APPENDIX I

Capillary Pressure Tests: Results Data Analysis and Interpretation

Appendix I
Capillary Pressure Testing: Results, Data Analysis and Interpretation

Capillary Pressure Testing of the Clay Aquitard

One of the primary concerns in a DNAPL-contaminated field site is the vertical migration of the DNAPL. Such vertical migration is usually arrested by the presence of clay aquitards, which have much lower permeabilities than the aquifer materials. The lower permeabilities impart a greater ability to resist further invasion and migration of DNAPL. This also accounts for the pooling of DNAPL at greater than residual immobile saturations above formations with low permeabilities i.e. a capillary trap. The ability of an aquitard to prevent entry and downward flow of DNAPL is determined by the pore size distribution of the medium, the head of DNAPL on the aquitard, and the wetting nature of the mineral surfaces in contact with the DNAPL.

The process of water displacement by a nonaqueous phase is termed drainage; conversely, the process of displacement of the nonaqueous phase by water is termed imbibition. This assumes that water is the wetting phase. Capillary pressure experiments provide information on the pore throat geometry and the capillary pressure-saturation relationship of the porous medium. This information is very useful in determining the entry pressure required to penetrate a given capillary barrier. In addition it provides information on the ability of such capillary barriers to support a column of DNAPL. This information is significant while using a remediation technology such as surfactant flooding, which reduces the NAPL-water IFT and hence alters the capillary characteristics.

A capillary pressure experiment was conducted with aquitard material from the boring for injection well IN-I in the demonstration area. The objective of this experiment was to determine the pore-size distribution and the ability of the aquitard material to resist the entry of DNAPL (i.e. determine the DNAPL-entry pressure). The details of the soil sample tested by the capillary pressure experiment are given in Table E-I. DNAPL collected from monitor wells installed in the demonstration area was used as the invading fluid in the capillary pressure experiment with sample IN-I.

Table I-I Description of Soil Samples Tested in Capillary Pressure Experiments

Sample ID	Depth (ft)	Porosity (%)	Premeability (μ m^2)	Infiltrating Fluid Used
IN-1	18.0 – 22.0	49.5	Not measured	Field DNAPL

Theory

Capillary pressure experiments provide both the capillary entry pressure and a characterization of the pore-throat diameters of the porous medium being tested. In these experiments, mercury is forced into a soil pack at a fixed pressure. The pressure at which mercury first penetrates the soil pack is termed the capillary entry pressure. The volume of mercury which invades the pack is measured to determine the non-wetting phase saturation at a given inlet pressure. The pore-throat diameter for a given inlet pressure is calculated using the following equation:

$$P_C = \frac{2\sigma Cos\theta}{r} \qquad (5.1.1\text{-}1)$$

where:

P_c	=	capillary pressure (Pa)
σ	=	displacing-displaced phase IFT ($N\text{-}m^{-1}$)
r	=	pore throat radius (in)
θ	=	contact angle (degrees)

In these experiments mercury is the non-wetting fluid and hence the process of mercury invasion is a capillary drainage process, i.e., water drainage.

In the DNAPL-entry capillary pressure experiment, mercury was replaced with field DNAPL from Camp Lejeune as the displacing fluid. The displaced fluid was water. The objective in this experiment was to determine the capillary entry pressure characteristics of the aquitard material in the presence of the Camp Lejeune DNAPL.

Results and Discussion of Capillary Pressure Experiments

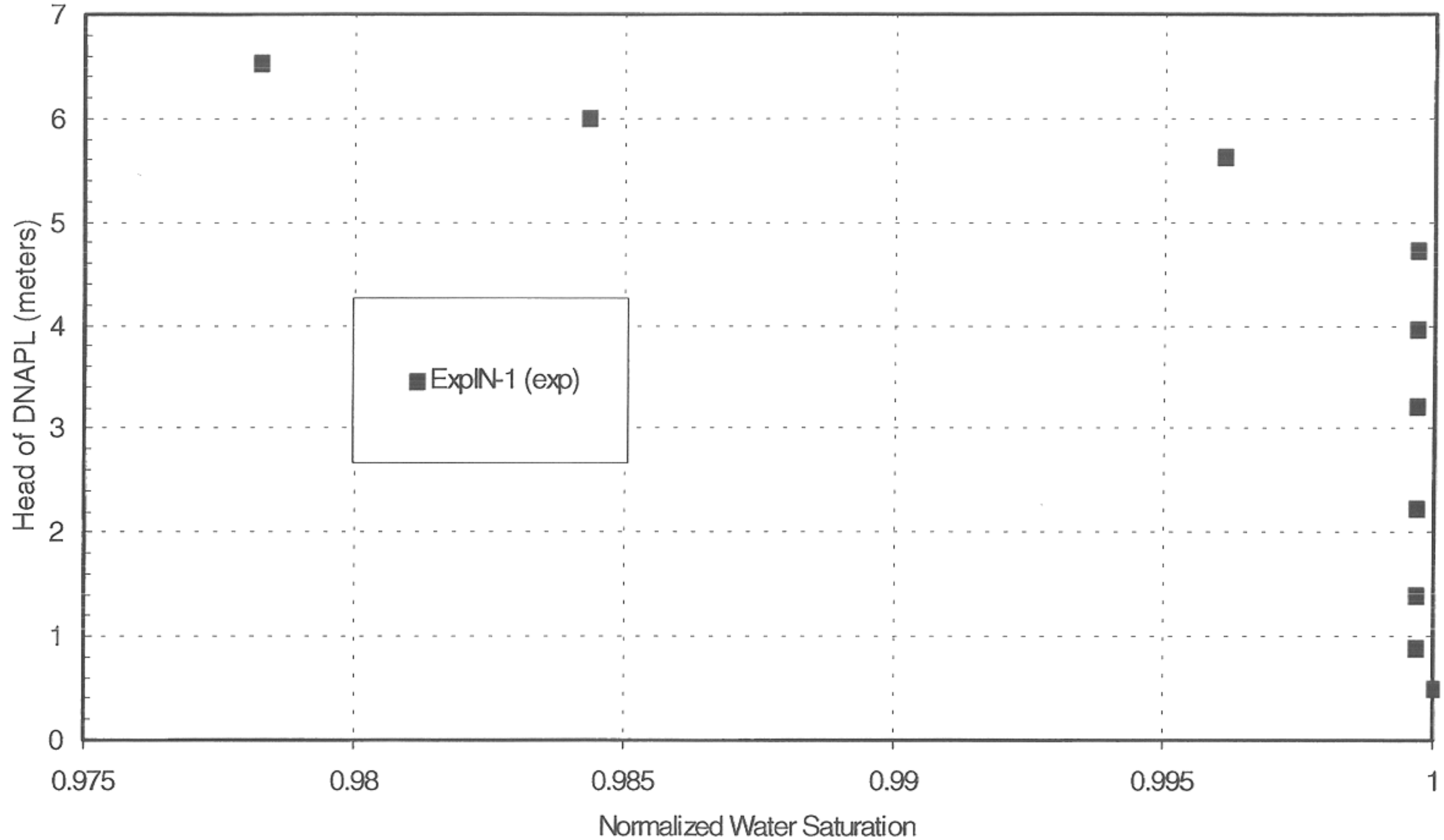
The DNAPL-water capillary pressure curve was estimated by using equation (5.1.1-1), the measured DNAPL-water IFT (10.36 dynes/cm or 0.01 N/m), and assuming a DNAPL-water contact angle of 30°. The capillary pressure was converted into an equivalent head of DNAPL using the following equation:

$$H = \frac{P_C}{\rho_{DNAPL}\, g} \qquad (5.1.2\text{-}1)$$

H	=	head of DNAPL (m)
ρ_{DNAPL}	=	density of DNAPL (kg/m^3)
g	=	acceleration due to gravity = 9.81 m/s^2

The capillary-pressure saturation relationship for the sample tested is shown in Figure I-1. The figure shows that the aquitard is a significant capillary barrier as it requires approximately 5 meters of DNAPL (i.e., ~15 ft) in order to enter the aquitard sample.

Based on these results it can be concluded that vertical mobilization of DNAPL through the aquitard will not be expected as sediments with similar characteristics can support approximately 15 ft of DNAPL without allowing infiltration. Under such conditions these sediments will act as an effective capillary barrier, allowing the DNAPL to collect at greater than immobile residual saturations. If surfactant solutions injected into the shallow aquifer lowers the DNAPL-ground water interfacial tension by an order of magnitude, the entry pressure of any DNAPL that has not been solubilized will also be lowered by a similar amount.



DATE: 2/23/99	Capillary Pressure Characteristics of the Aquitard Sample
REF: TDN 307	
FILE: Fig I-1.PPT	
Duke Engineering & Services. A Duke Energy Company	MCB Camp Lejeune, NC — Figure I-1

PHYSICAL PROPERTIES DATA
(Methodology: API RP40, EPA 9100)

Project Name: MCB Camp Lejeune

			Confining Stress: 25.0 psi	
Sample ID.	Depth, ft.	Sample Orientation	Native State Effective Permeability to Water (millidarcy)	Native State Effective Water Conductivity (cm/s)
IS23-04	19.5 - 19.9	vertical	0.082	7.74E-08
IS22-06	21.0 - 21.7	vertical	0.341	3.22E-07

TerraTek

TerraTek Inc.

June 16, 1998

Mr. John Londergan
Duke Engineering
9111 Research Blvd.
Austin, TX 78758

Dear Mr. Londergan:

Attached are the procedures I used in order to determine the capillary pressure curve and porosity on the sample you submitted for testing.

If you have any questions or need more information, please give me a call at (801)584-2489. TerraTek sincerely appreciates the opportunity to work with you on this project.

Respectfully,
TerraTek, Inc.

Dick Winzenried

Dick Winzenried
Laboratory Supervisor

DW/sh

Introduction

Two soil samples, one approximately 18 inches long and one approximately 6 inches long by 1-5/8 inches diameter were submitted for testing. The samples were designated NO 1, 18-22 ft. Two test samples from the 18 inch long piece were prepared for testing and designated Sample #1 (21.0 ft.) and Sample #2 (21.1 ft.). Sample #1 was used to determine capillary pressure using DNAPL as the driving fluid and Sample #2 was used to determine porosity of the formation.

Procedures for Capillary Pressure Test

- Sample was cut to length.
- Measurements were taken to determine bulk volume.
- Sample was placed in test apparatus at an overburden stress of 25 psi.
- The sample and flow system was vacuum back-filled with water.
- Approximately 2.3 ml of water was flowed through the sample at in injection pressure of 5.4 psi. This was over a period of three days.
- DNAPL was flowed across the face of the sample to displace water from the flow lines and establish DNAPL contact with the face of the sample.
- The injection pressure of DNAPL was established at 1.05 psi and maintained for approximately 3 days. Water displaced = 0.00 ml.
- The injection pressure of DNAPL was raised to 2.02 psi and maintained for approximately 4 days. Water displaced = 0.01 ml.
- The injection pressure of DNAPL was raised to 3.17 psi and maintained for approximately 2 days. Water displaced = 0.00 ml.
- The injection pressure of DNAPL was raised to 5.25 psi and maintained for approximately 2 days. Water displaced = 0.00 ml.
- The injection pressure of DNAPL was raised to 7.25 psi and maintained for approximately 2 days. Water displaced = 0.00 ml.
- The injection pressure of DNAPL was raised to 8.75 psi and maintained for approximately 1 day. Water displaced = 0.00 ml.

- The injection pressure of DNAPL was raised to 10.85 psi and maintained for approximately 2 days. Water displaced = 0.00 ml.

- The injection pressure of DNAPL was raised to 12.55 psi and maintained for approximately 5 days. Water displaced = 0.10 ml.

- The injection pressure of DNAPL was raised to 14.0 psi and maintained for approximately 12 days. Water displaced = 0.20 ml.

- The injection pressure of DNAPL was raised to 14.4 psi and maintained for approximately 9 days. Water displaced = 0.13 ml.

- The injection pressure of DNAPL was raised to 14.7 psi and maintained for approximately 29 days. Water displaced = 0.22 ml.

- Total water displaced over a 63 day period was 0.66 ml.

The test was terminated at this time. The water continued to be displaced at a fairly constant rate, but at the rate it was going it would take a very unreasonable amount of time to reach equilibrium. Since it was taking so long it was decided that enough data had been generated so that calculations could be made in order to get the required information.

Procedures for Porosity Determination

- Sample was cut to length.

- Measurements were taken to determine bulk volume.

- Sample was placed in test apparatus at an overburden stress of 25 psi.

- The sample and flow system was vacuum back-filled with water.

- Approximately 3 ml of water was flowed through the sample at in injection pressure of —10 psi in order to ensure 100% saturation of the sample.

- The sample was removed from the test fixture and the sample was weighed to determine the saturated mass.

- The sample was placed in a convection oven at 60~ C until a constant dry mass was achieved.

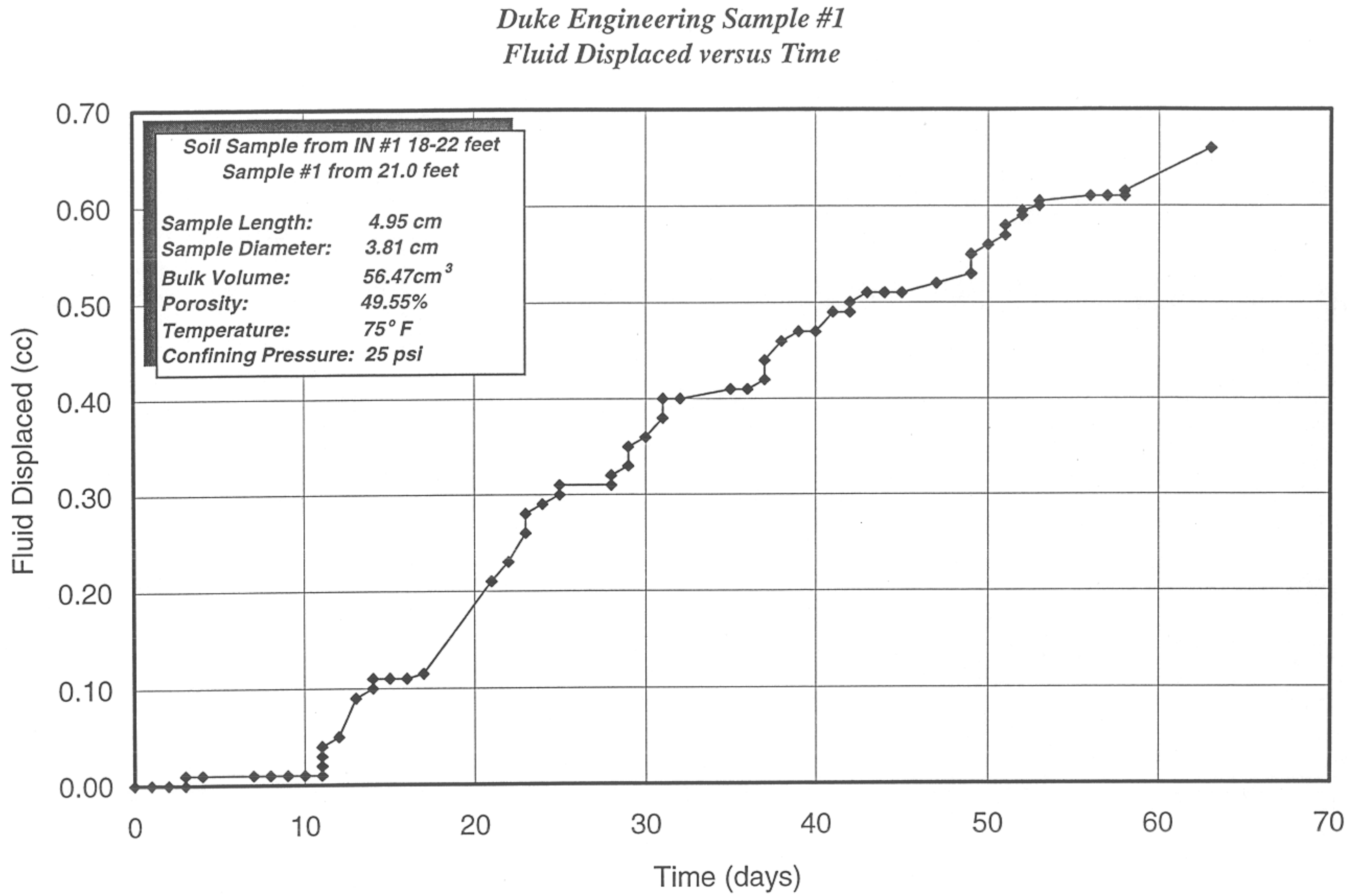
- The weight change and the original bulk volume were then used to calculate porosity.

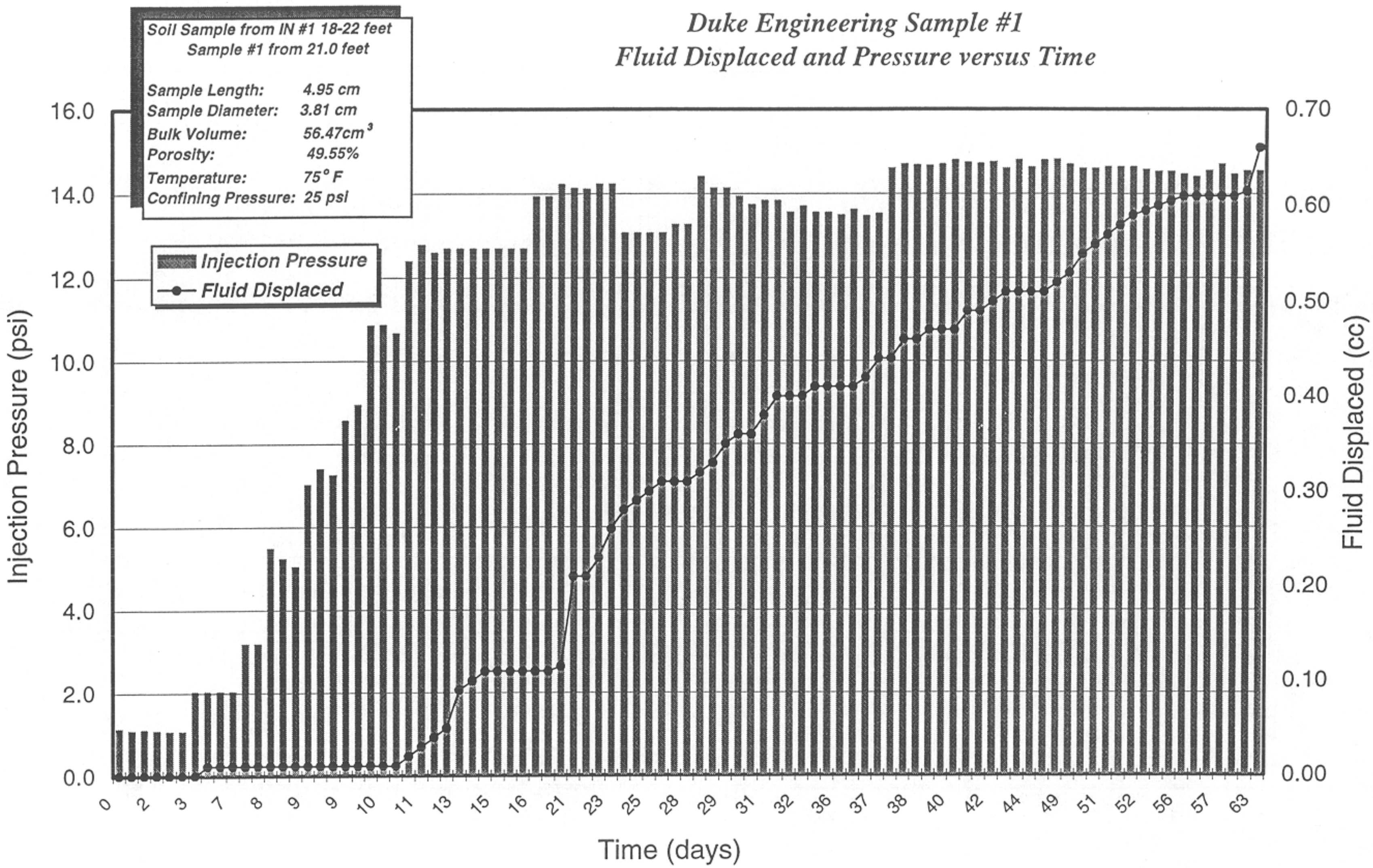
Sample Identification Table

Sample Number	***Length (cm)***	***Diameter (cm)***	***Bulk Volume (cm^3)***	***Wet Mass (g)***	***Dry Mass (g)***	***Pore Volume (ml)***	***Porosity (%)***
1	4.95	3.81	56.47			27.98	49.55
2	5.347	3.81	60.953	104.733	74.534	32.20	49.55

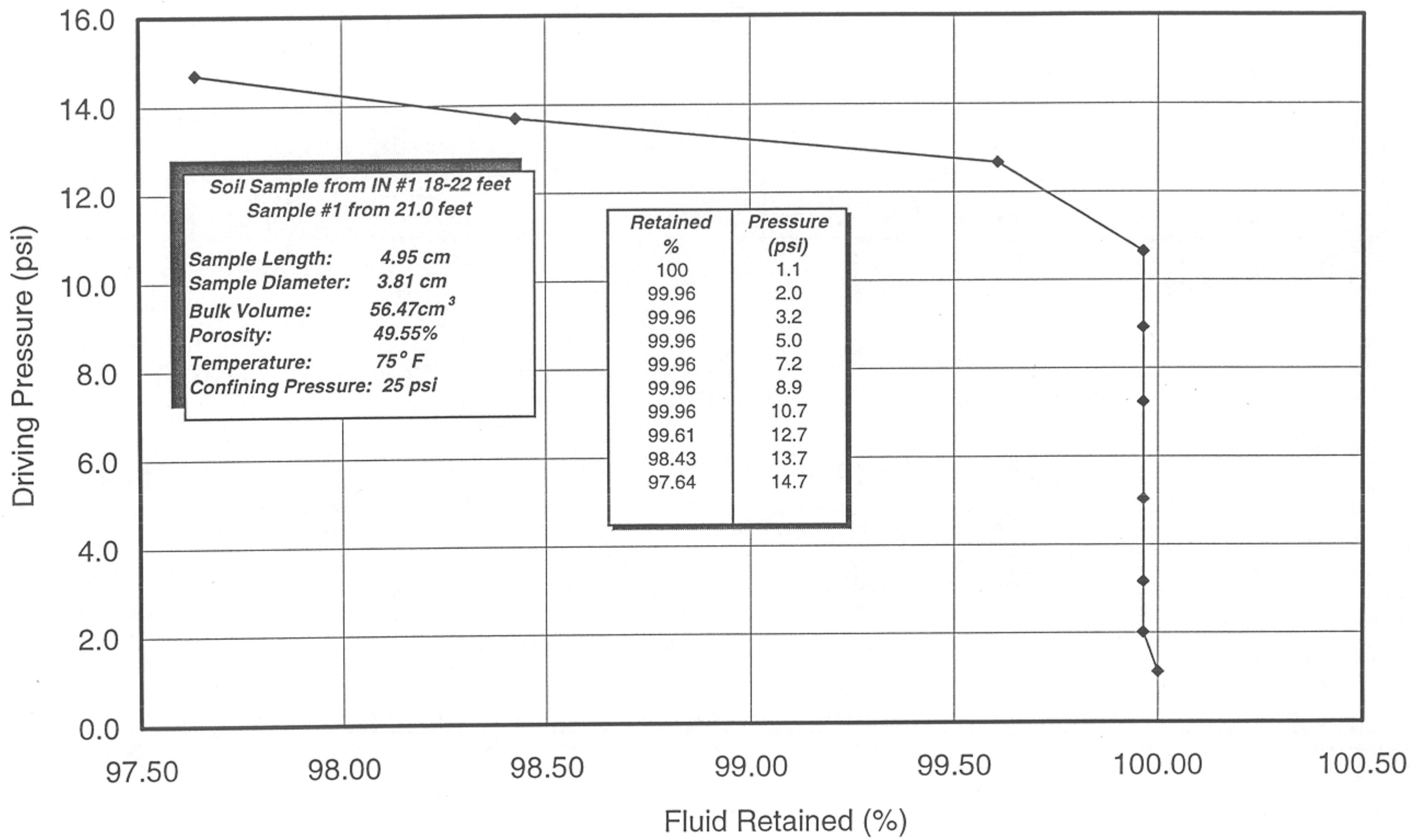
All of the raw data for the capillary pressure study was entered in an Excel file spread sheet. This information was e-mailed to Duke Engineering so they could make their own observations as to what took place during the test.

Included in this letter report is a table of the raw data and three plots of the data acquired. The three plots including a Capillary Pressure Curve, Fluid Displaced versus Time and Fluid Displaced and Pressure versus Time.


Duke Engineering Sample #1
Fluid Displaced versus Time
Soil Sample from IN #1 18-22 feet
Sample #1 from 21.0 feet
Sample Length: 4.95 cm
Sample Diameter: 3.81 cm
Bulk Volume: 56.47cm³
Porosity: 49.55%
Temperature: 75° F
Confining Pressure: 25 psi
Fluid Displaced (cc)
0.00
0.10
0.20
0.30
0.40
0.50
0.60
0.70
Time (days)
0
10
20
30
40
50
60
70


Duke Engineering Sample #1
Fluid Displaced and Pressure versus Time
Soil Sample from IN #1 18-22 feet
Sample #1 from 21.0 feet
Sample Length: 4.95 cm
Sample Diameter: 3.81 cm
Bulk Volume: 56.47cm³
Porosity: 49.55%
Temperature: 75° F
Confining Pressure: 25 psi
Injection Pressure
Fluid Displaced
Injection Pressure (psi)
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
Fluid Displaced (cc)
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
0 2 3 7 8 9 9 10 11 13 15 16 21 23 25 28 29 31 32 36 37 38 40 42 44 49 51 52 56 57 63
Time (days)

Duke Engineering Sample #1
Capillary Pressure Curve



Retained %	Pressure (psi)
100	1.1
99.96	2.0
99.96	3.2
99.96	5.0
99.96	7.2
99.96	8.9
99.96	10.7
99.61	12.7
98.43	13.7
97.64	14.7

Capillary Pressure Study
Soil Core from IN#1 18-22 feet
Sample #1 from 21 feet

Sample Length: 4.95 cm
Sample Diameter: 3.81 cm
Bulk Volume: 56.47 cm^3
Pore Volume: 27.98 cm^3
Porosity: 49.55%

Raw Data used for Calculations						Data used for Plots						
Date	Time	Time (days)	Total Fluid Displaced (cc)	Effluent Burette Reading (cc)	DNAPL Injection Pressure (mm/Hg)	Time (days)	DNAPL Injection Pressure (psi)	Total Fluid Displaced (cc)	DNAPL Injection Pressure (psi)	Water Retained (%)	Water Retained (%)	DNAPL Injection Pressure (psi)
23-Feb	8:00a.m.	0	0.00	1.31	5.9	0	1.1	0.00	1.1		100.00	1.1
24-Feb	7:12a.m.	1	0.00	1.31	5.6	1	1.1	0.00	1.1		99.96	2.0
24-Feb	5:00p.m.	1	0.00	1.31	5.7	1	1.1	0.00	1.1		99.96	3.2
25-Feb	9:35a.m.	2	0.00	1.31	5.6	2	1.1	0.00	1.1		99.96	5.0
25-Feb	5:00p.m.	2	0.00	1.31	5.5	2	1.1	0.00	1.1		99.96	7.2
26-Feb	9:15a.m.	3	0.00	1.31	5.5	3	1.1	0.00	1.1	100	99.96	8.9
26-Feb	9:19a.m.	3	0.00	1.31	10.5	3	2.0	0.00	2.0		99.96	10.7
26-Feb	4:37p.m.	3	0.01	1.30	10.5	3	2.0	0.01	2.0		99.61	12.7
27-Feb	9:21a.m.	4	0.01	1.30	10.5	4	2.0	0.01	2.0		98.43	13.7
2-Mar	8:05a.m.	7	0.01	1.30	10.5	7	2.0	0.01	2.0	99.96	97.64	14.7
2-Mar	8:00a.m.	7	0.01	1.30	16.5	7	3.2	0.01	3.2			
3-Mar	8:00a.m.	8	0.01	1.30	16.5	8	3.2	0.01	3.2	99.96		
3-Mar	8:02a.m.	8	0.01	1.30	28.5	8	5.5	0.01	5.5			
3-Mar	5:14p.m.	8	0.01	1.30	27.2	8	5.2	0.01	5.2			
4-Mar	7:53a.m.	9	0.01	1.30	26.2	9	5.0	0.01	5.0	99.96		

Raw Data used for Calculations						Data used for Plots				
Date	Time	Time (days)	Total Fluid Displaced (cc)	Effluent Burette Reading (cc)	DNAPL Injection Pressure (mm/Hg)	Time (days)	DNAPL Injection Pressure (psi)	Total Fluid Displaced (cc)	DNAPL Injection Pressure (psi)	Water Retained (%)
4-Mar	7:54a.m.	9	0.01	1.30	36.5	9	7.0	0.01	7.0	
4-Mar	9:47a.m.	9	0.01	1.30	38.5	9	7.4	0.01	7.4	
4-Mar	5:09p.m.	9	0.01	1.30	37.7	9	7.2	0.01	7.2	99.96
4-Mar	5:11p.m.	9	0.01	1.30	44.5	9	8.5	0.01	8.5	
5-Mar	8:14a.m.	10	0.01	1.30	46.5	10	8.9	0.01	8.9	99.96
5-Mar	8:16a.m.	10	0.01	1.30	56	10	10.8	0.01	10.8	
5-Mar	11:44a.m.	10	0.01	1.30	56.5	10	10.9	0.01	10.9	
6-Mar	8:29a.m.	11	0.01	1.30	55.5	11	10.7	0.01	10.7	99.96
6-Mar	8:30a.m.	11	0.02	1.29	64.5	11	12.4	0.02	12.4	
6-Mar	9:23a.m.	11	0.03	1.28	66.5	11	12.8	0.03	12.8	
6-Mar	5:02p.m.	11	0.04	1.27	65.5	11	12.6	0.04	12.6	
7-Mar	8:25a.m.	12	0.05	1.26	66	12	12.7	0.05	12.7	
8-Mar	3:00p.m	13	0.09	1.22	66	13	12.7	0.09	12.7	
9-Mar	7:32p.m.	14	0.10	1.21	66	14	12.7	0.10	12.7	
9-Mar	4:08a.m.	14	0.11	1.20	66	14	12.7	0.11	12.7	
10-Mar	9:26a.m.	15	0.11	1.20	66	15	12.7	0.11	12.7	
10-Mar	5:34p.m.	15	0.11	1.20	66	15	12.7	0.11	12.7	
11-Mar	8:26a.m.	16	0.11	1.20	66	16	12.7	0.11	12.7	99.61
11-Mar	8:27a.m.	16	0.11	1.20	72.5	16	13.9	0.11	13.9	
11-Mar	5:39p.m.	16	0.11	1.20	72.5	16	13.9	0.11	13.9	
12-Mar	10:25a.m.	17	0.12	1.20	74	17	14.2	0.12	14.2	

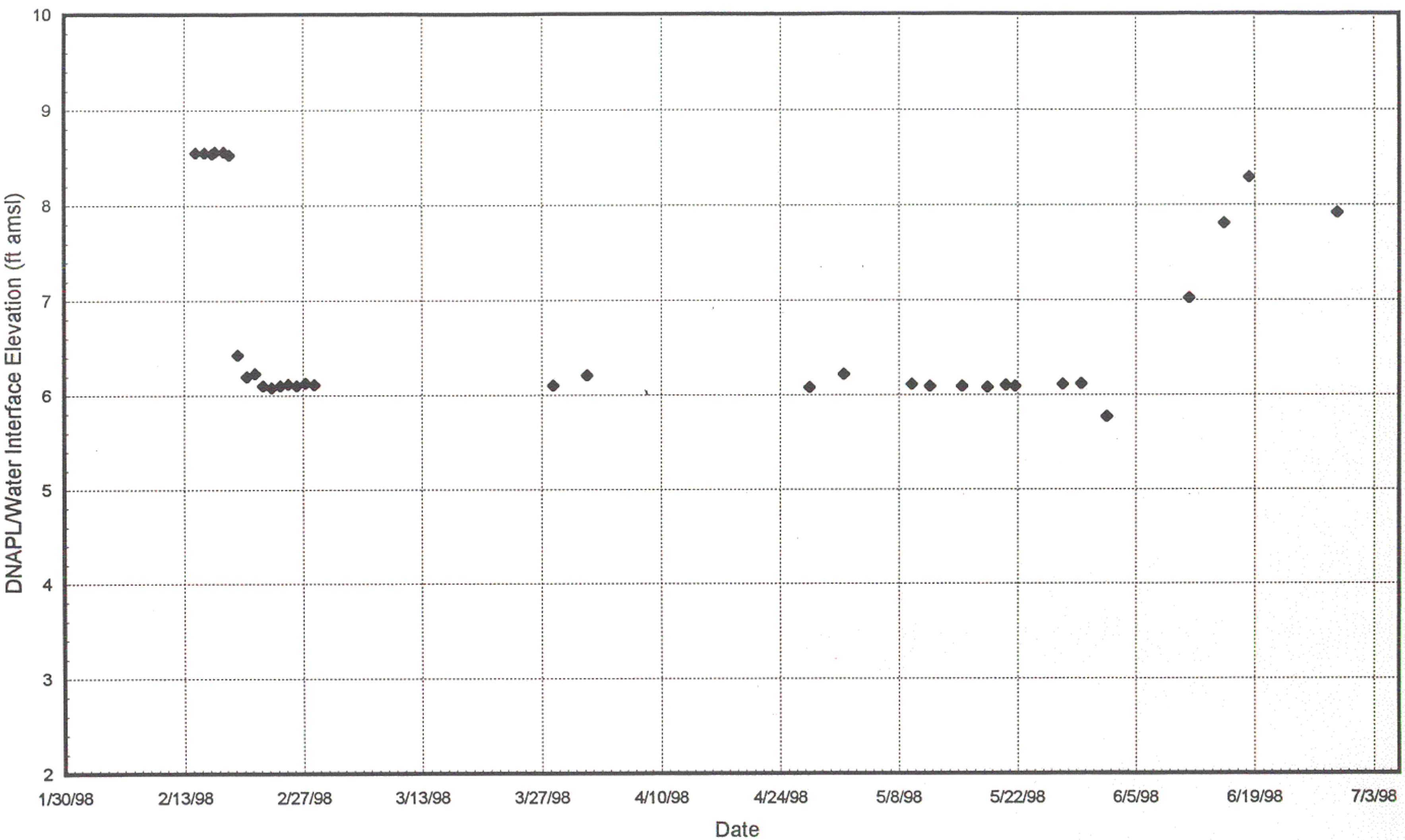
Raw Data used for Calculations						Data used for Plots				
Date	Time	Time (days)	Total Fluid Displaced (cc)	Effluent Burette Reading (cc)	DNAPL Injection Pressure (mm/Hg)	Time (days)	DNAPL Injection Pressure (psi)	Total Fluid Displaced (cc)	DNAPL Injection Pressure (psi)	Water Retained (%)
16-Mar	7:45a.m.	21	0.21	1.10	73.5	21	14.1	0.21	14.1	
16-Mar	5:04p.m.	21	0.21	1.10	73.4	21	14.1	0.21	14.1	
17-Mar	10:13a.m.	22	0.23	1.08	74	22	14.2	0.23	14.2	
18-Mar	9:44a.m.	23	0.26	1.05	74	23	14.2	0.26	14.2	
18-Mar	5:13p.m.	23	0.28	1.03	68	23	13.1	0.28	13.1	
19-Mar	9:07a.m.	24	0.29	1.02	68	24	13.1	0.29	13.1	
20-Mar	8:11a.m.	25	0.30	1.01	68	25	13.1	0.30	13.1	
20-Mar	3:27p.m.	25	0.31	1.00	68	25	13.1	0.31	13.1	
20-Mar	6:18p.m.	25	0.31	1.00	69	25	13.2	0.31	13.2	
23-Mar	7:59a.m.	28	0.31	1.00	69	28	13.2	0.31	13.2	
23-Mar	5:13p.m.	28	0.32	0.99	75	28	14.4	0.32	14.4	
24-Mar	8:01a.m.	29	0.33	0.98	73.5	29	14.1	0.33	14.1	
24-Mar	4:33p.m.	29	0.35	0.96	73.5	29	14.1	0.35	14.1	
25-Mar	7:46a.m.	30	0.36	0.95	72.5	30	13.9	0.36	13.9	
25-Mar	5:48p.m.	30	0.36	0.95	71.5	30	13.7	0.36	13.7	
26-Mar	7:58a.m.	31	0.38	0.93	72	31	13.8	0.38	13.8	
26-Mar	5:06p.m.	31	0.40	0.91	72	31	13.8	0.40	13.8	
27-Mar	7:58a.m.	32	0.40	0.91	70.5	32	13.5	0.40	13.5	
27-Mar	12:25p.m.	32	0.40	0.91	71.3	32	13.7	0.40	13.7	
30-Mar	7:29a.m.	35	0.41	0.90	70.5	35	13.5	0.41	13.5	
30-Mar	5:15p.m.	35	0.41	0.90	70.5	35	13.5	0.41	13.5	

Raw Data used for Calculations						Data used for Plots				
Date	Time	Time (days)	Total Fluid Displaced (cc)	Effluent Burette Reading (cc)	DNAPL Injection Pressure (mm/Hg)	Time (days)	DNAPL Injection Pressure (psi)	Total Fluid Displaced (cc)	DNAPL Injection Pressure (psi)	Water Retained (%)
31-Mar	7:56a.m.	36	0.41	0.90	70.2	36	13.5	0.41	13.5	
31-Mar	5:26p.m.	36	0.41	0.90	70.9	36	13.6	0.41	13.6	
1-Apr	8:05a.m.	37	0.42	0.89	70.1	37	13.5	0.42	13.5	Avg = 13.7
1-Apr	5:01p.m.	37	0.44	0.87	70.4	37	13.5	0.44	13.5	98.43
1-Apr	5:02p.m.	37	0.44	0.87	76	37	14.6	0.44	14.6	
2-Apr	8:29a.m.	38	0.46	0.85	76.5	38	14.7	0.46	14.7	
2-Apr	6:30p.m.	38	0.46	0.85	76.4	38	14.7	0.46	14.7	
3-Apr	7:43a.m.	39	0.47	0.84	76.3	39	14.6	0.47	14.6	
3-Apr	4:00p.m.	39	0.47	0.84	76.5	39	14.7	0.47	14.7	
4-Apr	10:00a.m.	40	0.47	0.84	77	40	14.8	0.47	14.8	
5-Apr	2:30p.m.	41	0.49	0.82	76.7	41	14.7	0.49	14.7	
6-Apr	8:00a.m..	42	0.49	0.82	76.6	42	14.7	0.49	14.7	
6-Apr	5:00p.m.	42	0.50	0.81	76.8	42	14.7	0.50	14.7	
7-Apr	8:00a.m.	43	0.51	0.80	76	43	14.6	0.51	14.6	
7-Apr	4:30p.m.	43	0.51	0.80	77	43	14.8	0.51	14.8	
8-Apr	8:00a.m.	44	0.51	0.80	76.1	44	14.6	0.51	14.6	
9-Apr	1:35p.m.	45	0.51	0.80	77	45	14.8	0.51	14.8	
11-Apr	1:48p.m.	47	0.52	0.79	77.1	47	14.8	0.52	14.8	
13-Apr	8:10a.m.	49	0.53	0.78	76.5	49	14.7	0.53	14.7	
13-Apr	5:34p.m.	49	0.55	0.76	76	49	14.6	0.55	14.6	

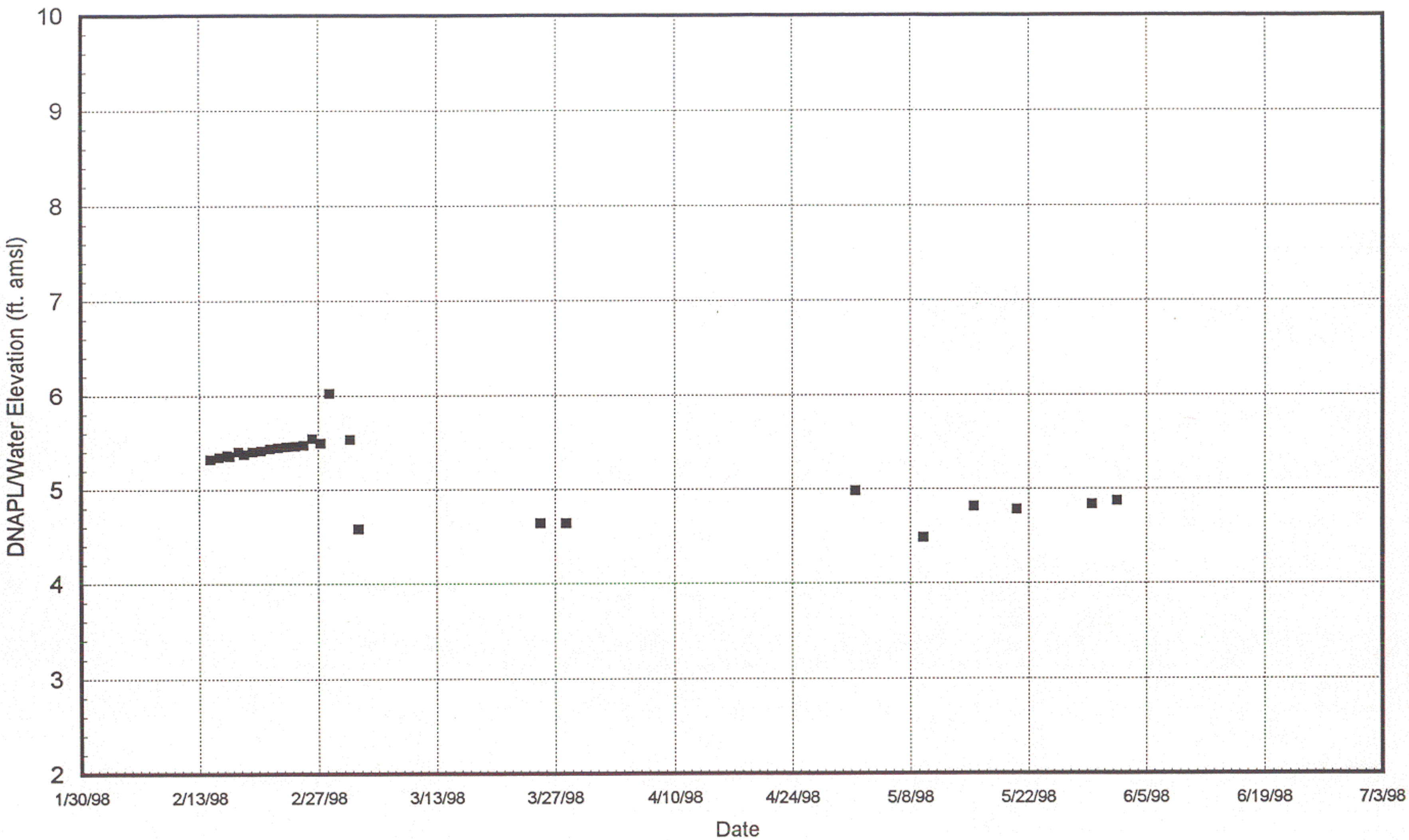
Raw Data used for Calculations						Data used for Plots				
Date	Time	Time (days)	Total Fluid Displaced (cc)	Effluent Burette Reading (cc)	DNAPL Injection Pressure (mm/Hg)	Time (days)	DNAPL Injection Pressure (psi)	Total Fluid Displaced (cc)	DNAPL Injection Pressure (psi)	Water Retained (%)
14-Apr	4:28p.m.	50	0.56	0.75	76	50	14.6	0.56	14.6	
15-Apr	11:18a.m.	51	0.57	0.74	76.2	51	14.6	0.57	14.6	
15-Apr	5:33p.m.	51	0.58	0.73	76.2	51	14.6	0.58	14.6	
16-Apr	7:47a.m.	52	0.59	0.72	76.2	52	14.6	0.59	14.6	
16-Apr	5:15p.m.	52	0.60	0.72	75.8	52	14.6	0.60	14.6	
17-Apr	8:03a.m.	53	0.60	0.71	75.6	53	14.5	0.60	14.5	
17-Apr	5:32p.m.	53	0.61	0.71	75.6	53	14.5	0.61	14.5	
20-Apr	10:40a.m.	56	0.61	0.70	75.3	56	14.5	0.61	14.5	
20-Apr	5:00p.m.	56	0.61	0.70	75	56	14.4	0.61	14.4	
21-Apr	7:44a.m.	57	0.61	0.70	75.7	57	14.5	0.61	14.5	
21-Apr	6:04p.m.	57	0.61	0.70	76.5	57	14.7	0.61	14.7	
22-Apr	7:59a.m.	58	0.61	0.70	75.3	58	14.5	0.61	14.5	
22-Apr	5:26	58	0.62	0.70	75.7	58	14.5	0.62	14.5	
27-Apr	11:32	63	0.66	0.65	75.7	63	14.5	0.66	14.5	97.64

APPENDIX J

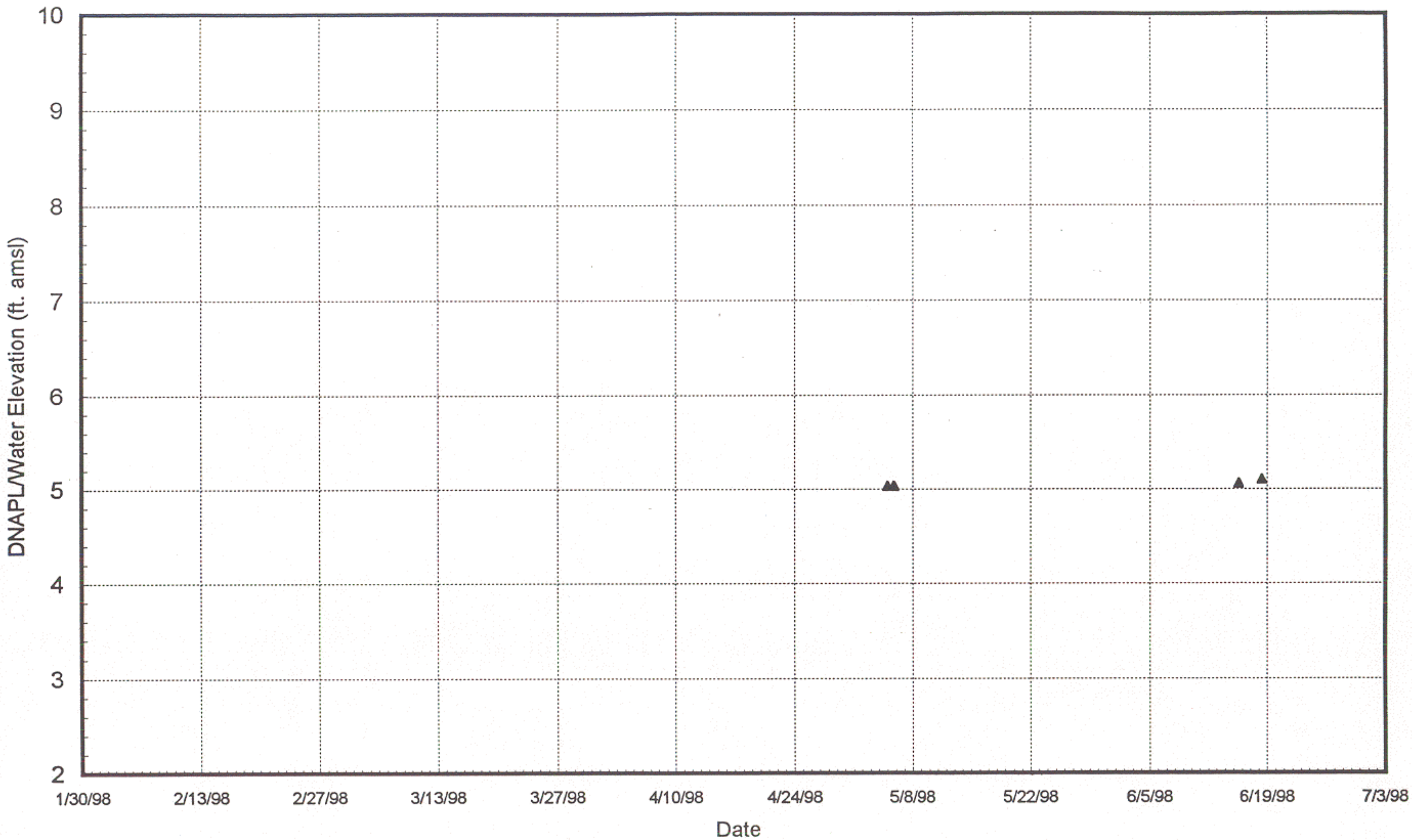
Plots of DNAPL/Water Interface Elevations



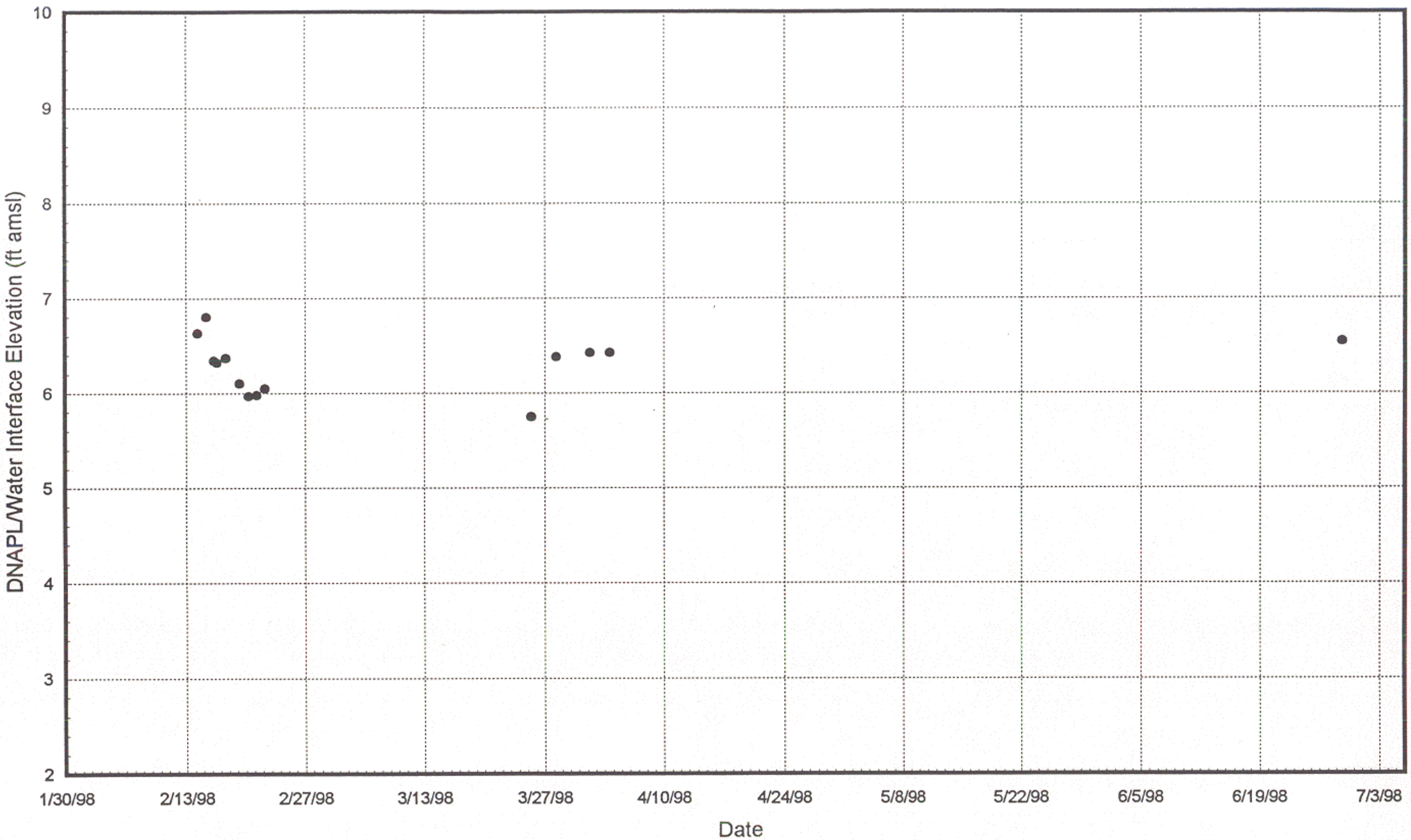
DNAPL/Water Interface Elevation During Field Operations in Well EX01



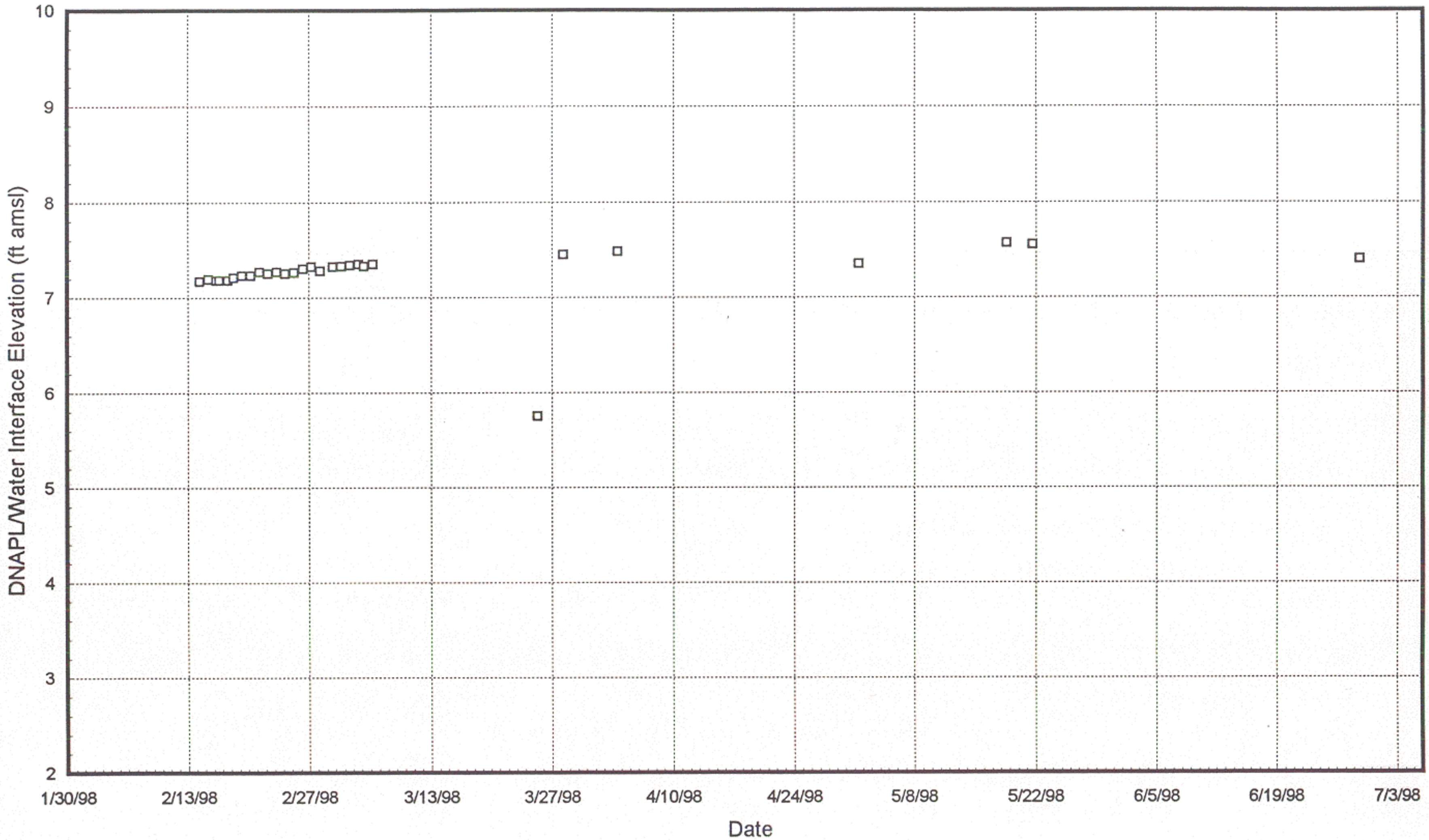
DNAPL/Water interface Elevation During Field Operations in Well EX02



DNAPL/Water interface Elevation During Field Operations in Well EX04



DNAPL/Water Interface Elevation During Field Operations in Well RW01



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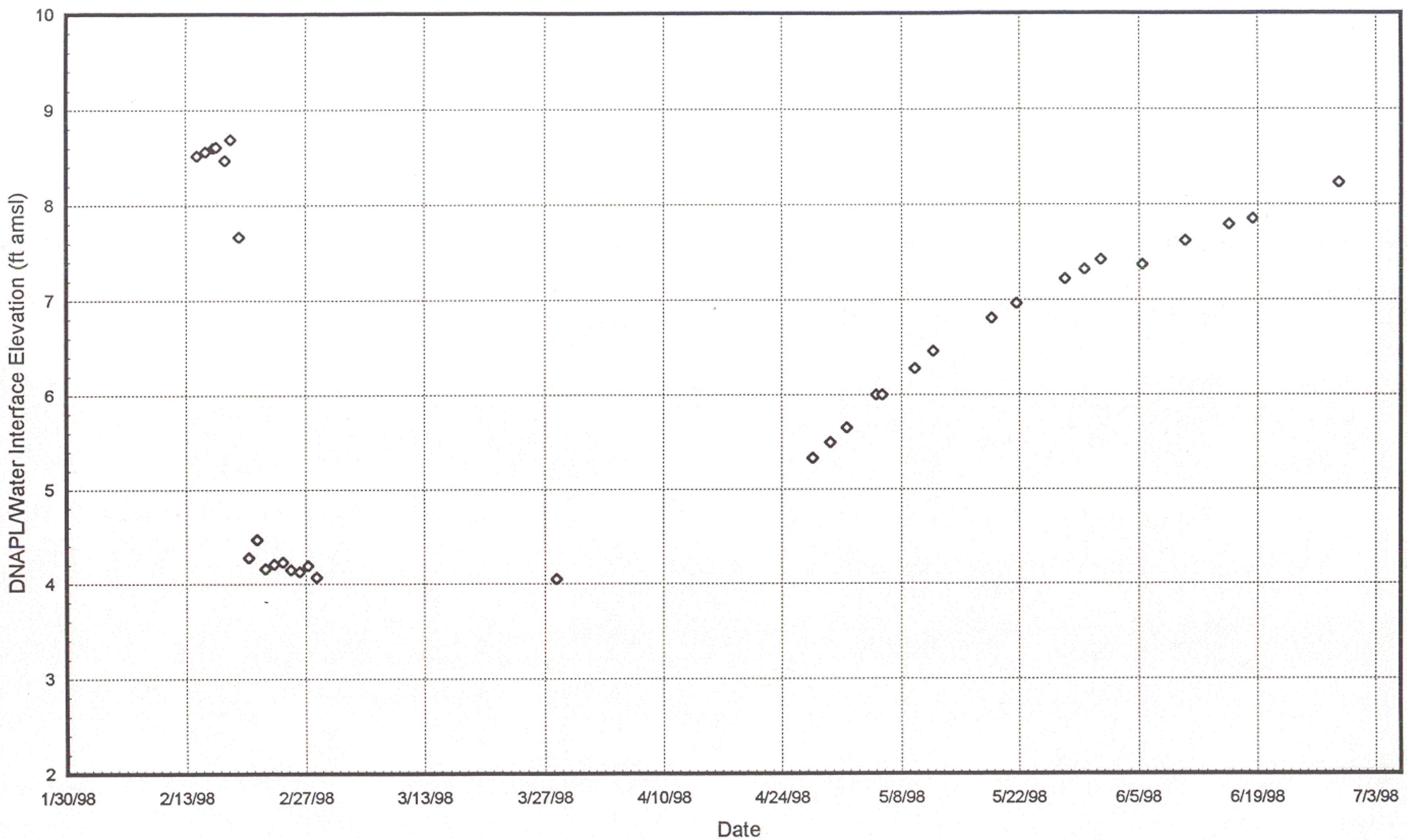
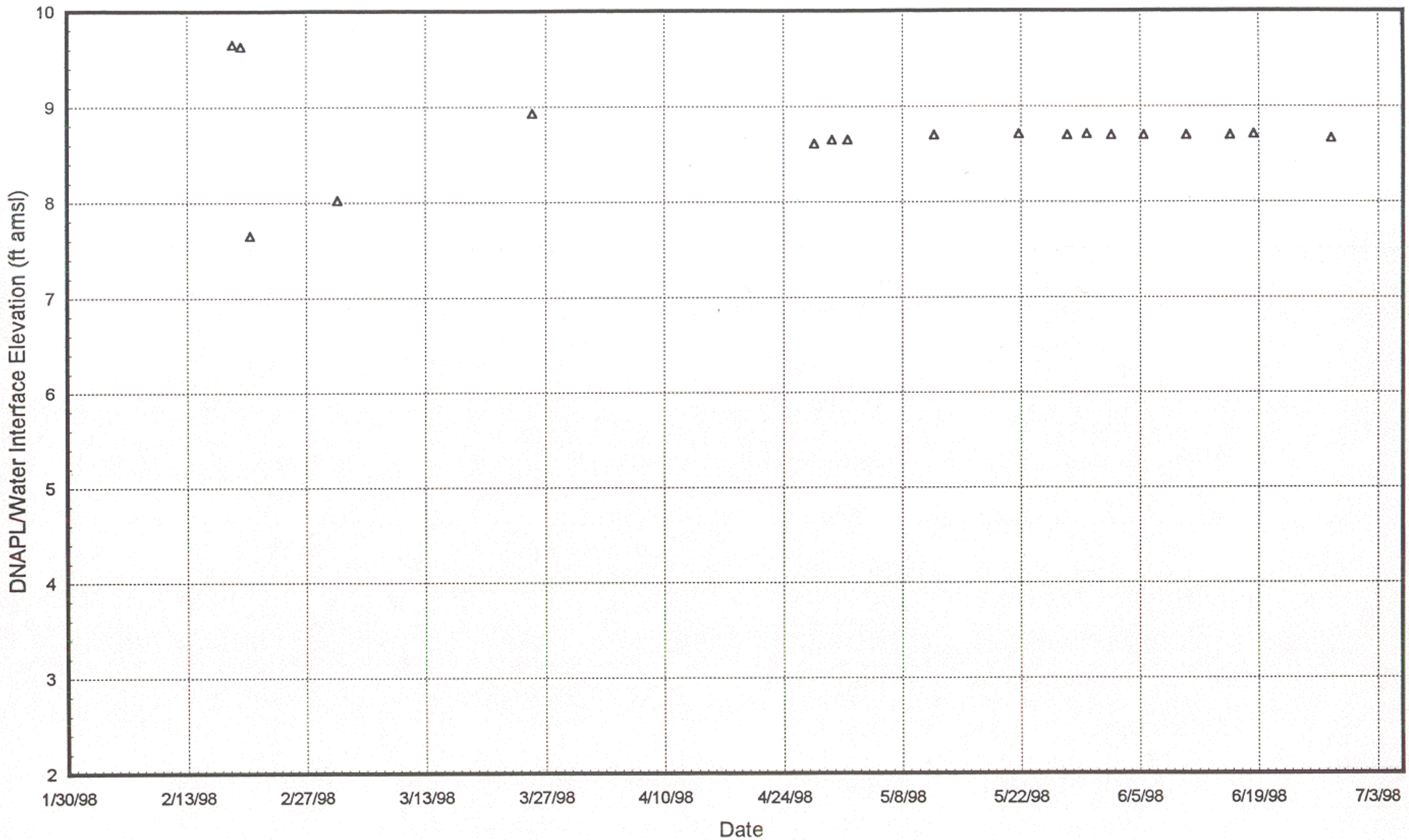


DNAPL/Water Interface Elevation During Field Operations in Well RW04



DNAPL/Water Interface Elevation During Field Operations in Well RW06

APPENDIX K

Laboratory Procedures for Tracer Selection and Column Tests, and the Method of Moments for Data Analysis

APPENDIX K
LABORATORY PROCEDURES FOR TRACER SELECTION AND COLUMN TESTS, AND THE METHOD OF MOMENTS FOR DATA ANALYSIS

DNAPL Density Measurement

The density of Site 88 DNAPL was measured using a pycnometer. First, the weight of the empty pycnometer was measured. The pycnometer was filled with deionized water and weighed again. The difference in weight between the dry and water-filled pycnometer was divided by the density of water under ambient conditions to calculate the volume of the pycnometer. The pycnometer was then dried, filled with DNAPL and weighed again. The difference in weight between the empty pycnometer and the DNAPL-filled pycnometer was divided by the previously determined volume of the pycnometer to calculate the density of the DNAPL - put in Appendix. This measurement was done three times to ensure repeatability. The density of the field DNAPL sample from Site 88, Camp Lejeune (from well RWO2) was 1.588 g/cm^3. This is very close to the density of pure POE (1.63 g/cm^3) which suggests that the DNAPL contained a small fraction of dissolved mineral oils and grease.

