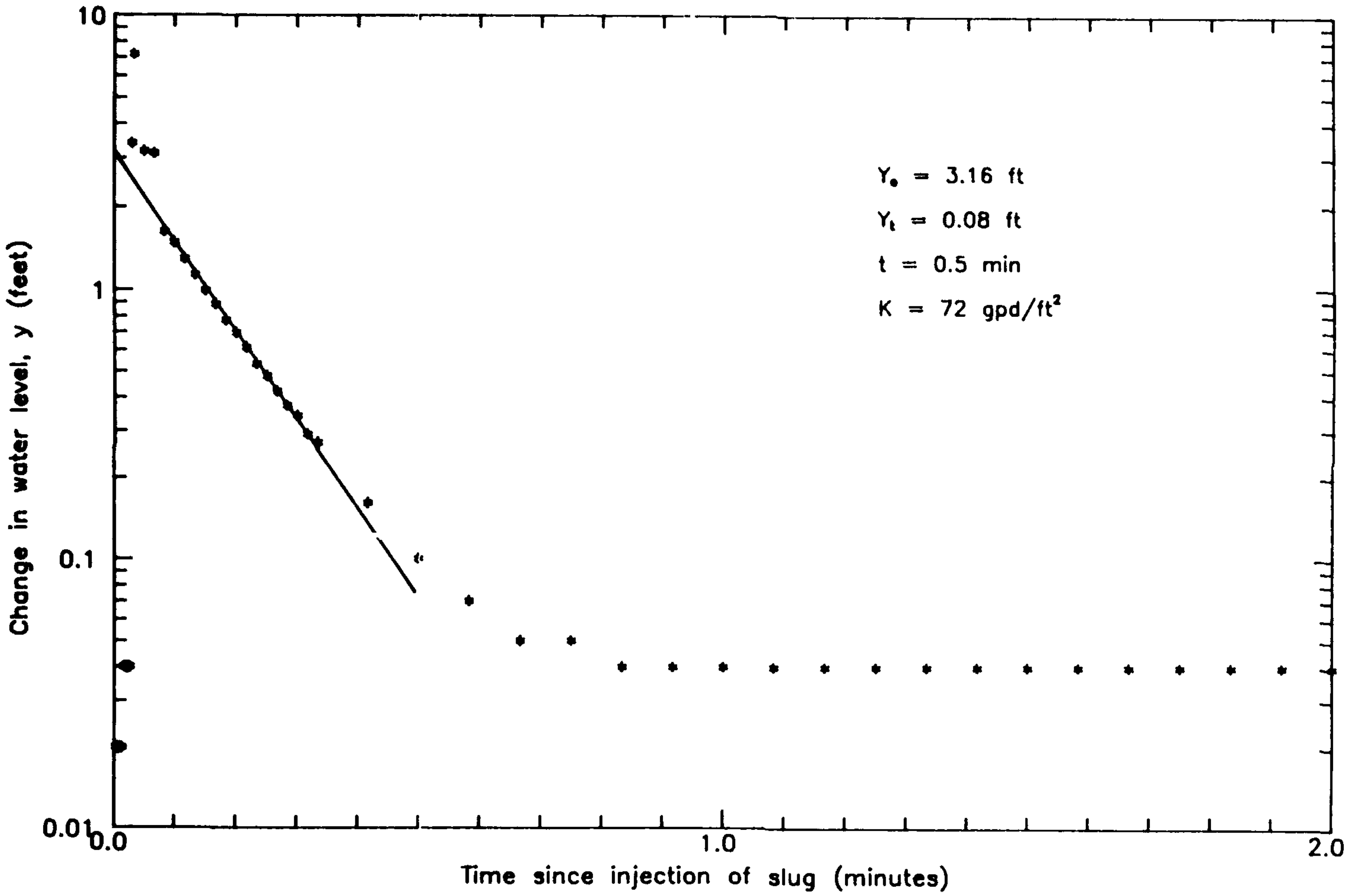


FIGURE C.45 Slug Injection Test Analysis Using Data from Well VF1 MW-3

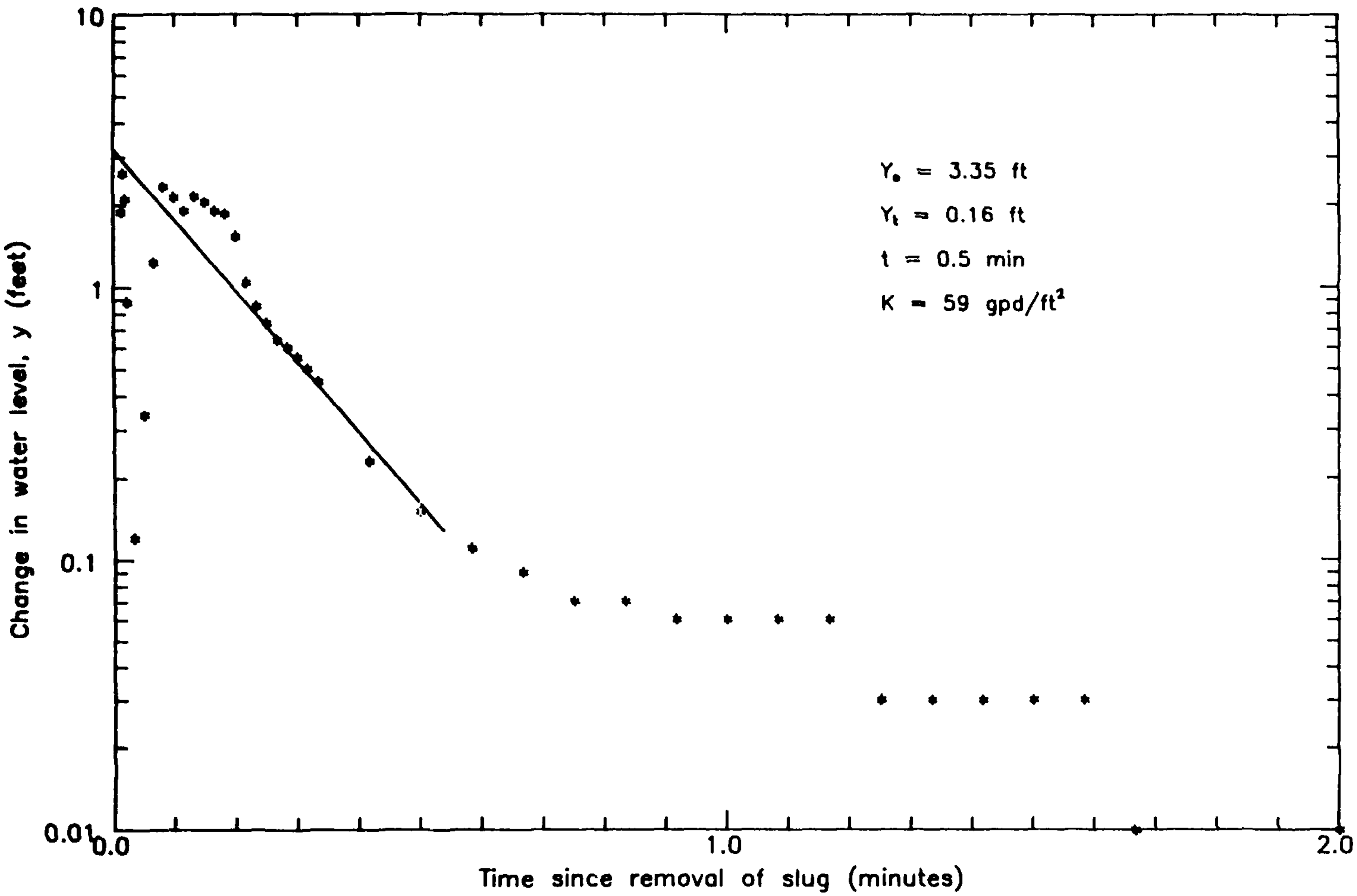


FIGURE C.46 Slug Removal Test Analysis Using Data from Well VF1 MW-3

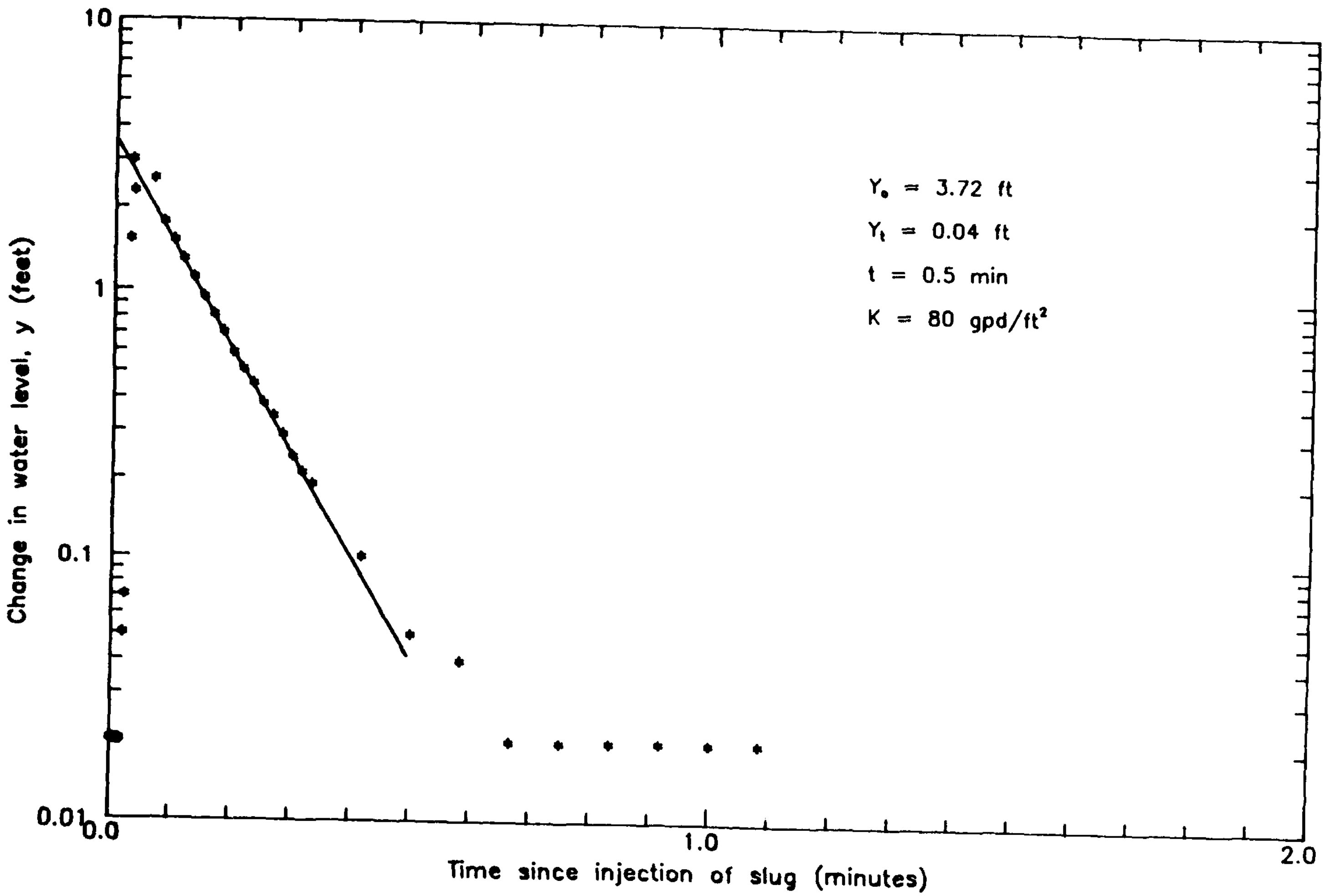


FIGURE C.47 Sluç Injection Test Analysis Using Data from Well VF1 MW-4

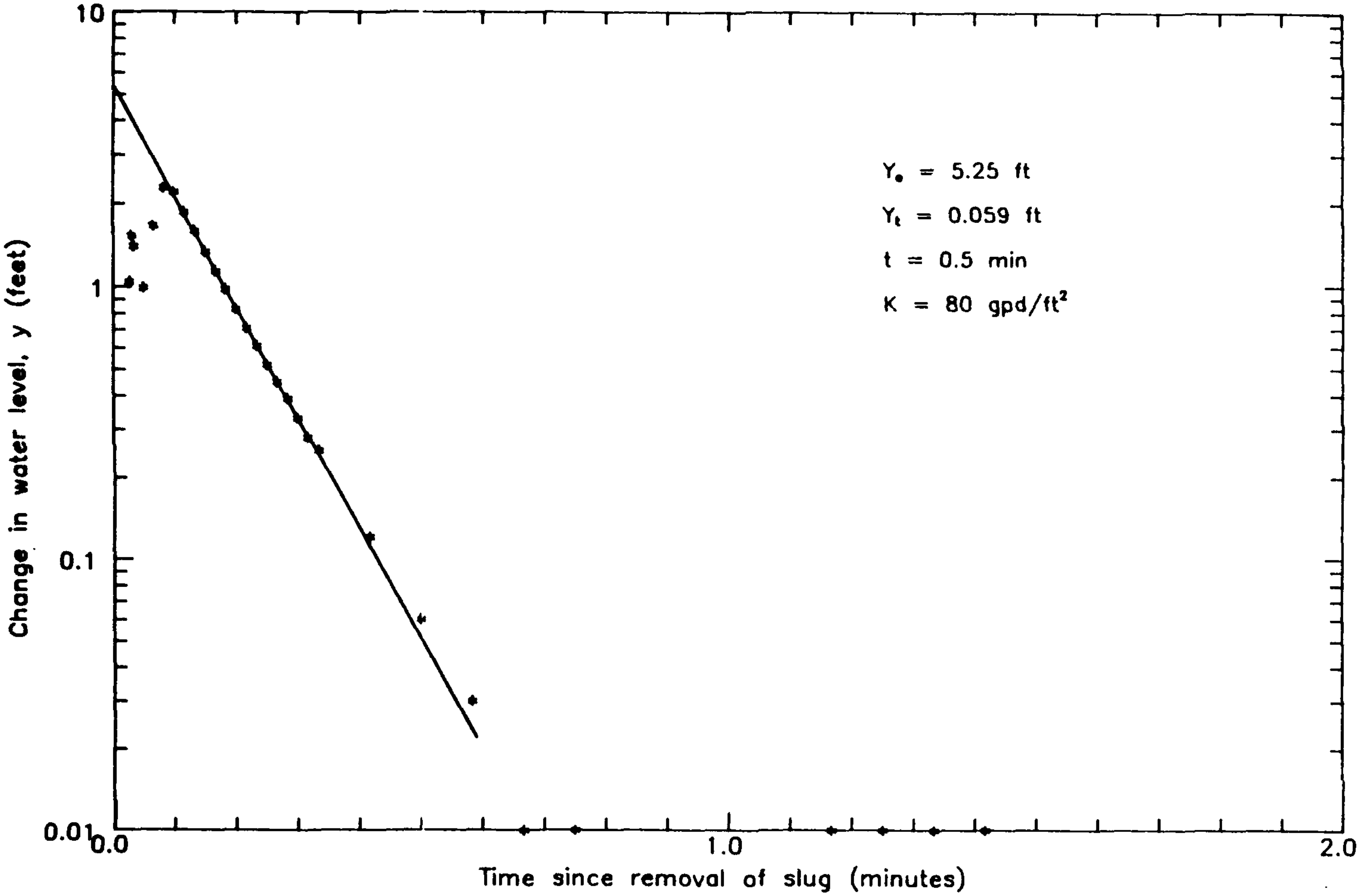


FIGURE C.48 Slug Removal Test Analysis Using Data from Well VF1 MW-4

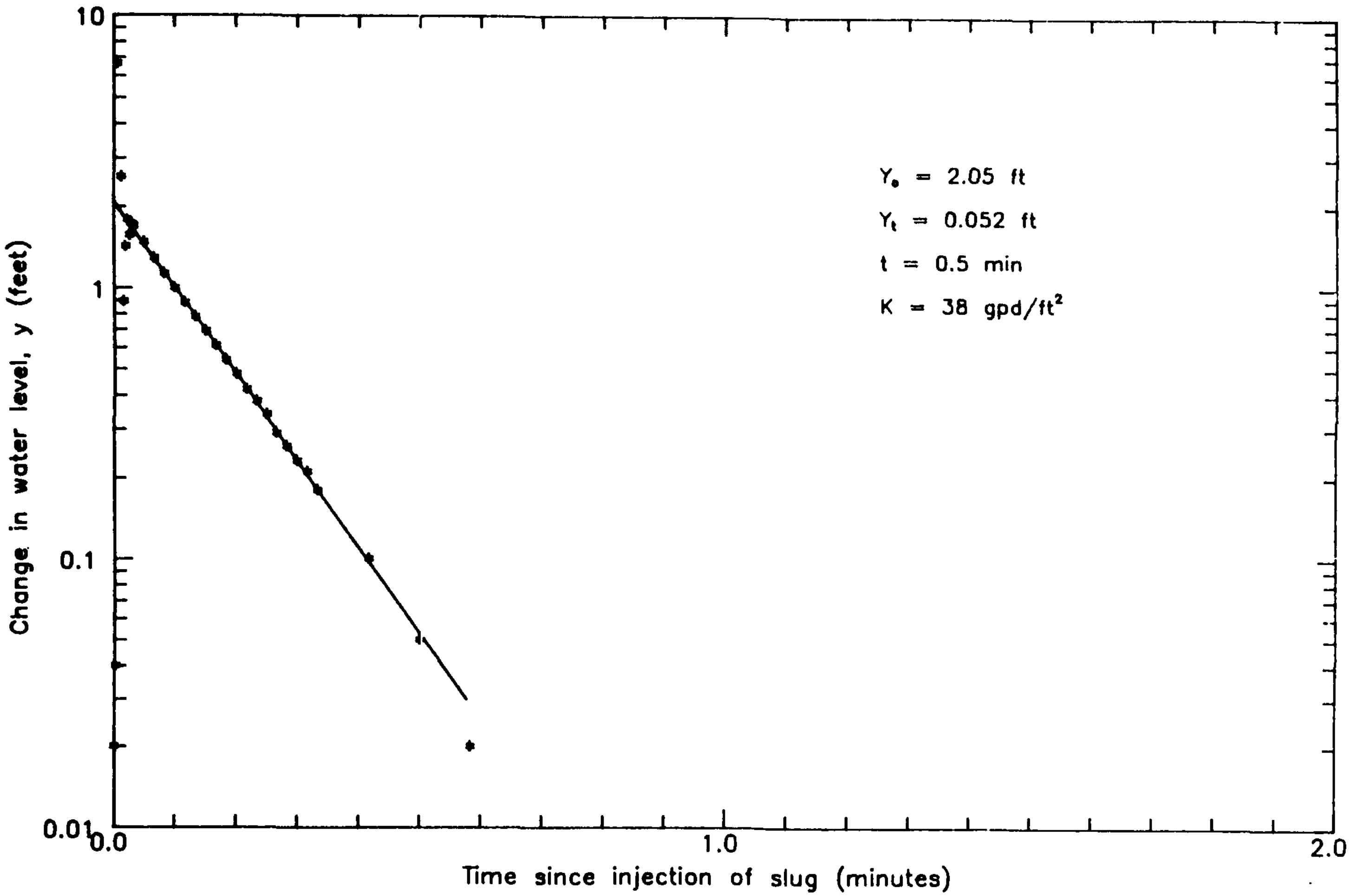


FIGURE C.49 Slug Injection Test Analysis Using Data from Well ET-1

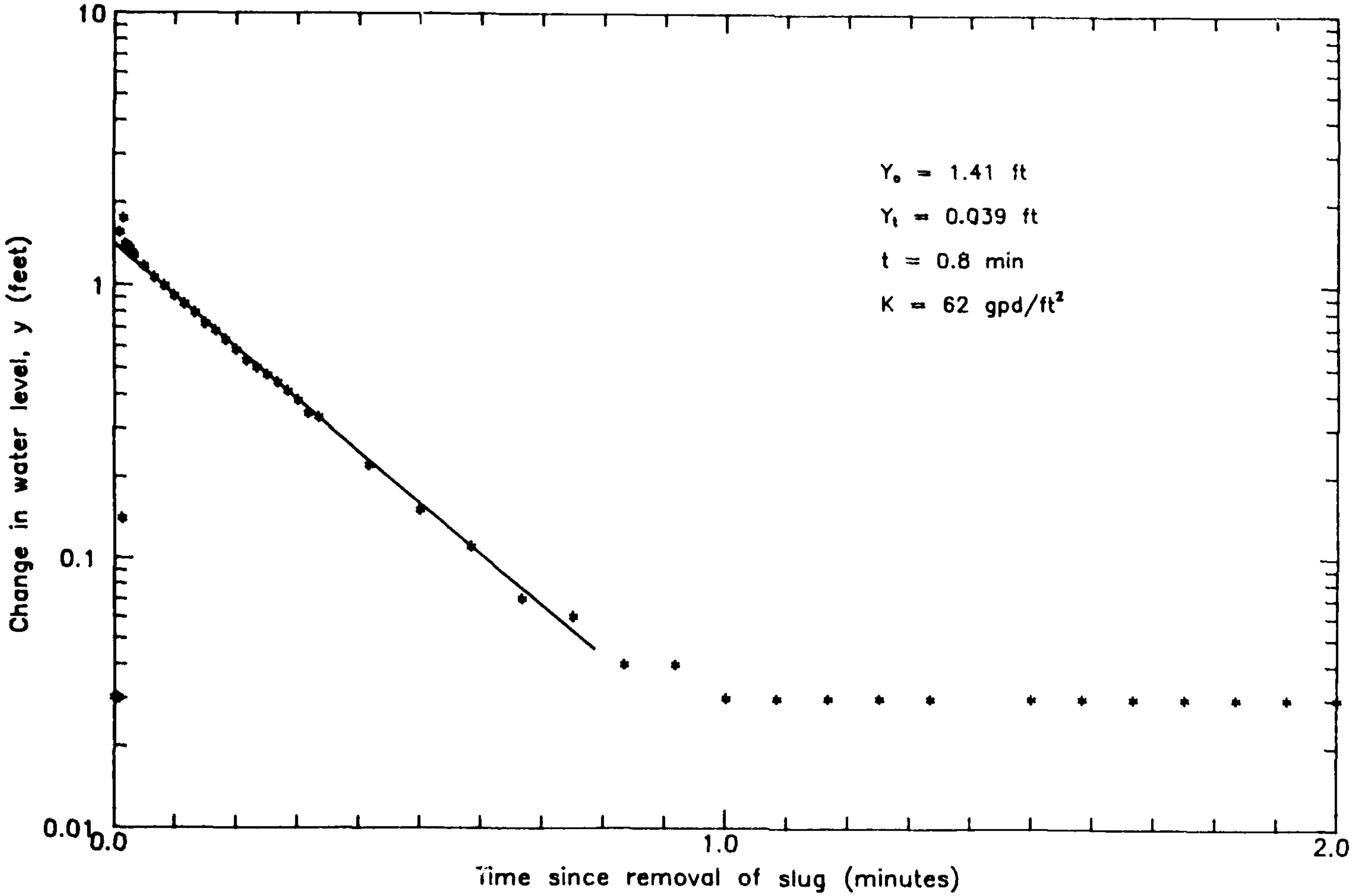


FIGURE C.50 Slug Removal Test Analysis Using Data from Well ET-1

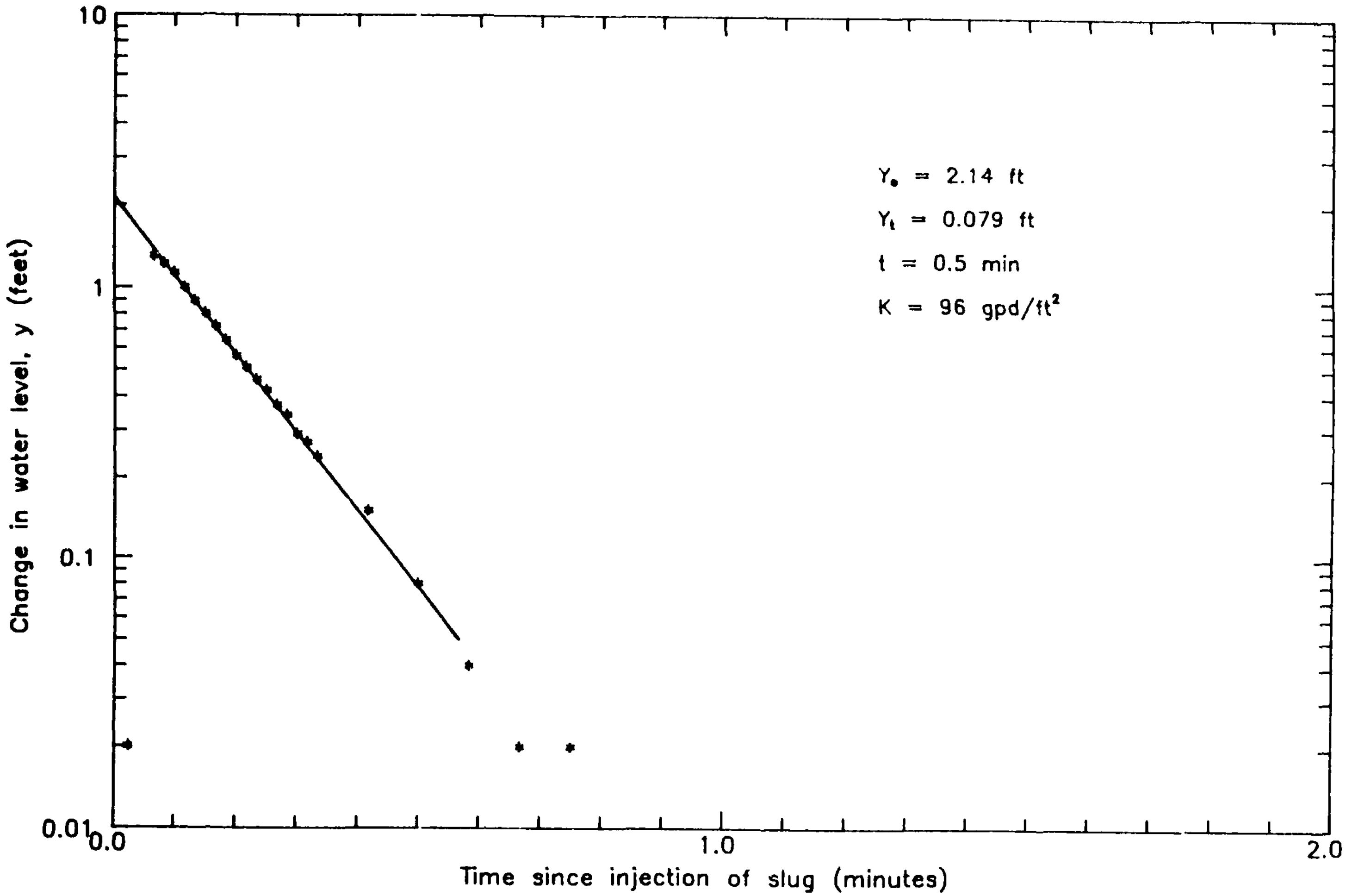


FIGURE C.51 Slug Injection Test Analysis Using Data from Well ET–2

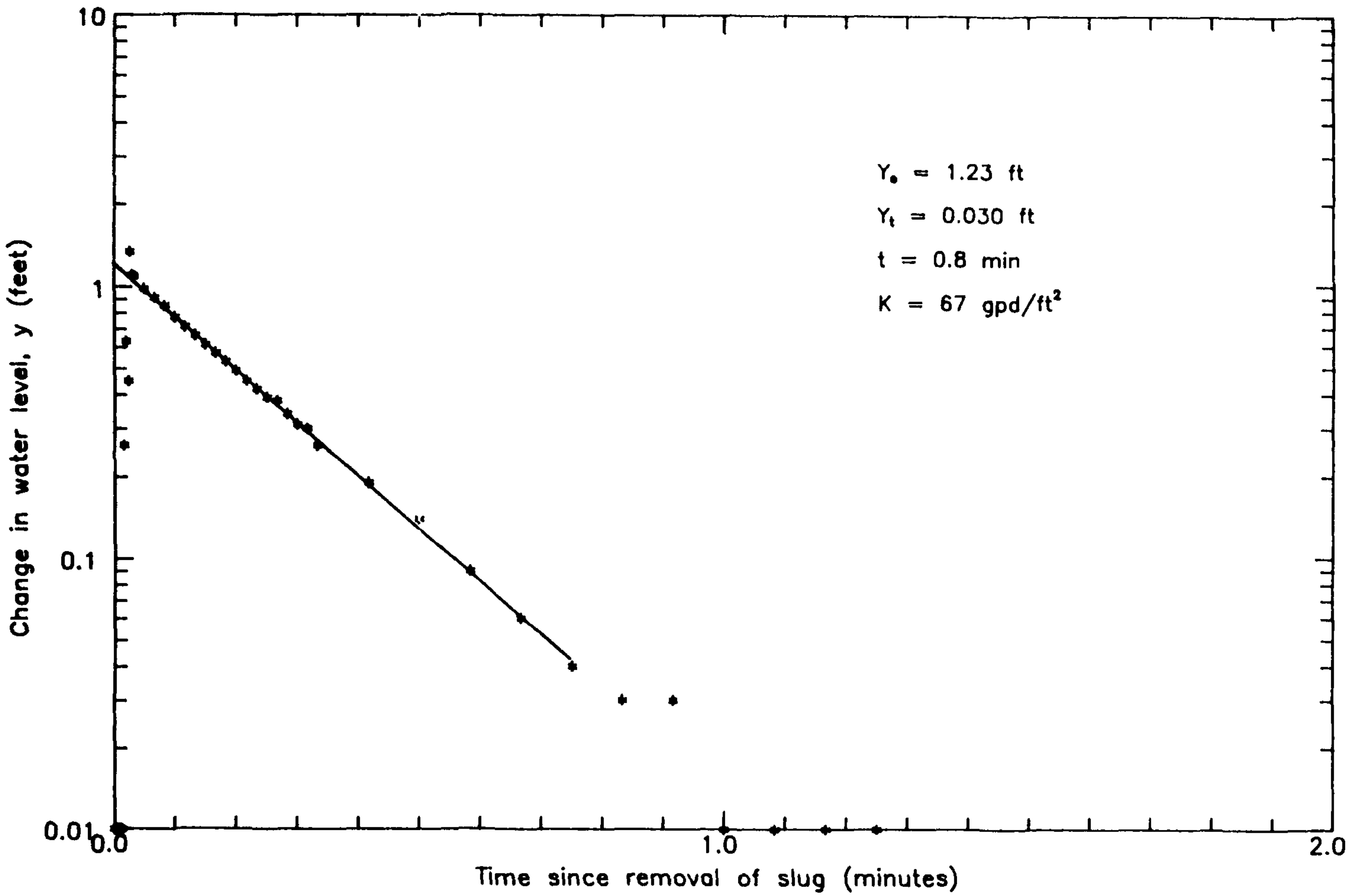


FIGURE C.52 Slug Removal Test Analysis Using Data from Well ET-2

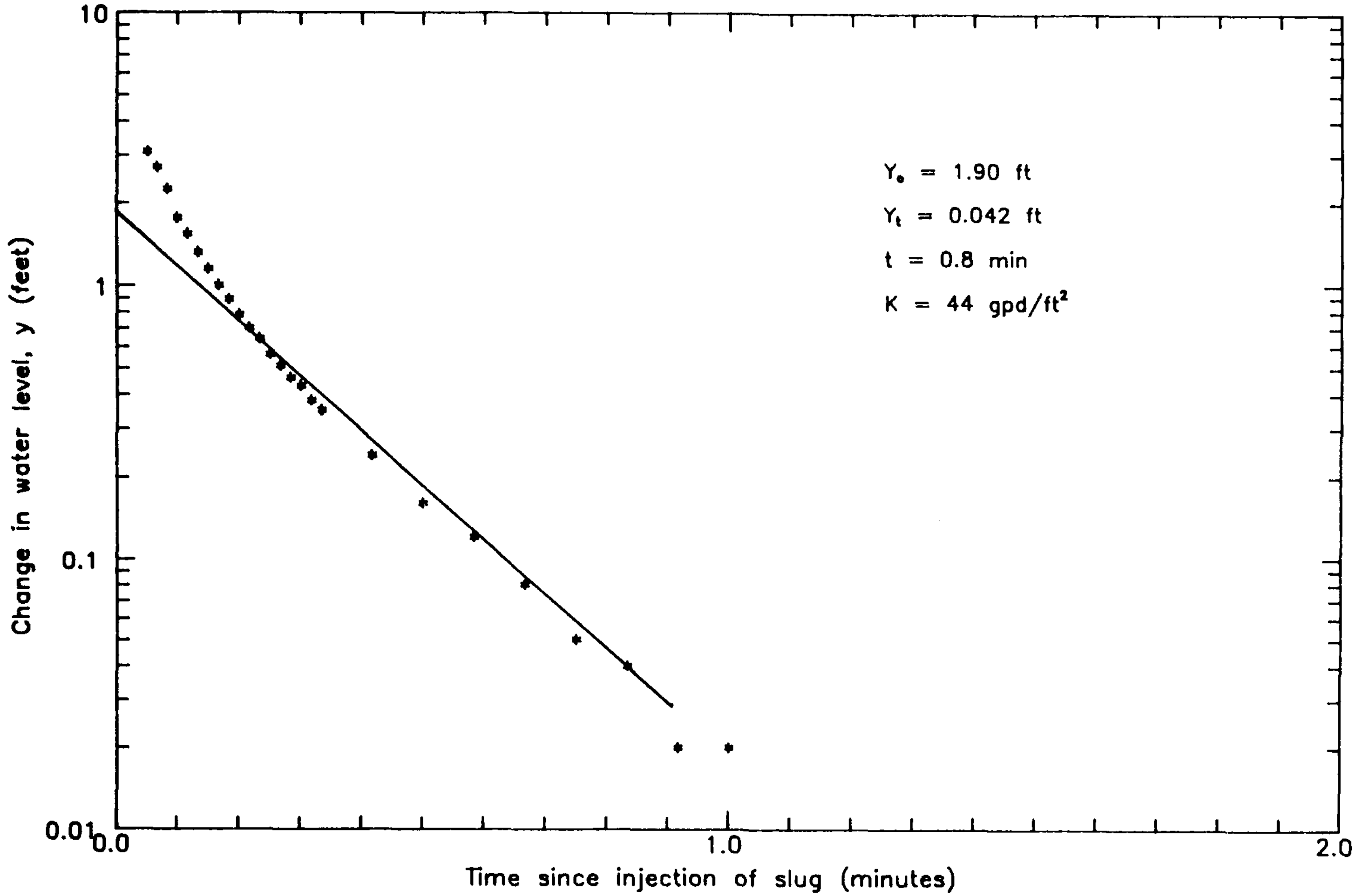


FIGURE C.53 Slug Injection Test Analysis Using Data from Well ET–4

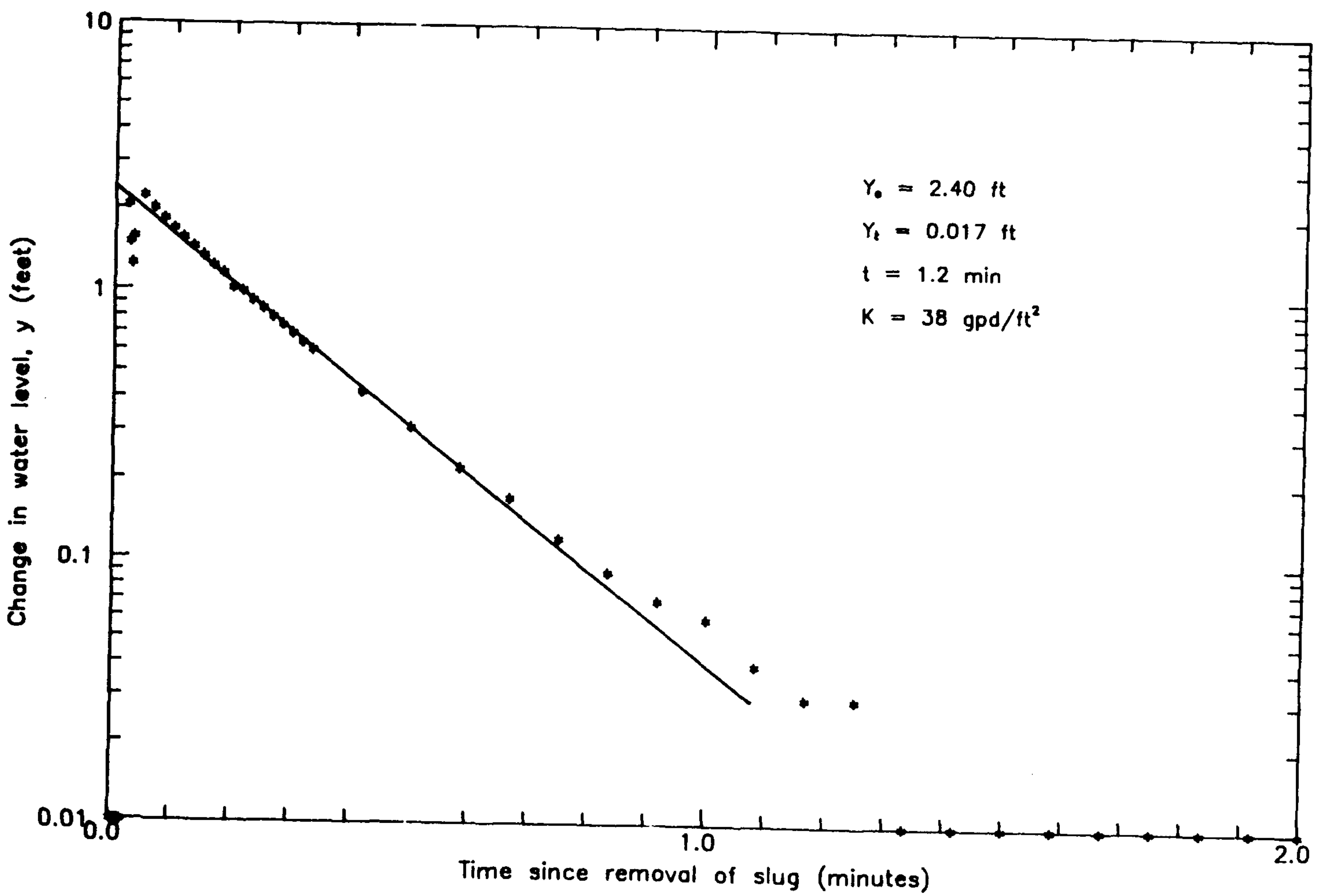


FIGURE C.54 Slug Removal Test Analysis Using Data from Well ET-4

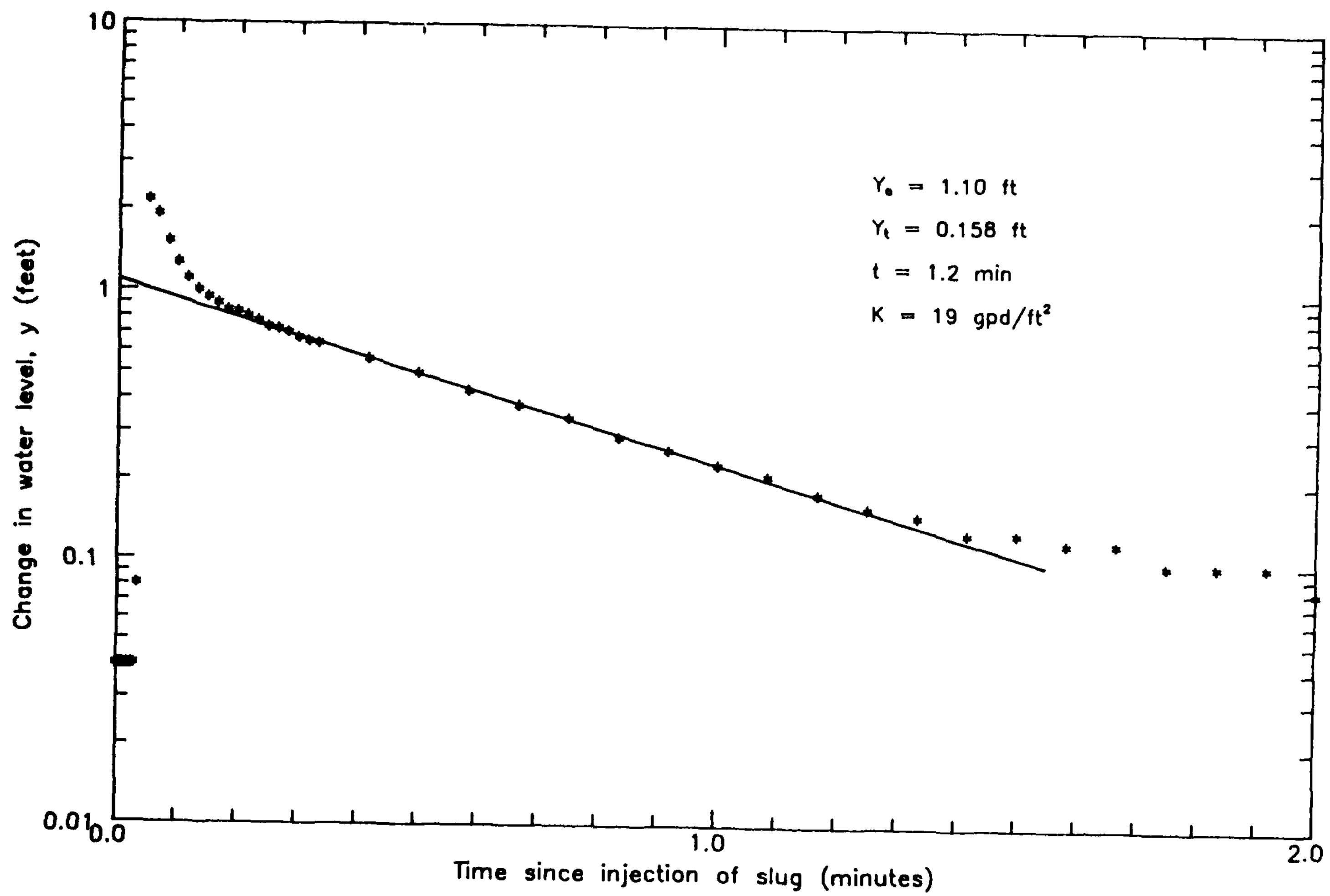


FIGURE C.55 Slug Injection Test Analysis Using Data from Well ET–5

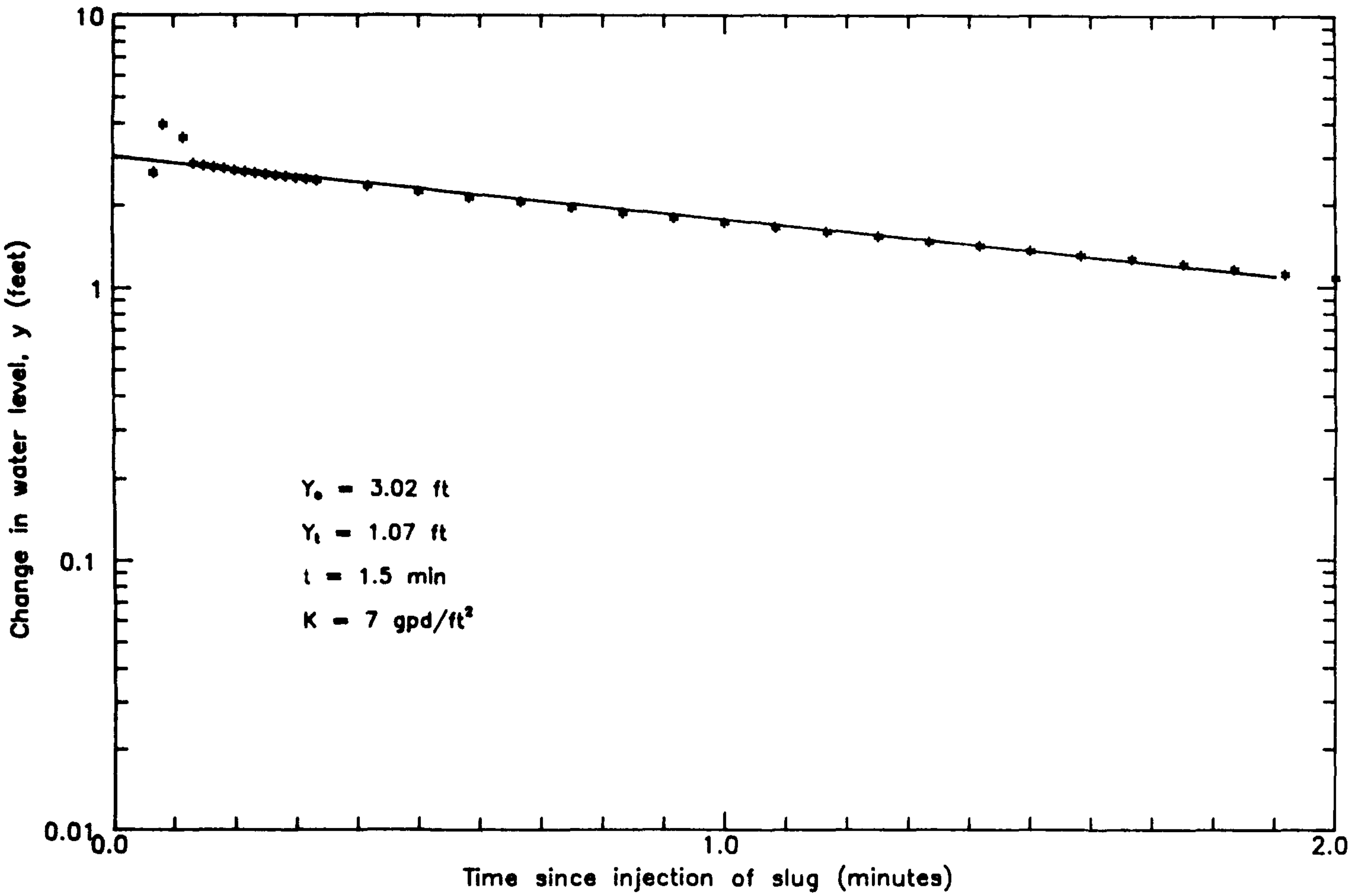


