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April 23, 2001

Mr. Colin J. Basye, Engineering Associate
Alaska Dept. of Environmental Conservation
Division of Spill Prevention and Response
Storage Tank Program
43335 Kalifornsky Beach Rd, Suite 11
Soldotna, Alaska 99669

RE: Kenai Airport Fuel Service
UST Facility ID #2187, Reckey #90230026801
Interim Remedial Action Report #3

Dear Mr. Basye:

This document reports the installation of three additional monitor wells and the sampling of three rounds of water samples at the KAFS site. The additional wells were installed in response to data obtained and presented in a previous remedial action report dated 9-28-99.

Monitor Well Installation and Sample Collection

Three additional down-gradient monitor wells (MW-6, MW-7, and MW-8) were installed at the Airport Fuel site at locations shown in Figure 1. The wells were installed by Hughes Drilling on 11-23-99 using a hollow-stem rotary auger. Soil samples were collected for field screen analysis using a 340 pound hydraulic hammer and 2-inch diameter split spoon sampler. Soil boring and well installation logs are included with the report. The logs give detailed information on the soil type and monitor well design. Split spoon samples were collected from 5 to 7 feet bgs in each boring. A field screen sample was collected from each split spoon and was tested for the presence of volatile hydrocarbons using a PID. Field screen samples were collected within 6 inches of the groundwater interface.

The monitor wells were developed manually by bailing water from the wells using a stainless steel bailer. Each well was bailed until the water became clear and free of fines. About 54 gallons of water were bailed from MW-6, about 32 gallons from MW-7, and about 36 gallons from MW-8. Water samples were collected from MW-1, MW-4, MW-6, MW-7, and MW-8 on November 29, 1999, July 6, 2000, and December 13, 2000. Water samples were sent to CT&E Environmental Services Inc. for analytical testing to determine the presence of GRO and BTEX. About 10 gallons of water were bailed from each well prior to sample collection. Additionally, during several sample rounds other groundwater parameters were measured when samples were collected: temperature (T), dissolved oxygen content (DO), pH, and electrical conductivity (eC).

EDB TESTING?

Measurement of Aquifer Hydraulic Conductivity

On November 29, 1999, a slug test to determine the hydraulic conductivity (K) of the aquifer was performed using MW-6 as the test well. About 10 gallons of water were poured into the well and the rate of decline in the water level in the well was measured using a water level meter. Because the slug could not be introduced instantaneously, the data plot (Figure 8) did not fit the normal pattern when analyzed using Hvorslev's method. The data is not incorrect, but the recharge into the well was substantially high enough to make prediction using a slug test very inaccurate.

An attempt was made to perform a slug test by removing a bailer full of water from the well and measuring the recharge into the well. The test was not successful because recharge into the well was too rapid to detect a measurable drop in the water level. Based on the data obtained, the estimated hydraulic conductivity of the aquifer material is assumed to be greater than 100 ft/day. Tests on a split spoon sample indicated that K was on the order of 80 ft/day, porosity was 0.34, and effective porosity 0.26. In addition, there is vast experimental data showing that tests using core samples typically underestimate conductivity. This result provides further evidence to indicate the magnitude of the aquifer conductivity.

Using these parameters (K=80 ft/day, n_e=0.26, i=0.0025), the average groundwater velocity is calculated to be 0.77 ft/day. Assuming the release occurred about 10 years ago, groundwater flowing through the contaminated area would have moved about 2800 feet down-gradient. Calculation of the location of the leading edge of the plume using an estimated retardation factor (R) of 1.5 (estimated based on soil and chemical data) indicates that the leading edge would be about 1800 to 1900 feet down-gradient. Since this is evidently not the case, the data tends to support the theory that the plume is naturally attenuating.

Analytical Results

Tables 1 - 6 report analytical results of water samples in mg/l. Where available, results are included for monitor well samples collected since August 3, 1994. The physical parameters are reported in Table 7 (appendix). On Tables 1-6, "SWL" refers to the elevation in feet of the static water level at the monitor wells. The elevations are relative to a temporary reference elevation of 100.00 feet on the northeast corner of the concrete sidewalk outside the southwest door of the Alaska Flying Network office. "NA" indicates no analysis was performed. "U" indicates analysis was performed but the analyte was not detected at the concentration shown. "NS" indicates no sample was collected. Concentrations that exceed the cleanup levels are shaded.

MW-1. Results of analytical testing of six water samples collected from this monitor well are reported in Table 1. Sample KAFS-99-21W was collected at the same time that seven temporary wells were sampled; described in Interim Remedial Action Report #2. Samples were not collected from the other monitor wells at that time. Historical BTEX contamination levels at MW-1 are graphed in Figure 2. Inspection of analytical results shows that contamination levels have dropped since 1994, but the contamination levels still exceed the cleanup levels, and the levels in the two sample collected in 2000 are significantly higher than the levels in the three samples collected in 1999.

TABLE 1 – Groundwater Analytical Results — MW-1

Sample ID#	Round-Date	SWL	GRO	Benzene	Toluene	E-Benzene	Xylenes
KA-42	1- 8/03/94	90.8	NA	64.2	62.7	2.46	11.6
KAFS-99-2	2- 6/16/99	91.5	79	12.6	21.5	1.45	7.1
KAFS-99-21W	2A 9/13/99	91.6	3.4	0.5	0.7	0.13	0.4
KAFS-99-24W	3- 11/29/99	91.6	64	12.8	12.1	0.06	2.5
KAFS-00-32W	4- 7/06/00	91.6	200	32.4	45.5	2.64	12.7
KAFS-00-38	5- 12/13/00	91.1	170	34.6	45.2	2.14	10.1
CLEANUP LEVEL			1.3	0.005	1.00	0.70	10.0

MW-2 Results of analytical testing of groundwater samples collected from this well are reported in Table 2. Contamination was not detected in any samples collected from this well, therefore, samples were not collected after 6/16/99.

TABLE 2 – Groundwater Analytical Results — MW-2

Sample ID#	Round/Date	SWL	GRO	Benzene	Toluene	E-Benzene	Xylenes
KA-41	1- 9/03/94	90.7	NA	0.001U	0.001U	0.001U	0.001U
KAFS-99-1	2- 6/16/99	91.4	0.09U	0.0005U	0.002U	0.002U	0.002U
CLEANUP LEVEL			1.3	0.005	1.00	0.70	10.0

MW-4. Results of analytical testing of five rounds of groundwater samples collected from this up-gradient monitor well are reported in Table 3. Historical BTEX contamination levels are graphed in Figure 3. Inspection of analytical results shows most of the contamination levels in 1999 were somewhat higher than 1994, but the levels dropped in 2000.

