SR
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BAF

Soil, interim
GW

SEACOR

#2495

March 2, 1992

Off-site
Investig. at
nearby station

Mr. Bruce W. Hilyer
Culp, Guterson & Grader
27th Floor, One Union Square
600 University Street
Seattle, Washington 98101-3143

RESULTS OF SOIL VAPOR STUDY, 4557 BROOKLYN AVENUE NE, SEATTLE, WASHINGTON SEACOR JOB NO. 00148-002-01

Dear Mr. Hilyer:

SEACOR is pleased to provide the following letter report documenting activities and results of a soil gas survey at 4557 Brooklyn Avenue NE, Seattle, Washington. This report provides a background of the previous subsurface investigation conducted at the site, the methods and procedures used for the soil vapor study, and the results of the soil vapor study. The scope of services was performed in accordance with the SEACOR proposal dated November 12, 1991 and supplements work completed during a soil and groundwater investigation study completed on September 23, 1991.

SITE BACKGROUND

The following briefly summarizes the conclusions of the previous environmental studies at the site and provides the rationale for the present study:

- During the SEACOR study of the site conducted in September 1991 up to 1.8 feet of free-floating hydrocarbon product was found on the groundwater surface in two monitoring wells.

- With the exception of an underground storage tank (UST) reportedly located below the building foundation, which was closed in place, all USTs were reportedly removed from the site in 1988. Soil containing petroleum hydrocarbon constituents was reportedly excavated and removed from the site. The tanks presently at the site have passed tightness testing. The source of the hydrocarbons previously detected by SEACOR at the site was not identified.

11040 Main Street
Suite 240
Bellevue, WA 98004
(206) 646-0280
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- Based upon the groundwater data, there does not appear to be an interconnection between the site and the nearby Chevron property, where a documented release of unleaded gasoline has occurred. It is possible there is a migration pathway, such as a utility conduit, between the Chevron property and the site.

To further assess the source of petroleum hydrocarbons at the site, and to investigate whether utility conduits may provide a possible migration pathway, the following tasks were completed:

- Soil vapor samples were collected from 12 soil vapor sample locations at the site. Soil vapor sampling locations were selected to evaluate the areas at the site containing elevated concentrations of petroleum hydrocarbon constituents in soil and groundwater. The vapor probe locations at the site and surrounding area are shown on Figure 1.

- Soil vapor samples were collected at 10 locations off site to assess if there is a migration pathway for petroleum hydrocarbons from the Chevron property. Soil vapor samples were collected near utility conduits and from near the Chevron property boundaries in the City of Seattle easement.

METHODS AND PROCEDURES

The following methods and procedures were used to complete the soil vapor survey.

Soil Vapor Survey

Before subsurface borings were initiated, underground utilities in the area were located. A hand auger was also used in some areas to avoid utilities. To collect soil vapor samples, a 1-1/2 inch pilot hole was drilled through the surface material. A stainless steel probe was driven to a depth of approximately 6 feet below ground surface at each location. A vacuum was created on the probe and the soil gas vapors were collected into Tedlar bags for laboratory analysis. Between each sampling location the stainless steel probe was decontaminated using a Liqui-Nox soap and water wash. All associated sampling tubing was replaced between sampling locations.

RESULTS

The results of the laboratory analysis for the vapor survey are presented below. The laboratory report and chain-of-custody record for the vapor samples are contained in Appendix A.

Soil Vapor Analysis

Soil vapor samples were analyzed for total petroleum hydrocarbons (TPH) by EPA Method 8015 modified, and benzene, toluene, ethyl benzene and xylene (BTEX) by EPA Method 8020. The results of the samples are shown in Table 1. The concentration of TPH in soil vapor at each sampling location is shown in Figure 1. There are currently no regulatory cleanup levels based upon vapor concentrations. There are two sampling points (VS-10 and VS-6), near the northwestern and southeastern portion of the site that have the highest concentration of TPH in soil vapor. The results indicate there are no detectable concentrations of petroleum hydrocarbons in soil vapor near the subsurface storm drain (VS-5 and VS-15) which is located on the west side of the site. The elevated vapor concentration at the sample location (VS-17) near the intersection of 47th Street and Brooklyn Avenue is possibly the result of migration from the Chevron property.

