CONTAMINATION ASSESSMENT

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UNOCAL SERVICE STATION No. 4652

15th. Avenue & C Street
Anchorage, Alaska

Prepared For

UNOCAL

A-1204-1

January, 1989

RITTENHOUSE-ZEMAN & ASSOCIATES
Geotechnical & Hydrogeological Consultants

RZA

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0002

30 December 1988 A-1204-8

UNOCAL
3131 Elliott Avenue
Seattle, Washington 98121

Attention: Mr. Leigh Carlson

Subject: Contamination Assessment Report
UNOCAL Station No. 4652
15th Avenue and C St.
Anchorage, Alaska

Gentlemen:

In accordance with your authorization, RZA, Inc. has completed a contamination assessment at the above referenced facility. This report summarizes the available information regarding this site, and documents the procedures and findings of this current scope of work. This assessment has been prepared in part to assist UNOCAL in meeting the requirements of the Alaska Department of Environmental Conservation (ADEC).

RZA, Inc. has been pleased to be of assistance to you on this project, and will develop remedial action plans based on the findings of this study. If you have any questions, or if we may be of any further assistance, please feel free to contact us.

Respectfully submitted,

RZA, Inc.

Daniel S. Whitman
Senior Hydrogeologist

V.L. CARLSON

JAN 4 1989

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Anchorage, Alaska

1.0 SUMMARY

This contamination assessment report has been prepared to assist UNOCAL in meeting the requirements of the Alaska Department of Environmental Conservation (ADEC). RZA, Inc. has conducted a series of subsurface petroleum hydrocarbon investigations at UNOCAL Service Station No. 4652 located at 15th Avenue and C Street in Anchorage, Alaska. This report summarizes the previous evaluations and presents the results of recently completed field studies. Our investigations disclosed:

- Subsurface soils generally consist of fine silty SAND containing some gravel which is considered to be a fill deposit. This fill overlies very fine SAND or SILT, interpreted as an outwash deposit. This outwash layer is discontinuous and ranges from 0 to 5 1/2 feet in thickness. Underlying the outwash deposit is an extensive SILT/CLAY layer, considered to be a part of the Bootlegger Cove Formation.
- Groundwater levels in monitoring wells installed on and near the site typically range from 4 to 9.5 feet below the ground surface, indicating shallow, perched groundwater conditions overlying the SILT/CLAY layer.
- Groundwater migration is generally to the south southeast. A groundwater divide occurs south of the site in the area of boring B-10 resulting in restricted groundwater flow south of the site, and preferential flow to the southeast.
- Two potential sources of petroleum were on the UNOCAL property. A known gasoline leak occurred in the area of underground tanks in the central part of the site, and a cess-pool and waste oil tank were located near the southeast corner of the property.
- Volatile aromatic hydrocarbons are dissolved in groundwater and have migrated beyond the site boundaries.

- Trace concentrations of chlorinated solvents have been detected both on and off the UNOCAL property by a soil vapor survey and by soil and groundwater sampling.
- The petroleum impacts which have been observed indicated that petroleum migration has occurred generally to the south and southeast. Significant impact has not been observed west of C Street.

These conclusions and others are discussed in detail in the text of this report. This summary is presented for introductory purposes only and should be used in conjunction with the full text. This report has been prepared for the exclusive use of UNOCAL and their agents for specific application for this project.

2.0 PROJECT BACKGROUND

In July 1986 a subsurface petroleum loss was detected at UNOCAL Service Station No. 4652, at 15th Avenue and C St., in Anchorage, Alaska. Figure 1, a Site Vicinty Map indicates the project site and it's surroundings. At that time, a monitoring well adjacent to underground storage tanks indicated the presence of the free phase gasoline floating on the shallow groundwater table. A review of inventory records indicated that approximately 600 gallons of gasoline may have been lost, apparently from a defective in-line leak detector.

In August and September 1986, RZA conducted a subsurface product loss evaluation at the facility. Two reports of the findings of these studies were prepared, dated August and September, 1986, reporting at the completion of two phases of work on the site. The September, 1986 report contains and expands on the data from the August report.

During this 1986 evaluation a recovery well and skimmer was installed near the tank location on-site. This operation was not successful at retrieving any of the free phase petroleum, and recovery efforts were eventually terminated.

In November, 1986, RZA returned to the site to drill two soil borings to obtain soil samples for laboratory analyses, and to measure groundwater levels in the existing monitoring wells. These borings were drilled only for analytical sampling, and are addressed in a RZA report dated 9 December 1986.

Conclusions about the soil and groundwater conditions which can be drawn from the previous studies include:

- Groundwater migration is generally to the south southeast, and is limited to a perched groundwater condition overlying clayey strata. A groundwater divide occurs south of the site in the area of boring B-10, restricting groundwater flow in the southerly direction.
- Free phase liquid petroleum was not widely distributed and had not migrated a significant distance.
- Volatile aromatic hydrocarbons were dissolved in groundwater and had migrated beyond the site boundaries.
- Monitoring wells are slow to recharge, which indicates the perched groundwater table to be in a formation of relatively low hydraulic conductivity.

In December, 1986, RZA performed a records search for water wells in the area of the site. Records were reviewed from the Department of Health and Human Services and U.S. Geological Survey to located water wells, then the Anchorage Water and Wastewater Utility (AWWU) Permit Department connection records were cross referenced to determine if City water was being used at locations where wells were indicated. By this search two apparently downgradient wells were located, near the commercial buildings approximately 650 feet south of the site boundaries. The two wells were drilled in 1968 and 1976, to depths of 110 to 113 feet, respectively. AWWU records indicate the commercial buildings are billed for City water connections, so it is likely these two wells are not actively in use. No other wells were located south of the site within a 1,320 foot radius.

During October 1987 the service station was demolished, and all underground tanks were removed. Soils from the excavation of below grade facilites were stockpiled, and in April 1988 were moved to a soil landspreading area developed for UNOCAL at Stephan's Rental, 9760 Old Seward Highway. This disposal site has been documented separately in a work plan and reports dated 20 June, 1988 and 6 September 1988 regarding observations and analyses during the initial soil spreading and after a period of 3 1/2 months of aeration.

Since the time of these studies the monitoring wells on and adjacent to the site have been monitored and sampled periodically, including March 1987 and quarterly monitoring and sampling since October, 1987. A summary report which included all available analytical data from groundwater sampling was prepared in May, 1988. The tabulated analytical results over time have been updated to include more recent sampling events and are included in Appendix C of this assessment report. Tabulated groundwater level mesurments from the monitoring wells are included in Appendix B.

Data from previous studies, including site diagrams, boring logs, and well construction data pertinent to the interpretation of site conditions have been included in Appendix D of this report. Figure D-1 indicates the configuration of the former on site facilities and the locations of monitoring wells which had been installed during previous study phases.

3.0 PROJECT DESCRIPTION

This phase of work was performed to provide a more current and comprehensive understanding of conditions on site and in the surrounding area. Much of the current scope of work was planned to determine off-site conditions in the area south of the UNOCAL property, the most likely direction of migration for contaminants from the site. Figure 2 indicates the study area surrounding the UNOCAL property.

Studies in this phase of work incuded a Petrex soil vapor survey; a backhoe dug exploratory test pit program; drilled exploratory borings and monitoring well installations; groundwater monitoring and sampling; and laboratory analyses of soil and groundwater samples. The procedures used and the findings of each field study are addressed in this report.

3.1 Petrex Soil Vapor Survey

During August, 1988, Petrex soil vapor samplers were installed on the surrounding properties in a grid pattern. The samplers consisted of a steel wire partially coated with activated carbon, held in a glass tube. The samplers are constructed and decontaminated at the laboratories of the Petrex division of the Northeast Research Institute, Inc., in Lakewood, Colorado. The samplers were shipped to the site with a sealed screw top cap on each tube. At each grid location, a 2" diameter hole was drilled to a depth of approximately 18 inches using an electric drill. A sample tube was then

uncapped and placed in the hole, then covered with a ball of aluminum foil and the remainder of the hole was backfilled with native soil. The sample holes were marked and the samplers were left in place, exposed to the subsurface environment.

The Petrex sampler locations are indicated on Figure 2, the Site and Exploration Plan. West of C Street samplers No. 1 through 12 were placed in a grid 25 feet on center, with two additional samplers placed between the grid points on the lawn of Central Junior High School, in the area north of 15th Avenue. Southwest of the intersection, samplers No. 14 through 19 were placed along the municipal right of way at 50 foot intervals, with two additional samples located at feasible locations near the intersection.

On the property southeast of the intersection of 15th Avenue and C Street, samplers No. 20 through 46 were installed in east-west lines with samplers at 50 foot intervals along the lines. Lines were spaced 25 feet apart in the north-south direction, with grid points offset by 25 feet, resulting in maximum spacing of approximately 35 feet between adjacent samplers. This property is undeveloped, and currently is covered with under brush and small trees. Some samplers were offset from the planned grid locations by up to several feet to avoid tree roots or other obstructions.

At the time the samplers arrived at the site, the existing school building west of C Street was being painted, using sprayed xylene based paint. Because airborne contaminants were clearly present during painting, the sampler grid installation was delayed until a weekend when no active painting was occurring. To gauge the effect of airborne xylenes, a sampler was installed above ground, by taping the tube to the branch of a tree, designated sampler No. 13.

Two groups of time dependent samplers were installed at two locations in the grid. Sample tubes were recovered from each time dependent group after 11 and 18 days of exposure, capped and sent to the Petrex laboratory for analysis to monitor the progress of the exposed samplers.

The sampling tubes were left in place for a period of 26 days. The entire grid was removed on 1 and 2, September 1988. Three of the tubes could not be located, from grid locations Nos. 4, 11 and 16. Each recovered tube was sealed with a screw cap,

labelled and all were shipped to the Petrex laboratory for analysis by mass spectrometer. A report, prepared by Petrex, is included in Appendix A, which details the sample handling, analysis and quality assurance/quality control procedures of the study.

The results of this soil vapor survey are indicated graphically in Figures 3A through D, and are discussed in Section 4.1 of this report.

3.2 Test Pit Program

After reviewing the preliminary findings of the Petrex soil vapor survey a series of five test pits were dug on site, and on the property south of 15th Ave. The test pits were dug on 1 November, 1988, by Isabelle Construction Co., using a backhoe, and were observed by a representative of RZA and Mr. John Rader, the owner of the property south of 15th Avenue. The test pit locations are indicated on Figure 2, the Site and Exploration Plan. Test pit logs are included in Appendix B of this report. After completion each test pit was backfilled with the native soil.

Test pit TP-1 was dug to evaluate conditions in the area of a former septic system, suspected to be a potential source of contaminants unrelated to the known gasoline leak. An old sanitary sewer line is indicated on old plans of the site, extending from the southeast corner of the UNOCAL property to the southeast, intersecting the sanitary main on the south side of 15th Avenue. This connection was abandoned with the demolition of the station, but was suspected to be a path of migration of contaminants, either due to leakage or through the backfill and bedding material surrounding the pipe. Test pit TP-2 was dug near the intersection of the old sanitary sewer line with the sanitary main, south of 15th Avenue. Test pits TP-3, 4 and 5 were dug on the property south of 15th Avenue, to evaluate the soil conditions and screen for the presence of petroleum contaminants in areas potentially impacted.

Generally, test pits were dug to a depth which encountered a silty and clayey strata, part of the Bootlegger Cove Formation, which would impede the downward migration of groundwater or petroleum impacts. The clayey strata was generally encountered at depths of 5 to 8 feet, the test pits were dug to maximum depths ranging from 8.5 to 13 feet. Test pit TP-2 encountered only fill overlying the sewer lines, and was terminated at the depth of the sewer connection, approximately 9 feet.

Soil samples were taken from each of the test pits in strata which appeared most susceptible to impacts, i.e. depths where groundwater was encountered or coarser grained sediments were evident. In test pits TP-1 and TP-2 samples were obtained from areas where detectable impacts had occurred, the water table surface and the sanitary sewer bedding, respectively. In test pits TP-3 and TP-4, samples were taken from narrow zones of soils where some seepage of groundwater was occurring, but no obvious impacts could be detected in the field. Soil samples were sealed in laboratory prepared vials and held under Chain of Custody until delivered to the laboratory for analysis.

3.3 Drilling and Monitoring Well Installation

Two hollow-stem auger borings were drilled on properties located west and southwest of the UNOCAL property, to obtain soil samples and install monitoring wells. Boring B-12 was advanced on the Central Junior High School grounds, and boring B-13 was completed on the First Assembly of God Church grounds located to the southwest, both on the west side of C Street. Monitoring wells consisting of 2" PVC were installed in the borings. The approximate monitoring well locations are indicated on Figure 2, the Site and Exploration Plan. Boring logs, including as-built construction diagrams of the monitoring wells are included in Appendix B.

Soil samples were obtained by split spoon sampling, using decontaminated equipment and were identified by boring number and sample number within the boring (i.e. B-12, S-3). Each sample number pertains to the depth from which the sample was collected and is indicated on the boring logs in Appendix B. Due to the relatively impermeable nature of the subsurface silt/clay, samples selected for laboratory analyses were obtained at or near the groundwater surface, since contaminant migration would most likely be related to the shallow groundwater flow.

3.4 Groundwater Sampling

After installation, the two new monitoring wells were developed by surging and bailing to increase hydrogeologic communication with the surrounding formation. Generally, both wells were found to have relatively slow recharge characteristics, both wells requiring several hours to overnight to recharge. This is consistent with other monitoring wells in

the study area. On 18 November 1988 all of the currently accessible monitoring wells on site and on surrounding properties were sampled. Decontaminated stainless steel bailers were used to purge a minimum of three well volumes from each monitoring well, then to obtain groundwater samples using the procedures of the RZA field quality assurance/quality control manual. Groundwater samples were sealed in laboratory prepared vials, chilled and held under chain of custody until delivered to the laboratory for analysis. All groundwater analyses were subcontracted to Northern Testing Laboratories, Inc. of Anchorage, Alaska.

4.0 CONTAMINATION ASSESSMENT

The previous studies, combined with the current scope of work allows an assessment of the conditions on the subject site and surrounding properties. This contamination assessment integrates the current findings with previously existing data where possible.

4.1 Soil Vapor Results

The results of the Petrex soil vapor survey are indicated graphically in Figures 3A through 3D for various parameters which indicated anomalous relative ion flux over portions of the sampling grid. Figure 3A indicates the combined ion flux of benzene, toluene, xylenes and ethylbenzene (BTEX). Figure 3B indicates the contoured combined ion flux of cycloalkanes and cycloalkenes (compounds containing from 4 to 8 carbons per molecule). Figure 3C indicates the ion flux of dichloroethylene. Figure 3D indicates the ion flux of combined xylene and ethylbenzene, which was of interest based on the airborne xylene contamination from the adjacent painting of Central Junior High School.

It should be noted that the contoured results of relative ion flux indicated on the Figures is <u>not</u> considered a quantitative measure of the concentration of any compound at a given location. Relative ion flux is a measure of the number of ions adsorbed on the activated charcoal of the sampler wire. The number of the adsorbed ions depends on a wide variety of factors, including temperature, volume of air the sampler is exposed to, the Henry's Constant of the individual vapor constituents, permeability (to air) of the soil and concentration of contaminants at the sampling location. The Petrex samplers provide useful information by indicating the relative number of ions adsorbed by each sampler installed under similar conditions for the same length of time.

Figure 3A indicates a distinct area of anomalously high relative ion counts of BTEX to the southeast of the UNOCAL property. Sampler No. 17 in the southwest corner of the intersection of C Street and 15th Avenue also detected anomalously high flux valves. The basic pattern of anomalously high relative ion flux to the southeast of the site, extending to the east beyond the grid coordinates is repeated for the other detected compounds as indicated in Figures 3B, 3C and 3D. The area of anomalous soil vapor flux measurements generally correlates with a low lying area with poor drainage characteristics at the east end of the sampling grid. This area is a relatively small drainage basin, as indicated by the ground surface elevation contours shown on the Site Plan. Surface drainage from this area is generally to the south.

Figure 3B, the relative flux of cycloalkanes and alkenes, indicates the widest distribution of petroleum related compounds. These light hydrocarbons are highly volatile and would be among the first compounds to partition from an aging petroleum mixture. This more wide spread anomaly indicates light petroleum compounds extend beyond the grid coordinates to the south and southeast of the sampling grid.

Figure 3C indicates that dichloroethylene was detected in three samplers in the southeast portion of the grid. Dichloroethylene, a common degreasing agent, would not be anticipated from the known petroleum spill which occurred near the tank area on the UNOCAL site. The presence of this compound and its limited distribution indicates a second source of contaminant to be present. This finding led to modifications to the scope of work for this assessment, including modified test pit locations and analysis of soil and groundwater samples for chlorinated solvents.

Figure 3D, for xylenes and ethylbenzene, indicates the same pattern of contaminant distribution to the southeast of the UNOCAL site. This pattern indicates that the samplers were generally not affected by airborne contaminants from a source west of the soil vapor survey grid. Sampler No. 13 (an air sampler located in the tree west of C Street) indicates the affect of the airborne contaminants, however adjacent buried samplers show only limited detection of xylenes.

Based on these findings, test pits were planned in order to observe soil conditions in areas which indicated high ion flux or were otherwise suspected of being impacted by

petroleum hydrocarbons. In particular, the old sanitary sewer line was considered to be a primary path of migration for contaminants which could be carried from the UNOCAL site to the adjacent property.

4.2 Subsurface Conditions

Subsurface soil conditions on the property surrounding the UNOCAL site were determined by test pits, soil borings and data from test holes originally drilled for geotechnical purposes on the property south of 15th Avenue. These boring logs were provided by Mr. John Rader, the property owner.

4.2.1 Test Pit Results

Test pit logs are included in Appendix B of this report. Generally, soil conditions consisted of silty sands, fill or organic soils overlying fine grained grayish brown silt, overlying gray clay containing some coarse sand within the clay matrix. This dense gray clay is interpreted as part of the Bootlegger Cover formation, an extensive clayey unit found throughout much of the Anchorage area.

In test pits TP-1 and TP-2, the soils disclosed were generally FILL to depths of approximately 8 to 9 feet attributed to previous site utility excavations. TP-1, on the UNOCAL property, encountered grayish brown gravelly fill containing debris and cobbles, overlying a 1/2 foot thick layer of black organic soils above clayey silt. Strong petroleum odors were encountered in the fill, particularly at the depth of about 7 feet, where groundwater infiltrated from the sidewalls of the test pit. TP-2 encountered silt and silty sand fill overlying the sewer lines. The sewer bedding material consisted of grayish brown silty sand and gravel. Some strong organic and petroleum odors were encountered in the area of the sewer connection. No significant groundwater was observed in test pit TP-2, however, soils at the depth of the sewer were wet.

TP-3 encountered 21 inches of dark brown peat overlying 6 inches of silty sand with a trace of gravel. The silty sand zone was wet and a small amount of water seeped into the test pit. Below this zone the test pit encountered gray silt and clayey silt to the full depth of 9 feet below ground surface. Within the silt and clayey silt strata a thin seam of silty sand was encountered at a depth of 5.5 to 6 feet where a small amount of seepage

occurred. Samples were obtained from both of the seepage zones for laboratory analysis. No petroleum odors or sheens could be detected in the field.

Test pit TP-4 encountered approximately 2 feet of dark brown sand and gravel overlying brown silty sand fill to a depth of 6 feet. At 6 feet a dark brown to black silty zone which contained tree roots and a stump was encountered. This deposit most likely represents a former topsoil horizon. This organic zone was slightly wet in a narrow discontinuous lense approximately one inch thick or less at the bottom of the topsoil horizon. Slight petroleum or organic odors could be detected in this wet zone. Below this zone the test pit encountered gray silts and silty clay extending to the full depth of 13 feet below ground surface. No other seepage zones or petroleum odors were encountered.

Test pit TP-5 encountered similar soil conditions to TP-4, with the exception that no wet zone was encountered in the buried topsoil horizon. A slight organic or petroleum odor was encountered within the organic soils of the buried topsoil horizon.

At the time of our field exploration Mr. John Rader supplied a site plan which included logs for several test holes which had been drilled on the property for geotechnical purposes by others. Test holes TH-2, 3, 4 and 5 are located in or near the study area, and are indicated on Figure 2, the Site and Exploration Plan. A diagram indicating the stratified soil conditions of the test holes drilled on this property is included as Figure D in Appendix D. Generally, soil conditions encountered in these test holes agree with those noted in the recent test pits, noting more organic soils, similar to those encountered in test pit TP-3.

The soil and groundwater conditions encountered by these test pits appears to reinforce the conclusions of the soil vapor survey. Test pits TP-2 and TP-3 indicate that the sanitary sewer line from the UNOCAL property may be a preferential flow path for contaminant migration. Two zones of relatively permeable, water bearing soils at the location of TP-3 indicates the groundwater and soil conditions in this area may allow greater mobility of contaminants than in the area immediately south of the UNOCAL site (near TP-4 and TP-5). This higher mobility of contaminants may have allowed higher exposure of the soil vapor samplers than in other areas of the study site, even though no obvious petroleum impacts could be determined in the field.

4.2.2 Drilling and Monitoring Well Installation Results

The two bore holes west of C Street were logged by an experienced geologist during drilling. A medium dense fine to medium sand Fill unit was noted to extend from near the surface to about 3 feet in boring B-13 and 7 feet in boring B-12. Underlying this unit a medium dense, silty, fine sand extended to depths of between 5 1/2 and 11 feet. Below the silty, fine sand soft to very stiff, silt/clay was encountered and extended to the boring termination of 20 and 20 1/2 feet, respectively in the borings. These units correspond to the fill, outwash deposits and silt/clay strata recognized in previous drilling at the site. No petroleum odors or obvious petroleum impacts were noted by field screening during drilling.

Groundwater was encountered in both borings at depths between 12 1/2 and 15 feet below the existing ground surface. Monitoring wells were installed with 10 foot screened intervals ranging from approximately 10 to 20 feet below ground surface. A sand filter pack was installed in the borehole, surrounding the screen, and extending to a level within 2 feet of the ground surface. At the ground surface, a bentonite/cement surface seal was installed. An iron monument was placed flush to the ground surface as a protective cover. The wells were developed and the elevation of the top of each well was determined relative to existing wells at the site.

4.3 Soil Analytical Results

Laboratory analyses of the soil samples from the test pits and borings were subcontracted to AmTest, Inc. of Redmond, Washington. The soil samples were analyzed for total petroleum hydrocarbons by EPA Method 418.1, and for volatile aromatic hydrocarbons by EPA Method 8020. The volatile aromatic hydrocarbon analyses included benzene, toluene, m+p -xylenes, o -xylene and ethylbenzene. Test pit samples were also analyzed for purgeable halocarbons by EPA Method 8010. This analysis was performed to attempt to quantify the presence of chlorinated solvents indicated by the Petrex soil vapor survey. The 8010 analysis detects 24 halogenated compounds, including dichloroethylene which was detected by the Petrex sample analysis. The laboratory analytical reports are included in Appendix C. The volatile and purgeable analytical results are presented in ug/kg units which are equivalent to parts per billion (ppb) concentrations. Total petroleum hydrocarbon results are presented in

ug/g units which are equivalent to parts per million (ppm) concentrations. Our interpretation of the test results follow.

4.3.1 Total Petroleum Hydrocarbons

Test pit samples indicate total petroleum hydrocarbons (TPH) values are elevated, particulary at the on-site location of TP-1 (5,170 ppm) and to a lesser degree at the sewer connection in TP-2 (410 ppm). Shallow soils tested from TP-2 and TP-3, and from the seepage lense in TP-4, indicate concentrations of 69.1, 80.8 and 62.3 ppm, respectively. The TPH values for the deeper permeable zone in TP-3 and the sample from TP-5 are below detection limits, and 6.8 ppm, respectively. Soil samples from the two borings demonstrated petroleum hydrocarbon concentrations of less than the detection limit (5 parts per million (ppm)) and 26.4 ppm in borings B-12 and B-13, respectively.

Test pit TP-1 was located near a former cess-pool and waste oil tank, apparently sources for heavier petroleum compounds. The result of the analyses of TP-2 and TP-3 appears to indicate migration and dilution of petroleum impacts to the southeast of the UNOCAL site.

4.3.2 Volatile Aromatic Hydrocarbons

The volatile aromatic hydrocarbon analyses indicated petroleum impacts have occurred south of 15th Avenue, but not at the boring locations west of C Street. In particular, the sample from TP-4 indicated 4,650 ppb benzene, with much lower concentrations of other volatiles. In other test pit samples, benzene concentrations ranged from 15 ppb in TP-1 to 88 ppb in the deeper permeable zone in TP-3. This zone in TP-3 did not contain other detectable volatile aromatics. Samples TP-4 and TP-3, S-2 indciate that the more volatile benzene is partitioning and has most likely migrated to a greater extent than heavier petroleum components. Both of these samples are from narrow permeable zones most likely to be impacted at the test pit locations. It should be noted that these sample results are representative of only these limited zones, not the soil mass as a whole.

TP-1 indicates some impacts, particulary xylenes. TP-2 was also the only sample which contained chlorobenzene (25 ppb), another indication of a second, non-gasoline source for impacts in the southeast of the site. Sample TP-2, S-2 in the sewer bedding also

indicates xylene impacts. TP-3, S-1 and TP-5 incicate only benzene and low xylene concentrations. The soil samples tested recovered from borings B-12 and B-13 do not contain detectable concentrations of volatile aromatic hydrocarbons.

4.3.3 Purgeable Halocarbons

The purgeable halocarbon analyses indicate consistent detection of methylene chloride and chloroform, common laboratory chemicals. The presence of these compounds at the low concentrations reported commonly occurs due to cross contamination or laboratory contamination. In our opinion, these detections do not indicate the presence of these compounds in the soil samples.

