PROGRESS REPORT NO. 2 REMEDIAL ACTION CONSULTATION SERVICES SUBSURFACE FUEL VAPOR EXTRACTION PROGRAM SERVICE STATION 5353 SEATTLE, WASHINGTON

FOR

UNOCAL



January 3, 1991

Consulting Geotechnical Engineers and Geologists

Unocal P.O. Box 76 Seattle, Washington 98111

Attention: Mr. Gary Gunderson

We are submitting five copies of Progress Report No. 2 for our remedial action consultation services at the site of Unocal Station 5353 in Seattle, Washington. This progress report provides information for the time period between July 21, 1988 and December 7, 1990. Future progress reports will be issued to update the information presented in this report.

We appreciate the opportunity to be of continued service to Unocal. Please call if you have any questions regarding this report.

Yours very truly,

GeoEngineers, Inc.

Stephen C. Perrigo Associate

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File No. 0161-013-B04

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PROGRESS REPORT NO. 2 REMEDIAL ACTION CONSULTATION SERVICES SUBSURFACE FUEL VAPOR EXTRACTION PROGRAM SERVICE STATION 5353, SEATTLE, WASHINGTON FOR UNOCAL

#### INTRODUCTION

This progress report summarizes ongoing site remediation efforts and monitoring activities at Unocal Service Station 5353 for the period of July 21, 1988 through December 7, 1990. The site is located northeast of the intersection between Mercer Street and Westlake Avenue in Seattle, Washington (Figure 1). Details of the site history, design, installation and operation of the VRS (vapor recovery system) are given in Progress Report No. 1 dated July 27, 1988. An Interim Status Report, dated October 3, 1988, summarized vapor recovery progress and proposed changes to the operation of the VRS.

Figure 1 shows the main features of the site and the locations of monitor wells and recovery wells discussed in this report. Field data collected during this reporting period are presented in Appendix A. Laboratory analytical data are presented in Appendices B and C.

#### VAPOR RECOVERY SYSTEM OPERATION

Earlier in this reporting period, a decision was made to continue operating the VRS using the thermal incinerator unit rather than switching the unit to a catalytic reactor as was previously planned. This decision was based on cost considerations and is discussed in our Interim Status Report dated October 3, 1988. The relatively low cost of supplementary fuel (natural gas) in this area makes the operation of the thermal incinerator more cost effective than changing to the catalytic reactor unit.

Approximately 869 days elapsed during this reporting period of July 21, 1988 through December 7, 1990. The VRS was operational for about 544 days during this same period. Nonoperational periods have consisted of



unscheduled and scheduled shutdowns. About 100 days of unscheduled shutdown time and 225 days of scheduled shutdown time elapsed during this reporting period.

Some difficulties with the operation of the VRS were encountered during the early portion of this reporting period. These difficulties forced the VRS to shut down operation automatically on numerous occasions (mainly from December 1988 through February 1989), for approximately 58 days of Troubleshooting the VRS and the vapor collection unscheduled down time. system by GeoEngineers and B & C Equipment representatives indicated that excess water entering the system (probably from condensation) was partially responsible for the problem. A new water trap was installed in October 1988 to collect additional condensation collecting in the system. Operational problems attributable to excess water in the system continued after the new water trap was installed, through February 1989. At this time, a larger water trap consisting of a 55-gallon drum was installed. We also determined that fine soil matter and grit from the interior of the piping system clogged the internal vanes on the flame arrestor. This problem was remedied in September 1988 by the installation of a filter screen near the flame arrester to capture the grit. Since these modifications were incorporated, the VRS maintained fairly continuous operation, provided that the water traps were checked frequently.

There continued to be occasional unscheduled shutdowns of the VRS during this reporting period because of the accumulation of water and other miscellaneous mechanical problems in the system. These shutdowns were of relatively short duration and accounted for 42 days of unscheduled shutdown time. GeoEngineers and B & C Equipment worked together to remedy these problems.

There were two intervals of scheduled shutdown time during this reporting period. These shutdowns occurred from February 2 to May 11, 1990 (98 days) and from August 2 through December 7, 1990 (127 days). The VRS remains inoperative at the time this report is issued. These scheduled shutdowns were implemented after routine system monitoring indicated that vapor concentrations in the VRS were reduced to the point where it was determined that hydrocarbon recovery was nominal.

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Smoke tests were conducted across the surface of the site on August 2, 1988. These tests were conducted to determine the location of areas where ground vacuum was being reduced because of cracks in pavement and/or poorly sealed surface monuments. Two areas determined to have significant surface leakage were the vault located just south of the incinerator enclosure and the vault located near RW-7. These areas were subsequently sealed by B & C Equipment.

A sample of the waste condensate water was obtained from the 55-gallon water trap on March 31, 1989. This condensate sample was analyzed for total petroleum hydrocarbons (EPA Method 418.1) and purgeable aromatics (EPA Method 8020) in order to evaluate the appropriate method of water disposal. The laboratory report is presented in Appendix C.

#### MONITORING ACTIVITIES

#### GENERAL

The two types of monitoring activities at the site include: (1) monitoring of subsurface conditions, and (2) VRS performance monitoring. The time interval between monitoring activities varied from one week to four weeks during this reporting period. The intensity of monitoring decreased as the VRS operation and subsurface vapor concentrations became more predictable. Some inconsistencies in the frequency of monitoring are attributed to scheduled and unscheduled shutdowns of the VRS.

#### SUBSURFACE CONDITIONS

Ground Water Level Monitoring: Ground water levels were measured in the monitor wells and recovery wells at the site during the current reporting period on April 14, 1989, October 27, 1989, February 1, 1990, May 1, 1990, June 15, 1990 and December 7, 1990. Water table elevations measured from February 14, 1988 (prior to the initial start-up of the VRS) through the latest measurements on December 7, 1990 are presented in Table A-1 in Appendix A. Ground water level measurements were made using a fiberglass tape and water-finding paste.

The water table at the site typically occurs at a depth of about 10 feet below site grades. Ground water elevations as measured on December 7, 1990 (the latest full round of measurements) and referenced to

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the Seattle datum ranged from 9.68 feet to 10.94 feet. The elevation of the water table appears to have fluctuated by about 0.6 to 1.6 feet since our initial 1988 measurements. Fluctuations in the ground water table elevations do not appear to be related to normal seasonal conditions.

Free Product Monitoring: Free product thicknesses were measured in the monitor wells and recovery wells at the site during the current reporting period on April 14, 1989, October 27, 1989, February 1, 1990, May 1, 1990, June 15, 1990 and December 7, 1990. Free product thicknesses measured from February 14, 1988 (previous to the initial start-up of the VRS) through the latest measurements on December 7, 1990 are presented in Table A-1 in Appendix A. Free product thickness measurements were made using a fiberglass tape and gasoline-finding paste or a water/product interface probe.

Since our initial measurements in 1988, measurable product has been detected in monitor wells MW-1, MW-2, MW-13, MW-17, MW-18, MW-19 and MW-24, and in recovery wells RW-4, RW-7, RW-10 and RW-28. The product thicknesses have varied from 0.01 feet to 0.66 feet. A trace of free product (detectable but not measurable) was found in monitor wells MW-3, MW-11 and MW-30, and in recovery wells RW-5, RW-8, RW-9 and RW-26, during our measurements.

A product sample was obtained from monitor well MW-2 on June 15, 1990 and from monitor well MW-19 on July 24, 1990. These product samples were submitted to the laboratory for fuel fingerprint analysis (EPA Method 8015, modified) to evaluate the type and relative age of the product. The laboratory reports are presented in Appendix C.

Soil Vapor Monitoring: Combustible vapor concentrations in all accessible monitor wells and recovery wells were measured on 28 occasions during this reporting period. Combustible vapor concentrations measured with field instrumentation prior to the current reporting period were erratic, probably because of the lack of oxygen in the subsurface environment. During this reporting period, the field instrumentation behaved more reliably, which we feel indicates the effectiveness of the vapor recovery system in drawing ambient air into the subsurface environment. Subsurface vapor concentrations measured from June 29, 1988

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through the latest measurements on December 7, 1990 are presented in Table A-2 in Appendix A. Subsurface vapors were monitored in the well casings using a Bacharach TLV Sniffer calibrated to hexane.

Vapor samples were collected from selected monitor wells and recovery wells on several occasions throughout this reporting period. These vapor samples were submitted to the laboratory and analyzed for total volatile hydrocarbons and methane. The purpose of this analysis is to distinguish between fuel hydrocarbon vapors and methane gas.

Methane gas is present at high concentrations in the subsurface environment at this site. The presence of the methane gas is unrelated to the fuel leak or operation of the service station. The results of the vapor analyses on the samples obtained from May 16, 1988 (prior to the initial startup of the VRS) through July 24, 1990 are presented in Table A-3 in Appendix A. The laboratory reports for samples obtained during this reporting period are presented in Appendix B. The vapor samples were obtained by withdrawing vapors from the headspace in the well casings into stainless steel cylinders.

Periodic measurements of carbon dioxide concentrations also were made in selected wells, including monitor wells MW-3, MW-14, MW-17, MW-29 and MW-30. Subsurface carbon dioxide concentrations measured from August 9, 1988 through the latest measurements on July 24, 1990 are presented in Table A-3 in Appendix A. The percentage of carbon dioxide in vapor within the headspace in these well casings was measured using a Bacharach Fyrite Gas Analyzer.

Ground Water Sampling: Ground water samples were obtained from monitor wells MW-1 and MW-30 on October 19, 1988. Biological tests were performed on the water samples to determine aerobic plate counts over time. The purpose of this analysis was to determine the relative amount of biological activity in ground water. Plate counts were determined immediately after sample collection, after one day, after three days, and after seven days. These results are illustrated in Figure 2. The laboratory report is presented in Appendix C.



#### VAPOR RECOVERY SYSTEM PERFORMANCE MONITORING

The VRS was constructed with the capability to withdraw vapor from any combination of the four vapor recovery wells at the site. During the initial reporting period (Progress Report No. 1) the withdrawal mode was changed frequently in order to evaluate the relative efficiency of the different modes of operation. In order to evaluate efficiency of an operational mode, monitoring is required at each change in operation mode. The VRS was monitored on a less frequent basis during the current reporting period because the most preferred operational modes had been determined.

Monitoring the performance of the VRS involves measurement of several operational parameters including: (1) the total system flow rate measured in cubic feet per minute, (2) system vacuum expressed in inches of water column, (3) combustible vapor concentration in the extracted vapors using a Bacharach TLV Sniffer, (4) carbon dioxide concentration in the extracted vapors using a Bacharach Fyrite Gas Analyzer, (5) temperature of the extracted vapors, and (6) rate of consumption of supplementary fuel by the incinerator. Measurement of these parameters generally takes place each time the withdrawal mode is changed. Samples of extracted vapors are also collected from the system immediately before and after the withdrawal mode is changed. These vapors are analyzed for TVH (total volatile hydrocarbons) and methane, The laboratory reports for samples obtained during this reporting period are included in Appendix B. All of the VRS monitoring data collected since the startup of the system are summarized in Table A-4 in Appendix A.

Ground vacuum also is monitored to evaluate the performance of the VRS. Ground vacuum in all accessible monitor wells and recovery wells was measured on 22 occasions during this reporting period. Ground vacuum measured from June 29, 1988 through the latest measurements on July 24, 1990 are presented in Table A-5 in Appendix A. Ground vacuum measurements were made in the wells casings using a magnahelic gauge with a resolution of 0.005 inches water column.



#### DISCUSSION AND CONCLUSIONS

#### SUBSURFACE CONDITIONS

Ground Water and Free Product. The ground water level fluctuatations during this reporting period did not follow seasonal fluctuations that are typical of the Puget Sound Region. The ground water monitoring data indicate that the ground water levels are higher than would normally be expected in some of the wells located close to areas of vapor extraction. These anomalous variations in ground water levels are likely attributable to the effect of the subsurface vacuum. The vacuum effectively raises the water table locally in those areas of greatest vacuum. These ground water levels return to normal relative to nearby wells when operation of the VRS is terminated.

Artificial fluctuation of the ground water table probably has a beneficial effect on the removal of residual gasoline from the subsurface environment. Natural biodegradation of residual fuel hydrocarbons in the subsurface environment requires that (1) the hydrocarbons must be available to bacteria, and (2) oxygen, moisture and other nutrients must be available. The repeated rise and fall of ground water levels as induced by the cyclic operation of the VRS probably made the conditions for natural biodegradation more favorable.

At the onset of this monitoring period, measurable thicknesses of free product were present in five monitor wells, with a maximum thickness of 0.44 feet. At the end of this monitoring period, measurable thicknesses of free product were not observed in any of the monitor wells.

We obtained a product sample from two wells (MW-2 and MW-19) in June to evaluate the fuel type and degree of weathering. The fuel samples were analyzed by EPA Method 8015 (modified). The results of those analyses provided confirmation that the fuel type was gasoline and that the fuel was weathered. The chromatograms from the analyses show a distinct loss of the lighter phase of the gasoline. It is our opinion that the free product observed during this monitoring period can be attributed to historic releases rather than a recent, ongoing release.

Subsurface Hydrocarbon Vapors: Interpretation of subsurface hydrocarbon vapor data at this site has been hampered by the presence of



methane gas in the subsurface environment. Field measurements of vapors cannot distinguish between vapor types. The field monitoring instrument (a Bacharach TLV Sniffer) employs a sensor which is sensitive to methane and any other combustible vapor. We attempted to use a PID (photoionization detector) along with the TLV Sniffer instrumentation to assist in vapor discrimination. The PID is not sensitive to methane but is sensitive to other hydrocarbon vapors. Thus, in theory, it should be possible to determine the concentrations of methane versus other hydrocarbon vapors when using the instruments together. We found poor correlation of field data to actual laboratory data using this method, and as a result have discontinued attempts to distinguish vapor type using field instrumentation.

The VRS has been effective in reducing combustible vapor concentrations beneath the service station site during periods of active operation. When the system is turned off, the ground vapor concentration gradually return to relatively high levels. The VRS has not been effective in lowering combustible vapor concentrations in monitor wells located north of the site.

Subsurface vapor concentrations in areas unaffected by the VRS typically exceed the upper limit of the field monitoring instrument's range, which is 10,000 parts per million (this is one percent on a total volume basis, which corresponds to about 90 percent of the Lower Explosive Limit for gasoline). Vapor concentrations as measured by laboratory analysis have shown concentrations as high as 30 percent methane and 16 percent other TVH (total volatile hydrocarbons) expressed on a volume/volume basis. Twenty-two vapor samples have been collected from monitor wells for chemical analysis since the VRS operation began. The average methane concentration in these analyses has been 76,100 ppm (7.6%) and the average TVH concentration has been 15,700 ppm (1.6%).

There is significant ongoing methane production in the vicinity of the site. The location of the methane source is not readily apparent from our monitoring data; however, the methane appears to be ubiquitous across the site. Risks of fire, explosion and/or asphyxiation posed by methane gas are similar to those posed by gasoline vapors. We recommend that the Washington State Department of Ecology be made aware of the presence of methane in the vicinity of the site. The continued high concentrations of methane gas

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indicate that there is a nearby, ongoing source of methane production. Sawdust fill was encountered in explorations completed in 1980 to characterize contamination in the vicinity of the site. The methane observed in the wells may be the result of decomposition of sawdust fill.

Despite the presence of methane vapors in the ground, the monitoring data clearly show reduced concentrations of gasoline vapors within the subsurface environment. This indicates that there is air exchange occurring within the zone of residual gasoline contamination. In addition to removing gasoline vapors through evaporation, this air exchange transports oxygen to the contaminated zone which helps stimulate natural biodegradation of the residual gasoline.

Indications of Biological Activity: Ground water samples were obtained from two monitor wells in October 1988 to evaluate the presence and activity of naturally occurring bacteria with an affinity to degrade gasoline. Counts of aerobic bacteria were evaluated initially and then at periodic intervals as each sample was mildly agitated (aerated). The testing showed a significant increase of 20 to 30 fold in bacterial populations over the seven-day test period. Figure 2 shows the increase in bacterial activity during this test. This testing indicates that, given sufficient oxygen, the naturally occurring bacteria at the site will increase their rate of destruction of residual gasoline.

We measured carbon dioxide concentrations in selected wells during this reporting period. Carbon dioxide is produced by bacterial decomposition of organic materials. The highest carbon dioxide concentrations were noted in wells MW-14 and MW-30, which are located northwest and northeast of the service station site, respectively. These high carbon dioxide measurements likely can be attributed to the same process that is producing the methane gas (which may be the decomposition of sawdust fill). In the absence of methane gas generation, elevated carbon dioxide concentrations could be attributed to biodegradation of the gasoline.

#### VRS SYSTEM PERFORMANCE

System Vacuum: System vacuum has been measured at the VRS system to evaluate the maximum potential vacuum applied to the ground at the withdrawal locations. A high system vacuum in conjunction with an adequate



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flow rate indicates that the vapor recovery system is operating efficiently and affecting a large subsurface area. Low system vacuum may be attributed to short-circuiting of subsurface air flow paths to the ground surface with the resulting loss of vacuum.

The greatest system vacuum measurements were obtained when vapor withdrawal was from the southern vapor recovery wells (RW-4A and RW-5A). Significant declines in system vacuum were noted when withdrawal was from the entire system or when withdrawal was from the northern part of the site. This probably indicates that short-circuiting of vacuum occurred in the northern part of the system. Smoke testing to identify surface leaks identified several locations of significant air flow into the ground in the northern part of the system. These areas were repaired. It is our opinion that additional short-circuiting of vapor flow in the northern part of the system is occurring at the location where the gravel backfill of the collection trenches intersects the backfill of the sewer line and/or other buried utilities along Westlake Avenue.

Ground vacuum measurements clearly show that withdrawal from the southern part of the vapor recovery system induces measurable vacuums over a greater area than from the northern part of the VRS. Figure 3 shows a contour map of the maximum vapor concentration measured at each monitor well during the period of operation of the VRS. Maximum ground vacuums in excess of 10 inches water column were typical in the southern part of the system, while maximum vacuums in the northern part of the system never exceeded 1 inch of water column.

The maximum measurable extent of vacuum impact of the VRS is also shown in Figure 3. The VRS has been effective in vapor withdrawal beneath the service station property. Off-site influence to the west is likely limited by the presence of a deep sewer line and its backfill. The VRS impact to the south, across Mercer Street also may be affected by buried utilities. The data indicate limited impact of the VRS to the east and north of the site, in areas with known fuel-related hydrocarbon vapor concentrations.

Vapor Withdrawal: Vapor withdrawal efficiency has been calculated using monitoring information about flow rates and chemical composition of the effluent gas at the VRS. Table A-6 shows the estimated equivalent vapor

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recovery for methane and gasoline for each individual period of system operation. Since the onset of operation of the system, we estimate that the equivalent of about 4,300 gallons of gasoline have been recovered in the withdrawn vapors. During the same period, about 120,800 cubic feet of methane gas have been recovered. Figure 4 shows the general trend in daily recovery rates during the period of operation of the system. Seasonal influence in vapor recovery rates are not apparent in the data. Some of the changing trends shown are caused by shifts in the operating mode of the VRS and withdrawal ports.

The most significant trend identified in the data shown in Figure 4 is the rate of decline of recovery rates with time. Initially, gasoline recovery rates for TVH declined from over 10 gallons per day to about 1 gallon per day over a period of about six months. During the next period of operation the system exhibited a greater rate of decline. During the final period of VRS operation, the average daily gasoline recovery rates declined from over 10 gallons per day to less than 0.01 gallons per day over a period of about three months.

The declining rates of recovery can be due to several reasons, including:

- increased inefficiency of the system due to desiccation of the soils and subsequent short-circuiting of air flow paths,
- (2) reduced volume of available residual gasoline for recovery,
- (3) depletion of residual hydrocarbon vapors in the subsurface.

We believe that the recent rapid declines in gasoline recovery rates during operation of the VRS are attributed to the latter two reasons. The rapid decline in recovery rates correlates closely with the disappearance of free product from monitor wells. The volume of air removed by the VRS represents a volume equivalent to about 600 exchanges of the available unsaturated pore space in the area of measured influence of the VRS. Therefore, it is likely that the area influenced by the VRS has effectively undergone several full "flushings" of its soil pore space.



#### FUTURE ACTIONS AND MONITORING

#### VAPOR RECOVERY SYSTEM OPERATION

The recent performance of the VRS gives valuable insight into the most effective mode of further operation of the system. We recommend that the system be operated in a "pulsed" mode with a sequence of two weeks on followed by two weeks off. Most air withdrawal should be from the southern part of the system, but periodically the northern part of the system should be purged to remove accumulated vapors.

The system efficiency should be observed closely during the periods of pulsed operations. After about three to six months, depending upon observed efficiencies, the system operation should be reevaluated.

#### PERFORMANCE MONITORING

Performance monitoring should continue in general accordance with past monitoring protocol. This includes measurements of water level and product thickness on a monthly basis, and measurement of ground vacuum and vapor concentrations in wells at each time the system configuration is changed. Periodic sampling and analysis of vapors from selected wells will support an understanding of the influence of methane on the cleanup activities.

Measurements of system vacuum, flow rate, combustible vapor concentration, carbon dioxide concentration, and fuel consumption should be made each time the VRS is turned on and off. Vapor samples also should be obtained to evaluate methane and TVH concentrations.

We also recommend the evaluation of additional field vapor monitoring techniques to differentiate methane from TVH.

#### FUTURE REPORTING

We will provide a progress report of system operation after completion of the recommended period of pulsed operation (three to six months, depending upon observed efficiencies under this mode of operation).

#### LIMITATIONS

We have prepared this report for use by Unocal in their evaluation of ongoing vapor recovery efforts at Station 5353 in Seattle, Washington. This report may be made available to potential buyers of the property and to

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regulatory agencies. The report is not intended for use by others and the information contained herein may not be applicable to other sites.

Our services have been executed in accordance with generally accepted practices in this area at the time the report was prepared. No other conditions, express or implied, should be understood.

Please call if you have questions concerning this progress report.

Respectfully submitted,

GeoEngineers, Inc.

