CHANGES BETWEEN 1984 AND 1989 IN THE CONCENTRATION AND AREAL EXTENT OF GROUND-WATER CONTAMINATION FROM A GASOLINE AND DIESEL FUEL LEAK AT A SITE IN YAKIMA, WASHINGTON

By Richard J. Wagner and J. C. Ebbert

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MANUEL LUJAN, JR., Secretary

U.S. GEOLOGICAL SURVEY

Dallas L. Peck, Director

For additional information write to:

District Chief U.S. Geological Survey 1201 Pacific Avenue - Suite 600 Tacoma, Washington 98402 Copies of this report can be purchased from:

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CONVERSION FACTORS AND VERTICAL DATUM

Multiply inch-pound units	By	To obtain metric units
inch	25.4	millimeter (mm)
foot	0.3048	meter (m)
mile	1.609	kilometer (km)
square mile	2.590	square kilometer(km²)
gallon (gal)	3.785	liter (L)
micromho per centimeter at 25 degrees Celsius (μmho/cm at 25 °Celsius)		microsiemen per centi- meter at 25 degrees Celsius (µS/cm at 25 °C)

<u>Sea Level</u>: In this report "sea level" refers to the National Geodetic Vertical Datum of 1929 (NGVD of 1929 (--a geodetic datum derived from a general adjustment of the first-order level nets of both the United States and Canada, formerly called Sea Level Datum of 1929.

<u>Temperature</u>: To covert degrees Farhrenheit (°F) to degrees Celsius (°C), use the following equation: $^{\circ}C = 5/9$ (°F - 32).

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CHANGES BETWEEN 1984 AND 1989 IN THE CONCENTRATION AND

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AND DIESEL FUEL LEAK AT A SITE IN YAKIMA, WASHINGTON

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ABSTRACT

Following discovery in the early 1980's of a gasoline and diesel-fuel leak at a service station in Yakima, Washington an unsuccessful attempt was made to recover the free-floating petroleum product. From 1984 through 1989, data were collected from observation wells drilled near the site of the leak and from nearby domestic wells. Between February 1985 and November 1986, benzene, toluene, xylenes, and other soluble compounds of petroleum origin were found at relatively large concentrations in all samples from observation wells within 300 feet of the service station. These same compounds were also found in some samples and at smaller concentrations in domestic wells as far as 1,500 feet downgradient of the service station. Ground-water samples collected in March 1989 indicate concentrations of these soluble compounds had decreased, and areal extent where they were present was smaller than when monitoring began in 1984.

INTRODUCTION

In 1980, 1981, and 1982, the residents of a neighborhood in the northeast part of Yakima, Washington, complained to the Washington State Department of Ecology (WDOE) about the odor and taste of gasoline in water from their domestic or irrigation wells, which are open to a shallow, unconfined ground-water system. The WDOE investigated the complaints and determined that the source of the gasoline and diesel fuel was leakage near the land surface from improperly installed pump delivery lines at a service station located on North First Street (fig. 1). New delivery lines and storage tanks had been installed at the station in May and June 1979. Leak tests, reported to have been performed at that time and again in December 1980, did not reveal any leaks. Additional tests, conducted in September 1982 as a result of the complaints from private well owners, revealed leaks in the delivery lines, which were repaired immediately.

An audit of gasoline and diesel fuel inventory records, conducted by representatives of the service station, indicated that about 5,970 gallons of leaded gasoline and 1,740 gallons of diesel fuel were lost during the period from September 1981 through October 1982. This represents an average leakage rate of 550 gallons of product per month. If the leak began shortly after the December 1980 test and was constant, then about 12,000 gallons could have been lost during the 22-month period from the time of the test to the repair of the leaks. If the December 1980 test was invalid, and the system leaked at constant rate during the entire 40-month period from the time of installation, then the product loss could have been as much as 22,000 gallons.

An insurance company, representing the service station, initiated an attempt to recover the lost gasoline and diesel fuel in 1982-83 because of the potential to further contaminate drinking water. At least 13 observation wells and two recovery wells were installed on, or adjacent to, the service station property. Three of the observation wells contained several inches of free product, pure gasoline or diesel fuel, floating on top of the water. The recovery operation was discontinued because only 40 gallons of free product were recovered. All but three of the wells were subsequently destroyed. In the summer of 1985, most homes having affected wells were connected to alternate water supplies.

Purpose and Scope

The purpose of this report is to present and compare current and past distributions and concentrations of petroleum-related compounds in ground water near the site of the gasoline and diesel-fuel leak on North First Street in Yakima, Washington. This report presents data collected from three separate investigations: a March 1989 single sampling, sample collection during a 1985 to 1987 study that was part of the Ground-Water Toxics Substances Hydrology Program, and sample collection from October 1984 through November 1986 that was part of the insurance company study. Data collected by the three sampling studies are presented in tables in this report. Comparisons between studies and changes in time are made by presenting distributions of selected compounds in maps. Sampling procedures and laboratory methods that were used by the three studies are also described.

Description of the Study Area

The City of Yakima is the commercial center for the Yakima River valley, a major agricultural area within south-central Washington. The service station on North First Street, where the gasoline and diesel-fuel leak occurred, is located approximately 2,000 feet southwest of the Yakima River (fig. 1). Land use in the vicinity of the service station consists of some orchards and vacant lots interspersed among commercial and residential properties.

The general direction of ground-water flow is eastward from the service station to the river. The subsurface geologic materials immediately underlying the area consist predominantly of coarse-grained alluvial deposits. The water table is approximately 10 feet below land surface. Additional information on the geohydrology is given in the section "Geohydrologic Setting".

Annual precipitation in the valley is about 8 inches (U.S. Department of Commerce, 1987), with more than half of this occurring during the winter months as snow. Potential evapotranspiration, using a modified Blaney-Criddle calculation (U.S. Department of Agriculture, 1970), is approximately 38 inches annually. Consequently, crops require extensive irrigation. Most irrigation water is diverted surface water, but some is pumped ground water. The main municipal water supply for the city of Yakima is surface water; however, some individual residences and small water purveyors rely on ground water.

Geohydrologic Setting

The study area in Yakima, Washington is located in the Ahtanum-Moxee subbasin (fig. 2), which lies along an east-west oriented alluvial valley between two similarly oriented basalt ridges: Cowiche Mountain and Yakima Ridge on the north, and Ahtanum Ridge and Rattlesnake Hills on the south. The valley lies along a broad structural syncline, is approximately 7 miles wide and 40 miles long, and has a relatively flat alluvial surface that ranges between 1,000 and 1,500 feet in elevation. The basalt ridges on either side of the valley were formed by anticlinal upwarp, are much narrower than the valley, and range between 2,000 and 3,000 feet in elevation. Perennial east-west oriented streams flow along the valley from both directions toward the valley center and empty into the perennial north-south, through-flowing Yakima River. A significant summer inflow of water into the higher parts of the valley comes by way of irrigation canals fed by dam-regulated flow along the Yakima River and its tributaries upstream of the study area.

Folded and faulted basalts are exposed along the anticlinal ridges and are found at depths of 300 to 1,000 feet beneath the synclinal valley (fig. 3). The basalt flows belong to the Columbia River Group (table 1), and they are interbedded with, and underlie, a thick section of clastic rocks of debris-flow, lacustrine, and fluvial origin located along the valley axis. The oldest of these clastic units, the Ellensburg Formation (table 1), is from 100 to perhaps 1,000 feet thick in the valley and is dominated by semi-consolidated laharic (volcanically generated debris flow) fine to coarse clastics. Above these beds lie about 100 to 500 feet of Pleistocene glaciofluvial fine-grained lake, and coarser-grained river-laid clastics.

Above these, and comprising much of the surficial material at and near the study site, are 50 to 75 feet of Holocene unconsolidated alluvial sands and gravels laid down beneath the present flood plain by the Yakima River and beneath adjacent terraces by streams older, and perhaps larger, than the present Yakima River. The clasts within these two recent alluvial deposits are dominantly of volcanic (andesitic and basaltic) composition.

The shallow stratigraphy of the study site was determined by descriptive geologic logs from recent drilling of observation wells (fig. 4). In general, the lithologic descriptions show an upper 15- to 20-foot-thick depositional unit beneath the present flood plain, with about 5 feet of clay, silt, and sand at the surface (overbank deposits), and 10 feet of sandy, coarse gravels and cobbles below the overbank deposits. The lower contact of this upper unit is indistinct, but it overlies 30 to 50 feet of lower, older gravels and sands, probably deposited in similar environments. At normal stages of flow, the Yakima River is flowing within the upper fluvial unit, and perhaps within the top of the gravel layer of these fluvial deposits. There is a good permeable connection between the Yakima River and the adjacent water-table aquifer within these recent fluvial deposits. The ground-water-quality data at the site indicate that the leaked gasoline and diesel fuel, and the dispersed dissolved compounds downgradient of the leak, are wholly contained within the upper and lower Holocene alluvial deposits.

There is upward ground-water flow from the basalts through the Ellensburg clastics into Holocene alluvium and into the perennial drainages (personal communication, Henry Bauer, USGS, 1990), including the Yakima River (fig. 4).

Regionally, the ground-water flow is generally eastward (fig. 5) from the leak

site toward the Yakima River. During the study, the general direction of local ground-water movement was from west to east-southeast, and the velocity of ground water was estimated from between 0.2 to 1.2 feet per day, based upon water-level measurements and interpretation of geologic well logs (written communication, J. Pankow, OCG, 1986). In general, the water table lies 7 to 12 feet beneath ground level. The upper sand, silt, and clay of the alluvium is unsaturated, and the lower parts of the coarser-grained alluvium is saturated.

Continuous hydrographs of two water-table wells document annual fluctuations of 2 to 3 feet, and there are two unequal annual peaks.

One peak is in late spring, coincident with maximum vertical recharge from precipitation, and a second peak is in the late summer and early fall, coincident with upgradient recharge from irrigation returns and canal leakage (figs. 6 and 7, and table 2).

Data Collection

Three studies have been conducted since the gasoline and diesel fuel recovery program was discontinued. The first study, under the general direction of the insurance company, consisted of several phases with different contractors. Three wells still remained from the original recovery program at the end of 1984 (M1-82 through M3-82, pl. 1). In October 1984, selected domestic wells were sampled for the analysis of soluble aromatic compounds in ground water. In December 1984, 12 new observation wells (M1-85 through M12-85, pl. 1) were drilled. Beginning in February 1985, water levels were measured, and selected observation and domestic wells were sampled for the

insurance-company study at 3-month intervals to determine the direction of ground-water flow and concentrations of petroleum-related compounds in ground water.

The second study, which started in 1985, was conducted by the U.S. Geological Survey (USGS) and the Oregon Graduate Center (OGC) as part of the U.S. Geological Survey Toxic Substances Hydrology Program, hereafter referred to as the ground-water toxics study. This study was initiated to determine the transport and fate of gasoline and diesel fuel in a subsurface environment. The study was discontinued in 1987, and no data or results were published. During this study, the USGS and OGC collected ground-water samples three times, soil-gas samples twice, and samples of aquifer material once. Soil-gas samples and volatile samples were analyzed by OGC and inorganic samples were analyzed by the USGS National Water Quality Laboratory (NWQL). In August 1985, water samples were analyzed for petroleum-related hydrocarbons. In November 1985, soil-gas samples were collected, using driven probes, and analyzed for petroleum-related hydrocarbons. From April through June of 1986, water samples were collected from selected domestic and observation wells and from temporary wells driven to the water table and pulled out after sampling. In late summer and early fall of 1986, 32 observation wells and 8 multilevel soil-gas sampling tubes were installed. November 1986, water samples were collected from the new, larger network of observation wells. All ground-water samples were analyzed for volatile hydrocarbons and dissolved oxygen, and selected samples were analyzed for trace metals and common ions. In November 1986, samples of ground water and aquifer material were collected from selected observation wells and analyzed for lead. During the ground-water toxics study, water levels were measured

monthly from February 1985 to April 1987. Water-level recorders, which were installed in M8 and M14, have operated continuously from January 1987 to the present (1991).