The analyses did detect trans - 1,2-dichloroethylene in samples TP-3, S-2 and TP-4, S-1 at concentrations of 8.8 and 11 ppb, respectively. TP-4, S-2 also contained 1,2-dichloroethane (11 ppb) and trichloroethylene (10 ppb).

4.4 Groundwater Analytical Reports

Groundwater samples were identified by monitoring well/boring and sample number. Representative samples were obtained from nine monitoring wells, on and off the project site. As in most previous sampling events, monitoring well B-10 did not contain water. Samples were analyzed for total petroleum hdyrocarbons by EPA Method 418.1 and volatile aromatic hydrocarbons by EPA Method 602. In addition samples from monitoring wells B-3 and B-8 were analyzed for purgeable halocarbons by EPA Method 601.

Laboratory reports are included in Appendix C. This data has been tabulated in the groundwater analytical summaries, also in Appendix C. Our interpretations of the test results follows.

4.4.1 Total Petroleum Hydrocarbons

Groundwater analyses indicate total petroleum hydrocarbon impacts to be greatest in monitoring wells B-6 and B-7, on the south boundary of the UNOCAL property, with concentrations of 6.9 and 8.0 ppm respectively. Of the off-site wells, only B-9 indicates significant impacts, 1.7 ppm. Wells B-4, B-5 and B-13 did not contain detectable concentrations of total petroleum hydrocarbons.

4.4.2 Volatile Aromatic Hydrocarbons

Volatile aromatic hydrocarbon analyses indicate detectable concentrations of BTEX compounds in all of the on and off site wells sampled. The greatest impacts are found in monitoring wells B-6 and B-7 with total BTEX concentrations in excess of 58,800 ppb and 36,500 ppb respectively. Monitoring wells B-9, B-3, and to a lesser degree B-8 also indicate some significant impacts. This data is consistent with previous quarterly monitoring results in both magnitude and distribution of contaminants. The two new monitoring wells showed little indication of petroleum impacts.

During the May and July 1988 sampling events B-8 has not been indicating volatile aromatics, although earlier anlayses had shown some evidence of impacts, particularly in March 1987. Variations in groundwater level also occur over time, and appear to correlate with variations in chemistry, lower water concentrations at times of relatively high water levels. Recharge, and thus dilution is apparently occurring at some times, with higher water levels evident in all the monitoring wells during the summer and fall. More long-term monitoring data would be required to determine overall trends in water level and chemistry correlations.

4.4.3 Purgeable Halocarbons

Samples from monitoring wells B-3 and B-8 both indicated the presence of chloroethane and 1,2- dichloroethane at low levels. Future groundwater sampling events should include EPA 601 analyses for more wells to determine the distribution of chlorinated compounds.

5.0 INTERPRETATION OF ASSESSMENT FINDINGS

The summarized data regarding site conditions have been interpreted in terms of shallow geologic setting, hydrogeologic conditions and petroleum occurrence.

5.1 Geologic Setting

The shallow geologic conditions are generally silty fine sands and silts, overlying a silt/clay unit which is considered to be the lower hydrogeologic boundary of the study area. Drilling and test pits have extended into the silt/clay unit far enough to indicate the soils are a relatively continuous aquitard which would limit downward migration of

perched water or contaminants. This silt/clay unit has been encountered in every boring and test pit in the study area that extended through the overlying fill deposits.

Based on the drilling and test pit data, cross sections indicating the shallow soil conditions have been prepared. Figure 4, a Cross Section Location Diagram, indicates the plan view of the cross section traces. Figures 4A, 4B and 4C indicate generalized soil conditions and the inferred soil unit contacts across the site. Figures 4A and 4B are generally north-south traces which indicate the varying soil conditions which are interpreted to occur near the south property boundary and beneath 15th Avenue. Figure 4B indicates a trench of a former water line encountered in boring B-7, and likewise indicates the inferred rise of the silt/clay unit to create the groundwater divide in the area of B-10.

Figure 4C illustrates the inferred conditions along an east-west line, generally along the south side of 15th Avenue. This figure indicates the silt/clay unit at a relatively high elevation in B-13, west of C Street and B-10, where the groundwater divide occurs. The silty outwash deposit overlying the silt/clay basement was not encountered in boring B-10.

It is likely the configuration of the top surface of the silt/clay unit to a great degree controls the direction of groundwater flow across the site. The ground surface slopes to the south and apparently shallow groundwater may come close to the ground surface to result in surface water run-off, particularly southeast of the UNOCAL property. Test pit TP-3, in this area, encountered a water bearing strata very close to the ground surface which indicated slight petroleum impacts.

5.2 Hydrogeologic Conditions

Figure 5 indicates the groundwater piezometric surface contour inferred from groundwater level measurements on 17 November 1988. The groundwater contours indicate a relatively steep gradient to the south southeast, across the site. South of the site, beneath 15th Avenue the inferred gradient shifts to the south, most likely due to the influence of the groundwater divide. Southeast of MW-3, the contours indicate flow in this area could continue in the southeasterly direction. It is likely that the sanitary sewer

bedding material acts as a preferential flow path in this direction. It is possible that other buried utilities also provide a conduit for groundwater and thus petroleum migration.

Soil conditions are such that groundwater flow is limited primarily to the sandy fill composites and underlying silty outwash, both of which are units of relatively low hydraulic conductivity. Monitoring wells are generally slow to recharge, indicating a low flow environment. This low hydraulic conductivity may be a primary limiting factor in the distribution of petroleum impacts in the down gradient direction. This low conductivity envrionment is relatively impermeable compared to the granular bedding used surrounding utility lines, suggesting utility trenches would be preferential flow paths.

The groundwater level measurements over time indicate variations in water level occur. In all wells the lowest water levels were measured in March 1987 and the highest water levels were measured in May 1988. Although water levels vary, the over all configuration of the shallow groundwater table stays the same, with a consistent gradient to the south southeast. More water level measurements would be required to define seasonal fluctuations of the water table.

5.3 Petroleum Hydrocarbon Occurrence

Petroleum hydrocarbon impacts have occurred on site, apparently from two separate sources, and are crossing the south site boundary. A soil vapor survey detected the wide spread presence of volatile compounds related to petroleum. A plume of various hydrocarbon components was detected to the southeast of the site, however, the test pits and soil sampling in the area directly south of the UNOCAL property indicates that small volumes of more highly concentrated petroleum impacts are occurring west of the indicated plume. The soil vapor samplers may have been reflecting the higher mobility of contaminants in this area through more permeable soils.

Soil and groundwater sampling has indicated the highest concentrations of volatile aromatic compounds are located on the site in a plume extending from the former tank location towards the south boundary in the area of borings B-6 and B-7. Groundwater flow has apparently allowed migration of petroleum to the south. A narrow seepage zone encountered in TP-4 contained volatile aromatic hydrocarbons, particularly benzene.

Down gradient soil and groundwater sampling indicates benzene is partitioning from the petroleum mixture as the material degrades. In MW-9, TP-4 and TP-3, benzene is the primary volatile aromatic hydrocarbon found during analysis.

Monitoring wells MW-12 and MW-13 on the west side of C Street did not encounter significant petroleum impacts.

6.0 RECOMMENDATIONS

Based on the findings of our studies it is apparent that petroleum hydrocarbon impacts have occurred to the south southeast, beyond the limits of the area investigated to date. Additional monitoring wells are anticipated on the properties south of the site, however, reviewing the existing data has been critical in the location of any future monitoring wells in order to avoid further inconvenience to Mr. Rader, the property owner. Currently, we anticipate three additional monitoring wells should be installed within the utility easement on Mr. Rader's property. Utility corridors are considered to be likely flow paths for shallow groundwater and dissolved petroleum components. These monitoring wells have already been authorized by UNOCAL as a part of our scope of work.

Determining the extent of off-site impacts will not affect the overall planning of remedial actions on the site and in the areas which are known to have significant off-site impacts. Remedial action plans are being prepared to limit the off-site migration and eliminate contaminate sources on the site.

CLOSURE

RZA has been pleased to be of service to you on this project. If you have any questions regarding the enclosed information or if we may be of any further service to you please feel free to contact us.

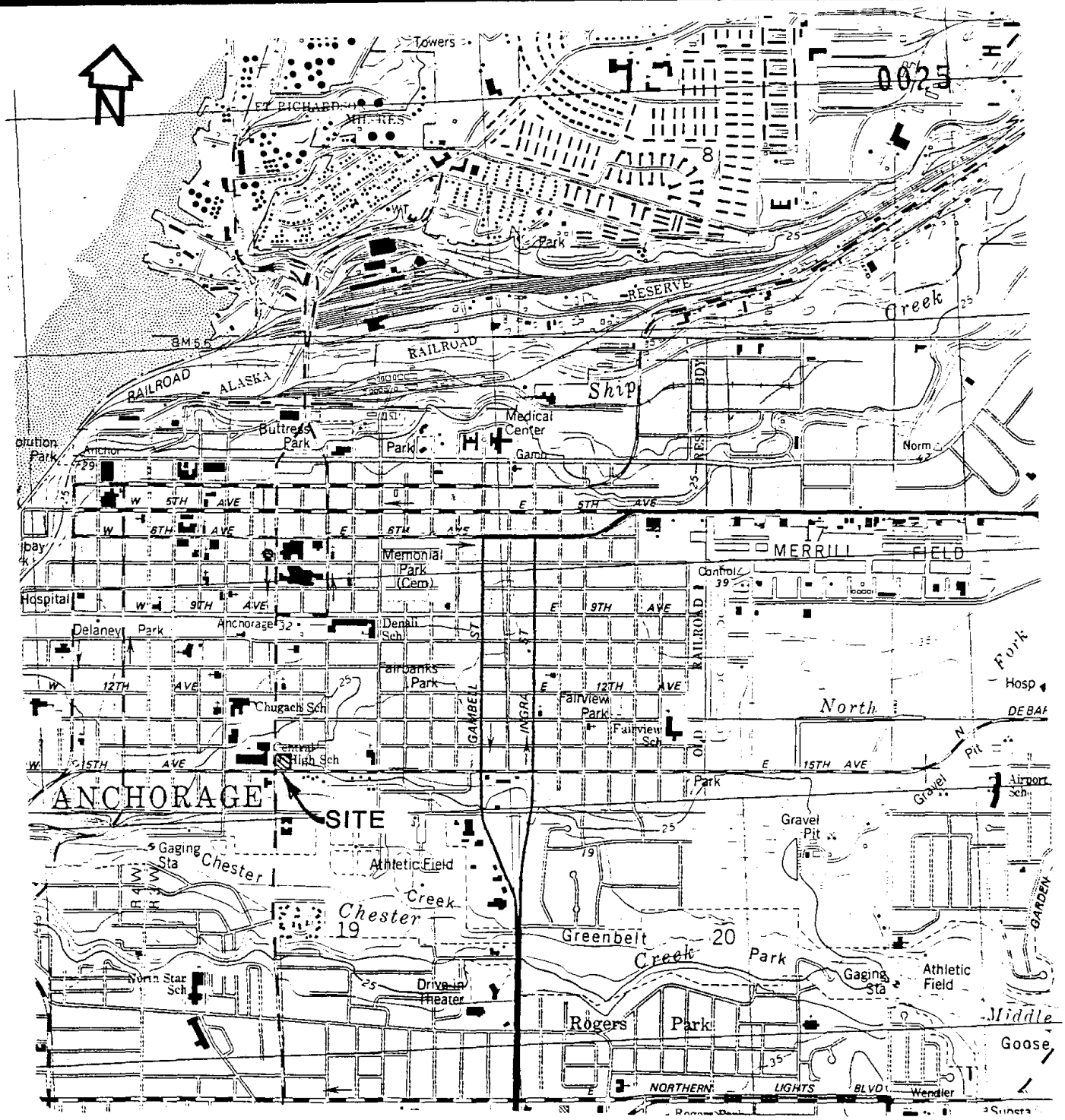
Respectfully submitted,

RZA, Inc.

Daniel S. Whitman
Senior Hydrogeologist

Alvin R. Zeman, P.E.

STATE OF ALASKA
49TH
No. 1783-E
REGISTERED
PROFESSIONAL ENGINEER



UNOCAL SERVICE STATION No. 4652
ANCHORAGE, ALASKA

SITE VICINITY MAP

FIGURE 1

W.O. A-1204-8

By DSW

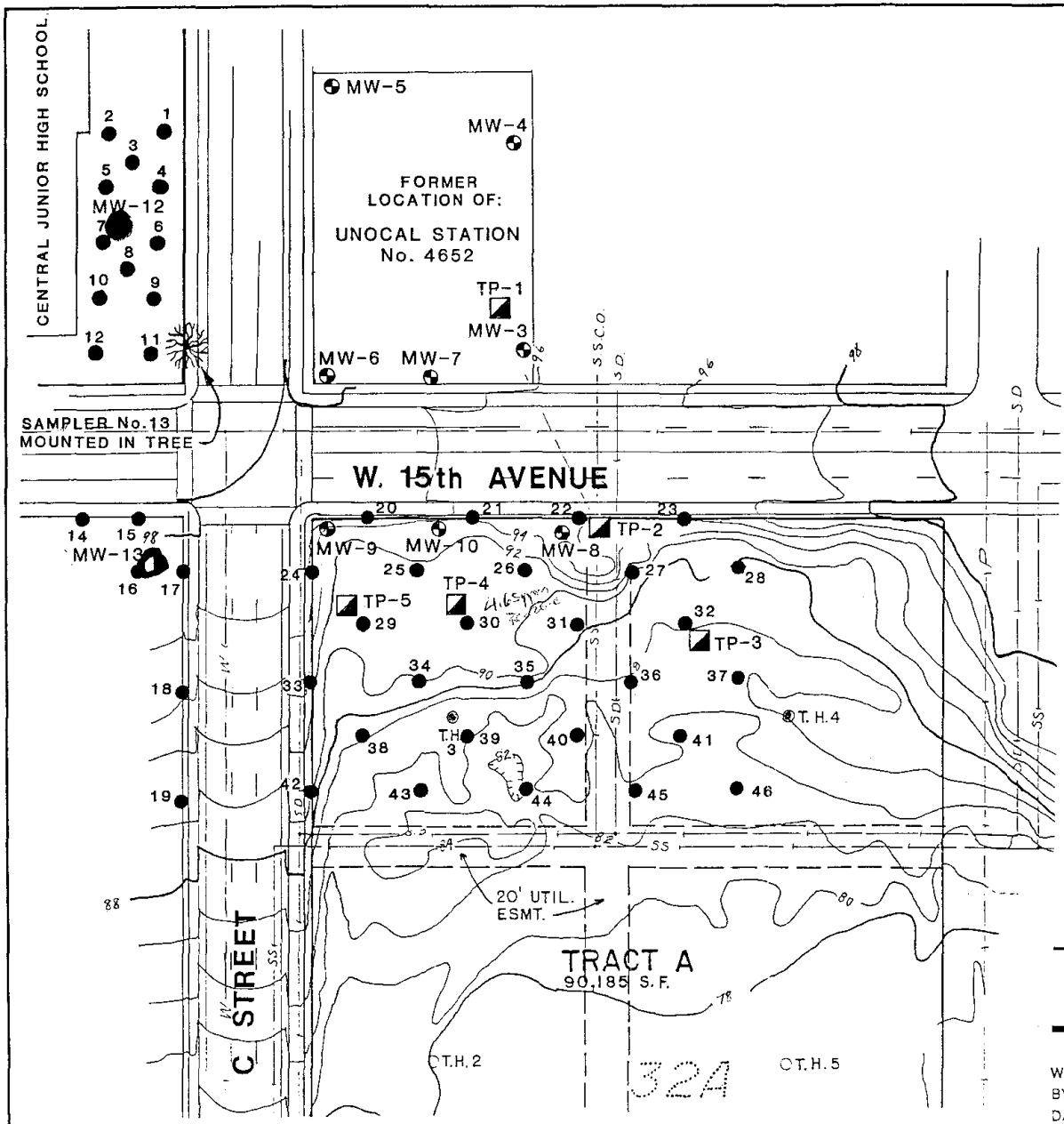
Date DEC 1988

Scale N.T.S.

RZA, Inc.
Geotechnical Consultants

Anchorage, Alaska 99501

RZA



0026

N

0 50 100

APPROXIMATE SCALE IN FEET

LEGEND

- LOCATION OF PETREX SOIL VAPOR SAMPLER INSTALLED 8/7/88
- EXISTING MONITORING WELLS
- TEST PIT LOCATIONS
- MONITORING WELLS INSTALLED NOV. 1988
- TEST HOLES BY OTHERS

UNOCAL SERVICE STATION No. 4652

CONTAMINATION ASSESSMENT
SITE & EXPLORATION PLAN

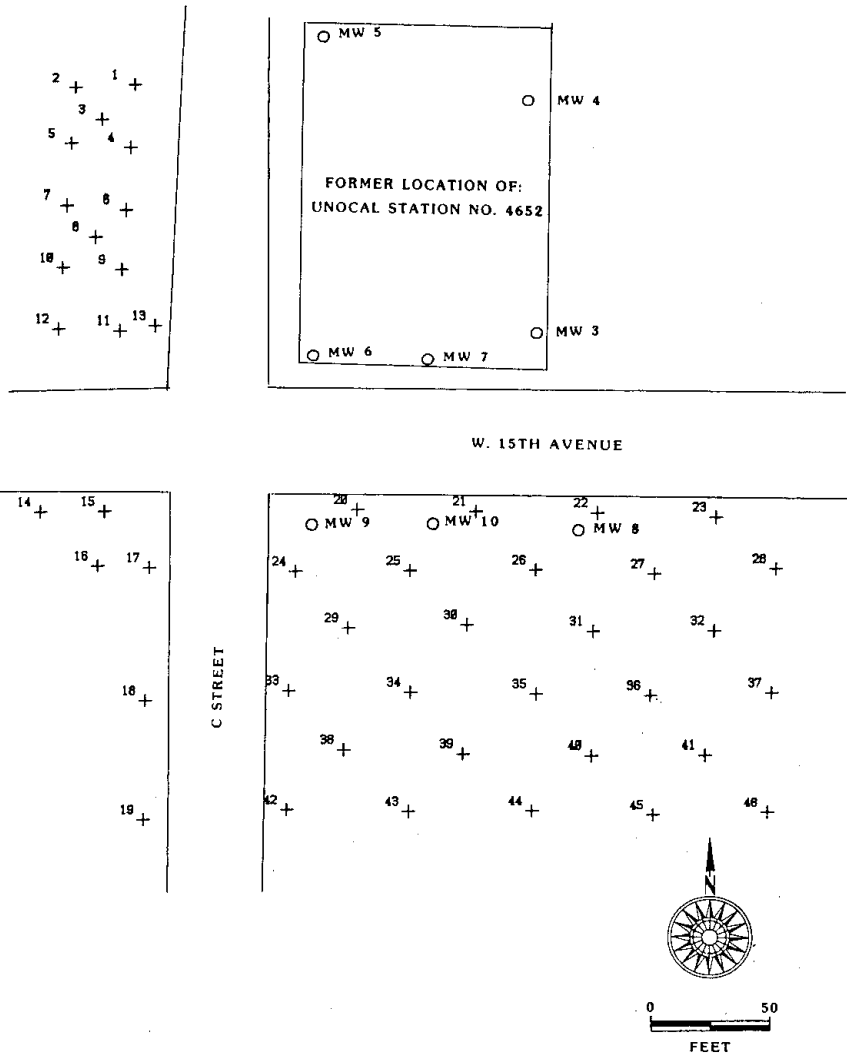
FIGURE 2

W.O. A-1204-8
BY DSW
DATE DEC 1988
SCALE NOTED

RITTENHOUSE-ZEMAN & ASSOCIATES, INC.

RZA

PETREX
A DIVISION OF NORTHEAST RESEARCH INSTITUTE
605 PARFET STREET
SUITE 100
LAKEWOOD, COLORADO 80215
(303) 238-0090
B502



RITTENHOUSE-ZEMAN & ASSOCIATES, INC.

FORMER UNOCAL STATION NO. 4652 SITE

ANCHORAGE, ALASKA

Sample Locations

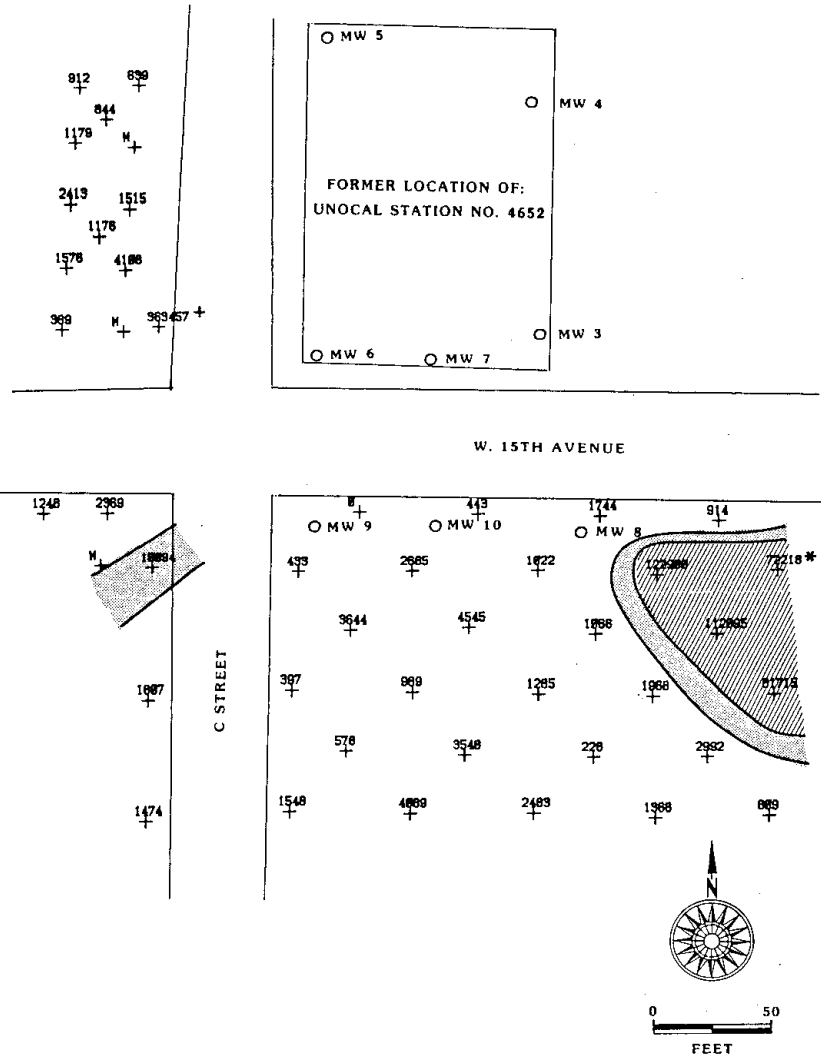
0027

October 13, 1988 Plate: 5 Scale: 1in.= 50ft.

FIGURE 3

A-1204-8

PETREX
A DIVISION OF NORTHEAST RESEARCH INSTITUTE
605 PARFET STREET
SUITE 100
LAKEWOOD, COLORADO 80215
(303) 238-0090
B502



Legend:

Ion Count:

- ≥ 50,000
- 10,000–49,999

* Actual Values For Benzene, Toluene, Xylenes, and Ethylbenzene May Be Lower Than Shown Due To Vegetative Interference (Terpenes)

\+ Sample Placed In Tree–Data Not Comparable

M = Missing Sample

RITTENHOUSE-ZEMAN & ASSOCIATES, INC.

FORMER UNOCAL STATION NO. 4652 SITE

ANCHORAGE, ALASKA

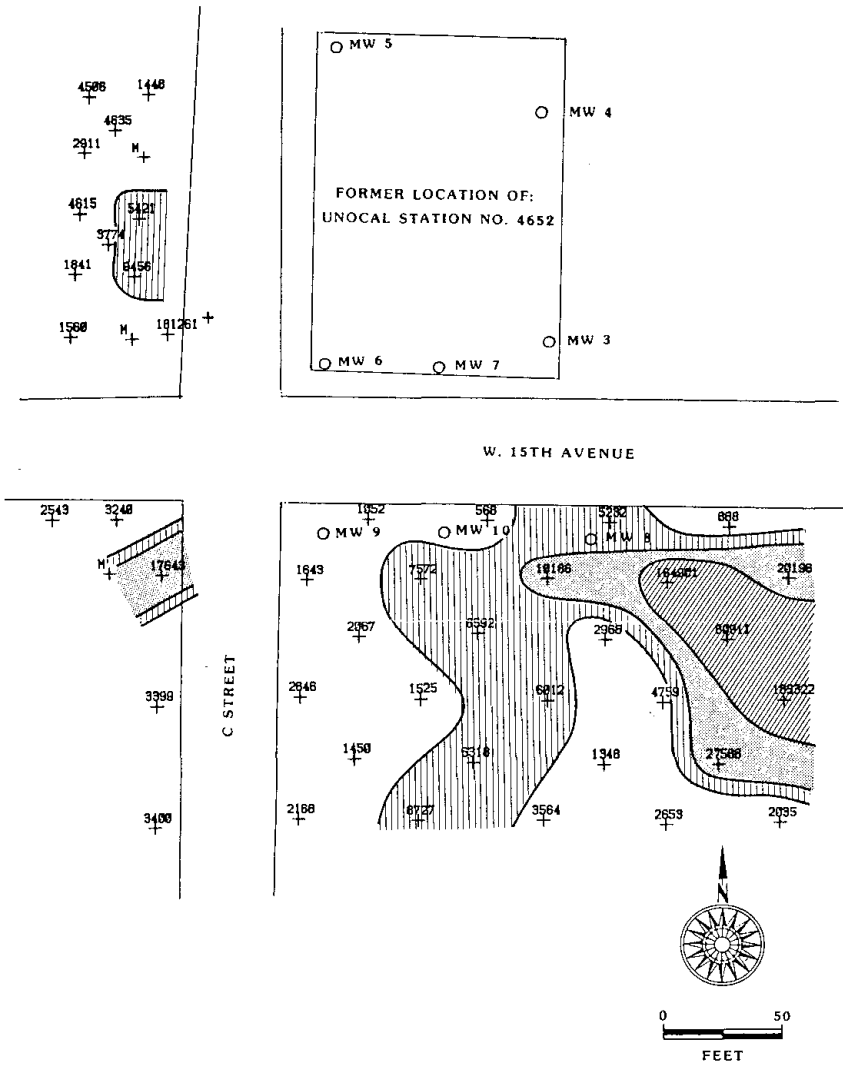
Relative Flux
Combined Benzene, Toluene, Xylenes, and Ethylbenzene

October 13, 1988 Plate: 1 Scale: 1in.= 50ft.

