POST-REMEDIATION GROUND-WATER SAMPLING RESULTS
NOVEMBER 1993 TO APRIL 1996
N.E. PORTION OF CASCADE TIMBER LOG SORT YARD NO. 3
PORT OF TACOMA, WASHINGTON

Prepared for

U.S. Oil & Refining Co.
Tacoma, Washington

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POST-REMEDIATION GROUND-WATER SAMPLING RESULTS
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N.E. PORTION OF CASCADE TIMBER LOG SORT YARD NO. 3
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I. INTRODUCTION

This report summarizes and evaluates the results of nine rounds of ground-water sampling and analyses (November 19, 1993 to April 9, 1996) following remediation of a crude oil spill within the northeast portion of the Cascade Timber Log Sort Yard No. 3, located in the Port of Tacoma, Washington (Figure 1). Figure 2 shows a site plan and the location of the ground-water monitoring wells.

Monitoring results have been reported after each round of sampling (DOF 1993a through 1995.) This report summarizes the results of the ninth round (April 9, 1996) and also provides an evaluation of the trends in the monitoring data as well as an assessment of the effects of the interim action on ground-water quality. Based on the data, recommendations regarding the path forward are also provided.

1.1 BACKGROUND

On January 6, 1991, a break in a sixteen inch diameter oil transmission pipeline owned by U.S. Oil resulted in a release of Alaskan crude oil onto the northeast portion of the Cascade No. 3 Log Sort Yard (Figures 1 and 2). In response to the spill, U.S. Oil completed a series of initial remedial actions (under Ecology Order No. DE 90-I006) to contain and recover the oil. These actions included recovery of free phase oil using pumps and vacuum trucks, removal of oily bark, and excavation of oily grass and soil from the top approximately 6-inches of the ground surface within portions of the site in which oil flowed. Approximately 3,000 cubic yards of material were removed from the site.

After completion of the initial remedial actions, soil sampling was completed (March 1991) in the oil spill area according to an Ecology approved Sampling and Analysis Plan (SAP). Based on the sampling results, an Interim Action Plan (DOF 1993a) was prepared and approved by Ecology in June 1993, as required by the First Amendment to the Ecology Order. The interim action plan included soil cleanup standards based on protection of marine water quality.

As part of the interim action completed in late summer/early fall of 1993 (DOF 1993b), approximately 5,700 cubic yards of soil exceeding cleanup standards for total petroleum hydrocarbons were excavated and removed from the oil spill site. Results of screening and performance sample analyses indicate that, with the exception of limited portions of the northeastern side of the excavated area (as shown on Figure 2), soils remaining on the bottom and sides of the excavated areas are well below the Interim Action Plan cleanup levels of 1,000 mg/kg for WTPH-D and 70 mg/kg for benzene. Screening and performance sampling indicate

that concentrations of the above analytes for most of the samples are also below MTCA Method A cleanup levels (WTPH-D <200 mg/kg; benzene <0.5 mg/kg).

Along the northeastern edge of the excavation (Figure 2), a small quantity of oily soil (estimated to be approximately 75 cubic yards) was left in place because the soil underlies paving and based on experience with other portions of the remediated area, likely extends only a few feet into the adjacent pipeline corridor. Further, in the excavated area, these soils were observed to be above the water table (at a depth of about four feet).

Following remediation, water quality samples were obtained from the shallow monitoring wells (Figure 2) on:

- November 19, 1993,
- February 24, 1994,
- May 10, 1994,
- August 29, 1994,
- December 7, 1994,
- March 14, 1995,
- August 24, 1995,
- December 12, 1995, and
- April 9, 1996.

This information supplements the site data contained in the Interim (Phase 1) Remedial Investigation/Feasibility Study report prepared by Dalton, Olmsted & Fuglevand, Inc. (DOF 1993a).

The sampling was completed in accordance with the Ecology-approved Ground-Water Sampling and Analysis Plan, Attachment D-3 of the Interim Action Plan (DOF, 1993a). The plan was prepared in accordance with the First Amendment to Agreed Order DE 91TC-S198 between the U.S. Oil & Refining Co. (U.S. Oil) and the Washington State Department of Ecology (Ecology) and in accordance with the requirements of the Model Toxics Control Act (specifically WAC-173-340-430). Beginning in the December 1995, low-flow (approximately 0.5 liters per minute) purging and sampling techniques were used to sample the wells. This method minimizes turbidity and possible incorporation of soil particulates in the ground-water samples.

II. SHALLOW ZONE GROUND-WATER FLOW DIRECTION

Table 1 summarizes the ground-water elevations measured through April 9, 1996. The shallow zone ground-water contours and estimated flow directions for selected sampling rounds are shown on Figures 3 through 8. The maps represent conditions following remedial activities (completed by September 1993). As discussed in the Interim Phase 1 Remedial Investigation Report (DOF, 1993a), fluctuating tides have little influence on water levels in the shallow zone. As observed during the RI/FS work, the data indicates that ground water flows generally toward the east from beneath the remediated area. Seasonally, northerly and westerly

flow components are present within the remediated area. Hydraulic gradients in the site area are relatively uniform and generally range between 0.002 and 0.003 feet/foot. During wetter portions of the year gradients on the order of 0.005 feet/foot have occurred.

III. GROUND-WATER QUALITY

Ground water samples were obtained from the seven shallow wells (MW-USO-1S, 2S, 3S, 4S, 5S, 6S, and 7S) during each of the first four water quality sampling rounds (11/19/93, 2/24/94, 5/10/94, and 8/29/94). Based on the results of the first four rounds that indicated either low concentrations or concentrations below laboratory reporting limits for compounds of concern in wells MW-USO-1S, 2S, 4S, and 7S, sampling of these wells was discontinued. Sampling of wells MW-3S, 5S, and 6S has continued. The analytical results are summarized in Table 2. Detailed laboratory results for the ninth sampling round (4/9/96) are provided in Appendix A. The laboratory results for the previous sampling rounds are presented in technical memoranda or reports relating to the specific sampling round (DOF 1994 a, b, c and d, and DOF 1995 a, b and c, and DOF 1996).

The samples were analyzed for:

- Field Parameters - pH, specific conductivity, and temperature
- Purgeable hydrocarbons using method WTPH-G.
- Benzene, toluene, ethylbenzene, and xylenes using method 8020.
- Total petroleum hydrocarbons using method WTPH-D.

Floating product was not detected in any of the sampled wells.

3.1 FIELD PARAMETERS

The following table summarizes the range of each parameter measured in the field for each shallow well for the sampling rounds completed between November 1993 and April 1996. The detailed results are shown on Table 2.

Well	pH	Specific Conductivity (umhos)	Temperature Degrees F	Dissolved Oxygen(mg/l)
MW-USO-1S	6.6-6.9	514-729	9-18	nr
MW-USO-2S	6.5-7.3	171-435	9-20	nr
MW-USO-3S	6.1-6.6	628-990	11-23	0.2-0.3
MW-USO-4S	6.4--6.6	646-1556	11.5-19	nr
MW-USO-5S	6.0-6.4	516-798	10-21	0.3-0.4
MW-USO-6S	6.3-6.7	864-1262	9.5-21	0.1-0.3
MW-USO-7S	6.6-6.8	1407-1980	10-20.5	nr

nr = not measured

3.2 TOTAL PETROLEUM HYDROCARBONS - GASOLINE RANGE (WTPH-G) AND BTEX

As shown in Table 2, no total gasoline-range petroleum hydrocarbons using method WTPH-G (0.050 mg/l reporting limits) have been detected in wells MW-USO-1S, 2S, 4S, or 7S. The same is true for well MW-USO-6S, with the exception of the last sample round (4/9/96) when a concentration near reporting limits (0.062 mg/l) was detected. Total gasoline-range hydrocarbons (WTPH-G) have been detected in wells MW-USO-3S, and 5S, located down-gradient of the spill site. WTPH-G concentrations in MW-USO-3S have declined from a high of 16 mg/l in December, 1992 (prior to remediation) to at or near detection limits (0.05 mg/l) since November, 1993 following completion of the interim remediation. The WTPH-G concentrations in well MW-USO-5S, installed on October 30, 1993 rose from 1.7 mg/l initially (11/19/93), to a high of 11 mg/l (3/14/95) and has since varied between 3.5 mg/l (8/29/94) and 9.7 (4/9/96).

Benzene, toluene, ethylbenzene, and total xylenes (BTEXs) have not been detected in wells MW-USO-1S, 2S, 4S, or 7S (reporting limits 0.00050 to 0.0010 mg/l). Benzene, toluene, and total xylenes were detected in several samples from MW-USO-3S since sampling began in September 1992; however, only benzene has been consistently detected. Concentrations of benzene in well MW-USO-3S have declined from a high of 5.1 mg/l in December, 1992 to 0.0075 mg/l in November, 1993, declining further to near or below method reporting limits (0.00055-0.00063 mg/l) from May of 1994 to April of 1996. In the last sampling round (April 9, 1996) a benzene concentration of 0.029 mg/l in well MW-USO-3S was detected. With the exception of the April 1996 sampling results, the downward trend in benzene concentrations is consistent with the downward trend in gasoline-range hydrocarbon concentrations based on WTPH-G analyses of samples from MW-USO-3S.

In the first sampling of well MW-USO-5S (November, 1993), benzene, toluene, ethylbenzene, and total xylenes were detected. Benzene was detected at 0.10 mg/l, with toluene at 0.0008 mg/l, ethylbenzene at 0.054 mg/l, and total xylenes at 0.041 mg/l. Over the period of sampling since November 1993, benzene concentrations have varied from 0.39 mg/l to a high of 3.9 mg/l in December of 1995, decreasing to 2.4 mg/l in April 1996. There has been a generally corresponding variation in toluene, ethylbenzene, and total xylenes over this same period.

In the first sampling of well MW-USO-6S (November, 1993) benzene was detected at 0.023 mg/l. The benzene concentration increased to a high of 0.95 mg/l in February 1994, then varied between 0.043 mg/l and 0.48 mg/l over the period from May, 1994 to March 1995. Since March 1995, benzene concentrations have remained below reporting limits of 0.050 mg/l. Toluene, ethylbenzene, and total xylenes have been below or very near reporting limits in samples from MW-USO-6S.

3.3 TOTAL PETROLEUM HYDROCARBONS - DIESEL-RANGE (WTPH-D)

As shown on Table 2, low levels of total petroleum hydrocarbons - diesel range (WTPH-D) were detected in wells MW-USO-1S (less than 0.25 mg/l to 0.45 mg/l), -2S (less than 0.25 mg/l to 0.52 mg/l), -4S (0.44 to 0.56 mg/l) and -7S (0.76 to 1.4 mg/l).

Samples from well MW-USO-3S indicated concentration levels of WTPH-D ranging from 3.6 mg/l in November, 1993 to a high of 6.3 mg/l in February 1994, to a low of 3.7 in August, 1994, to a high of 6.1 mg/l in April 1996. WTPH-D concentrations in water from well MW-USO-5S has ranged from 2.6 mg/l in November, 1993 to a high of 3.3 mg/l in February 1994, to a low of 2.1 mg/l in August, 1994, and then varying between 2.3 mg/l and 4.4 mg/l over the period of December 1994 to April 1996. The sampling of well MW-USO-6S indicated WTPH-D concentrations ranging from a low of 0.52 mg/l in November 1993 to a high of 9.5 mg/l in August, 1994, the decreasing over time to a low of 0.41 mg/l in April 1996.

IV. EVALUATION OF WATER-QUALITY TRENDS AND RECOMMENDATIONS

In the two and one-half year period since remediation was completed (Fall of 1993 to April 1996) gasoline-range (WTPH-G and benzene) and diesel-range (WTPH-D) hydrocarbons have only been detected at significant levels in the area northeast (downgradient) of the crude-oil spill area in wells MW-USO-3S, MW-USO-5S, and MW-USO-6S. Since gasoline and diesel range components of crude oil are the most soluble and mobile constituents of crude oil and have the greatest potential to contaminate ground water, they have been used to assess the beneficial effects of remediation. Although these components are the most mobile, they also degrade the most rapidly in the subsurface environment.

Figure 9 shows the concentrations of WTPH-G (gasoline range petroleum hydrocarbons), benzene, and WTPH-D (diesel range petroleum hydrocarbons) in ground-water samples from the seven monitoring wells. For wells MW-USO-1S, 2S, 4S, and 7S, the results for the last sampling event for these wells (August 29, 1994) is shown. For wells MW-USO-3S, 5S, and 6S, the latest sampling event (April 9, 1996) results are shown. The trends with time of benzene and diesel range (WTPH-D) hydrocarbons for the three wells located downgradient of the spill area are shown graphically on Figures 10, 11, and 12.

Well MW-USO-3S is located hydraulically approximately 80 feet downgradient of the spill area and is the well located closest to the spill area (Figure 2). The highest concentrations of petroleum hydrocarbons have been detected (prior to remediation) in samples from this well. The earliest water quality improvement resulting from the remediation was (as expected) detected in this well because it is located closest to the spill area.

Water quality analyses have indicated that gasoline (WTPH-G) concentrations declined from a high of 16 mg/l prior to remediation to 0.054 mg/l by November 1993, and has remained at or below method detection limits to the present time

(April 1996), see Figure 10). Similarly, benzene concentrations declined from a high of approximately 5 mg/l to below method detection limits (0.00050 mg/l) by March 1995, and remained below method detection limits through December 1995. Results from the last sampling round (April 1996) indicated a benzene concentration in this well at 0.029 mg/l, although there was no corresponding increase in the WTPH-G concentrations (<0.050 mg/l) in this well. Additional monitoring will be required to evaluate the validity of this last benzene result.

The diesel-range hydrocarbon (WTPH-D) results have varied over time from a low of 3.4 mg/l in December 1992 to a high of 6.3 mg/l in February 1994, to a low of 3.7 mg/l in December 1994, and increasing to a high of 6.1 at the time of the last round of sampling (April 1996). As shown on Figure 10 and in Table 2, the diesel-range hydrocarbon concentrations in downgradient ground water have been on an apparent increasing trend since remediation. Since the diesel-range components are slower to degrade than the gasoline-range components, it is anticipated that the levels of diesel-range hydrocarbons will also improve with time.

Well MW-USO-5S is located hydraulically approximately 110 feet downgradient of the spill near its northern extent (Figure 2). As shown on Figure 11, gasoline (WTPH-G) range concentrations have varied over time, with the overall trend generally unchanged since remediation. Likewise, benzene concentrations have also varied over time, and corresponding to the variation in WTPH-G concentrations. Diesel-range concentrations have also followed a pattern similar to WTPH-G and benzene concentrations. It appears that the variation in gasoline and diesel range concentrations correlate with the wet or dry portions of the year, the highest concentrations occurring in the wetter months and the lower concentrations occurring in the dryer months. It is anticipated that over time, the concentration of petroleum hydrocarbons in this well will decline.

Well MW-USO-6S is located approximately 280 feet downgradient of the spill area and approximately 200 feet downgradient of well MW-USO-3S (Figure 2). As shown on Figure 12, gasoline (WTPH-G) concentrations in this well have remained below or very near method reporting limits (0.050 mg/l) since its installation in 1993. Through April 1996, benzene concentrations have decreased from a high of 0.95 mg/l in February 1994 to below method reporting limits (0.0050 mg/l) by August 1995. Benzene concentrations in this well have remained below method reporting limits through the April 1996 sampling event. Diesel-range (WTPH-D) concentrations have decreased from a high of 9.5 mg/l in August 1994 to about 1 mg/l or less since December 1995. Overall, water quality has substantially improved in this well since remediation of the spill area.