FIGURE C.56 Slug Injection Test Analysis Using Data from Well ET-6

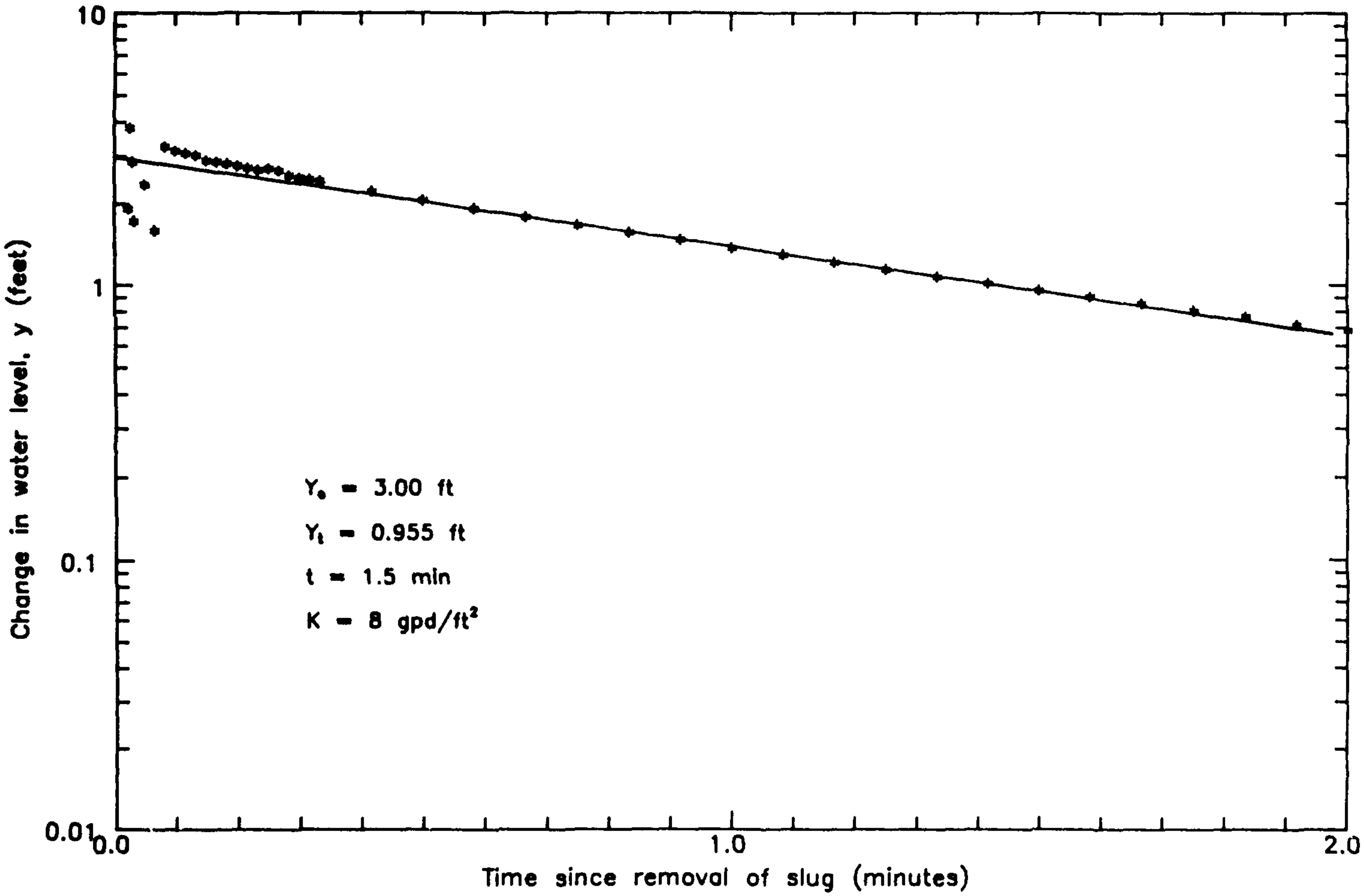


FIGURE C.57 Slug Removal Test Analysis Using Data from Well ET-6

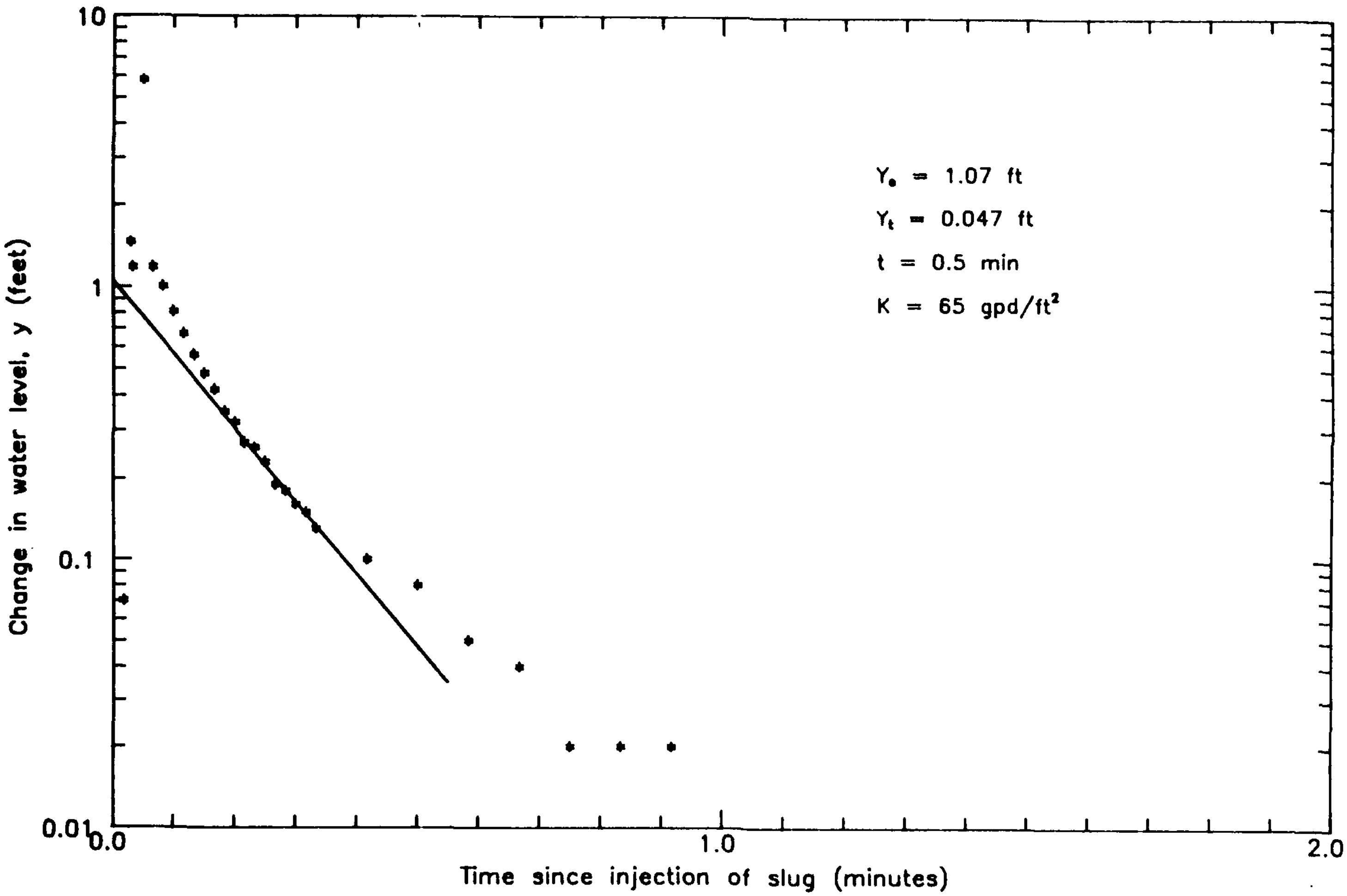


FIGURE C.58 Slug Injection Test Analysis Using Data from Well ET-7

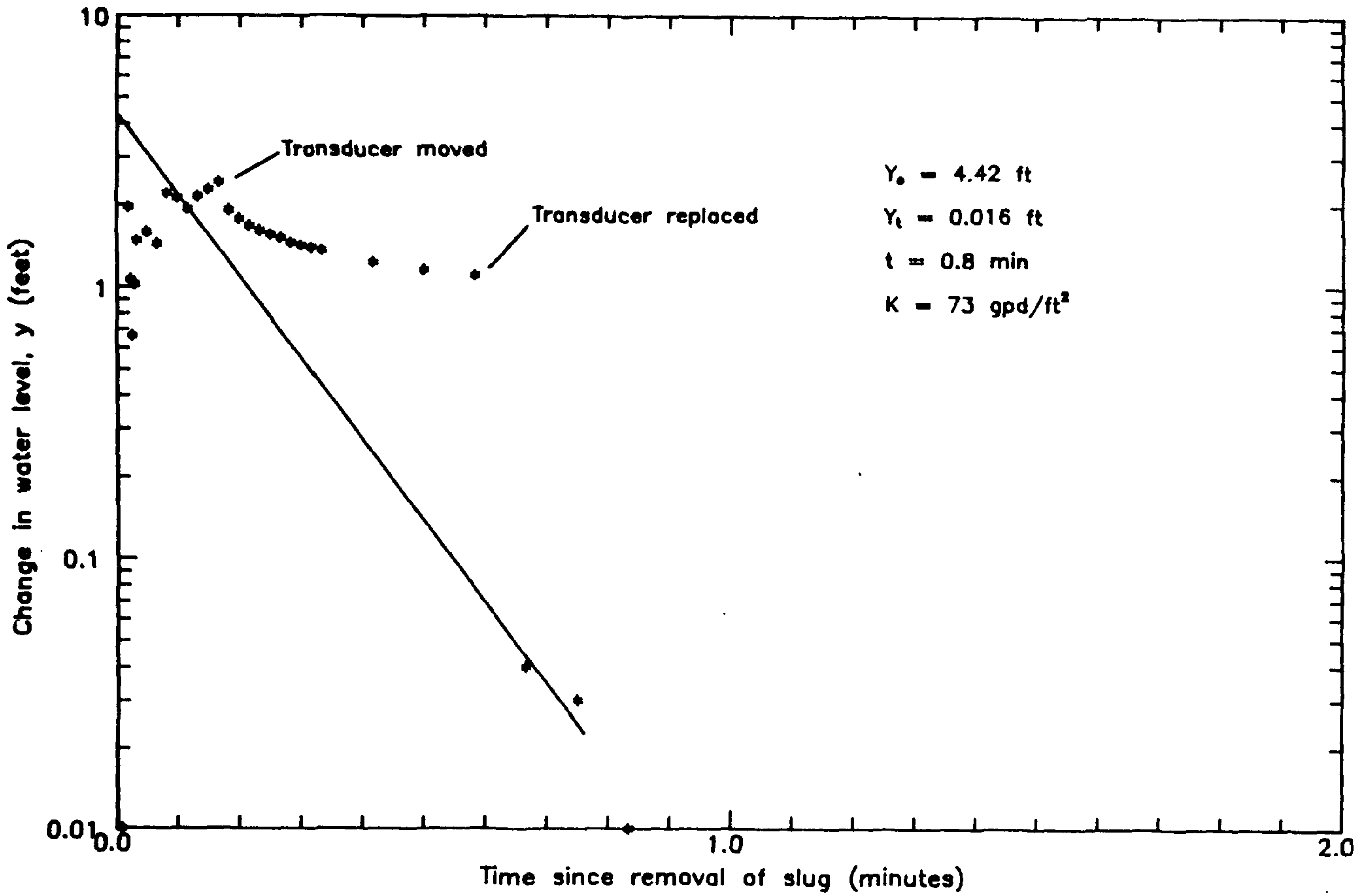


FIGURE C.59 Slug Removal Test Analysis Using Data from Well ET-7

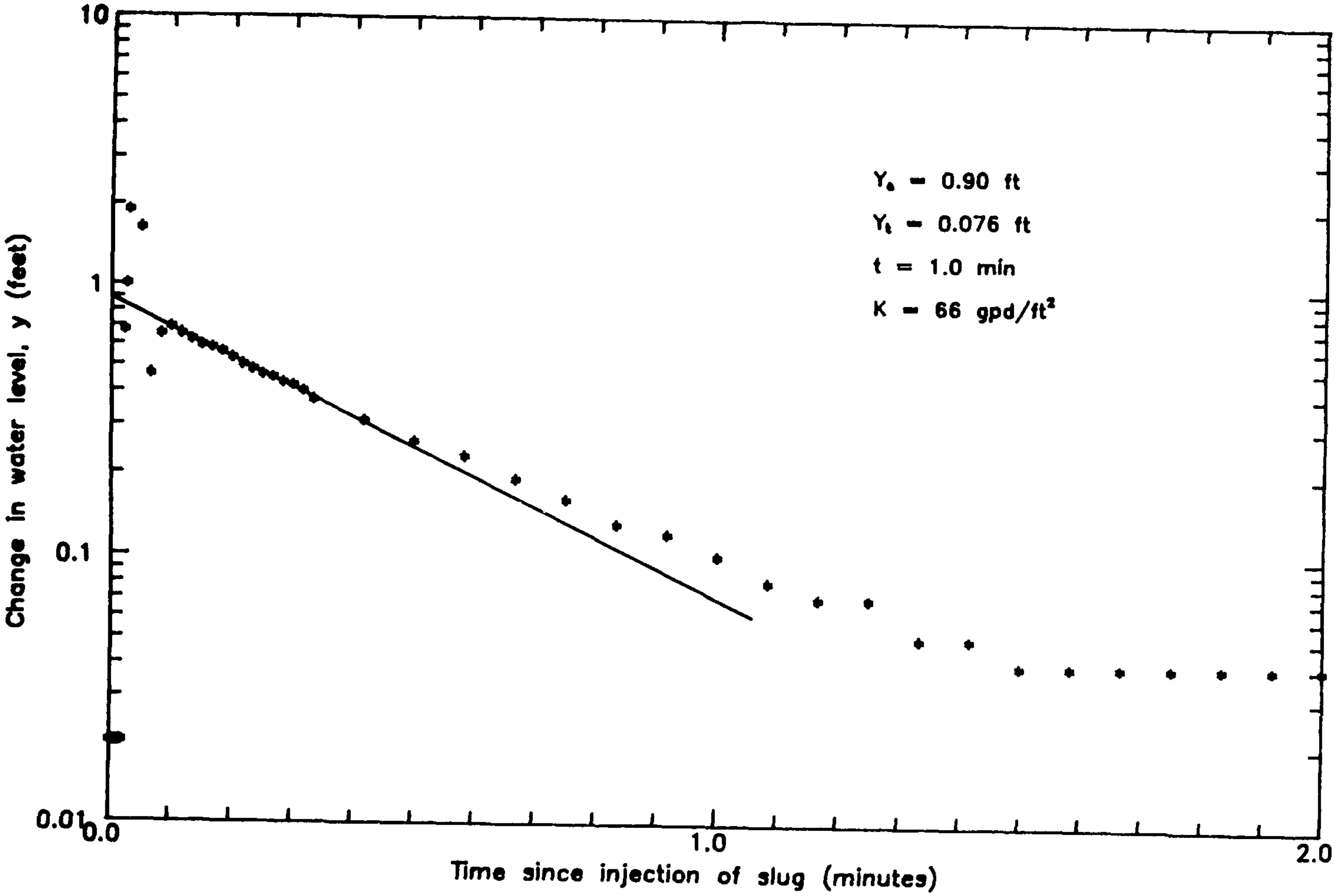


FIGURE C.60 Slug Injection Test Analysis Using Data from Well WW-3

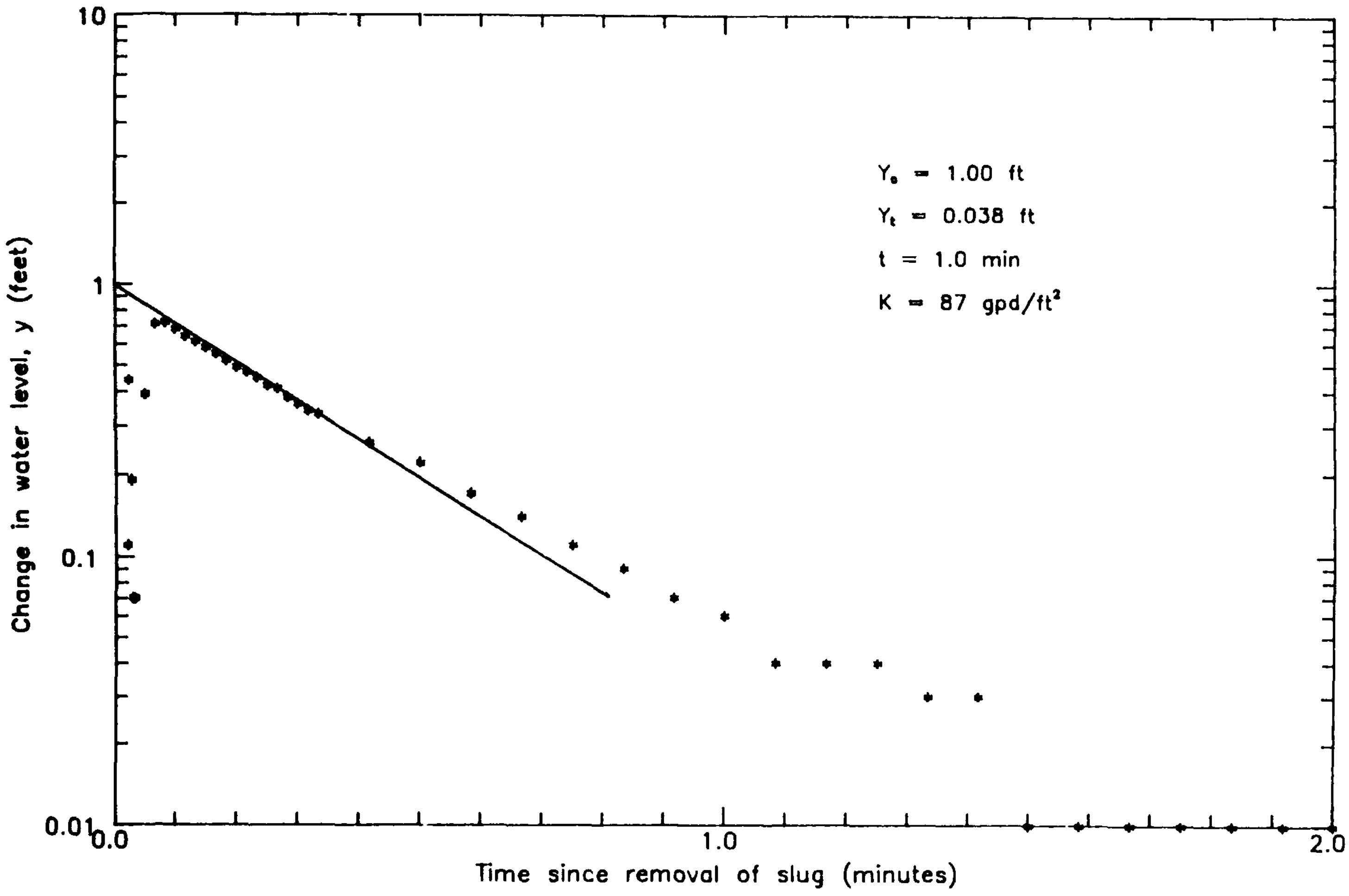


FIGURE C.61 Slug Removal Test Analysis Using Data from Well WW-3

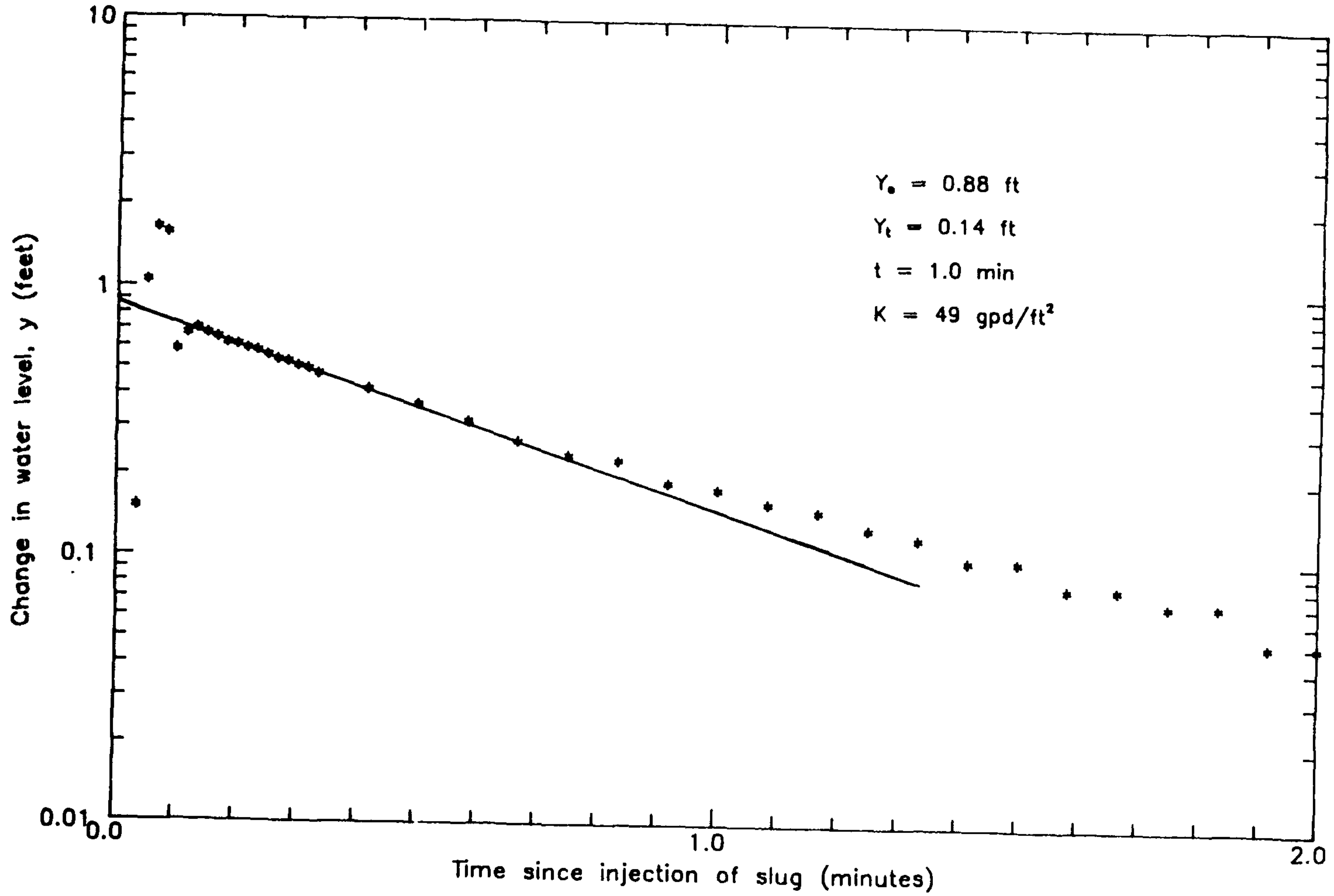


FIGURE C.62 Slug Injection Test Analysis Using Data from Well WW-4

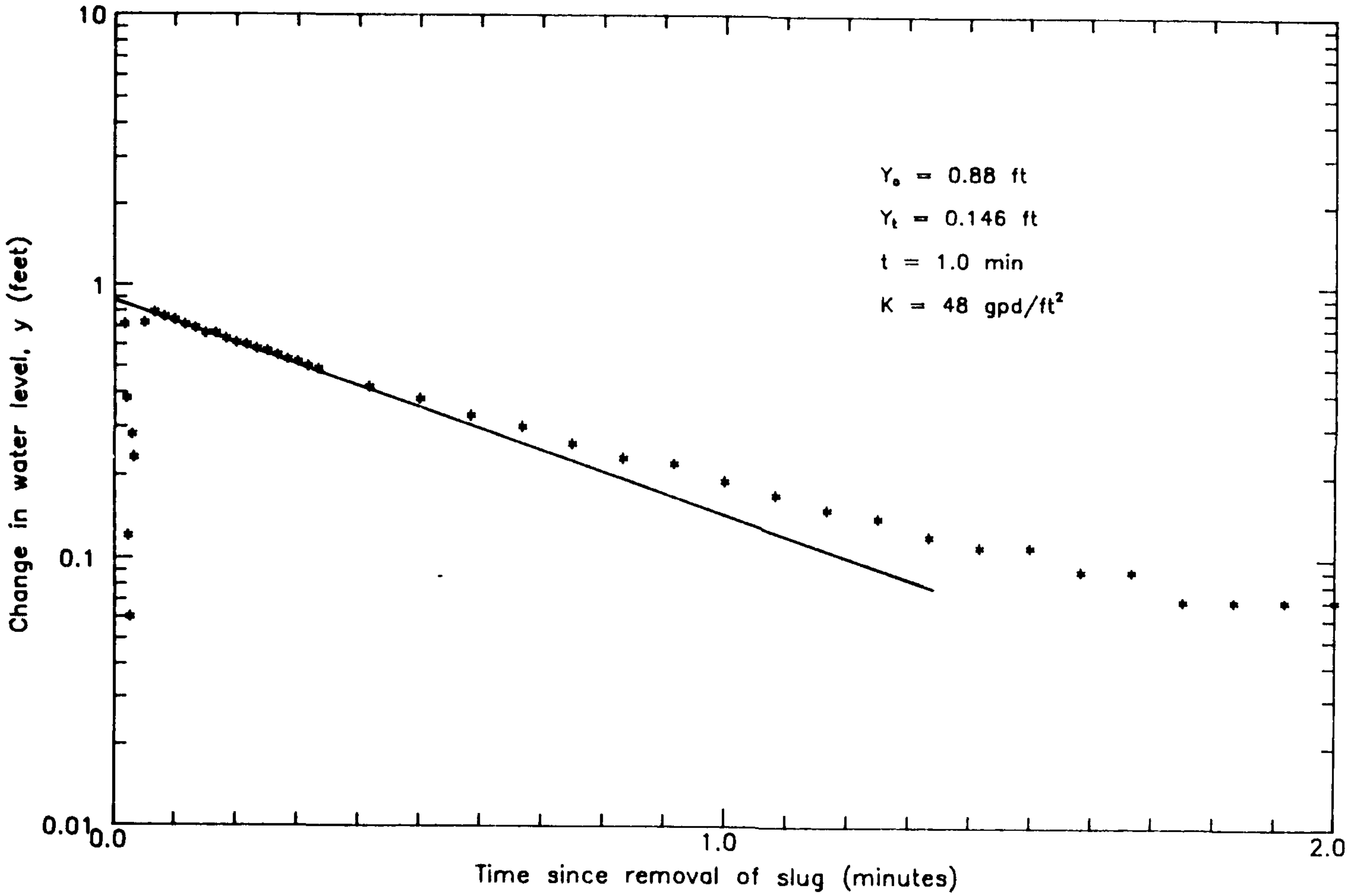


FIGURE C.63 Slug Removal Test Analysis Using Data from Well WW-4

APPENDIX D
SOIL GAS SURVEY DATA

The following information has been extracted from a document entitled "Report of Soil Vapor Contaminant Assessment Conducted 11-20 November 1987 at Volk Filed Air National Guard Base, Tomah, Wisconsin". The referenced document was prepared for Engineering-Science, Inc., Atlanta, Georgia by EA Engineering, Science, and Technology, Inc Sparks, Maryland (EA Project No. VAB81A).