FIGURE 3A

A-1204-8

PETREX A DIVISION OF NORTHEAST RESEARCH INSTITUTE
605 PARFET STREET
SUITE 100
LAKEWOOD, COLORADO 80215
(303) 238-0098
B502



Legend:

Ion Count:

- ≥ 50,000
- 10,000-49,999
- 5,000-9,999

\+ Sample Placed In Tree-Data Not Comparable

M = Missing Sample

RITTENHOUSE-ZEMAN & ASSOCIATES, INC.

FORMER UNOCAL STATION NO. 4652 SITE

ANCHORAGE, ALASKA

Relative Flux

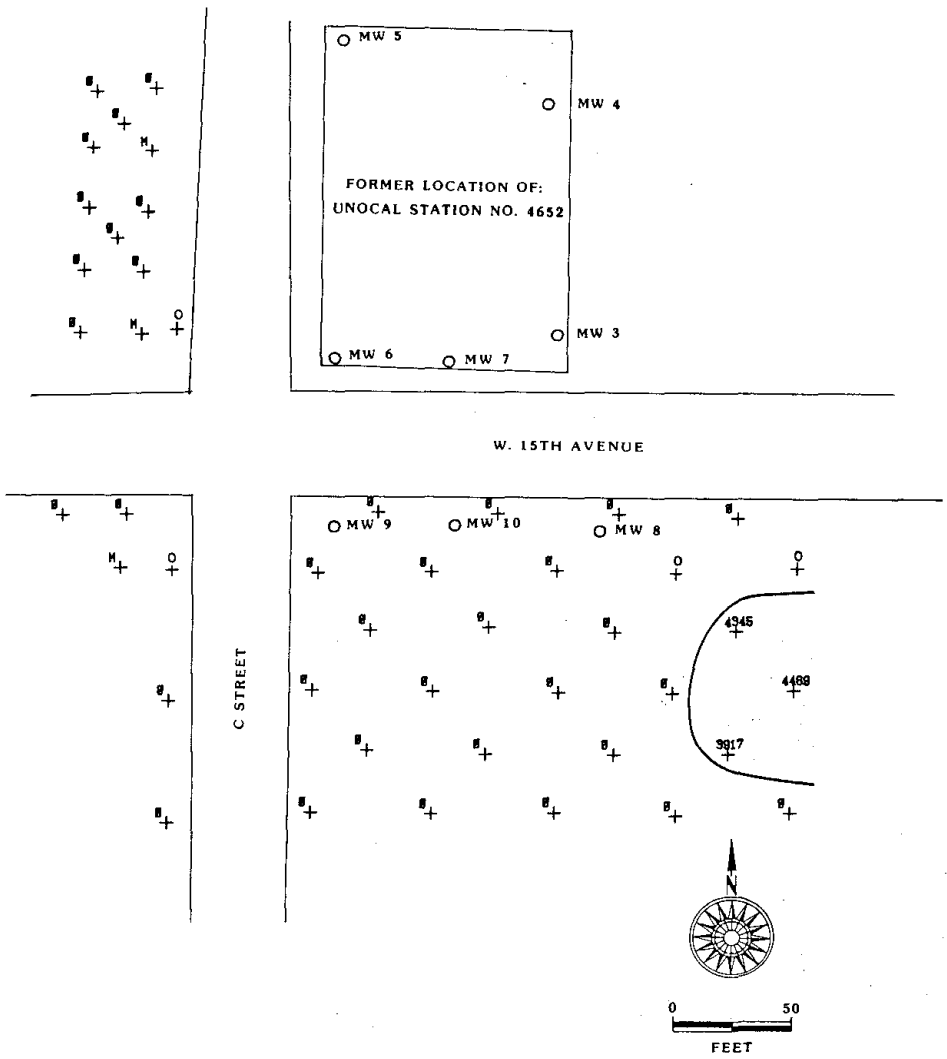
Combined Cycloalkanes and Alkenes (C_4-C_8)

October 13, 1988 Plate: 2 Scale: 1in.= 50ft.

FIGURE 3B

A-1204-8

PETREX
A DIVISION OF NORTHEAST RESEARCH INSTITUTE
605 PARFET STREET
SUITE 100
LAKEWOOD, COLORADO 80215
(303) 238-0090
B502



Legend:

Ion Count:

≥ 1,000

0 = Non-Detect

M = Missing Sample

RITTENHOUSE-ZEMAN & ASSOCIATES, INC.

FORMER UNOCAL STATION NO. 4652 SITE

ANCHORAGE, ALASKA

Relative Flux

Dichloroethylene

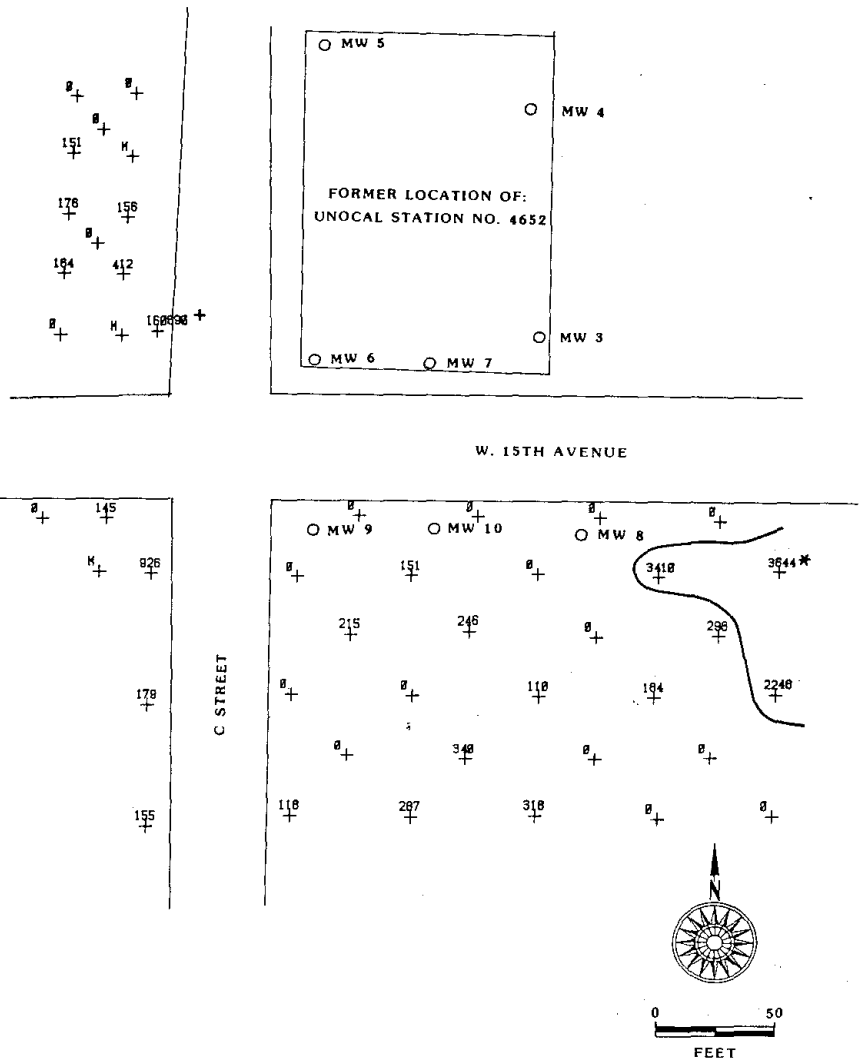
0030

October 13, 1988 Plate: 4 Scale: 1in.= 50ft.

FIGURE 3C

A-1204-8

PETREX A DIVISION OF NORTHEAST RESEARCH INSTITUTE
605 PARFET STREET
SUITE 100
LAKEWOOD, COLORADO 80215
(303) 238-0090
B502



Legend:

Ion Count:

☐ ≥ 1,000

* Actual Values For Xylenes and Ethylbenzene May be Lower Than Shown Due To Vegetative Interference (Terpenes)

\+ Sample Placed In Tree–Data Not Comparable

M = Missing Sample

RITTENHOUSE-ZEMAN & ASSOCIATES, INC.

FORMER UNOCAL STATION NO. 4652 SITE

ANCHORAGE, ALASKA

Relative Flux

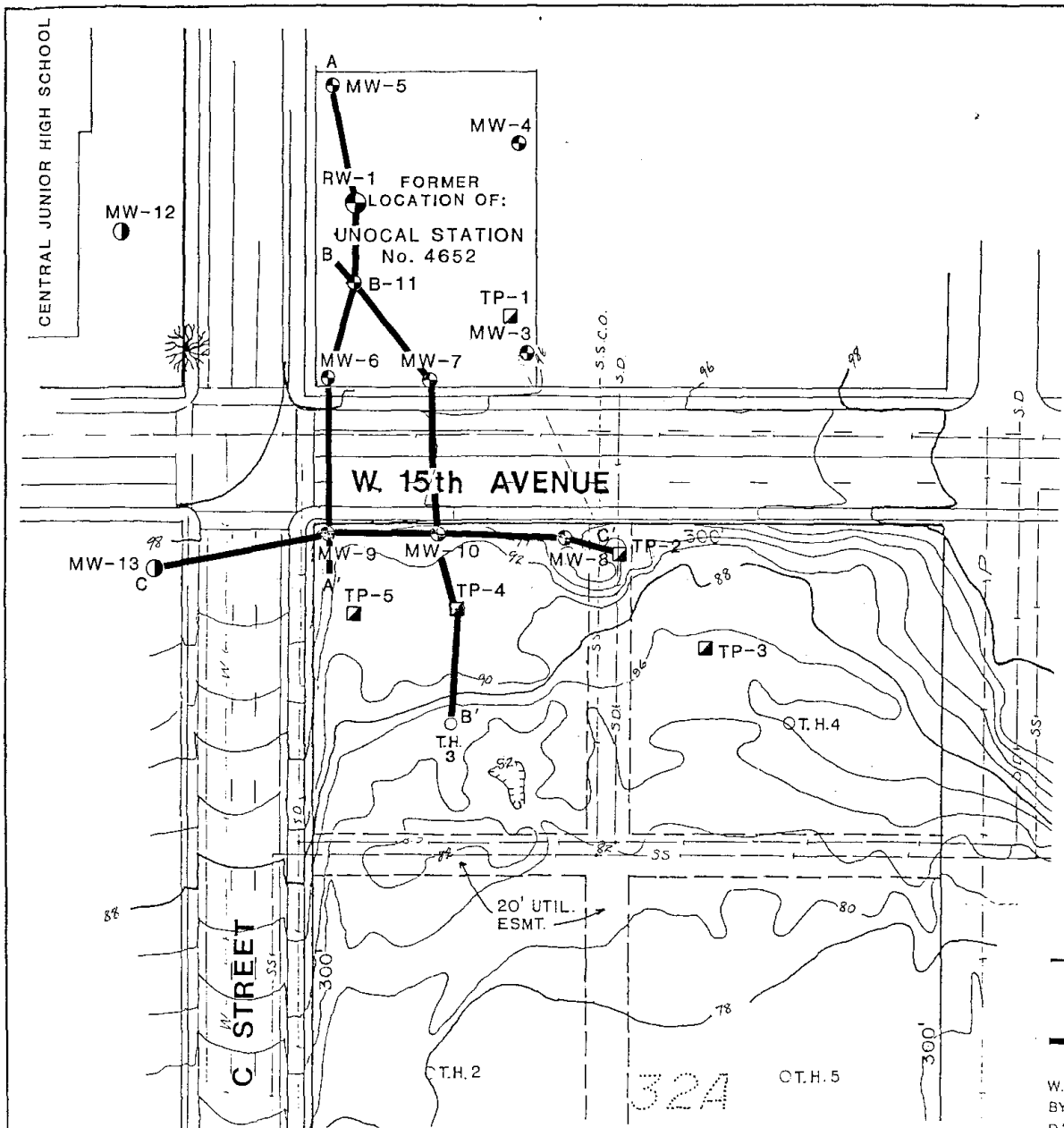
Combined Xylenes and Ethylbenzene

0031

October 13, 1988 Plate: 3 Scale: 1in.= 50ft.

FIGURE 3D

A-1204-8



Ground surface elevations are relative to an assigned datum

0032

N

0 50 100

APPROXIMATE SCALE IN FEET

LEGEND

- EXISTING MONITORING WELLS
- NEWLY INSTALLED MONITORING WELLS
- TEST PITS
- C C' CROSS SECTION LOCATION AND DESIGNATION (SEE FIGURES 4A, 4B, 4C)

UNOCAL SERVICE STATION No. 4652

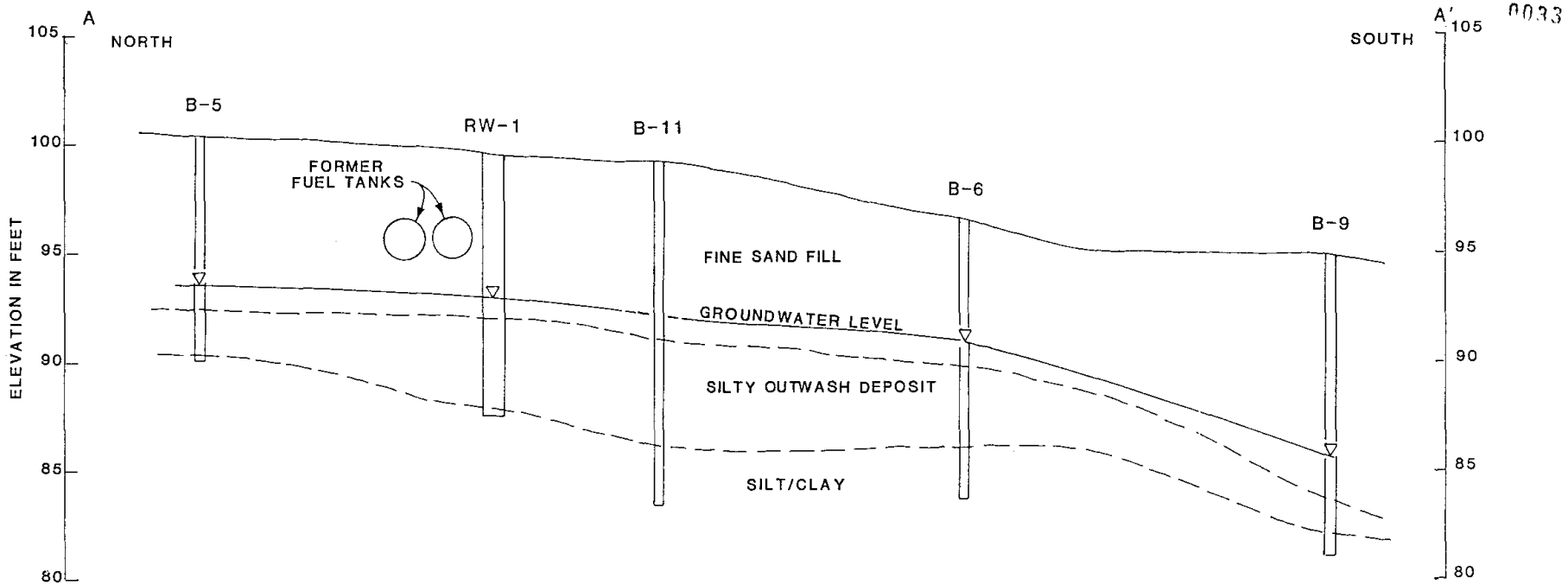
CONTAMINATION ASSESSMENT
CROSS SECTION LOCATION DIAGRAM

FIGURE 4

W.O. A-1204-8
BY DSW
DATE JAN 1989
SCALE NOTED

RITTENHOUSE-ZEMAN & ASSOCIATES, INC.
Geotechnical & Hydrogeological Consultants

RZA



NOTES:

1) WATER LEVELS AS OF 11-17-88
2) THE STRATUM ARE BASED UPON INTERPOLATION BETWEEN BORINGS AND MAY NOT REPRESENT ACTUAL SUBSURFACE CONDITIONS
3) ALL ELEVATIONS ARE BASED ON ASSUMED REFERENCE POINT

0 5 10
VERTICAL SCALE IN FEET

0 20 40
HORIZONTAL SCALE IN FEET

VERTICAL EXAGGERATION 4X

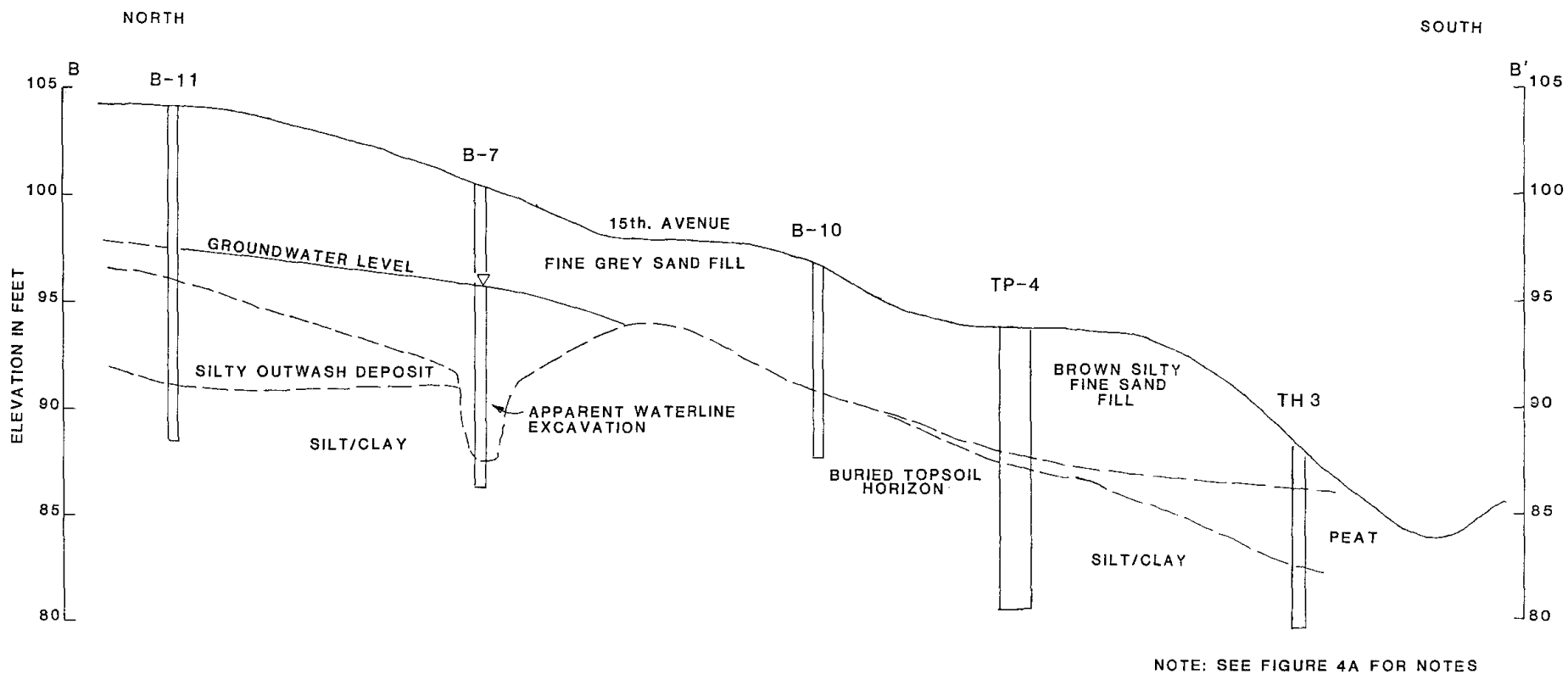
UNOCAL SERVICE STATION No. 4652
15th AVENUE & C STREET
ANCHORAGE, ALASKA

GENERALIZED CROSS SECTION A-A'

FIGURE 4A

W.O. A-1204-8
BY DSW
DATE JAN 1989
SCALE NOTED

RZA, INC.
Geotechnical & Environmental Consultants
711 'H' Street, Suite 450
Anchorage, Alaska 99501



NOTE: SEE FIGURE 4A FOR NOTES

0 5 10
VERTICAL SCALE IN FEET

0 20 40
HORIZONTAL SCALE IN FEET

VERTICAL EXAGGERATION 4X

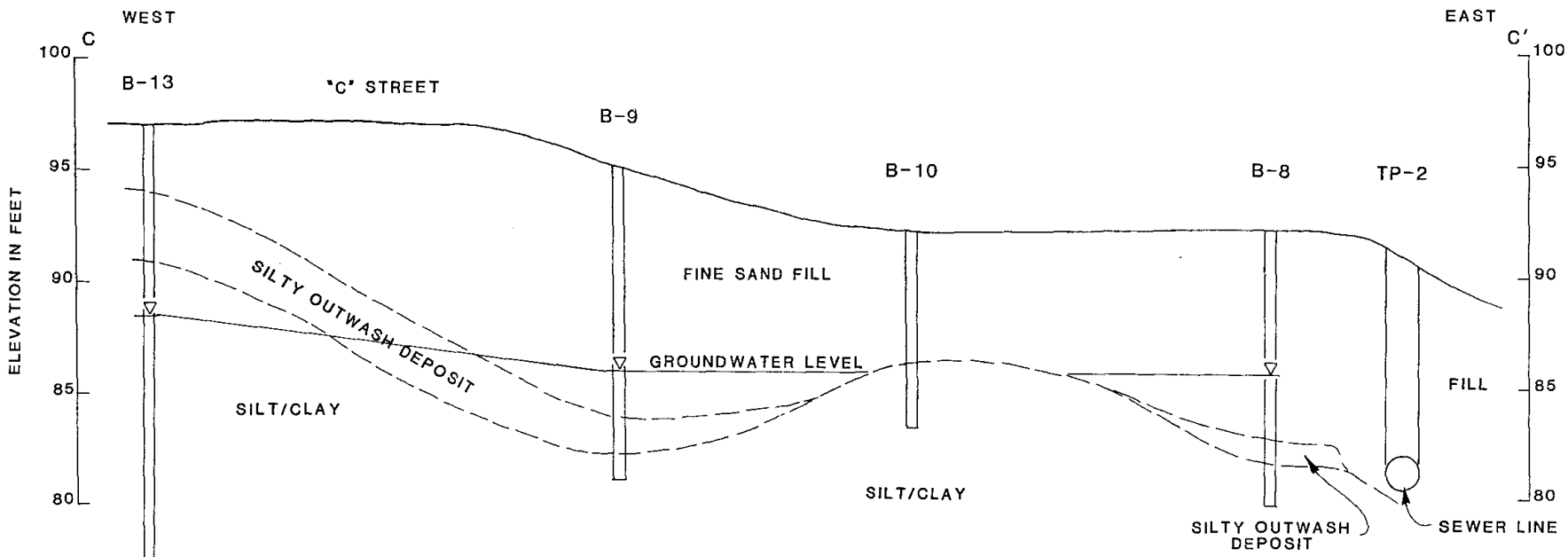
UNOCAL SERVICE STATION No. 4652
15th AVENUE & C STREET
ANCHORAGE, ALASKA

GENERALIZED CROSS SECTION B-B'

FIGURE 4B

W.O. A-1204-8
BY DSW
DATE JAN 1989
SCALE NOTED

RZA, INC.
Geotechnical & Environmental Consultants
711 'H' Street, Suite 450
Anchorage, Alaska 99501