To verify the benefits of the remediation on ground water quality, we recommend that monitoring continue until water-quality trends are confirmed. Water quality samples should be obtained from wells MW-USO-3S, MW-USO-5S, and MW-USO-6S on a semi-annual basis, with one round during the wet portion of the year (March) and drier portion of the year

(September). The samples should be analyzed for field parameters (pH, specific conductivity, temperature, and dissolved oxygen); benzene, toluene, ethylbenzene, and xylenes; gasoline range hydrocarbons (WTPH-G); and diesel range hydrocarbons (WTPH-D).

V. REFERENCES

DOF (Dalton, Olmsted & Fuglevand, Inc.), 1991, Preliminary Soil-Quality Evaluation, Port of Tacoma Road Log Sort Yard, Tacoma, Washington; prepared for U.S. Oil & Refining Co.; April 19, 1991.

DOF (Dalton, Olmsted & Fuglevand, Inc.), 1993a, Interim Phase 1 Remedial Investigation Report and Interim Action Plan, N.E. Portion of Cascade Timber Log Sort Yard No. 3, Port of Tacoma, Washington; prepared for U.S. Oil & Refining Co.; June 1993.

DOF (Dalton, Olmsted & Fuglevand, Inc.), 1993b, As-Built Constuction Report, Interim Remedial Action, N.E. Portion of Cascade Timber Log Sort Yard No. 3, Port of Tacoma, WA, prepared for U.S. Oil & Refining Co.; November 1993

DOF (Dalton, Olmsted & Fuglevand, Inc.), 1994a, Technical Memorandum - Additional Well Installations and Initial Post-Remediation Ground-Water Sampling Results, N.E. Portion of Cascade Timber Log Sort Yard No. 3, Port of Tacoma, Washington; prepared for U.S. Oil & Refining Co.; November 1993.

DOF (Dalton, Olmsted & Fuglevand, Inc.), 1994b, Technical Memorandum - Results of Second Quarterly Water Quality Sampling Round, N.E. Portion of Cascade Timber Log Sort Yard No. 3, Port of Tacoma, Washington; prepared for U.S. Oil & Refining Co.; March 1994.

DOF (Dalton, Olmsted & Fuglevand, Inc.), 1994c, Technical Memorandum - Results of Third Quarterly Water Quality Sampling Round, N.E. Portion of Cascade Timber Log Sort Yard No. 3, Port of Tacoma, Washington; prepared for U.S. Oil & Refining Co.; May 1994.

DOF (Dalton, Olmsted & Fuglevand, Inc.), 1994d, Post-Remediation Ground-Water Sampling Results, N.E. Portion of Cascade Timber Log Sort Yard No. 3, Port of Tacoma, Washington; prepared for U.S. Oil & Refining Co.; October 1994.

DOF (Dalton, Olmsted & Fuglevand, Inc.), 1995a, Technical Memorandum - Results of Fifth Quarterly Water Quality Sampling Round, N.E. Portion of Cascade Timber Log Sort Yard No. 3, Port of Tacoma, Washington; prepared for U.S. Oil & Refining Co.; January 1995.

DOF (Dalton, Olmsted & Fuglevand, Inc.), 1995b, Technical Memorandum - Results of Sixth Quarterly Water Quality Sampling Round, N.E. Portion of Cascade Timber Log Sort Yard No. 3, Port of Tacoma, Washington; prepared for U.S. Oil & Refining Co.; April 1995.

DOF (Dalton, Olmsted & Fuglevand, Inc.), 1995c, Technical Memorandum - Results of Seventh Quarterly Water Quality Sampling Round, N.E. Portion of Cascade Timber Log Sort Yard No. 3, Port of Tacoma, Washington; prepared for U.S. Oil & Refining Co.; October 1995.

DOF (Dalton, Olmsted & Fuglevand, Inc.), 1996, Technical Memorandum - Results of Eighth Quarterly Water Quality Sampling Round, N.E. Portion of Cascade Timber Log Sort Yard No. 3, Port of Tacoma, Washington; prepared for U.S. Oil & Refining Co.; January 1996.

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APPENDIX A

NORTH CREEK ANALYTICAL RESULTS FOR APRIL 9, 1996 SAMPLING ROUND

Table 1. Water Level Measurements
Monitoring Wells Piezometers (All Measurements in Feet)

U.S. Oil
Cascade Timber Log Sort Yard No. 3
Port of Tacoma, Washington

Measurement Point	Date Installed	ocations (U.S. Oil Coordinate		Zone Screened	Screen Depth (Ft.)	Elev. of TOC (Port of Tacoma Datum)	Elev. of TOC (US Oil Datum)	Date: 10/28/92			1/20/93 Before Treat. Plant Startup		
		Northing	Easting					Depth from TOC	Time	Elev. of water level	Depth from TOC	Time	Elev. of water level
MW-USO-1S	7/17/92	12,007.0628	19,721.0564	Shallow	5-10	17.50	24.20	4.67	1147	**12.83**	2.72	0924	**14.78**
MW-USO-1M	8/25/92	12,003.8381	19,736.5044	Middle	15-25	17.60	24.30	8.47	1150	**9.13**	7.63	0922	**9.97**
MW-USO-1D	7/17/92	12,010.8064	19,728.4353	Deep	39-49	18.05	24.75	9.06	1149	**8.99**	8.26	0920	**9.79**
MW-USO-2S	7/16/92	12,334.2045	20,053.7575	Shallow	2.5-7.5	16.64	23.34	3.99	1130	**12.65**	1.95	0927	**14.69**
MW-USO-2M	7/16/92	12,336.1801	20,049.8380	Middle	15-25	16.75	23.45	7.61	1131	**9.14**	6.75	0930	**10.00**
MW-USO-3S	7/15/92	11,772.0528	20,173.2125	Shallow	4-9	17.53	24.23	4.86	1136	**12.67**	3.82	0933	**13.71**
MW-USO-3M	7/15/92	11,761.4717	20,177.1841	Middle	15-25	17.47	24.17	8.48	1135	**8.99**	7.62	0935	**9.85**
MW-USO-4S	7/16/92	11,462.9457	19,719.9963	Shallow	4-9	18.45	25.15	5.08	1155	**13.37**	4.03	0845	**14.42**
MW-USO-4M	7/17/92	11,460.2566	1,972.1419	Middle	14.5-24.5	18.64	25.34	9.50	1156	**9.14**	8.66	0850	**9.98**
MW-USO-5S	10/30/93	11,885.7062	20,345.2466	Shallow	3-8	16.82	23.52	-	-	-	-	-	-
MW-USO-6S	10/30/93	11,771.5132	20,393.9986	Shallow	3-8	17.59	24.29	-	-	-	-	-	-
MW-USO-7S	10/30/93	11,584.3730	20,247.2513	Shallow	3-8	17.70	24.40	-	-	-	-	-	-
P1	7/17/92	12,110.8266	20,025.4123	Shallow	4-6	18.38	25.00	5.61(dry)	1207	**<12.77**	3.92	0831	**14.46**
P2	7/17/92	11,748.1999	19,567.7995	Shallow	4-6	17.89	24.59	4.83	1228	**13.06**	3.37	0916	**14.52**
P3	7/17/92	11,549.4861	19,819.2882	Shallow	4-6	17.79	24.49	4.53	1226	**13.26**	2.51	0815	**15.28**
P4	7/17/92	11,762.5610	19,806.4836	Shallow	4-6	19.15	25.85	5.75(dry)	1230	**<13.40**	3.81	0841	**15.34**
P5	7/17/92	11,794.7153	19,964.9067	Shallow	4-6	17.81	24.51	4.71	1217	**13.10**	3.20	0837	**14.61**
P6	7/17/92	11,942.0503	19,948.8478	Shallow	4-6	19.04	25.74	5.91(dry)	1215	**<13.13**	4.44	0835	**14.60**
P7	7/17/92	12,002.9995	20,110.4480	Shallow	4-6	18.06	24.76	5.32	1208	**12.74**	3.45	0828	**14.61**
P8	7/17/92	11,949.3580	20,197.3240	Shallow	4-6	17.36	24.06	4.72	1211	**12.64**	3.97	0825	**13.39**
P9	8/21/92	11,823.9001	20,116.7128	Shallow	3-5	16.36	23.06	NR**	NR**	NR**	NR**	NR**	NR**
P10	8/21/92	11,629.5905	20,029.5690	Shallow	3-5	17.06	23.76	4.04	1221	**13.02**	2.55	0820	**14.51**
P11	8/21/92	11,611.7772	19,973.1064	Shallow	3-5	16.32	23.02	3.16	1222	**13.16**	1.00	0817	**15.32**
P12	8/21/92	11,476.8675	19,895.7349	Shallow	2-4	14.86	21.56	1.67	1224	**13.19**	NR*	NR*	NR*

*Notes: (1) Coordinates and Elevations of top of PVC riser pipe (TOC) determined by David Evans & Associates 9/18/92

Table 1. Water Level Measurements
Monitoring Wells Piezometers (All Measurements in Feet)

U.S. Oil
Cascade Timber Log Sort Yard No. 3
Port of Tacoma, Washington

Measurement Point	8/29/94			12/7/94			8/24/95			12/12/95		
	Depth from TOC	Time	Elev. of water level	Depth from TOC	Time	Elev. of water level	Depth from TOC	Time	Elev. of water level	Depth from TOC	Time	Elev. of water level
MW-USO-1S	4.85	0905	12.65	2.30	1011	15.20	NR	-	-	NR	-	-
MW-USO-1M	NR	-	-	NR	-	-	NR	-	-	NR	-	-
MW-USO-1D	NR	-	-	NR	-	-	NR	-	-	NR	-	-
MW-USO-2S	3.85	0800	12.79	1.89	1000	14.75	NR	-	-	NR	-	-
MW-USO-2M	NR	-	-	NR	-	-	NR	-	-	NR	-	-
MW-USO-3S	4.71	1145	12.82	3.92	0930	13.61	4.48	1215	13.05	2.24	0720	15.29
MW-USO-3M	NR	-	-	NR	-	-	NR	-	-	NR	-	-
MW-USO-4S	4.89	0840	13.56	3.83	1031	14.62	NR	-	-	NR	-	-
MW-USO-4M	NR	-	-	NR	-	-	NR	-	-	NR	-	-
MW-USO-5S	4.28	1035	12.54	3.52	0750	13.30	4.08	1055	12.74	2.24	0935	14.58
MW-USO-6S	5.25	1056	12.34	4.90	1056	12.69	5.00	1145	12.59	3.90	0858	13.69
MW-USO-7S	4.92	1120	12.78	4.39	1120	13.31	NR	-	-	NR	-	-
P1	5.50	1000	12.88	NR	-	-	NR	-	-	NR	-	-
P2	NR	-	-	NR	-	-	NR	-	-	NR	-	-
P3	4.63	0942	13.16	NR	-	-	NR	-	-	NR	-	-
P4	dry	0950	<13.40	NR	-	-	NR	-	-	NR	-	-
P5	4.84	0954	12.97	NR	-	-	NR	-	-	NR	-	-
P6	dry	0955	<13.13	NR	-	-	NR	-	-	NR	-	-
P7	Removed	-	-	Removed	-	-	Removed	-	-	Removed	-	-
P8	Removed	-	-	Removed	-	-	Removed	-	-	Removed	-	-
P9	Removed	-	-	Removed	-	-	Removed	-	-	Removed	-	-
P10	4.06	1015	13.00	NR	-	-	NR	-	-	NR	-	-
P11	Removed	-	-	Removed	-	-	Removed	-	-	Removed	-	-
P12	Removed	-	-	Removed	-	-	Removed	-	-	Removed	-	-

NR *= Not read - Water ponded
NR**=Not read - Product in Piezometer

Table 1. Water Level Measurements
Monitoring Wells Piezometers (All Measurements in Feet)

U.S. Oil
Cascade Timber Log Sort Yard No. 3
Port of Tacoma, Washington

Measurement Point	4/9/96		
	Depth from TOC	Time	Elev. of water level
MW-USO-1S	2.04	1011	15.46
MW-USO-1M	NR	-	-
MW-USO-1D	NR	-	-
MW-USO-2S	0.83	1000	15.81
MW-USO-2M	NR	-	-
MW-USO-3S	2.93	0930	14.60
MW-USO-3M	NR	-	-
MW-USO-4S	3.79	1031	14.66
MW-USO-4M	NR	-	-
MW-USO-5S	2.30	0750	14.52
MW-USO-6S	3.97	1056	13.62
MW-USO-7S	3.66	1120	14.04
P1	2.63	-	15.75
P2	3.13	-	15.25
P3	2.50	-	15.29
P4	3.80	-	13.99
P5	2.30	-	15.51
P6	3.44	-	14.35
P7	Removed	-	-
P8	Removed	-	-
P9	Removed	-	-
P10	2.00	-	15.06
P11	Removed	-	-
P12	Removed	-	-

NR *= Not read - Water ponded
NR**=Not read - Product in Piezometer

Table 2. Summary of Water Quality Data (All Concentrations in mg/l)

U.S. Oil
Cascade Timber Log Sort Yard No. 3
Port of Tacoma, Washington

Well Number		MW-USO-3S	MW-USO-3S	MW-USO-3S	MW-USO-3S	MW-USO-3S	MW-USO-3S	MW-USO-3S	MW-USO-3S
Date		2/24/94	5/10/94	8/29/94	12/7/94	3/14/95	8/24/95	12/12/95	4/9/96
Total Petroleum Hydrocarbons	Method								
WTPH-G	WTPH-G	<0.050	0.055	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
WTPH-D	WTPH-D	6.3	5.0	3.7	4.0	4.1	4.9	4.4	6.1
BTEX	8020								
Benzene		0.0041	0.00055	0.00063	0.0011	<0.00050	<0.00050	<0.00050	0.029
Toluene		0.00061	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Ethylbenzene		<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Total Xylenes		0.0016	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Conductivity (micromhos)		754	628	690	743	n.r.	776	838	990
Temp. (Celsius)		11	19	23	17	n.r.	24	16	15
pH		6.5	6.5	n.r.*	6.2	n.r.	6.2	6.1	6.6
Turbidity (NTU)		n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	1.4	2.8
Dissolved Oxygen (mg/l)		n.r.	n.r.	n.r.	0.2	n.r.	0.3	n.r.	0.2

Well Number		MW-USO-4S	MW-USO-4S	MW-USO-4S	MW-USO-4S	MW-USO-4S	MW-USO-5S	W-USO-5S(d	MW-USO-5S
Date		9/3/92	11/19/93	2/24/94	5/10/94	8/29/94	11/19/93	11/19/93	2/24/94
Total Petroleum Hydrocarbons	Method								
WTPH-G	WTPH-G	<0.050	<0.050	<0.050	<0.050	<0.050	1.7	1.6	8.5
WTPH-D	WTPH-D	*	0.59	0.56	0.44	0.45	2.6	2.4	3.3(D-1)
BTEX	8020								
Benzene		<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	0.10	0.11	1.7
Toluene		<0.00050	<0.00050	0.00052	<0.00050	<0.00050	0.00079	0.00083	<0.0080
Ethylbenzene		<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	0.054	0.054	0.67
Total Xylenes		<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.041	0.041	0.35
Conductivity (micromhos)		756	770	1,556	1,411	646	730	n.r.	798
Temp. (Celsius)		17	16	11.5	17	19	14	n.r.	10
pH		n.r.*	6.4	6.6	6.4	n.r.*	6.2	n.r.	6.4
Turbidity (NTU)		n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.
Dissolved Oxygen (mg/l)		n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.