The third study was conducted in cooperation with WDOE to determine the current distributions and concentrations of petroleum-related compounds in ground water. In March 1989, ground-water samples were collected from 27 observation wells and analyzed for volatile hydrocarbons. Samples from six wells were analyzed for trace metals and common ions. Water levels were measured at the time the samples were taken.

The results and additional information on the conduct of this, and the other two sampling programs, are given in the sections "Sampling Studies, Field Techniques, and Laboratory Procedures," and "Chemistry of Ground Water, Soil Gas, and Aquifer Materials".

Processes Affecting the Fate and Distribution of Petroleum Hydrocarbons in a Subsurface Environment

Both gasoline and diesel fuel are refined petroleum products and are mixtures of numerous organic compounds with different physical and chemical properties. The fate and distribution of the individual compounds in a subsurface environment are governed to a large extent by these properties. For example, the aromatic hydrocarbons are the most water-soluble components of gasoline and diesel fuel and are relatively easily dissolved and transported in ground water. Selected properties of some of the major aromatic compounds in gasoline and diesel fuel are given in table 3.

After the spill or leak of a liquid petroleum product, some of it will flow through the unsaturated zone to the water table by gravity, and some of it will be held in the unsaturated zone by surface tension. The petroleum that reaches the water table will float and spread on top of the water table because it is less dense than water. The transport of hydrocarbon compounds by ground water initially will be limited to those which can be dissolved in ground water at the petroleum-water interface. Once dissolved in ground water, compounds may be transported by advection and dispersed horizontally and vertically in the ground water.

Seasonal variations in the water-table elevation can increase dispersion and dissolution of hydrocarbon compounds in the ground water. When the water table rises, some of the petroleum will remain trapped in the interstitial pores by surface tension below the rising interface (Schwille, 1981). When the water table falls, some water is trapped above the falling interface. This sequence of events substantially increases the vertical distance over which the petroleum is dispersed and provides additional surface area for the dissolution of hydrocarbon compounds into ground water. During periods of ground-water recharge, downward percolating ground water can dissolve hydrocarbons from the petroleum trapped in the unsaturated zone.

The relative proportions of various petroleum hydrocarbons dissolved in the ground water also are affected by volatilization, biodegradation, and sorption. The low-molecular-weight hydrocarbon compounds can volatilize from the petroleum product or from the ground water and diffuse into the unsaturated zone. The presence of hydrocarbon gases in the unsaturated zone is sometimes used to indicate the presence of petroleum hydrocarbons in ground water.

Some hydrocarbons preferentially sorb to soil particles. These compounds are not as readily transported as those in the gas phase or the ground water. Some sediment characteristics that affect sorption are grain size, moisture, and organic content.

A variety of naturally occurring soil microbes can, under favorable conditions, degrade hydrocarbon compounds found in gasoline and diesel fuel. Biodegradation is most efficient under aerobic conditions with sufficient supplies of nitrogen and phosphorus, a near-neutral pH, and warm soil temperatures. Under these conditions, some hydrocarbon compounds can be completely degraded into carbon dioxide and water (Atlas, 1981). Anaerobic biodegradation of petroleum hydrocarbons also has been observed, but generally at lower rates than aerobic biodegradation (Healy and Daughton, 1986).

Samples collected for the analysis of volatile hydrocarbons during all three studies were preserved by chilling to 4 °C. It has been observed, however, that significant biodegradation can occur if analyses are not performed within seven days (personal commun., Brooke Connor, USGS, 1989).

<u>Acknowledgments</u>

Clar Pratt, Alan Newman, and William Meyers of the WDOE provided much background information about the Yakima site. Dr. James F. Pankow, professor at the Oregon Graduate Center (OGC) and director of the OGC Water Research Laboratory in Portland, Oregon, provided technical advice, as well as planning and executing much of the reconnaissance sampling. J.R. McPherson and Lorne M. Isabelle of OGC analyzed the volatile organic compounds in the

1985-86 ground-water toxics study, and William Fish coordinated the program for the analysis of lead in the aquifer material and in water. Mark S. Mason, of Soil Exploration Company, St. Paul, Minnesota, provided information about the drilling and monitoring program during the insurance study. Michael Schroeder and the staff at the U.S. Geological Survey National Water Quality Laboratory (NWQL) provided technical advice and assistance for the 1989 sampling. Brooke Connor and Donna Rose of NWQL analyzed the volatile organic compounds sampled in 1989. Valuable assistance for the quality assurance program used during the 1989 reconnaissance was provided by Mark Sandstrom of the NWQL Methods Research and Development Section.

Appreciation also is extended to the many property owners who granted access to land, private wells, and monitoring wells during the samplings.

Well-Identification System

Wells in this report are referenced by identification numbers that are listed in table 4. Their locations are shown on plate 1. The table cross-references these identification numbers with the station name stored in WATSTORE, the U.S. Geological Survey computer data base, and identifiers used in correspondence and progress reports during previous studies. The identification numbers in this report are prefixed by an M for observation wells, D for domestic wells, T for temporary wells installed for the collection of water samples, SG for multidepth soil-gas wells, and SGT for temporary wells installed for the collection of soil-gas samples. The temporary water wells and soil-gas wells were removed immediately after sample collection.

SAMPLING STUDIES, FIELD TECHNIQUES, AND LABORATORY PROCEDURES

Field and laboratory methods used during the three studies were, in general, quite similar, and the methods are detailed for comparative purposes. Field and laboratory methods are discussed separately, and quality assurance procedures and results are given in Appendix A.

Ground-Water Sampling

Insurance Company Study

Twelve observation wells were installed using a cable-tool drilling rig. Wells were constructed with 2-inch-diameter, flush-threaded, PVC (polyvinyl chloride) casing and 15 feet of PVC screen, 10 feet of which extended below the water table. Water samples were collected from the wells using bottom-filling Teflon bailers. A minimum of three casing volumes of water were pumped from a well before a ground-water sample was collected. Water samples from domestic wells were collected from cold-water faucets that were allowed to run at a rate of about 1 gallon per minute for a 30-minute period prior to sampling. The samples were from untreated sources that were non-filtered and non-aerated. All samples were preserved on ice and transported to a private laboratory for analysis.

Ground-Water Toxics Study

The ground-water toxics study included three water-sampling periods with different objectives. The first sampling was done (August 1985) to determine the farthest extent of dissolved hydrocarbon movement in the ground water.

The second sampling (April through June 1986) was done with additional temporary wells to better delineate the extent of dissolved hydrocarbons and to determine appropriate sites for 34 additional observation wells. In the third sampling period (November 1986), samples were collected from some of the new observation wells.

The additional 34 observation wells were drilled using the air-rotary method. The wells were constructed of 2-inch PVC casing, with 3- to 5-foot lengths of 0.10-inch slotted PVC screen at the bottom. Most screens were set so that the middle part of the screen was close to the surface of the water table at the time of drilling. Sections of PVC casing were welded together rather than cemented to prevent contamination by solvents used in the cement. The annulus around each screen was packed with sand to a depth of several feet above the screen and then sealed to the surface with bentonite or a bentonite and cement mix. Several deeper wells that were drilled below the water table were packed with sand several feet above the screen, backfilled with clean cuttings, and then surface sealed with a bentonite and cement mix. The wells were developed by pumping.

In the spring of 1985, staff of the Oregon Graduate Center collected ground-water samples from 28 temporary wells. The wells were installed by jackhammering a steel drive tube to a depth 2 feet below the water table and then removing the tube with a railroad jack. A 3-foot length of 3/8-inch flexible tubing was attached to the top of a 3/8-inch stainless steel pipe and lowered down the hole to collect a sample, a vacuum was applied when the pipe was a few inches below the water table, the flexible tubing was then bent and clamped, and the pipe was lifted out of the hole. Two 14-mL (milliliter)

sample vials were filled. The sample vials were filled by slowly releasing the clamp, and the vials were stored on ice for later analysis. Some modifications to this sample collection procedure were made during the course of the study. To prevent borehole collapse upon removal of the steel drive tube, a perforated tip was attached to the end of the tube and the tube was left in the hole during sample collection. Also, samples were collected by securing the sample vial at the end of a thin stainless steel rod and lowering the vial to the water table directly through the driven hollow tube. All downhole tools that were used in this phase were cleaned with a methanol solution and dried with an electric hair dryer.

Bottom-filling glass bailers were used to collect water samples from observation wells for the analysis of volatile hydrocarbons. Before each sample was collected, five casing volumes were pumped from the well. Prior to sampling each well, the bailer was rinsed with a 10-percent methanol solution and an acetone-hexane mixture (60 to 40, by volume). Remaining solvent residues were then removed from the bailer by baking in an oven, by heating with an electric hair dryer, or by aspirating with a vacuum pump. The cleaned sampler was then rinsed by bailing three times from the well. A sample vial was filled from the fourth bailing and packed in ice until analysis. The technique used to collect samples from domestic wells was similar to that used during the insurance company study. All volatile hydrocarbon water samples collected were analyzed by the staff from the Oregon Graduate Center.

1989 Study

The procedure used to sample observation wells in the 1989 study was nearly identical to that used during the ground-water toxics study. One difference was that the bailer was rinsed with organic-free water after the acetone-hexane rinse. Also, the bailer was routinely baked in an oven at 105 °C for 1/2 hour after the organic-free water rinse. Results of tests to check the adequacy of the cleaning procedure are given in Appendix A.

Samples collected were analyzed by the U.S. Geological Survey National Water Quality Laboratory (NWQL) in Arvada, Colorado. Field quality-assurance procedures included duplicate samples, field blanks, and field-spiked samples with known amounts of target compounds. These procedures are described in Appendix A.

Ground-Water Analysis Methods

All three studies utilized similar gas-chromatographic techniques for determining concentrations of volatile hydrocarbons in ground-water samples. Differences in techniques are noted below and references are given for more details. Analyses performed by Oregon Graduate Center produced concentrations that were blank-corrected, as referenced in Appendix A. Analyses performed by the other studies were not blank-corrected.

Insurance Company Study

Samples were analyzed for benzene, toluene, and total xylenes (the sum of the meta, para, and ortho isomers), and a value was calculated for total hydrocarbons expressed as gasoline. Samples were analyzed using a Tekmar LSC-2 liquid sample concentrator linked to a Perkin-Elmer Sigma 300 gas chromatograph with flame ionization detection (FID), on a 6-foot stainless steel column with SP-1000 100/120 mesh packing. Total xylenes, benzene, and toluene were identified by retention time and quantified by comparison with known standards using an SP-4000 data system. Total gasoline concentrations were calculated by comparison of total peak area to a gasoline standard total peak area.