0 5 10

VERTICAL SCALE IN FEET

0 20 40

HORIZONTAL SCALE IN FEET

VERTICAL EXAGGERATION 4X

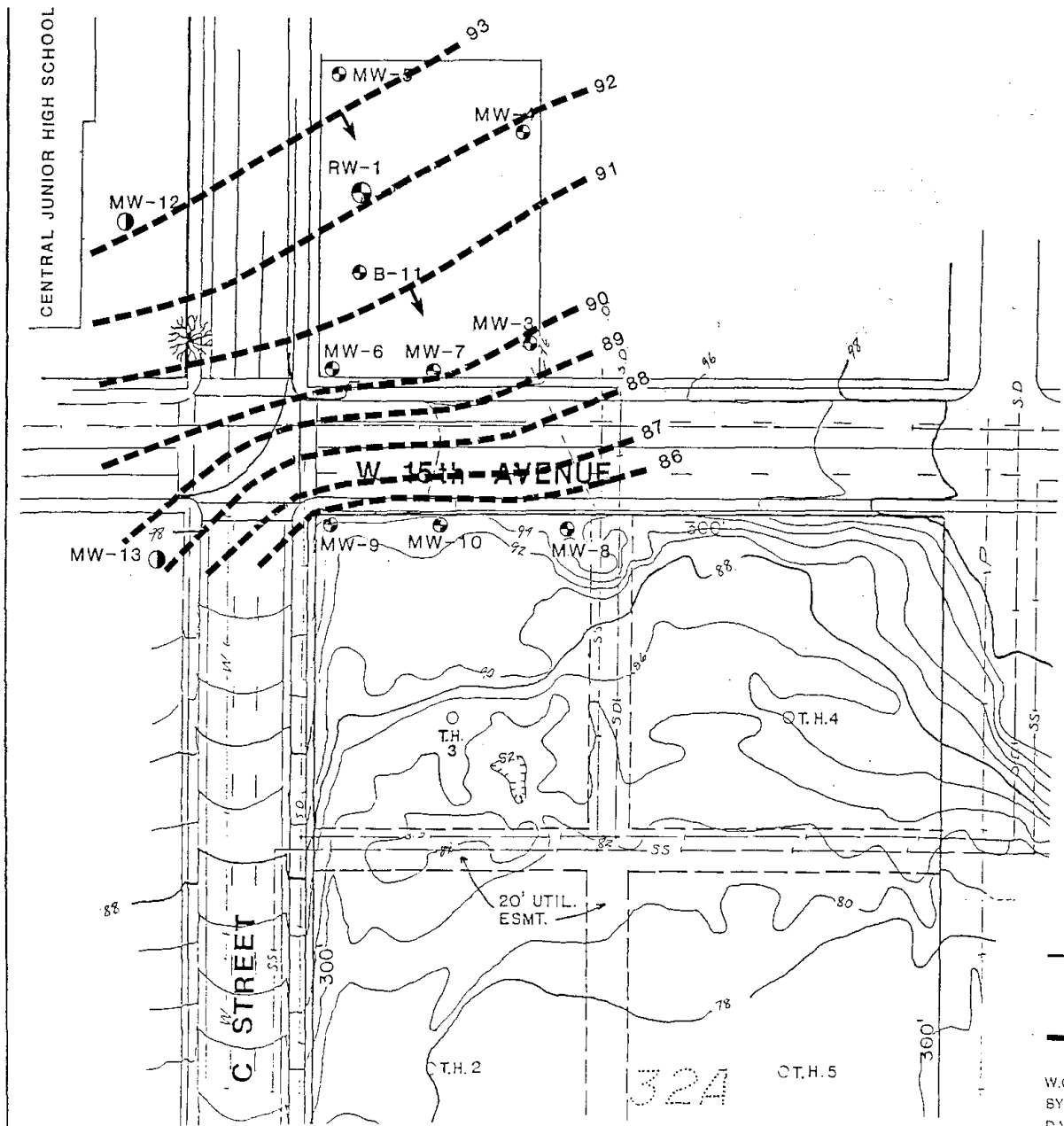
UNOCAL SERVICE STATION No. 4652
15th. AVENUE & C STREET
ANCHORAGE ALASKA

GENERALIZED CROSS SECTION C-C'

FIGURE 4C

W.O. A-1204-8
BY DSW
DATE JAN 1989
SCALE NOTED

RZA, INC.
Geotechnical & Environmental Consultants
711 'H' Street, Suite 450
Anchorage, Alaska 99501



elevations are relative to an assigned datum

N

0036

0 50 100

APPROXIMATE SCALE IN FEET

LEGEND

- EXISTING MONITORING WELLS
- NEWLY INSTALLED MONITORING WELLS
- PIEZOMETRIC SURFACE CONTOURS
  based on water level measurements of 11-17-88

UNOCAL SERVICE STATION No. 4652

CONTAMINATION ASSESSMENT
PIEZOMETRIC SURFACE CONTOUR

FIGURE 5

W.O. A-1204-8
BY DSW
DATE JAN 1989
SCALE NOTED

RITTENHOUSE-ZEMAN & ASSOCIATES, INC.
Geotechnical & Hydrogeological Consultants

RZA

Appendix A
Petrex Report

FINAL REPORT ON THE FINDINGS OF THE PETREX SOIL GAS SURVEY CONDUCTED FOR RITTENHOUSE-ZEMAN & ASSOCIATES, INC. THE FORMER UNOCAL STATION NO. 4652 SITE IN ANCHORAGE, ALASKA

PREPARED BY
PETREX
A DIVISION OF NORTHEAST RESEARCH INSTITUTE, INC.

OCTOBER 31, 1988

INTRODUCTION

Rittenenhouse-Zeman & Associates (RZA) were investigating the extent of migration for gasoline associated contaminants in an area near the former Unocal Station No. 4652 in Anchorage, Alaska. RZA already had a number of monitoring wells located in this area and reported significant concentrations of hydrocarbons (benzene, tolulene, and xylenes) in a number of these wells. RZA requested that Northeast Research Institute (NERI) conduct a Petrex soil gas survey to help determine the areal extent of contamination.

SURVEY OBJECTIVES

The objectives of the Petrex investigation were to:

1. Detect and identify volatile organic compounds (VOC's) associated with gasoline.

2. Detect and identify VOC's associated with other compounds or compound mixtures.

3. Map the extent of the gasoline associated VOC's detected to show the areas of downgradient gasoline contaminant migration.

4. Map the extent of other contaminants to identify if other contaminant plumes are present in the survey area.

SURVEY DESIGN

The design and implementation of the Petrex soil gas survey conducted in the area of the former Unocal Station No. 4652 was performed by personnel of RZA, Inc. Approximately fifty Petrex soil gas collectors were placed throughout the survey area. The collectors were placed in an offset grid pattern approximately 50 feet apart in one portion and approximately 25 feet apart in another portion of the survey area.

The collectors were installed and retrieved by personnel of RZA, Inc. the collectors were installed in middle August, 1988. Based on information obtained by retrieving and analyzing several Petrex collectors with different lengths of exposure, it was decided that all collectors should remain in place for three to four weeks, therefore the collectors were retrieved in early September, 1988.

RESULTS

The following Petrex soil gas maps were generated for the CPS site:

Plate 1. Combined Benzene, Toluene, Xylenes, and Ethylbenzene
Plate 2. Combined Cycloalkanes and Alkenese (C_4-C_8)
Plate 3. Combined Xylenes and Ethylbenzene
Plate 4. Dichloroethylene
Plate 5. Sample Locations Map

Additional information concerning the Petrex soil gas method is provided in Attachment 1.

DISCUSSION

Plates 1-3 show the distibutions of the specified hydrocarbons detected in the soil gas. These hydrocarbon compounds would typically be found in gasoline and may indicate areas of gasoline associated contaminant migration. Plate 3 shows values for compounds which are also included in Plate 1. Plate 3 was provided to give information on possible airborne contamination not associated with the subsurface contaminants. The question of Petrex collector contamination by airborne contaminants was raised because painting and a paint smell was noticed while the collectors were being installed. It was determined that xylenes were the greatest constituent of the paint and that a map of xylenes and ethylbenzene (Petrex cannot positively distinguish xylenes from ethylbenzene) would be the best representation of any paint contamination. The painting was at a school to the west of the former Unocal Station No. 4652. The xylenes and ethylbenzene values on Plate 3 indicate that airborne contaminants did not affect the Petrex collectors. The samplers with anomalous values on Plate 3 are a significant distance from the painting and the Petrex samplers near the painting (except for the sampler placed in tree) do not have significant amounts of these compounds.

It was reported to Petrex that water samples from monitoring well 9 had elevated levels of benzene, toluene, and xylenes, but Plate 1 does not identify this area as having significant amounts of these compounds in the soil gas. Two explanations for this absence of soil gas detection would be biodegradation and local topography. If high amounts of biodegradation of hydrocarbons in the vadose zone is occurring, this may prohibit the hydrocarbons from reaching the soil gas collectors in the near surface.

The samples along C Street and West 15th Avenue were placed on top of a bank near a relatively steep slope. Since soil gas migration is mostly driven by a diffusion process, the path of lowest concentration would be the direction of most likely migration. The cut surface of the bank would be an area of lower concentrations and would therefore be a more likely direction of migration than the more distant top of the bank. The possible result would be that the collectors on top of the bank were not in good communication with the subsurface hydrocarbons.

Plate 4 shows relative values for dichloroethylene, which is a compound commonly used as a degreaser. If the DCE was used as a degreaser, the presence of DCE with hydrocarbons would not be unlikely, but DCE would not likely be associated with hydrocarbon fuels in storage tanks. The location of the DCE anomaly also corresponds to where the highest hydrocarbon soil gas anomalies occur. Since these anomalies are not in the area of monitoring well 9 and DCE was not reported in monitoring well 9, it is likely that the contamination shown in the east portion of the survey area is from a different source than the contamination found in monitoring well 9.

CONCLUSIONS

The data generated from the Petrex soil gas survey at the Former Unocal Staion No. 4652 site in Anchorage, Alaska support the following conclusions:

1. VOC's were detected and identified from the subsurface soil gas in the survey area and the painting did not have an affect on the soil gas survey results.

2. The areas of contaminant detection did not include the area near monitoring well 9, which was reported to have groundwater contamination from from benzene, toluene, and xylenes. The absence of the soil gas detection of these compounds in this area is likely due to biodegredation of hydrocarbons or local topography.

3. The DCE and hydrocarbon anomalies in the east portion of the survey area are likely from a different source than the source of the contamination in monitoring well 9.

ATTACHMENT 1

PETREX SOIL GAS PROTOCOL

INTRODUCTION

The Petrex Static Collection Technique provides a means by which trace quantities of subsurface derived organic compounds can be detected and collected at the earth's surface. It is integrative, thereby eliminating the short-term variations associated with other gas/vapor detection methods. The Petrex Technique directly collects and records a broad range of organic compounds emanating from subsurface sources.

SOIL GAS COLLECTOR PREPARATION

Soil gas collectors are prepared as follows:

1. Adsorption wires (after construction) are cleaned by heating to 358^{o}C in a high vacuum system.
2. Wires are packed under an inert atmosphere in airtight tubes.
3. One collector out of every thirty is checked for cleanliness by mass spectrometry. Based on the results, the group of thirty collectors is approved for release into the field.

SAMPLER SHIPMENT AND FIELD HANDLING

Five percent transportation blanks are included with each shipment. Transportation blank samplers are stored unopened until analysis with the field samplers.

SOIL GAS COLLECTOR INSTALLATION

The collector consists of a ferromagnetic wire coated with an activated adsorbent. Each sample is typically placed in a shallow hole, 20-30 cm deep, within a protective container. The hole is backfilled and the location is marked. The collector is left in the ground for as long as 45 days, then retrieved and sealed in its container for transportation back to the laboratory for analysis.

MASS SPECTROMETER TUNING

An Extranuclear Quadrupole Mass Spectrometer equipped with a Curie-point pyrolysis/thermal desorption inlet is used for collector analysis. Mass assignment and resolution are manually adjusted using a perfluorotributylamine (PFTBA) standard. A linear correction, based on the known spectrum of PFTBA, is calculated. This correction is applied to a second PFTBA spectrum. If correct mass (M/Z) values are obtained, the operator proceeds to the next tuning step. If not, the procedure is repeated until correct masses are obtained.

Peak intensity ratios are set from the major peaks in the PFTBA spectrum using the following values:

Mass (M/Z)		Spectrum Intensities
69	=	100%
131	=	25% ± 5%
219	=	35% ± 5%

During tuning, the ion signal for mass (M/Z) 69 of PFTBA is measured at a preset sample pressure and detector voltage and compared to previous values at the same setting.

Electron energy is set to 70 electron volts and emission is set at 12 milliseconds. All other operating parameters, such as scans, scan range, and mass offset, are established in the computer program. These values may only be changed by the laboratory manager.

Tuning is performed at the beginning of a run so that an individual survey is analyzed at the same set of instrument conditions. The samples are analyzed in random order.

LABORATORY ANALYSIS

Machine background analyses are performed periodically (approximately every 20 samples) to assure that there is no carryover between successive samples. If there are peaks which are not related to atmospheric gases, the supervisor is notified and the mass spectrometer is shut down and cleaned as necessary.

A written sample number record is kept during the analysis to prevent accidental sample number duplication. The mass spectrometer control program contains appropriate "flag statements" that prompt the operator with a warning if an input sample number has already been analyzed. The operator then checks the current number, along with the disk storage location of the previously entered number to identify the true sample number.

COMPOUND IDENTIFICATION

Compound identification is based on molecular weight, compound fragmentation, and isotope distribution, as applicable. Each compound exhibits a unique mass spectral signature. NERI/Petrex maintains a large library of spectra for individual compounds, accessible by computer. In addition, the company maintains a large library of commonly used chemical mixtures, e.g., gasolines, diesels, industrial oils and solvents, coatings, and plastics. These are used to assist in both compound and mixture identifications.

Indicator peaks, indicative of the compound and away from interference by other compounds, are selected for data presentation and mapping.

RELATIVE FLUX DETERMINATION

The process of determining ion counts (fluxes) of indicator peaks for the specified compounds is totally computerized. Sample locations on a base map are digitized as X-Y coordinates and flux data for the given compounds are plotted at respective locations. All flux data are then extracted from the original data file for subsequent processing.

Mapping of the relative flux data occurs after contour intervals for each compound or component class are determined. In order to establish the contour intervals, factors such as flux distribution, physiochemical considerations, and component-source material relationship (if known) are taken into account for each compound or class, in each area, on an individual basis. Each map is then contoured by hand, or in special cases, computer contoured. The resultant contour zones for each compound or component in each area are color-coded on a relative basis.

It should be noted that the reported ion counts are representative of a flux which is proportional to the component's emanation rate at a particular sample location and is not a measure of concentration. Flux values for one compound cannot be quantitatively compared to flux values for different compounds. At this time, there has been no absolute equation established from which subsurface compound concentrations can be calculated from surficial flux levels.

[redacted] [redacted]

0047

Appendix B
Field Exploration, Monitoring and Sampling Procedures;
Test-Pit and Soil Boring Logs
Tabulated Groundwater Level Measurements

Appendix B
Subsurface Exploration, Monitoring Well Installation and Chemical Sampling

The field exploration program conducted for this study consisted of advancing a series of backhoe dug test pits and augered monitoring well borings to a maximum depth of 20.5 feet, approximately 7-1/2 to 8-1/2 feet below the groundwater surface. The approximate locations of the test pits and monitoring well borings are illustrated on the Site and Exploration Plan, Figure 2. The boring locations were chosen based on the available information regarding former site facility locations, the goals of the exploration program, and locations which would accessible to drilling equipment.

The test pits were dug on 1 November 1988, and monitoring well borings were drilled on 15 November 1988 by local contractors under subcontract to RZA. The borings were completed by advancing a 3-3/8 inch ID hollow stem auger using a Mobil Drill B61 drill rig. All drill rods, augers and samplers were steam-cleaned or otherwise decontaminated prior to use. During the drilling process, samples were generally obtained at 2-1/2 foot intervals below the groundwater surface. The test pits and borings were continuously observed and logged by a hydrogeologist from our firm. Final logs indicating the sample intervals, soil descriptions and monitoring well as-built diagrams are included in this appendix.

Representative soil samples were obtained during the drilling by using the standard penetration test procedure in general accordance with the specifications of ASTM:D 1586. This sampling method consists of driving a split-barrel sampler a distance of 18 inches on to the undisturbed soil below the auger using a 140-pound hammer free-falling a distance of 30 inches. The sampler was then retrieved and opened. At selected intervals soil samples were immediately placed in laboratory prepared vials and bottles, then placed in an ice chest for transportation to the analytical laboratory. RZA's Chain of Custody Procedures were used during handling and transportation to assure sample integrity.

Groundwater monitoring wells were installed in the drilled borings as indicated on the hydrogeologic logs enclosed in this Appendix. The wells installed during this study

consisted of 10 foot long 2-inch diameter, Schedule 40 PVC well screens with a 0.020 inch slot size, flush threaded to a 2-inch diameter Schedule 40 PVC blank riser casing. The PVC casing extended to the surrounding ground surface or to a few inches below it. The screen was surrounded with a select sand pack extending from the bottom of the bore hole to about two feet below the ground surface. A bentonite seal was placed from the top of the sand pack to about 6 inches below the ground surface and a 6 inch diameter steel protective casing equipped with an overlapping, bolted steel cap was installed and cemented in place to limit access to the wells. The elevation of the top of each well casing was determined relative to the previously installed wells. The site survey is referenced to a temporary benchmark assigned an elevation + 100.00. Summaries of water level data and the calculated water level elevations are included in this Appendix.

The two new monitoring wells were developed by surging and bailing. The development equipment was dedicated, and bailers were decontaminated prior to each use to avoid potential cross-contamination of monitoring wells. Approximately 3 to 5 well volumes of water were removed from each well during development. After developing these wells, the entire montoring network was sampled on 18 November 1988. Prior to sampling, each well was purged of approximately 3 to 5 casing volumes of water using a decontaminated stainless steel bailer. The samples were placed in laboratory prepared vials and bottles, chilled and transported to the analytical laboratory under Chain-of-Custody.

TEST PIT LOGS
UNOCAL #4652, 15th & C St., Anchorage, Alaska
A-1204-8

Depth (Feet)	Soil Description
Test Pit TP-1	
0.0 - 0.2	Asphalt
0.2 - 8.0	Greyish brown gravelly sand, trace silt with some debris and cobbles - FILL - slight petroleum odors to depth of 6 feet. Moist, turning wet at 6 feet, water infiltration at 7 feet - strong petroleum odor, sheen on water. Sample TP-1, S-1 obtained from depth of 7.5 feet.
8.0 - 8.5	Black organic silt and fibrous PEAT- wet - some odor of petroleum and organic, slight sheen.
8.5 - 9.0	Grey SILT or clayey silt, trace fine to medium sand - no petroleum odor.
Test Pit TP-2	
0.0 - 5.5	Reddish brown silt, little fine to medium sand, trace gravel and debris - FILL - moist - no petroleum odor.
5.5 - 6.25	Dark brown to greyish brown silty SAND, trace clay - possible old topsoil horizon - slightly wet zone with sewer and petroleum odors. Sample TP-2, S-1 obtained from a depth of 6 feet.
6.25 - 8.5	Greyish brown sandy SILT - moist - no petroleum odor.

TEST PIT LOGS
UNOCAL #4652, 15th & C St., Anchorage, Alaska
A-1204-8

Depth (Feet)	Soil Description
8.5 - 9.0	Encountered RCP storm sewer line surrounded by dark greyish brown silty sand and gravel. Encountered 4" asbestos type line west of storm line, broken and disconnected - filled with wet sand - oily sheen and strong sewer and petroleum odors. Sample TP-2, S-2 taken from inside 4" sewer line.
Test Pit TP-3	
0.0 - 1.75	Dark brown organic SILT and PEAT - wet - soft - slight organic odor.
1.75 - 2.25	Dark greyish brown silty SAND, trace gravel - wet zone at the base of peat - no petroleum odor. Sample TP-3, S-1 obtained from depth of 2 feet.
2.25 - 5.5	Grey SILT, little fine to medium sand, trace clay - moist to wet - no odor.
5.5 - 6.0	Grey fine to coarse silty SAND, some gravel - wet, with water oozing from strata - no petroleum odor. Sample TP-3, S-2 obtained from a depth of 5.5 feet.
6.0 - 9.0	Grey clayey silt and clay - moist - firm - no odor.
Test Pit TP-4	
0.0 - 2.0	Dark brown silty fine to coarse SAND, some gravel - moist - loose - no odor.
2.0 - 6.0	Brown to greyish brown, silty fine SAND and SILT, trace debris - FILL - moist - slight organic odor.

TEST PIT LOGS
UNOCAL #4652, 15th & C St., Anchorage, Alaska
A-1204-8

00052

Depth (Feet)	Soil Description
6.0 - 6.5	Dark brown to black silty fine SAND, trace organic, with roots and tree stump - possible old topsoil horizon - slightly wet zone - slight petroleum or organic odor. Sample TP-4, S-1 obtained from depth of 6.5 feet.
6.5 - 12.0	Grey silt with fine SAND, increasing clay content with depth - moist - no petroleum odor.
12.0 - 13.0	Grey silty CLAY, some coarse sand and gravel in clay matrix - moist - no petroleum odor.
Test Pit TP-5	
0.0 - 4.5	Brown, silty fine SAND and SILT - Fill - moist - slight organic odor.
4.5 - 5.0	Dark brown sandy SILT, trace organic with roots - possible buried topsoil horizon - moist - slight organic or petroleum odor. Sample TP-5, S-1 obtained from depth of 5.0 feet.
5.0 - 7.0	Grey SILT with fine sand - moist - no petroleum odor.
7.0 - 8.5	Grey silty CLAY, some fine to coarse sand in clay matrix - moist - no petroleum odors.

RZA
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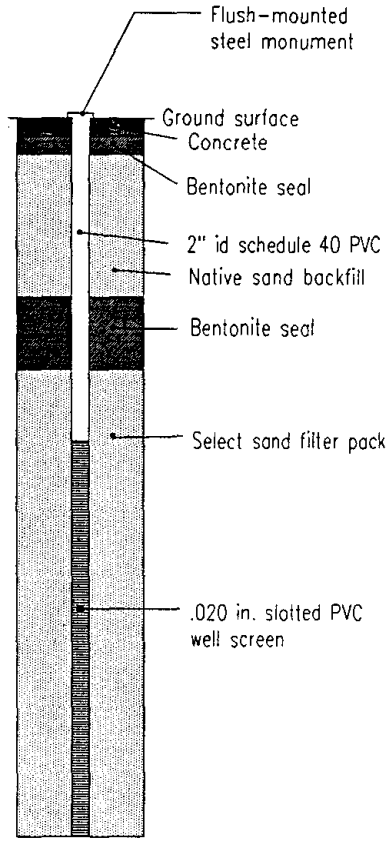
WELL NUMBER B-12 PAGE 1 OF 1
PROJECT NAME Unocal - 15th & C W.O. A-1204-8

SOIL OR ROCK DESCRIPTION	HNU READING	WATER LEVEL	DEPTH (IN FEET)	SOIL SAMPLES	SAMPLE INTERVAL
DRILLED BY: Ambler Exploration DRILLING METHOD: HSA/SPT REFERENCE ELEVATION: 100.00 Assigned CASING: 102.97 GROUND: 102.5 +/-					
Medium dense, moist, brown, gravelly, silty, fine to medium SAND (fill?)			5	S-1	
Medium dense, moist to wet, gray, silty, fine SAND			10	S-2	
Medium stiff to very stiff, moist to wet, gray, SILT/CLAY			15	S-3 S-4	
No product odors or sheens noted.			20	S-5	
Bottom of borehole @ 20' Note: Water level shown was observed in well on 11-17-88			25 30 35		

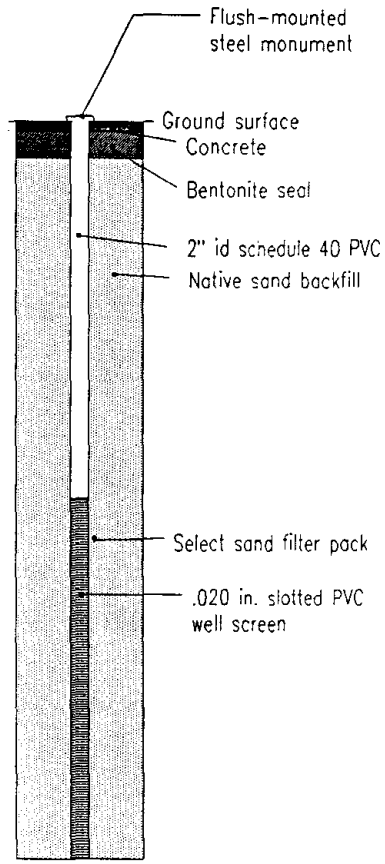
AS-BUILT



RZA RITTTENHOUSE-ZEMAN & ASSOCIATES, INC.
Geotechnical & Hydrogeological Consultants

WELL NUMBER B-13 PAGE 1 OF 1
PROJECT NAME Unocal - 15th & C W.O. A-1204-8

SOIL OR ROCK DESCRIPTION	HNU READING	WATER LEVEL	DEPTH (IN FEET)	SOIL SAMPLES	SAMPLE INTERVAL	AS-BUILT
DRILLED BY: Ambler Exploration DRILLING METHOD: HSA/SPT REFERENCE ELEVATION: 100.00 Assigned CASING: 96.99 GROUND: 96.5 +/-						
Medium dense, moist, brown, fine to medium SAND; trace gravel				S-1		
Medium dense, moist, gray, silty, fine SAND			5			
Very soft to stiff, moist to wet, gray, SILT/CLAY				S-2		
			10			
				S-3		
			15	S-4		
				S-5		
No product odors or sheens noted.			20			
Bottom of borehole @ 20.5' Note: Water level shown was observed in well on 11-17-88			25			
			30			
			35			



Tabulated Groundwater Level Measurements

MONITORING WELL B-1 RZA JOB NO. A-1204-8

FILE NAME: B1-1204-8

00056

DATE	CLOCK TIME	MEASURING POINT ELEVATION	MEASURED DEPTH TO WATER	MEASURED DEPTH TO PRODUCT	MEASURED PRODUCT THICKNESS	WATER-LEVEL ELEVATION	REMARKS
07/31/86	1140	97.72	5.76	--	0.00	91.96	
07/31/86	1730	97.72	5.86	--	0.00	91.86	
08/01/86	0849	97.72	5.76	--	0.00	91.96	
08/01/86	1659	97.72	5.76	--	0.00	91.96	
08/02/86	0941	97.72	5.73	--	0.00	91.99	
08/02/86	1742	97.72	5.73	--	0.00	91.99	
08/03/86	1128	97.72	5.72	--	0.00	92.00	
08/04/86	1403	97.72	5.80	--	0.00	91.92	
08/05/86	0714	97.72	5.78	--	0.00	91.94	
08/05/86	1826	97.72	5.78	--	0.00	91.94	
08/06/86	0725	97.72	5.80	--	0.00	91.92	
08/07/86	1053	97.72	5.82	--	0.00	91.90	
08/08/86	1123	97.72	5.70	--	0.00	92.02	
08/15/86	2003	97.72	5.65	--	0.00	92.07	
08/18/86	1811	97.72	5.78	--	0.00	91.94	
08/21/86	2010	97.72	5.65	--	0.00	92.07	
09/06/86	1532	97.72	5.75	--	0.00	91.97	
09/22/86	1225	97.72	5.50	--	0.00	92.22	
03/17/87	1455	97.72	6.90	--	0.00	90.82	
10/08/87	1133	97.72	5.95	--	0.00	91.77	

MONITORING WELL DESTROYED BY TANK EXCAVATION.