Measurement of Static Partition Coefficients

Experimental Procedures and Results

Measuring static partition coefficients involved the mixing of fixed volumes of DNAPL with water containing candidate partitioning tracer. The DNAPL-tracer-water samples were vigorously mixed and allowed to equilibrate for two days. The initial and equilibrium concentrations of the partitioning tracers in the aqueous phase were measured using a gas chromatograph (GO) with a flame ionization detector (FID). The concentration of the partitioning tracer in the DNAPL was calculated by mass balance using the following equation:

$$C_{i,DNAPL} = \frac{V_{water}}{V_{DNAPL}}\left(C^{initial}_{i,water} - C_{i,water}\right) \qquad (7.2.2\text{-}1)$$

where:

V_{water} = volume of water (cm^3)

V_{DNAPL} = volume of DNAPL (cm^3)
$C^{initial}_{1, water}$ = initial concentration of tracer ‘i’ in water (mg/L)

The experiments were repeated for a range of initial tracer concentrations in the aqueous phase. A tracer partitioning isotherm in which the variation of the tracer concentration in the DNAPL with the increase in the tracer concentration in the aqueous phase was plotted. An example calculation is shown in Figure K-I in which the partition coefficient of 4-methyl-2-pentanol for a sample of the Camp Lejeune DNAPL is determined. The slope of the best-fit line through the partitioning isotherm is the static partition coefficient, and the apparent non-linearity of the isotherm is due to the hydrophobicity of the POE. The summary of results from static partition coefficient experiments, along with the percentage uncertainty in each of the experimental measurements are given in Table K-I.

The accuracy of the experimental measurements was tested by using the equivalent alkaline carbon number approach, developed by Dwarakanath and Pope (1998) to estimate the partition coefficients. Both the measured and estimated static partition coefficients are presented in Table K-I. A close match between the measured and predicted static partition coefficients is observed, within the experimental uncertainty, suggesting that the accuracy of the partition coefficient measurements was acceptable.

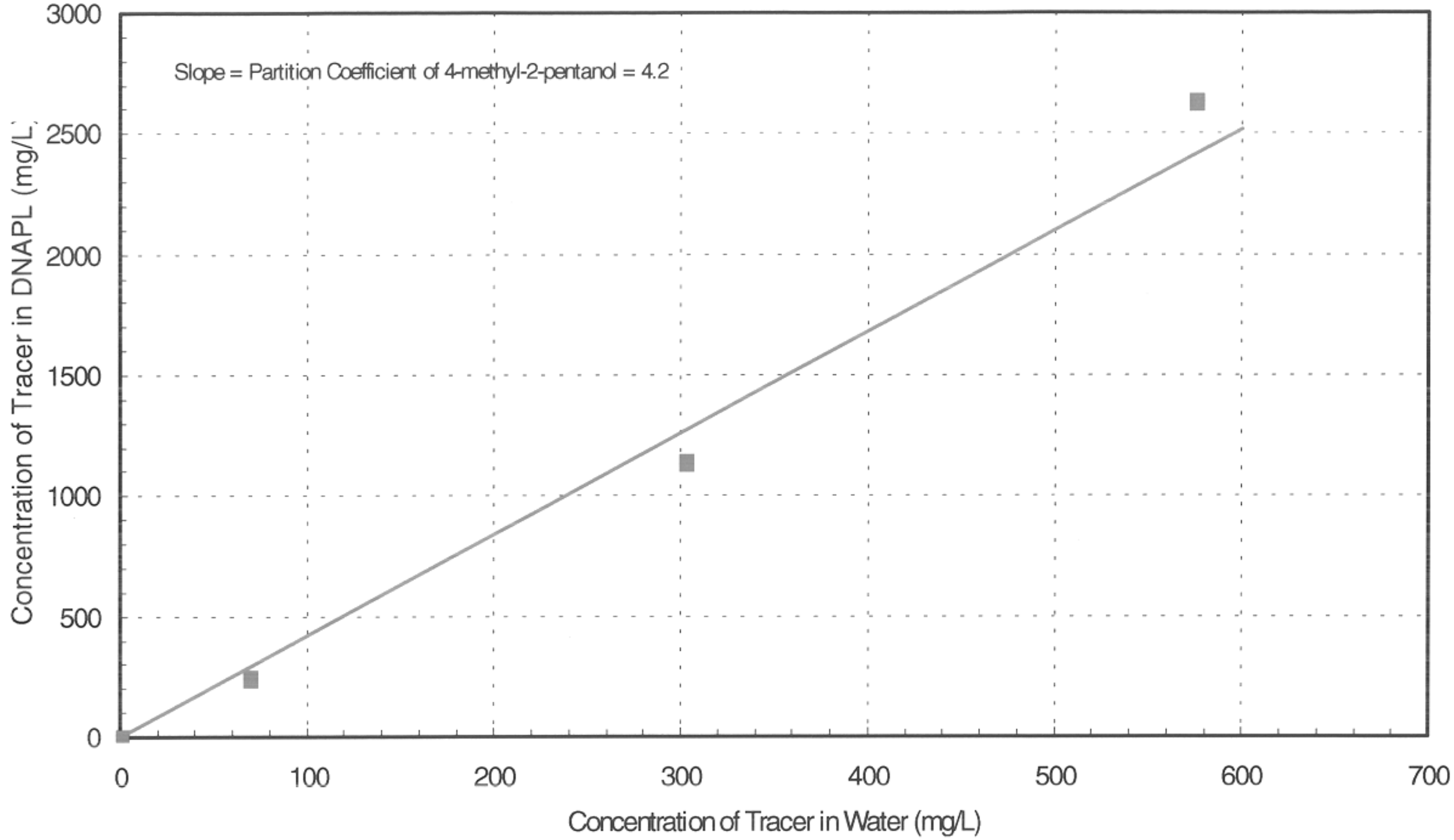
Table K-I Partition Coefficients of Alcohols with Camp Lejeune DNAPL

Alcohol	**Measured Partition Coefficient**	**% Uncertainty**	**Estimated Partition Coefficient**
1-Methoanol	0.0	?	0.1
1-Propanol	0.0	?	0.1
4-Methyl-2-Pentanol	4.2	3.8	4.4
1-Hexanol	8.1	3.6	7.6
2-Ethyl-1-Butanol	6.0	3.9	5.7
5-Methyl-2-Hexanol	24.1	8.7	24.4
1-Heptanol	35.0	9.3	34.5
2-Ethyl-1Hexanol	115	2.6	115

Soil Column Experiments

Experimental Procedures

Two different columns were used to perform the partitioning tracer experiments. Both columns were 2.21 cm in diameter and made of 304 stainless steel with specially designed end pieces. One column was 60 cm long and the other column was 30.5 cm long. Two sets of stainless steel screens were used in each of the end pieces to hold the soil in place. The first screen was a fine #150 mesh (99 μ m) screen and the second



DATE: 7/27/99	Calculation of Static Partition Coefficient
REF: TDN 307	
FILE: Fig7-1.PPT	
Duke Engineering & Services A Duke Energy Company	MCB Camp Lejeune, NC — Figure K-1

screen was a #60 mesh (250 μ m) screen. The columns were pressure tested at 100 psi (6.9 x 10^5 Pa) to ensure that the system was free of leaks. The columns were then mounted on a vibrating jig. Sediment was slowly added in increments of approximately 3-4 grams using a spatula. Particles larger than 0.5 cm in diameter were not packed into the columns. The soil column was slowly tamped down using a steel rod while the jig was vibrating. Once the column was packed, it was saturated by flushing the alluvium with 500 mL of deaired water. In the first column experiment, water containing 150 mg/L calcium chloride was used for saturating the column. permeability measurements and the initial partitioning tracer test. At the end of the first partitioning tracer test, the mobilization of large quantities of fines was observed. This was attributed to ion exchange. Hence in both the second and third soil column experiment, a solution containing a mixture of 1000 mg/L calcium chloride and 1000 mg/L sodium chloride was used in all the injection and extraction operations. Under these conditions, no visible mobilization of fines was observed.

After packing and saturating with water, each column was attached to the flow apparatus. The initial permeability of the soil column was measured by allowing water to flow through the column at different flow rates and measuring the potential across the column at these different flow rates. Darcy's Law was then applied:

$$k = \frac{Q\mu L}{A\Delta\Phi}$$

where:

k = intrinsic permeability (m^2)
Q = flow rate (m^3/sec)
μ = viscosity of the flowing fluid (N/m).
A = cross sectional area (m^2)
$\Delta\Phi$ = potential drop across the column (Pa)
L = length of the column (m)

After measuring the permeabilities, an initial partitioning tracer test was conducted in all the experiments to determine the retardation of the partitioning tracers by the uncontaminated soil. At the end of the initial partitioning tracer test, two columns were saturated with Camp Lejeune DNAPL by introducing a fixed volume of DNAPL from the bottom up. This was done to ensure stable mobilization of the water by the DNAPL. The columns were then water-flooded from the top down to remove the mobile DNAPL. A partitioning tracer test was conducted on the DNAPL-contaminated soil columns to determine the ability of the partitioning tracers to accurately estimate the volume of DNAPL. A summary of the experiments conducted and the depth interval from which the soil used to pack the columns was taken are given in Table K-2. The physical properties of all the soil columns are given Table K-3.

Table K- 2 Summary of Soil Column Experiments with Site 88 Shallow Aquifer Sediments

Column	Soil Source	Experimental Conducted
CLJ#1	Well RW01, 15'-17' bgs and IW01, 16.25'-17' bgs	Uncontaminated Soil PITT
CLJ#2	Well RW02, 13'-15' bgs	Uncontaminated Soil PITT, Contaminated Soil PITT
CLJ#3	Well RW-02m, 15'-17' bgs	Contaminated Soil PITT

Table K- 3 Summary of Soil Column Properties

Column	Length (cm)	Diameter (cm)	Porosity fraction	Permeability (X 10^{-11} cm^2)
CLJ#1	60.4	2.21	0.420	214
CLJ#2	30.2	2.21	0.424	199
CLJ#3	60.4	2.21	0.453	1455

Analysis of Partitioning Tracer Experiments by Method of Moments

Detailed information on the method of moments for the DNAPL saturation estimation can be found in Jin et al. (1995) and Jin (1995). In general, the residual DNAPL saturation can be estimated from the first moments of conservative and partitioning tracers using the following equation:

$$S_N = \frac{\bar{V}_{2} - \bar{V}_1}{(K_2 - 1)\bar{V}_1 - (K_1 - 1)\bar{V}_2}$$

where:

$$\bar{V}_i = \frac{\int_0^\infty V_i C(V_i) dV_i}{\int_0^\infty C(V_i) dV_i}$$

$C(V_i)$ = the tracer concentration expressed as a function of volume (mg/L),
V_i = the first moment of volume (cm^3),
S_N = saturation of the DNAPL,
K_1 =partition coefficient of tracer '1'
K_2 = partition coefficient of tracer '2'

To estimate the DNAPL volume accurately, the tracer response curves should be complete, but some of the information contained in the tails of the tracer response curves can be lost if tracer concentrations fall below the detection limit. However the tracer response curves can be extrapolated with an exponential function provided the experiment is long enough to establish this decline (Pope et al., 1994; Jin, i995). The first moments of the tracer curves can be obtained by dividing the data into two parts. The first part represents the data from zero to the volume V_b where it becomes exponential, and the second covers the exponential part in which it goes from V_b to infinity. After the cumulative volume V_b the tracer response is assumed to follow an exponential decline given by:

$$C = C_b e^{-(\frac{V-V_b}{a})}$$

$\frac{1}{a}$ = the slope of the straight line when the tracer response curves are plotted on a semi-log scale

C_b = the tracer concentration at the cumulative volume V_b (mg/L).

By integration of the above, the first moment can be re-derived as (Jin, 1995):

$$\bar{V} = \frac{\int_0^{V_b} VC(V)dV + a(a+V_b)C_b}{\int_0^{V_b} C(V)dV + aC_b}$$

Tracer extrapolation was significant in the analysis of experimental data from all the soil column experiments as much of the retardation was evident in the tails of the tracer curves.

APPENDIX L

DE&S Standard Operating Procedures for Br Analysis, and Monitor-Well Sampling

SOP-BR-I
February 14,1997
Revision 0

I. SCOPE AND APPLICATION

This procedure is used to ensure proper preparation, start up, monitoring, and operation of the DE&S bromide analysis method. The procedure includes methods for calibration, quality control checks, sample analysis and instrument setup.

II. PREPARATION

1. Electrodes.
   - a.) The reference electrode should contain no liquid. If it does empty the old liquid out and clean any filling solution residue that may remain. Failure to do so will result in leaks of the filling solutions and inaccurate measurements.
   - b.) Cleaning of the reference electrode can be done by rinsing with deionized water. Caution should be used to not touch the sensory ends of the electrodes. See the electrode instruction manual for specific instructions for electrode disassembly.
   - c.) The ion specific electrode needs no filling solution. The cap should be removed from the electrode and it should be rinsed with deionized water. This should be followed by buffing of the sensor end of the electrode with a polishing strip and a second rinse.
   - d.) The inside of the reference electrode should be filled with the inner solution (green) and the band replaced over the hole (or parafilm). The outer chamber should then be filled with the outer solution (KNO_3).
   - e.) The reference electrode should then be re-assembled and rinsed with deionized water.
2. Meter
   - a.) The electrodes should be plugged into the meter and the power turned on. The electrodes should be kept wet anytime the meter is on. The meter should be allowed to warm up for several minutes.
   - b.) Instructions should then be followed to program the meter as given in the meter s instruction manual:
     1. The Alarm setting should be five minutes. The reading at the sounding of the alarm should be recorded as the measured value.

III. CALIBRATION

1. Preparing Standards.
   - a.) Standards should be prepared which encompass the expected range of concentrations in the samples. A three point calibration curve should be constructed. The calibration standards should be run once a day. The r-squared value obtained from this calibration should be at least .999. The slope-intercept equation should also be determined to calculate the concentrations in the samples. This is obtained by the log of the concentration representing the x value and the mV reading representing the y value.

b.) A calibration check standard should be prepared at a low midpoint in the calibration range. This solution should be used to check the calibration for every batch and to determine the precision at the beginning of the analyses.

c.) Deionized water should be run at the beginning of each batch, before and after the calibration, and before and after the precision check. Additionally the deionized water rinse measurement should be allowed to reach a reading of at least 125 mV prior to the next analysis.

d.) All samples and standards should have ionic strength adjuster added at a concentration of ###% for $NaNO_3$, or ###% for KNO_3 prior to analysis.

IV. SAMPLES

1. Sample Selection

a.) Samples should be run for every three samples collected prior to and just after the peak. This can be extended to every four samples for the tail of the curve. A single well should be selected and the samples should be run in chronological order. All samples should have ionic strength adjuster added as prescribed in section 111.1.d.

2. Sample Batch

a.) A sample batch consists of a deionized water blank and a calibration check, followed by ten samples. The samples should be run only after the calibration check falls within +/- 20% of the average concentration, as determined by the precision checks.

b.) Once a sample is analyzed over the five minute timed interval, the meter should be turned off and the electrodes should be rinsed with deionized water and placed in a separate deionized water rinse beaker until the my reading reaches at least 125.

c.) The electrodes should then be rinsed again and BLOTTED dry with a Kimwipe. The electrodes can then be immersed in the next sample and the meter turned on. Once a reading is obtained on the meter the timer button should be reset for another five minute interval.

3. Storage

a.) At the end of a day of sampling the meter should be turned off and the electrodes stored with their tips submerged in deionized water. If no more analyses are to be performed on the given project, the reference electrode should be emptied of the filling solutions and rinsed. The ion selective electrode should be rinsed and capped. The meter should be unplugged.

This Standard Operating Procedure is concerned with the collection of valid and representative samples from ground-water monitor wells. Ground-water samples are collected and analyzed to determine the presence or absence and/or quantity of various contaminants as part of site characterization, remediation, and/or monitoring activities.

Equipment

The following list identifies the types of equipment that may be used for a range of ground-water sampling applications. A project-specific equipment list will be selected from this list, based on project objectives and well conditions.

- Bailer and/or pump
- pH meter
- Specific conductance meter
- Water-level measurement equipment
- Water-sampling data form
- Filtration apparatus (project-dependent)
- Sample shuttles
- Sample containers and laboratory-supplied preservatives (if any)
- Sample labels
- Custody seals
- Personal protective equipment
- Decontamination equipment
- Waterproof pens
- Field logbook
- Chain-of-custody forms
- Sample control logs

Water-Level Measurement

Before obtaining a water-level measurement, cut a slit in one side of the plastic sheet and slip it over and around the well, creating a clean surface onto which the sampling equipment can be positioned. This clean working area should be a minimum of 8 feet square. Care will be taken not to kick, transfer, drop, or in any way allow soil or other materials to fall onto this sheet, unless it comes from inside the well. Do not place meters, tools, equipment, etc. on the sheet unless they have been cleaned first.

After unlocking and/or opening a monitor well, the first task will be to obtain a water-level measurement. Water-level measurements will be made using an electronic measurement device.

Water-Level Measurement Procedures

- Unlock and/or open the monitor well. Enter a description of the condition of the security system and protective casing in the field logbook.
- Check for the measuring point for the well. The measuring point location should be clearly marked on the outermost casing or identified in previous sample-collection records. If no measuring point can be determined, a measuring point should be established. Typically, the top (highest point) of the protective or outermost well casing will be used as the measuring point. The measuring-point location should be described on the water-sampling data form and should be the same point used for all subsequent sampling efforts.
- To obtain a water-level measurement, lower the level indicator into the monitor well. Care must be taken to assure that the water-level measurement device hangs freely in the monitor well and does not adhere to the wall of the well casing. The water-level measuring tape will be lowered into the well until the sound and light on the electronic sounder are activated. At this time, the precise measurement should be determined (to a hundredth of a foot) by repeatedly raising and lowering the tape to converge on the exact measurement. The water-level measurement should be entered on the water-sampling data form.
- The measurement device will be decontaminated after use. Generally only that portion of the tape that enters the water table will be cleaned. It is important that the measuring tape is never placed directly on the ground surface.

Well Purging

Prior to sample collection, purging must be performed for all ground-water monitor wells to remove stagnant water from within the well casing and to ensure that a representative sample is obtained. Wells will be purged of at least three well volumes (moderate- to high-yield formations) or at least one well volume for low-yield formations.

Well casing volume is determined using the following equation:

$$V_{WC} = \frac{\pi D^2 h}{4}$$

where:	$V_W(ft^3)$	=	well volume
	D (ft)	=	internal diameter of the well casing
	h (ft)	=	length of the water column in the well casing

Well casing volumes can also be determined graphically using the information presented in Figure A.8-1.

The volume of the filter pack can be determined by calculating the volume of the portion of the borehole with one filter pack, less the casing volume.

Filter pack volume is calculated using the following equation:

$$V_{FP} = \left[\frac{\pi D^2 h}{4} - V_{WC}\right](n)$$

where:	VFP(ft3)	=	filter pack volume
	D (ft)	=	diameter of the borehole
	h (ft)	=	lesser of (a) length of filter pack, or (b) length of water column in the casing
	n	=	filter pack porosity (assume 30%)
	V_{wc} (ft3)	=	well casing volume
	Well Volume Total	=	$V_{FP} + V_{wc}$
	Conversion: $1\ ft^3$	=	7.48 gal; 1 gal = 0.134 ft^3

Indicator parameters (pH, temperature, and conductivity) will be monitored and recorded for each well volume removed. Generally, well purging will continue until the pH is within 0.2 standard units, temperature is within 1 °C, and electrolytic conductivity is within 10% of the three previous determinations. Very low-yield wells that are dry after removal of one well volume are considered purged and should be allowed to recharge for 24 hours before sampling.

Purged water will be placed in the project effluent tanker.

Well-Purging Methods

Three general types of equipment are used for well purging: bailers, surface pumps, or down-well submersible pumps.

Bailing

In many cases, bailing is the most convenient method for well purging. Bailers are constructed using a variety of materials; generally, PVC, stainless steel, and Teflon®. Care must be taken to select a specific type of bailer that suits a study's particular needs. Teflon® bailers are generally most "inert" and are used most frequently. It is preferable to use one bailer per well, but field decontamination is a relatively simple task if required.

Bailing presents two potential problems with well purging. First, increased suspended solids may be present in samples as a result of the turbulence caused by raising and lowering the bailer through the water column. High solids concentrations may require that total suspended solids (TDS) and the chemical character of solids be evaluated during sample analyses.

Second, bailing may not be feasible for wells which require that more than 20 gallons be removed during purging. Such bailing conditions mandate that long periods be spent during purging and sample collection, or that centrifugal pumps be used.

Surface Pumping

Ground-water withdrawal using pumps located at the ground surface is commonly performed with centrifugal or peristaltic pumps.

All applications of surface pumping will be governed by the depth to the ground-water surface. Peristaltic and centrifugal pumps are limited to conditions where ground water need only be raised through approximately 20 feet of vertical distance. The lift potential of a surface-pumping system will depend on the net positive suction head of the pump and the friction losses associated with the particular suction line, as well as the relative percentage of suspended particulates.

Surface pumping can be used for many applications of well purging and ground-water-sample collection. In all cases, pumping cannot be used for the collection of samples to be analyzed for volatile organic compounds (VOCs).

- *Peristaltic pumps* provide a low rate of flow, typically in the range of 0.02 to 0.2 gallons per minute (75 to 750 mI/mm). For this reason, peristaltic pumps are not particularly effective for well purging. Peristaltic pumps are suitable for purging situations where disturbance of the water column must be kept minimal for particularly sensitive analyses. Peristaltic pumps are most often used in conjunction with field filtering of samples and therefore can be used to obtain water samples for direct filtration at the wellhead.

- *Centrifugal pumps* are designed to provide a high rate of pumping, in the range of 10 to 40 gallons per minute (gpm), depending on pump capacity. Discharge rates can also be regulated somewhat, provided the pump has an adjustable throttle.

  When centrifugal pumps are used, samples should be obtained from the suction (influent) line during pumping by an entrapment scheme. Construction of this sampling scheme is relatively simple and will not be explained as part of this SOP. It is suggested that, if samples cannot be obtained from the influent line in front of the pump, they be obtained by using a bailer once pumping has ceased. Collecting samples from the pump discharge is not recommended.

- *Submersible pumps* provide an effective means for well purging, and, in some cases, sample collection. Submersible pumps are particularly useful for situations where the depth to water table is greater than 20 to ~0 feet and the depth or diameter of the well requires that a large purge volume be removed during purging.

  As with other pump-type purge/sample-collection methods, submersible pumps will not be used for the collection of samples to be analyzed for volatile organic compounds. Submersible pumps should never be used for well development, *as this can seriously damage the pump.*

Purging and Sample-Collection Procedures — Method Specific

Bailing

Obtain a clean/decontaminated bailer and a spool of polypropylene rope or equivalent bailer cord. Using the rope at the end of the spool, tie a bowline knot or equivalent through the bailer loop. Test the knot for security and the bailer itself to ensure that all parts are intact before inserting the bailer into the well.

Remove the protective wrapping from the bailer. Lower the bailer to the bottom of the monitor well and cut the cord at a proper length. Bailer rope should never touch the ground surface at any time during the purge routine.

Raise the bailer by grasping a section of cord using each hand alternately in a “rocking” action. This method requires the sampler’s hands to be kept approximately 2 to 3 feet apart and the bailer rope to be alternately looped onto or off each hand as the bailer is raised and lowered. Bailed ground water is poured from the bailer into a graduated bucket to measure the purged water volume.

For slowly recharging wells, the bailer is generally lowered to the bottom of the monitor well and withdrawn slowly through the entire water column. Rapidly recharging wells should be purged by varying the level of bailer insertion to ensure that all stagnant water is removed. The water column should be allowed to recover to 70-90% of its static volume before a sample is collected. Water samples should be obtained from midpoint or lower within the water column.

Samples collected by bailing will be poured directly into sample containers from full bailers. During sample collection, bailers will not be allowed to contact the sample container.

Peristaltic Pump

Place a new suction and discharge line to the peristaltic pump. Silicon tubing must be used through the pump head. A second type of tubing may be attached to the silicon tubing to create the suction and discharge lines. Such connection is advantageous for the purpose of reducing tubing costs, but can only be used if airtight connections can be achieved. Tygon tubing will not be used when performing well purging or collecting samples for organic analysis. The suction line must be long enough to extend to the static ground-water surface and reach further, should drawdown occur during pumping.

Measure the length of the suction line and lower it down the monitor well until the end is 2 to 5 inches below the water level in the well. Start the pump and direct the discharge into a graduated bucket.

Measure the pumping rate in gallons per minute by recording the time required to fill a selected volume of a bucket. Flow measurements shall be performed three times to obtain an average rate.

The pumping shall be monitored to assure continuous discharge. If drawdown causes the discharge to stop, the suction line will be lowered very slowly further down into the well until pumping restarts.

Measurements of pH and specific conductance will be made periodically during well purging. All readings will be entered on the Ground-Water Sample Collection Record.

Samples will be collected after the required purge volume has been withdrawn and the field parameters (pH and specific conductance) have stabilized.

When the sample bottles are prepared, each shall be filled directly from the discharge line of the peristaltic pump. Care will be taken to keep the pump discharge line from contacting the sample bottles. Ground-water samples requiring filtration prior to placement in sample containers will be placed in intermediate containers for subsequent filtration, or filtered directly.

At each monitoring point, when the peristaltic pumping has been completed, all tubing including the suction line, pump head, and discharge line must be disposed of. In some cases, where sampling will be performed frequently at the same point, the peristaltic pump tubing may be retained between each use in a clean ziplock plastic bag.

Centrifugal Pump

- *Direct Connection Method.*

  Note: this method requires that the well casing be threaded at the top.

  Establish direct connection to the top of the monitor well, if possible, using pipe connections, extensions, and elbows, with Teflon® tape wrapping on all threaded connections. If the centrifugal pump will subsequently be used for sample collection, a sample isolation chamber will be placed in the suction line configuration in front of the pump.

  Prime the pump by adding tap water to the pump housing until the housing begins to overflow.

  Start the pump and direct the discharge into a graduated bucket or a bucket of known capacity (> 2.5 gallons).

Start the pump and measure the pumping rate in gallons per minute by recording the time required to fill the graduated bucket. Flow measurement should be checked periodically to determine if pumping rates are continuous, fluctuating, or diminishing. If discharge stops, the pump will be throttled back to determine if pumping will restart at a lower rate. If pumping does not restart, the pump should be shut off to allow the well to recharge.

Measurements of pH and specific conductance will be made periodically during well purging. All readings will be entered on the Ground-Water Sample Collection Record. Samples will be collected after the required purge volume has been withdrawn and the field parameters (pH and specific conductance) have stabilized. Samples should be collected from an in-line discharge valve. The pump should be properly decontaminated between wells.

- *Down-Well Suction-Line Method*

  Lower a new suction line into the well. The suction line will have a total length great enough to extend to the water table and account for a minimum of 5 feet of drawdown. It should be noted that the pump may draw the water in the well down to the depth where pumping will terminate as a result of a limitation derived from the lift potential of the pump. All connections should be made using Teflon® ferrules and Teflon® thread wrapping tape. Run the pump as for the direct connection method described above.

  At each monitor well, when use of a centrifugal pump is complete, all suction line tubing should be disposed of properly.

Submersible Pump

Before using a submersible pump, a check will be made of well diameter and alignment, if deemed necessary, a decontaminated cylindrical tube of the proper diameter should be lowered to the bottom of each monitor well to determine if the alignment or plumbness of a well is adequate to accommodate the submersible pump. All observations will be entered in the Ground-Water Sample Collection Record.

Slowly lower the submersible pump into the monitor well, taking notice of any roughness or restrictions within the riser. Stop lowering the pump when the stainless-steel motor is approximately 3 feet above the bottom of the monitor well. Secure the discharge line and power cord to the well casing.

Connect the power cord to the power source (e.g., rechargeable battery pack or auto battery monitor) and turn the pump on (forward mode). When running, the pump can usually be heard by listening near the well head.

The pump manufacturer's specified operating voltage and amperage ratings should be noted and verified, and voltage and amperage meter readings on the pump discharge should be checked continuously. The voltage reading from battery-powered pumps will decline slowly during the course of a field day, representing the use of power from the battery. Amperage readings will vary, depending on the depth to water table. Above-normal amperage readings usually indicate a high solids content in the ground water, which may cause pump clogging and serious damage. If a steady increase in amperage is observed, the pump should be shut off, allowed to stop, switched to the reverse mode, stopped again, and then placed in forward mode. If high amperage readings persist, the pump should be withdrawn and checked using an upright cylinder (e.g., a drum) and tap water. Ground-water conditions such as high solids may require that an alternate purge/sample method be used.

Drawdown must also be monitored continuously by remaining near the well at all times and listening to the pump. When drawdown to the pump intake occurs, a metallic rotary sound will be heard as the pump intake becomes exposed and ceases to discharge water, but continues to run. The pump should be lowered immediately to continue pumping water within the uppermost section of the static water column. *NOTE: the submersible pump cannot be allowed to run while not pumping, or the pump moror will burn out.*

If drawdown continues to the extent that the well may be pumped dry, the discharge rate of the pump can be reduced to slow the rate of drawdown. Care should be taken to avoid cutting the pump back below its minimum operating standard. If drawdown is such that the well is still pumped dry, the pump should be shut off and the well allowed to recharge. This on/off cycle may need to be repeated several times to purge the well properly.

Measurements of the pumping rate, pH, and specific conductance should be made periodically during well purging. All readings and respective purge volumes should be entered on the Ground-Water Sample Collection Record.

Sample bottles will be filled directly from the discharge line of the pump during pumping, taking care not to touch sample bottles to the discharge line.

At each monitor well, after pumping has been completed, the pump, discharge line, and power cord shall be decontaminated according to the procedures contained in *Standard Operating Procedures, Decontamination.*

Sample Collection Procedures — Method Independent

- Samples intended for volatile organic analysis should be collected first. Sample containers should be filled quickly and smoothly to avoid agitation, aeration, and loss of volatile components. To further avoid loss of volatile components. samples should be filled completely so that no headspace is present, and capped securely with a Teflon®-lined lid.

- Samples for semivolatile, metal, or other analyses will be collected in the proper sample containers.

- Replicate samples will be collected when QA/OC samples are needed for volatile organic analysis (VOA). VOA samples typically consist of two sample vials, referred to as the sample set. Alternating between the primary sample set and the replicate sample set, each vial will be filled completely and capped immediately in the order shown below:

  (i) fill vial #1 - primary sample set;
  (ii) fill vial #1 - replicate sample set;
  (iii) fill vial #2 - primary sample set; and
  (iv) fill vial #2 - replicate sample set.

  Duplicate samples will be collected when QA/QC samples are required for sample analyses other than VOA. Duplicates are collected by alternately filling the sample containers as in the VOA procedure, except that containers are filled incrementally instead of completely and the filling procedure continues until the sample containers are full.

- All sample containers will be labeled with the following information:

  — project name and/or number;
  — company (DE&S);
  — field sample number;
  — initials of collector;
  — date and time of collection;
  — analysis required; and
  — sample type and preservative, if any.
  —

- Samples should be placed in the sample shuttles as soon as possible and, if required, stored and transported at <4°C (39°F), using frozen ice packs or double-bagged ice.

- The use of protective packaging will be dictated by the mode of transport.

- Sample information will be recorded in the field logbook and on the sample control log as soon as possible after sample collection.

- Chain-of-custody forms will be completed and placed in the sample shuttle for shipment to the laboratory.

- Custody seals will be placed across sample shuttle lids so that sample shuttles cannot be opened without breaking the custody seal. Custody seals will contain the following information:

  — collector's signature or initials; and
  — date of sampling.

- Samples will be shipped to the laboratory for analysis, carefully observing all minimum holding-time requirements for degradable constituents.

APPENDIX M

PITT Flow Rates and Cumulative Volume Water Levels

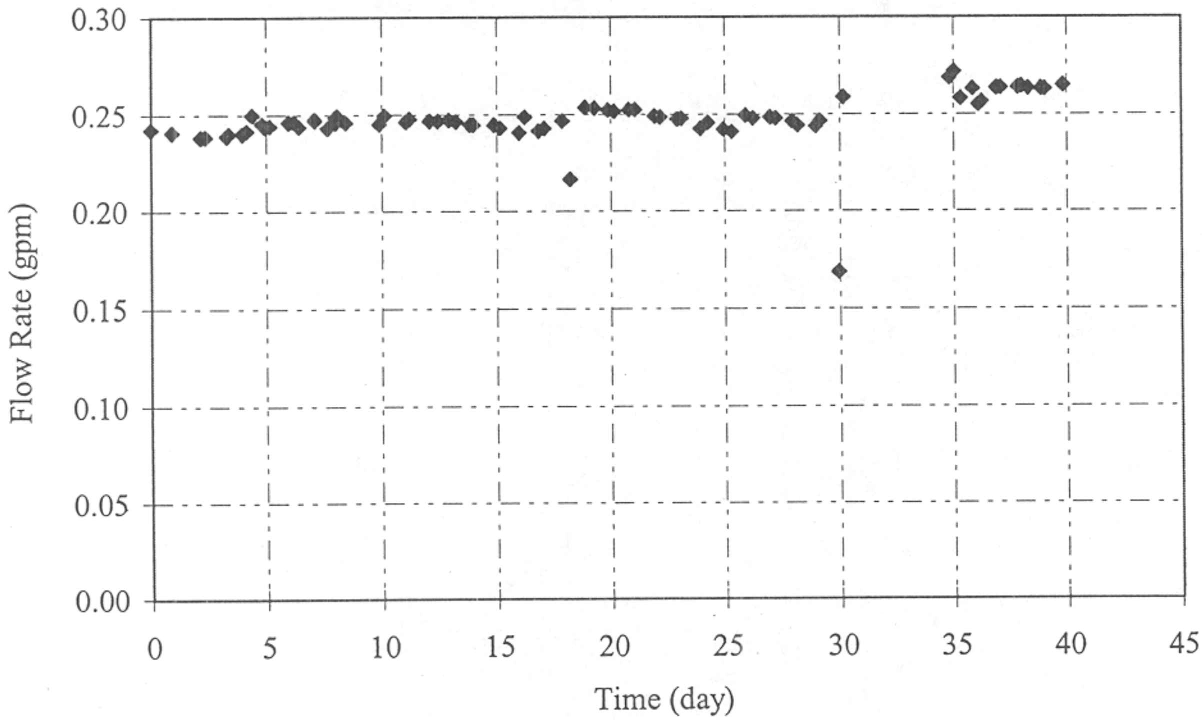


Figure M-1 Extaction well EX01 flow rate as a function of time

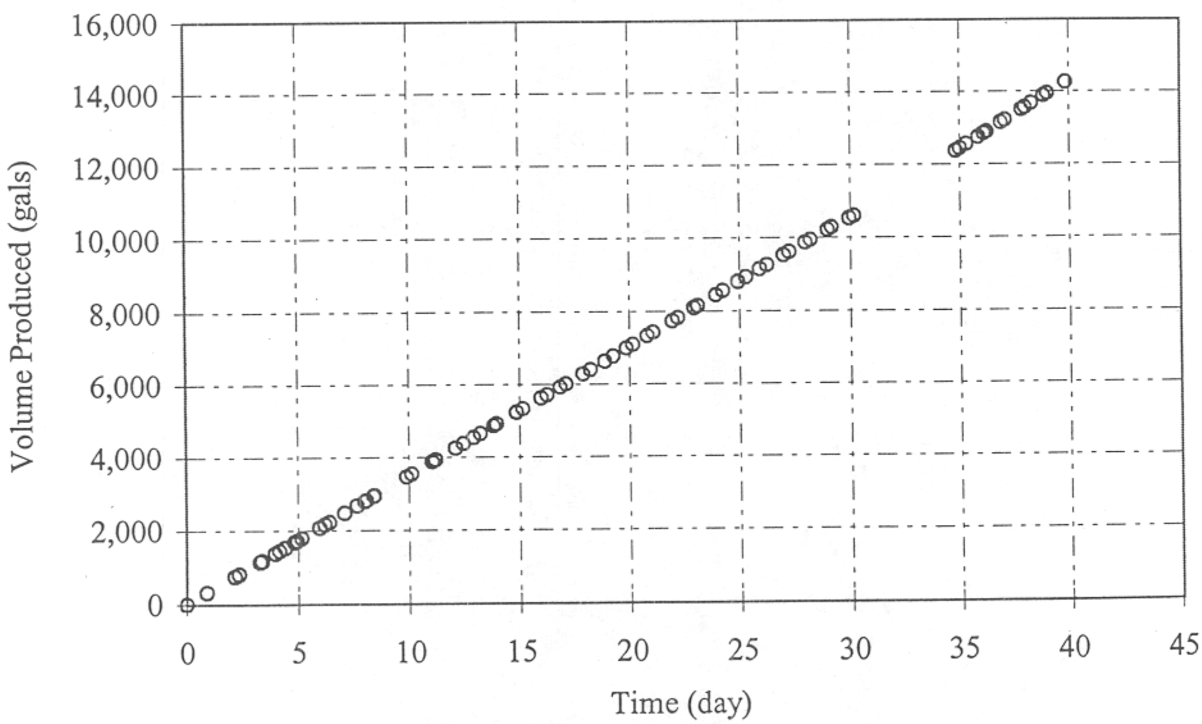


Figure M-2 Extaction well EX01 cumulative volume produced as a function of time

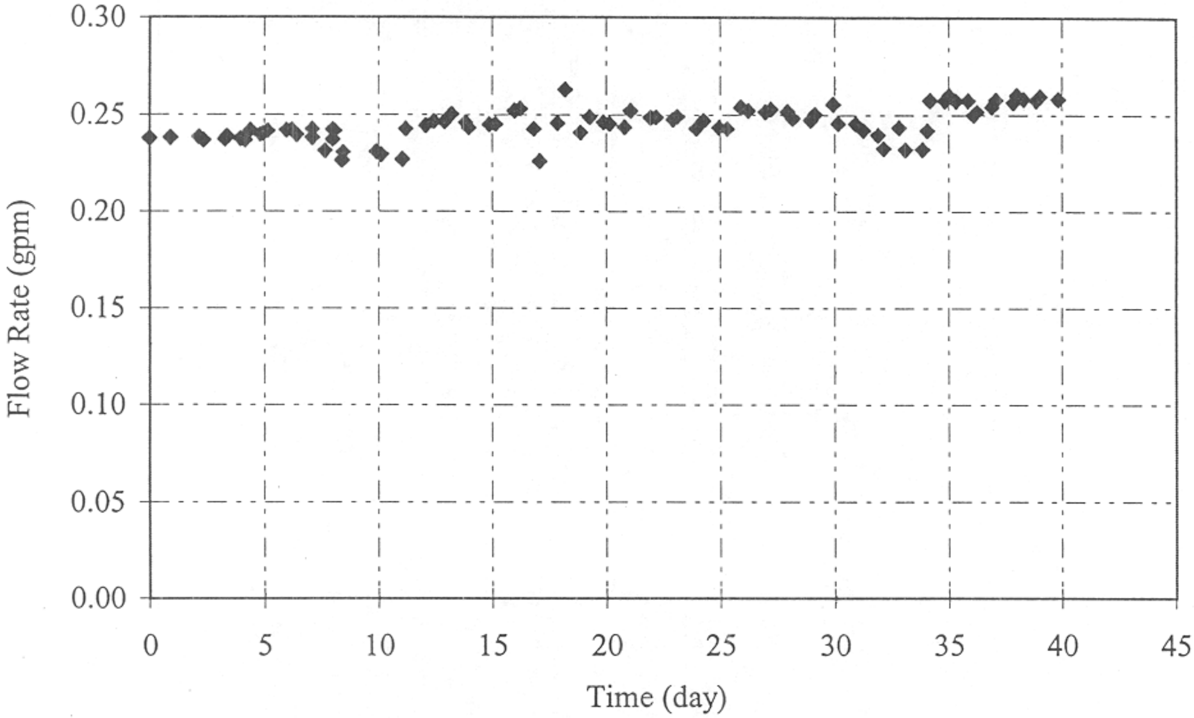


Figure M-3 Extraction well EX02 flow rate as a function of time

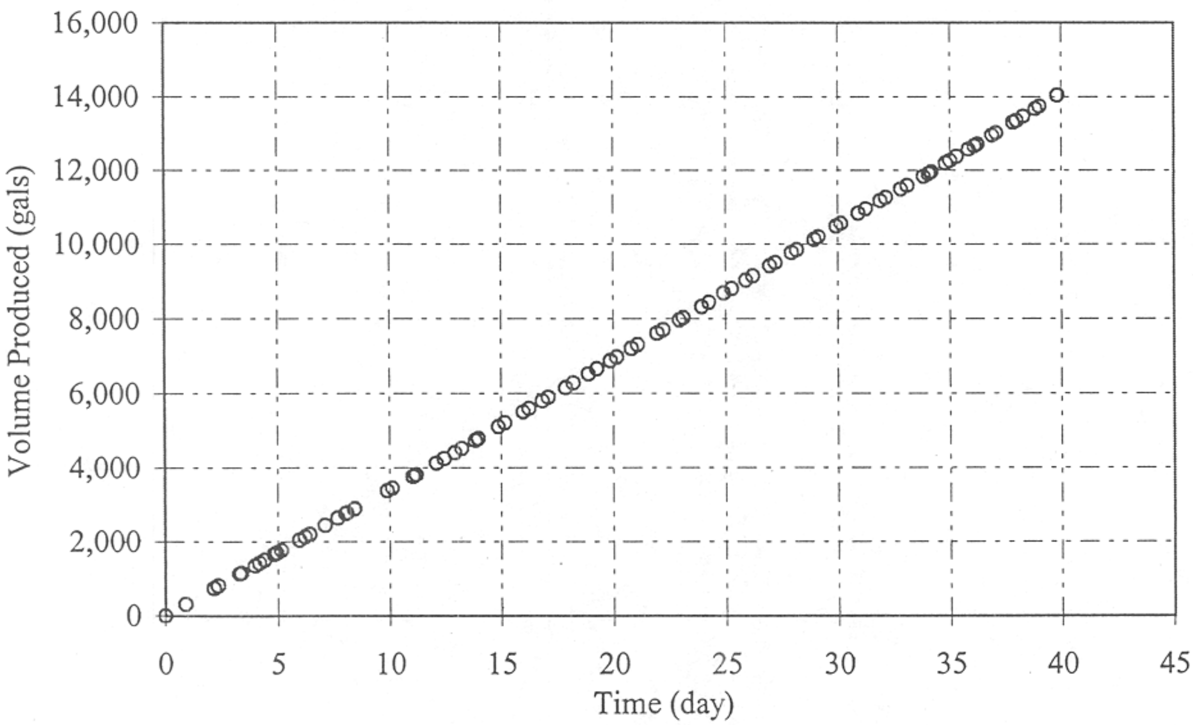


Figure M-4 Extraction well EX02 cumulative volume produced as a function of time

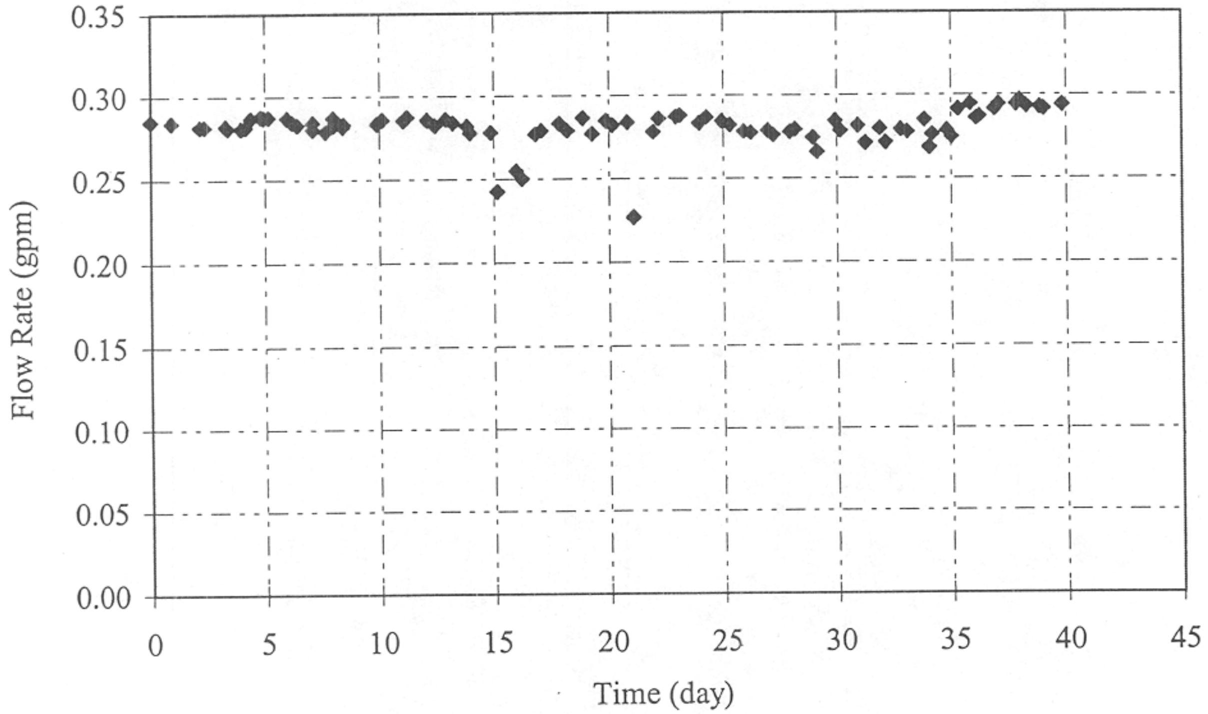


Figure M-5 Extraction well EX03 flow rate as a function of time

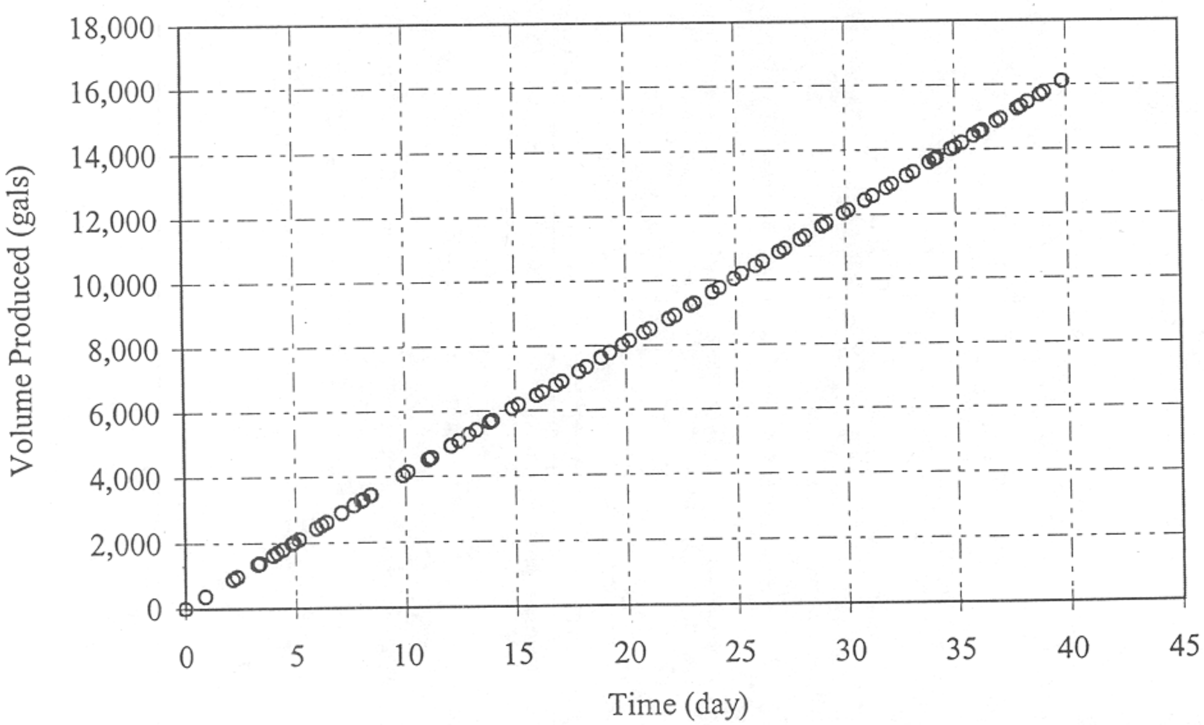


Figure M-6 Extraction well EX03 cumulative volume produced as a function of time

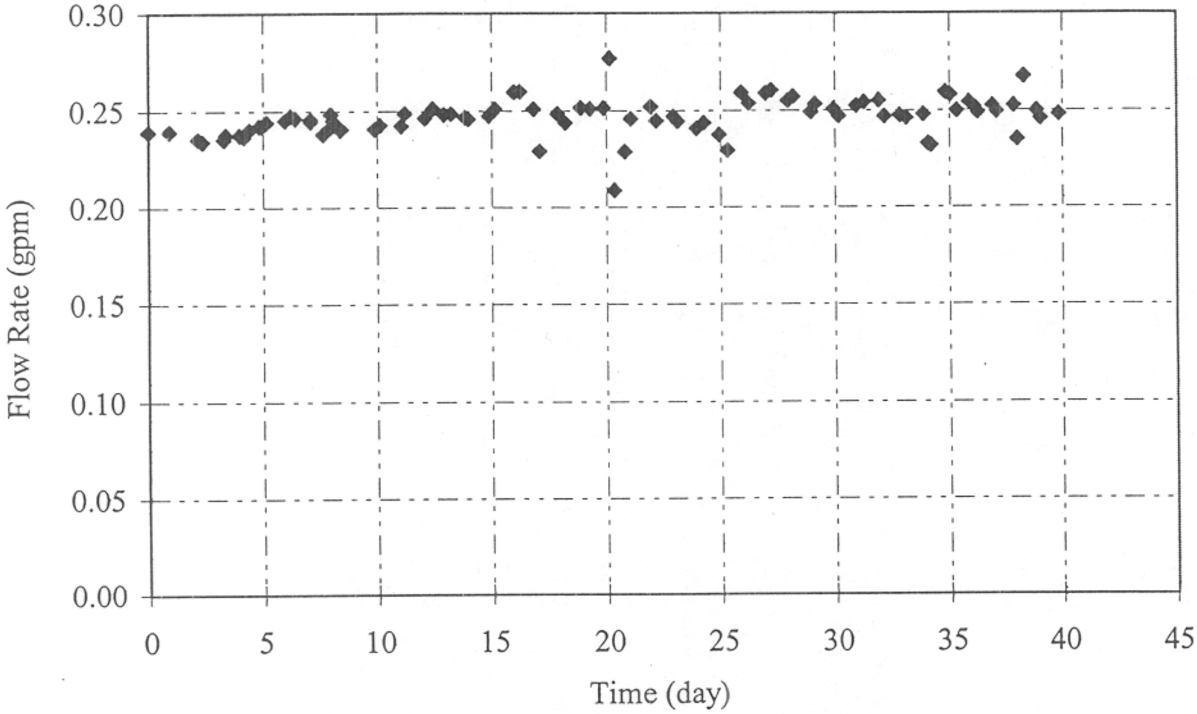


Figure M-7 Extraction well EX04 flow rate as a function of time

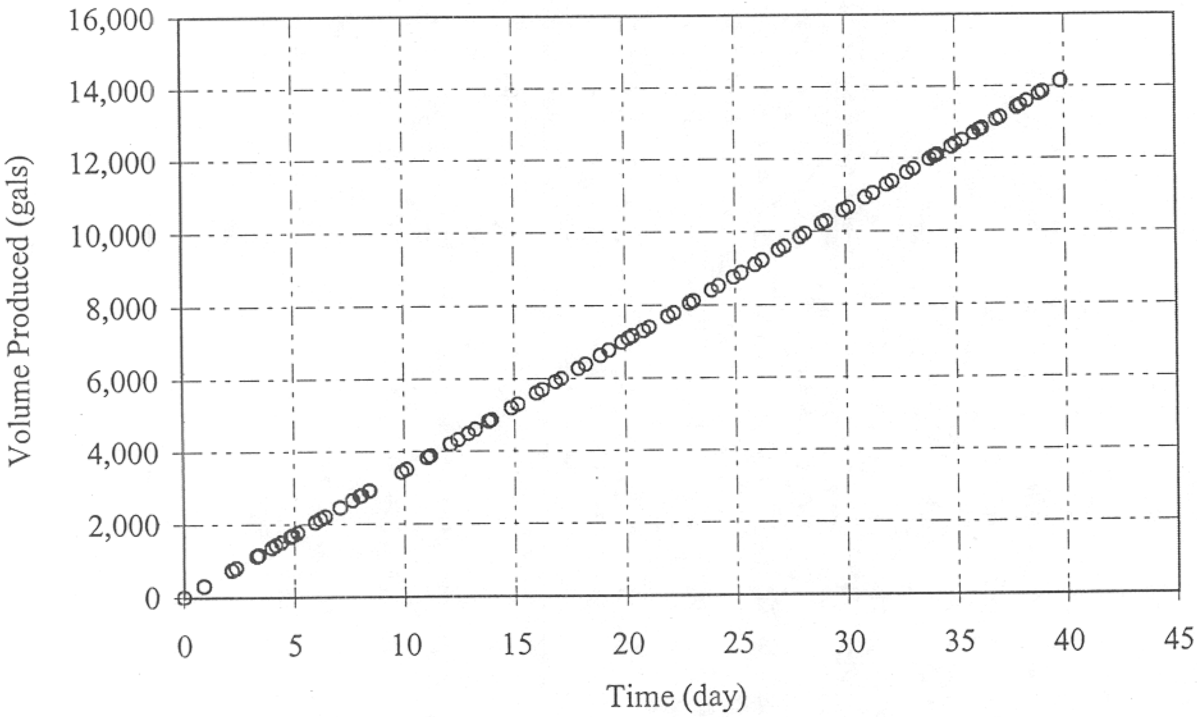


Figure M-8 Extraction well EX04 cumulative volume produced as a function of time

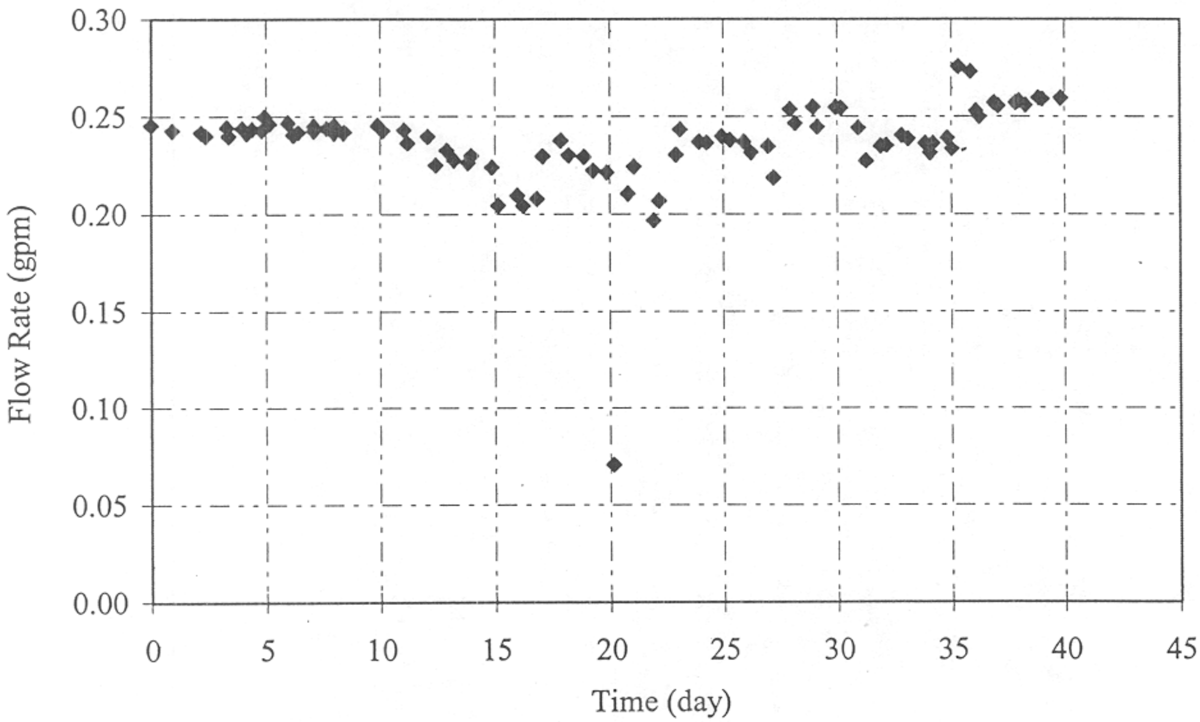


Figure M-9 Extraction well EX05 flow rate as a function of time

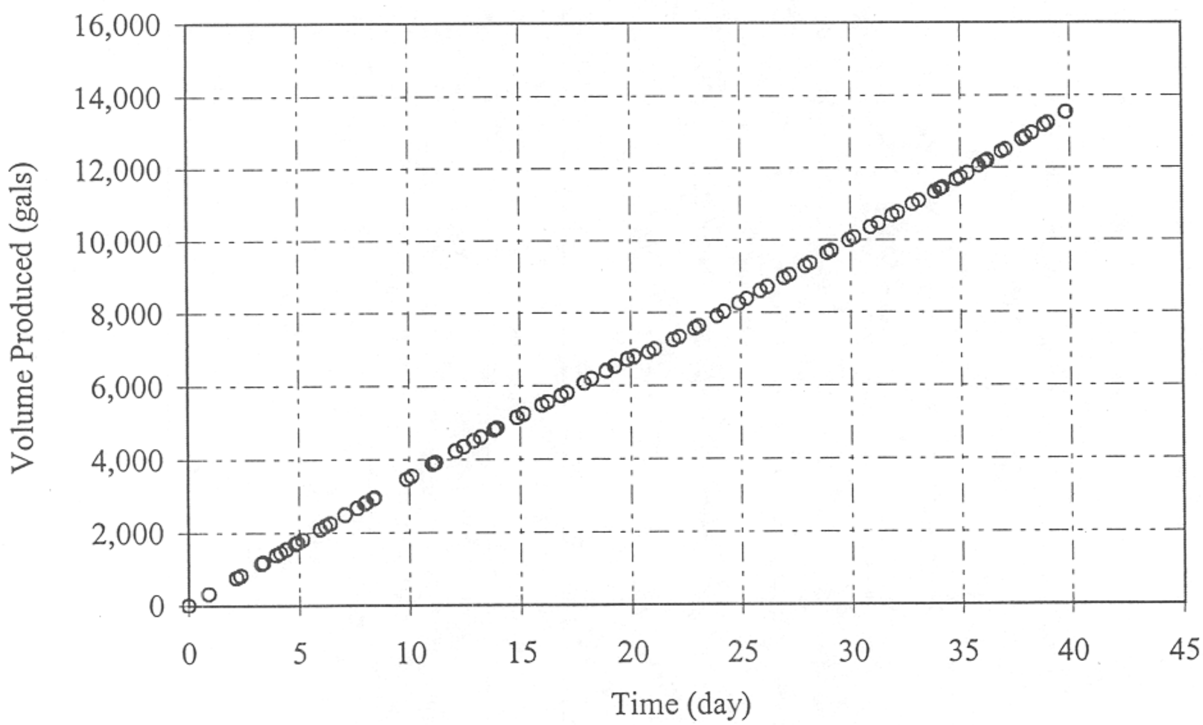


Figure M-10 Extraction well EX05 cumulative volume produced as a function of time