CONCLUSIONS

Based upon the results of the soil vapor sampling and analysis the following items can be concluded:

- The soil vapor results at the site do not appear to correlate with the results of the previous groundwater study. The highest vapor concentrations of TPH were detected near the northwestern and southeastern portions of the site. Free floating petroleum product was previously encountered near the central and southeast portions of the site.

- Based upon previous studies, the groundwater flow in the area is to the southeast. Based upon the relatively high soil vapor concentration detected near the northwestern (VS-10) portion of the property elevated levels of petroleum hydrocarbons may be present in soil and/or groundwater in this area. The elevated concentration of petroleum hydrocarbons in the southeast (VS-6) portion of the site also suggests the presence of petroleum hydrocarbons. The presence of petroleum hydrocarbons in this area are likely due to transportation with groundwater in a southeasterly direction.

- There are detectable concentrations of hydrocarbons in soil vapor around the perimeter of the Chevron property. It appears that soil vapor from the Chevron property has migrated to the south and west.

- There are no detectable concentrations of hydrocarbons in soil vapors around the perimeter of the site or near the subsurface utility conduits. Based upon the study results no migration pathways from the Chevron property to the site were identified.

RECOMMENDATIONS

During a site meeting on January 20, 1992, Mr. Dale Erickson indicated the extent of excavation at the site during previous UST removal was not as extensive as originally communicated. In addition, Mr. Erickson indicated that additional USTs may be present in the northwestern portion of the site. Further geophysical investigation completed by another consultant reportedly was inconclusive as to whether additional tanks are buried at the site.

The following tasks are recommended to further investigate if tanks are present and to estimate the extent of the plume at the site.

Task 1 - Geophysical Investigation

Because the previous geophysical survey was inconclusive, it is recommended that a ground penetrating radar (GPR) be used to assess if an UST is located north of the station building at the site. The GPR is useful because it is sometimes possible to locate a tank without subsurface excavation. However, the GPR is often inconclusive because of the possibility of encountering non penetrable subsurface materials such as buried pipelines. If the GPR survey is inconclusive, Task 2 is recommended to be completed.

Task 2 - Backhoe Investigation

If the GPR survey is inconclusive, it is recommended that a backhoe be used to excavate a trench in the vicinity of the venting pipes located north of the station building at the site to assess if a UST is potentially buried in this area. If a tank is present it is expected to be located between four to six feet below ground surface. Care will be taken during investigation activities to not break any exposed venting pipes encountered.

Task 3 - Monitoring Wells

Three monitoring wells and one soil boring are recommended to further define the extent of petroleum hydrocarbons in soil and groundwater at the site. The locations of the three monitoring wells are shown in Figure 2. One monitoring well will be located near the northwest corner of the property to assess the source of the elevated concentration of TPH detected in soil vapor sample location VS-10. One well will be installed near the southern portion of the site to help define the extent of petroleum hydrocarbons. A monitoring well will be installed near the southeast property boundary to asses the eastern extent of petroleum hydrocarbons. A soil boring will be completed near the southern portion of the property where the soil vapor sample VS-6 indicated the highest concentration of petroleum hydrocarbons. If field observations indicate the presence of petroleum hydrocarbons at this location, SEACOR will recommend completing the boring as a vapor extraction well.

All wells will be screened from 5 feet below ground surface to the base of the borehole so that the wells may be possibly converted to vapor extraction wells in the future. It is expected that monitoring wells will be installed to a depth of 25 feet below ground surface. Increased length in the screen interval allows for greater surface area to extract petroleum hydrocarbon vapors. Increasing the screen length above 5 feet below ground surface would require a variance to conform to Washington Minimum Standards for Construction and Maintenance of Wells (173-160 WAC).

Soil and groundwater samples will be collected during drilling and backhoe excavation for analysis of total petroleum hydrocarbons for gasoline by Modified EPA Method 8015 and 8020. One groundwater sample and up to two soil samples will be collected from each monitoring well and boring. Upon completion of all tasks and receipt of analysis from the project laboratory a report will be prepared presenting the sample results, and documenting the field activities.