Notes: * = not analyzed; nr = no reading
(*) indicates no reading - probe malfunction
D-1 = Sample appears to contain volatile gasoline-range organics
(d) = duplicate

Table 2. Summary of Water Quality Data (All Concentrations in mg/l)

U.S. Oil
Cascade Timber Log Sort Yard No. 3
Port of Tacoma, Washington

Well Number		MW-USO-5S	MW-USO-5S	MW-USO-5S	W-USO-5S(d	MW-USO-5S	MW-USO-5S(d)	MW-USO-5S	MW-USO-5S
Date		5/10/94	8/29/94	12/7/94	12/7/94	3/14/95	3/14/95	8/24/95	12/12/95
Total Petroleum Hydrocarbons	Method								
WTPH-G	WTPH-G	5.2	3.5	6.6	5.6	11.0	9.6	3.4	7.5
WTPH-D	WTPH-D	2.7(D-1)	2.1(D-1)	4.0(D-1)	3.2(D-1)	4.4(D-1)	4.2(D-1)	2.3(D-1)	3.7(D-1)
BTEX	8020								
Benzene		2.5	0.390	0.71	0.80	3.7	3.0	0.84	3.90
Toluene		0.018	0.0028	<0.004	<0.008	0.029	0.025	<0.004	<0.004
Ethylbenzene		0.54	0.17	0.42	0.38	1.2	1.0	0.18	0.93
Total Xylenes		0.11	0.025	0.025	0.022	0.33	0.26	0.0076	0.22
Conductivity (micromhos)		607	704	792	-	n.r	n.r	618	785
Temp. (Celsius)		17	21	15	-	n.r	n.r	21	13
pH		6.2	n.r.*	6.1	-	n.r	n.r	6.0	6.2
Turbidity (NTU)		n.r.	n.r.	n.r.	-	n.r.	n.r.	n.r.	5.2
Dissolved Oxygen (mg/l)		n.r.	n.r.	0.4	-	n.r	n.r	0.4	0.3

Well Number		MW-USO-5S	MW-USO-6S	MW-USO-6S	MW-USO-6S	MW-USO-6S(d	MW-USO-6S	MW-USO-6S	MW-USO-6S
Date		4/9/96	11/19/93	2/24/94	5/10/94	5/10/94	8/29/94	12/7/91	3/14/95
Total Petroleum Hydrocarbons	Method								
WTPH-G	WTPH-G	9.7	<0.050	<0.050	<0.050	<0.050	<0.050	0.058	<0.050
WTPH-D	WTPH-D	3.2(D-1)	0.52	3.7	3.2	2.9	9.5	8.1	1.2(D-1)
BTEX	8020	%							
Benzene		2.4 63	0.023	0.95	0.16	0.20	0.48	0.043	0.076
Toluene		0.093 2	<0.00050	<0.00050	<0.00050	<0.00050	<0.004	<0.00050	<0.00050
Ethylbenzene		0.96 25	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Total Xylenes	T13.883	0.38 10	<0.0010	<0.0010	<0.0010	<0.0010	<0.004	<0.0010	0.0015
Conductivity (micromhos)		516	1,262	1,054	1,151	-	1,113	1,076	n.r
Temp. (Celsius)		12	13.5	9.5	17.5	-	21	15	n.r
pH		6.3	6.6	6.6	6.5	-	n.r.*	6.4	n.r
Turbidity (NTU)		2.8	n.r.	n.r.	n.r.	-	n.r.	n.r.	n.r.
Dissolved Oxygen (mg/l)		0.3	n.r.	n.r.	n.r.	-	n.r.	0.3	n.r

Notes: * = not analyzed; nr = no reading
(*) indicates no reading - probe malfunction
D-1 = Sample appears to contain volatile gasoline-range organics
(d) = duplicate

Table 2. Summary of Water Quality Data (All Concentrations in mg/l)

U.S. Oil
Cascade Timber Log Sort Yard No. 3
Port of Tacoma, Washington

Well Number		MW-USO-6S	MW-USO-6S(d	MW-USO-6S	MW-USO-6S	MW-USO-6S(d	MW-USO-7S	MW-USO-7S	MW-USO-7S(d)
Date		8/24/95	8/24/95	12/12/95	4/9/96	4/9/96	11/19/93	2/24/94	2/24/94
Total Petroleum Hydrocarbons	Method								
WTPH-G	WTPH-G	<0.050	<0.050	<0.050	0.062	0.067	<0.050	<0.050	<0.050
WTPH-D	WTPH-D	3.8	3.5	1.4	0.41	0.40	1.2	1.0	0.76
BTEX	8020								
Benzene		<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Toluene		<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Ethylbenzene		<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Total Xylenes		<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Conductivity (micromhos)		1,239	-	975	864	-	1,606	1,407	-
Temp. (Celsius)		20	-	13	12	-	14	10	-
pH		6.3	-	6.3	6.7	-	6.7	6.8	-
Turbidity (NTU)		n.r.	-	3.4	85**	-	n.r.	n.r.	-
Dissolved Oxygen (mg/l)		0.3	-	n.r.	0.1	-	n.r.	n.r.	-

** red algae

Well Number		MW-USO-7S	MW-USO-7S	Field Blank	Field Blank	Field Blank	Field Blank	Field Blank	Field Blank
Date		5/10/94	8/29/94	9/3/92	11/19/93	2/24/94	5/10/94	8/29/94	12/7/94
Total Petroleum Hydrocarbons	Method								
WTPH-G	WTPH-G	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
WTPH-D	WTPH-D	1.2	1.4	*	<0.25	<0.25	<0.25	<0.25	<0.25
BTEX	8020								
Benzene		<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Toluene		<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	0.00064	<0.00050
Ethylbenzene		<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Total Xylenes		<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0012	<0.0010
Conductivity (micromhos)		1980	1850	-	-	-	-	-	-
Temp. (Celsius)		16	20.5	-	-	-	-	-	-
pH		6.6	n.r.*	-	-	-	-	-	-
Turbidity (NTU)		n.r.	n.r.	-	-	-	-	-	-
Dissolved Oxygen (mg/l)		n.r.	n.r.	-	-	-	-	-	-

Notes: * = not analyzed; nr = no reading
(*) indicates no reading - probe malfunction
D-1 = Sample appears to contain volatile gasoline-range organics
(d) = duplicate

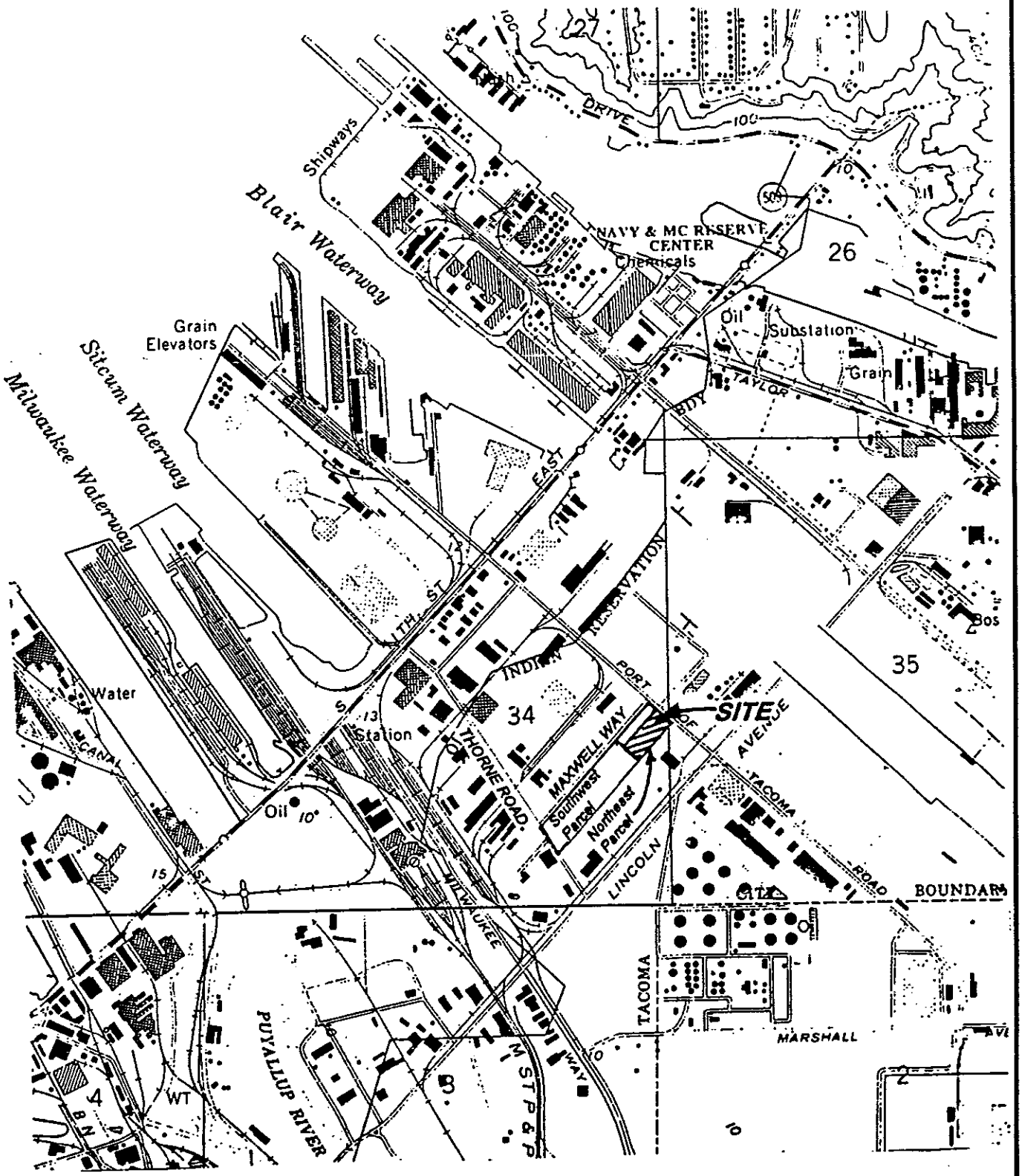
Table 2. Summary of Water Quality Data (All Concentrations in mg/l)

U.S. Oil
Cascade Timber Log Sort Yard No. 3
Port of Tacoma, Washington

Well Number		Rins.Blank	Method Blank	Method Blank	Method Blan	Method Blank	Method Blank	Method Blank	Method Blank
Date		12/12/95	10/14/92	12/8/92	11/24/93	2/28/94	5/10/94	8/29/94	12/13/94
Total Petroleum Hydrocarbons	Method								
WTPH-G	WTPH-G	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
WTPH-D	WTPH-D	<0.25	*	<0.25	0.84	<0.25	<0.25	<0.25	<0.25
BTEX	8020								
Benzene		<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Toluene		<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Ethylbenzene		<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Total Xylenes		<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Conductivity (micromhos)			-	-	-	-	-	-	-
Temp. (Celsius)			-	-	-	-	-	-	-
pH			-	-	-	-	-	-	-

Well Number		Method Blank	Method Blank	Method Blank
Date		3/14/95	9/30/95	12/16/96
Total Petroleum Hydrocarbons	Method			
WTPH-G	WTPH-G	<0.050	<0.050	<0.050
WTPH-D	WTPH-D	<0.25	<0.25	<0.25
BTEX	8020			
Benzene		<0.00050	<0.00050	<0.00050
Toluene		<0.00050	<0.00050	<0.00050
Ethylbenzene		<0.00050	<0.00050	<0.00050
Total Xylenes		<0.0010	<0.0010	<0.0010
Conductivity (micromhos)		-	-	-
Temp. (Celsius)		-	-	-
pH		-	-	-

Notes: * = not analyzed; nr = no reading
(*) indicates no reading - probe malfunction
D-1 = Sample appears to contain volatile gasoline-range organics
(d) = duplicate



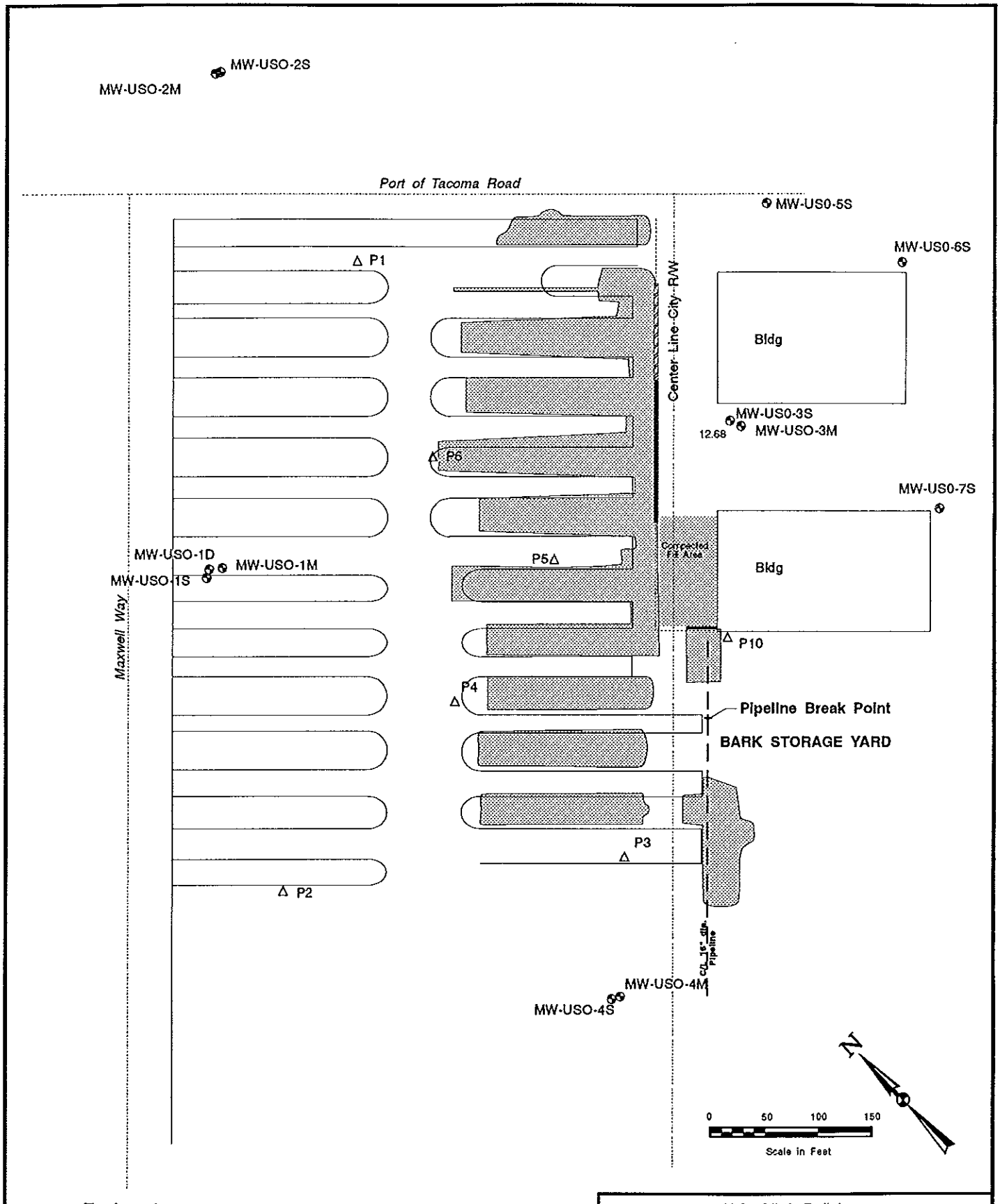
U.S. Oil & Refining
Cascade Log Sort Yard No. 3

Site Vicinity Map

Map Source: U.S.G.S. 7-1/2 Minute Quadrangle

USO-001-01 **FIGURE 1** January 1994

Dalton, Olmsted & Fuglevand, Inc.