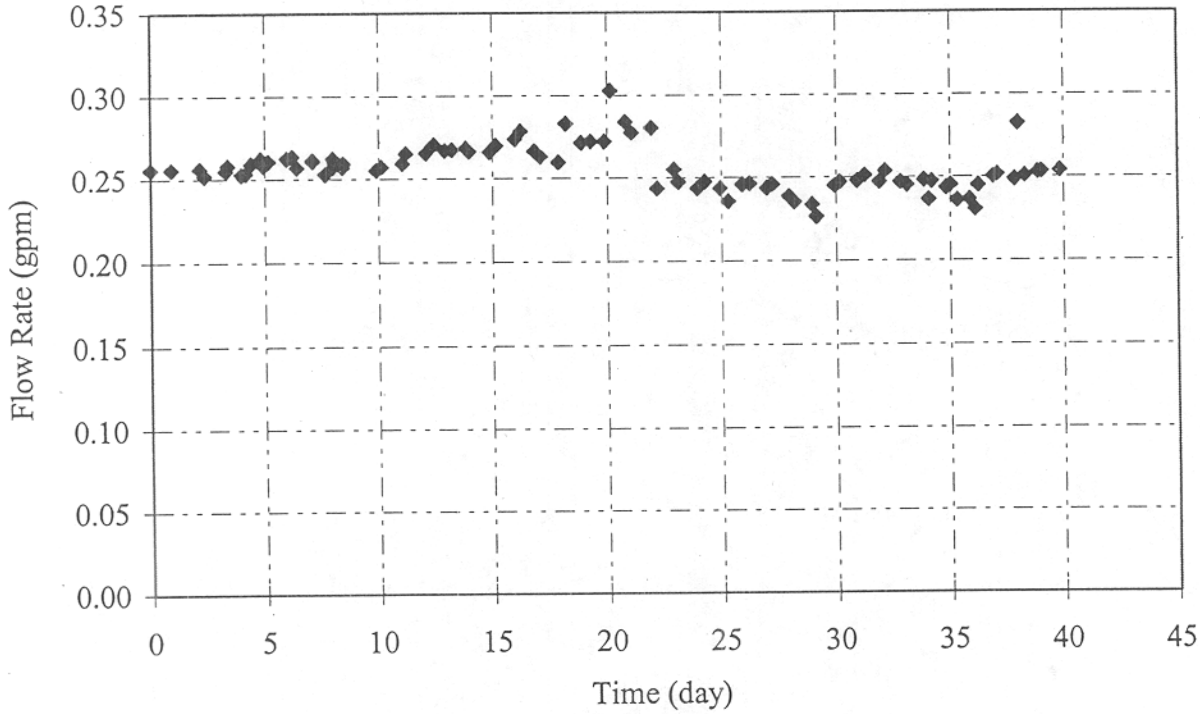


Figure M-11 Extraction well EX06 flow rate as a function of time

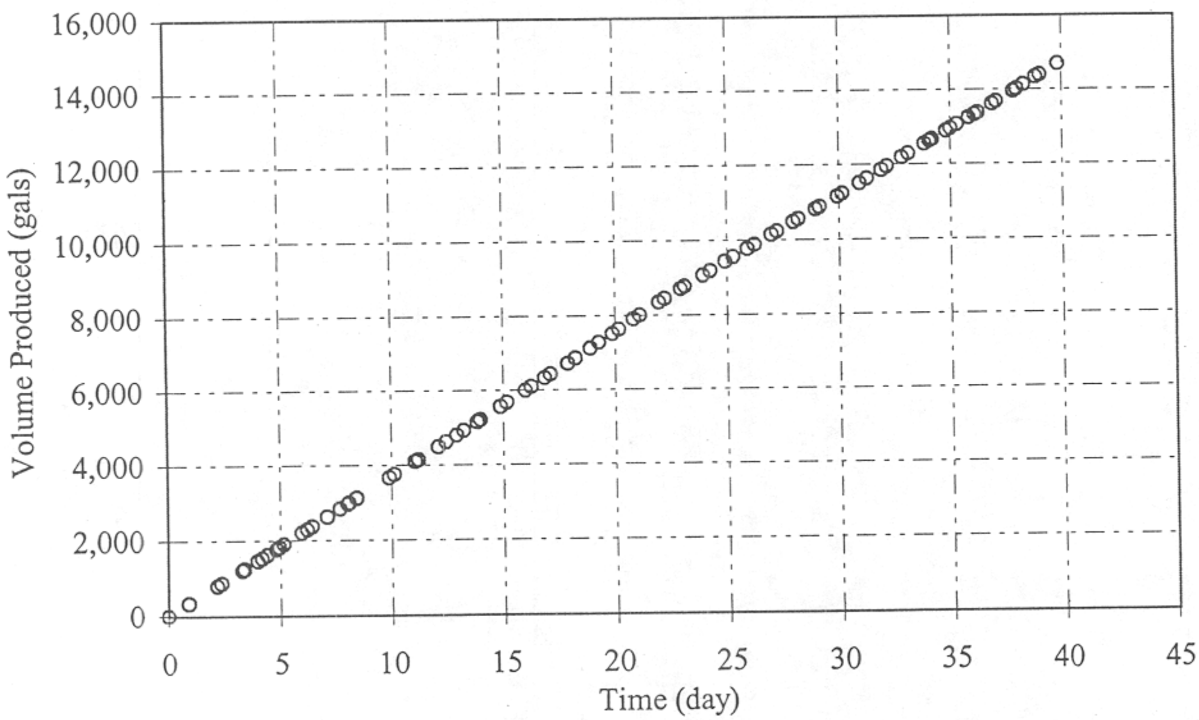


Figure M-12 Extraction well EX06 cumulative volume produced as a function of time

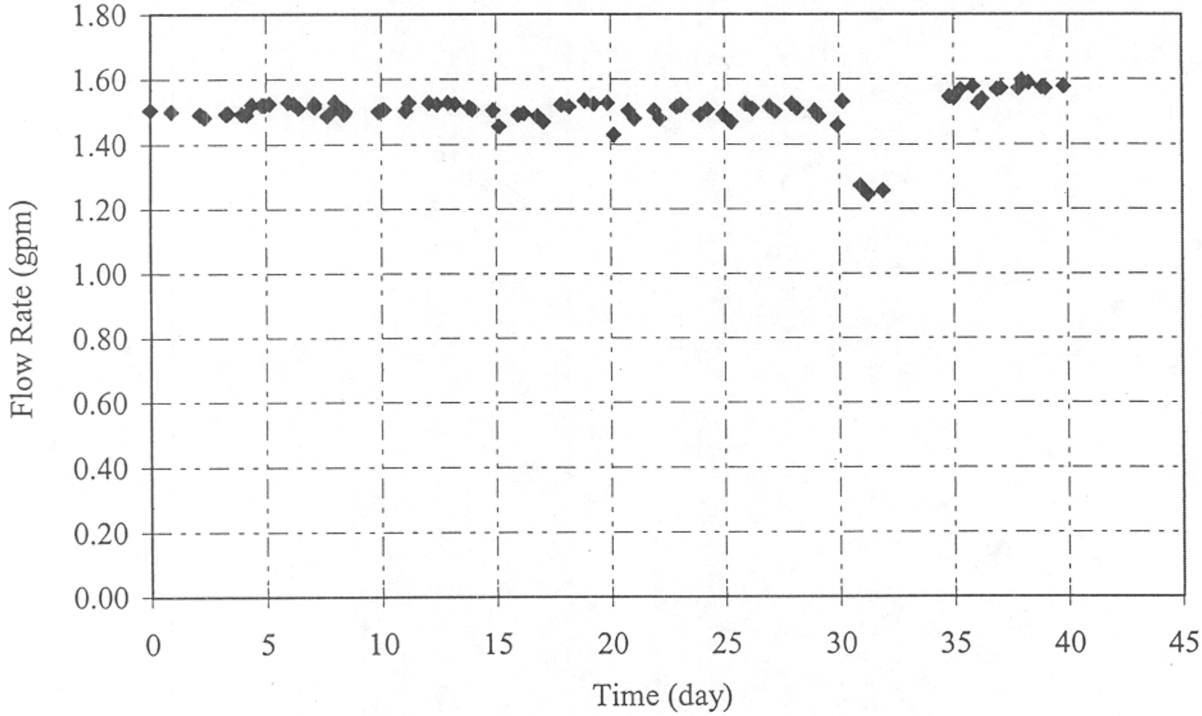


Figure M-13 Total extraction well flow rate as a function of time (sum of all EX flow rates)

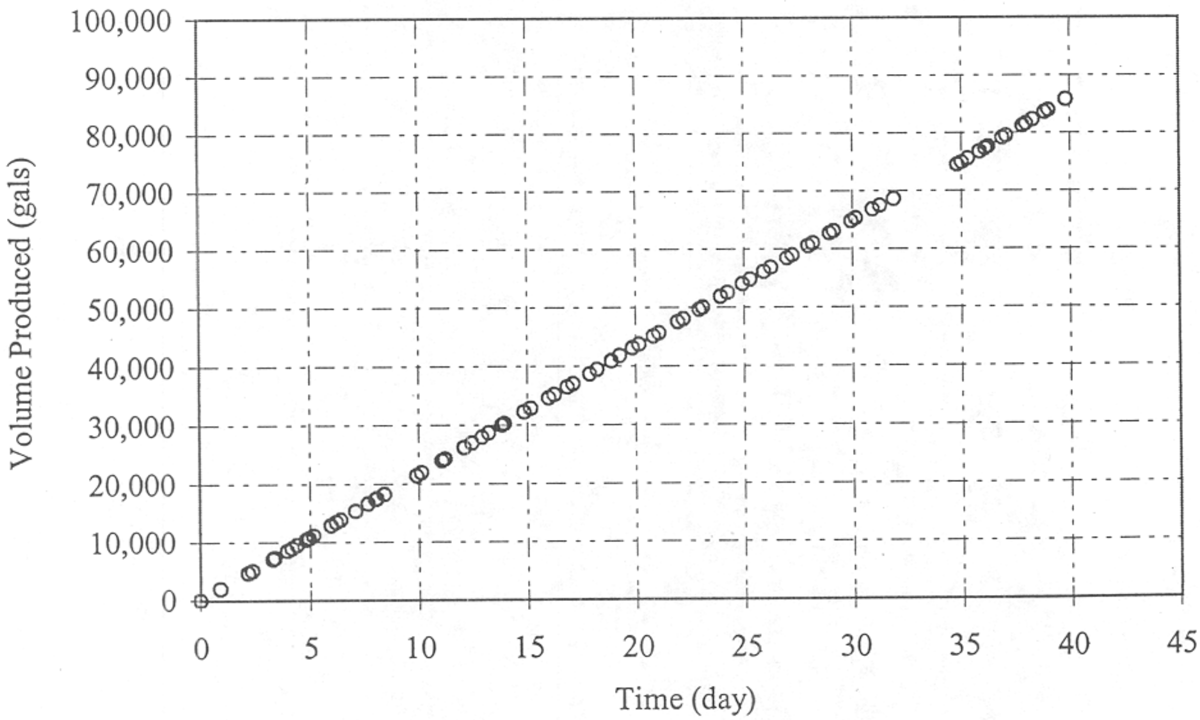


Figure M-14 Total extraction well cumulative volume produced as a function of time

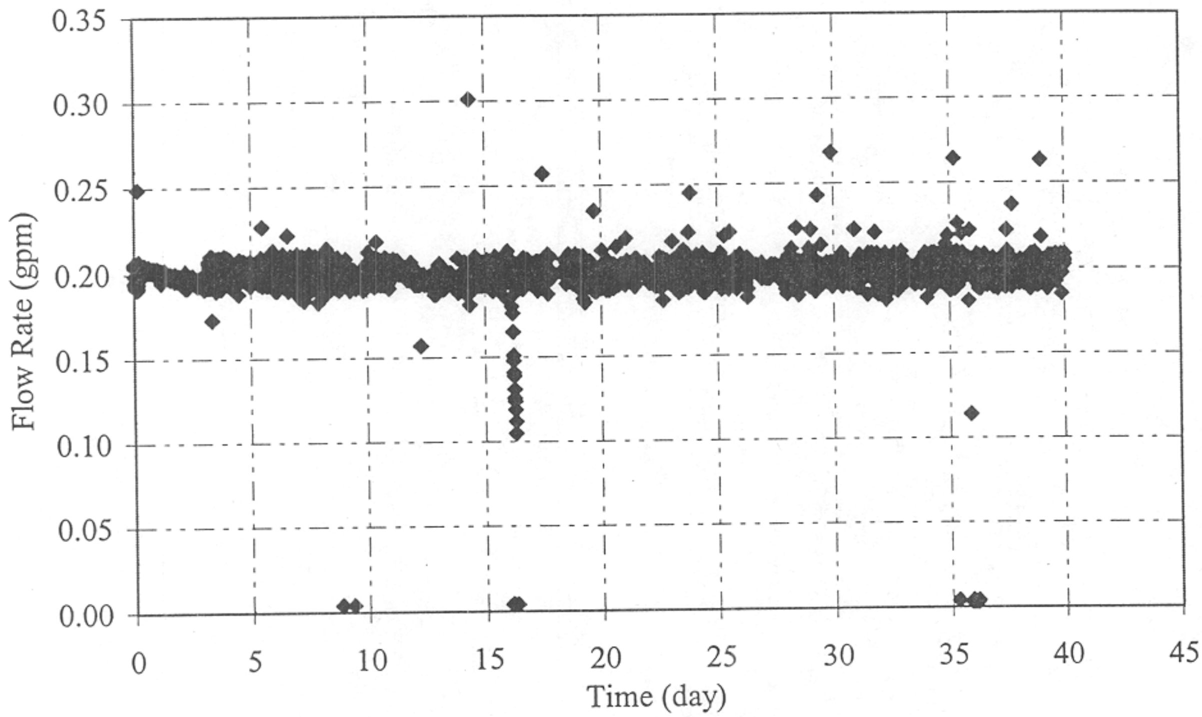


Figure M-15 Injection well IN01 flow rate as a function of time

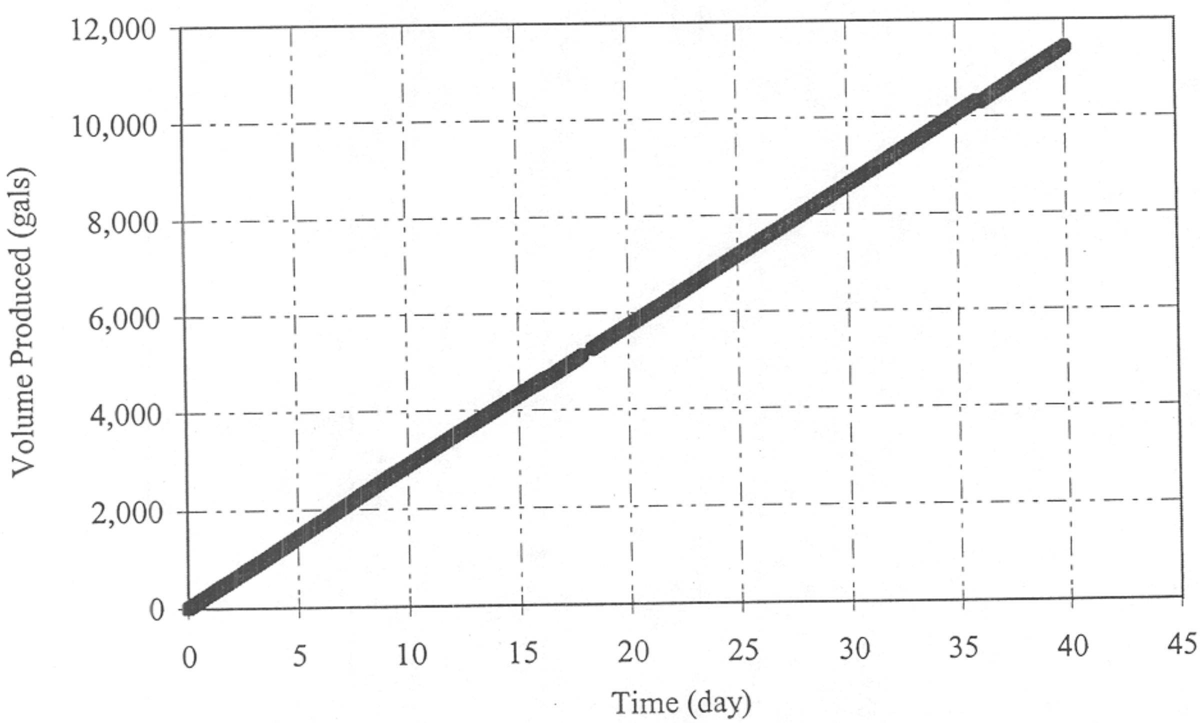


Figure M-16 Injection well IN01 cumulative volume injected as a function of time

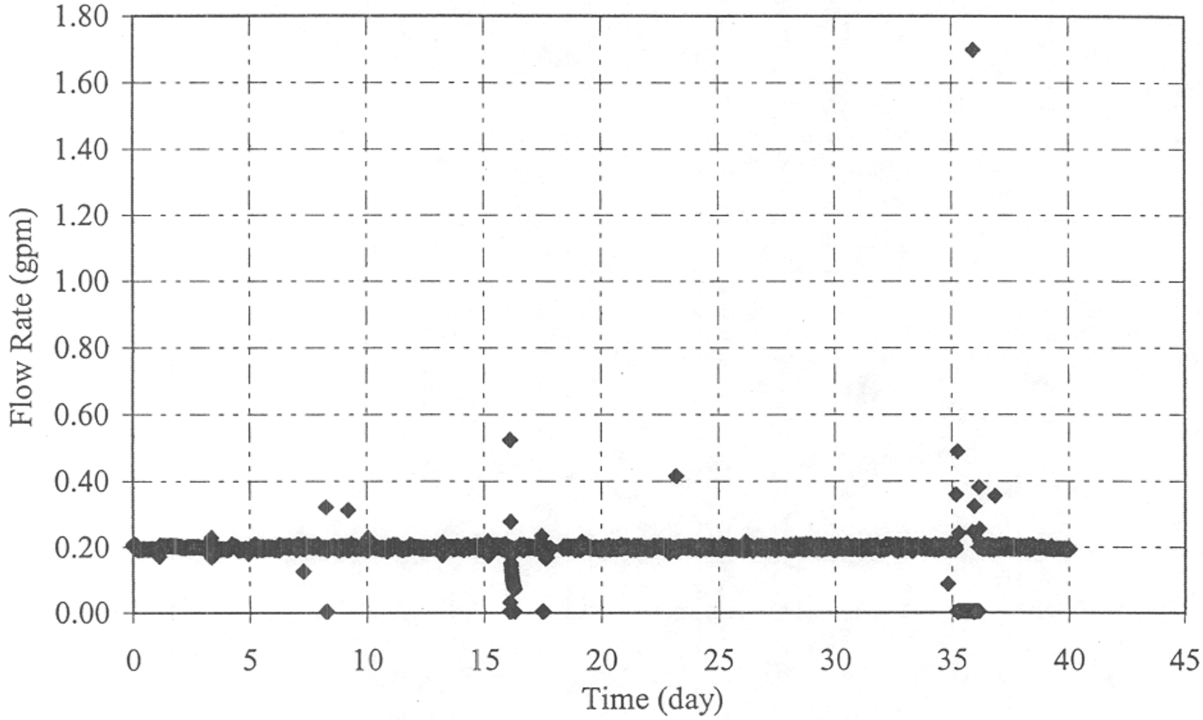


Figure M-17 Injection well IN02 flow rate as a function of time

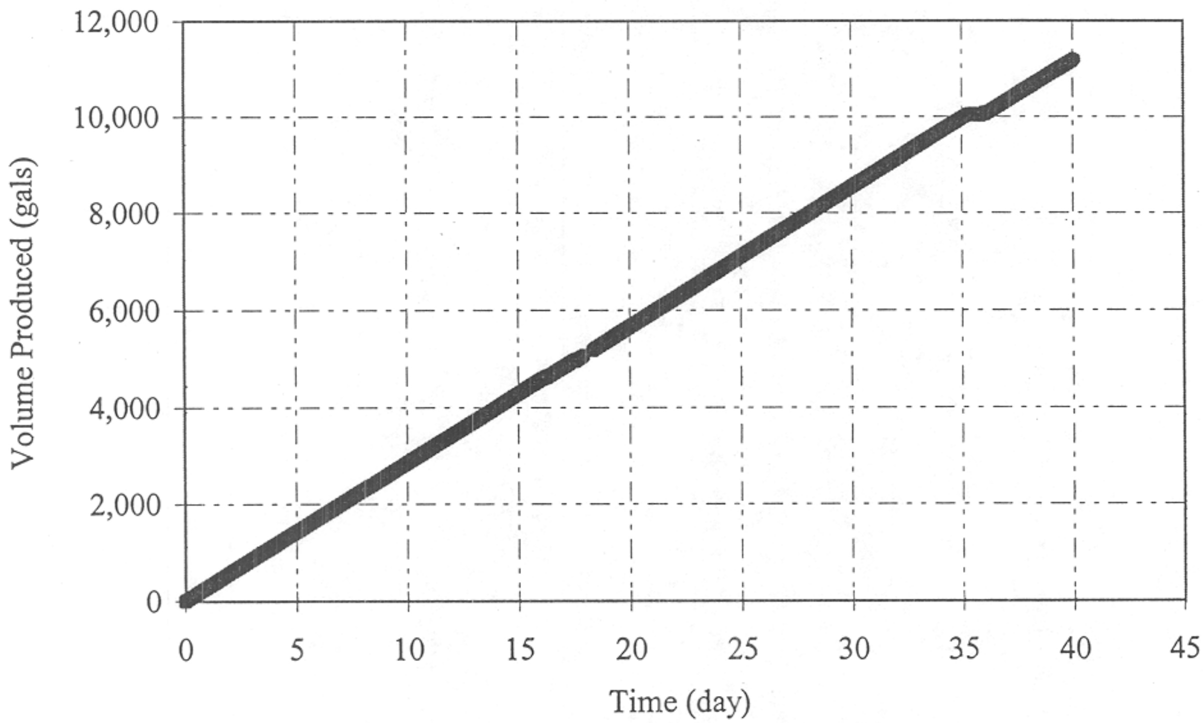


Figure M-18 Injection well IN02 cumulative volume injected as a function of time

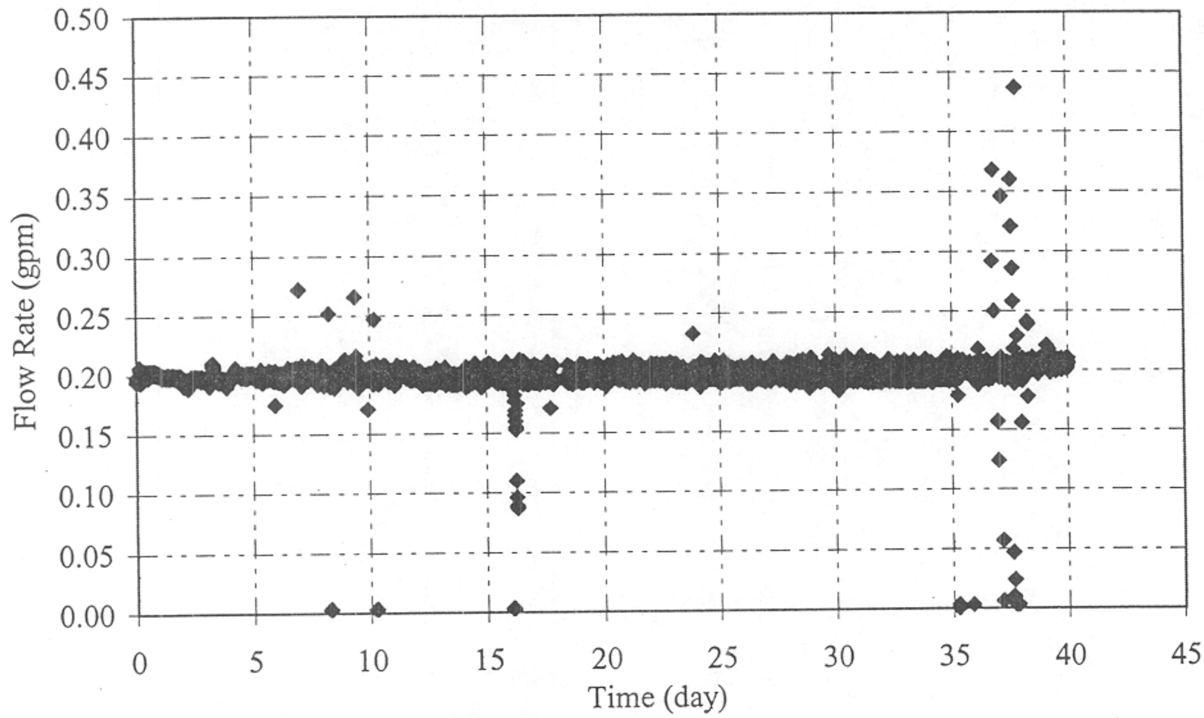


Figure M-19 Injection well IN03 flow rate as a function of time

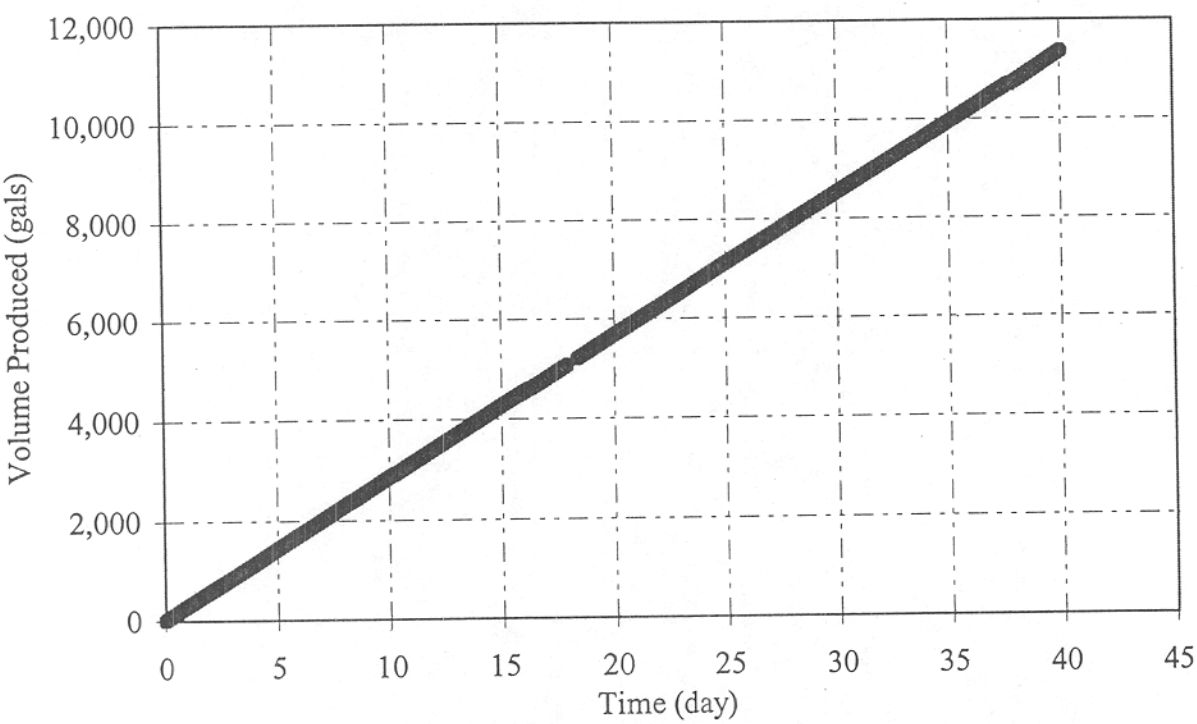


Figure M-20 Injection well IN03 cumulative volume injected as a function of time

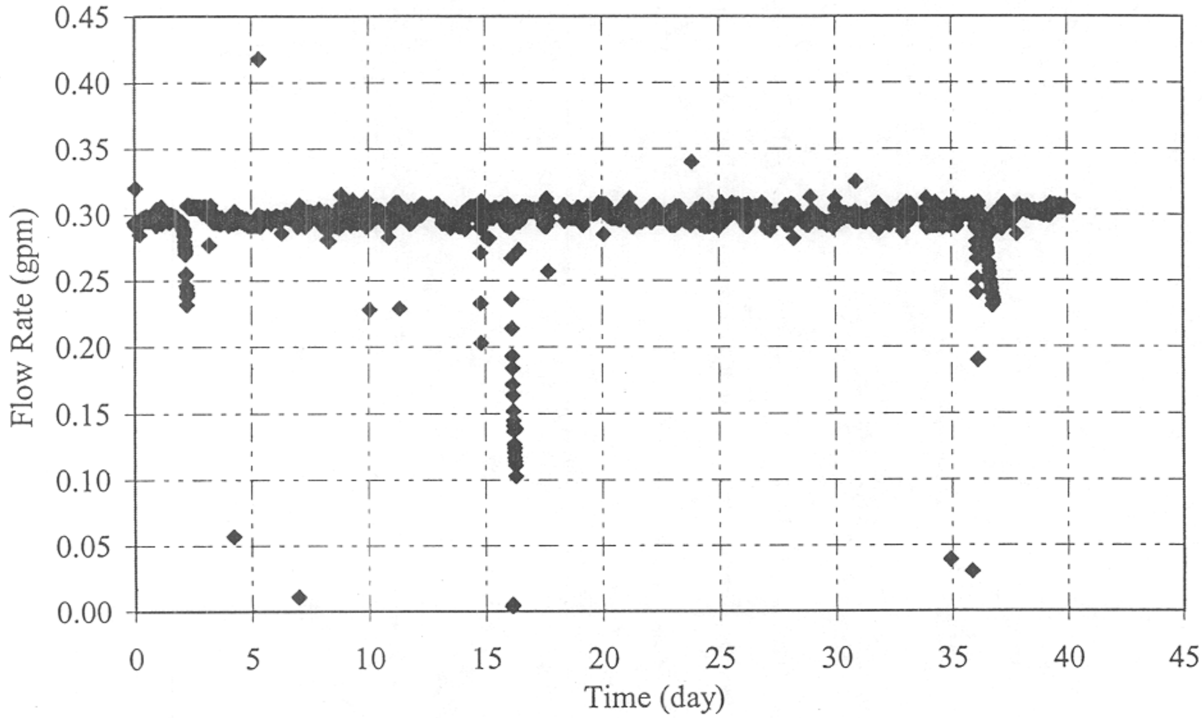


Figure M-21 Hydraulic control well HC01 injection flow rate as a function of time

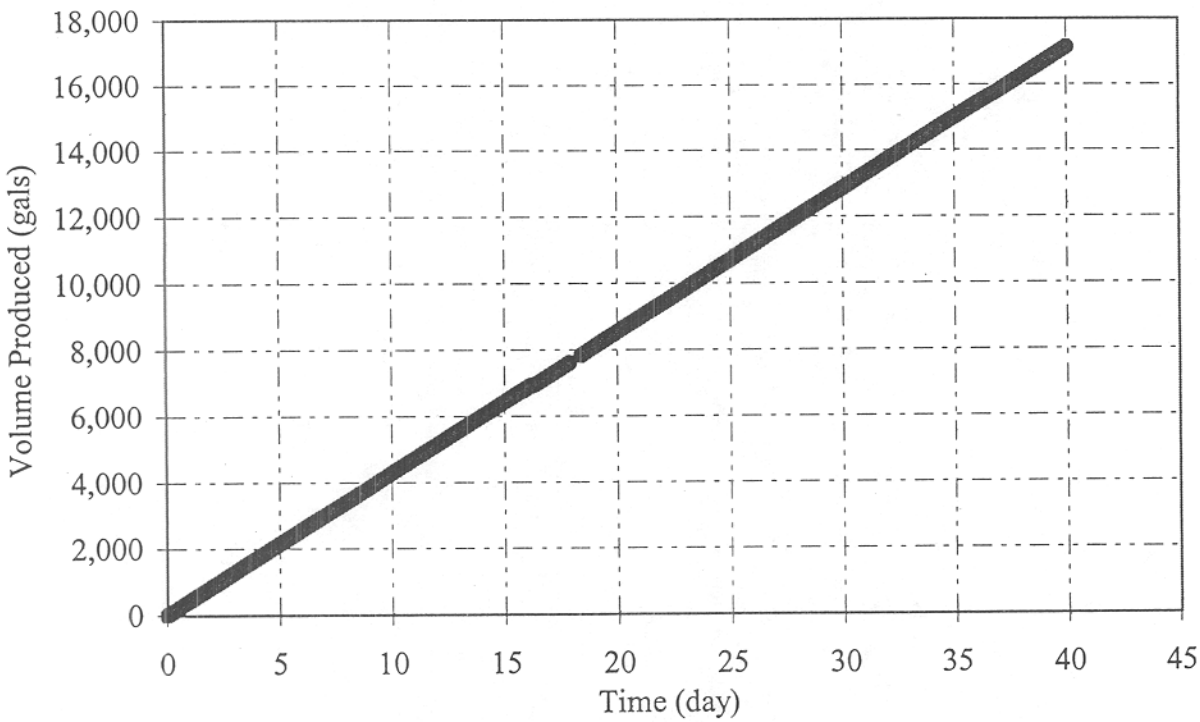


Figure M-22 Hydraulic control well HC01 cumulative volume injected as a function of time

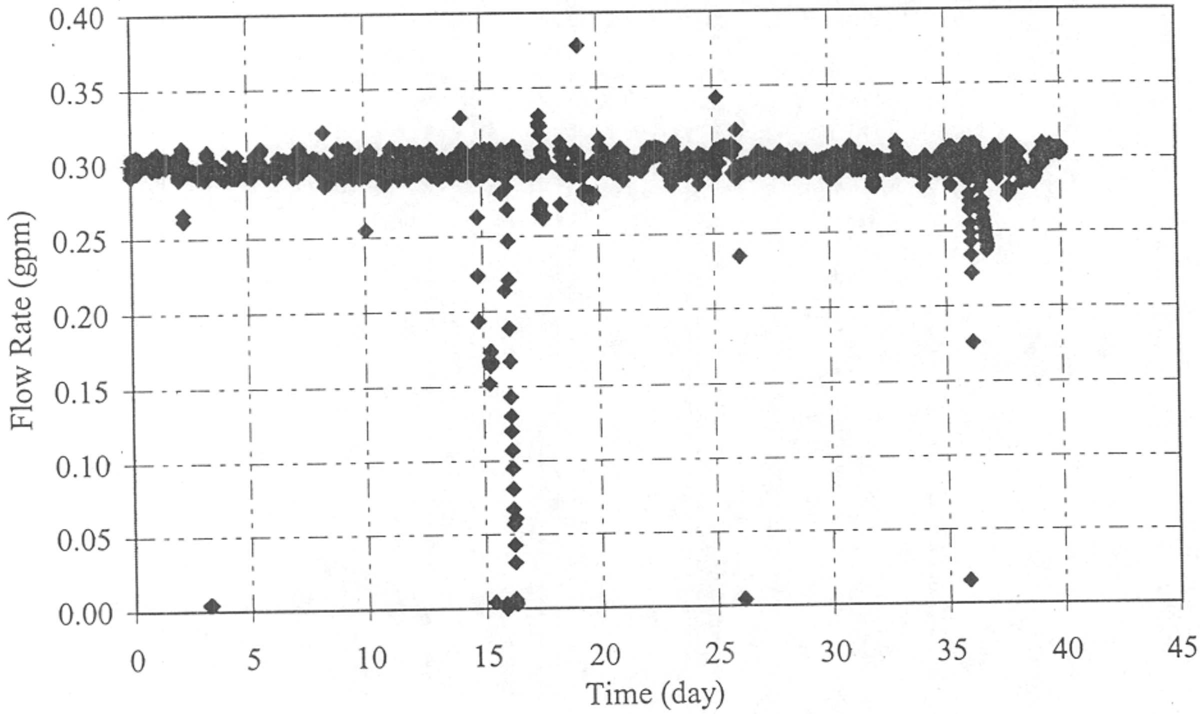


Figure M-23 Hydraulic control well HC02 injection flow rate as a function of time

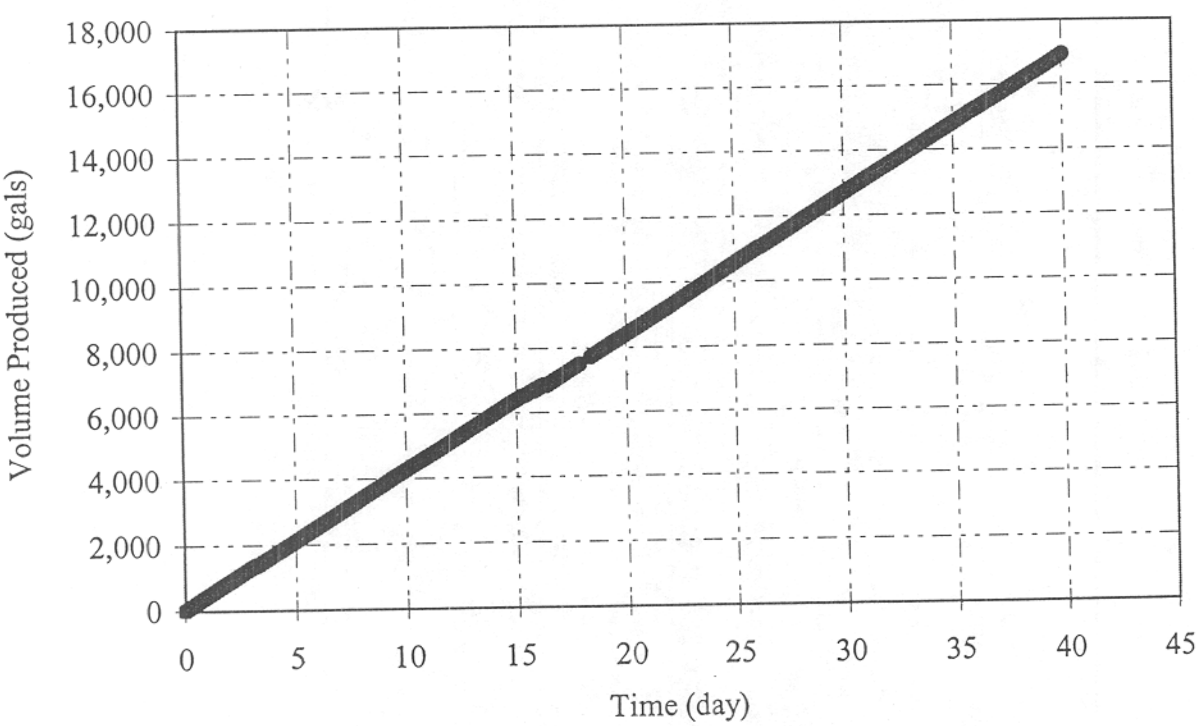


Figure M-24 Hydraulic control well HC02 cumulative volume injected as a function of time

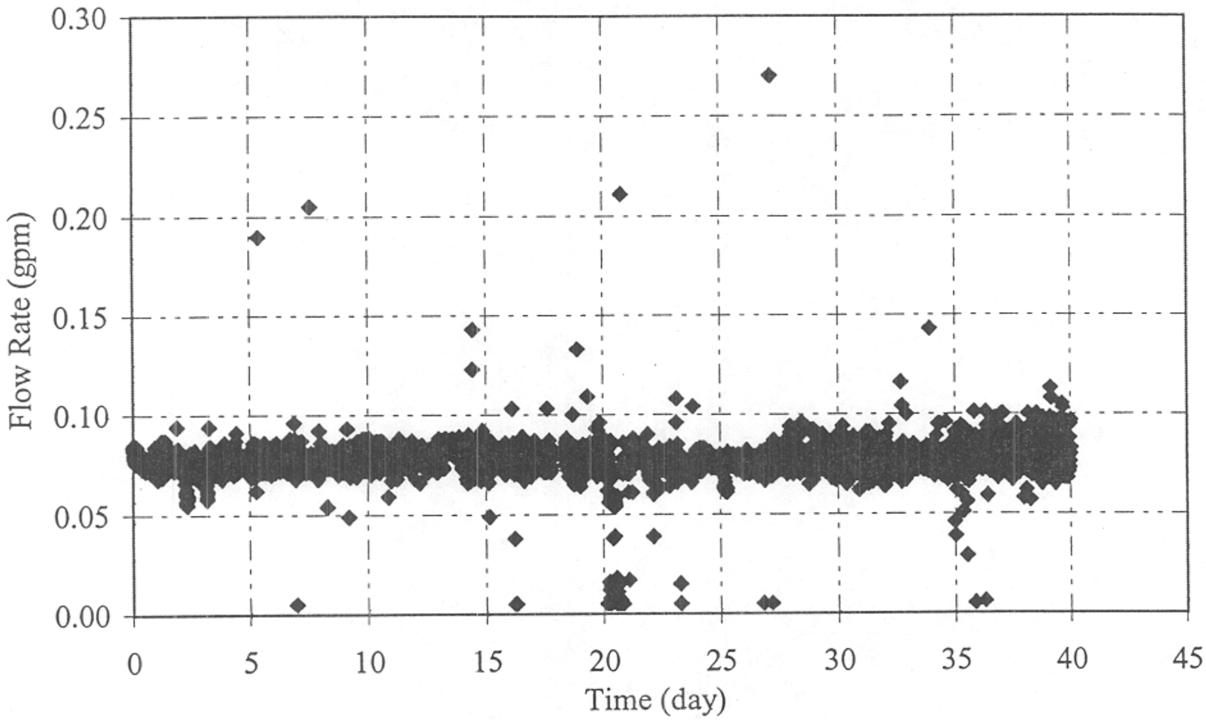


Figure M-25 Upper injection well IN01up flow rate as a function of time

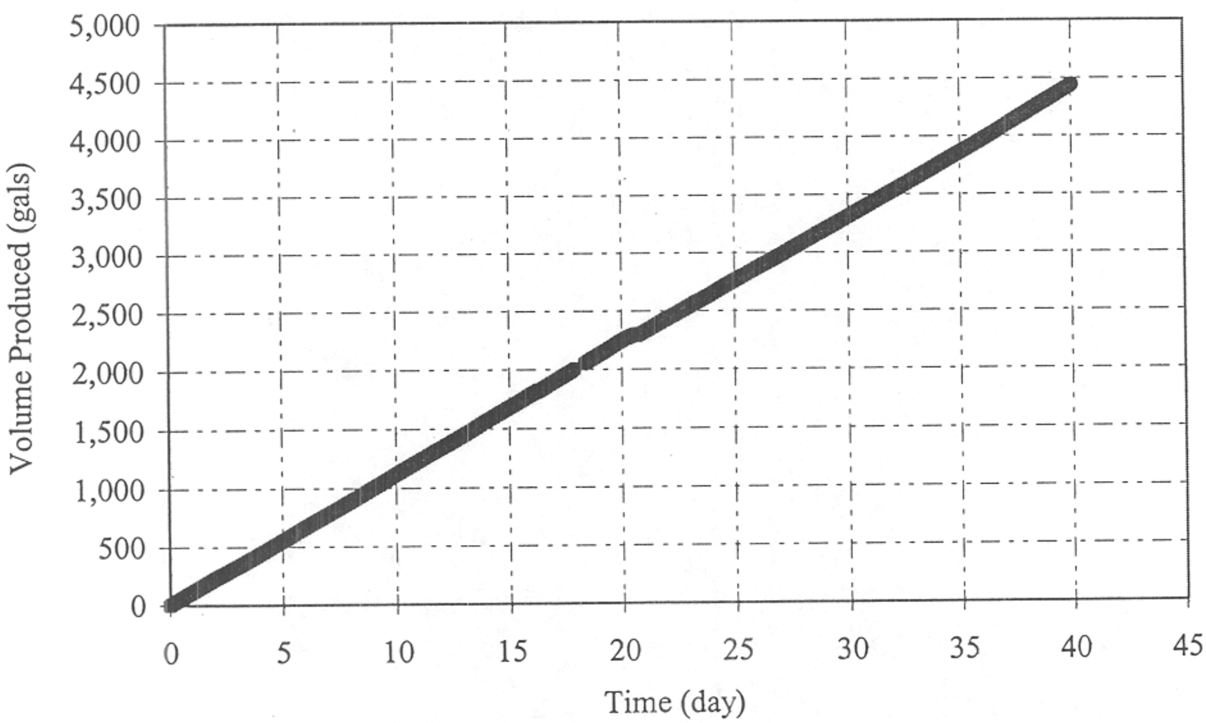


Figure M-26 Upper injection well IN01up cumulative volume injected as a function of time

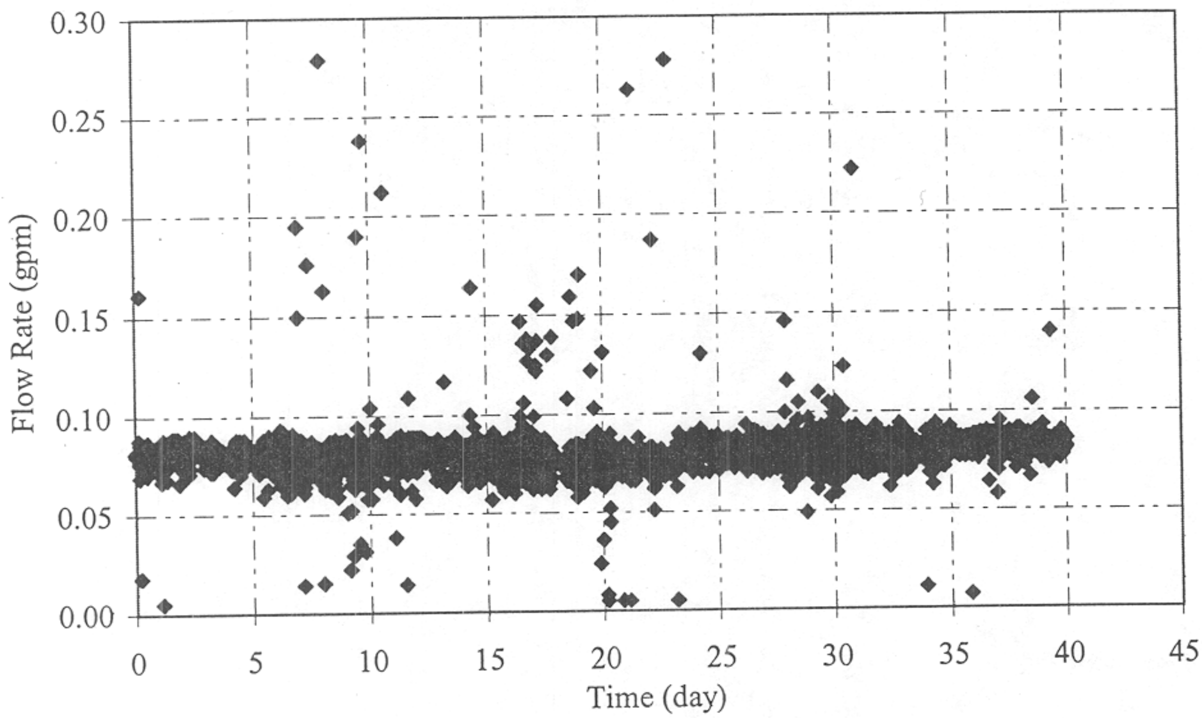


Figure M-27 Upper injection well IN02up flow rate as a function of time

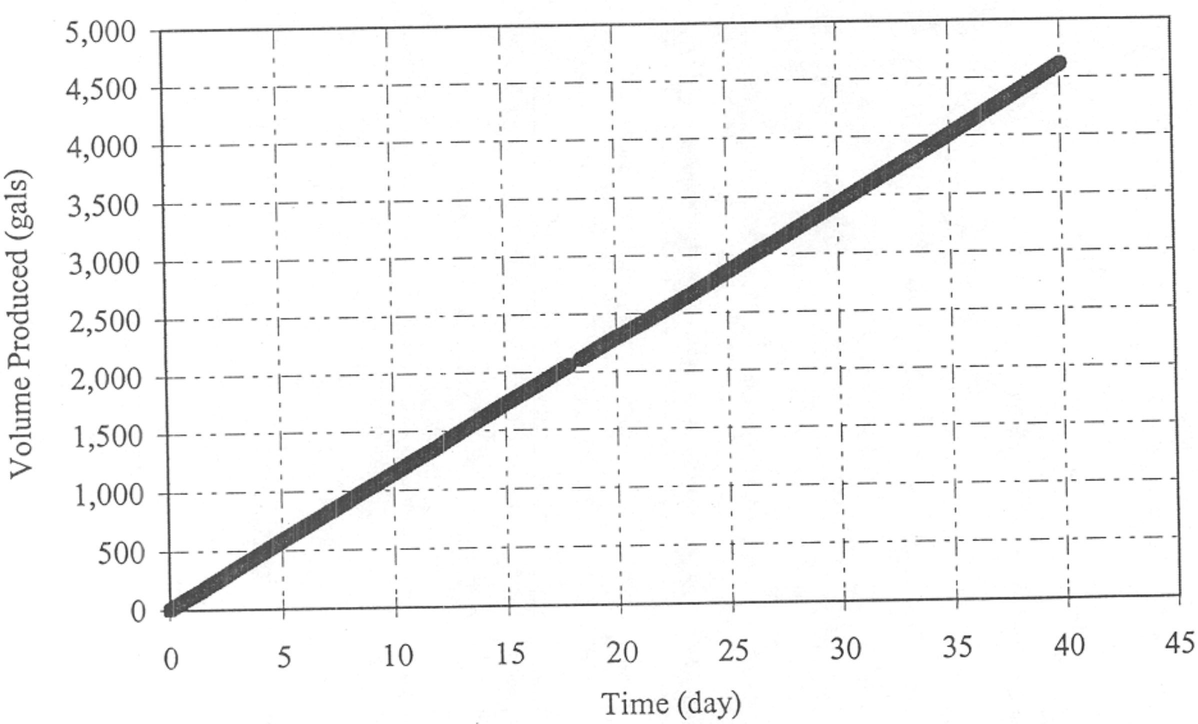


Figure M-28 Upper injection well IN02up cumulative volume injected as a function of time

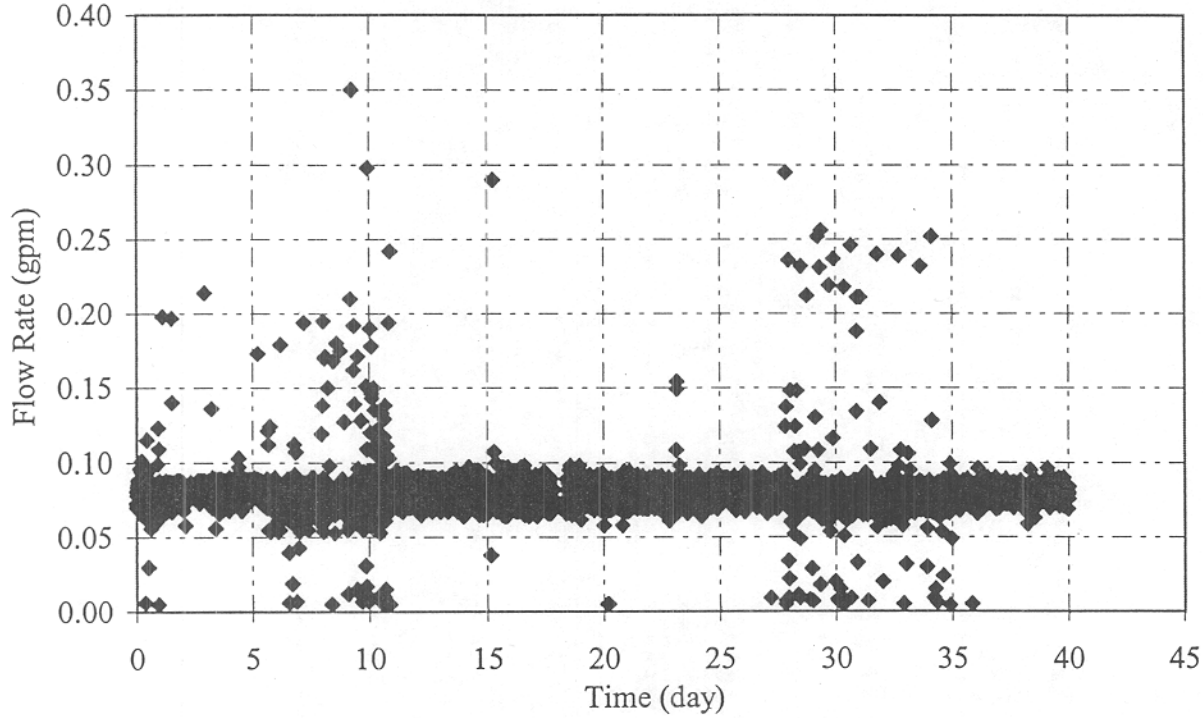


Figure M-29 Upper injection well IN03up flow rate as a function of time

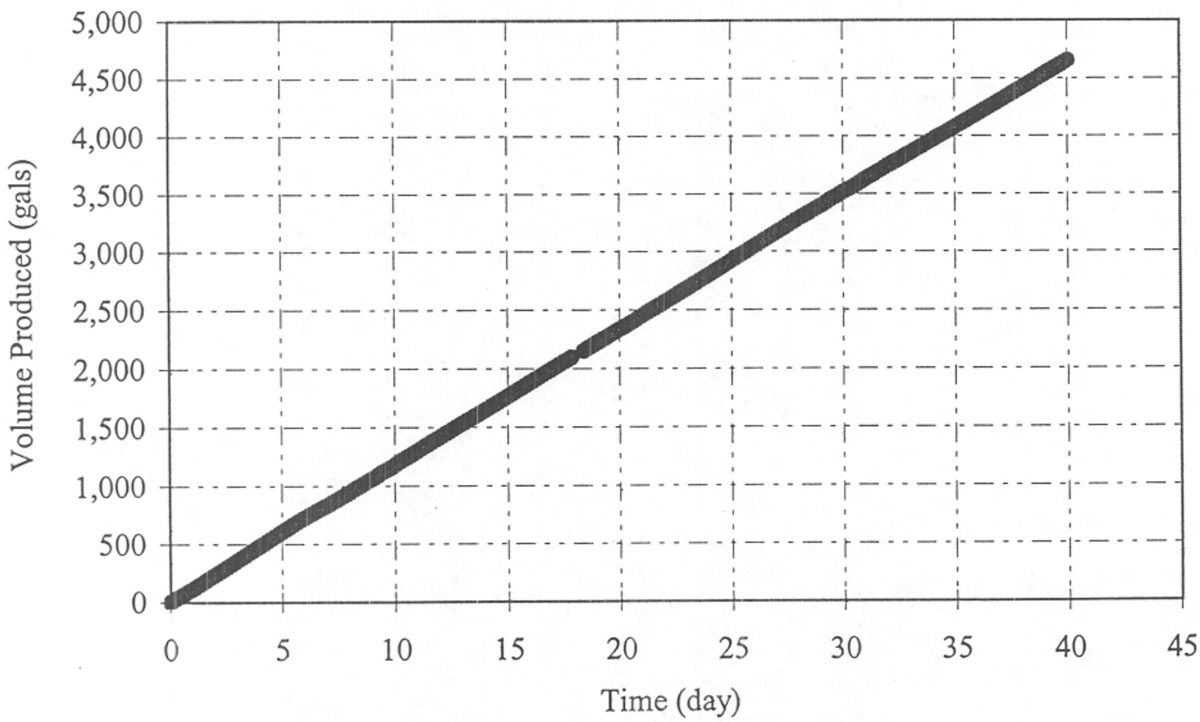


Figure M-30 Upper injection well IN03up cumulative volume injected as a function of time