NOTES:

1) ALL MEASUREMENTS ARE IN FEET. ELEVATIONS ARE BASED ON ARBITRARY DATUM.

MONITORING WELL B-2 RZA JOB NO. A-1204-8

FILE NAME: B2-1204-8

00057

DATE	CLOCK TIME	MEASURING POINT ELEVATION	MEASURED DEPTH TO WATER	MEASURED DEPTH TO PRODUCT	MEASURED PRODUCT THICKNESS	WATER-LEVEL ELEVATION	REMARKS
07/31/86	1140	98.72	UNKNOWN		1.35		
07/31/86	1728	98.72	UNKNOWN		1.12		
08/01/86	0851	98.72	UNKNOWN		1.52		
08/01/86	1706	98.72	UNKNOWN		1.53		
08/02/86	0942	98.72	UNKNOWN		1.53		
08/02/86	1743	98.72	UNKNOWN		1.53		
08/03/86	1130	98.72	UNKNOWN		1.50		
08/04/86	1049	98.72	UNKNOWN		1.57		
08/05/86	0718	98.72	UNKNOWN		1.58		
08/05/86	1900	98.72	BAILED APPROXIMATELY 1/2 TO 3/4 GALLON				OF GASOLINE FROM WELL
08/06/86	0728	98.72	UNKNOWN		1.16		
08/07/86	1056	98.72	UNKNOWN		1.48		
08/08/86	1128	98.72	UNKNOWN		1.39		
08/15/86	2013	98.72	5.99	--	0.00	92.73	
08/21/86	2040	98.72	7.09	--	0.00	91.63	
09/06/86	1542	98.72	6.11	--	0.00	92.61	
09/22/86	1252	98.72	5.98	--	0.00	92.74	
03/17/87	1450	98.72	7.52	--	0.00	91.20	
10/08/87	1135	98.72	6.58	--	0.00	92.14	SHEEN ON BAILED WATER

MONITORING WELL DESTROYED BY TANK EXCAVATION.

NOTES:

1) ALL MEASUREMENTS ARE IN FEET. ELEVATIONS ARE BASED ON ARBITRARY DATUM.

MONITORING WELL B-3 RZA JOB NO. A-1204-8

FILE NAME: B3-1204-8

00058

DATE	CLOCK TIME	MEASURING POINT ELEVATION	MEASURED DEPTH TO WATER	MEASURED DEPTH TO PRODUCT	MEASURED PRODUCT THICKNESS	WATER-LEVEL ELEVATION	REMARKS
07/31/86	1738	95.05	5.09	--	0.00	89.96	
08/01/86	0855	95.05	5.12	--	0.00	89.93	
08/01/86	1655	95.05	5.15	--	0.00	89.90	
08/02/86	0935	95.05	5.17	--	0.00	89.88	
08/02/86	1757	95.05	5.17	--	0.00	89.88	
08/03/86	1126	95.05	5.19	--	0.00	89.86	
08/04/86	1111	95.05	5.21	--	0.00	89.84	
08/05/86	0704	95.05	5.23	--	0.00	89.82	
08/05/86	1825	95.05	5.29	--	0.00	89.76	
08/06/86	0713	95.05	5.26	--	0.00	89.79	
08/07/86	1043	95.05	5.29	--	0.00	89.76	
08/08/86	1114	95.05	5.25	--	0.00	89.80	
08/15/86	1936	95.05	5.21	--	0.00	89.84	
08/21/86	2000	95.05	5.20	--	0.00	89.85	
09/06/86	1557	95.05	5.29	--	0.00	89.76	
09/22/87	1120	95.05	5.23	--	0.00	89.82	
03/17/87	1100	95.05	6.79	--	0.00	88.26	
10/08/87	1100	95.05	5.33	--	0.00	89.72	
01/15/88	1508	95.05	6.45	--	0.00	88.60	
05/03/88	0914	95.05	3.89	--	0.00	91.16	
07/26/88	0854	95.05	5.21	--	0.00	89.84	
11/17/88	1531	95.05	5.45	--	0.00	89.60	

NOTES:

1) ALL MEASUREMENTS ARE IN FEET. ELEVATIONS ARE BASED ON ARBITRARY DATUM.

MONITORING WELL B-4 RZA JOB NO. A-1204-8

FILE NAME: B4-1204-8

00059

DATE	CLOCK TIME	MEASURING POINT ELEVATION	MEASURED DEPTH TO WATER	MEASURED DEPTH TO PRODUCT	MEASURED PRODUCT THICKNESS	WATER-LEVEL ELEVATION	REMARKS
08/02/86	0939	97.15	5.11	--	0.00	92.04	
08/02/86	1735	97.15	5.08	--	0.00	92.07	
08/03/86	1123	97.15	5.09	--	0.00	92.06	
08/04/86	1040	97.15	5.16	--	0.00	91.99	
08/05/86	0712	97.15	5.16	--	0.00	91.99	
08/06/86	0722	97.15	5.18	--	0.00	91.97	
08/07/86	1050	97.15	5.21	--	0.00	91.94	
08/08/87	1121	97.15	5.11	--	0.00	92.04	
09/22/86	1105	97.15	4.77	--	0.00	92.38	
03/17/87		97.15		NOT ACCESSIBLE			
10/08/87	1114	97.15	5.34	--	0.00	91.81	
01/15/88	1504	97.15	5.96	--	0.00	91.19	
05/03/88	0912	97.15	4.29	--	0.00	92.86	
07/26/88	1843	97.15	5.10	--	0.00	92.05	
11/17/88	1405	97.15	5.38	--	0.00	91.77	

NOTES:
1) ALL MEASUREMENTS ARE IN FEET. ELEVATIONS ARE BASED ON ARBITRARY DATUM.

MONITORING WELL B-5 RZA JOB NO. A-1204-8

FILE NAME: B5-1204-8

00060

DATE	CLOCK TIME	MEASURING POINT ELEVATION	MEASURED DEPTH TO WATER	MEASURED DEPTH TO PRODUCT	MEASURED PRODUCT THICKNESS	WATER-LEVEL ELEVATION	REMARKS
08/02/86	0938	100.36	7.14	--	0.00	93.22	
08/02/86	1745	100.36	7.14	--	0.00	93.22	
08/03/86	1124	100.36	7.13	--	0.00	93.23	
08/04/86	1056	100.36	7.18	--	0.00	93.18	
08/05/86	1828	100.36	7.17	--	0.00	93.19	
08/07/86	1049	100.36	7.20	--	0.00	93.16	
08/08/86	1119	100.36	7.16	--	0.00	93.20	
08/15/86	2017	100.36	7.10	--	0.00	93.26	
08/18/86	1814	100.36	7.14	--	0.00	93.22	
09/06/87	1552	100.36	7.12	--	0.00	93.24	
09/22/86	1105	100.36	7.98	--	0.00	92.38	
03/17/87	1000	100.36	8.04	--	0.00	92.32	
10/08/87	1111	100.36	7.21	--	0.00	93.15	
01/15/88	1458	100.36	7.78	--	0.00	92.58	
05/03/88	0916	100.36	6.03	--	0.00	94.33	
07/26/88	2044	100.36	6.99	--	0.00	93.37	
11/17/88	1324	100.36	7.13	--	0.00	93.23	

NOTES:

1) ALL MEASUREMENTS ARE IN FEET. ELEVATIONS ARE BASED ON ARBITRARY DATUM.

MONITORING WELL B-6 RZA JOB NO. A-1204-8

FILE NAME: B6-1204-8 00061

DATE	CLOCK TIME	MEASURING POINT ELEVATION	MEASURED DEPTH TO WATER	MEASURED DEPTH TO PRODUCT	MEASURED PRODUCT THICKNESS	WATER-LEVEL ELEVATION	REMARKS
08/03/86	1133	96.54	5.57	--	0.00	90.97	
08/04/86	1059	96.54	5.29	--	0.00	91.25	
08/05/86	0710	96.54	5.63	--	0.00	90.91	
08/05/86	1830	96.54	5.64	--	0.00	90.90	
08/06/86	0718	96.54	5.62	--	0.00	90.92	
08/07/86	1047	96.54	5.66	--	0.00	90.88	
08/08/86	1117	96.54	5.55	--	0.00	90.99	
08/15/86	1954	96.54	5.54	--	0.00	91.00	
08/18/86	1808	96.54	5.70	--	0.00	90.84	
08/21/86	2007	96.54	5.64	--	0.00	90.90	
09/06/86	1609	96.54	5.68	--	0.00	90.86	
09/22/86	1142	96.54	5.44	--	0.00	91.10	
03/17/87	1505	96.54	7.27	--	0.00	89.27	
10/08/87	1127	96.54	6.01	--	0.00	90.53	
01/15/88	1650	96.54	6.75	--	0.00	89.79	
05/03/88	0932	96.54	4.46	--	0.00	92.08	
07/26/88	2049	96.54	5.60	--	0.00	90.94	
11/17/88	1536	96.54	5.99	--	0.00	90.55	

NOTES:
1) ALL MEASUREMENTS ARE IN FEET. ELEVATIONS ARE BASED ON ARBITRARY DATUM.

MONITORING WELL B-7 RZA JOB NO. A-1204-8

FILE NAME: B7-1204-8 00062

DATE	CLOCK TIME	MEASURING POINT ELEVATION	MEASURED DEPTH TO WATER	MEASURED DEPTH TO PRODUCT	MEASURED PRODUCT THICKNESS	WATER-LEVEL ELEVATION	REMARKS
08/03/86	1136	95.38	4.77	--	0.00	90.61	
08/04/86	1107	95.38	4.83	--	0.00	90.55	
08/05/86	0707	95.38	4.74	--	0.00	90.64	
08/05/86	1833	95.38	4.73	--	0.00	90.65	
08/06/86	0715	95.38	4.71	--	0.00	90.67	
08/07/86	1045	95.38	4.79	--	0.00	90.59	
08/08/86	1116	95.38	4.56	--	0.00	90.82	
08/15/86	1945	95.38	4.72	--	0.00	90.66	
08/18/86	1805	95.38	4.88	--	0.00	90.50	
08/21/86	2002	95.38	4.75	--	0.00	90.63	
09/06/86	1604	95.38	4.79	--	0.00	90.59	
09/22/86	1130	95.38	4.59	--	0.00	90.79	
03/17/87	1510	95.38	4.59	--	0.00	90.79	
10/08/87	1125	95.38	5.00	--	0.00	90.38	
01/15/88	1634	95.38	5.72	--	0.00	89.66	
05/03/88	0930	95.38	3.33	--	0.00	92.05	
07/26/88	2053	95.38	4.68	--	0.00	90.70	
11/17/88	1545	95.38	5.02	--	0.00	90.36	

NOTES:
1) ALL MEASUREMENTS ARE IN FEET. ELEVATIONS ARE BASED ON ARBITRARY DATUM.

MONITORING WELL B-8 RZA JOB NO. A-1204-8

FILE NAME: B8-1204-8 00063

DATE	CLOCK TIME	MEASURING POINT ELEVATION	MEASURED DEPTH TO WATER	MEASURED DEPTH TO PRODUCT	MEASURED PRODUCT THICKNESS	WATER-LEVEL ELEVATION	REMARKS
09/06/86	1637	91.78	6.31	--	0.00	85.47	
09/22/86	1212	91.78	6.09	--	0.00	85.69	
03/17/87	1420	91.78	7.84	--	0.00	83.94	
10/08/87	1120	91.78	6.50	--	0.00	85.28	
01/18/88	1620	91.78	7.28	--	0.00	84.50	
05/03/88	0919	91.78	5.40	--	0.00	86.38	
07/26/88	2055	91.78	6.17	--	0.00	85.61	
11/17/88	1553	91.78	6.57	--	0.00	85.21	

NOTES:
1) ALL MEASUREMENTS ARE IN FEET. ELEVATIONS ARE BASED ON ARBITRARY DATUM.

MONITORING WELL B-9 RZA JOB NO. A-1204-8

FILE NAME: B9-1204-8

00064

DATE	CLOCK TIME	MEASURING POINT ELEVATION	MEASURED DEPTH TO WATER	MEASURED DEPTH TO PRODUCT	MEASURED PRODUCT THICKNESS	WATER-LEVEL ELEVATION	REMARKS
09/06/86	1655	94.98	9.05	--	0.00	85.93	
09/22/86	1155	94.98	8.75	--	0.00	86.23	
03/17/87	1001	94.98	10.03	--	0.00	84.86	
10/08/87	1122	94.98	9.54	--	0.00	85.44	
01/15/88	1634	94.98	9.60	--	0.00	85.38	
05/03/88	0925	94.98	8.02	--	0.00	86.96	
07/26/88	2057	94.98	6.30	--	0.00	88.68	
11/17/88	1600	94.98	9.20	--	0.00	85.78	

NOTES:
1) ALL MEASUREMENTS ARE IN FEET. ELEVATIONS ARE BASED ON ARBITRARY DATUM.

MONITORING WELL B-10 RZA JOB NO. A-1204-8

FILE NAME: B10-12048

0065

DATE	CLOCK TIME	MEASURING POINT ELEVATION	MEASURED DEPTH TO WATER	MEASURED DEPTH TO PRODUCT	MEASURED PRODUCT THICKNESS	WATER-LEVEL ELEVATION	REMARKS
09/06/86	1642	91.79	--	--	0.00	NONE OBSERVED	DRY WELL
09/22/86	1206	91.79	--	--	0.00	NONE OBSERVED	DRY WELL
03/17/87			NOT LOCATED				
10/08/87	1121	91.79	--	--	0.00	NONE OBSERVED	DRY WELL
05/03/88	0927	91.79	4.72	--	0.00	87.07	
07/26/88	2055	91.79	--	--	0.00	NONE OBSERVED	DRY WELL
11/17/88	1610	91.79	--	--	0.00	NONE OBSERVED	DRY WELL

NOTES:
1) ALL MEASUREMENTS ARE IN FEET. ELEVATIONS ARE BASED ON ARBITRARY DATUM.

MONITORING WELL B-11 RZA JOB NO. A-1204-8

FILE NAME: B11-1204- 8

00066

DATE	CLOCK TIME	MEASURING POINT ELEVATION	MEASURED DEPTH TO WATER	MEASURED DEPTH TO PRODUCT	MEASURED PRODUCT THICKNESS	WATER-LEVEL ELEVATION	REMARKS
09/06/86	1625	98.02	6.61		0.00	91.41	
09/22/86	1240	98.02	6.49	6.46	0.03	91.53	
03/17/87			NOT LOCATED				WELL APPARENTLY DESTROYED

NOTES:
1) ALL MEASUREMENTS ARE IN FEET. ELEVATIONS ARE BASED ON ARBITRARY DATUM.

MONITORING WELL B-12 RZA JOB NO. A-1204-8

FILE NAME:B12-1204-8 0067

DATE	CLOCK TIME	MEASURING POINT ELEVATION	MEASURED DEPTH TO WATER	MEASURED DEPTH TO PRODUCT	MEASURED PRODUCT THICKNESS	WATER-LEVEL ELEVATION	REMARKS
11/17/88	1215	102.97	9.88	--	0.00	93.09	

NOTES:
1) ALL MEASUREMENTS ARE IN FEET. ELEVATIONS ARE BASED ON ARBITRARY DATUM.

MONITORING WELL B-13 RZA JOB NO. A-1204-8

FILE NAME:B13-1204-8 00068

DATE	CLOCK TIME	MEASURING POINT ELEVATION	MEASURED DEPTH TO WATER	MEASURED DEPTH TO PRODUCT	MEASURED PRODUCT THICKNESS	WATER-LEVEL ELEVATION	REMARKS
11/17/88	1222	96.99	8.68	--	0.00	88.31	

NOTES:
1) ALL MEASUREMENTS ARE IN FEET. ELEVATIONS ARE BASED ON ARBITRARY DATUM.

Appendix C
Laboratory Analytical Reports
Soil Analyses
Groundwater Analyses
Tabulated Groundwater Analytical Summaries

Laboratory Analytical Reports
Soil Samples

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

ANALYSIS REPORT

CLIENT: Rittenhouse - Zeman & Associates

DATE RECEIVED: 11/3/88

REPORT TO: Dan Whitman
1400 - 140th NE
Bellevue, WA 98005

DATE REPORTED: 11/17/88

JOB NO.: A 1204-8

GC ANALYSIS OF PURGEABLE AROMATIC COMPOUNDS BY EPA METHOD 8020

Laboratory Sample Nos.	BLANK	822291	822292	DETECTION LIMIT
Client Identification	--	TP1, S-1	TP2, S-1	(ug/kg)
Benzene	ND	15.	22.	8.
Toluene	ND	12.	ND	8.
Chlorobenzene	ND	25.	ND	8.
Ethyl Benzene	ND	145.	200.	8.
m+p-Xylene	ND	575.	98.	16.
o-Xylene	ND	305.	24.	8.
1,3-Dichlorobenzene	ND	ND	ND	8.
1,4-Dichlorobenzene	ND	ND	ND	8.
1,2-Dichlorobenzene	ND	ND	ND	8.

ND = Not Detected.
All results are reported in ug/kg.
m-Xylene & p-Xylene coelute.

CLIENT: Rittenhouse - Zeman & Associates

REPORT TO: Dan Whitman

DATE RECEIVED: 11/3/88

DATE REPORTED: 11/17/88

JOB NO.: A 1204-8

GC ANALYSIS OF PURGEABLE AROMATIC COMPOUNDS BY EPA METHOD 8020

Laboratory Sample Nos.	822293	822294	822295	DETECTION LIMIT
Client Identification	TP2, S-2	TP3, S-1	TP3, S-2	(ug/kg)
Benzene	39.	25.	88.	8.
Toluene	7.	ND	ND	8.
Chlorobenzene	ND	ND	ND	8.
Ethyl Benzene	395.	5.	ND	8.
m+p-Xylene	595.	29.	ND	16.
o-Xylene	144.	ND	ND	8.
1,3-Dichlorobenzene	ND	ND	ND	8.
1,4-Dichlorobenzene	ND	ND	ND	8.
1,2-Dichlorobenzene	ND	ND	ND	8.

ND = Not Detected.
All results are reported in ug/kg.
m-Xylene & p-Xylene coelute.

CLIENT: Rittenhouse - Zeman & Associates

DATE RECEIVED: 11/3/88

REPORT TO: Dan Whitman

DATE REPORTED: 11/17/88

JOB NO.: A 1204-8

GC ANALYSIS OF PURGEABLE AROMATIC COMPOUNDS BY EPA METHOD 8020

Laboratory Sample Nos.	822296	DETECTION LIMIT
Client Identification	TP4, S-1	(ug/kg)
Benzene	4,650.	40.
Toluene	41.	40.
Chlorobenzene	ND	40.
Ethylbenzene	57.	40.
m+p-Xylene	126.	80.
o-Xylene	79.	40.
1,3-Dichlorobenzene	ND	40.
1,4-Dichlorobenzene	ND	40.
1,2-Dichlorobenzene	ND	40.

ND = Not Detected.
All results are reported in ug/kg.
m-Xylene & p-Xylene coelute.

CLIENT: Rittenhouse - Zeman & Associates DATE RECEIVED: 11/3/88

REPORT TO: Dan Whitman DATE REPORTED: 11/17/88

JOB NO.: A 1204-8

GC ANALYSIS OF PURGEABLE AROMATIC COMPOUNDS BY EPA METHOD 8020

Laboratory Sample Nos.	822297	822297 DUPLICATE	DETECTION LIMIT
Client Identification	TP5, S-1	TP5, S-1	(ug/kg)
Benzene	19.	13.	8.
Toluene	ND	ND	8.
Chlorobenzene	ND	ND	8.
Ethylbenzene	ND	ND	8.
m+p-Xylene	34.	36.	16.
o-Xylene	ND	ND	8.
1,3-Dichlorobenzene	ND	ND	8.
1,4-Dichlorobenzene	ND	ND	8.
1,2-Dichlorobenzene	ND	ND	8.

ND = Not Detected.
All results are reported in ug/kg.
m-Xylene & p-Xylene coelute.

CLIENT: Rittenhouse - Zeman & Associates

REPORT TO: Dan Whitman

DATE RECEIVED: 11/3/88
DATE REPORTED: 11/17/88
JOB NO.: A 1204-8

GC ANALYSIS OF PURGEABLE HALOCARBONS BY EPA METHOD 8010

Laboratory Sample Nos.	BLANK	822291	822292	DETECTION LIMIT
Client Identification	--	TP1, S-1	TP2, S-1	(ug/kg)
Chloromethane	ND	ND	ND	15.
Vinyl Chloride	ND	ND	ND	15.
Bromomethane	ND	ND	ND	15.
Chloroethane + Dichlorodifluoromethane	ND	ND	ND	15.
Trichlorofluoromethane	ND	ND	ND	15.
1,1-Dichloroethylene	ND	ND	ND	15.
Methylene Chloride	16.	63.	53.	3.
Trans-1,2-Dichloroethylene	ND	ND	ND	3.0
1,1-Dichloroethane	ND	ND	ND	3.0
Chloroform	1.5	1.2	1.2	1.
1,1,1-Trichloroethane	ND	ND	ND	8.0
Carbon Tetrachloride	ND	ND	ND	8.0
1,2-Dichloroethane	ND	ND	ND	8.0
Trichloroethylene	ND	ND	ND	8.0
1,2-Dichloropropane	ND	ND	ND	8.0
Dichlorobromomethane	ND	ND	ND	8.0
Trans-1,3-Dichloropropene	ND	ND	ND	8.0
Cis-1,3-Dichloropropene	ND	ND	ND	8.0
1,1,2-Trichloroethane	ND	ND	ND	8.0
Tetrachloroethylene	ND	ND	ND	8.0
Dibromochloromethane	ND	ND	ND	8.0
Bromoform	ND	ND	ND	8.0
1,1,2,2-Tetrachloroethane	ND	ND	ND	8.0

ND = Not Detected.
Chloroethane & Dichlorodifluoromethane coelute.
Methylene Chloride & Chloroform are reported in ug/l; all other results are reported in ug/kg.
Methylene Chloride & Chloroform are found in the Blank; therefore, laboratory contamination is suspected.

CLIENT: Rittenhouse - Zeman & Associates
DATE RECEIVED: 11/3/88
DATE REPORTED: 11/17/88
REPORT TO: Dan Whitman
JOB NO.: A 1204-8

GC ANALYSIS OF PURGEABLE HALOCARBONS BY EPA METHOD 8010

Laboratory Sample Nos.	822293	822294	822295	DETECTION LIMIT
Client Identification	TP2, S-2	TP3, S-1	TP3, S-2	(ug/kg)
Chloromethane	ND	ND	ND	15.
Vinyl Chloride	ND	ND	ND	15.
Bromomethane	ND	ND	ND	15.
Chloroethane + Dichlorodifluoromethane	ND	ND	ND	15.
Trichlorofluoromethane	ND	ND	ND	15.
1,1-Dichloroethylene	ND	ND	ND	15.
Methylene Chloride	50.	7.0	7.0	3.0
Trans-1,2-Dichloroethylene	ND	ND	8.8	8.0
1,1-Dichloroethane	ND	ND	ND	8.0
Chloroform	1.4	1.2	1.2	1.0
1,1,1-Trichloroethane	ND	ND	ND	8.0
Carbon Tetrachloride	ND	ND	ND	8.0
1,2-Dichloroethane	ND	ND	ND	8.0
Trichloroethylene	ND	ND	ND	8.0
1,2-Dichloropropane	ND	ND	ND	8.0
Dichlorobromomethane	ND	ND	ND	8.0
Trans-1,3-Dichloropropene	ND	ND	ND	8.0
Cis-1,3-Dichloropropene	ND	ND	ND	8.0
1,1,2-Trichloroethane	ND	ND	ND	8.0
Tetrachloroethylene	ND	ND	ND	8.0
Dibromochloromethane	ND	ND	ND	8.0
Bromoform	ND	ND	ND	8.0
1,1,2,2-Tetrachloroethane	ND	ND	ND	8.0

ND = Not Detected.
Chloroethane & Dichlorodifluoromethane coelute.
Methylene Chloride & Chloroform are reported in ug/l; all other results are reported in ug/kg.
Methylene Chloride & Chloroform are found in the Blank; therefore, laboratory contamination is suspected.