Ground-Water Toxics Study

The analytical method utilized by Oregon Graduate Center was purge and trap with whole-column cryotrapping. This method was employed with fused-silica, capillary-column gas chromatography (GC), as developed by Pankow and Rosen (1984) and optimized by Pankow (1986). Both FID and mass spectrometric (MS) detection were utilized. The purge and trap device used was a Chemical Data Systems Model 320 concentrator. The GC/MS used was a Hewlett-Packard 5790A GC interfaced to a Finnigan 4000 MS/DS (data system). The carrier flow from the capillary column exiting the GC was split, approximately half of the flow directed into the MS source, and the remainder to a FID housed in a Hewlett-Packard 5700A GC.

Normally, a 5.0-mL aliquot of sample was loaded into the sparging vessel and each aliquot was spiked with 10 µL (microliter) of an internal standard solution in methanol. In the case of highly contaminated samples, smaller sample aliquots were loaded into the sparging vessel and organic-free water was added to produce 5.0 mL of diluted sample for analysis. Samples were analyzed for a set of 18 target compounds (table 5) known to be components of gasoline and diesel fuel. During sample analysis, standards containing known concentrations of target and internal standards compounds were routinely run. Replicates of the samples were run back to back, a day apart, and in one case, 6 days apart.

Sample concentrations were computed based on the appropriate sample and standard peak areas and were blank-corrected using replicate values of blanks, duplicates, and standards. The internal-standard compounds served to compensate for any variations in the purging efficiencies and the system response. The response factors were assumed to be linear over the concentration range of interest.

1989 Study

The method utilized by the NWQL to analyze samples was purge and trap. This method was employed with gas chromatography and electron impact mass spectrometry (GC/MS) as per EPA Method 524.2 (U.S. Environmental Protection Agency, 1988a), and the list of volatile organic compounds targeted by this analytical method was modified by adding standards for the quantification of five compounds in addition to those targeted by EPA Method 524.2 (table 5). The purge and trap device used was a Tekmar LSC 2000 with an ALS 2016 and

ALS 2032. The 25-mL sample was purged for 11 minutes at ambient temperature with a gas flow of 40 mL per minute, desorbed at 180 °C for 4 minutes onto a 30 meter x 0.53 mm ID (inside diameter) DB-624 megabore column and baked at 225 °C for 15 minutes. Temperature of the Finnigan Incos 50 MS/DS was held at 10 °C for 1 minute, then increased to 160 °C at 5 degrees per minute, and held at 160 °C for 1 minute. The megabore column was coupled directly to the mass spectrometer, which was set to analyze from 45 to 300 atomic mass units with a scan time of 1 second. A Hewlett-Packard HP5996A MS/DS was used for those samples on which a library search was performed. Ten percent of the samples were run in duplicate, and 10 percent of the less-contaminated samples were spiked with a solution containing six matrix spike compounds. Additional quality assurance measures included daily blanks, daily standards, daily instrument tuning, and quality control check samples.

A library search was performed on selected analyses in an attempt to identify non-target compounds. Mass spectra from corresponding GC peak maxima were compared with National Bureau of Standards library reference spectra using a computer library search. The best library matches were selected according to a "reliability factor"—a parameter used by the library search algorithm to quantify the match between the sample and library spectra. The best computer matches were compared with the sample spectrum manually to attempt the best possible tentative identification.

Soil Gas

Samples of soil gas, the gas in the pore spaces in the soils and sediments above the water table, were collected from temporary-driven sampling

tubes and from permanent wells in which multidepth sampling tubes were installed. Samples from the temporary-driven wells were taken from locations with the lowest expected concentrations and then from locations where larger concentrations were expected. A 6-foot-long, 3/4-inch OD (outside diameter), 1/4-inch ID stainless steel casing tube was driven to a depth of 5.5 feet below land surface and then backed out a few inches. Then, a 7-foot stainless steel sampling tube was inserted 1 inch beyond the bottom of the casing tube. Two hundred mL of soil gas, an amount which was greater than 5 times the volume of the sampling system, were drawn through the sampling tube with a vacuum pump. A Tenax-GC sample cartridge was then placed in line and the system was pumped for about 12 minutes at a rate of about 40 mL per minute. The sample cartridge was then removed, the ends were capped, and the sample was stored in an organic-free environment at ambient temperature prior to analysis.

Sampling techniques and analytical methods for multidepth wells were the same as for the temporary driven wells. The stainless steel sampling tubes each extended to a specified depth, were surrounded with sand, and were sealed from each other with concrete.

Soil-gas analysis was done by adsorption onto a Tenax cartridge followed by thermal desorption with whole-column cryotrapping on the GC and FID and MS detection. The Tenax cartridges needed no sample preparation prior to desorption. The cartridge was placed in the desorption apparatus and purged for 10 minutes with a backflow of helium to remove the oxygen and most of the methanol. The Tenax cartridge was desorbed at 250 °C for 10 minutes at 30 psi and the released compounds were readsorbed onto the GC column, which was held

at a temperature of -80 °C. After desorption, the GC column temperature was raised rapidly to 0 °C, and then programmed to increase at 10 °C per minute to 250 °C. Additional details are given by Ligocki and Pankow (1985).

Aguifer Materials

In November 1986, samples of both solid aquifer material and water were collected from selected observation wells. Concentrations of lead dissolved in water and lead adsorbed onto the surface of the less-than-63-µm (micrometer) fraction of the aquifer material were determined. Because samples of aquifer material could not be obtained easily by coring, due to the cobblely nature of the deposits, samples of fine-grained aquifer materials that had passed through well screens after installation of the well were obtained by placing a pump intake near the bottom of the well. Approximately 5 gallons of sediment-laden water were pumped from each undeveloped well and collected in a clean plastic bucket. The sediment was separated by settling, dewatered by filtering into a firm cake, placed in a polyethylene bag, and stored on ice. The firm cake was then processed by mixing with water and wetsieving through a 63-μm polypropylene sieve. The less-than-63-μm fraction was filtered to a moist cake, subsampled, and digested with a solution composed of 6% Ultrex nitric acid and 1 molar reagent-grade ammonium acetate. The samples were then analyzed in the same manner as the filtered ground water (Fish, 1987). After developing the well by pumping at 10 gallons per minute for 20 to 30 minutes, ground-water samples were collected by pumping through acidwashed Tygon tubing and filtering through acid-washed 0.1 µm (pore-size) membrane filters into acid-washed polypropylene bottles.

CHEMISTRY OF GROUND WATER, SOIL GAS, AND AQUIFER MATERIALS

Volatile Organic Compounds in Ground Water

Insurance Company Study

During the insurance company study, at least one of the three target compounds (benzene, toluene and total xylenes) was detected at least once in four of the 21 wells (figs. 8 to 12 and table 6). Target compounds were detected consistently, and at relatively large concentrations, in water from well M11-85, located about 150 feet from the leak site. Target compounds were consistently detected in only one domestic well, D10, located about 1,200 feet downgradient, but concentrations were smaller than in M11-85. Target compounds were detected in wells M8-85 and M10-85, located about 900 feet downgradient of the leak site, but the occurrences were sporadic and concentrations were relatively small. The wells used in this study were too widely separated to define in detail the distributions of hydrocarbon compounds in ground water.

Ground-Water Toxics Study

During the ground-water toxics study, ground-water samples were analyzed for up to 23 aromatic hydrocarbons, primarily alkylated-benzenes (table 5).

All but six of the compounds were identified in ground water. Concentrations of compounds found during the different sampling periods of this study are given in table 7. Because of changes in analytical methods during the course

of the study, not all of the target compounds were analyzed in each of the sampling periods. Furthermore, the method for reporting analytical results when concentrations were near background or detection levels differed among sampling periods.

Data for benzene, toluene, naphthalene, and total xylenes are shown in figures 8 through 11. These four compounds are some of the more water-soluble aromatic compounds in gasoline (table 3), and their presence and concentrations compare well with the presence of other target compounds. Concentration isopleths of 5 µg/L (micrograms per liter) are estimated and approximate locations shown for each of the four compounds, and the symbols identify locations where concentrations are greater or less than 500 µg/L. A value of 5 $\mu g/L$ was chosen as the isopleth concentration because it is an order of magnitude greater than the level of detection for most compounds and, consequently, there is a high certainty of detection at this concentration, eliminating any doubt of trace detections at or near the detection level. The isopleth concentration is significant because it is also the drinking water MCL for benzene (U.S. Environmental Protection Agency, 1988c). An MCL does not exist for toluene, naphthalene, or total xylenes, but there is a proposed MCL for toluene of 2,000 µg/L and a secondary MCL for total xylenes of 10,000 µg/L.

During the first sampling period in August 1985, detectable concentrations of benzene, toluene, naphthalene, and total xylenes were identified in samples from 5 of 15 insurance company observation wells, 1 of 13 temporary wells, and 2 of 31 domestic wells (table 7). Although petroleum-related compounds were detected as far as 1,000 feet from the service station,

concentrations of individual compounds exceeded 500 μ g/L only in samples from the three wells closest to the service station (figs. 8 to 11). A petroleum sheen was noted on samples from two of these three wells (M3-82 and M11-85), indicating the presence of free product.

During the second sampling, from April through June 1986, detectable concentrations of benzene, toluene, naphthalene, or total xylenes were found in the samples from 5 of 6 insurance company observation wells and at all 29 of the temporary wells. Observed concentrations of benzene, toluene, naphthalene, and total xylenes (figs. 8 to 11) indicate that some of the dissolved compounds had migrated in an east-north easterly direction.

During the third sampling in November 1986, benzene, toluene, naphthalene, or total xylenes were detected in samples from 5 of 8 insurance company observation wells and in 18 of the 23 observation wells installed during this study (pl. 1 and table 4). Concentrations of some of these four compounds exceeded 500 μ g/L at eight of the observation wells within 400 feet of the service station (figs. 8 to 11).

The vertical distribution of hydrocarbons dissolved in ground water was also investigated. Observation wells which penetrated deeper into the aquifer, M2, M6.1, M7.1, and M13 (pl. 1 and table 4) were sampled in November 1986. Observation wells M6.1 and M7.1 are paired with shallow wells, M6.2 and M7.2, respectively. Observation wells M6.1 and M6.2 were installed in the same hole about 1,300 feet downgradient of the service station, with M6.1 extending to 46 feet below land surface and the latter well screened at the water table. Observation wells M7.1 and M7.2 are a similar pair installed in

a hole about 500 feet downgradient from the service station. Benzene, toluene, naphthalene, total xylenes, ethyl benzene, and other alkyl benzenes were detected in all the deeper observation wells that were sampled.

Concentrations of dissolved hydrocarbons in the ground water from observation wells M2 and M6.1 were less than 1 µg/L; whereas, observation well M7.1 had a concentration of 3.2 µg/L total xylenes. Concentrations of dissolved hydrocarbons in ground water from observation well M13 ranged from 0.5 to 47 µg/L. The concentrations of dissolved hydrocarbons in ground water from deeper wells range from one to more than three orders of magnitude smaller in comparison to the concentrations of hydrocarbons dissolved in ground water from observation wells at the water-table surface. The major portion of the leaked gasoline and diesel fuel dissolved in the ground water appears to be near the surface of the water table. Further, the migration of dissolved hydrocarbons in the ground water is preferentially in a horizontal downgradient direction.