TABLE 3 – Groundwater Analytical Results — MW-4

Sample ID#	Round/Date	SWL	GRO	Benzene	Toluene	E-Benzene	Xylenes
KA-43	1- 8/03/94	90.6	NA	0.027	1.2	0.01	0.04
KAFS-99-4	2- 6/16/99	91.2	12	0.013	2.11	0.245	1.82
KAFS-99-24W	3- 11/29/99	91.0	7.9	0.18	2.14	0.04U	0.18
KAFS-00-30W	4- 7/06/00	92.4	3.1	0.014	0.75	0.01U	0.02
KAFS-00-36	5- 12/13/00	91.8	1.3	0.014	0.005	0.002U	0.005
CLEANUP LEVEL			1.3	0.005	1.00	0.70	10.0

MW-6. Results of analytical testing on three rounds of groundwater samples collected from this new monitor well are reported in Table 4. BTEX contamination levels are graphed in Figure 4. Analytical results shows that contamination levels in the 12/13/00 sample are approximately three times higher than the previous two samples.

TABLE 4 – Groundwater Analytical Results — MW-6

Sample ID#	Round/Date	SWL	GRO	Benzene	Toluene	E-Benzene	Xylenes
KAFS-99-25W	3- 11/29/99	91.6	75	11.2	14.7	1.08	4.5
KAFS-00-32W	4- 7/06/00	91.1	55	9.41	12.1	0.79	3.2
KAFS-00-37	5- 12/13/00	91.1	163	30.2	41.5	2.57	11.5
CLEANUP LEVEL			1.3	0.005	1.00	0.70	10.0

MW-7. Results of analytical testing on three rounds of groundwater samples collected from this new monitor well are reported in Table 5. BTEX contamination levels are graphed in Figure 5. Analytical results shows that, except for benzene, BTEX levels have been below the cleanup levels, and most contamination levels on 7/06/00 were noticeably higher than the levels before and after.

TABLE 5 – Groundwater Analytical Results — MW-7

Sample ID#	Round/Date	SWL	GRO	Benzene	Toluene	E-Benzene	Xylenes
KAFS-99-23W	3- 11/29/99	91.3	0.26	0.077	0.002U	0.005	0.011
KAFS-00-29W	4- 7/06/00	91.3	3.4	0.851	0.531	0.041	0.14
KAFS-00-38	5- 12/13/00	90.8	0.47	0.178	0.008	0.019	0.03
CLEANUP LEVEL			1.3	0.005	1.000	0.700	10.0

MW-8. Results of analytical testing on three rounds of groundwater samples collected from this new monitor well are reported in Table 6. BTEX contamination levels are graphed in Figure 6. Analytical results show that, except for benzene, BTEX levels have been below the cleanup levels. GRO and benzene levels on 7/06/00 were noticeably higher than the levels before and after.

TABLE 6 – Groundwater Analytical Results — MW-8

Sample ID#	Round/Date	SWL	GRO	Benzene	Toluene	E-Benzene	Xylenes
KAFS-99-22W	3- 11/29/99	90.8	0.64	0.239	0.002U	0.002U	0.002U
KAFS-00-28W	4- 7/06/00	90.3	3.9	1.80	0.02U	0.02U	0.02U
KAFS-00-38	5- 12/13/00	90.3	1.6	0.83	0.023	0.02	0.02U
CLEANUP LEVEL			1.3	0.005	1.00	0.70	10.0

Results of measuring groundwater temperature (°C), dissolved oxygen (DO), pH, and conductivity (eC) are reported in the following table. Physical parameters were taken with an ICM 51600 water analyzer equipped with a probe that allowed measurements to be taken without drawing a sample. The probe was lowered down the well casing to one foot below the water table, held at depth for 5 to 10 minutes to stabilize, and the displayed values were recorded.

TABLE 7 – Groundwater Physical Measurements

MW-1

Sample Date	SWL, ft	Temp, °C	DO, ppm	pH	eC, µS
8/3/94	90.8	8.9	*	6.2	89
11/29/99	91.6	6.2	2.1	6.9	60
7/06/00	91.6	6.9	6.8	6.5	74

* No value available, the DO sensor had not been properly calibrated

MW-4

Sample Date	SWL, ft	Temp, °C	DO, ppm	pH	eC, µS
8/3/94	90.6	6.6	*	6.1	60
11/29/99	91.0	5.3	1.4	6.6	41
7/06/00	92.4	7.1	0.3	6.5	49

* No value available, the DO sensor had not been properly calibrated

MW-6

Sample Date	SWL, ft	Temp, °C	DO, ppm	pH	eC, µS
11/29/99	91.6	5.9	1.0	6.9	56
7/06/00	91.1	8.3	0.2	6.5	36

MW-7

Sample Date	SWL, ft	Temp, °C	DO, ppm	pH	eC, µS
11/29/99	91.3	5.7	1.3	6.6	30
7/06/00	91.3	7.1	0.3	6.5	49

MW-8

Sample Date	SWL, ft	Temp, °C	DO, ppm	pH	eC, µS
11/29/99	90.8	5.9	2.5	6.4	39
7/06/00	90.3	8.6	6.4	6.1	37

Interpretation of Results

Benzene concentration contours were estimated using analytical data and are plotted in Figure 1. It is evident from the contour map that contamination in excess of cleanup standards has moved off the subject property. The leading edge of the contamination plume is at least 150 feet south of MW-8, the farthest down-gradient monitor well. The location of MW-8 had been selected to be beyond the leading edge of the plume based on data obtained from temporary wells installed and sampled on 9/10/99.

Figure 7 shows groundwater contamination levels as a function of distance from the source area. Groundwater contamination at the source was not measured, but was estimated using soil contamination data from test hole PSB-2, drilled on 9/10/99 about 40 feet south of the middle of the source. The rest of the data points are from analysis of the most recent samples (12/13/00). It appears from the data that degradation is occurring beneath the paved apron, but the drop in concentration could result more from dilution of the contaminants than to biodegradation. As noted in the 9/28/99 report, a dramatic decrease in benzene level occurs between monitor wells MW-6 and MW-7, a distance of about 125 feet. We suspect that a similar, though not as dramatic, reduction in contamination also occurs down-gradient of MW-1. The reduction is probably due to volatilization and biodegradation of contaminants in the uncovered area between MW-6 and MW-7. There is a drainage swale located between MW-6 and the access road to the airport ramp, and groundwater is only about three feet below ground surface most of the year. Given the physical characteristics of the sandy soil, the diurnal temperature fluctuations and barometric tides would cause significant gaseous exchange between the atmosphere and the soil to depths of several feet. More than sufficient oxygen would be available for microbial degradation of the contaminants under this condition.

The groundwater direction and gradient fluctuate, but during the last five sample events the flow has generally been south to southeast and the gradient has varied from 0.0021 to 0.0025 ft/ft. The water table surveys in June and August of 1999, indicated the groundwater direction was toward the locations of MW-7 and MW-8. Evaluation of the analytical data from the last three sample rounds indicates the plume is oriented more toward the airport terminal as shown on the contour map provided with this report, rather than toward MW-8 as shown on the contour map included with Interim Remedial Action Report #2 (9/28/99). The following factors support changing the plume orientation to the south:

a. Contaminant levels have generally been higher at MW-1 than at MW-6, indicating the center of the contamination mass is closer to MW-1 than to MW-6
b. The plume down-gradient of MW-1 will benefit less from gaseous exchange with the atmosphere because there is less uncovered surface and less drainage swale in that area
c. Three of five surveys show the groundwater flow is to the south, toward the terminal

Physical data collected from the monitor wells has not provided information needed to quantify biological activity at the site. The DO levels vary considerably without any apparent relationship to the plume. We suspect the DO levels are affected less by biological activity than by other factors such as infiltration of surface water from the airport ramp and recharge from the large muskeg to the north.