Explanation

MW-USO-4S — Monitoring Well & Designation

P2 — Piezometer & Designation

Extent of Excavation

Area where 1 to 2 foot zone of residual oil remains in excavation sidewall below 3.5 feet of "clean" soil

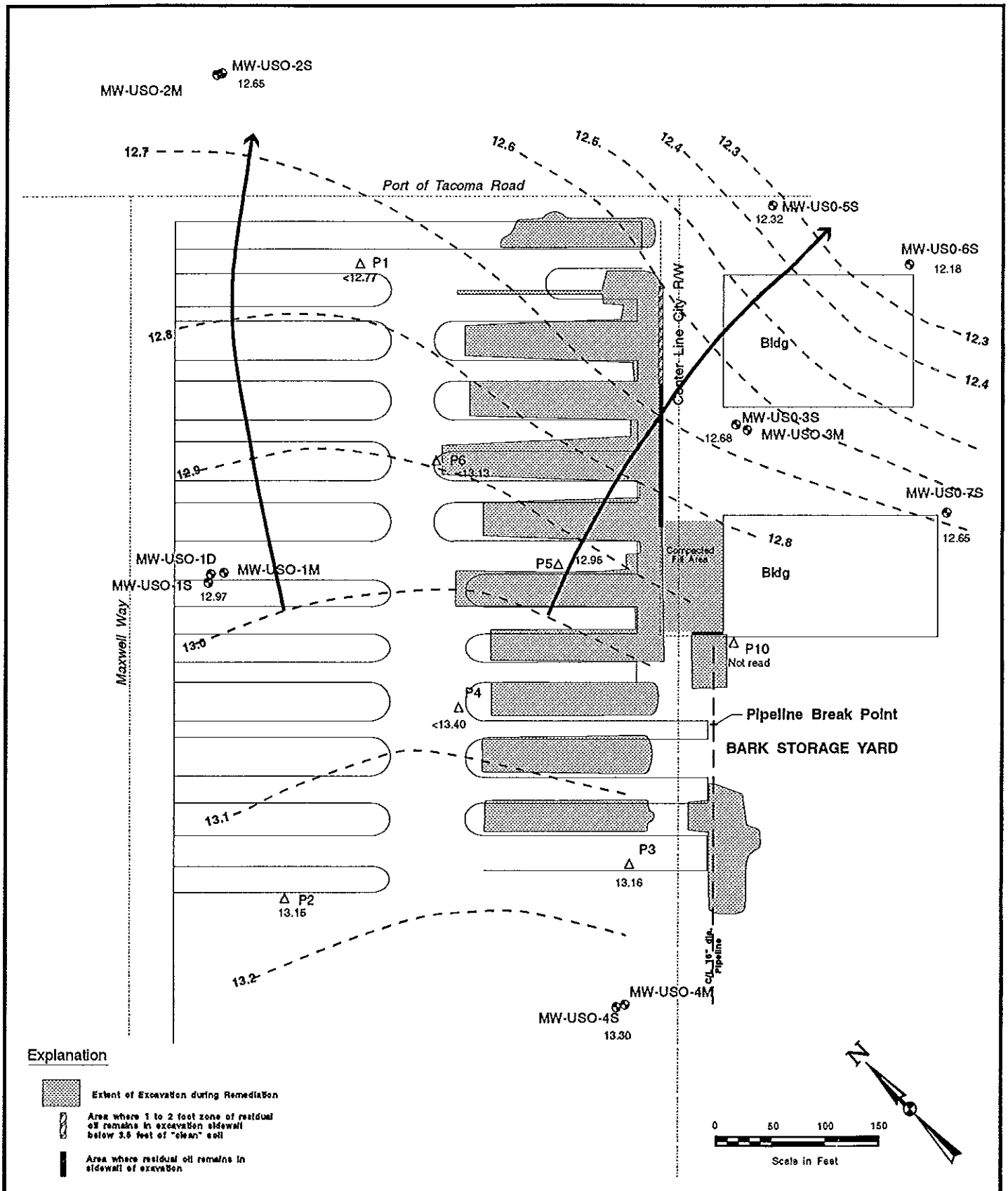
Area where residual oil remains in sidewall of excavation

U.S. Oil & Refining
Cascade Log Sort Yard No. 3

SITE PLAN AND LOCATION OF MONITORING WELLS

USO-001-01 **FIGURE 2** October 1994

Dalton, Olmsted & Fuglevand, Inc.



Explanation

- Extent of Excavation during Remediation
- Area where 1 to 2 foot zone of residual oil remains in excavation sidewall below 3.5 feet of "clean" soil
- Area where residual oil remains in sidewall of excavation

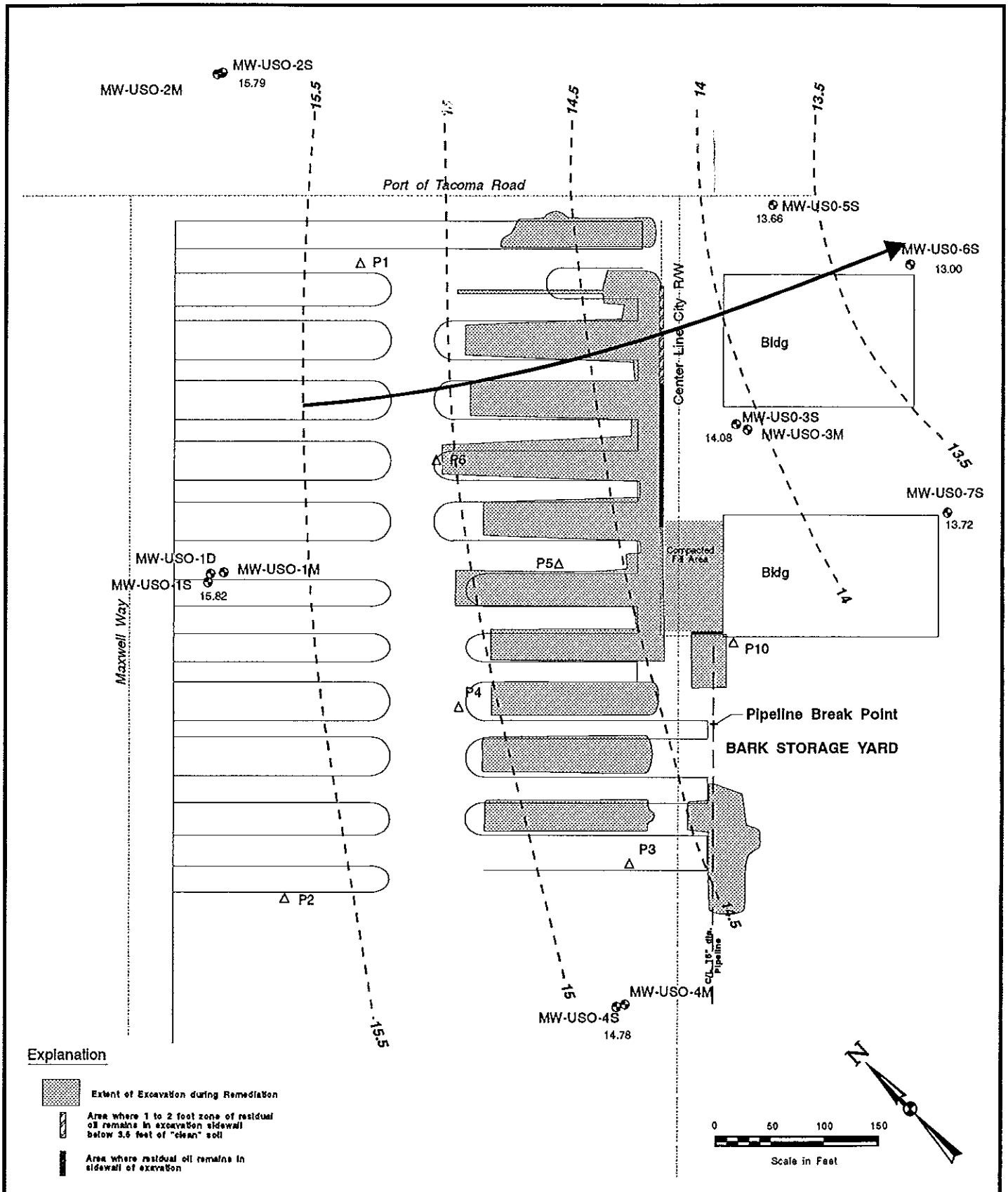
- MW-USO-4S — Monitoring Well & Designation (13.37 = Ground-water elev. ⊕ well or piezometer)
- Δ P2 — Piezometer & Designation
- 12.5 — Ground Water Contour - Elev. In Ft. (P.O.T. Datum)
- Estimated Ground Water Flow Direction

U.S. Oil & Refining
Cascade Log Sort Yard No. 3

GROUND-WATER CONTOURS SHALLOW AQUIFER (11/19/93)

USO-001-01 **FIGURE 3** October 1994

Dalton, Olmsted & Fuglevand, Inc.

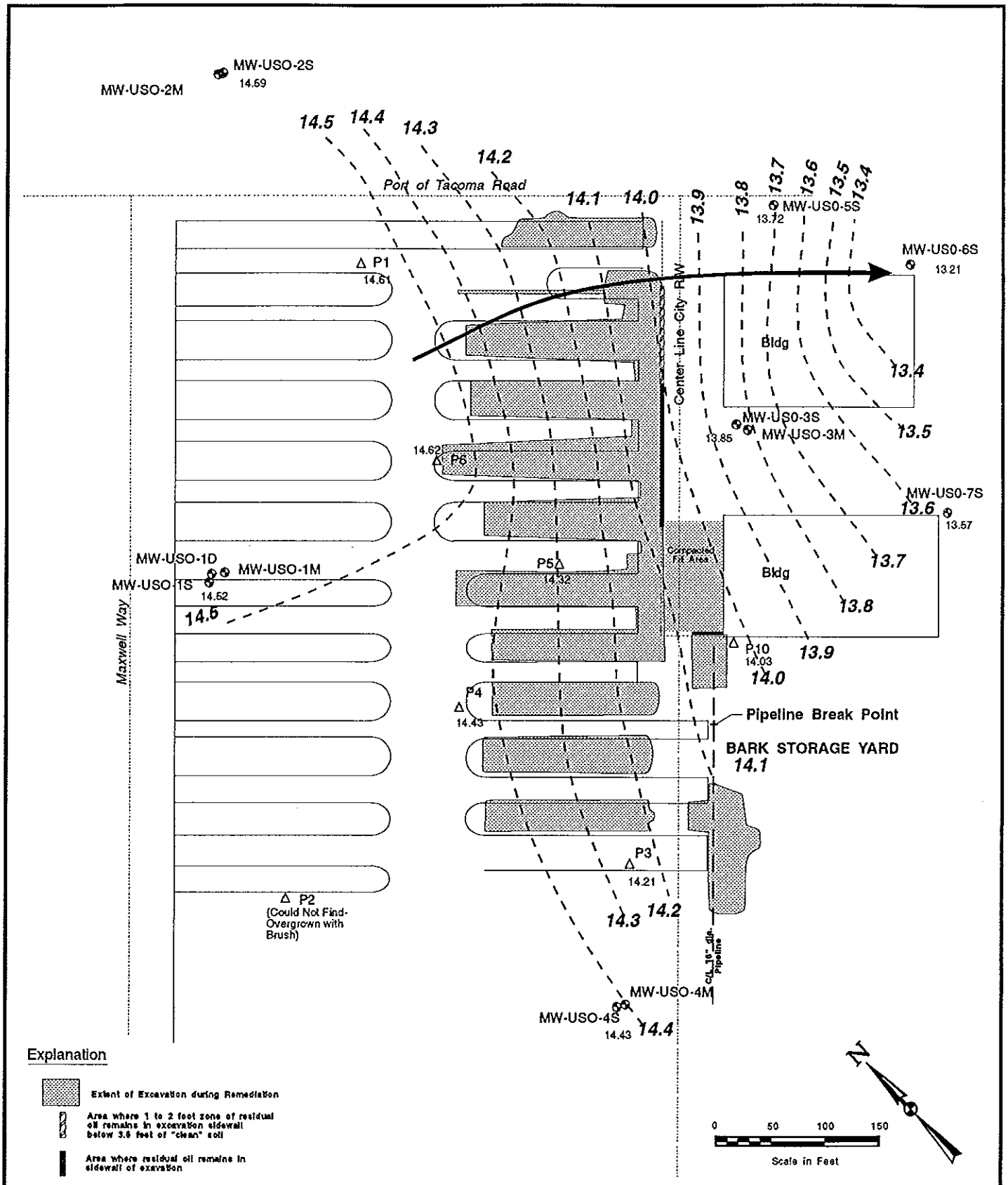


U.S. Oil & Refining
Cascade Log Sort Yard No. 3

WELL LOCATIONS AND GROUND-WATER CONTOURS SHALLOW AQUIFER 2/24/94

USO-001-01 **FIGURE 4** October 1994

Dalton, Olmsted & Fuglevand, Inc.

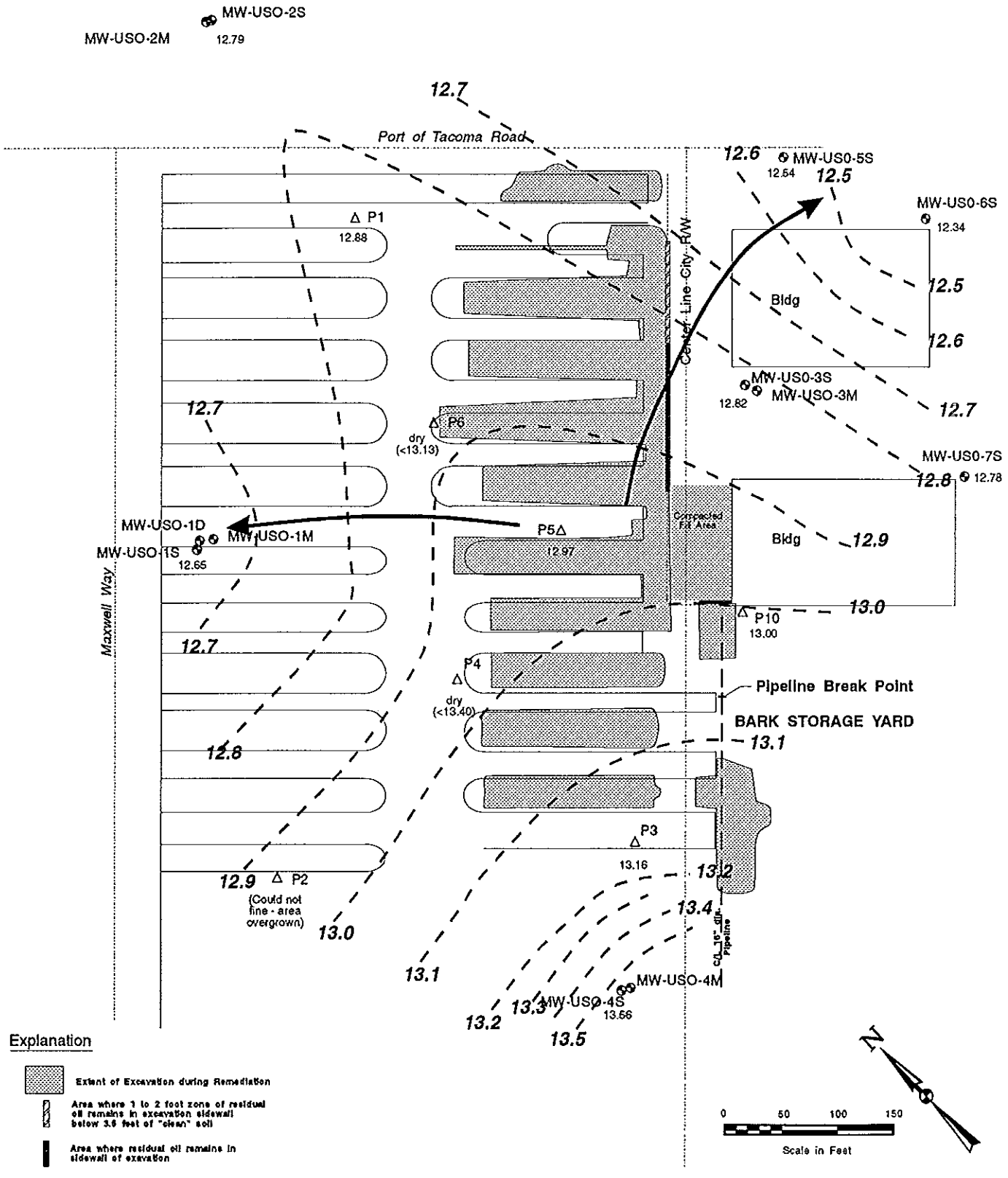


U.S. Oil & Refining
Cascade Log Sort Yard No. 3

WELL LOCATIONS AND GROUND-WATER CONTOURS SHALLOW AQUIFER 5/10/94

USO-001-01 **FIGURE 5** October 1994

Dalton, Olmsted & Fuglevand, Inc.