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#### APPENDIX A

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## TABLE A-1 (Page 1 of 2) WATER AND PRODUCT LEVELS IN MONITOR AND RECOVERY WELLS

		02/1	4/88	05/1	5/88	07/2	0/88	04/1	4/89
	Casing	Water		Water		Water		Water	
	Rim	Table	Product	Table	Product	Table	Product	Table	Product
Well	Elevation(1)	Elevation	Thickness	Elevation	Thickness	Elevation	Thickness	Elevation	Thickness
MW-1	20.12	9.62*	0.22	10.06*	0.10			10.48	Trace
MW-2	20.07							10.18*	0.18
MW-3	19.38	9.61	Trace	10.02	0.00			10.34	Trace
MW-11	19.82	9.64	Trace	10.26	0.00			10.26	0.00
MW-13	21.73	9.86	0.00	10.30	0.00			10.63	0.00
MW-14	19.28	9.63	0.00	10.33	0.00			10.33	0.00
MW-15	20.48	9.86	0.00	10.30	0.00			10.52	0.00
MW-16	21.19	10.04	0.00	10.43	0.00			10.65	0.00
MW-17	21.28	9.77*	0.07	10.09*	0.04			10.53	0.00
MW-18	21.0 <del>9</del>	9.98	0.00	10.36*	0.06			10.89	0.00
MW-19	20.97	9.91*	0.23	10.25*	0.44			10.65*	0.57
MW-24	21.49	(2)	(2)	(2)	(2)			10.78	0.00
MW-25	21.16	10.52	0.00	10.75	0.00	***		11.59	0.00
MW-29	18.63	9.00	0.00	9.93	0.00			10.02	0.00
MW-30	18.86	8.91	Trace	9.69	0.00	10.52	Trace	9.72	0.00
RW-4A	21.28	9.50*	0.17			10.58	Trace	10.82	0.00
RW-5A	21.40	9.61	0.00			<del>9</del> .83	Trace	10.93	0.00
RW-7	20.66	9.38*	0.13	140 orth		9.79	Trace	10.36	0.00
RW-8	19.92	9.31	0.00			9.74	Trace		
RW-9	20.61	9.24	Trace			9.71	Trace	9.99	0.00
RW-10	20.59	9.29	0.00			9.88*	0.01	9.99	0.00
RW-26	20.72	9.42	0.00			9.68	Trace	10.11	0.00
RW-28	21.17	9.23*	0.09					9.98	0.00

Notes: "--" signifies "no measurement taken"

(1) Elevations measured in feet and referenced to Seattle Datum

(2) Well was dry on date measured

\* Water table elevation adjusted for presence of free product

## TABLE A-1 (PAGE 2 OF 2)

		10/2	27/89	02/0	01/90	05/0	01/90	06/1	5/90	12/0	7/90
	Casing	Water									
	Rim	Table	Product								
Well	Elevation (1)	Elevation	Thickness								
MW-1	20.12	10.14	0.00			10.30	0.00			10.44	0.00
MW-2	20.07			10.82	0.00	10.10*	0.14	10.34*	0.12	10.28	0.00
MW-3	19.38	10.08	0.00			10.25	0.00			10.39	0.00
MW-11	19.82	10.10	Trace	10.17	0.00	10.21	0.00			10.23	0.00
MW-13	21.73	10.39*	0.03	10.76	0.00	10.60	0.00			10.62	0.00
MW-14	19.28	10.12	0.00	10.13	0.00	10.29	0.00			10.24	0.00
MW-15	20.48	10.20	0.00	10.31	0.00	10.30	0.00			10.35	0.00
MW-16	21.19	10.39	0.00	10.59	0.00	10.60	0.00			10.61	0.00
MW-17	21.28	10.06	0.00	10.57	0.00	10.38	0.00			10.50	0.00
MW-18	21.09	10.26	0.00	10.67	Trace	10.48	0.00			10.73	0.00
MW-19	20.97	10.01	Trace	9.93	Trace	10.55*	0.43	10.65*	0.47	10.78	0.00
MW-24	21.49	(2)	(2)	(2)	(2)	10.66*	0.66			(2)	(2)
MW-25	21.16	11.60	0.00	(2)	(2)	(2)	(2)			(2)	(2)
MW-29	18.63	9.54	0.00	9.93	0.00	10.08	0.00			9.68	0.00
MW-30	18.86	9.28	0.00	9.78	0.00	9.73	0.00				
RW-4A	21.28	10.20	0.00	10.32	0.00	10.16	0.00			10.31	0.00
RW-5A	21.40	9.94	0.00	10.76	0.00	10.17	0.00			10.94	0.00
RW-7	20.66	9.92	0.00	10.11	0.00	10.10	0.00			10.23	0.00
RW-8	19.92	9.84	0.00	10.03	0.00	10.00	0.00			10.15	0.00
RW-9	20.61	9.75	0.00	9.93	0.00	9.91	0.00			10.05	0.00
RW-10	20.59	9.73	0.00	9.92	0.00	9.89	0.00			10.04	0.00
RW-26	20.72	9.85	0.00	10.03	0.00	10.02	0.00			10.27	0.00
RW-28	21.17	10.10	0.00	9.87	0.00	9.87	0.00			9.80	0.00

Notes:

"--" signifies "no measurement taken" (1) Elevations referenced to Seattle Datum

(2) Well was dry on date measured

\* Water table elevation adjusted for presence of free product

TABLE A-2 (Page 1 of 3) SUBSURFACE COMBUSTIBLE VAPOR MONITORING DATA

02/0	1/188         07/08/88           <100         NV           <100         NV           <100         660           <100         6700           <100         660           <100         6700           <100         700           <100         <100           <100         <100           <100         <100           <100         <100           <100         <100           <100         <100           <100         <100           <100         <100           <100         <100           <100         <100           <100         <100           <100         <100	07/11/88 >10,000 >10,000 <10,000 >10,000 >10,000 NV NV NV NV NV NV NV NV		07/18/88 5,400 380 380 380 380 380 5,400 5,400 <100 <100 <100 <100 <100 <100	07/25/88 >10,000 >10,000 >10,000 >10,000 >10,000 <100 <100 <100	08/02/88 <100 <100 <100 >10,000 <100 <100 <100 <100	08/09/88  2,400 2,400  2,400  2,400  2,400  2,400   2,400  2,400   2,400 	08/16/88 <100 <100 <100 2,800	08/30/88
		>10,000 >10,000 >10,000 >10,000 >10,000 NV NV NV NV NV NV NV NV	300 <100    	5,400 380 380 380 5,400 510,000 510,000 5100 5100 5100 5100	250 250 250 250 250 250 250 250 250 250	$\overline{}$	2,400 >10,000 >10,000 <100 <100 <100	<100 <100 <100 2,800	1
		>10,000 <10,000 >10,000 >10,000 NV NV NV NV	<pre>&lt;100  NV NV NV NV NV NV NV</pre>	380 >10,000 >10,000 >10,000 >100,000 >100	250 210,000 210,000 210,000 210,000 210,000 210,000 2100 2100 2100 2100 2100 2100 2100 2100 2100 210,000	7	<pre>&lt;100 </pre>	<100 <100 2,800	
		<pre>&lt;100 &gt;10,000 &gt;10,000 NV NV NV NV NV NV</pre>	>10,000 NV NV NV NV NV	>10,000 >10,000 >10,000 >100 <100 <100 <100	× 10,000 × 10,000 × 10,000 × 10,000 × 10,000 × 1000 × 1000 × 1000	7	2,400 ×10,000 ×100 ×100 ×100	<100 2,800	√00
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			2222	100 100 100	8888		Š	<100	220
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		22	22	A100	88		<100	>10,000	<100
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				8,400	3		<100 <100	<100	>10,000
		N	Ž	4 00 100	√100		<100	500	00 100
		000'01<	>10,000	<100	<100	>10,000	<100	>10,000	>10,000
		N	N	v100	100	√100	<100	<100	1,800
<100		>10,000	>10,000	>10,000	>10,000		>10,000	>10,000	>10,000
		>10,000		9,700	>10,000	>10,000	>10,000	>10,000	>10,000
5,100 <	<100	006' <del>1</del>	7,100	3,800	<100	5,200	640	4,000	1,000
		V100	1,600	1,600	<100		<100	2,500	2,400
	120	940	3,700	320	<ul><li>4100</li></ul>	1,800	180	2,200	340
		180	760	230	110	340	460	1,400	1,200
		<100	400	<100	<100	1,200	100	3,300	5,200
	100 740	310	180	400	140	<100	920	100	1,900
100		1,200	√100 100	280	₹ 100	<100 <100	<100	110	210
		<100	100	<100	<100	<100	<100	110	₹100 100

Vapor Collection System Operational Status

Northwest	0	Nonthwest 0 -	•	ı	ł	0	1	1	0	t	0	1
Northeast	0	;	1	I	1	0	I	1	0	1	0	,
Southwest	0	0	0	0	1	0	0	0	0	0	0	0
Southeast	0	0	0	0	0	0	0	0	0	0	0	0

Notes: Vapor concentrations were measured using a Bacharach TLV Snifter calibrated to hexane Besults are expressed as parts per million (volivol) Must of the readings of <100 ppm are suspect. This is discussed in the text Wur" signifies that a measurement was taken but the value was not valid. ->* agoifies that * -> * signifies * greater than*, * * signifies * no reading taken* Vapor collection system operational status shows the configuration of vepor withdrawel at the time the vapor readings were taken.		
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NOtes: Vapor concentratio Paeults are expres Must of the reading "NV" signifies that "C" signifies "Jess Vapor collection sy "C" signifies "O	s ware measured using a Bac) ad as parts per million (volvol) of <100 ppm are suspect. Thi measurement was taken but ian *. *>* signifies "greater th em operational status showe t	en" and "-" signifies " Close
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<b>Z</b>	Les: appr concentrations were measured using a Bach asults are expressed as parts per million (volvol) ust of the readings of <100 ppm are suspect. The V* signifies that a measurement was taken but tor collection system operational status shows to por collection system operational status shows to the collection system operational status shows to the collection status status shows to the collection status sta	O signifies Copen and signifies Close
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	Notes: Vapor concentrations were measured using a Bach Pesuits are expressed as parts per million (volvol) Must of the readings of <100 ppm are suspect. Thi "NV" signifies that a measurement was taken but t "are" signifies "less than ".">" signifies "greater th Vapor collection system operational status shows to vapor collection system operational status shows to are are are are are are are are are are	O signifies Copent and signifies Close

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						Date	ite					
Well	09/16/88	10/11/88	10/25/88	11/08/88	12/06/88	01/03/89	01/24/89 02/21/89		03/16/89	04/14/89	05/11/89	06/16/89
MW-1	600	<100	>10,000	<100	200	120	<100	<100	<100	<100	<100	100
2-MW	000'01<	001	>10,000	1,300		>10,000	>10,000	>10,000	2,800	<100	<100	
5-MM			000'01<			000,01<	3,000		000'01<	>10,000	<100	
	>10,000	000'01<	> 10,000	000'n1<	000'01 <	000'01<	000'01<	000'9	7,400	000'01<	>10,000	, , ,
51-WW	000,01<	>10,000	000,01<	008	>10,000	2,200	120	>10,000	120	160	200	120
51-MW	1,400	000'01<	>10,00,01<	>10,000	000,01<	>10,000	000,01<	000,01<	>10,000	>10,000	>10,000	>10,000
ST-WM	3,200		4,600		005		2,400	00 IV 7	00L>	160	2 ₽ 8 8	V 1 2 8 8 8
01-WW	002'1		>10,000	1,200	380	000'01<	>10,000	>10,000	3,200	560	100	<100 <
/L-MM	000,01<		>10,000	000,01<	000,01<	000'01<	000,01<	>10,000	>10,000	>10,000	300	>10,000
MW-18	>10,000	20 V	180	V100	180	>10,000	>10,000	>10,000	18	×100	100	100
MW-19	>10,000	000'0;<	>10,000	>10,000	▲100	>10,000	>10,000	>10,000	>10,000	₹ 100	>10,000	√18
MW-24	980	200	<100	<100	<100	1,400	>10,000	200	<100	100 100	√100 √1	√100 √1
MW-25	>10,000	>10,000	>10,000	>10,000	>10,000	100	>10,000	160	5,000	>10,000	>10,000	<100
MW-27	200	140	<100 <100	<pre>&lt;100</pre>	√100	100	220	600	<100	<100	100	110
MW-29	>10,000	>10,000	>10,000	>10,000	>10,000	>10,000	>10,000	>10,000	>10,000	>10,000	2,000	>10,000
MW-30	>10,000	>10,000	>10,000	>10,000	>10,000	>10,000	>10,000	>10,000	>10,000	>10,000	>10,000	>10,000
RW-4A	3,500	3,200	096	2,800	280	4,500	8,600	2,600	1,300	180	600	320
RW-5A	2,000	310	240	180	<100	220	240	4,000	1,200	280	620	520
RW-7	1,700	1,400	1,200	2,400	160					<100	√ 100	240
RW-8	2,000	1,200	2,000	2,400	330	200	220	4,200	720	160	<100	200
RW-9	2,000	1,400	560	1,900	1,200	220	280	2,800	440	<100	310	120
RW-10	1,000	220	4,800	<100	640	1,800	<u>5</u> 0	120	<100	100	28	200
RW-26	540	160	290	200	200	200	230	380	120	100	₹	120
RW-28	1,500	140	<100	<100	<100	<100	<100	<100	410	<100	<100	<100
Vanor Co	oltection Svs	Vapor Collection System Operational Status	nal Status									
Northwest			1			0	1	0	0	1	0	-
Northeast	ł	0	ı	0	,	0	ı	0	0	,	0	
Southwest	ı	ł	ı	ı	I	0	o	0	0	0	0	0
Southeast	1	Ű	0	0	0	0	o	0	0	0	0	0
Notes: Vapor co	ccentrationa v	lotes: Vapor concentrations were measured using a Baci	using & Bacha	harach TLV Shiffer calibrated to hexane	er celibrated t	o hexane						
Results & Most of N	are expressed he readings of	Reaults are expressed as parts per million (vol∧or). Most of the readings of <100 ppm are suspect. This is discussed in the text	llion (volwol) suspect. This	ls discussed in	the text.							
Dia VV.	nifies that a m	• NV* signifies that a measurement was taken but the value was not valid	is taken but th	e velue was no	• was not valid:							
Vapor co	diection system	C signines less that ; > signines gleater that ; signines to leading area Vapor collection system operational status shows the configuration of vapor withdrawel at the time the vapor readings were taken	atus shows the	configuration	of vapor with	ing landin Srawal at the tin	me the vapor n	edings were t	aken.			
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					Ö	Date					
Well	07/18/89 08/21/8	08/21/89	9 09/21/89	10/27/89	11/27/89	12/29/89	05/01/90	05/01/90	06/15/90	07/24/90	12/07/90
MW-1	110	1	4,000	<100	V 100	100		270	100	<100	100
MW-2	8,000	1	1	>10,000	√00	1	6,000	>10,000	500	√100	>10,000
MW-3	>10,000	V100	<100	250			1	>10,000	200	<100	>10,000
MW-11	>10,000	>10,000	>10,000	>10,000	>10,000	1,200	>10,000	3,900	>10,000	>10,000	>10,000
MW-13	6,000	<100	<100	180	8 ⊽	100	<100	140	100	200	>10,000
MW-14	>10,000	>10,000	>10,000	>10,000	>10,000	>10,000	>10,000	>10,000	>10,000	>10,000	>10,000
MW-15	1,300	₹ 700		200	200	160	>10,000	00 √	√100	120	260
MW-16	>10,000	>10,000	1000	480	<100 100	3,300	140	220	<100	2,200	>10,000
MW~17	>10,000	1,100	<100	<100	>10,000	>10,000	>10,000	>10,000	<100 ∧100	120	>10,000
MW-18	>10,000	V 100	<pre>&lt;100</pre>	<100 100	100	<100	8,200	>10,000	0 ₽	>10,000	>10,000
MW-19	>10,000	100	>10,000	<100	100	400	300	>10,000	4100	>10,000	>10,000
MW-24	120	240		<100	0 V	<100	<100	>10,000	√100 1	200	>10,000
MW-25	001>	220		<100	00 ₹	<100	2,500	>10,000	<100	>10,000	>10,000
MW-27	100	100	×100	100	₹ 78	<100	<100	2 ₹	00 ₹	<pre>&lt;100</pre>	180
MW-29	>10,000	4,500	4,400	6,400	>10,000	>10,000	>10,000	>10,000	>10,000	>10,000	ļ
MW-30	>10,000	-	>10,000	>10,000	6,000	>10,000	>10,000	5,000	>10,000	>10,000	1
RW-4A	1,000	800	1,600	220	500	<100	200	6,200	300	1,500	8,000
RW-5A	360		200	100	₹ 18	<100	100 100	100	150	130	<100
RW-7	440	160	300	180	500	160	720	140	√100	<100	920
RW-8	230		√100 √1	130	440	9,600	510	120	120	<100	100
8-WA	200	340	180	350	300	400	380	160	√100	<100	120
RW-10	620	2,000	<100	140	v100	180	400	180	190	<100	430
RW-26	400	√100	<100 <100	320	√100	160	<100	140	<100 100	<100	110
RW-28	180	<100	<100	v100	<100	<100	<100	<100	<100	<100	10

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lotes:	vapor concentrauons were messured using a bacharach i LV Sruner callorated to rexane. Results are expressed as parts per million (volvol) Mout of the readings of <100 ppm are suspect. This is discussed in the text	£ ∖	Vapor collection system operational status shows the configuration of vapor withdrawal at Ille time the vapor readings were taken * 0* signifies "Open" and *-* signifies "Closed"
13	> ⊑ ⊇	"NV" signifies that a measurement was taken but the value was not valid. "<" signifies "fess than"; ">" signifies "greater than", "" signifies "no reading taken"	200
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## TABLE A-3 (Page 1 of 2) ADDITIONAL TESTING OF VAPORS FROM SELECTED MONITOR WELLS

				Laboratory Ana	lyses of Vapors
		Field Measurer	nent of Vapors		Total Volatile
		TLV Reading	Carbon Dioxide	Methane	Hydrocarbons
Well	Date	(ppm) (1)	(%) (2)	(ppm) (3)	(ppm) (4)
MW-1	05/16/88	>10,000		36,000	12,000
	08/03/88	6,000		33	<10
MW-3	07/11/89			26,000	14,000
	07/18/89	>10,000	5.5		
	05/01/90	>10,000		98,000	13,000
MW-14	07/18/89	>10,000	12.5	80,000	570
	10/27/89	>10,000		110,000	47,000
	02/01/90	>10,000		110,000	2,800
	05/01/90	>10,000	7.0	91,000	3,400
MW-17	05/16/88	>10,000		120,000	49,000
	08/03/88	<100		<10	<10
	07/18/89	>10,000	3.5	12,000	1,800
	02/01/90	>10,000		260,000	2,700
	05/01/90	>10,000	4.5	49,000	9,700
MW-19	10/27/89	<100		50	380
MW-29	05/16/88	>10,000		300,000	160,000
	08/03/88	>10,000		200,000	16,000
	08/09/88	>10,000	0.0		
	08/16/88	>10,000	1.0		
	08/30/88	>10,000	2.5		
	09/16/88	>10,000	0.0		
	10/11/88	>10,000	1.5		
	10/25/88	>10,000	2.5		
	11/08/88	>10,000	0.0		
	12/06/88	>10,000	0.0	1,000	1,200
	01/03/89	>10,000	0.0		
	02/21/89	>10,000	0.0		
	03/16/89	>10,000	1.5		

NOTES:

\*>" signifies "greater than", "<" signifies "less than"

"ppm" signifies "parts per million; "----" signifies " no measurement taken"

(1) Field measurements for TLV taken using a Bacharach TLV Sniffer calibrated to hexane

(2) Carbon dioxide measured using a Bacharach Fyrite Gas Analyzer

(3) Analyses for methane by GC/FID and expressed as ppm methane (vol/vol)

(4) Analyses for Total Volatile Hydrocarbons by GC/FID and expressed as ppm hexane (vol/vol)

## TABLE A-3 (Page 2 of 2)

				Laboratory Ana	lyses of Vapors
		Field Measurer			Total Volatile
		TLV Reading	Carbon Dioxide	Methane	Hydrocarbons
Well	Date	(ppm) (1)	(%) (2)	(ppm) (3)	(ppm) (4)
MW-29 (con	05/11/89	2,000	1.0	***	
	06/16/89	>10,000	2.0		
	07/11/89			9,100	980
	07/18/89	>10,000	5.5		
	08/21/89	4,500	0.0		
	09/21/89	4,400	1.0		
	11/27/89	>10,000	0.0		
	12/29/89	>10,000	5.0		
	02/01/90	>10,000		37,000	860
	05/01/90	>10,000	6.5	32,000	1,500
	07/24/90	>10,000	2.0		
MW-30	08/09/88	>10,000	0.5		
	08/16/88	>10,000	14.0		
	08/30/88	>10,000	10.0		
	09/16/88	>10,000	9.0		
	10/11/88	>10,000	10.0		
	10/25/88	>10,000	8.5		
	11/08/88	>10,000	2.0		
	01/03/89	>10,000	11.5		
	02/21/89	>10,000	11.0		
	03/16/89	>10,000	10.0		
	05/11/89	>10,000	14.5		
	06/16/89	>10,000	3.0		
	07/18/89	>10,000	13.0		
	09/21/89	>10,000	9.0		
	10/27/89	>10,000	6.5	92,000	8,300
	11/27/89	6,000	0.0		
	12/29/89	>10,000	13.0		
	05/01/90	6,000	11.5		
	07/24/90	>10,000	14.5		
RW-4A	05/01/90	6,200		11,000	260

NOTES:

">" signifies "greater than", "<" signifies "less than" "ppm" signifies "parts per million; "----" signifies "no measurement taken"

(1) Field measurements for TLV taken using a Bacharach TLV Sniffer calibrated to hexane

(2) Carbon dloxide measured using a Bacharach Fyrite Gas Analyzer

(3) Analyses for methane by GC/FID and expressed as ppm methane (vol/vol)

(4) Analyses for Total Volatile Hydrocarbons by GC/FID and expressed as ppm hexane (vol/vol)

## TABLE A-4 (Page 1 of 3) VAPOR RECOVERY SYSTEM OPERATION AND MONITORING DATA

						[ · · · ·					Sample I	Port A(4)	
		Flow	Vapor				Syst	tern		TLV	%		
		Rate	Temperature	Vacuum	Fuel Use	Co	nfigu	ration	(3)	Reading	Carbon	түн	Methane
Date	Time	(CFM)	(degrees F)	(Inches)(1)	(CFM)(2)	NW	NE	S₩	SE	(ppm)(5)	Dioxide(6)	(ppm)(7)	(ppm)(8)
06/24/88	130 <b>6</b>	110	-	_		-	-	0	0	>10,000		600	110,000
06/24/88	1408	110					-	0	o	>10,000		520	110,000
06/28/88	1334	115	—			0	0	0	0	>10,000	1	6,500	75,000
06/28/88	1412	105	—			-	-	- 1	0	>10,000	—	1,400	110,000
06/28/88	1415	105	—	—			-	-	0	>10,000	-	1,800	95,000
06/28/88	1421	115				-	0	- 1	-	615		7,800	58,000
06/28/88	1429	110				0	-	-	-	700		5,400	43,000
06/28/88	1435	110				-	-	0	-	>10,000		450	17,000
06/28/88	1440	115			3.5	0	0	0	0	>10,000			<del></del>
06/29/88	1512	118	—	8.6		0	0	0	0	>10,000		760	8,600
06/29/88	1554	115		>10.0		-		0	0	>10,000		8,800	46,000
06/30/88	1535	115			-	-	-	0	0		-	15,000	63,000
07/01/88	1358	110				-	-	0	0			8,000	38,000
07/01/88	1418	110	—			-	0	-	0			410	4,900
07/05/88	1325	115	-				0	-	0			2,000	22,000
07/05/88	1330					0	0	o	0	<u> </u>			
07/06/88	0955	110		7.0		0	0	0	0			1,600	10,000
07/06/88	1010	105		16.0		-	-	-	0		—	5,900	55,000
07/06/88	1025	110	<u> </u>	10.0		-	0	-	-			820	11,000
07/06/88	1100	110		11.0		0	-	-	-			1,200	5,900
07/06/88	1130	110		15.5		-	-	0				5,200	31,000
07/06/88	1130	110		15.5				0	0	and the second	-		
07/08/88	1020	110		11.0		-	-	0	0	>10,000		1,700	16,000
07/08/88	1040	105		16.8	3.3	-	-	-	0	>10,000	-	2,200	25,000
07/12/88	0920	105		16.0		-	-	-	0	4,700		990	4,800
07/12/88	0940	115	—	7.5	3.3	0	0	0	0	2,000	—	490	930
07/15/88	1505	115		7.0		0	0	0	0	4,100		1,100	3,700
07/15/88	1525	112		10.5	2.9	_	-	0	0	>10,000	_	560	1,430
07/20/88	1550	110	_	10.5	3.0	_	-	0	0	4,700		9,000	1,500

Notes:

(1) Vacuum expressed as inches of water column

(2) Supplementary fuel consumption (cubic feet per minute)

(3) "-" = "Closed" and "O" = "Open"

(4) Sample Port A located on line between blower and burner units

(5) Measurement made with Bacharach TLV Sniffer calibrated to hexane

(6) Carbon dioxide measured using a Bacharach fyrite gas analyzer.