Only minor editorial changes have been made to the original document to allow for consistency and ease of reading this report.

D.1 INTRODUCTION

EA Engineering, Science, and Technology, Inc. (EA) was subcontracted by Engineering-Science, Inc. to furnish soil-gas monitoring service to detect volatile organic compounds in the subsurface at two separate areas of Volk Field ANGB. The first area, Site 1, was used as a "Fire Training Area" where volatile compounds were ignited and then extinguished by fire crews. The second area, Site 3/6, is within the POL storage areas. Routine spills of JP-4 and AVGAS have occurred at this site as well as a 2,500 gallon discharge of JP-4. Underground storage tanks of considerable age are also located on Site 3/6. The intent of the investigation was to obtain information that would be useful in assessing subsurface contamination at the sites and to determine likely sources.

The SVCA technique is based on the behavior of gases or vapors evaporated from liquids in the subsurface. Vapors from a source such as a fuel discharge to the subsurface or leaking underground storage tank migrate from the source through the atmosphere in the soil interstices following a concentration gradient. Raoult's Law and Henry's Law can be used to describe equilibrium vapor phase contaminant concentrations above a bulk product phase and a contaminated water phase, respectively. Vapor phase transport can be expressed according to the following mathematical expression:

$$\frac{\partial C}{\partial t} = D \frac{\partial^2 C}{\partial y^2} - V \frac{\partial C}{\partial y}$$

where:

C = gaseous constituent concentration

t = time

D = diffusion coefficient

y = distance

V = interstitial gas velocity

Transport of vapor in the soil interstices is primarily a diffusion-dominated process in the absence of mass flow or thermal gradients. While this expression is an oversimplification in that it addresses only one dimension, it is nevertheless valid to illustrate the process. The sandy nature of the soil underlying Volk Field allow for the maximum utility of the SVCA and proved to be a somewhat ideal site for this technique.

The SVCA technique is carried out by driving a sampling probe into the subsurface in a pattern that will generate data to meet the investigation objectives. After the probe has been driven and seated (generally to a depth of 2 to 6 feet), a vacuum is applied to the distal probe and gas is withdrawn and discharged to waste until a near-steady state condition is established. After near-steady state conditions have been established, an aliquot of gas is collected and introduced into an appropriate detection device. The detection device is selected based on the compounds of interest at the subject site. The options include gross contaminant indicators, selective detector gas chromatographs, and gas chromatograph/mass spectrometers. In soil vapor surveys it is generally desirable to generate data as near real time as possible as that more definitive sampling and remediation can be implemented in a timely fashion. One of the primary advantages of the SVCA technique is that it yields results rapidly so that assessments or plans for additional data gathering can be quickly developed.

D.2 MATERIALS AND METHODS

Based on the data needs and site conditions it was determined that the most appropriate approach to use at Volk Field ANGB was to conduct a SVCA on a grid. A 50-ft by 50-ft grid spacing was used in areas of suspected contamination and the grid spacing was condensed to 25-ft by 25-ft in certain areas to further define the extent of the contamination. Some areas were not sampled due to uncertainty of the location of underground structures and utilities. Sampling locations were chosen by Engineering-Science, Inc. The sample locations, designated VP-#, are shown in Figure 1.

Sampling was conducted by a three person EA team from November 11-20 1987. Underground utilities and structures were located and the grid was established prior to sampling. After the grid had been established soil vapor samples were collected through a small diameter stainless steel well point sampler. In areas covered with asphalt or concrete, 1-inch holes were drilled through the pavement to allow access to the subsurface. The sampler was driven to a depth of 3-12 feet with a slide hammer. In all instances special care was taken to insure that the sampler was seated such that aspiration of ambient air was precluded. After the sampler was firmly seated, a vacuum source was applied to the distal end and the system was pumped until a near-steady state was attained. After near-steady state was reached, samples were collected for analysis. Clean gas-tight syringes were used to collect samples for compound specific identification and quantitation using gas chromatography.

The probes were cleaned between usage. If contamination was suspected, use of that probe was discontinued. Probe and sampler blanks were collected and analyzed periodically to demonstrate system cleanliness.

Vapor samples were analyzed on site using an HNu® 421 chromatograph interfaced with a Shimadzu integrator. The HNu® is a programmable gas chromatograph equipped with a flame ionization detector (FID). The FID is specific to components which in the flame will give a carbon skeleton which is then oxidized. Therefore, it is sensitive to all organic compounds except formaldehyde and formic acid. Compounds are first ionized in the air-hydrogen flame. These molecules then attach to an electrode which increased the signal current. The signal is amplified, integrated, and reported as a chromatographic peak. Vapor samples tend to contain many compounds. When a sample is injected onto the gas chromatograph, compounds are separated on a SP-2100 analytical column, detected by the FID, integrated, and reported as peaks on the chromatograms.

The instrument was calibrated by injecting known amounts of vapor standards. The standard contained benzene, toluene, ethylbenzene trichloroethylene (TCE) and o-xylene. Compound retention time and response data were stored in the integrator/recorder's computer and subsequently used to make identifications and to quantify unknowns in samples. Blanks were also run to insure that the system was free of contamination. Samples were also periodically run in duplicate. These data along with multiple standard runs insures that the analytical system is producing reliable values.

D.3 RESULTS AND DISCUSSION

The results of the soil vapor contaminant assessment conducted 11-20 November 1987 at Volk Field ANGB are given in Table 2 and Figures 2-6. Chromatograms and supporting information are presented at the end of this appendix.

D.3.1 Site 1, Fire Training Area

The results of the soil vapor contaminant assessment at Site 1, Fire Training Area indicate an area of contamination extending approximately 100 ft. east of the spill location. No other significant contamination was found outside of the section of the Fire Training Area. Contaminants identified included benzene, toluene, ethylbenzene and xylenes. Several chromatograms of vapor samples indicated the presence of higher molecular weight compounds. These compounds are usually associated with heavier fuels and motor oils. The relative age of the discharge and the influence by the IITRI project at this site is believed to have had an influence on the extent of the contamination.

TABLE 1 GAS CHROMATOGRAPHIC OPERATING CONDITIONS

COLUMN	6 ft. 10% SP-2100
CARRIER GAS	High-purity nitrogen, 30 cc/minute
OPERATING TEMPERATURES	Column, programmed at 60°C for 3 minutes, then 60°C to 160°C at a rate of increase of 10°C/minute, followed by constant temperature at 160°C
INJECTION PORT TEMPERATURE	175°C
DETECTOR TEMPERATURE	250°C

TABLE 2 RESULTS OF THE SOIL VAPOR CONTAMINANT ASSESSMENT CONDUCTED NOVEMBER 11-20 1987
SITE 1, FIRE TRAINING AREA, VOLK FIELD ANGB TOMAH, WISCONSIN

Sample	Sum of the Peaks Eluting Prior to Toluene (ppm toluene equivalents)	Benzene (ppm)	Toluene (ppm)	Ethylbenzene and xylenes (ppm)	TCE (ppm)
VP-1, 6′	<0.5	<0.1	<0.1	<0.2	<0.4
VP-1, 9′	<0.5	<0.1	<0.1	<0.2	<0.4
VP-1, 12′			Water, No Sample		
VP-2, 3′	<0.5	<0.1	<0.1	<0.2	<0.4
VP-2, 6′	<0.5	<0.1	<0.1	<0.2	<0.4
VP-2, 9′	<0.5	<0.1	<0.1	<0.2	<0.4
VP-2, 12′	150	~20	44	~6	(a)
VP-3, 6′	<0.5	<0.1	<0.1	<0.2	<0.4
VP-3, 9′	<0.5	<0.1	<0.1	<0.2	<0.4
VP-3, 12′	5	<0.5	2	~0.7	<0.4
VP-4, 11′			Water, No Sample		
VP-4, 9′			Water, No Sample		
VP-4, 6′	<0.5	<0.1	<0.1	<0.2	<0.4
VP-5, 6′	<0.5	<0.1	<0.1	<0.2	<0.4
VP-6, 6′	<0.5	<0.1	<0.1	<0.2	<0.4
VP-7, 6′			Water, No Sample		
VP-7, 4.5′	<0.5	<0.1	<0.1	<0.2	<0.4
VP-8, 6′			Water, No Sample		
VP-8, 4.5′	<0.5	<0.1	<0.1	<0.2	<0.4
VP-9, 5′	<0.5	<0.1	<0.1	<0.2	<0.4
VP-10, 5′	<0.5	<0.1	<0.1	<0.2	<0.4
VP-11, 6′	<0.5	<0.1	<0.1	<0.2	<0.4
VP-12, 4.5′	<0.5	<0.1	<0.1	<0.2	<0.4
VP-13, 4.5′	<0.5	<0.1	<0.1	<0.2	<0.4
VP-14, 6′	<0.5	<0.1	<0.1	<0.2	<0.4
VP-15, 6′	<0.5	<0.1	<0.1	<0.2	<0.4
VP-16, 6′	<0.5	<0.1	<0.1	<0.2	<0.4
VP-17, 6′	<0.5	<0.1	<0.1	<0.2	<0.4
VP-18, 8′	<0.5	<0.1	<0.1	<0.2	<0.4
VP-19, 9′	<0.5	<0.1	<0.1	<0.2	<0.4
VP-20, 10.5′	<0.5	<0.1	<0.1	<0.2	<0.4

TABLE 2 CONTINUED

Sample	Sum of the Peaks Eluting Prior to Toluene (ppm toluene equivalents)	Benzene (ppm)	Toluene (ppm)	Ethylbenzene and xylenes (ppm)	TCE (ppm)
VP-21, 9'	4,700	(a)	~100	~60	(a)
VP-22, 9'	<0.5	<0.1	<0.1	<0.2	<0.4
VP-23, 9'	<0.5	<0.1	<0.1	<0.2	<0.4
VP-24, 9'	<0.5	<0.1	<0.1	<0.2	<0.4
VP-25, 9'	<0.5	<0.1	<0.1	<0.2	<0.4
VP-26, 9'	<0.5	<0.1	<0.1	<0.2	<0.4
VP-27, 9'	<0.5	<0.1	<0.1	<0.2	<0.4
VP-28, 9'	<0.5	<0.1	<0.1	<0.2	<0.4
VP-29, 9'	<0.5	<0.1	<0.1	<0.2	<0.4
VP-30, 9'	<0.5	<0.1	<0.1	<0.2	<0.4
VP-31, 9'	<0.5	<0.1	<0.1	<0.2	<0.4
VP-32, 9'	~1,500	(a)	~70	~90	(a)
VP-33, 9'	<0.5	<0.1	<0.1	<0.2	<0.4
VP-34, 9'	<0.5	<0.1	<0.1	<0.2	<0.4
VP-35, 9'	<0.5	<0.1	<0.1	<0.2	<0.4
VP-36, 9'	<0.5	<0.1	<0.1	<0.2	<0.4
VP-37, 9'	<0.5	<0.1	<0.1	<0.2	<0.4
VP-38, 9'	<0.5	<0.1	<0.1	<0.2	<0.4
VP-39, 9'	<0.5	<0.1	<0.1	<0.2	<0.4
VP-40, 9'	<0.5	<0.1	<0.1	<0.2	<0.4
VP-41, 9'	<0.5	<0.1	<0.1	<0.2	<0.4
VP-42, 3'	<0.5	<0.1	<0.1	<0.2	<0.4
VP-42, 6'	<0.5	<0.1	<0.1	<0.2	<0.4
VP-43, 6'	<0.5	<0.1	<0.1	<0.2	<0.4
VP-44, 6'	<0.5	<0.1	<0.1	<0.2	<0.4
VP-45, 6'	<0.5	<0.1	<0.1	<0.2	<0.4
VP-46, 6'	<0.5	<0.1	<0.1	<0.2	<0.4
VP-47, 6'	<0.5	<0.1	<0.1	<0.2	<0.4
VP-48, 6'	<0.5	<0.1	<0.1	<0.2	<0.4
VP-49, 6'	<0.5	<0.1	<0.1	<0.2	<0.4

TABLE 2 CONTINUED

Sample	Sum of the Peaks Eluting Prior to Toluene (ppm toluene equivalents)	Benzene (ppm)	Toluene (ppm)	Ethylbenzene and xylenes (ppm)	TCE (ppm)
VP-50, 6'	<1	<0.2	<0.2	<0.4	<1
VP-51, 6'	<1	<0.2	<0.2	<0.4	<1
VP-52, 6'	<0.5	<0.1	<0.1	<0.2	<0.4
VP-53, 6'	<0.5	<0.1	<0.1	<0.2	<0.4
VP-54, 9'	2,000	~250	~170	~30	(a)
VP-55, 9'	<0.5	<0.1	<0.1	<0.2	<0.4
VP-56, 9'	<0.5	<0.1	<0.1	<0.2	<0.4

(a) Unable to qualitate from chromatogram.

TABLE 3 - SAMPLE LOCATION DESIGNATION CHANGES SITE 1
FIRE TRAINING AREA

Old	New
A-3	VP-1
-B-1	VP-2
C-2	VP-3
D-2	VP-4
E-2	VP-5
E-1	VP-6
F+0	VP-7
G+1	VP-8
H+2	VP-9
E+0	VP-10
D-1	VP-11
B-5	VP-12
B-4	VP-13
B-3	VP-14
B-2	VP-15
B-1	VP-16
B-0	VP-17
B+1	VP-18
A-1	VP-19
-C-1	VP-20
-C-2	VP-21
-D-1	VP-22
-D-2	VP-23
-D-3	VP-24
-D-4	VP-25
-D-5	VP-26
-C-5	VP-27
-B(+7')-5	VP-28
A-5, 9'	VP-29
A-4, 9'	VP-30
A-2	VP-31
-B-2	VP-32
A+00	VP-33
-B0	VP-34
-.5B0	VP-35
A-.5,9'	VP-36
-.5C0	VP-37
-B+1	VP-38
A+1	VP-39
.5B+1	VP-40
-C0	VP-41
C-3	VP-42
C-4	VP-43
C-1	VP-44

TABLE 3 CONTINUED

Old	New
C+0	VP-45
C+1	VP-46
C+2	VP-47
B+2	VP-48
A+2	VP-49
-.5B, -3.5'	VP-50
-.5B, -2.5'	VP-51
-.5B, -1.5'	VP-52
-.5B, -.5'	VP-53
-.5D, -1.5'	VP-54
-D00 (-5)	VP-55
-C+1	VP-56

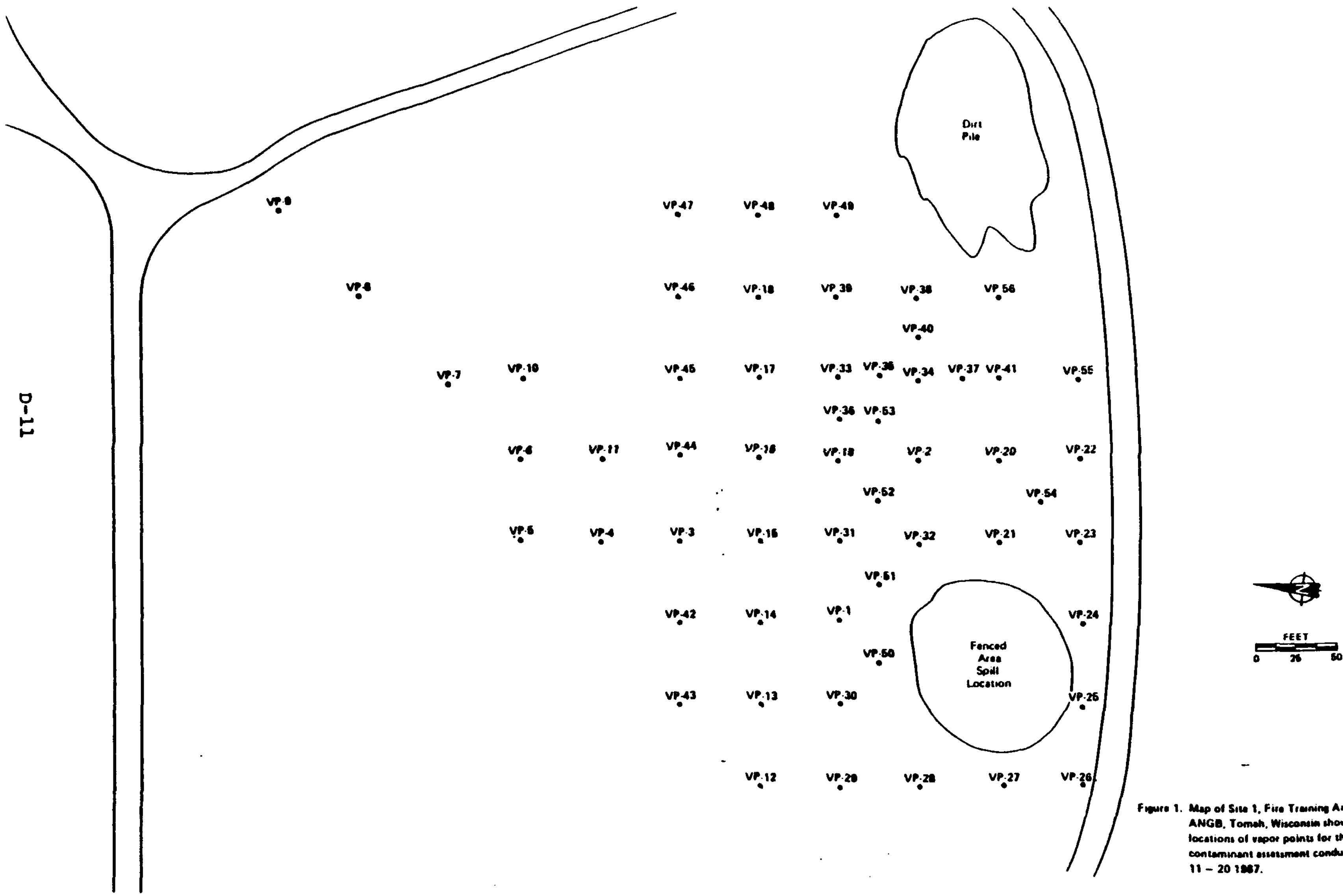


Figure 1. Map of Site 1, Fire Training Area, Volk Field ANGB, Tomah, Wisconsin showing approximate locations of vapor points for the soil vapor contaminant assessment conducted November 11 – 20 1987.

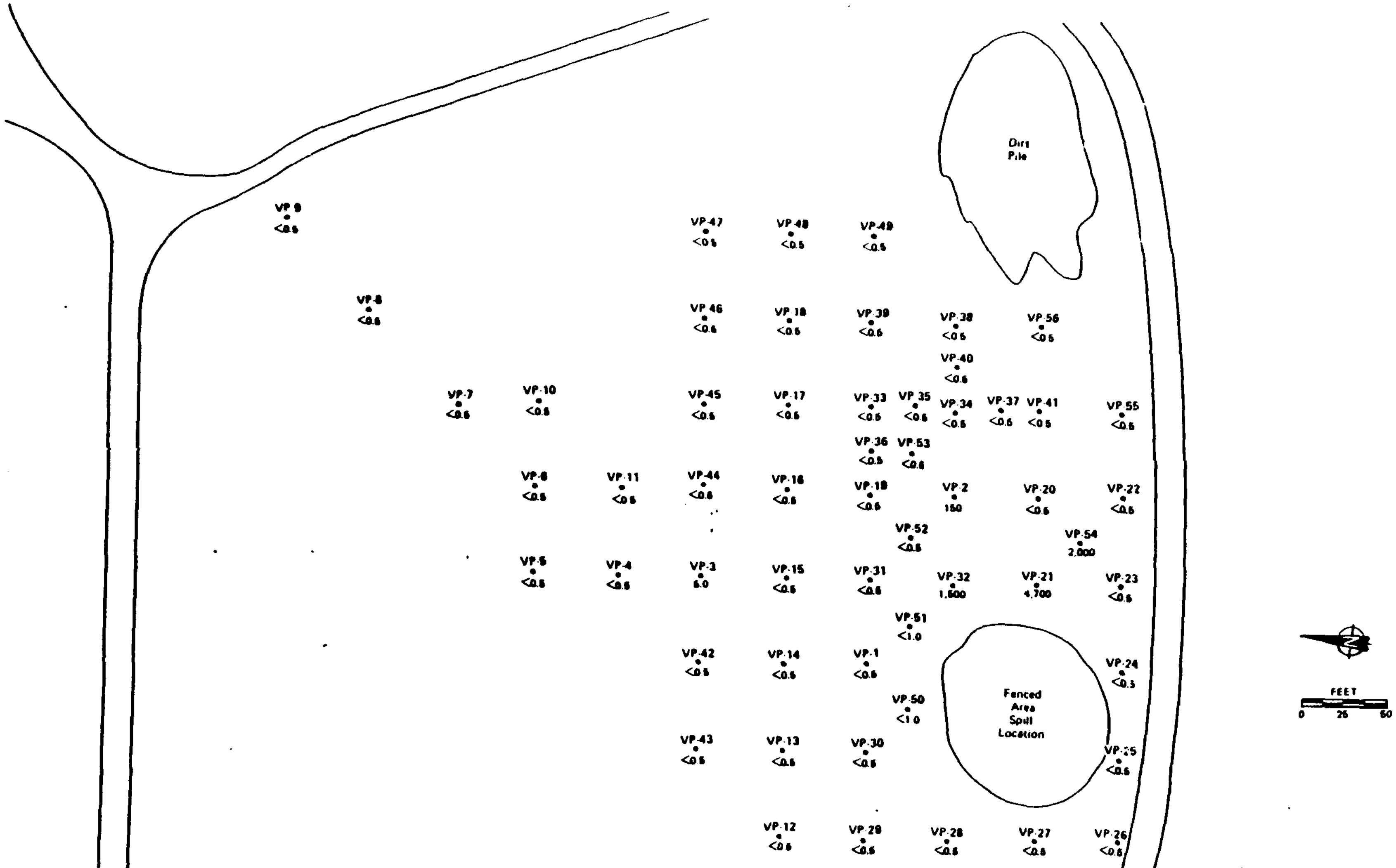


Figure 2. Concentrations for peaks eluting prior to toluene (ppm toluene equivalents) in the soil vapor at Site 1, Fire Training Area, Volk Field, ANGB, Tomah, Wisconsin, 11 – 20 November 1987.

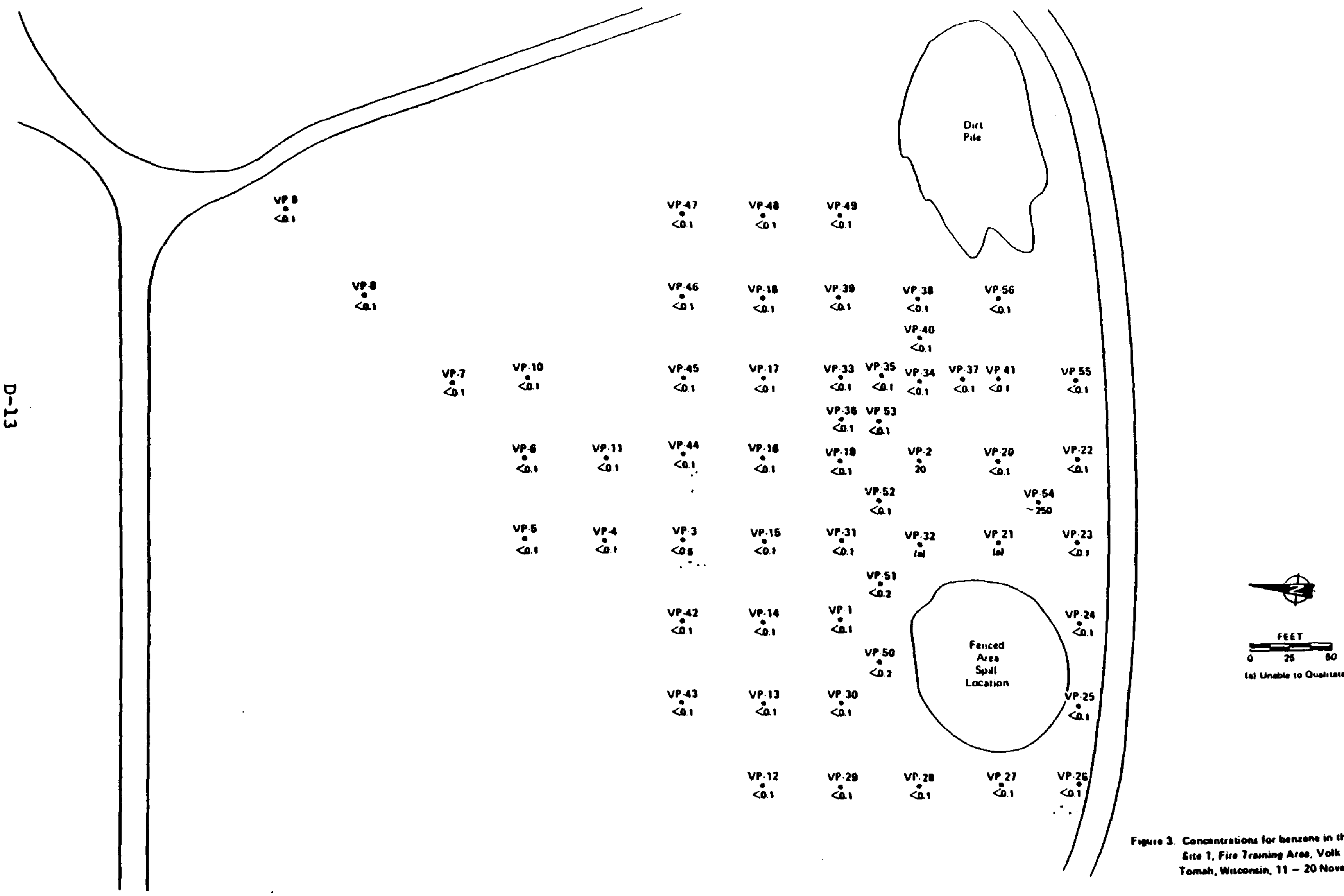


Figure 3. Concentrations for benzene in the soil vapor at Site 1, *Fire Training Area*, Volk Field, ANGB, Tomah, Wisconsin, 11 – 20 November 1987.

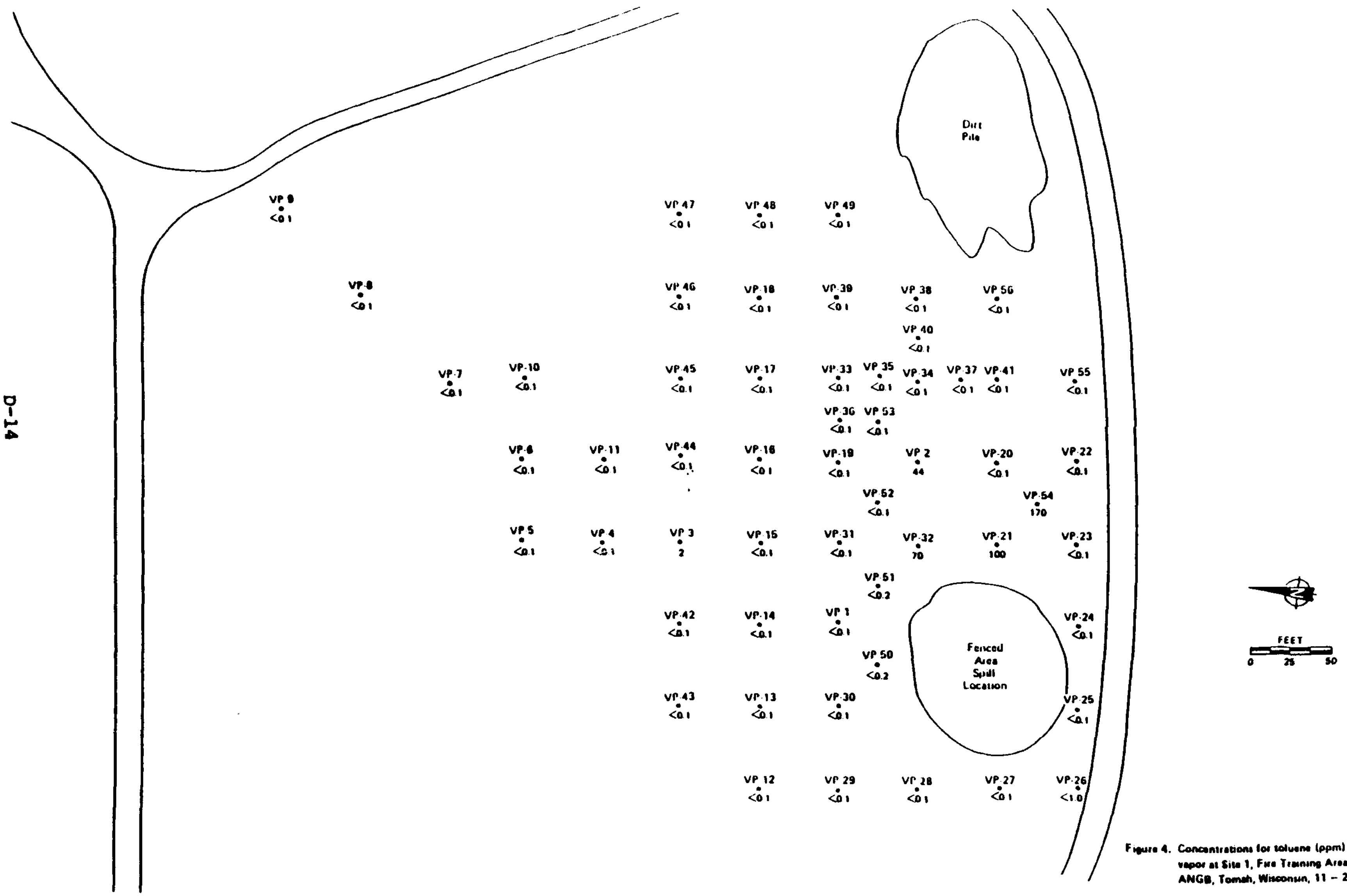


Figure 4. Concentrations for toluene (ppm) in the soil vapor at Site 1, Fire Training Area, Volk Field, ANGB, Tomah, Wisconsin, 11 – 20 November 1987.

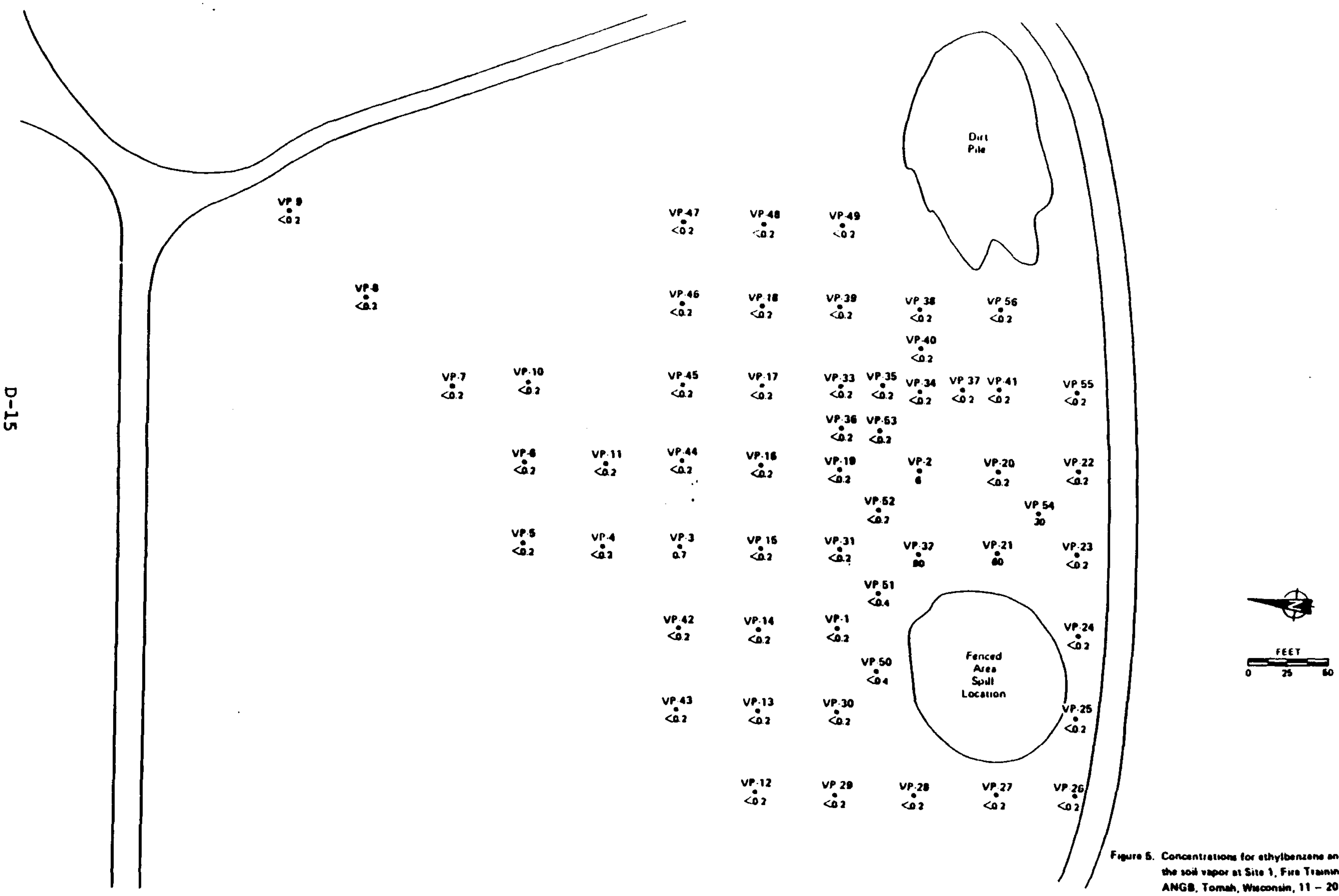


Figure 5. Concentrations for ethylbenzene and xylenes (ppm) in the soil vapor at Site 1, Fire Training Area, Volk Field, ANGB, Tomah, Wisconsin, 11 – 20 November 1987.