We appreciate the opportunity to work with you on this project. Attached to this letter is a cost estimate for completing additional services at the site. Please feel free to call regarding any questions on this report.

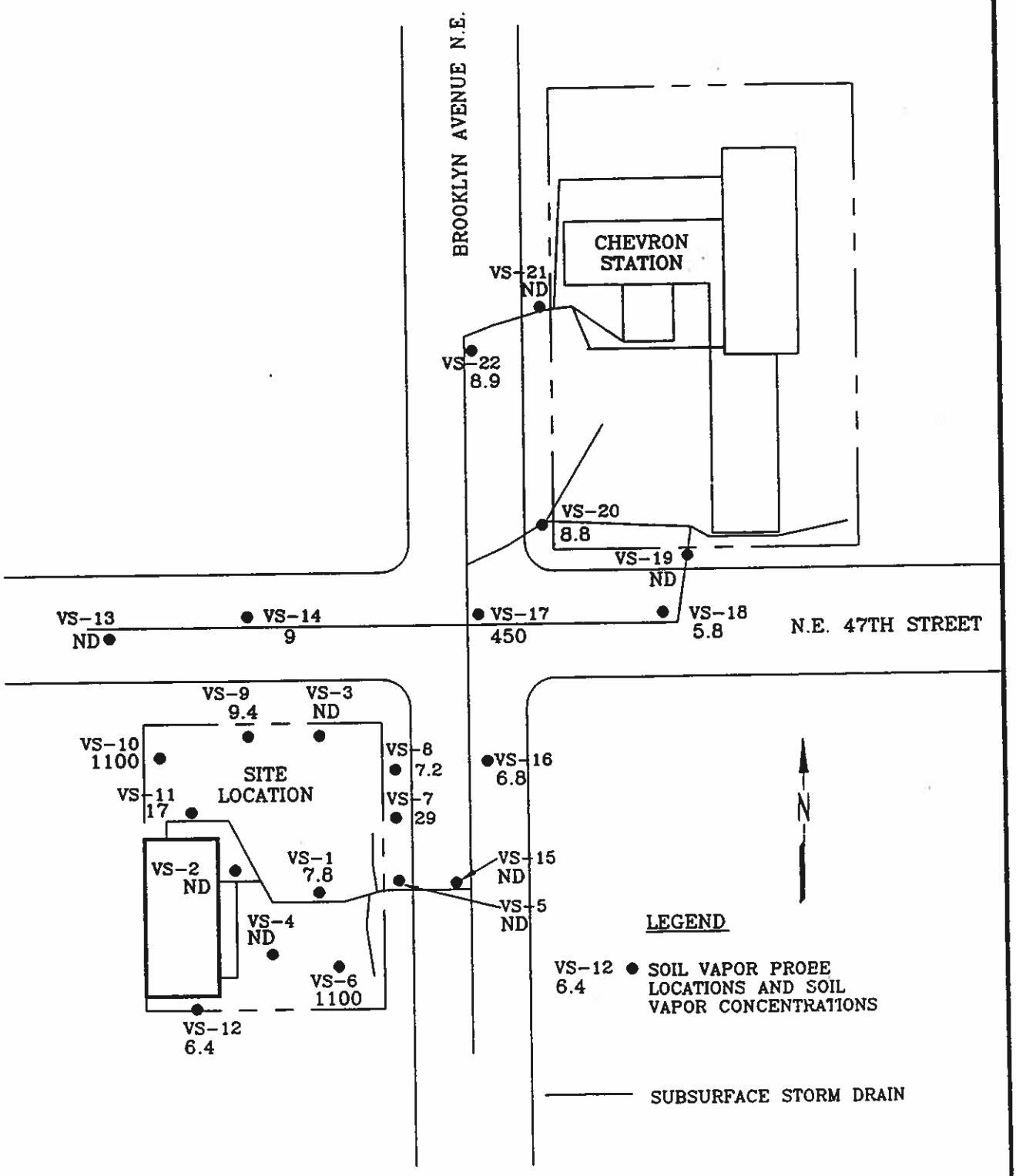
Sincerely,

Tim Slotta
Senior Hydrogeologist

James H. Flynn
Principal Hydrogeologist

TABLE 1
SUMMARY OF LABORATORY RESULTS OF VAPOR SAMPLES
(11/29, 12/2, 1990)