(7) Total Volatile Hydrocarbon analysis by GC/FID, expressed as ppm (vol/vol)

(8) Methane analysis by GC/FID, expressed as ppm (vol/vol)

"---" signifies "no reading taken"; ">" signifies "greater than"; "<" signifies "less than".

### TABLE A-4 (Page 2 of 3)

											Sample F	Port A(4)	<u> </u>
		Flow	Vapor				Syst	lem		TLV	%		
		Rate	Temperature	Vacuum	Fuel Use	Co	nfigui	ration	(3)	Reading	Carbon	түн	Methane
Date	Time	(CFM)	(degrees F)	(Inches)(1)	(CFM)(2)	NW	NE	SW	SE	(ppm)(5)	Dioxide(6)	(ppm)(7)	(ppm)(8)
07/27/88	0755	112	81	10.5	2.9	-	-	0	0	3,900		6,600	650
07/27/88	0810	115		7.5	2.9	ο	0	0	0	1,100		5,200	250
08/02/88	0700	115	75	7.0	3.0	0	0	0	0	2,600	0.5		
08/03/88	0910	115	78	7.2	3.0	0	0	0	0	2,400	1.0	1,500	1,200
08/03/88	1100	112	81	9.7	3.0	-	-	0	0			5,100	2,000
08/09/88	0710	110	7 <del>6</del>	10.5	1.5	-	-	0	0	2,700	1.5	2,800	4,600
08/09/88	0820	115	77	8.5	1,5	0	ο	0	0	2,300	2.5	2,500	2,800
08/16/88	0713	115	74	8.5	1.5	0	0	0	0	3,200	1.0	450	1,000
08/16/88	1015	108	73	13.0	3.0	_	_	0	ο	4,600	1.5	3,800	1,200
08/30/88	0735	110	74	11.0	3.25	-	-	0	0	2,500	1.0	870	460
0 <b>8/30/88</b>	0830	112	74	8.0	2.75	0	0	0	0	2,200	3,5	690	860
09/21/88	0820	85	72	5.0	5.3	0	0	0	0	2,200		210	250
09/23/88	1120	82	72	14.0	6.0	-	ο	-	0	2,800	1.5	950	2,800
10/11/88	0713	40	84	13.0	6.0	-	0	-	0	2,000	0.5	4,400	6,100
10/11/88	0818	25	90	17.0	6.0	-	-	-	0	7,200	2.5	1,500	480
10/25/88	0815	105	59	—	8,5	-	-		0	2,000	0.5	1,400	730
10/25/88	0835	105	60	_	6.5	-	0	-	0	2,500	6.5	2,500	3,400
11/08/88	0710	110	62	_	7.0	-	0	-	0	2,000	1.0	2,100	320
11/08/88	0915	80	58		7.0	-	-	-	0	2,700	1.0	2,900	2,600
12/06/88	0715	100	<50		5.0	-	-		0	1,200		940	500
12/06/88	0920	100	<50		5.0	0	0	_	-	1,200	2.0	270	560
02/21/89	0700	110	<65	>30.0	2.5	0	0	0	0	3,100	0.5	840	3,000
03/16/89	0714	110	<50	>30.0	0.7	0	0	0	0		0.0	610	370
03/16/89	0920	105	<50	>30.0	0.7	-	-	о	о		0.0	1,000	1,400

- Notes:
  - (1) Vacuum expressed as inches of water column
  - (2) Supplementary fuel consumption (cubic feet per minute)
  - (3) "-" = "Closed" and "O" = "Open"
  - (4) Sample Port A located on line between blower and burner units
  - (5) Measurement made with Bacharach TLV Sniffer calibrated to hexane
  - (6) Carbon dioxide measured using a Bacharach fyrite gas analyzer.
  - (7) Total Volatile Hydrocarbon analysis by GC/FID, expressed as ppm (vol/vol)
  - .(3) Methane analysis by GC/FiD, expressed as ppm (vol/vol)
  - "---" signifies "no reading taken"; ">" signifiee "greater than"; "<" signifies "less than".

### TABLE A-4 (Page 3 of 3)

						[					Sample	Port A(4)	<u> </u>
		Flow	Vapor				Sys	tem		TLV	%		
		Rate	Temperature	Vacuum	Fuel Use	Co	nfigu	ration	n(3)	Reading	Carbon	түн	Methane
Date	Time	(CFM)	(degrees F)	(Inches)(1)	(CFM)(2)	NW	NE	sw	SE	(ppm)(5)	Dioxide(6)	(ppm)(7)	(ppm)(8)
04/14/89	0730	107	58	15.0	6.5	-	-	0	0	1,000		1,500	240
04/14/89	0748	110	58	5.0	6.5	0	0	о	0	500		3,300	220
05/11/89	0657	110	60	5.0	6,5	0	0	0	0	500	0.0	770	520
05/11/89	0808	105	60	16.0	6.5	-	-	0	σ	920	0.0	510	180
06/16/89	0740	105	66	15.0	6,0	-	-	0	0	720	0.0	380	220
06/16/89	0817	110	66	5.0	8.0	0	0	0	0	500	2.5	140	170
07/06/89	0710	108	68	6.5	7.0	0	0	0	0			260	63
07/06/89	0735	110	68	6.5	7.0	-	ο	-	-	570		190	150
07/18/89	0840	102	70	7.0	7.0	-	0	-	0	2,700	7.0	500	4,000
08/21/89	0935	110	70	8.0	7.0	-	0	+	0	540	1.5		
08/21/89	1000	110	72	5.0	7.0	0	0	0	0	500	1.5	260	240
09/21/89	0755	110	68	5.0	7.0	0	0	0	0	500	1.0	370	<10
09/21/89	0845	102	68	>30.0	7.0	_	_	-	о	2,600	3.0	810	<10
10/27/89	0715	100	55	>30.0	7.0		ł	1	0	420	0.5	3,600	210
10/27/89	0747	110	55	8.0	7.0	-	0	-	0	680	4.0	620	870
11/27/89	0815	110	52	0.5	7.0	-	0	-	0	620	0.0		~~
12/06/89	0840	110	52	0.0	7.0		0	-	0	400	0.0	560	240
12/08/89	0900	100	52	0.0	7.0			-	0	1,000	0.0	690	740
12/29/89	0700	100	<50	>30.0	7.0	-	ł	ł	0	260	0.0	140	76
12/29/89	0800	110	<50	8.0	7.0	-	0	-	ο	480	3.5	35	380
02/01 <b>/9</b> 0	0730	110	<50	>30.0	7.0	-	-	-	0	480	_	16	<10
02/02/90	0800	Blower/E	urner shutdown										
05/11/ <b>90</b>	1100	Blower/B	lumer restarted									<b></b>	
05/11/90	1715	110	62	>30	7.0	_	_	0	ο	8,800	2.0		
05/14/90	1400	110	61	>30	7,0		-	0	0	1,600	1.0		
06/15/90	0700	113	62	22	7.0	-		o	0	180		150	100
06/15/90	0800	113	62	20	7.0	-	0	_	о	150		90	100
07/24/90	0755	90	72		6,9	~	0	-	0	20	0.0		
07/24/90	0810	85		_	6.9	0	0	0	0	20	0.0		

Notes:

(1) Vacuum expressed as inches of water column

(2) Supplementary fuel consumption (cubic feet per minute)

(3) "-" = "Closed" and "O" = "Open"

(4) Sample Port A located on line between blower and burner units

(5) Measurement made with Bacharach TLV Sniffer calibrated to hexene

(6) Carbon dioxide measured using a Bacharach fyrite gas analyzer.

(7) Total Volatile Hydrocarbon analysis by GC/FID, expressed as ppm (vol/vcl)

(8) Methane analysis by GC/FID, expressed as ppm (vol/vol)

"---" signifies "no reading taken"; ">" signifiee "greater than"; "<" signifies "loss than".

TABLE A-5 (Page 1 of 3) GROUND VACUUM MONITORING DATA

						Date						
Well	06/29/88	06/30/88	07/01/88	07/08/88	07/11/88	07/14/88	07/18/88	07/25/88	08/02/88	08/09/88	08/09/88 08/16/88	08/30/88
NW-1	0.010	0.005	0.010	0.010	0.000	0.030	0.000	0.000	0.045		0.125	1
MW-2	0.065	0.010	0.000	0.000	0.000	0.000	0.000	0.000	0.050	0.000	0.190	0.000
MW-3	0.055	0.015	0.000	0.000	0.000	)   		0.000	0.040	0.000	0.105	0.000
MW-11	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
MW-13	0.020	0.050	0.065	0.010	0.005	0.005	0.000	0.020	0.000	0.005	0.035	0.020
MW-14	0.015	0.010	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
MW-15	0.000	0.000	0.000	0.000	0.000	0.00	0.000	0.000	0.000	0.000	0.000	0.000
MW-16	0.025	0.000	0.025	0.000	0.015	0.000	0.000	0.000	0.000	0.000	0.000	0.005
71-WM	0.075	0.250	0.050	0.050	0.025	0.010	0.025	090'0	0.000	0.010	0.055	0.100
MW-18	0.190	1.300	1.000	0.540	0.460	0.120	0.380	0.480	0.090	0.500	0.215	0.560
MW-19	0.200	0.880	1.000	0.740	0.720	0.130	0.800	0.370	0.050	0.200	0.130	0.430
MW-24	0.015	0.250	0.260	0.120	0.070	0.015	0.080	0.120	0.000	0.010	0.035	0.100
MW-25	0.050	0.045	0.120	0.025	0.000	0.000	0.075	0.000	0.000	0.000	0.000	0.000
MW-27	0.010	0.000	0.005	0.000	0.000	0.000	0.005	0.000	0.000	0.000	0.015	0.000
MW-29	0.005	0.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
MW-30	0.000	0.000	0.000	0.000	0.000		0.000	0.000	0.000	0.000	0.000	0.000
RW-4A	5 1 1	3.800	9.400	7.400	>10.000	1.400	6.600	5.600	0.800	5.200	0.760	4.800
RW-5A		9.200	10.000	8.400	0.230	1.200	8.200	7.400	1	7.000	2.000	6.600
RW-7	1	0.030	0.010	0.005	0.000	0.029	0.000	0.000	0.250	0.010	0.590	0.010
RW-8		0.000	0.010	0.000	0.000	0.027	0.000	0.000	0.270	0.010	0.590	0.005
6-WH	1	0.025	0.010	0.000	0.000	0.027	0.000	0.000	0.300	0.010	0.590	0.000
FW/-10		0.000	0.005	0.000	0.000	0.300	0.000	0.000	0.240	0.010	0.560	0.000
FW-26	1 1 1	0.000	0.000	0.002	0.000	0.270	0.000	0.000	0.240	0.015	0.500	0.010
RW-28		0.035	0.050	0.020	0.035	NV	0.010	0.020	0.000	0.015	0.000	0.010
Vapor C(	Vapor Collection Sy	System Operational S		tatus			•	-				
Northwest	0	ſ	E	1	1	0	i	1	0	1	0	I
Northeast	0	I	ł	I	1	0	i	I	0	I	0	ł
Southwest	0	0	0	0	i	0	0	0	0	0	0	0
Southeast	0	0	0	0	0	0	0	0	0	0	٥	0
Notes:												
Меазигел	Measurements were made using magnahelic gauges	le using magn		with a resolution of 0.005 inches water column	on of 0.005 Inc	hes water colui	UL.					
> signif	> signifies "greater than"	Ju,										
	🕂 signifies "no reading taken"	ng taken										
NV" sign	"NV" signifies that a measurement was taken but the	asurement was		value was not valid	valid.							
Vapor coll	Vapor collection system operational status shows the	operational sta		configuration of vapor withdrawal at the time the vacuum readings were taken	of vapor withdr	awal at the tim	e the vacuum r	eadings were	lakan.			
ð C	"O" signifies "Open" and "-" signifies "Closed"	ອກປີຕີ- ສາຍູກເ	lies Closed	2016-0110000-0000				00000000000000000000000000000000000000				

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						Date					
Well	10/11/88	10/25/88	11/08/88	12/06/88	02/21/89	03/16/89	04/14/89	05/11/89	06/16/89	08/21/89	09/21/89
MW~1	0.020	0.000	0.000	0.000	0.025	0.050	0.000	0.040	-		0.020
MW-2	0.030	0.000	0.140	3	0.150	0.000	0.000	0.075		1	1 1
MW-3	0.030	0.000	0.075	0.000	0.000	0.110	0.000	0.075	0.000	0.085	0.030
AW-11	0.000	0.000	0.000	0.000	0.000	0.050	0.000	0.000	0.000	0.000	0.000
MW-13	0.000	0.000	0.025	0.000	0.010	0.035	0.020	0.01	0.000	0.000	0.000
MW-14	0.000	0.000	0.000	0.000	0.000	0.000	0.000	   	0.000	0.000	0.000
MW-15	0.000	0.000	0.000	0.000	0.000	0.020	0.000	0.01	0.000	0.010	0.000
MW-16	0.000	G.000	0.000	0.000	0.050	0.020	0.020	0.000	0.000	0.005	0.000
MW-17	0.015	0.000	0.055	0.000	0.050	0.050	0.000	0.150	0.000	0.000	0.010
MW-18	0.020	0.080	0.065	0.220	0.135	0.260	0.440	0.150	0.450	0.035	0.035
MW-19	0.045	0.000	0.220	1.200	0.160	0.170	0.470	0.085	0.300	0.045	0.060
MW-24	0.000	0.015	0.000	0.000	0.050	0.050	0.000	0.040	0.020	0.005	0.000
MW-25	0.000	0.000	0.000	000.0	0.020	0.050	0.000	0.010	0.000	0.000	0.000
MW-27	0.010	0.000	0.035	0.000	0.150	0.025	0.000	0.010	0.000	0.010	0.010
MW-29	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
MW-30	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	-	0.000
RW-4A	0.620	4.000	2.400	>10.000	2.000	1.100	6.600	0.800	6.000	2.200	1.000
RW-5A	0.010	0.025	0.120	0.000	1.000	1.200	8.200	1.500	9.000		0.940
RW-7	0.140	0.000	0.720	0.015	t 1	ł	0.010	0.700	0.010	0.540	0.510
RW-8	0.160	0.000	0.710	0.020	0.510	0.720	0.010	0.480	0.000		0.054
8-WH	0.190	0.000	0.780	0.015	0.550	0.760	0.015	0.460	0.000	0.620	0.540
HW-10	0.155	0.000	0.760	0.010	0.520	0.760	0.015	0.470	0.000	0.580	0.520
RW-26	0.130	0.000	0.700	0.000	0.500	0.720	0.020	0.440	0.000	0.500	0.450
RW-28	0.000	0.005	0.010	0.110	0.010	0.020	0.025	0.000	0.000	0.015	0.000
Vapor Co	Vapor Collection System Ope		rational Status	atus							
Northwest	1	1	1	F	0	0		0	1	-	0
Northeast	0	ł	0	ı	0	0	1	0	1	o	0
Southwest	1	ł	ı	I	0	0	0	0	0	i	0
Southeast	0	0	0	0	0	0	0	0	0	0	0
Notes:											
Measurem	Measurements were made using magn	C	helic gauges >	with a resolutio	in of 0.005 inct	helic gauges with a resolution of 0.005 inches water column	an.				
">" eignifi	">" signifies "greater than"	u,*									
	** eignifies "no reading taken"	ng taken"									
NV. SIGN	*NV* signifies that a measurement was taken but the value was not valid	Isurement was	taken but the	velue was not	valid						
Vapor colle	Vapor collection system operational status shows the configuration of vapor withdrawal at the time the vacuum readings were taken.	perational stat	tus shows the c	configuration o	ft vapor withdre	awal at the time	) the vacuum n	eadings were to	aken.		
O siç	"O" signifies "Open" and "-" signif	and *-* signif	fies Closed								

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		made using magnahelic gauges with a resolution of 0.006 inches water column. er than " reading taken" r measurement was taken but the value was not valid tem operational status shows the configuration of vapor withdrawal at the time the vacuum readings were taken pen" and "" signifies "Closed"
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		Notes: Measurements were made using magnaheli ">" signifies "greater than" "" signifies "no reading taken" "" signifies that a measurement was take Vapor collection system operational status s "O" signifies "Open" and "" signifies

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TABLI	TABLE A-5 (page 3 of 3)	oage 3 (	of 3)			
			Date			
Well	10/27/89	11/27/89	12/29/89	02/01/90	06/15/90	07/24/90
MW-1	0.020	0.000	0.000	1	0.000	0.000
MW-2	0.000	0.000	ł	0.000	0.000	0.040
MW-3	0.050	0.000	1		0.000	0.010
MW-11	0.000	0.000	0.000	0.000	0.000	0.000
MW-13	0.000	0.000	0.000	0.000	0.000	0.000
MW-14	0.000	0.000	0.000	N N	0.000	0.000
MW-15	0.000	0.000	0.000	0.330	0.000	0.000
MW-16	0.000	0.000	0.000	0.030	0.000	0.000
MW-17	0.000	0.000	0.010	0.000	0.040	0.010
MW-18	0.036	0.000	0.410	0.000	0.250	0.000
MW-19	0.620	0.000	0.770	0.000	0.170	0.000
MW-24	0.002	0.000	0.110	0.060	0.250	0.000
MW-25	0.080	0.000	0.070	0.000	0.000	0.000
MW-27	0.000	0.000	0.000	0.020	0.000	0.000
MW-29	0.000	0.000	0.000	0.000	0.000	0.000
MW-30	0.000	0.000	0.000	0.000	0.000	0.000
RW-4A	3.200	2.400	>10.000	2.400	3.000	0.000
RW-5A	0.030	0.050	0.110	0.110	4.800	0.060
RW-7	0.460	0.440	0.000	0.720	0.010	0.030
RW-8	0.500	0.480	0.010	0.860	0.010	0.030
RW-9	0.520	0.580	0.000	0.740	0.010	0.050
RW-10	0.470	0.500	0.005	0.860	0.000	0.030
RW-26	0.420	0.400	0.000	0.660	0.010	0.040
RW-28	0.000	0.000	0.070	0.000	0.025	0.000
Vapor Co	Vapor Collection System Operational Status	/stem Oper	rational St	atus		
Northwest	1	1	t	ı	1	1
Northeast	ı	0	1	ŧ	ı	0
Southwest	I	t	1	ı	0	I
Southeast	0	0	0	0	0	•

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Measurements were made using magn o Notes:

\*----\* signifies "no reading taken" ">" signifies "greater than"

\*NV\* signifies that a measurement was taken but the value was not valid. Vapor collection system operational status shows the configuration of vapor withdrawal at the time the vacuum readings were taken.