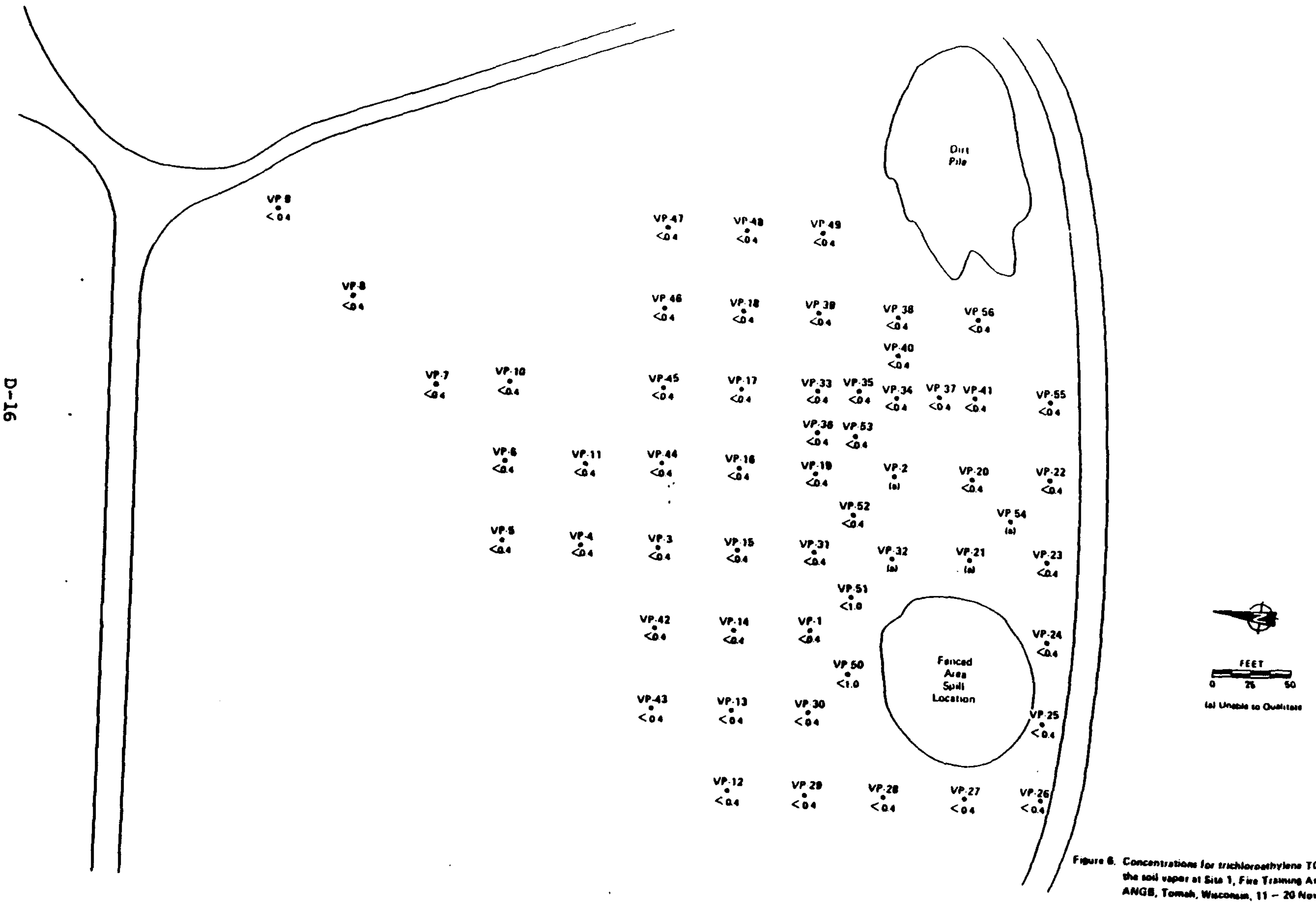


Figure 6. Concentrations for trichloroethylene TCE, (ppm) in the soil vapor at Site 1, Fire Training Area, Volk Field, ANGB, Tomah, Wisconsin, 11 – 20 November 1987.

SOIL GAS ANALYSIS
(Raw Data)

The data presented in the following section is reproduced directly from the EA Engineering, Science and Technology, Inc. Report entitled "Report of Soil Vapor Contaminant Assessment Conducted 11-20 November 1987 at Volk Field Air National Guard Base, Tomah, Wisconsin". The referenced document was prepared by EA Engineering, Science and Technology, Inc., Sparks, Maryland (EA Project No. VAB81A) for Engineering-Science, Inc. Atlanta, Georgia. In the original document duplicate analysis data were inadvertently omitted. These have been incorporated into appropriate data sections of this report.

EA ENGINEERING, SCIENCE, AND TECHNOLOGY, INC.

SOIL VAPOR CONTAMINANT ASSESSMENT CHROMATOGRAM REPORT SHEET

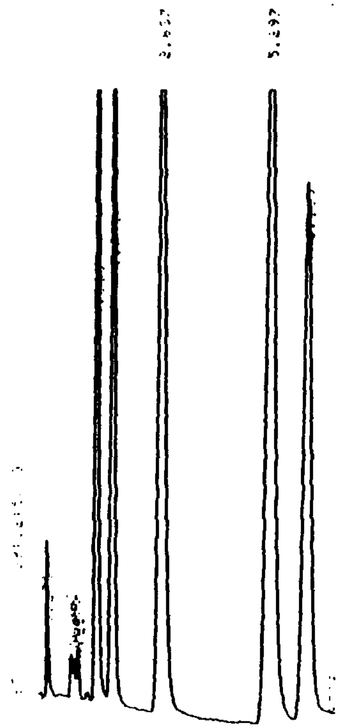
Project Number: YAB 81A **Date:** 11/11/87

Project Manager: ET **Chemist:** DW

Sample: Standard Initial **Geologist:**

Volume Injected: 400ul **Std. Vol. Inj.:**

Comments: 8.1ppm Benzene, 30.4ppm TCE, 20ppm Toluene, 14.2 ppm Ethylbenzene, 10.2ppm O-Xylene



CHROMATOGRAM FILE 0 METHOD 41

Standard 400ul

NAME	CONC
BENZENE	13,464/ppm
TCE	3937/ppm
TOLUENE	10,473/ppm
ETHYLBENZENE	19,511/ppm
O-XYLENE	16870/ppm

CALIBRATION MADE IN IDENTIFICATION FILE 0 WINDOW 5

EA ENGINEERING, SCIENCE, AND TECHNOLOGY, INC.

SOIL VAPOR CONTAMINANT ASSESSMENT
CHROMATOGRAM REPORT SHEET

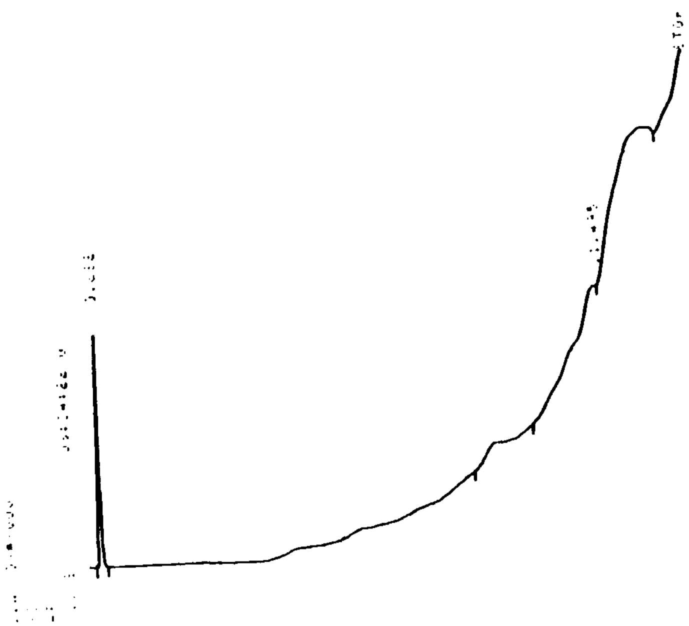
Project Number: VAB 81A **Date:** 11/11/87

Project Manager: R.T **Chemist:** D.W

Sample: Probe Blank **Geologist:**

Volume Injected: 1ml **Std. Vol. Inj.:**

Comments:



Probe Blank 1ml

EA ENGINEERING, SCIENCE, AND TECHNOLOGY, INC.

SOIL VAPOR CONTAMINANT ASSESSMENT CHROMATOGRAM REPORT SHEET

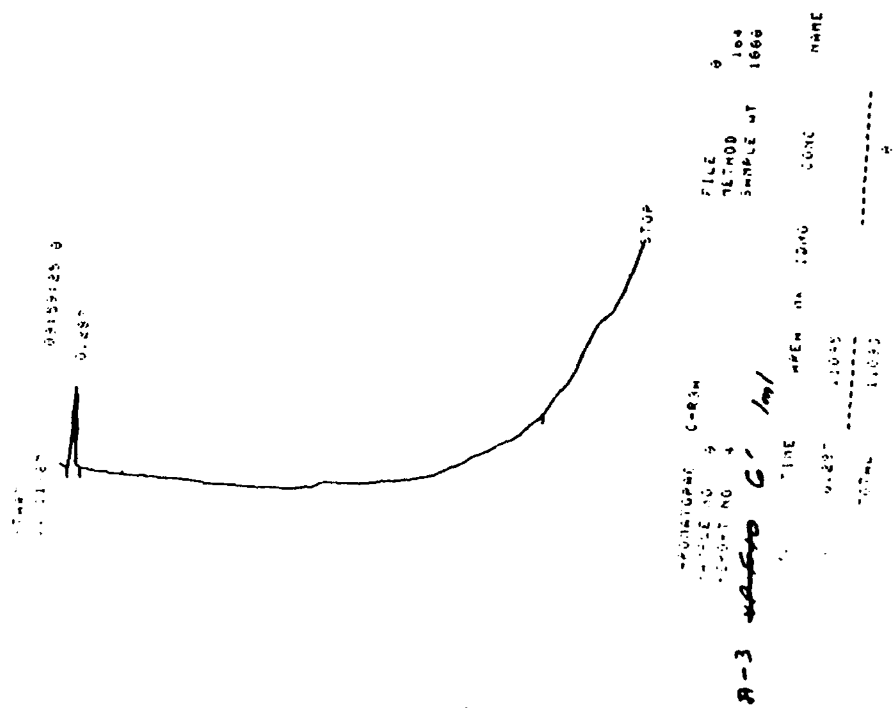
Project Number: VAB81A Date: 11/11/87

Project Manager: RT Chemist: DW

Sample: VP-1, 6' Geologist:

Volume Injected: 1ml Std. Vol. Inj.:

Comments:

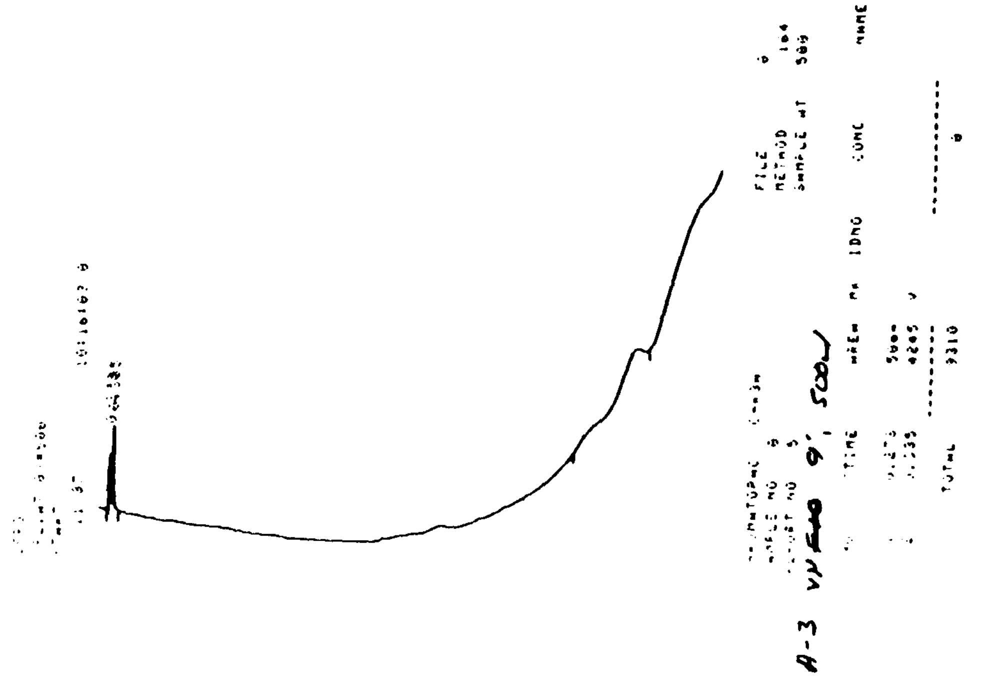


EA ENGINEERING, SCIENCE, AND TECHNOLOGY, INC.

SOIL VAPOR CONTAMINANT ASSESSMENT
CHROMATOGRAM REPORT SHEET

Project Number: YAB81A **Date:** 11/11/87
Project Manager: RT **Chemist:** DW
Sample: VP-1, 9' **Geologist:**
Volume Injected: 500ul **Std. Vol. Inj.:**

Comments:

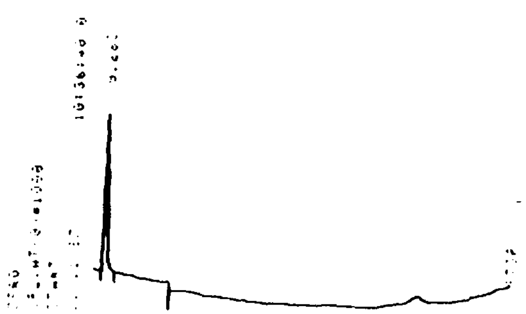


EA ENGINEERING, SCIENCE, AND TECHNOLOGY, INC.

SOIL VAPOR CONTAMINANT ASSESSMENT CHROMATOGRAM REPORT SHEET

Project Number: YAB81A Date: 11/11/87
Project Manager: RT Chemist: DW
Sample: VP-2, 3' Geologist: ____
Volume Injected: 1ml Std. Vol. Inj.: ____

Comments: ____



CHROMATOPAC C-R3A
SAMPLE NO 9
REPORT NO 6
FILE 0
METHOD 164
SAMPLE WT 1000

VP-B-1 3', 1ml

PKNO	TIME	AREA	MK	IDNO	CONC	NAME
1	0.253	17669				
	TOTAL	17669			0	

EA ENGINEERING, SCIENCE, AND TECHNOLOGY, INC.

SOIL VAPOR CONTAMINANT ASSESSMENT
CHROMATOGRAM REPORT SHEET

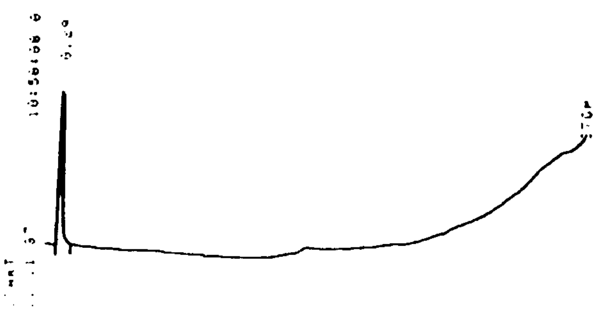
Project Number: VAB81A Date: 11/11/87

Project Manager: RT Chemist: DW

Sample: VP-2, 6' Geologist: ______

Volume Injected: 1ml Std. Vol. Inj.: ______

Comments: ______



CHROMATOPAC C-R3A
SAMPLE NO 0
REPORT NO
FILE 0
METHOD 104
SAMPLE WT 1000

VP-B-1 6', 1ml

PKNO	TIME	AREA	MK	IDNO	CONC	NAME
	0.29	23458				
	TOTAL	23458			0	

EA ENGINEERING, SCIENCE, AND TECHNOLOGY, INC.

SOIL VAPOR CONTAMINANT ASSESSMENT CHROMATOGRAM REPORT SHEET

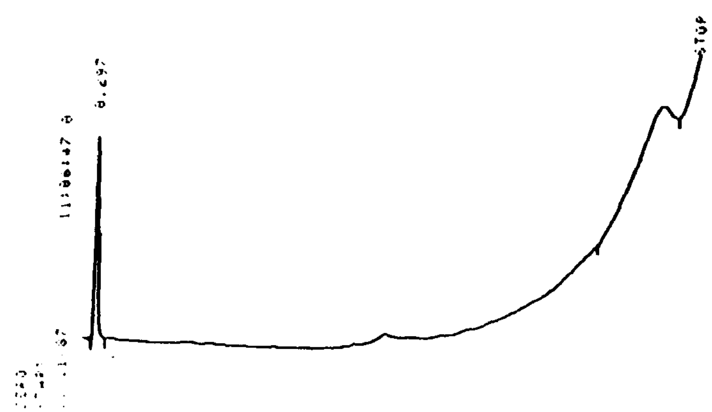
Project Number: VAB81A Date: 11/11/87

Project Manager: RT Chemist: DW

Sample: YP-2, 9' Geologist:

Volume Injected: 1ml Std. Vol. Inj.:

Comments:



CHROMATOPAC C-R3A   FILE 0
SAMPLE NO 0   METHOD 164
REPEAT NO 0   SAMPLE WT 1000

YP-B-1 9' 1ml

PKNO	TIME	AREA	MK	IDNO	CONC	NAME
	0.297	25034				
	TOTAL	25034			0	

EA ENGINEERING, SCIENCE, AND TECHNOLOGY, INC.

SOIL VAPOR CONTAMINANT ASSESSMENT CHROMATOGRAM REPORT SHEET

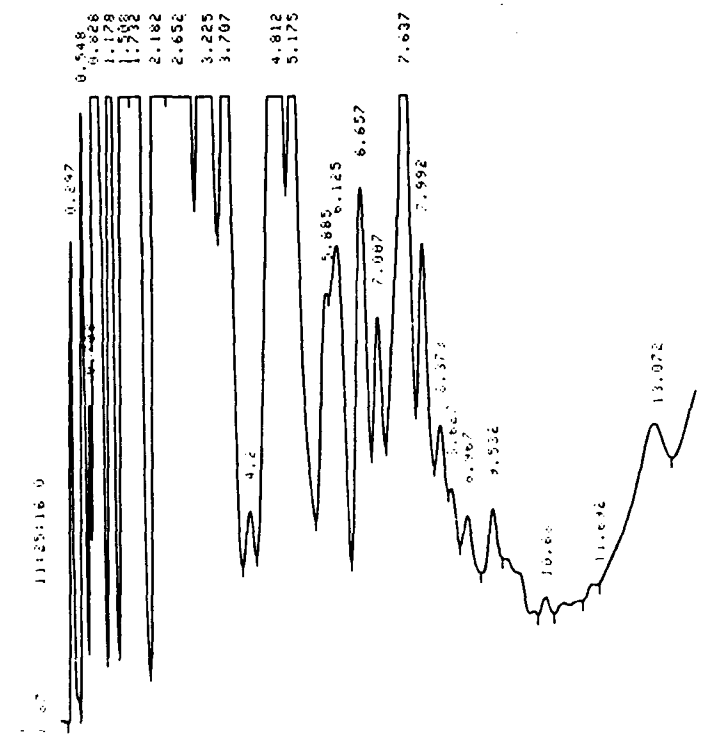
Project Number: VAB 81A, 10595.01 Date: 11-11-87

Project Manager: RT Chemist: DW

Sample: FTA, VP-2, 12' Geologist: ______

Volume Injected: 1ml Std. Vol. Inj.: ______

Comments: ______



FILE 0
METHOD 164
SAMPLE WT 1000

VP-B-1, 12', 1ml'

NO	TIME	AREA	BC	IDNO	CONC	NAME
[illegible]	0.297	5784[illegible]				
2	0.548	83797	V			
[illegible]	0.7[illegible]	32449	V			
4	0.828	600041	V			
[illegible]	1.178	325712	V			
[illegible]	1.508	750319	V			
[illegible]	1.732	1543584	V	2	157.2194	TCE
[illegible]	2.182	708840	V			
[illegible]	2.652	1368625	V			
[illegible]	3.225	570967	V			
[illegible]	3.707	35546[illegible]	V			
[illegible]	4.2	59255	V			
[illegible]	4.812	648463	V			
[illegible]	5.175	342849	V	4	7.0297	ETHYLBENZENE
[illegible]	5.885	125495	V	5	2.9756	O-XYLENE
[illegible]	6.125	204467	V	5	4.8486	O-XYLENE
[illegible]	6.657	1920[illegible]	V			
[illegible]	7.087	112550	V			
[illegible]	7.637	3990[illegible]	V			
[illegible]	7.992	150010	V			
[illegible]	8.373	653[illegible]	V			
[illegible]	8.627	29604	V			
[illegible]	8.967	23511	V			
[illegible]	9.532	16773				
[illegible]	10.66	4565				
[illegible]	11.692	[illegible]				
[illegible]	13.072	[illegible]				
	TOTAL	8641[illegible]			172.6732	

EA ENGINEERING, SCIENCE, AND TECHNOLOGY, INC.

SOIL VAPOR CONTAMINANT ASSESSMENT CHROMATOGRAM REPORT SHEET

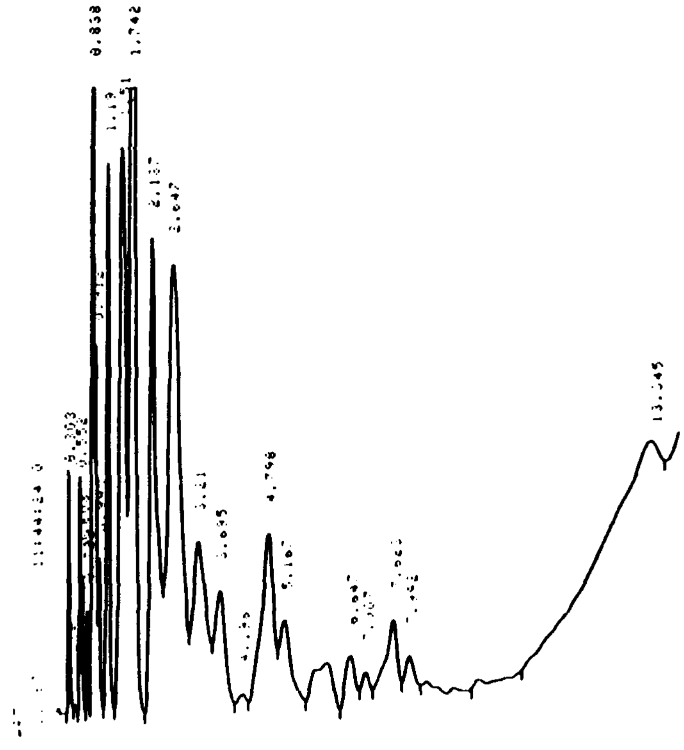
Project Number: VAB81A **Date:** 11/11/87

Project Manager: KT **Chemist:** DW

Sample: VP-2, 12' **Geologist:**

Volume Injected: 200ul **Std. Vol. Inj.:**

Comments:



[illegible] FILE 6
[illegible] METHOD 164
[illegible] SAMPLE WT 200

VP-B-1, 12', 200ul

#	TIME	AREA	MK	IDNO	CONC	NAME
1	0.303	13700	c/4			
2	0.552	13162	v			
3	0.605	6295	v			
4	0.722	7371	v			
5	0.838	68131	v			
6	0.942	28563	v			
7	[illegible]	13445	v			
8	1.19	67107	v			
9	1.51	150705	v -B			
10	1.742	297309	v	2	151.4097	TCE
11	2.137	134123				
12	2.647	242099	v - T			
13	3.21	94753	v			
14	3.695	51767	v			
15	4.198	3677	v			
16	4.798	86035	v			
17	5.167	38214	v	4	3.917	ETHYLBENZENE
18	6.647	21065				
19	7.097	16066	v			
20	7.623	38045	v			
21	7.992	11498	v			
22	13.345	44361				
	TOTAL	1466043			155.3267	

EA ENGINEERING, SCIENCE, AND TECHNOLOGY, INC.

SOIL VAPOR CONTAMINANT ASSESSMENT CHROMATOGRAM REPORT SHEET

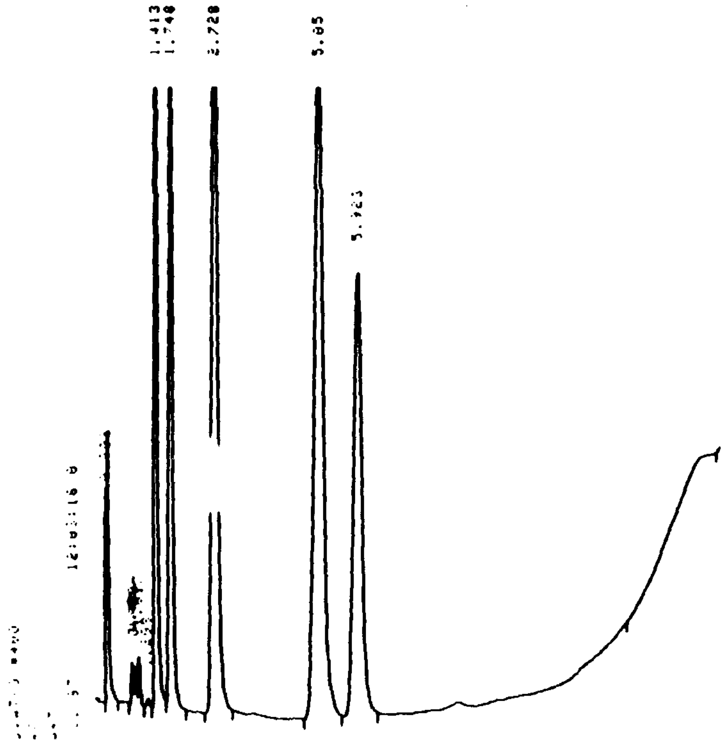
Project Number: VABSIA **Date:** 11/11/87

Project Manager: RT **Chemist:** DW

Sample: Standard **Geologist:**

Volume Injected: 400ul **Std. Vol. Inj.:**

Comments: 8.1ppm Benzene, 30.4 ppm TCE, 20ppm Toluene, 14.2ppm Ethylbenzene, 10.2 ppm O-Xylene



CHROMATOPAC C-R3A FILE 0
SAMPLE NO 0 METHOD 164
REPORT NO 11 SAMPLE WT 400
standard 400ul
[illegible]
STANDARD 1

	TIME	AREA	MK	IDNO	CONC	NAME
	0.302	32010				
	0.363	3812				
	0.933	3624	V			
	1.017	4970	V			
	1.203	1165				
	1.413	100333	V	1		BENZENE
	1.748	109488	V	2		TCE
	2.728	196367		3	99% ppm	TOLUENE
	5.05	244991		4		ETHYLBENZENE
	5.923	151605		5		O-XYLENE
TOTAL		840365				

CALIBRATION MADE IN IDENTIFICATION FILE 0
MODE# 121 WINDOW 5

IDNO	NAME	TIME	FACTOR	CONC
1	BENZENE	1.41	0.000322923	8.1
2	TCE	1.74	0.00111062	30.4
3	TOLUENE	2.72	0.0004074	20
4	ETHYLBENZENE	5.05	0.000231045	14.2
5	O-XYLENE	5.92	0.00026912	10.2

EA ENGINEERING, SCIENCE, AND TECHNOLOGY, INC.

SOIL VAPOR CONTAMINANT ASSESSMENT
CHROMATOGRAM REPORT SHEET

Project Number: VAB81A Date: 11/11/87

Project Manager: RT Chemist: DW

Sample: VP-3, 6' Geologist: ______

Volume Injected: 1ml Std. Vol. Inj.: ______

Comments: ______

CHROMATOPAC C-R3A
SAMPLE NO 0
REPORT NO 13
VP C-2 6' 1ml

FILE 0
METHOD 164
SAMPLE WT 1000

PKNO	TIME	AREA	MK	IDNO	CONC	NAME
1	0.345	8967				
TOTAL		8967			0	

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SOIL VAPOR CONTAMINANT ASSESSMENT CHROMATOGRAM REPORT SHEET

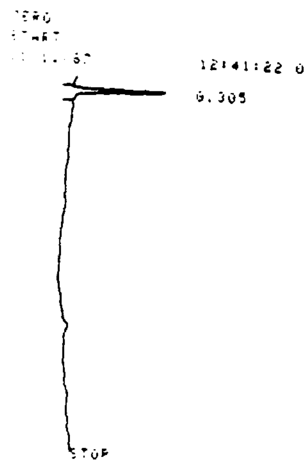
Project Number: YA03840 **Date:** 11/6/87

Project Manager: RT **Chemist:** DW

Sample: VP-3, 9' **Geologist:**

Volume Injected: 1ml **Std. Vol. Inj.:**

Comments:



CHROMATOPAC C-R3A
SAMPLE NO 0 FILE 0
REPORT NO 14 METHOD 164
SAMPLE WT 1000

VPMC-2, 9', 1ml

PKNO	TIME	AREA	MK	IDNO	CONC	NAME
1	0.305	16634				
	TOTAL	16634			0	

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SOIL VAPOR CONTAMINANT ASSESSMENT CHROMATOGRAM REPORT SHEET

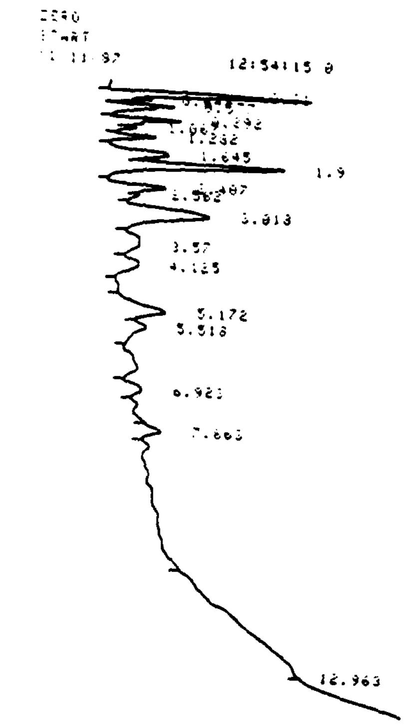
Project Number: YAB 81A Date: 11/11/87

Project Manager: RT Chemist: DW

Sample: VP-3, 12' Geologist:

Volume Injected: 1ml Std. Vol. Inj.:

Comments:



CHROMATOPAC C-R3A
SAMPLE NO 0
REPORT NO 15
VP C-2, 12', 1ml

FILE 0
METHOD 164
SAMPLE WT 1000

PKNO	TIME	AREA	MK	IDNO	CONC	NAME
1	0.31	38573				
2	0.442	4364	V			
3	0.577	13000	V			
4	0.992	13628	V			
5	1.067	4492	V			
6	1.282	7635	V			
7	1.645	19385	V			
8	1.9	41001	V			
9	2.407	15069				
10	2.562	6497	V			
11	3.016	54537	V - T			
12	3.57	19760	V			
13	4.125	12363	V			
14	5.172	20667		4	0.4778	ETHYLBENZENE
15	5.518	16346	V			
16	6.923	5240				
17	7.863	4774				
18	12.963	8743				
	TOTAL	292395			0.4778	

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SOIL VAPOR CONTAMINANT ASSESSMENT
CHROMATOGRAM REPORT SHEET

Project Number: VAB 81A Date: 11/11/87

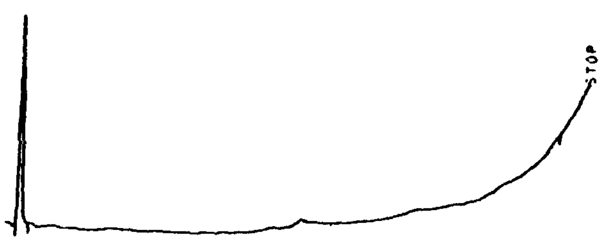
Project Manager: RJ Chemist: DW

Sample: Probe Blank Geologist: ______

Volume Injected: 1ml Std. Vol. Inj.: ______

Comments: ______

ZERO
START
11/11/87 13:15:58 0



CHROMATOPAC C-R3A
SAMPLE NO 0
REPORT NO 16
Probe Blank, 1ml

FILE 0
METHOD 104
SAMPLE WT 1000

PKNO	TIME	AREA	MK	IDNO	CONC	NAME
1	0.308	25916				
	TOTAL	25916			0	

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SOIL VAPOR CONTAMINANT ASSESSMENT CHROMATOGRAM REPORT SHEET

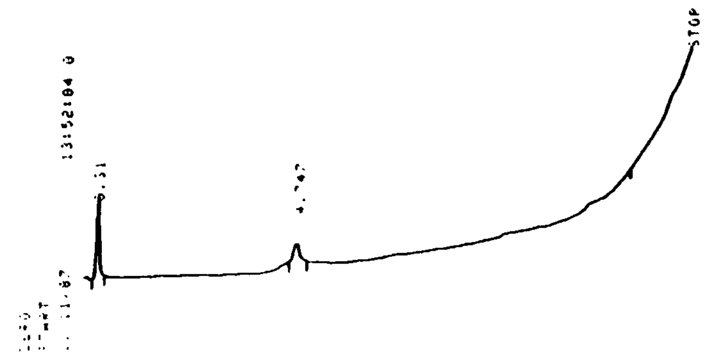
Project Number: VAB81A **Date:** 11/11/87

Project Manager: RT **Chemist:** DW

Sample: VP-4, 6' **Geologist:**

Volume Injected: 1ml **Std. Vol. Inj.:**

Comments:



CHROMATOPAC C-R3A FILE 0
SAMPLE NO 0 METHOD 164
REPORT NO 17 SAMPLE WT 1000

VP D-2 6', 1ml

PKNO	TIME	AREA	MK	IDNO	CONC	NAME
1	0.31	8216				
2	4.747	4405				
TOTAL		12620			0	

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SOIL VAPOR CONTAMINANT ASSESSMENT CHROMATOGRAM REPORT SHEET

Project Number: VAB81A Date: 11/11/87

Project Manager: RT Chemist: DW

Sample: VP-5, 6' Geologist: ____

Volume Injected: 1ml Std. Vol. Inj.: ____

Comments: ____

CHROMATOPAC C-R3A

SAMPLE NO 0

REPORT NO 18

vp #-2, 6', 1ml

FILE 0

METHOD 164

SAMPLE WT 1000

PKNO	TIME	AREA	MK	IDNO	CONC	NAME
1	0.333	16034				
	TOTAL	16034			0	

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SOIL VAPOR CONTAMINANT ASSESSMENT CHROMATOGRAM REPORT SHEET

Project Number: VAB81A Date: 11/11/87

Project Manager: RT Chemist: DW

Sample: VP-6, 6' Geologist: ____

Volume Injected: 1ml Std. Vol. Inj.: ____

Comments: ____

CHROMATOPAC C-R3A
SAMPLE NO 0
REPORT NO 19

FILE 0
METHOD 164
SAMPLE WT 1000

VPE-1, 6', 1ml

NO	TIME	AREA	MK	IDNO	CONC	NAME
1	6.31	29037				
TOTAL		29037			0	

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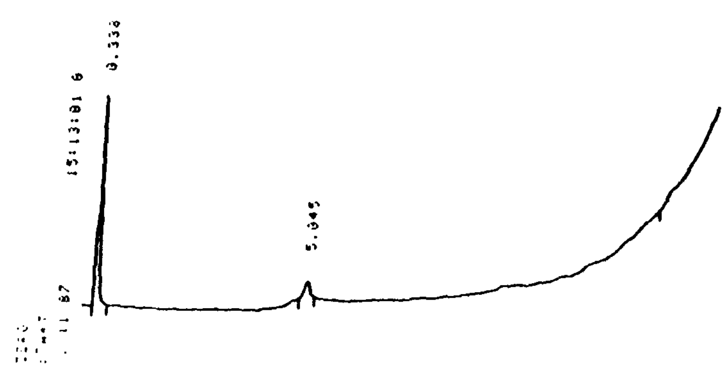
SOIL VAPOR CONTAMINANT ASSESSMENT
CHROMATOGRAM REPORT SHEET

Project Number: YAB 81A **Date:** 11/11/87
Project Manager: RT **Chemist:** DW
Sample: VP-7, 4.5' **Geologist:**
Volume Injected: 1ml **Std. Vol. Inj.:**
Comments:



CHROMATOPAC C-R3A
SAMPLE NO 0
REPORT NO 20

FILE 0
METHOD 164
SAMPLE WT 1000

VP Fto, 4.5', 1ml

PKNO	TIME	AREA	MK	IDNO	CONC	NAME
1	0.338	21624				
2	5.045	3670		4	0.0651	ETHYLBENZENE
TOTAL		25294			0.0851	

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SOIL VAPOR CONTAMINANT ASSESSMENT CHROMATOGRAM REPORT SHEET

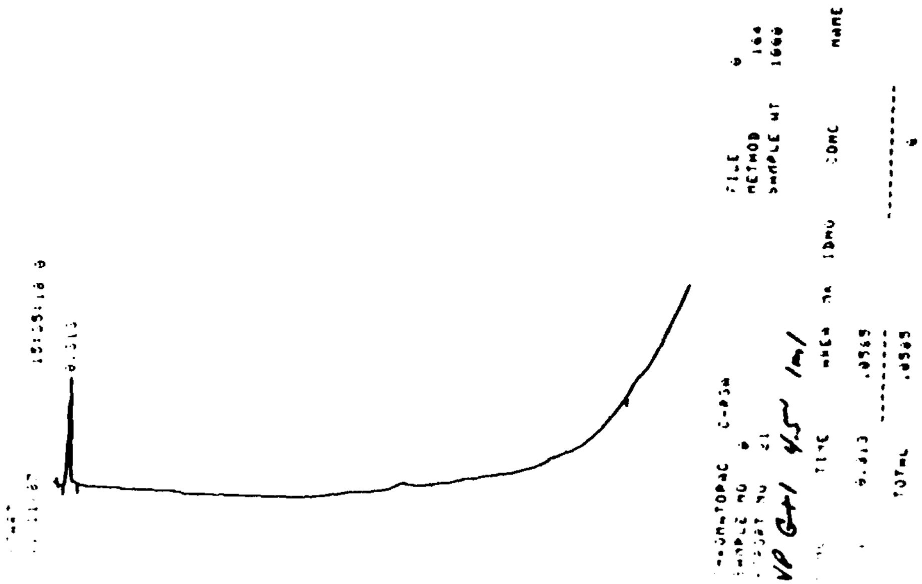
Project Number: VAB81A Date: 11/6/87

Project Manager: RT Chemist: DIV

Sample: VP-8, 4.5' Geologist: ______

Volume Injected: 1ml Std. Vol. Inj.: ______

Comments: ______



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SOIL VAPOR CONTAMINANT ASSESSMENT
CHROMATOGRAM REPORT SHEET

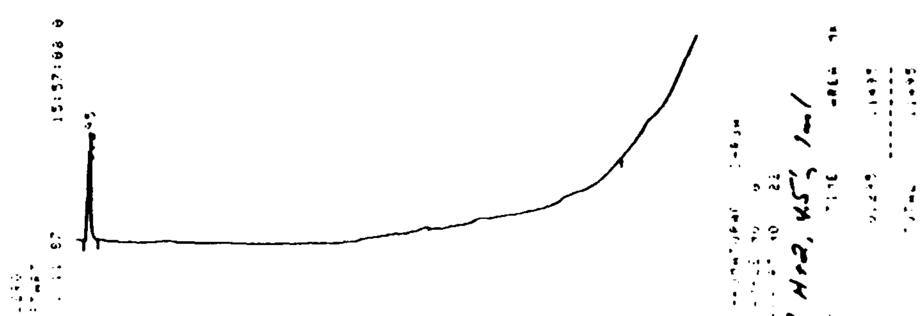
Project Number: VAB81A Date: 11/11/87

Project Manager: RT Chemist: DW

Sample: VP-9, 4.5' Geologist:

Volume Injected: 1ml Std. Vol. Inj.:

Comments:



VP H-2, 4.5', 1ml

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SOIL VAPOR CONTAMINANT ASSESSMENT CHROMATOGRAM REPORT SHEET

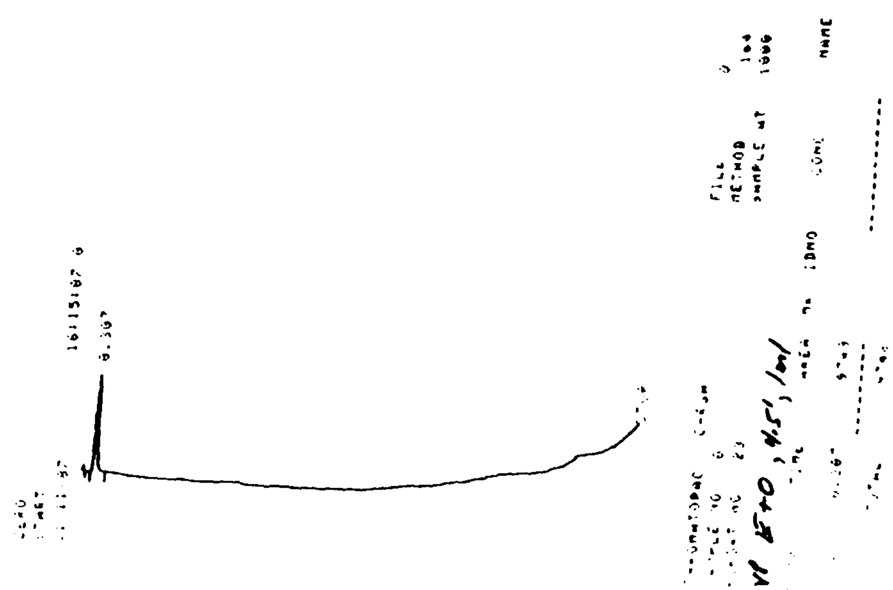
Project Number: VAB81A **Date:** 11/u/87

Project Manager: R— **Chemist:** DW

Sample: VP-10, 4.5' **Geologist:**

Volume Injected: 1ml **Std. Vol. Inj.:**

Comments:



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SOIL VAPOR CONTAMINANT ASSESSMENT CHROMATOGRAM REPORT SHEET

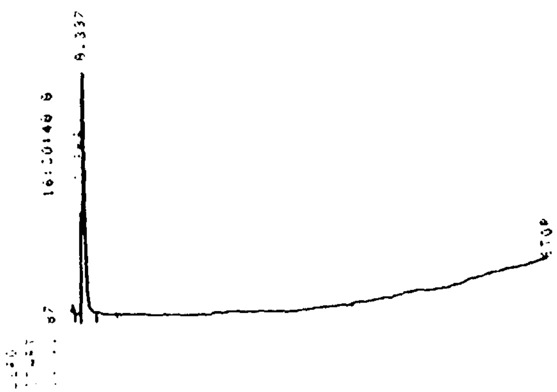
Project Number: YABB31A **Date:** 11/11/87

Project Manager: RT **Chemist:** DW

Sample: VP-11, 6' **Geologist:**

Volume Injected: 1ml **Std. Vol. Inj.:**

Comments:



CHROMATOPAC C-R3A FILE 0
SAMPLE NO 0 METHOD 164
REPORT NO 24 SAMPLE WT 1000

VP D-1, 6', 1ml

PKNO	TIME	AREA	MK	IDNO	CONC	NAME
[illegible]	0.266	9705				
2	0.337	16651	V			
TOTAL		25356			0	

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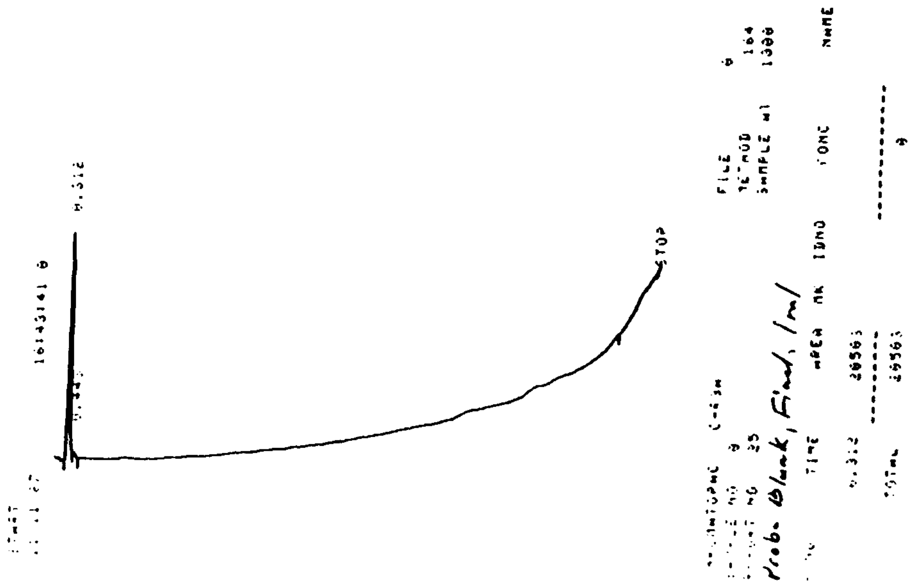
SOIL VAPOR CONTAMINANT ASSESSMENT
CHROMATOGRAM REPORT SHEET

Project Number:	VAB81B	**Date:**	11/11/87
Project Manager:	RT	**Chemist:**	CW
Sample:	Probe Blank, Final	**Geologist:**	
Volume Injected:	1ml	**Std. Vol. Inj.:**	

Comments:



EA ENGINEERING, SCIENCE, AND TECHNOLOGY, INC.

SOIL VAPOR CONTAMINANT ASSESSMENT CHROMATOGRAM REPORT SHEET

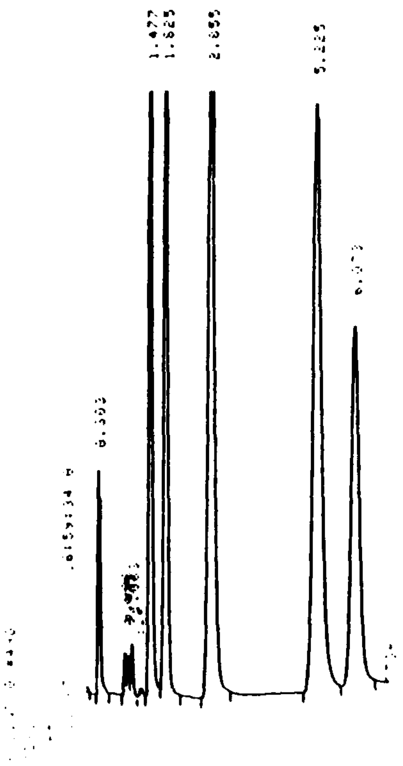
Project Number: VAB81A **Date:** 11/11/87

Project Manager: RT **Chemist:** DW

Sample: Standard, Final **Geologist:**

Volume Injected: 400ul **Std. Vol. Inj.:**

Comments: 8.1ppm Benzene, 30.4 ppm TCE, 20 ppm Toluene 14.2 ppm Ethylbenzene, 10.2 ppm O-Xylene



FILE 0
METHOD 164
SAMPLE WT 400

standard, 400ul, Final

TIME	AREA	MK	IDNO	CONC	NAME
0.303	25460				
0.396	4044				
[illegible]	3673	V			
[illegible]	5241	V			
[illegible]	1212				
1.477	182542		1	8.2799	BENZENE
1.625	109667	V	2	30.2775	TCE
2.855	164866		3	16.0867	TOLUENE
5.225	268919		4	11.6397	ETHYLBENZENE
6.073	117755	V	5	7.9226	O-XYLENE
TOTAL	754704			74.9564	

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SOIL VAPOR CONTAMINANT ASSESSMENT CHROMATOGRAM REPORT SHEET

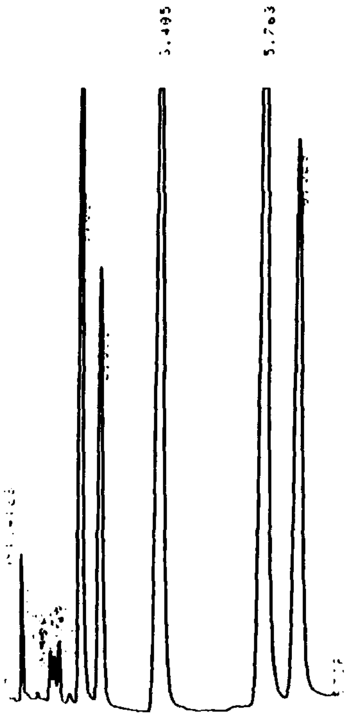
Project Number: VAB81A **Date:** 11/12/87

Project Manager: RT **Chemist:** DW

Sample: Standard, Initial **Geologist:**

Volume Injected: **Std. Vol. Inj.:** 400ul

Comments: 8.1 ppm Benzene, 30.4 ppm TCE, 20 ppm Toluene, 14.2 ppm Ethylbenzene, 10.2 ppm O-Xylene



FILE 0
METHOD 41

Std. Initial 400ul

AREA	IDNO	CONC	NAME
[illegible]		14.6025	
[illegible]		24.4691	
[illegible]		36.254	
[illegible]		16.3422	
TOTAL		100	

FILE 0
METHOD 164
SAMPLE WT 400

AREA	IDNO	CONC	NAME
134625		11,6645/ppm	BENZENE
[illegible]		2724/ppm	TCE
225407		11,245/ppm	TOLUENE
279314		19,670/ppm	ETHYLBENZENE
169346		16,603/ppm	O-XYLENE

CALIBRATION MADE IN IDENTIFICATION FILE 0
WINDOW 5

NAME	TIME	FACTOR	CONC
BENZENE	1.63	0.000240312	8.1
TCE	[illegible]	[illegible]	30.4
TOLUENE	[illegible]	[illegible]	20
ETHYLBENZENE	[illegible]	[illegible]	14.2
O-XYLENE	[illegible]	[illegible]	10.2

EA ENGINEERING, SCIENCE, AND TECHNOLOGY, INC.

SOIL VAPOR CONTAMINANT ASSESSMENT
CHROMATOGRAM REPORT SHEET

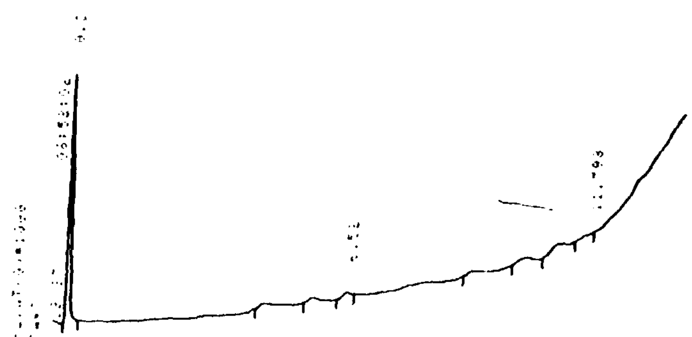
Project Number: VAB81A **Date:** 11/12/87

Project Manager: RT **Chemist:** DW

Sample: Probe Blank, Initial **Geologist:**

Volume Injected: 1ml **Std. Vol. Inj.:**

Comments:



CHROMATOGRAM C-ASM
SAMPLE NO 6
REPORT NO 1
FILE 0
METHOD 104
SAMPLE WT 1000

Probe Blank, Initial, 1ml

PK NO	TIME	AREA	MK	IDNO	CONC	NAME
	[illegible]	29658				
4	4.52	1492		5	0.0359	O-XYLENE
	TOTAL	31[illegible]44			0.0359	

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SOIL VAPOR CONTAMINANT ASSESSMENT CHROMATOGRAM REPORT SHEET

Project Number: VAB81A   Date: 11/12/87

Project Manager: RT   Chemist: DW

Sample: VP-12, 4.5'   Geologist: ______

Volume Injected: 1ml   Std. Vol. Inj.: ______

Comments: ______

CHROMATOPAC C-R3A
SAMPLE NO 0
REPORT NO 4

FILE 0
METHOD 164
SAMPLE WT 1000

B-5, 4.5', 1ml

PKNO	TIME	AREA	MK	IDNO	CONC	NAME
1	0.255	13228				
2	0.327	15361	V			
TOTAL		28589			0	

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SOIL VAPOR CONTAMINANT ASSESSMENT CHROMATOGRAM REPORT SHEET

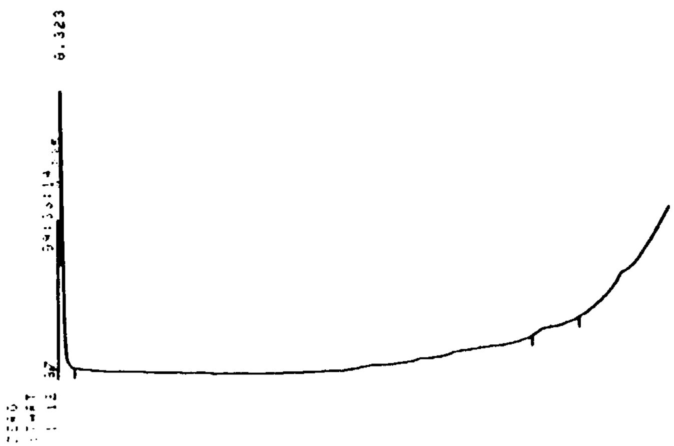
Project Number: YAB 81A **Date:** 11/12/87

Project Manager: RT **Chemist:** DW

Sample: VP-13, 4.5' **Geologist:**

Volume Injected: 1ml **Std. Vol. Inj.:**

Comments:



CHROMATOPAC C-R3A
SAMPLE NO 0
REPORT NO 5
FILE 0
METHOD 104
SAMPLE WT 1000

B-4, 4.5', 1ml

PKNO	TIME	AREA	MK	IDNO	CONC	NAME
1	0.235	12910				
2	0.323	21909	V			
	TOTAL	33919			0	

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SOIL VAPOR CONTAMINANT ASSESSMENT
CHROMATOGRAM REPORT SHEET

Project Number: YAB 81A **Date:** 11/12/87

Project Manager: RT **Chemist:** DW

Sample: VP-14, 6' **Geologist:**

Volume Injected: 1ml **Std. Vol. Inj.:**

Comments:

CHROMATOPAC C-R3A
SAMPLE NO 0
REPORT NO 0
FILE 0
METHOD 104
SAMPLE WT 1000

B-3, 6', 1ml

PKNO	TIME	AREA	MK	IDNO	CONC	NAME
1	0.272	5404				
2	0.302	10547	V			
TOTAL		15952			0	

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SOIL VAPOR CONTAMINANT ASSESSMENT CHROMATOGRAM REPORT SHEET

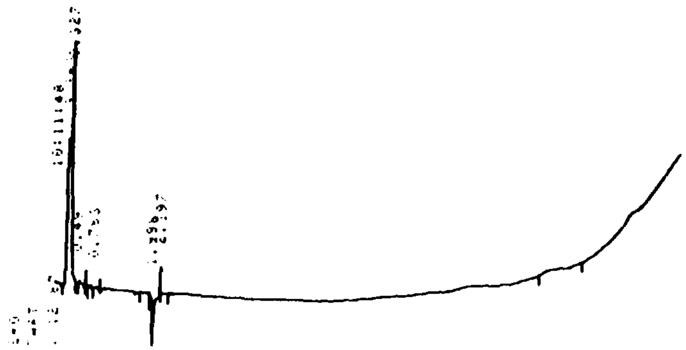
Project Number: VAB81A Date: 11/12/87

Project Manager: RT Chemist: DW

Sample: VP-15, 6' Geologist: ______

Volume Injected: 1ml Std. Vol. Inj.: ______

Comments: ______



[illegible]MATOPAC C-R3A
[illegible] NO 0
[illegible] NO 7
B-2, 6', 1ml

FILE 0
METHOD 164
SAMPLE WT 1000

[illegible]	TIME	AREA	MK	IDNO	CONC	NAME
1	0.[illegible]	15512				
2	0.327	15687	SV			
3	[illegible].988	8540		2	1.2516	TCE
4	2.397	3938				
	TOTAL	43678			1.2516	

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SOIL VAPOR CONTAMINANT ASSESSMENT
CHROMATOGRAM REPORT SHEET

Project Number: VAB81A Date: 11/12/87

Project Manager: RT Chemist: DW

Sample: VP-16, 6' Geologist: ____

Volume Injected: 1ml Std. Vol. Inj.: ____

Comments: ____

CHROMATOPAC C-R3A
SAMPLE NO 0
REPORT NO 9

FILE 0
METHOD 164
SAMPLE WT 1000

B-1, 6', 1ml

PKNO	TIME	AREA	MK	IDNO	CONC	NAME
1	0.295	7118				
2	0.323	6685	V			
TOTAL		14003			0	

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SOIL VAPOR CONTAMINANT ASSESSMENT CHROMATOGRAM REPORT SHEET

Project Number: VABBIA Date: 11/12/87

Project Manager: RT Chemist: DW

Sample: VP-17, 6' Geologist:

Volume Injected: 1ml Std. Vol. Inj.:

Comments:

CHROMATOPAC C-R3A
SAMPLE NO 0
REPORT NO 4
FILE 0
METHOD 164
SAMPLE WT 1000

B-0, 6', 1ml

PK NO	TIME	AREA	MK	IDNO	CONC	NAME
1	0.293	21004				
	TOTAL	21004			0	

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SOIL VAPOR CONTAMINANT ASSESSMENT CHROMATOGRAM REPORT SHEET

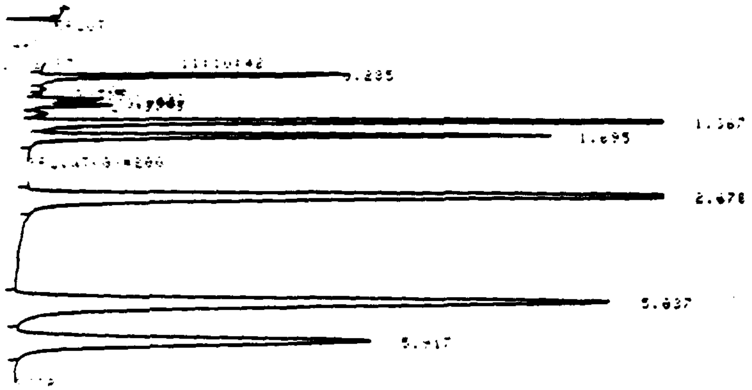
Project Number: YNBS1A Date: 11/13/87

Project Manager: RT Chemist: DW

Sample: Standard Geologist: ______

Volume Injected: ______ Std. Vol. Inj.: 200ul

Comments: 8.1ppm Benzene, 30.4ppm TCE, 20ppm Toluene, 14.2ppm Ethylbenzene, 10.2ppm O-Xylene



CHROMATOPAC C-R3A FILE 0
SAMPLE NO 0 METHOD 164
REPORT NO 10 SAMPLE WT 200

std 1 d 200ul

PKNO	TIME	AREA	MK	IDNO	CONC	NAME
1	0.285	17419				
2	0.333	2553				
3	0.461	2597	V			
4	0.48	3439	V			
5	1.367	64.65				
6	1.695	36966	V	1	4.674	BENZENE
7	2.678	99521				
8	5.037	167832				
9	5.917	61051	V	4	6.2106	ETHYLBENZENE
	TOTAL	397530			10.6846	

NEW FILE [illegible]
MODE(0)=41317
WINDOW(0)=5
FREE MEMORY 46 PEAKS

IDNO	NAME	TIME	FACTOR	CONC
1	BENZENE	1.367	0	8.1
2	TCE	1.695	0	30.4
3	TOLUENE	2.678	0	20
4	ETHYLBENZENE	5.037	0	14.2
5	O-XYLENE	5.917	0	10.2
6	END			

METHOD(0)=164
CALIB 1
PRINT

CHROMATOPAC C-R3A FILE 0
SAMPLE NO 0 METHOD 164
REPORT NO 11 SAMPLE WT 200
[illegible]

PKNO	TIME	AREA	MK	IDNO	CONC	NAME
1	0.285	17419				
2	0.333	2553				
3	0.463	2597	.			
4	0.96	3439	V			
5	1.367	64165		1	7924/ppm	BENZENE
6	1.695	36966	V	2	1274/ppm	TCE
7	2.678	99521		3	4976/ppm	TOLUENE
8	5.037	167832		4	7544/ppm	ETHYLBENZENE
9	5.917	61661	V	5	5985/ppm	O-XYLENE
	TOTAL	397530				

CALIBRATION MADE IN IDENTIFICATION FILE 0
MODE8 (2) WINDOW 5

IDNO	NAME	TIME	FACTOR	CONC
1	BENZENE	1.36	0.000252303	8.1
2	TCE	1.69	0.001563	30.4
3	TOLUENE	2.67	0.000401924	20
4	ETHYLBENZENE	5.63	0.000263373	14.2
5	O-XYLENE	5.91	0.000332981	10.2

EA ENGINEERING, SCIENCE, AND TECHNOLOGY, INC.

SOIL VAPOR CONTAMINANT ASSESSMENT CHROMATOGRAM REPORT SHEET

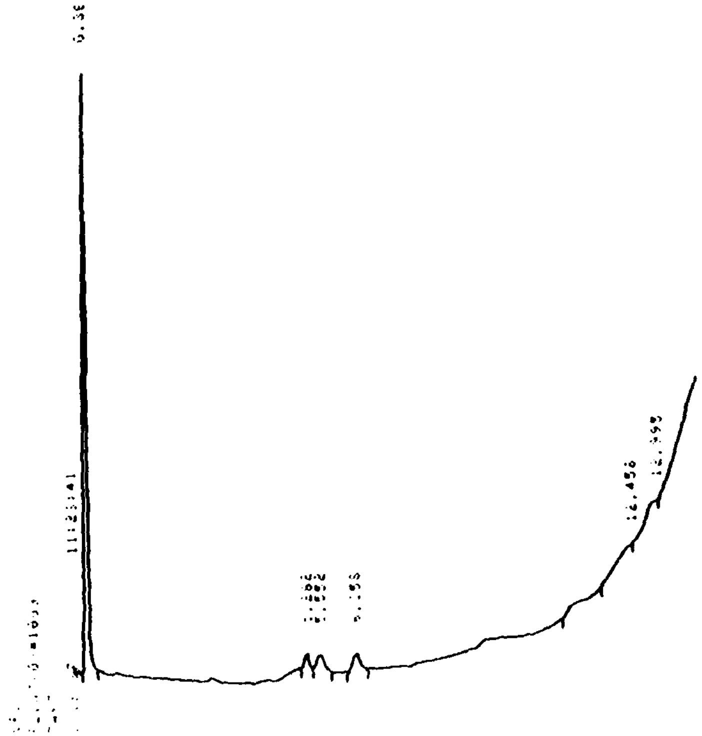
Project Number: VAB81A Date: 11/12/87

Project Manager: RT Chemist: DW

Sample: Probe Blank Geologist: ______

Volume Injected: 1ml Std. Vol. Inj.: ______

Comments: ______



CHROMATOPAC C-R3A FILE 0
SAMPLE NO 0 METHOD 164
REPORT NO 12 SAMPLE WT 1000

Probe Blank, 1ml, AH=3

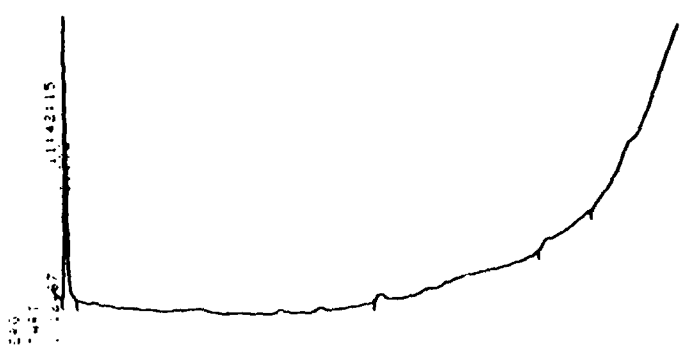
PKNO	TIME	AREA	MK	IDNO	CONC	NAME
1	0.367	37537				
2	5.232	1473		4	0.0366	ETHYLBENZENE
3	5.552	2549	V			
4	6.153	2686				
5	12.456	1254				
	TOTAL	45499			0.0366	

EA ENGINEERING, SCIENCE, AND TECHNOLOGY, INC.

SOIL VAPOR CONTAMINANT ASSESSMENT
CHROMATOGRAM REPORT SHEET

Project Number: YAB81A Date: 11/12/87
Project Manager: RT Chemist: DW
Sample: VP-18, 8' Geologist: ____
Volume Injected: 1ml Std. Vol. Inj.: ____

Comments: ____



CHROMATOPAC	C-R3A	FILE	0
SAMPLE NO	0	METHOD	164
REPORT NO	13	SAMPLE WT	1000

B+1, 8', 1ml

PKNO	TIME	AREA	MK	IDNO	CONC	NAME
1	0.302	16694				
	TOTAL	16694			0	

EA ENGINEERING, SCIENCE, AND TECHNOLOGY, INC.

SOIL VAPOR CONTAMINANT ASSESSMENT CHROMATOGRAM REPORT SHEET

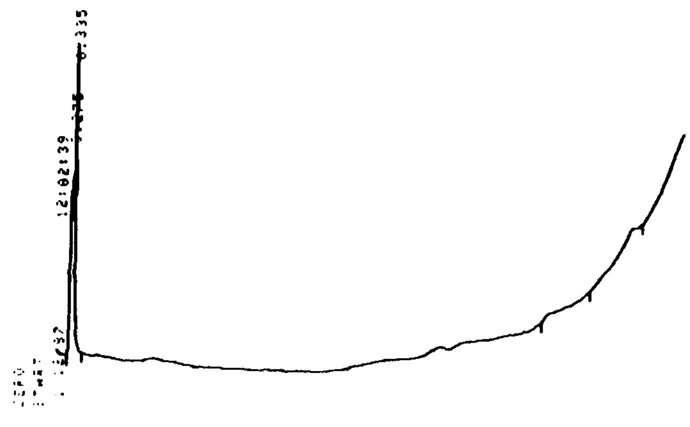
Project Number: YAB81A **Date:** 11/12/87

Project Manager: RT **Chemist:** DW

Sample: VP-19, 9' **Geologist:**

Volume Injected: 1ml **Std. Vol. Inj.:**

Comments:



CHROMATOPAC C-R3A FILE 0
SAMPLE NO 0 METHOD 164
REPORT NO 14 SAMPLE WT 1000

H-1, 9', 1ml

PKNO	TIME	AREA	MK	IDNO	CONC	NAME
1	0.275	11311				
2	0.335	7955	V			
TOTAL		19266			0	

EA ENGINEERING, SCIENCE, AND TECHNOLOGY, INC.

SOIL VAPOR CONTAMINANT ASSESSMENT
CHROMATOGRAM REPORT SHEET

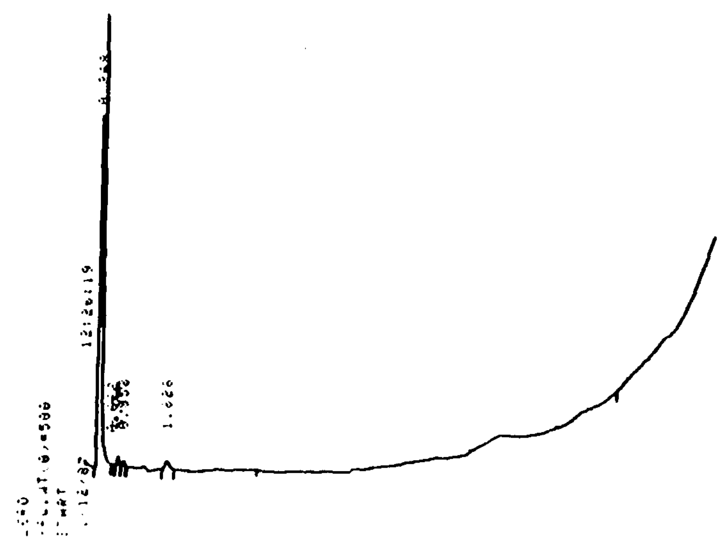
Project Number: YAB81A Date: 11/12/87

Project Manager: RT Chemist: DW

Sample: VP-20, 10.5' Geologist:

Volume Injected: 500ul Std. Vol. Inj.:

Comments:



CHROMATOPAC C-R3A FILE 0
SAMPLE NO 0 METHOD 164
REPORT NO 15 SAMPLE WT 500

-C-1 10.5', 500-l

PKNO	TIME	AREA	MK	IDNO	CONC	NAME
1	0.268	27239	S			
	TOTAL	27239			0	

EA ENGINEERING, SCIENCE, AND TECHNOLOGY, INC.

SOIL VAPOR CONTAMINANT ASSESSMENT CHROMATOGRAM REPORT SHEET

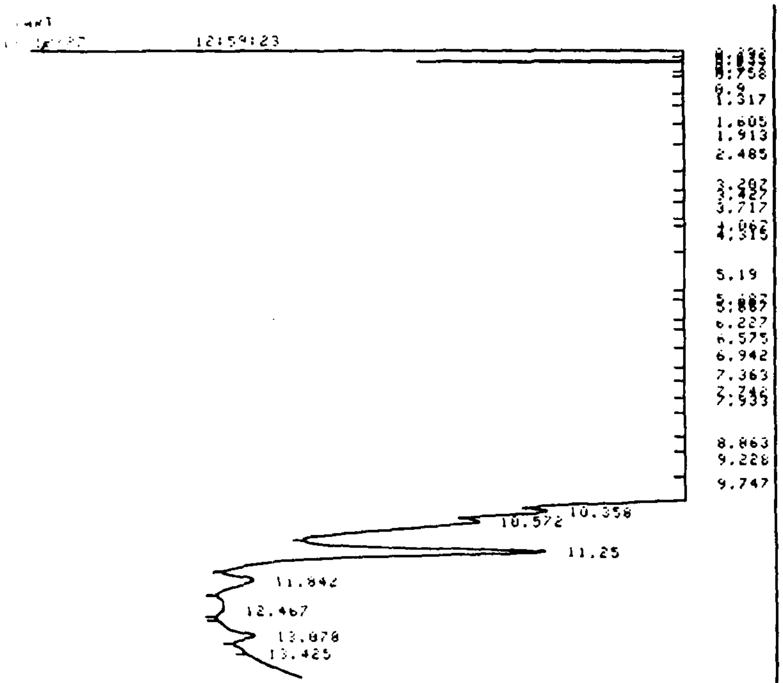
Project Number: VAB81A, 10595.01 Date: 11-12-87

Project Manager: RT Chemist: DW

Sample: ETA, VP-21, 9' Geologist: ______

Volume Injected: 1ml Std. Vol. Inj.: ______

Comments: ______



CHROMATOPAC C-R3A FILE 0
SAMPLE NO 0 METHOD 164
REPORT NO 16 SAMPLE WT 1000

-C-2, 9', 1ml

PKNO	TIME	AREA	MK	IDNO	CONC	NAME
1	0.292	3141019				
2	0.433	114597	V			
3	0.577	11436935	VE			
4	0.758	1271062	V			
5	0.9	27657446	VE			
6	1.317	12171385	VE	1	307.1852	BENZENE
7	1.605	25325112	VE	2	3956.3144	TCE
8	1.913	26380408	VE			
9	2.485	19645614	VE	3	789.6842	TOLUENE
10	3.207	8219570	V			
11	3.427	4954643	V			
12	3.717	5283292	V			
13	4.067	1891207	V			
14	4.315	4977248	V			
15	5.19	4563944	V			
16	5.687	689728	V	5	23.0356	O-XYLENE
17	5.887	2593067	V	5	66.6015	O-XYLENE
18	6.227	791373	V			
19	6.575	1163752	V			
20	6.942	1240216	V			
21	7.363	160864				
22	7.742	410972	V			
23	7.933	139531	V			
24	8.863	130160				
[illegible]	9.228	258462				
[illegible]	9.747	64229				
[illegible]	10.358	5186				
[illegible]	10.572	5770				
[illegible]	11.25	44186				
[illegible]	11.842	6456				
[illegible]	12.467	1954				
[illegible]	13.078	4154				
	TOTAL	165161184			5164.7397	

EA ENGINEERING, SCIENCE, AND TECHNOLOGY, INC.