CLIENT: Rittenhouse - Zeman & Associates
DATE RECEIVED: 11/3/88
DATE REPORTED: 11/17/88
REPORT TO: Dan Whitman
JOB NO.: A 1204-8

GC ANALYSIS OF PURGEABLE HALOCARBONS BY EPA METHOD 8010

Laboratory Sample Nos.	822296	822297	822297 Duplicate	DETECTION LIMIT
Client Identification	TP4, S-1	TP5, S-1	TP5, S-1	(ug/kg)
Chloromethane	ND	ND	ND	15.
Vinyl Chloride	ND	ND	ND	15.
Bromomethane	ND	ND	ND	15.
Chloroethane + Dichlorodifluoromethane	ND	ND	ND	15.
Trichlorofluoromethane	ND	ND	ND	15.
1,1-Dichloroethylene	ND	ND	ND	15.
Methylene Chloride	7.0	5.0	6.0	3.0
Trans-1,2-Dichloroethylene	11.	ND	ND	8.0
1,1-Dichloroethane	ND	ND	ND	8.0
Chloroform	ND	1.3	3.0	1.0
1,1,1-Trichloroethane	ND	ND	ND	8.0
Carbon Tetrachloride	ND	ND	ND	8.0
1,2-Dichloroethane	11.	ND	ND	8.0
Trichloroethylene	10.	ND	ND	8.0
1,2-Dichloropropane	ND	ND	ND	8.0
Dichlorobromomethane	ND	ND	ND	8.0
Trans-1,3-Dichloropropene	ND	ND	ND	8.0
Cis-1,3-Dichloropropene	ND	ND	ND	8.0
1,1,2-Trichloroethane	ND	ND	ND	8.0
Tetrachloroethylene	ND	ND	ND	8.0
Dibromochloromethane	ND	ND	ND	8.0
Bromoform	ND	ND	ND	8.0
1,1,2,2-Tetrachloroethane	ND	ND	ND	8.0

ND = Not Detected.
Chloroethane & Dichlorodifluoromethane coelute.
Methylene Chloride & Chloroform are reported in ug/l; all other results are reported in ug/kg.
Methylene Chloride & Chloroform are found in the Blank; therefore, laboratory contamination is suspected.

CLIENT: Rittenhouse - Zeman & Associates

REPORT TO: Dan Whitman

DATE RECEIVED: 11/3/88

DATE REPORTED: 11/17/88

JOB NO.: A 1204-8

Laboratory Sample Nos.	Client Identification	Total Petroleum Hydrocarbons (ug/g) ppm
822291	TP1, S-1	5,170.
822292	TP2, S-1	69.1
822293	TP2, S-2	410.
822294	TP3, S-1	80.8
822295	TP3, S-2	-
822296	TP4, S-1	62.3
822297	TP5, S-1	6.8

REPORTED BY _____
Kenneth Pang

KP/pb

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

0079

ANALYSIS REPORT

CLIENT: Rittenhouse - Zeman & Associates

REPORT TO: Carl Anderson
1400 - 140th NE
Bellevue, WA 98005

DATE RECEIVED: 11/23/88
DATE ANALYZED: 12/1/88
DATE REPORTED: 12/5/88
PROJECT NO.: A1204.8

BTEX BY EPA METHOD 8020

Lab Sample Nos.	Client I.D.	Benzene (ug/kg)	Toluene (ug/kg)	m+p- Xylene (ug/kg)	o- Xylene (ug/kg)	Ethyl Benzene (ug/kg)
823821	B-12, S-3	ND	ND	ND	ND	ND
823822	B-13, S-3	ND	ND	ND	ND	ND
DETECTION LIMIT		7.	7.	14.	7.	7.

ND = Not Detected.

Sample container has large head-space.

CLIENT: Rittenhouse - Zeman & Associates

REPORT TO: Carl Anderson

DATE RECEIVED: 11/23/88
DATE ANALYZED: 12/1/88
DATE REPORTED: 12/5/88
PROJECT NO.: A1204.8

Laboratory Sample Nos.	823821	823822
Client Identification	B-12, S-3	B-13,S-3
Total Petroleum Hydrocarbons (ug/g)	<5.	26.4

REPORTED BY _____
Kenneth Pang

KP/pb

Laboratory Analytical Reports
Groundwater Samples

NORTHERN TESTING LABORATORIES, INC.

600 UNIVERSITY PLAZA WEST, SUITE A — FAIRBANKS, ALASKA 99709 — 907-479-3115
2505 FAIRBANKS STREET — ANCHORAGE, ALASKA 99503 — 907-277-8378

Rittenhouse-Zeman & Associates
1400-140th Avenue, N.E.
Bellevue, Washington 98005

Attn: Dan Whitman

Source: See Below
Sample ID#: A111888-5 Through 14

Date Arrived: 11/18/88
Time Arrived: 1530
Date Sampled: 11/18/88
Time Sampled: Various
Date Completed: 12/14/88
UNOCAL Service Station 4652
15th and C St.

NTL ID #	Client ID #	Total Petroleum Hydrocarbons mg/l
A111888-5	B-3	1.3
A111888-6	B-4	<0.4
A111888-7	B-5	<0.4/<0.4
A111888-8	B-6	6.9
A111888-9	B-7	8.0
A111888-10	B-8	0.6
A111888-11	B-9	1.7
A111888-12	B-12	0.5
A111888-13	B-13	<0.4
A111888-14	B-14*	1.5/1.6

NOTE: B-14 is a laboratory-blind duplicate sample from B-9 analyzed for QA/QC purposes

Reported By: _____ Date: 12/14/88

Francois Rodigari, Anchorage Operations Manager

NORTHERN TESTING LABORATORIES, INC.

600 UNIVERSITY PLAZA WEST, SUITE A, FAIRBANKS, ALASKA 99709, 907-479-3115
2505 FAIRBANKS STREET, ANCHORAGE, ALASKA 99503, 907-277-8378

Rittenhouse-Zeman & Associates
1400-140th Avenue, N.E.
Bellevue, Washington 98005

Attn: Dan Whitman

Source: See Below
Sample ID#: A111888-5,6,7

Date Arrived: 11/18/88
Time Arrived: 1530
Date Sampled: 11/18/88
Time Sampled: Various
Date Completed: 12/14/88

UNOCAL Service Station 4652
15th and C St.

Parameter	Units	A111888-5 B-3	A111888-6 B-4	A111888-7 B-5	Standard Detection Limit
Purgeable Aromatics: EPA Method 602					
Benzene	ug/l	1100	0.3	<DL	0.2
Chlorobenzene	ug/l	<DL	<DL	<DL	0.2
1,2-Dichlorobenzene	ug/l	<DL	<DL	<DL	0.2
1,3-Dichlorobenzene	ug/l	<DL	<DL	<DL	0.2
1,4-Dichlorobenzene	ug/l	<DL	<DL	<DL	0.2
Ethylbenzene	ug/l	400	1.3	0.3	0.2
Toluene	ug/l	7.5	1.1	0.3	0.2
Xylenes	ug/l	2400	1.4	1.5	0.6

Reported By: [signature] Date: 12/14/88

Results apply only to Anchorage operations. Service

NORTHERN TESTING LABORATORIES, INC.

600 UNIVERSITY PLAZA WEST, SUITE A, FAIRBANKS, ALASKA 99709, 907-479-3115
2505 FAIRBANKS STREET, ANCHORAGE, ALASKA 99503, 907-277-8378

0084

Rittenhouse-Zeman & Associates
1400-140th Avenue, N.E.
Bellevue, Washington 98005

Attn: Dan Whitman

Source: See Below
Sample ID#: A111800-8,9,10

Date Arrived: 11/19/88
Time Arrived: 1550
Date Sampled: 11/18/88
Time Sampled: Various
Date Completed: 12/02/88

UNOCAL Service Station 4652
15th and C St.

Parameter	Units	A111800-8	A111800-9	A111800-10	Standard Detection Limit
		2-6	6-7	8-9	
Purgeable Aromatics: EPA Method 602					
Benzene	ug/l	14000	7000	97	0.2
Chlorobenzene	ug/l	<100	<400	2.1	0.2
1,2-Dichlorobenzene	ug/l	<100	<400	1.1	0.2
1,3-Dichlorobenzene	ug/l	<100	<400	2.1	0.2
1,4-Dichlorobenzene	ug/l	<100	<400	1.1	0.2
Ethylbenzene	ug/l	2000	2700	27	0.2
Toluene	ug/l	24000	12000	4.7	0.2
Xylenes	ug/l	14000	14000	171	0.6

Reported By: [signature] Date: 12/2/88

Francois Gelinas, Laboratory Operations Manager

NORTHERN TESTING LABORATORIES, INC.

600 UNIVERSITY PLAZA WEST, SUITE A, FAIRBANKS, ALASKA 99709, 907-479-3115
2505 FAIRBANKS STREET, ANCHORAGE, ALASKA 99503, 907-277-8378

0085

Rittenhouse-Zeman & Associates
1400-140th Avenue, N.E.
Bellevue, Washington 98005

Attn: Dan Whitman

Source: See Below
Sample ID#: A111888-11,12,13

Date Arrived: 11/10/88
Time Arrived: 1530
Date Sampled: 11/10/88
Time Sampled: Various
Date Completed: 12/02/88

UNOCAL Service Station 4652
15th and C St.

Parameter	Units	A111888-11 B-9	A111888-12 B-12	A111888-13 B-13	Standard Detection Limit
Purgeable Aromatics: EPA Method 602					
Benzene	ug/l	1400	1.9	0.3	0.2
Chlorobenzene	ug/l	20	<DL	<DL	0.2
1,2-Dichlorobenzene	ug/l	20	<DL	<DL	0.2
1,3-Dichlorobenzene	ug/l	20	<DL	<DL	0.2
1,4-Dichlorobenzene	ug/l	20	<DL	<DL	0.2
Ethylbenzene	ug/l	320	1.3	1.7	0.2
Toluene	ug/l	42	1.1	0.7	0.2
Xylenes	ug/l	1700	12	4.9	0.6

Reviewed By: _____ Date: 12/2/88

Project Manager - Northern Testing Laboratories

NORTHERN TESTING LABORATORIES, INC.

600 UNIVERSITY PLAZA WEST, SUITE A — FAIRBANKS, ALASKA 99709 — 907-479-3115
2505 FAIRBANKS STREET — ANCHORAGE, ALASKA 99503 — 907-277-8378

Rittenhouse-Zeman & Associates
1400-140th Avenue, N.E.
Bellevue, Washington 98005

Attn: Dan Whitman

Source: See Below
Sample ID#: A111888-14,15

Date Arrived: 11/18/88
Time Arrived: 1530
Date Sampled: 11/18/88
Time Sampled: Various
Date Completed: 12/02/88

UNOCAL Service Station 4652
15th and C St.

Parameter	Units	A111888-14 B-14*	A111888-15 Travel Blank	Standard Detection Limit
Purgeable Aromatics: EPA Method 602				
Benzene	ug/l	[illegible]200	[illegible]	0.2
Chlorobenzene	ug/l	<1.0	<DL	0.2
1,2-Dichlorobenzene	ug/l	<1.0	DL	0.2
1,3-Dichlorobenzene	ug/l	<1.0	DL	0.2
1,4-Dichlorobenzene	ug/l	<1.0	DL	0.2
Ethylbenzene	ug/l	[illegible]	<DL	0.2
Toluene	ug/l	200	1.7	0.2
Xylenes	ug/l	1000	0.9	0.6

*NOTE: B-14 is a laboratory-blind duplicate sample from B-9 analyzed for QA/QC purposes

Reported By: [signature] Date: 12/14/88

[illegible] Anchorage Operations Manager

NORTHERN TESTING LABORATORIES, INC.

600 UNIVERSITY PLAZA WEST, SUITE A — FAIRBANKS, ALASKA 99709 — 907-479-3115
2505 FAIRBANKS STREET — ANCHORAGE, ALASKA 99503 — 907-277-8378

Rittenhouse-Zeman & Associates
1400-140th Avenue, N.E.
Bellevue, Washington 98005

Attn: Dan Whitman

Source: See Below
Sample ID#: A111888-5,6,7

Date Arrived: 11/18/88
Time Arrived: 1530
Date Sampled: 11/18/88
Time Sampled: Various
Date Completed: 12/02/88

UNOCAL Service Station 4652
15th and C St.

Parameter	Unit	A111888-5 B-3	A111888-10 B-8	A111888-15 Trvl Blnk	Standard Detection Limits
Purgeable Halocarbons - EPA Method 601:					
Bromodichloromethane	ug/l	<DL	<DL	<DL	0.3
Bromoform	ug/l	<DL	<DL	<DL	1.0
Bromomethane	ug/l	<DL	<DL	<DL	2.0
Carbon tetrachloride	ug/l	<DL	<DL	<DL	0.2
Chlorobenzene	ug/l	<DL	<DL	<DL	0.2
Chloroethane	ug/l	12	3.0	<DL	2.0
2-Chloroethylvinyl ether	ug/l	<DL	<DL	<DL	2.0
Chloroform	ug/l	<DL	<DL	[illegible]	0.2
Chloromethane	ug/l	<DL	<DL	<DL	2.0
Dibromochloromethane	ug/l	<DL	<DL	<DL	0.5
1,2-Dichlorobenzene	ug/l	<DL	<DL	<DL	0.2
1,3-Dichlorobenzene	ug/l	<DL	<DL	<DL	0.2
1,4-Dichlorobenzene	ug/l	<DL	<DL	<DL	0.2
1,1-Dichloroethane	ug/l	<DL	<DL	<DL	0.2
1,2-Dichloroethane	ug/l	3.2	10	<DL	0.2
1,1-Dichloroethene	ug/l	<DL	<DL	<DL	1.0
trans-1,2-Dichloroethene	ug/l	<DL	<DL	<DL	1.0
1,2-Dichloropropane	ug/l	<DL	<DL	<DL	0.5
cis-1,3-Dichloropropene	ug/l	<DL	<DL	<DL	0.2
trans-1,3-Dichloropropene	ug/l	<DL	<DL	<DL	0.2
Methylene chloride	ug/l	<DL	<DL	<DL	2.0
1,1,2,2-Tetrachloroethane	ug/l	<DL	<DL	<DL	0.4
Tetrachloroethene	ug/l	<DL	<DL	<DL	0.2
1,1,1-Trichloroethane	ug/l	<DL	<DL	<DL	0.4
1,1,2-Trichloroethane	ug/l	<DL	<DL	<DL	0.4
Trichloroethene	ug/l	<DL	<DL	<DL	0.2
Trichlorofluoromethane	ug/l	<DL	<DL	<DL	2.0
Vinyl chloride	ug/l	<DL	<DL	<DL	2.0

Reviewed By: [signature] Date: [illegible]

[illegible]

Anchorage Operations Manager

NORTHERN TESTING LABORATORIES, INC.

600 UNIVERSITY PLAZA WEST, SUITE A, FAIRBANKS, ALASKA 99709, 907-479-3115
2505 FAIRBANKS STREET, ANCHORAGE, ALASKA 99503, 907-277-8378

00088

UNOCAL Service Station 4652
15th and C St.

Quality Control Report

Client: RZA
ID#: A111888-5 Through 15

Listed below are quality control assurance reference samples with a known concentration prior to analysis. The acceptable limits represent a 95% confidence interval established by the Environmental Protection Agency or by our laboratory through repetitive analyses of the reference sample. The reference samples indicated below were analyzed at the same time as your sample, ensuring the accuracy of your results.

Standard ID#	Parameter	Unit	QC Result	Acceptable Range
EPA WP483-3	Chloroform	ug/l	13.1	8.4 - 18.7
	Bromodichloromethane	ug/l	2.1	0.3 - 2.9
	Dibromochloromethane	ug/l	2.7	0.5 - 11.8
	Bromoform	ug/l	5.5	1.0 - 7.2
	1,2-Dichloroethane	ug/l	1.8	0.2 - 4.7
EPA 379-3	Oil & Grease	mg/l	20.1	13.2 - 26.5

Reported By: Date: 12/14/88

Francois Rodigari, Anchorage Operations Manager

Tabulated Groundwater Analytical Results

GROUNDWATER SAMPLING RESULTS

Job Name: UNOCAL STA. NO. 4652 Job Number: A-1204-8
Address: 15TH & C ST. Monitoring Well B-1
ANCHORAGE, ALASKA

DATE	SEP 86	MAR 87	OCT 87	JAN 88
CONTAMINANT				
BENZENE (ppb)	NOT SAMPLED	7,390.00	22,600.00	WELL DESTROYED DURING TANK REMOVAL
TOLUENE (ppb)		3,190.00	1,100.00	
ETHYLBENZENE (ppb)		54.00	45.50	
CHLOROBENZENE (ppb)		ND(1)	ND(1)	
XYLENES (ppb)				
p & m		764.00	223.00	
o		372.00	179.00	
DICHLOROBENZENE (ppb)				
1,4		ND(1)	ND(1)	
1,3		ND(1)	ND(1)	
1,2		ND(1)	ND(1)	
OIL & GREASE (mg/l)		0.84	--	
TOTAL PETROLEUM HYDROCARBONS (mg/l)		0.30	3.52	

GROUNDWATER SAMPLING RESULTS

Job Name: UNOCAL STA. NO. 4652 Job Number: A-1204-8
Address: 15TH & C ST. Monitoring Well B-2
ANCHORAGE, ALASKA

DATE	SEP 86	MAR 87	OCT 87	JAN 88
CONTAMINANT				
BENZENE (ppb)	1.44 FT OF FREE-PHASE PRODUCT ON WATER SURFACE	8,280.00	18,100.00	WELL DESTROYED DURING TANK REMOVAL
TOLUENE (ppb)		21,100.00	29,900.00	
ETHYLBENZENE (ppb)		4,260.00	3,280.00	
CHLOROBENZENE (ppb)		ND(1)	ND(1)	
XYLENES (ppb)				
p & m		9,120.00	7,290.00	
o		4,360.00	5,580.00	
DICHLOROBENZENE (ppb)				
1,4		ND(1)	ND(1)	
1,3		ND(1)	ND(1)	
1,2		ND(1)	ND(1)	
OIL & GREASE (mg/l)		13.00	--	
TOTAL PETROLEUM HYDROCARBONS (mg/l)		6.80	7.69	

GROUNDWATER SAMPLING RESULTS

Job Name: UNOCAL STA. NO. 4652 Job Number: A-1204-8
Address: 15TH & C ST. Monitoring Well B-3
ANCHORAGE, ALASKA

DATE	SEP 86	MAR 87	OCT 87	JAN 88	MAY 88	JUL 88	
CONTAMINANT							
BENZENE (ppb)	ND(1)	694.00	230.00	653.00	2.00	560.00	1,100.00
TOLUENE (ppb)	ND(1)	12.00	28.00	7.00	ND(0.2)	ND(1)	7.50
ETHYLBENZENE (ppb)	ND(1)	68.00	17.50	60.00	ND(0.2)	9.80	400.00
CHLOROBENZENE (ppb)	ND(1)	ND(1)	ND(1)	ND(1)	ND(0.2)	ND(1)	ND(0.2)
XYLENES, TOTAL (ppb)	ND(1)				1.90		2,400.00
p & m		172.00	172.00	130.00			
o		103.00	103.00	85.00			
DICHLOROBENZENE (ppb)							
1,4	ND(1)	ND(1)	ND(1)	ND(1)	ND(0.2)	ND(1)	ND(0.2)
1,3	ND(1)	ND(1)	ND(1)	ND(1)	ND(0.2)	ND(1)	ND(0.2)
1,2	ND(1)	ND(1)	ND(1)	ND(1)	ND(0.2)	ND(1)	ND(0.2)
OIL & GREASE (mg/l)	--	1.70	--	0.31	7.70	--	--
TOTAL PETROLEUM HYDROCARBONS (mg/l)	--	0.70	0.26	0.12	0.24	1.10	1.30

2900

GROUNDWATER SAMPLING RESULTS

Job Name: UNOCAL STA. NO. 4652 Job Number: A-1204-8
Address: 15TH & C ST. Monitoring Well B-4
ANCHORAGE, ALASKA

DATE	SEP 86	MAR 87	OCT 87	JAN 88	MAY 88	JUL 88	NOV 88
CONTAMINANT							
BENZENE (ppb)	NOT	NOT	ND(1)	ND(1)	ND(0.2)	0.20	0.20
TOLUENE (ppb)	SAMPLED	SAMPLED	ND(1)	3.30	ND(0.2)	ND(0.2)	0.50
ETHYLBENZENE (ppb)			ND(1)	ND(1)	ND(0.2)	ND(0.2)	0.30
CHLOROBENZENE (ppb)			ND(1)	ND(1)	ND(0.2)	ND(0.2)	ND(0.2)
XYLENES, TOTAL (ppb)					ND(0.2)	ND(0.2)	1.40
p & m			ND(1)	ND(1)			
o			ND(1)	ND(1)			
DICHLOROBENZENE (ppb)							
1,4			ND(1)	ND(1)	ND(0.2)	ND(0.2)	ND(0.2)
1,3			ND(1)	ND(1)	ND(0.2)	ND(0.2)	ND(0.2)
1,2			ND(1)	ND(1)	ND(0.2)	ND(0.2)	ND(0.2)
OIL & GREASE (mg/l)			--	0.17	7.40	--	--
TOTAL PETROLEUM HYDROCARBONS (mg/l)			0.15	0.15	0.80	ND(0.5)	ND(0.4)

GROUNDWATER SAMPLING RESULTS

Job Name: UNOCAL STA. NO. 4652 Job Number: A-1204-8
Address: 15TH & C ST Monitoring Well B-5
ANCHORAGE, ALASKA

DATE	SEPT 86	MAR 87	OCT 87	JAN 88	MAY 88	JUL 88	NOV 88
CONTAMINANT							
BENZENE (ppb)	NOT	3.30	ND(1)	ND(1)	ND(0.2)	ND(0.2)	ND(0.2)
TOLENE (ppb)	SAMPLED	7.40	ND(1)	13,000.00	ND(0.2)	0.40	0.80
ETHYLBENZENE (ppb)		4.70	ND(1)	25.00	ND(0.2)	ND(0.2)	0.30
CHLOROBENZENE (ppb)		ND(1)	ND(1)	ND(1)	ND(0.2)	ND(0.2)	ND(0.2)
XYLENES, TOTAL (ppb)					ND(0.2)	ND(0.2)	1.50
p & m		11.00	ND(1)	40.00			
o		4.40	ND(1)	14.00			
DICHLOROBENZENE (ppb)							
1,4		ND(1)	ND(1)	ND(1)	ND(0.2)	ND(0.2)	ND(0.2)
1,3		ND(1)	ND(1)	ND(1)	ND(0.2)	ND(0.2)	ND(0.2)
1,2		ND(1)	ND(1)	ND(1)	ND(0.2)	ND(0.2)	ND(0.2)
OIL & GREASE (mg/l)		0.19	--	2.70	5.80	--	--
TOTAL PETROLEUM HYDROCARBONS (mg/l)		0.60	0.16	0.60	1.30	ND(0.5)	ND(0.4)

GROUNDWATER SAMPLING RESULTS

Job Name: UNOCAL STA. NO. 4652 Job Number: A-1204-8
Address: 15TH & C ST. Monitoring Well B-6
ANCHORAGE, ALASKA

DATE	SEP 86	MAR 87	OCT 87	JAN 88	MAY 88	JUL 88	NOV 88
CONTAMINANT							
BENZENE (ppb)	14,000.00	14,300.00	18,700.00	23,900.00	1,400.00	15,000.00	16,000.00
TOLUENE (ppb)	17,000.00	19,000.00	31,200.00	28,400.00	3,600.00	27,000.00	24,000.00
ETHYLBENZENE (ppb)	2,100.00	2,390.00	2,710.00	1,850.00	590.00	1,400.00	2,800.00
CHLOROBENZENE (ppb)	ND(1)	ND(1)	ND(1)	ND(1)	ND(200)	ND(100)	ND(100)
XYLENES, TOTAL (ppb)	14,000.00	[illegible]	[illegible]	[illegible]	5,800.00	13,000.00	16,000.00
p & m		10,100.00	13,700.00	13,300.00			
o		4,400.00	5,040.00	4,600.00			
DICHLOROBENZENE (ppb)							
1,4	ND(1)	ND(1)	ND(1)	ND(1)	ND(200)	ND(100)	ND(100)
1,3	ND(1)	ND(1)	ND(1)	ND(1)	ND(200)	ND(100)	ND(100)
1,2	ND(1)	ND(1)	ND(1)	ND(1)	ND(200)	ND(100)	ND(100)
OIL & GREASE (mg/l)	--	24.00	--	9.40	7.60	--	--
TOTAL PETROLEUM HYDROCARBONS (mg/l)	--	12.00	11.30	6.60	6.80	10.10	6.90

GROUNDWATER SAMPLING RESULTS

Job Name: UNOCAL STA. NO. 4652 Job Number: A-1204-8
Address: 15TH & C ST. Monitoring Well B-7
ANCHORAGE, ALASKA

DATE	SEPT 86	MAR 87	OCT 87	JAN 88	MAY 88	JUL 88	NOV 88
CONTAMINANT							
BENZENE (ppb)	2,400.00	6,030.00	8,400.00	8,200.00	6,300.00	6,400.00	7,800.00
TOLUENE (ppb)	4,900.00	12,300.00	19,800.00	3,900.00	17,000.00	15,000.00	12,000.00
ETHYLBENZENE (ppb)	390.00	2,660.00	2,070.00	2,400.00	1,100.00	1,500.00	2,700.00
CHLOROBENZENE (ppb)	ND(1)	ND(1)	ND(1)	ND(1)	ND(200)	ND(200)	ND(400)
XYLENES, TOTAL (ppb)		13,100.	18,000	17,500	9,900.00	11,000.00	14,000.00
p & m	5,600.00	9,440.00	12,700.00	12,400.00			
o		4,460.00	5,300.00	5,100.00			
DICHLOROBENZENE (ppb)							
1,4	ND(1)	ND(1)	ND(1)	ND(1)	ND(200)	ND(200)	ND(200)
1,3	ND(1)	ND(1)	ND(1)	ND(1)	ND(200)	ND(200)	ND(200)
1,2	ND(1)	ND(1)	ND(1)	ND(1)	ND(200)	ND(200)	ND(200)
	--						
OIL & GREASE (mg/l)	--	27.00		7.10	7.50	--	--
TOTAL PETROLEUM HYDROCARBONS (mg/l)		18.00	9.28	3.20	7.30	10.60	8.00

9600

GROUNDWATER SAMPLING RESULTS

Job Name: UNOCAL STA. NO. 4652 Job Number: A-1204-8
Address: 15TH & C ST. Monitoring Well B-8
ANCHORAGE, ALASKA