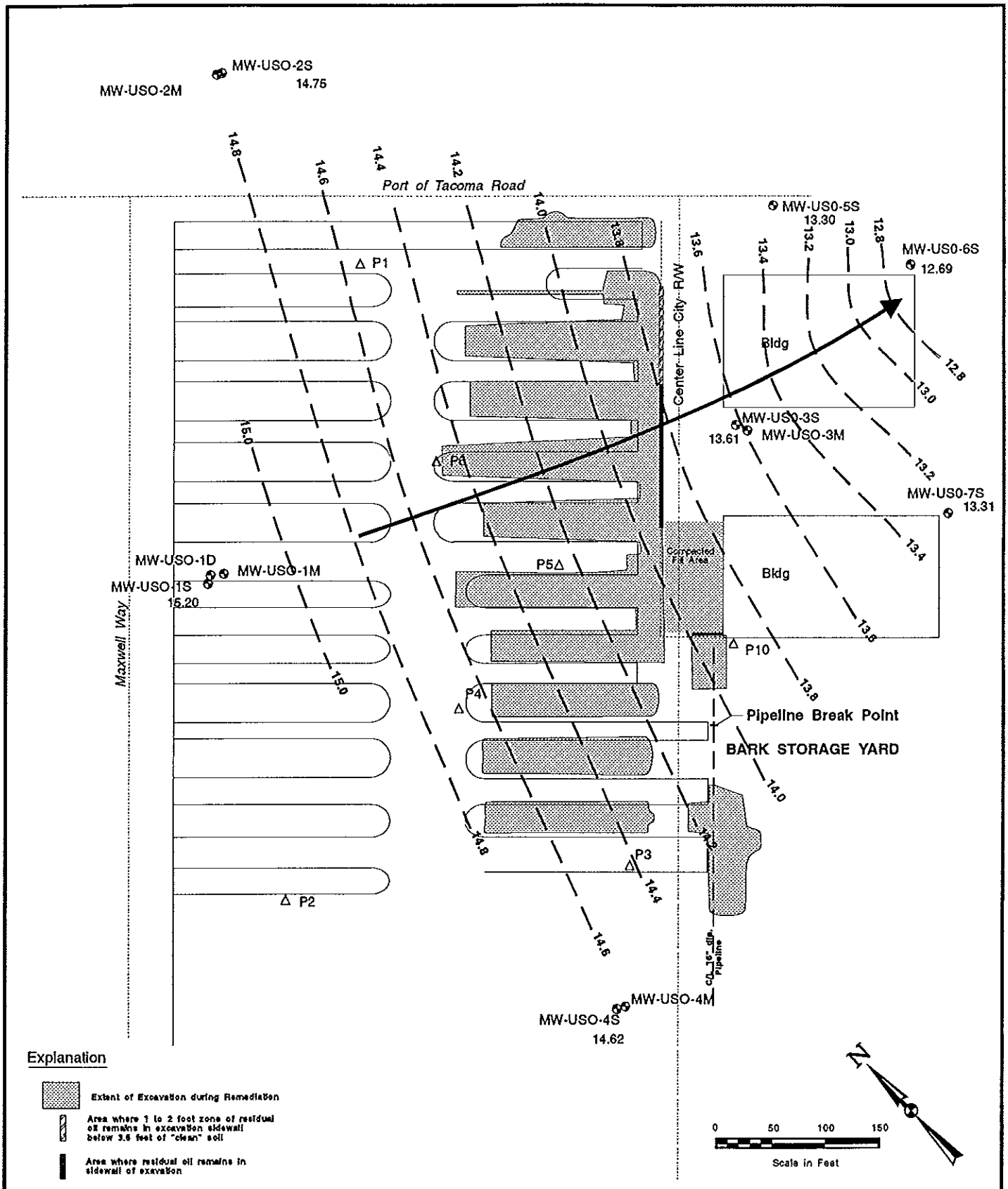


U.S. Oil & Refining
Cascade Log Sort Yard No. 3

WELL LOCATIONS AND GROUND-WATER CONTOURS SHALLOW AQUIFER 8/29/94

USO-001-01 **FIGURE 6** October 1994

Dalton, Olmsted & Fuglevand, Inc.

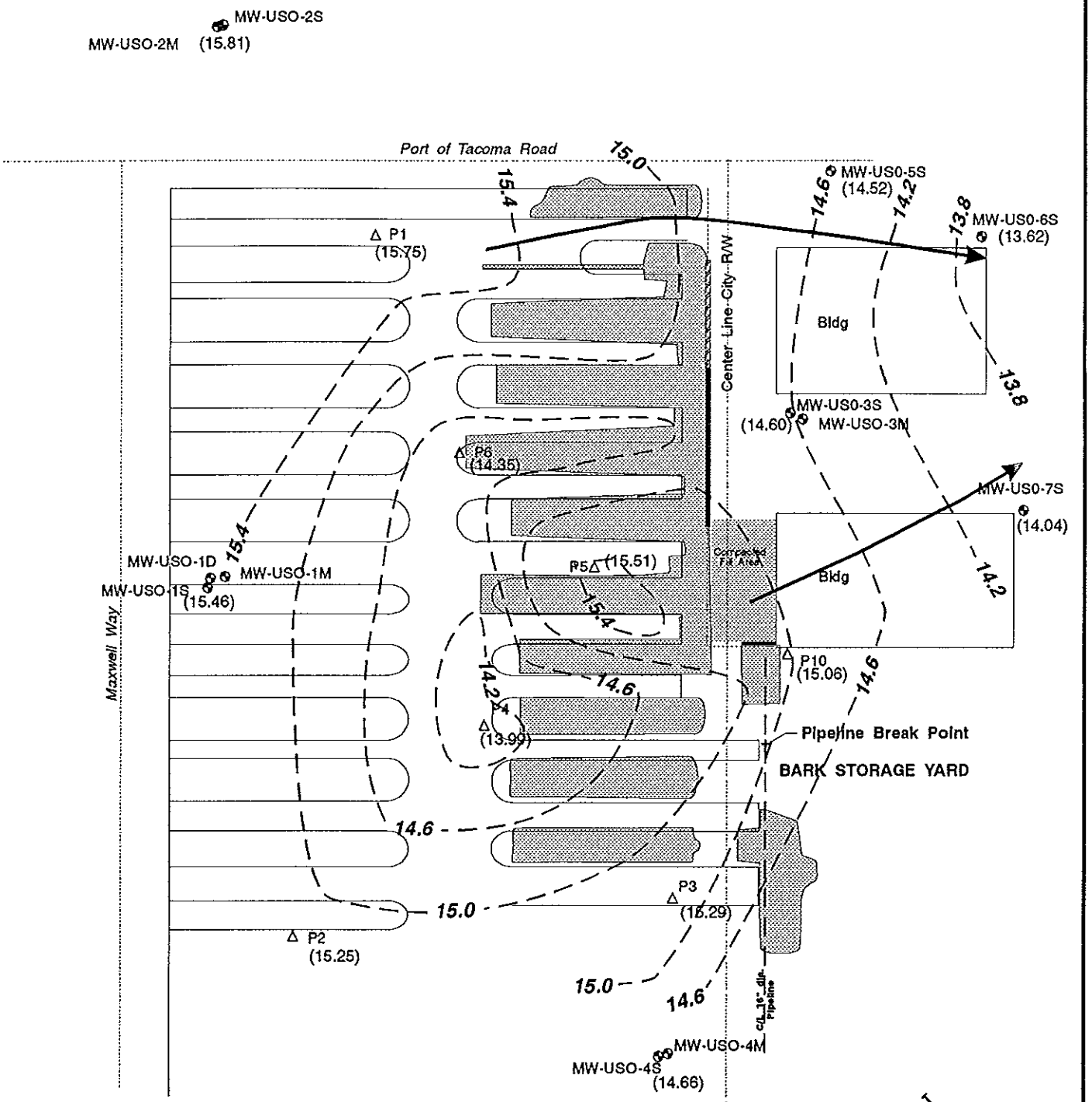


U.S. Oil & Refining
Cascade Log Sort Yard No. 3

WELL LOCATIONS AND GROUND-WATER CONTOURS SHALLOW AQUIFER 12/7/94

USO-001-01 **FIGURE 7** December 1994

Dalton, Olmsted & Fuglevand, Inc.

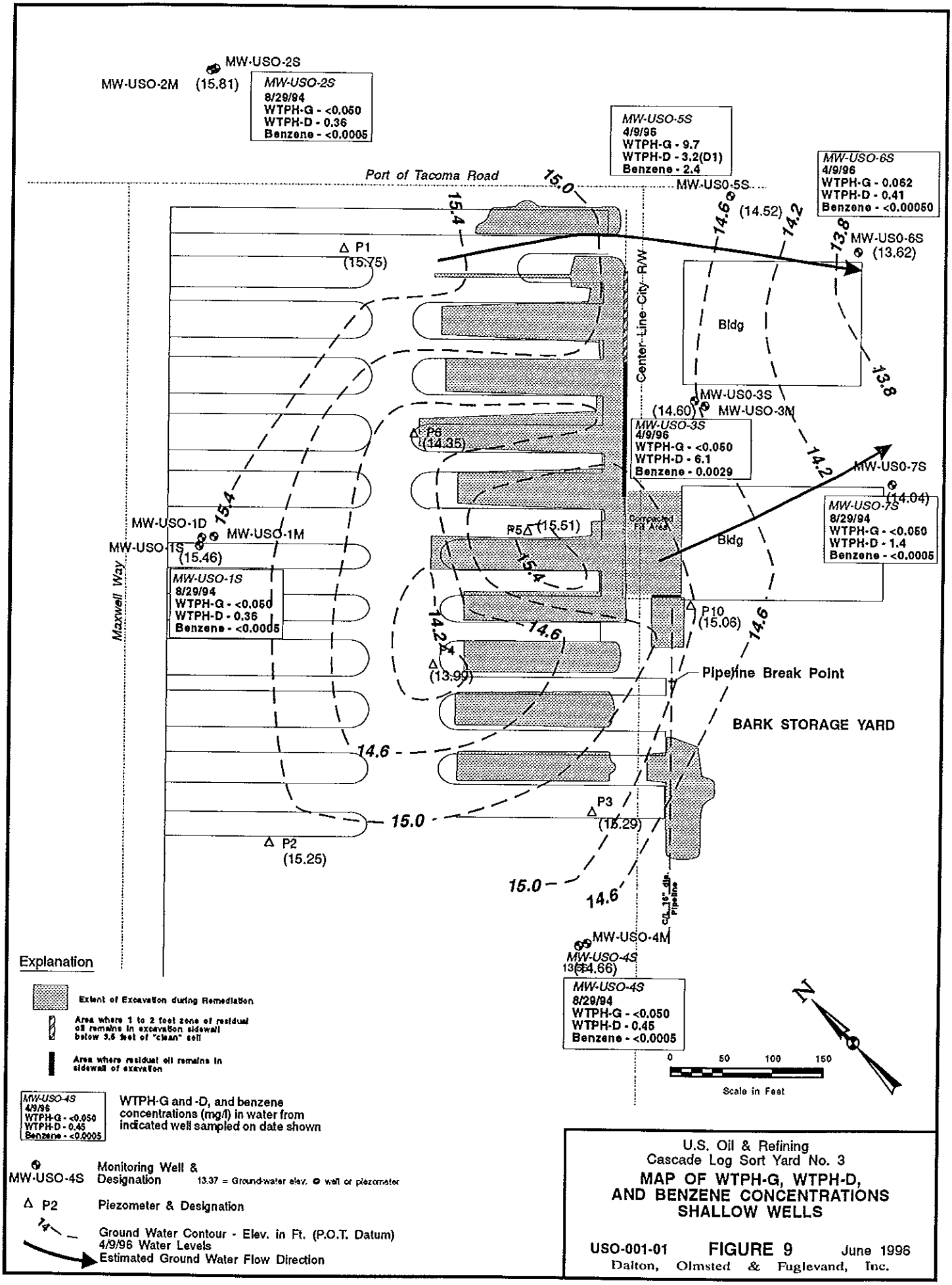


U.S. Oil & Refining
Cascade Log Sort Yard No. 3

WELL LOCATIONS AND GROUND-WATER CONTOURS SHALLOW AQUIFER 4/9/96

USO-001-01 **FIGURE 8** June 1996

Dalton, Olmsted & Fuglevand, Inc.