1989 Study

Concentrations of volatile organic compounds in ground-water samples collected in 1989 indicate that there are still dissolved components of gasoline and diesel fuel in the ground water (table 8, figs. 8 to 11). Concentrations of benzene, toluene, naphthalene, and total xylenes greater than the detection limit of 0.2 μ g/L were found in ground-water samples from 11 of the 27 sampled wells. Concentrations exceeded 500 μ g/L for only total xylenes at two wells, M3-82 and M16. Significant amounts of toluene or other alkyl benzenes were also found at these two wells and at M11-85, but concentrations for all compounds were less than 500 μ g/L.

In March 1989, concentrations of petroleum-related compounds in ground water were less than in 1985 and 1986 (tables 6 and 7, figs. 8 to 11).

Consequently, the concentrations of petroleum-related products dissolved in ground water appear to be decreasing, and the area within specific concentration isopleths also appears to be decreasing. However, one should note the above conclusion is based on a single sampling in 1989.

Common Constituents, Trace Metals, and Dissolved Organic Carbon in Ground Water

The shallow ground water within the leak area is predominantly of the calcium-magnesium bicarbonate type (see fig. 13 and table 9). Specific conductance values ranged from 208 to 390 µS/cm (microsiemens per centimeter) at 25 °C, and values of pH ranged from 6.3 to 6.9. Dissolved-oxygen concentrations were low, with a median value of 0.6 mg/L (milligrams per liter). Dissolved-oxygen concentrations upgradient of the leak area at observation well M1-85 ranged from 6.3 to 6.8 mg/L; whereas the ground water contained little or no oxygen at sites M2082, M3-82, M11-85, M12, M16 and M18 in the leak area. Concentrations of metals were generally less than 0.10 mg/L and did not exceed the MCL (Maximum Contaminant Level) for drinking water, except for dissolved manganese, which exceeded the secondary MCL at 15 sites, and dissolved iron, which exceeded the secondary MCL at 12 sites (U.S. Environmental Protection Agency, 1988b). The median concentration of dissolved organic carbon was 1.9 mg/L, with values ranging from 0.6 to

Small dissolved-oxygen concentrations in ground water caused by the oxidation of organic compounds in the gasoline and diesel fuel affected concentrations of iron and manganese as well as the concentrations and speciation of nitrogen compounds in ground water at the site. Small concentrations of dissolved oxygen are often indicative of the biological oxidation of carbon and consumption of oxygen. Under these reducing conditions, iron and manganese are more soluble and concentrations of iron and manganese in ground water are generally larger than under oxidizing conditions. Reduced forms of nitrogen, particularly ammonia, are also found in anoxic ground water. Samples analyzed during the ground-water toxics study and the 1989 study show a strong relationship between the detection of volatile hydrocarbons in the ground water and large concentrations of iron and manganese, detectable ammonium, and nitrate values at or near the level of detection. Reduced forms of sulfur were not specifically analyzed, but the smallest concentrations of sulfate were analyzed in ground water from wells within the leak area. Samples analyzed for dissolved organic carbon generally showed a relationship between elevated concentrations of dissolved organic carbon in the ground water and the detection of volatile hydrocarbons. Elevated concentrations of dissolved organic carbon from observation wells M7-85 and M6.2 could be due to contamination during processing and handling, but these values could also be representative of non-volatile forms of hydrocarbons.

A sufficient number of samples were analyzed for inorganic constituents to accurately define the area of reduced conditions during the November 1986 sampling (see fig. 14 and table 9). The differences between the areas of reducing conditions and oxidizing conditions are clearly defined. In 1989,

however, the smaller number of samples shows a general picture of reduced conditions immediately downgradient of the leak area and oxidizing conditions upgradient and further downgradient of the leak area (fig. 14). There were exceptions to this relationship in both studies. Samples from observation well M29 also indicate reduced conditions, but the concentrations of volatiles were small. During the ground-water toxics study and the 1989 study, results from observation well M18 indicate reduced conditions, but concentrations of volatile samples during the 1989 study are much smaller than November 1986. As the spill products age, non-volatile forms of carbon will prevail and the oxidation of these species will also cause reduced conditions. During the ground-water toxics study, samples from observation well M1-82 contained large concentrations of volatile hydrocarbons and dissolved manganese, but the concentrations of ammonium, nitrate, and iron were small.

It is quite unlikely that reduced conditions in the leak area are due to a natural phenomenon. The permeable soils and the relatively large influx of freshly-oxygenated ground water that flows past the leak area toward the river are strongly supportive of biodegradation of the spilled diesel and gasoline as the cause of the reduced conditions of ground water immediately downgradient of the leak site.

Lead in Ground Water and Aquifer Materials

Concentrations of lead in the filtered ground-water samples ranged from 1.4 to 10.1 μ g/L (table 10). These concentrations are less than the EPA drinking-water MCL of 50 μ g/L (U.S. Environmental Protection Agency, 1988c). Samples of aquifer material contained lead with concentrations 30 to 10,000

times greater than in ground-water samples on a per weight basis (table 9).

Because of the large affinity of the divalent lead ion for sediment, it is not unusual to find small concentrations of lead in ground water and large concentrations of lead in sediments. As a result of this affinity, inorganic lead is relatively immobile in ground water.

There is little or no correlation between concentrations of lead in soil and in ground water (correlation coefficient = -0.19). Fish (1987) concluded that a simple adsorption or ion-exchange model does not explain the distribution of lead between the solid and aqueous phases. Calculations indicated that the observed concentrations of lead in the ground water were near the limit of solubility for PbCo₃. Therefore, precipitation of PbCo₃ may control the concentration of lead in ground water. Because the area with elevated concentrations of lead in the aquifer materials is similar to the area with elevated levels of aromatic hydrocarbons dissolved in ground water (fig 15), the source of the lead is probably lead additives in gasoline, tetraethyl and tetramethyl lead.

The similarity between spatial distributions of lead in the aquifer materials and some of the aromatic compounds dissolved in ground water suggests that some of the lead has moved in approximately the same direction as some of the aromatic compounds dissolved in the ground water (Fish, 1987). Consequently, Fish concluded that the lead is, or has been, more mobile than the retardation factors imply, and that there are several possible modes of transport. Shortly after the gasoline leak, the lead could have been transported as part of the free product. It could have been transported by ground water when in the more soluble alkyl lead phase, which subsequently

degraded to inorganic lead that precipitated out of solution. The lead in the aquifer materials also could have been transported by colloidal-size particles.

Soil Gas

In November 1985, soil-gas samples were collected from seven temporary wells, SGT1 through SGT3 and SGT6 through SGT9 (fig. 16). Although plans were made to collect samples from about 25 wells, problems with frozen ground and cobblely soil resulted in fewer samples collected than planned. Also, because of problems with internal standards, concentrations of compounds detected in the soil-gas samples were qualitative and not quantitative.

In November 1986, soil-gas samples were collected from six multidepth soil-gas tubes (fig. 16, table 11). Target compounds (table 12) and mixed alkanes were detected at some depths at three of the six wells, SG3, SG5, and SG8 (fig. 16). With the exception of toluene and several alkyl benzenes that were found at mid-depths of 3 to 6 feet below land surface in SG8, most compounds were detected only close to the water table at the deepest levels from which samples were withdrawn (table 11). This is consistent with the steep concentration gradients of concentrations in soil gas near the water table that have been found by others (see for example, Hult and Grabbe, 1985).

Target compounds (table 12) were detected in samples from wells SGT2 and SGT7. Also, chromatographs for samples from wells SGT1, SGT3, and SGT9 contained peaks that are indicative of likely degradation products of aromatic hydrocarbon compounds (J.R. McPherson, Oregon Graduate Center, Beaverton,

Oregon, verbal commun., 1989). Soil gas from wells SGT6 and SGT8 did not contain detectable amounts of hydrocarbon compounds. Although gas samples were collected from wells SGT4 and SGT5, difficulties with collection and analyses of samples from these two wells preclude making any statements about the presence or absence of hydrocarbon compounds in soil gas at these two sites. These two wells are not shown in figure 16.

SUMMARY AND CONCLUSIONS

An estimated 12,000 to 22,000 gallons of gasoline and diesel fuel were leaked to unsaturated sediments and shallow ground water from an improperly installed delivery line at a service station in Yakima, Washington. Data indicate the fuel leak is contained within unconsolidated sediments and shallow ground water 7 to 12 feet below land surface.

Unsuccessful attempts in 1982-83 at recovery of fuel in the ground were followed by a study in 1984-85, under the direction of an insurance company, to monitor the presence of dissolved hydrocarbons in ground water. From August 1985 through November 1986, in a separate study by the U.S. Geological Survey, dissolved hydrocarbons and lead were determined in ground water and soil gas was determined in the unsaturated sediments. Fine-grained sediments in the aquifer were also analyzed for lead. The gasoline leak in Yakima was selected to be a part of a national study of ground-water sites contaminated by toxic compounds, but the study was discontinued before an interpretive phase was completed. In a follow-up study, data were collected in March 1989 to determine the concentrations and areal extent of dissolved hydrocarbons in ground water and to compare results with those of the two previous studies.

All three studies utilized similar gas-chromatographic techniques for determining concentrations of benzene, toluene, naphthalene, and total xylenes in shallow ground water for five sampling periods beginning in 1985. A large concentration of 600 μ g/L toluene and 980 μ g/L of total xylenes was found in one domestic well about 1,200 feet downgradient of the leak, but water in other domestic wells sampled beginning in 1984 had hydrocarbon concentrations

that were all less than 500 μ g/L. Samples collected from 1985 to 1986 indicate dissolved hydrocarbons in observation wells commonly exceeded 500 μ g/L at distances of 150 to 500 feet downgradient from the gasoline leak. Soil-gas samples taken in November 1986 indicated dissolved hydrocarbons were detected only close to the water table.

By March 1989, concentrations of dissolved hydrocarbons had decreased and the areal extent over which they were present in shallow ground water was smaller. Concentrations of dissolved hydrocarbons were less than 500 μg/L near the source of the leak and were generally below 5 μg/L at distances more than 350 feet from the source of the leak. In contrast, during the sample periods of November 1986 and earlier, hydrocarbon concentrations exceeded 5 μg/L at distances of 600 to 1,000 feet from the source of the leak. The decrease in dissolved hydrocarbons in the shallow ground water between 1984-86 and 1989 could be due to natural dispersal, volatilization, or biodegradation.

Concentrations of dissolved lead in ground water were small for the sample periods from 1986-89. These concentrations were 1.4 to 10.1 μ g/L and less than the MCL of 50 μ g/L for drinking water. Lead has a high affinity for soils and is relatively immobile in ground water. However, concentrations of lead in aquifer sediments suggest lead has moved in the aquifer in the same direction as the dissolved hydrocarbons have moved.

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APPENDIX A: QUALITY ASSURANCE

The quality of the data from all three studies cited in this report appears to be good. Differences between concentrations in duplicate samples are within reasonable limits and concentrations of standards, spiked samples, and blank samples were satisfactory (see tables A1 to A6).

Insurance Company Study

The quality assurance portion of the insurance company study consisted of field blanks, lab blanks, and duplicate samples. Concentrations of benzene, toluene, and total xylenes in field and laboratory blanks were less than the detection limit of 1 microgram per liter (table A1). Sample results for the insurance company study were not blank corrected. Replicate analyses of a sample from observation well M11-85 indicate good reproducibility for all compounds except toluene. On August 27, 1985, personnel from the insurance company study and the ground-water toxics study independently collected samples from four wells and the samples were analyzed by their respective laboratories (see table A2). The agreement between the two sets of results is good except for the concentration of benzene in the samples from W11-85, and perhaps the concentration of toluene in the samples from M11-85. Differences between other concentrations can easily be attributed to variabilities in sample collection and analysis.