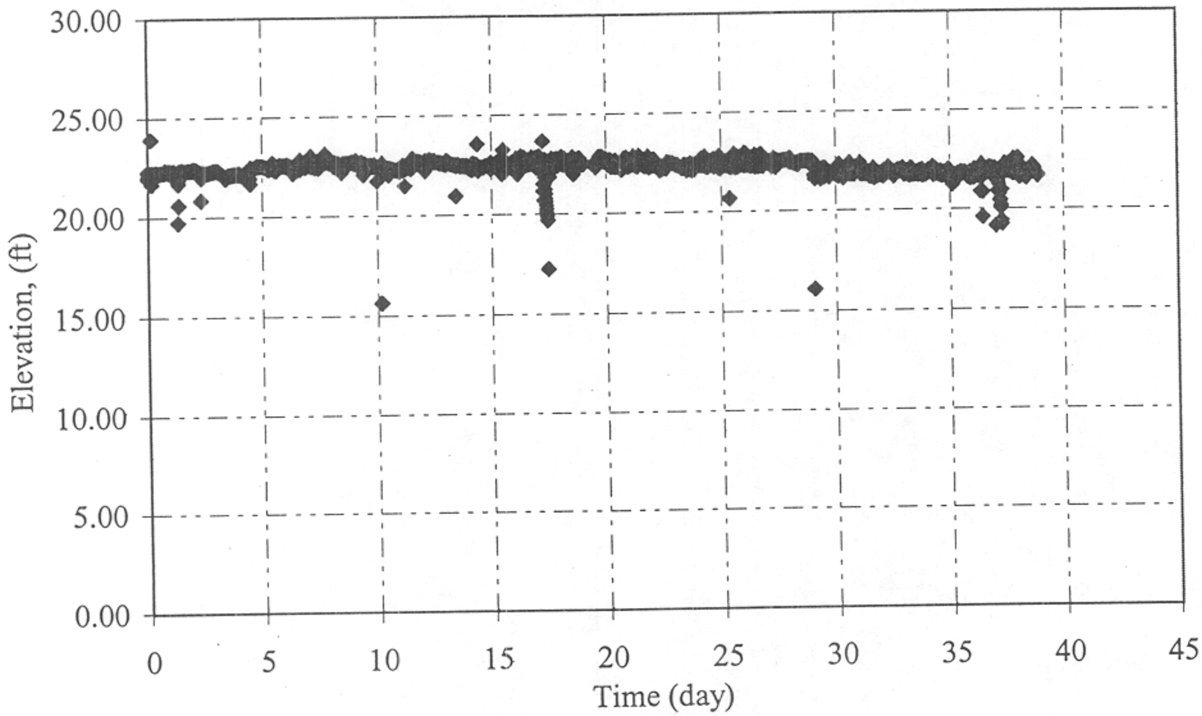


Figure M-31 Water level elevation at injection well IN01 as a function of time

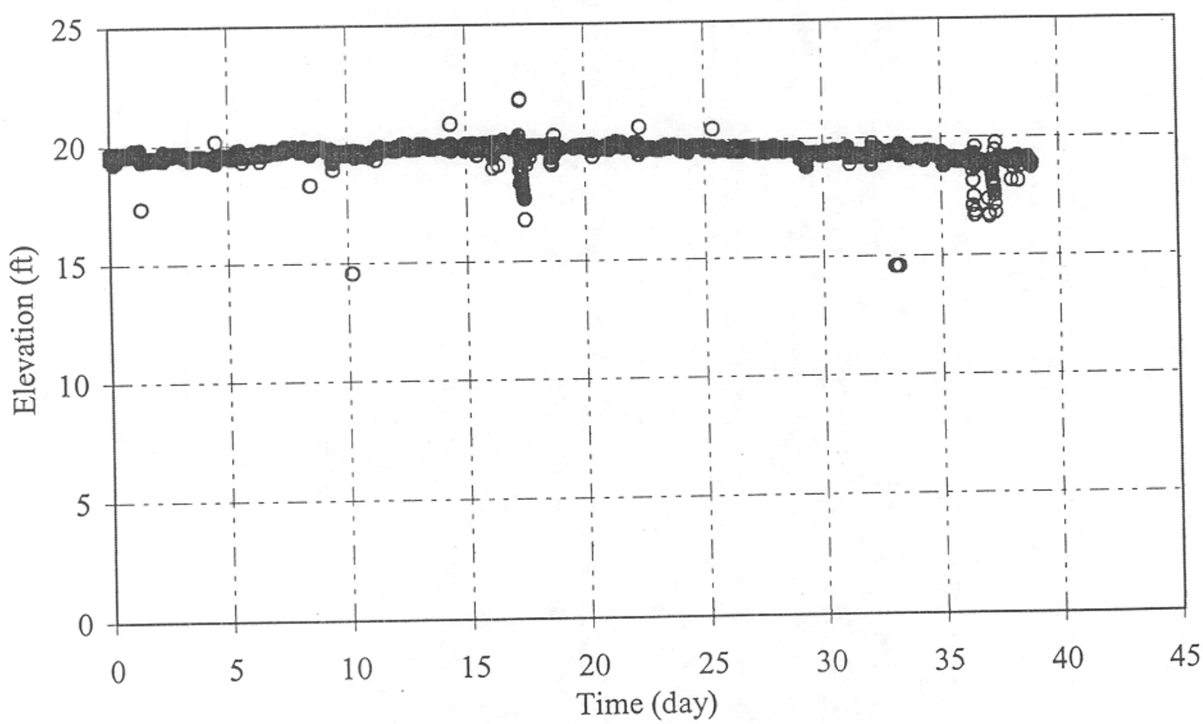


Figure M-32 Water level elevation at injection well IN02 as a function of time

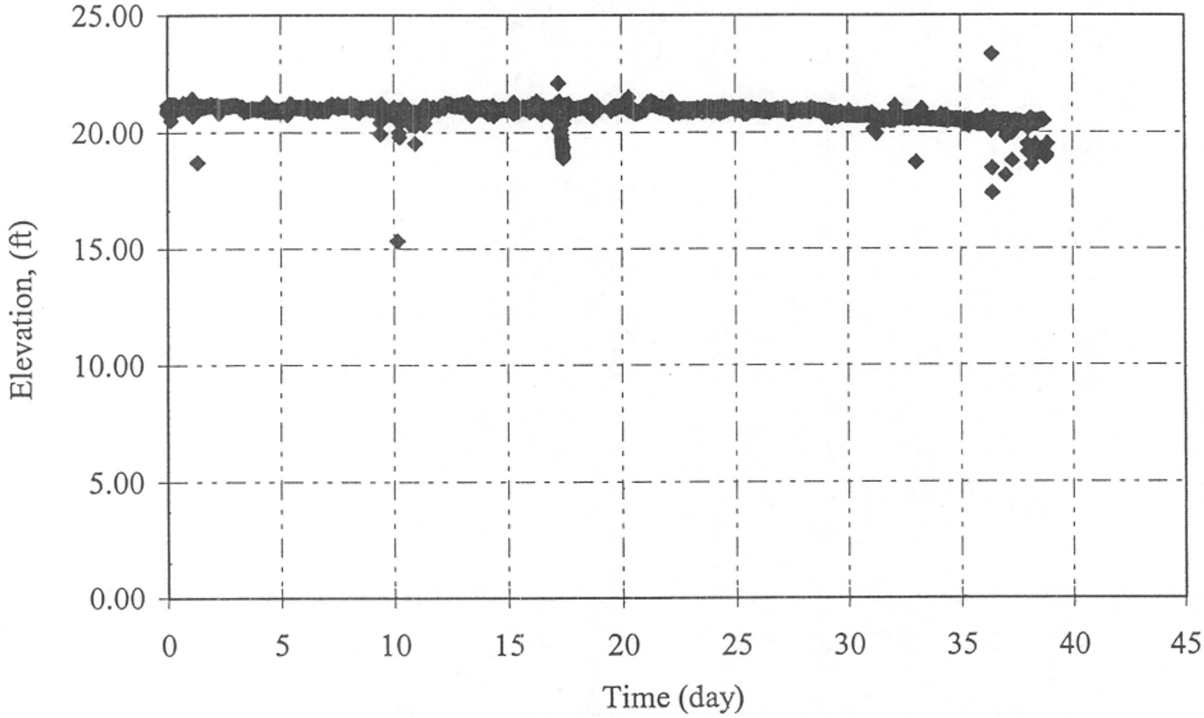


Figure M-33 Water level elevation at injection well IN03 as a function of time

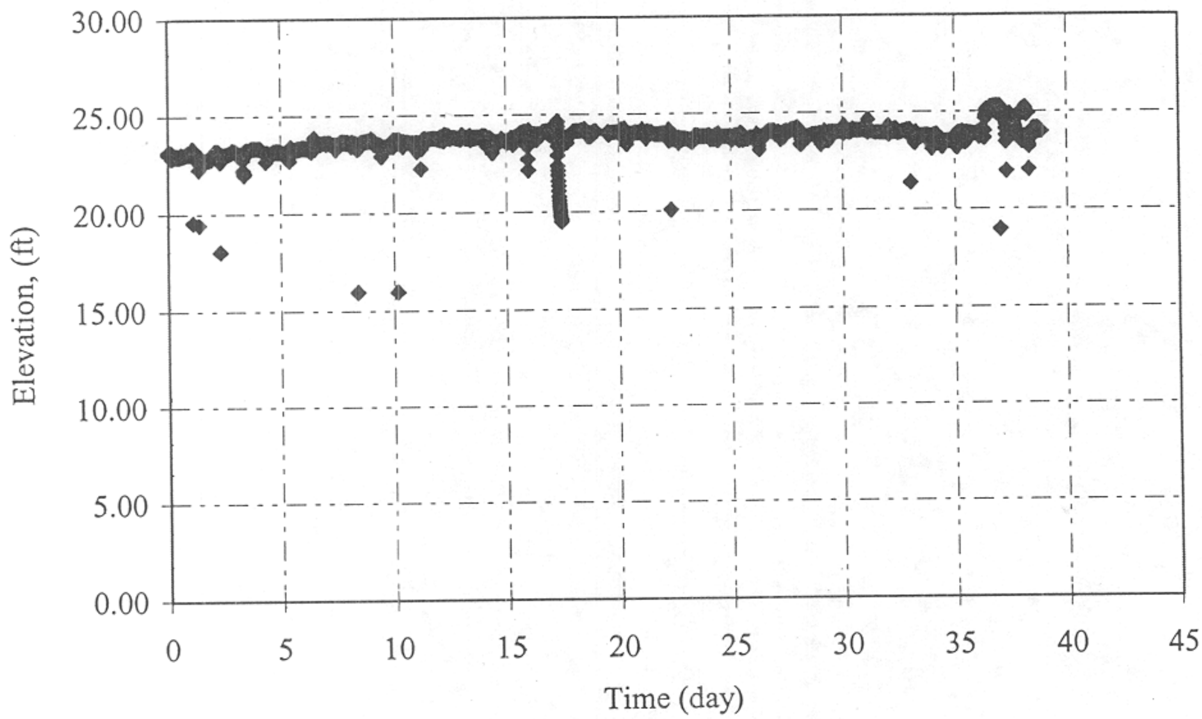


Figure M-34 Water level elevation at hydraulic control well HC01 as a function of time

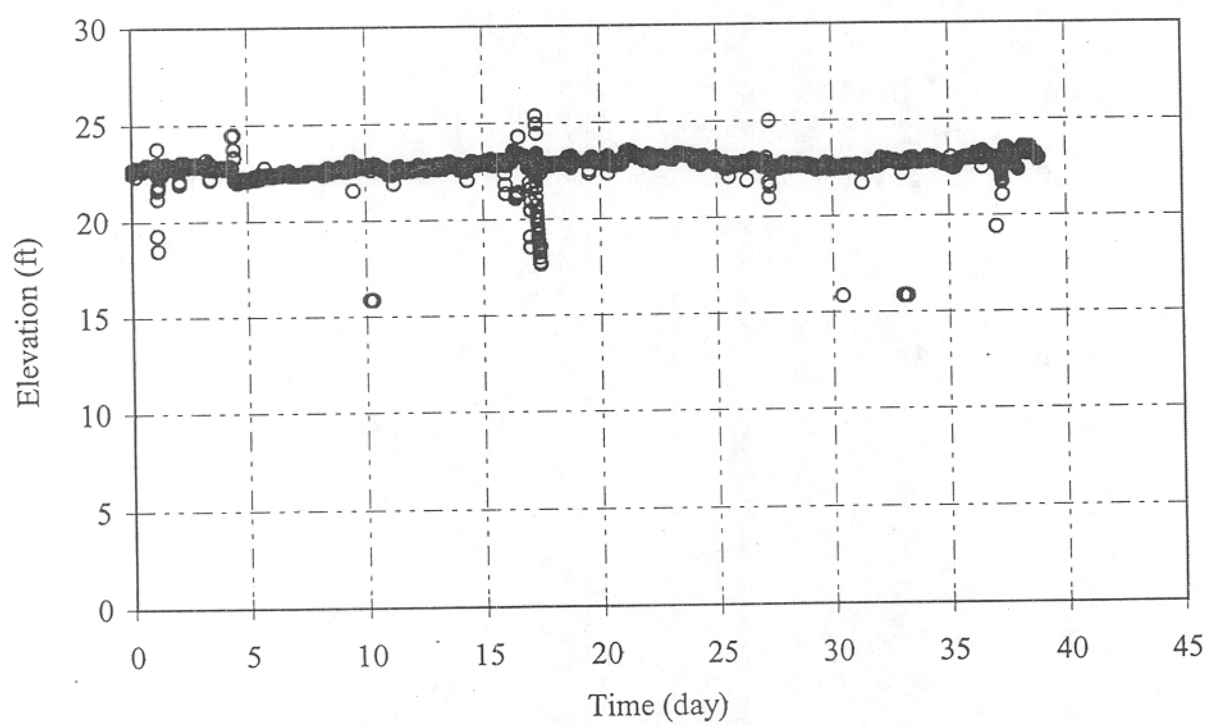


Figure M-35 Water level elevation at hydraulic control well HC02 as a function of time

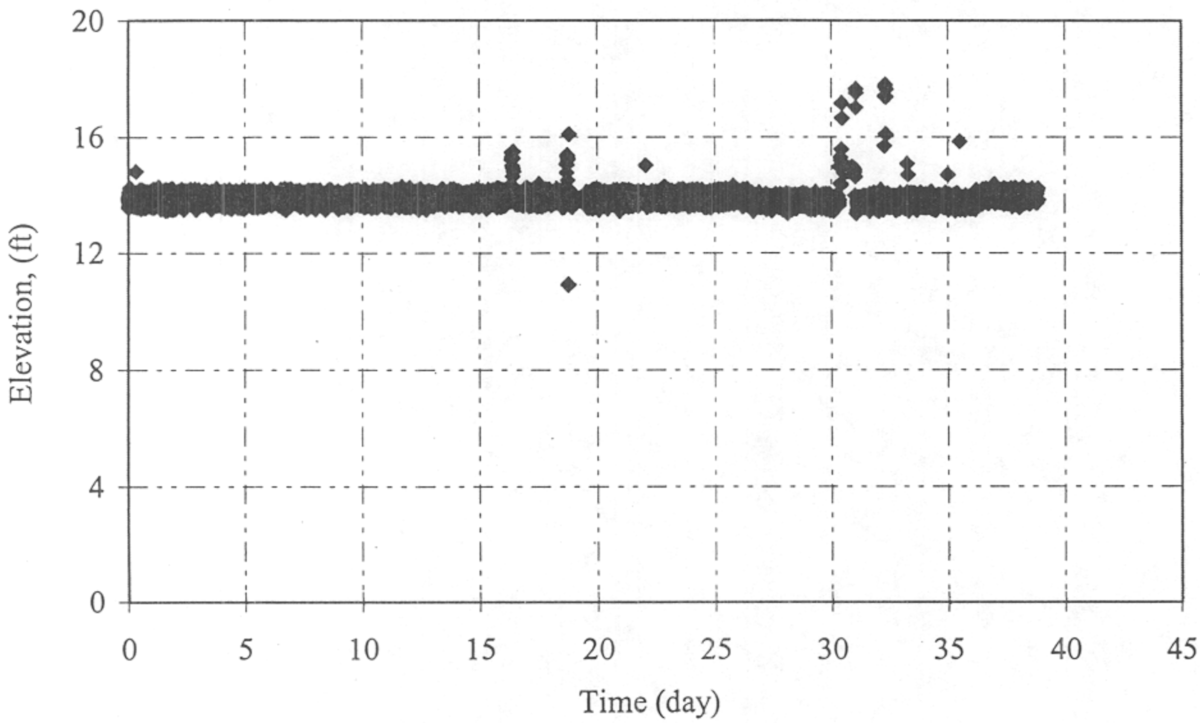


Figure M-36 Water level elevation at extraction well EX01 as a function of time

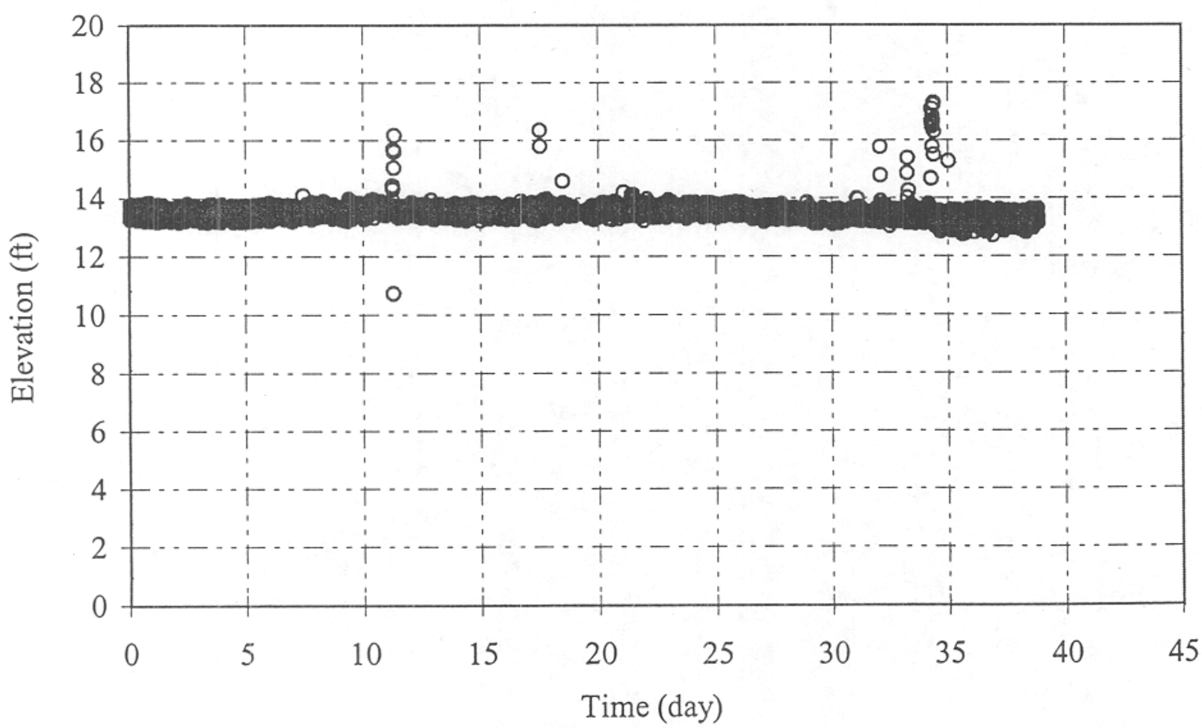


Figure M-37 Water level elevation at extraction well EX02 as a function of time

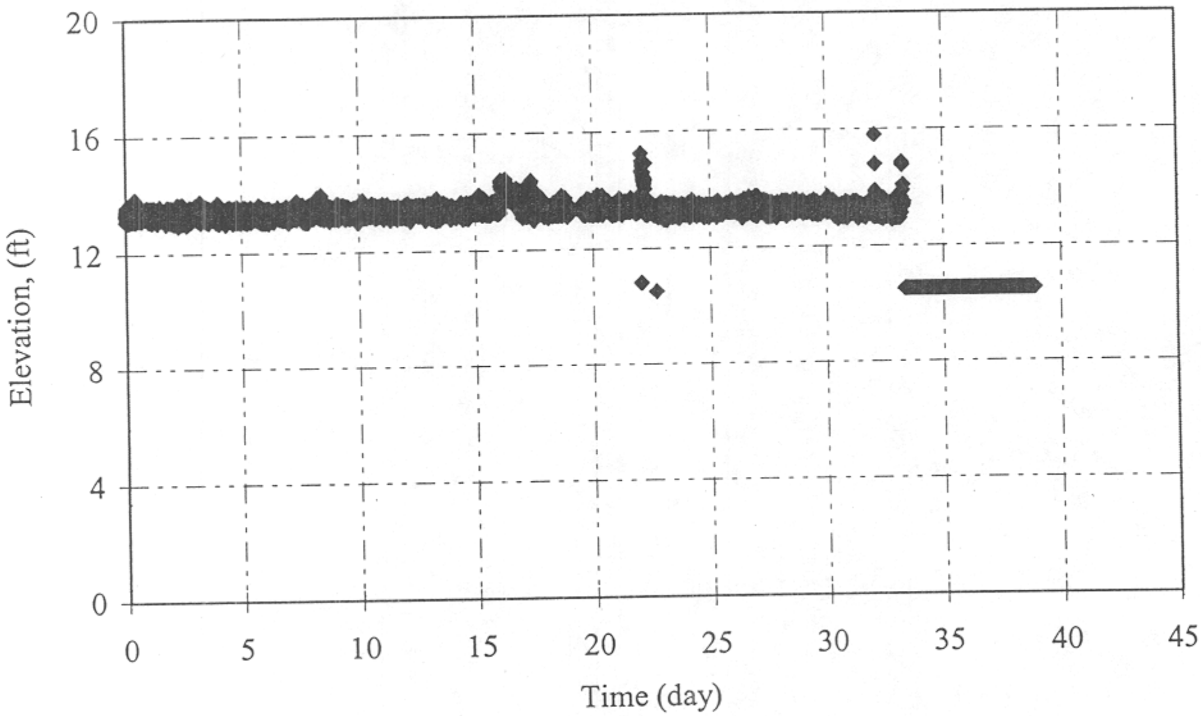


Figure M-38 Water level elevation at extraction well EX03 as a function of time

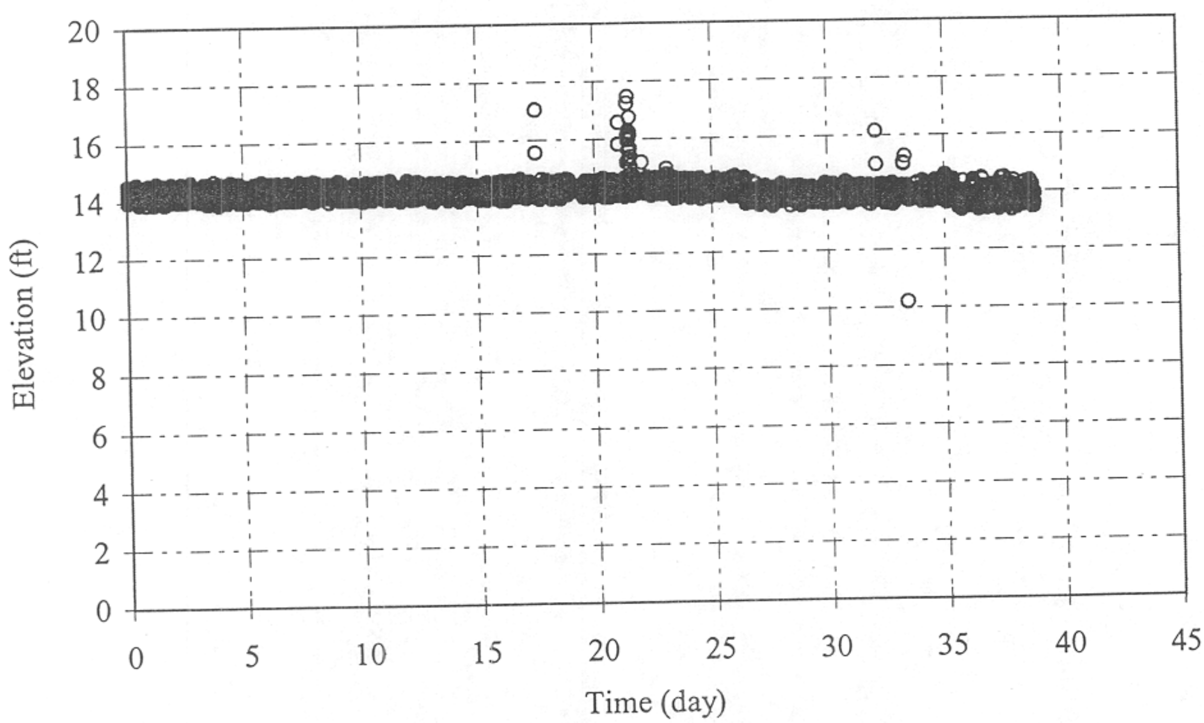


Figure M-39 Water level elevation at extraction well EX04 as a function of time

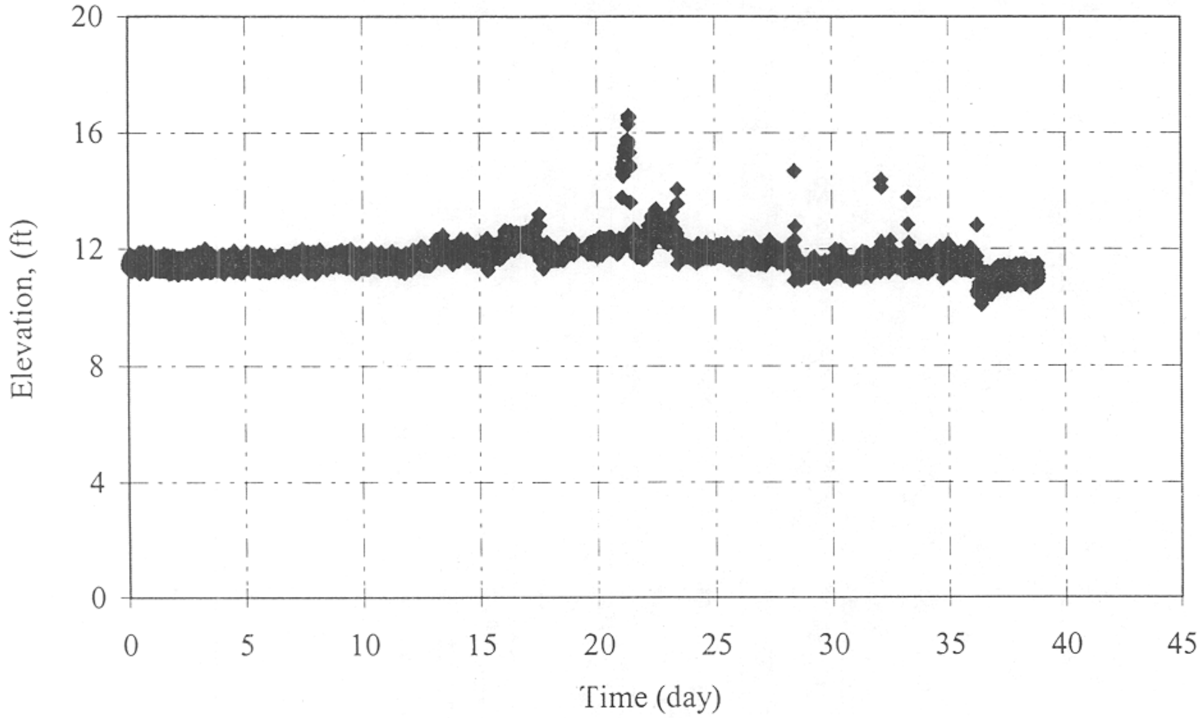


Figure M-40 Water level elevation at extraction well EX05 as a function of time

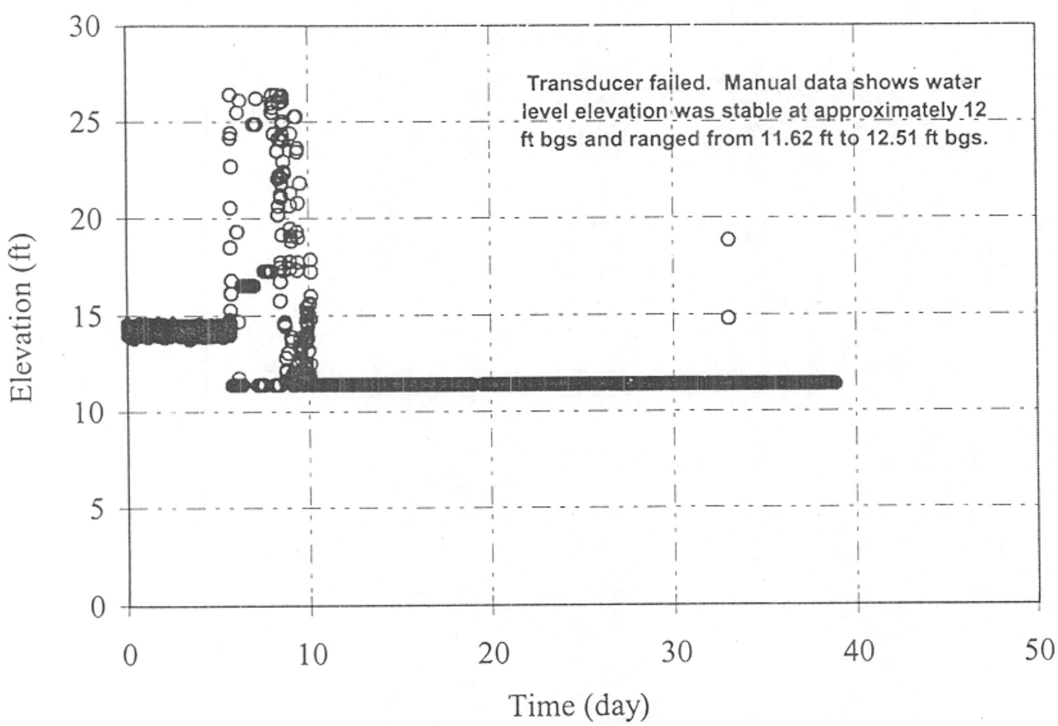


Figure M-41 Water level elevation at extraction well EX06 as a function of time

APPENDIX N

PITT Operations – Water Quality Data

INTERA
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MW05 WATER QUALITY DATA & Sampling

PROJECT NAME: CAMP LEJEUNE PITT PROJECT NO.: TON 307
WATER QUALITY INSTRUMENT:

WELL	DATE	TIME	TOTAL WATER PURGED (gal)	TEMP ☐°C ☐°F	CONDUCTIVITY (µS)	pH	TECH	COMMENTS
MW05	5/29/98	0959	3.0	24.3	119.3	5.12	GY	TD: 23.00
		1015	6.0	23.7	125	5.46		SWL: 6.63
		1032	9.0	23.0	131.9	5.55		WC: 16.37
		1040	Sample collected for ARSNIC					1 Vol: 2.7 gallons
	6.26.98	1310	∅				JC	SWL: 7.33
	↓	1415	9.0	Collected Sample			JC	DTW: 8.28

Note: Water quality readings listed are assumed to be final water quality readings obtained at the end of development/redevelopment, at the time of ground-water sampling, or at any other time the well was sufficiently purged.

INTERA
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(Exol)

WATER QUALITY DATA

PROJECT NAME: Camp Lejeune PITT
WATER QUALITY INSTRUMENT:
PROJECT NO.: TDN-307

WELL	DATE	TIME	TOTAL WATER PURGED (gal)	TEMP ☒°C ☐°F	CONDUCTIVITY (µS)	pH	TECH	COMMENTS
EX01	5/12/98	15:39		23.9	1416 ms		HCL	PH Meter giving SIP E-23 Env. Messa.
↓	5/13	1337		22.9	1447		HCL	PH Meter down
	5/14	11:40		26.4	1370		KJS	"
				~~[illegible]~~	~~[illegible]~~			
	5/18	1416		28.3	1,460	4.2	MKD	From AC manual port
	5/20	1502		27.8	1,450	3.63	MKD	From filter port
	5/22	1340		25.3	383	4.18	MKD	from wellhead
	5/27	1512		25.2	1145	4.0	GY	
	5/28	0817		24.8	1418	3.91	GY	
	5/28	0910		25.2	1490	3.62	GY	Top of pump
	5/30	0750		24.6	1465	4.08	GY	
	5/31	0840		25.3	1436	3.81	GY	
	6/2	1007		26.4	1250	~~[illegible]~~	JC	3.90 PH
*	6-6-98	0815		26.7	1540	3.88	FJH	From AC filter port
*	6-11-98	0852		26.	1630	3.90	"	" "
	6-15-98	0827		26.5	1540	3.68	JC	" "
	6-18-98	1000		27.7	1530	3.65	JC	" "

* Good representative data taken in morning with minimal temp. interference (ie: sun low, overcast, ambient temp = 28.3°C), & good sample purging at AC filter port.

Note: Water quality readings listed are assumed to be final water quality readings obtained at the end of development/redevelopment, at the time of ground-water sampling, or at any other time the well was sufficiently purged.

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EX02

WATER QUALITY DATA

PROJECT NAME: Camp Lejeune PITT PROJECT NO.: TDN-307
WATER QUALITY INSTRUMENT:

WELL	DATE	TIME	TOTAL WATER PURGED (gal)	TEMP ☒°C ☐°F	CONDUCTIVITY (µS)	pH	TECH	COMMENTS
EX02	5/12	1557		24.1	1219 ms	?	HCL	PH Meter giving slope Error-2
	5/13	1341		22.6	1261		HCL	"
	5/14	1146		26.9	1190		KJS	"
	5/18	1421		28.0	1,240	4.12	MKD	From AC manual port
	5/20	1505		27.6	1,290	3.89	MKD	From Filter port
	5/22	1348		25.9	564	4.27	MKD	from wellhead
	5/27	1517		25.3	1087	4.01	GY	
	5/28	0824		25.4	566	3.96	GY	
	5/28	0905		25.4	1085	4.05	GY	Top of pump
	5/30	0755		25.1	1163	4.13	GY	
	5/31	0845		25.5	1162	4.0	GY	
	6/2	1030		26.8	1270	[illegible]	JC	38.1 pH
*	6-6-98	0821		27.0	1320	4.22	FJH	From AC Filter Port
*	6-11-98	0858		26.9	1360	~~4.00~~ 3.96	"	" " " (mixed NAPL from EX2
	6-15-98	0833		26.9	1360	3.94	JC	From AC Filter Port
	6-18-98	1005		27.6	1360	3.99	JC	" "

* See Note on EX01

Note: Water quality readings listed are assumed to be final water quality readings obtained at the end of development/redevelopment, at the time of ground-water sampling, or at any other time the well was sufficiently purged.

INTERA
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Ex03

WATER QUALITY DATA

PROJECT NAME: Camp Lejeune PITT PROJECT NO.: TDN-307
WATER QUALITY INSTRUMENT:

WELL	DATE	TIME	TOTAL WATER PURGED (gal)	TEMP ☒°C ☐°F	CONDUCTIVITY (µS)	pH	TECH	COMMENTS
Ex03	5/12	1601		25.2	1144 ms		HCL	
	5/13	1346		23.3	1220		HCL	
	5/14	1150		27.5	1160		KJS	
	5/18	1426		28.8	1190	4.08	MKD	From AC manual port
	5/20	1508		28.8	1,230	3.93	MKD	From filter port
	5/20	1406		29.2	348	4.35	MKD	from wellhead
	5/27	1523		27.4	1180	3.84	Gy	
	5/28	0829		28.1	397	3.95	GY	
	5/28	0900		26.9	1295	3.92	GY	Top of pump
	5/30	0800		27.5	980	3.92	GY	
	5/31	0848		27.6	1230	3.86	GY	
	6/2	1038		29.4	460	3.83	JC	
	6/2	1042		29.5	450	3.77	JC	
*	6-6-98	0818		28.1	1330	4.3	FJH	From AC filter port
*	6-11-98	0905		28.7	1430	3.92	"	" " "
	6-15-98	0837		28.6	1460	3.72	JC	" " "
	6-18-98	1010		29.9	1430	3.77	JC	

* Good representative data taken in morning (sun low) & overcast for minimal temp. interference, and good purging at AC filter ports.

Note: Water quality readings listed are assumed to be final water quality readings obtained at the end of development/redevelopment, at the time of ground-water sampling, or at any other time the well was sufficiently purged.

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EXO4R

WATER QUALITY DATA

PROJECT NAME: Camp Lejeune PITT
PROJECT NO.: TDN-307
WATER QUALITY INSTRUMENT:

WELL	DATE	TIME	TOTAL WATER PURGED (gal)	TEMP ☒°C ☐°F	CONDUCTIVITY (µS)	pH	TECH	COMMENTS
EX04	5/12	1605		22.6	1274 µs		HCL	
	5/13	1350	21.1	~~23.3~~	1307		HCL	
	5/14	1155		24.9	1260		KJS	
	5/18	1431		27.1	1,350	3.79	MKD	From AC manual port
	5/20	1512		26.6	1,360	4.10	MKD	From Filter port
	5/22	1413		23.8	1,330	4.10	MKD	From wellhead
	5/27	1550		23.7	~~545~~ 1136	4.30	GY	Bottom of well
	5/28	0834		24.6	[545] 510	4.14	GY	~~Mid~~ up from Bottom
	5/28	0847		23.6	1370	3.92	GY	Top of pump
	5/30	0807		24.0	1285	3.98	GY	
	5/31	0855		24.5	1370	3.92	GY	
	6/2	1057		25.8	1390	3.68	JC	
*	6-6-98	0832		25.8	1430	4.25	FJH	From AC Filter port
*	6-11-98	0910		25.9	1470	3.93	"	" " "
	6-15-98	0845		26.0	1500	3.75	JC	" " "
↓	6-18-98	1014		26.5	1490	3.80	JC	

* See note on EX01

Note: Water quality readings listed are assumed to be final water quality readings obtained at the end of development/redevelopment, at the time of ground-water sampling, or at any other time the well was sufficiently purged.

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Ex05

WATER QUALITY DATA

PROJECT NAME: Camp Lejeune PITT
WATER QUALITY INSTRUMENT: ____ PROJECT NO.: TDN-307

WELL	DATE	TIME	TOTAL WATER PURGED (gal)	TEMP ☒°C ☐°F	CONDUCTIVITY (µS)	pH	TECH	COMMENTS
EX05	5/12	1608		21.9	1184 µs		HCL	PH See EX01
	5/13	1342		21.6	1227		HCL	
	5/14	1200		25.2	1150		KJS	
	5/18	1436		26.1	1,250	3.89	MKD	From AC manual port
	5/20	1515		24.0	1,250	4.17	MKD	From filter port
	5/22	1420		22.0	1,143	4.11	MKD	from wellhead
	5/27	1600		22.7	1434	4.74	GY	
	5/28	0837		22.9	145	4.77	GY	MID
	5/28	0843		22.6	1019	4.10	GY	ON TOP of pump
	5/30	0810		23.0	924	4.19	GY	
	5/31	0900		23.3	1170	4.14	GY	
	6/2	1105		25.4	1310	3.90	JC	
*	6-6-98	0837		24.8	1280	4.24	FJH	From AC Filter Port
*	6-11-98	0915		24.6	1300	4.20	FJH	" " "
	6-15-98	0849		24.5	1310	3.99	JC	" " "
	6-18-98	1019		25.2	1320	4.20	JC	" " "

* See Note on EX01

Note: Water quality readings listed are assumed to be final water quality readings obtained at the end of development/redevelopment, at the time of ground-water sampling, or at any other time the well was sufficiently purged.

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Page 1 of ____

EX06.

WATER QUALITY DATA

PROJECT NAME: Camp Lejeune PITT
WATER QUALITY INSTRUMENT: ____
PROJECT NO.: TDN-307

WELL	DATE	TIME	TOTAL WATER PURGED (gal)	TEMP ☑°C ☐°F	CONDUCTIVITY (µS)	pH	TECH	COMMENTS
EX06	5/12	1615		21.8	1200		HCL	PH See Ex01
	5/13	1355		21.5	1233		HCL	"
	5/14	1155		24.8	1180		KJS	"
	5/18	1439		25.9	1,230	4.10	MKD	From AC manual port
	5/20	1510		23.3	1,310	4.20	MKD	from filter port
	5/20	1425		21.5	847	4.50	MKD	from wellhead
	5/27	1110		22.4	1277	4.12	GY	@ bottom
	5/28	0852		22.1	1303	4.19	GY	top of pump
	5/30	0814		22.7	1252	4.24	GY	
	5/31	0904		23.1	1265	4.42	GY	
	6/1			25.3	1015	4.0	JC	
	6/2	1116		25.3	1290	4.87	JC	
*	6-5-98	0840		24.0	1330	4.28	FJH	From AC Filter Port
*	6-11-98	0921		24.1	1380	4.15	FJH	" " "
	6-15-98	0856		24.6	1390	4.00	JC	" " "
	6-18-98	1026		24.9	1400	4.09	JC	" "

* See Note on EX01

Note: Water quality readings listed are assumed to be final water quality readings obtained at the end of development/redevelopment, at the time of ground-water sampling, or at any other time the well was sufficiently purged.

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RW01

WATER QUALITY DATA

PROJECT NAME: Camp Lejeune PITT PROJECT NO.: TDN307
WATER QUALITY INSTRUMENT:

WELL	DATE	TIME	TOTAL WATER PURGED (gal)	TEMP ☒°C ☐°F	CONDUCTIVITY (µS)	pH	TECH	COMMENTS
RW01	5/18/98	1529	1.5	24.0	969	5.04	MKD	Measured at wellhead
↓	5/21	1601	3.0	24.4	1,009	5.15	MKD	" " "
	5/27	1753	1.0	24.6	263	5.33	GY	
	↓	1758	2.0	24.6	314	5.31		
		1803	3.0	24.6	425	5.26		
		1808	4.0	24.5	493	5.23		
		1812	5.0	24.6	669	5.11		
	5/29	1002	1.0	26.3	726	5.10	GY	TOP
	↓	1007	2.0	25.1	734	5.10		
		1012	3.0	24.7	729	5.15		↓12" from bottom
		1018	1.0	24.7	1111	4.94		↓
		1023	2.0	24.8	1156	4.91		
		1027	3.0	24.8	1173	4.69		
	5/30	0825	1.0	25.1	1105	5.10	GY	
		0830	2.0	24.9	1109	5.04	↓	
		0834	3.0	24.9	1129	4.99		
	5/31	0914	1.0	25.2	1104	4.97	GY	
		0917	2.0	25.1	1075	5.00	↓	
		0922	3.0	24.9	1031	5.04		
	6/3	1437	1.0	27.6	1030		JC	
	↓	1441	2.0	27.6	1020		↓	
		1445	3.0	27.4	1020			
	6/10	1447	2.0	26.1	740	5.08	JC	2 FT. From Top Approx 11 ft.
↓	↓	1500	3.0	26.0	760	5.0	↓	" "
		1513	4.0	26.0	1315	4.93		13 Ft. ↓

Note: Water quality readings listed are assumed to be final water quality readings obtained at the end of development/redevelopment, at the time of ground-water sampling, or at any other time the well was sufficiently purged.

INTERA
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RW 01

WATER QUALITY DATA

PROJECT NAME: PITT 1: Camp Lejeune PROJECT NO.: TDN 307
WATER QUALITY INSTRUMENT:

WELL	DATE	TIME	TOTAL WATER PURGED (gal)	TEMP ☐°C ☐°F	CONDUCTIVITY (µS)	pH	TECH	COMMENTS
RW01	6-16-98	0833	1.0	26.2	843	5.14	JC	Measured at 11 Ft.
	↓	0845	2.0	26.7	851	5.10	↓	↓
		0857	3.0	26.2	1474	4.89		Measured at 15 Ft
	6-19-98	0831	1.0	26.9	896	5.12	JC	Measured at 11 F
	↓	0845	2.0	27.1	901	5.16	↓	↓
		0858	3.0	26.6	1450	4.70		" " 15 Ft

Note: Water quality readings listed are assumed to be final water quality readings obtained at the end of development/redevelopment, at the time of ground-water sampling, or at any other time the well was sufficiently purged.

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RW02

WATER QUALITY DATA

PROJECT NAME: Camp Lejeune PITT 1 PROJECT NO.: TDN307
WATER QUALITY INSTRUMENT:

WELL	DATE	TIME	TOTAL WATER PURGED (gal)	TEMP ☒°C ☐°F	CONDUCTIVITY (µS)	pH	TECH	COMMENTS
RW02	5/18	1545	2.5	23.2	2,220	6.55	MKD	Measured at wellhead
↓	5/21	1620	2.5	24.4	2,160	6.62	MKD	" " "
	5/27	1816	3.0	24.6	1990	6.41	GY	
	↓	1821	↓	24.8	1940	6.48		
		1825		24.7	1980	6.55		
	5/28	1035	1.0	25.4	2080	6.30	GY	TOP
	↓	1040	2.0	25.1	2090	6.36	↓	↓
		1043	3.0	24.9	2085	6.42		
		1048	1.0	25.6	2100	6.46		Bottom
		1053	2.0	26.1	2090	6.49		↓
	↓	1057	3.0	26.2	2080	6.50		
	5/30	0841	1.0	26.3	2080	6.34	GY	
		0845	2.0	25.9	2090	6.45	↓	
		0849	3.0	25.6	2100	6.51		
	5/31	0930	1.0	25.8	2080	6.36	GY	
		0934	2.0	25.4	2090	6.45		
		0938	3.0	25.4	2090	6.51	↓	
	6/3	1420	1.0	29.1	1980		JC	
	↓	1425	2.0	28.8	2020		↓	
		1429	3.0	28.5	2000			
	6/10	1529	1.0	26.6	2100	6.57	JC	Measured 2ft. below top
	↓	1537	2.0	26.5	2090	6.61	↓	↓
↓		1555	3.0	26.2	2080	6.75		measured at 15 ft

Note: Water quality readings listed are assumed to be final water quality readings obtained at the end of development/redevelopment, at the time of ground-water sampling, or at any other time the well was sufficiently purged.

RW02

WATER QUALITY DATA

PROJECT NAME: PITT 1: Camp Lejeune PROJECT NO.: TDN 307
WATER QUALITY INSTRUMENT:

WELL	DATE	TIME	TOTAL WATER PURGED (gal)	TEMP ☐°C ☐°F	CONDUCTIVITY (µS)	pH	TECH	COMMENTS
RW02	6-16-98	0918	1.0	27.8	2110	6.50	JC	Measured at 9 FT.
	↓	0930	2.0	28.1	2110	6.54	↓	↓
		0944	3.0	27.4	2110	6.59		Measured at 13 Ft
	6-19-98	0912	1.0	28.0	2140	6.50	JC	Measured at 9 FT
		0925	2.0	28.0	2120	6.60	↓	↓
		0939	3.0	28.1	2120	6.[illegible]		Measured at 13 Ft

Note: Water quality readings listed are assumed to be final water quality readings obtained at the end of development/redevelopment, at the time of ground-water sampling, or at any other time the well was sufficiently purged.

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RW 04

WATER QUALITY DATA

PROJECT NAME: PITT 1: Camp Lejeune PROJECT NO.: TDN 307
WATER QUALITY INSTRUMENT:

WELL	DATE	TIME	TOTAL WATER PURGED (gal)	TEMP ☒°C ☐°F	CONDUCTIVITY (µS)	pH	TECH	COMMENTS
RW4	5/21	1708	3.5	24.3	235	4.36	MKD	Measured at wellhead
	5/27	1850	3.0	24.5	194	4.35	GY	
	↓	1853	↓	24.5	227	4.31		
		1857		24.5	227	4.32		
	5/29	1135	1.0	27.1	231	4.18	GY	TOP
		1139	2.0	26.3	233	4.19		↓
		1144	3.0	25.2	235	4.20		
		1150	1.0	25.3	228	4.18		[illegible]
		1154	2.0	25.5	228	4.16		
	↓	1158	3.0	25.8	229	4.16	↓	↓
	5/30	0910	1.0	26.1	229	4.19	[illegible]	
		0914	2.0	25.6	228	4.19		
		0918	3.0	25.6	228	4.17		
		1000	1.0	25.4	233	4.20		
		1004	2.0	24.8	231	4.18		
		1008	3.0	24.9	233	4.20	↓	
	6/3	1335	1.0	28.9	250		JC	
	↓	1340	2.0	28.3	220		JC	
		1345	3.0	27.3	220		JC	
	6/10	1638	1.0	25.7	232	4.34	JC	Measured at 11Ft.
	↓	1644	2.0	25.8	236	4.32	↓	
		1650	3.0	25.7	231	4.30		Measured at 15Ft.

Note: Water quality readings listed are assumed to be final water quality readings obtained at the end of development/redevelopment, at the time of ground-water sampling, or at any other time the well was sufficiently purged.

INTERA
A Duke Engineering & Services Company

RW 04

WATER QUALITY DATA

PROJECT NAME: PITT 1 : Camp Lejeune PROJECT NO.: TDN 307

WATER QUALITY INSTRUMENT:

WELL	DATE	TIME	TOTAL WATER PURGED (gal)	TEMP ☒ °C ☐ °F	CONDUCTIVITY (µS)	pH	TECH	COMMENTS
RW04	6.16.98	1047	1.0	26.8	224	4.08	JC	Measured at 11Ft
	↓	1101	2.0	273	227	4.09	↓	" ↓ "
		1116	3.0	26.7	223	4.07		" " 15Ft
	6.19.98	1045	1.0	27.2	232	4.16	JC	Measured at 11Ft
	↓	1058	2.0	26.8	229	4.15	↓	↓
		1110	3.0	26.5	224	4.08		" " 15Ft

Note: Water quality readings listed are assumed to be final water quality readings obtained at the end of development/ redevelopment, at the time of ground-water sampling, or at any other time the well was sufficiently purged.

INTERA
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IW 01

WATER QUALITY DATA

PROJECT NAME: Camp Lejeune PITT 1 PROJECT NO.: TDN307
WATER QUALITY INSTRUMENT:

WELL	DATE	TIME	TOTAL WATER PURGED (gal)	TEMP ☒°C ☐°F	CONDUCTIVITY (µS)	pH	TECH	COMMENTS
IW01	5/18/98	1558	2.0	22.0	2,200	4.90	MKD	Measured at well head
	5/21	1640	2.5	22.7	1,770	4.97	MKD	" " "
	5/27	1832	4.0	23.3	1620	4.74	64	
		1836		23.1	1650	4.71		
		1840		23.1	1760	4.59		
	↓	1844	↓	23.1	1810	4.55		
	5/28	1104	1.0	25.6	1700	4.53	64	TOP
		1109	2.0	24.8	1775	4.61		↓
		1114	3.0	25.4	1800	4.46		
		1120	1.0	25.4	1850	4.47		Bottom
		1124	2.0	25.4	1860	4.40		↓
	↓	1128	3.0	25.4	1870	4.36	↓	
	5/30	0855	1.0	24.6	1785	4.64	64	
		0859	2.0	24.3	1823	4.59		
		0903	3.0	24.5	1855	4.49		
	5/31	0942	1.0	24.2	1840	4.6		
	↓	0946	2.0	24.0	1880	4.55		
		0950	3.0	24.2	1880	4.51	↓	
	6/3	1401	1.0	26.8	1820		JC	
	↓	1407	2.0	26.9	1840		↓	
		1413	3.0	26.9	1860			
	6/10	1612	1.0	26.0	1943	4.44	JC	Measured at Approx. 11Ft.
	↓	1621	2.0	25.8	1929	4.49	↓	↓
		1630	3.0	25.8	1957	4.42		Measured at 15Ft.

Note: Water quality readings listed are assumed to be final water quality readings obtained at the end of development/ redevelopment, at the time of ground-water sampling, or at any other time the well was sufficiently purged.

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WATER QUALITY DATA

PROJECT NAME: PITT 1: Camp Lejeune PROJECT NO.: TDN 307

WATER QUALITY INSTRUMENT:

WELL	DATE	TIME	TOTAL WATER PURGED (gal)	TEMP ☐°C ☐°F	CONDUCTIVITY (µS)	pH	TECH	COMMENTS
IW01	6-16-98	1002	1.0	26.4	1930	4.25	JC	Measured at 11 Ft
	↓	1017	2.0	26.7	1910	4.24	↓	↓
	↓	1034	3.0	26.4	1930	4.36	↓	Measured at 15 Ft
	6-19-98	1000	1.0	26.9	1920	4.49	JC	Measured at 11 Ft
		1012	2.0	27.4	1930	4.47	↓	" ↓ "
	↓	1025	3.0	27.3	1950	4.36	↓	Measured at 15 Ft

Note: Water quality readings listed are assumed to be final water quality readings obtained at the end of development/redevelopment, at the time of ground-water sampling, or at any other time the well was sufficiently purged.

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MW02 WATER QUALITY DATA & Sampling

PROJECT NAME: Camp Lejeune PITT 1 PROJECT NO.: TDN 307
WATER QUALITY INSTRUMENT:

WELL	DATE	TIME	TOTAL WATER PURGED (gal)	TEMP °C °F	CONDUCTIVITY (µS)	pH	Clarity ~~TECH~~	COMMENTS
MW02	5/20	1617	2.5	25.3	84.4	5.61	sl turbid	TD 23.00
	↓	1632	5.0	25.4	86.9	5.75	sl turbid	WL: 8.17
		1647	7.5	25.1	81.6	5.63	sl turbid	14.83×(0.167)
	Collected water sample (for tracer analysis, PCE)							~2.5 GAL/WELL VOL
		after the above purging.						
	5/27/98	1327	2.5	25.8	88	5.74	turbid	TD: 23.0
	↓	1337	5.0	25.7	85.6	5.60	↓	SWL 8.70
		1347	7.5	24.8	83.5	5.46		WC [illegible]
		1400	10.0	24.8	82.6	5.60		2.5 gal/well volume
		1405	Collected sample for (PCE)					
	5/29/98	1114	2.5	24.1	80.6	5.62	GY	TD: 23.00
		1126	5.0	~~25~~ 25.6	80.9	5.34	↓	SWL: 8.22
		1138	7.5	25.7	78.6	5.28		WC: 14.78
		1145	Sample Collected for Arsenic					1 Vol: 2.4 gallons
	6-8-98	1255 ~~1238~~	3.0	23.9	89.2	5.55	JC/EH	Static WL = 8.47'
	6-8-98	1309	6.0	23.8	83.5	5.4[illegible]	JC	
	↓	1323	9.0	23.9	81.9	5.36	JC	
		1327	Collected Sample				JC	
	6-16-98	1200	2.5	25.5	80.1	5.48	JC	SWL = 8.08
		1216	5.0	25.3	79.4	5.31	↓	
	↓	1234	7.5	25.0	75.9	5.18		
		1413 ~~[illegible]~~	Collected Sample					

Note: Water quality readings listed are assumed to be final water quality readings obtained at the end of development/redevelopment, at the time of ground-water sampling, or at any other time the well was sufficiently purged.

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MW02IW WATER QUALITY DATA & Sampling

PROJECT NAME: Camp Lejeune PITT I   PROJECT NO.: TDN 307
WATER QUALITY INSTRUMENT: ____

WELL	DATE	TIME	TOTAL WATER PURGED (gal)	TEMP ☒°C ☐°F	CONDUCTIVITY (µS)	pH	TECH	COMMENTS
MW02IW	5/20	1725	5.8	26.1	265	11.54	clear	TD: 50.00
	↓	1756	11.5	25.3	264	7.16	Turbid	WL: 14.81
		1840	17.3	24.8	265	6.86	"	35.19 (×0.167)
		1911	23.1	23.7	257	6.68	"	5.8 GAL/WELL VOL
	Collected water sample (for tracers & PCE analysis after							
		the above purging						
	5/23/98	1046	6.0	25.7	234	6.24	GY	TD: 50.0
	↓	1115	12.0	26.2	236	6.33	"	SWL: 14.92
		1145	18.0	26.6	235	6.29	"	WC: 35.08
	↓	1150	Collected sample for (PCE)				"	5.7 gallons per well volume
	6/8/98	14:21	6.0	24.3	240	6.66	JC	Static WL: 15.19
	↓	14:51	12.0	24.5	214	6.33	"	
		15:24	18.0	24.2	220	6.30	"	
	↓	1528	Collected Sample				"	
	6-16-98	1315	6.0	24.4	205	6.25	JC	SWL = 15.64
	↓	1346	12.0	24.5	210	6.19	↓	
		1405	18.0	24.7	217	6.20		
	↓	1407	Collected Sample				↓	
	6-26-98	0915	Ø	–	Purging	–	JC	SWL: 15.59
	↓	1110	18.0	Collected Sample		–	↓	DTW: 15.89

Note: Water quality readings listed are assumed to be final water quality readings obtained at the end of development/redevelopment, at the time of ground-water sampling, or at any other time the well was sufficiently purged.

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MW03 WATER QUALITY DATA & Sampling

PROJECT NAME: CAMP LEJUENE PITT PROJECT NO.: TDN 307
WATER QUALITY INSTRUMENT:

WELL	DATE	TIME	TOTAL WATER PURGED (gal)	TEMP ☐°C ☐°F	CONDUCTIVITY (µS)	pH	TECH	COMMENTS
MW03	5/29/98	0835	1.5	24.9	125.5	4.92	GY	
		0845	3.0	24.4	94.8	4.88		turn pump down
		0902	4.5	25.2	90.5	4.80		TD: 15.00
		0915	6.0	25.6	89.5	4.91		SWL: 6.93
		0920	Sample collected for Arsnic					WC: 8.07
								1 Vol: 1.3 gallons
	6/26/98	1150	Ø	-	Purging	-	JC	PTW: 8.16
	↓	1240	6.0	-	Collected Sample		↓	SWL 7.41

Note: Water quality readings listed are assumed to be final water quality readings obtained at the end of development/redevelopment, at the time of ground-water sampling, or at any other time the well was sufficiently purged.

APPENDIX O

PITT Analytical Data QA/QC Report

Appendix O
PITT Data Quality Assurance / Quality Control Report

Introduction

EPA's contract laboratory, Mantech Environmental (Mantech), was used to analyze water samples produced during the initial PITT at Site 88. The PITT data includes gas chromatograph (GC) analysis of the PITT samples for methanol, 1-propanol, 4-methyl-2-pentanol, 1-hexanol, 1-heptanol and perchloroethene (PCE). Methanol was not used in the moment analysis to determine the residual NAPL saturation, hence the Quality Assurance/Quality Control (QA/QC) addressed herein was mainly limited to the conservative tracer, 1-propanol, and the partitioning tracers, 4-methyl-2-pentanol, 1-hexanol, and 1-heptanol. Quality assurance flags relevant to the measured tracer concentration data in the effluent samples are tabulated in this appendix. Data for calibration check standards and for each sampling point (e.g. injectate, extraction wells, MLS's) are presented in separate worksheets.

Normally, analytical data generated by a laboratory using non-standard analytical procedures must meet Level II requirements. Instead, establishing a Level Ill, type of QA/QO, was attempted. Level III is normally applied to standard methods of analysis. No standard methods are available for GC analysis of the alcohol tracers used during the PITT. Rather, the methods used to analyze PITT samples for these alcohols had to be specifically developed to prevent analyte interferences and to reduce analytical costs. Requiring Level Ill QA/QC for these data demonstrates a commitment to producing high quality, defensible data.

The following QC samples were analyzed:

- calibration check standards,
- method blanks,
- field blanks,
- field duplicates, and
- trip blanks.

A summary of the analytical results of the QO samples is described in the following section.

Data from PITTs

The Mantech laboratory analyzed the effluent water samples for the conservative and partitioning tracer concentrations, and POE during the PITT. A modified SW8015B method was used for measuring the tracer concentrations. Calibration was performed according to the calibration factor method in SW-846 8000A. A Carbopak packed GC column with a 1% SP-1000 coating was used to analyze the partitioning tracers. The holding time for the tracers was determined to be 21 days. The reporting limit for all the tracers and the PCE was 10 mg/L and all the data below this limit are suitably flagged with a ‘j’ identifier. The upper calibration limit for all the data was 200 mg/L and all the data above this concentration are flagged with a ‘jj’ identifier. Even though most of these samples were usually diluted before analysis, some of the analyzed samples reported a concentration higher than 200 mg/L after dilution and are suitably flagged. The diluted samples were flagged with a “d” and the dilution ratios are also given with the Sample ID.

Calibrations on separate GCs based on the analysis of the same calibration standards do not ensure identical performance among the GCs. EPA guidelines were used to calibrate the GCs, but the inherent variability between individual calibration standard analyses result in imperfect, though acceptable, calibrations. As a result, duplicate analyses on different GCs will often show a systematic error, i.e., consistently higher or lower analyte concentrations may be measured on a given GC compared to another GC. Certainly this error should be within QC limits. To correct for this small potential systematic error, normalized concentrations are used in the moment analysis of the tracer breakthrough curves. Normalized concentrations, which are dimensionless, are calculated by dividing the measured sample concentrations by the average tracer concentration in the injectate measured by the same GC. In this appendix, only non-normalized concentrations are presented.

Analyzing a method blank at the beginning of every batch monitors the effect of instrument contamination. Ideally, no analyte should be detected in the method blank. However, because of carry-over effects from samples that contain the analytes (especially at high concentrations) and potential injection port contamination, analytes are sometimes detected in method blank analyses. This is not a problem except when the concentrations detected in the method blank analysis are significant, e.g., greater than 10% of the concentrations in the subsequent samples being analyzed.

In this project, results of method blanks occasionally showed slight instrument contamination, usually due to carry-over from a preceding sample containing high concentrations of analytes. Concentration data are flagged with a “j,b” whenever the measured sample concentration is less than the reporting limit but is detected by the GC. Overall, such carry-over and other potential instrument contamination are believed to be negligible.

Control limits of 70-130% would be acceptible on the recoveries of calibration check standards, however, controls limits were set at 80-120% for this QA/QC report. These control limits were infrequently exceeded for the tracers. When a control limit for an analyte was exceeded, all data for the analyte obtained in the batch was flagged with a “jj”. In no case was a GC believed to be out of calibration when such an event occurred. The poor recoveries in these cases were attributed to degradation of the batch calibration check standard and possibly erroneous injections by the autosampler.

In general field duplicates showed a reasonable degree of repeatability. Poor repeatability was generally observed when the measured concentrations were below the reporting limit.