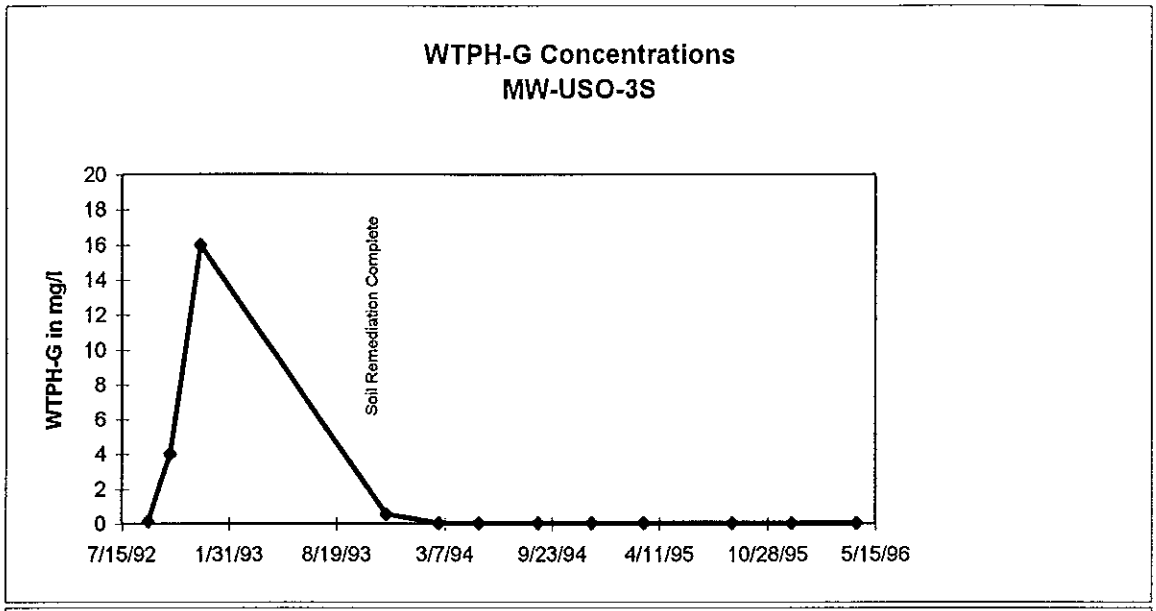
U.S. Oil & Refining
Cascade Log Sort Yard No. 3

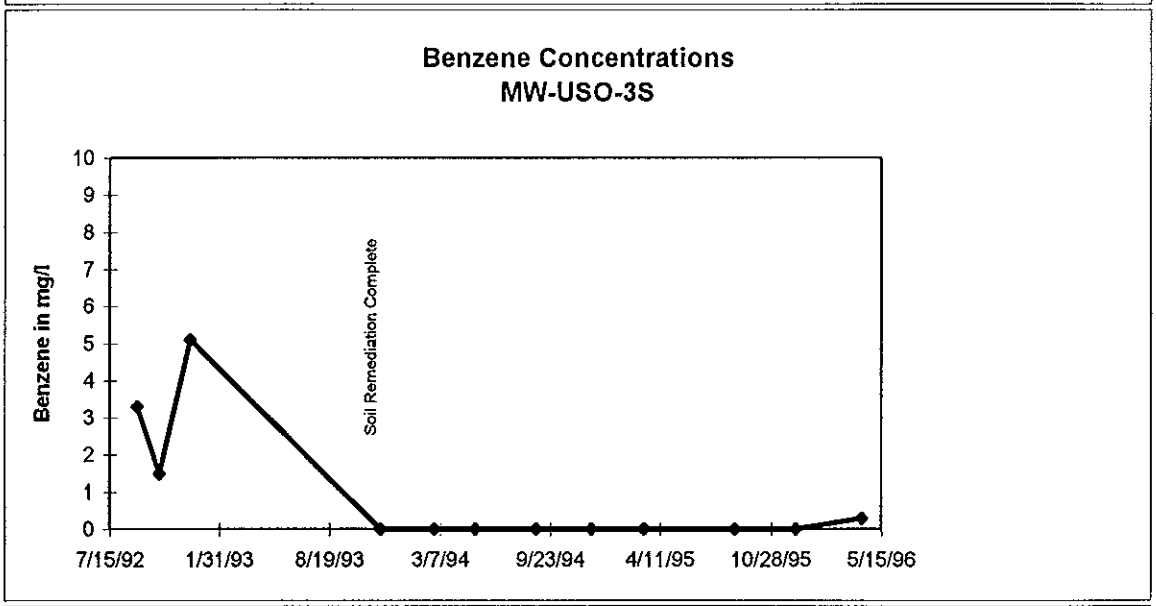
MAP OF WTPH-G, WTPH-D, AND BENZENE CONCENTRATIONS SHALLOW WELLS

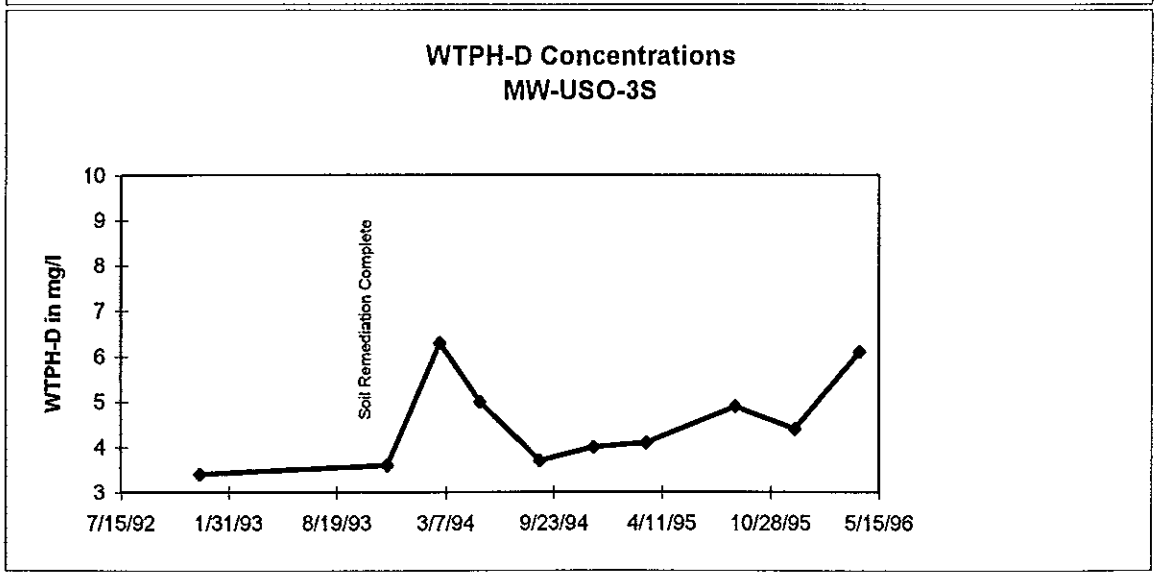
USO-001-01 **FIGURE 9** June 1996
Dalton, Olmsted & Fuglevand, Inc.