DATE	SEP 86	MAR 87	OCT 87	JAN 88	MAY 88	JUL 88	NOV 88
CONTAMINANT							
BENZENE (ppb)	200.00	1,340.00	116.00	278.00	ND(0.2)	0.20	97.00
TOLUENE (ppb)	31.00	875.00	608.00	39.40	ND(0.2)	ND(0.2)	4.70
ETHYLBENZENE (ppb)	ND(1)	1,040.00	17.70	46.00	ND(0.2)	ND(0.2)	65.00
CHLOROBENZENE (ppb)	ND(1)	ND(1)	ND(1)	ND(1)	ND(0.2)	ND(0.2)	ND(0.2)
XYLENES, TOTAL (ppb)	790.00	4,440	55.70	304	0.60	ND(0.2)	270.00
p & m		3,200.00	40.20	238.00			
o		1,440.00	15.50	66.00			
DICHLOROBENZENE (ppb)							
1,4	ND(1)	ND(1)	ND(1)	ND(1)	ND(0.2)	ND(0.2)	ND(0.2)
1,3	ND(1)	ND(1)	ND(1)	ND(1)	ND(0.2)	ND(0.2)	ND(0.2)
1,2	ND(1)	ND(1)	ND(1)	ND(1)	ND(0.2)	ND(0.2)	ND(0.2)
OIL & GREASE (mg/l)	--	6.60	--	4.50	6.80	--	--
TOTAL PETROLEUM HYRDOCARBONS (mg/l)	--	3.40	0.26	0.57	1.50	0.80	0.60

2600

GROUNDWATER SAMPLING RESULTS

Job Name: UNOCAL STA. NO. 4652 Job Number: A-1204-8
Address: 15TH & C ST. MONITORING WELL B-9
ANCHORAGE, ALASKA

DATE	SEP 86	MAR 87	OCT 87	JAN 88	MAY 88	JUL 88	NOV 88
CONTAMINANT							
BENZENE (ppb)	3,300.00	4,710.00	5,430.00	4,800.00	5,300.00	6,700.00	4,400.00
TOLUENE (ppb)	34.00	71.00	607.00	58.30	62.00	850.00	42.00
ETHYLBENZENE (ppb)	150.00	73.00	98.50	492.00	ND(40)	220.00	520.00
CHLOROBENZENE (ppb)	ND(1)	ND(1)	ND(1)	ND(1)	ND(40)	ND(100)	ND(20)
XYLENES, TOTAL (ppb)	560.00	3896	3189	1894	960.00	2,600.00	1,300.00
p & m		2,390.00	2,520.00	1,560.00			
o		506.00	669.00	334.00			
DICHLOROBENZENE (ppb)							
1,4	ND(1)	ND(1)	ND(1)	ND(1)	ND(40)	ND(100)	ND(20)
1,3	ND(1)	ND(1)	ND(1)	ND(1)	ND(40)	ND(100)	ND(20)
1,2	ND(1)	ND(1)	ND(1)	ND(1)	ND(40)	ND(100)	ND(20)
OIL & GREASE (mg/l)	--	5.10	--	0.96	6.90	--	--
TOTAL PETROLEUM HYDROCARBONS (mg/l)	--	3.10	2.24	0.44	4.90	2.70	1.70

8600 0098

GROUNDWATER SAMPLING RESULTS

Job Name: UNOCAL STA. NO. 4652 Job Number: A-1204-8
Address: 15TH & C ST. Monitoring Well B-10
ANCHORAGE, ALASKA

DATE	SEP 86	MAR 87	OCT 87	JAN 88	MAY 88	JUL 88	NOV 88
CONTAMINANT							
BENZENE (ppb)	DRY	DRY	DRY	DRY	ND(0.4)	DRY	DRY
TOLUENE (ppb)	WELL	WELL	WELL	WELL	ND(0.4)	WELL	WELL
ETHYLBENZENE (ppb)					ND(0.4)		
CHLOROBENZENE (ppb)					ND(0.4)		
XYLENES, TOTAL (ppb)					ND(1.2)		
p & m							
o							
DICHLOROBENZENE (ppb)							
1,4					ND(0.4)		
1,3					ND(0.4)		
1,2					ND(0.4)		
OIL & GREASE (mg/l)					--		
TOTAL PETROLEUM HYDROCARBONS (mg/l)					--		

GROUNDWATER SAMPLING RESULTS

Job Name: UNOCAL STA. NO. 4652 Job Number: A-1204-8
Address: 15TH & C ST. Monitoring Well B-11
ANCHORAGE, ALASKA

DATE	SEP 86	MAR 87	OCT 87	JAN 88
CONTAMINANT				
BENZENE (ppb)	33,000.00	1.56 ft OF FREE-PHASE PRODUCT ON WATER SURFACE	0.01 ft OF FREE-PHASE PRODUCT ON WATER SURFACE	WELL APPARENTLY DESTROYED
TOLUENE (ppb)	25,000.00			
ETHYLBENZENE (ppb)	3,900.00			
CHLOROBENZENE (ppb)	ND(1)			
XYLENES, TOTAL (ppb)				
p & m	20,000.00			
o				
DICHLOROBENZENE (ppb)				
1,4	ND(1)			
1,3	ND(1)			
1,2	ND(1)			
OIL & GREASE (mg/l)	--			
TOTAL PETROLEUM HYDROCARBONS (mg/l)	--			

0100

GROUNDWATER SAMPLING RESULTS

Job Name: UNOCAL STA. NO. 4652 Job Number: A-1204-8
Address: 15TH & C ST. Monitoring Well B-12
ANCHORAGE, ALASKA

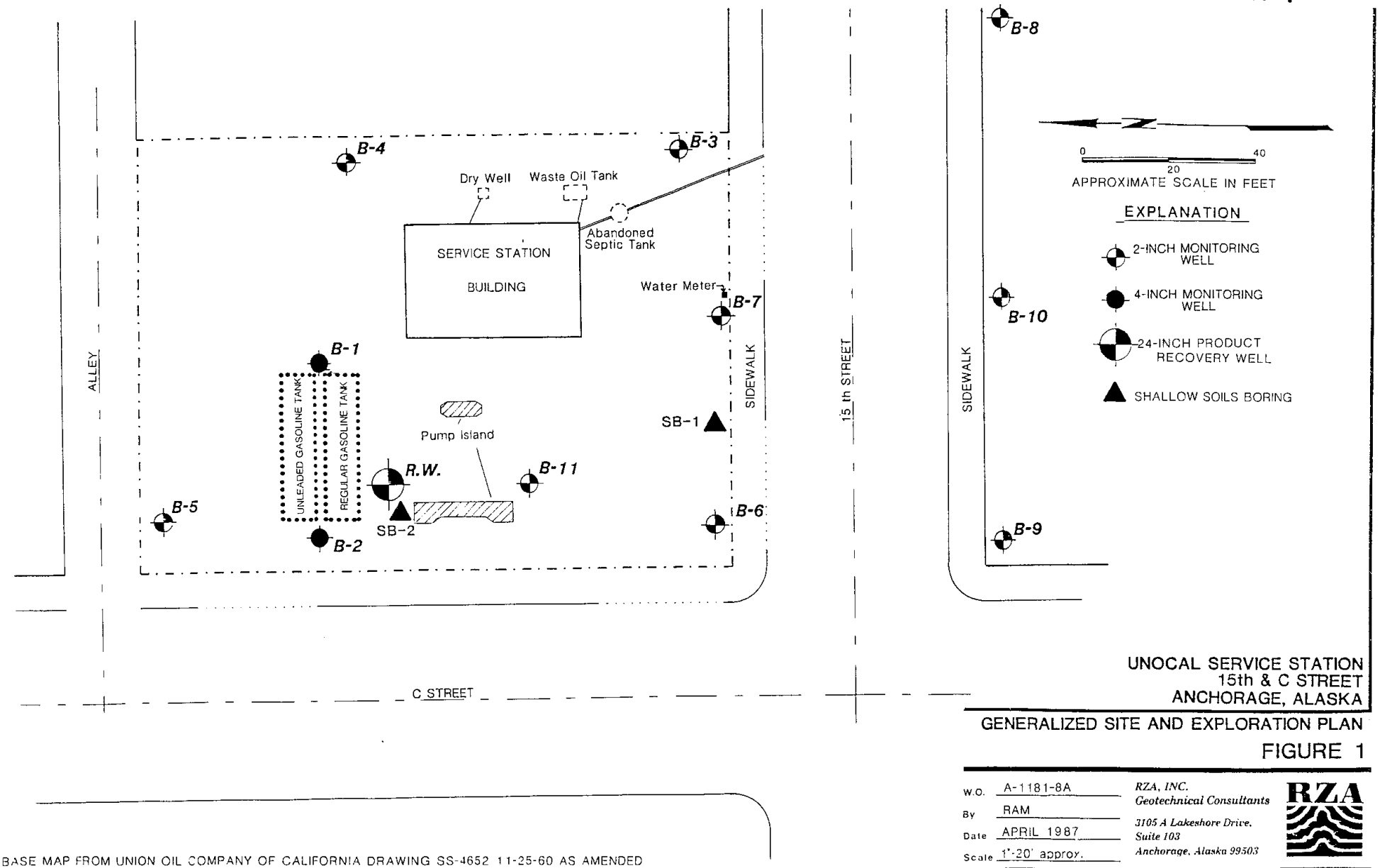
DATE	NOV 88
CONTAMINANT	
BENZENE (ppb)	1.90
TOLUENE (ppb)	6.10
ETHYLBENZENE (ppb)	2.30
CHLOROBENZENE (ppb)	ND(0.2)
XYLENES, TOTAL (ppb)	12.00
p & m	
o	
DICHLOROBENZENE (ppb)	
1,4	ND(0.2)
1,3	ND(0.2)
1,2	ND(0.2)
OIL & GREASE (mg/l)	--
TOTAL PETROLEUM HYDROCARBONS (mg/l)	0.50

GROUNDWATER SAMPLING RESULTS

Job Name: UNOCAL STA. NO. 4652 Job Number: A-1204-8
Address: 15TH & C ST. Monitoring Well B-13
ANCHORAGE, ALASKA

DATE	NOV 88
CONTAMINANT	
BENZENE (ppb)	0.30
TOLUENE (ppb)	0.90
ETHYLBENZENE (ppb)	1.30
CHLOROBENZENE (ppb)	ND(0.2)
XYLENES, TOTAL (ppb)	4.90
p & m	
o	
DICHLOROBENZENE (ppb)	
1,4	ND(0.2)
1,3	ND(0.2)
1,2	ND(0.2)
OIL & GREASE (mg/l)	--
TOTAL PETROLEUM HYDROCARBONS (mg/l)	ND(0.4)

Appendix D
Data From Previous Studies



UNOCAL SERVICE STATION
15th & C STREET
ANCHORAGE, ALASKA

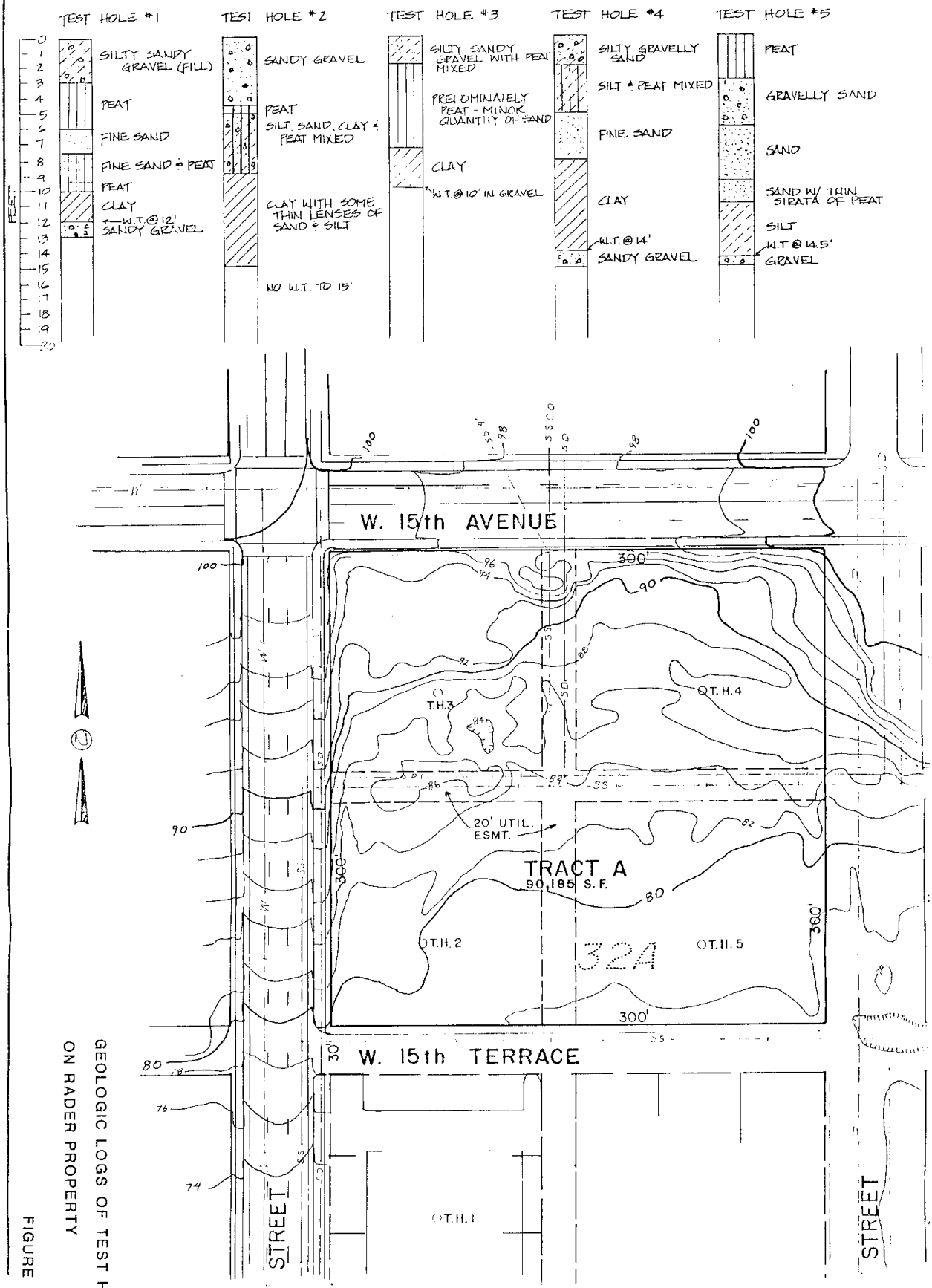
GENERALIZED SITE AND EXPLORATION PLAN

FIGURE 1

W.O. A-1181-8A
By RAM
Date APRIL 1987
Scale 1"=20' approx.

RZA, INC.
Geotechnical Consultants
3105 A Lakeshore Drive,
Suite 103
Anchorage, Alaska 99503

BASE MAP FROM UNION OIL COMPANY OF CALIFORNIA DRAWING SS-4652 11-25-60 AS AMENDED



GEOLOGIC LOGS OF TEST HOLES ON RADER PROPERTY

FIGURE D-2

TABLE D-1

Monitoring Well Completion Data

Monitoring Well	Date Drilled	Elevation in Feet[1] Top of Monitoring Well Casing	Elevation in Feet[1] Approximate Ground Surface	Approximate Depth in Feet Below Ground Surface: Top of Screen	Approximate Depth in Feet Below Ground Surface: Bottom of Screen	Screen Size
B-1[2]	NA	98.05	98.59	1.0	9.7	Saw-Cut
B-2[2]	NA	98.72	99.33	1.	10.5	Saw-Cut
B-3	7/31	95.05	95.30	3.8	13.6	10 slot
B-4	8/1	97.15	97.27	3.6	13.4	10 slot
B-5	8/1	100.36	100.66	5.6	10.4	10 slot
B-6	8/2	96.54	96.84	3.0	12.8	3)
B-7	8/2	95.38	95.48	3.0	12.8	3)
B-8	9/3	91.78	92.07	1.8	11.6	10 slot
B-9	9/4	94.98	95.41	4.4	14.2	10 slot
B-10	9/4	91.79	92.20	1.6	6.5	10 slot
B-11	9/4	98.02	98.49	5.0	19.6	10 slot

NA = Not Available

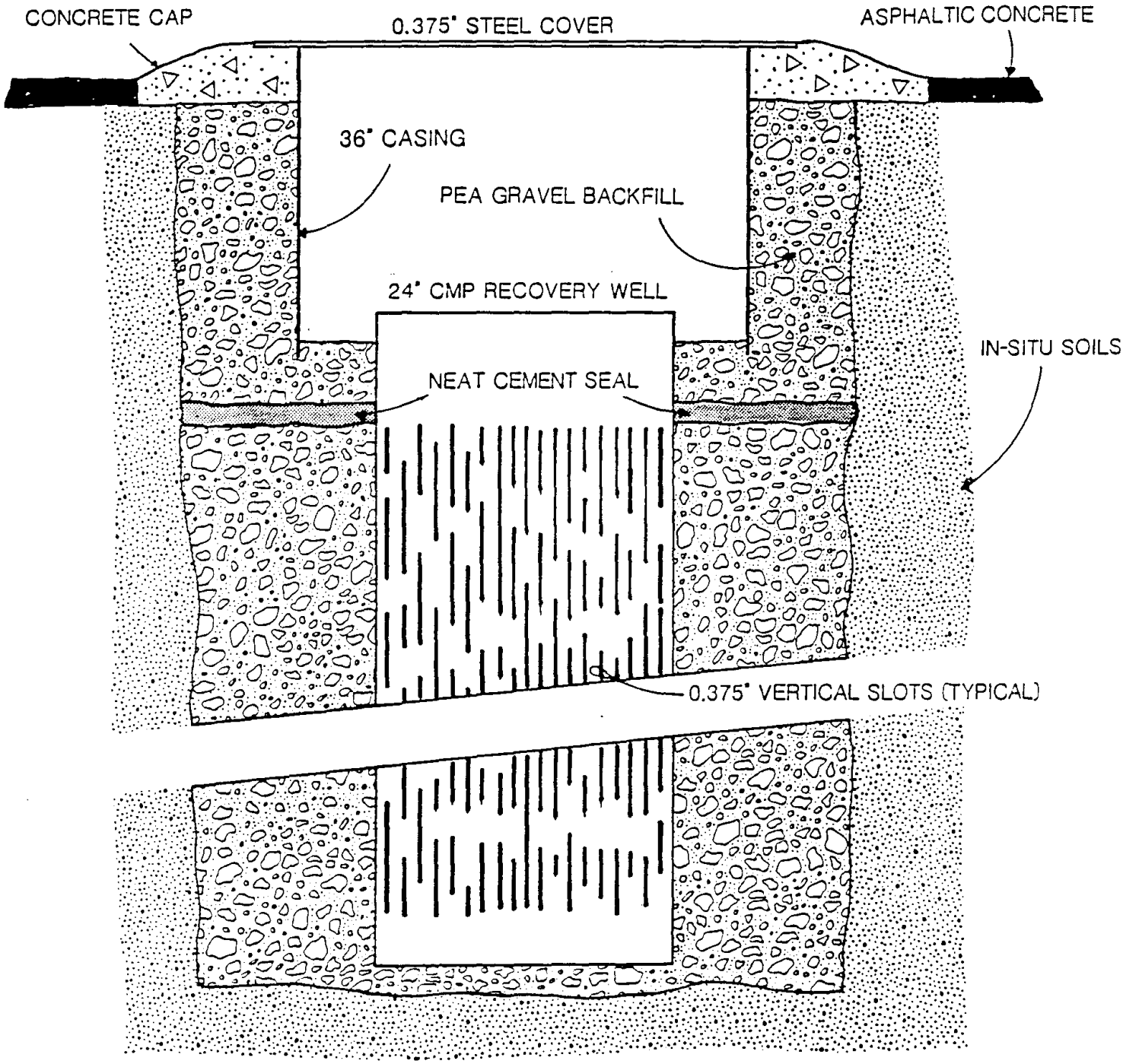
1) Based on arbitary datum

2) Monitoring well installed by others

3) Bottom 4.9 feet of screen is 10 slot, upper 4.9 feet of screen is 20 slot

FIGURE D-3

0107



NOTE: SEE TEXT FOR COMPLETE DISCUSSION

UNOCAL 15th & C STREET

GENERALIZED RECOVERY WELL SECTION

W.O. A-1172
By RAM
Date Sept 1986
Scale NOT TO SCALE

RZA, INC.
Geotechnical Consultants
3105 A Lakeshore Drive.
Suite 103
Anchorage, Alaska 99503

RZA

TABLE C-1
0108

CHEMICAL & GEOLOGICAL LABORATORIES OF ALASKA, INC.

ANCHORAGE INDUSTRIAL CENTER 5633 B STREET ANCHORAGE, ALASKA 99518
TELEPHONE (907) 562-2343

ANALYTICAL REPORT

CLIENT Rittenhouse-Zeman Associates — CLIENT P. O. # --

ADDRESS 3105 A Lakeshore Dr., Ste 103 — SAMPLES RECEIVED: 8/12/86

Anchorage, AK 99517 — SAMPLES COLLECTED: --

REFER QUESTION TO: Daniel J. Bacon — DATE ANALYZED: 8/14/86

APPROVED BY: Stephen C. Ede — LAB SAMPLE NO. 3842

CLIENT SAMPLE I.D.:

MATRIX: Soil

METHOD: Capillary Gas Chromatography

LAB #	SAMPLE ID	OIL & GREASE, ppm
3842-1	B-3 S-1	116
3842-2	B-6 S-2	261
3842-3	B-7 S-1	263

The samples of soil listed above were extracted and analyzed by computerized gas chromatography. Although samples B-6, S-2 and B-7, S-1 had the distinctive odor of gasoline only high molecular weight hydrocarbon components were recovered from the soil. A standard 2% bottoms distillation residue of gasoline was analyzed and compared to the hydrocarbons recovered from the soil. It is recommended to analyze samples for volatile aromatics which would be present in gasoline.

ND = NONE DETECTED
DETECTION LIMIT IN ( )

RESIDUAL SAMPLES WILL BE HELD UNTIL: _____

INVOICE # 39370

Table A-1
A-1181-8

CHEMICAL & GEOLOGICAL LABORATORIES OF ALASKA, INC.

ANCHORAGE INDUSTRIAL CENTER 5633 B STREET ANCHORAGE, ALASKA 99518
TELEPHONE (907) 562-2343

0109

ANALYTICAL REPORT

CLIENT Rittenhouse-Zeman & Associates — CLIENT P. O. # Richard Mitchells

ADDRESS 3105 A Lakeshore Dr., #103 — SAMPLES RECEIVED: 11/26/86

Anchorage, AK 99517 — SAMPLES COLLECTED: 11/22/86

REFER QUESTION TO: Stephen C. Ede — DATE ANALYZED: 12/3/86

APPROVED BY: Stephen C. Ede — LAB SAMPLE NO. 4905

CLIENT SAMPLE I.D.: A-1181-8

MATRIX: Soil

METHOD: Standard Methods, 16th Edition
503C, 503B, 503E

DATE/TIME	SAMPLE	OIL & GREASE, ppm	HYDROCARBONS, ppm
11/22/86 1120	SB-1, S-2 @ 6'	1,812	981
11/22/86 1235	SB-2, S-3 @ 8'	86	52

ND = NONE DETECTED
DETECTION LIMIT IN ( )

RESIDUAL SAMPLES WILL BE HELD UNTIL: 12/30/86

INVOICE #4905

0110

CHEMICAL & GEOLOGICAL LABORATORIES OF ALASKA, INC.

5633 B STREET•ANCHORAGE, ALASKA 99518
TELEPHONE (907) 562-2343

ANALYTICAL REPORT

CLIENT Rittenhouse-Zeman & Associates
ADDRESS 3105 A Lakeshore Dr., Suite 103
Anchorage, AK 99517
REFER QUESTIONS TO Stephen C. Ede
APPROVED BY Stephen C. Ede SCE
RESIDUAL SAMPLES HELD UNTIL Not Held

CLIENT PO# --
SAMPLES REC'D 9/5/86
SAMPLES COLLECTED 9/4/86
DATE ANALYZED 9/18/86
LAB SAMPLE # 4120-3
INVOICE # 40054

CLIENT'S SAMPLE IDENTIFICATION B - 8 S - 1 - A (5.9' - 6.4')
MATRIX Soil
METHOD 8020

VOLATILE AROMATIC HYDROCARBONS, ppb	RESULTS
BENZENE	ND (5)
TOLUENE	ND (5)
ETHYLBENZENE	ND (5)
CHLOROBENZENE	ND (5)
p-XYLENE	ND (5)
m-XYLENE	ND (5)
o-XYLENE	ND (5)
1, 4 DICHLOROBENZENE	ND (5)
1, 3 DICHLOROBENZENE	ND (5)
1, 2 DICHLOROBENZENE	ND (5)

ND = None Detected
Detection limit in ( )

0111

CHEMICAL & GEOLOGICAL LABORATORIES OF ALASKA, INC.
5633 B STREET•ANCHORAGE, ALASKA 99518
TELEPHONE (907) 562-2343

ANALYTICAL REPORT

CLIENT Rittenhouse-Zeman & Associates
ADDRESS 3105 A Lakeshore Dr., Suite 103
Anchorage, AK 99517
REFER QUESTIONS TO Stephen C. Ede
APPROVED BY Stephen C. Ede SCE
RESIDUAL SAMPLES HELD UNTIL Not Held

CLIENT PO# --
SAMPLES REC'D 9/5/86
SAMPLES COLLECTED 9/4/86
DATE ANALYZED 9/18/86
LAB SAMPLE # 4120-1
INVOICE # 40054

CLIENT'S SAMPLE IDENTIFICATION B - 9 S - 1 - A (8.0' - 9.0')
MATRIX Soil
METHOD 8020

VOLATILE AROMATIC HYDROCARBONS, ppb	RESULTS
BENZENE	17
TOLUENE	5.0
ETHYLBENZENE	7.1
CHLOROBENZENE	ND (5)
p-XYLENE }	} 50
m-XYLENE }	
o-XYLENE	38
1, 4 DICHLOROBENZENE	ND (5)
1, 3 DICHLOROBENZENE	ND (5)
1, 2 DICHLOROBENZENE	ND (5)

ND = None Detected
Detection limit in ( )

0112

CHEMICAL & GEOLOGICAL LABORATORIES OF ALASKA, INC.