"O" signifies "Open" and "-" signifies "Closed"

## TABLE A-6 (Page 1 of 2) VOLUME OF RECOVERED PRODUCT

		Estimated I	-	Baseyonu
		Total Re		Recovery
Start	Duration	Gasoline	Methane	System
Date	(Days)	(Gallons)	(cubic feet)	Configuration
06/28/88	1.1	26.92	7696.07	All Open
06/29/88	1.0	78.76	8953.75	South
06/30/88	1.0	71.39	7782.18	South
07/01/88	4.0	31.15	8631.17	East
07/05/88	0.8	9.03	1400.70	All Open
07/06/88	2.0	44.81	7576.63	South
07/08/88	4.0	38.45	8917.65	Southeast
07/12/88	3.2	17.20	1243.54	All Open
07/15/88	5.0	158.78	1159.32	South
07/20/88	6.7	336.50	1151.25	South
07/27/88	7.0	157.49	846.07	All Open
08/03/88	5.9	150.02	3111.21	South
08/09/88	7.0	68.88	2202.48	All Open
08/16/88	13.9	205.53	1813.56	South
08/30/88	12.3	37.58	1020.18	All Open
09/16/88	2.6	2.30	49.65	All Open
09/19/88	0.3	0.27	6.76	All Open
09/20/88	1.0	0.86	23.63	All Open
09/22/88	1.9	19.85	167.16	East
09/27/88	1.3	24.12	263.04	East
09/28/88	1.0	6.62	97.96	East
09/29/88	2.5	36.39	724.87	East
10/03/88	0.1	1.92	44.84	East
10/04/88	0.1	0.89	21.00	East
10/05/88	5.6	48.84	1444.62	East Southeast
10/11/88	1.0	2.46	19.98	Southeast
10/12/88	0.1	0.44	3.75 146.17	Southeast
10/12/88	4.9	15.02 9.21	140.17	Southeast
10/17/88	2.7	9.21 7.24	91.95	Southeast
10/24/88	0.8	144.79	3918.82	East
10/25/88 11/04/88	10.0 3.7	49.76	588.47	East
	8.9	118.32	2560.87	Southeast
11/08/88 11/17/88	0.9	0.39	8.22	Southeast
	4.2	49.31	1001.95	Southeast
11/17/88 11/21/88	4.2 0.5	49.31	80.60	Southeast
11/21/88	3.7	35.02	663.20	Southeast
11/28/88	3.9	30.57	524.73	Southeast
12/02/88	0.2	1.01	15.96	Southeast
12/03/88	2.8	16.77	245.12	Southeast
12/06/88	2.0	4.12	236.04	North
12/08/88	1.7	3.49	226.32	North
12/10/88	0.9	1.72	118.12	North
12/11/88	1.3	3.00	214.45	North
12/12/88	0.3	0.49	36.05	North
12/13/88	0.5	1.35	99.98	North
12/13/88	0.8	1.13	84.94	North
1	0.7	0.10	7.23	North
12/14/88	U.1	0.10	(.23	

# TABLE A-6 (Page 2 of 2)

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Start         Duration         Total Recovery         Recovery           Start         Duration         Gasoline         (Wethane         System           12/16/88         0.8         1.97         151.55         North           12/16/88         0.8         10.15         826.65         North           0/1/3/89         0.1         0.10         8.50         North           0/1/3/89         0.1         0.06         5.30         North           0/1/3/89         0.1         0.06         5.30         All Open           0/2/10/89         3.6         5.75         495.24         All Open           0/2/14/89         1.0         5.40         473.33         All Open           0/2/14/89         1.1         6.73         228.10         South           0/2/14/89         1.3         6.45.7         North         0/2/21/89           0/2/14/89         1.4         6.73         228.10         South           0/2/14/89         1.3         8.44.55         South           0/2/14/89         3.9         20.33         531.00         South           0/2/14/89         1.6         15.18         1.644.35         South <t< th=""><th>[</th><th>· · · · · · · · · · · · · · · · · · ·</th><th>Estimated</th><th>Fauivalent</th><th></th></t<>	[	· · · · · · · · · · · · · · · · · · ·	Estimated	Fauivalent	
Start         Duration         Gasoline (Gallons)         Methane (cubic feet)         System           12/16/88         0.8         1.97         151.55         North           12/20/88         5.8         10.15         826.65         North           01/13/89         0.1         0.10         8.50         North           01/14/88         0.1         0.06         5.30         All Open           02/10/89         0.1         0.06         5.30         All Open           02/10/89         0.7         4.12         364.00         All Open           02/10/89         0.7         4.12         364.00         All Open           02/14/89         1.0         6.73         228.10         South           03/16/89         1.1         6.73         228.10         South           03/17/89         2.9         18.46         569.39         South           03/16/89         1.1         6.63         711.39         South           03/16/89         1.2         52.9         123.99         All Open           03/16/89         3.8         34.95         188.13         South           04/10/89         3.6         15.2         5.29 <td< td=""><td></td><td></td><td colspan="2">Estimated Equivalent</td><td>Decover</td></td<>			Estimated Equivalent		Decover
Date         (Days)         (Gallons)         (cubic feet)         Configuration           12/16/88         0.8         1.97         151.55         North           12/20/88         5.8         10.15         826.65         North           01/13/89         0.1         0.10         8.50         North           01/13/89         0.1         0.08         6.57         North           01/13/89         0.1         0.06         5.30         All Open           02/10/89         0.1         0.06         5.30         All Open           02/14/89         1.0         5.40         473.33         All Open           02/21/89         0.7         4.12         364.40         All Open           02/21/89         1.1         6.73         228.10         South           03/16/89         1.1         6.73         228.10         South           03/20/89         3.9         20.33         531.00         South           03/20/89         3.8         34.95         188.13         South           03/20/89         3.8         34.95         188.13         South           03/20/89         5.2         5.23         123.99         All Open	_		<u> </u>		-
12/16/88         0.8         1.97         151.55         North           12/20/88         5.8         10.15         826.65         North           01/13/89         0.1         0.10         8.50         North           01/18/89         0.1         0.10         8.51         North           01/18/89         0.1         0.06         5.30         All Open           02/10/89         3.6         5.75         495.24         All Open           02/14/89         1.0         5.40         473.33         All Open           02/20/89         0.7         4.12         364.40         All Open           02/21/89         23.0         104.39         6.022.64         All Open           02/21/89         2.9         18.46         569.39         South           03/20/89         3.9         20.33         531.00         South           03/20/89         16.9         115.18         1,644.35         South           04/10/69         3.8         34.95         188.13         South           04/10/69         3.8         34.95         188.13         South           06/26/89         9.8         13.66         150.71         All Open	Start	Duration	Gasoline	Methane	•
12/20/88         5.8         10.15         826.65         North           01/13/89         0.1         0.10         8.50         North           01/18/89         0.1         0.08         6.57         North           02/07/89         0.1         0.06         5.30         All Open           02/10/89         3.6         5.75         495.24         All Open           02/10/89         0.7         4.12         364.40         All Open           02/10/89         0.7         4.12         364.40         All Open           02/20/89         0.7         4.12         364.40         All Open           02/16/89         1.1         6.73         228.10         South           03/16/89         1.9         18.46         569.39         South           03/22/89         3.9         20.3         531.00         South           03/24/89         16.9         115.16         1,644.35         South           04/10/89         3.8         34.95         188.13         South           04/14/89         27.0         350.90         1,583.76         All Open           05/11/89         4.2         5.82         322.16         Northeast	Date	(Days)	(Gallons)	(cubic feet)	Configuration
12/20/88         5.8         10.15         826.65         North           01/13/89         0.1         0.10         8.50         North           01/18/89         0.1         0.08         6.57         North           02/07/89         0.1         0.06         5.30         All Open           02/10/89         3.6         5.75         495.24         All Open           02/10/89         0.7         4.12         364.40         All Open           02/20/89         0.7         4.12         364.40         All Open           02/20/89         0.7         4.12         364.40         All Open           02/16/89         1.1         6.73         228.10         South           03/16/89         1.9         18.46         569.39         South           03/22/89         3.9         20.3         531.00         South           03/24/89         16.9         115.18         1,644.35         South           04/10/89         3.8         34.95         188.13         South           04/14/89         27.0         350.90         1,583.76         All Open           05/11/89         2.0         43.66         171.39         South	12/16/88	0.8	1.97	151.55	North
01/13/89         0.1         0.10         8.50         North           01/13/89         0.1         0.10         8.51         North           01/24/89         0.1         0.06         5.30         All Open           02/07/89         0.1         0.06         5.30         All Open           02/10/89         3.6         5.75         495.24         All Open           02/14/89         1.0         5.40         473.33         All Open           02/20/89         0.7         4.12         364.40         All Open           02/21/89         2.30         104.39         6,022.64         All Open           02/316/89         1.1         6.73         228.10         South           03/16/89         1.1         6.73         228.10         South           03/20/89         3.9         20.33         531.00         South           03/20/89         3.8         34.95         188.13         South           03/20/89         1.6         9.15.18         1.644.35         South           03/20/89         3.8         34.95         188.13         South           04/10/89         2.2         5.29         123.99         All Open			10.15	826.65	North
01/18/89         0.1         0.10         8.51         North           01/24/89         0.1         0.06         6.57         North           02/07/89         0.1         0.06         5.30         All Open           02/10/89         3.6         5.75         495.24         All Open           02/14/89         1.0         5.40         473.33         All Open           02/20/89         0.7         4.12         364.40         All Open           02/20/89         1.1         6.73         228.10         South           03/17/89         2.9         18.46         569.39         South           03/22/89         3.9         20.33         531.00         South           03/22/89         3.8         3.4.95         188.13         South           03/22/89         3.8         3.4.95         188.13         South           04/10/89         27.0         350.90         15.58.7         All Open           05/11/89         24.1         66.69         711.39         South           04/14/89         3.1         7.52         322.16         Northeast           07/16/89         4.2         5.82         322.16         Northeast	01/13/89				North
01/24/89         0.1         0.06         6.57         North           02/07/89         0.1         0.06         5.30         All Open           02/10/89         3.6         5.75         495.24         All Open           02/14/89         1.0         5.40         473.33         All Open           02/20/89         0.7         4.12         364.40         All Open           02/21/89         23.0         104.39         6.022.64         All Open           02/21/89         2.9         18.46         569.39         South           03/16/89         3.9         20.33         531.00         South           03/27/89         1.69         115.18         1,644.35         South           03/27/89         3.8         34.95         188.13         South           03/27/89         1.6.9         115.18         1,644.35         South           04/10/89         3.8         34.95         188.13         South           04/16/89         2.7.0         350.90         1,583.76         All Open           05/11/89         2.4         5.82         322.16         Northeast           07/06/89         4.2         5.82         322.16					
02/07/89         0.1         0.06         5.30         All Open           02/10/89         3.6         5.75         495.24         All Open           02/14/89         1.0         5.40         473.33         All Open           02/14/89         0.7         4.12         364.40         All Open           02/21/89         23.0         104.39         6,022.64         All Open           03/16/89         1.1         6.73         228.10         South           03/20/89         3.9         20.33         531.00         South           03/24/89         16.9         115.18         1,644.35         South           04/10/89         3.8         34.95         188.13         South           04/10/89         3.8         34.95         188.13         South           04/14/89         27.0         350.90         1,583.76         All Open           05/11/89         24.1         66.69         711.39         South           06/02/689         9.8         13.66         150.71         All Open           07/06/89         4.2         5.82         322.16         Northeast           07/06/89         4.0         11.76         2,120.34					
02/10/89         3.6         5.75         495.24         All Open           02/14/89         1.0         5.40         473.33         All Open           02/20/89         0.7         4.12         364.40         All Open           02/21/89         23.0         104.39         6.022.64         All Open           03/16/89         1.1         6.73         228.10         South           03/17/89         2.9         18.46         569.39         South           03/24/89         16.9         115.18         1,644.35         South           03/24/89         3.8         34.95         188.13         South           04/10/89         3.8         34.95         188.13         South           04/10/89         3.8         34.95         188.13         South           06/14/89         2.7.0         350.90         1,583.76         All Open           05/11/89         24.1         66.69         371.39         South           06/05/89         10.8         24.66         357.50         South           06/16/89         5.2         5.29         123.99         All Open           07/06/89         4.0         1.76         2,120.34	02/07/89			5.30	
02/14/89         1.0         5.40         473.33         All Open           02/20/89         0.7         4.12         364.40         All Open           02/21/89         23.0         104.39         6.022.64         All Open           03/16/89         1.1         6.73         228.10         South           03/17/89         2.9         18.46         569.39         South           03/20/89         3.9         20.33         531.00         South           03/20/89         3.9         20.33         531.00         South           03/24/89         16.9         115.18         1,644.35         South           04/10/89         3.8         34.95         188.13         South           06/11/89         24.1         66.69         711.39         South           06/16/89         5.2         5.29         123.99         All Open           06/26/89         9.8         13.66         150.71         All Open           07/06/89         4.0         11.76         2.120.34         East           08/07/89         4.0         11.76         2.120.34         East           08/07/89         3.1         7.52         1,032.63         Ea		3.6	5.75		
02/21/89         23.0         104.39         6.022.64         All Open           03/16/89         1.1         6.73         228.10         South           03/16/89         2.9         18.46         569.39         South           03/20/89         3.9         20.33         531.00         South           03/24/89         16.9         115.18         1,644.35         South           04/10/89         3.8         34.95         188.13         South           04/14/89         27.0         350.90         1,583.76         All Open           05/11/89         24.1         66.69         711.39         South           06/16/89         5.2         5.29         123.99         All Open           06/26/89         9.8         13.66         150.71         All Open           07/06/91         4.2         5.82         322.16         Northeast           07/18/89         20.0         43.68         7.021.90         East           08/07/89         4.2         5.82         322.16         Northeast           07/18/89         3.1         7.52         1,56.63         East           08/07/89         4.0         16.54         369.03	02/14/89		5.40	473.33	All Open
02/21/89         23.0         104.39         6.022.64         All Open           03/16/89         1.1         6.73         228.10         South           03/16/89         2.9         18.46         569.39         South           03/20/89         3.9         20.33         531.00         South           03/24/89         16.9         115.18         1,644.35         South           04/10/89         3.8         34.95         188.13         South           04/10/89         3.8         34.95         188.13         South           04/14/83         27.0         350.90         1,583.76         All Open           05/11/89         24.1         66.69         711.39         South           06/16/89         5.2         5.29         123.99         All Open           06/26/89         9.8         13.66         150.71         All Open           07/06/89         4.2         5.82         322.16         Northeast           07/18/89         3.1         7.52         1,032.63         East           08/07/89         4.0         11.76         2,120.34         East           08/07/89         3.1         7.52         556.63 <td< td=""><td>02/20/89</td><td>0.7</td><td>4.12</td><td>364.40</td><td></td></td<>	02/20/89	0.7	4.12	364.40	
03/16/89         1.1         6.73         228.10         South           03/17/89         2.9         18.46         569.39         South           03/20/89         3.9         20.33         531.00         South           03/20/89         3.9         20.33         531.00         South           03/24/89         16.9         115.18         1.644.35         South           04/10/89         3.8         34.95         188.13         South           04/14/99         27.0         350.90         1,583.76         All Open           05/11/89         24.1         66.69         711.39         South           06/26/89         9.8         13.66         150.71         All Open           07/06/89         4.2         5.82         322.16         Northeast           07/16/89         4.0         11.76         2,120.34         East           08/07/89         4.0         11.76         2,120.34         East           08/17/89         3.1         7.52         1,032.63         East           08/17/89         3.1         7.52         1,56.63         East           08/21/89         3.10         62.21         588.34         All Op	02/21/89	23.0	104.39	6,022.64	
03/20/89         3.9         20.33         531.00         South           03/24/89         16.9         115.18         1,644.35         South           04/10/89         3.8         34.95         188.13         South           04/10/89         27.0         350.90         1,583.76         All Open           05/11/89         24.1         66.69         711.39         South           06/05/89         10.8         24.66         357.50         South           06/16/89         5.2         5.29         123.99         All Open           07/06/89         4.2         5.82         322.16         Northeast           07/18/89         20.0         43.68         7,021.90         East           08/07/89         4.0         11.76         2,120.34         East           08/17/89         3.1         7.52         1,032.63         East           08/17/89         3.10         62.21         588.34         All Open           09/21/89         31.0         62.21         588.34         All Open           09/21/89         3.0         55.42         1,634.69         East           10/27/89         14.3         55.42         1,634.69	03/16/89		6.73	228.10	South
03/24/89         16.9         115.18         1,644.35         South           04/10/89         3.8         34.95         188.13         South           04/14/89         27.0         350.90         1,583.76         All Open           05/11/89         24.1         66.69         711.39         South           06/05/89         10.8         24.66         357.50         South           06/16/89         5.2         5.29         123.99         All Open           07/06/89         4.2         5.82         322.16         Northeast           07/16/89         4.2         5.82         322.16         Northeast           08/07/89         4.0         11.76         2,120.34         East           08/07/89         3.1         7.52         1,032.63         East           08/17/89         3.9         7.52         556.63         East           08/21/89         31.0         62.21         588.34         All Open           09/21/89         36.0         464.53         549.13         Southeast           10/27/89         14.3         55.42         1,634.69         East           11/20/89         4.0         16.54         369.03	03/17/89	2.9	18.46	569.39	South
04/10/89         3.8         34.95         188.13         South           04/14/89         27.0         350.90         1,583.76         All Open           05/11/89         24.1         66.69         711.39         South           06/05/89         10.8         24.66         357.50         South           06/16/89         5.2         5.29         123.99         All Open           06/26/89         9.8         13.66         150.71         All Open           07/06/89         4.2         5.82         322.16         Northeast           07/18/89         20.0         43.68         7,021.90         East           08/07/89         4.0         11.76         2,120.34         East           08/17/89         3.1         7.52         556.63         East           08/17/89         3.9         7.52         556.63         East           08/21/89         31.0         62.21         588.34         All Open           09/21/89         36.0         464.53         549.13         Southeast           11/20/89         4.0         16.54         369.03         East           11/20/89         4.0         16.54         369.03	03/20/89	3.9	20.33	531.00	South
04/14/89         27.0         350.90         1,583.76         All Open           05/11/89         24.1         66.69         711.39         South           06/05/89         10.8         24.66         357.50         South           06/16/89         5.2         5.29         123.99         All Open           06/26/89         9.8         13.66         150.71         All Open           07/06/89         4.2         5.82         322.16         Northeast           07/18/9         20.0         43.68         7,021.90         East           08/07/89         4.0         11.76         2,120.34         East           08/14/89         3.1         7.52         1,032.63         East           08/17/89         3.9         7.52         556.65         East           08/21/89         31.0         62.21         588.34         All Open           09/21/89         36.0         464.53         549.13         Southeast           10/27/89         14.3         55.42         1,634.69         East           11/20/89         4.0         16.54         369.03         East           12/29/89         35.2         5.72         1,058.38	03/24/89		115.18	1,644.35	South
05/11/89         24.1         66.69         711.39         South           06/05/89         10.8         24.66         357.50         South           06/16/89         5.2         5.29         123.99         All Open           06/26/89         9.8         13.66         150.71         All Open           07/06/89         4.2         5.82         322.16         Northeast           07/18/89         20.0         43.68         7,021.90         East           08/07/89         4.0         11.76         2,120.34         East           08/17/89         3.1         7.52         1,032.63         East           08/17/89         3.1         7.52         556.63         East           08/21/89         31.0         62.21         588.34         All Open           09/21/89         36.0         464.53         549.13         Southeast           10/27/89         14.3         55.42         1,634.69         East           11/20/89         4.0         16.54         369.03         East           12/29/89         35.2         5.72         1,058.38         East           05/11/90         5.9         218.42         4,262.15 <td< td=""><td>04/10/89</td><td>3.8</td><td>34.95</td><td>188.13</td><td>South</td></td<>	04/10/89	3.8	34.95	188.13	South
05/11/89         24.1         66.69         711.39         South           06/05/89         10.8         24.66         357.50         South           06/16/89         5.2         5.29         123.99         All Open           06/26/89         9.8         13.66         150.71         All Open           07/06/89         4.2         5.82         322.16         Northeast           08/07/89         4.0         11.76         2,120.34         East           08/07/89         3.1         7.52         1,032.63         East           08/17/89         3.1         7.52         556.63         East           08/17/89         31.0         62.21         588.34         All Open           09/21/89         36.0         464.53         549.13         Southeast           10/27/89         14.3         55.42         1,634.69         East           11/20/89         4.0         16.54         369.03         East           12/29/89         35.2         5.72         1,058.38         East           05/11/90         5.9         218.42         4,262.15         South           05/21/90         10.0         247.50         4,574.46         <	04/14/89		350.90		All Open
$\begin{array}{ c c c c c c c c c c c c c c c c c c c$	05/11/89				
$\begin{array}{ c c c c c c c c c c c c c c c c c c c$	06/05/89				
06/26/89         9.8         13.66         150.71         All Open           07/06/89         4.2         5.82         322.16         Northeast           07/18/89         20.0         43.68         7,021.90         East           08/07/89         4.0         11.76         2,120.34         East           08/14/89         3.1         7.52         1,032.63         East           08/17/89         3.9         7.52         556.63         East           08/21/89         31.0         62.21         588.34         All Open           09/21/89         36.0         464.53         549.13         Southeast           10/27/89         14.3         55.42         1,634.69         East           11/20/89         4.0         16.54         369.03         East           11/20/89         11.8         42.60         672.05         East           12/20/89         35.2         5.72         1,058.38         East           05/11/90         5.9         218.42         4,262.15         South           05/21/90         10.0         247.50         4,574.46         South           06/07/90         1.1         7.81         143.36					
$\begin{array}{ c c c c c c c c c c c c c c c c c c c$					
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08/07/89         4.0         11.76         2,120.34         East           08/14/89         3.1         7.52         1,032.63         East           08/17/89         3.9         7.52         556.63         East           08/21/89         31.0         62.21         588.34         All Open           09/21/89         36.0         464.53         549.13         Southeast           10/27/89         14.3         55.42         1,634.69         East           11/20/89         4.0         16.54         369.03         East           11/20/89         4.0         16.54         369.03         East           12/06/89         23.0         55.27         1,414.97         Southeast           12/29/89         35.2         5.72         1,058.38         East           05/11/90         5.9         218.42         4,262.15         South           05/21/90         10.0         247.50         4,574.46         South           05/31/90         1.1         16.09         157.49         South           06/07/90         1.1         7.81         143.36         South           06/07/90         6.7         35.55         646.83         So			43.68		
08/14/89         3.1         7.52         1,032.63         East           08/17/89         3.9         7.52         556.63         East           08/21/89         31.0         62.21         588.34         All Open           09/21/89         36.0         464.53         549.13         Southeast           10/27/89         14.3         55.42         1,634.69         East           11/20/89         4.0         16.54         369.03         East           11/20/89         4.0         16.54         369.03         East           12/06/89         23.0         55.27         1,414.97         Southeast           12/29/89         35.2         5.72         1,058.38         East           05/11/90         5.9         218.42         4,262.15         South           05/21/90         10.0         247.50         4,574.46         South           05/31/90         1.1         16.09         157.49         South           05/31/90         1.1         7.81         143.36         South           06/07/90         6.7         35.55         646.83         South           06/07/90         8.2         4.36         120.39         East	08/07/89	4.0	11.76		East
08/17/89         3.9         7.52         556.63         East           08/21/89         31.0         62.21         588.34         All Open           09/21/89         36.0         464.53         549.13         Southeast           10/27/89         14.3         55.42         1,634.69         East           11/20/89         4.0         16.54         369.03         East           11/24/89         11.8         42.60         672.05         East           12/06/89         23.0         55.27         1,414.97         Southeast           12/29/89         35.2         5.72         1,058.38         East           05/11/90         5.9         218.42         4,262.15         South           05/21/90         10.0         247.50         4,574.46         South           05/31/90         1.1         16.09         157.49         South           05/31/90         1.1         7.81         143.36         South           06/07/90         6.0         84.02         1,547.83         South           06/07/90         1.1         7.81         143.36         South           06/07/90         6.7         35.55         646.83         S					East
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	[	3.9	7.52		East
$\begin{array}{c c c c c c c c c c c c c c c c c c c $					All Open
11/20/894.016.54369.03East11/24/8911.842.60672.05East12/06/8923.055.271,414.97Southeast12/29/8935.25.721,058.38East05/11/905.9218.424,262.15South05/21/9010.0247.504,574.46South05/31/901.116.09157.49South06/01/906.084.021,547.83South06/07/901.17.81143.36South06/08/906.735.55646.83South06/23/902.00.7821.37East06/25/907.82.9380.86East07/03/906.01.2634.58East07/09/9010.21.1831.86East07/24/902.10.220.00West07/24/902.10.220.00West07/26/901.00.050.00West	09/21/89	36.0	464.53	549.13	Southeast
11/24/8911.842.60672.05East12/06/8923.055.271,414.97Southeast12/29/8935.25.721,058.38East05/11/905.9218.424,262.15South05/21/9010.0247.504,574.46South05/31/901.116.09157.49South06/01/906.084.021,547.83South06/07/901.17.81143.36South06/08/906.735.55646.83South06/23/902.00.7821.37East06/25/907.82.9380.86East07/03/906.01.2634.58East07/09/9010.21.1831.86East07/19/904.70.153.97East07/24/902.10.220.00West07/26/901.00.050.00West	10/27/89	14.3	55.42	1,634.69	East
12/06/89         23.0         55.27         1,414.97         Southeast           12/29/89         35.2         5.72         1,058.38         East           05/11/90         5.9         218.42         4,262.15         South           05/21/90         10.0         247.50         4,574.46         South           05/31/90         1.1         16.09         157.49         South           06/01/90         6.0         84.02         1,547.83         South           06/07/90         1.1         7.81         143.36         South           06/08/90         6.7         35.55         646.83         South           06/15/90         8.2         4.36         120.39         East           06/23/90         2.0         0.78         21.37         East           06/23/90         7.8         2.93         80.86         East           07/03/90         6.0         1.26         34.58         East           07/09/90         10.2         1.18         31.86         East           07/19/90         4.7         0.15         3.97         East           07/24/90         2.1         0.22         0.00         West	11/20/89	4.0	16.54	369.03	East
12/29/89         35.2         5.72         1,058.38         East           05/11/90         5.9         218.42         4,262.15         South           05/21/90         10.0         247.50         4,574.46         South           05/31/90         1.1         16.09         157.49         South           06/01/90         6.0         84.02         1,547.83         South           06/07/90         1.1         7.81         143.36         South           06/07/90         6.7         35.55         646.83         South           06/08/90         6.7         35.55         646.83         South           06/23/90         2.0         0.78         21.37         East           06/25/90         7.8         2.93         80.86         East           07/03/90         6.0         1.26         34.58         East           07/09/90         10.2         1.18         31.86         East           07/19/90         4.7         0.15         3.97         East           07/24/90         2.1         0.22         0.00         West	11/24/89	11.8	42.60	672.05	East
05/11/90         5.9         218.42         4,262.15         South           05/21/90         10.0         247.50         4,574.46         South           05/31/90         1.1         16.09         157.49         South           06/01/90         6.0         84.02         1,547.83         South           06/07/90         1.1         7.81         143.36         South           06/08/90         6.7         35.55         646.83         South           06/15/90         8.2         4.36         120.39         East           06/23/90         2.0         0.78         21.37         East           06/25/90         7.8         2.93         80.86         East           07/03/90         6.0         1.26         34.58         East           07/09/90         10.2         1.18         31.86         East           07/19/90         4.7         0.15         3.97         East           07/24/90         2.1         0.22         0.00         West	12/06/89	23.0	55.27	1,414.97	Southeast
05/21/90         10.0         247.50         4,574.46         South           05/31/90         1.1         16.09         157.49         South           06/01/90         6.0         84.02         1,547.83         South           06/07/90         1.1         7.81         143.36         South           06/08/90         6.7         35.55         646.83         South           06/15/90         8.2         4.36         120.39         East           06/23/90         2.0         0.78         21.37         East           06/25/90         7.8         2.93         80.86         East           07/03/90         6.0         1.26         34.58         East           07/09/90         10.2         1.18         31.86         East           07/19/90         4.7         0.15         3.97         East           07/24/90         2.1         0.22         0.00         West           07/26/90         1.0         0.05         0.00         West	12/29/89	35.2	5.72	1,058.38	East
05/31/90         1.1         16.09         157.49         South           06/01/90         6.0         84.02         1,547.83         South           06/07/90         1.1         7.81         143.36         South           06/08/90         6.7         35.55         646.83         South           06/15/90         8.2         4.36         120.39         East           06/23/90         2.0         0.78         21.37         East           06/25/90         7.8         2.93         80.86         East           07/03/90         6.0         1.26         34.58         East           07/09/90         10.2         1.18         31.86         East           07/19/90         4.7         0.15         3.97         East           07/24/90         2.1         0.22         0.00         West           07/26/90         1.0         0.05         0.00         West	05/11/90	5.9	218.42	4,262.15	South
05/31/90         1.1         16.09         157.49         South           06/01/90         6.0         84.02         1,547.83         South           06/07/90         1.1         7.81         143.36         South           06/08/90         6.7         35.55         646.83         South           06/15/90         8.2         4.36         120.39         East           06/23/90         2.0         0.78         21.37         East           06/25/90         7.8         2.93         80.86         East           07/03/90         6.0         1.26         34.58         East           07/09/90         10.2         1.18         31.86         East           07/19/90         4.7         0.15         3.97         East           07/24/90         2.1         0.22         0.00         West		10.0	247.50	4,574.46	South
06/01/90         6.0         84.02         1,547.83         South           06/07/90         1.1         7.81         143.36         South           06/08/90         6.7         35.55         646.83         South           06/15/90         8.2         4.36         120.39         East           06/23/90         2.0         0.78         21.37         East           06/25/90         7.8         2.93         80.86         East           07/03/90         6.0         1.26         34.58         East           07/09/90         10.2         1.18         31.86         East           07/19/90         4.7         0.15         3.97         East           07/24/90         2.1         0.22         0.00         West           07/26/90         1.0         0.05         0.00         West	05/31/90		16.09	157.49	South
06/07/90         1.1         7.81         143.36         South           06/08/90         6.7         35.55         646.83         South           06/15/90         8.2         4.36         120.39         East           06/23/90         2.0         0.78         21.37         East           06/25/90         7.8         2.93         80.86         East           07/03/90         6.0         1.26         34.58         East           07/09/90         10.2         1.18         31.86         East           07/19/90         4.7         0.15         3.97         East           07/24/90         2.1         0.22         0.00         West           07/26/90         1.0         0.05         0.00         West	06/01/90		84.02		South
06/08/90         6.7         35.55         646.83         South           06/15/90         8.2         4.36         120.39         East           06/23/90         2.0         0.78         21.37         East           06/25/90         7.8         2.93         80.86         East           07/03/90         6.0         1.26         34.58         East           07/09/90         10.2         1.18         31.86         East           07/19/90         4.7         0.15         3.97         East           07/24/90         2.1         0.22         0.00         West           07/26/90         1.0         0.05         0.00         West	06/07/90		7.81		South
06/23/90         2.0         0.78         21.37         East           06/25/90         7.8         2.93         80.86         East           07/03/90         6.0         1.26         34.58         East           07/09/90         10.2         1.18         31.86         East           07/19/90         4.7         0.15         3.97         East           07/24/90         2.1         0.22         0.00         West           07/26/90         1.0         0.05         0.00         West	06/08/90				South
06/25/90         7.8         2.93         80.86         East           07/03/90         6.0         1.26         34.58         East           07/09/90         10.2         1.18         31.86         East           07/19/90         4.7         0.15         3.97         East           07/24/90         2.1         0.22         0.00         West           07/26/90         1.0         0.05         0.00         West	06/15/90	8.2	4.36	120.39	East
06/25/90         7.8         2.93         80.86         East           07/03/90         6.0         1.26         34.58         East           07/09/90         10.2         1.18         31.86         East           07/19/90         4.7         0.15         3.97         East           07/24/90         2.1         0.22         0.00         West           07/26/90         1.0         0.05         0.00         West	06/23/90	2.0	0.78	21.37	East
07/03/90         6.0         1.26         34.58         East           07/09/90         10.2         1.18         31.86         East           07/19/90         4.7         0.15         3.97         East           07/24/90         2.1         0.22         0.00         West           07/26/90         1.0         0.05         0.00         West	06/25/90		2.93	80.86	East
07/09/90         10.2         1.18         31.86         East           07/19/90         4.7         0.15         3.97         East           07/24/90         2.1         0.22         0.00         West           07/26/90         1.0         0.05         0.00         West	07/03/90	6.0	1.26	34.58	East
07/19/90         4.7         0.15         3.97         East           07/24/90         2.1         0.22         0.00         West           07/26/90         1.0         0.05         0.00         West	07/09/90		1.18	31.86	East
07/24/90         2.1         0.22         0.00         West           07/26/90         1.0         0.05         0.00         West				3.97	
07/26/90 1.0 0.05 0.00 West	07/24/90				
			0.05		West
Unansu 3.2 U.24 U.UU West	07/27/90	5.2	0.24	0.00	West
08/01/90 1.1 0.01 0.00 West			0.01		West
Totals 557.1 4,262.46 120,766.79	Totals	and the second	4.262.46	120.766.79	
### APPENDIX B