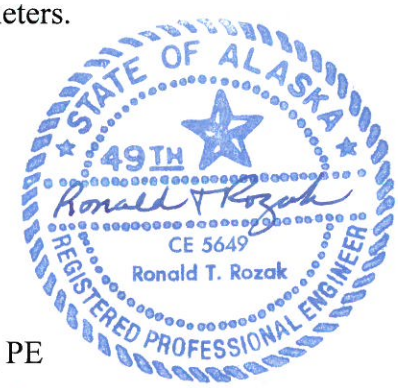
Conclusions

It appears the contamination migration has been retarded by natural attenuation, however, the plume extends beyond the down-gradient monitor wells and the leading edge has not been accurately defined. Data indicates the leading edge of the plume is between the north entrance and the main entrance of the terminal building. Ideally, a water sample should be collected from a location near the main entrance, but installing a traditional monitor well in that area would be challenging and perhaps not acceptable to the airport management. A manual slide hammer should be able to drive a sampling probe in this area, if located at least 10 feet from the building. I recommend collecting water samples as close as possible to this area.

Data from samples collected to date are insufficient to establish whether the plume is expanding, stable, or shrinking. I recommend collecting two more rounds of water samples, including a location closer to the terminal main entrance, before trying to evaluate the status of the plume. For comparative purposes I recommend collecting the samples during June and December of 2001. If a sampling point cannot be installed near the main entrance, perhaps one can be placed near the southeast corner of the terminal.

Analytical data shows there is a sharp decrease in contamination across the unpaved area, probably due to a combination of volatilization and biodegradation. Measurement of DO and other physical parameters has not provided reliable data to quantify biological activity. It does not seem like it is worth the effort at this time to determine how much of the contamination decrease is due to biological volatile activity, therefore I recommend dropping the measurement of physical parameters.

Sincerely,



Ronald T. Rozak, PE
Principal Investigator

Attachments:

1. Figure 1. Estimated benzene contamination contours
2. Figures 2-6. Historical BTEX levels measured at monitor wells
3. Figure 7. Benzene concentration as a function of distance from source
4. Figure 8. Slug test results at MW-6 (11/29/99)
5. Soil boring logs
6. Laboratory Analysis Report

cc: Dan Pitts, Kenai Airport Fuel Service

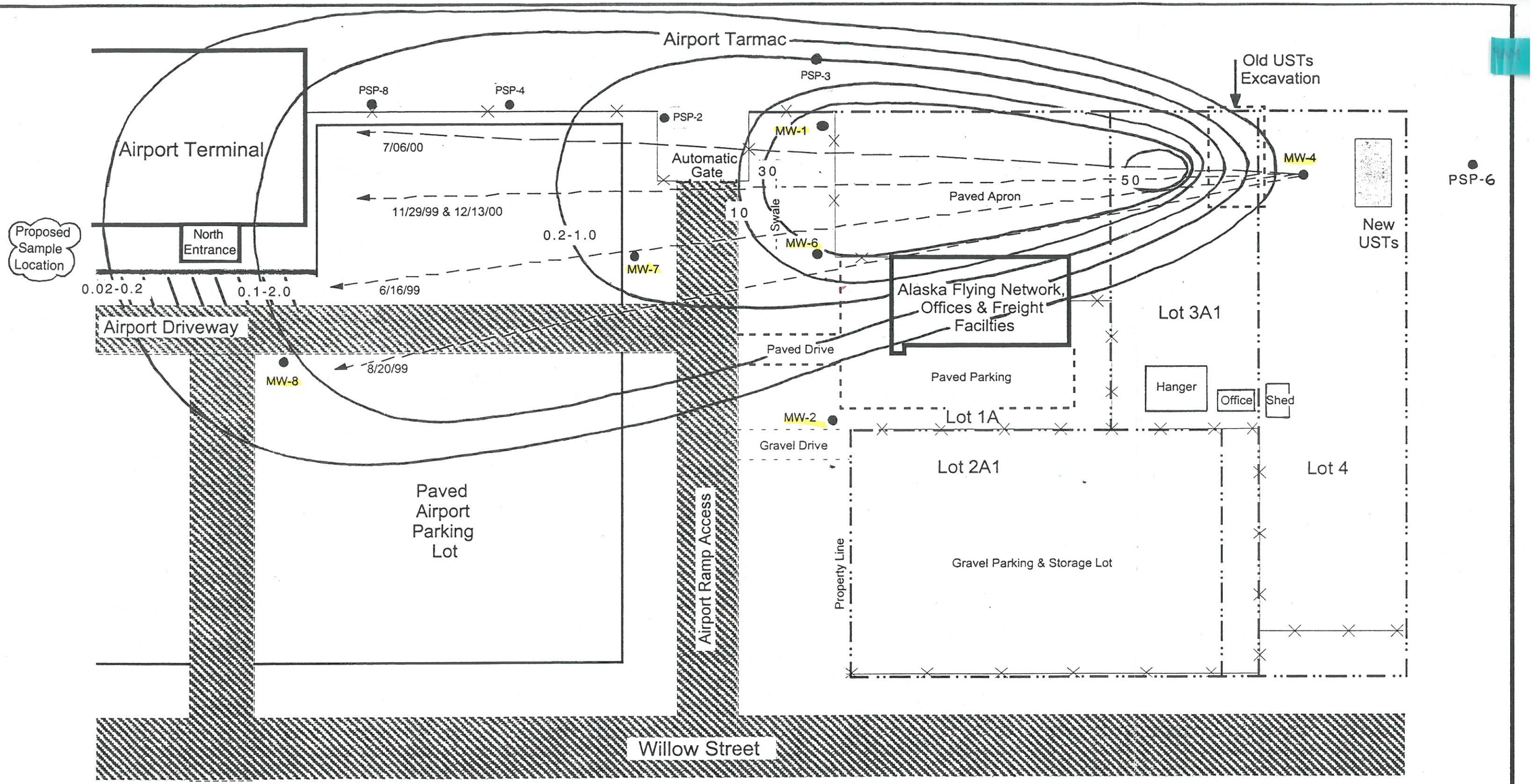


Figure 1. Estimated Benzene Contamination Contours

Kenai Airport Fuel Service — ADEC Reckey #90230026801

Rozak Engineering — Drawing Revision No. 1 April 2001

Legend

- Monitor Well (MW)
- Property Line
- Chain Link Fence
- Groundwater Flow
- Asphalt Pavement

Plan North

0 50' 100'

BTEX Data Table

Date	Benzene	Toluene	E-Benzene	Xylenes	Elevation
8/3/94	64.2	62.7	2.46	11.6	90.8
6/16/99	12.6	21.5	1.45	7.1	91.5
9/13/99	0.5	0.65	0.13	0.4	91.6
11/29/99	12.8	12.1	0.06	2.5	91.6
7/6/00	32.4	45.5	2.64	12.7	91.6
12/13/00	34.6	45.2	2.14	10.1	91.1