Ground-Water Toxics Study

The quality assurance during the ground-water toxics study consisted of collecting duplicate samples, doing replicate analysis, and analyzing tripblank samples. Organic-free blank water for trip blanks and sample dilutions was prepared in the OGC laboratory. The replicate analyses of trip blanks and duplicate samples were used for the calculation of statistical limits of detection. Mean and standard deviation of concentrations detected in the trip blanks for the August 1985 sampling are listed in table A3. Sample results were correspondingly blank-corrected. Concentrations determined for mixtures of standard solutions supplied by the U.S. Environmental Protection Agency are compared with concentrations in the standards (table A4).

1989 Study

Organic Constituents

The quality assurance during the 1989 study consisted of collecting duplicate samples and equipment-rinse samples, using blank-water samples and trip-blank samples, and spiking samples with identical concentrations of target compounds in the field and in the laboratory. The blank water used during the current program was commercially available, Burdick & Jackson HPLC water. Equipment-rinse samples consisted of 40 mL of this water that was passed through the sampler after cleaning. Tests were made to check the adequacy of the cleaning procedure prior to field sampling and also during the sampling period.

Samples of the blank water, blank water from an equipment rinse, and blank water from an equipment rinse after baking the sampler were analyzed for volatile hydrocarbon compounds (table A5). The blank water contained relatively small concentrations of methylene chloride and chloroform. Compounds tentatively identified using a NBS library search routinely were hexane and methylcyclopentane. Equipment-rinse blanks contained small concentrations of benzene, toluene, total xylenes, and larger concentrations of methylene chloride and chloroform. The equipment-rinse blanks also contained relatively large concentrations of compounds that were tentatively identified as hexane, methylcyclopentane, 3-methylpentane, and acetone. Equipment-rinse blanks that were passed through the sampler after it was baked at 105 °C contained only small concentrations of chloroform, bromodichloromethane, chlorodibromomethane, and 1,2-dichloropropane. This could complicate the identification of bromide or chloride-substituted methane compounds used as fuel additives, but this poses no problem with the interpretation of other petroleum-related hydrocarbons in the ground-water samples.

Trip blanks were collected with the intention of analyzing the samples only if a problem was suspected in collection or processing techniques.

Because no anomalous results were found, the trip blanks were not analyzed.

Sample results for the 1989 study are not blank-corrected.

One set of replicate samples from observation well M8-85 was spiked in the field with target compounds to check the effective recovery of compounds from a field-matrix sample. Supelco VOC Standard Mixture 2, containing target compounds at a concentration of 2,000 ng/ μ L (manograms per microliter), was

diluted at NWQL to 4 ng/µL. One hundred µL of the 4 ng/µL solution were added to the sample in the field to give a spike concentration of 10 mg/L. An extra sample, un-spiked, also was sent to the laboratory for spiking in the laboratory (table A5). The difference in recovery between the field spikes and the lab spikes ranges from +25 to -7 percent, with an average difference for FS1 of 4 percent and an average of 12 percent for FS2. These differences are considered to be normal, but differences between some of the field and laboratory spike values suggest a partial loss of some compounds which may be due to biodegradation (personal commun., Brooke Connors).

Inorganic Constituents

Various sums, differences, and ratios, based on aquatic chemistry principles, were computed for each inorganic sample. These computations check the consistency between constituent concentrations in a sample and provide a gross check in the accuracy and completeness of the analysis. Two of the most useful computations are the cation-anion balance and calculated dissolved-solids concentration, which are defined in the following paragraphs.

The cation-anion balance is the difference, in percent, between the sums of the concentrations of cations and anions, expressed in milliequivalents. Ideally, this value is zero, but non-zero values occur when a cation or anion concentration is in error, or when the concentration of a significant ion (often a metal) is not determined. The acceptable difference varies with the total sum of cations and anions. The differences ranged from 0.0 to 5.97 percent.

Calculated solids is the dissolved-solids concentration determined by summing the concentrations of cations, anions, silica, and other major dissolved constituents. This value is theoretically equal to the dissolved-solids concentration determined in the laboratory by residue upon evaporation. Differences usually are due to errors in analyses of the various cations or anions (which may be verified by the cation-anion balance), or errors in the laboratory-determined dissolved-solids concentration. For analyses at the study site, differences between the calculated and analyzed dissolved solids ranged from 2 to 9 percent.

The primary controls on field values of pH, specific conductance, dissolved oxygen, and temperature are proper instrument calibration and field procedures. However, pH and specific conductance also are determined in the laboratory. Differences between laboratory and field specific conductances were less than 5 percent in all cases (table A6).

Field and laboratory pH differed by more than 0.2 units for only three out of 18 samples and none of these differences are more than 0.5 units.

Because pH and specific conductance can change during the time between the field and laboratory determinations, these comparisons must be considered approximations at best, but the good agreement generally serves to confirm the field values.

Field determinations of bicarbonate concentrations were checked by calculating alkalinities from them and comparing the results to laboratory-determined alkalinities. Field and laboratory alkalinities differed by more than 5 percent for only one of six samples.

Duplicate samples were collected and analyzed for both inorganic and organic constituents during the 1989 study (table A7). Dissolved zinc is the only constituent where duplicate sample results do not agree. Results were verified by reruns of split samples. The differences could be explained by contamination during handling or natural variability in the water. The ground water sampled at the site contained particulate matter which could be variable from one sample to another (see turbidity values, table A6). Upon acidification, colloidal zinc would be transformed into the dissolved state.

Table 1.--Major hydrogeologic units in the Ahtanum-Moxee subbasin, Washington

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System	Series	Group	Formation	Hydrogeologic description
Quaternary	Нотоселе		,	Alluvium and terrace deposits consisting principally of unconsolidated stream deposits of silt, sand, and gravel, with cobbles throughout. Locally lacustrine, paludal, and eolian deposits occur. Generally, deposit is a thin mantle less than 50 feet thick, but known to reach 165 feet thick at one point in subbasin. Estimates of porosity range from 15 to 25 percent and from 0.4 to 86 feet per day hydraulic conductivity.
Quate	Pleistocene			Coarse sand and gravel deposits including large amounts of cemented mixture of basaltic gravel, sand, silt, and clay. Locally contains discontinous and unconsolidated bodies of glacial fluvial and lacustrine deposits. Up to 500 feet in thickness. In general unit has low permeability except in unconsolidated sections.
lary	o Pliocene	-	Ellensburg	A thick sequence of stream- and lake-deposited silt, sand, and gravel which is composed chiefly of volcanic ash, punice, and hornblende andesite. Thickness exceeds 1,000 feet in some parts of subbasin. It has moderate to high porosity and low to medium permeability, and provides a large amount of effective storage. Permeable strata form important aquifers. Unit includes all conformably underlying sediments of similar lithology that intertongue with flows of the Columbia River Basalt.
Tertlary	Micocene to Pliocene	Columbia	Saddle Mountains Wanapum	Sequence of dark lava flows which contains some interbedded lake- and stream-deposited materials. Individual lava flows range from less than 20 to over 200 feet in thickness. The maximum thickness of the Columbia River Basalt exceeds 4,000 feet in the Yakima River Basin. Water generally moves along the
		River Basalt	Grande Ronde	interflow zones, which are more permeable than the massive centers of the flood. The porosity of this formation probably ranges from 5 to 10 percent, and its permeability ranges from low to very high. Provides a large quantity of effective ground-water storage and includes some important aquifers.

Table 2.--Observed water levels in observation and domestic wells
[Water levels are in feet below land surface (table 4)]

					•					2				
Well iden- tifier	S	Dat	е	Water level	Well iden- tifier		Dat	е	Water level	Well iden- tifer		Dat	е	Wate leve
M1-82	Feb	21,	1985	11.37	M2-82	Feb	21,	1985	11.48	M3-82	Feb	21.	1985	10.0
	May	11.55		10.57		May	11000000		10.55		May	-	1,00	9.2
	Aug			8.84		Aug			9.47		Aug			8.0
	Apr	23,	1986	10.00		Apr	23,	1986	9.88				1986	8.6
	May	14		9.36		May	14		9.12		May			7.9
	Jun	23		9.00		Jun	23		8.54		Jun			7.5
	Jul	28		8.91		Jul	28		8.40		Jul	28		7.4
	Sep	22		8.69		Sep	22		8.25		Sep	22		7.2
	Nov	19		11.12		Nov	19		11.01		Nov			9.7
	Dec	17		11.46		Dec	17		11.40		Dec			10.0
	Jan	20,	1987	11.67		Jan	20,	1987	11.60		Jan	22,	1987	10.2
	Feb	17		11.58		Feb	17		11.46		Feb	17		10.1
	Mar	16		11.39		Mar	16		11.32		Mar	16		9.9
	Apr	22		11.05		Apr	22		10.86		Apr	22		9.6
						Mar	18,	1989	11.65		Mar	18,	1989	10.1
11-85	Feb	21,	1985	12.9	M2-85	Feb	20,	1985	6.22	M3-85	Feb	20.	1985	7.9
	May	10		11.58			21		6.27			21		8.0
	Jun	09		9.37		May	10		6.11		May			7.6
	Aug	02		9.84		Jun	09		5.37		Jun			6.6
		29		9.95		Aug	02		5.66		Aug			7.1
		30		9.69			29		5.72			29		7.2
	Sep	21		9.68			30		5.58			30		7.0
	Oct	16		10.91		Sep	21		5.57		Sep	21		6.9
	Nov	15		11.86		Oct	16		5.44		Oct			6.5
	Dec	13		12.69		Nov	15		6.29		Nov	15		7.2
	Jan	24,	1986	12.24		Jan	24,	1986	6.06		Dec			8.0
	Feb	21		11.99		Feb	21		5.87		Jan	24,	1986	8.1
	Mar	20		11.59		Mar	20		5.67		Feb			7.8
	Apr	23		10.58		Apr	23		5.67		Mar	20		7.7
	May	14		9.72		May	14,	1986	5.67		Apr	23		7.40
	Jun	23		9.11		Jun	23		6.34		May	14		6.86
	Jul	28		9.00		Jul	28		6.60		Jun	23		7.13
	Sep	22		8.96		Sep	22		5.51		Jul	28		7.1
	Nov	20		12.48		Nov	20		6.62		Sep	22		6.4
	Dec	17		12.85		Dec	18		7.04		Nov	20		8.9
	Jan	21,	1987	13.17		Jan	22,	1987	7.18		Dec	17		8.6
	Feb	18		13.05		Feb	17		6.64		Jan	22,	1987	8.6
	Mar	16		12.75		Mar	16		6.24		Feb			8.59
	Apr	23		12.25		Apr	23		6.66		Mar			8.40
	Mar	13,	1989	13.33		Mar	14,	1989	9.14		Apr			8.38