Sample Description	Analytical Results (µg/L)					
	EPA Method 8015 Modified	EPA Method 8020				
	TPH(g)	Benzene	Toluene	Ethyl Benzene	Xylene	
VS-1	7.8	ND	0.10	0.085	0.47	
VS-2	ND	ND	ND	ND	ND	
VS-3	ND	ND	ND	ND	ND	
VS-4	ND	ND	ND	ND	ND	
VS-5	ND	ND	ND	ND	ND	
VS-6	1,100	ND	ND	ND	4.9	
VS-7	29	ND	0.056	ND	ND	
VS-8	7.2	ND	ND	ND	ND	
VS-9	9.4	ND	ND	ND	ND	
VS-10	1,100	5.5	2.5	1.4	3.7	
VS-11	17	0.070	0.12	0.063	0.20	
VS-12	6.4	ND	0.072	ND	0.11	
VS-13	ND	ND	ND	ND	ND	
VS-14	9.0	ND	ND	ND	ND	
VS-15	ND	ND	ND	0.20	1.8	
VS-16	6.8	ND	ND	ND	0.18	
VS-17	450	0.71	ND	ND	ND	
VS-18	5.8	ND	ND	ND	0.10	
VS-19	ND	ND	ND	ND	ND	
VS-20	8.8	ND	ND	ND	ND	
VS-21	ND	ND	ND	ND	ND	
VS-22	8.9	ND	ND	0.24	2.2	



SEACOR	DWN TB APPR TS DATE 11/12/91 JOB# 00148-002-01	FIGURE 1 TPH CONCENTRATIONS DALE ERICKSON PROPERTY SEATTLE, WASHINGTON

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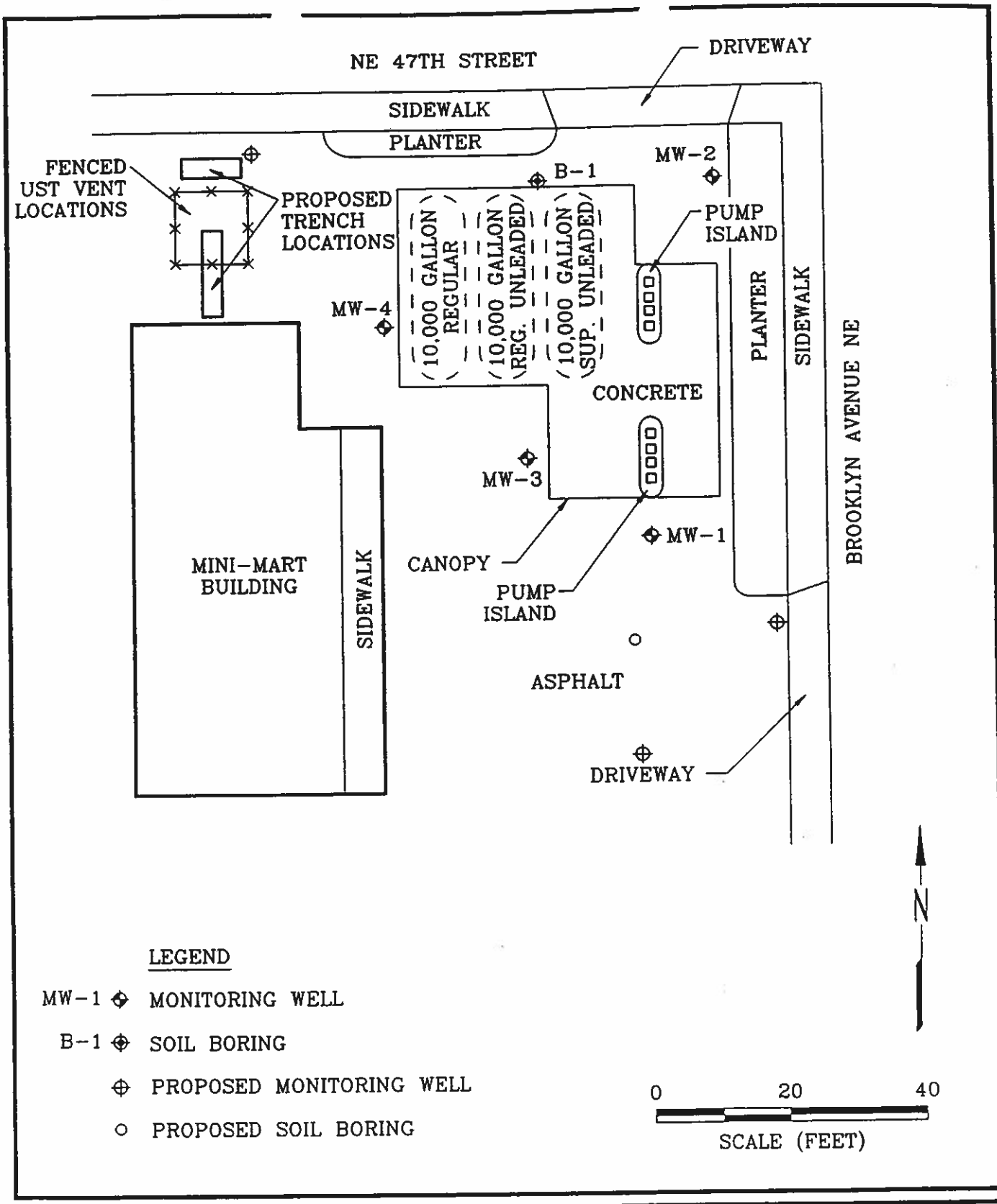