General Comments Regarding QA/QC

The overall quality of the data analyzed by the EPA-Mantech lab is acceptable and conforms to Level II. However Level Ill was not attained since unforeseen problems were encountered due to the sample matrix. As a result of the unforeseen problems, a crash effort was instituted to analyze the samples before the expiration of the 21 day holding time. Hence, no matrix spikes and matrix spike duplicate samples were analyzed and no QC reference samples were run to quantify the certainty of the measured data. However since the results from a PITT is influenced more by the trends of the breakthrough curves, rather than individual points, and only requires consistent measurements (i.e., no instrument drift), it was concluded that the data was acceptable for estimating the residual NAPL saturation in the PITT test zone. For the upcoming post-SEAR PITT, the Quality Assurance Project Plan (QAPP) must be rewritten to account for possible mishaps and ensure that a higher level of QA/QC (Level Ill) is maintained.

MANAGEMENT TECHNOLOGY

Ref: 98-RC12
Contract #68-C-98-138
October 15, 1998

Dr. Lynn Wood
National Risk Management Research Laboratory
Subsurface Protection & Remediation Division
U.S. Environmental Protection Agency
P.O. Box 1198
Ada, OK 74820

THRU: D.D. Fine DDFine

Dear Lynn,

In response to your request for the analytical method(s) used to analyze samples from the Camp Lejeune alcohol tracer experiment, I have compiled a sample preparation and analyses overview and two outlines describing the operating conditions of the Hewlett-Packard 5880A gas chromatograph relative to the time that either a capillary or packed column was in use in the instrument.

Capillary column analyses were performed from the beginning of analyses until the end of May 1998, while packed column analyses were performed from June 1998, until the completion of analyses in mid-July 1998.

There is not an existing SOP, as such, that details the analytical method used for either column, since they were developed and modified during the course of the aforementioned analyses. Hopefully, the outlines will provide you with the information you require. If you need more thorough or specific information pertaining to these methods, please contact me at your convenience.

Sincerely,

Randy Callaway

Randy Callaway

xc: R.L. Cosby
J.L. Seeley
G.B. Smith

ManTech Environmental Research Services Corporation

R.S. Kerr Environmental Research Center, P.O. Box 1198, 919 Kerr Research Drive
Ada, Oklahoma 74821-1198 580-436-8660 FAX 580-436-8501

RE-4-482, CAMP LEJEUNE, NC
SAMPLE PREP AND ANALYSES
SCHEME FOR ALCOHOL TRACERS

Aqueous samples from Camp Lejeune, NC, were received in both 4 ml vials (MLS samples) and 20 ml vials (extraction well samples / injection well samples). Approximately 2 ml of the original sample was transferred by glass pasteur pipette to an 11 mm autosampler vial and crimp sealed. Samples were stored under refrigeration prior to analyses. In some instances, such as the injection well samples, the sample was diluted with deionized water before analysis.

Calibration standards and calibration check standards of the alcohols were prepared from a single aqueous stock solution at a concentration of 200 ppm. This concentration was determined by the solubility of 1-heptanol in water. Standards of lower concentration were prepared by serial dilution of the stock with deionized water.

Calibration standards and calibration check standards of PCE were prepared from a methanolic stock solution of PCE at a concentration of 10,000 ng/ul. Serial dilution was not used for the preparation of any PCE standards, rather, they were prepared by spiking an appropriate amount of the methanolic standard into a specific volume of deionized water.

During the time that analyses were performed using a capillary column, 0.5 ul of aqueous sample was injected directly into the inlet port liner for flash vaporization and subsequent separation in the GC column. Samples were injected at their original concentration unless a dilution was indicated. Calibration and calibration check standards were analyzed in an identical manner.

During the time that analyses were performed using a packed column, 5 ul of aqueous sample was injected directly into the steel 1/8” column adapter for flash vaporization and subsequent separation in the the GC column. As with the capillary column, samples were injected at their original concentration unless dilutions were indicated, and all standards were analyzed in a manner identical to the samples.

RE-4-482 - CAMP LEJEUNE, NC
CAPILLARY COLUMN ANALYSES

I. HP5880 GC - HARDWARE SPECIFICATIONS

A. Compressed Gasses
1. Carrier: hydrogen @ 10 ml/min (40C)
2. Detector Make-up: nitrogen @ 20 ml/min
3. Split Vent: hydrogen @ 20 ml/min
4. Purge Vent: hydrogen @ 2ml/min
5. Fuel: hydrogen @ 30 ml/min
6. Oxidant: air @ 390 ml/min

B. Column
1. Type: J&W Scientific DB-624
2. Dimensions: 30m x 0.32mm x 1.8um film
3. Material: fused silica
4. Temp Limit: -20 - 260C

C. Injector
1. Inlet Port: capillary
2. Mode: splitless
3. Liner: 2mm ID glass w/ fused silica wool plug
4. Liner Seal: viton O-ring
5. Septa: Supelco Thermogreen LB-2

D. Detector
1. Type: flame ionization (FID)
2. Jet: capillary
3. Air/Fuel Ratio: 13:1

II. HP5880 GC - SOFTWARE SPECIFICATIONS

A. Instrument Control
1. Analyses: “ALCOHOL TRACERS” (for capillary column)
2. Calibration: none

B. Temperature Program
1. Type: two stage ramp
2. Initial Temp & Time: 40C for 0.00 min
3. Level 1: rate = 8C/min to 80C, final time = 4.00 min
4. Level 2: rate = 25C/min to 205C, final time = 0.00 min
5. Run Time: 14.00 min
6. Oven Equilibration Time: 1.00 min

C. Miscellaneous Integrator Parameters
1. Peak Width: 0.02
2. Attenuation: 2^2
3. Chart Speed: 0.30
4. Threshold: 3
5. Offset: 10%

III. HP7673A AUTOINJECTOR OPERATING CONDITIONS

A. Injector Program (AUTO SEQ 2)
1. Mode: normal
2. Pre-Injection Sample Washes: 3
3. Viscosity: 7
4. Sample Pumps: 6
5. Sample Volume: 1 (equivalent to 0.5 ul w/ 75ASN syringe)
6. Post Injection Solvent A Washes: 3
7. Post Injection Solvent B Washes: 3

B. Syringe Wash Solvents
1. Solvent A: acetone
2~. Solvent B: deionized water

C. Syringe
1. Type: Hamilton 75ASN
2. Volume: 5 ul w/ 0.5 ul graduations
3. Plunger: stainless steel

IV. MILLENNIUM PROCESSING METHOD PARAMETERS

A. Integration Window
1. Peak Width: 10
2. Minimum Area: 500
3. Threshold: 30
4. Minimum Height: 450
5. Timed Events:

	Start	Event Description	Value	Stop
a.	11.000	Inhibit Integration		14.000

B. Component Table Window
1. Components:
   a. methanol
   b. 1-propanol
   c. 4-methyl-2-pentanol
   d. tetrachloroethene (PCE)
   e. 1-hexanol
   f. 1-heptanol
2. Quantified by: area
3. Calibration Curves for Alcohols
   a. Range: 1 - 200 ppm
   b. Curve Fit: linear
   c. Weighting: 1/X
4. Calibration Curve for PCE
   a. Range: 1-l50 ppm
   b. Curve Fit: quadratic
   c. Weighting: 1/X

C. QuickSet Parameters for Data Acquisition
1. Data Start: 0.28 min
2. Run Time: 14.00 min
3. Acquisition Rate: 5 points/sec

RE-4-482 - CAMP LEJEUNE, NC
PACKED COLUMN ANALYSES

I. HP5880 GC - HARDWARE SPECIFICATIONS

A. Compressed Gasses
1. Carrier: hydrogen @ 20 ml/min (170C)
2. Fuel: hydrogen @ 20ml/min
3. Oxidant: air @ 400 ml/min

B. Column
1. Type: Alltech Gas Chrom 254, 80/100 mesh
2. Dimensions: 6' x 1/8" x .085"
3. Material: stainless steel
4. Temp Limit: 275-310C

C. Injector
1. Inlet Port: capillary
2. Liner: none, 1/8" steel column adapter
3. Septa: Supelco Thermogreen LB-2

D. Detector
1. Type: flame ionization (FID)
2. Jet: packed
3. Air/Fuel Ratio: 10:1

II. HP5880 GC - SOFTWARE SPECIFICATIONS

A. Instrument Control
1. Analyses: "ALCOHOL TRACERS" (for packed column)
2. Calibration: none

B. Temperature Program
1. Type: isothermal
2. Initial Temp & Time: 170C for 25.00 min
3. Run Time: 23.00 min
4. Oven Equilibration Time: 3.00 min

C. Integrator Run Table
1. 0.00 Valve 7 On: contact closure for Millennium start signal
2. 0.10 Valve 7 Off: contact open (reset)
3. 0.50 Valve 6 Off: septum purge flow off
4. 22.00 Stop: end chromatogram plot

D. Miscellaneous Integrator Parameters
1. Peak Width: 0.04
2. Attenuation: 2^2
3. Chart Speed: 0.30
4. Threshold: 4
5. Offset: 10%

III. HP7673A AUTOINJECTOR OPERATING CONDITIONS

A. Injector Program (AUTO SEQ 2)
1. Mode: normal
2. Pre-Injection Sample Washes: 3
3. Viscosity: 7
4. Sample Pumps: 3
5. Sample volume: 5 (equivalent to 5 ul w/ 175ASN syringe)
6. Post Injection Solvent A Washes: 3
7. Post Injection Solvent B Washes: 3

B. Syringe Wash Solvents
1. Solvent A: acetone
2. Solvent B: deionized water

C. Syringe
1. Type: Hamilton 175ASN
2. Volume: 5 ul w/ 1.0 ul graduations
3. Plunger: teflon tipped stainless steel

IV. MILLENNIUM PROCESSING METHOD PARAMETERS

A. Integration Window
1. Peak Width: 70
2. Minimum Area: 6000
3. Threshold: 10
4. Minimum Height: 70
5. Timed Events:

	Start	Event Description	Value	Stop
a.	0.000	Inhibit Integration		0.866

B. Component Table Window
1. Components:
   a. 1-propanol
   b. 4-methyl-2-pentanol
   c. 1-hexanol
   d. 1-heptanol
2. Quantified by: area
3. Calibration Curve for Alcohols except 1-Heptanol
   a. Range: 5 - 200 ppm
   b. Curve Fit: linear
   c. Weighting: 1/X
4. Calibration Curve for 1-Heptanol
   a. Range: 10 - 200 ppm
   b. Curve Fit: linear
   c. Weighting: 1/X

C. QuickSet Parameters for Data Acquisition
1. Data Start: 0.20 min
2. Run Time: 23.00 min
3. Acquisition Rate: 5 points/sec

MANTECH ENVIRONMENTAL RESEARCH SERVICES CORP.

SUBSURFACE PROTECTION AND REMEDIATION DIVISION

NATIONAL RISK MANAGEMENT RESEARCH LABORATORY, USEPA

ROBERT S. KERR ENVIRONMENTAL RESEARCH LABORATORY, ADA, OKLAHOMA

STANDARD OPERATING PROCEDURE CLEARANCE FORM

SOP Number: 201

TITLE: GC Analysis of Alcohol compounds in Water Samples.

Draft

AUTHOR(S):

Author's Signature [signature] Date 9/24/98

Section Supervisor ______________________ Date __________

QA Coordinator ______________________ Date __________

Program Manager ______________________ Date __________

STANDARD OPERATING PROCEDURE

GC ANALYSIS OF ALCOHOL COMPOUNDS IN WATER SAMPLES

I. Disclaimer:

This Standard Operating Procedure has been prepared for the use of the Subsurface Protection and Remediation Division of the U.S. Environmental Protection Agency and may not be specifically applicable to the activities of other organizations. **THIS IS NOT AN OFFICIAL EPA APPROVED METHOD.** This document has not been through the Agency's peer review process or ORD clearance process.

II. Purpose (Scope and Application)

This method is a gas chromatography (GC) technique applicable to the quantitative analysis of alcohol compounds in aqueous samples. These alcohols are used in partitioning tracer tests for field studies. The alcohol compounds that can be analyzed are methanol, 1-propanol, 2-propanol, 4-methyl-2-pentanol, 1 -hexanol, 1 -heptanol, 2,2-dimethyl-3-pentanol, 2,4-dimethyl-3 -pentanol, 2-methyl-2-propanol (TBA), 2-methyl-1-propanol (IBA), 3-heptanol, 2,6-dimethyl-2-heptanol, 2-ethyl-1-hexanol, 1-octanol, and 2-octanol. The above list is not meant to be all inclusive, as there are others that could be analyzed by this method. The calibration range for the alcohol compounds is 1 to 100 ppm or 1 to 200 ppm, depending on the solubility of the individual component.

It should be noted that the aqueous samples are analyzed with no sample clean-up or preparation. i.e. the aqueous samples are transferred into autosampler vials and directly injected into GC with capillary column and FID detector without sample clean-up.

Approximately, twenty analytical runs can be performed per eight hour day. The autoinjector sample carousel can be loaded with 100 sample vials which can be analyzed overnight, requiring about 33 hours to complete.

This method is restricted to use by or under the supervision of analysts experienced in the use of gas chromatography and in the interpretation of chromatograms.

Method detection limits (MDLs) are compound dependent. The MDLs for selected analytes are presented in Table 1. 1 ppm standards were analyzed four times, the standard deviation, SD, was determined for each analyte and MDLs were estimated as 3 times SD. Quantitation limits were estimated as 10 times SD. Also included in Table 1 are retention times for each individual alcohol compound.

III. Summary of Method:

An aqueous sample is transferred into an autosampler vial. An autoinjector withdraws a small volume (1 μL) of the aqueous sample and injects it into the GC injection port. The alcohol compounds are separated on DB624 capillary column (connected with a guard column) and detected by flame ionization detector (FID). The FID signals are processed by a computerized data system to yield concentrations of the alcohols.

IV. References:

1. HIP 5880A Gas Chromatograph and HP 5880A Series GC Terminal Manuals.

2. HP 7673A Automatic Injector Manual.

3. Waters, Millennium Software User's Guide.

V. Reagents and Equipment Needed

Neat individual alcohols and MilliQ water are used to prepare calibration standards. Volumetric flasks, and graduated pipettes are used to make the standard solutions.

VI. Safety Issues:

Since some of the alcohols are toxic, the standards should be prepared in a hood, using gloves, lab coat, and safety glasses.

VII. Interferences:

Samples can be contaminated by further dilution with MilliQ 1120. Therefore, a MilliQ 1120 blank needs to be run whenever a further dilution is required. If samples contain chlorinated ethylenes, different temperature program should be carried out to avoid coelluents [35°C (5mm) at 15°C/min to 155°C (1min)]. If samples contain $CaCI_2$, a packed column should be used.

VIII. Procedures:

A. Sample Preparation

Transfer at least 1 ml of an aqueous sample into an autosampler vial. For samples less than 1 ml, a plastics insert must be used in the autosampler vial.

Table 1. Alcohol Components and Their Detection Limits

Analytes	LOD*	LOQ**	RT***	r^2****
2,2-dimethyl-3-pentanol	0.5	1.5	5.26	0.989
2,4-dimethyl-3-pentanol	0.2	0.5	5.49	0.999
2,6-dimethyl-2-heptanol	0.4	1.5	8.25	0.991
2-ethyl-1-hexanol	0.4	1.2	9.00	0.997
1-heptanol	0.1	0.2	8.10	0.999
3-heptanol	0.2	0.6	6.63	0.999
1-hexanol	0.1	0.3	6.27	0.999
methanol	o.i	0.2	0.76	0.999
4-methyl-2-pentanol	0.1	0.2	4.36	0.999
2-methyl-2-propanol (TBA)	0.4	1.5	1.38	0.999
2-methyl-1-propanol (IBA)	0.1	0.4	2.54	0.998
1-propanol	0.1	0.2	1.73	0.998
2-propanol	0.7	2.1	1.21	0.994
1-octanol	0.1	0.3	9.71	0.999
2-octanol	0.6	1.9	8.46	0.999

* Limit of Detection, ppm
** Limit of Quantitation, ppm
*** Retention Time, min
**** Regression Coefficient

B. GC analysis

Prepare the Millennium data system for data acquisition by conducting the following procedures: type all standard, and sample names into quick-set, click setup instrument icon and then run tray icon.

AUTOSAMLPLER AND GC CONDITIONS

Gas Chromatograph	HP 5880A
Autosampler	HP 7673A Automatic Injector Syringe: gas tight syringe

Injector (2) parameters:
Mode:0 (0=normal, 1'~on column)
Pre-injection sample wash: 3
Viscosity: 5
Sample pumps: 6
Sample volume: 1 µl
Post-injection acetone wash: 3
Post-injection MilliQ H_2O wash: 3
Injections per bottle: 1

Data System	Waters, Millennium
Flame Ionization Detector	
Temperature	250°C
Carrier Gas	10.5 ml/min
Split Vent	51 ml/min
Make-up Gas w/H_2	30 ml/min
Carrier Gas + FID H_2	40 ml/min
Septum Purge	2 ml/min
Injector Temperature	175°C
Injection Volume	1 µl
Split Ratio	1:5
Column	DB-624 (123-1334), JW Scientific Length: 30 m, ID: 0.32 mm, Film: 1.8 µm
Guard Column	Connex 160-2325 (Deact Fused Silica) Length: 5m, ID: 0.32 mm
GC Conditions	
Programmed Oven	
Oven Initial Temperature	40°C
Initial Time	1 min
Program Rate	10°C/min
Final Temperature	170°C
Final Time	1 min
Oven Temperature Equilibrium Time	1 min

Integrator

Threshold	4
Attenuation	2
Peak Width	0.04
Chart Speed	0.3 cm/min

The integrator is used only as a charting device, to provide ready access for viewing instrument output. It is not used for quantitation.

IX. Calibration Control:

Alcohol calibration standards are prepared from 100 or 200 ppm stock solution. Care should be taken that the alcohols are completely solubilized. The stock solution are prepared from neat compounds and MilliQ water. Calibration curves are set up on the GC using 1, 10, 25, 50, 100 or 1, 10, 50, 100 and 200 ppm as the data points respectively.

Analysis Scheme:

1. MilliQ water blank.
2. Calibration standards.
3. Check standards are analyzed after calibration curve, and after every 10 samples.
4. Duplicate sample.
5. Samples

X. Corrective Action:

Before analyzing any samples, organic-free water (MilliQ water) should be analyzed as a blank sample. A calibration curve should be run daily just after the blank. A check standard that represents a point on a calibration curve close to the concentration of sample should be analyzed. Additional check standards should be analyzed after every 10 samples. A duplicate sample should be run for each sample set. The QC goal for the check standards is $\pm$10%. If the QC check standards can not meet the goal, the new calibration curve, which is run at the beginning should be used. The goal for the blank sample is that the corresponding components should be below detection limits. If some components are detectable and above the quantitation limits, a blank needs to be reanalyzed and an anomaly note should be provided in the reports. The QC goal for a duplicate is $\pm$10%. If this goal is not met, an anomaly should be noted in the report.

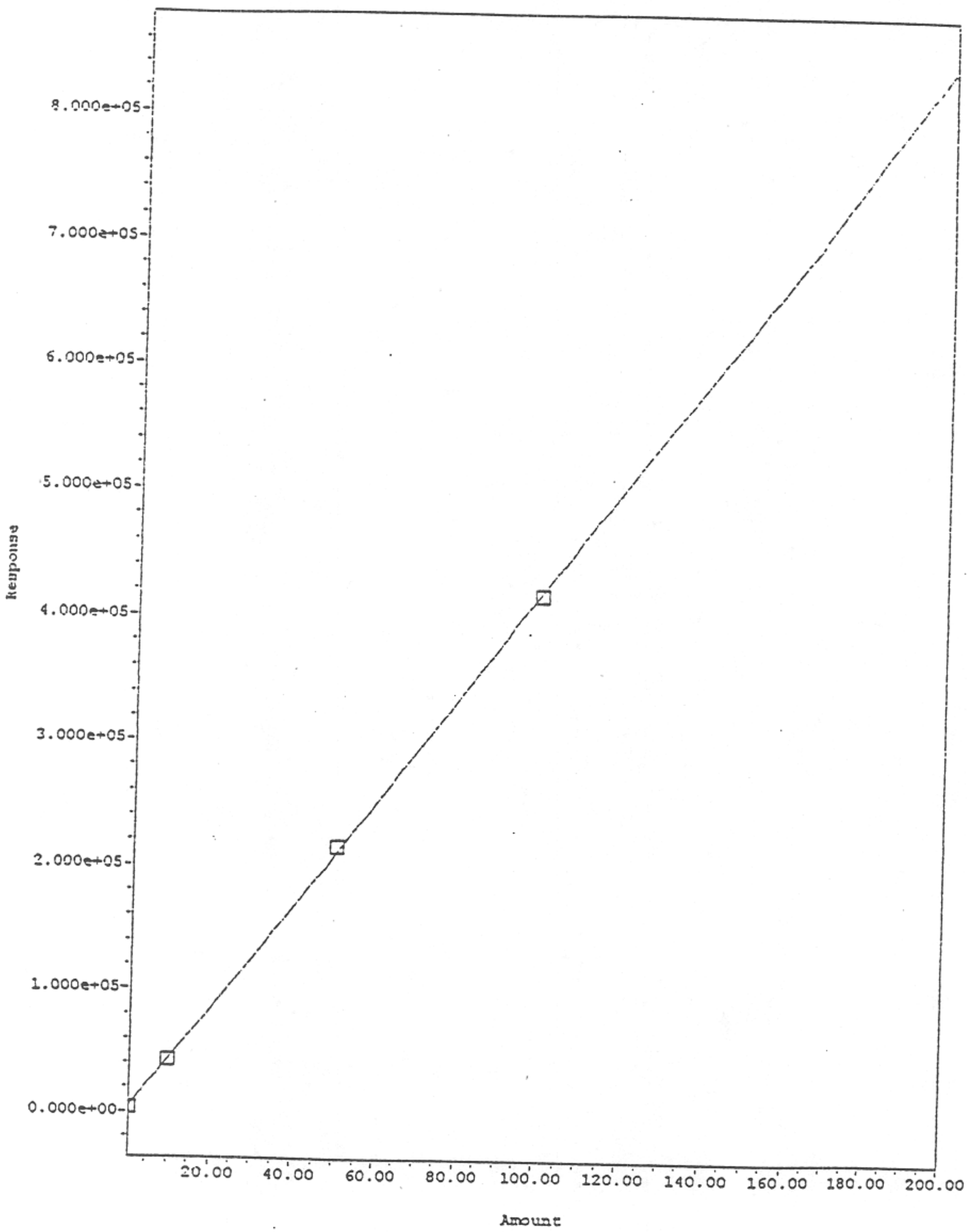
If concentration for any components in a sample is higher than calibration range, the sample needs to be reanalyzed for those components at further appropriate dilution.

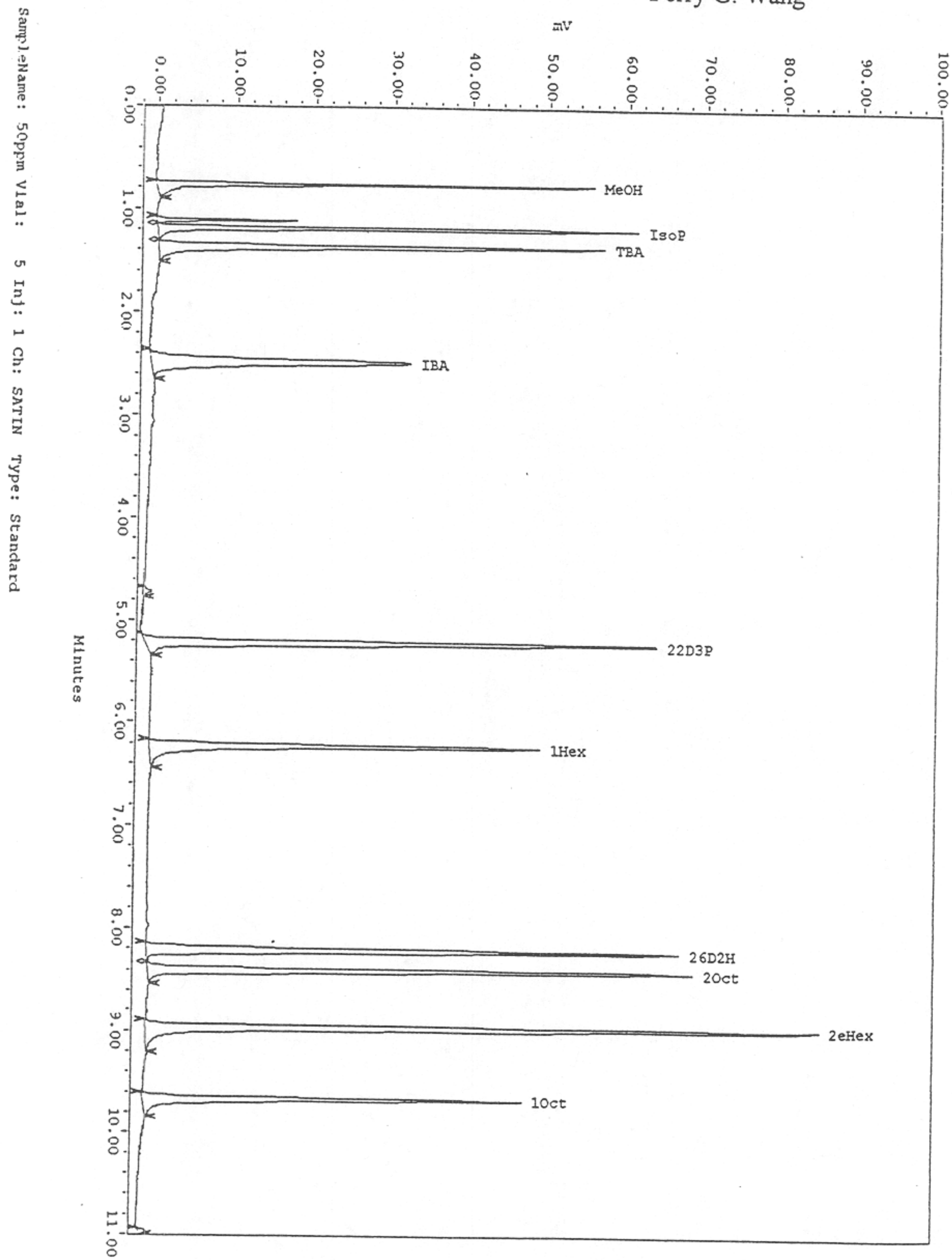
XI. Data Analysis

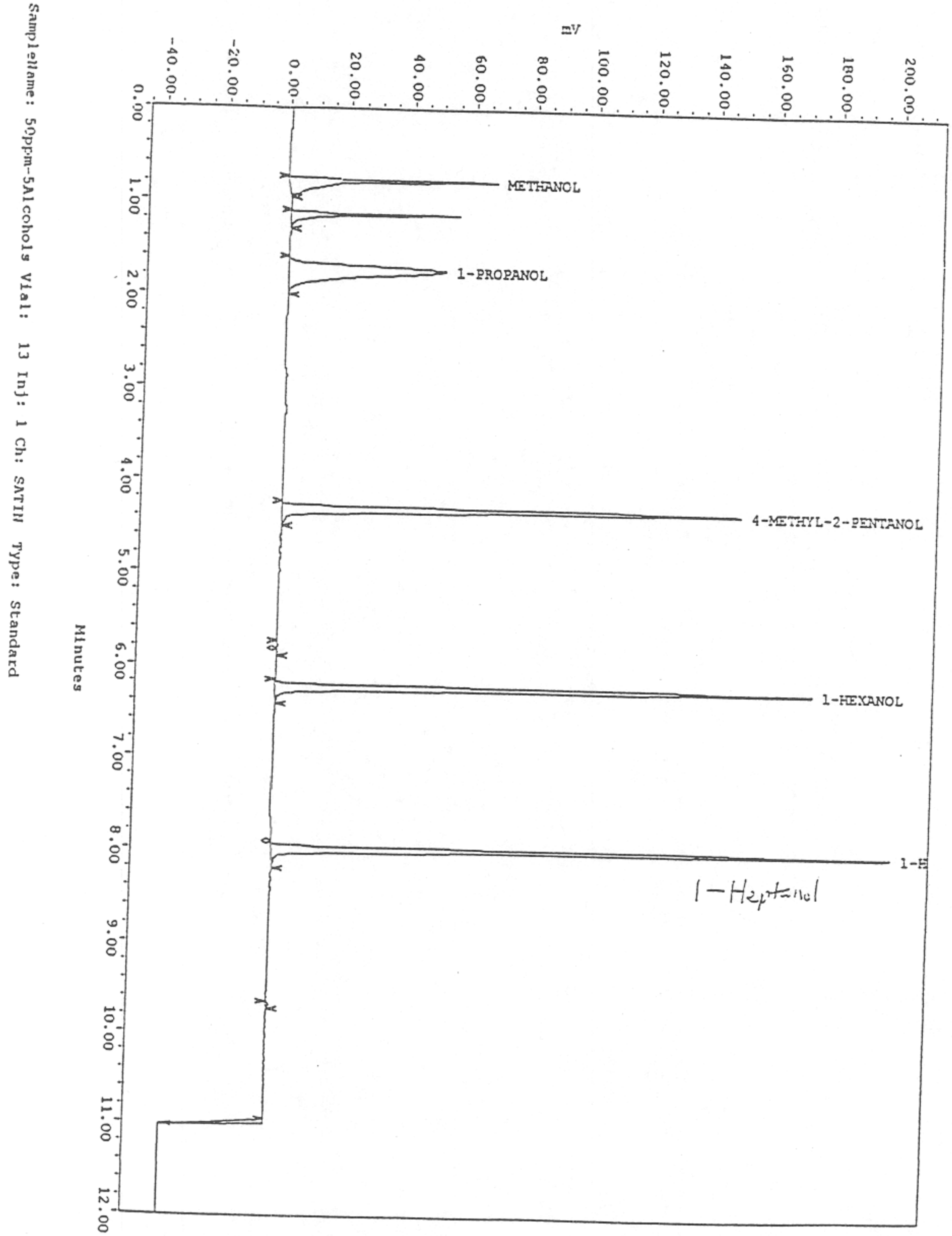
An external standard method is used for calibration and quantitation. Both linear and quadratic curve fits are used based on their linearity. See attached (see Table 1 for statistics of the curves).

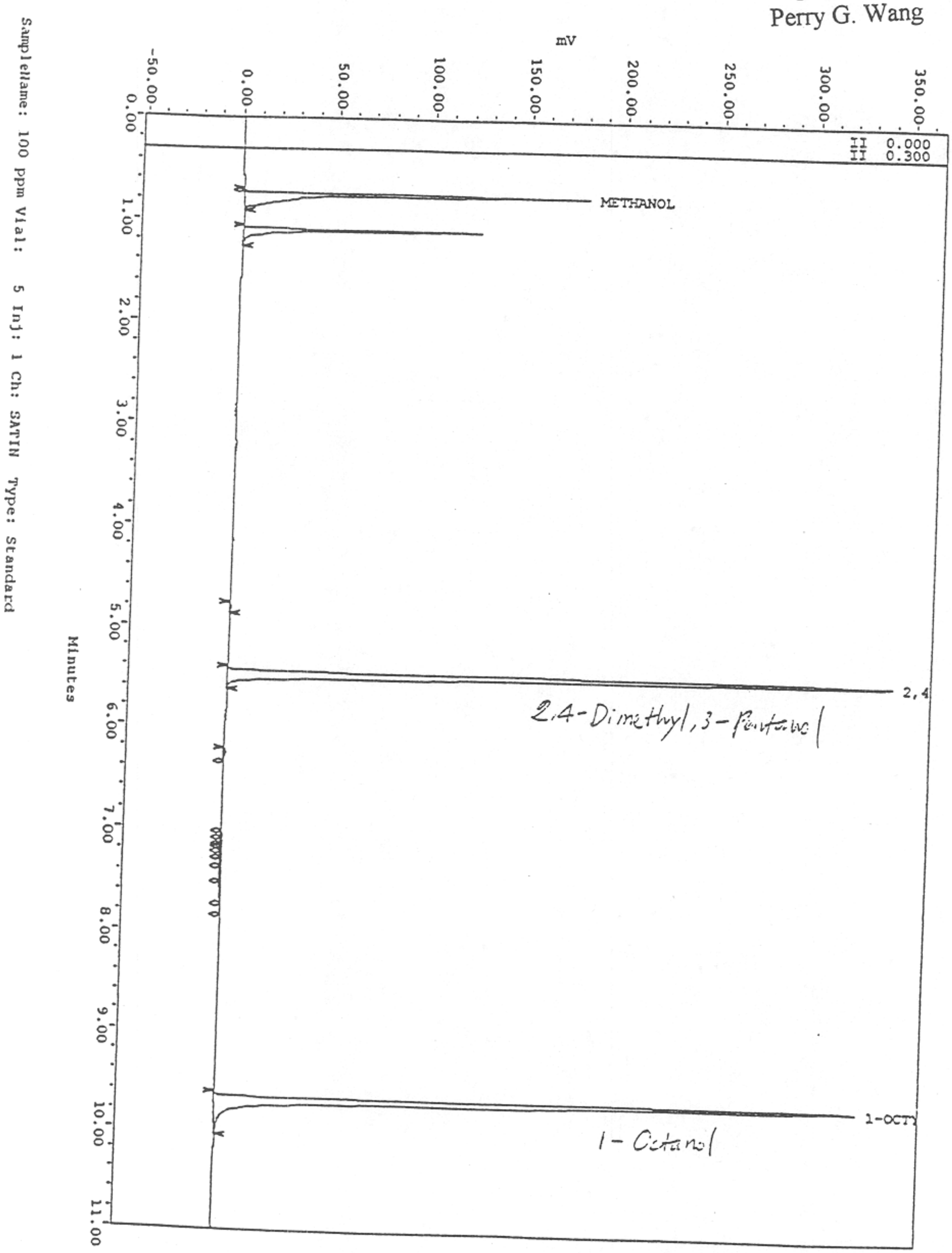
XII. Miscellaneous:

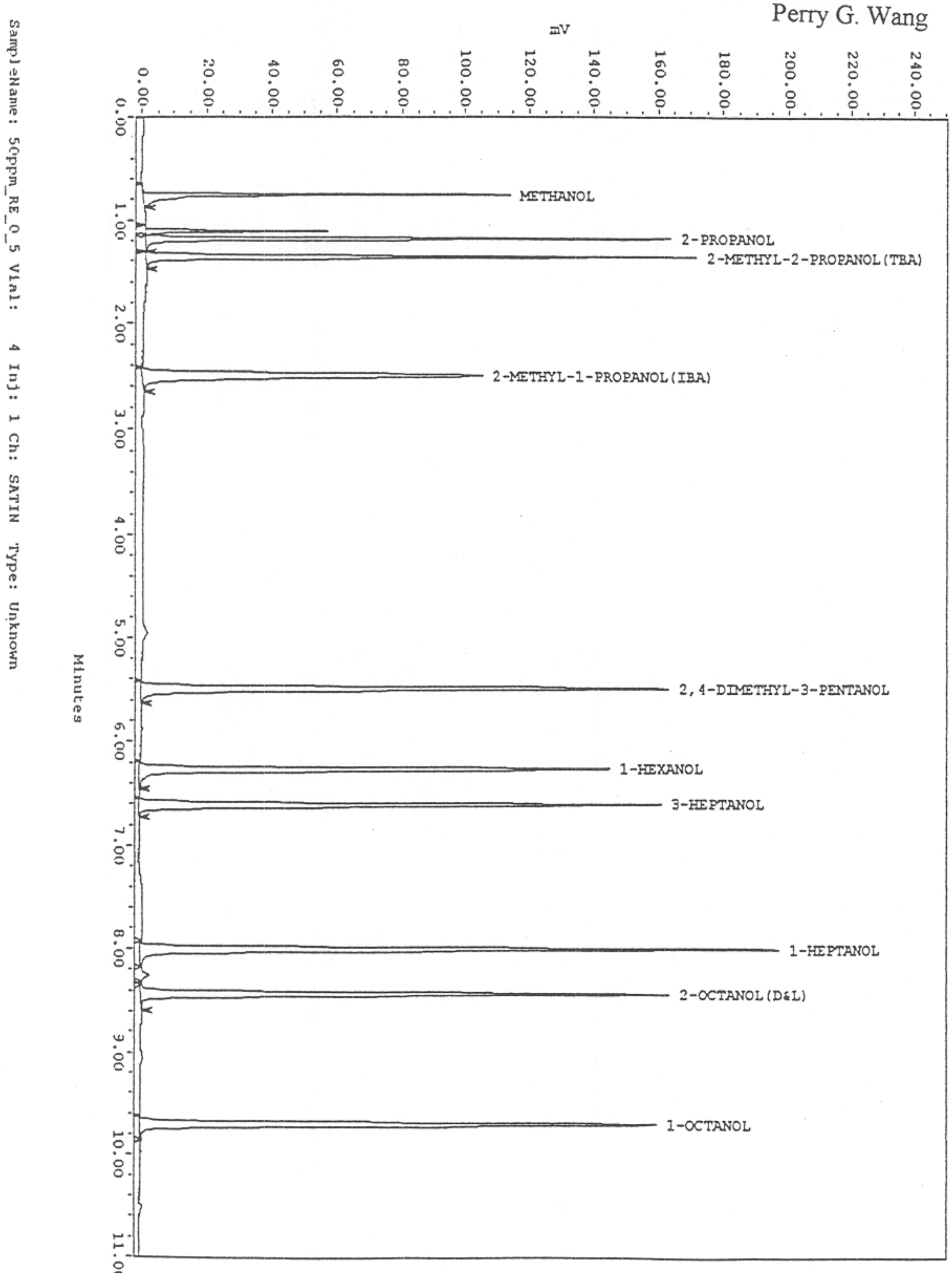
None.


8.000e+05
7.000e+05
6.000e+05
5.000e+05
4.000e+05
3.000e+05
2.000e+05
1.000e+05
0.000e+00
Response
20.00
40.00
60.00
80.00
100.00
120.00
140.00
160.00
180.00
200.00
Amount


mV
Minutes
MeOH
IsoP
TBA
IBA
22D3P
1Hex
26D2H
2Oct
2eHex
1Oct
SampleName: 50ppm Vial: 5 Inj: 1 Ch: SATIN Type: Standard


mV
METHANOL
1-PROPANOL
4-METHYL-2-PENTANOL
1-HEXANOL
1-H
1-Heptanol
Minutes
SampleName: 50ppm-5Alcohols Vial: 13 Inj: 1 Ch: SATIN Type: Standard


mV
-50.00
0.00
50.00
100.00
150.00
200.00
250.00
300.00
350.00
0.000
0.300
METHANOL
2,4
2,4-Dimethyl,3-Pentanol
1-OCTY
1-Octanol
0.00
1.00
2.00
3.00
4.00
5.00
6.00
7.00
8.00
9.00
10.00
11.00
Minutes
SampleName: 100 ppm Vial: 5 Inj: 1 Ch: SATIN Type: Standard


mV
Minutes
SampleName: 50ppm_RE_0_5 Vial: 4 Inj: 1 Ch: SATIN Type: Unknown
METHANOL
2-PROPANOL
2-METHYL-2-PROPANOL(TBA)
2-METHYL-1-PROPANOL(IBA)
2,4-DIMETHYL-3-PENTANOL
1-HEXANOL
3-HEPTANOL
1-HEPTANOL
2-OCTANOL(D&L)
1-OCTANOL

Project: PITT at ESTCP Camp Lejeune
Acceptable QA/QC limits: % Recovery between 80% and 120%

Data QA/QC by	DW
Date created	1/22/99
Date last modified	1/26/99

Sample Legend
CC = Calibration check
j = below reporting limit
d = diluted sample
BDL = below detection limit
NA = not applicable
jj = out of acceptable QA/QC and/or calibration limits
OK = within acceptable QA/QC limits

Calibration Check results: 1 and 10 ppm tracers

Sample Type	Sample ID	Date and Time Sampled	Date Analyzed	Methanol (mg/L)	% Recovery Methanol	Flag for Methanol	1-Propanol (mg/L)	% Recovery 1 Propanol	Flag for 1-Propanol	4-Methyl-2-pentanol (mg/L)	% Recovery 4-Methyl-2-pentanol	Flag for 4-Methyl-2-pentanol	PCE (mg/L)	% Recovery PCE	Flag for PCE	1-Hexanol (mg/L)	% Recovery 1-Hexanol	Flag for 1-Hexanol	1-Heptanol (mg/L)	% Recovery 1-Heptanol	Flag for 1-Heptanol
CC	1 ppm tracer alcohols		5/19/98	1	100%	OK	1	91%	OK	1	96%	OK	nd	NA	NA	1	80%	jj	0	36%	jj
CC	10 ppm tracer alcohols		5/19/98	10	98%	OK	10	100%	OK	10	97%	OK	nd	NA	NA	9	88%	OK	8	77%	jj
CC	10 ppm tracers	N/A	5/25/98	7	71%	jj	8	83%	OK	8	82%	OK	nd	NA	NA	8	83%	OK	8	81%	OK
CC	10 ppm PCE	N/A	5/25/98	nd	NA	NA	nd	NA	NA	nd	NA	NA	9	92%	OK	nd	NA	NA	nd	NA	NA
CC	10 ppm tracers	N/A	6/4/98		NA	NA	19	195%	jj	16	164%	jj		NA	NA	15	153%	jj	15	150%	jj
CC	10 ppm tracers	N/A	6/5/98		NA	NA	10	100%	OK	10	99%	OK		NA	NA	10	96%	OK	10	101%	OK
CC	10 ppm tracers	N/A	6/8/98		NA	NA	10	101%	OK	12	124%	jj		NA	NA	12	116%	OK	9	93%	OK
CC	10 ppm tracers	N/A	6/11/98		NA	NA	10	97%	OK	9	92%	OK		NA	NA	10	103%	OK	10	104%	OK
CC	10 ppm tracers	N/A	6/11/98		NA	NA	11	108%	OK	10	101%	OK		NA	NA	11	111%	OK	10	103%	OK
CC	10 ppm tracers	N/A	6/12/98		NA	NA	10	96%	OK	11	105%	OK		NA	NA	11	108%	OK	10	101%	OK
CC	10 ppm tracers	N/A	6/15/98		NA	NA	11	110%	OK	12	115%	OK		NA	NA	12	118%	OK	10	104%	OK
CC	10 ppm tracers	N/A	6/16/98		NA	NA	10	96%	OK	11	107%	OK		NA	NA	10	99%	OK	10	104%	OK
CC	10 ppm tracers	N/A	6/17/98		NA	NA	13	126%	jj	8	82%	OK		NA	NA	7	75%	jj	8	80%	jj
CC	10 ppm tracers	N/A	6/18/98		NA	NA	10	102%	OK	10	105%	OK		NA	NA	11	106%	OK	10	100%	OK
CC	10 ppm tracers	N/A	6/20/98		NA	NA	12	124%	jj	10	103%	OK		NA	NA	10	104%	OK	10	100%	OK
CC	10 ppm tracers	N/A	6/21/98		NA	NA	10	105%	OK	11	106%	OK		NA	NA	11	111%	OK	9	92%	OK
CC	10 ppm tracers	N/A	6/22/98		NA	NA	6	56%	jj	7	71%	jj		NA	NA	8	81%	OK	4	42%	jj
CC	10 ppm tracers	N/A	6/24/98		NA	NA	9	91%	OK	8	80%	OK		NA	NA	8	83%	OK	9	92%	OK
CC	10 ppm tracers	N/A	6/24/98		NA	NA	9	89%	OK	9	92%	OK		NA	NA	11	112%	OK	11	108%	OK
CC	10 ppm tracers	N/A	6/25/98		NA	NA	9	91%	OK	12	119%	OK		NA	NA	9	95%	OK	10	99%	OK
CC	10 ppm tracers	N/A	6/26/98		NA	NA	8	79%	jj	6	56%	jj		NA	NA	7	71%	jj	9	90%	OK
CC	10 ppm tracers	N/A	6/26/98		NA	NA	12	121%	jj	13	131%	jj		NA	NA	13	126%	jj	13	132%	jj
CC	10 ppm tracers	N/A	6/27/98		NA	NA	10	96%	OK	9	94%	OK		NA	NA	8	81%	OK	8	85%	OK
CC	10 ppm tracers	N/A	6/27/98		NA	NA	10	96%	OK	9	94%	OK		NA	NA	8	81%	OK	8	85%	OK
CC	10 ppm tracers	N/A	6/30/98		NA	NA	11	106%	OK	11	107%	OK		NA	NA	10	100%	OK	10	100%	OK
CC	10 ppm tracers	N/A	7/1/98		NA	NA	8	79%	jj	7	71%	jj		NA	NA	8	83%	OK	7	72%	jj
CC	10 ppm tracers	N/A	7/8/98		NA	NA	10	97%	OK	8	78%	jj		NA	NA	9	88%	OK	10	96%	OK
CC	10 ppm tracers	N/A	7/8/98		NA	NA	10	97%	OK	8	78%	jj		NA	NA	9	88%	OK	10	96%	OK
CC	10 ppm tracers	N/A	7/9/98		NA	NA	10	100%	OK	10	97%	OK		NA	NA	10	101%	OK	10	95%	OK
CC	10 ppm tracers	N/A	7/9/98		NA	NA	10	100%	OK	10	97%	OK		NA	NA	10	101%	OK	10	95%	OK
CC	10 ppm tracers	N/A	7/14/98		NA	NA	10	102%	OK	10	96%	OK		NA	NA	9	89%	OK	10	104%	OK

Project: PITT at ESTCP Camp Lejeune
Acceptable QA/QC limits: % Recovery between 80% and 120%

Data QA/QC by DW
Date created 1/22/99
Date last modified 1/26/99

Sample Legend
CC = Calibration check
j = below reporting limit
d = diluted sample
BDL = below detection limit
NA = not applicable
jj = out of acceptable QA/QC and/or calibration limits
OK = within acceptable QA/QC limits

Calibration Check results: 5 and 50 ppm tracers

Sample Type	Sample ID	Date and Time Sampled	Date Analyzed	Methanol (mg/L)	% Recovery Methanol	Flag for Methanol	1-Propanol (mg/L)	% Recovery 1-Propanol	Flag for 1-Propanol	4-Methyl-2-pentanol (mg/L)	% Recovery 4-Methyl-2-pentanol	Flag for 4-Methyl-2-pentanol	PCE (mg/L)	% Recovery PCE	Flag for PCE	1-Hexanol (mg/L)	% Recovery 1 Hexanol	Flag for 1-Hexanol	1-Heptanol (mg/L)	% Recovery 1 Heptanol	Flag for 1-Heptanol
	50 ppm tracers	N/A	5/25/98	52	103%	OK	50	99%	OK	50	100%	OK	nd	NA	NA	50	101%	OK	50	100%	OK
	50 ppm PCE	N/A	5/25/98	nd	NA	NA	nd	NA	NA	nd	NA	NA	50	101%	OK	nd	NA	NA	nd	NA	NA
	5 ppm tracers	N/A	5/26/98	5	100%	OK	5	100%	OK	5	99%	OK	nd	NA	NA	5	100%	OK	5	96%	OK
	5 ppm PCE	N/A	5/26/98	nd	NA	NA	nd	NA	NA	nd	NA	NA	5	100%	OK	nd	NA	NA	nd	NA	NA
	50 ppm tracers	N/A	5/26/98	51	102%	OK	51	103%	OK	51	103%	OK	nd	NA	NA	51	103%	OK	51	103%	OK
	50 ppm PCE	N/A	5/27/98	nd	NA	NA	nd	NA	NA	nd	NA	NA	50	100%	OK	nd	NA	NA	nd	NA	NA
	50 ppm PCE	N/A	5/27/98	nd	NA	NA	nd	NA	NA	nd	NA	NA	53	105%	OK	nd	NA	NA	nd	NA	NA
	5 ppm tracers	N/A	5/28/98	3	65%	jj	3	69%	jj	4	75%	jj	nd	NA	NA	4	74%	jj	4	72%	jj
	50 ppm PCE	N/A	5/28/98	nd	NA	NA	nd	NA	NA	nd	NA	NA	42	83%	OK	nd	NA	NA	nd	NA	NA
	50 ppm tracers	N/A	6/4/98		NA	NA	50	100%	OK	55	109%	OK		NA	NA	53	105%	OK	50	99%	OK
	50 ppm tracers	N/A	6/6/98		NA	NA	44	89%	OK	46	92%	OK		NA	NA	48	96%	OK	51	102%	OK
	50 ppm tracers	N/A	6/8/98		NA	NA	52	104%	OK	48	96%	OK		NA	NA	45	90%	OK	45	91%	OK
	5 ppm tracers	N/A	6/8/98		NA	NA	5	96%	OK	5	93%	OK		NA	NA	5	105%	OK	3	65%	jj
	50 ppm tracers	N/A	6/8/98		NA	NA	46	93%	OK	44	89%	OK		NA	NA	45	89%	OK	57	113%	OK
	5 ppm tracers	N/A	6/9/98		NA	NA	5	99%	OK	4	70%	jj		NA	NA	4	83%	OK	2	42%	jj
	50 ppm tracers	N/A	6/9/98		NA	NA	54	108%	OK	49	98%	OK		NA	NA	48	96%	OK	45	90%	OK
C	50 ppm tracers	N/A	6/9/98		NA	NA	44	89%	OK	41	82%	OK		NA	NA	41	81%	OK	nd	NA	NA
	5 ppm tracers	N/A	6/11/98		NA	NA	5	99%	OK	6	112%	OK		NA	NA	6	114%	OK	7	136%	jj
	5 ppm tracers	N/A	6/11/98		NA	NA	5	92%	OK	5	102%	OK		NA	NA	5	103%	OK	6	127%	jj
	50 ppm tracers	NA	6/11/98		NA	NA	50	99%	OK	49	98%	OK		NA	NA	50	100%	OK	47	95%	OK
	5 ppm tracers	N/A	6/12/98		NA	NA	6	117%	OK	7	137%	jj		NA	NA	10	194%	jj	7	145%	jj
	50 ppm tracers	N/A	6/12/98		NA	NA	46	92%	OK	47	95%	OK		NA	NA	45	90%	OK	38	76%	jj
	5 ppm tracers	N/A	6/15/98		NA	NA	5	107%	OK	4	89%	OK		NA	NA	5	97%	OK	4	86%	OK
	50 ppm tracers	N/A	6/15/98		NA	NA	50	100%	OK	50	100%	OK		NA	NA	50	99%	OK	51	101%	OK
	5 ppm tracers	N/A	6/16/98		NA	NA	4	82%	OK	5	91%	OK		NA	NA	5	96%	OK	5	98%	OK
	50 ppm tracers	N/A	6/16/98		NA	NA	53	105%	OK	51	101%	OK		NA	NA	49	97%	OK	52	105%	OK
	5 ppm tracers	N/A	6/17/98		NA	NA	9	173%	jj	5	91%	OK		NA	NA	4	88%	OK	5	109%	OK
	50 ppm tracers	N/A	6/17/98		NA	NA	49	98%	OK	45	90%	OK		NA	NA	45	90%	OK	43	86%	OK
	5 ppm tracers	N/A	6/18/98		NA	NA	6	111%	OK	5	99%	OK		NA	NA	5	109%	OK	6	112%	OK
	50 ppm tracers	N/A	6/18/98		NA	NA	51	101%	OK	51	102%	OK		NA	NA	52	104%	OK	48	96%	OK
	5 ppm tracers	N/A	6/20/98		NA	NA	5	90%	OK	5	95%	OK		NA	NA	5	99%	OK	4	84%	OK
	50 ppm tracers	N/A	6/20/98		NA	NA	50	100%	OK	50	100%	OK		NA	NA	46	92%	OK	46	91%	OK
	5 ppm tracers	N/A	6/21/98		NA	NA	4	83%	OK	3	68%	jj		NA	NA	5	91%	OK	5	96%	OK
	50 ppm tracers	N/A	6/21/98		NA	NA	53	107%	OK	52	105%	OK		NA	NA	52	103%	OK	52	104%	OK
	5 ppm tracers	N/A	6/22/98		NA	NA	3	54%	jj	5	99%	OK		NA	NA	6	126%	jj	5	100%	OK
	50 ppm tracers	N/A	6/22/98		NA	NA	47	93%	OK	48	96%	OK		NA	NA	50	101%	OK	50	99%	OK
	5 ppm tracers	N/A	6/22/98		NA	NA	4	88%	OK	3	58%	jj		NA	NA	5	93%	OK	4	85%	OK

Sample Type	Sample ID	Date and Time Sampled	Date Analyzed	Methanol (mg/L)	% Recovery Methanol	Flag for Methanol	1-Propanol (mg/L)	% Recovery 1-Propanol	Flag for 1-Propanol	4-Methyl-2-pentanol (mg/L)	% Recovery 4-Methyl-2-pentanol	Flag for 4-Methyl-2-pentanol	PCE (mg/L)	% Recovery PCE	Flag for PCE	1-Hexanol (mg/L)	% Recovery 1 Hexanol	Flag for 1-Hexanol	1-Heptanol (mg/L)	% Recovery 1 Heptanol	Flag for 1-Heptanol
	50 ppm tracers	N/A	6/22/98		NA	NA	56	112%	OK	57	115%	OK		NA	NA	55	111%	OK	58	116%	OK
	5 ppm tracers	N/A	6/22/98		NA	NA	5	100%	OK	5	97%	OK		NA	NA	5	100%	OK	5	95%	OK
	50 ppm tracers	N/A	6/23/98		NA	NA	53	106%	OK	46	92%	OK		NA	NA	49	99%	OK	47	95%	OK
	5 ppm tracers	N/A	6/23/98		NA	NA	5	94%	OK	5	91%	OK		NA	NA	4	75%	jj	4	81%	OK
	50 ppm tracers	N/A	6/24/98		NA	NA	50	100%	OK	50	100%	OK		NA	NA	48	97%	OK	50	101%	OK
	5 ppm tracers	N/A	6/24/98		NA	NA	6	129%	jj	4	87%	OK		NA	NA	5	103%	OK	8	156%	jj
	50 ppm tracers	N/A	6/24/98		NA	NA	48	95%	OK	47	94%	OK		NA	NA	46	92%	OK	47	95%	OK
	5 ppm tracers	N/A	6/24/98		NA	NA	5	106%	OK	5	107%	OK		NA	NA	5	106%	OK	7	134%	jj
	50 ppm tracers	N/A	6/24/98		NA	NA	54	108%	OK	59	117%	OK		NA	NA	56	113%	OK	57	115%	OK
	5 ppm tracers	N/A	6/25/98		NA	NA	5	106%	OK	6	120%	OK		NA	NA	5	108%	OK	7	136%	jj
	5 ppm tracers	N/A	6/25/98		NA	NA	5	102%	OK	6	111%	OK		NA	NA	4	72%	jj	6	119%	OK
	50 ppm tracers	N/A	6/25/98		NA	NA	51	101%	OK	53	107%	OK		NA	NA	49	97%	OK	52	103%	OK
	5 ppm tracers	N/A	6/26/98		NA	NA	5	97%	OK	6	116%	OK		NA	NA	8	165%	jj	6	119%	OK
	50 ppm tracers	N/A	6/26/98		NA	NA	49	97%	OK	51	102%	OK		NA	NA	50	100%	OK	53	105%	OK
	5 ppm tracers	N/A	6/26/98		NA	NA	5	99%	OK	4	86%	OK		NA	NA	5	102%	OK	3	65%	jj
	5 ppm tracers	N/A	6/27/98		NA	NA	3	67%	jj	3	65%	jj		NA	NA	3	50%	jj	4	71%	jj
	5 ppm tracers	N/A	6/27/98		NA	NA	3	67%	jj	3	65%	jj		NA	NA	3	50%	jj	4	71%	jj
	50 ppm tracers	N/A	6/27/98		NA	NA	53	105%	OK	52	103%	OK		NA	NA	52	104%	OK	49	97%	OK
	50 ppm tracers	N/A	6/27/98		NA	NA	53	105%	OK	52	103%	OK		NA	NA	52	104%	OK	49	97%	OK
	5 ppm tracers	N/A	6/30/98		NA	NA	5	101%	OK	5	98%	OK		NA	NA	4	88%	OK	6	118%	OK
	50 ppm tracers	N/A	6/30/98		NA	NA	57	114%	OK	55	111%	OK		NA	NA	54	108%	OK	51	102%	OK
	50 ppm tracers	N/A	6/30/98		NA	NA	44	89%	OK	47	95%	OK		NA	NA	45	91%	OK	47	95%	OK
	5 ppm tracers	N/A	7/1/98		NA	NA	3	60%	jj	4	76%	jj		NA	NA	4	73%	jj	4	82%	OK
	50 ppm tracers	N/A	7/1/98		NA	NA	51	101%	OK	55	110%	OK		NA	NA	52	104%	OK	55	110%	OK
	5 ppm tracers	N/A	7/8/98		NA	NA	5	103%	OK	6	118%	OK		NA	NA	6	113%	OK	6	111%	OK
	50 ppm tracers	N/A	7/8/98		NA	NA	49	98%	OK	49	97%	OK		NA	NA	47	94%	OK	47	93%	OK
	5 ppm tracers	N/A	7/9/98		NA	NA	5	109%	OK	4	86%	OK		NA	NA	6	130%	jj	5	107%	OK
	50 ppm tracers	N/A	7/9/98		NA	NA	50	99%	OK	48	96%	OK		NA	NA	47	94%	OK	46	93%	OK
a	5 ppm tracers	N/A	7/14/98		NA	NA	5	95%	OK	5	96%	OK		NA	NA	5	108%	OK	5	98%	OK
a	50 ppm tracers	N/A	7/14/98		NA	NA	51	102%	OK	51	101%	OK		NA	NA	53	105%	OK	50	100%	OK

Project: PITT at ESTCP Camp Lejeune
Acceptable QA/QC limits: % Recovery between 80% and 120%

Data QA/QC by DW
Date created 1/22/99
Date last modified 1/26/99

Sample Legend
CC = Calibration check
j = below reporting limit
d = diluted sample
BDL = below detection limit
NA = not applicable
jj = out of acceptable QA/QC and/or calibration limits
OK = within acceptable QA/QC limits

Calibration Check results: 100 ppm tracers

Sample Type	Sample ID	Date and Time Sampled	Date Analyzed	Methanol (mg/L)	% Recovery Methanol	Flag for Methanol	1-Propanol (mg/L)	% Recovery 1-Propanol	Flag for 1-Propanol	4-Methyl-2-pentanol (mg/L)	% Recovery 4-Methyl-2-pentanol	Flag for 4-Methyl-2-pentanol	PCE (mg/L)	% Recovery PCE	Flag for PCE	1-Hexanol (mg/L)	% Recovery 1 Hexanol	Flag for 1-Hexanol	1-Heptanol (mg/L)	% Recovery 1 Heptanol	Flag for 1-Heptanol
CC	100 ppm tracer alcohols		5/19/98	97	97%	OK	97	97%	OK	95	95%	OK	nd	NA	NA	94	94%	OK	95		
CC	100 ppm tracers	N/A	5/26/98	98	98%	OK	99	99%	OK	100	100%	OK	nd	NA	NA	100	100%	OK	100		
CC	100 ppm PCE	N/A	5/26/98	nd	NA	NA	nd	NA	NA	nd	NA	NA	96	96%	OK	nd	NA	NA	nd		
CC	100 ppm tracers	N/A	5/27/98	98	98%	OK	97	97%	OK	97	97%	OK	nd	NA	NA	97	97%	OK	97		
CC	100 ppm tracers	N/A	6/5/98				100	100%	OK	105	105%	OK				104	104%	OK	100		
CC	100 ppm tracers	N/A	6/5/98				81	81%	OK	76	76%	jj				74	74%	jj	93		
CC	100 ppm tracers	N/A	6/9/98				99	99%	OK	100	100%	OK				99	99%	OK	130		
CC	100 ppm tracers	N/A	6/10/98				106	106%	OK	107	107%	OK				104	104%	OK	103		
CC	100 ppm tracers	N/A	6/10/98				128	128%	jj	114	114%	OK				111	111%	OK	116		
CC	100 ppm tracers	N/A	6/11/98				102	102%	OK	98	98%	OK				97	97%	OK	101		
CC	100 ppm tracers	N/A	6/12/98				100	100%	OK	104	104%	OK				100	100%	OK	95		
CC	100 ppm tracers	N/A	6/16/98				107	107%	OK	104	104%	OK				103	103%	OK	106		
CC	100 ppm tracers	N/A	6/17/98				105	105%	OK	99	99%	OK				99	99%	OK	94		
CC	100 ppm tracers	N/A	6/18/98				100	100%	OK	102	102%	OK				102	102%	OK	102		
CC	100 ppm tracers	N/A	6/20/98				105	105%	OK	103	103%	OK				107	107%	OK	113		
CC	100 ppm tracers	N/A	6/21/98				105	105%	OK	105	105%	OK				105	105%	OK	110		
CC	100 ppm tracers	N/A	6/22/98				95	95%	OK	97	97%	OK				95	95%	OK	96		
CC	100 ppm tracers	N/A	6/24/98				87	87%	OK	84	84%	OK				83	83%	OK	85		
CC	100 ppm tracers	N/A	6/25/98				106	106%	OK	109	109%	OK				102	102%	OK	111		
CC	100 ppm tracers	N/A	6/25/98				98	98%	OK	98	98%	OK				99	99%	OK	102		
CC	100 ppm tracers	N/A	6/26/98				104	104%	OK	106	106%	OK				101	101%	OK	109		
CC	100 ppm tracers	N/A	6/27/98				105	105%	OK	109	109%	OK				107	107%	OK	112		
CC	100 ppm tracers	N/A	6/27/98				105	105%	OK	109	109%	OK				107	107%	OK	112		
CC	100 ppm tracers	N/A	6/30/98				107	107%	OK	104	104%	OK				107	107%	OK	104		
CC	100 ppm tracers	N/A	7/1/98				104	104%	OK	106	106%	OK				100	100%	OK	102		
CC	100 ppm tracers	N/A	7/1/98				110	110%	OK	112	112%	OK				108	108%	OK	106		
CC	100 ppm tracers	N/A	7/8/98				102	102%	OK	104	104%	OK				105	105%	OK	104		
CC	100 ppm tracers	N/A	7/9/98				95	95%	OK	93	93%	OK				95	95%	OK	94		
CC	100 ppm tracers	N/A	7/14/98				98	98%	OK	99	99%	OK				98	98%	OK	100		
CC	50 ppm PCE	N/A	5/19/98	nd			nd	NA	NA	nd	NA	NA	39	78%	jj	nd	NA	NA	nd		