Table 2.--Observed water levels in observation and domestic wells

										•	_	_			
Well iden-		Dat	.e	Water level	Well iden-		Dat	ce	Water level	Well iden-		Dat	e		ter
tifier	:				tifier	c				tifer					
M4-85	Feb	20.	1985	8.95	M5-85	Feb	20	1985	5.39	W6 05	P-1-	20	1005		
		21		8.95	110 00	LCD	21	1303	5.38	M6-85		21	1985		.55
	May			7.91		May			5.17		May				.55
	Jun			5.83		Jun			4.69		Jun				.25
	Aug			6.12		Aug			5.04		Aug				.61
	-	29		6.31		,	29		5.13		55.0	29			.48
		30		6.07			30		4.91			30			.89
	Sep	21		6.04		Sep			4.89		Sep				.88
	Oct	16		7.10		Oct			4.67		Oct				.66
	Nov	15		8.09		Nov	15		5.23		Nov				.88
	Dec	13		8.90		Dec	13		5.39		Dec				.01
	Jan	24,	1986	8.69		Jan	21,	1986	5.05				1986		.64
	Feb	21		8.58		Feb	21		4.90		Feb				.36
	Mar	20		8.15		Mar	20,	1986	4.85		Mar				.25
	Apr	23		6.96		Apr			5.02		Apr			200	.14
	May	14		6.07		May	14		4.79		1ay				.70
	Jun	23		5.40		Jun	23		5.02		Jun				.16
	Jul	28		5.07		Jul	28		5.10		Jul				.34
	Sep	22		4.94		Sep	22		4.56		Sep				.37
	Nov	20		8.55		Nov	20		5.30	1	lov	20			.72
	Dec			8.98		Dec	18		5.49)ec				.11
	Jan	21,	1987	9.26		Jan	22,	1987	5.56		Jan	22,	1987		.31
	Feb	17		9.04		Feb	18		5.48		eb				.03
	Mar	16		8.92		Mar	16		5.32	h	lar	16			. 87
	Apr	23		8.27		Apr	23		5.46	7	pr	23			. 93
						Mar	13,	1989	5.64	4	la r	13,	1989	8	.52
17-85	Feb	20.	1985	7.40	M8-85	Fob	20	1005	9.47	W0 00		١. ٥			
		21		7.43			21	1505	9.49	143-02	1		0, 19	83	9.8
	May			7.13		May			8.92		M		1		9.
	Jun			6.09		Jun			7.92			ay 1			9.
	Aug			6.72		Aug			8.43			nd 0			7.
		29		6.79			29		8.50		n	- S	9		8.
		30		5.63			30		7.33				0		8.
	Sep			6.09		Sep			7.93		Se	p 2			8.
	Oct			6.40		Oct			8.38			t 1			8.
	Nov			7.42		Nov			8.99			v 1			8.
	Dec			7.66		Dec			9.29			c 1			9.
			1986	7.14				1986	9.17				3 4, 19	0.6	9.
	Feb :			7.07		Feb		1,00	9.07			b 2		00	9.
	Mar :			6.89				1986	8.73			r 2			9.
	Apr :			6.83		Apr		2300	8.56			r 2			9.
	May :			6.13		May			8.08			y 1			8. 7.
	Jun :			6.40		Jun			8.04			n 2			
	Jul 2			6.63		Jul			8.04			1 2			7. 7.
	Sep 2			5.84		Sep			7.45			p 2			7.
	Nov 2			7.40		Nov			9.07			v 2			
	Dec 1			7.78		Dec			9.31			c 1			9.
	Jan 2		1987	7.93				1987	9.48					7	9.
	Feb 1			7.75		Feb			9.42			n 2	0, 198) /	10.
	Mar 1			7.62		Mar			9.22						9.
	Apr 2			7.65		Apr			9.18			r 1			9.
	Mar 1		1989	8.05				1989				r 2			9.5
		,	_ , , ,	0.00		Har	111	1989	9.59		ма	r I	5, 198	19	10.

Table 2.--Observed water levels in observation and domestic wells

					_										
Well iden- tifi	-	Dat	:e	Water level	Well iden- tifier		Dat	e	Water level	id	ll len- fer		Dat	e	Water level
M1.0-1	85 Feb	20	1005	9.72	M11-85	D-L	20	1005	10.04						
1110	00 160	21	1505	9.72	M11-63	reb	21	1983	10.94	MI	2-85	Feb	150	1985	11.52
	May			9.09		May			10.94				21		11.52
	Jun			8.06		Jun			9.96			May			10.68
	Aug			8.34		Aug			11.81 7.83			Jun			9.24
	iiug	29		7.93		Aug	29					Aug			9.82
		30		7.24			30		7.56				29		9.73
	Sep			7.08		Con			6.72			_	30		9.61
	Oct			7.72		Sep			6.76			Sep			9.50
	Nov			8.20		Oct			9.47			0ct			10.12
	Dec			8.55		Nov			10.27			Nov			10.86
			1986	9.23		Dec		1000	10.92			Dec			11.52
	Feb		1900	9.17				1986	10.65					1986	11.15
	Mar					Feb		1000	10.44			Feb			10.98
	Apr			8.83				1986	9.98			Mar			10.53
	- 0.00			8.68		Apr			9.34			Apr			10.13
	May Jun			8.22		May			8.64			May			9.53
	Jul			8.05		Jun			8.11			Jun			9.13
			#6	8.05		Jul			8.01			Jul			9.08
	Sep			7.67		Sep			7.79	22		Sep			8.83
				9.34		Nov			10.58			Nov			11.06
	Dec		1007	9.52		Dec		10112	10.92			Dec	17		11.30
			1987	9.68				1987	10.83				- 5000	1987	11.38
	Feb			9.70		Feb			11.01			Feb			11.50
	Mar			9.52		Mar			10.81		i	Mar	16		11.26
	Apr	22		9.37		Apr		W	10.38		-	Apr	23		11.01
						Mar	18,	1989	11.10						
м1		1111111	1986	12.01	M2			1986	10.55	мз	ĺ	Nov	20,	1986	10.73
	Dec			12.69		Dec			10.84		į	Dec	17		11.02
			1987	12.72				1987	11.01		,	Jan	20,	1987	11.22
	Feb			12.55		Feb			10.94		1	Feb	17		11.16
	Mar			12.39		Mar			10.76		1	Mar	16		10.96
	Apr	22		12.08		Apr	22		10.48		i	Apr	22		10.67
14			1986	10.91	M5	Nov	19,	1986	10.94	М6.	1 1	Nov	20,	1986	10.51
	Dec			11.07		Dec			11.27			Dec	200000		10.89
			1987	11.28		Jan	20,	1987	11.50					1987	11.04
	Feb	17		11.19		Feb	17		11.40			Feb			10.95
	Mar	16		11.01		Mar	16		11.20			Mar			10.76
	Apr	22		10.68		Apr	22		10.72			Apr			10.48
	Mar	17,	1989	11.2											

Table 2.--Observed water levels in observation and domestic wells

Well iden- tifier		Date	•	Water level	Well iden- tifier	Date		Water level	Well iden- tifer	Dat	e	Water level
M6.2	Nov	20,	1986	10.53	M7.1	Nov 19,	1986	11.16	M7.2	Mar 16	. 1987	11.33
	Dec	17		10.79		Dec 17		11.42		Apr 22		10.82
	Jan	20,	1987	10.98		Jan 20,	1987	11.67		5		
	Feb			10.89		Feb 17		11.56				
	Mar			10.72		Mar 16		11.38				
	Apr Mar		1989	10.38		Apr 22		10.97				
м8	Nov	20.	1986	11.32	м9	Nov 20,	1986	11.28	M10	Nov. 20	1000	11 02
	Dec		1,00	11.75		Dec 17	1,000	11.62	1410	Nov 20 Dec 17	, 1986	11.03
			1987	11.92		Jan 20,	1987	11.70		Jan 20	1987	11.41 11.61
	Feb			11.81		Feb 19		11.71		Feb 17	1301	11.50
		18		11.82		Mar 16		11.53		Mar 16		11.32
	Mar	16		11.64		Apr 22		11.13		Apr 22		10.95
	Apr	22		11.14								
м11	Nov	20,	1986	10.89	M12	Nov 19,	1986	11.13	М13	Nov 19	1986	11.15
	Dec	17		11.23		Dec 17		11.46		Dec 17		11.58
			1987	11.45		Jan 20,	1987	11.63		Jan 20	1987	11.83
	Feb			11.35		Feb 17		11.57		Feb 17		11.72
	Mar			11.19		Mar 16		11.40		Mar 16		11.53
	Apr		1000	10.87		Apr 22		11.05		Apr 22		11.17
	mar	17,	1989	11.56		Mar 18,	1989	11.69		Mar 16,	1989	11.90
414	Nov		1986	9.58	M16	Nov 19,	1986	10.99	М17	Nov 20,	1986	11.35
	Dec		1007	9.88		Dec 17	1000	11.42		Dec 17	v 15 V SEBS 90 V SES	11.73
	Jan Feb		1987	10.09		Jan 20,	1987	11.63		Jan 20,	1987	11.97
		18		9.92 9.93		Feb 17		11.52		Feb 17		11.86
	Mar			9.76		Mar 16 Apr 22		11.34		Mar 16		11.64
	Apr			9.43		Mar 18,	1989	11.59	*5	Apr 22 Mar 17,	1989	11.12
	Mar		1989	10.14		nessa . na s		5.53.5.		1142 17,	1,00	12.02
118	Nov	20,	1986	10.99	М19	Nov 20,	1986	11.38	M20	Nov 20,	1986	11.21
	Dec	17		11.36		Dec 17		11.69		Dec 17		11.62
	Jan		1987	11.58		Jan 20,	1987	11.90		Jan 20,	1987	11.88
	Feb			11.46		Feb 17		11.77		Feb 17		11.75
	Mar			11.26		Mar 16		11.61		Mar 16		11.53
	Apr .			10.84		Apr 22		11.16		Apr 22		10.92
	Mar	17,	1989	11.70		Mar 15,	1989	12.08		Mar 17,	1989	12.00
	Nov :		1986	11.49	M22	Nov 20,	1986	10.79	M23	Nov 20,	1986	10.10
	Dec :			11.88		Dec 17		11.03		Dec 17		10.39
	Jan 2		1987	12.15		Jan 21,	1987	11.33		Jan 22,	1987	10.60
	Feb :			11.90		Feb 17		11.13		Feb 18		10.53
	Mar :			11.71 11.31		Mar 16		10.95		Mar 16		10.32
	Apr 2	4		11.31		Apr 22		10.47		Apr 22		10.02

Table 7.--Concentrations of volatile organic compounds in ground water, August 1985 through November 1986--Continued

1,2,3,5- Tetra- methyl- benzene	S	NO	NO	ND	ND	ND	NO	ND	QN	QN	ND							
1,2,3,4- Tetra- methyl- benzene	£	S	S	Q	N	N	S	N	QN	NO	NO	N ON	N	Ω.	S	2	NON	N O
l,3,5- Tri- methyl- benzene	g g	QN	QN.	QN.	2	S	S	QN.	ON	Q.	S	QN.	S	N	N	QX	QN.	S
1,2,4- Tri- methyl- benzene	QN	ND	ND	ND	ND	ΩN	ND	QN	ND	ND	ND	ND	ND	NO	N	N	ND	N
1,2,3- Tri- methyl- benzene	l	1	1	1	I	1	ŀ	I	1	1	L	ł	!	1	1	1	1	-
Naph- thalene	ND	ND	ND	ND	NO	NO	ON	NO	NO	NO	NO	ND	ND	N	N	ON	ND	ND
Total xyl- lenes	QN	ND	NΩ	ND														
Ethyl- benzene	Ŋ	NO	ΩN	ND	ΩN	NO	ND	ND	ND	ND	ND	ND	ΩN	QN	NO	ND	ND	QN
Toluene	QN	NO	NO	NO	NO	ND	NO	QN	N	NO	ND	NO	NO	ΩN	NO	NO	NO	QN
Benzene	ND	ND	ND	NΩ	ΩN	ND	ND	QN	ND	QN	ND	QN	ON.	ND	ND	ND	ND	ND
Date	08-28-85	08-27-85	08-27-85	08-27-85	08-27-85	08-28-85	08-28-85	08-27-85	08-28-85	08-28-85	08-28-85	08-28-85	08-28-85	08-28-85	08-28-85	08-28-85	08-28-85	08-28-85
Well identi- fier	D14	D15	910	710	D18	019	D20	D21	D22	D23	D24	D25	D26	D27	D28	D29	D30	D31