SEACOR	DWN TB APPR CJ/TS DATE JOB# 00148-002-01	FIGURE 2 SITE PLAN AND LOCATION OF PROPOSED SOIL BORINGS AND MONITORING WELLS DALE ERICKSON PROPERTY SEATTLE, WASHINGTON

DISC:0007 DWG:DALERI02

APPENDIX A

NORTH CREEK ANALYTICAL

18939 120th Avenue N.E., Suite 101 • Bothell, WA 98011-2569
Phone (206) 481-9200 • FAX (206) 485-2992

SEACOR	Client Project ID:	Dale Ericson 00148-002-01	Sampled: 11/29,12/2 1991
11040 Main Street, #240	Matrix Descript:	Air	Received: Dec 2, 1991
Bellevue, WA 98004	Analysis Method:	EPA 5030/8015/8020	Analyzed: Dec 2-3, 1991
Attention: Tim Slotta	First Sample #:	112-0021	Reported: Dec 5, 1991

TOTAL PETROLEUM FUEL HYDROCARBONS with BTEX DISTINCTION (WTPH-G/BTEX)

Sample Number	Sample Description	Purgeable Hydrocarbons µg/L Air	Benzene µg/L Air	Toluene µg/L Air	Ethyl Benzene µg/L Air	Xylenes µg/L Air	Surrogate Recovery %
112-0021	VS-1	7.8	N.D.	0.10	0.085	0.47	88
112-0022	VS-2	N.D.	N.D.	N.D.	N.D.	N.D.	83
112-0023	VS-3	N.D.	N.D.	N.D.	N.D.	N.D.	83
112-0024	VS-4	N.D.	N.D.	N.D.	N.D.	N.D.	84
112-0025	VS-5	N.D.	N.D.	N.D.	N.D.	N.D.	85
112-0026	VS-6	1,100 G-2	N.D.	N.D.	N.D.	4.9	115
112-0027	VS-7	29 G-2	N.D.	0.056	N.D.	N.D.	95
112-0028	VS-8	7.2 G-2	N.D.	N.D.	N.D.	N.D.	88
112-0029	VS-9	9.4 G-2	N.D.	N.D.	N.D.	N.D.	88
112-0030	VS-10	1,100	5.5	2.5	1.4	3.7	89
Detection Limits:		2.0	0.050	0.050	0.050	0.10	

Purgeable Hydrocarbons are quantitated against a gasoline standard (nC5 - nC14). Surrogate recovery reported is for Bromofluorobenzene.
Analytes reported as N.D. were not present above the stated limit of detection.