SOIL VAPOR CONTAMINANT ASSESSMENT CHROMATOGRAM REPORT SHEET

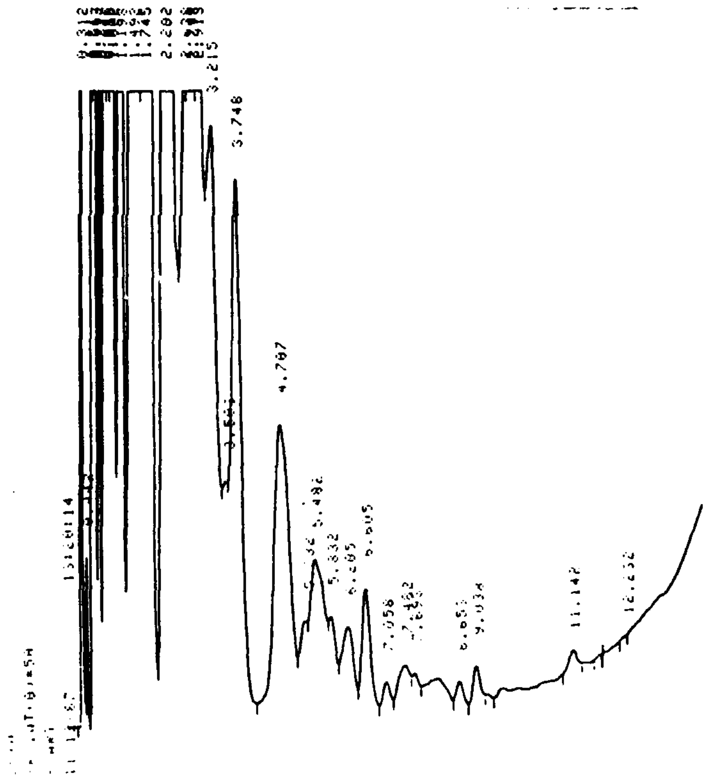
Project Number: VAB81A, 10595.01 Date: 11-12-87

Project Manager: RT Chemist: DW

Sample: ETA, VP-21, 9' Geologist: ______

Volume Injected: 50 ul Std. Vol. Inj.: ______

Comments: ______



CHROMATOGRAM C-R3A
SAMPLE NO 0
REPORT NO 17
FILE 0
METHOD 164
SAMPLE WT 50

-C-2, 9', 60 ul

NO	TIME	AREA	MK	IDNO	CONC	NAME
1	0.312	105880	S			
2	0.442	2876	T			
3	0.56	181931	V			
4	[illegible]	51491	V			
5	[illegible]	6564	V			
6	0.84?	17200	V			
7	[illegible]	413470	V			
8	1.006	[illegible]558	V			
9	1.196	[illegible]5	V			
10	1.492	[illegible]45	V			
[illegible]	1.745	[illegible]39295	V	2	2936.2346	TCE
[illegible]	2.202	544068	V			
[illegible]	2.63?	64891	V	3	55.3778	TOLUENE
[illegible]	2.79?	137923	V	3	110.6687	TOLUENE
[illegible]	2.91?	123472	V			
[illegible]	3.215	126311	V			
[illegible]	3.56?	22990	V			
[illegible]	3.748	110027	V			
[illegible]	4.787	91763	V			
[illegible]	5.234	14184	V	4	7.4292	ETHYLBENZENE
[illegible]	5.482	[illegible]	V		~29	
[illegible]	5.832	[illegible]	V	5	9.0032	O-XYLENE
[illegible]	6.285	[illegible]	V	5	12.8967	O-XYLENE
[illegible]	6.605	[illegible]	V		58	
25	7.058	6965				
[illegible]	7.462	5011				
[illegible]	7.693	[illegible]	V			
[illegible]	[illegible]	2558				
[illegible]	[illegible]	433?				
[illegible]	11.[illegible]	26[illegible]				
TOTAL		66235[illegible]			3131.8095	

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SOIL VAPOR CONTAMINANT ASSESSMENT CHROMATOGRAM REPORT SHEET

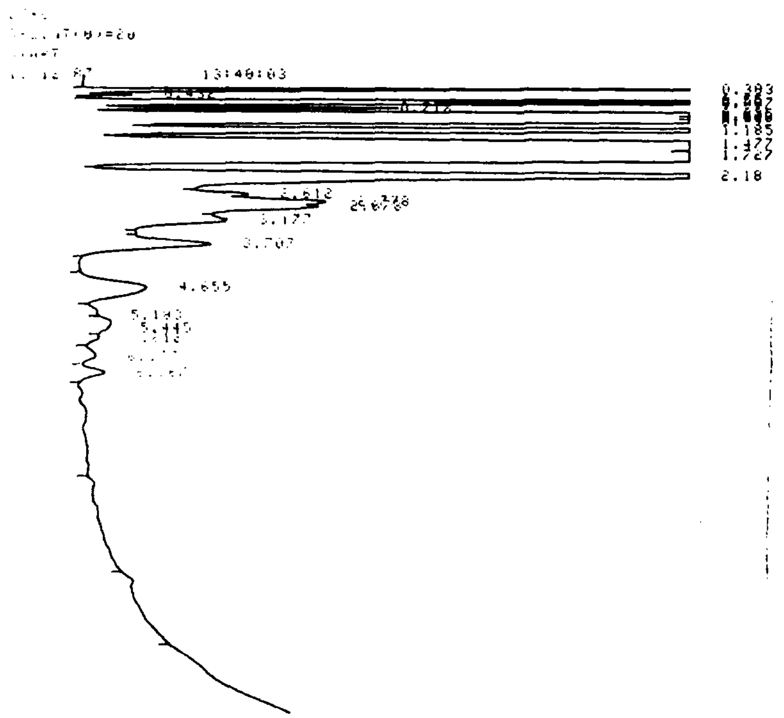
Project Number: VAB81A, 10595.01 Date: 11-12-87

Project Manager: RT Chemist: DW

Sample: FTA, VP-21, 9' Geologist: ____

Volume Injected: 20ul Std. Vol. Inj.: ____

Comments: ____



FILE 0
METHOD 164
SAMPLE WT 20

-C-2, 9', 20ul

PK NO	TIME	AREA	BK	IDNO	CONC	NAME
[illegible]	0.383	43634	S			
[illegible]	0.55	44255	V			
[illegible]	[illegible]	57881	V			
[illegible]	[illegible]	10627	V			
[illegible]	[illegible]	254163	V			
[illegible]	[illegible]	91554	V			
[illegible]	[illegible]	147334	V			
[illegible]	[illegible]	139959	V			
[illegible]	[illegible]	267201	V			
[illegible]	[illegible]	232416	V	2	1816.3293	TCE
[illegible]	[illegible]	136126				
[illegible]	[illegible]	15656	V	3	31.4636	TOLUENE
[illegible]	[illegible]	26800	V	3	53.8571	TOLUENE
[illegible]	[illegible]	24014	V			
[illegible]	3.177	16724	V			
[illegible]	3.707	15557				
[illegible]	4.655	19401				
[illegible]	5.153	3101	V	4	4.0838	ETHYLBENZENE
[illegible]	5.445	8231	V			
[illegible]	5.512	2769	V	5	4.6238	O-XYLENE
[illegible]	6.177	3377	V	5	5.6481	O-XYLENE
22	6.567	3749	V			
	TOTAL	1558473			1915.9974	

EA ENGINEERING, SCIENCE, AND TECHNOLOGY, INC.

SOIL VAPOR CONTAMINANT ASSESSMENT CHROMATOGRAM REPORT SHEET

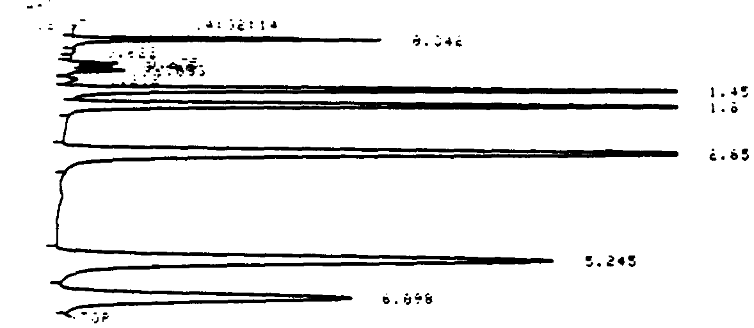
Project Number: VAB81A Date: 11/12/87

Project Manager: RT Chemist: DW

Sample: Standard Geologist:

Volume Injected: Std. Vol. Inj.: 200ul

Comments: 8.1ppm Benzene, 30.4ppm TCE, 20ppm Toluene, 14.2 ppm Ethylbenzene, 10.2ppm o-xylene




```
CHROMATOPAC C-R3A                        FILE        0
SAMPLE NO   0                            METHOD       164
REPORT NO   19                           SAMPLE WT   200
```

standard 200ul

```
PKNO     TIME      AREA   MK  IDNO      CONC        NAME

 1       0.342     12651
 2       0.675      2187
 3       0.948      1936  V
 4       1.033      2799  V
 5       1.45      58614
 6       1.8       52415  V
 7       2.85      86001
 8       5.245     86147          4       11.3444 ETHYLBENZENE
 9       6.898     47833          5        7.8541 O-XYLENE
                 ---------            -------------
         TOTAL    341783                  19.1965

NEW FILE ? (Y N)    Y
MODE#:0;=*121*
WINDOW:0;=5
FREE MEMORY              46 PEAKS
IDNO   NAME            TIME    FACTOR            CONC
 1     BENZENE         1.45    0                 8.1
 2     TCE             1.8     0                 30.4
 3     TOLUENE         2.35    0                 20
 4     ETHYLBENZENE    5.245   0                 14.2
 5     O-XYLENE        6.898   0                 10.2
 6     END
METHOD#:0;=*164*
TABLE .
REPEAT

CHROMATOPAC C-R3A                        FILE        0
SAMPLE NO   0                            METHOD       164
REPORT NO   20                           SAMPLE WT   200
STANDARD       .

PKNO     TIME      AREA   MK  IDNO      CONC        NAME

         0.342     12651
 2       0.675      2187
 3       0.948      1936  V
 4       1.033      2799  V
 5       1.45      58614          1                 BENZENE
 6       1.8       52415  V       2                 TCE
 7       2.85      86001          3                 TOLUENE
 8       5.245     86147          4                 ETHYLBENZENE
 9       6.898     47833          5                 O-XYLENE
                 ---------
         TOTAL    341783

CALIBRATION MADE IN IDENTIFICATION  FILE 0
 MODE# 121                       WINDOW 5

IDNO   NAME            TIME    FACTOR            CONC

       BENZENE         1.45    0.000320069       8.1
 2     TCE             1.8     0.00115998        30.4
       TOLUENE         2.85    0.000405109       20
 4     ETHYLBENZENE    5.24    0.000329009       14.2
       O-XYLENE        6.89    0.000433735       10.2
```

EA ENGINEERING, SCIENCE, AND TECHNOLOGY, INC.

SOIL VAPOR CONTAMINANT ASSESSMENT CHROMATOGRAM REPORT SHEET

Project Number: VAB81A Date: 11/13/87

Project Manager: RT Chemist: DW

Sample: VP-22, 9' Geologist: ______

Volume Injected: 500ul Std. Vol. Inj.: ______

Comments: ______

CHROMATOPAC C-R3A FILE 0
SAMPLE NO 0 METHOD 164
REPORT NO 21 SAMPLE WT 500

VP-1, 9', 500ul

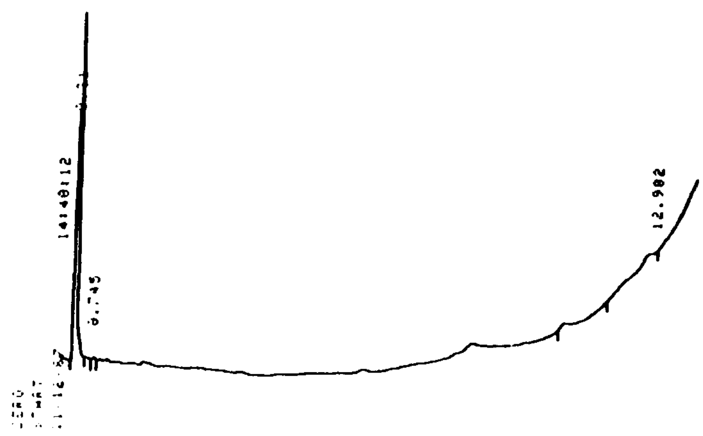
NO	TIME	AREA	MK	IDNO	CONC	NAME
1	0.3	19063				
	TOTAL	19063			0	

EA ENGINEERING, SCIENCE, AND TECHNOLOGY, INC.

SOIL VAPOR CONTAMINANT ASSESSMENT
CHROMATOGRAM REPORT SHEET

Project Number: VAB81A **Date:** 11/12/87
Project Manager: RT **Chemist:** DW
Sample: VP-23, 9' **Geologist:**
Volume Injected: 500ul **Std. Vol. Inj.:**

Comments:



CHROMATOPAC C-R3A
SAMPLE NO 0
REPORT NO 22
FILE 0
METHOD 164
SAMPLE WT 500

-D-2, 9' 500ul

PKNO	TIME	AREA	MK	IDNO	CONC	NAME
	0.31	19808				
2	12.982	2043				
	TOTAL	21852			0	

EA ENGINEERING, SCIENCE, AND TECHNOLOGY, INC.

SOIL VAPOR CONTAMINANT ASSESSMENT CHROMATOGRAM REPORT SHEET

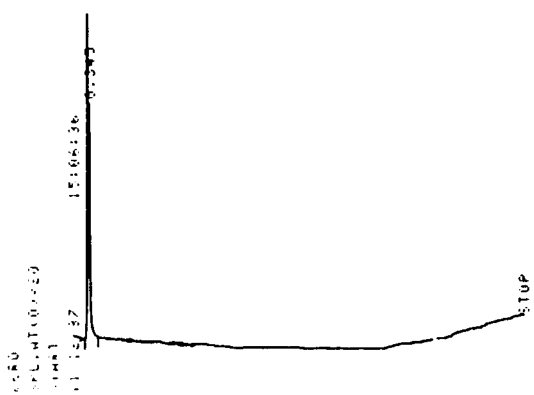
Project Number: VAB81A, 10595.01 Date: 11-12-87

Project Manager: RT Chemist: DW

Sample: FTA, VP-24, 9' Geologist: ______

Volume Injected: 20ul Std. Vol. Inj.: ______

Comments: ______



FILE 0
METHOD 164
SAMPLE WT 20

-D-3, 20ul, 9'

NO	TIME	AREA	MK	IDNO	CONC	NAME
1	0.345	11936				
TOTAL		[illegible]			[illegible]	

EA ENGINEERING, SCIENCE, AND TECHNOLOGY, INC.

SOIL VAPOR CONTAMINANT ASSESSMENT CHROMATOGRAM REPORT SHEET

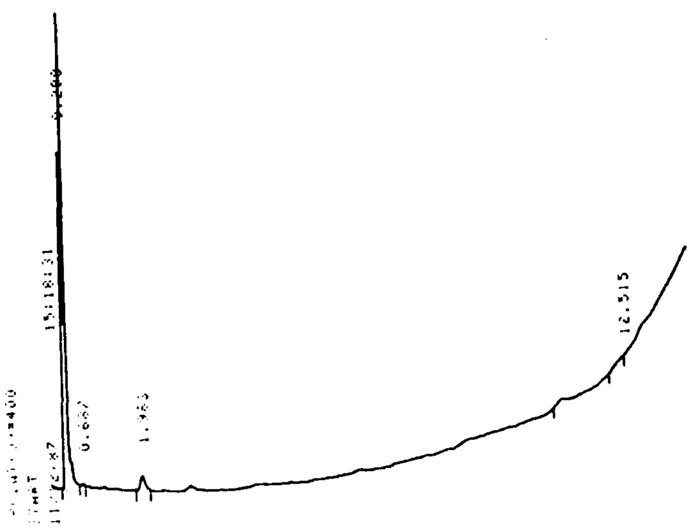
Project Number: VAB81A, 10595.01 **Date:** 11-12-87

Project Manager: RT **Chemist:** DW

Sample: ETA, VP-24, 9' **Geologist:**

Volume Injected: 400ul **Std. Vol. Inj.:**

Comments:



CHROMATOPAC C-R3A
SAMPLE NO 0
REPORT NO 24

FILE 0
METHOD 164
SAMPLE WT 400

-D-3, 9', 400ul

PKNO	TIME	AREA	MK	IDNO	CONC	NAME
1	0.288	26230				
2	1.383	1416				
TOTAL		27646			0	

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SOIL VAPOR CONTAMINANT ASSESSMENT CHROMATOGRAM REPORT SHEET

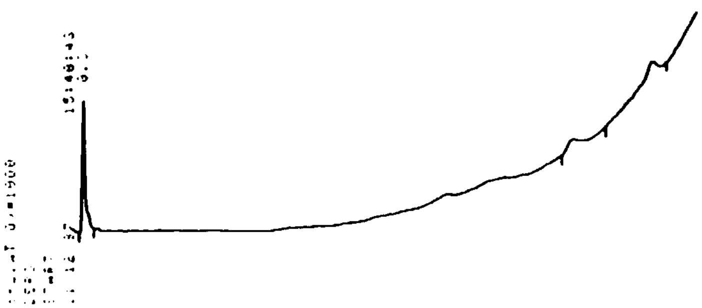
Project Number: VABBIA Date: 11/12/87

Project Manager: RT Chemist: DW

Sample: VP-25, 9' Geologist:

Volume Injected: 1ml Std. Vol. Inj.:

Comments:



CHROMATOGRAM C-F3A FILE 0
SAMPLE NO 0 METHOD 104
REPORT NO 25 SAMPLE WT 1000

-D-4, 9'; 1ml

TIME	AREA	MK	IDNO	CONC	NAME
[illegible]	7623				
TOTAL	7623			0	

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SOIL VAPOR CONTAMINANT ASSESSMENT
CHROMATOGRAM REPORT SHEET

Project Number: XAB 81A Date: 11/12/87

Project Manager: RT Chemist: DW

Sample: Probe Blank, Final Geologist: ______

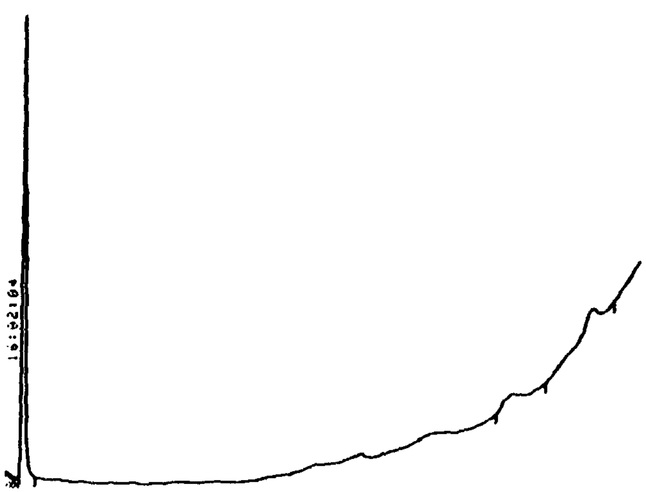
Volume Injected: 1ml Std. Vol. Inj.: ______

Comments: ______

CHROMATOPAC C-R3A
SAMPLE NO 0
REPORT NO 26
FILE 0
METHOD 164
SAMPLE WT 1000

PKNO	TIME	AREA	MK	IDNO	CONC	NAME
1	0.045	9603				
	TOTAL	9603			0	

ZERO
START
11 12/87 16:02:04



0.3

CHROMATOPAC C-R3A
SAMPLE NO 0
REPORT NO 27
FILE 0
METHOD 164
SAMPLE WT 1000

Probe Blank Final

PKNO	TIME	AREA	MK	IDNO	CONC	NAME
1	0.3	28794				
	TOTAL	[illegible]			0	

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SOIL VAPOR CONTAMINANT ASSESSMENT
CHROMATOGRAM REPORT SHEET

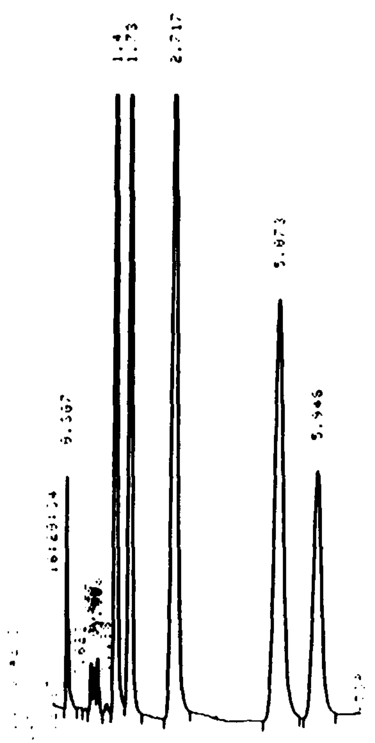
Project Number: VAB81A **Date:** 11/12/87

Project Manager: RT **Chemist:** DW

Sample: Standard, Final **Geologist:**

Volume Injected: **Std. Vol. Inj.:** 200 ul

Comments: 8.1 ppm Benzene, 30.4 ppm TCE, 20 ppm Toluene, 14.2 ppm Ethylbenzene, 10.2 ppm O-xylene



[illegible] CH-A3A FILE 0
[illegible] 0 METHOD 164
[illegible] 28 SAMPLE WT 200

Std 1 Final

	TIME	AREA	MK	IDNO	CONC	NAME
1	0.367	7594				
2	0.557	2018				
	0.921	1916	V			
3	1.093	[illegible]	V	2	28.8282	BENZENE
		79631		3	18.5186	TOLUENE
	2.717					
	5.873	76926		4	12.6603	ETHYLBENZENE
	5.946	42763		5	9.274	O-XYLENE
TOTAL		311919			77.21[illegible]	

[illegible]

[illegible] CH-A3A FILE 0
[illegible] 0 METHOD 164
[illegible] 29 SAMPLE WT 200

	TIME	AREA	MK	IDNO	CONC	NAME
	0.367	7594				
	0.557	2018				
	0.921	1916	V			
	1.008	2539	V			
	1.4	48538		1	7.7757	BENZENE
	1.73	49940	V	2	28.9644	TCE
	2.717	79631		3	18.5186	TOLUENE
	5.873	76926		4	12.6603	ETHYLBENZENE
	5.946	42763		5	9.274	O-XYLENE
TOTAL		311919			77.2129	

EA ENGINEERING, SCIENCE, AND TECHNOLOGY, INC.

SOIL VAPOR CONTAMINANT ASSESSMENT CHROMATOGRAM REPORT SHEET

Project Number: VAB81A **Date:** 11/13/87

Project Manager: RT **Chemist:** DW

Sample: Standard, Initial **Geologist:**

Volume Injected: **Std. Vol. Inj.:** 200ul

Comments: 8.1 ppm Benzene, 30.4 ppm TCE, 20 ppm Toluene 14.2 ppm Ethylbenzene, 10.2 ppm O-Xylene

Standard, Initial, 200ul

CONC	NAME
2268/ppm	BENZENE
1169/ppm	TCE
3964/ppm	TOLUENE
5664 ppm	ETHYLBENZENE
4912/ppm	O-XYLENE

TOTAL 330539

CALIBRATION MADE IN IDENTIFICATION FILE 0

NAME	TIME	FACTOR	CONC
BENZENE	1.62	0.000275165	8.1
TCE	2.0[illegible]	0.0013036	30.4
TOLUENE	[illegible]	0.0005045[illegible]	20
ETHYLBENZENE	5.74	0.00025[illegible]	14.2
O-XYLENE	6.5	0.000[illegible]	10.2

EA ENGINEERING, SCIENCE, AND TECHNOLOGY, INC.

SOIL VAPOR CONTAMINANT ASSESSMENT CHROMATOGRAM REPORT SHEET

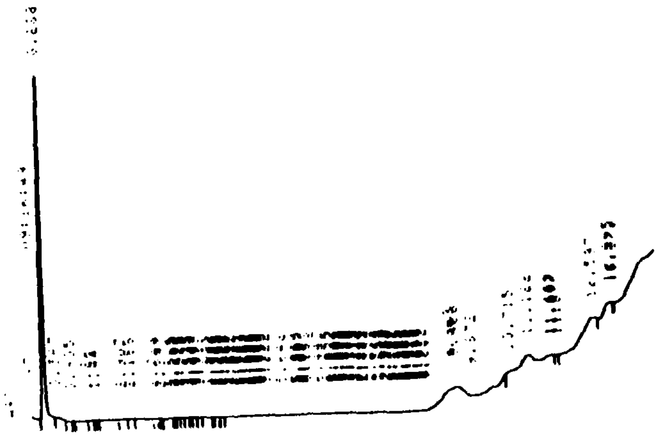
Project Number: VAB81A Date: 11/13/87

Project Manager: RT Chemist: DW

Sample: Probe Blank, Initial Geologist:

Volume Injected: 1ml Std. Vol. Inj.:

Comments:



CHROMATOPAC C-R3A FILE 9
SAMPLE NO 0 METHOD 164
REPORT NO 4 SAMPLE WT 1000

Probe Blank Initial, 1ml

NO	TIME	AREA	MK	IDNO	CONC	NAME
1	0.255?	[illegible]				
2	5.642?	6651?	V	4	0.0937	ETHYLBENZENE
3	[illegible]	[illegible]	V	5	[illegible]	O-XYLENE
4	9.063?	2823?	V			
5	[illegible]	[illegible]	V			
6	11.186?	4167?	V			
TOTAL		[illegible]			[illegible]	

EA ENGINEERING, SCIENCE, AND TECHNOLOGY, INC.

SOIL VAPOR CONTAMINANT ASSESSMENT CHROMATOGRAM REPORT SHEET

Project Number: VAB81A **Date:** 11/13/87

Project Manager: RT **Chemist:** DW

Sample: VP-26, 9' **Geologist:**

Volume Injected: 1ml **Std. Vol. Inj.:**

Comments:

CHROMATOPAC C-R3A FILE 0
SAMPLE NO 0 METHOD 164
REPORT NO 5 SAMPLE WT 1000

-D-5, 1ml, 9'

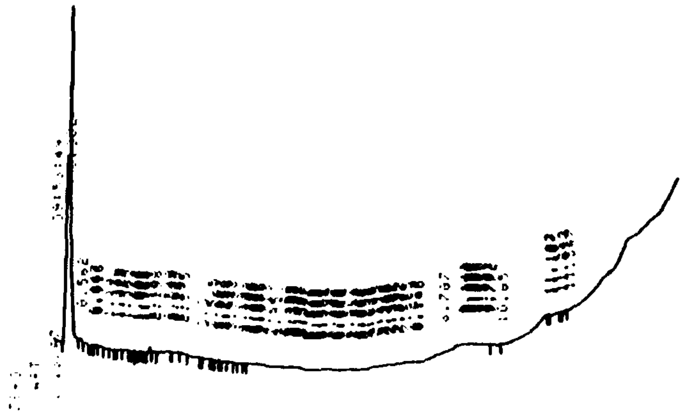
PKNO	TIME	AREA	MK	IDNO	CONC	NAME
1	6.282	6264				
2	9.455	1212				
3	12.996	4543				
TOTAL		12018			0	

EA ENGINEERING, SCIENCE, AND TECHNOLOGY, INC.

SOIL VAPOR CONTAMINANT ASSESSMENT
CHROMATOGRAM REPORT SHEET

Project Number: YAB81A **Date:** 11/13/87
Project Manager: RT **Chemist:** DW
Sample: YP-27, 9' **Geologist:**
Volume Injected: 1ml **Std. Vol. Inj.:**

Comments:



CHROMATOPAC C-R3A
SAMPLE NO 0
REPORT NO 0
FILE 0
METHOD 164
SAMPLE WT 1000

-C-5, 9', 1ml

PKNO	TIME	AREA	MK	IDNO	CONC	NAME
1	0.362	21793				
2	9.142	1925				
	TOTAL	23719			0	

EA ENGINEERING, SCIENCE, AND TECHNOLOGY, INC.

SOIL VAPOR CONTAMINANT ASSESSMENT
CHROMATOGRAM REPORT SHEET

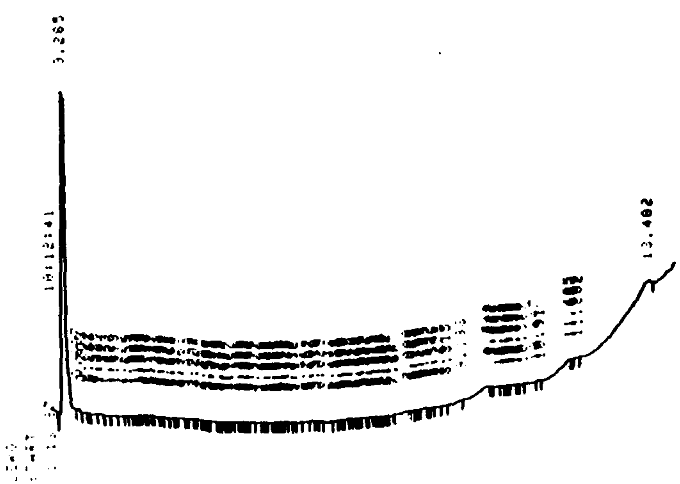
Project Number: VAB81A **Date:** 11/13/87

Project Manager: RT **Chemist:** DW

Sample: VP 28, 9' **Geologist:**

Volume Injected: 1ml **Std. Vol. Inj.:**

Comments:



CHROMATOPAC C-R3A FILE 0
SAMPLE NO 0 METHOD 164
REPORT NO [illegible] SAMPLE WT 1000

-B(+7)-5, 9', 1ml

NO	TIME	AREA	MK	IDNO	CONC	NAME
1	6.285	32624	S			
2	4.743	2348	V			
	TOTAL	34972			0	

EA ENGINEERING, SCIENCE, AND TECHNOLOGY, INC.

SOIL VAPOR CONTAMINANT ASSESSMENT CHROMATOGRAM REPORT SHEET

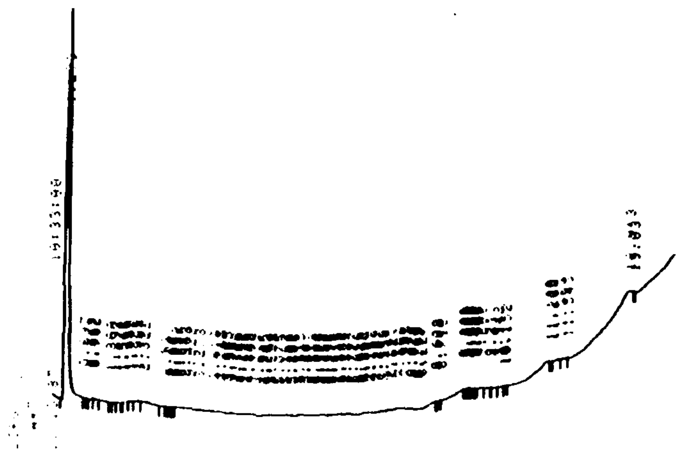
Project Number: VAB81A Date: 11/3/87

Project Manager: RT Chemist: DW

Sample: VP-24, 9' Geologist: ______

Volume Injected: 1ml Std. Vol. Inj.: ______

Comments: ______



CHROMATOPAC C-R3A

SAMPLE NO 0

REPORT NO 6

FILE 0

METHOD 164

SAMPLE WT 1000

A-5, 9', 1ml

PKNO	TIME	AREA	MK	IDNO	CONC	NAME
1	0.293	27331	S			
2	9.295	2091	V			
	TOTAL	29422			0	

EA ENGINEERING, SCIENCE, AND TECHNOLOGY, INC.

SOIL VAPOR CONTAMINANT ASSESSMENT CHROMATOGRAM REPORT SHEET

Project Number: VAB81A Date: 11/13/87

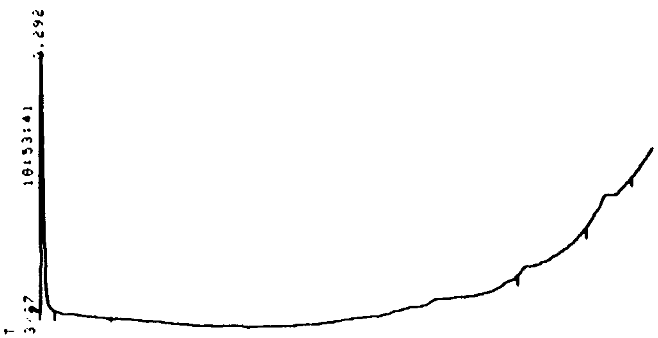
Project Manager: RT Chemist: DW

Sample: VP-30, 9' Geologist:

Volume Injected: 1ml Std. Vol. Inj.:

Comments:

TEST
TESTING 50 sec
SLOPE 914.401
PRINT LEVEL
ZERO
PRINT LEVEL
EPLOT
EPLOT
ZERO
START



CHROMATOPAC C-R3A FILE 0
SAMPLE NO 6 METHOD 164
REPORT NO 9 SAMPLE WT 1000

A-4, 9', 1ml

PKNO	TIME	AREA	MK	IDNO	CONC	NAME
1	0.292	14893				
	TOTAL	14893			0	

EA ENGINEERING, SCIENCE, AND TECHNOLOGY, INC.

SOIL VAPOR CONTAMINANT ASSESSMENT CHROMATOGRAM REPORT SHEET

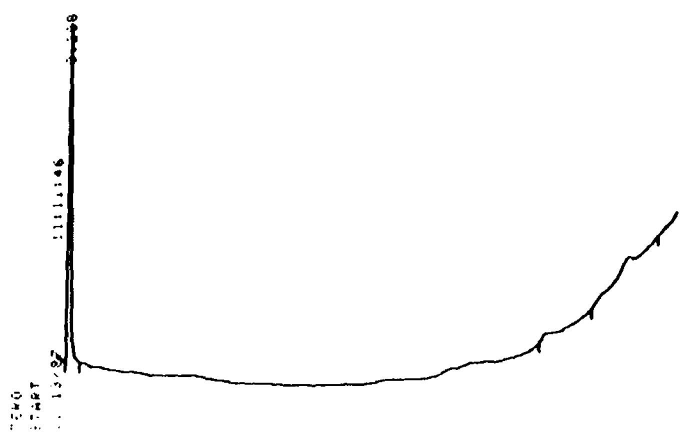
Project Number: VAB81A Date: 11/13/87

Project Manager: RT Chemist: DW

Sample: VP-31, 9' Geologist: ______

Volume Injected: 1ml Std. Vol. Inj.: ______

Comments: ______



CHROMATOPAC C-R3A FILE 0
SAMPLE NO 0 METHOD 164
REPORT NO 10 SAMPLE WT 1000

A-2, 9', 1ml

NO	TIME	AREA	MK	IDNO	CONC	NAME
	0.288	10163				
	TOTAL	10163			0	

EA ENGINEERING, SCIENCE, AND TECHNOLOGY, INC.

SOIL VAPOR CONTAMINANT ASSESSMENT CHROMATOGRAM REPORT SHEET

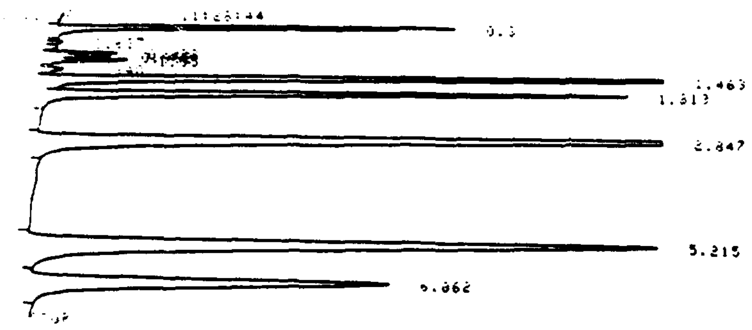
Project Number: YAB 81A Date: 11/13/87

Project Manager: BT Chemist: DW

Sample: Standard Geologist:

Volume Injected: 200ul Std. Vol. Inj.:

Comments: 8.1ppm Benzene, 30.4ppm TCE, 20ppm Toluene, 14.2ppm Ethylbenzene, 10.2ppm O-xylene



CHROMATOPAC C-R3A FILE 0

SAMPLE NO 0 METHOD 164

REPORT NO 11 SAMPLE WT 200

Standard, 200ul

PKNO	TIME	AREA	MK	IDNO	CONC	NAME
1	0.3	21862				
2	0.868	2691				
3	0.962	2676	V			
4	1.05	3581	V			
5	1.463	69915				
6	1.613	45428	V			
7	2.847	107181				
8	5.215	108789				
9	6.062	59667	V			
	TOTAL	420643			0	

[illegible] FILE [illegible] Y

[illegible]121

[illegible]

FREE MEMORY 46 PEAKS

IDNO	NAME	TIME	FACTOR	CONC
1	BENZENE	1.463	0	8.1
2	TCE	1.613	0	30.4
3	TOLUENE	2.847	0	20
4	ETHYLBENZENE	5.215	0	14.2
5	O-XYLENE	6.062	0	10.2
6	END			

METHOD[illegible]164

CALIB 1

REPEAT

CHROMATOPAC C-R3A FILE 0

SAMPLE NO 0 METHOD 164

REPORT NO 12 SAMPLE WT 200

STANDARD 1

PKNO	TIME	AREA	MK	IDNO	CONC	NAME
1	0.3	21862				
2	0.868	2691				
3	0.962	2676	V			
4	1.05	3581	V			
5	1.463	69915		1	8508/ppm	BENZENE
6	1.613	45428	V	2	1494/ppm	TCE
7	2.847	107181		3	5354/ppm	TOLUENE
8	5.215	108789		4	7661/ppm	ETHYLBENZENE
9	6.062	59667	V	5	5852/ppm	O-XYLENE
	TOTAL	420643				

CALIBRATION MADE IN IDENTIFICATION FILE 0

[illegible] WINDOW 5

IDNO	NAME	TIME	FACTOR	CONC
1	BENZENE	1.46	0.000235073	8.1
2	TCE	1.61	0.00133834	30.4
3	TOLUENE	2.84	0.000373202	20
4	ETHYLBENZENE	5.21	0.000261057	14.2
5	O-XYLENE	6.06	0.00034224	10.2

EA ENGINEERING, SCIENCE, AND TECHNOLOGY, INC.