FIGURE 10 - WTPH-G, Benzene and WTPH-D Concentrations in Well MW-USO-3S

U.S. Oil Refining Co.
Cascade Timber Log Sort Yard No. 3



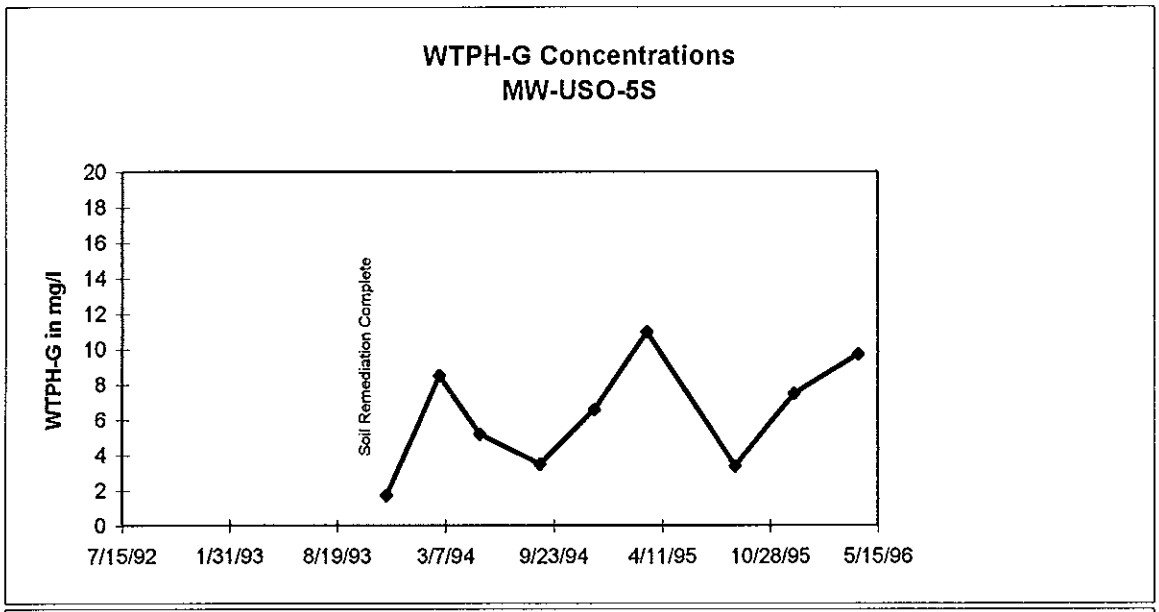


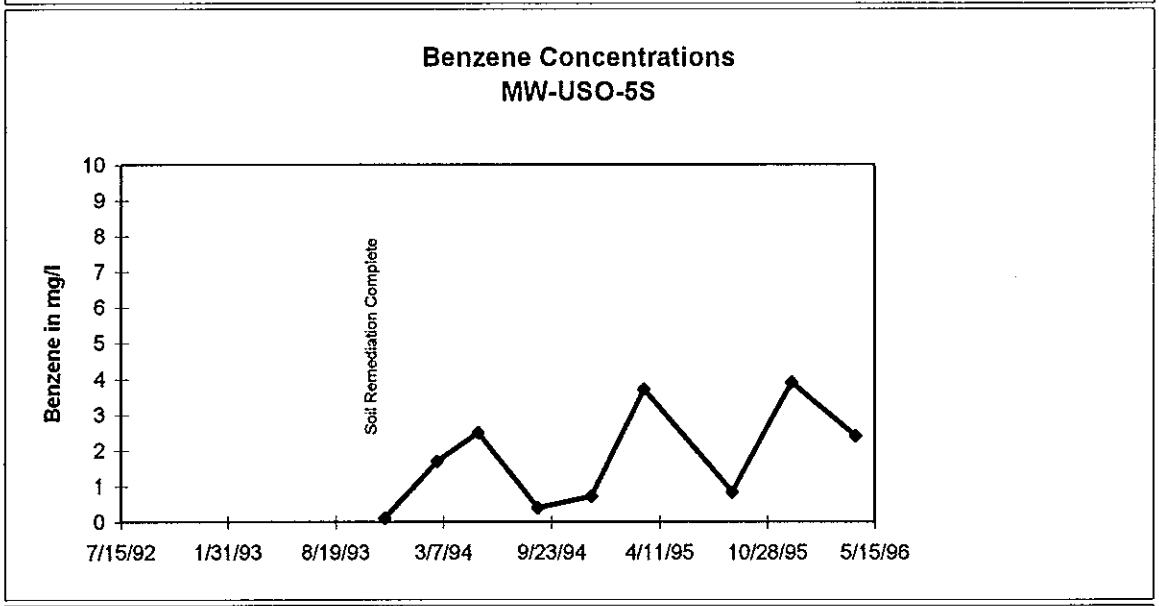


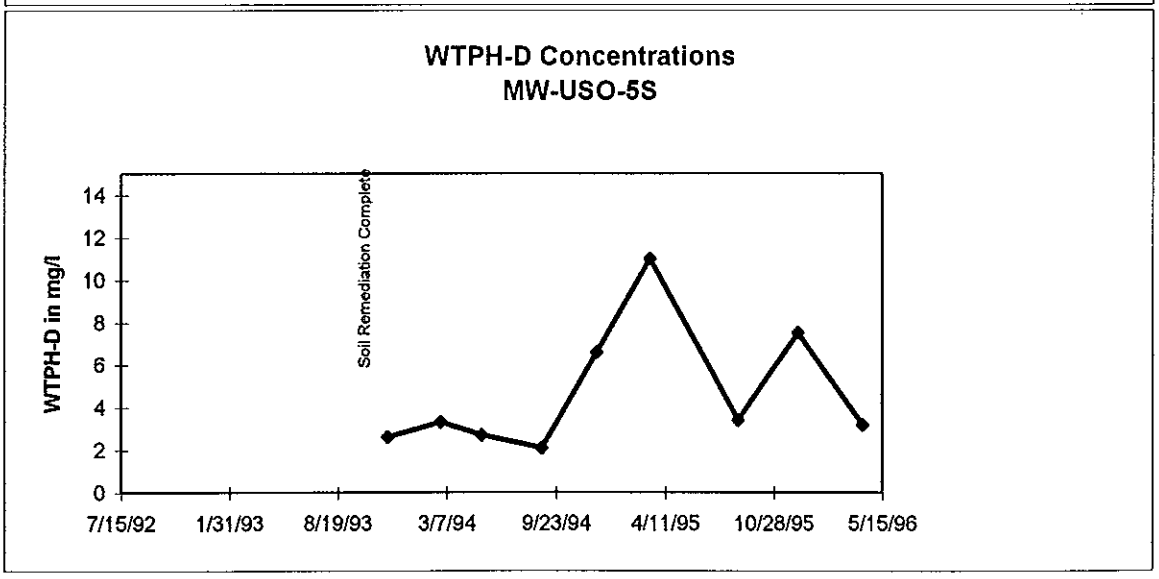
TRENDS1.XLSMW-USO-3S
6/17/96

FIGURE 11 - WTPH-G, Benzene and WTPH-D Concentrations in Well MW-USO-5S

U.S. Oil Refining Co.
Cascade Timber Log Sort Yard No. 3



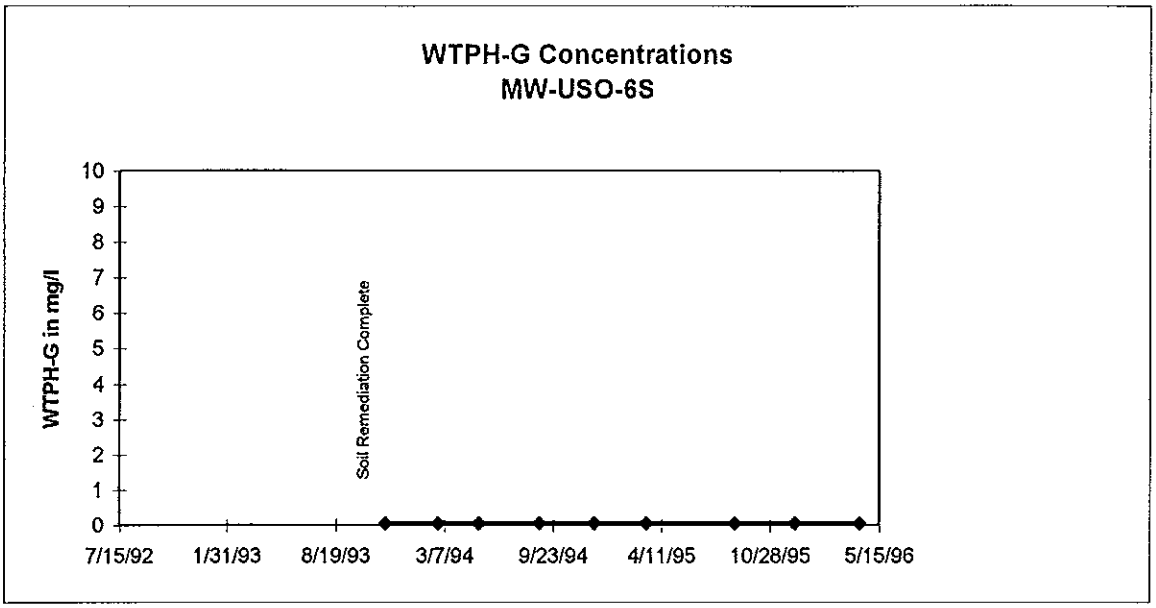


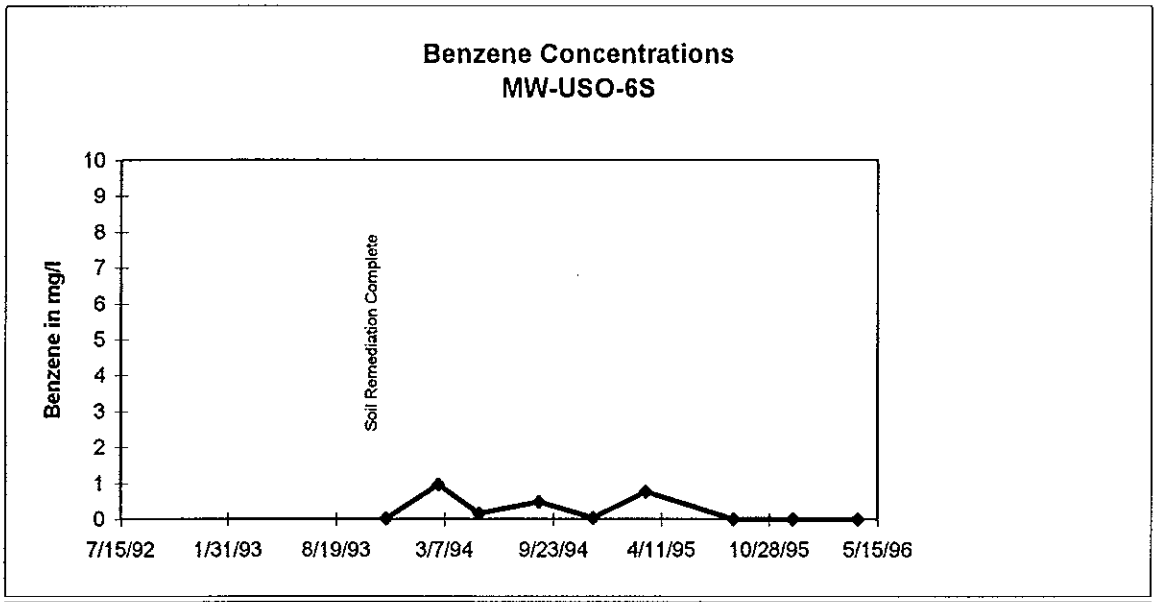


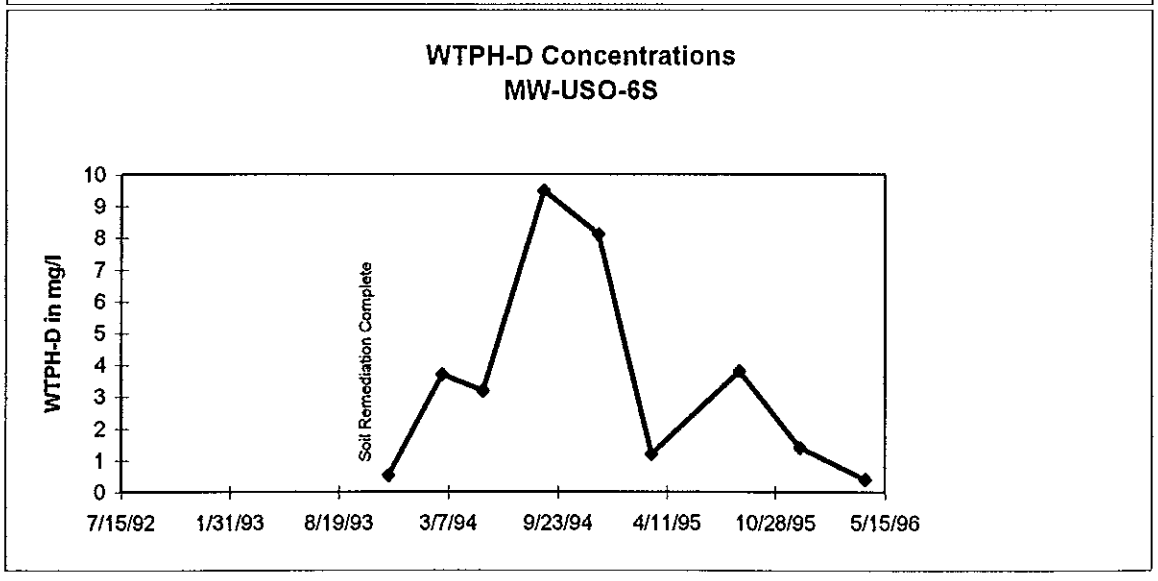
TRENDS1.XLSMW-USO-5S
6/17/96

FIGURE 12 - WTPH-G, Benzene and WTPH-D Concentrations in Well MW-USO-6S

U.S. Oil Refining Co.
Cascade Timber Log Sort Yard No. 3







TRENDS1.XLSMW-USO-6S
6/17/96

APPENDIX A

NORTH CREEK ANALYTICAL RESULTS FOR APRIL 9, 1996 SAMPLING ROUND

NORTH CREEK ANALYTICAL
Environmental Laboratory Services

BOTHELL ■ (206) 481-9200 ■ FAX 485-2992
SPOKANE ■ (509) 924-9200 ■ FAX 924-9290
PORTLAND ■ (503) 643-9200 ■ FAX 644-2202

Dalton, Olmsted & Fuglevand, Inc.	Project Name:	Cascade Log Sort Yard, #3	
11711 N. Creek Parkway, #D-101	Client Project :	#USO-001-02	
Bothell, WA 98011			Received: Apr 9, 1996
Attention: Terry Olmsted	NCA Project #:	B604140	Reported: Apr 12, 1996

PROJECT SUMMARY PAGE

Laboratory Sample Number	Sample Description	Sample Matrix	Date Sampled
B604140-01	MWUSO-3S	Water	4/9/96
B604140-02	MWUSO-5S	Water	4/9/96
B604140-03	MWUSO-6S	Water	4/9/96
B604140-04	DUPLICATE 1	Water	4/9/96

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.

NORTH CREEK ANALYTICAL Inc.

Laura Dutton

Laura Dutton
Project Manager

NORTH CREEK ANALYTICAL
Environmental Laboratory Services

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SPOKANE ■ (509) 924-9200 ■ FAX 924-9290
PORTLAND ■ (503) 643-9200 ■ FAX 644-2202

Dalton, Olmsted & Fuglevand, Inc.	Client Project ID:	Cascade Log Sort Yard, #3	Sampled:	Apr 9, 1996
11711 N. Creek Parkway, #D-101	Sample Matrix:	Water	Received:	Apr 9, 1996
Bothell, WA 98011	Analysis Method:	WTPH-G	Analyzed:	Apr 10, 1996
Attention: Terry Olmsted	First Sample #:	B604140-01	Reported:	Apr 12, 1996

TOTAL PETROLEUM HYDROCARBONS-GASOLINE RANGE

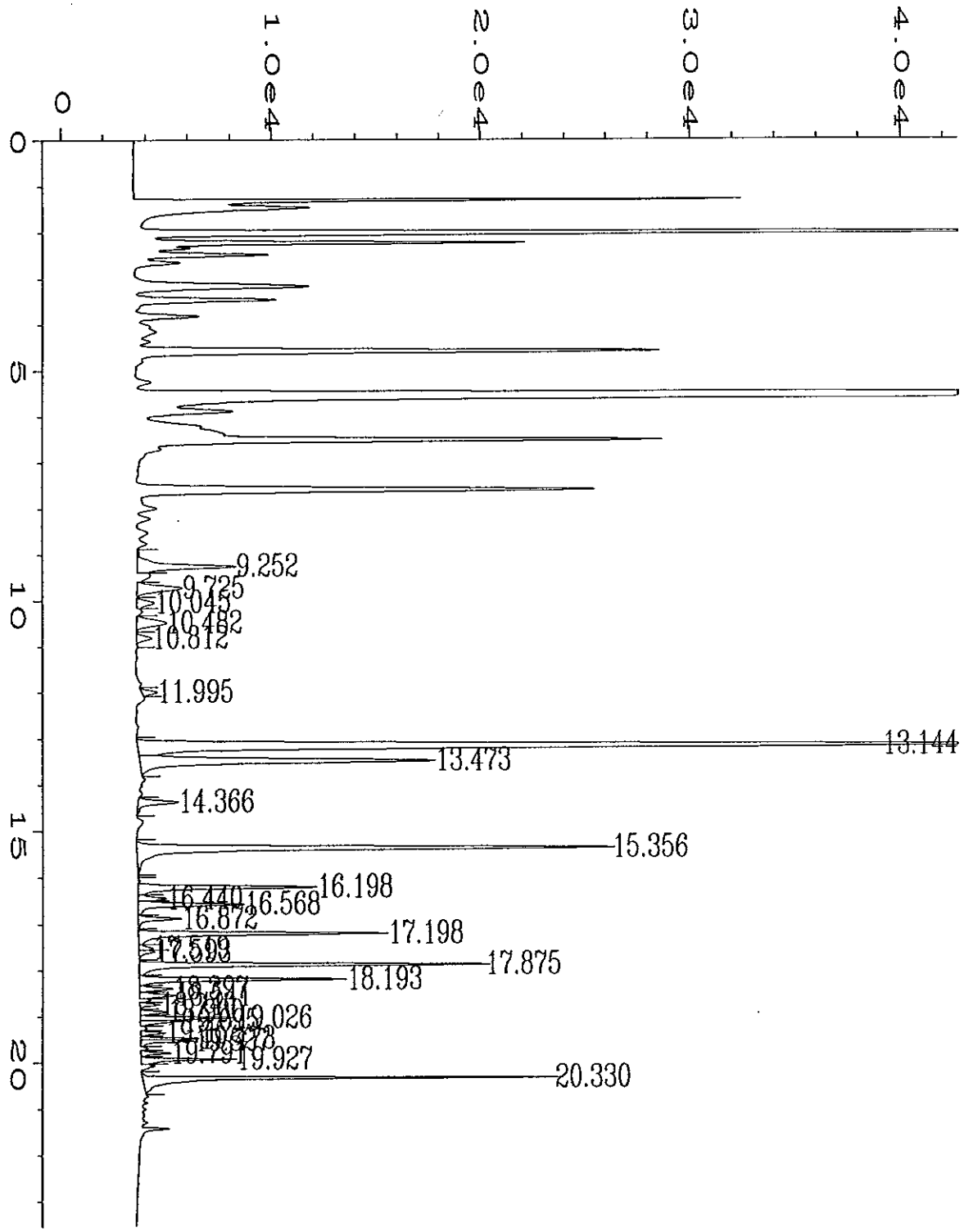
Sample Number	Sample Description	Sample Result µg/L (ppb)	Surrogate Recovery %
B604140-01	MWUSO-3S	N.D.	111
B604140-02	MWUSO-5S	9,700	130
B604140-03	MWUSO-6S	62	128
B604140-04	DUPLICATE 1	67	132
BLK041096	Method Blank	N.D.	95

Reporting Limit:	**50**

4-Bromofluorobenzene surrogate recovery control limits are 50 - 150 %.
Volatile Total Petroleum Hydrocarbons are quantitated as Gasoline Range Organics (toluene - dodecane).
Analytes reported as N.D. were not detected above the stated Reporting Limit.

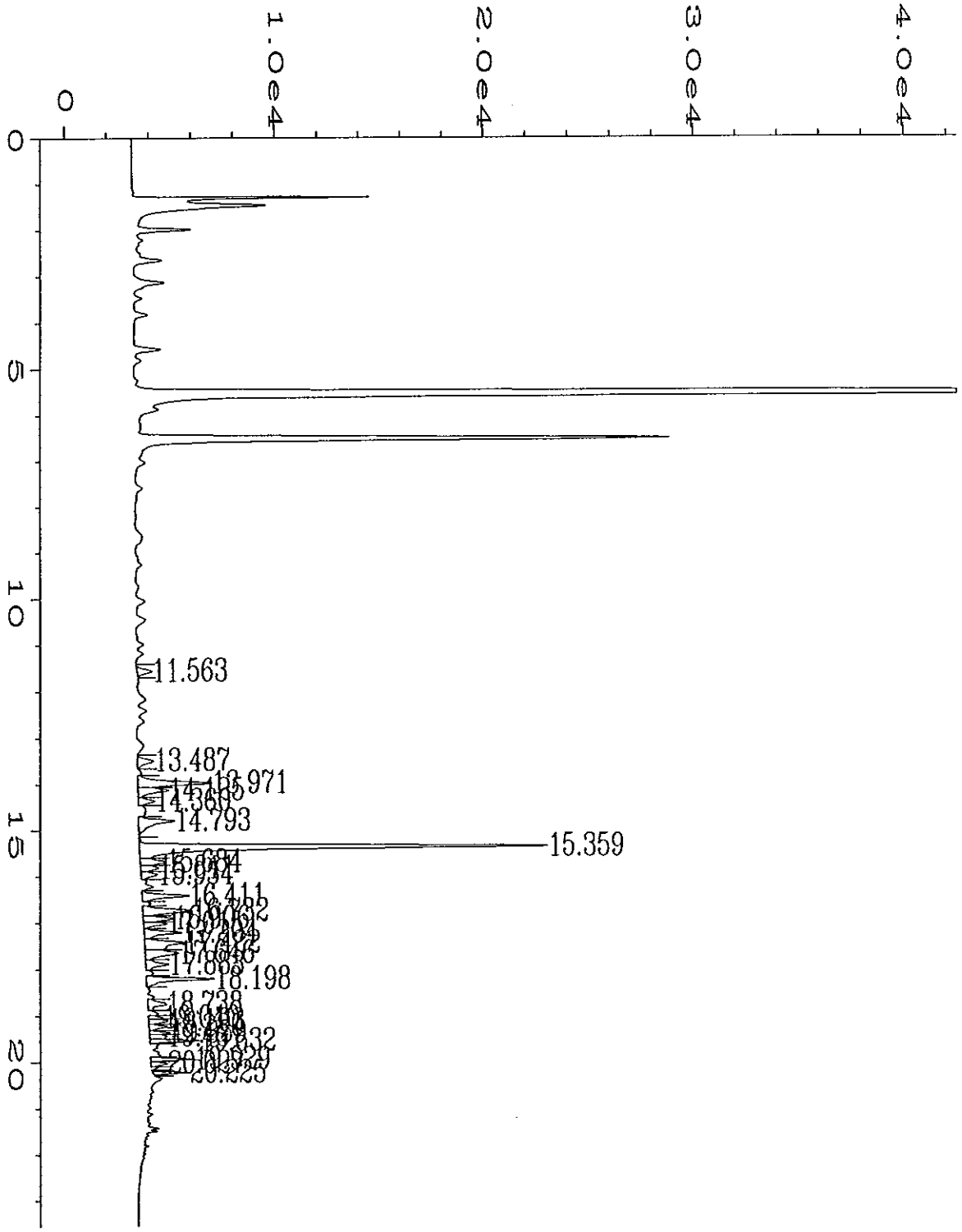
NORTH CREEK ANALYTICAL Inc.

Laura Dutton
Project Manager



Data File Name : C:\HPCHEM\3\DATA\041096\005F0101.D
Operator :
Instrument : GC#2
Sample Name : b604140-02
Run Time Bar Code:
Acquired on : 10 Apr 96 09:31 AM
Report Created on: 10 Apr 96 09:55 AM
Multiplier : 50
Sample Info : 100 ul

Page Number : 1
Vial Number : 5
Injection Number : 1
Sequence Line : 1
Instrument Method: WA-WATER.MTH
Analysis Method : WA-WATER.MTH



Data File Name : C:\HPCHEM\3\DATA\041096\004F0101.D
Operator :
Instrument : GC#2
Sample Name : b604140-01
Run Time Bar Code:
Acquired on : 10 Apr 96 09:01 AM
Report Created on: 10 Apr 96 09:25 AM
Sample Info : 5 ml

Page Number : 1
Vial Number : 4
Injection Number : 1
Sequence Line : 1
Instrument Method: WA-WATER.MTH
Analysis Method : WA-WATER.MTH

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Environmental Laboratory Services

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SPOKANE ■ (509) 924-9200 ■ FAX 924-9290
PORTLAND ■ (503) 643-9200 ■ FAX 644-2202

Dalton, Olmsted & Fuglevand, Inc.
11711 N. Creek Parkway, #D-101
Bothell, WA 98011
Attention: Terry Olmsted

Client Project ID: Cascade Log Sort Yard, #3
Sample Matrix: Water
Analysis Method: WTPH-G
Units: µg/L (ppb)

Analyzed: Apr 10, 1996
Reported: Apr 12, 1996

HYDROCARBON QUALITY CONTROL DATA REPORT

ACCURACY ASSESSMENT
Laboratory Control Sample

Gasoline

Spike Conc. Added:	100
Spike Result:	102
% Recovery:	102
Upper Control Limit %:	132
Lower Control Limit %:	56

PRECISION ASSESSMENT
Sample Duplicate

Gasoline Range Organics

Sample Number:	B604140-02
Original Result:	9,700
Duplicate Result:	10,000
Relative % Difference:	3.0
Maximum RPD:	50

NORTH CREEK ANALYTICAL Inc.