NORTH CREEK ANALYTICAL

Scot Cocanour
Laboratory Director

Please Note:
The detection limit for Benzene, Toluene and Ethyl Benzene in #112-0026 = 0.50 µg/L Air.

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SEACOR	Client Project ID:	Dale Ericson 00148-002-01	Sampled: 11/29,12/2 1991
11040 Main Street, #240	Matrix Descript:	Air	Received: Dec 2, 1991
Bellevue, WA 98004	Analysis Method:	EPA 5030/8015/8020	Analyzed: Dec 2-3, 1991
Attention: Tim Slotta	First Sample #:	112-0031	Reported: Dec 5, 1991

TOTAL PETROLEUM FUEL HYDROCARBONS with BTEX DISTINCTION (WTPH-G/BTEX)

Sample Number	Sample Description	Purgeable Hydrocarbons µg/L Air	Benzene µg/L Air	Toluene µg/L Air	Ethyl Benzene µg/L Air	Xylenes µg/L Air	Surrogate Recovery %
112-0031	VS-11	17 G-2	0.070	0.12	0.063	0.20	92
112-0032	VS-12	6.4 G-2	N.D.	0.072	N.D.	0.11	88
BLK120291	Method Blank	N.D.	N.D.	N.D.	N.D.	N.D.	84
Detection Limits:		2.0	0.050	0.050	0.050	0.10	

Purgeable Hydrocarbons are quantitated against a gasoline standard (nC5 - nC14). Surrogate recovery reported is for Bromofluorobenzene.
Analytes reported as N.D. were not present above the stated limit of detection.

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Scot Cocanour
Laboratory Director

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SEACOR	Client Project ID:	00148-002-01	Sampled: Dec 10, 1991
11040 Main Street, #240	Matrix Descript:	Air	Received: Dec 11, 1991
Bellevue, WA 98004	Analysis Method:	EPA 5030/8015/8020	Analyzed: Dec 12, 1991
Attention: Tim Slotta	First Sample #:	112-0368	Reported: Dec 23, 1991

TOTAL PETROLEUM FUEL HYDROCARBONS with BTEX DISTINCTION (WTPH-G/BTEX)

Sample Number	Sample Description	Purgeable Hydrocarbons µg/L Air	Benzene µg/L Air	Toluene µg/L Air	Ethyl Benzene µg/L Air	Xylenes µg/L Air	Surrogate Recovery %
112-0368	VS-13	N.D.	N.D.	N.D.	N.D.	N.D.	82
112-0369	VS-14	9.0	N.D.	N.D.	N.D.	N.D.	84
112-0370	VS-15	N.D.	N.D.	N.D.	0.20	1.8	86
112-0371	VS-16	6.8	N.D.	N.D.	N.D.	0.18	86
112-0372	VS-17	450	0.71	N.D.	N.D.	N.D.	84
112-0373	VS-18	5.8	N.D.	N.D.	N.D.	0.10	87
112-0374	VS-19	N.D.	N.D.	N.D.	N.D.	N.D.	87
112-0375	VS-20	8.8	N.D.	N.D.	N.D.	N.D.	86
112-0376	VS-21	N.D.	N.D.	N.D.	N.D.	N.D.	89
112-0377	VS-22	8.9	N.D.	N.D.	0.24	2.2	91
Detection Limits:		5.0	0.050	0.10	0.10	0.10	

Purgeable Hydrocarbons are quantitated against a gasoline standard (nC5 - nC14). Surrogate recovery reported is for Bromofluorobenzene.
Analytes reported as N.D. were not present above the stated limit of detection.

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Scot Cocanour
Laboratory Director

Please Note:
The detection limit for Toluene, Ethyl Benzene, and Xylenes = 0.20 µg/L Air.