5633 B STREET•ANCHORAGE, ALASKA 99518
TELEPHONE (907) 562-2343

ANALYTICAL REPORT

CLIENT Rittenhouse-Zeman & Associates
ADDRESS 3105 A Lakeshore Dr., Suite 103
Anchorage, AK 99517
REFER QUESTIONS TO Stephen C. Ede
APPROVED BY Stephen C. Ede SCE
RESIDUAL SAMPLES HELD UNTIL Not Held

CLIENT PO# --
SAMPLES REC'D 9/5/86
SAMPLES COLLECTED 9/4/86
DATE ANALYZED 9/18/86
LAB SAMPLE # 4120-4
INVOICE # 40054

CLIENT'S SAMPLE IDENTIFICATION B - 10 S - 1 - A (5.5' - 6.0')
MATRIX Soil
METHOD 8020

VOLATILE AROMATIC HYDROCARBONS, ppb	RESULTS
BENZENE	ND (5)
TOLUENE	5
ETHYLBENZENE	ND (5)
CHLOROBENZENE	ND (5)
p-XYLENE ?	{ 9.5
m-XYLENE }	
o-XYLENE	ND (5)
1, 4 DICHLOROBENZENE	ND (5)
1, 3 DICHLOROBENZENE	ND (5)
1, 2 DICHLOROBENZENE	ND (5)

ND = None Detected
Detection limit in ( )

0113

CHEMICAL & GEOLOGICAL LABORATORIES OF ALASKA, INC.

5633 B STREET•ANCHORAGE, ALASKA 99518
TELEPHONE (907) 562-2343

ANALYTICAL REPORT

CLIENT Rittenhouse-Zeman & Associates
ADDRESS 3105 A Lakeshore Dr., Suite 103
Anchorage, AK 99517
REFER QUESTIONS TO Stephen C. Ede
APPROVED BY Stephen C. Ede SCE
RESIDUAL SAMPLES HELD UNTIL Not Held

CLIENT PO# --
SAMPLES REC'D 9/5/86
SAMPLES COLLECTED 9/4/86
DATE ANALYZED 9/18/86
LAB SAMPLE # 4120 -2
INVOICE # 40054

CLIENT'S SAMPLE IDENTIFICATION B - 11 S - 1 - A (6.0' - 8.0')

MATRIX Soil

METHOD 8020

VOLATILE AROMATIC HYDROCARBONS, ppb	RESULTS
BENZENE	82,800
TOLUENE	453,000
ETHYLBENZENE	149,000
CHLOROBENZENE	ND (100)
p-XYLENE }	537,000
m-XYLENE }	
o-XYLENE	269,000
1, 4 DICHLOROBENZENE	ND (100)
1, 3 DICHLOROBENZENE	ND (100)
1, 2 DICHLOROBENZENE	ND (100)

ND = None Detected
Detection limit in ( )

CHEMICAL & GEOLOGICAL LABORATORIES OF ALASKA, INC.
5633 'B' STREET, ANCHORAGE, AK 99518
TELEPHONE (907) 562-2343

Table A-2
A-1181-8

0114

REPORT OF ANALYSIS

CLIENT:	Rittenhouse-Zeman & Assoc.	CLIENT PO NO:	Richard Mitchells
SEND REPORT TO:	3105 A Lakeshore Dr., #103 Anchorage, AK 99517	ORDERED BY:	Richard Mitchells
		SAMPLE RECVD:	11/26/86
SEND REPORT TO:	Same	DATE ANALYZED:	12/1/86
EPA METHOD:	8020	APPROVED BY:	STEPHEN C. EDE
MATRIX:	Soil	SAMPLES HELD UNTIL:	12/30/86
REFER QUESTIONS:	STEPHEN C EDE	LAB SAMPLE NO:	4905- 1

CLIENT SAMPLE ID: A-1181-8 SB-1, S-2 @6'

VOLATILE AROMATIC HYDROCARBONS, ppb	RESULTS
BENZENE	10,200
TOLUENE	81,300
ETHYLBENZENE	26,100
CHLOROBENZENE	ND (5)
p-XYLENE m-XYLENE	88,800
o-XYLENE	38,600
1, 4 DICHLOROBENZENE	ND (5)
1, 3 DICHLOROBENZENE	ND (5)
1, 2 DICHLOROBENZENE	ND (5)

ND-NONE DETECTED
DETECTION LIMITS IN ( )

INVOICE # 4905

CHEMICAL & GEOLOGICAL LABORATORIES OF ALASKA, INC.
5633 'B' STREET, ANCHORAGE, AK 99518
TELEPHONE (907) 562-2343

Table A-3
A-1181-8

0115

REPORT OF ANALYSIS

CLIENT:	Rittenhouse-Zeman & Assoc.	**CLIENT PO NO:**	Richard Mitchells
SEND REPORT TO:	3105 A Lakeshore Dr., #103 Anchorage, AK 99517	**ORDERED BY:**	Richard Mitchells
		SAMPLE RECVD:	11/26/86
SEND REPORT TO:	Same	**DATE ANALYZED:**	12/1/86
EPA METHOD:	8020	**APPROVED BY:**	STEPHEN C. EDE
MATRIX:	Soil	**SAMPLES HELD UNTIL:**	12/30/86
REFER QUESTIONS:	STEPHEN C EDE	**LAB SAMPLE NO:**	4905- 2

CLIENT SAMPLE ID: A-1181-8 SR-2, S-3 @8'

VOLATILE AROMATIC HYDROCARBONS, ppb	RESULTS
BENZENE	2,430
TOLUENE	4,290
ETHYLBENZENE	911
CHLOROBENZENE	ND (5)
p-XYLENE ?	3,040
m-XYLENE ?	
o-XYLENE	870
1, 4 DICHLOROBENZENE	ND (5)
1, 3 DICHLOROBENZENE	ND (5)
1, 2 DICHLOROBENZENE	ND (5)

ND-NONE DETECTED
DETECTION LIMITS IN ( )

INVOICE # 4905

DEPTH (FEET)	SOIL DESCRIPTION BORING NO. B-3	SAMPLES	FROZEN
	0.2 surface asphaltic concrete pavement		
	Medium dense to dense, moist to wet, gray-brown becoming brown, fine gravelly SAND, trace to some silt, trace cobbles. No gasoline odor or sheen observed in samples or cuttings (Fill)	S 1	
5		S 2	
		S 3	
10	Dense, wet, red-brown, silty SAND, some fine gravel, trace cobbles. No gasoline odor or sheen was observed in sample or cuttings (Outwash Sand)	S 4	
	Stiff, moist, blue-gray silty CLAY with thin layers of silt between 15 and 16 feet. No gasoline odor or sheen was observed in sample. (SILT/CLAY)		
15		S 5	
	Bottom of boring 17.0 feet		
20			

STANDARD PENETRATION RESISTANCE #
▲ Blows per foot (140 lb. hammer, 30" drop)
10 20 30 40 50

0116

15 AVE & C ST
UNOCAL SERVICE STATION

= MODIFIED, SEE TEXT

A-1172
AUGUST 1986

LEGEND

H	2.0" O.D. split spoon sampler	P	Sampler pushed
U	3.0" O.D. undisturbed sampler	•	% moisture content
G	Grab sample interval	*	Sample not recovered

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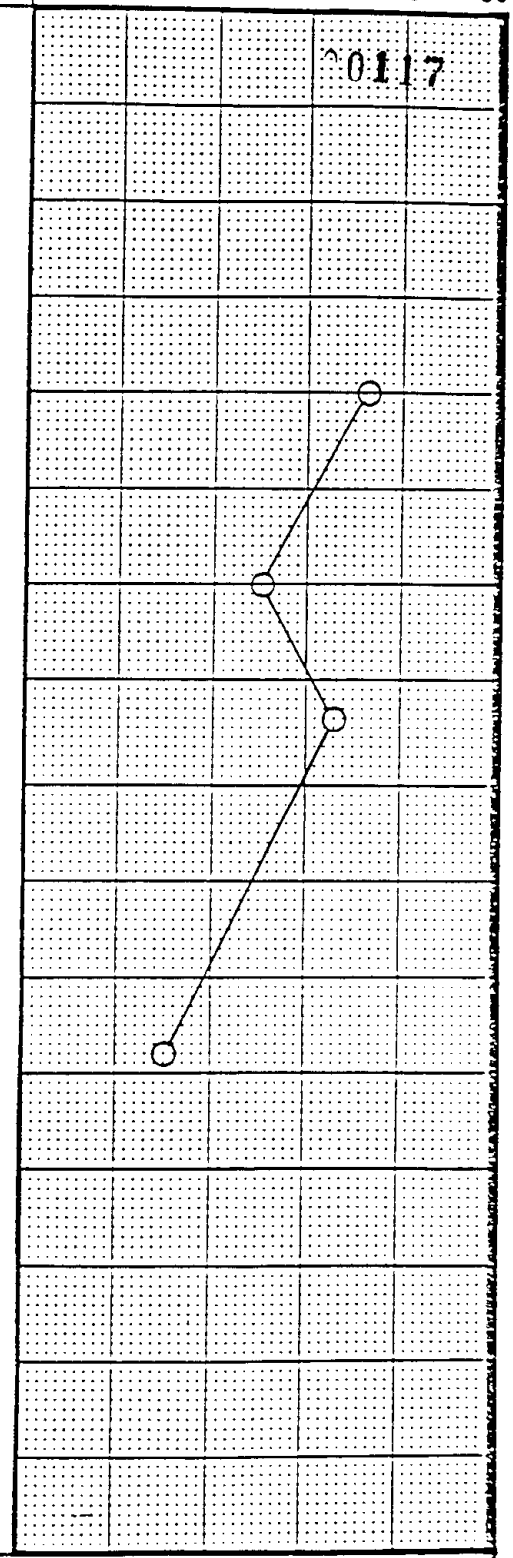
Anchorage, Alaska 99503

Figure A-2

DEPTH (FEET)	SOIL DESCRIPTION BORING NO. B-4	SAMPLES	FROZEN
	0.2 feet asphaltic concrete pavement		
	Medium dense becoming dense, moist to wet, brown, fine gravelly SAND to SAND, trace silty to silty, trace organics. No gasoline odor or sheen observed in samples or cuttings. (Fill)		
5		S 1	
		S 2	
		S 3	
10	Dense, wet, blue-gray, silty, fine SAND. No gasoline odor or sheen observed in sample. (Outwash sand)		
	Stiff, moist, blue CLAY. No gasoline odor or sheen observed in sample. (Silt/Clay)	S 4	
15	Bottom of boring 14.0 feet		
20			

STANDARD PENETRATION RESISTANCE #
▲ Blows per foot (140 lb. hammer, 30" drop)
10 20 30 40 50



15 AVE & C ST
UNOCAL SERVICE STATION

MODIFIED, SEE TEXT

A-1172
AUGUST 1986

LEGEND

S	3.0" O.D. split spoon sampler	P	Sampler pushed
U	3.0" O.D. undisturbed sampler	•	% moisture content
G	Grab sample interval	*	Sample not recovered

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Figure A-3

DEPTH (FEET)	SOIL DESCRIPTION BORING NO. B-5	SAMPLES	FROZEN
	0.3 feet surface asphaltic concrete pavement		
	Medium dense to dense, moist to wet, gray-brown, gravelly SAND, trace to some silt, trace cobbles. No gasoline odors or sheen observed in sample or cuttings (Fill)	S 1	
5			
	Dense, wet, green-gray, fine SAND, trace silty. No gasoline odor or sheen observed in sample. (Outwash Sand)	S 2	
10	Stiff, moist, blue-gray, silty CLAY, locally fine SAND. No gasoline odors or sheen observed in sample (Silt/Clay)	S 3	
	Bottom of boring 11.5 feet		
15			
20			

STANDARD PENETRATION RESISTANCE
▲ Blows per foot (140 lb. hammer, 30" drop)
10 20 30 40 50

0118

Blowcount overstated

15 AVE & C ST
UNOCAL SERVICE STATION

MODIFIED, SEE TEXT

A-1172
AUGUST 1986

LEGEND

SHH	2.0" O.D. split spoon sampler	P	Sampler pushed
	3.0" O.D. undisturbed sampler	•	% moisture content
G	Grab sample interval	*	Sample not recovered

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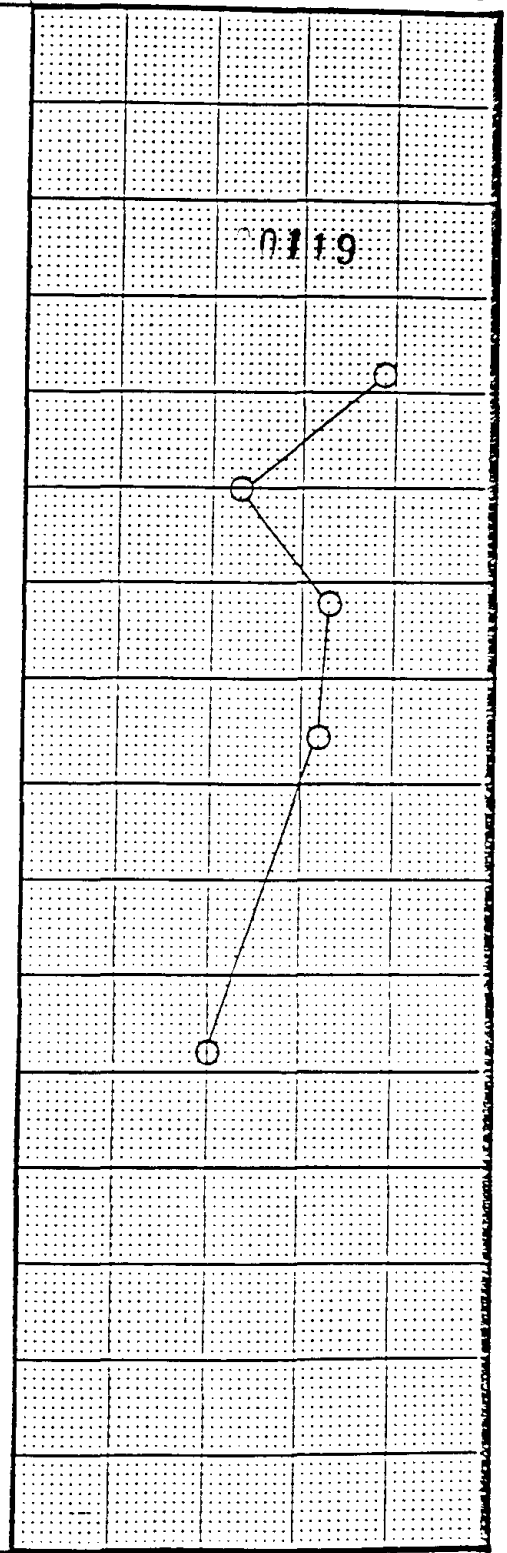
Anchorage, Alaska 99503

Figure A-4

DEPTH (FEET)	SOIL DESCRIPTION BORING NO. B-6	SAMPLES	FROZEN
	0.2 feet surface asphaltic concrete pavement		
	Medium dense to dense, moist, gray-brown, gravelly SAND, trace to some silt, trace cobbles. Gasoline odor noted, but no sheen observed in sample (Fill)		
5		S 1	
		S 2	
	Dense, moist, dark brown, silty fine SAND, some organics. Gasoline odor and sheen observed in sample (FIll)	S 3	
	Stiff, wet, blue-gray SILT and medium dense fine SAND. Gasoline odor and sheen observed in samples (Outwash sands)	S 4	
10			
	Stiff, moist, blue-gray, silty CLAY. No gasoline odor or sheen observed in sample. (SILT/CLAY)	S 5	
15	Bottom of boring 14.5 feet		
20			

STANDARD PENETRATION RESISTANCE #
▲ Blows per foot (140 lb. hammer, 30" drop)
10 20 30 40 50



15 AVE & C ST
UNOCAL SERVICE STATION

MODIFIED, SEE TEXT

A-1172
AUGUST 1986

LEGEND

GHH	2.0" O.D. split spoon sampler	P	Sampler pushed
	3.0" O.D. undisturbed sampler	•	% moisture content
	Grab sample interval	*	Sample not recovered

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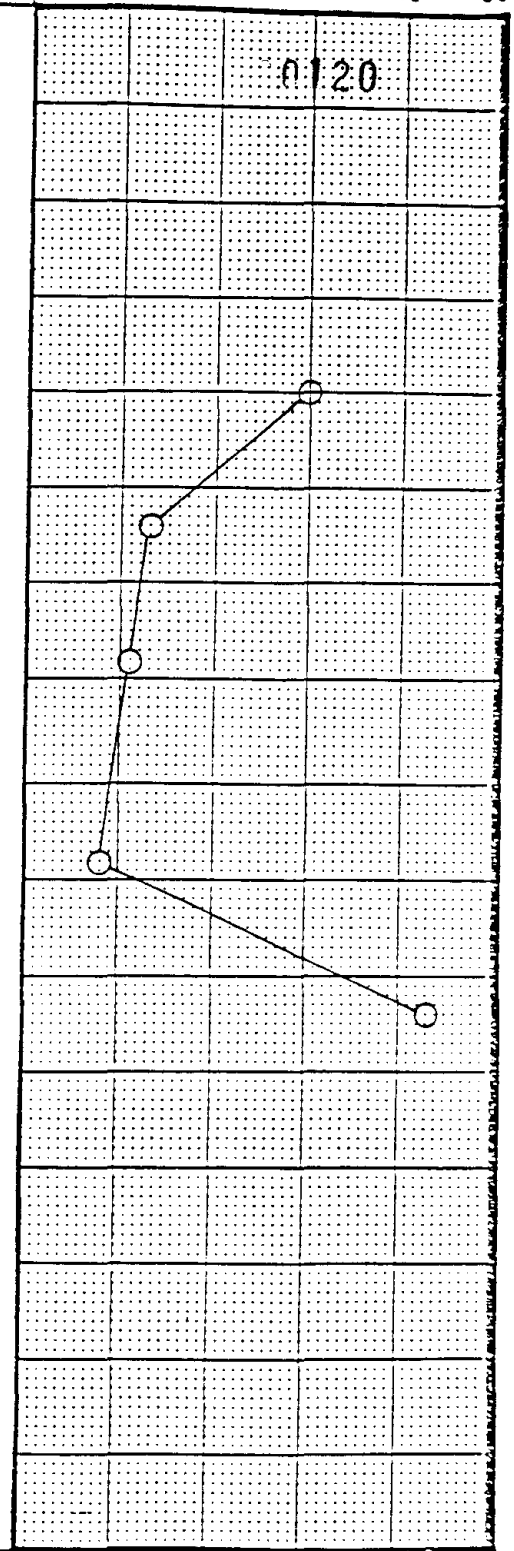
Anchorage, Alaska 99503

Figure A-5

DEPTH (FEET)	SOIL DESCRIPTION BORING NO. B-7	SAMPLES	FROZEN
	0.3 feet surface asphaltic concrete pavement		
	Dense, becoming medium dense, moist, gray, fine gravelly SAND, trace silty. Gasoline odor and sheen observed in samples and cuttings (Fill)		
5		S 1	
		S 2	
		S 3	
10		S 4	
	Stiff to very stiff, moist, blue-gray CLAY, some silt. No gasoline odor or sheen observed in sample (Silt/Clay)	S 5	
	Bottom of boring 14.0 feet		
15			
20			

STANDARD PENETRATION RESISTANCE #
▲ Blows per foot (140 lb. hammer, 30" drop)
10 20 30 40 50



15 AVE & C ST
UNOCAL SERVICE STATION

MODIFIED, SEE TEXT

A-1172
AUGUST 1986

LEGEND

SHH	2.0" O.D. split spoon sampler	P	Sampler pushed
	3.0" O.D. undisturbed sampler	•	% moisture content
G	Grab sample interval	*	Sample not recovered

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Anchorage, Alaska 99503

Figure A-6

DEPTH (FEET)	SOIL DESCRIPTION BORING NO. B-8	SAMPLES	FROZEN	STANDARD PENETRATION RESISTANCE # ▲ Blows per foot (140 lb. hammer, 30" drop) 10 20 30 40 50
	Medium dense to dense, moist, brown, fine gravelly SAND. No gasoline odor or sheen was observed in samples or cuttings (Fill)			0121
5	Medium dense, moist to wet, brown, SAND, some fine gravel. No gasoline odor or sheen was observed in samples or cuttings (Fill)	S 1		
		S 2		
10	Medium dense, wet, gray, fine SAND, trace to some silt. No gasoline odor or sheen was observed in samples or cuttings (Outwash Sand)	S 3		
	Stiff, wet, blue-gray, silty CLAY. No gasoline odor or sheen was observed in samples or cuttings (SILT/CLAY)			
	Bottom of boring 12.5 feet			
15				
20				

15 AVE & C ST
UNOCAL SERVICE STATION

MODIFIED, SEE TEXT

A-1172
SEPTEMBER 1986

LEGEND

H H H	2.0" O.D. split spoon sampler	P	Sampler pushed
	3.0" O.D. undisturbed sampler	•	% moisture content
G	Grab sample interval	*	Sample not recovered

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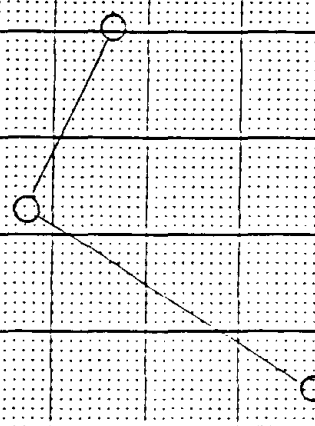
DEPTH (FEET)	SOIL DESCRIPTION BORING NO. B-9	SAMPLES	FROZEN
	Medium dense, moist, brown, fine gravelly SAND. No gasoline odor or sheen was observed in sample or cuttings. (Fill)		
5	Medium dense, moist to wet, brown, fine gravelly SAND. No gasoline odor or sheen was observed in sample or cuttings (Fill)	S 1	
10	Loose to medium dense, wet, gray, fine SAND. No gasoline odor or sheen was observed in sample or cuttings (Outwash sand)	S 2	
	Stiff, wet, blue-gray, silty CLAY. No gasoline odor or sheen was observed in samples or cuttings (Silt/clay)	S 3	
15	Bottom of boring 14.5 feet		
20			

STANDARD PENETRATION RESISTANCE #
▲ Blows per foot (140 lb. hammer, 30" drop)
10 20 30 40 50

0122



MODIFIED, SEE TEXT

15 AVE & C ST
UNOCAL SERVICE STATION

A-1172
SEPTEMBER 1986

LEGEND

H	2.0" O.D. split spoon sampler	P	Sampler pushed
H	3.0" O.D. undisturbed sampler	•	% moisture content
G	Grab sample interval	*	Sample not recovered

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DEPTH (FEET)	SOIL DESCRIPTION BORING NO. B-10	SAMPLES	FROZEN	STANDARD PENETRATION RESISTANCE # ▲ Blows per foot (140 lb. hammer, 30" drop) 10 20 30 40 50
	Dense, moist, brown, fine gravelly SAND. No gasoline odor or sheen was observed in samples or cuttings (Fill)			0123
5	Medium dense, moist, brown, fine gravelly SAND No gasoline odor or sheen was observed in samples or cuttings (Fill)	S 1		
	Stiff, moist, blue-gray, silty CLAY. No gasoline odor or sheen was observed in samples or cuttings (Silt/clay)	S 2		
10	Bottom of boring 9.0 feet			
15				
20				

15 AVE & C ST
UNOCAL SERVICE STATION

= MODIFIED, SEE TEXT

A-1172
SEPTEMBER 1986

LEGEND

HH	2.0" O.D. split spoon sampler	P	Sampler pushed
H	3.0" O.D. undisturbed sampler	•	% moisture content
G	Grab sample interval	*	Sample not recovered

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Anchorage, Alaska 99503

Figure A-9

DEPTH (FEET)	SOIL DESCRIPTION BORING NO. B-11	SAMPLES	FROZEN
	Medium dense, moist, brown, gravelly SAND. No gasoline odor or sheen was observed in sample or cuttings (Fill)		
5	Medium dense, moist to wet, brown, fine gravelly SAND, trace silt. Gasoline odor and sheen observed in cuttings below depth of approximately 4.5 feet (Fill)	S 1	
10	Medium dense, wet, brown to gray, fine SAND. Very strong gasoline odor and sheen observed in samples and cuttings (Outwash sand)	S 2	
15	Stiff, wet, blue-gray SILT to clayey SILT, grades to CLAY. Very strong gasoline odor and sheen observed in sample and cuttings to approximate depth of 15.0 feet (Silt/clay)	S 3	
20	Bottom of boring 20.0 feet		

STANDARD PENETRATION RESISTANCE #
▲ Blows per foot (140 lb. hammer, 30" drop)
10 20 30 40 50

0124

15 AVE & C ST
UNOCAL SERVICE STATION

MODIFIED, SEE TEXT

A-1172
SEPTEMBER 1986

LEGEND

H	2.0" O.D. split spoon sampler	P	Sampler pushed
H	3.0" O.D. undisturbed sampler	•	% moisture content
G	Grab sample interval	*	Sample not recovered

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Anchorage, Alaska 99503