Project: PITT at ESTCP Camp Lejeune
Acceptable QA/QC limits: % Recovery between 80% and 120%

Data QA/QC by DW
Date created 1/22/99
Date last modified 1/26/99

Sample Legend
CC = Calibration check
j = below reporting limit
d = diluted sample
BDL = below detection limit
NA = not applicable
jj = out of acceptable QA/QC and/or calibration limits
OK = within acceptable QA/QC limits

Calibration Check results: 200 ppm tracers and miscellaneous (2 and 150 ppm)

Sample ID	Date and Time Sampled	Date Analyzed	Methanol (mg/L)	% Recovery Methanol	Flag for Methanol	1-Propanol (mg/L)	% Recovery 1-Propanol	Flag for 1-Propanol	4-Methyl-2-pentanol (mg/L)	% Recovery 4-Methyl-2-pentanol	Flag for 4-Methyl-2-pentanol	PCE (mg/L)	% Recovery PCE	Flag for PCE	1-Hexanol (mg/L)	% Recovery 1 Hexanol	Flag for 1-Hexanol	1-Heptanol (mg/L)	% Recovery 1 Heptanol	Flag for 1-Heptanol
1-16.0 (1)	05/15/98 @ 0958	5/24/98	0	0%	jj	nd	NA	NA	nd	NA	NA	49	24%	jj	nd	NA	NA	nd	NA	NA
1-16.0 (2)	05/15/98 @ 1436	5/24/98	0	0%	jj	nd	NA	NA	nd	NA	NA	42	21%	jj	nd	NA	NA	nd	NA	NA
1-16.0 (3)	05/15/98 @ 1957	5/24/98	nd	NA	NA	nd	NA	NA	nd	NA	NA	45	22%	jj	nd	NA	NA	nd	NA	NA
2 ppm tracers	N/A	5/24/98	2	1%	jj	2	1%	jj	2	1%	jj	nd	NA	NA	2	1%	jj	2	1%	jj
2 ppm PCE	N/A	5/24/98	nd	NA	NA	nd	NA	NA	nd	NA	NA	2	1%	jj	nd	NA	NA	nd	NA	NA
200 ppm tracers	N/A	5/26/98	196	98%	OK	193	97%	OK	199	100%	OK	nd	NA	NA	199	100%	OK	201	100%	OK
150 ppm PCE	N/A	5/26/98	nd	NA	NA	nd	NA	NA	nd	NA	NA	142	71%	jj	nd	NA	NA	nd	NA	NA
200 ppm tracers	N/A	5/27/98	202	101%	OK	191	95%	OK	198	99%	OK	nd	NA	NA	199	99%	OK	197	99%	OK
150 ppm PCE	N/A	5/27/98										150	75%	jj						
2 ppm tracers	N/A	5/27/98	1	0%	jj	2	1%	jj	2	1%	jj	nd	NA	NA	2	1%	jj	2	1%	jj
2 ppm PCE	N/A	5/27/98	nd	NA	NA	nd	NA	NA	nd	NA	NA	2	1%	jj	nd	NA	NA	nd	NA	NA
200 ppm tracers	N/A	5/28/98	206	103%	OK	189	95%	OK	196	98%	OK	nd	NA	NA	199	99%	OK	204	102%	OK
200 ppm tracers	N/A	6/4/98				192	96%	OK	203	101%	OK				204	102%	OK	198	99%	OK
200 ppm tracers	N/A	6/5/98				208	104%	OK	209	104%	OK				208	104%	OK	202	101%	OK
200 ppm tracers	N/A	6/6/98				200	100%	OK	199	100%	OK				199	99%	OK	200	100%	OK
200 ppm tracers	N/A	6/6/98				211	105%	OK	210	105%	OK				206	103%	OK	207	103%	OK
200 ppm tracers	N/A	6/7/98				186	93%	OK	187	94%	OK				189	94%	OK	196	98%	OK
200 ppm tracers	N/A	6/8/98				214	107%	OK	198	99%	OK				200	100%	OK	198	99%	OK
200 ppm tracers	N/A	6/9/98				166	83%	OK	160	80%	jj				157	78%	jj	199	100%	OK
200 ppm tracers	N/A	6/10/98				194	97%	OK	194	97%	OK				193	96%	OK	196	98%	OK
200 ppm tracers	N/A	6/12/98				202	101%	OK	195	97%	OK				195	98%	OK	201	101%	OK
200 ppm tracers	N/A	6/12/98				218	109%	OK	213	107%	OK				219	110%	OK	211	106%	OK
200 ppm tracers	N/A	6/16/98				240	120%	OK	247	123%	jj				251	125%	jj	253	126%	jj
200 ppm tracers	N/A	6/17/98				198	99%	OK	189	95%	OK				191	96%	OK	192	96%	OK
200 ppm tracers	N/A	6/18/98				191	96%	OK	203	101%	OK				195	97%	OK	193	97%	OK
200 ppm tracers	N/A	6/20/98				202	101%	OK	210	105%	OK				207	104%	OK	196	98%	OK
200 ppm tracers	N/A	6/21/98				186	93%	OK	192	96%	OK				189	95%	OK	194	97%	OK
200 ppm tracers	N/A	6/22/98				191	96%	OK	194	97%	OK				203	101%	OK	195	98%	OK
200 ppm tracers	N/A	6/23/98				198	99%	OK	201	101%	OK				196	98%	OK	194	97%	OK
200 ppm tracers	N/A	6/24/98				201	101%	OK	205	103%	OK				200	100%	OK	204	102%	OK
200 ppm tracers	N/A	6/24/98				186	93%	OK	183	91%	OK				179	90%	OK	187	93%	OK
200 ppm tracers	N/A	6/25/98				211	105%	OK	211	106%	OK				213	107%	OK	211	105%	OK
200 ppm tracers	N/A	6/25/98				212	106%	OK	208	104%	OK				222	111%	OK	202	101%	OK
200 ppm tracers	N/A	6/26/98				211	106%	OK	215	107%	OK				214	107%	OK	210	105%	OK

Sample ID	Date and Time Sampled	Date Analyzed	Methanol (mg/L)	% Recovery Methanol	Flag for Methanol	1-Propanol (mg/L)	% Recovery 1-Propanol	Flag for 1-Propanol	4-Methyl-2-pentanol (mg/L)	% Recovery 4-Methyl-2-pentanol	Flag for 4-Methyl-2-pentanol	PCE (mg/L)	% Recovery PCE	Flag for PCE	1-Hexanol (mg/L)	% Recovery 1 Hexanol	Flag for 1-Hexanol	1-Heptanol (mg/L)	% Recovery 1 Heptanol	Flag for 1-Heptanol
200 ppm tracers	N/A	6/27/98				179	90%	OK	170	85%	OK				176	88%	OK	169	85%	OK
200 ppm tracers	N/A	6/27/98				179	90%	OK	170	85%	OK				176	88%	OK	169	85%	OK
200 ppm tracers	N/A	6/30/98				210	105%	OK	224	112%	OK				218	109%	OK	220	110%	OK
200 ppm tracers	N/A	7/1/98				194	97%	OK	202	101%	OK				199	99%	OK	185	93%	OK
200 ppm tracers	N/A	7/1/98				221	111%	OK	241	120%	jj				236	118%	OK	241	120%	jj
200 ppm tracers	N/A	7/8/98				199	100%	OK	197	99%	OK				198	99%	OK	198	99%	OK
200 ppm tracers	N/A	7/9/98				196	98%	OK	192	96%	OK				198	99%	OK	194	97%	OK
200 ppm tracers	N/A	7/14/98				202	101%	OK	199	100%	OK				202	101%	OK	200	100%	OK
200 ppm tracer alcohols		5/19/98	198	99%	OK	200	100%	OK	199	99%	OK	nd			201	101%	OK	201	101%	OK

Project: PITT at ESTCP Camp Lejeune
Acceptable QA/QC limits: % Recovery between 80% and 120%

Data QA/QC by DW
Date created 1/22/99
Date last modified 1/26/99

Sample Legend
CC = Calibration check
j = below reporting limit
d = diluted sample
BDL = below detection limit
NA = not applicable
jj = out of acceptable QA/QC and/or calibration limits
OK = within acceptable QA/QC limits
nd = not detected
DUP = Duplicate
d,DUP = diluted duplicate
j,b = carrover in method blanks

Blank Results

Sample ID	Date and Time	Date Analyzed	Methanol	Flag for Methanol	1-Propanol	Flag for 1-Propanol	4-Methanol-2 pentanol	Flag for 4-Methanol-2-pentanol	PCE	Flag for PCE	1-Hexanol	Flag for 1-Hexanol	1-Heptanol	Flag for 1-Heptanol
blank (Milli-Q)	N/A	5/19/98	nd	BDL	nd	BDL	nd	BDL	nd	BDL	nd	BDL	nd	BDL
blk H2O	N/A	5/24/98	nd	BDL	nd	BDL	nd	BDL	nd	BDL	nd	BDL	nd	BDL
blk H2O	N/A	5/27/98	0	j,b	nd	BDL	nd	BDL	nd	BDL	nd	BDL	nd	BDL
blk H2O	N/A	5/27/98	nd	BDL	nd	BDL	nd	BDL	nd	BDL	nd	BDL	nd	BDL
blk	N/A	6/4/98			4	j,b	nd	BDL			nd	BDL	nd	BDL
blk H2O	N/A	6/6/98			nd	BDL	nd	BDL			nd	BDL	nd	BDL
blk H2O	N/A	6/6/98			1	j,b	1	j,b			2	j,b	5	j,b
blk H2O	N/A	6/8/98			nd	BDL	nd	BDL			nd	BDL	nd	BDL
blk H2O	N/A	6/8/98			2	j,b	2	j,b			nd	BDL	nd	BDL
blk H2O	N/A	6/9/98			nd	BDL	nd	BDL			nd	BDL	nd	BDL
blk H2O	N/A	6/11/98			nd	BDL	2	j,b			3	j,b	nd	BDL
blk H2O	N/A	6/11/98			nd	BDL	nd	BDL			nd	BDL	nd	BDL
blk H2O	N/A	6/16/98			1	j,b	nd	BDL			nd	BDL	nd	BDL
blk H2O	N/A	6/20/98			nd	BDL	nd	BDL			nd	BDL	nd	BDL
blk H2O	N/A	6/22/98			nd	BDL	nd	BDL			nd	BDL	nd	BDL
blk H2O	N/A	6/24/98			2	j,b	2	j,b			nd	BDL	4	j,b
blk H2O	N/A	6/25/98			nd	BDL	nd	BDL			nd	BDL	nd	BDL
blk H2O	N/A	6/26/98			1	j,b	nd	BDL			nd	BDL	nd	BDL
blk H2O	N/A	6/26/98			nd	BDL	nd	BDL			nd	BDL	nd	BDL
blk H2O	N/A	6/26/98			nd	BDL	nd	BDL			nd	BDL	nd	BDL
blk H2O	N/A	6/30/98			nd	BDL	nd	BDL			nd	BDL	5	j,b
blk H2O	N/A	7/8/98			nd	BDL	nd	BDL			nd	BDL	nd	BDL
blk H2O	N/A	7/8/98			nd	BDL	1	j,b			5	j,b	6	j,b
blk H2O	N/A	7/9/98			nd	BDL	nd	BDL			nd	BDL	nd	BDL
blk H2O	N/A	7/9/98			1	j,b	1	j,b			4	j,b	6	j,b
blk H2O	N/A	7/14/98			nd	BDL	nd	BDL			nd	BDL	nd	BDL
blk H2O	N/A	7/14/98			nd	BDL	1	j,b			4	j,b	4	j,b

Project: PITT at ESTCP Camp Lejeune
Acceptable QA/QC limits: % Recovery between 80% and 120%

Data QA/QC by DW
Date created 1/22/99
Date last modified 1/26/99

Sample Legend
CC = Calibration check
j = below reporting limit
d = diluted sample
BDL = below detection limit
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OK = within acceptable QA/QC limits
nd = not detected
DUP = Duplicate
d,DUP = diluted duplicate

Sample Point: MLS-3 @ 17.5 ft BGS

Sample ID	Date and Time	Date Analyzed	Methanol (mg/L)	Flag for Methanol	1-Propanol (mg/L)	Flag for 1-Propanol	4-Methanol-2 pentanol (mg/L)	Flag for 4-Methanol-2-pentanol	PCE (mg/L)	Flag for PCE	1-Hexanol (mg/L)	Flag for 1-Hexanol	1-Heptanol (mg/L)	Flag for 1-Heptanol
3-17.5	5/13/98 20:20	5/19/98	nd	BDL	nd	BDL	nd	BDL	~221	jj	nd	BDL	nd	BDL
3-17.5 (1)	5/14/98 9:15	5/19/98	nd	BDL	nd	BDL	nd	BDL	~213	jj	nd	BDL	nd	BDL
3-17.5 (1)	5/15/98 9:20	5/24/98	0	j	nd	BDL	nd	BDL	55	OK	nd	BDL	nd	BDL
3-17.5 (2)	5/15/98 15:12	5/24/98	0	j	nd	BDL	nd	BDL	78	OK	nd	BDL	nd	BDL
3-17.5 (2) D	5/15/98 15:12	5/24/98	0	j	nd	BDL	nd	BDL	80	OK	nd	BDL	nd	BDL
3-17.5 (3)	5/15/98 20:20	5/24/98	0	j	nd	BDL	nd	BDL	66	OK	nd	BDL	nd	BDL
3-17.5 (1)	5/16/98 8:31	5/24/98	nd	BDL	nd	BDL	nd	BDL	49	OK	nd	BDL	nd	BDL
3-17.5/011	5/16/98 19:50	5/26/98	nd	BDL	nd	BDL	nd	BDL	7	j	nd	BDL	nd	BDL
3-17.5/012	5/17/98 8:50	5/26/98	nd	BDL	nd	BDL	nd	BDL	20	OK	nd	BDL	nd	BDL
3-17.5/013	5/17/98 13:23	5/26/98	nd	BDL	nd	BDL	nd	BDL	14	OK	nd	BDL	nd	BDL
3-17.5/014	5/17/98 19:03	5/27/98	nd	BDL	nd	BDL	nd	BDL	14	OK	nd	BDL	nd	BDL
3-17.5/014 [dup]	5/17/98 19:03	5/27/98	nd	DUP	nd	DUP	nd	DUP	11	DUP	nd	DUP	nd	DUP
3-17.5/015	5/18/98 9:15	6/4/98			nd	BDL	nd	BDL			4	j	nd	BDL
3-17.5/015 [dup]	5/18/98 9:15	6/4/98			nd	DUP	nd	DUP			4	DUP	nd	DUP
3-17.5/015 A	5/18/98 13:54	6/5/98			nd	BDL	nd	BDL			4	j	nd	BDL
3-17.5/016	5/18/98 19:50	6/5/98			nd	BDL	nd	BDL			5	j	nd	BDL
3-17.5/017	5/19/98 8:28	6/5/98			nd	BDL	nd	BDL			1	j	nd	BDL
3-17.5/018	5/19/98 19:17	6/6/98			1	j	1	j			0	j	nd	BDL
3-17.5/018 [dup]	5/19/98 19:17	6/6/98			2	DUP	2	DUP			1	DUP	nd	DUP
3-17.5/019	5/20/98 9:43	6/7/98			3	j	1	j			nd	BDL	nd	BDL
3-17.5/020	5/20/98 19:48	6/7/98			4	j	1	j			nd	BDL	nd	BDL
3-17.5/021	5/21/98 10:55	6/7/98			20	OK	11	OK			7	j	nd	BDL
3-17.5/022	5/21/98 19:47	6/7/98			26	OK	16	OK			10	OK	5	j
3-17.5/023	5/22/98 8:15	6/8/98			31	OK	19	OK			14	OK	6	j
3-17.5/024	5/22/98 19:42	6/8/98			71	OK	48	OK			40	OK	12	OK
3-17.5/024D	5/22/98 19:42	6/8/98			89	OK	61	OK			52	OK	16	OK
3-17.5/022 [dup]	5/22/98 19:47	6/7/98			31	DUP	20	DUP			13	DUP	5	DUP
3-17.5/025	5/23/98 9:06	6/9/98			84	OK	65	OK			59	OK	26	OK
3-17.5/026	5/23/98 18:38	6/9/98			81	OK	58	OK			47	OK	25	OK

Sample ID	Date and Time	Date Analyzed	Methanol (mg/L)	Flag for Methanol	1-Propanol (mg/L)	Flag for 1-Propanol	4-Methanol-2 pentanol (mg/L)	Flag for 4-Methanol-2-pentanol	PCE (mg/L)	Flag for PCE	1-Hexanol (mg/L)	Flag for 1-Hexanol	1-Heptanol (mg/L)	Flag for 1-Heptanol
3-17.5/026 [dup]	5/23/98 18:38	6/9/98			82	DUP	57	DUP			48	DUP	19	DUP
3-17.5/027	5/24/98 9:26	6/9/98			98	OK	74	OK			60	OK	24	OK
3-17.5/028	5/24/98 19:20	6/9/98			130	OK	97	OK			83	OK	34	OK
3-17.5/029	5/25/98 8:17	6/9/98			90	OK	67	OK			56	OK	nd	BDL
3-17.5/029 (1:10)	5/25/98 8:17	7/1/98			118	d	82	d			84	d	40	d
3-17.5/030	5/25/98 21:00	6/9/98			85	OK	62	OK			50	OK	nd	BDL
3-17.5/030	5/25/98 21:00	6/10/98			299	jj	198	OK			170	OK	75	OK
3-17.5/031	5/26/98 7:40	6/11/98			208	jj	147	OK			134	OK	59	OK
3-17.5/032	5/27/98 7:50	6/11/98			188	OK	139	OK			118	OK	55	OK
3-17.5/033	5/28/98 7:30	6/11/98			176	OK	142	OK			126	OK	60	OK
3-17.5/034	5/29/98 7:30	6/12/98			180	OK	169	OK			154	OK	77	OK
3-17.5/035	5/30/98 7:30	6/12/98			199	OK	159	OK			154	OK	79	OK
3-17.5/036	5/31/98 7:20	6/12/98			186	OK	160	OK			141	OK	60	OK
3-17.5/037	6/1/98 10:05	6/15/98			208	jj	195	OK			188	OK	108	OK
3-17.5/038	6/2/98 7:50	6/15/98			193	OK	189	OK			179	OK	110	OK
3-17.5/038	6/2/98 7:50	6/15/98			193	OK	202	jj			179	OK	110	OK
3-17.5/038 [dup]	6/2/98 7:50	6/15/98			192	DUP	184	DUP			180	DUP	107	DUP
3-17.5/039	6/3/98 7:45	6/21/98			144	OK	136	OK			140	OK	75	OK
3-17.5/040	6/4/98 8:12	6/21/98			153	OK	152	OK			150	OK	94	OK
3-17.5/041	6/5/98 8:50	6/21/98			105	OK	105	OK			107	OK	75	OK
3-17.5/042	6/6/98 8:37	6/22/98			80	OK	74	OK			75	OK	52	OK
3-17.5/043	6/7/98 9:02	6/18/98			79	OK	76	OK			73	OK	51	OK
3-17.5/043 [dup]	6/7/98 9:02	6/18/98			71	DUP	68	DUP			67	DUP	46	DUP
3-17.5/044	6/8/98 9:02	6/18/98			75	OK	70	OK			68	OK	46	OK
3-17.5/045	6/9/98 8:33	6/18/98			66	OK	64	OK			59	OK	40	OK
3-17.5/046	6/10/98 9:07	6/18/98			62	OK	59	OK			58	OK	36	OK
3-17.5/047	6/11/98 9:32	6/18/98			62	OK	56	OK			56	OK	36	OK
3-17.5/048	6/12/98 9:26	6/18/98			64	OK	61	OK			58	OK	38	OK
3-17.5/049	6/13/98 9:22	6/18/98			55	OK	55	OK			49	OK	31	OK
3-17.5/050	6/14/98 10:25	6/24/98			42	OK	41	OK			37	OK	26	OK
3-17.5/051	6/15/98 9:30	6/24/98			48	OK	43	OK			41	OK	25	OK
3-17.5/052	6/16/98 7:53	6/24/98			47	OK	46	OK			44	OK	26	OK
3-17.5/053	6/17/98 11:31	6/23/98			49	OK	46	OK			41	OK	29	OK
3-17.5/054	6/17/98 11:35	6/23/98			41	OK	43	OK			33	OK	24	OK
3-17.5/055	6/19/98 7:50	6/25/98			37	OK	42	OK			39	OK	25	OK
3-17.5/056	6/20/98 8:20	6/25/98			28	OK	32	OK			29	OK	20	OK
3-17.5/057	6/21/98 8:20	6/26/98			26	OK	31	OK			31	OK	18	OK
3-17.5/058	6/22/98 7:45	6/26/98			26	OK	35	OK			27	OK	22	OK
3-17.5/058	6/22/98 7:45	6/26/98			26	OK	35	OK			27	OK	22	OK

Project: PITT at ESTCP Camp Lejeune
Acceptable QA/QC limits: % Recovery between 80% and 120%

Data QA/QC by DW
Date created 1/22/99
Date last modified 1/26/99

Sample Legend
CC = Calibration check
j = below reporting limit
d = diluted sample
BDL = below detection limit
NA = not applicable
jj = out of acceptable QA/QC and/or calibration limits
OK = within acceptable QA/QC limits
nd = not detected
DUP = Duplicate
d,DUP = diluted duplicate

Sample Point: MLS-2 @ 18.5 ft BGS

Sample ID	Date and Time	Date Analyzed	Methanol (mg/L)	Flag for Methanol	1-Propanol (mg/L)	Flag for 1-Propanol	4-Methanol-2 pentanol (mg/L)	Flag for 4-Methanol-2-pentanol	PCE (mg/L)	Flag for PCE	1-Hexanol (mg/L)	Flag for 1-Hexanol	1-Heptanol (mg/L)	Flag for 1-Heptanol
2-18.5	5/13/98 20:05	5/19/98	nd	BDL	nd	BDL	nd	BDL	*~243*	jj	nd	BDL	nd	BDL
2-18.5 (1)	5/14/98 8:50	5/19/98	nd	BDL	nd	BDL	nd	BDL	*~236*	jj	nd	BDL	nd	BDL
2-18.5 (2)	5/14/98 14:30	5/21/98	nd	BDL	nd	BDL	nd	BDL	49	OK	nd	BDL	nd	BDL
2-18.5 (3)	5/14/98 19:58	5/22/98	nd	BDL	nd	BDL	nd	BDL	108	OK	nd	BDL	nd	BDL
2-18.5 (1)	5/15/98 9:46	5/24/98	0	j	nd	BDL	nd	BDL	84	OK	nd	BDL	nd	BDL
2-18.5 (2)	5/15/98 15:06	5/24/98	0	j	nd	BDL	nd	BDL	139	OK	nd	BDL	nd	BDL
2-18.5 (3)	5/15/98 20:14	5/24/98	0	j	nd	BDL	nd	BDL	61	OK	nd	BDL	nd	BDL
2-18.5 (1)	5/16/98 8:45	5/24/98	0	j	nd	BDL	nd	BDL	157	OK	nd	BDL	nd	BDL
2-18.5/011 (1:1)	5/16/98 19:58	5/26/98	nd	d	nd	d	nd	d	212	d	nd	d	nd	d
2-18.5/012 (1:3)	5/17/98 8:35	5/26/98	nd	d	nd	d	nd	d	67	d	1	d	nd	d
2-18.5/013 (1:3)	5/17/98 13:42	5/26/98	nd	d	nd	d	nd	d	71	d	1	d	nd	d
2-18.5/014 (1:3)	5/17/98 19:15	5/27/98	nd	d	nd	d	nd	d	64	d	1	d	nd	d
2-18.5/015 (1/3)	5/18/98 9:06	6/4/98			12	d	19	d			37	d	32	d
2-18.5/015 A (1/3)	5/18/98 13:47	6/4/98			12	d	18	d			24	d	25	d
2-18.5/016 (1/3)	5/18/98 19:46	6/5/98			13	d	20	d			51	d	45	d
2-18.5/017 (1/3)	5/19/98 8:20	6/5/98			nd	d	nd	d			10	d	1	d
2-18.5/024	5/22/98 19:52	6/8/98			nd	BDL	nd	BDL			nd	BDL	0	j
2-18.5/025	5/23/98 9:01	6/9/98			nd	BDL	nd	BDL			nd	BDL	1	j
2-18.5/026	5/23/98 18:52	6/9/98			nd	BDL	nd	BDL			nd	BDL	nd	BDL
2-18.5/027	5/24/98 9:17	6/9/98			0	j	nd	BDL			nd	BDL	nd	BDL
2-18.5/028	5/24/98 19:33	6/9/98			2	j	nd	BDL			nd	BDL	nd	BDL
2-18.5/029	5/25/98 8:11	6/9/98			4	j	45	OK			nd	BDL	nd	BDL
2-18.5/029 [dup]	5/25/98 8:11	6/9/98			3	DUP	40	DUP			nd	DUP	nd	DUP
2-18.5/030	5/25/98 20:53	6/9/98			7	j	26	OK			nd	BDL	nd	BDL
2-18.5/030	5/25/98 20:53	6/10/98			18	OK	2	j			nd	BDL	5	j
2-18.5/031	5/26/98 7:35	6/11/98			16	OK	nd	BDL			nd	BDL	nd	BDL
2-18.5/032	5/27/98 8:05	6/11/98			39	OK	11	OK			nd	BDL	nd	BDL

Sample ID	Date and Time	Date Analyzed	Methanol (mg/L)	Flag for Methanol	1-Propanol (mg/L)	Flag for 1-Propanol	4-Methanol-2 pentanol (mg/L)	Flag for 4-Methanol-2-pentanol	PCE (mg/L)	Flag for PCE	1-Hexanol (mg/L)	Flag for 1-Hexanol	1-Heptanol (mg/L)	Flag for 1-Heptanol
2-18.5/032 [dup]	5/27/98 8:05	6/11/98			37	DUP	7	DUP			nd	DUP	nd	DUP
2-18.5/033	5/28/98 7:50	6/11/98			63	OK	12	OK			2	j	nd	BDL
2-18.5/034	5/29/98 7:50	6/12/98			81	OK	18	OK			4	j	nd	BDL
2-18.5/035	5/30/98 7:50	6/12/98			114	OK	31	OK			9	j	nd	BDL
2-18.5/035 [dup]	5/30/98 7:50	6/12/98			118	DUP	32	DUP			9	DUP	nd	DUP
2-18.5/036	5/31/98 7:40	6/12/98			136	OK	50	OK			15	OK	nd	BDL
2-18.5/037	6/1/98 10:00	6/15/98			163	OK	71	OK			30	OK	18	OK
2-18.5/038	6/2/98 7:45	6/15/98			200	OK	105	OK			46	OK	nd	BDL
2-18.5/039	6/3/98 7:40	6/21/98			153	OK	93	OK			46	OK	nd	BDL
2-18.5/040	6/4/98 8:07	6/21/98			144	OK	109	OK			56	OK	nd	BDL
2-18.5/041	6/5/98 8:44	6/21/98			153	OK	127	OK			72	OK	nd	BDL
2-18.5/042	6/6/98 8:50	6/22/98			112	OK	100	OK			67	OK	nd	BDL
2-18.5/043	6/7/98 8:55	6/17/98			128	OK	123	OK			84	OK	nd	BDL
2-18.5/044	6/8/98 8:55	6/17/98			107	OK	107	OK			80	OK	nd	BDL
2-18.5/045	6/9/98 8:23	6/17/98			112	OK	100	OK			98	OK	0	j
2-18.5/046	6/10/98 9:02	6/18/98			112	OK	119	OK			103	OK	1	j
2-18.5/047	6/11/98 9:26	6/18/98			98	OK	94	OK			80	OK	nd	BDL
2-18.5/048	6/12/98 9:16	6/18/98			97	OK	87	OK			84	OK	nd	BDL
2-18.5/049	6/13/98 9:16	6/18/98			84	OK	87	OK			77	OK	2	j
2-18.5/055	6/19/98 7:45	6/25/98			65	OK	65	OK			68	OK	16	OK
2-18.5/056	6/20/98 8:15	6/25/98			55	OK	57	OK			52	OK	16	OK
2-18.5/057	6/21/98 8:30	6/26/98			47	OK	42	OK			44	OK	12	OK
2-18.5/058	6/22/98 7:35	6/26/98			54	OK	54	OK			59	OK	20	OK

Project: PITT at ESTCP Camp Lejeune
Acceptable QA/QC limits: % Recovery between 80% and 120%

Data QA/QC by DW
Date created 1/22/99
Date last modified 1/26/99

Sample Legend
CC = Calibration check
j = below reporting limit
d = diluted sample
BDL = below detection limit
NA = not applicable
jj = out of acceptable QA/QC and/or calibration limits
OK = within acceptable QA/QC limits
nd = not detected
DUP = Duplicate
d,DUP = diluted duplicate

Sample Point: MLS-2 @ 17.0 ft BGS

Sample ID	Date and Time	Date Analyzed	Methanol (mg/L)	Flag for Methanol	1-Propanol (mg/L)	Flag for 1-Propanol	4-Methanol-2-pentanol (mg/L)	Flag for 4-Methanol-2-pentanol	PCE (mg/L)	Flag for PCE	1-Hexanol (mg/L)	Flag for 1-Hexanol	1-Heptanol (mg/L)	Flag for 1-Heptanol
2-17.0	5/13/98 19:58	5/19/98	nd	BDL	nd	BDL	nd	BDL	2	j	nd	BDL	nd	BDL
2-17.0 (1)	5/14/98 8:35	5/19/98	nd	BDL	nd	BDL	nd	BDL	73	OK	nd	BDL	nd	BDL
2-17.0 (1) D	5/14/98 8:40	5/19/98	nd	BDL	nd	BDL	nd	BDL	69	OK	nd	BDL	nd	BDL
2-17.0 (1)	5/15/98 9:39	5/24/98	0	j	nd	BDL	nd	BDL	74	OK	nd	BDL	nd	BDL
2-17.0 (2)	5/15/98 14:47	5/24/98	nd	BDL	nd	BDL	nd	BDL	71	OK	nd	BDL	nd	BDL
2-17.0 (3)	5/15/98 20:03	5/24/98	nd	BDL	nd	BDL	nd	BDL	72	OK	nd	BDL	nd	BDL
2-17.0 (1)	5/16/98 9:01	5/24/98	4	j	4	j	1	j	60	OK	0	j	nd	BDL
2-17.0/011	5/16/98 19:53	5/26/98	516	jj	601	jj	473	jj	4	j	350	jj	33	OK
2-17.0/012	5/17/98 8:25	5/26/98	930	jj	1050	jj	940	jj	nd	BDL	849	jj	309	jj
2-17.0/013	5/17/98 13:38	5/26/98	999	jj	1100	jj	1010	jj	38	OK	945	jj	420	jj
2-17.0/014	5/17/98 19:10	5/26/98	914	jj	964	jj	890	jj	15	OK	840	jj	435	jj
2-17.0/015	5/18/98 8:54	6/4/98			>200	jj	>200	jj			>200	jj	>200	jj
2-17.0/015 (1:10)	5/18/98 8:54	7/8/98			1000	d	895	d			815	d	380	d
2-17.0/015 A	5/18/98 13:39	6/4/98			>200	jj	>200	jj			>200	jj	>200	jj
2-17.0/015 A (1:10)	5/18/98 13:39	7/8/98			947	d	798	d			751	d	336	d
2-17.0/016	5/18/98 19:40	6/5/98			>200	jj	>200	jj			>200	jj	>200	jj
2-17.0/016 (1:10)	5/18/98 19:40	7/8/98			968	d	856	d			782	d	433	d
2-17.0/017	5/19/98 8:14	6/5/98			>200	jj	>200	jj			>200	jj	>200	jj
2-17.0/017 (1:10)	5/19/98 8:14	7/8/98			981	d	829	d			765	d	386	d
2-17.0/018	5/19/98 19:20	6/5/98			>200	jj	>200	jj			>200	jj	>200	jj
2-17.0/018 (1:10)	5/19/98 19:20	7/8/98			1020	d	863	d			839	d	444	d
2-17.0/019 (1:10)	5/20/98 9:20	6/30/98			1050	d	991	d			901	d	529	d
2-17.0/020 (1:10)	5/20/98 19:57	6/30/98			1070	d	997	d			910	d	539	d
2-17.0/021 (1:10)	5/21/98 10:43	7/1/98			973	d	838	d			846	d	432	d
2-17.0/021 (1:10) [dup]	5/21/98 10:43	7/1/98			1050	d,DUP	1020	d,DUP			963	d,DUP	606	d,DUP
2-17.0/022 (1:10)	5/21/98 19:36	7/1/98			566	d	633	d			750	d	453	d
2-17.0/023 (1:10)	5/22/98 8:22	7/1/98			67	d	90	d			183	d	309	d
2-17.0/025	5/23/98 8:56	6/9/98			19	OK	20	OK			44	OK	163	OK
2-17.0/026	5/23/98 18:46	6/9/98			7	j	17	OK			33	OK	143	OK
2-17.0/027	5/24/98 9:05	6/9/98			3	j	6	j			16	OK	89	OK

Sample ID	Date and Time	Date Analyzed	Methanol (mg/L)	Flag for Methanol	1-Propanol (mg/L)	Flag for 1-Propanol	4-Methanol-2-pentanol (mg/L)	Flag for 4-Methanol-2-pentanol	PCE (mg/L)	Flag for PCE	1-Hexanol (mg/L)	Flag for 1-Hexanol	1-Heptanol (mg/L)	Flag for 1-Heptanol
2-17.0/028	5/24/98 19:28	6/9/98			39	OK	2	j			6	j	37	OK
2-17.0/029	5/25/98 8:05	6/9/98			nd	BDL	nd	BDL			nd	BDL	nd	BDL
2-17.0/029	5/25/98 8:05	6/9/98			40	OK	55	OK			71	OK	34	OK
2-17.0/030	5/25/98 20:48	6/10/98			nd	BDL	3	j			8	j	41	OK
2-17.0/031	5/26/98 7:28	6/10/98			nd	BDL	nd	BDL			nd	BDL	17	OK
2-17.0/032	5/27/98 7:55	6/11/98			nd	BDL	nd	BDL			nd	BDL	23	OK
2-17.0/033	5/28/98 7:40	6/11/98			nd	BDL	nd	BDL			nd	BDL	7	j
2-17.0/034	5/29/98 7:40	6/12/98			nd	BDL	nd	BDL			nd	BDL	2	j
2-17.0/035	5/30/98 7:40	6/12/98			nd	BDL	nd	BDL			nd	BDL	nd	BDL
2-17.0/036	5/31/98 7:30	6/12/98			nd	BDL	nd	BDL			nd	BDL	nd	BDL
2-17.0/036 [dup]	5/31/98 7:30	6/12/98			nd	DUP	nd	DUP			nd	DUP	nd	DUP
2-17.0/037	6/1/98 9:50	6/13/98			nd	BDL	nd	BDL			nd	BDL	nd	BDL
2-17.0/038	6/2/98 7:35	6/15/98			nd	BDL	nd	BDL			nd	BDL	nd	BDL
2-17.0/039	6/3/98 7:35	6/21/98			nd	BDL	nd	BDL			nd	BDL	nd	BDL
2-17.0/040	6/4/98 8:00	6/21/98			nd	BDL	nd	BDL			nd	BDL	nd	BDL
2-17.0/041	6/5/98 8:37	6/21/98			nd	BDL	1	j			nd	BDL	nd	BDL
2-17.0/042	6/6/98 8:45	6/22/98			nd	BDL	nd	BDL			nd	BDL	nd	BDL
2-17.0/043	6/7/98 8:48	6/17/98			nd	BDL	nd	BDL			nd	BDL	nd	BDL
2-17.0/044	6/8/98 8:48	6/17/98			0	j	nd	BDL			nd	BDL	nd	BDL
2-17.0/045	6/9/98 8:14	6/17/98			0	j	1	j			3	j	4	j
2-17.0/046	6/10/98 8:55	6/17/98			2	j	nd	BDL			nd	BDL	nd	BDL
2-17.0/046D	6/10/98 8:55	6/17/98			2	j	nd	BDL			nd	BDL	nd	BDL
2-17.0/047	6/11/98 9:20	6/17/98			1	j	nd	BDL			nd	BDL	nd	BDL
2-17.0/047 [dup]	6/11/98 9:20	6/17/98			1	DUP	nd	DUP			nd	DUP	0	DUP
2-17.0/048	6/12/98 9:00	6/17/98			2	j	nd	BDL			nd	BDL	nd	BDL
2-17.0/049	6/13/98 9:07	6/17/98			1	j	nd	BDL			nd	BDL	nd	BDL
2-17.0/055	6/19/98 7:40	6/25/98			nd	BDL	2	j			nd	BDL	nd	BDL
2-17.0/056	6/20/98 8:06	6/25/98			nd	BDL	nd	BDL			2	j	nd	BDL
2-17.0/057	6/21/98 8:40	6/26/98			nd	BDL	nd	BDL			nd	BDL	nd	BDL
2-17.0/058	6/22/98 7:20	6/26/98			nd	BDL	nd	BDL			nd	BDL	nd	BDL

Project: PITT at ESTCP Camp Lejeune

Acceptable QA/QC limits: % Recovery between 80% and 120%

Data QA/QC by DW

Date created 1/22/99

Date last modified 1/26/99

Sample Legend

CC = Calibration check

j = below reporting limit

d = diluted sample

BDL = below detection limit

NA = not applicable

jj = out of acceptable QA/QC and/or calibration limits

OK = within acceptable QA/QC limits

nd = not detected

DUP = Duplicate

d,DUP = diluted duplicate

Sample Point: Extraction Well EX1

Sample ID	Date and Time	Date Analyzed	Methanol (mg/L)	Flag for Methanol	1-Propanol (mg/L)	Flag for 1-Propanol	4-Methanol-2-pentanol (mg/L)	Flag for 4-Methanol-2-pentanol	PCE (mg/L)	Flag for PCE	1-Hexanol (mg/L)	Flag for 1-Hexanol	1-Heptanol (mg/L)	Flag for 1-Heptanol
EX1/004 A	5/13/98 17:30	5/19/98	nd	BDL	nd	BDL	nd	BDL	107	OK	nd	BDL	nd	BDL
EX1/003 M	5/14/98 7:33	5/19/98	nd	BDL	nd	BDL	nd	BDL	156	OK	nd	BDL	nd	BDL
EX1/005 A	5/14/98 7:40	5/19/98	nd	BDL	nd	BDL	nd	BDL	129	OK	nd	BDL	nd	BDL
EX1/010 A	5/14/98 13:30	5/19/98	nd	BDL	nd	BDL	nd	BDL	~204	jj	nd	BDL	nd	BDL
EX1/011 A	5/14/98 19:30	5/19/98	nd	BDL	nd	BDL	nd	BDL	~227	jj	nd	BDL	nd	BDL
EX1/006 M	5/14/98 19:47	5/19/98	nd	BDL	nd	BDL	nd	BDL	~239	jj	nd	BDL	nd	BDL
EX1/012 A	5/15/98 1:30	5/20/98	nd	BDL	nd	BDL	nd	BDL	~220	jj	nd	BDL	nd	BDL
EX1/013 A	5/15/98 7:30	5/20/98	nd	BDL	nd	BDL	nd	BDL	~232	jj	nd	BDL	nd	BDL
EX1/014 A	5/15/98 13:30	5/20/98	nd	BDL	nd	BDL	nd	BDL	~235	jj	nd	BDL	nd	BDL
EX1/015 A	5/15/98 19:30	5/20/98	0	j	0	j	0	j	~221	jj	0	j	nd	BDL
EX1/016 AD	5/15/98 19:40	5/20/98	0	j	0	j	0	j	~230	jj	0	j	nd	BDL
EX1/008 M	5/15/98 19:54	5/20/98	0	j	0	j	0	j	~217	jj	0	j	nd	BDL
EX1/017 A	5/16/98 1:30	5/20/98	1	j	1	j	1	j	~198	jj	0	j	0	j
EX1/018 A	5/16/98 7:30	5/20/98	3	j	3	j	2	j	~216	jj	1	j	0	j
EX1/009 M	5/16/98 7:42	5/20/98	3	j	3	j	2	j	~232	jj	2	j	0	j
EX1/019 EB	5/16/98 10:40	5/24/98	nd	BDL	nd	BDL	nd	BDL	~264	jj	nd	BDL	nd	BDL
EX1/019 EB	5/16/98 10:40	5/24/98	nd	BDL	nd	BDL	nd	BDL	183	OK	0	j	nd	BDL
EX1/019 EB	5/16/98 10:40	5/24/98	nd	BDL	nd	BDL	nd	BDL	~264	jj	nd	BDL	nd	BDL
EX1/019 EB	5/16/98 10:40	5/24/98	nd	BDL	nd	BDL	nd	BDL	183	OK	0	j	nd	BDL
EX1/022 A	5/16/98 13:30	5/25/98	6	j	7	j	5	j	150	OK	4	j	1	j
EX1/023 A	5/16/98 19:40	5/25/98	11	OK	12	OK	9	j	93	OK	6	j	1	j
EX1/020 M	5/16/98 20:20	5/25/98	13	OK	16	OK	11	OK	~239	jj	8	j	2	j
EX1/024 A	5/17/98 7:05	5/26/98	34	OK	39	OK	27	OK	~276	jj	18	OK	4	j
EX1/021 M	5/17/98 7:40	5/26/98	36	OK	38	OK	27	OK	~270	jj	19	OK	4	j
EX1/029 A	5/17/98 13:40	5/26/98	50	OK	53	OK	37	OK	~309	jj	26	OK	7	j
EX1/030 A	5/17/98 19:40	5/26/98	69	OK	75	OK	51	OK	~220	jj	37	OK	8	j
EX1/031 A	5/18/98 1:40	5/27/98	82	OK	84	OK	60	OK	~217	jj	43	OK	10	OK
EX1/032 A	5/18/98 7:40	5/27/98	90	OK	93	OK	67	OK	~234	jj	50	OK	12	OK
EX1/033 AD	5/18/98 7:50	5/27/98	87	OK	90	OK	66	OK	~207	jj	50	OK	12	OK

Sample ID	Date and Time	Date Analyzed	Methanol (mg/L)	Flag for Methanol	1-Propanol (mg/L)	Flag for 1-Propanol	4-Methanol-2-pentanol (mg/L)	Flag for 4-Methanol-2-pentanol	PCE (mg/L)	Flag for PCE	1-Hexanol (mg/L)	Flag for 1-Hexanol	1-Heptanol (mg/L)	Flag for 1-Heptanol
EX1/026 M	5/18/98 8:00	6/4/98			97	OK	64	OK		j	54	OK	16	OK
EX1/035 A	5/18/98 13:40	5/27/98	99	OK	103	OK	75	OK	~222	jj	57	OK	15	OK
EX1/036 A	5/18/98 19:40	5/27/98	116	OK	120	OK	83	OK	~227	jj	63	OK	17	OK
EX1/037 A	5/19/98 1:40	6/5/98			136	OK	78	OK		j	68	OK	15	OK
EX1/028 M	5/19/98 7:37	6/5/98			146	OK	76	OK		j	57	OK	18	OK
EX1/038 A	5/19/98 7:40	6/5/98			145	OK	88	OK		j	77	OK	15	OK
EX1/034 EB	5/19/98 10:39	6/5/98			nd	BDL	nd	BDL		j	5	j	nd	BDL
EX1/040 A	5/19/98 13:40	6/5/98			183	OK	114	OK		j	96	OK	20	OK
EX1/041 A	5/19/98 19:40	6/5/98			228	jj	129	OK		j	106	OK	24	OK
EX1/039 M	5/19/98 19:53	6/5/98			187	OK	95	OK		j	66	OK	20	OK
EX1/042 A	5/20/98 1:50	6/6/98			>200	jj	172	OK		j	134	OK	33	OK
EX1/042 A (1:10)	5/20/98 1:50	6/30/98			181	OK	138	OK		j	125	OK	60	OK
EX1/043 A	5/20/98 7:50	6/6/98			>200	jj	182	OK		j	143	OK	39	OK
EX1/043 A (1:10)	5/20/98 7:50	6/30/98			204	jj	155	OK		j	111	OK	32	OK
EX1/045 A	5/20/98 21:00	6/6/98			>200	jj	191	OK		j	148	OK	37	OK
EX1/045 A (1:10)	5/20/98 21:00	6/30/98			224	jj	153	OK		j	104	OK	30	OK
EX1/044 M	5/20/98 21:40	6/7/98			228	jj	152	OK		j	120	OK	30	OK
EX1/046 A	5/21/98 9:00	6/7/98			>200	jj	167	OK		j	131	OK	28	OK
EX1/046 A (1:10)	5/21/98 9:00	6/30/98			215	jj	157	OK		j	125	OK	40	OK
EX1/048 A	5/21/98 21:00	6/7/98			215	jj	171	OK		j	149	OK	47	OK
EX1/048 A (1:10)	5/21/98 21:00	7/1/98			210	jj	141	OK		j	148	OK	55	OK
EX1/047 M	5/21/98 21:01	6/7/98			227	jj	165	OK		j	134	OK	40	OK
EX1/049 A	5/22/98 9:00	6/7/98			214	jj	181	OK		j	153	OK	53	OK
EX1/051 A	5/22/98 21:00	6/7/98			196	OK	172	OK		j	150	OK	48	OK
EX1/050 M	5/22/98 21:01	6/8/98			200	OK	163	OK		j	140	OK	47	OK
EX1/052 A	5/23/98 8:50	6/8/98			175	OK	178	OK		j	167	OK	62	OK
EX1/053 M	5/23/98 19:06	6/8/98			154	OK	156	OK		j	161	OK	63	OK
EX1/055 A	5/23/98 21:00	6/8/98			117	OK	118	OK		j	114	OK	50	OK
EX1/056 A	5/24/98 9:00	6/9/98			90	OK	104	OK		j	97	OK	37	OK
EX1/057 A	5/24/98 21:00	6/9/98			86	OK	116	OK		j	113	OK	47	OK
EX1/058 A	5/25/98 9:00	6/9/98			74	OK	104	OK		j	106	OK	42	OK
EX1/058 A [dup]	5/25/98 9:00	6/9/98			60	OK	84	OK		j	87	OK	40	OK
EX1/054 M	5/25/98 10:30	6/9/98			47	OK	63	OK		j	60	OK	nd	BDL
EX1/059 A	5/25/98 21:00	7/14/98			67	OK	105	OK		j	134	OK	56	OK
EX1/060 A	5/26/98 8:50	6/10/98			36	OK	55	OK		j	65	OK	nd	BDL
EX1/060 A	5/26/98 8:50	6/10/98			112	OK	145	OK		j	198	OK	85	OK
EX1/061 AD	5/26/98 9:00	6/10/98			0	j	8	j		j	nd	BDL	nd	BDL
EX1/061 AD	5/26/98 9:00	6/10/98			66	OK	86	OK		j	120	OK	52	OK
EX1/062	5/26/98 9:20	6/10/98			>200	jj	>200	jj		j	181	OK	88	OK
EX1/062 EB	5/26/98 9:20	6/10/98			nd	BDL	2	j		j	5	j	nd	BDL
EX1/063 M	5/26/98 12:10	6/10/98			57	OK	68	OK		j	108	OK	49	OK

Sample ID	Date and Time	Date Analyzed	Methanol (mg/L)	Flag for Methanol	1-Propanol (mg/L)	Flag for 1-Propanol	4-Methanol-2-pentanol (mg/L)	Flag for 4-Methanol-2-pentanol	PCE (mg/L)	Flag for PCE	1-Hexanol (mg/L)	Flag for 1-Hexanol	1-Heptanol (mg/L)	Flag for 1-Heptanol
EX1/064A	5/27/98 11:00	6/11/98			34	OK	47	OK		j	107	OK	53	OK
EX1/067 A	5/28/98 10:50	6/11/98			20	OK	26	OK		j	47	OK	35	OK
EX1/065 A	5/28/98 11:00	6/11/98			28	OK	40	OK		j	73	OK	48	OK
EX1/066 M	5/28/98 12:35	6/11/98			27	OK	34	OK		j	67	OK	36	OK
EX1/068 M	5/29/98 20:40	6/12/98			16	OK	18	OK		j	34	OK	nd	BDL
EX1/070 A	5/30/98 11:00	6/12/98			16	OK	19	OK		j	34	OK	37	OK
EX1/069 M	5/30/98 11:24	6/12/98			16	OK	21	OK		j	31	OK	25	OK
EX1/071 A	5/31/98 11:00	6/12/98			12	OK	17	OK		j	25	OK	29	OK
EX1/072 M	5/31/98 11:31	6/12/98			12	OK	17	OK		j	25	OK	22	OK
EX1/073 A	6/1/98 10:50	6/12/98			11	OK	14	OK		j	20	OK	24	OK
EX1/074 M	6/1/98 11:29	6/15/98			13	OK	18	OK		j	27	OK	35	OK
EX1/075 A	6/2/98 11:00	6/15/98			9	j	11	OK		j	15	OK	26	OK
EX1/076 A	6/3/98 11:00	6/20/98			7	j	10	OK		j	17	OK	32	OK
EX1/077 M	6/3/98 11:39	6/21/98			6	j	8	j		j	12	OK	24	OK
EX1/078 M	6/4/98 11:37	6/21/98			6	j	8	j		j	16	OK	34	OK
EX1/079 A	6/5/98 11:00	6/21/98			6	j	8	j		j	14	OK	30	OK
EX1/080 M	6/5/98 11:08	6/21/98			5	j	7	j		j	11	OK	33	OK
EX1/081 A	6/6/98 11:00	6/21/98			4	j	9	j		j	14	OK	36	OK
EX1/082 A	6/7/98 10:50	6/24/98			7	j	7	j		j	13	OK	30	OK
EX1/083 M	6/7/98 11:19	6/24/98			5	j	7	j		j	6	j	25	OK
EX1/084 A	6/8/98 11:00	6/24/98			5	j	5	j		j	8	j	26	OK
EX1/085 A	6/9/98 11:00	6/24/98			5	j	8	j		j	9	j	28	OK
EX1/086 M	6/9/98 11:05	6/25/98			6	j	7	j		j	12	OK	29	OK
EX1/086 M [dup]	6/9/98 11:05	6/25/98			6	DUP	9	DUP		DUP	10	DUP	39	DUP
EX1/087 A	6/10/98 10:50	6/16/98			3	j	4	j		j	7	j	18	OK
EX1/089 A	6/11/98 11:00	6/16/98			4	j	4	j		j	5	j	20	OK
EX1/089 A	6/11/98 11:00	6/16/98			6	j	4	j		j	5	j	20	OK
EX1/088 M	6/11/98 11:16	6/16/98			5	j	4	j		j	7	j	22	OK
EX1/090 M/A	6/12/98 11:56	6/16/98			3	j	3	j		j	4	j	14	OK
EX1/091 M/A	6/13/98 11:07	6/17/98			4	j	4	j		j	5	j	18	OK
EX1/092 M	6/13/98 11:08	6/17/98			3	j	3	j		j	3	j	15	OK
EX1/092 M [dup]	6/13/98 11:08	6/17/98			5	DUP	3	DUP		DUP	3	DUP	16	DUP
EX1/093 M/A	6/14/98 11:03	6/23/98			6	j	3	j		j	5	j	14	OK
EX1/094 M/A	6/15/98 11:10	6/23/98			6	j	2	j		j	3	j	10	OK
EX1/095 M	6/15/98 11:32	6/23/98			6	j	3	j		j	4	j	5	j
EX1/096 A	6/16/98 10:50	6/23/98			5	j	4	j		j	3	j	4	j
EX1/097 AD	6/16/98 11:00	6/23/98			7	j	3	j		j	3	j	9	j
EX1/098 EB	6/16/98 11:22	6/23/98			nd	BDL	nd	BDL		j	nd	BDL	nd	BDL
EX1/099 A	6/17/98 11:00	6/22/98			4	j	3	j		j	4	j	8	j
EX1/100 M	6/17/98 11:25	6/22/98			4	j	3	j		j	4	j	9	j
EX1/101 A	6/18/98 11:00	6/22/98			4	j	3	j		j	4	j	9	j

Sample ID	Date and Time	Date Analyzed	Methanol (mg/L)	Flag for Methanol	1-Propanol (mg/L)	Flag for 1-Propanol	4-Methanol-2-pentanol (mg/L)	Flag for 4-Methanol-2-pentanol	PCE (mg/L)	Flag for PCE	1-Hexanol (mg/L)	Flag for 1-Hexanol	1-Heptanol (mg/L)	Flag for 1-Heptanol
EX1/102 A	6/19/98 10:50	6/25/98			5	j	3	j		j	4	j	11	OK
EX1/103 M	6/19/98 11:29	6/25/98			5	j	5	j		j	5	j	4	j
EX1/104 A	6/20/98 11:00	6/25/98			5	j	5	j		j	4	j	8	j
EX1/105 A	6/21/98 11:00	6/26/98			6	j	5	j		j	8	j	9	j
EX1/107 A	6/22/98 10:50	6/26/98			6	j	8	j		j	5	j	8	j

Project: PITT at ESTCP Camp Lejeune
Acceptable QA/QC limits: % Recovery between 80% and 120%

Data QA/QC by	DW
Date created	1/22/99 0:00
Date last modified	1/26/99 0:00

Sample Legend
CC = Calibration check
j = below reporting limit
d = diluted sample
BDL = below detection limit
NA = not applicable
jj = out of acceptable QA/QC and/or calibration limits
OK = within acceptable QA/QC limits
nd = not detected
DUP = Duplicate
d,DUP = diluted duplicate

Sample Point: Extraction Well EX2

Sample ID	Date and Time	Date Analyzed	Methanol (mg/L)	Flag for Methanol	1-Propanol (mg/L)	Flag for 1-Propanol	4-Methanol-2-pentanol (mg/L)	Flag for 4-Methanol-2-pentanol	PCE (mg/L)	Flag for PCE	1-Hexanol (mg/L)	Flag for 1-Hexanol	1-Heptanol (mg/L)	Flag for 1-Heptanol
EX2/004 A	5/13/98 17:30	5/19/98	nd	BDL	nd	BDL	nd	BDL	52	OK	nd	BDL	nd	BDL
EX2/003 M	5/14/98 7:34	5/19/98	nd	BDL	nd	BDL	nd	BDL	56	OK	nd	BDL	nd	BDL
EX2/005 A	5/14/98 7:40	5/19/98	nd	BDL	nd	BDL	nd	BDL	49	OK	nd	BDL	nd	BDL
EX2/006 EB	5/14/98 11:30	5/19/98	nd	BDL	nd	BDL	nd	BDL	1	j	nd	BDL	nd	BDL
EX2/006 EB	5/14/98 11:30	5/19/98	nd	BDL	nd	BDL	nd	BDL	1	j	nd	BDL	nd	BDL
EX2/011 A	5/14/98 13:30	5/20/98	nd	BDL	nd	BDL	nd	BDL	84	OK	nd	BDL	nd	BDL
EX2/012 A	5/14/98 19:30	5/20/98	nd	BDL	nd	BDL	nd	BDL	131	OK	nd	BDL	nd	BDL
EX2/007 M	5/14/98 19:50	5/20/98	nd	BDL	nd	BDL	nd	BDL	83	OK	nd	BDL	nd	BDL
EX2/013 A	5/15/98 1:30	5/20/98	nd	BDL	nd	BDL	nd	BDL	91	OK	nd	BDL	nd	BDL
EX2/013 A [dup]	5/15/98 1:30	5/20/98	nd	DUP	nd	DUP	nd	DUP	90	DUP	nd	DUP	nd	DUP
EX2/014 A	5/15/98 7:30	5/20/98	nd	BDL	nd	BDL	nd	BDL	81	OK	nd	BDL	nd	BDL
EX2/015 A	5/15/98 13:30	5/20/98	nd	BDL	nd	BDL	nd	BDL	95	OK	nd	BDL	nd	BDL
EX2/016 A	5/15/98 19:30	5/20/98	nd	BDL	nd	BDL	nd	BDL	91	OK	nd	BDL	nd	BDL
EX2/009 M	5/15/98 19:55	5/20/98	nd	BDL	nd	BDL	nd	BDL	111	OK	nd	BDL	nd	BDL
EX2/017 A	5/16/98 1:30	5/20/98	0	j	0	j	0	j	100	OK	0	j	nd	BDL
EX2/018 A	5/16/98 7:30	5/20/98	1	j	1	j	1	j	154	OK	1	j	0	j
EX2/010 M	5/16/98 7:44	5/20/98	1	j	1	j	1	j	98	OK	1	j	0	j
EX2/022 A	5/16/98 13:30	5/25/98	2	j	3	j	3	j	58	OK	2	j	0	j
EX2/023 A	5/16/98 19:40	5/25/98	6	j	8	j	7	j	44	OK	5	j	2	j
EX2/019 M	5/16/98 20:22	5/25/98	9	j	11	OK	10	j	99	OK	7	j	3	j
EX2/024 A	5/17/98 7:05	5/26/98	31	OK	36	OK	31	OK	119	OK	25	OK	10	j
EX2/022 M	5/17/98 7:42	5/26/98	34	OK	38	OK	34	OK	98	OK	27	OK	11	OK
EX2/029 A	5/17/98 13:40	5/26/98	54	OK	62	OK	55	OK	106	OK	46	OK	20	OK
EX2/030 A	5/17/98 19:40	5/26/98	81	OK	92	OK	82	OK	107	OK	71	OK	32	OK
EX2/031 A	5/18/98 1:40	5/27/98	104	OK	108	OK	99	OK	152	OK	87	OK	43	OK
EX2/032 A	5/18/98 7:40	5/27/98	8	j	132	OK	121	OK	~172	jj	111	OK	56	OK
EX2/026 M	5/18/98 8:02	6/4/98			177	OK	132	OK		j	125	OK	60	OK
EX2/033 A	5/18/98 13:40	5/27/98	151	OK	159	OK	145	OK	~171	jj	132	OK	71	OK
EX2/034 A	5/18/98 19:40	5/27/98	173	OK	179	OK	163	OK	~233	jj	150	OK	83	OK