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SEACOR	Client Project ID:	00148-002-01	
11040 Main Street, #240	Matrix Descript:	Soil	
Bellevue, WA 98004	Analysis Method:	EPA 5030/8015/8020	Analyzed: Dec 12, 1991
Attention: Tim Slotta	First Sample #:	BLK121291	Reported: Dec 23, 1991

TOTAL PETROLEUM FUEL HYDROCARBONS with BTEX DISTINCTION (WTPH-G/BTEX)

Sample Number	Sample Description	Purgeable Hydrocarbons µg/L Air	Benzene µg/L Air	Toluene µg/L Air	Ethyl Benzene µg/L Air	Xylenes µg/L Air	Surrogate Recovery %
BLK121291	Method Blank	N.D.	N.D.	N.D.	N.D.	N.D.	86
Detection Limits:		1.0	0.050	0.10	0.10	0.10	

Purgeable Hydrocarbons are quantitated against a gasoline standard (nC5 - nC14). Surrogate recovery reported is for Bromofluorobenzene.
Analytes reported as N.D. were not present above the stated limit of detection.

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SEACOR 11040 Main Street, #240 Bellevue, WA 98004 Attention: Tim Slotta	Client Project ID: 00148-002-01 Method : EPA 5030/8020 Sample Matrix : Air Units : µg/L QC Sample #: BLK121291	Analyst : Analyzed: Reported:	R. Lister S. Stowell Dec 12, 1991 Dec 23, 1991

QUALITY CONTROL DATA REPORT

ANALYTE	Benzene	Toluene	Ethyl benzene	Xylenes
Sample Conc.:	N.D.	N.D.	N.D.	N.D.
Spike Conc. Added:	0.50	0.50	0.50	1.50
Conc. Matrix Spike:	0.48	0.50	0.52	1.44
Matrix Spike % Recovery:	96	100	104	96
Conc. Matrix Spike Dup.:	0.48	0.50	0.50	1.42
Matrix Spike Duplicate % Recovery:	96	100	100	95
Relative % Difference:	0	0	3.9	1.0

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Laboratory Director

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

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

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18939 120th Avenue N.E., Suite 101 • Bothell, WA 98011-2569
Phone (206) 481-9200 • FAX (206) 485-2992

SEACOR 11040 Main Street, #240 Bellevue, WA 98004 Attention: Tim Slotta	Client Project ID: Dale Ericson 00148-002-01 Method : EPA 5030/8020 Sample Matrix : Air Units : µg/L QC Sample #: BLK120291	Analyst : Analyzed: Reported:	R. Lister S. Stowell Dec 2, 1991 Dec 5, 1991

QUALITY CONTROL DATA REPORT

ANALYTE	Benzene	Toluene	Ethyl benzene	Xylenes
Sample Conc.:	N.D.	N.D.	N.D.	N.D.
Spike Conc. Added:	0.50	0.50	0.50	1.50
Conc. Matrix Spike:	0.44	0.46	0.50	1.42
Matrix Spike % Recovery:	88	92	100	95
Conc. Matrix Spike Dup.:	0.44	0.48	0.50	1.44
Matrix Spike Duplicate % Recovery:	88	96	100	96
Relative % Difference:	0	4.3	0	1.0

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Scot Cocanour
Laboratory Director

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

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

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SEACOR	Client Project ID: Dale Ericson 00148-002-01	Analyst :	R. Lister
11040 Main Street, #240	Method : EPA 5030/8020		S. Stowell
Bellevue, WA 98004	Sample Matrix : Air		
Attention: Tim Slotta	Units : µg/L	Analyzed:	Dec 2, 1991
	QC Sample #: BLK120291	Reported:	Dec 5, 1991

QUALITY CONTROL DATA REPORT

ANALYTE	Benzene	Toluene	Ethyl benzene	Xylenes
Sample Conc.:	N.D.	N.D.	N.D.	N.D.
Spike Conc. Added:	0.50	0.50	0.50	1.50
Conc. Matrix Spike:	0.44	0.46	0.50	1.42
Matrix Spike % Recovery:	88	92	100	95
Conc. Matrix Spike Dup.:	0.44	0.48	0.50	1.44
Matrix Spike Duplicate % Recovery:	88	96	100	96
Relative % Difference:	0	4.3	0	1.0

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Laboratory Director

% Recovery:	Conc. of M.S. - Conc. of Sample / Spike Conc. Added	x 100
Relative % Difference:	Conc. of M.S. - Conc. of M.S.D. / (Conc. of M.S. + Conc. of M.S.D.) / 2	x 100