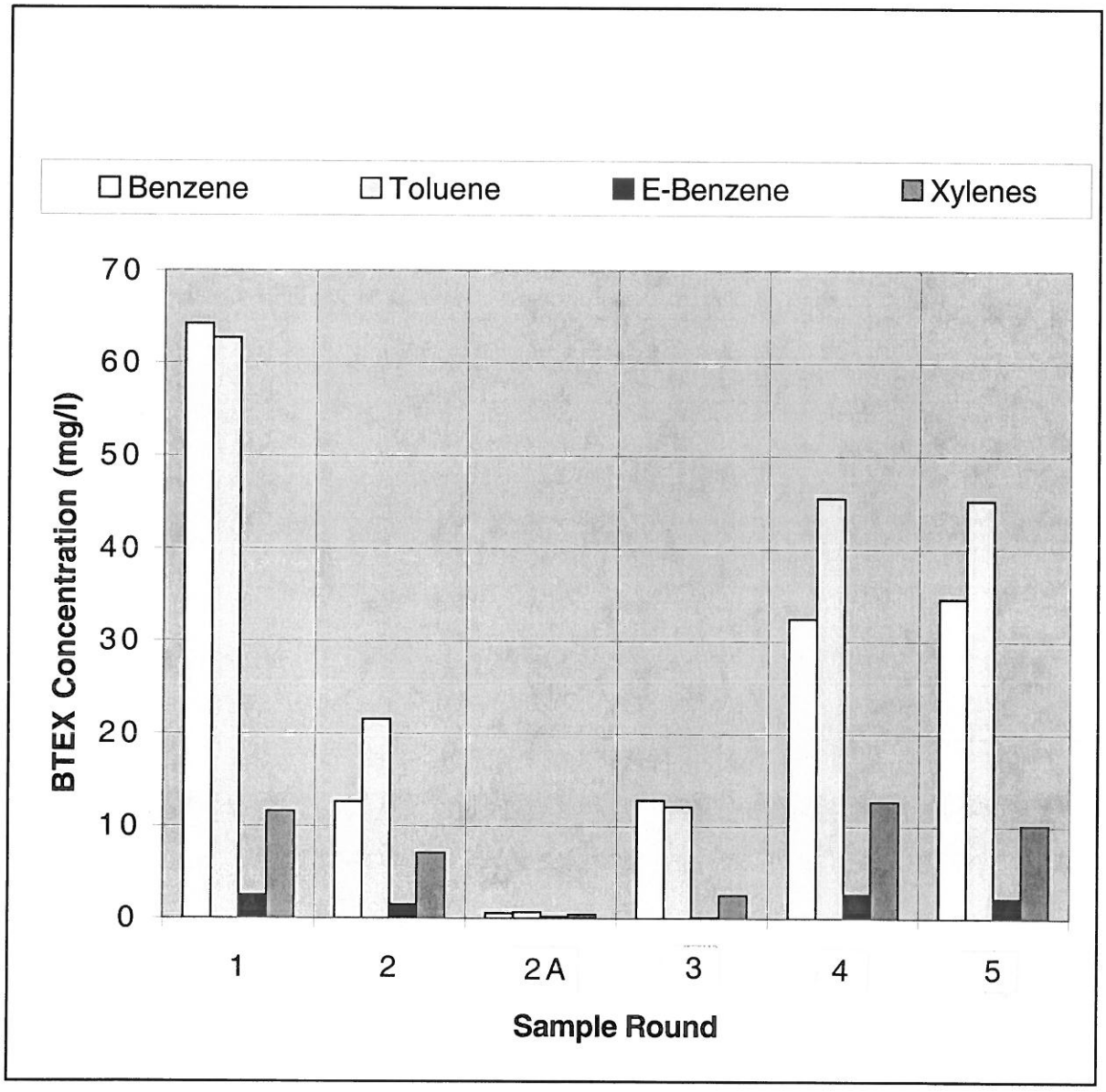


Figure 2. Historical BTEX levels at MW-1

BTEX Data Table

Date	Benzene	Toluene	E-Benzene	Xylenes	Elevation
8/3/94	0.027	1.2	0.01	0.04	90.6
6/16/99	0.013	2.11	0.245	1.82	91.2
11/29/99	0.18	2.14	0.04UÍ∏	0.18	91
7/6/00	0.014	0.75	0.01U	0.2	92.4
12/13/00	0.014	0.005	0.002U	0.005	91.8