### CHEMICAL ANALYTICAL DATA FROM VAPOR SAMPLES

### ENVIRONMENTAL CHEMISTS

James K. Farr, Ph.D. Andrew John Friedman James E. Bruya, Ph.D. 3008 B - 16th West Seattle, WA 98119 (206) 285-8282

July 28, 19 GeoEngineers

Routinz

File

Steve Perrigo, Project Manager GeoEngineers, Inc. 2405-140th Avenue N.E., Suite 105 Bellevue, WA 98005 AUG 0 9 1988

<u>-2017</u>

î.

Dear Steve:

Enclosed are the results of the analyses of samples submitted on July 27, 1988 from Project 0161-13-4.

We appreciate this opportunity to be of service to you on this project. If you have any questions regarding this material, or if you just want to discuss any aspect of your projects, please do not hesitate to contact me.

Sincerely,

James K. Farr, Ph.D.

JKF

# ENVIRONMENTAL CHEMISTS

Date of Report: July 28, 1988 Date Submitted: July 27, 1988 Project: 0161-13-4

> RESULTS OF ANALYSES OF ENVIROMENTAL SAMPLES FOR METHANE BY GC/FID

<u>Sample #</u>	• • •	t	<u>Methane</u> (ppm)
880727-1			650
880727-2	· .		250
Quality Assurance			
Method Blank			<100

1001100 D		~100
880727-2	(Replicate)	220

### ENVIRONMENTAL CHEMISTS

Date of Report: July 28, 1988 Date Submitted: July 27, 1988 Project: 0161-13-4

### RESULTS OF ANALYSES OF ENVIRONMENTAL SAMPLES FOR TOTAL VOLATILE HYDROCARBONS AS N-HEXANE

<u>Sample #</u>	<u>Total Volatile Hydrocarbons</u> (ppm)
880727-1	6,600
880727-2	5,200
<u>Quality Assurance</u>	
Method Blank	<10
880727-2 (Replicate)	5,100

B – 3.

### ENVIRONMENTAL CHEMISTS

James K. Farr, Ph.D. Andrew John Friedman James E. Bruya, Ph.D. 3008 B - 16th West Seattle, WA 98119 (206) 285-8282

August 9, 198

Steve Perrigo, Project Coordinator GeoEngineers, Inc. 2405-140th Avenue N.E., Suite 105 Bellevue, WA 98005

Dear Steve:

Enclosed are the results of the analyses of samples submitted on August 3, 1988 from Project 0161-13-4.

We appreciate this opportunity to be of service to you on this project. If you have any questions regarding this material, or if you just want to discuss any aspect of your projects, please do not hesitate to contact me.

Sincerely,

er f. fair, in Bob's absence

Robert J. Wallace, Chemist

RJW

# ENVIRONMENTAL CHEMISTS

Date of Report: August 9, 1988 Date Submitted: August 3, 1988 Project: 0161-13-4

### RESULTS OF ANALYSES OF ENVIRONMENTAL SAMPLES FOR METHANE BY GC/FID

<u>Sample #</u>	<u>Methane</u> (ppm)
#1 air	1,200 <sup>a</sup>
#2 air	200,000ª
#3 air	33
#4 air	<10
#5 air	2,000 <sup>a</sup>

# Quality AssuranceMethod Blank<10</td>#3 (Replicate)29

a - Value reported exceeded the calibration range established for the sample.

### ENVIRONMENTAL CHEMISTS

Date of Report: August 9, 1988 Date Submitted: August 3, 1988 Project: 0161-13-4

### RESULTS OF ANALYSES OF ENVIRONMENTAL SAMPLES FOR TOTAL VOLATILE HYDROCARBONS AS n-HEXANE

Sample #	Total Volatile Hydrocarbons <u>as n-Hexane</u> (ppm)
#1 air	1,500 <sup>a</sup>
#2 air	16,000 <sup>a</sup>
#3 air	<10
#4 air	<10
#5 air	5,100 <sup>a</sup>

### Quality Assurance

Air Blank	<10
#5 (Replicate)	3,000ª

a - Value reported exceeded the calibration range established for the sample.

B- 6

#### ENVIRONMENTAL CHEMISTS

James K. Farr, Ph.D. Andrew John Friedman James E. Bruya, Ph.D. 3008 B - 16th West Seattle, WA 98119 (206) 285-8282

August 15, 1988

GeoEngineers

Steve Perrigo, Project Coordinator GeoEngineers, Inc. 2405-140th Avenue N.E., Suite 105 Bellevue, WA 98005

AUG 1 8 1988 Routing File

Dear Steve:

Enclosed are the results of the analyses of samples submitted on August 9, 1988 from Project 0161-13-4.

We appreciate this opportunity to be of service to you on this project. If you have any questions regarding this material, or if you just want to discuss any aspect of your projects, please do not hesitate to contact me.

Sincerely,

Robert I Wallace

Robert J. Wallace, Chemist

RJW

# ENVIRONMENTAL CHEMISTS

Date of Report: August 15, 1988 Date Submitted: August 9, 1988 Project: 0161-13-4

> RESULTS OF ANALYSES OF ENVIROMENTAL SAMPLES FOR METHANE BY GC/FID

<u>Sample #</u>	<u>Methane</u> (ppm)
#1 air	2,000
#2 air	2,800
Ouality Assurance	
Method Blank	<10

#1 (Replicate) 2,600

### ENVIRONMENTAL CHEMISTS

Date of Report: August 15, 1988 Date Submitted: August 9, 1988 Project: 0161-13-4

> RESULTS OF ANALYSES OF ENVIRONMENTAL SAMPLES FOR TOTAL VOLATILE HYDROCARBONS AS n-HEXANE

> > •

:

Sample #	<u>Total Volatile Hydrocarbons</u> (ppm)
#1 air	2,800
#2 air	2,500
Quality Assurance	
Method Blank	<10

#1 (Replicate) 1,700

B - 9

ENVIRONMENTAL CHEMISTS

James K. Farr, Ph.D. Andrew John Friedman James E. Bruya, Ph.D. 3008 B - 16th West Seattle, WA 98119 (206) 285-8282

August 16, 1988

GeoEngineers

Steve Perrigo, Project Coordinator GeoEngineers, Inc. 2405-140th Avenue N.E., Suite 105 Bellevue, WA 98005

AUG 1 9 1988 Routing File

Dear Steve:

Enclosed are the results of the analyses of samples submitted on August 16, 1988 from Project 0161-13-4.

We appreciate this opportunity to be of service to you on this project. If you have any questions regarding this material, or if you just want to discuss any aspect of your projects, please do not hesitate to contact me.

Sincerely,

274 James K. Farr, Ph.D.

James K. Fall, Ph.D

JKF

# ENVIRONMENTAL CHEMISTS

Date of Report: August 16, 1988 Date Submitted: August 16, 1988 Project: 0161-13-4

> RESULTS OF ANALYSES OF ENVIROMENTAL SAMPLES FOR METHANE BY GC/FID

<u>Sample #</u>		<u>Methane</u> (ppm)
#1 air		1,000 <sup>a</sup>
#2 air		1,200 <sup>a</sup>
<u>Quality Assura</u>	nce	• •
Method Blank		<10
#1 (Replicate)		970 <sup>a</sup>

a - Value reported exceeded the calibration range established for the sample.

# ENVIRONMENTAL CHEMISTS

Date of Report: August 16, 1988 Date Submitted: August 16, 1988 Project: 0161-13-4

### RESULTS OF ANALYSES OF ENVIRONMENTAL SAMPLES FOR TOTAL VOLATILE HYDROCARBONS AS n-HEXANE

Sample #	<u>Total Volatile Hydrocarbons</u> (ppm)
#1 air	450
#2 air	3,800 <sup>a</sup>
Quality Assurance	
Method Blank	<10
	5 0003

#2 (Replicate) 3,900<sup>a</sup>

a - Value reported exceeded the calibration range established for the sample.

### ENVIRONMENTAL CHEMISTS

James K. Farr, Ph.D. Andrew John Friedman James E. Bruya, Ph.D. 3008 B - 16th West Seattle, WA 98119 (206) 285-8282

September 2, 1988

Steve Perrigo, Project Coordinator GeoEngineers, Inc. 2405-140th Avenue N.E., Suite 105 Bellevue, WA 98005

SEP 9 1988 Routing -Dr-File

GeoEngineers

Dear Steve:

Enclosed are the results of the analyses of samples submitted on August 30, 1988 from Project 0161-13-4.

We appreciate this opportunity to be of service to you on this project. If you have any questions regarding this material, or if you just want to discuss any aspect of your projects, please do not hesitate to contact me.

Sincerely,

Robert J. Wellace

Robert J. Wallace, Chemist

RJW

Enclosures

B - 13

# ENVIRONMENTAL CHEMISTS

Date of Report: September 2, 1988 Date Submitted: August 30, 1988 Project: 0161-13-4

> RESULTS OF ANALYSES OF ENVIRONMENTAL SAMPLES FOR METHANE BY GC/FID

<u>Sample #</u>	<u>Methane</u> (ppm)
#1 air	460
#2 air	860
<u>Quality Assurance</u>	
Method Blank	<10
#1 (Replicate)	460

# ENVIRONMENTAL CHEMISTS

Date of Report: September 2, 1988 Date Submitted: August 30, 1988 Project: 0161-13-4

### RESULTS OF ANALYSES OF ENVIRONMENTAL SAMPLES FOR TOTAL VOLATILE HYDROCARBONS AS n-HEXANE

Sample #	<u>Total Volatile Hydrocarbons</u> (ppm)
#1 air	870
#2 air	690
Quality Assurance	
Method Blank	<10
#1 (Replicate)	1,200

### ENVIRONMENTAL CHEMISTS

James K. Farr, Ph.D. Andrew John Friedman James E. Bruya, Ph.D. 3008 B - 16th West Seattle, WA 98119 (206) 285-8282

September 26, 1988

Steve Perrigo, Project Coordinator GeoEngineers, Inc. 2405-140th Avenue N.E., Suite 105 Bellevue, WA 98005

Dear Steve:

Enclosed are the results of the analysis of the sample submitted on September 21, 1988 from Project 161-13-4.

We appreciate this opportunity to be of service to you on this project. If you have any questions regarding this material, or if you just want to discuss any aspect of your projects, please do not hesitate to contact me.

Sincerely,

in Bug

James E. Bruya, Ph.D.

JEB

### ENVIRONMENTAL CHEMISTS

Date of Report: September 26, 1988 Date Submitted: September 21, 1988 Project: 161-13-4

> RESULTS OF ANALYSES OF ENVIRONMENTAL SAMPLES FOR METHANE BY GC/FID

Sample #	<u>Methane</u> (ppm)
880921-1 air	250

**Quality Assurance** 

Method Blank

<1

# ENVIRONMENTAL CHEMISTS

Date of Report: September 26, 1988 Date Submitted: September 21, 1988 Project: 161-13-4

> RESULTS OF ANALYSES OF ENVIRONMENTAL SAMPLES FOR TOTAL VOLATILE HYDROCARBONS AS n-HEXANE

Sample #	<u>Total Volatile Hydrocarbons</u> (ppm)
880921-1 air	210
Quality Accurance	

Quality Assurance

Method Blank

<10

### ENVIRONMENTAL CHEMISTS

James K. Farr, Ph.D. Andrew John Friedman James E. Bruya, Ph.D. 3008 B - 16th West Seattle, WA 98119 (206) 285-8282

September 26, 1988

GeoEngineers

Steve Perrigo, Project Coordinator GeoEngineers, Inc. 2405-140th Avenue N.E., Suite 105 Bellevue, WA 98005

SEP 2 7 1983 Routinz ...........

File

Dear Steve:

Enclosed are the results of the analysis of the sample submitted on September 23, 1988 from Project 161-13-4.

We appreciate this opportunity to be of service to you on this project. If you have any questions regarding this material, or if you just want to discuss any aspect of your projects, please do not hesitate to contact me.

Sincerely,

in Bugg

James E. Bruya, Ph.D.

JEB

Enclosures

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# ENVIRONMENTAL CHEMISTS

Date of Report: September 26, 1988 Date Submitted: September 23, 1988 Project: 161-13-4

# RESULTS OF ANALYSES OF ENVIRONMENTAL SAMPLES FOR METHANE BY GC/FID

<u>Sample #</u>	<u>Methane</u> (ppm)
880923-1 air	2,800 <sup>a</sup>

### Quality Assurance

Method Blank	<1
880923-1 (Duplicate)	2,500 <sup>a</sup>

 a - Value reported exceeded the calibration range established for the sample.

B - 20

### ENVIRONMENTAL CHEMISTS

Date of Report: September 26, 1988 Date Submitted: September 23, 1988 Project: 161-13-4

> RESULTS OF ANALYSES OF ENVIRONMENTAL SAMPLES FOR TOTAL VOLATILE HYDROCARBONS AS n-HEXANE

Sample #	<u>Total Volatile Hydrocarbons</u> (ppm)
880923-1 air	950 <sup>a</sup>

### <u>Quality Assurance</u>

Method B	lank	<10
880923-1	(Duplicate)	920a

a - Value reported exceeded the calibration range established for the sample.

B - 21

### ENVIRONMENTAL CHEMISTS

James K. Farr, Ph.D. Andrew John Friedman James E. Bruya, Ph.D. 3008-B 16th West Seattle, WA 98119 (206) 285-8282

# October 13GeoEngineers

Steve Perrigo, Project Coordinator GeoEngineers, Inc. 2405-140th Avenue N.E., Suite 105 Bellevue, WA 98005

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File	

OCT 1 9 1983

Dear Steve:

Enclosed are the results of the analyses of samples submitted on October 11, 1988 from Project 161-13-4.

We appreciate this opportunity to be of service to you on this project. If you have any questions regarding this material, or if you just want to discuss any aspect of your projects, please do not hesitate to contact me.

Sincerely,

Robert J Wellan

Robert J. Wallace, Chemist

RJW

### ENVIRONMENTAL CHEMISTS

Date of Report: October 13, 1988 Date Submitted: October 11, 1988 Project: 161-13-4

...

### RESULTS OF ANALYSES OF ENVIRONMENTAL SAMPLES FOR METHANE BY GC/FID

.

<u>Methane</u> (ppm)
6100
480

### <u>Ouality Assurance</u>

Method Blank	<10
881011-2 (Duplicate)	530

### ENVIRONMENTAL CHEMISTS

Date of Report: October 13, 1988 Date Submitted: October 11, 1988 Project: 161-13-4

### RESULTS OF ANALYSES OF ENVIRONMENTAL SAMPLES FOR TOTAL VOLATILE HYDROCARBONS (as n-HEXANE)

Sample #	Total Volatile <u>Hydrocarbons</u> (ppm)
<u> </u>	
881011-1	4400
881011-2	1500
Quality Assurance	
Method Blank	<10

1700

881011-2 (Duplicate)

B - 24

### ENVIRONMENTAL CHEMISTS

James K. Farr, Ph.D. Andrew John Friedman James E. Bruya, Ph.D. 3008-B 16th West Seattle, WA 98119 (206) 285-8282

October 27, 1988

Steve Perrigo, Project Manager GeoEngineers, Inc. 2405-140th Avenue N.E., Suite 105 Bellevue, WA 98005

Dear Steve:

Enclosed are the results of the analyses of samples submitted on October 25, 1988 from Project 0161-13-4.

We appreciate this opportunity to be of service to you on this project. If you have any questions regarding this material, or if you just want to discuss any aspect of your projects, please do not hesitate to contact me.

Sincerely,

Robert Jevalle

Robert J. Wallace, Chemist

RJW

# ENVIRONMENTAL CHEMISTS

Date of Report: October 27, 1988 Date Submitted: October 25, 1988 Project: 0161-13-4

### RESULTS OF ANALYSES OF ENVIRONMENTAL SAMPLES FOR METHANE BY GC/FID

<u>Sample #</u>	<u>Methane</u> (ppm)
881025-1 gas	730 <sup>a</sup>
881025-2 gas	3,400a

### Quality Assurance

Method Blank	<10
881025-2 (Replicate)	3,500 <sup>a</sup>

a - Value reported exceeded the calibration range established for the sample.

### ENVIRONMENTAL CHEMISTS

Date of Report: October 27, 1988 Date Submitted: October 25, 1988 Project: 0161-13-4

> RESULTS OF ANALYSES OF ENVIRONMENTAL SAMPLES FOR TOTAL VOLATILE HYDROCARBONS

Sample #	<u>TVH</u> (ppm)
881025-1	1,400ª
881025-2	2,500 <sup>a</sup>
Quality Assurance	
Method Blank	<10

881025-2 (Replicate) 2,500<sup>a</sup>

a - - Value reported exceeded the calibration range established for the sample.