Table 7.--Concentrations of volatile organic compounds in ground water, August 1985 through November 1986--Continued

1,2,3,5- Tetra- methyl- benzene	0 ND	0 ND ON	. 2 930 230 15 ND ND 97 ND 10 ND ND N
1,2,3,4- Tetra- methyl- benzene	ON ON TO THE TOTAL THE TOTAL TO THE TOTAL TOTAL TO THE TO		
1,3,5- Tri- methyl- benzene	0 ND ND ND 120 120 120 120 120 120 120 120 120 120	1400 1400 8 8 0 0 0 ND	0 0 1 1 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
1,2,4- Tri- methyl- benzene	820 1,600	3,8 800 1 H 0 0 0 0 N D N D N D N D N D N D N D N D N	3,400 1,900 1,900 4,9 00 00 00 00 00 00 00 00 00 00 00 00 00
1,2,3- Tri- methyl- benzene	H QN	0 0 0 0 0 0 Q Q	0 12 8 820 4 20 0 ND ND 7.3
Naph- thalene	300 00	онн	2.1 280 63 63 63 63 64 66 00 00 00 00 00 00 00 00 00 00 00 00
Total xyl- lenes	T 0 .04 .8 .12 970 4,900	1,300 1,300 7 7 0	36.2 2,620 8 8 8 0 12.2 1 1 22.2 ND ND N
Ethyl- benzene			28 28 28 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6
Toluene	0.06 0 0 0 1,600 1,600	2,100 4 .05 .1	2
Benzene	1.2 H 1.5 1.70 670	8 8 8 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	3.1 240 31 31 31 30 40 60 60 60 60 60 60 60 60 60 60 60 60 60
Date	066-22 05-13-13-1-2 05-13-13-1-3 05-13-1-8-8 05-13-1-8-8 05-13-1-8-8 05-13-8-8 05-13-8-8 05-13-8-8 05-13-8-8 05-13-8-8	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Well identi- fier	116 117 118 120 122 123	122 122 123 123 130 131	132 1334 1336 1337 1440 159 100 100 100 100 100 100 100 100 100 10

Table 7.--Concentrations of volatile organic compounds in ground water, August 1985 through November 1986--Continued

1,2,3,5- Tetra- methyl- benzene	110 - 02 14 260 ND	114 62
1,2,3,4- Tetra- methyl- benzene		6.5 27
l,3,5- Tri- methyl- benzene	390 800 10	
1,2,4- Tri- methyl- benzene	1,600 1,600 1,600 45 2,100 460 320 320 02,200 320 02,200 1,700 1,700 ND	39 310
1,2,3- Tri- methyl- benzene	340 NO NO 155 4 4 4 4 5 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	20
Naph- thalene	480 110 58 110 550 180 180 180 180 160 160 160 160 160 160 160 16	13 150
Total xyl- lenes	8500 500 53 5,900 7.3 4,000 9,600 9,600 NQ NQ NQ NQ NQ NQ NQ NQ NQ NQ	120
Ethyl- benzene	3000 1,900 1,900 1,900 1,400 4,30 4,30 4,30 4,30 1,400 1,000	UD 78
Toluene	1100 NQ 51 2.2 490	.2
Benzene	1700 1.3 130 130 130 380 380 380 380 1,500 1,500 1,600 1,600 1,600 1,500	100
Date	111-17-86 111-17-86 111-17-86 111-18-86 111-20-86 111-20-86 111-18-86	05-13-86 05-13-86
Well identi- fier	M7.2 M8 M9 M11 M12 M13 M14 M16 M18 M24 M24 M24 M23 M23 M23 M24 M24 M27 M29 M23 M29 M29 M29 M29 M29 M29 M29 M29	T14 T15

Table 7.--Concentrations of volatile organic compounds in ground water, August 1985 through November 1986

[Data from the ground-water toxics study, analyzed by OGC; concentrations are blank-corrected and are in micrograms per liter;

ND, concentration is below limit of detection, see text and table A3; 0 indicates compound detected, but not above blank levels;

--, compound not specifically analyzed for; NQ, compound peak present at proper retention time, but only one or two characteristic ions were present; NAB, concentration not above background (compound's characteristic ions were identified, but quantitative level was not greater than the average of travel blanks plus three standard deviations of the travel blanks); T, concentration is more than twice blank level, but less than twice the blank level plus three blank level standard deviations].

1,2,3,5- Tetra- methyl- benzene	8.6	130	380 180 ND	ON ON	O S	SS	O K	. 66	NO	S 5	S S	Q.	8 8	81	190	88 8	2 5	ON	7.2	ON	2.1	ÖN
2,3,4- stra- sthyl-	5.6	55	180 82 ND	1 8	9 9	S	8 8	2.	1	1 8		N Q		46	94	9	}	ł	1	ı	ł	1
1,3,5- 1,2,3,4- Tri- Tetra- methyl- methyl- benzene benzene	25	620	930 310 ND	<u>8</u> 8	8 8	8	8 8		NO	S S	S	ON	NAB	420	780	330	2 2	.01	20	ON	ON	.32
1,2,4- Tri- methyl- benzene	ON 76	1,500	2,400 990 ND	o o	ON ON	S	8 8	.13	QV	2 2	ÖN	S.	2 2	1,200	2,500	1,400	Q N	1.	17	.02	3.4	-:
1,2,3- Tri- methyl- benzene	1 1	180	230	Q	1 1	I		l	EH	<u>8</u>	ON	1	2 2	1	780	320	Q	ÖN	1.9	ON	o.	.52
Naph- thalene	2.8	400	280 ND	N N	Q Q	ND	9 5	3.0	QN	o a	QN	QN !	NAB	440	950	530 CN	N	ON	32	ω.	8.6	ÖN
Total xyl- lenes	ND 110	10,500	3,800 ND	Ö Q	ON ON	ND	S S	1.0	0	Ø Q	ON	ON G	NAB	7,300	11,900	0067 CN	ÖN	ON	15	ÖN	2.5	3.2
Ethyl- benzene	ND 530	910	240 ND	O'N O'N	ON ON	ND	8 8	QN	0	I. QN	ND	ON C	P Q	220	1,600	2700 CN	ON	ON	06	ÖN	70	ON
Toluene	ND 6.5	3200	1,500 ND	ND CN	2 2	ND	2 2	ND	Q ;	NAB ND	NAB	2 5	NAB	3,400	5,500	0000	NAB	NAB	1.0	NAB	2.9	.32
Benzene	ON 170	3,300	280 ND	NAB	O O	ND	S S	ND	0 (ON ON	NAB	ND										
Date	08-28-85 11-18-86	11-18-86	05-13-86 08-26-85	11-19-86 08-26-85	08-26-85	08-27-85	08-26-85	08-27-85	06-25-86	08-27-85	11-19-86	08-27-85	11-19-86	08-27-85	05-13-86	08-27-85	11-20-86	11-20-86	11-18-86	11-20-86	11-20-86	11-20-86
Well identi- fier	M1-82	M2-82	M1-85	M2-85	M3-85 M4-85	M5-85	M6-85 M7-85	M8-85		M9-85		M10-85		M11-85		M12-85		M2	M4	M6.1	M6.2	M7.1

Table 9.--Concentrations of inorganic compounds and dissolved organic carbon in ground water, November 1986 and March 1989--Cont.

No.		14- V.SK
Manga- Molyb- Stron- Vana-		Carbon,
nese, denum, Nickel, Silver, tium, dium,	Zinc,	organic
dis- dis- dis- dis- dis-	dis-	dis-
Well solved solved solved solved solved	solved	solved
identi- (μ g/L	(µg/L	(mg/L
fier as Mn) as Mo) as Ni) as Ag) as Sr) as V)	as Zn)	as C)
M1-82 1,600 <10 120 <6	5	1.6
M2-82 1,900 <10 140 <6	8	2.1
M3-82		4.1
M1-85 <1 <10 95 <6	8	7.5 1.2
16 <10 <10 <1 87 <6	130	.9
M5-85 2 <10 <10 <1 110 <6	52	1.0
M6-85		.9
M7-85		11
M8-85		.6
M9-85 28 <10 100 <6	<3	1.1
85 <10 <10 <1 100 <6	100	1.1
M10-85 <1 <10 120 <6	<3	1.2
M11-85 2,400 <10 110 <6	6	2.9
1,900 <10 <10 <1 130 <6	5	2.8
14 3,400 <10 140 <6	7	2.3
M6.2		81
M7.2 2,300 <10 150 <6	10	3.4
M8 3 <10 100 <6	10	1.2
M9 1,300 <10 120 <6	10	1.6
M11 4,700 <10 140 <6	11	1.8
W12 2 500 410	191	1.7
M12 2,500 <10 150 <6	9	3.4
		4.7
		2.2
		1.5
M16 3,000 <10 170 <6	6	3.0
M17		2.4
		5.5
	5	2.0
2,800 <10 <10 <1 150 <6 419 26 <10 100 <6	69 <3	1.9
100 (6	<3	1.8
120		0.8
M23 5,600 <10 200 <6	7	3.7
		9.8
424 3,700 <10 170 <6	4	3.4
126		2.8
M27		2.1
M29 1,900 <10 120 <6	7	1.2
130 14 <10 <10 2 120 <6	c	.9
The state of the s	5	. 8
M31 840 <10 110 <6 M34	<3 	1.2
ADDI	- 0.00	1.0

Table 9.--Concentrations of inorganic compounds and dissolved organic carbon in ground water, November 1986 and March 1989--Cont.