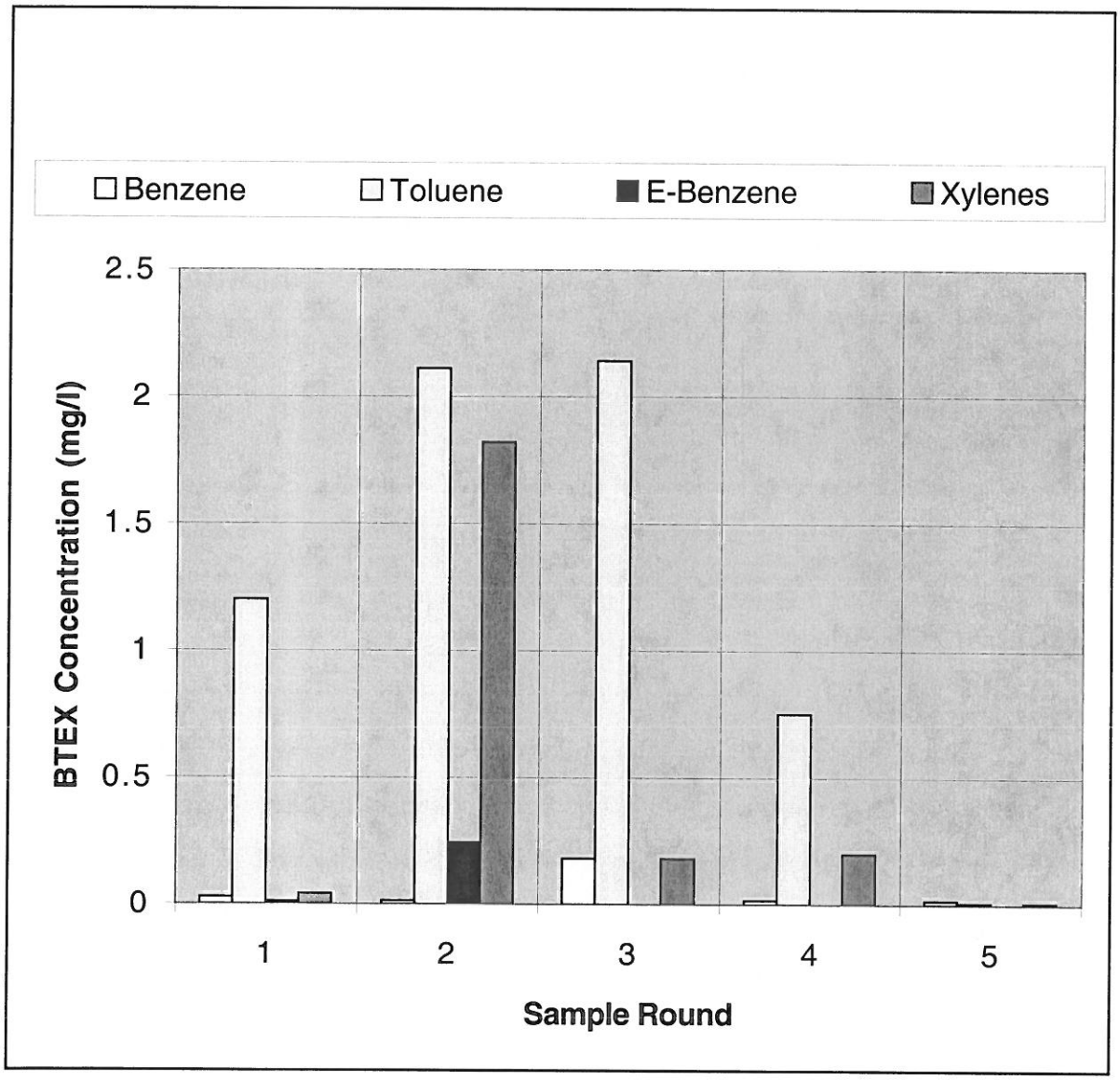


Figure 3. Historical BTEX levels at MW-4

BTEX Data Table

Date	Benzene	Toluene	E-Benzene	Xylenes	Elevation
8/3/94	NS	NS	NS	NS	NS
6/16/99	NS	NS	NS	NS	NS
11/29/99	11.2	14.7	1.08	4.5	91.6
7/6/00	9.41	12.1	0.79	13.3	91.6
12/13/00	30.2	41.5	2.57	44.4	91

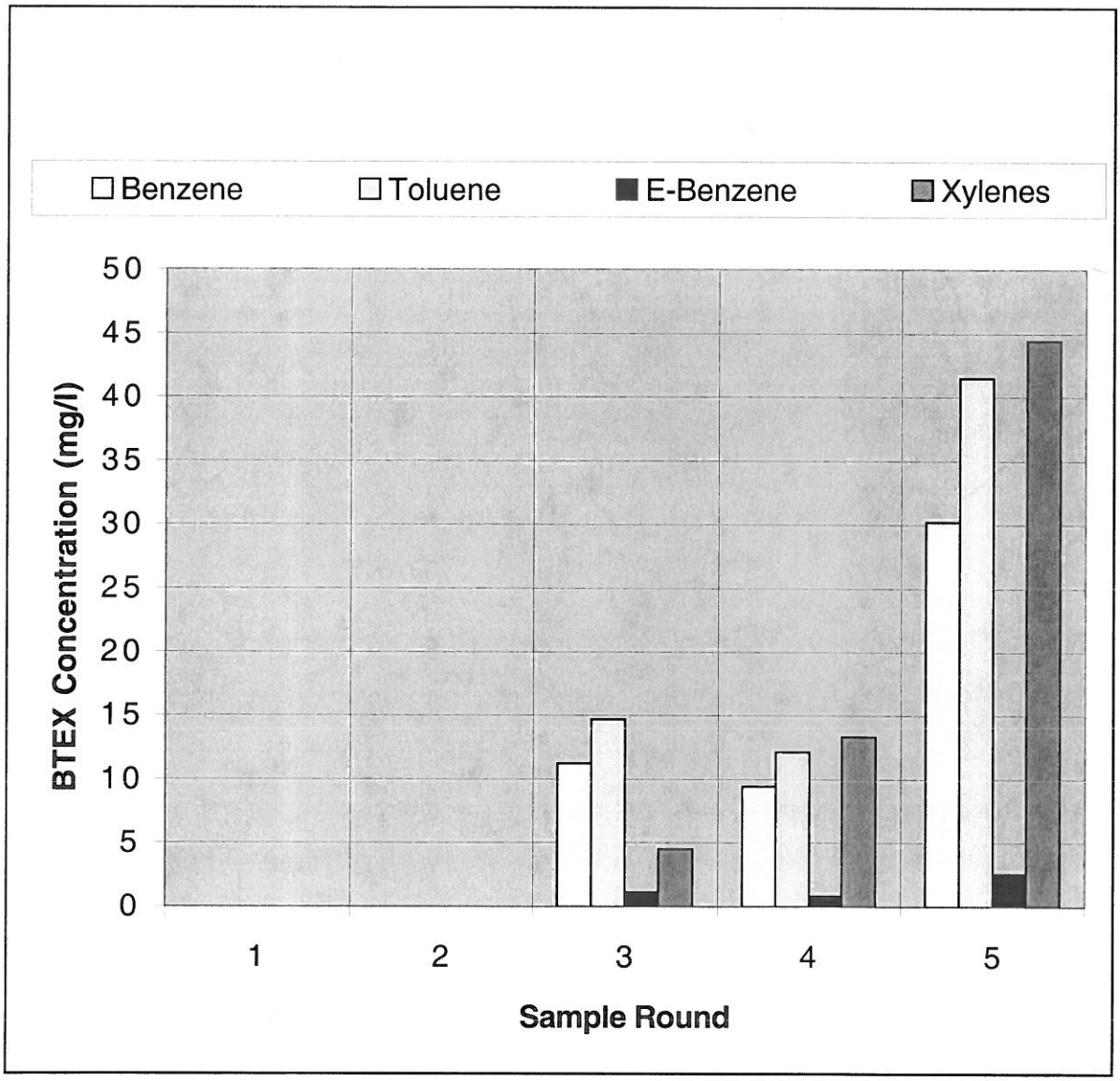


Figure 4. Historical BTEX levels at MW-6

BTEX Data Table

Date	Benzene	Toluene	E-Benzene	Xylenes	Elevation
8/3/94	NS	NS	NS	NS	NS
6/16/99	NS	NS	NS	NS	NS
11/29/99	0.077	0.002U	0.005	0.011	91.3
7/6/00	0.851	0.531	0.041	0.14	91.3
12/13/00	0.178	0.008	0.019	0.03	90.8