Sample ID	Date and Time	Date Analyzed	Methanol (mg/L)	Flag for Methanol	1-Propanol (mg/L)	Flag for 1-Propanol	4-Methanol-2-pentanol (mg/L)	Flag for 4-Methanol-2-pentanol	PCE (mg/L)	Flag for PCE	1-Hexanol (mg/L)	Flag for 1-Hexanol	1-Heptanol (mg/L)	Flag for 1-Heptanol
EX2/035 A	5/19/98 1:40	6/5/98			191	OK	155	OK		j	177	OK	76	OK
EX2/028 M	5/19/98 7:39	6/5/98			209	jj	138	OK		j	122	OK	64	OK
EX2/036 A	5/19/98 7:40	6/5/98			178	OK	160	OK		j	183	OK	91	OK
EX2/038 A	5/19/98 13:40	6/5/98			217	jj	191	OK		j	218	jj	111	OK
EX2/039 A	5/19/98 19:40	6/5/98			291	jj	225	jj		j	257	jj	129	OK
EX2/040 AD	5/19/98 19:50	6/5/98			241	jj	202	jj		j	234	jj	110	OK
EX2/040 AD [dup]	5/19/98 19:50	6/5/98			237	DUP	200	DUP		DUP	224	DUP	105	DUP
EX2/037 M	5/19/98 19:54	6/5/98			183	OK	148	OK		j	133	OK	101	OK
EX2/043 A	5/20/98 7:50	6/6/98			>200	jj	>200	jj		j	>200	jj	186	OK
EX2/043 A (1:10)	5/20/98 7:50	6/30/98			271	d	238	d		d	250	d	110	d
EX2/041 EB	5/20/98 18:22	6/6/98			1	j	1	j		j	nd	BDL	1	j
EX2/045 A	5/20/98 21:00	6/6/98			>200	jj	>200	jj		j	>200	jj	152	OK
EX2/045 A (1:10)	5/20/98 21:00	6/30/98			311	d	266	d		d	267	d	163	d
EX2/044 M	5/20/98 21:41	6/7/98			>200	jj	>200	jj		j	>200	jj	158	OK
EX2/044 M (1:10)	5/20/98 21:41	6/30/98			267	d	224	d		d	212	d	127	d
EX2/046 A	5/21/98 9:00	6/7/98			>200	jj	>200	jj		j	>200	jj	156	OK
EX2/046 A (1:10)	5/21/98 9:00	7/1/98			335	d	307	d		d	292	d	152	d
EX2/048 A	5/21/98 21:00	6/7/98			>200	jj	239	jj		j	>200	jj	156	OK
EX2/047 M	5/21/98 21:02	6/7/98			>200	jj	>200	jj		j	>200	jj	177	OK
EX2/047 M (1:10)	5/21/98 21:02	7/1/98			285	d	265	d		d	251	d	143	d
EX2/049 A	5/22/98 9:00	6/7/98			4	j	14	OK		j	24	OK	36	OK
EX2/051 A	5/22/98 21:00	6/7/98			236	jj	196	OK		j	195	OK	136	OK
EX2/050 M	5/22/98 21:02	6/8/98			>200	jj	208	jj		j	215	jj	151	OK
EX2/050 M (1:10)	5/22/98 21:02	7/1/98			238	d	180	d		d	211	d	143	d
EX2/050 M (1:10) [dup]	5/22/98 21:02	7/1/98			229	d,DUP	169	d,DUP		d,DUP	206	d,DUP	129	d,DUP
EX2/052 A	5/23/98 8:50	6/8/98			209	jj	209	jj		j	223	jj	203	jj
EX2/053 AD	5/23/98 9:00	6/8/98			216	jj	213	jj		j	227	jj	207	jj
EX2/054 EB	5/23/98 10:45	6/8/98			nd	BDL	nd	BDL		j	4	j	3	j
EX2/055 M	5/23/98 19:09	6/8/98			180	OK	213	jj		j	197	OK	176	OK
EX2/055 M [dup]	5/23/98 19:09	6/9/98			178	DUP	206	DUP		DUP	192	DUP	176	DUP
EX2/057 A	5/23/98 21:00	6/8/98			152	OK	135	OK		j	135	OK	125	OK
EX2/058 A	5/24/98 9:00	6/9/98			120	OK	104	OK		j	100	OK	85	OK
EX2/059 A	5/24/98 21:00	6/9/98			130	OK	126	OK		j	127	OK	111	OK
EX2/060 AD	5/24/98 21:10	6/9/98			137	OK	123	OK		j	124	OK	113	OK
EX2/062 A	5/25/98 9:00	6/9/98			75	OK	66	OK		j	66	OK	29	OK
EX2/056 M	5/25/98 10:32	6/9/98			78	OK	73	OK		j	71	OK	53	OK
EX2/061 EB	5/25/98 12:35	6/9/98			nd	BDL	nd	BDL		j	nd	BDL	nd	BDL
EX2/063 A	5/25/98 21:00	7/14/98			89	OK	88	OK		j	101	OK	73	OK
EX2/064 A	5/26/98 8:50	6/10/98			91	OK	75	OK		j	85	OK	67	OK
EX2/065 M	5/26/98 12:12	6/10/98			84	OK	70	OK		j	79	OK	61	OK
EX2/066A	5/27/98 11:00	6/11/98			63	OK	52	OK		j	71	OK	53	OK

Sample ID	Date and Time	Date Analyzed	Methanol (mg/L)	Flag for Methanol	1-Propanol (mg/L)	Flag for 1-Propanol	4-Methanol-2-pentanol (mg/L)	Flag for 4-Methanol-2-pentanol	PCE (mg/L)	Flag for PCE	1-Hexanol (mg/L)	Flag for 1-Hexanol	1-Heptanol (mg/L)	Flag for 1-Heptanol
EX2/067 A	5/28/98 11:00	6/11/98			47	OK	40	OK		j	49	OK	35	OK
EX2/068 M	5/28/98 12:37	6/11/98			69	OK	53	OK		j	62	OK	44	OK
EX2/068 M [dup]	5/28/98 12:37	6/11/98			88	DUP	66	DUP		DUP	74	DUP	51	DUP
EX2/069 A	5/29/98 10:50	6/11/98			33	OK	33	OK		j	39	OK	27	OK
EX2/069 A [dup]	5/29/98 10:50	6/11/98			34	DUP	33	DUP		DUP	36	DUP	28	DUP
EX2/070 M	5/29/98 20:41	6/12/98			33	OK	29	OK		j	38	OK	24	OK
EX2/072 A	5/30/98 11:00	6/12/98			29	OK	27	OK		j	32	OK	25	OK
EX2/071 M	5/30/98 11:25	6/12/98			24	OK	24	OK		j	26	OK	17	OK
EX2/073 A	5/31/98 11:00	6/12/98			22	OK	20	OK		j	25	OK	23	OK
EX2/074 M	5/31/98 11:32	6/12/98			19	OK	21	OK		j	22	OK	17	OK
EX2/075 A	6/1/98 10:50	6/12/98			17	OK	18	OK		j	20	OK	10	j
EX2/076 M	6/1/98 11:34	6/15/98			22	OK	22	OK		j	24	OK	22	OK
EX2/077 A	6/2/98 11:00	6/15/98			18	OK	18	OK		j	20	OK	16	OK
EX2/078 A	6/3/98 11:00	6/21/98			12	OK	11	OK		j	15	OK	12	OK
EX2/079 M	6/3/98 11:41	6/21/98			12	OK	12	OK		j	14	OK	13	OK
EX2/080 A	6/4/98 10:50	6/21/98			12	OK	11	OK		j	12	OK	13	OK
EX2/081 AD	6/4/98 11:00	6/21/98			11	OK	10	OK		j	12	OK	13	OK
EX2/082 EB	6/4/98 11:40	6/21/98			nd	BDL	1	j		j	nd	BDL	nd	BDL
EX2/083 A	6/5/98 11:00	6/21/98			11	OK	12	OK		j	14	OK	14	OK
EX2/083 A [dup]	6/5/98 11:00	6/21/98			10	DUP	10	DUP		DUP	12	DUP	12	DUP
EX2/084 M	6/5/98 11:06	6/21/98			8	j	10	j		j	10	OK	12	OK
EX2/085 A	6/6/98 11:00	6/21/98			8	j	12	OK		j	14	OK	14	OK
EX2/086 A	6/7/98 10:50	6/24/98			10	j	9	j		j	10	OK	9	j
EX2/087 M	6/7/98 11:07	6/24/98			9	j	8	j		j	10	OK	10	OK
EX2/088 A	6/8/98 11:00	6/24/98			9	j	8	j		j	8	j	11	OK
EX2/088 A [dup]	6/8/98 11:00	6/24/98			8	DUP	8	DUP		DUP	8	DUP	10	DUP
EX2/089 A	6/9/98 11:00	6/24/98			9	j	10	j		j	10	OK	9	j
EX2/090 M	6/9/98 11:07	6/25/98			11	OK	11	OK		j	11	OK	13	OK
EX2/091 A	6/10/98 10:50	6/17/98			10	OK	9	j		j	8	j	9	j
EX2/093 A	6/11/98 11:00	6/17/98			10	j	7	j		j	8	j	6	j
EX2/092 M	6/11/98 11:18	6/17/98			12	OK	9	j		j	8	j	6	j
EX2/094 A	6/12/98 11:00	6/17/98			8	j	7	j		j	7	j	6	j
EX2/096 A	6/13/98 10:50	6/17/98			8	j	6	j		j	6	j	5	j
EX2/095 M	6/13/98 11:09	6/17/98			8	j	9	j		j	9	j	7	j
EX2/097 A	6/14/98 11:00	6/23/98			9	j	6	j		j	6	j	7	j
EX2/098 A	6/15/98 11:00	6/23/98			8	j	6	j		j	8	j	7	j
EX2/099 M	6/15/98 11:34	6/23/98			9	j	7	j		j	7	j	5	j
EX2/100 A	6/16/98 10:50	6/23/98			12	OK	7	j		j	7	j	5	j
EX2/100 A [dup]	6/16/98 10:50	6/23/98			11	DUP	7	DUP		DUP	7	DUP	4	DUP
EX2/101 A	6/17/98 11:00	6/22/98			6	j	7	j		j	7	j	4	j
EX2/102 M	6/17/98 11:29	6/22/98			5	j	4	j		j	5	j	nd	BDL

Sample ID	Date and Time	Date Analyzed	Methanol (mg/L)	Flag for Methanol	1-Propanol (mg/L)	Flag for 1-Propanol	4-Methanol-2-pentanol (mg/L)	Flag for 4-Methanol-2-pentanol	PCE (mg/L)	Flag for PCE	1-Hexanol (mg/L)	Flag for 1-Hexanol	1-Heptanol (mg/L)	Flag for 1-Heptanol
EX2/103 M/A	6/18/98 11:32	6/22/98			5	j	6	j		j	6	j	4	j
EX2/103 M/A [dup]	6/18/98 11:32	6/22/98			6	DUP	6	DUP		DUP	5	DUP	5	DUP
EX2/104 A	6/19/98 10:50	6/25/98			7	j	8	j		j	9	j	10	j
EX2/105 M	6/19/98 11:31	6/25/98			6	j	7	j		j	7	j	9	j
EX2/106 A	6/20/98 11:00	6/25/98			6	j	7	j		j	9	j	14	OK
EX2/107 A	6/21/98 11:00	6/26/98			6	j	8	j		j	8	j	6	j
EX2/108 M	6/21/98 11:28	6/26/98			5	j	6	j		j	6	j	5	j
EX2/109 A	6/22/98 10:50	6/26/98			5	j	6	j		j	6	j	6	j

Project: PITT at ESTCP Camp Lejeune
Acceptable QA/QC limits: % Recovery between 80% and 120%

Data QA/QC by	DW
Date created	1/22/99
Date last modified	1/26/99

Sample Legend
CC = Calibration check
j = below reporting limit
d = diluted sample
BDL = below detection limit
NA = not applicable
jj = out of acceptable QA/QC and/or calibration limits
OK = within acceptable QA/QC limits
nd = not detected
DUP = Duplicate
d,DUP = diluted duplicate

Sample Point: Extraction Well EX3

Sample ID	Date and Time	Date Analyzed	Methanol (mg/L)	Flag for Methanol	1-Propanol (mg/L)	Flag for 1-Propanol	4-Methanol-2-pentanol (mg/L)	Flag for 4-Methanol-2-pentanol	PCE (mg/L)	Flag for PCE	1-Hexanol (mg/L)	Flag for 1-Hexanol	1-Heptanol (mg/L)	Flag for 1-Heptanol
EX3/004 A	5/13/98 17:30	5/19/98	nd	BDL	nd	BDL	nd	BDL	2	j	nd	BDL	nd	BDL
EX3/003 M	5/14/98 7:37	5/19/98	nd	BDL	nd	BDL	nd	BDL	2	j	nd	BDL	nd	BDL
EX3/005 A	5/14/98 7:40	5/19/98	nd	BDL	nd	BDL	nd	BDL	2	j	nd	BDL	nd	BDL
EX3/010 A	5/14/98 13:30	5/20/98	nd	BDL	nd	BDL	nd	BDL	3	j	nd	BDL	nd	BDL
EX3/012 A	5/14/98 19:30	5/20/98	nd	BDL	nd	BDL	nd	BDL	3	j	nd	BDL	nd	BDL
EX3/006 M	5/14/98 19:51	5/20/98	nd	BDL	nd	BDL	nd	BDL	3	j	nd	BDL	nd	BDL
EX3/013 A	5/15/98 1:30	5/20/98	nd	BDL	nd	BDL	nd	BDL	3	j	nd	BDL	nd	BDL
EX3/015 A	5/15/98 7:30	5/20/98	nd	BDL	nd	BDL	nd	BDL	3	j	nd	BDL	nd	BDL
EX3/016 A	5/15/98 13:30	5/20/98	nd	BDL	nd	BDL	nd	BDL	3	j	nd	BDL	nd	BDL
EX3/017 A	5/15/98 19:30	5/23/98	nd	BDL	nd	BDL	nd	BDL	2	j	nd	BDL	nd	BDL
EX3/018 AD	5/15/98 19:40	5/23/98	nd	BDL	nd	BDL	nd	BDL	2	j	nd	BDL	nd	BDL
EX3/008 M	5/15/98 19:57	5/23/98	nd	BDL	nd	BDL	nd	BDL	2	j	nd	BDL	nd	BDL
EX3/019 A	5/16/98 1:30	5/23/98	nd	BDL	nd	BDL	nd	BDL	2	j	nd	BDL	nd	BDL
EX3/020 A	5/16/98 7:30	5/23/98	0	j	0	j	0	j	2	j	0	j	nd	BDL
EX3/009 M	5/16/98 7:45	5/23/98	0	j	0	j	0	j	2	j	0	j	nd	BDL
EX3/009 M [dup]	5/16/98 7:45	5/23/98	0	DUP	0	DUP	0	DUP	2	DUP	0	DUP	nd	DUP
EX3/014 EB	5/16/98 11:52	5/24/98	nd	BDL	nd	BDL	nd	BDL	nd	BDL	nd	BDL	nd	BDL
EX3/014 EB	5/16/98 11:52	5/24/98	0	j	nd	BDL	nd	BDL	nd	BDL	nd	BDL	nd	BDL
EX3/014 EB	5/16/98 11:52	5/24/98	nd	BDL	nd	BDL	nd	BDL	nd	BDL	nd	BDL	nd	BDL
EX3/014 EB	5/16/98 11:52	5/24/98	0	j	nd	BDL	nd	BDL	nd	BDL	nd	BDL	nd	BDL
EX3/023 A	5/16/98 13:30	5/25/98	nd	BDL	1	j	1	j	2	j	0	j	nd	BDL
EX3/024 A	5/16/98 19:40	5/25/98	1	j	2	j	2	j	1	j	1	j	0	j
EX3/021 M	5/16/98 20:24	5/25/98	2	j	4	j	3	j	2	j	2	j	1	j
EX3/025 A	5/17/98 7:05	5/26/98	11	OK	13	OK	12	OK	2	j	9	j	4	j
EX3/022 M	5/17/98 7:43	5/26/98	12	OK	17	OK	15	OK	2	j	12	OK	4	j
EX3/031 A	5/17/98 19:40	5/26/98	37	OK	42	OK	38	OK	2	j	31	OK	14	OK
EX3/032 A	5/18/98 1:40	5/27/98	49	OK	47	OK	45	OK	4	j	39	OK	19	OK
EX3/033 A	5/18/98 7:40	5/27/98	66	OK	66	OK	64	OK	3	j	58	OK	29	OK
EX3/027 M	5/18/98 8:03	6/4/98			79	OK	76	OK			66	OK	31	OK
EX3/034 A	5/18/98 13:40	5/27/98	68	OK	68	OK	67	OK	4	j	61	OK	34	OK
EX3/035 A	5/18/98 19:40	5/27/98	85	OK	85	OK	83	OK	5	j	78	OK	44	OK
EX3/036 A	5/19/98 1:40	6/5/98			91	OK	101	OK			96	OK	55	OK
EX3/037 A	5/19/98 7:40	6/5/98			134	OK	122	OK			111	OK	62	OK
EX3/029 M	5/19/98 7:41	6/5/98			106	OK	86	OK			77	OK	41	OK

Sample ID	Date and Time	Date Analyzed	Methanol (mg/L)	Flag for Methanol	1-Propanol (mg/L)	Flag for 1-Propanol	4-Methanol-2-pentanol (mg/L)	Flag for 4-Methanol-2-pentanol	PCE (mg/L)	Flag for PCE	1-Hexanol (mg/L)	Flag for 1-Hexanol	1-Heptanol (mg/L)	Flag for 1-Heptanol
EX3/039 A	5/19/98 13:40	6/5/98			111	OK	129	OK			117	OK	68	OK
EX3/040 A	5/19/98 19:40	6/5/98			118	OK	129	OK			117	OK	70	OK
EX3/041 AD	5/19/98 19:50	6/5/98			125	OK	137	OK			123	OK	72	OK
EX3/038 M	5/19/98 19:55	6/5/98			109	OK	95	OK			88	OK	66	OK
EX3/043 A	5/20/98 1:50	6/6/98			180	OK	159	OK			143	OK	87	OK
EX3/044 A	5/20/98 7:50	6/6/98			144	OK	142	OK			130	OK	83	OK
EX3/042 EB	5/20/98 18:40	6/6/98			1	j	nd	BDL			nd	BDL	nd	BDL
EX3/042 EB [dup]	5/20/98 18:40	6/6/98			1	DUP	nd	DUP			nd	DUP	nd	DUP
EX3/046 A	5/20/98 21:00	6/6/98			145	OK	138	OK			131	OK	85	OK
EX3/045 M	5/20/98 21:42	6/7/98			154	OK	149	OK			141	OK	92	OK
EX3/047 A	5/21/98 9:00	6/7/98			168	OK	184	OK			178	OK	114	OK
EX3/050 A	5/21/98 21:00	6/7/98			161	OK	157	OK			150	OK	98	OK
EX3/048 M	5/21/98 21:03	6/7/98			175	OK	160	OK			151	OK	102	OK
EX3/051 A	5/22/98 9:00	6/7/98			153	OK	138	OK			130	OK	89	OK
EX3/052 A	5/22/98 21:00	6/7/98			141	OK	122	OK			113	OK	84	OK
EX3/049 M	5/22/98 21:03	6/8/98			157	OK	140	OK			131	OK	100	OK
EX3/053 A	5/23/98 8:50	6/8/98			4	j	13	OK			13	OK	8	j
EX3/054 M	5/23/98 19:11	6/9/98			95	OK	107	OK			112	OK	110	OK
EX3/056 A	5/23/98 21:00	6/8/98			96	OK	107	OK			106	OK	108	OK
EX3/056 A	5/24/98 9:00	6/9/98			67	OK	66	OK			65	OK	64	OK
EX3/058 A	5/24/98 21:00	6/9/98			49	OK	50	OK			49	OK	51	OK
EX3/059 A	5/25/98 9:00	7/14/98			39	OK	47	OK			45	OK	38	OK
EX3/055 M	5/25/98 10:33	6/9/98			26	OK	22	OK			24	OK	nd	BDL
EX3/060 A	5/25/98 21:00	6/9/98			21	OK	20	OK			20	OK	0	j
EX3/061 A	5/26/98 8:50	6/10/98			32	OK	31	OK			31	OK	27	OK
EX3/062 M	5/26/98 12:14	6/10/98			36	OK	34	OK			34	OK	27	OK
EX3/063 A	5/27/98 11:00	6/11/98			22	OK	17	OK			24	OK	23	OK
EX3/064 A	5/28/98 11:00	6/11/98			16	OK	15	OK			18	OK	13	OK
EX3/065 M	5/28/98 12:39	6/11/98			25	OK	27	OK			25	OK	22	OK
EX3/066 A	5/29/98 10:50	6/11/98			14	OK	14	OK			14	OK	11	OK
EX3/067 AD	5/29/98 11:00	6/12/98			12	OK	12	OK			12	OK	10	OK
EX3/068 EB	5/29/98 11:33	6/12/98			nd	BDL	nd	BDL			nd	BDL	nd	BDL
EX3/069 M	5/29/98 20:43	6/12/98			12	OK	12	OK			12	OK	8	j
EX3/071 A	5/30/98 11:00	6/12/98			9	j	9	j			8	j	4	j
EX3/070 M	5/30/98 11:26	6/12/98			9	j	9	j			8	j	4	j
EX3/072 A	5/31/98 11:00	6/12/98			10	j	7	j			9	j	7	j
EX3/073 A	6/1/98 10:50	6/12/98			10	j	9	j			9	j	nd	BDL
EX3/074 M	6/1/98 11:35	6/15/98			9	j	9	j			9	j	5	j
EX3/075 A	6/2/98 11:00	6/15/98			11	OK	10	OK			12	OK	3	j
EX3/076 A	6/3/98 11:00	6/21/98			8	j	8	j			8	j	6	j
EX3/077 M	6/3/98 11:43	6/21/98			7	j	7	j			7	j	5	j
EX3/078 A	6/4/98 10:50	6/21/98			6	j	6	j			6	j	4	j
EX3/078 A [dup]	6/4/98 10:50	6/21/98			7	DUP	6	DUP			7	DUP	4	DUP
EX3/079 A	6/5/98 11:00	6/21/98			7	j	7	j			7	j	5	j
EX3/080 M	6/5/98 11:13	6/21/98			7	j	7	j			8	j	7	j
EX3/081 A	6/6/98 11:00	6/21/98			7	j	9	j			9	j	6	j
EX3/082 A	6/7/98 10:50	6/24/98			9	j	8	j			9	j	7	j

Sample ID	Date and Time	Date Analyzed	Methanol (mg/L)	Flag for Methanol	1-Propanol (mg/L)	Flag for 1-Propanol	4-Methanol-2-pentanol (mg/L)	Flag for 4-Methanol-2-pentanol	PCE (mg/L)	Flag for PCE	1-Hexanol (mg/L)	Flag for 1-Hexanol	1-Heptanol (mg/L)	Flag for 1-Heptanol
EX3/083 M	6/7/98 11:09	6/24/98			8	j	8	j			8	j	7	j
EX3/084 A	6/8/98 11:00	6/24/98			8	j	6	j			6	j	7	j
EX3/085 A	6/9/98 11:00	6/24/98			8	j	7	j			7	j	7	j
EX3/086 M	6/9/98 11:08	6/25/98			8	j	7	j			8	j	6	j
EX3/087 A	6/10/98 10:50	6/17/98			8	j	7	j			7	j	4	j
EX3/089 A	6/11/98 11:00	6/17/98			10	OK	6	j			5	j	4	j
EX3/088 M	6/11/98 11:19	6/17/98			10	j	6	j			5	j	4	j
EX3/090 A	6/12/98 11:00	6/17/98			12	OK	7	j			7	j	4	j
EX3/092 A	6/13/98 10:50	6/17/98			nd	BDL	5	j			6	j	3	j
EX3/091 M	6/13/98 11:12	6/17/98			9	j	6	j			7	j	3	j
EX3/091 M [dup]	6/13/98 11:12	6/17/98			10	DUP	6	DUP			6	DUP	2	DUP
EX3/093 A	6/14/98 11:00	6/23/98			9	j	6	j			6	j	3	j
EX3/094 A	6/15/98 11:00	6/23/98			9	j	5	j			4	j	3	j
EX3/095 M	6/15/98 11:35	6/23/98			8	j	5	j			6	j	3	j
EX3/096 A	6/16/98 10:50	6/23/98			9	j	6	j			7	j	3	j
EX3/097 A	6/17/98 11:00	6/22/98			5	j	4	j			4	j	nd	BDL
EX3/098 M	6/17/98 11:31	6/22/98			6	j	4	j			5	j	2	j
EX3/099 A	6/18/98 11:00	6/22/98			5	j	4	j			5	j	2	j
EX3/100 A	6/19/98 10:50	6/25/98			7	j	7	j			8	j	10	j
EX3/100 AD	6/19/98 11:00	6/25/98			6	j	7	j			7	j	6	j
EX3/100 AD [dup]	6/19/98 11:00	6/25/98			6	DUP	6	DUP			5	DUP	6	DUP
EX3/102 EB	6/19/98 11:02	6/25/98			nd	BDL	nd	BDL			nd	BDL	4	j
EX3/103 M	6/19/98 11:32	6/25/98			5	j	6	j			6	j	5	j
EX3/103 M [dup]	6/19/98 11:32	6/25/98			7	DUP	8	DUP			7	DUP	7	DUP
EX3/104 A	6/20/98 11:00	6/25/98			6	j	7	j			7	j	7	j
EX3/105 A	6/21/98 11:00	6/26/98			5	j	6	j			6	j	6	j
EX3/106 M	6/21/98 11:30	6/26/98			4	j	5	j			2	j	3	j
EX3/107 A	6/22/98 10:50	6/26/98			5	j	5	j			5	j	nd	BDL

Project: PITT at ESTCP Camp Lejeune
Acceptable QA/QC limits: % Recovery between 80% and 120%

Data QA/QC by DW
Date created 1/22/99
Date last modified 1/26/99

Sample Legend
CC = Calibration check
j = below reporting limit
d = diluted sample
BDL = below detection limit
NA = not applicable
jj = out of acceptable QA/QC and/or calibration limits
OK = within acceptable QA/QC limits
nd = not detected
DUP = Duplicate
d,DUP = diluted duplicate

Sample Point: Extraction Well EX4R

Sample ID	Date and Time	Date Analyzed	Methanol (mg/L)	Flag for Methanol	1-Propanol (mg/L)	Flag for 1-Propanol	4-Methanol-2-pentanol (mg/L)	Flag for 4-Methanol-2-pentanol	PCE (mg/L)	Flag for PCE	1-Hexanol (mg/L)	Flag for 1-Hexanol	1-Heptanol (mg/L)	Flag for 1-Heptanol
EX4R/004 A	5/13/98 17:30	5/19/98	nd	BDL	nd	BDL	nd	BDL	61	OK	nd	BDL	nd	BDL
EX4R/003 M	5/14/98 7:38	5/19/98	nd	BDL	nd	BDL	nd	BDL	72	OK	nd	BDL	nd	BDL
EX4R/005 A	5/14/98 7:40	5/19/98	nd	BDL	nd	BDL	nd	BDL	89	OK	nd	BDL	nd	BDL
EX4R/005 A [dup]	5/14/98 7:40	5/19/98	nd	BDL	nd	DUP	nd	DUP	91	DUP	nd	DUP	nd	DUP
EX4R/010 A	5/14/98 13:30	5/21/98	nd	BDL	nd	BDL	nd	BDL	82	OK	nd	BDL	nd	BDL
EX4R/011 A	5/14/98 19:30	5/21/98	nd	BDL	nd	BDL	nd	BDL	97	OK	nd	BDL	nd	BDL
EX4R/006 M	5/14/98 19:52	5/21/98	nd	BDL	nd	BDL	nd	BDL	79	OK	nd	BDL	nd	BDL
EX4R/012 A	5/15/98 1:30	5/23/98	nd	BDL	nd	BDL	nd	BDL	74	OK	nd	BDL	nd	BDL
EX4R/013 A	5/15/98 7:30	5/23/98	nd	BDL	nd	BDL	nd	BDL	86	OK	nd	BDL	nd	BDL
EX4R/014 A	5/15/98 13:30	5/23/98	nd	BDL	nd	BDL	nd	BDL	88	OK	nd	BDL	nd	BDL
EX4R/015 A	5/15/98 19:30	5/23/98	nd	BDL	nd	BDL	nd	BDL	85	OK	nd	BDL	nd	BDL
EX4R/008 M	5/15/98 19:58	5/23/98	nd	BDL	nd	BDL	nd	BDL	95	OK	nd	BDL	nd	BDL
EX4R/016 A	5/16/98 1:30	5/23/98	0		0	j	0	j	79	OK	nd	BDL	nd	BDL
EX4R/016 A [dup]	5/16/98 1:30	5/24/98	0		0	DUP	nd	DUP	86	DUP	nd	DUP	nd	DUP
EX4R/017 A	5/16/98 7:30	5/23/98	1		1	j	1	j	85	OK	0	j	nd	BDL
EX4R/009 M	5/16/98 7:47	5/23/98	1		1	j	1	j	90	OK	0	j	nd	BDL
EX4R/020 A	5/16/98 13:30	5/25/98	2		3	j	2	j	54	OK	1	j	nd	BDL
EX4R/021 A	5/16/98 19:40	5/25/98	8		10	j	7	j	51	OK	4	j	0	j
EX4R/021 A [dup]	5/16/98 19:40	5/25/98	9		11	DUP	7	DUP	35	DUP	4	DUP	0	DUP
EX4R/018 M	5/16/98 20:25	5/25/98	10		12	OK	8	j	89	OK	5	j	1	j
EX4R/022 A	5/17/98 7:05	5/26/98	32		34	OK	25	OK	79	OK	16	OK	2	j
EX4R/019 M	5/17/98 7:44	5/26/98	34		42	OK	32	OK	77	OK	21	OK	3	j
EX4R/027 A	5/17/98 13:40	5/26/98	49		56	OK	41	OK	83	OK	28	OK	5	j
EX4R/027 A [dup]	5/17/98 13:40	5/26/98	58		66	DUP	50	DUP	76	DUP	34	DUP	6	DUP
EX4R/028 A	5/17/98 19:40	5/26/98	67		70	OK	52	OK	76	OK	38	OK	7	j
EX4R/029 A	5/18/98 1:40	5/27/98	84		86	OK	64	OK	111	OK	47	OK	10	j
EX4R/030 A	5/18/98 7:40	5/28/98	97		97	OK	72	OK	101	OK	54	OK	12	OK
EX4R/031 AD	5/18/98 7:50	6/4/98			258	jj	152	OK			118	OK	25	OK
EX4R/031 AD [dup]	5/18/98 7:50	6/4/98			97	DUP	78	DUP			63	DUP	14	DUP

Sample ID	Date and Time	Date Analyzed	Methanol (mg/L)	Flag for Methanol	1-Propanol (mg/L)	Flag for 1-Propanol	4-Methanol-2-pentanol (mg/L)	Flag for 4-Methanol-2-pentanol	PCE (mg/L)	Flag for PCE	1-Hexanol (mg/L)	Flag for 1-Hexanol	1-Heptanol (mg/L)	Flag for 1-Heptanol
EX4R/024 M	5/18/98 8:05	6/4/98			102	OK	72	OK			62	OK	13	OK
EX4R/033 A	5/18/98 13:40	6/4/98			119	OK	78	OK			62	OK	13	OK
EX4R/034 A	5/18/98 19:40	6/4/98			119	OK	84	OK			68	OK	16	OK
EX4R/035 A	5/19/98 1:40	6/5/98			199	OK	122	OK			98	OK	28	OK
EX4R/036 A	5/19/98 7:40	6/5/98			215	jj	127	OK			98	OK	25	OK
EX4R/036 A [dup]	5/19/98 7:40	6/5/98			207	DUP	123	DUP			97	DUP	25	DUP
EX4R/026 M	5/19/98 7:42	6/5/98			189	OK	107	OK			78	OK	20	OK
EX4R/032 EB	5/19/98 12:10	6/5/98			4	j	6	j			9	j	7	j
EX4R/038 A	5/19/98 13:40	6/5/98			243	jj	157	OK			124	OK	25	OK
EX4R/039 A	5/19/98 19:40	6/5/98			239	jj	169	OK			141	OK	26	OK
EX4R/037 M	5/19/98 19:56	6/5/98			158	OK	116	OK			89	OK	26	OK
EX4R/040 A	5/20/98 1:50	6/6/98			232	jj	169	OK			139	OK	38	OK
EX4R/041 A	5/20/98 7:50	6/6/98			>200	jj	182	OK			149	OK	38	OK
EX4R/041 A (1:10)	5/20/98 7:50	6/30/98			225	d	212	d			145	d	42	d
EX4R/043 A	5/20/98 21:00	6/6/98			>200	jj	206	jj			175	OK	45	OK
EX4R/043 A (1:10)	5/20/98 21:00	6/30/98			257	d	221	d			151	d	30	d
EX4R/042 M	5/20/98 21:43	6/7/98			>200	jj	191	OK			167	OK	42	OK
EX4R/042 M (1:10)	5/20/98 21:43	6/30/98			208	d	177	d			143	d	39	d
EX4R/044 A	5/21/98 9:00	6/7/98			>200	jj	193	OK			168	OK	47	OK
EX4R/044 A [dup]	5/21/98 9:00	6/7/98			>200	DUP	203	DUP			173	DUP	43	DUP
EX4R/044 A (1:10)	5/21/98 9:00	7/1/98			223	d	217	d			148	d	61	d
EX4R/047 A	5/21/98 21:00	6/7/98			>200	jj	202	jj			181	OK	54	OK
EX4R/047 A (1:10)	5/21/98 21:00	7/1/98			237	d	215	d			157	d	49	d
EX4R/045 M	5/21/98 21:04	6/7/98			>200	jj	212	jj			179	OK	51	OK
EX4R/045 M (1:10)	5/21/98 21:04	7/1/98			261	d	239	d			177	d	51	d
EX4R/048 A	5/22/98 9:00	6/7/98			226	jj	171	OK			154	OK	49	OK
EX4R/049 A	5/22/98 21:00	6/7/98			191	OK	156	OK			154	OK	48	OK
EX4R/046 M	5/22/98 21:04	6/8/98			227	jj	201	jj			191	OK	65	OK
EX4R/050 A	5/23/98 8:50	6/8/98			177	OK	187	OK			194	OK	88	OK
EX4R/051 AD	5/23/98 9:00	6/8/98			191	OK	208	jj			215	jj	101	OK
EX4R/052 EB	5/23/98 11:30	6/8/98			nd	BDL	nd	BDL			4	j	nd	BDL
EX4R/053M	5/23/98 19:13	6/9/98			154	OK	187	OK			202	jj	107	OK
EX4R/055 A	5/23/98 21:00	6/8/98			139	OK	174	OK			182	OK	92	OK
EX4R/056 A	5/24/98 9:00	6/9/98			101	OK	130	OK			137	OK	73	OK
EX4R/057 A	5/24/98 21:00	6/9/98			76	OK	106	OK			124	OK	70	OK
EX4R/058 A	5/25/98 9:00	7/14/98			72	OK	91	OK			129	OK	62	OK
EX4R/054 M	5/25/98 10:35	6/9/98			40	OK	50	OK			65	OK	nd	BDL
EX4R/059 A	5/25/98 21:00	6/9/98			44	OK	54	OK			74	OK	19	OK
EX4R/059 A [dup]	5/25/98 21:00	6/9/98			44	DUP	52	DUP			76	DUP	41	DUP
EX4R/060 A	5/26/98 8:50	6/10/98			65	OK	68	OK			111	OK	57	OK
EX4R/060 A [dup]	5/26/98 8:50	6/10/98			66	DUP	67	DUP			119	DUP	62	DUP

Sample ID	Date and Time	Date Analyzed	Methanol (mg/L)	Flag for Methanol	1-Propanol (mg/L)	Flag for 1-Propanol	4-Methanol-2-pentanol (mg/L)	Flag for 4-Methanol-2-pentanol	PCE (mg/L)	Flag for PCE	1-Hexanol (mg/L)	Flag for 1-Hexanol	1-Heptanol (mg/L)	Flag for 1-Heptanol
EX4R/061 M	5/26/98 12:16	6/10/98			53	OK	54	OK			92	OK	65	OK
EX4R/062 A	5/27/98 11:00	6/11/98			45	OK	48	OK			81	OK	61	OK
EX4R/063 A	5/28/98 11:00	6/11/98			30	OK	30	OK			44	OK	37	OK
EX4R/064 M	5/28/98 12:41	6/11/98			50	OK	48	OK			73	OK	87	OK
EX4R/065 A	5/29/98 10:50	6/12/98			20	OK	23	OK			32	OK	49	OK
EX4R/066 M	5/29/98 20:44	6/12/98			18	OK	22	OK			28	OK	50	OK
EX4R/066 M [dup]	5/29/98 20:44	6/12/98			19	DUP	22	DUP			32	DUP	53	DUP
EX4R/068 A	5/30/98 11:00	6/12/98			13	OK	15	OK			21	OK	36	OK
EX4R/067 M	5/30/98 11:27	6/12/98			14	OK	18	OK			22	OK	29	OK
EX4R/069 A	5/31/98 11:00	6/12/98			12	OK	14	OK			22	OK	50	OK
EX4R/070 A	6/1/98 10:50	6/12/98			10	j	10	j			16	OK	41	OK
EX4R/071 M	6/1/98 11:36	6/15/98			11	OK	12	OK			19	OK	45	OK
EX4R/072 A	6/2/98 11:00	6/15/98			10	OK	10	j			15	OK	46	OK
EX4R/073 A	6/3/98 11:00	6/21/98			5	j	7	j			9	j	33	OK
EX4R/074 M	6/3/98 11:44	6/21/98			5	j	6	j			8	j	26	OK
EX4R/074 M [dup]	6/3/98 11:44	6/21/98			4	DUP	5	DUP			8	DUP	33	DUP
EX4R/075 A	6/4/98 10:50	6/21/98			6	j	6	j			8	j	30	OK
EX4R/076 A	6/5/98 11:00	6/21/98			4	j	5	j			8	j	32	OK
EX4R/077 M	6/5/98 11:17	6/21/98			5	j	7	j			12	OK	38	OK
EX4R/078 A	6/6/98 11:00	6/21/98			2	j	5	j			10	j	33	OK
EX4R/079 A	6/7/98 10:50	6/24/98			5	j	4	j			6	j	22	OK
EX4R/080 M	6/7/98 11:10	6/24/98			5	j	5	j			6	j	20	OK
EX4R/081 A	6/8/98 11:00	6/24/98			4	j	4	j			3	j	14	OK
EX4R/082 A	6/9/98 11:00	6/24/98			4	j	4	j			4	j	16	OK
EX4R/083 M	6/9/98 11:11	6/25/98			4	j	5	j			7	j	22	OK
EX4R/084 A	6/10/98 10:50	6/17/98			7	j	3	j			3	j	12	OK
EX4R/085 AD	6/10/98 11:00	6/17/98			5	j	2	j			3	j	10	j
EX4R/086 EB	6/10/98 12:35	6/17/98			nd	BDL	nd	BDL			nd	BDL	nd	BDL
EX4R/088 A	6/11/98 11:00	6/17/98			4	j	3	j			2	j	11	OK
EX4R/087 M	6/11/98 11:20	6/17/98			4	j	1	j			2	j	11	OK
EX4R/089 A	6/12/98 11:00	6/17/98			4	j	3	j			2	j	9	j
EX4R/091 A	6/13/98 10:50	6/17/98			3	j	2	j			2	j	7	j
EX4R/091 A [dup]	6/13/98 10:50	6/17/98			4	DUP	2	DUP			2	DUP	6	DUP
EX4R/090 M	6/13/98 11:14	6/17/98			7	j	2	j			3	j	7	j
EX4R/092 A	6/14/98 11:00	6/23/98			5	j	1	j			4	j	7	j
EX4R/093 A	6/15/98 11:00	6/23/98			4	j	1	j			2	j	3	j
EX4R/094 M	6/15/98 11:37	6/23/98			3	j	4	j			6	j	10	j
EX4R/095 A	6/16/98 10:50	6/23/98			5	j	1	j			3	j	8	j
EX4R/096 A	6/17/98 11:00	6/22/98			3	j	1	j			3	j	4	j
EX4R/097 M	6/17/98 11:32	6/23/98			2	j	1	j			2	j	nd	BDL
EX4R/098 A	6/18/98 11:00	6/23/98			3	j	1	j			2	j	nd	BDL

Sample ID	Date and Time	Date Analyzed	Methanol (mg/L)	Flag for Methanol	1-Propanol (mg/L)	Flag for 1-Propanol	4-Methanol-2-pentanol (mg/L)	Flag for 4-Methanol-2-pentanol	PCE (mg/L)	Flag for PCE	1-Hexanol (mg/L)	Flag for 1-Hexanol	1-Heptanol (mg/L)	Flag for 1-Heptanol
EX4R/099 A	6/19/98 10:50	6/25/98			4	j	5	j			4	j	8	j
EX4R/100 M	6/19/98 11:34	6/25/98			4	j	4	j			4	j	7	j
EX4R/101 A	6/20/98 11:00	6/25/98			4	j	3	j			3	j	6	j
EX4R/102 A	6/21/98 11:00	6/26/98			4	j	3	j			3	j	5	j
EX4/103 M	6/21/98 11:31	6/26/98			3	j	2	j			2	j	nd	BDL
EX4R/104 A/M	6/22/98 10:50	6/26/98			4	j	3	j			4	j	3	j
EX4R/104 A/M [dup]	6/22/98 10:50	6/26/98			3	DUP	5	DUP			2	DUP	4	DUP

Project: PITT at ESTCP Camp Lejeune
Acceptable QA/QC limits: % Recovery between 80% and 120%

Data QA/QC by DW
Date created 1/22/99
Date last modified 1/26/99

Sample Legend
CC = Calibration check
j = below reporting limit
d = diluted sample
BDL = below detection limit
NA = not applicable
jj = out of acceptable QA/QC and/or calibration limits
OK = within acceptable QA/QC limits
nd = not detected
DUP = Duplicate
d,DUP = diluted duplicate

Sample Point: Extraction Well EX5

Sample ID	Date and Time	Date Analyzed	Methanol (mg/L)	Flag for Methanol	1-Propanol (mg/L)	Flag for 1-Propanol	4-Methanol-2-pentanol (mg/L)	Flag for 4-Methanol-2-pentanol	PCE (mg/L)	Flag for PCE	1-Hexanol (mg/L)	Flag for 1-Hexanol	1-Heptanol (mg/L)	Flag for 1-Heptanol
EX5/004 A	5/13/98 17:30	5/19/98	nd	BDL	nd	BDL	nd	BDL	17	OK	nd	BDL	nd	BDL
EX5/003 M	5/14/98 7:35	5/19/98	nd	BDL	nd	BDL	nd	BDL	17	OK	nd	BDL	nd	BDL
EX5/005 A	5/14/98 7:40	5/19/98	nd	BDL	nd	BDL	nd	BDL	16	OK	nd	BDL	nd	BDL
EX5/010 A	5/14/98 13:30	5/21/98	nd	BDL	nd	BDL	nd	BDL	16	OK	nd	BDL	nd	BDL
EX5/011 A	5/14/98 19:30	5/21/98	nd	BDL	nd	BDL	nd	BDL	16	OK	nd	BDL	nd	BDL
EX5/006 M	5/14/98 19:53	5/21/98	nd	BDL	nd	BDL	nd	BDL	17	OK	nd	BDL	nd	BDL
EX5/012 A	5/15/98 1:30	5/23/98	nd	BDL	nd	BDL	nd	BDL	18	OK	nd	BDL	nd	BDL
EX5/013 A	5/15/98 7:30	5/23/98	nd	BDL	nd	BDL	nd	BDL	16	OK	nd	BDL	nd	BDL
EX5/014 A	5/15/98 13:30	5/23/98	nd	BDL	nd	BDL	nd	BDL	17	OK	nd	BDL	nd	BDL
EX5/015 A	5/15/98 19:30	5/23/98	nd	BDL	nd	BDL	nd	BDL	17	OK	nd	BDL	nd	BDL
EX5/016 AD	5/15/98 19:40	5/23/98	0	j	0	j	nd	BDL	15	OK	nd	BDL	nd	BDL
EX5/008 M	5/15/98 19:59	5/23/98	nd	BDL	nd	BDL	nd	BDL	17	OK	nd	BDL	nd	BDL
EX5/017 A	5/16/98 1:30	5/23/98	1	j	1	j	1	j	17	OK	0	j	nd	BDL
EX5/018 A	5/16/98 7:30	5/23/98	3	j	4	j	3	j	16	OK	2	j	nd	BDL
EX5/009 M	5/16/98 7:48	5/23/98	4	j	4	j	3	j	18	OK	2	j	nd	BDL
EX5/019 EB	5/16/98 12:45	5/24/98	nd	BDL	nd	BDL	nd	BDL	1	j	nd	BDL	nd	BDL
EX5/019 EB	5/16/98 12:45	5/24/98	nd	BDL	nd	BDL	nd	BDL	1	j	nd	BDL	nd	BDL
EX5/019 EB	5/16/98 12:45	5/24/98	nd	BDL	nd	BDL	nd	BDL	1	j	nd	BDL	nd	BDL
EX5/019 EB	5/16/98 12:45	5/24/98	nd	BDL	nd	BDL	nd	BDL	1	j	nd	BDL	nd	BDL
EX5/023 A	5/16/98 13:30	5/25/98	8	j	10	OK	9	j	13	OK	7	j	2	j
EX5/024 A	5/16/98 19:40	5/25/98	24	OK	nd	BDL	23	OK	13	OK	17	OK	6	j
EX5/020 M	5/16/98 20:26	5/25/98	31	OK	36	OK	31	OK	17	OK	24	OK	9	j
EX5/025 A	5/17/98 7:05	5/26/98	81	OK	85	OK	77	OK	15	OK	68	OK	29	OK
EX5/022 M	5/17/98 7:45	5/26/98	98	OK	117	OK	106	OK	24	OK	91	OK	40	OK
EX5/030 A	5/17/98 13:40	5/26/98	111	OK	119	OK	108	OK	16	OK	98	OK	49	OK
EX5/031 A	5/17/98 19:40	5/26/98	133	OK	140	OK	129	OK	16	OK	120	OK	63	OK
EX5/032 A	5/18/98 1:40	6/4/98			140	OK	144	OK			115	OK	61	OK
EX5/033 A	5/18/98 7:40	6/4/98			155	OK	166	OK			136	OK	71	OK
EX5/027 M	5/18/98 8:06	6/4/98			176	OK	175	OK			157	OK	74	OK

Sample ID	Date and Time	Date Analyzed	Methanol (mg/L)	Flag for Methanol	1-Propanol (mg/L)	Flag for 1-Propanol	4-Methanol-2-pentanol (mg/L)	Flag for 4-Methanol-2-pentanol	PCE (mg/L)	Flag for PCE	1-Hexanol (mg/L)	Flag for 1-Hexanol	1-Heptanol (mg/L)	Flag for 1-Heptanol
EX5/034 A	5/18/98 13:40	6/4/98			193	OK	206	jj			185	OK	88	OK
EX5/035 A	5/18/98 19:40	6/4/98			372	jj	304	jj			274	jj	146	OK
EX5/036 A	5/19/98 1:40	6/5/98			281	jj	241	jj			226	jj	110	OK
EX5/037 A	5/19/98 7:40	6/5/98			275	jj	232	jj			221	jj	111	OK
EX5/029 M	5/19/98 7:43	6/5/98			191	OK	158	OK			132	OK	71	OK
EX5/029 M [dup]	5/19/98 7:43	6/5/98			264	DUP	221	DUP			189	DUP	104	DUP
EX5/039 A	5/19/98 13:40	6/5/98			261	jj	239	jj			227	jj	118	OK
EX5/040 A	5/19/98 19:40	6/5/98			263	jj	229	jj			221	jj	116	OK
EX5/041 AD	5/19/98 19:50	6/5/98			299	jj	237	jj			224	jj	120	OK
EX5/038 M	5/19/98 19:57	6/5/98			186	OK	176	OK			151	OK	107	OK
EX5/043 A	5/20/98 1:50	6/6/98			>200	jj	239	jj			222	jj	129	OK
EX5/043 A (1:10)	5/20/98 1:50	6/30/98			263	d	245	d			188	d	118	d
EX5/044 A	5/20/98 7:50	6/6/98			>200	jj	>200	jj			>200	jj	154	OK
EX5/044 A (1:10)	5/20/98 7:50	6/30/98			263	d	239	d			228	d	123	d
EX5/042 EB	5/20/98 17:06	6/6/98			nd	BDL	0	j			1	j	nd	BDL
EX5/046 A	5/20/98 21:00	6/6/98			>200	jj	>200	jj			>200	jj	153	OK
EX5/046 A [dup]	5/20/98 21:00	6/6/98			>200	DUP	>200	DUP			>200	DUP	146	DUP
EX5/046 A (1:10)	5/20/98 21:00	6/30/98			266	d	239	d			228	d	73	d
EX5/046 A (1:10) [du	5/20/98 21:00	6/30/98			270	d, DUP	249	d, DUP			228	d, DUP	145	d, DUP
EX5/045 M	5/20/98 21:44	6/7/98			>200	jj	>200	jj			>200	jj	163	OK
EX5/045 M (1:10)	5/20/98 21:44	6/30/98			302	d	292	d			265	d	149	d
EX5/047 A	5/21/98 9:00	6/7/98			>200	jj	>200	jj			230	jj	140	OK
EX5/047 A (1:10)	5/21/98 9:00	7/1/98			243	d	230	d			209	d	121	d
EX5/050 A	5/21/98 21:00	6/7/98			>200	jj	>200	jj			>200	jj	172	OK
EX5/050 A [dup]	5/21/98 21:00	6/7/98			>200	DUP	>200	DUP			>200	DUP	181	DUP
EX5/050 A (1:10)	5/21/98 21:00	7/1/98			264	d	228	d			229	d	117	d
EX5/048 M	5/21/98 21:05	6/7/98			>200	jj	>200	jj			>200	jj	156	OK
EX5/048 M (1:10)	5/21/98 21:05	7/1/98			273	d	259	d			211	d	111	d
EX5/051 A	5/22/98 9:00	6/7/98			>200	jj	233	jj			219	jj	159	OK
EX5/051 A (1:10)	5/22/98 9:00	7/1/98			220	d	220	d			250	d	176	d
EX5/052 A	5/22/98 21:00	6/7/98			199	OK	192	OK			179	OK	137	OK
EX5/052 A [dup]	5/22/98 21:00	6/7/98			218	DUP	199	DUP			183	DUP	138	DUP
EX5/049 M	5/22/98 21:05	6/8/98			196	OK	187	OK			174	OK	130	OK
EX5/053 A	5/23/98 8:50	6/8/98			141	OK	141	OK			126	OK	116	OK
EX5/054 M	5/23/98 19:16	6/9/98			143	OK	170	OK			158	OK	144	OK
EX5/056 A	5/23/98 21:00	6/8/98			137	OK	143	OK			151	OK	128	OK
EX5/057 A	5/24/98 9:00	6/9/98			111	OK	112	OK			103	OK	93	OK
EX5/057 A [dup]	5/24/98 9:00	6/9/98			118	DUP	120	DUP			113	DUP	99	DUP
EX5/058 A	5/24/98 21:00	6/9/98			93	OK	97	OK			90	OK	82	OK
EX5/059 A	5/25/98 9:00	7/14/98			88	OK	91	OK			85	OK	63	OK
EX5/055 M	5/25/98 10:37	6/9/98			70	OK	63	OK			57	OK	12	OK

Sample ID	Date and Time	Date Analyzed	Methanol (mg/L)	Flag for Methanol	1-Propanol (mg/L)	Flag for 1-Propanol	4-Methanol-2-pentanol (mg/L)	Flag for 4-Methanol-2-pentanol	PCE (mg/L)	Flag for PCE	1-Hexanol (mg/L)	Flag for 1-Hexanol	1-Heptanol (mg/L)	Flag for 1-Heptanol
EX5/061 A	5/26/98 8:50	6/10/98			73	OK	64	OK			67	OK	50	OK
EX5/062 M	5/26/98 12:18	6/10/98			73	OK	62	OK			70	OK	56	OK
EX5/063 A	5/27/98 11:00	6/11/98			56	OK	59	OK			67	OK	53	OK
EX5/064 A	5/28/98 11:00	6/11/98			37	OK	34	OK			45	OK	23	OK
EX5/065 M	5/28/98 12:42	6/11/98			69	OK	57	OK			64	OK	50	OK
EX5/066 A	5/29/98 10:50	6/12/98			25	OK	26	OK			30	OK	23	OK
EX5/067 M	5/29/98 20:45	6/12/98			24	OK	24	OK			28	OK	23	OK
EX5/069 A	5/30/98 11:00	6/12/98			19	OK	20	OK			21	OK	13	OK
EX5/069 A [dup]	5/30/98 11:00	6/12/98			19	DUP	21	DUP			21	DUP	14	DUP
EX5/068 M	5/30/98 11:28	6/12/98			20	OK	20	OK			22	OK	14	OK
EX5/070 A	5/31/98 11:00	6/12/98			17	OK	21	OK			22	OK	18	OK
EX5/071 A	6/1/98 10:50	6/12/98			16	OK	16	OK			18	OK	16	OK
EX5/072 AD	6/1/98 11:00	6/12/98			16	OK	15	OK			18	OK	19	OK
EX5/073 EB	6/1/98 11:30	6/12/98			1	j	3	j			nd	BDL	2	j
EX5/074 M	6/1/98 11:38	6/15/98			17	OK	17	OK			20	OK	13	OK
EX5/075 A	6/2/98 11:00	6/15/98			21	OK	17	OK			21	OK	17	OK
EX5/076 A	6/3/98 11:00	6/21/98			10	j	10	OK			12	OK	13	OK
EX5/077 M	6/3/98 11:45	6/21/98			10	OK	10	j			18	OK	13	OK
EX5/078 A	6/4/98 10:50	6/21/98			7	j	7	j			7	j	8	j
EX5/079 A	6/5/98 11:00	6/21/98			8	j	11	OK			12	OK	10	OK
EX5/080 M	6/5/98 11:21	6/21/98			6	j	7	j			9	j	9	j
EX5/081 A	6/6/98 11:00	6/21/98			5	j	7	j			8	j	9	j
EX5/082 A	6/7/98 10:50	6/24/98			8	j	8	j			8	j	9	j
EX5/083 M	6/7/98 11:12	6/24/98			9	j	11	OK			10	OK	13	OK
EX5/084 A	6/8/98 11:00	6/24/98			8	j	8	j			10	j	8	j
EX5/085 A	6/9/98 11:00	6/24/98			7	j	8	j			5	j	8	j
EX5/086 M	6/9/98 11:13	6/25/98			7	j	9	j			8	j	8	j
EX5/087 A	6/10/98 10:50	6/17/98			10	j	7	j			6	j	5	j
EX5/089 A	6/11/98 11:00	6/17/98			9	j	6	j			5	j	4	j
EX5/088 M	6/11/98 11:22	6/17/98			8	j	6	j			5	j	3	j
EX5/090 A	6/12/98 11:00	6/17/98			10	OK	6	j			5	j	5	j
EX5/092 A	6/13/98 10:50	6/17/98			7	j	5	j			6	j	3	j
EX5/093 AD	6/13/98 11:00	6/17/98			9	j	6	j			5	j	4	j
EX5/091 M	6/13/98 11:16	6/17/98			8	j	6	j			6	j	4	j
EX5/094 EB	6/13/98 11:38	6/17/98			0	j	0	j			1	j	nd	BDL
EX5/095 A	6/14/98 11:00	6/23/98			8	j	5	j			6	j	8	j
EX5/096 A	6/15/98 11:00	6/23/98			5	j	5	j			5	j	3	j
EX5/096 A [dup]	6/15/98 11:00	6/23/98			6	DUP	5	DUP			5	DUP	4	DUP
EX5/097 M	6/15/98 11:38	6/23/98			5	j	4	j			4	j	3	j
EX5/098 A	6/16/98 10:50	6/23/98			5	j	4	j			4	j	2	j
EX5/099 A	6/17/98 11:00	6/23/98			4	j	4	j			4	j	2	j

Sample ID	Date and Time	Date Analyzed	Methanol (mg/L)	Flag for Methanol	1-Propanol (mg/L)	Flag for 1-Propanol	4-Methanol-2-pentanol (mg/L)	Flag for 4-Methanol-2-pentanol	PCE (mg/L)	Flag for PCE	1-Hexanol (mg/L)	Flag for 1-Hexanol	1-Heptanol (mg/L)	Flag for 1-Heptanol
EX5/100 M	6/17/98 11:34	6/23/98			4	j	3	j			2	j	nd	BDL
EX5/101 A	6/18/98 11:00	6/23/98			4	j	2	j			4	j	nd	BDL
EX5/102 A	6/19/98 10:50	6/25/98			4	j	6	j			6	j	5	j
EX5/103 M	6/19/98 11:36	6/25/98			4	j	4	j			4	j	6	j
EX5/104 A	6/20/98 11:00	6/25/98			4	j	5	j			6	j	6	j
EX5/104 A [dup]	6/20/98 11:00	6/25/98			4	DUP	6	DUP			6	DUP	5	DUP
EX5/105 A	6/21/98 11:00	6/26/98			4	j	5	j			7	j	3	j
EX5/106 M	6/21/98 11:32	6/26/98			4	j	5	j			5	j	nd	BDL
EX5/107 A	6/22/98 10:50	6/26/98			4	j	4	j			4	j	3	j
EX5/108 AD	6/22/98 11:00	6/26/98			3	j	5	j			4	j	3	j
EX5/109 EB	6/22/98 11:29	6/26/98			nd	BDL	nd	BDL			nd	BDL	nd	BDL

Project: PITT at ESTCP Camp Lejeune

Acceptable QA/QC limits: % Recovery between 80% and 120%

Data QA/QC by DW

Date created 1/22/99

Date last modifie 1/26/99

Sample Legend

CC = Calibration check

j = below reporting limit

d = diluted sample

BDL = below detection limit

NA = not applicable

jj = out of acceptable QA/QC and/or calibration limits

OK = within acceptable QA/QC limits

nd = not detected

DUP = Duplicate

d,DUP = diluted duplicate

Sample Point: Extraction Well EX6

Sample ID	Date and Time	Date Analyzed	Methanol (mg/L)	Flag for Methanol	1-Propanol (mg/L)	Flag for 1-Propanol	4-Methanol-2 pentanol (mg/L)	Flag for 4-Methanol-2-pentanol	PCE (mg/L)	Flag for PCE	1-Hexanol (mg/L)	Flag for 1-Hexanol	1-Heptanol (mg/L)	Flag for 1-Heptanol
EX6/004 A	5/13/98 17:30	5/19/98	nd	BDL	nd	BDL	nd	BDL	2	j	nd	BDL	nd	BDL
EX6/003 M	5/14/98 7:34	5/19/98	nd	BDL	nd	BDL	nd	BDL	3	j	nd	BDL	nd	BDL
EX6/005 A	5/14/98 7:40	5/19/98	nd	BDL	nd	BDL	nd	BDL	2	j	nd	BDL	nd	BDL
EX6/010 A	5/14/98 13:30	5/24/98	nd	BDL	nd	BDL	nd	BDL	2	j	nd	BDL	nd	BDL
EX6/011 A	5/14/98 19:30	5/24/98	nd	BDL	nd	BDL	nd	BDL	2	j	nd	BDL	nd	BDL
EX6/006 M	5/14/98 19:54	5/24/98	nd	BDL	nd	BDL	nd	BDL	2	j	nd	BDL	nd	BDL
EX6/012 A	5/15/98 1:30	5/23/98	nd	BDL	nd	BDL	nd	BDL	2	j	nd	BDL	nd	BDL
EX6/013 A	5/15/98 7:30	5/23/98	nd	BDL	nd	BDL	nd	BDL	2	j	nd	BDL	nd	BDL
EX6/014 A	5/15/98 13:30	5/23/98	nd	BDL	nd	BDL	nd	BDL	2	j	nd	BDL	nd	BDL
EX6/014 A [dup]	5/15/98 13:30	5/24/98	nd	DUP	nd	DUP	nd	DUP	2	DUP	nd	DUP	nd	DUP
EX6/015 A	5/15/98 19:30	5/24/98	0	j	0	j	0	j	2	j	nd	BDL	nd	BDL
EX6/008 M	5/15/98 20:00	5/24/98	0	j	0	j	0	j	2	j	0	j	nd	BDL
EX6/016 A	5/16/98 1:30	5/24/98	1	j	1	j	1	j	2	j	1	j	0	j
EX6/017 A	5/16/98 7:30	5/24/98	3	j	4	j	3	j	2	j	2	j	1	j
EX6/009 M	5/16/98 7:49	5/24/98	4	j	4	j	3	j	2	j	2	j	1	j
EX6/020 A	5/16/98 13:30	5/25/98	5	j	6	j	6	j	2	j	5	j	2	j
EX6/021 A	5/16/98 19:40	5/25/98	13	OK	14	OK	13	OK	2	j	10	OK	5	j
EX6/018 M	5/16/98 20:28	5/25/98	16	OK	19	OK	17	OK	2	j	13	OK	6	j
EX6/018 M [dup]	5/16/98 20:28	5/26/98	17	DUP	19	DUP	17	DUP	2	DUP	13	DUP	6	DUP
EX6/022 A	5/17/98 7:05	5/26/98	55	OK	58	OK	53	OK	2	j	45	OK	19	OK