Laura Dutton

Laura Dutton
Project Manager

% Recovery: $\frac{\text{Spike Result}}{\text{Spike Concentration Added}} \times 100$

Relative % Difference: $\frac{\text{Original Result - Duplicate Result}}{(\text{Original Result + Duplicate Result}) / 2} \times 100$

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SPOKANE ▪ (509) 924-9200 ▪ FAX 924-9290
PORTLAND ▪ (503) 643-9200 ▪ FAX 644-2202

Dalton, Olmsted & Fuglevand, Inc.
11711 N. Creek Parkway, #D-101
Bothell, WA 98011
Attention: Terry Olmsted

Client Project ID: Cascade Log Sort Yard, #3
Sample Matrix: Water
Analysis Method: EPA 8020
Units: µg/L (ppb)
QC Sample #: B604140-03

Analyzed: Apr 10, 1996
Reported: Apr 12, 1996

BLANK SPIKE QUALITY CONTROL DATA REPORT
MATRIX SPIKE QUALITY CONTROL DATA REPORT

ANALYTE	Benzene	Toluene	Ethyl Benzene	Xylenes
Sample Result:	N.D.	N.D.	N.D.	N.D.
Spike Conc. Added:	10.0	10.0	10.0	30.0
Spike Result:	8.9	9.1	9.3	29.0
Spike % Recovery:	89%	91%	93%	97%
Spike Dup. Result:	9.0	9.1	9.6	29.1
Spike Duplicate % Recovery:	90%	91%	96%	97%
Upper Control Limit %:	115	116	122	122
Lower Control Limit %:	82	81	85	85
Relative % Difference:	1.1	0	3.2	0.34
Maximum RPD:	16	16	16	17

NORTH CREEK ANALYTICAL Inc.

Laura Dutton

Laura Dutton
Project Manager

% Recovery: $\frac{\text{Spike Result - Sample Result}}{\text{Spike Conc. Added}} \times 100$

Relative % Difference: $\frac{\text{Spike Result - Spike Dup. Result}}{\text{(Spike Result + Spike Dup. Result) / 2}} \times 100$

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Environmental Laboratory Services

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PORTLAND ■ (503) 643-9200 ■ FAX 644-2202

Dalton, Olmsted & Fuglevand, Inc.	Client Project ID:	Cascade Log Sort Yard, #3	Sampled:	Apr 9, 1996
11711 N. Creek Parkway, #D-101	Sample Matrix:	Water	Received:	Apr 9, 1996
Bothell, WA 98011	Analysis Method:	WTPH-D	Extracted:	Apr 10, 1996
Attention: Terry Olmsted	First Sample #:	B604140-01	Analyzed:	Apr 11-12, 1996
			Reported:	Apr 12, 1996

TOTAL PETROLEUM HYDROCARBONS-DIESEL RANGE

Sample Number	Sample Description	Sample Result mg/L (ppm)	Surrogate Recovery %
B604140-01	MWUSO-3S	6.1	56
B604140-02	MWUSO-5S	3.2 D-1	67
B604140-03	MWUSO-6S	0.41	71
B604140-04	DUPLICATE 1	0.40	68
BLK041096	Method Blank	N.D.	60

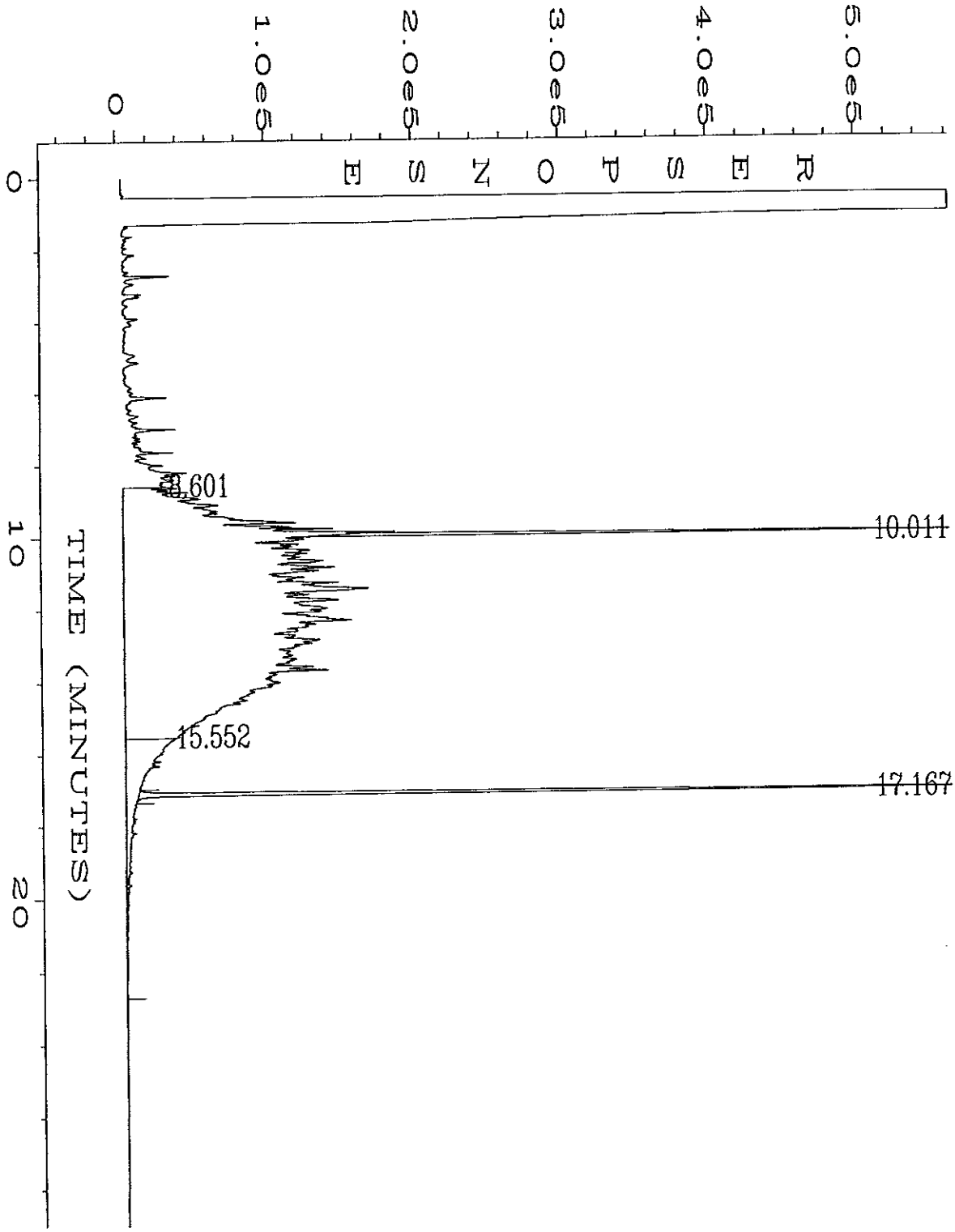
Reporting Limit:	**0.25**

2-Fluorobiphenyl surrogate recovery control limits are 50 - 150 %.
Extractable Total Petroleum Hydrocarbons are quantitated as Diesel Range Organics (C12 - C24).
Analytes reported as N.D. were not detected above the stated Reporting Limit.

NORTH CREEK ANALYTICAL Inc.

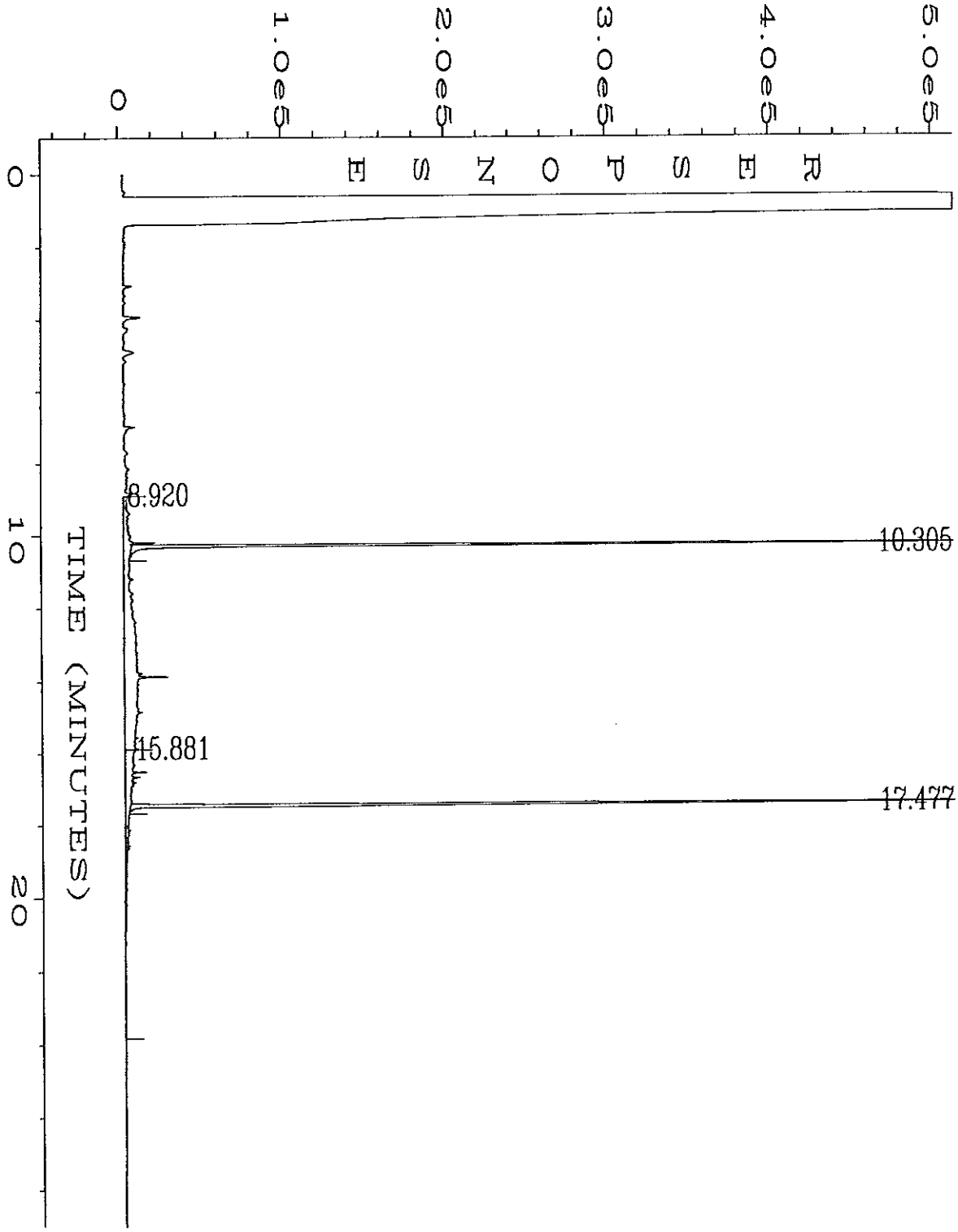
Laura Dutton

Laura Dutton
Project Manager



Data File Name : C:\HPCHEM\2\DATA\APR11\008F0301.D
Operator : TF
Instrument : BOB
Sample Name : 604140-01 W
Run Time Bar Code:
Acquired on : 11 Apr 96 06:45 PM
Report Created on: 11 Apr 96 07:22 PM

Page Number : 1
Vial Number : 8
Injection Number : 1
Sequence Line : 3
Instrument Method: TPHE.MTH
Analysis Method : TPHE.MTH



Data File Name : C:\HPCHEM\2\DATA\APR11\011R2101.D
Operator : TF
Instrument : BOB
Sample Name : 604140-04 W
Run Time Bar Code:
Acquired on : 12 Apr 96 02:49 PM
Report Created on: 12 Apr 96 03:27 PM

Page Number : 1
Vial Number : 11
Injection Number : 1
Sequence Line : 21
Instrument Method: TPHE.MTH
Analysis Method : TPHE.MTH

NORTH CREEK ANALYTICAL
Environmental Laboratory Services

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PORTLAND ▪ (503) 643-9200 ▪ FAX 644-2202

Dalton, Olmsted & Fuglevand, Inc.
11711 N. Creek Parkway, #D-101
Bothell, WA 98011
Attention: Terry Olmsted

Client Project ID: Cascade Log Sort Yard, #3
Sample Matrix: Water
Analysis Method: WTPH-D
Units: mg/L (ppm)

Extracted: Apr 10, 1996
Analyzed: Apr 11, 1996
Reported: Apr 12, 1996

HYDROCARBON QUALITY CONTROL DATA REPORT

ACCURACY ASSESSMENT
Laboratory Control Sample

Diesel

Spike Conc. Added:	2.04
Spike Result:	1.70
% Recovery:	83
Upper Control Limit %:	121
Lower Control Limit %:	54

PRECISION ASSESSMENT
Sample Duplicate

Diesel Range Organics

Sample Number:	B604137-01
Original Result:	N.D.
Duplicate Result:	N.D.
Relative % Difference:	Relative Percent Difference values are not reported at sample concentration levels less than 10 times the Reporting Limit.
Maximum RPD:	44

NORTH CREEK ANALYTICAL Inc.

Laura Dutton

Laura Dutton
Project Manager

% Recovery: $\frac{\text{Spike Result}}{\text{Spike Concentration Added}} \times 100$

Relative % Difference: $\frac{\text{Original Result - Duplicate Result}}{(\text{Original Result + Duplicate Result}) / 2} \times 100$

Dalton, Olmsted & Fuglevand, Inc

Environmental Consultants

Contract Laboratory:

CHAIN OF CUSTODY REPORT

CLIENT: Dalton, Olmsted & Fuglevand

ADDRESS:
19017 120th Avenue N.E., Suite 107
Bothell, Washington 98011-9508

PHONE: (206) 486-7905 FAX: (206) 486-7651

PROJECT NAME: Cascade Log Sort Yard No. 3

PROJECT NUMBER: USO-001-02

SAMPLED BY: T. Olmsted

REPORT TO: Terry Olmsted, DOF

BILLING TO: U.S. Oil - Dan Riley

P.O. NUMBER:

QUOTE #:

SAME DAY RUSH	(+150%)	
1 BUSINESS DAY RUSH	(+100%)	
2 BUSINESS DAY RUSH	(+80%)	
3 BUSINESS DAY RUSH	(+60%)	
5 BUSINESS DAY RUSH	(+40%)	
10 BUS. DAY STANDARD	(LIST)	
5 BUS. DAY HYDROCARBON	(LIST)	X

Analysis Request

SAMPLE IDENTIFICATION: (NUMBER OR DESCRIPTION)	SAMPLING DATE / TIME	MATRIX (W,S,O)	# OF CONT.	WTPH-G/BETX	WTPH-D	COMMENTS & PRESERVATIVES USED	LABORATORY SAMPLE NUMBER
1. MWUSO-3S	4/8/96 0900	W	3	X	X		B604140-01
2. MWUSO-5S	4/8/96 1100	W	3	X	X		-02
3. MWUSO-6S	4/8/96 0945	W	3	X	X		-03
4. Duplicate #1 ~~Rinsate Blank~~	4/8/96 0945	W	3	X	X		-04
5.							
6.							
7.							
8.							
9.							
10.							

RELINQUISHED BY: [signature] DATE: 4/9/96
FIRM: Dalton, Olmsted & Fuglevand, Inc. TIME: 14:20

RECEIVED BY: Dana Hu
FIRM: NCA-B
DATE: 4/9/96
TIME: 1420

RELINQUISHED BY:
FIRM:
DATE:
TIME:

RECEIVED BY:
FIRM:
DATE:
TIME:

SAMPLE RECEIPT INFORMATION: CONTAINER CONDITION?: GOOD VIOLATED COOL (4° C)? YES NO

CUSTODY SEALS? GOOD VIOLATED NOT USED HAZARDOUS SAMPLES?: NO YES; DESCRIBE ON BACK