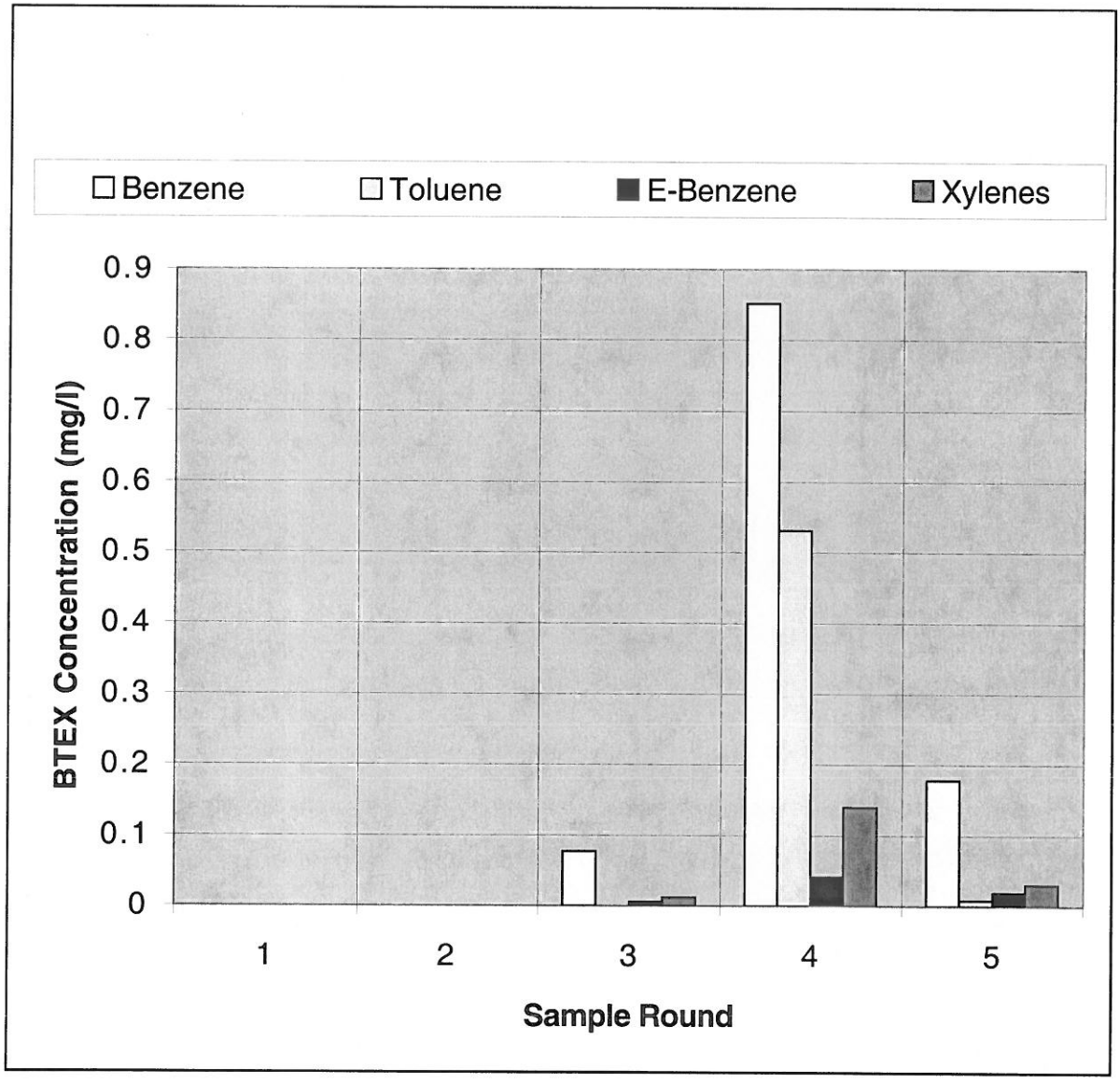


Figure 5. Historical BTEX levels at MW-7

BTEX Data Table

Date	Benzene	Toluene	E-Benzene	Xylenes	Elevation
8/3/94	NS	NS	NS	NS	NS
6/16/99	NS	NS	NS	NS	NS
11/29/99	0.239	0.002U	0.002U	0.002U	90.8
7/6/00	1.8	0.02U	0.02U	0.02U	90.3
12/13/00	0.83	0.023	0.02	.02U	90.3