### ENVIRONMENTAL CHEMISTS

James K. Farr, Ph.D. Andrew John Friedman James E. Bruya, Ph.D. 3008 B - 16th West Seattle, WA 98119 (206) 285-8282

November 15, 1988

GeoEngineers

Steve Perrigo, Project Coordinator GeoEngineers, Inc. 2405-140th Avenue N.E., Suite 105 Bellevue, WA 98005



Dear Steve:

Enclosed are the results of the analyses of samples submitted on November 8, 1988 from Project 0161-13-4.

We appreciate this opportunity to be of service to you on this project. If you have any questions regarding this material, or if you just want to discuss any aspect of your projects, please do not hesitate to contact me.

Sincerely,

Robert Jurallace

Robert J. Wallace, Chemist

RJW

# ENVIRONMENTAL CHEMISTS

Date of Report: November 15, 1988 Date Submitted: November 8, 1988 Project: 0161-13-4

> RESULTS OF ANALYSES OF ENVIRONMENTAL SAMPLES FOR METHANE BY GC/FID

Sample #	<u>Methane</u> (ppm)
881108-1 gas	320
881108-2 gas	2,600
Quality Assurance	

Method Blank <10 881108-1 (Replicate) 440

# ENVIRONMENTAL CHEMISTS

Date of Report: November 15, 1988 Date Submitted: November 8, 1988 Project: 0161-13-4

### RESULTS OF ANALYSES OF ENVIRONMENTAL SAMPLES FOR TOTAL VOLATILE HYDROCARBONS AS N-HEXANE

Sample #	(ppm)
881108-1 gas	2,100
881108-2 gas	2,900

Quality Assurance

Method Blank		<10
881108-1 (Replicate)	2	2,100

### ENVIRONMENTAL CHEMISTS

James K. Farr, Ph.D. Andrew John Friedman James E. Bruya, Ph.D. 3008-B 16th West Seattle, WA 98119 (206) 285-8282

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Steve Perrigo, Project Coordinator GeoEngineers, Inc. 2405-140th Avenue N.E., Suite 105 Bellevue, WA 98005

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Dear Steve:

Enclosed are the results of the analyses of the air samples submitted on December 6, 1988 from Project 0161-13-4.

We appreciate this opportunity to be of service to you on this project. If you have any questions regarding this material, or if you just want to discuss any aspect of your projects, please do not hesitate to contact me.

Sincerely,

Robert Wallace

Robert J. Wallace, Chemist

RJW

### FAKK, FRIEDIVIAIN & DRUTA, IINC.

### ENVIRONMENTAL CHEMISTS

Date of Report: December 12, 1988 Date Submitted: December 6, 1988 Project: 0161-13-4

### RESULTS OF ANALYSES OF ENVIRONMENTAL SAMPLES FOR METHANE BY GC/FID

<u>Sample #</u>	<u>Matrix</u>	<u>Dilution</u> <u>Factor</u>	<u>Methane</u> (ppm)
881206-1	air	100	1,000
881206-2	air	20	500
881206-3	air	20	560
<u>Quality A</u>	ssurance		
Method Bl	ank		<10
881206-3	(Replica	te)	460

# ENVIRONMENTAL CHEMISTS

Date of Report: December 12, 1988 Date Submitted: December 6, 1988 Project: 0161-13-4

.

### RESULTS OF ANALYSES OF ENVIRONMENTAL SAMPLES FOR TOTAL VOLATILE HYDROCARBONS AS n-HEXANE

Sample #	<u>Matrix</u>	<u>Dilution</u> Factor	<u>TVH</u> (ppm)
881206-1	air	1	1,200
881206-2	air	1	940
881206-3	air	1	270
<u>Ouality A</u>	ssurance		
Method Bla	ank		<10

881206-3	(Replicate)	310
----------	-------------	-----

#### ENVIRONMENTAL CHEMISTS

February 22, 1989

Steve Perrigo, Project Coordinator GeoEngineers, Inc. 2405-140th Avenue N.E., Suite 105 Bellevue, WA 98005

FEB 2 7 1989 Routing SCP of KSK PS

GeoEngineers

Dear Steve:

Enclosed are the results of the analyses of the air sample submitted on February 21, 1989 from Project 0161-13-4.

We appreciate this opportunity to be of service to you on this project. If you have any questions regarding this material, or if you just want to discuss any aspect of your projects, please do not hesitate to contact me.

Sincerely,

Robert J Wallan

Robert J. Wallace, Chemist

RJW

### ENVIRONMENTAL CHEMISTS

Date of Report: February 22, 1989 Date Submitted: February 21, 1989 Project: 0161-13-4

> RESULTS OF ANALYSES OF ENVIRONMENTAL SAMPLES FOR METHANE BY GC/FID

Sample #	<u>Matrix</u>	<u>Dilution</u> <u>Factor</u>	<u>Methane</u> (ppm)
890222-1	air	500	3,000
Quality A	ssurance		
Method Blank			<10
890222-1 (Replicate)			3,600
FARR, FRIEDWAN & DRUTA, INC.

#### ENVIRONMENTAL CHEMISTS

Date of Report: February 22, 1989 Date Submitted: February 21, 1989 Project: 0161-13-4

#### RESULTS OF ANALYSES OF ENVIRONMENTAL SAMPLES FOR TOTAL VOLATILE HYDROCARBONS AS n-HEXANE

<u>Sample #</u>	<u>Matrix</u>	<u>Dilution</u> <u>Factor</u>	<u>TVH</u> (ppm)
890222-1	air	1	840

<u>Ouality Assurance</u>

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Method Blank	<1
890222-1 (Replicate)	1,200

#### ENVIRONMENTAL CHEMISTS

Andrew John Friedman James E. Bruya, Ph.D. (206) 285-8282 3008-B 16th Avenue West Seattle, WA 98119 FAX: (206) 283-5044

March 17, 1989

Steve Perrigo, Project Leader GeoEngineers, Inc. 2405-140th Avenue N.E., Suite 105 Bellevue, WA 98005





Dear Mr. Perrigo:

Enclosed are the results of the analyses of samples submitted on March 16, 1989 from Project 161-13-4.

We appreciate this opportunity to be of service to you on this project. If you have any questions regarding this material, or if you just want to discuss any aspect of your projects, please do not hesitate to contact me.

Sincerely

Thomas M. Stapp, chemist

BAO

Enclosures

#### ENVIRONMENTAL CHEMISTS

Date of Report: March 17, 1989 Date Submitted: March 16, 1989 Project: 161-13-4

.

#### RESULTS OF ANALYSES OF ENVIRONMENTAL SAMPLES FOR METHANE BY GC/FID

<u>Sample #</u>	<u>Matrix</u>	<u>Dilution</u> <u>Factor</u>	<u>Methane</u> (ppm)
890316-1	Gas	20 .	370
890316-2	Gas	20	1400

#### <u>Ouality Assurance</u>

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Method Blank	1	<10
890316-2(Replicate)	20	1300
890316-1 (Duplicate)	20	440

#### ENVIRONMENTAL CHEMISTS

Date of Report: March 17, 1989 Date Submitted: March 16, 1989 Project: 161-13-4

#### RESULTS OF ANALYSES OF ENVIRONMENTAL SAMPLES FOR TOTAL VOLATILE HYDROCARBONS AS n-HEXANE

<u>Sample #</u>	<u>Matrix</u>	<u>Dilution</u> <u>Factor</u>	<u>TVH</u> (ppm)
890316-1	Gas	1	610
890316-2	Gas	1	1000
000010 2	043	*	1000

#### **Ouality Assurance**

Method Blank	1	<10
890316-2(Replicate)	1	1100

#### ENVIRONMENTAL CHEMISTS

Andrew John Friedman James E. Bruya, Ph.D. (206) 285-8282 3008-B 16th Avenue West Seattle, WA 98119 FAX: (206) 283-5044

April 18, 1989

GeoEngineers

Steve Perrigo, Project Leader GeoEngineers, Inc. 2405-140th Avenue N.E., Suite 105 Bellevue, WA 98005

APR 2 1 1989

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Dear Steve:

Enclosed are the results of the analyses of samples submitted on April 14, 1989 from Project 161-13-4 Unocal.

We appreciate this opportunity to be of service to you on this project. If you have any questions regarding this material, or if you just want to discuss any aspect of your projects, please do not hesitate to contact me.

Sincerely,

Thomas M. Stapp, Chemist

TMS/ddh

Enclosures

#### ENVIRONMENTAL CHEMISTS

Date of Report: April 18, 1989 Date Submitted: April 14, 1989 Project: 161-13-4 Unocal

#### RESULTS OF ANALYSES OF ENVIRONMENTAL SAMPLES FOR TOTAL VOLATILE HYDROCARBONS AS n-HEXANE

<u>Sample #</u>	Matrix	Dilution <u>Factor</u>	<u>TVH</u> (ppm)
890414-1	gas	100	1,500
890414-2	gas	100	3,300

<u>Quality Assurance</u>		
Method Blank	100	<1
890414-1 (Duplicate)	100	2,600

#### ENVIRONMENTAL CHEMISTS

Date of Report: April 18, 1989 Date Submitted: April 14, 1989 Project: 161-13-4 Unocal

#### RESULTS OF ANALYSES OF ENVIRONMENTAL SAMPLES FOR METHANE BY GC/FID

<u>Sample #</u>	<u>Matrix</u>	Dilution <u>Factor</u>	Methane (ppm)
890414-1	gas	0	240
890414-2	gas	0	220
<u>Quality As</u>	<u>surance</u>		
Method Bla	nk	0	<10
890414-1 (Duplicate	)	0	230

# GeoEngineers

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May 12, 1989

Steve Perrigo, Project Coordinator GeoEngineers, Inc. 2405-140th Avenue N.E., Suite 105 Bellevue, WA 98005

Dear Steve:

Enclosed are the results of the analyses of the air samples submitted on May 11, 1989 from Project 0161-13-4.

We appreciate this opportunity to be of service to you on this project. If you have any questions regarding this material, or if you just want to discuss any aspect of your projects, please do not hesitate to contact me.

Sincerely,

James K. Farr, Ph.D. JKF/jkf

Enclosures

endiros

Date of Report: May 12, 1989 Date Submitted: May 11, 1989 Project: 0161-13-4

#### RESULTS OF ANALYSES OF ENVIROMENTAL SAMPLES FOR METHANE BY GC/FID

Sample #	Dilution Factor	<u>Methane</u> (ppm)
890511-1	1	520
890511-2	1	180

#### **Ouality Assurance**

Method Blank	<10
890511-1 (Replicate)	510

enviros

Date of Report: May 12, 1989 Date Submitted: May 11, 1989 Project: 0161-13-4

#### RESULTS OF ANALYSES OF ENVIRONMENTAL SAMPLES FOR TOTAL VOLATILE HYDROCARBONS AS n-HEXANE

Sample #	Dilution <u>Factor</u>	<u>TVH</u> (ppm)
890511-1	1	770
890511-2	1	510
<u>Ouality Assurance</u>		
Method Blank		<10
890511-1 (Replicate)		730



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June 16, 1989

Kathy Killman, Project Coordinator GeoEngineers, Inc. 2405-140th Avenue N.E., Suite 105 Bellevue, WA 98005

Dear Kathy:

Enclosed are the results of the analyses of air samples submitted on June 16, 1989 from Project 0161-13-4.

We appreciate this opportunity to be of service to you on this project. If you have any questions regarding this material, or if you just want to discuss any aspect of your projects, please do not hesitate to contact me.

Sincerely,

James K. Farr, Ph.D.

JKF/cag

Enclosures



Date of Report: June 16, 1989 Date Submitted: June 16, 1989 Project: 0161-13-4

#### RESULTS OF ANALYSES OF ENVIROMENTAL SAMPLES FOR METHANE BY GC/FID

Sample #	Matrix	Dilution <u>Factor</u>	<u>Methane</u> (ppm)
61689-1	air	1:1	220
61689-2	air	1:1	170
Quality As	ssurance		
Method Bla		<10	
61689-2 (1	Replicate)		170



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Date of Report: June 16, 1989 Date Submitted: June 16, 1989 Project: 0161-13-4

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#### RESULTS OF ANALYSES OF ENVIRONMENTAL SAMPLES FOR TOTAL VOLATILE HYDROCARBONS AS N-HEXANE

Sample #	<u>Matrix</u>	Dilution <u>Factor</u>	( <del>ppm</del> )
61689-1	air	1:1	380
61689-2	air	1:1	140
Quality As	surance		
Method Bla	nk		<10
61689-2 (R	eplicate)		130

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ation Laboratory: 225 112th Ave NE Bellevue, WA 98004 (206) 453-8174		PROJECT LOCATION: UJOCHCHR & Mercel SITE NUMBER: 161-13-4	Comments	Methous			· ·		Received by: (Signature) Date: 6/10 NAME: 617 with	FIRM. Ferinal Itme. 10:53	ed by: (Signature)	
Corporation Laboratory: 225 112th Bellevue, W (206) 453-1	<u>Custody Record</u>	6/10/83	Analyses Required	HVT	11		-		66/			, ,
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File 01	61.13-	4	<b>.</b>

July 9, 1989

Steve Perrigo, Project Manager GeoEngineers, Inc. 2405-140th Avenue N.E., Suite 105 Bellevue, WA 98005

Dear Steve:

Enclosed are the results of the analyses of samples submitted on July 6, 1989 from Project 0161-13-4.

We appreciate this opportunity to be of service to you on this project. If you have any questions regarding this material, or if you just want to discuss any aspect of your projects, please do not hesitate to contact me.

Sincerely, James K. Farr, Ph.D.

JKF

Enclosures



Date of Report: July 9, 1989 Date Submitted: July 6, 1989 Project: 0161-13-4

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#### RESULTS OF ANALYSES OF ENVIROMENTAL SAMPLES FOR METHANE BY GC/FID

<u>Sample #</u>	<u>Matrix</u>	Dilution <u>Factor</u>	<u>Methane</u> (ppm)
890706-1G	gas	1:1	63
890706-2G	gas	1:1	150
Quality As	surance		
Method Bla	nk		<10
890706-1G	(Replicat	e)	60



Date of Report: July 9, 1989 Date Submitted: July 6, 1989 Project: 0161-13-4

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#### RESULTS OF ANALYSES OF ENVIRONMENTAL SAMPLES FOR TOTAL VOLATILE HYDROCARBONS AS N-HEXANE

<u>Sample #</u>	<u>Matrix</u>	Dilution <u>Factor</u>	<u>TVH</u> (ppm)
890706-1G	gas	1:1	260
890706-2G	gas	1:1	190
<u>Quality As</u>	surance		
Method Bla	nk		<10
890706-2G	(Replicate)		210



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July 13, 1989

Steve Perrigo, Project Coordinator GeoEngineers, Inc. 2405-140th Avenue N.E., Suite 105 Bellevue, WA 98005

Dear Steve:

Enclosed are the results of the analyses of air samples submitted on July 11, 1989 from Project 0161-13-4.

We appreciate this opportunity to be of service to you on this project. If you have any questions regarding this material, or if you just want to discuss any aspect of your projects, please do not hesitate to contact me.

Sincerely,

Robert Juvelloe

Robert J. Wallace Senior Environmental Chemist.

RJ₩

Enclosures



Date of Report: July 13, 1989 Date Submitted: July 11, 1989 Project: 0161-13-4

#### RESULTS OF ANALYSES OF ENVIROMENTAL SAMPLES FOR METHANE BY GC/FID

<u>Sample #</u>	<u>Matrix</u>	Dilution <u>Factor</u>	<u>Methane</u> (ppm)
890711-1	air	1	9,100
890711-2	air	100	26,000
Quality As	surance		

Method Blank	<10
890711-2 (Replicate)	26,000



Date of Report: July 13, 1989 Date Submitted: July 11, 1989 Project: 0161-13-4

#### RESULTS OF ANALYSES OF ENVIRONMENTAL SAMPLES FOR TOTAL VOLATILE HYDROCARBONS AS N-HEXANE

<u>Sample #</u>	<u>Matrix</u>	Dilution <u>Factor</u>	<u>TVH</u> (ppm)
890711-1	air	1	980
890711-2	air	100	14,000
Quality As	ssurance		
Method Bla	ank		<10
890711-2	(Replicate)		9,700



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July 27, 1989

Mr. Steve Perrigo, Project Manager GeoEngineers, Inc. 2405-140th Avenue N.E., Suite 105 Bellevue, WA 98005

Dear Steve:

Enclosed are the results of the analyses of samples submitted on July 18, 1989 from Project 0161-13-4.

We appreciate this opportunity to be of service to you on this project. If you have any questions regarding this material, or if you just want to discuss any aspect of your projects, please do not hesitate to contact me.

Sincerely, -Bob alsiewski

Bob Olsiewski, Environmental Chemist

Enclosures



Date of Report: July 27, 1989 Date Submitted: July 18, 1989 Project: 0161-13-4

#### RESULTS OF ANALYSES OF ENVIROMENTAL SAMPLES FOR METHANE BY GC/FID

<u>Sample #</u>	<u>Matrix</u>	Dilution <u>Factor</u>	<u>Methane</u> (ppm)
890718-1	Air	400	80,000
890718-2	Air	20	12,000
890718-3	Air	4	4,000
<u>Quality As</u>	surance		
Method Bla	nk	1.	<10
890718-1 (	Duplicate)	400	79,000



Date of Report: July 27, 1989 Date Submitted: July 18, 1989 Project: 0161-13-4

#### RESULTS OF ANALYSES OF ENVIRONMENTAL SAMPLES FOR TOTAL VOLATILE HYDROCARBONS AS N-HEXANE

Sample #	Dilution <u>Factor</u>	<u>TVH</u> (ppm)
890718-1	40	570
890718-2	40	1800
890718-3	40	500
Quality Assurance		
Method Blank	1	<10
890718-1 (Duplicate)	40	430

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GeoEngineers AUG 2 9 1989 Routing GAT INKS

August 22, 1989

Cheryl Haines, Project Coordinator GeoEngineers, Inc. 2405-140th Avenue N.E., Suite 105 Bellevue, WA 98005

Dear Cheryl:

Enclosed are the results of the analyses of the sample submitted on August 21, 1989 from Project 0161-13-4.

We appreciate this opportunity to be of service to you on this project. If you have any questions regarding this material, or if you just want to discuss any aspect of your projects, please do not hesitate to contact me.

Sincerely,

- Olsienster

Bob A. Olsiewski Environmental Chemist

Enclosures

endípos

Date of Report: August 22, 1989 Date Submitted: August 21, 1989 Project: 0161-13-4

#### RESULTS OF ANALYSES OF ENVIROMENTAL SAMPLE FOR METHANE BY GC/FID

<u>Sample #</u>	<u>Matrix</u>	Dilution <u>Factor</u>	<u>Methane</u> (ppm)
2	Air	1	240
<u>Quality As</u> Method Bla			<10
(Replicate 2	2) Air	1	290



Date of Report: August 22, 1989 Date Submitted: August 21, 1989 Project: 0161-13-4

#### RESULTS OF ANALYSES OF ENVIRONMENTAL SAMPLE FOR TOTAL VOLATILE HYDROCARBONS AS N-HEXANE

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<u>Sample #</u>	<u>Matrix</u>	Dilution <u>Factor</u>	<u></u> (ppm)		
2	Air	1	260		

Quality Assurance

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Method Blank	<10

(Replicate)			
2	Air	1	290



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October 24, 1989

Kathy Killman, Project Coordinator GeoEngineers, Inc. 2405-140th Avenue N.E., Suite 105 Bellevue, WA 98005

Dear Kathy:

Enclosed are the results of the analyses of samples submitted on September 21, 1989 from Project 0161-13-4.

We appreciate this opportunity to be of service to you on this project. If you have any questions regarding this material, or if you just want to discuss any aspect of your projects, please do not hesitate to contact me.

Sincerely,

James K. Farr, Ph.D.

JKF

Enclosures



Date of Report: October 24, 1989 Date Submitted: September 21, 1989 Project: 0161-13-4

#### RESULTS OF ANALYSES OF ENVIRONMENTAL SAMPLES FOR TOTAL VOLATILE HYDROCARBONS AS N-HEXANE AND METHANE

.

<u>Sample #</u>	<u>Matrix</u>	Dilution <u>Factor</u>	<u>TVH</u> (ppm)	<u>CH4</u> (ppm)
890921-1	Air	l	370	<10
890921-2	Air	1	810	<10
Quality As	surance			
Method Bla	ank	1	<10	
890921-2 (Replicat		1	1100a	
890921-1 (Duplicat		1	440	
Cont. Cal @ 10 ppm	.ib.	1	19	

a - Value reported exceeded the calibration range established for the sample.

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GeoEngineers

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November 2, 1989

Kathy Kilman GeoEngineers, Inc. 2405-140th Avenue N.E., Suite 105 Bellevue, WA 98005

Dear Kathy:

Enclosed are the results of the analyses of samples submitted on October 27, 1989 from Project 161-13-04.

We appreciate this opportunity to be of service to you on this project. If you have any questions regarding this material, or if you just want to discuss any aspect of your projects, please do not hesitate to contact me.

Sincerely,

James K. Farr, Ph.D.

JKF

Enclosures

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Date of Report: November 2, 1989 Date Submitted: October 27, 1989 Project: 161-13-04

#### RESULTS OF ANALYSES OF ENVIRONMENTAL SAMPLES FOR TOTAL VOLATILE HYDROCARBONS AS N-HEXANE

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<u>Sample #</u>	<u>Matrix</u>	Dilution <u>Factor</u>	<u>TVH</u> (ppm)
891027-1	Gas	1	3,600a
891027-2	Gas	1	620
891027-3	Gas	1	47,000a
891027-4	Gas	1	380
891027-5	Gas	1	8,300a

#### <u>Quality Assurance</u>

a - Value reported exceeded the calibration range established for the sample.

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Date of Report: November 2, 1989 Date Submitted: October 27, 1989 Project: 161-13-04

#### RESULTS OF ANALYSES OF ENVIROMENTAL SAMPLES FOR METHANE BY GC/FID

<u>Sample #</u>	<u>Matrix</u>	Dilution <u>Factor</u>	<u>Methane</u> (ppm)
891027-1	Gas	1	210
891027-2	Gas	1	870
891027-3	Gas	1	110,000a
891027-4	Gas	1	50
891027-5	Gas	1	92,000a

#### Quality Assurance

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Method Blank	1 <10 .
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 a - Value reported exceeded the calibration range established for the sample.



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<u>B - 71</u>

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December 18, 1989

Kathy Killman, Project Coordinator GeoEngineers, Inc. 2405-140th Avenue N.E., Suite 105 Bellevue, WA 98005

Dear Kathy:

Enclosed are the results of the analyses of samples submitted on December 6, 1989 from Project 0161-13-4 Unocal.

We appreciate this opportunity to be of service to you on this project. If you have any questions regarding this material, or if you just want to discuss any aspect of your projects, please do not hesitate to contact me.

Sincerely,

Robert J Wellar

Robert J. Wallace Senior Environmental Chemist.