Sample ID	Date and Time	Date Analyzed	Methanol (mg/L)	Flag for Methanol	1-Propanol (mg/L)	Flag for 1-Propanol	4-Methanol-2 pentanol (mg/L)	Flag for 4-Methanol-2-pentanol	PCE (mg/L)	Flag for PCE	1-Hexanol (mg/L)	Flag for 1-Hexanol	1-Heptanol (mg/L)	Flag for 1-Heptanol
EX6/019 M	5/17/98 7:47	5/26/98	62	OK	77	OK	70	OK	2	j	58	OK	25	OK
EX6/027 A	5/17/98 13:40	5/26/98	76	OK	80	OK	73	OK	2	j	65	OK	32	OK
EX6/028 A	5/17/98 19:40	5/26/98	97	OK	101	OK	95	OK	2	j	87	OK	47	OK
EX6/029 A	5/18/98 1:40	6/4/98			124	OK	119	OK			101	OK	57	OK
EX6/030 A	5/18/98 7:40	6/4/98			133	OK	136	OK			116	OK	66	OK
EX6/031 AD	5/18/98 7:50	6/4/98			160	OK	146	OK			126	OK	70	OK
EX6/024 M	5/18/98 8:08	6/4/98			145	OK	140	OK			129	OK	68	OK
EX6/033 A	5/18/98 13:40	6/4/98			155	OK	145	OK			128	OK	74	OK
EX6/033 A [dup]	5/18/98 13:40	6/4/98			155	DUP	172	DUP			157	DUP	90	DUP
EX6/034 A	5/18/98 19:40	6/4/98			167	OK	162	OK			149	OK	84	OK
EX6/035 A	5/19/98 1:40	6/5/98			180	OK	125	OK			108	OK	57	OK
EX6/036 A	5/19/98 7:40	6/5/98			184	OK	139	OK			123	OK	73	OK
EX6/026 M	5/19/98 7:45	6/5/98			165	OK	135	OK			115	OK	72	OK
EX6/032 EB	5/19/98 13:10	6/5/98			4	j	5	j			10	j	6	j
EX6/038 A	5/19/98 13:40	6/5/98			217	jj	159	OK			139	OK	81	OK
EX6/039 A	5/19/98 19:40	6/5/98			212	jj	169	OK			151	OK	93	OK
EX6/039 A [dup]	5/19/98 19:40	6/5/98			205	DUP	154	DUP			141	DUP	84	DUP
EX6/037 M	5/19/98 19:58	6/5/98			144	OK	119	OK			115	OK	83	OK
EX6/040 A	5/20/98 1:50	6/6/98			224	jj	210	jj			200	jj	132	OK
EX6/041 A	5/20/98 7:50	6/6/98			197	OK	190	OK			184	OK	122	OK
EX6/043 A	5/20/98 21:00	6/6/98			237	jj	218	jj			207	jj	135	OK
EX6/042 M	5/20/98 21:45	6/7/98			220	jj	217	jj			202	jj	138	OK
EX6/042 M [dup]	5/20/98 21:45	6/7/98			227	DUP	215	DUP			205	DUP	133	DUP
EX6/044 A	5/21/98 9:00	6/7/98			215	jj	210	jj			197	OK	128	OK
EX6/047 A	5/21/98 21:00	6/7/98			>200	jj	>200	jj			237	jj	166	OK
EX6/047 A (1:10	5/21/98 21:00	7/1/98			204	DUP	203	DUP			195	DUP	143	DUP
EX6/045 M	5/21/98 21:06	6/7/98			199	OK	191	OK			185	OK	124	OK
EX6/048 A	5/22/98 9:00	6/7/98			232	jj	204	jj			197	OK	142	OK
EX6/049 A	5/22/98 21:00	6/7/98			181	OK	162	OK			156	OK	121	OK
EX6/046 M	5/22/98 21:06	6/8/98			177	OK	159	OK			156	OK	118	OK
EX6/050 A	5/23/98 8:50	6/8/98			94	OK	92	OK			87	OK	89	OK
EX6/050 A [dup]	5/23/98 8:50	6/8/98			133	DUP	142	DUP			139	DUP	144	DUP

Sample ID	Date and Time	Date Analyzed	Methanol (mg/L)	Flag for Methanol	1-Propanol (mg/L)	Flag for 1-Propanol	4-Methanol-2 pentanol (mg/L)	Flag for 4-Methanol-2-pentanol	PCE (mg/L)	Flag for PCE	1-Hexanol (mg/L)	Flag for 1-Hexanol	1-Heptanol (mg/L)	Flag for 1-Heptanol
EX6/051 AD	5/23/98 9:00	6/8/98			126	OK	139	OK			137	OK	138	OK
EX6/052 EB	5/23/98 12:05	6/8/98			nd	BDL	nd	BDL			2	j	nd	BDL
EX6/053 M	5/23/98 19:17	6/9/98			108	OK	121	OK			118	OK	118	OK
EX6/055 A	5/23/98 21:00	6/8/98			103	OK	112	OK			115	OK	110	OK
EX6/056 A	5/24/98 9:00	6/9/98			93	OK	74	OK			73	OK	72	OK
EX6/057 A	5/24/98 21:00	6/9/98			86	OK	63	OK			62	OK	65	OK
EX6/058 A	5/25/98 9:00	7/14/98			54	OK	52	OK			58	OK	44	OK
EX6/054 M	5/25/98 10:39	6/9/98			42	OK	38	OK			38	OK	31	OK
EX6/059 A	5/25/98 21:00	6/9/98			26	OK	24	OK			22	OK	nd	BDL
EX6/060 A	5/26/98 8:50	6/10/98			40	OK	32	OK			40	OK	34	OK
EX6/061 M	5/26/98 12:20	6/10/98			39	OK	42	OK			46	OK	42	OK
EX6/062 A	5/27/98 11:00	6/11/98			25	OK	30	OK			28	OK	30	OK
EX6/063 A	5/28/98 11:00	6/11/98			18	OK	22	OK			21	OK	18	OK
EX6/064 M	5/28/98 12:45	6/11/98			18	OK	18	OK			18	OK	17	OK
EX6/065 A	5/29/98 10:50	6/12/98			13	OK	12	OK			13	OK	11	OK
EX6/066 M	5/29/98 20:46	6/12/98			10	OK	13	OK			13	OK	10	OK
EX6/068 A	5/30/98 11:00	6/12/98			10	OK	11	OK			10	OK	6	j
EX6/067 M	5/30/98 11:30	6/12/98			10	OK	10	OK			10	j	6	j
EX6/069 A	5/31/98 11:00	6/12/98			8	j	7	j			7	j	6	j
EX6/070 A	6/1/98 10:50	6/12/98			8	j	8	j			8	j	6	j
EX6/070 A [dup]	6/1/98 10:50	6/13/98			8	DUP	7	DUP			8	DUP	7	DUP
EX6/071 M	6/1/98 11:39	6/15/98			9	j	8	j			9	j	3	j
EX6/072 A	6/2/98 11:00	6/15/98			8	j	6	j			7	j	4	j
EX6/073 A	6/3/98 11:00	6/21/98			5	j	5	j			6	j	6	j
EX6/074 M	6/3/98 11:47	6/21/98			4	j	4	j			6	j	7	j
EX6/075 A	6/4/98 10:50	6/21/98			5	j	5	j			5	j	5	j
EX6/076 A	6/5/98 11:00	6/21/98			3	j	4	j			5	j	nd	BDL
EX6/077 M	6/5/98 11:25	6/21/98			2	j	3	j			5	j	3	j
EX6/077 M [dup]	6/5/98 11:25	6/21/98			2	DUP	5	DUP			5	DUP	4	DUP
EX6/078 A	6/6/98 11:00	6/21/98			1	j	3	j			4	j	nd	BDL
EX6/079 A	6/7/98 10:50	6/24/98			5	j	4	j			4	j	5	j
EX6/080 AD	6/7/98 11:00	6/24/98			4	j	4	j			4	j	4	j

Sample ID	Date and Time	Date Analyzed	Methanol (mg/L)	Flag for Methanol	1-Propanol (mg/L)	Flag for 1-Propanol	4-Methanol-2 pentanol (mg/L)	Flag for 4-Methanol-2-pentanol	PCE (mg/L)	Flag for PCE	1-Hexanol (mg/L)	Flag for 1-Hexanol	1-Heptanol (mg/L)	Flag for 1-Heptanol
EX6/082 M	6/7/98 11:13	6/25/98			5	j	5	j			6	j	7	j
EX6/081 EB	6/7/98 11:46	6/24/98			nd	BDL	nd	BDL			nd	BDL	nd	BDL
EX6/083 A	6/8/98 11:00	6/24/98			4	j	3	j			4	j	nd	BDL
EX6/085 A	6/9/98 11:00	6/24/98			3	j	4	j			4	j	4	j
EX6/085 A [dup]	6/9/98 11:00	6/24/98			3	DUP	3	DUP			3	DUP	6	DUP
EX6/084 M	6/9/98 11:15	6/25/98			4	j	4	j			4	j	nd	BDL
EX6/086 A	6/10/98 10:50	6/17/98			4	j	2	j			2	j	1	j
EX6/088 A	6/11/98 11:00	6/17/98			4	j	2	j			2	j	2	j
EX6/088 A [dup]	6/11/98 11:00	6/17/98			5	DUP	2	DUP			2	DUP	2	DUP
EX6/087 M	6/11/98 11:23	6/17/98			6	j	2	j			1	j	2	j
EX6/089 A	6/12/98 11:00	6/17/98			4	j	2	j			2	j	1	j
EX6/091 A	6/13/98 10:50	6/17/98			5	j	2	j			2	j	1	j
EX6/090 M	6/13/98 11:18	6/17/98			1	j	3	j			2	j	1	j
EX6/092 A	6/14/98 11:00	6/23/98			3	j	2	j			4	j	nd	BDL
EX6/093 A	6/15/98 11:00	6/23/98			3	j	2	j			4	j	nd	BDL
EX6/094 M	6/15/98 11:39	6/23/98			3	j	1	j			1	j	nd	BDL
EX6/095 A	6/16/98 10:50	6/23/98			2	j	2	j			1	j	1	j
EX6/096 A	6/17/98 11:00	6/23/98			3	j	2	j			2	j	nd	BDL
EX6/096 A [dup]	6/17/98 11:00	6/23/98			3	DUP	2	DUP			2	DUP	nd	DUP
EX6/097 M	6/17/98 11:35	6/23/98			3	j	2	j			2	j	nd	BDL
EX6/098 A	6/18/98 11:00	6/23/98			3	j	2	j			2	j	nd	BDL
EX6/099 A	6/19/98 10:50	6/25/98			3	j	4	j			4	j	nd	BDL
EX6/100 M	6/19/98 11:37	6/25/98			3	j	3	j			4	j	nd	BDL
EX6/101 A	6/20/98 11:00	6/25/98			3	j	3	j			3	j	nd	BDL
EX6/102 A	6/21/98 11:00	6/26/98			3	j	3	j			3	j	nd	BDL
EX6/103 M	6/21/98 11:35	6/26/98			2	j	4	j			2	j	2	j
EX6/103 M [dup]	6/21/98 11:35	6/26/98			2	DUP	2	DUP			2	DUP	nd	DUP
EX6/104 A	6/22/98 10:50	6/26/98			3	j	2	j			2	j	nd	BDL

Project: PITT at ESTCP Camp Lejeune
Acceptable QA/QC limits: % Recovery between 80% and 120%

Data QA/QC by DW
Date created 1/22/99
Date last modified 1/26/99

Sample Legend
CC = Calibration check
j = below reporting limit
d = diluted sample
BDL = below detection limit
NA = not applicable
jj = out of acceptable QA/QC and/or calibration limits
OK = within acceptable QA/QC limits
nd = not detected
DUP = Duplicate
d,DUP = diluted duplicate

Injectate, Trip Blank, and Monitoring Well Samples

Sample ID	Date and Time	Date Analyzed	Methanol (mg/L)	Flag for Methanol	1-Propanol (mg/L)	Flag for 1-Propanol	4-Methanol-2-pentanol (mg/L)	Flag for 4-Methanol-2-pentanol	PCE (mg/L)	Flag for PCE	1-Hexanol (mg/L)	Flag for 1-Hexanol	1-Heptanol (mg/L)	Flag for 1-Heptanol
PER/001	5/12/98 17:05	5/19/98	nd	BDL	nd	BDL	nd	BDL	6	j	nd	BDL	nd	BDL
INJ/010	5/13/98 11:25	5/19/98	nd	BDL	nd	BDL	nd	BDL	5	j	nd	BDL	nd	BDL
INJ/011 (1:10)	5/13/98 11:45	5/19/98	752	d	780	d	717	d	nd	d	706	d	494	d
INJ/011 (1:10) [dup]	5/13/98 11:45	5/19/98	766	d, DUP	778	d, DUP	730	d, DUP	nd	d, DUP	730	d, DUP	506	d, DUP
INJ/011 (1:10)	5/13/98 11:45	7/9/98		d	772	d	690	d		d	672	d	452	d
INJ/012 (1:10)	5/14/98 10:40	5/19/98	957	d	1050	d	974	d	nd	d	973	d	682	d
INJ/012 (1:10)	5/14/98 10:40	7/9/98		d	989	d	898	d		d	856	d	587	d
INJ/013 TB	5/14/98 11:50	5/19/98	nd	BDL	nd	BDL	nd	BDL	nd	BDL	nd	BDL	nd	BDL
INJ/014 (1:10)	5/15/98 12:05	5/24/98	890	d	942	d	901	d	nd	d	926	d	672	d
INJ/014 (1:10)	5/15/98 12:05	5/24/98	1060	d	1060	d	1010	d			1030	d	726	d
INJ/014 (1:10)	5/15/98 12:05	7/9/98		d	936	d	824	d			846	d	565	d
TB02	5/16/98 0:00	5/24/98	nd	BDL	nd	BDL	nd	BDL	nd	BDL	nd	BDL	nd	BDL
TB02	5/16/98 0:00	5/24/98	nd	BDL	nd	BDL	nd	BDL	nd	BDL	nd	BDL	nd	BDL
TB03	5/16/98 0:00	5/25/98	nd	BDL	nd	BDL	nd	BDL	nd	BDL	nd	BDL	nd	BDL
TB03	5/16/98 0:00	5/25/98	nd	BDL	nd	BDL	nd	BDL	nd	BDL	nd	BDL	nd	BDL
TB04	5/16/98 0:00	5/25/98	nd	BDL	nd	BDL	nd	BDL	nd	BDL	nd	BDL	nd	BDL
INJ/015 (1:10)	5/16/98 16:25	5/25/98	855	d	876	d	815	d	nd	d	832	d	587	d
INJ/015 (1:10)	5/16/98 16:25	7/9/98			956	d	885	d			863	d	584	d
INJ/016 (1:10)	5/18/98 8:28	5/27/98	925		943	d	895	d	nd	d	898	d	647	d
INJ/016 (1:10) [dup]	5/18/98 8:28	5/27/98	806		812	d, DUP	755	d, DUP	nd	d, DUP	770	d, DUP	551	d, DUP
INJ/016 (1:10)	5/18/98 8:28	7/9/98			950	d	850	d			827	d	516	d
INJ/017 (1:10)	5/18/98 16:25	5/27/98	824		853	d	782	d	nd	d	803	d	569	d
INJ/017 (1:10)	5/18/98 16:25	7/9/98			963	d	895	d			890	d	595	d
INJ/018	5/18/98 16:35	5/27/98	nd		nd	BDL	nd	BDL	nd	BDL	nd	BDL	nd	BDL
INJ/019	5/18/98 16:50	5/27/98	nd		nd	BDL	nd	BDL	nd	BDL	nd	BDL	nd	BDL
TB/07	5/20/98 0:00	6/6/98				j	0.18	j			nd	BDL	0.87	j
TB/06	5/20/98 0:00	6/7/98			0.56	j	0.11	j			nd	BDL	nd	BDL
MW02/02	5/20/98 16:50	6/6/98			nd	BDL	nd	BDL			nd	BDL	nd	BDL
MW02IW/02	5/20/98 19:25	6/7/98			nd	BDL	nd	BDL			nd	BDL	0.34	j

Sample ID	Date and Time	Date Analyzed	Methanol (mg/L)	Flag for Methanol	1-Propanol (mg/L)	Flag for 1-Propanol	4-Methanol-2-pentanol (mg/L)	Flag for 4-Methanol-2-pentanol	PCE (mg/L)	Flag for PCE	1-Hexanol (mg/L)	Flag for 1-Hexanol	1-Heptanol (mg/L)	Flag for 1-Heptanol
INJ/021 TB	5/26/98 12:05	6/10/98			nd	BDL	nd	BDL			nd	BDL	nd	BDL
INJ/022 TB	5/26/98 12:36	6/10/98			nd	BDL	nd	BDL			nd	BDL	nd	BDL
INJ/022 TB [dup]	5/26/98 12:36	6/10/98			nd	DUP	nd	DUP			nd	DUP	nd	DUP
MW02IW-03	5/27/98 11:50	6/11/98			nd	BDL	nd	BDL			nd	BDL	nd	BDL
MW02-3	5/27/98 14:05	6/11/98			nd	BDL	nd	BDL			nd	BDL	nd	BDL
INJ/024 TB	5/28/98 13:14	6/11/98			nd	BDL	nd	BDL			nd	BDL	nd	BDL
INJ/025 TB	5/28/98 13:28	6/11/98			nd	BDL	nd	BDL			nd	BDL	nd	BDL
INJ/026 TB	5/30/98 12:01	6/12/98			nd	BDL	nd	BDL			nd	BDL	nd	BDL
INJ/027 TB	6/2/98 12:13	6/15/98			nd	BDL	nd	BDL			nd	BDL	nd	BDL
INJ/027 TB [dup]	6/2/98 12:13	6/15/98			nd	DUP	nd	DUP			nd	DUP	nd	DUP
INJ/028 TB	6/2/98 12:16	6/15/98			nd	BDL		j			nd	BDL	nd	BDL
TB/029	6/4/98 14:28	6/21/98			nd	BDL	nd	BDL			nd	BDL	nd	BDL
TB/030	6/4/98 14:30	6/21/98			nd	BDL	nd	BDL			nd	BDL	nd	BDL
TB/031	6/6/98 12:05	6/21/98			nd	BDL	nd	BDL			nd	BDL	nd	BDL
TB/031 [dup]	6/6/98 12:05	6/22/98			nd	DUP	nd	DUP			nd	DUP	nd	DUP
TB/032	6/6/98 12:06	6/22/98			nd	BDL	nd	BDL			nd	BDL	nd	BDL
MW02/05	6/8/98 13:27	6/24/98			nd	BDL	1.76	j			nd	BDL	nd	BDL
MW02IW/04	6/8/98 15:28	6/24/98			nd	BDL	1.66	j			nd	BDL	nd	BDL
TB/033	6/9/98 12:14	6/24/98			nd	BDL	nd	BDL			nd	BDL	nd	BDL
TB/034	6/9/98 12:15	6/25/98			nd	BDL	nd	BDL			nd	BDL	nd	BDL
TB/035	6/11/98 12:06	6/16/98			nd	BDL	1.27	j			4.45	j	6.02	j
TB/036	6/11/98 12:06	6/16/98			nd	BDL	nd	BDL			0.75	j	1.75	j
TB/036	6/11/98 12:06	6/16/98			nd	BDL	nd	BDL			0.75	j	nd	BDL
TB/038	6/13/98 11:30	6/16/98			nd	BDL	nd	BDL			nd	BDL	nd	BDL
TB/039	6/13/98 11:53	6/23/98			nd	BDL	nd	BDL			2.24	j	nd	BDL
TB/040	6/15/98 12:50	6/23/98			nd	BDL	nd	BDL			nd	BDL	nd	BDL
TB/040 [dup]	6/15/98 12:50	6/23/98			nd	DUP	nd	DUP			nd	DUP	nd	DUP
MW02IW/05	6/16/98 14:07	6/22/98			nd	BDL	nd	BDL			nd	BDL	nd	BDL
MW02/06	6/16/98 14:13	6/22/98			nd	BDL	nd	BDL			nd	BDL	nd	BDL
TB/041	6/18/98 11:15	6/22/98			nd	BDL	nd	BDL			3.41	j	4.85	j
TB/042	6/18/98 11:17	6/22/98			nd	BDL	nd	BDL			0.88	j	nd	BDL
TB/043	6/20/98 9:08	6/25/98			nd	BDL	nd	BDL			nd	BDL	nd	BDL
TB/044	6/20/98 10:18	6/25/98			nd	BDL	nd	BDL			nd	BDL	nd	BDL
TB/045	6/22/98 12:26	6/26/98			nd	BDL	nd	BDL			nd	BDL	nd	BDL
TB/046	6/22/98 12:26	6/26/98			nd	BDL	nd	BDL			nd	BDL	nd	BDL
MW02/626	6/26/98 9:10	7/1/98			nd	BDL	nd	BDL			nd	BDL	nd	BDL
MW02IW/626	6/26/98 11:10	7/1/98			nd	BDL	nd	BDL			nd	BDL	nd	BDL

Project: PITT at ESTCP Camp Lejeune
Acceptable QA/QC limits: % Recovery between 80% and 120%

Data QA/QC by	DW
Date created	1/22/99 0:00
Date last modified	1/27/99 0:00

Sample Legend
CC = Calibration check
j = below reporting limit
d = diluted sample
BDL = below detection limit
NA = not applicable
jj = out of acceptable QA/QC and/or calibration limits
OK = within acceptable QA/QC limits
nd = not detected
DUP = Duplicate
d,DUP = diluted duplicate

Duplicate Samples

Sample ID	Date and Time	Date Analyzed	1-Propanol (mg/L)	Flag for 1-Propanol	Duplicate Analyses for 1-Propanol	4-Methanol-2 pentanol (mg/L)	Flag for 4-Methanol-2-pentanol	Duplicate Analyses for 4-Methyl-2-pentanol	1-Hexanol (mg/L)	Flag for 1-Hexanol	Duplicate Analyses for 1-Hexanol	1-Heptanol (mg/L)	Flag for 1-Heptanol	Duplicate Analyses for 1-Heptanol
3-17.5/014	5/17/98 19:03	5/27/98	nd	BDL		nd	BDL		nd	BDL		nd	BDL	
3-17.5/014 [dup]	5/17/98 19:03	5/27/98	nd	DUP		nd	DUP		nd	DUP		nd	DUP	
3-17.5/015	5/18/98 9:15	6/4/98	nd	BDL		nd	BDL		4	j		nd	BDL	
3-17.5/015 [dup]	5/18/98 9:15	6/4/98	nd	DUP		nd	DUP		4	DUP	92	nd	DUP	
3-17.5/018	5/19/98 19:17	6/6/98	1	j		1	j		0	j		nd	BDL	
3-17.5/018 [dup]	5/19/98 19:17	6/6/98	2	DUP	191	2	DUP	148	1	DUP	124	nd	DUP	
3-17.5/024D	5/22/98 19:42	6/8/98	89	OK		61	OK		52	OK		16	OK	
3-17.5/022 [dup]	5/22/98 19:47	6/7/98	31	DUP	35	20	DUP	32	13	DUP	25	5	DUP	32
3-17.5/026	5/23/98 18:38	6/9/98	81	OK		58	OK		47	OK		25	OK	
3-17.5/026 [dup]	5/23/98 18:38	6/9/98	82	DUP	101	57	DUP	99	48	DUP	102	19	DUP	79
3-17.5/038	6/2/98 7:50	6/15/98	193	OK		202	jj		179	OK		110	OK	
3-17.5/038 [dup]	6/2/98 7:50	6/15/98	192	DUP	99	184	DUP	91	180	DUP	100	107	DUP	97
3-17.5/043	6/7/98 9:02	6/18/98	79	OK		76	OK		73	OK		51	OK	
3-17.5/043 [dup]	6/7/98 9:02	6/18/98	71	DUP	90	68	DUP	90	67	DUP	92	46	DUP	92
2-18.5/029	5/25/98 8:11	6/9/98	4	j		45	OK		nd	BDL		nd	BDL	
2-18.5/029 [dup]	5/25/98 8:11	6/9/98	3	DUP	84	40	DUP	88	nd	DUP		nd	DUP	
2-18.5/032	5/27/98 8:05	6/11/98	39	OK		11	OK		nd	BDL		nd	BDL	
2-18.5/032 [dup]	5/27/98 8:05	6/11/98	37	DUP	95	7	DUP	61	nd	DUP		nd	DUP	
2-18.5/035	5/30/98 7:50	6/12/98	114	OK		31	OK		9	j		nd	BDL	
2-18.5/035 [dup]	5/30/98 7:50	6/12/98	118	DUP	104	32	DUP	102	9	DUP	96	nd	DUP	
2-17.0/021 (1:10)	5/21/98 10:43	7/1/98	973	d		838	d		846	d		432	d	
2-17.0/021 (1:10) [du	5/21/98 10:43	7/1/98	1050	d,DUP	108	1020	d,DUP	122	963	d,DUP	114	606	d,DUP	141
2-17.0/036	5/31/98 7:30	6/12/98	nd	BDL		nd	BDL		nd	BDL		nd	BDL	
2-17.0/036 [dup]	5/31/98 7:30	6/12/98	nd	DUP		nd	DUP		nd	DUP		nd	DUP	
2-17.0/047	6/11/98 9:20	6/17/98	1	j		nd	BDL		nd	BDL		nd	BDL	
2-17.0/047 [dup]	6/11/98 9:20	6/17/98	1	DUP	90	nd	DUP		nd	DUP		0	DUP	

Sample ID	Date and Time	Date Analyzed	1-Propanol (mg/L)	Flag for 1-Propanol	Duplicate Analyses for 1-Propanol	4-Methanol-2 pentanol (mg/L)	Flag for 4-Methanol-2-pentanol	Duplicate Analyses for 4-Methyl-2-pentanol	1-Hexanol (mg/L)	Flag for 1-Hexanol	Duplicate Analyses for 1-Hexanol	1-Heptanol (mg/L)	Flag for 1-Heptanol	Duplicate Analyses for 1-Heptanol
EX1/058 A	5/25/98 9:00	6/9/98	74	OK		104	OK		106	OK		42	OK	
EX1/058 A [dup]	5/25/98 9:00	6/9/98	60	OK	82	84	OK	80	87	OK	82	40	OK	94
EX1/086 M	6/9/98 11:05	6/25/98	6	j		7	j		12	OK		29	OK	
EX1/086 M [dup]	6/9/98 11:05	6/25/98	6	DUP	93	9	DUP	127	10	DUP	83	39	DUP	137
EX1/092 M	6/13/98 11:08	6/17/98	3	j		3	j		3	j		15	OK	
EX1/092 M [dup]	6/13/98 11:08	6/17/98	5	DUP	179	3	DUP	106	3	DUP	101	16	DUP	109
EX2/013 A	5/15/98 1:30	5/20/98	nd	BDL		nd	BDL		nd	BDL		nd	BDL	
EX2/013 A [dup]	5/15/98 1:30	5/20/98	nd	DUP		nd	DUP		nd	DUP		nd	DUP	
EX2/040 AD	5/19/98 19:50	6/5/98	241	jj		202	jj		234	jj		110	OK	
EX2/040 AD [dup]	5/19/98 19:50	6/5/98	237	DUP	98	200	DUP	99	224	DUP	96	105	DUP	95
EX2/050 M (1:10)	5/22/98 21:02	7/1/98	238	d		180	d		211	d		143	d	
EX2/050 M (1:10) [du	5/22/98 21:02	7/1/98	229	d,DUP	96	169	d,DUP	94	206	d,DUP	98	129	d,DUP	90
EX2/055 M	5/23/98 19:09	6/8/98	180	OK		213	jj		197	OK		176	OK	
EX2/055 M [dup]	5/23/98 19:09	6/9/98	178	DUP	99	206	DUP	97	192	DUP	97	176	DUP	100
EX2/068 M	5/28/98 12:37	6/11/98	69	OK		53	OK		62	OK		44	OK	
EX2/068 M [dup]	5/28/98 12:37	6/11/98	88	DUP	127	66	DUP	123	74	DUP	119	51	DUP	114
EX2/069 A	5/29/98 10:50	6/11/98	33	OK		33	OK		39	OK		27	OK	
EX2/069 A [dup]	5/29/98 10:50	6/11/98	34	DUP	103	33	DUP	98	36	DUP	92	28	DUP	102
EX2/083 A	6/5/98 11:00	6/21/98	11	OK		12	OK		14	OK		14	OK	
EX2/083 A [dup]	6/5/98 11:00	6/21/98	10	DUP	85	10	DUP	81	12	DUP	87	12	DUP	88
EX2/088 A	6/8/98 11:00	6/24/98	9	j		8	j		8	j		11	OK	
EX2/088 A [dup]	6/8/98 11:00	6/24/98	8	DUP	97	8	DUP	97	8	DUP	98	10	DUP	89
EX2/100 A	6/16/98 10:50	6/23/98	12	OK		7	j		7	j		5	j	
EX2/100 A [dup]	6/16/98 10:50	6/23/98	11	DUP	94	7	DUP	98	7	DUP	95	4	DUP	96
EX2/103 M/A	6/18/98 11:32	6/22/98	5	j		6	j		6	j		4	j	
EX2/103 M/A [dup]	6/18/98 11:32	6/22/98	6	DUP	123	6	DUP	96	5	DUP	86	5	DUP	102
EX3/009 M	5/16/98 7:45	5/23/98	0	j		0	j		0	j		nd	BDL	
EX3/009 M [dup]	5/16/98 7:45	5/23/98	0	DUP	107	0	DUP	99	0	DUP	106	nd	DUP	
EX3/042 EB	5/20/98 18:40	6/6/98	1	j		nd	BDL		nd	BDL		nd	BDL	
EX3/042 EB [dup]	5/20/98 18:40	6/6/98	1	DUP	93	nd	DUP		nd	DUP		nd	DUP	
EX3/078 A	6/4/98 10:50	6/21/98	6	j		6	j		6	j		4	j	
EX3/078 A [dup]	6/4/98 10:50	6/21/98	7	DUP	107	6	DUP	100	7	DUP	109	4	DUP	105
EX3/091 M	6/13/98 11:12	6/17/98	9	j		6	j		7	j		3	j	
EX3/091 M [dup]	6/13/98 11:12	6/17/98	10	DUP	122	6	DUP	92	6	DUP	85	2	DUP	65
EX3/100 AD	6/19/98 11:00	6/25/98	6	j		7	j		7	j		6	j	
EX3/100 AD [dup]	6/19/98 11:00	6/25/98	6	DUP	98	6	DUP	91	5	DUP	72	6	DUP	108
EX3/103 M	6/19/98 11:32	6/25/98	5	j		6	j		6	j		5	j	
EX3/103 M [dup]	6/19/98 11:32	6/25/98	7	DUP	124	8	DUP	134	7	DUP	126	7	DUP	132
EX4R/005 A	5/14/98 7:40	5/19/98	nd	BDL		nd	BDL		nd	BDL		nd	BDL	

Sample ID	Date and Time	Date Analyzed	1-Propanol (mg/L)	Flag for 1-Propanol	Duplicate Analyses for 1-Propanol	4-Methanol-2 pentanol (mg/L)	Flag for 4-Methanol-2-pentanol	Duplicate Analyses for 4-Methyl-2-pentanol	1-Hexanol (mg/L)	Flag for 1-Hexanol	Duplicate Analyses for 1-Hexanol	1-Heptanol (mg/L)	Flag for 1-Heptanol	Duplicate Analyses for 1-Heptanol
EX4R/005 A [dup]	5/14/98 7:40	5/19/98	nd	DUP		nd	DUP		nd	DUP		nd	DUP	
EX4R/016 A	5/16/98 1:30	5/23/98	0	j		0	j		nd	BDL		nd	BDL	
EX4R/016 A [dup]	5/16/98 1:30	5/24/98	0	DUP	105	nd	DUP		nd	DUP		nd	DUP	
EX4R/021 A	5/16/98 19:40	5/25/98	10	j		7	j		4	j		0	j	
EX4R/021 A [dup]	5/16/98 19:40	5/25/98	11	DUP	110	7	DUP	114	4	DUP	117	0	DUP	87
EX4R/027 A	5/17/98 13:40	5/26/98	56	OK		41	OK		28	OK		5	j	
EX4R/027 A [dup]	5/17/98 13:40	5/26/98	66	DUP	118	50	DUP	120	34	DUP	121	6	DUP	117
EX4R/031 AD	5/18/98 7:50	6/4/98	258	jj		152	OK		118	OK		25	OK	
EX4R/031 AD [dup]	5/18/98 7:50	6/4/98	97	DUP	37	78	DUP	51	63	DUP	53	14	DUP	57
EX4R/036 A	5/19/98 7:40	6/5/98	215	jj		127	OK		98	OK		25	OK	
EX4R/036 A [dup]	5/19/98 7:40	6/5/98	207	DUP	96	123	DUP	97	97	DUP	99	25	DUP	101
EX4R/044 A	5/21/98 9:00	6/7/98	>200	jj		193	OK		168	OK		47	OK	
EX4R/044 A [dup]	5/21/98 9:00	6/7/98	>200	DUP		203	DUP		173	DUP		43	DUP	
EX4R/066 M	5/29/98 20:44	6/12/98	18	OK		22	OK		28	OK		50	OK	
EX4R/066 M [dup]	5/29/98 20:44	6/12/98	19	DUP	107	22	DUP	104	32	DUP	113	53	DUP	105
EX4R/074 M	6/3/98 11:44	6/21/98	5	j		6	j		8	j		26	OK	
EX4R/074 M [dup]	6/3/98 11:44	6/21/98	4	DUP	91	5	DUP	95	8	DUP	90	33	DUP	124
EX4R/091 A	6/13/98 10:50	6/17/98	3	j		2	j		2	j		7	j	
EX4R/091 A [dup]	6/13/98 10:50	6/17/98	4	DUP	118	2	DUP	100	2	DUP	105	6	DUP	80
EX4R/104 A/M	6/22/98 10:50	6/26/98	4	j		3	j		4	j		3	j	
EX4R/104 A/M [dup]	6/22/98 10:50	6/26/98	3	DUP	85	5	DUP	141	2	DUP	52	4	DUP	138
EX5/029 M	5/19/98 7:43	6/5/98	191	OK		158	OK		132	OK		71	OK	
EX5/029 M [dup]	5/19/98 7:43	6/5/98	264	DUP	138	221	DUP	140	189	DUP	143	104	DUP	147
EX5/046 A	5/20/98 21:00	6/6/98	>200	jj		>200	jj		>200	jj		153	OK	
EX5/046 A [dup]	5/20/98 21:00	6/6/98	>200	DUP		>200	DUP		>200	DUP		146	DUP	
EX5/046 A (1:10)	5/20/98 21:00	6/30/98	266	d		239	d		228	d		73	d	
EX5/046 A (1:10) [du	5/20/98 21:00	6/30/98	270	d, DUP	101	249	d, DUP	104	228	d, DUP	100	145	d, DUP	198
EX5/050 A	5/21/98 21:00	6/7/98	>200	jj		>200	jj		>200	jj		172	OK	
EX5/050 A [dup]	5/21/98 21:00	6/7/98	>200	DUP		>200	DUP		>200	DUP		181	DUP	
EX5/052 A	5/22/98 21:00	6/7/98	199	OK		192	OK		179	OK		137	OK	
EX5/052 A [dup]	5/22/98 21:00	6/7/98	218	DUP	110	199	DUP	103	183	DUP	102	138	DUP	101
EX5/057 A	5/24/98 9:00	6/9/98	111	OK		112	OK		103	OK		93	OK	
EX5/057 A [dup]	5/24/98 9:00	6/9/98	118	DUP	106	120	DUP	107	113	DUP	109	99	DUP	106
EX5/069 A	5/30/98 11:00	6/12/98	19	OK		20	OK		21	OK		13	OK	
EX5/069 A [dup]	5/30/98 11:00	6/12/98	19	DUP	97	21	DUP	104	21	DUP	102	14	DUP	111
EX5/096 A	6/15/98 11:00	6/23/98	5	j		5	j		5	j		3	j	
EX5/096 A [dup]	6/15/98 11:00	6/23/98	6	DUP	115	5	DUP	98	5	DUP	97	4	DUP	126
EX5/104 A	6/20/98 11:00	6/25/98	4	j		5	j		6	j		6	j	
EX5/104 A [dup]	6/20/98 11:00	6/25/98	4	DUP	97	6	DUP	131	6	DUP	98	5	DUP	78

Sample ID	Date and Time	Date Analyzed	1-Propanol (mg/L)	Flag for 1-Propanol	Duplicate Analyses for 1-Propanol	4-Methanol-2 pentanol (mg/L)	Flag for 4-Methanol-2-pentanol	Duplicate Analyses for 4-Methyl-2-pentanol	1-Hexanol (mg/L)	Flag for 1-Hexanol	Duplicate Analyses for 1-Hexanol	1-Heptanol (mg/L)	Flag for 1-Heptanol	Duplicate Analyses for 1-Heptanol
EX6/014 A	5/15/98 13:30	5/23/98	nd	BDL		nd	BDL		nd	BDL		nd	BDL	
EX6/014 A [dup]	5/15/98 13:30	5/24/98	nd	DUP		nd	DUP		nd	DUP		nd	DUP	
EX6/018 M	5/16/98 20:28	5/25/98	19	OK		17	OK		13	OK		6	j	
EX6/018 M [dup]	5/16/98 20:28	5/26/98	19	DUP	97	17	DUP	100	13	DUP	100	6	DUP	100
EX6/033 A	5/18/98 13:40	6/4/98	155	OK		145	OK		128	OK		74	OK	
EX6/033 A [dup]	5/18/98 13:40	6/4/98	155	DUP	100	172	DUP	119	157	DUP	122	90	DUP	122
EX6/039 A	5/19/98 19:40	6/5/98	212	jj		169	OK		151	OK		93	OK	
EX6/039 A [dup]	5/19/98 19:40	6/5/98	205	DUP	97	154	DUP	91	141	DUP	94	84	DUP	90
EX6/042 M	5/20/98 21:45	6/7/98	220	jj		217	jj		202	jj		138	OK	
EX6/042 M [dup]	5/20/98 21:45	6/7/98	227	DUP	103	215	DUP	99	205	DUP	101	133	DUP	97
EX6/050 A	5/23/98 8:50	6/8/98	94	OK		92	OK		87	OK		89	OK	
EX6/050 A [dup]	5/23/98 8:50	6/8/98	133	DUP	142	142	DUP	154	139	DUP	159	144	DUP	162
EX6/070 A	6/1/98 10:50	6/12/98	8	j		8	j		8	j		6	j	
EX6/070 A [dup]	6/1/98 10:50	6/13/98	8	DUP	101	7	DUP	88	8	DUP	96	7	DUP	110
EX6/077 M	6/5/98 11:25	6/21/98	2	j		3	j		5	j		3	j	
EX6/077 M [dup]	6/5/98 11:25	6/21/98	2	DUP	115	5	DUP	135	5	DUP	89	4	DUP	115
EX6/085 A	6/9/98 11:00	6/24/98	3	j		4	j		4	j		4	j	
EX6/085 A [dup]	6/9/98 11:00	6/24/98	3	DUP	94	3	DUP	94	3	DUP	75	6	DUP	153
EX6/088 A	6/11/98 11:00	6/17/98	4	j		2	j		2	j		2	j	
EX6/088 A [dup]	6/11/98 11:00	6/17/98	5	DUP	115	2	DUP	107	2	DUP	134	2	DUP	81
EX6/096 A	6/17/98 11:00	6/23/98	3	j		2	j		2	j		nd	BDL	
EX6/096 A [dup]	6/17/98 11:00	6/23/98	3	DUP	114	2	DUP	118	2	DUP	115	nd	DUP	
EX6/103 M	6/21/98 11:35	6/26/98	2	j		4	j		2	j		2	j	
EX6/103 M [dup]	6/21/98 11:35	6/26/98	2	DUP	88	2	DUP	64	2	DUP	107	nd	DUP	

Camp Lejeune Background Arsenic Analyses

STAR ANALYTICAL
14500 Trinity Boulevard, Suite 106 • Fort Worth, Texas 76155
Tarrant County • (817) 571-6800 • Metro (817) 540-6982 • FAX (817) 267-5431

Duke Engineering & Services
9111 Research Blvd.
Austin, TX 78758
Attention: Fred Holzmer

Client Project ID: Camp Lejeune
Sample Matrix: Water
First Sample #: 804-0351

Sampled: Apr 10, 1998
Received: Apr 14, 1998
Reported: Apr 20, 1998

Analytical and Quality Control Report

Enclosed is the Analytical and Quality Control Report for the following samples submitted to Star Analytical for analysis. The results in this report are limited to the samples tested. Reproduction of this report is permitted only in its entirety with written permission from the laboratory.

Sample No. 804-0351 to 804-0354

Comments:

All **holding times** were within method criteria.

All **calibration criteria** were met for these analyses.

... **method blanks** were within required quality control criteria.

Total Number of Pages in Report: 03

STAR ANALYTICAL

...ony Dilday
Laboratory Director

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Duke Engineering & Services
9111 Research Blvd.
Austin, TX 78758
Attention: Fred Holzmer

Client Project ID: Camp Lejeune
Sample Descript: Water
Analysis for: Arsenic
First Sample #: 804-0351
Method: EPA 206.2

Sampled: Apr 10, 1998
Received: Apr 14, 1998
Extracted: Apr 20, 1998
Analyzed: Apr 20, 1998
Reported: Apr 20, 1998

LABORATORY ANALYSIS FOR: Arsenic

Sample Number	Sample Description	Reporting Limit mg/L	Sample Result mg/L
804-0351	88-MW02(S)	0.0050	N.D.
804-0352	88-MW03(S)	0.0050	N.D.
804-0353	88-MW05(S)	0.0050	N.D.
804-0354	TW04	0.0050	N.D.

Analytes reported as N.D. were not present above the stated limit of detection.

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Anthony Dilday
Laboratory Director

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Duke Engineering & Services
9111 Research Blvd.
Austin, TX 78758
Attention: Fred Holzmer

Client Project ID: Camp Lejeune
Matrix: Water
QC Sample Group: 8040351-354

Reported: Apr 20, 1998

QUALITY CONTROL DATA REPORT

ANALYTE	Arsenic
Method:	EPA 206.2
Analyst:	SW
Reporting Units:	µg/L
Date Prepared:	Apr 20, 1998
Date Analyzed:	Apr 20, 1998
LCS ID #:	LCS042098
Spike Conc. Added:	10
LCS Spike % Recovery:	98
Control Limits:	80-120
MS/MSD SAMPLE #:	8040351MS
Matrix Spike % Recovery:	114
Matrix Spike Duplicate % Recovery:	109
Relative % Difference:	4.5

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Anthony Dilday
Laboratory Director

Please Note: The LCS is a Laboratory control sample of interferent free matrix that is analyzed using the same reagents, preparation and methods employed for the samples. The LCS % recovery data is used for validation of sample batch results. Due to matrix effects, MS/MSD's QC limits are advisory only and are not used to accept or reject batch results. The % Rec. and RPD are calculated as follows:

$$\% \text{ Recovery} = \frac{\text{Conc. of M.S.} - \text{Conc. of Sample}}{\text{Spike Conc. Added}} \times 100$$

$$\text{Relative \% Difference} = \frac{\text{Conc. of M.S.} - \text{Conc. of M.S.D.}}{(\text{Conc. of M.S.} + \text{Conc. of M.S.D.})/2} \times 100$$

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Duke Engineering & Services 9111 Research Blvd. Austin, TX 78758	Project: TDN 307 PITT Project Number: none Project Manager: John Londergan	Sampled: 5/29/98 Received: 6/1/98 Reported: 6/8/98 15:32

Total Metals by EPA 6000/7000 Series Methods
Star Analytical, Inc.

Analyte	Batch Number	Date Prepared	Date Analyzed	Specific Method	Reporting Limit	Result	Units	Notes*
MW02-4			**8060026-00**				**Water**	
Arsenic	06V8125	6/2/98	6/8/98	EPA 206.2	0.0050	ND	mg/l	
MW03-4			**8060026-01**				**Water**	
Arsenic	06V8125	6/2/98	6/8/98	EPA 206.2	0.0050	ND	mg/l	
MW05-4			**8060026-02**				**Water**	
Arsenic	06V8125	6/2/98	6/8/98	EPA 206.2	0.0050	ND	mg/l	

Star Analytical, Inc.

L Hall

Lari Hall, Project Manager

Refer to end of report for text of notes and definitions.

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Duke Engineering & Services 9111 Research Blvd. Austin, TX 78758	Project: TDN 307 PITT Project Number: none Project Manager: John Londergan	Sampled: 5/29/98 Received: 6/1/98 Reported: 6/8/98 15:32

Total Metals by EPA 6000/7000 Series Methods/Quality Control
Star Analytical, Inc.

Analyte	Date Analyzed	Spike Level	Sample Result	QC Result	Units	Reporting Limit Recov. Limits	Recov. %	RPD Limit	RPD %	Notes*
Batch: 06V8125	**Date Prepared: 6/2/98**				**Extraction Method: EPA 3010**					
Blank	**06V8125-BLK1**									
Arsenic	6/8/98			**ND**	mg/l	**0.0050**				
LCS	**06V8125-BS1**									
Arsenic	6/8/98	0.010		0.010	mg/l	80-120	100			
LCS Dup	**06V8125-BSD1**									
Arsenic	6/8/98	0.010		0.010	mg/l	80-120	100		0	
Matrix Spike	**06V8125-MS1**		**8060012-00**							
Arsenic	6/8/98	0.010	ND	0.013	mg/l	80-120	130			
Matrix Spike Dup	**06V8125-MSD1**		**8060012-00**							
Arsenic	6/8/98	0.010	ND	0.012	mg/l	80-120	120	30	8.0	

Star Analytical, Inc.

**Refer to end of report for text of notes and definitions.*

LHall
Lari Hall, Project Manager

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Duke Engineering & Services 9111 Research Blvd. Austin, TX 78758	Project: TDN 307 PITT Project Number: none Project Manager: John Londergan	Sampled: 5/29/98 Received: 6/1/98 Reported: 6/8/98 15:32

Notes and Definitions

#	Note
DET	Analyte DETECTED
ND	Analyte NOT DETECTED at or above the reporting limit
NR	Not Reported
dry	Sample results reported on a dry weight basis
Recov.	Recovery
RPD	Relative Percent Difference

S[illegible]nalytical, Inc.

L Hall

Lari Hall, Project Manager

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CHAIN-OF-CUSTODY FORM

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Company Name: DUKE ENGINEERING & SERVICES	Project Name: TDN 307 PITT
Address: 9111 RESEARCH Blvd	Billing Address (if different):
City: AUSTIN State: TX Zip Code: 78758	
Telephone: 512-425-2000 FAX#:	P.O.#:
Report To: JOHN LONDERGAN Sampler: HARRY / JERRY	

Turnaround Time: ☐ 10 Working Days ☒ 7 Working Days ☐ 5 Working Days ☐ 4 Working Days ☐ 3 Working Days ☐ 2 Working Days ☐ 24 Hours ☐ 2 - 8 Hours

Analyses Requested

Client Sample I.D.	Date/Time Sampled	Matrix Desc.	# of Cont.	Cont. Type	Star's Sample #	ARSENIC HNO3									Comments
1. MW02 - 4	5/29/98 1145	Aq	1		8060026-00										
2. MW03 - 4	5/29/98 0920	Aq	1		8060026-01										
3. MW05 - 4	5/29/98 1040	Aq	1		8060026-02										
4.															
5.															
6.															
7.															
8.															
9.															
10.															

Relinquished By:	Date:	Time:	Received By:	Date:	Time:
[signature]	5/29/98	1300	[signature]	6/1/98	0930

Samples Received in Good Condition? ☑ Yes ☐ No Samples Cold? ☐ Yes ☒ No Method of Shipment FED EX Page 1 of 1

Pink - Client Yellow - Star White - Star

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ACCREDITED

FAX

Date: 6-8-98

Number of pages including cover sheet: 6

To: John Londergan

Company: Duke

Fax Number:

CC:

From: Lori Hall

Company: STAR ANALYTICAL
14500 Trinity Blvd., # 106
Fort Worth, Tx 76155

Phone: (817) 540-6982 metro

Fax Number: (817) 267-5431

REMARKS: ☐ Urgent ☐ For your review ☐ Reply ASAP ☐ Please comment

Should any problems occur during receiving this transmission, Please call (817)540-6982

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Duke Engineering & Services	Project: TDN 307 PITT	Sampled:	5/29/98
9111 Research Blvd.	Project Number: none	Received:	6/1/98
Austin, TX 78758	Project Manager: John Londergan	Reported:	6/8/98 15:32

ANALYTICAL REPORT FOR SAMPLES:

Sample Description	Laboratory Sample Number	Sample Matrix	Date Sampled
MW02-4	8060026-00	Water	5/29/98
MW03-4	8060026-01	Water	5/29/98
MW05-4	8060026-02	Water	5/29/98

Star Analytical, Inc.

LHall

Lari Hall, Project Manager

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.

APPENDIX P

Sample Holding Time Study

MANAGEMENT TECHNOLOGY

Ref: 98-PW4
EPA CONTRACT NO. 68-C-98-138

August 27, 1998

Dr. Lynn Wood
National Risk Management Research Laboratory
Subsurface Protection & Remediation Division
U.S. Environmental Protection Agency
P.O. Box 1198
Ada, OK 74820

THRU: D. Fine D.Fine

Dear Dr. Wood:

Attached is a data report for the analysis of aqueous samples made from tap water. The analyses were conducted on August 6 (0 day), 12 (6 days), 20 (14 days) and 27 (21 days), 1998 respectively, as per Service Request #RE-0-16. Five duplicates were run for each set. The samples were analyzed for methanol, 1-propanol, 4-methyl-2-pentanol, 1-hexanol and 1-heptanol.

Analyses were performed using RSKSOP-201, Revision No. 0 (under preparation) by Perry Wang.

Detection limits and quantitation limits for each component are as follows:

Analytes	LOD*	LOQ**
Methanol	0.05	0.18
1-Propanol	0.05	0.18
4-Methyl-2-pentanol	0.06	0.18
1-Hexanol	0.07	0.23
1-Heptanol	0.05	0.15

*Limits of Detection, ppm. **Limit of Quantitation ppm.

If you have any question, please feel free to contact me.

Sincerely,

Perry G. Wang

Perry G. Wang

xc: J.L. Seeley
R.L. Cosby
G.B. Smith

08/28/98 03:15 PM

Dada Sheet of RE-0-16

Units: ppm

0 DAY	MeOH	1-PRO	4M2P	1Hex	1Hep
	102.1	98.7	92.9	96.6	99.4
	94.0	94.9	100.1	94.6	96.3
	96.6	101.9	98.2	88.9	103.5
	97.2	97.2	101.3	96.5	99.5
	101.8	102.3	99.2	89.9	100.2
MEAN	98.3	99.0	98.3	93.3	99.7
SD	3.1	2.8	2.9	3.3	2.3
RSD	3.2%	2.8%	3.0%	3.5%	2.3%

6 DAYS	MeOH	1-PRO	4M2P	1Hex	1Hep
	93.3	90.3	99.4	93.8	93.9
	99.7	100.5	93.6	97.6	101.7
	100.6	101.2	95.6	86.8	102.9
	94.1	94.2	100.4	94.6	96.7
	94.5	96.2	99.2	95.7	98.5
MEAN	96.4	96.5	97.6	93.7	98.7
SD	3.1	4.0	2.6	3.7	3.3
RSD	3.2%	4.2%	2.6%	3.9%	3.3%

14 DAYS	MeOH	1-PRO	4M2P	1Hex	1Hep
	93.2	93.1	101.2	92.7	95.6
	100.2	101.3	97.8	83.6	102.6
	94.7	96.0	102.3	93.2	96.6
	99.0	103.1	99.4	85.5	103.6
	96.1	97.3	103.5	94.7	98.2
MEAN	96.6	98.2	100.8	89.9	99.3
SD	2.6	3.6	2.0	4.5	3.2
RSD	2.7%	3.7%	2.0%	5.0%	3.2%

21 DAYS	MeOH	1-PRO	4M2P	1Hex	1Hep
	90.1	95.6	100.8	91.5	93.6
	99.0	101.9	97.6	98.3	102.9
	97.9	99.7	104.1	95.4	100.3
	90.0	103.0	101.5	90.5	105.0
	101.3	102.0	97.5	98.0	104.1
MEAN	95.6	100.5	100.3	94.8	101.2
SD	4.7	2.7	2.5	3.2	4.1
RSD	5.0%	2.6%	2.5%	3.4%	4.0%

MEAN: Mean solution concentration (ppm) for each set.
SD: Standard Deviation

RSD:Relative Standard Deviation (=100 x (SD/MEAN))
Nomenclature: MeOH= methanol, 1-PRO = 1-propanol, 4M2P = 4-methyl-2-pentanol
1Hex = 1-hexanol, 1-Hep = 1-Heptanol

APPENDIX Q

EACN Discussion

Appendix Q
Effect of DNAPL Composition on Volume Estimation Using Partitioning Interwell Tracer Tests (PITTs)

The critical component in the use of PITTs for estimating the residual nonaqueous phase liquid (NAPL) volume is the accurate measurement of the tracer partition coefficients. The volume of NAPL in a PITT is determined by the following equation:

$$V_N = \frac{\bar{V}_p - \bar{V}_n}{K_i} \qquad (1)$$

where,

V_N = Volume of NAPL estimated by the PITT
$\bar{V}_p$ = First moment of the partitioning tracer
$\bar{V}_n$ = First moment of the nonpartitioning tracer
K_i = partition coefficient of tracer 'i'

From the above it is obvious that the error in the estimation of the NAPL volume is directly proportional to any error in the measurement or estimation of the tracer partition coefficient. The DNAPL at Camp Lejeune is primarily composed of tetrachloroethylene (PCE) and Varsol, a petroleum derivative. The objective of this write-up is to determine the effect of Varsol on the estimation of the DNAPL volume using PITTs.

Theory

The partition coefficient of a given tracer depends upon the relative hydrophobic or hydrophilic nature of the NAPL. The hydrophobic or hydrophilic nature of a petroleum hydrocarbon is defined by the equivalent alkane carbon number or EACN (Salager et al., 1979). A high NAPL EACN is indicative of a strongly hydrophobic NAPL and vice versa.

Dwarakanath and Pope (1998) used the EACN concept to estimate the tracer partition coefficients. They discovered that an alcohol tracer will partition weakly into a strongly hydrophobic NAPL with a high EACN, whereas it will partition strongly into a more polar NAPL with a lower EACN. Hence for a given partitioning tracer, a lower partition coefficient will be observed when the NAPL EACN is high, whereas a low NAPL EACN will translate into a higher partition coefficient. Since field NAPLs are frequently multi-component mixtures, some uncertainty in the PITT estimates of the DNAPL volume can be caused by differences in the NAPL composition.

The equation for estimating tracer partition coefficients using the EACN approach is given below:

$$\log K_i = -2.9562 + 0.6548 A_i - 0.0505 N_j \quad (2)$$

where,

A_i = EACN of alcohol tracer 'i'
N_j = EACN of NAPLT

The EACN of a NAPL mixture (N *mixture* with 'j'components is given below:

$$N_{mixture} = \sum_{j=1}^{n} x_j N_j \quad (3)$$

x_j = mole fraction of NAPL component 'j'

Using equations (2) and (3), the partition coefficient of a tracer ~i' with a complex NAPL mixture can be estimated. The concentration of POE and the primary components of Varsol in two DNAPL samples from Camp Lejeune is shown in Table 1.

Table 1. Analysis of DNAPL Samples from Camp Lejeune

Sample	**Component**	**EACN**	**Concentration (mg/L)**	**Mole Fraction**
	Tetrachloroethylene	2.21	1,590,600	0.997
	Decane	10	3,083	0.002
	Undecane	11	1,710	0.001
	Tetrachloroethylene	2.21	1,433,533	0.994
	Decane	10	4,842	0.004
	Undecane	11	3,098	0.002

Using the above equations, the percent change in the partition coefficient of 1-Heptanol as a function of increasing amounts of Varsol is shown in Figure 1. From this Figure it can be seen that if the mole fraction of POE is zero, then the partition coefficient of the Varsol is 20% less than the partition coefficient of POE. Hence, if the NAPL were entirely composed of Varsol and the POE-partition coefficients were used in the analysis of PITT data, then the DNAPL volume will be under-predicted by 20%. This is obviously the worst case scenario. However from Table 1, it is evident that the fraction of Varsol is less than 1% at which the error in the estimation of DNAPL volume due to the uncertainty in the DNAPL composition will be negligible.

References

Salager J.L., J.O. Morgan, R.S. Schechter and W.H. Wade: "Optimum Formulation of Surfactant/Water/Gil Systems for Minimum Interfacial Tension or Phase Behavior," SPE Journal, pp.107-115, April 1979.

Dwarakanath, V. and G.A. Pope, 1998. A New Approach for Estimating Alcohol Partition Coefficients between Nonaqueous Phase Liquids and Water. Environmental Science and Technology, 32(11) pp.1662-1666.

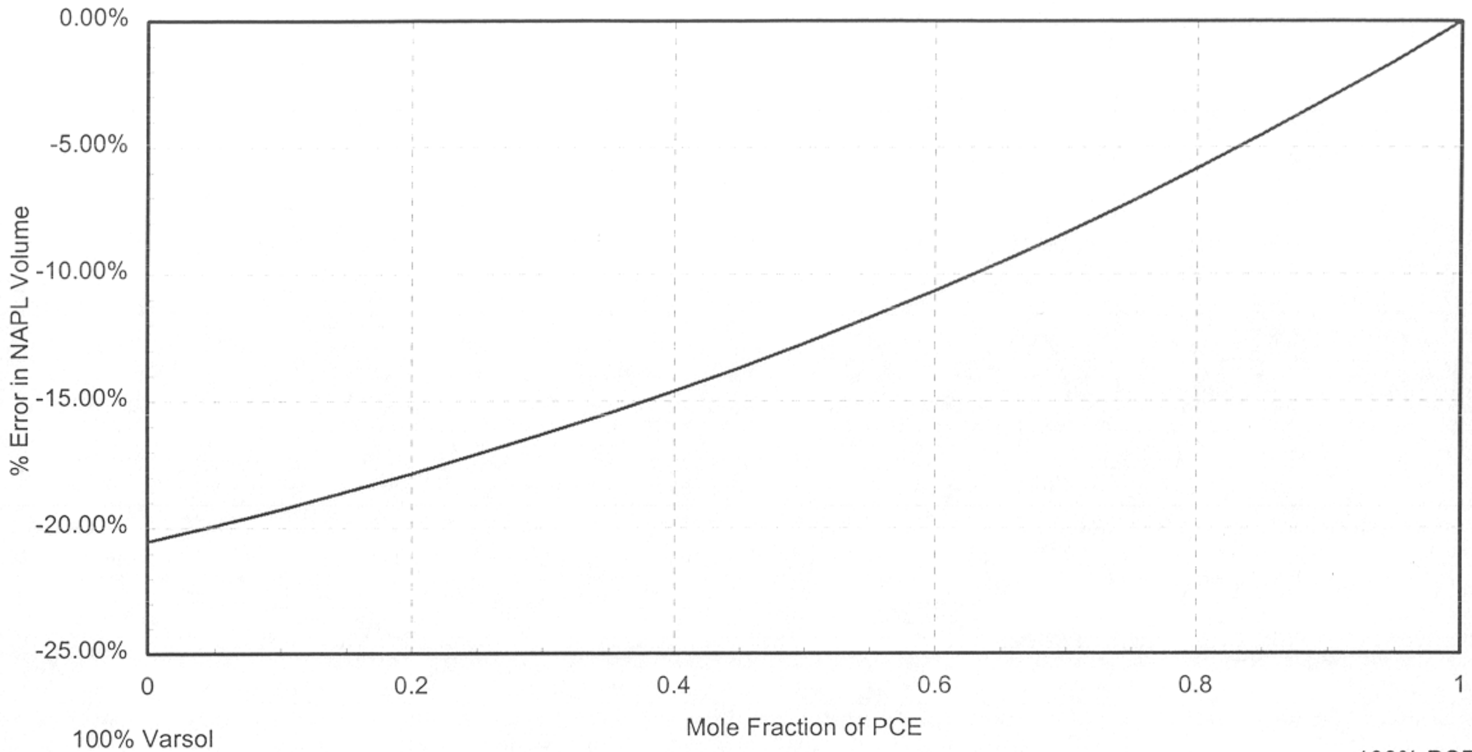

Figure 1. % Change in the Partition Coefficient of 1-Heptanol