SOIL VAPOR CONTAMINANT ASSESSMENT CHROMATOGRAM REPORT SHEET

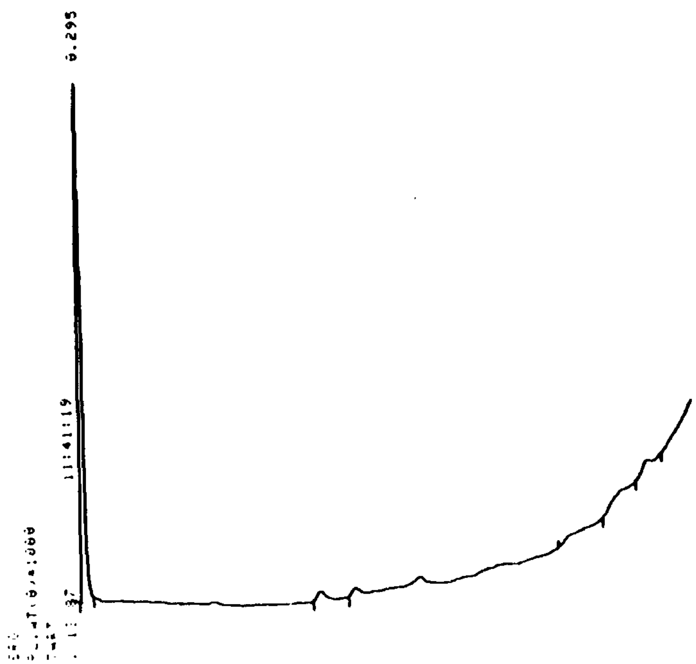
Project Number: VAB81A **Date:** 11/13/87

Project Manager: RT **Chemist:** DW

Sample: Probe Blank **Geologist:**

Volume Injected: 1ml **Std. Vol. Inj.:**

Comments:



CHROMATOPAC C-R3A
SAMPLE NO 0
REPORT NO 13
FILE 0
METHOD 164
SAMPLE WT 1000

Probe Blank, 1ml

PKNO	TIME	AREA	MK	IDNO	CONC	NAME
1	0.295	37218				
	TOTAL	37218			0	

EA ENGINEERING, SCIENCE, AND TECHNOLOGY, INC.

SOIL VAPOR CONTAMINANT ASSESSMENT CHROMATOGRAM REPORT SHEET

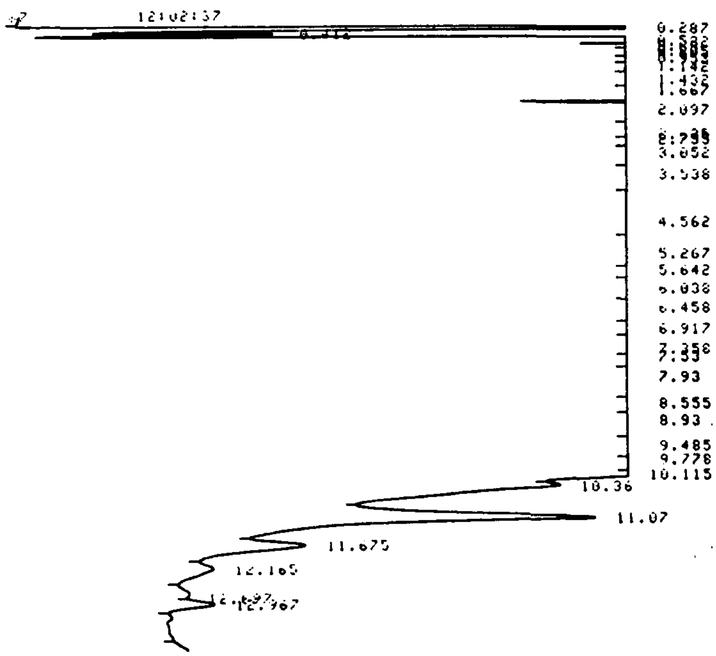
Project Number: YAB81A, 10595.01 Date: 11-13-87

Project Manager: RT Chemist: DW

Sample: ETA, VP-32, 9' Geologist: ______

Volume Injected: 500.l Std. Vol. Inj.: ______

Comments: ______



CHROMATOPAC C-R3A FILE 0
TABLE NO 0 METHOD 164
PORT NO 14 SAMPLE WT 500

-B-2, 9' 500ul

PKNO	TIME	AREA	MK	IDNO	CONC	NAME
1	0.287	231697				
2	0.412	10039	V			
3	0.582	919314	V			
4	0.69	165096	V			
5	0.805	4062971	V			
6	0.953	1541662	V			
7	1.142	2162791	V			
8	1.432	5256060	V	1	247.1118	BENZENE
9	1.667	6069561	V			
10	2.097	4305102	V			
11	2.635	3001658	V			
12	2.755	1761619	V	3	132.9806	TOLUENE
13	3.052	2479478	V			
14	3.538	2059235	V			
15	4.562	2956617	V			
16	5.267	2031055	V	4	106.6441	ETHYLBENZENE
17	5.642	579854	V	5	39.6898	O-XYLENE
18	6.038	955738	V	5	65.4183	O-XYLENE
19	6.458	316203	V			
20	6.917	405760	V			
21	7.358	618964	V			
22	7.53	465042	V			
23	7.93	943464	V			
24	8.555	290729	V			
25	8.93	363645	V			
26	9.485	281499	V			
27	9.778	142072	V			
28	10.115	96936	V			
29	10.36	125696	V			
30	11.07	139169	V			
31	11.675	39203	V			
32	12.165	16253	V			
33	12.697	5584	V			
34	12.967	4767	V			
	TOTAL	45406500			591.2445	

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SOIL VAPOR CONTAMINANT ASSESSMENT CHROMATOGRAM REPORT SHEET

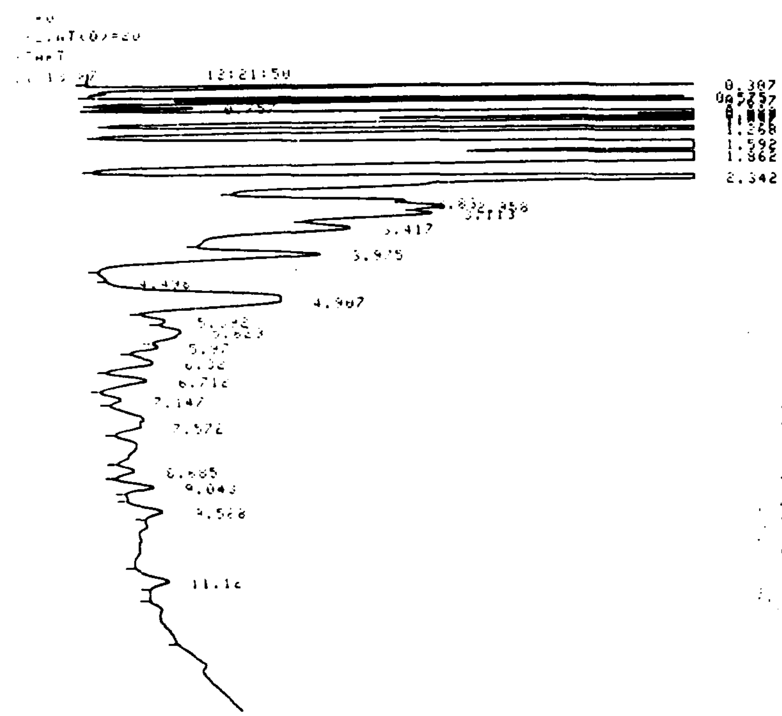
Project Number: VA1381A, 1055.01 Date: 11-13-87

Project Manager: RT Chemist: DW

Sample: VP-32, 9', FTA Geologist: ____

Volume Injected: 20.1 Std. Vol. Inj.: ____

Comments: ____



FILE 0
METHOD 164
SAMPLE WT 20

-B-2, 9', 20.1

#	TIME	AREA	MK	IDNO	CONC	NAME
[illegible]	0.307	22405	-city			
2	0.575	15028	V			
[illegible]	0.657	[illegible]	V			
4	0.757	[illegible]	V			
[illegible]	0.886	1042	V			
[illegible]	0.967	48555	V			
[illegible]	1.052	[illegible]	V			
[illegible]	1.268	75165	V			
[illegible]	1.592	[illegible]	V			
[illegible]	1.862	199467	V	2	[illegible]8.1591	TCE
[illegible]	2.342	[illegible]	V			
[illegible]	[illegible]	[illegible]	V	3	66.3343	TOLUENE
[illegible]	[illegible]	[illegible]	V	3	91.871	TOLUENE
[illegible]	[illegible]	51292	V			
[illegible]	3.417	71224	V			
[illegible]	[illegible]	46068	V			
[illegible]	4.438	1266	V			
[illegible]	4.987	60662	V			
[illegible]	5.29[illegible]	10776	V	4	14.8656	ETHYLBENZENE
20	5.623	23939	V			
[illegible]	5.97	9353	V	5	16.005	O-XYLENE
[illegible]	6.32	11952	V	5	20.452	O-XYLENE
[illegible]	6.712	6192	V			
24	7.147	2321				
[illegible]	7.572	19690	V			
26	8.685	2244				
[illegible]	9.043	4198				
[illegible]	9.558	3389				
[illegible]	11.12	3623				
	TOTAL	1256[illegible]			1548.0867	

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SOIL VAPOR CONTAMINANT ASSESSMENT CHROMATOGRAM REPORT SHEET

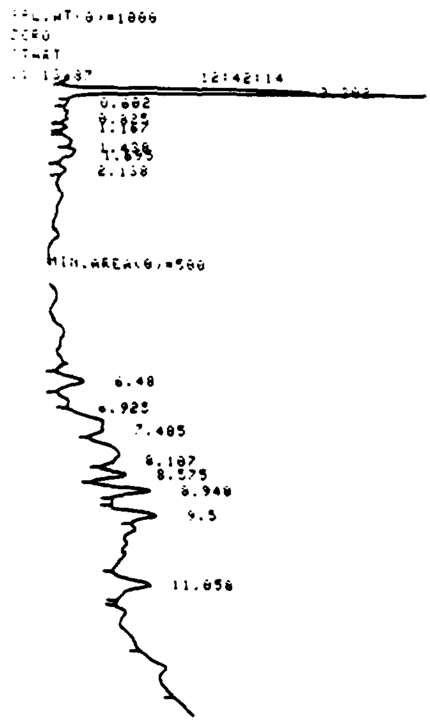
Project Number: KA838[illegible] Date: 11/13/87

Project Manager: RT Chemist: DW

Sample: KE-33, 9' Geologist:

Volume Injected: 1ml Std. Vol. Inj.:

Comments:



CHROMATOPAC C-R3A

SAMPLE NO 0

REPORT NO 16

FILE 0

METHOD 164

SAMPLE WT 1000

A +00, 4', 1ml

PKNO	TIME	AREA	MK	IDNO	CONC	NAME
1	0.302	24821				
2	0.825	1061	V			
3	1.436	1786		1	0.042	BENZENE
4	1.695	2410	V	2	0.3225	TCE
5	6.46	4025				
6	6.925	1428				
7	7.405	13380	V			
8	8.107	16274	V			
9	8.575	6016	V			
10	8.940	6347				
11	9.5	5065				
12	11.058	6741				
	TOTAL	89873			0.3645	

EA ENGINEERING, SCIENCE, AND TECHNOLOGY, INC.

SOIL VAPOR CONTAMINANT ASSESSMENT CHROMATOGRAM REPORT SHEET

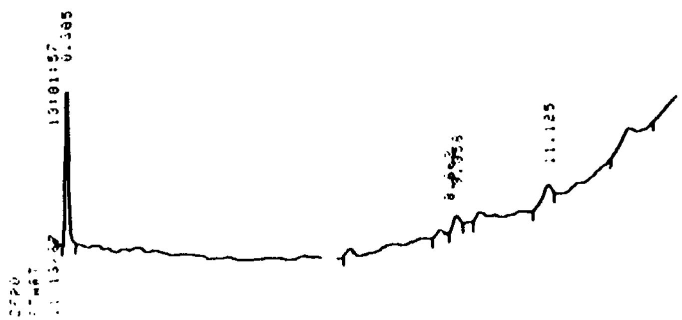
Project Number: VAB81A **Date:** 11/13/87

Project Manager: RT **Chemist:** DW

Sample: VP-34, 9' **Geologist:**

Volume Injected: 1ml **Std. Vol. Inj.:**

Comments:



CHROMATOPAC C-R3A FILE 0
SAMPLE NO 0 METHOD 164
REPORT NO 17 SAMPLE WT 1000

-80 9' 1ml

PKNO	TIME	AREA	MK	IDNO	CONC	NAME
1	0.385	10716				
2	8.662	751				
3	9.053	1587				
4	11.125	2064				
	TOTAL	15130			0	

EA ENGINEERING, SCIENCE, AND TECHNOLOGY, INC.

SOIL VAPOR CONTAMINANT ASSESSMENT CHROMATOGRAM REPORT SHEET

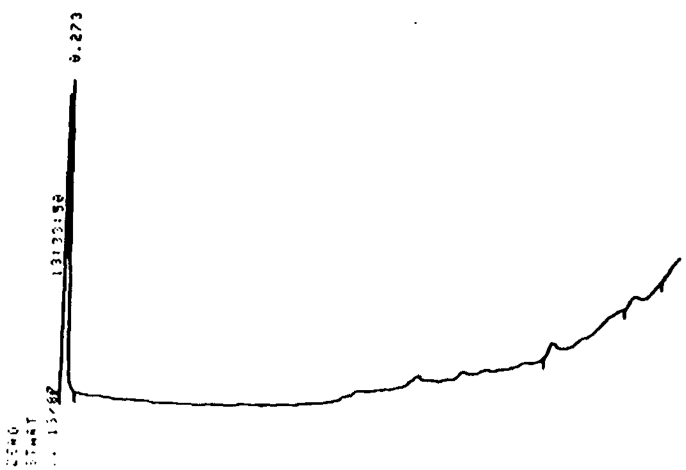
Project Number: VAB81A Date: 11/13/87

Project Manager: RT Chemist: DW

Sample: VP-35, 9' Geologist: ______

Volume Injected: 1ml Std. Vol. Inj.: ______

Comments: ______



CHROMATOPAC C-R3A
SAMPLE NO 0
REPORT NO 18

FILE 0
METHOD 164
SAMPLE WT 1000

-580, 9' 1ml

PKNO	TIME	AREA	MK	IDNO	CONC	NAME
1	0.273	26211				
	TOTAL	26211			0	

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SOIL VAPOR CONTAMINANT ASSESSMENT CHROMATOGRAM REPORT SHEET

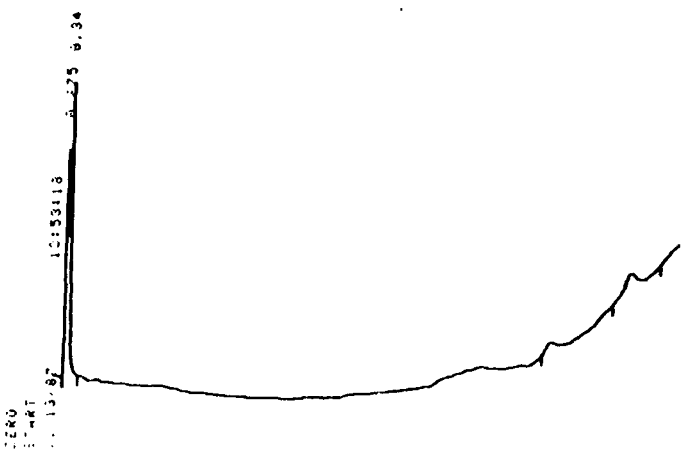
Project Number: VAB81A Date: 11/13/87

Project Manager: RT Chemist: DW

Sample: VP-36, 9' Geologist: ____

Volume Injected: 1ml Std. Vol. Inj.: ____

Comments: ____



CHROMATOPAC C-R3A
SAMPLE NO 0
REPORT NO 19

FILE 0
METHOD 164
SAMPLE WT 1000

A-.5 9', 1ml

PKNO	TIME	AREA	MK	IDNO	CONC	NAME
1	0.275	15432				
2	0.34	7098	V			
	TOTAL	22530			0	

EA ENGINEERING, SCIENCE, AND TECHNOLOGY, INC.

SOIL VAPOR CONTAMINANT ASSESSMENT CHROMATOGRAM REPORT SHEET

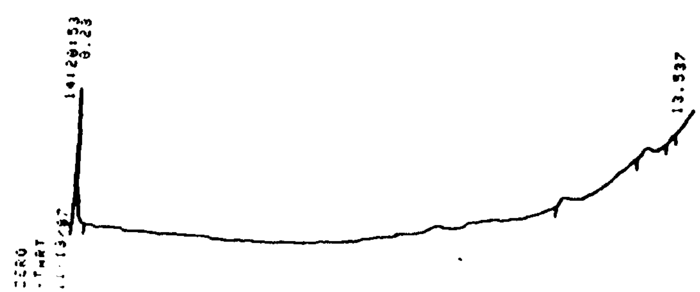
Project Number: VAB81A Date: 11/13/87

Project Manager: RT Chemist: DW

Sample: VP-32, 9' Geologist: ____

Volume Injected: 1ml Std. Vol. Inj.: ____

Comments: ____



CHROMATOPAC C-R3A
SAMPLE NO 0
REPORT NO 26

FILE 0
METHOD 164
SAMPLE WT 1000

-.500 9', 1ml

PKNO	TIME	AREA	MK	IDNO	CONC	NAME
1	0.28	5629				
TOTAL		5629			0	

EA ENGINEERING, SCIENCE, AND TECHNOLOGY, INC.

SOIL VAPOR CONTAMINANT ASSESSMENT
CHROMATOGRAM REPORT SHEET

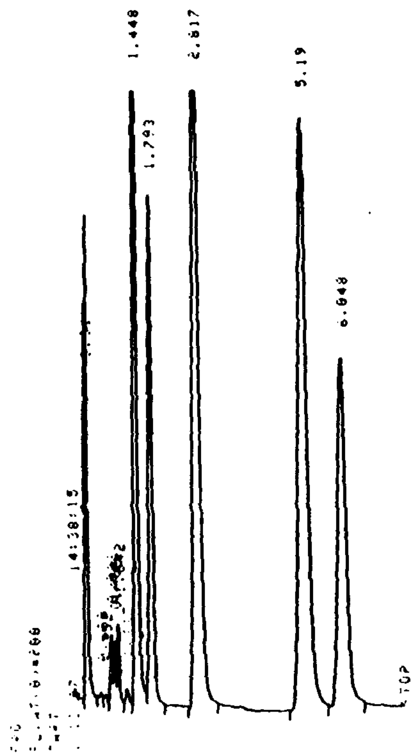
Project Number: VAB81A **Date:** 11/13/87

Project Manager: RT **Chemist:** DW

Sample: Standard **Geologist:**

Volume Injected: 200ul **Std. Vol. Inj.:**

Comments: 8.1ppm Benzene, 30.4 ppm TCE, 20ppm Toluene 14.2ppm Ethylbenzene, 10.2 ppm O-Xylene



CHROMATOPAC C-R3A FILE 0
SAMPLE NO 0 METHOD 164
REPORT NO 21 SAMPLE WT 200

standard

PKNO	TIME	AREA	MK	IDNO	CONC	NAME
1	0.31	24776				
2	0.638	541	V			
3	0.862	2721				
4	0.955	2785	V			
5	1.042	3647	V			
6	1.237	691				
7	1.448	66467		1	7.8123	BENZENE
8	1.793	39659	V	2	26.5594	TCE
9	2.617	99869		3	18.4863	TOLUENE
10	5.19	104898		4	13.5878	ETHYLBENZENE
11	6.046	59687	V	5	10.111	O-XYLENE
TOTAL		403738			76.5366	

EA ENGINEERING, SCIENCE, AND TECHNOLOGY, INC.

SOIL VAPOR CONTAMINANT ASSESSMENT CHROMATOGRAM REPORT SHEET

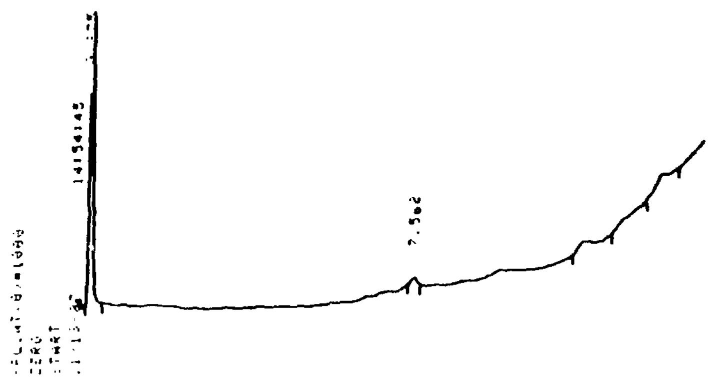
Project Number: VAD81A Date: 11/13/87

Project Manager: RT Chemist: DW

Sample: VP-38, 9' Geologist:

Volume Injected: 1ml Std. Vol. Inj.:

Comments:



AROMATOPAC C-R3A FILE 0
SAMPLE NO 0 METHOD 164
REPORT NO 22 SAMPLE WT 1000

-B+1, 9', 1ml

PKNO	TIME	AREA	MK	IDNO	CONC	NAME
1	0.275	20076				
2	7.562	720				
	TOTAL	20799			0	

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SOIL VAPOR CONTAMINANT ASSESSMENT
CHROMATOGRAM REPORT SHEET

Project Number: [illegible] Date: [illegible]

Project Manager: [illegible] Chemist: [illegible]

Sample: [illegible] Geologist:

Volume Injected: [illegible] Std Vol Inj.:

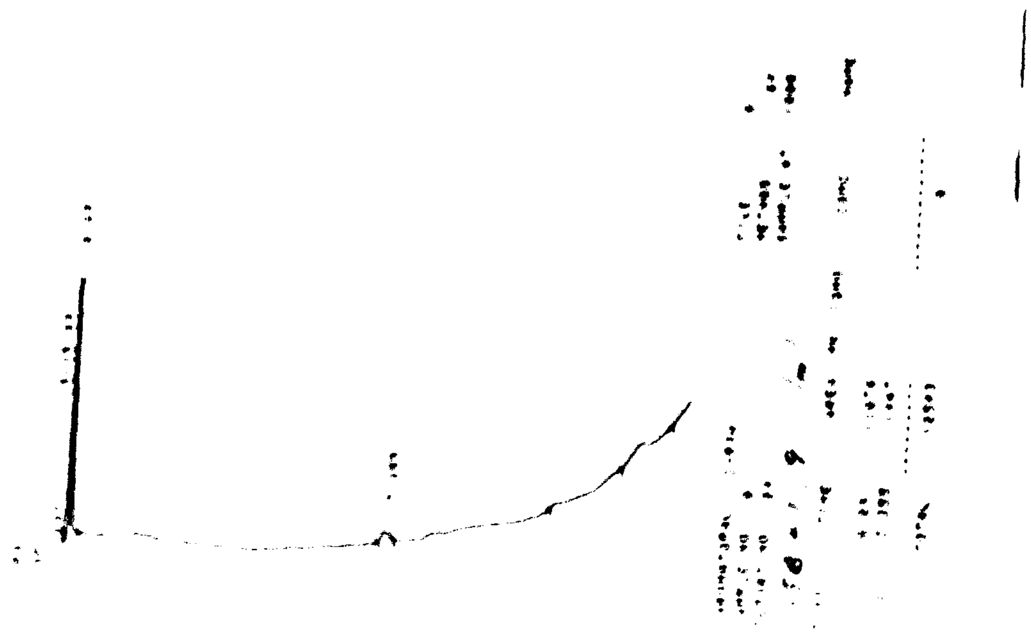
Comments:

EA ENGINEERING,
SCIENCE AND
TECHNOLOGY INC.

SOIL VAPOR CONTAMINANT ASSESSMENT
CHROMATOGRAM REPORT SHEET

Project Number: Y08801A **Date:** 11/13/87
Project Manager: RT **Chemist:** DW
Sample: VP 40, 9' **Geologist:**
Volume Injected: 1ml **Std. Vol. Inj.:**

Comments:



EA ENGINEERING, SCIENCE, AND TECHNOLOGY, INC.

SOIL VAPOR CONTAMINANT ASSESSMENT CHROMATOGRAM REPORT SHEET

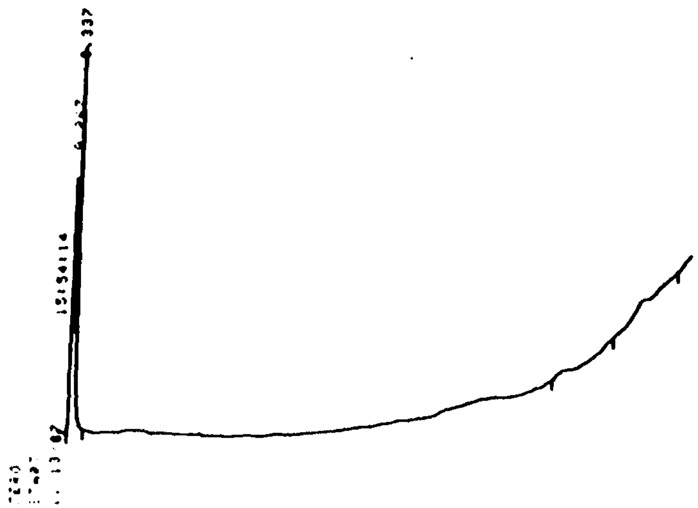
Project Number: V0B81A Date: 11/13/87

Project Manager: RT Chemist: DW

Sample: VP-41, 9' Geologist:

Volume Injected: 1ml Std. Vol. Inj.:

Comments:



CHROMATOPAC C-R3A
SAMPLE NO 9
REPORT NO 25

FILE 0
METHOD 164
SAMPLE WT 1000

-CO 9', 1ml

PKNO	TIME	AREA	MK	IDNO	CONC	NAME
1	6.167	14668				
2	6.337	11311	V			
	TOTAL	25979			0	

EA ENGINEERING, SCIENCE AND TECHNOLOGY, INC.

SOIL VAPOR CONTAMINANT ASSESSMENT CHROMATOGRAM REPORT SHEET

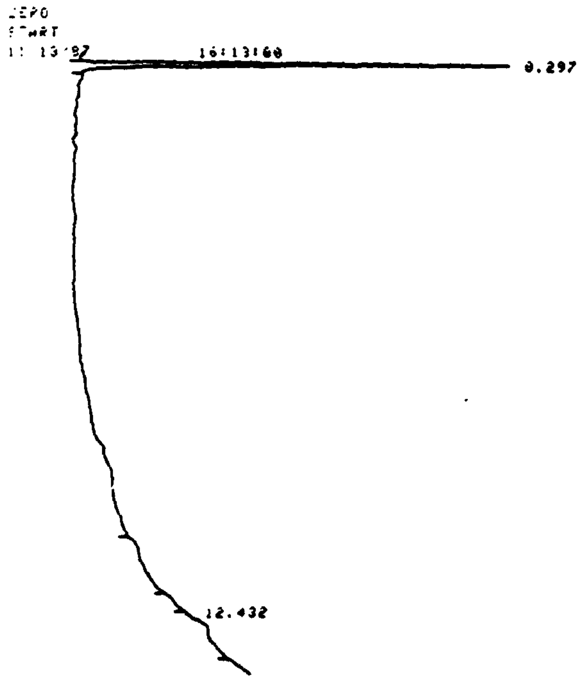
Project Number: VAB81A Date: 11/13/87

Project Manager: RT Chemist: DW

Sample: Probe Blank Final Geologist:

Volume Injected: 1ml Std. Vol. Inj.:

Comments:



CHROMATOPAC C-R3A FILE 0
SAMPLE NO 0 METHOD 164
REPORT NO 26 SAMPLE WT 1000

Probe Blank, Final, 1ml

PKNO	TIME	AREA	MK	IDNO	CONC	NAME
1	0.297	21766				
	TOTAL	21766			0	

EA ENGINEERING, SCIENCE, AND TECHNOLOGY, INC.

SOIL VAPOR CONTAMINANT ASSESSMENT CHROMATOGRAM REPORT SHEET

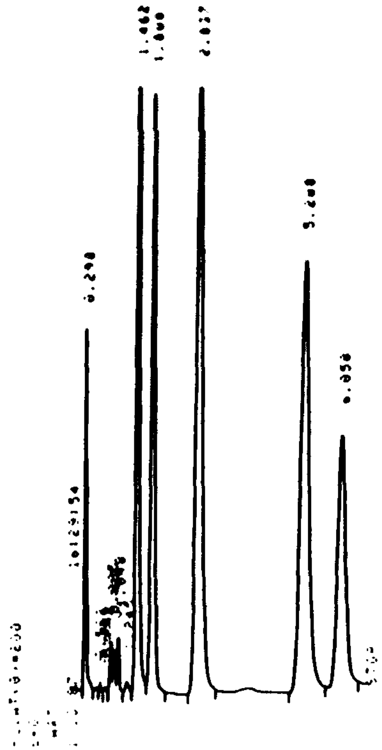
Project Number: VAB81A Date: 11/13/87

Project Manager: RT Chemist: DW

Sample: Standard, Final Geologist: ____

Volume Injected: 200ul Std. Vol. Inj.: ____

Comments: 8.1ppm Benzene, 30.4 ppm TCE, 20ppm Toluene 14.2 ppm Ethylbenzene, 16.2 ppm O-Xylene



CHROMATOPAC C-R3A FILE 0
SAMPLE NO 0 METHOD 164
REPORT NO 27 SAMPLE WT 200

Standard Final, 200ul

PKNO	TIME	AREA	MK	IDNO	CONC	NAME
1	0.293	13416				
2	0.665	1393				
3	0.962	1973	V			
4	1.046	2584	V			
5	1.245	697				
6	1.462	49767	V	1	5.3518	BENZENE
7	1.603	44576	V	2	31.0344	TCE
8	2.037	61949		3	15.2917	TOLUENE
9	5.248	75597		4	9.6675	ETHYLBENZENE
10	6.058	41756	V	5	7.1452	O-XYLENE
TOTAL		316126			69.1907	

EA ENGINEERING, SCIENCE AND TECHNOLOGY, INC.

SOIL VAPOR CONTAMINANT ASSESSMENT CHROMATOGRAM REPORT SHEET

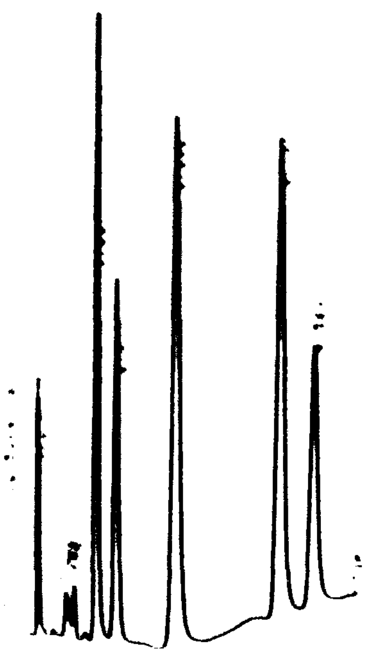
Project Number: VAB 91A Date: 11/12/87

Project Manager: RT Chemist: DW

Sample: Standard, Initial Geologist:

Volume Injected: Std. Vol. Inj.: 200ul

Comments: 8.1ppm Benzene, 30.4 ppm TCE, 20ppm Toluene, 14.2ppm Ethylbenzene, 10.2ppm O-Xylene



Standard, Initial, 200ul

FILE
METHOD
SAMPLE WT 200

TIME	AREA	BC	IDNO	CONC	NAME
[illegible]	13013				
[illegible]	4147				
[illegible]	4111	V			
[illegible]	2004	V			
[illegible]	53054		1	[illegible]	BENZENE
2.073	33538	V	2	[illegible]	TCE
3.392	76932		3	[illegible]	TOLUENE
5.757	71266		4	[illegible]	ETHYLBENZENE
6.523	30964		5	[illegible]	O-XYLENE
TOTAL	294400				

CALIBRATION MADE IN IDENTIFICATION FILE 0
WINDOW 5

NAME	TIME	FACTOR	CONC
BENZENE	1.63	0.000301936	8.1
TCE	2.07	0.0010[illegible]206	30.4
TOLUENE	3.39	0.000519937	20
ETHYLBENZENE	5.75	0.000396749	14.2
O-XYLENE	6.52	0.000523259	10.2

EA ENGINEERING, SCIENCE, AND TECHNOLOGY, INC.

SOIL VAPOR CONTAMINANT ASSESSMENT
CHROMATOGRAM REPORT SHEET

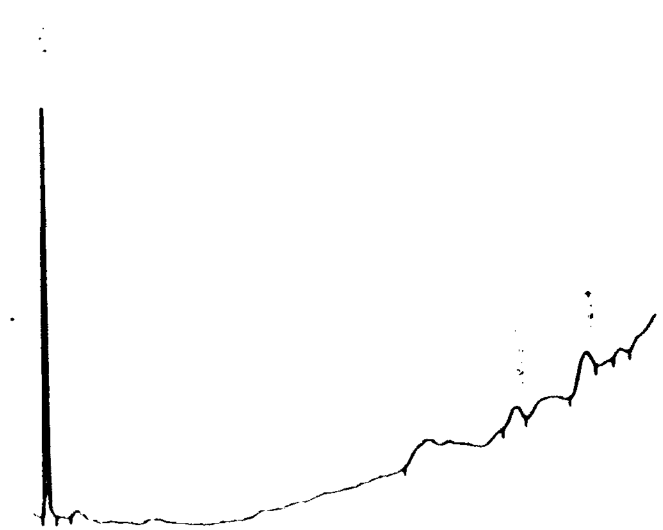
Project Number: YA0381A Date: 11/12/87

Project Manager: RT Chemist: DW

Sample: Probe Blank, Initial Geologist: ______

Volume Injected: 1 ml Std. Vol. Inj.: ______

Comments: ______



Probe Blank, Initial, 1ml

EA ENGINEERING, SCIENCE, AND TECHNOLOGY, INC.

SOIL VAPOR CONTAMINANT ASSESSMENT CHROMATOGRAM REPORT SHEET

Project Number: YAB 81A Date: 11/17/87

Project Manager: RT Chemist: DW

Sample: VP-42, 3' Geologist:

Volume Injected: 1ml Std. Vol. Inj.:

Comments:

C-3, 3', 1ml

EA ENGINEERING, SCIENCE, AND TECHNOLOGY, INC.