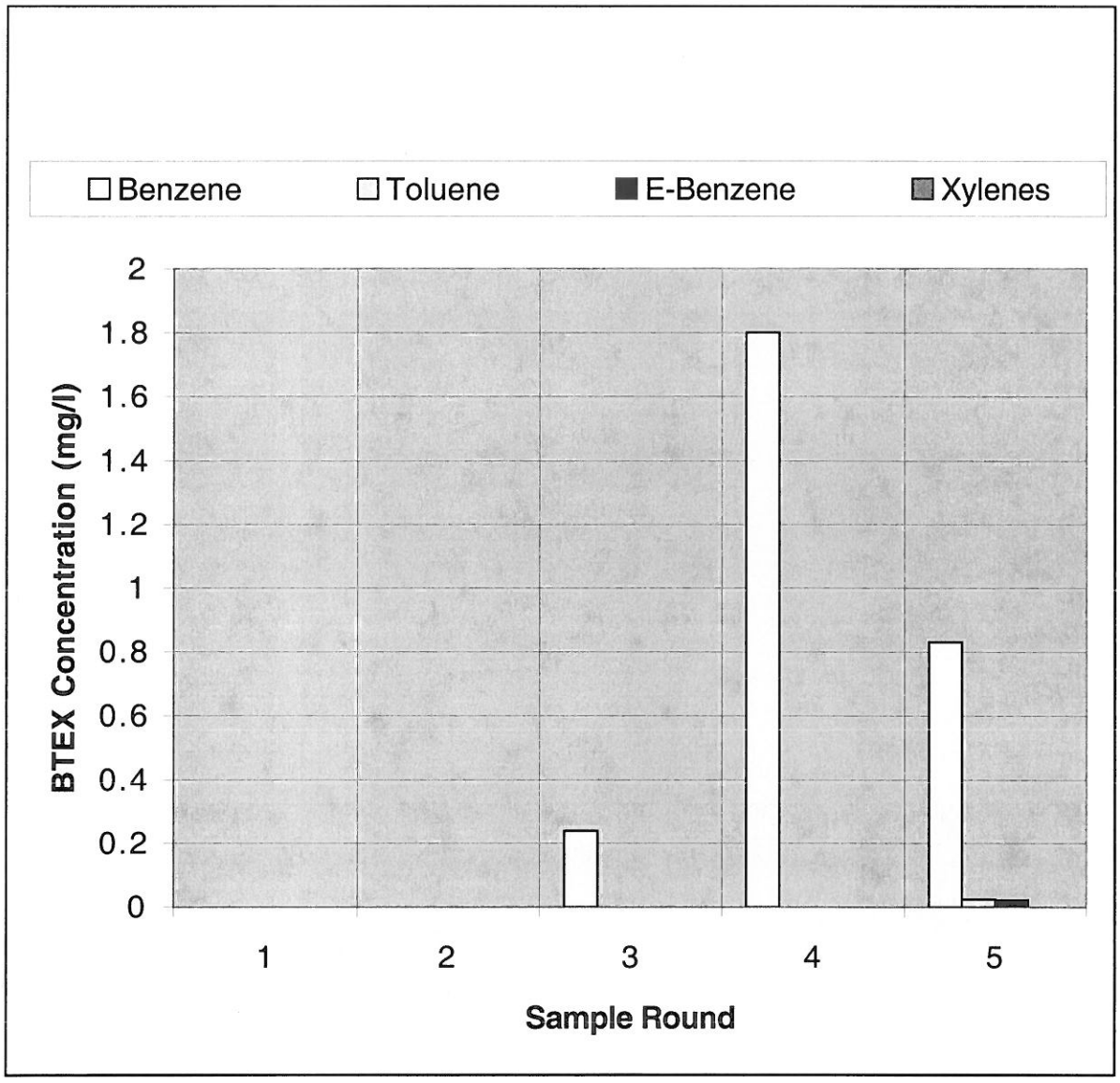


Figure 6. Historical BTEX levels at MW-8

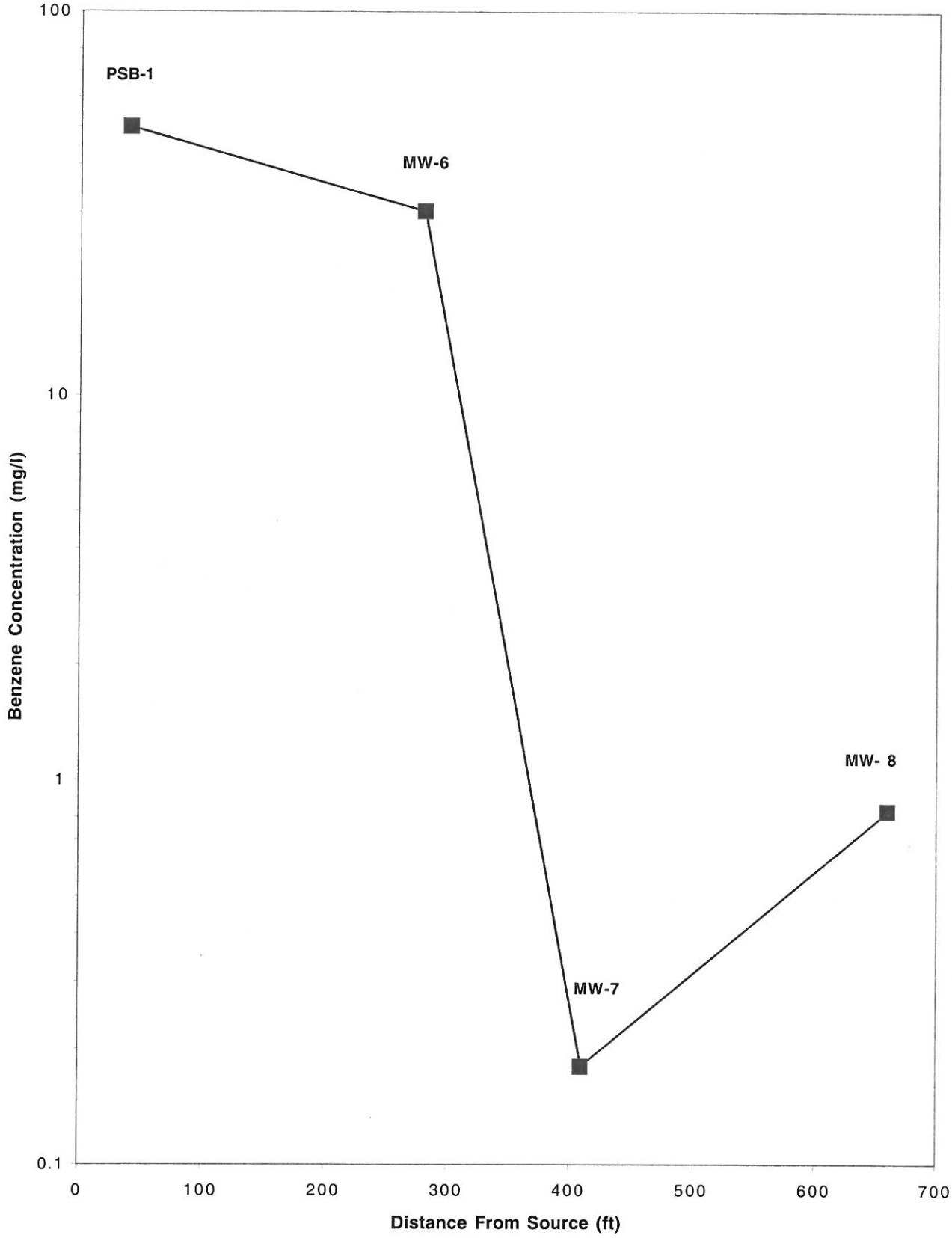


Figure 7. Benzene concentration as a function of distance from source (12/13/00)

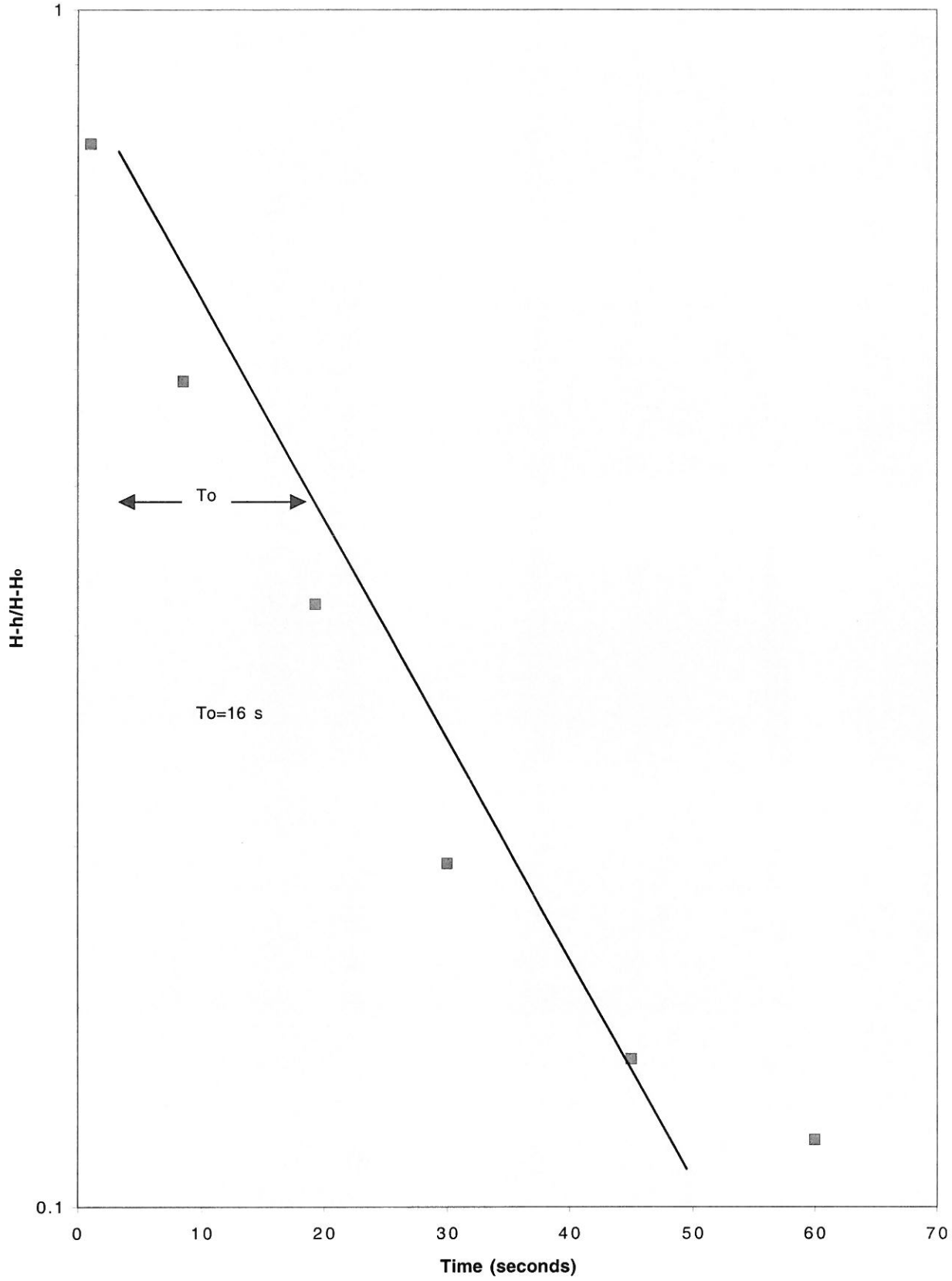


Figure 8. Slug Test Results at MW-6 (11/29/99)