RJW

Angen agener ag

Enclosures



Corporation Scientists & Engineers (206) 455-2962 fax 451-8546 600 Skyline Tower 10900 NE 4th Street Bellevue, Washington 98004 Analytical Laboratory: 225 112th Avenue NE (206) 453-8174 Date of Report: December 18, 1989 Date Submitted: December 6, 1989 Project: 0161-13-4 Unocal

#### RESULTS OF ANALYSES OF ENVIRONMENTAL SAMPLES FOR TOTAL VOLATILE HYDROCARBONS AS N-HEXANE

<u>Sample #</u>	<u>Matrix</u>	Dilution <u>Factor</u>	<u>TVH</u> (ppm)
891206-1	Air	1	560
891206-2	Air	1	690
<u>Quality As</u>	surance	<i>,</i>	
Method Bla	ink	1	<10
891206-2 (Replicat	e)	1	570



Date of Report: December 18, 1989 Date Submitted: December 6, 1989 Project: 0161-13-4 Unocal

#### RESULTS OF ANALYSES OF ENVIROMENTAL SAMPLES FOR METHANE BY GC/FID

<u>Sample #</u>	<u>Matrix</u>	Dilution <u>Factor</u>	<u>Methane</u> (ppm)
891206-1	Air	1	240
891206-2	Air	1	740
<u>Quality As</u>	surance		
Method Bla	ink	1	<10
891206-2 (Replicat	:e)	1	815



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GeoEngineers

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January 16, 1990

Norman Puri, Project Coordinator GeoEngineers, Inc. 2405-140th Avenue N.E., Suite 105 Bellevue, WA 98005

Dear Norman:

Enclosed are the results of the analyses of samples submitted on December 29, 1989 from Project 161-13-B04 Unocal.

We appreciate this opportunity to be of service to you on this project. If you have any questions regarding this material, or if you just want to discuss any aspect of your projects, please do not hesitate to contact me.

Sincerely,

f-Oliversti

Bob A. Olsiewski Environmental Chemist RAO

Enclosures

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Corporation Scientists & Engineers (206) 455-2962 fax 451-8546 600 Skyline Tower 10900 NE 4th Street Bellevue, Washington 98004 Analytical Laboratory: 225 112th Avenue NE (206) 453-8174 Date of Report: January 16, 1990 Date Submitted: December 29, 1989 Project: 161-13-B04 Unocal

#### RESULTS OF ANALYSES OF ENVIRONMENTAL SAMPLES FOR TOTAL VOLATILE HYDROCARBONS AS N-HEXANE

<u>Sample #</u>	<u>Matrix</u>	Dilution <u>Factor</u>	<u>TVH</u> (ppm)
891229-1	Air	1	140
891229-2	Air	1	35

#### Quality Assurance

Method Blank	1	<10
891229-2 Air (Replicate)	1	46



Sec. Sec.

Date of Report: January 16, 1990 Date Submitted: December 29, 1989 Project: 161-13-B04 Unocal

#### RESULTS OF ANALYSES OF ENVIROMENTAL SAMPLES FOR METHANE BY GC/FID

<u>Sample #</u>	<u>Matrix</u>	Dilution Factor	<u>Methane</u> (ppm)
891229-1	Air	1	76
891229-2	Air	1	380
Quality As	surance		
Method Bla	nk	1	<10
891229-2 (Replicat	Air e)	1	380



GeoEngineers			
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February 9, 1990

Norm Puri, Project Coordinator GeoEngineers, Inc. 2405-140th Avenue N.E., Suite 105 Bellevue, WA 98005

Dear Norm:

Enclosed are the results of the analyses of samples submitted on January 1, 1990 from Project 161-13-B04 Unocal.

We appreciate this opportunity to be of service to you on this project. If you have any questions regarding this material, or if you just want to discuss any aspect of your projects, please do not hesitate to contact me.

Sincerely,

Jon J. Bagby Chemist

JJB

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Enclosures



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Corporation Scientists & Engineers (206) 455-2962 fax 451-8546 600 Skyline Tower 10900 NE 4th Street Bellevue, Washington 98004 Analytical Laboratory: 225 112th Avenue NE (206) 453-8174

#### B - 78

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Date of Report: February 9, 1990 Date Submitted: January 1, 1990 Project: 161-13-B04 Unocal

#### RESULTS OF ANALYSES OF ENVIROMENTAL SAMPLES FOR METHANE BY GC/FID

<u>Sample #</u>	<u>Matrix</u>	Dilution <u>Factor</u>	<u>Methane</u> (ppm)
14	Air	100	110,000
17	Air	100	260,000
19	Air	100	37,000
900201-1	Air	1	<10

#### Quality Assurance

Air Blank	1	<10
Cont. Calib.	1	83
@ 100 ppm		

enviros

Date of Report: February 9, 1990 Date Submitted: January 1, 1990 Project: 161-13-B04 Unocal

#### RESULTS OF ANALYSES OF ENVIRONMENTAL SAMPLES FOR TOTAL VOLATILE HYDROCARBONS AS N-HEXANE

<u>Sample #</u>	<u>Matrix</u>	Dilution <u>Factor</u>	<u>TVH</u> (ppm)
14	Air	1	2,800
17	Air	1	2,700
19	Air	l	860
900201-1	Air	1	16

#### <u>Quality Assurance</u>

Air Bl	ank	1	20
17 (Repl	Air .icate)	5	2,200
Cont. @ 100	Calib. ppm	1	94

# CONDUTOS Page 2 Shi and 2 Shi a

Kathy Killman, Project Manager GeoEngineers, Inc. 2405 140th Avenue N.E., Suite 105 Bellevue, WA 98005

#### Dear Kathy:

Enclosed are the results of the analyses of samples submitted on May 1, 1990 from Project 161-13-B04 Mercer/Westlake.

We appreciate this opportunity to be of service to you on this project. If you have any questions regarding this material, or if you just want to discuss any aspect of your projects, please do not hesitate to contact me.

Sincerely,

Stephen J. Loague Environmental Chemist SJL

Enclosures

Enviros Analytical Services (206) 820-7575 fax 820-6337 12277 - 134th Court NE Suite 200 Redmond, Washington 98052

#### Date of Report: May 7, 1990 Date Submitted: May 1, 1990 Project: 161-13-B04 Mercer/Westlake

#### RESULTS OF ANALYSES OF ENVIROMENTAL SAMPLES FOR METHANE BY GC/FID

<u>Sample #</u>	<u>Matrix</u>	Dilution <u>Factor</u>	<u>Methane</u> (ppm)
MW-3	Gas	100	98,000
MW-14	Gas	100	91,000
MW-17	Gas	100	49,000
MW-29	Gas	100	32,000
RW-4A	Gas	100	11,000

<u>Quality Assuran</u>	<u>ce</u>	
Method Blank	100	<10
MW-3 (Replicate)	100	93,000
MW-17 (Replicate)	100	46,000
RW-4A (Replicate)	100	12,000

Cont. Calib. @ 500 ppm



440

Page 2 of 3

Page 3 of 3

Date of Report: May 7, 1990 Date Submitted: May 1, 1990 Project: 161-13-B04 Mercer/Westlake

#### RESULTS OF ANALYSES OF ENVIRONMENTAL SAMPLES FOR TOTAL VOLATILE HYDROCARBONS AS N-HEXANE

<u>Sample #</u>	<u>Matrix</u>	Dilution <u>TVH</u> <u>Factor</u> (ppm)
MW-3	Gas	100 13,000
MW-14	Gas	1 3,400
MW-17	Gas	1 9,700
MW-29	Gas	1,500
RW-4A	Gas	1 260

Quality Assurance

Lab Air <10 MW-3 (Replicate) 18,000 MW-14 (Replicate) 3,000

B - 83

RW-4A (Replicate)

Cont. Calib. @ 1,000 ppm

enviros

240

1,200

	LUC. MOLLOS / WES	FRUJELI NHITE ULOCAL STAS		CUMMENTS .										- SI 40 1021	_ <u> '</u> _								
			ND. DF SAMFLE	CUNTHING'				-						1000 A									·
EDENGINEE Oth AVE. Oth AVE. UE, WASHI 206-746- DF CUSTO DATE DATE	055	AESERVATIVE ANALYSES	TVH/	NH/	TVH/MEANALLS	TA WAR DIA LIG	TU+-/					1 14 11	TTAN BURNEL	ENNIE ENNIE	C								
	E111_1				ţ	t	ł				4			KATHY KILL					-				
	рат	FILTERED	,		1	•	١					╞	ATE TIME	TE TIME	MIT	و –	1	J					
2405 -	CHAIN		TYPE OF SAMPLE	VAPOR	VRPOR	VAPPE	Jeror.	VAPE						5-01-90	DA	<u>Ω</u> Σ	τ M A						
сь 2	N-P-	DEPTH OF SAMPLE	1	1	-	1	1	•					ure) 20-215		PROJEC			•					
		BY CAW	TIME SAMPLED	0770	0640	02 90	0800	0810		•				K hose worth	RELINQUISHED BY (SIGNATURE)		COMMENTS:						
		SAMFLED B	DATE SANPLED	5-01.90	06-10-5	5-01-90	5-01.90	5.01.90			·		NITSHED	FIRM Carlos K 12	IISHED BY		1						
		גט -	SAMFLE No.	Miu-3	MW - 14	MW - 17	P5-UM	RW. 4A					REL ING	FIRM -	RELINOL NAME		ADDITIONAL		•				

GEI 101-**4**4

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June 21, 1990

Kathy Killman, Project Manager GeoEngineers, Inc. 2405 140th Avenue N.E. Suite 105 Bellevue, WA 98005

Dear Kathy:

Enclosed are the results of the analyses of samples submitted on June 15, 1990 from Project 161-132-B04 Westlake/Mercer.

We appreciate this opportunity to be of service to you on this project. If you have any questions regarding this material, or if you just want to discuss any aspect of your projects, please do not hesitate to contact me.

Sincerely, Stephen J. Loague Environmental Chemist

SJL

Enclosures

Enviros Analytical Services (206) 820-7575 fax 820-6337 12277 - 134th Court NE Redmond, Washington 98052

B - 85

page 2 of 3

Date of Report: June 21, 1990 Date Submitted: June 15, 1990 Project: 161-131-B04 Westlake/Mercer

#### RESULTS OF ANALYSES OF ENVIROMENTAL SAMPLES FOR METHANE BY GC/FID

Sample # Matrix Dilution Factor	<u>Methane</u> (ppm)
900615-1 Air 1	100
900615-2 Air 1	100
<u>Quality Assurance</u>	
Method Blank 1	<10
900615-1 Air	. 110.

(Replicate)

900615-2 Air (Replicate)

enviros

110

page 3 of 3

Date of Report: June 21, 1990 Date Submitted: June 15, 1990 Project: 161-131-B04 Westlake/Mercer

> RESULTS OF ANALYSES OF ENVIRONMENTAL SAMPLES FOR TOTAL VOLATILE HYDROCARBONS AS N-HEXANE

1

<u>Sample #</u>	<u>Matrix</u>	Dilution	<u>TVH</u>
		Factor	(ppm)
900615-1	Air	1	150
900615-2	Air	1	90
Quality Assur	ance		
Method Blank			
Mechod Brank		<b></b>	<10

900615-1 Air 160 (Replicate)

Air

900615-2 (Replicate)

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81

1 LDC. Sea 110	FROJECT NAME Westford Merry	GEI FILE ND. 16/13/309	COMMENTS									DATE/ TIME				•		
FROJECT	FROJEC	GEI FI	CSAM.		-							Jet Le						
105			ANALYSES TO RE CONDUCTED	TUH . CH+	κ.	L				5	11 1	DEX BIENA PUL	D BY (SIGNATURE					
JEERS INC. E. N.E. SUITE SHINGTON 98005 16-5200	CUSTODY RECORD	TE 6/15/90	PRESERVATIVE ADDED TO SAMPLE									FIRM		FIRM	tillmon			
GEOENGINEERS INC 140th AVE. N.E. LEVUE, MASHINGTON 206-746-5200	CHAIN OF CU	DATE	FILTERED	l								DATE TIME (6/15/900	DATE TIME		Kathy			
2405 - BELL		~	TYPE OF SAMPLE	~00bn	19,00							DA	DA		4			
	·	W56, NEP	DEPTH OF SAMPLE									TURE)	JRE)		Besults			
<b>0 6 -</b> 0 2 0		BY 10-54	T I ME SAMFLED	0100	0810							D. BY (SIGUATURE)	BY (SIGNATURE)		COMMENTS:			
0 6 -		SAMPLED B	DATE SANFLED	6/15740	90015-26/15/90							FEL INQUISHED BY (SIGNATURE) NAME - MEAN ALCONAL - CULLA- FIRM - CERTRY - CULLA-	UISHED BY		1			
			SAMFLE No.	900615-1	900615-2							REL IN NAME FIRM	REL. INQUISHED	FIRM	ADDITIONAL			

GEI 101-94

enviros

August 3, 1990

Kathy Kilman, Project Manager GeoEngineers, Inc. 2405 140th Avenue N.E. Suite 105 Bellevue, WA 98005

Dear Kathy:

Enclosed are the results of the analyses of samples submitted on July 24, 1990 from Project 161-13-B9/Unocal, Seattle.

We appreciate this opportunity to be of service to you on this project. If you have any questions regarding this material, or if you just want to discuss any aspect of your projects, please do not hesitate to contact me.

Sincerely,

Robert J Wallace

Robert J. Wallace Senior Chemist

RJW:so

Enclosures

Enviros Analytical Services (206) 820-7575 fax 820-6337 12277 - 134th Court NE Redmond, Washington 98052 Date of Report: August 3, 1990 Date Submitted: July 24, 1990 Project: 161-13-B9/Unocal, Seattle

#### RESULTS OF ANALYSES OF ENVIRONMENTAL SAMPLES FOR TOTAL VOLATILE HYDROCARBONS AS N-HEXANE

<u>Sample #</u>	Matrix	Dilution <u>Factor</u>		<u>TVH</u> (ppm)
900729-2	Air	1		24
· .			-	

Quality Assurance

Method Blank Air 900729-2 Air

(Replicate)

enviros

<10

25

Date of Report: August 3, 1990 Date Submitted: July 24, 1990 Project: 161-13-B9/Unocal, Seattle

#### RESULTS OF ANALYSES OF ENVIROMENTAL SAMPLES FOR METHANE BY GC/FID

B - 91

<u>Sample #</u>	<u>Matrix</u>	Dilution <u>Factor</u>	<u>Methane</u> (ppm)
900729-2	Air	1	<10

1

**Ouality Assurance** 

Method Blank

900729-2 Air (Replicate)

enviros

< 10

<10

07-061 FROJECT LDC. Set Me FROJECT NAME 661 FILE NO. ///-/3-84	NERS			DATE TIME 7/24/90/12:20 DATE TIME	
105	ANALYSES NO. TO BE CONDUCTED CONT	TUH, CH		PHASIGOALARE)	
GINEERS INC. AVE. N.E. SULTE WASHINGTON 98005 -746-5200 CUSTODY RECORD DATE/20	EKVATIVE D TO LE			FIRM FIRM	
2405 - 140th AVE. N.E. BELLEVUE, WASHINGTON 206-746-5200 CHAIN OF CUSTODY RE	FIELD FILTERED			DATE TIME 7/24/90 DATE TIME	
	DEPTH TYPE OF 3AMPLE SAMPLE	523			
ΒY	TIME SAMPLED			HED BY (SIGNATURE) April 2 ED BY (SIGNATURE) COMMENTS:	
SAMPLED	SAMFLE DATE No. SAMFLED	Po124-2 7/29.		FELINQUISHED NAME FIRM	
			B - 92		GEI 100-94

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#### APPENDIX C

#### OTHER CHEMICAL ANALYTICAL DATA



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Routing BCP

14603 N.E. 87th St. • REDMOND, WASHINGTON 98052 • 206/885-1664

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#### ANALYSIS REPORT

| CLIENT: Geoengineers, Inc.                                      | DATE       | RECEIVED: | 10/19/88 |
|-----------------------------------------------------------------|------------|-----------|----------|
| REPORT TO: Steve Perrigo<br>2405 - 140th NE,<br>Bellevue, WA 98 | Suite 105  | REPORTED: | 10/28/88 |
| Laboratory Sample Number                                        | 74101      | 74102     |          |
| Client Identification                                           | MM 30      | MW l      |          |
| Aerobic Plate Count<br>(CFU/ml)<br>0 Hours, 10/19               | 120,000.   | 20,500.   |          |
| Aerobic Plate Count (<br>(CFU/ml)<br>24 Hours, 10/20            | 410,000.*  | 310,000.* |          |
| Aerobic Plate Count<br>(CFU/ml)<br>72 Hours, 10/22              | 860,000.*  | 570,000.* |          |
| Aerobic Plate Count<br>(CFU/ml)<br>7 Days, 10/26                | 2,200,000. | 540,000.  |          |

\* = Estimated Count - A count obtained from a plate having less than 30 or more than 300 colonies.

FG/pb

REPORTED BY <u>*House A.*</u> Florence A. Glesy

Analytical Technologies, Inc.

560 Naches Avenue, S.W., Suite 101, Renton, WA 98055, (206) 228-8335

ATI I.D. # 8903-153

1Engineers

PR 26 198

<u> -</u>

April 25, 1989

GeoEngineers, Inc. 2405 140th Ave. N.E. Suite 105 Bellevue, WA 98005

Attention : Steve Perrigo

Project Number : 161-13-4

Project Name : Unocal

On March 31, 1989 Analytical Technologies, Inc. received one water sample for analyses. The sample was analyzed with EPA methodology or equivalent methods as specified in the attached analytical schedule. The results, sample cross reference, and the quality control data are enclosed.

Vary Silva Mary &

GC Chemist

FWG/hbb

Fredercher Frotthe

Frederick W. Grothkopp Technical Manager

# GeoEngineers

### APR 2 6 1989

| Routing |  |
|---------|--|
| File    |  |

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#### SAMPLE CROSS REFERENCE SHEET

CLIENT : GEOENGINEERS, INC. PROJECT # : 161-13-4 PROJECT NAME : UNOCAL ATI # CLIENT DESCRIPTION MATRIX DATE SAMPLED 8903-153-1 WASTE WATER WATER 03/31/89

----- TOTALS -----

| MATRIX | # SAMPLES |
|--------|-----------|
|        |           |
| WATER  | 1         |

#### ATI STANDARD DISPOSAL PRACTICE

The samples from this project will be disposed of in thirty (30) days from the date of this report. If an extended storage period is required, please contact our sample control department before the scheduled disposal date.



#### ANALYTICAL SCHEDULE

# CLIENT : GEOENGINEERS, INC. PROJECT # : 161-13-4 PROJECT NAME : UNOCAL ANALYSIS TECHNIQUE REFERENCE/METHOD PURGEABLE AROMATICS GC/PID EPA 602 PETROLEUM HYDROCARBONS IR EPA 418.1

C - 4



#### PURGEABLE AROMATICS ANALYSIS DATA SUMMARY

# COMPOUNDS RESULTS

| BENZENE             | <0.5 |
|---------------------|------|
| CHLOROBENZENE       | <0.5 |
| 1,3-DICHLOROBENZENE | <0.5 |
| 1,2-DICHLOROBENZENE | <0.5 |
| 1,4-DICHLOROBENZENE | <0.5 |
| ETHYLBENZENE        | <0.5 |
| TOLUENE             | <0.5 |
| META & PARA XYLENE  | <0.5 |
| ORTHO XYLENE        | <0.5 |

#### SURROGATE PERCENT RECOVERIES

BROMOFLUOROBENZENE

\_\_\_\_\_

102



ATI I.D. # 8903-153-1

#### PURGEABLE AROMATICS ANALYSIS DATA SUMMARY

| CLIENT<br>PROJECT #<br>PROJECT NAME<br>CLIENT I.D.<br>SAMPLE MATRIX<br>EPA METHOD                                                           | : 161-13-4<br>: UNOCAL<br>: WASTE WATER | DATE SAMPLED : 03/31/89<br>DATE RECEIVED : 03/31/89<br>DATE EXTRACTED : N/A<br>DATE ANALYZED : 04/04/89<br>UNITS : ug/L<br>DILUTION FACTOR : 1 |
|---------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------|
| COMPOUNDS                                                                                                                                   |                                         | RESULTS                                                                                                                                        |
| BENZENE<br>CHLOROBENZENE<br>1,3-DICHLOROBE<br>1,2-DICHLOROBE<br>1,4-DICHLOROBE<br>ETHYLBENZENE<br>TOLUENE<br>META & PARA XX<br>ORTHO XYLENE | ENZENE<br>ENZENE                        | 1.2<br><0.5<br><0.5<br><0.5<br><0.5<br><0.5<br>2.4<br>1.7<br>0.7                                                                               |

#### SURROGATE PERCENT RECOVERIES

BROMOFLUOROBENZENE

105

G - 6



#### PURGEABLE AROMATICS QUALITY CONTROL DATA

| PROJECT # :<br>PROJECT NAME :                         | : GEOENG<br>: 161-13<br>: UNOCAL<br>: 602 | -4                          | INC.                         | DATE                         | LE MA                | YZED : 0<br>TRIX : W         | 903-1<br>4/03/<br>ATER<br>g/L |                    |
|-------------------------------------------------------|-------------------------------------------|-----------------------------|------------------------------|------------------------------|----------------------|------------------------------|-------------------------------|--------------------|
| COMPOUND                                              |                                           | SAMPLE<br>RESULT            | SPIKE<br>ADDED               | SPIKED<br>SAMPLE             | %<br>REC             | DUP<br>SPIKED<br>SAMPLE      | DUP<br>%<br>REC               | RPD                |
| BENZENE<br>CHLOROBENZENE<br>TOLUENE<br>META & PARA XY | LENE                                      | 1.4<br><0.5<br><0.5<br><0.5 | 8.00<br>8.00<br>8.00<br>21.9 | 8.32<br>7.26<br>6.89<br>19.6 | 87<br>91<br>86<br>89 | 8.64<br>6.48<br>6.75<br>17.4 | 91<br>81<br>84<br>79          | 4<br>11<br>2<br>12 |



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## GENERAL CHEMISTRY RESULTS

| CLIENT<br>PROJECT #<br>PROJECT NAME |       | INC. | SAMPLE MATRIX : WATER |
|-------------------------------------|-------|------|-----------------------|
| PARAMETER                           | UNITS | -1   |                       |
| PETROLEUM<br>HYDROCARBONS           | mg/L  | 0.77 |                       |

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#### GENERAL CHEMISTRY QUALITY CONTROL

|                           | : 161-1 |             | 2.               |               | S   | AMPLE MA       | TRIX :         | WATER    |
|---------------------------|---------|-------------|------------------|---------------|-----|----------------|----------------|----------|
| PARAMETER                 | UNITS   | ATI<br>I.D. | SAMPLE<br>RESULT | DUP<br>RESULT | RPD | SPIKED<br>CONC | SPIKE<br>ADDED | %<br>REC |
| PETROLEUM<br>HYDROCARBONS | mg/L    | 8904-007-1  | <0.05            | <0.05         | 0   | 4.05           | 5.14           | 79       |