SOIL VAPOR CONTAMINANT ASSESSMENT CHROMATOGRAM REPORT SHEET

Project Number: VAB 81A **Date:** 11/17/87

Project Manager: RT **Chemist:** DW

Sample: VP-42, 6' **Geologist:**

Volume Injected: 1ml **Std. Vol. Inj.:**

Comments:

FILE

METHOD 104

SAMPLE WT 1000

C-3, 6', 1ml

AREA CONC NAME

SOIL VAPOR CONTAMINANT ASSESSMENT
CHROMATOGRAM REPORT SHEET

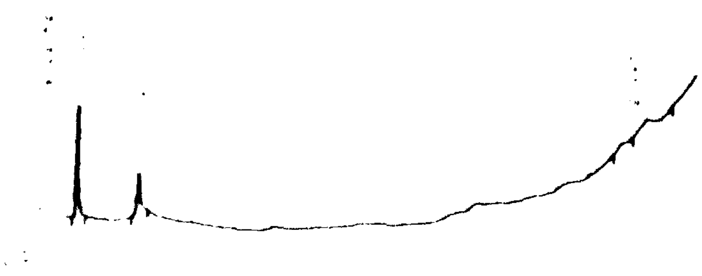
Project Number: VABX18 Date: 11/12/87

Project Manager: ET Chemist: DW

Sample: SP 43, 6' Geologist:

Volume Injected: 1ml Std. Vol. Inj.:

Comments:



C-4, 6', 1ml

ES ENGINEERING-SCIENCE AND TECHNOLOGY INC.

SOIL VAPOR CONTAMINANT ASSESSMENT
CHROMATOGRAM REPORT SHEET

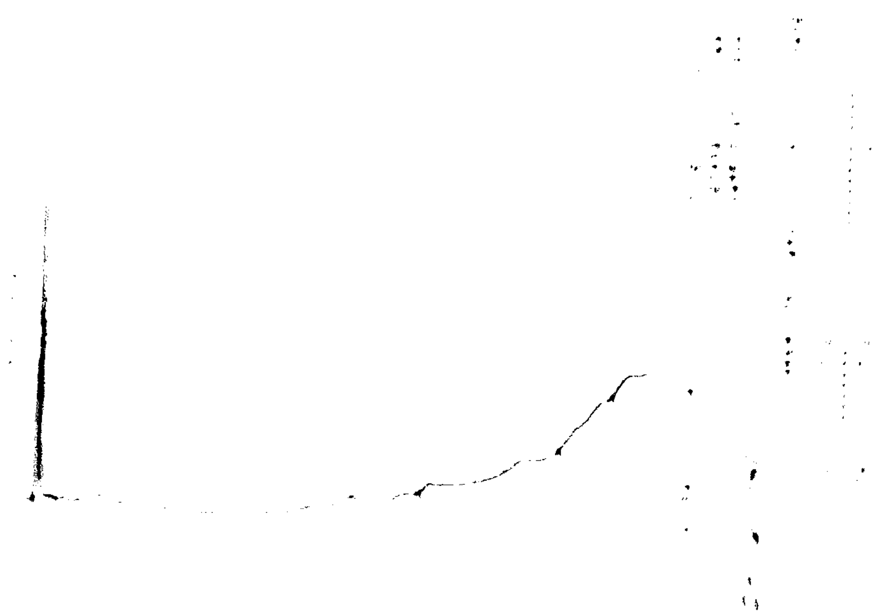
Project Number: VAB818 Date: 11/13/87

Project Manager: CT Chemist: DW

Sample: SG 44, 6' Geologist: ______

Volume Injected: 1 ml Std. Vol. Inj.: ______

Comments: ______



EA ENGINEERING, SCIENCE, AND TECHNOLOGY, INC.

SOIL VAPOR CONTAMINANT ASSESSMENT CHROMATOGRAM REPORT SHEET

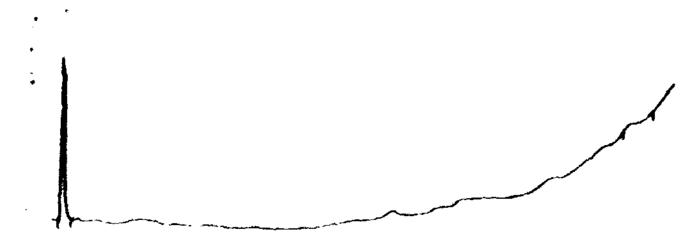
Project Number: YAB81A **Date:** 11/17/87

Project Manager: RT **Chemist:** DW

Sample: VP-45, 6' **Geologist:**

Volume Injected: 1ml **Std. Vol. Inj.:**

Comments:



EA ENGINEERING SCIENCE AND TECHNOLOGY INC

SOIL VAPOR CONTAMINANT ASSESSMENT
CHROMATOGRAM REPORT SHEET

Project Number: YAD81A Date: 11/17/87
Project Manager: BT Chemist: DW
Sample: YC-46, 6' Geologist:
Volume Injected: 1ml Std. Vol. Inj.:

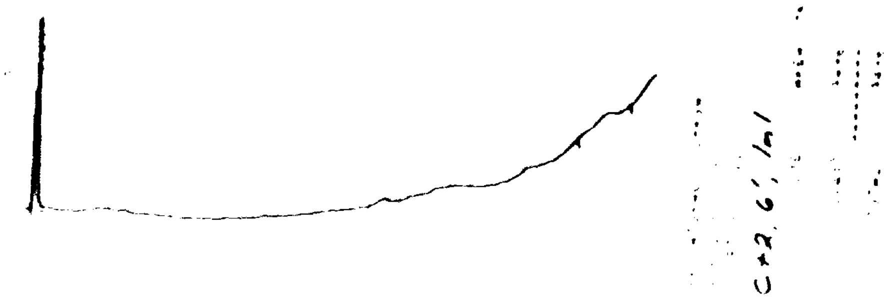
Comments:

EA ENGINEERING,
SCIENCE AND
TECHNOLOGY, INC.

SOIL VAPOR CONTAMINANT ASSESSMENT
CHROMATOGRAM REPORT SHEET

Project Number: YPAKIA Date: 11/17/87
Project Manager: RT Chemist: DW
Sample: KP-47, 6' Geologist: ______
Volume Injected: 1ml Std. Vol. Inj.: ______

Comments: ______



EA Engineering, Science and Technology, Inc.

SOIL VAPOR CONTAMINANT ASSESSMENT
CHROMATOGRAM REPORT SHEET

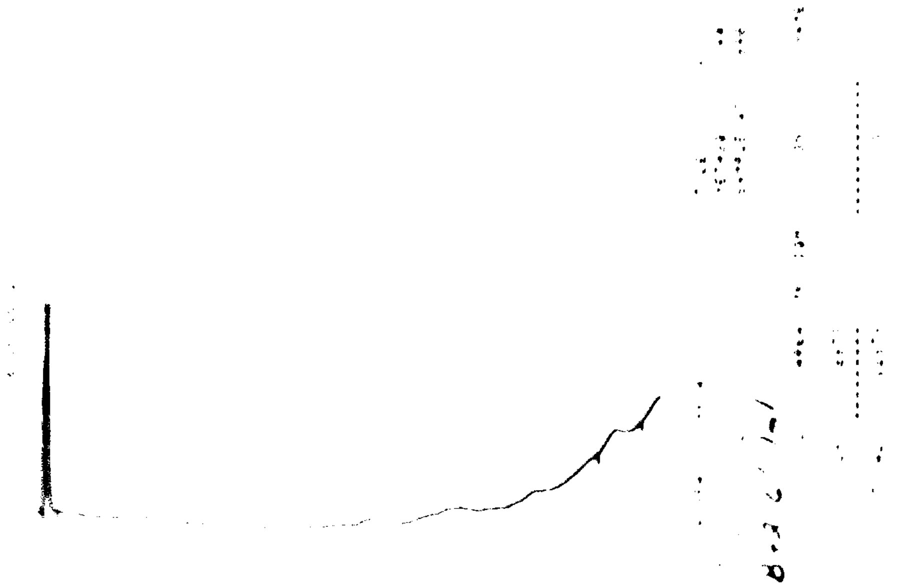
Project Number: VABB18 Date: 11/12/87

Project Manager: RT Chemist: DW

Sample: VP-45, 6' Geologist:

Volume Injected: 1ml Std. Vol. Inj.:

Comments:



EA ENGINEERING SCIENCE AND TECHNOLOGY, INC.

SOIL VAPOR CONTAMINANT ASSESSMENT
CHROMATOGRAM REPORT SHEET

Project Number: VABB1A Date: 11/12/87
Project Manager: RT Chemist: DW
Sample: VP-49, 6' Geologist:
Volume Injected: 1ml Std. Vol. Inj.:

Comments:

EA ENGINEERING, SCIENCE, AND TECHNOLOGY, INC.

SOIL VAPOR CONTAMINANT ASSESSMENT CHROMATOGRAM REPORT SHEET

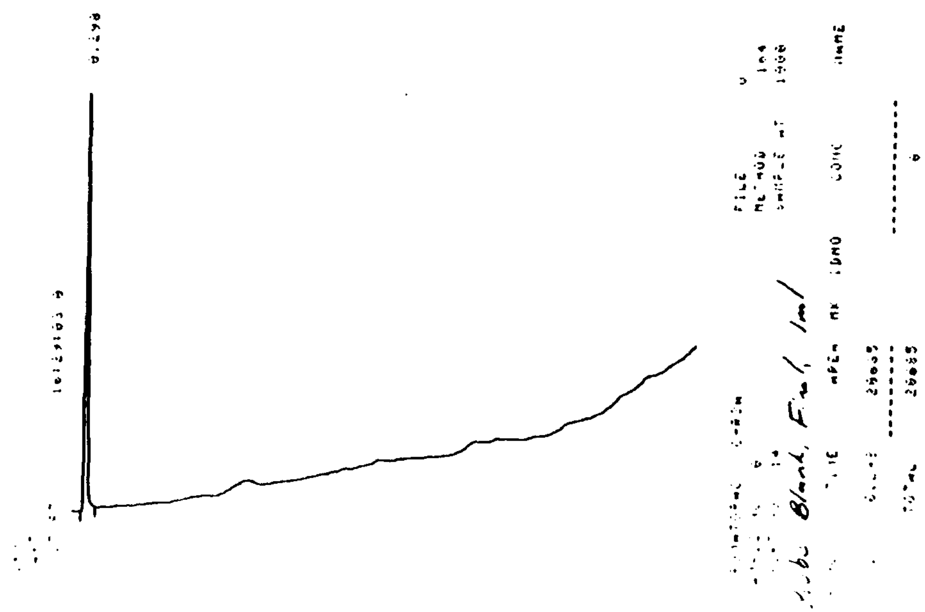
Project Number: VAB81A **Date:** 11/12/87

Project Manager: RT **Chemist:** DW

Sample: Probe Blank, Final **Geologist:** ______

Volume Injected: 1ml **Std. Vol. Inj.:** ______

Comments: ______



EA ENGINEERING, SCIENCE, AND TECHNOLOGY, INC.

SOIL VAPOR CONTAMINANT ASSESSMENT CHROMATOGRAM REPORT SHEET

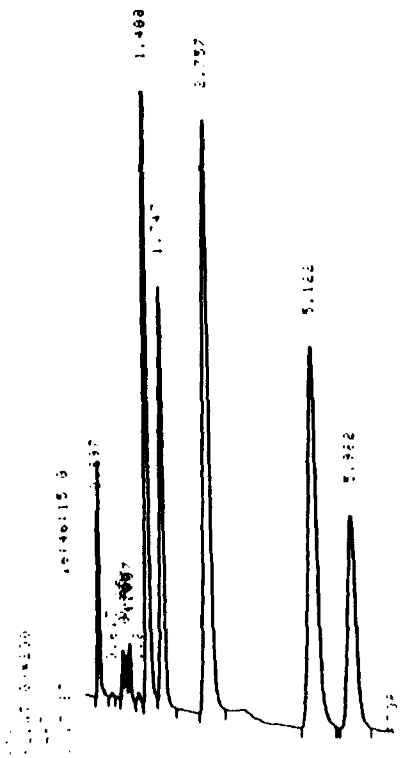
Project Number: VAB 81A **Date:** 11/17/87

Project Manager: RT **Chemist:** DW

Sample: Standard, Final **Geologist:**

Volume Injected: 200ul **Std. Vol. Inj.:**

Comments: 8.1 ppm Benzene, 30.4 ppm TCE, 20 ppm Toluene 14.2 ppm Ethylbenzene, 10.2 ppm O-Xylene



FILE 0 METHOD 164 SAMPLE WT 206

Standard, Final, 200ul

RT	AREA	BC	IDNO	CONC	NAME
0.297	9174				
0.352	2944				
0.925	1376	V			
1.007	2754	V			
1.483	50234		6207/ppm		
1.747	32033	V			
3.757	71690				
5.122	67114				
5.932	35993			7.1757	ETHYLBENZENE
TOTAL	[illegible]			7.1757	

EA ENGINEERING, SCIENCE, AND TECHNOLOGY, INC.

SOIL VAPOR CONTAMINANT ASSESSMENT CHROMATOGRAM REPORT SHEET

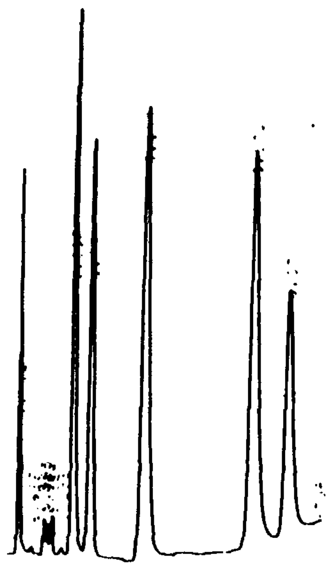
Project Number: VAB81A **Date:** 11/18/87

Project Manager: RT **Chemist:** DW

Sample: Standard, Initial **Geologist:** ______

Volume Injected: ______ **Std. Vol. Inj.:** 200ul

Comments: 8.1 ppm Benzene, 30.4 ppm TCE, 20 ppm Toluene 14.2 ppm Ethylbenzene, 10.2 ppm O-Xylene



Standard, Initial, 200ul

FILE 6
METHOD 164
SAMPLE WT 200

NAME	TIME	FACTOR	CONC
BENZENE	[illegible]	0	8.1
TCE	[illegible]	0	30.4
TOLUENE	[illegible]	0	20
ETHYLBENZENE	[illegible]	0	14.2
O-XYLENE	[illegible]	0	10.2

CONC	NAME
1993/ppm	BENZENE
1810/ppm	TCE
3233/ppm	TOLUENE
4574/ppm	ETHYLBENZENE
[illegible]	O-XYLENE

CALIBRATION MADE IN IDENTIFICATION FILE 6
WINDOW 5

NAME	TIME	FACTOR	CONC
BENZENE	1.53	0.000404635	8.1
TCE	1.93	0.0010535	30.4
TOLUENE	3.13	0.000618552	20
ETHYLBENZENE	5.57	0.000437531	14.2
O-XYLENE	6.37	0.000528963	10.2

EA ENGINEERING, SCIENCE, AND TECHNOLOGY, INC.

SOIL VAPOR CONTAMINANT ASSESSMENT CHROMATOGRAM REPORT SHEET

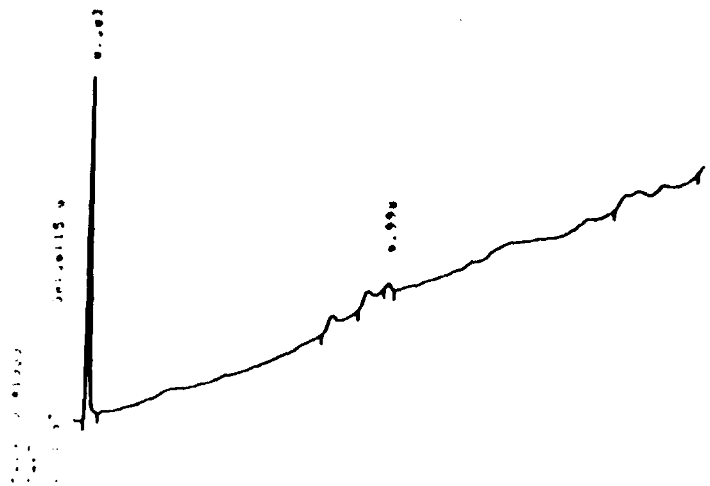
Project Number: YAB81A Date: 11/18/87

Project Manager: RT Chemist: DW

Sample: Probe Blank, Initial Geologist: ____

Volume Injected: 1ml Std. Vol. Inj.: ____

Comments: ____



Probe Blank, Initial, 1ml

FILE 0
METHOD 164
SAMPLE WT 1000

TIME	AREA	CONC	NAME
0.303	17853		
TOTAL	17853	0	

EA ENGINEERING, SCIENCE, AND TECHNOLOGY, INC.

SOIL VAPOR CONTAMINANT ASSESSMENT CHROMATOGRAM REPORT SHEET

Project Number: YABEIH Date: 11/18/82

Project Manager: RT Chemist: DW

Sample: YB-5D, 6' Geologist: ____

Volume Injected: 200ul Std. Vol. Inj.: ____

Comments: ____

-.58, -3.5, 6', 200ul

EA ENGINEERING, SCIENCE, AND TECHNOLOGY, INC.

SOIL VAPOR CONTAMINANT ASSESSMENT CHROMATOGRAM REPORT SHEET

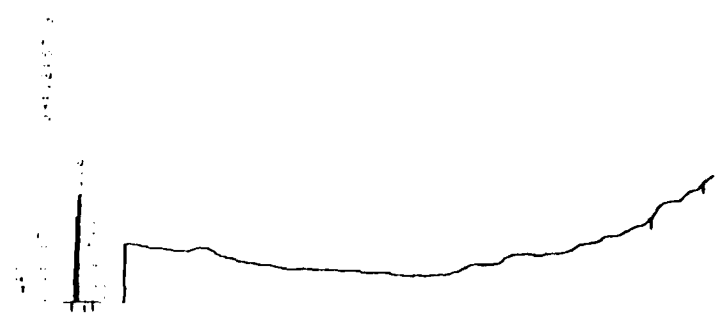
Project Number: YAB81A Date: 11/18/87

Project Manager: RT Chemist: DW

Sample: YP-51, 6' Geologist:

Volume Injected: 200ul Std. Vol. Inj.:

Comments:



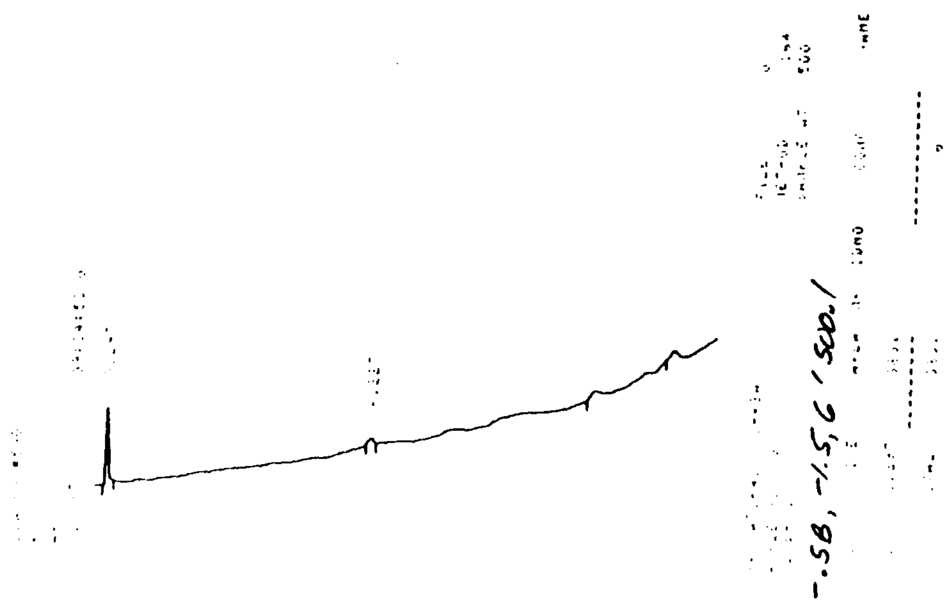
-.5B, -2.5, 6' 200ul

EA ENGINEERING, SCIENCE, AND TECHNOLOGY, INC.

SOIL VAPOR CONTAMINANT ASSESSMENT
CHROMATOGRAM REPORT SHEET

Project Number: VAB81A Date: 11/18/87
Project Manager: RT Chemist: DW
Sample: VP-53, 6' Geologist: ______
Volume Injected: 500ul Std. Vol. Inj.: ______

Comments: ______



EA ENGINEERING SCIENCE AND TECHNOLOGY INC

SOIL VAPOR CONTAMINANT ASSESSMENT
CHROMATOGRAM REPORT SHEET

Project Number: YAB81A Date: 11/18/87

Project Manager: RT Chemist: DW

Sample: YP-53, 6' Geologist: ______

Volume Injected: ______ Std. Vol. Inj.: ______

Comments: ______

-.5B, -.5, 6'/ml

EA ENGINEERING SCIENCE AND TECHNOLOGY INC

SOIL VAPOR CONTAMINANT ASSESSMENT CHROMATOGRAM REPORT SHEET

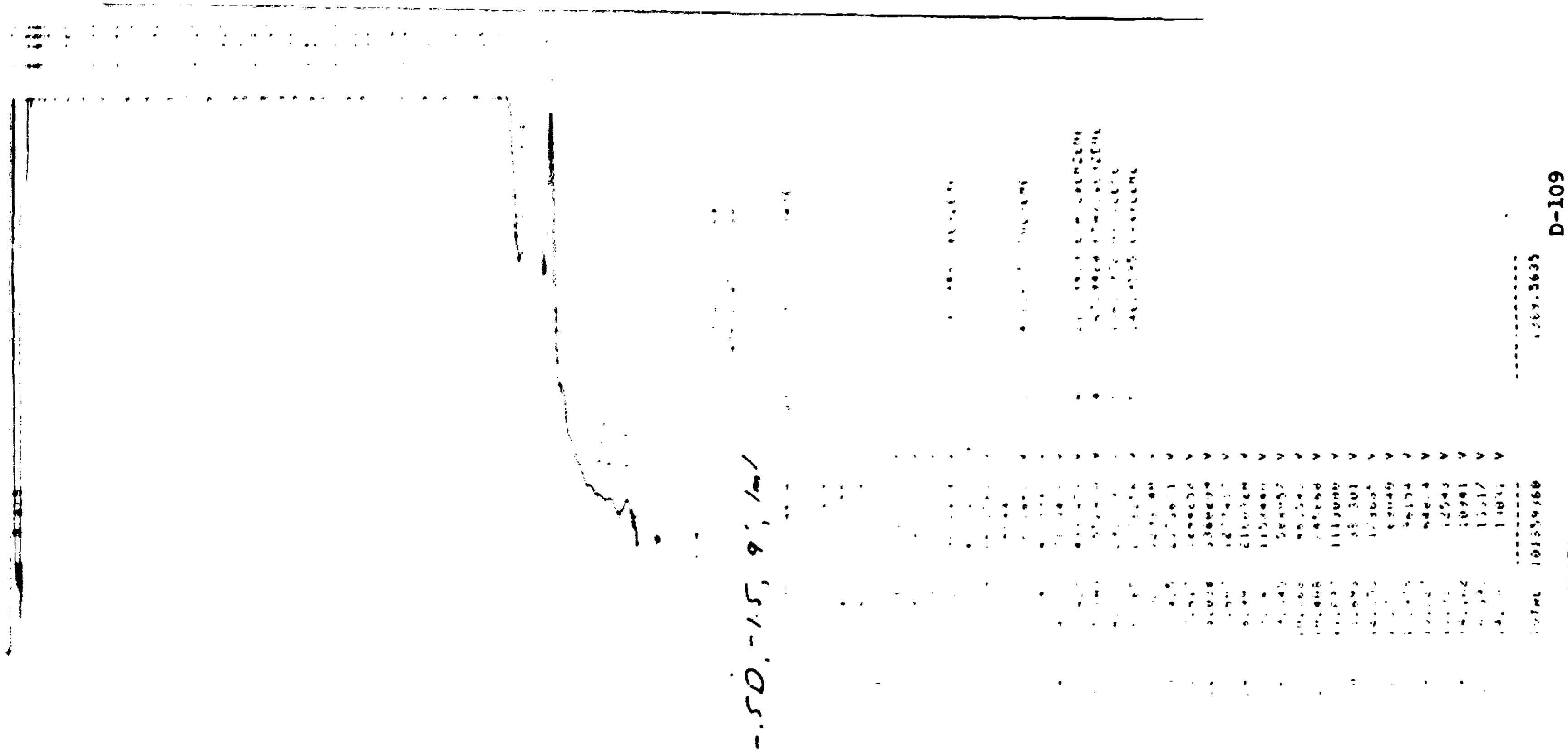
Project Number: VAB91A, 10595.01 Date: 11-18-87

Project Manager: RT Chemist: DW

Sample: ETA, VP-54, 9' Geologist: ______

Volume Injected: 1ml Std. Vol. Inj.: ______

Comments: ______



-.50, -1.5, 9', 1ml

EA ENGINEERING, SCIENCE, AND TECHNOLOGY, INC.

SOIL VAPOR CONTAMINANT ASSESSMENT CHROMATOGRAM REPORT SHEET

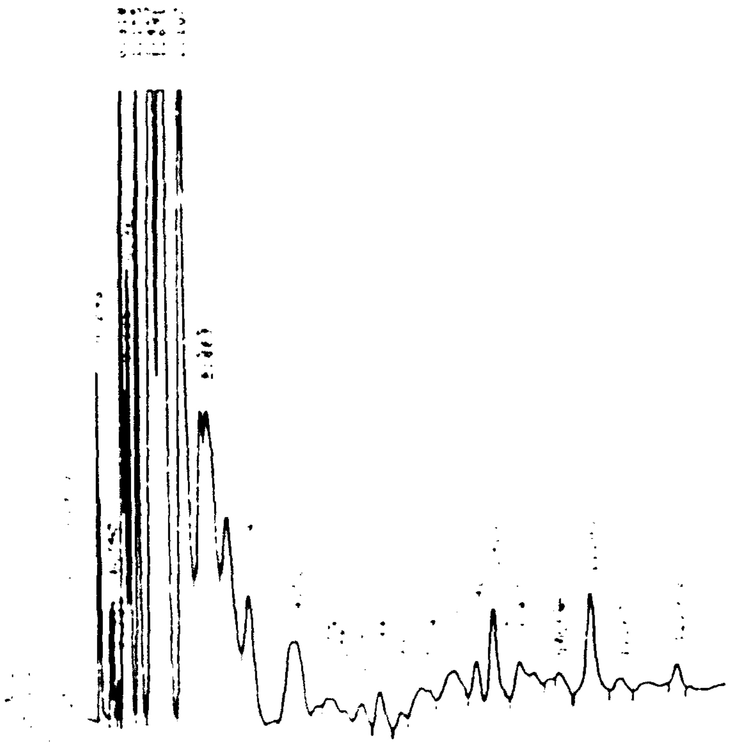
Project Number: VAB81A, 10595.01 **Date:** 11-18-87

Project Manager: RT **Chemist:** DW

Sample: ETA, VP-54, 9' **Geologist:**

Volume Injected: 20ul **Std. Vol. Inj.:**

Comments:



-.5D, -1.5, 9', 20ul

RT	AREA	TYPE	CAL#	AMOUNT	NAME
[illegible]	1655?				-CH4
[illegible]	2770	V			
[illegible]	3600	V			
[illegible]	1726	V			
[illegible]	12295	V			
[illegible]	1476	V			
[illegible]	4	V			
[illegible]	[illegible]	V			
[illegible]	2100	V	1	247.0287	BENZENE
[illegible]	4611	V			
[illegible]	464	V			
[illegible]	[illegible]	V			
[illegible]	[illegible]	V			
[illegible]	[illegible]	V	3	[illegible]	TOLUENE
[illegible]	[illegible]				
[illegible]	26191				
[illegible]	[illegible]	V			
[illegible]	[illegible]	V	4	[illegible]	ETHYLBENZENE
[illegible]	6431	V			
[illegible]	460	V	5	[illegible]	[illegible]
[illegible]	[illegible]				
[illegible]	2150				
[illegible]	12250	V			
[illegible]	17056	V			
[illegible]	7472	V			
[illegible]	14563	V			
[illegible]	4065				
10.332	1136				
10.54	2761	V			
11.05	17578				
11.67	2968	V			
12.432	2721				
TOTAL	657933			448.6651	

EA ENGINEERING, SCIENCE, AND TECHNOLOGY, INC.

SOIL VAPOR CONTAMINANT ASSESSMENT CHROMATOGRAM REPORT SHEET

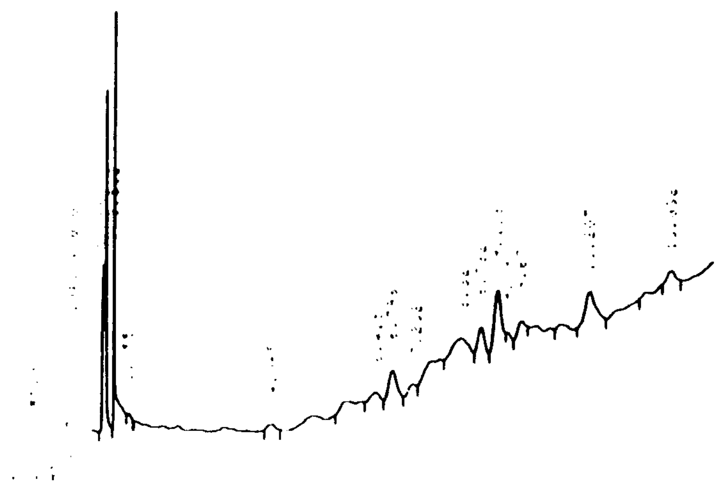
Project Number: VAB81A Date: 11/18/87

Project Manager: RT Chemist: DW

Sample: VP-55, 9' Geologist: ______

Volume Injected: 500ul Std. Vol. Inj.: ______

Comments: ______



-D00 (-5) 9', 500ul

EA ENGINEERING, SCIENCE, AND TECHNOLOGY, INC.

SOIL VAPOR CONTAMINANT ASSESSMENT
CHROMATOGRAM REPORT SHEET

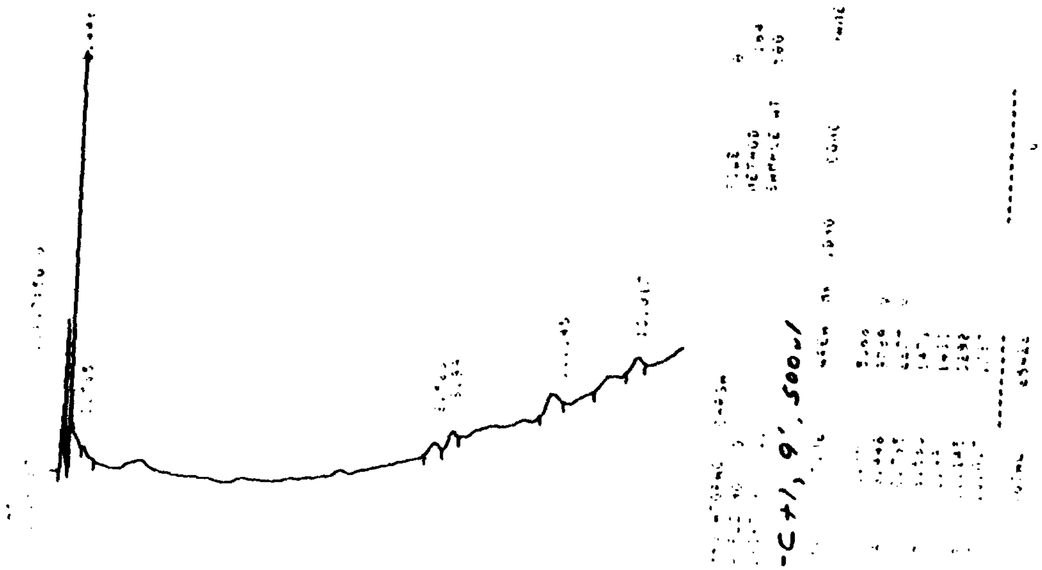
Project Number: VABBIA Date: 11/18/87

Project Manager: RT Chemist: DW

Sample: VP-56, 9' Geologist:

Volume Injected: 500ul Std. Vol. Inj.:

Comments:



EA ENGINEERING, SCIENCE, AND TECHNOLOGY, INC.

SOIL VAPOR CONTAMINANT ASSESSMENT CHROMATOGRAM REPORT SHEET

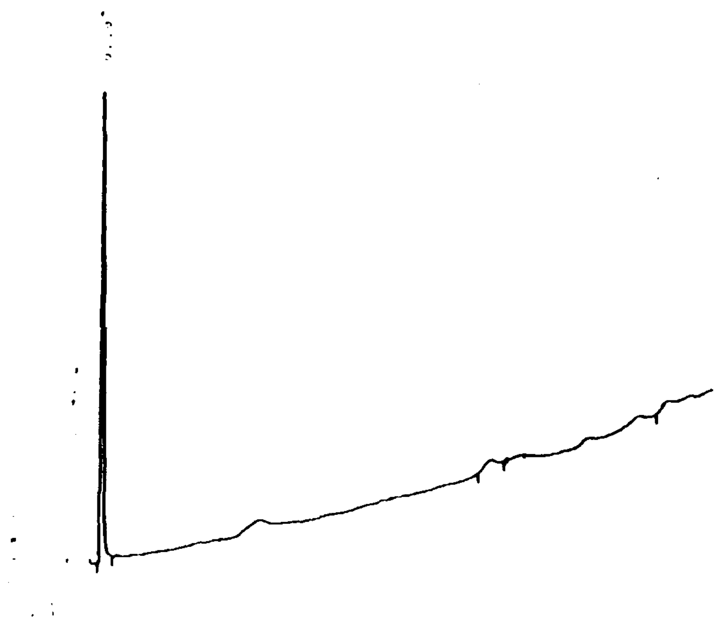
Project Number: VAB81A   Date: 11/18/87

Project Manager: RT   Chemist: DW

Sample: Probe Blank, Final   Geologist: ______

Volume Injected: 1ml   Std. Vol. Inj.: ______

Comments: ______



FILE

METHOD 164

SAMPLE WT 1000

Probe Blank, Final, 1ml

AREA   CONC   NAME

EA ENGINEERING, SCIENCE, AND TECHNOLOGY, INC.

SOIL VAPOR CONTAMINANT ASSESSMENT CHROMATOGRAM REPORT SHEET

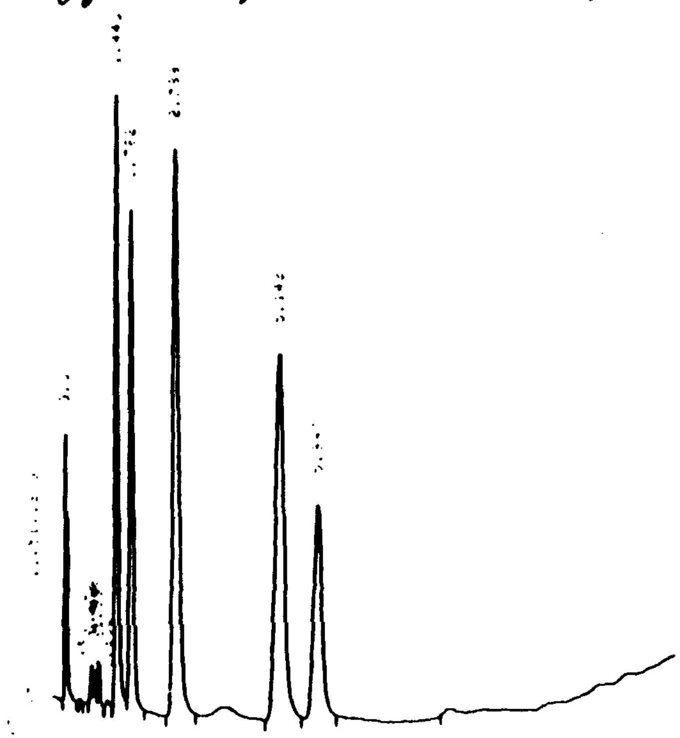
Project Number: VAB81A **Date:** 11/18/87

Project Manager: RT **Chemist:** DW

Sample: Standard, Final **Geologist:**

Volume Injected: 200ul **Std. Vol. Inj.:**

Comments: 8.1ppm Benzene, 30.4ppm TCE, 20ppm Toluene 14.2ppm Ethylbenzene, 10.2ppm O-Xylene



Standard, Final, 200ul