PROJECT: KENAI AIRPORT FUEL SERVICE - RELEASE INVESTIGATION **SOIL BORING:** MW-6

LEGEND
ATD = AT TIME OF DRILLING
BOH = BOTTOM OF HOLE
SWL = STATIC WATER LEVEL
▼ = WATER TABLE
F = FIELD SAMPLE
L = LAB SAMPLE
D = DEXIL PETROFLAG SAMPLE
= SPLIT SPOON SAMPLE

DATE DRILLED: 11-23-99 TIME: START 1045 FINISH 1140
DRILLING COMPANY: HUGHES DRILLING PAT + CARL
DRILLING METHOD: HOLLOW STEM ROTARY, HYDRAULIC HAMMER 340#
INSPECTOR(S): R.T. ROZAK, M. PRIEKSAT
☒ PHOTOVAC HL-2000 ☐ TEI 580 B CALIBRATION: 100 ppm @ 940 AM TEMP: 29°F @ 1100

PID (ppm) COLD	PID (ppm) WARM	GRD. WATER	DEPTH (ft)	SAMPLE LOC.	SAMPLE TIME	SAMPLE ID.	BLOWS/FT	MATERIALS DESCRIPTION AND REMARKS	ODOR N	ODOR L	ODOR M	ODOR H	USCS
			1		1045			6" Frozen sand	X				
								Med. sand					SP
			2										
			3										
			4										
			5										
		▼	ATD		1105								
			6				2	Top 7' 0.020 SLOT screen					
							1						
0.9	3.0		7	F L	1100		1		X				SP
							2						
			8										
			9										
			10										
			11										
			12					BOH @ 12' SLIP CAP W/2 Stainless screw					
			13										
			14										
			15										

6"x5' steel security casing Grouted

MW WELL

NATIVE

BENTONITE CHIPS

PVC SOLID RISER

#10÷20 SILICA SAND

7', 020 SLOT screen

0 2 4 5 12'

PROJECT: KENAI AIRPORT FUEL SERVICE - RELEASE INVESTIGATION **SOIL BORING:** MW-7

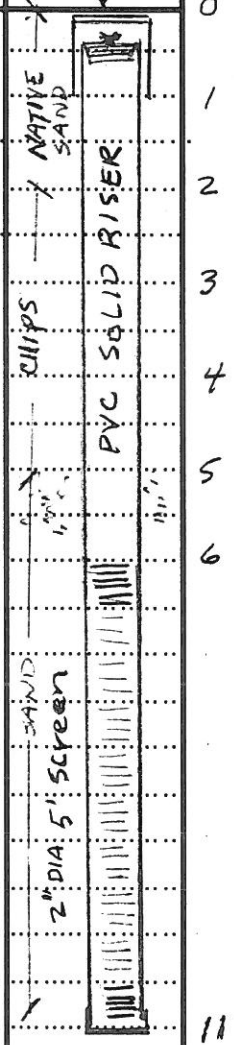
LEGEND
ATD = AT TIME OF DRILLING
BOH = BOTTOM OF HOLE
SWL = STATIC WATER LEVEL
▼ = WATER TABLE
F = FIELD SAMPLE
L = LAB SAMPLE
D = DEXIL PETROFLAG SAMPLE
= SPLIT SPOON SAMPLE

DATE DRILLED: 11-23-99 TIME: START 935 FINISH 1035
DRILLING COMPANY: HUGHES DRILLING Pat Smith, Carl
DRILLING METHOD: HOLLOW STEM ROTARY, HYDRAULIC HAMMER
INSPECTOR(S): R.T. ROZAK, M. PRIEKSAT p'cldy, 15mph
☒ PHOTOVAC HL-2000 ☐ TEI 580 B CALIBRATION: 100 ppm @ 0940 TEMP: 28°F

PID (ppm) COLD	PID (ppm) WARM	GRD. WATER	DEPTH (ft)	SAMPLE LOC.	SAMPLE TIME	SAMPLE ID.	BLOWS/FT	MATERIALS DESCRIPTION AND REMARKS	ODOR N L M H	USCS
			1		0935			Frozen topsoil		
								Med Sand, olive		SW
			2							
			3							
			4							
			5							
			6				2	← S/S sample @ 5-7'	X	SW
1.0	1.5			F	0945		2			
			7				2	Top screen @ 6' 0.020 SLOT →		
		▼	ATD	L			4			
			8					#1, 0-20 Silica Sand →		
			9							
			10							
			11					BOH & SCREEN @ 11' →		
								SLIP CAP W/2 S/S SCREWS		
			12							
			13							
			14							
			15							

Flush mount security casing W/Bentonite Grout

MW.WELL



0 1 2 3 4 5 6 11'

PROJECT: KENAI AIRPORT FUEL SERVICE - RELEASE INVESTIGATION **SOIL BORING:** MW-8

LEGEND
ATD = AT TIME OF DRILLING
BOH = BOTTOM OF HOLE
SWL = STATIC WATER LEVEL
▼ = WATER TABLE
F = FIELD SAMPLE
L = LAB SAMPLE
D = DEXIL PETROFLAG SAMPLE
= SPLIT SPOON SAMPLE

DATE DRILLED: 11-23-99 TIME: START 1240 FINISH 1340
DRILLING COMPANY: HUGHES DRILLING Pat + Carl
DRILLING METHOD: CME-75 HOLLOW STEM ROTARY, HYDRAULIC HAMMER
INSPECTOR(S): R.T. ROZAK, M. PRIEKSAT
☒ PHOTOVAC HL-2000 ☐ TEI 580 B CALIBRATION: 100 @ 940 TEMP: 28°F @ 1240

PID (ppm) COLD	PID (ppm) WARM	GRD. WATER	DEPTH (ft)	SAMPLE LOC.	SAMPLE TIME	SAMPLE ID.	BLOWS/FT	MATERIALS DESCRIPTION AND REMARKS	ODOR N	ODOR L	ODOR M	ODOR H	USCS
			1		1240			6" T/S Frozen					
								med sand, no fines	X				
			2										
			3					med-crse sand					
			4										
			5										
			6	F			4						
							5						
			7	F	1250		6		X				
0.0	0.3			L			7						
								Top 0.020 SLOT SCREEN					
			8										
		▼	ATD		1310			#10-20 Silica →					
			9										
			10										
			11										
			12										
								BOH/SCREEN @ 12'					
			13					W/ slip cap + 2 SS screws					
			14										
			15										

FLUSH MOUNT SECURITY CASING W/BENTONITE GROUT

MW.WELL