Average Result

|      |                                  |                          |           |                    |                                                     |              |           |          | ``                |               |          |                            |              |                             |                  |           | •                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                |          |                |                |                                         |                               |
|------|----------------------------------|--------------------------|-----------|--------------------|-----------------------------------------------------|--------------|-----------|----------|-------------------|---------------|----------|----------------------------|--------------|-----------------------------|------------------|-----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|----------|----------------|----------------|-----------------------------------------|-------------------------------|
| 100  | Analytical Technologies, Inc.    | Teci                     | 0<br>C    | logi               | es, in                                              | IJ           |           |          |                   |               |          |                            |              |                             |                  |           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | <b>U</b> -     | Chain    | ĩ              | of (           | Cust                                    | Custody                       |
| - 18 | San Diego 💿 Phoe                 | Phoenix S                | Seattle   |                    |                                                     |              |           |          |                   |               |          |                            |              |                             |                  | DATE      | 10                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 31/8           | 6        | - PAGE.        |                | <u>/of</u> .                            | 1                             |
|      | PROJ. MGR. Straid DATION         | Partio                   | c,        |                    |                                                     |              |           |          |                   |               |          |                            | AN           | ALYSI                       | ANALYSIS REQUEST | EST       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                |          |                |                |                                         | SF                            |
|      | COMPANY GEDEFIGION ADDRESS 24040 |                          | LA A      | C NE               |                                                     | ID CW5D2'    |           |          |                   | внемога       | 0108/10  | עוכ<br>וראדו <b>ו</b> בס   | 090          | $\bigcirc$                  |                  |           | TNATU11                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                | NICZ     |                |                |                                         | CONTAINE                      |
|      | SAMPLERS (SIGNATURE)             |                          | )         | PHONE NO           | (PHONE NO.)                                         | T            | 21 624/82 | CIDES/PC | NUCLEA<br>9 DITAN |               | ATILES 6 | 12 020<br>020<br>14020 020 | 6/214 NO     | OCARBO<br>OLEUM<br>DES 9020 |                  |           | METALS (<br>METALS (<br>MET | א איג<br>אדרכ. | 108001-0 |                |                | ·                                       | NBER OF                       |
|      | SAMPLE ID.                       | DATE                     | TIME      | MATRIX             | LAB ID.                                             | 38A8<br>M 20 |           |          | POLY              | 8/⊅09<br>N∃Hd | 10/      |                            | вяар<br>Атот | 8739                        |                  |           | ATBM                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | E6 TO          | d₩S      |                |                | · _ · · · · · · · · · · · · · · · · · · | IUN                           |
|      | 2 Server 1 Scrack                | 381879:15                | 51.       | وريحاجي            | <br>-                                               |              |           |          |                   |               |          | $\mathbf{x}$               |              |                             |                  |           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                |          |                |                |                                         | N                             |
|      |                                  | /                        | :         | -                  |                                                     |              |           |          | -                 |               |          |                            |              | $ \times$                   |                  |           | <br>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | <br>           |          |                |                |                                         | <u> </u>                      |
|      | ,                                |                          |           |                    |                                                     |              |           |          | ļ                 |               |          |                            |              |                             |                  |           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                |          |                |                |                                         |                               |
|      |                                  |                          |           |                    |                                                     |              | <b>_</b>  | <b> </b> | .<br>             |               | <u> </u> |                            |              |                             |                  | $\square$ |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                |          |                |                |                                         |                               |
| - 14 |                                  |                          |           |                    |                                                     |              | <u> </u>  | <b> </b> |                   |               |          |                            | <u> </u>     |                             |                  |           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                |          |                | ļ              | <u> </u>                                |                               |
| ,    |                                  |                          |           |                    |                                                     |              |           |          | .<br>             |               |          |                            |              |                             |                  |           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                |          |                |                |                                         |                               |
|      |                                  |                          |           |                    | <br>                                                |              |           | ļ        |                   |               |          |                            |              |                             |                  |           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                |          | <b> </b>       |                |                                         |                               |
| f    |                                  |                          |           |                    |                                                     |              |           |          |                   |               |          |                            |              |                             |                  |           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                |          |                |                |                                         |                               |
|      |                                  |                          |           |                    |                                                     |              |           |          |                   |               |          |                            |              |                             |                  |           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | ·              |          |                |                |                                         |                               |
|      | PROJECT INFORMATION              | TION                     |           | SAMPI              | SAMPLE RECEIPT                                      | 4            |           | RE       |                   | ISHED I       | 37       |                            | ÷.           | RELI                        | RELINQUISHED     | ED BY     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 5              |          | RELINQUISHED   | SHED ВY        | ~                                       | ຕໍ                            |
|      | PROJECT:                         |                          | TOTAL     | NO. OF             | TOTAL NO. OF CONTAINERS                             | ERS          | m         |          |                   | Ň             | K        | 05 11,                     | _            |                             |                  |           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                |          |                | 1              |                                         |                               |
|      | PQ NO. 1-13-4                    |                          | CHAIN     | GOOD CO            | CHAIN OF CUSTODY SEALS<br>BEC'D GOOD CONDITION/COLD |              | < >       | {Sig     | (Signature)       | Juri          |          | Kulazk:                    | (Time)       | (Signature)                 | ure)             |           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | (Time)         |          | (Signature)    |                |                                         | (Time)                        |
|      | SHIPPING ID. NO.                 |                          | CONFO     | CONFORMS TO RECORD | RECORD                                              |              |           |          | (Printed Name     |               | Seo B    | 100 (Da                    | (Date)       | (Printe                     | (Printed Name)   |           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | (Date)         |          | (Printed Name) | те)            |                                         | (Date)                        |
|      | VIA:                             |                          | LAB NO    | 5.00 i             | LABNO, SUN SULS                                     | <b></b>      |           | ŷ        | (Company)         |               |          |                            |              | {Company                    |                  |           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                |          | (Company)      |                |                                         |                               |
|      | SPECIAL INSTRUCTIONS/COMMENTS:   | /COMMEN                  | - isi     |                    |                                                     | ,            |           | й<br>Н   | RECEIVED BY       | , в<br>Г      |          |                            | ÷            | RECEIVED                    | IV ED BY         |           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                |          |                | в <b>у (LA</b> | RECEIVED BY (LABORATORY)                | атову) з<br>"Э`«//            |
|      |                                  |                          |           |                    |                                                     |              |           | (Sig     | (Signature)       |               |          |                            | (Time)       | (Signature)                 | ture}            |           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | (Time)         |          | (Sighature)    | 11 11          | F116 5                                  | 3/21/12                       |
|      |                                  |                          |           |                    |                                                     |              |           | (Pri     | (Printed Name)    | me)           |          |                            | (Date)       | {Printe                     | (Printed Name)   |           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | (Date)         |          | (Printed Name  | ne)            |                                         |                               |
|      |                                  |                          |           |                    |                                                     |              |           | ů<br>C   | (Campany)         |               |          | 1                          |              | (Company)                   | {yns             |           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                | AN       | γμλια          | AL TEC         | HNOLOC                                  | ANALYTICAL TECHNOLOGIES, INC. |
|      | ATI LABURATORIES: SAN            | SAN DIEGO (619) 458-9141 | 197 458 9 |                    | PHOERIX (602) 430                                   | 02)          | 0.1530    |          |                   |               | DISTREET | TION                       | LIT          | инте, оли АВУ               | ARY              | TY T      | T ION CO                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | гесн           |          | GIES           |                | IN OR                                   |                               |

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560 Naches Avenue, S.W., Suite 101, Renton, WA 98055, (206) 228-8335

ATI I.D. # 9006-114

# GeoEngineers



July 5, 1990

GeoEngineers, Inc. 2405-140th Avenue NE Suite 105 Bellevue, WA 98005

Attention : Kathy Killman

Project Number : 161-13-B4

Project Name : Unocal

On June 15, 1990 Analytical Technologies, Inc. received one product sample for analysis. The sample was analyzed with EPA methodology or equivalent methods as specified in the attached analytical schedule. The results, sample cross reference, and the quality control data are enclosed.

Van y myon

Karen L. Mixon Project Manager

FWG/tc

Fredericher Brott

Frederick W. Grothkopp Technical Manager

06/15/90

#### SAMPLE CROSS REFERENCE SHEET

CLIENT : GEOENGINEERS, INC. PROJECT # : 161-13-B4 PROJECT NAME : UNOCAL

ATI # CLIENT DESCRIPTION DATE SAMPLED MATRIX

9006-114-1 MW-2

----- TOTALS -----

| MATRIX  | # SAMPLES |
|---------|-----------|
|         |           |
| PRODUCT | 1         |

#### ATI STANDARD DISPOSAL PRACTICE

The samples from this project will be disposed of in thirty (30) days from the date of this report. If an extended storage period is required, please contact our sample control department before the scheduled disposal date.

PRODUCT



#### ANALYTICAL SCHEDULE

| CLIENT : GEOENGINEERS,<br>PROJECT # : 161-13-B4<br>PROJECT NAME : UNOCAL | INC.      |                   |     |
|--------------------------------------------------------------------------|-----------|-------------------|-----|
| ANALYSIS                                                                 | TECHNIQUE | REFERENCE         | LAB |
| FUEL HYDROCARBONS                                                        | GC/FID    | EPA 8015 MODIFIED | R   |

2

#### FUEL HYDROCARBONS ANALYSIS DATA SUMMARY

| CLIENT : GEOENGINEERS, INC.    | DATE SAMPLED : 06/15/90   |
|--------------------------------|---------------------------|
| PROJECT # : 161-13-B4          | DATE RECEIVED : 06/15/90  |
| PROJECT NAME : UNOCAL          | DATE EXTRACTED : 06/26/90 |
| CLIENT I.D. : MW-2             | DATE ANALYZED : 06/27/90  |
| SAMPLE MATRIX : PRODUCT        | UNITS : mg/Kg             |
| EPA METHOD : 8015 MODIFIED     | DILUTION FACTOR : 20      |
| COMPOUND                       | RESULT                    |
| FUEL HYDROCARBONS              | 1,900,000                 |
| HYDROCARBON RANGE              | C6 - C16                  |
| HYDROCARBONS QUANTITATED USING | GASOLINE                  |
| FUEL HYDROCARBONS              | <100                      |
| HYDROCARBON RANGE              |                           |
| HYDROCARBONS QUANTITATED USING | DIESEL                    |

Analytical**Technologies,**Inc.

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|                                                  | 1000-111-000h               |                              | Custody                                                      |                                  | DATE 6                             | 15h aver          | / <del>2</del> |
|--------------------------------------------------|-----------------------------|------------------------------|--------------------------------------------------------------|----------------------------------|------------------------------------|-------------------|----------------|
| - 1                                              |                             |                              | AROBATORY NI IMBER                                           |                                  | 5                                  |                   |                |
| NA<br>NA                                         |                             |                              |                                                              | ANAL YSIS REQUEST                |                                    |                   |                |
| OLA AN NF                                        | Sult 105                    | 0.00                         | (E2<br>                                                      |                                  | (51                                |                   | SH             |
| Helever July 18005<br>Durait. 76-520 Saugura Dur | ULP.                        |                              | Pesticic<br>& PCB's                                          | įįc                              | listo⊺                             |                   | aniatn         |
| SAMPLE DISPOS                                    | TIONS                       | V oder                       | ANG (<br>sebio<br>y<br>atarte<br>sebiok                      | ) å es<br>(beiti<br>)            | (8) sie                            |                   | € CO           |
| KT ATI Discosal @ \$5.00 each                    | Pickup (will call)          | ONL<br>Aron<br>Aron          | Her<br>Pesb<br>Pesb<br>HPL(                                  | 9050<br>906(<br>Woo              | Net                                |                   | ) H=           |
|                                                  | TIME MATRIX LABID           | 8540<br>8540<br>8050<br>8010 | MDOE<br>8120<br>8140<br>8140<br>8080<br>8080<br>8310<br>8310 | %<br>10X<br>10C<br>8012<br>41375 | EP TO)<br>EPTOX<br>Priorhy<br>TCLP |                   | BHUN           |
| MW-2 6/15/90                                     | Praduel -1                  |                              |                                                              | X                                |                                    |                   | 8              |
|                                                  |                             |                              |                                                              |                                  |                                    |                   |                |
|                                                  |                             |                              |                                                              |                                  |                                    |                   |                |
|                                                  | ŕ                           |                              |                                                              |                                  |                                    |                   |                |
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|                                                  |                             |                              |                                                              |                                  |                                    |                   |                |
|                                                  |                             |                              |                                                              |                                  |                                    |                   |                |
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|                                                  |                             |                              |                                                              |                                  |                                    |                   |                |
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|                                                  | -                           |                              |                                                              |                                  |                                    |                   |                |
|                                                  |                             |                              |                                                              |                                  |                                    |                   |                |
| PROJECT INFORMATION                              | SAMPLE RECEIPT              | EPT                          | RELINCUISHED BY:                                             | 1. RELINCUISHED BY:              | 08%: 2                             | RELINQUISHED BY:  | 4              |
| PROJECT NUMBER: 161-13-B4                        | TOTAL NUMBER OF CONTAINERS  | INERS /                      |                                                              | Time: Signature:                 | Time:                              | Signature:        | Time:          |
| PROJECT NAME: (Juora)                            | CHAIN OF CUSTODY SEALS YMMA | YNNA NA                      | t Dan                                                        | 7.5 Drinted Manaci               | Pate.                              | Distant Missay    | Date:          |
| PURCHASE ORDER NUMBER:                           | INTACT? YANNA               |                              | Monan Pur 61                                                 | 15/90 Primeo Name.               | Dale.                              | Primed Name.      | Uale.          |
| VIA:                                             | oo co                       | oLD   너희                     | Company:                                                     | Company:                         |                                    | Company:          |                |
| TAT: 24HR 48 HRS 72 HRS                          |                             | 3 WKS (Normal) :             | UAPE MINOR                                                   |                                  | ¢                                  | RECENTED RV-/1 AR | F 18           |
| PRICE AUTHORIZATION IS REQUIRED FOR RUSH DATA    | HDATA                       |                              | REVENUEL                                                     |                                  |                                    |                   |                |
| SPECIAL INSTRUCTIONS:                            |                             |                              | Signature: / Levit                                           | Signature:                       | Time:                              | Signature:        | Time:          |
| 8015 Fuel Fragerprint                            |                             |                              | 8                                                            | Date: Printed Name:              | Date:                              | Printed Name:     | Date:          |
| -                                                |                             |                              |                                                              |                                  |                                    |                   |                |

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560 Naches Avenue, S.W., Suite 101, Renton, WA 98055, (206) 228-8335

ATI I.D. # 9007-215

August 16, 1990

GeoEngineers, Inc. 2405 140th Ave. NE Suite 105 Bellevue, WA 98005

Attention : Kathy Killman

Project Number : 161-13-B4

Project Name : Unocal

On July 25, 1990 Analytical Technologies, Inc. received one product sample for analysis. The sample was analyzed with EPA methodology or equivalent methods as specified in the attached analytical schedule. The results, sample cross reference, and the quality control data are enclosed.

Karen L. Mixón Project Manager

FWG/hbb

Furticher Inothopp

Frederick W. Grothkopp Technical Manager



#### SAMPLE CROSS REFERENCE SHEET

1

| CLIENT<br>PROJECT #<br>PROJECT NAME |                    |              |         |
|-------------------------------------|--------------------|--------------|---------|
| ATI #                               | CLIENT DESCRIPTION | DATE SAMPLED | MATRIX  |
| 9007-215-1                          | MW-19              | 07/24/90     | PRODUCT |

----- TOTALS -----

| MATRIX  | # SAMPLES |
|---------|-----------|
|         |           |
| PRODUCT | 1         |

#### ATI STANDARD DISPOSAL PRACTICE

The samples from this project will be disposed of in thirty (30) days from the date of this report. If an extended storage period is required, please contact our sample control department before the scheduled disposal date.

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#### ANALYTICAL SCHEDULE

CLIENT : GEOENGINEERS, INC. PROJECT # : 161-13-B4 PROJECT NAME : UNOCAL

| ANALYSIS          | TECHNIQUE | REFERENCE        | LAB |
|-------------------|-----------|------------------|-----|
| <b></b>           |           |                  |     |
| FUEL HYDROCARBONS | GC/FID    | EPA 8015 MODIFIE | D R |

R = ATI - Renton SD = ATI - San Diego T = ATI - Tempe PNR = ATI - Pensacola FC = ATI - Fort CollinsSUB = Subcontract



#### FUEL HYDROCARBONS ANALYSIS DATA SUMMARY

| CLIENT : GEOENGINEERS, INC.    | DATE SAMPLED : 07/24/90   |
|--------------------------------|---------------------------|
| PROJECT # : 161-13-B4          | DATE RECEIVED : 07/25/90  |
| PROJECT NAME : UNOCAL          | DATE EXTRACTED : 08/07/90 |
| CLIENT I.D. : MW-19            | DATE ANALYZED : 08/07/90  |
| SAMPLE MATRIX : PRODUCT        | UNITS : mg/Kg             |
| EPA METHOD : 8015 MODIFIED     | DILUTION FACTOR : 20      |
| COMPOUND                       | RESULT                    |
| FUEL HYDROCARBONS              | 1,600,000                 |
| HYDROCARBON RANGE              | C6 - C14                  |
| HYDROCARBONS QUANTITATED USING | GASOLINE                  |
| FUEL HYDROCARBONS              | <100                      |
| HYDROCARBON RANGE              | _                         |
| HYDROCARBONS QUANTITATED USING | DIESEL                    |

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#### C - 21

| Analytical Technologies, Inc.<br>560 Naches Avenue SW, Suite 101 Renton, WA 98055  |                            | <b>Jain of</b>                         | Chain of Custody                                  | 9007            | 21-215                  | рате 2                                           | 124/90 PAGE_                                                     | L 02        |
|------------------------------------------------------------------------------------|----------------------------|----------------------------------------|---------------------------------------------------|-----------------|-------------------------|--------------------------------------------------|------------------------------------------------------------------|-------------|
| PROJECT MANAGER Za / K. Mm. n                                                      |                            | <b>ABORATO</b>                         | LABORATORY NUMBER:                                |                 |                         |                                                  |                                                                  |             |
| 1                                                                                  |                            | , , ,<br>, , ,                         | Å                                                 | NALYS           | ANAL YSIS REQUEST       |                                                  |                                                                  |             |
| ADDRESS: 2405 HO16 hu NE<br>Rellever WA 9805                                       | 5", H P5                   | ទទព្រ                                  | secides                                           |                 |                         | leto                                             |                                                                  | SHENIA      |
| PHONE: 746-5200 SAMPLED BY: A<br>SAMPLE DISPOSAL INSTRUCTIONS                      | <u> </u>                   | eloV oten<br>Y<br>Y<br>ANB SNA         | ANA C<br>Cides & P                                | 110 <b>8</b> 92 | G                       | trant Meta<br>DT (8) als<br>DT (8) als           |                                                                  | F CONT,     |
| DATI Disposal @ \$5.00 each                                                        | Pickup (will call)         | GCA<br>ONL<br>Aron                     | нен<br>Ироз<br>Ироз<br>Ироз<br>Ироз<br>Иен        |                 | 9050<br>6090            | teM X                                            |                                                                  | 0 830       |
| SAMPLE D DATE                                                                      | TIME MATRIX LABID          | 8540<br>8540<br>8540<br>8050<br>8010   | 8120<br>8140<br>bCB. <sup>2</sup><br>8080<br>8310 | 413'S           | %<br>10X<br>10C<br>8012 | EPTO                                             |                                                                  | BINN        |
| 1/2/2/2 b/-mW                                                                      | Product -1                 |                                        |                                                   |                 |                         |                                                  |                                                                  |             |
|                                                                                    |                            |                                        |                                                   |                 |                         |                                                  |                                                                  |             |
|                                                                                    |                            | · · · · ·                              |                                                   |                 |                         |                                                  |                                                                  |             |
|                                                                                    |                            |                                        |                                                   |                 |                         |                                                  |                                                                  |             |
|                                                                                    |                            |                                        |                                                   |                 |                         |                                                  |                                                                  |             |
|                                                                                    |                            |                                        |                                                   |                 |                         |                                                  |                                                                  |             |
|                                                                                    |                            |                                        |                                                   |                 |                         |                                                  |                                                                  |             |
|                                                                                    |                            |                                        |                                                   |                 |                         |                                                  |                                                                  |             |
|                                                                                    |                            |                                        |                                                   |                 |                         |                                                  |                                                                  |             |
|                                                                                    |                            |                                        |                                                   |                 |                         |                                                  |                                                                  |             |
|                                                                                    |                            | ·                                      |                                                   |                 |                         |                                                  |                                                                  |             |
|                                                                                    |                            |                                        |                                                   |                 |                         |                                                  |                                                                  |             |
|                                                                                    |                            |                                        |                                                   |                 |                         |                                                  |                                                                  |             |
| PROJECT INFORMATION                                                                | SAMPLE RECEIPT             | ग                                      | RELINOUISHED BY:                                  | 1.              | RELINCUISHED BY         |                                                  | 2 RELINCUISHED BY                                                | r: 3.       |
| PROJECT NUMBER: 12/-/3-189<br>DEATENT MANE: 11 1                                   | TOTAL NUMBER OF CONTAINERS | ERS I                                  | Ś                                                 | Time: S         | Signature:              | Time:                                            | Signature:                                                       | Time:       |
| PURCHASE ORDER NUMBER:                                                             | INTACT? YANNA              | +-                                     |                                                   |                 | Printed Name:           | Date:                                            | Printed Name:                                                    | Date:       |
| VIA: CDIN PLOA                                                                     | RECEIVED GOOD COND./COL    |                                        | Company:                                          | 124 km          | Company:                |                                                  | Company:                                                         |             |
| TAT: C 24HR C 48 HRS C 72 HRS                                                      | TWK / Dy WKS (Normal)      | MKS (Normal)                           | bat ry                                            | r.s             |                         | a di antista di antista di antista di 2000.<br>1 |                                                                  | 0.00000     |
| PRIOR AUTHORIZATION IS REQUIRED FOR RUSH DATA                                      | (DATA                      |                                        | RECEIVED BY:                                      | ÷               | RECEIVED BY:            | 2                                                | 2 RECEIVED BT: (LAB)                                             | 4B) 3.      |
| SPECIAL INSTRUCTIONS:                                                              | •                          |                                        | Signature: T                                      | Time: S         | Signature:              | Time:                                            | Signating, Mill                                                  | : J1998:    |
| are when when any product parties of                                               | Justice of sample          | De set                                 | ne:                                               | Date: P         | Printed Name:           | Date:                                            | Printed Name: NAVCR                                              | JL Date: A. |
| 1                                                                                  |                            |                                        | Company:                                          | 0               | Company:                |                                                  | Analytical Technologies, Int                                     | -<br>je     |
| 111 LABORATORIES: San Diago (619) 458-9141 · Phoanix (602) 438-1530 · Saattie (206 |                            | 228-8335 • Fort Collins (303) 490-1511 | 20) 490-1511 DISTRIBUTION:                        |                 | Canary - ANALY          | TICAL TECHNOL                                    | White, Canary - ANALYTICAL TECHNOLOGIES, INC. • Pink- ORIGINATOR | PIGINATOR   |

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