					Solids,	Solids,	Nitro-	Nitro-	Phos-
	Chlo-	Fluo-		Silica,	residue	sum of	gen,	gen,	phorus
	ride,	ride,	Bromide,	dis-	at	consti-	NO2+NO3	ammonia,	17
	dis-	dis-	dis-	solved	180 °C,	tuents,	dis ²	dis-	dis-
Well	solved	solved	solved	(mg/L	dis-	dis-	solved	solved	solved
identi-	(mg/L	(mg/L	(mg/L	as	solved	solved	(mg/L	(mg/L	(mg/L
fier	as Cl)	as F)	as Br)	SiO ₂)	(mg/L)	(mg/L)	as N)	as N)	as P)
M1-82	6.2	0.2	0.026	37		190	<0.10	<0.01	0.02
M2-82	6.9	.2	.032	40		213	<.10	.09	0.03
12 02	0.5	• 2	.032	40	Va.	213	V.10	.09	<.01
13-82									
11-85	5.4	. 2	.034	26		157	.68	<.01	.02
	6.2	. 2		25	136	145	.91	<.01	.02
5-85	6.5	. 2		33	166	176	.64	<.01	.02
6-85			0						-
17-85									-
18-85			:==						-
19-85	5.8	.2	.033	33		169	.49	<.01	.02
	6.7	. 2		32	168	171	.50	<.01	.06
110-85	8.6	. 2	.039	30		190	1.8	<.01	.02
11-85	6.1	.2	.039	40		196	<.10	.06	.02
	7.1	. 2		36	186	200	.10	.08	.06
4	7.2	.2	.037	43		227	<.10	.15	<.01
6.2									-
7.2	7.1	. 2	.019	44		242	<.10	.16	<.01
8	5.6	. 2	.034	32		170	1.1	<.01	.02
9	6.1	. 2	.027	34		190	<.10	.03	<.01
11	6.7	. 2	.031	39		210	<.10	.03	.02
112	6.4	. 2	.020	43		224	<.10	.13	<.01
13							<u></u>		<u>=</u> :
14									-
16	7.9	. 2	.030	44		242	<.10	.12	<.01
17		0							-
18	6.0	. 2	.026	41	==	208	<.10	.11	<.01
	7.0	. 2		38	209	227	<.10	.10	.05
19	5.6	. 2	.028	32		171	1.3	<.01	.04
20									
23	10	. 2	.029	50		274	<.10	.07	<.01
24	7.7	.2	.019	48		255	<.10	.18	<.01
26									
27									
29	6.3	.2	.033	34			<.10		.02
30	6.9	.2		32	172	188	.93	<.01	.05
31	6.7	. 2	.033	32		174	.54		<.01
34									

Table 9.--Concentrations of inorganic compounds and dissolved organic carbon in ground water, November 1986 and March 1989--Cont.

	Calcium,	Magne- sium, dis-	Sodium dis-		Sodium	Potas- sium, dis-	Alka- linity,	Sulfate, dis-
vell	solved	solved	solved		sorp-	solved	field	solved
lenti-	(mg/L	(mg/L	(mg/L	Sodium	tion	(mg/L	(mg/L as	(mg/L
fier	as Ca)	as Mg)	as Na)	percent	ratio	as K)	CaCO3)	as SO4)
11-82	31	10	13	19	0.5	3.3	131	8.5
12-82	34	11	12	16	.5	3.3	156	5.8
	()						160	
3-82 1-85	26	8.5	11	10			206	
1-05	23	7.5	12	19 22	.5 .6	2.3	103	12
5-85	29	9.5	13	20	.6	2.4	89 113	11 12
5-85 6-85							117	
7-85							122	
8-85	124						109	
BU 05/55/1								
9-85	27	8.9	12	20	.5	2.6	108	12
	27	8.9	12	20	.5	2.5	112	12
10-85	32	10	14	20	.6	2.6	116	15
11-85	27	8.9	11	18	.5	2.7	125	19
	31	10	12	18	.5	2.3	140	11
4	30	9.6	17	24	.7	3.7	151	16
6.2							116	
7.2	37	12	13	16	. 5	3.4	185	2.3
8	27	8.9	12	19	.5	3.3	105	13
9	29	9.6	12	18	. 5	3.2	133	13
11	33	10	14	19	.6	3.5	148	8.3
12	35	11	13				124	
12				17	.5	3.5	164	4.0
13							118 113	
14							115	
16	38	12	14	17	.5	3.8	172	7.6
1000							131	7.0
17							144	
18	30	9.8	12	18	.5	3.3	149	5.5
	32	11	12	17	. 5	2.6	132	34
19	26	8.7	13	21	.6	2.7	105	14
				-			91	
20			2-10,				113	
23	45	14	15	16	.5	3.9	193	8.4
				1000			135	
24	38	12	15	18	.6	3.7	190	2.9
26					100		110	
27							115	
29	28	8.8	13	20	.6	3.5	120	14
		10	13				114	
3.0		1.11	1 5	19	.5	2.7	128	11
30 31	31 28	9.1	12	19	.5	2.6	113	12

Table 9.--Concentrations of inorganic compounds and dissolved organic carbon in ground water, November 1986 and March 1989

[Data are from ground-water toxics study and 1989 study, analyzed by NWQL; concentrations are in mg/L, milligrams per liter or μ g/L, micrograms per liter, unless otherwise noted: --, not analyzed].

Well denti- Tier	Date	Time	cific con- duct- ance (µs/cm)	pH (stand- ard units)	Temper- ature (°C)	Tur- bid- ity (NTU)	Oxygen, dis- solved (mg/L)	Hard- ness (mg/L as CaCO ₃)	Hard- ness, non- carbonate (mg/L as CaCO ₃)
11-82	11-18-86	1215	280	6.8	15.0		<0.5	120	0
12-82	11-18-86	1430	320	6.7	14.0		< .3	130	ő
112-02	03-18-89	1630	323	6.8	14.0		.0		
13-82	03-18-89	1030	389	6.3	13.5		.0	12.22	
11-85	11-19-86	1230	238	6.7	14.5		5.7	100	0
11 03	03-13-89	1015	208	6.9	11.5	1.7	8.5	88	ő
15-85	03-13-89	1715	252	6.7	9.5	27	3.1	110	0
15-85 16-85	03-13-89	1500	262	6.7	12.5		1.8		
10-85 17-85	03-13-89	0930	278	6.7	10.5		1.2		
17-85 18-85	03-14-89	1500	235	6.6	13.5		1.6		
			254	6.5			.4	100	0
19-85	11-19-86	1130			14.0				
110.05	03-15-89	1515	249	6.5	13.0	5.2	.2	100	0
110-85	11-19-86	1000	298	6.6	14.5		2.2	120	5 0
111-85	11-17-86	1155	264	6.6	16.0		.0	100	
	03-18-89	1530	292	6.6	15.0	19	.2	120	0
14	11-18-86	1110	313	6.6	15.5		1.2	110	0
16.2	03-17-89	1610	258	6.6	13.5		1.2		==
7.2	11-17-86	0945	352	6.4	15.5		.0	140	0
8	11-17-86	1450	247	6.6	14.5		1.7	100	0
9	11-17-86	1555	279	6.6	15.0		.0	110	0
111	11-18-86	1000	307	6.6	15.0		.3	120	0
	03-17-89	1330	265	6.6	13.5		. 2		
112	11-18-86	1345	323	6.5	16.0		.0	130	0
	03-18-89	0900	280	6.4	13.0		.0	1,77	
13	03-16-89	1200	252	6.6	13.5		1.2		
14	03-16-89	0915	246	6.6	11.5		. 2		
16	11-17-86	1115	342	6.7	16.0		.0	140	0
	03-18-89	1215	259	6.7	15.0		.0		==
17	03-17-89	1200	282	6.5	13.0		1.0		==
18	11-18-86	0930	292	6.6	15.0		.7	120	0
	03-17-89	1030	319	6.7	13.0	40	.0	130	0
19	11-18-86	0805	257	6.6	15.0		2.7	100	0
	03-15-89	1800	236	6.6	10.5		3.5		
20	03-17-89	0845	/ 328	6.5	12.5		3.5		
23	11-18-86	1630	390	6.7	16.0		.7	170	0
	03-16-89	1700	280	6.8	12.0		. 4		
24	11-18-86	1430	365	6.5	15.0		.0	140	0
26	03-16-89	1600	268	6.6	12.0		2.2		
27	03-16-89	1450	248	6.6	13.0		.2		
29	11-19-86	0830	259	6.6	14.5		.3	110	0
ನಾರೆ	03-15-89	1100	250	6.6	9.5		1.1		
30	03-14-89	1730	268	6.6	12.0	. 4	.8	120	0
31	11-19-86	0930	261	6.5	15.0		.3	110	0
34	03-14-89	1130	242	6.7	13.0		2.5		

Table 6.--Concentrations of volatile organic compounds in ground water, October 1984 through June 1986

[Data from the insurance company study, analyzed by a private laboratory; concentrations are in micrograms per liter; ND, below the detection limit of 1 microgram per liter unless otherwise indicated; --, not analyzed]

Well Identifier	Date	Benzene	Toluene	Total xylenes	Total hydrocarbon (as gasoline)
M1-85	2-21-85	ND	ND	ND	ND
	5-10-85	ND	ND	ND	ND
M2-85	2-21-85	ND	ND	ND	ND
	5-10-85	ND	ND	ND	ND
M3-85	2-21-85	ND	ND	ND	ND
	5-11-85	ND	ND	ND	ND
M4-85	2-21-85	ND	ND	ND	ND
	5-11-85	ND	ND	ND	ND
M5-85	2-21-85	ND	ND	ND	ND
V/C 05	5-10-85	ND	ND	ND	ND
M6-85	2-21-85	ND	ND	ND	ND
M7-85	5-10-85 2-21-85	ND ND	ND	ND	ND
M/-03	5-11-85	ND	ND ND	ND ND	ND ND
	8-27-85	ND	ND	ND	ND ND
	12-16-85	ND	ND	ND	ND
	6-20-86	ND	ND	ND	ND
M8-85	2-21-85	ND	ND	ND	ND
	5-11-85	ND	ND	ND	ND
	8-27-85	96	1	9	230
	6-20-86	ND	ND	ND	ND
M9-85	2-21-85	ND	ND	ND	ND
	5-11-85	ND	ND	ND	ND
	12-16-85	ND	ND	ND	ND
	6-20-86	ND	ND	ND	ND
M10-85	2-21-85	ND	ND	ND	ND
	5-11-85	ND	2	5	17
	8-27-85	ND	ND	ND	ND
	12-16-85	ND	ND	ND	ND
W11 05	6-20-86	ND	ND 5 200	ND	ND
M11-85	2-21-85	1,460	5,300	6,260	23,400
	5-11-85	1,240 ^a	5,850 ^a	13,940 ^a	33,000 ^a
	8-27-85	920	1,100	6,300	12,000
	12-16-85	710	1,100	750	28,000
	6-20-86	680	7,000	18,000	45,000
M12-85	2-21-85	ND	ND	ND	ND
580520	5-10-85	ND	ND	ND	ND
D3	2-19-85	ND	ND	ND	ND
	3-25-85	ND	ND	ND	ND
	5-10-85	ND	ND	ND	ND
	6-25-85 7-25-85	ND ND	ND ND	ND	ND
	12-16-85	1300		ND	ND
	6-20-86	ND	ND ND	ND	ND ND
D5	2-19-85	ND	ND	ND	ND
D6	10-02-84	<0.5	<0.5	0.9	
	2-19-85	ND	ND	ND	ND
D10	10-02-84	<0.5	<0.5	<0.5	
	2-19-85	ND	ND	5	14
	3-25-85	28	680	980	3,120
	5-10-85	ND	1	4	17
D11	10-02-84	<.5	<.5	<.5	-1-
D12	2-19-85	ND	ND	ND	ND
D13	2-19-85	ND	ND	ND	ND
D14	2-19-85	ND	ND	ND	ND
D15	10-02-84	<0.5	<0.5	<0.5	
D16	2-19-85	ND	ND	ND	ND
D17	10-02-84	40	70	45	÷=,
	2-19-85	ND	ND	ND	ND

a Average of two values

Table 5.--Target compounds in water analyzed for volatile organic compounds by the purge and trap method--Continued

Compound	Chemical Abstract Services Registry Number
1,1-Dichloroethane	75-34-3
1,2-Dichloroethane	107-06-2
1,1-Dichloroethene	75-35-4
cis-1,2-Dichloroethene	156-59-4
trans-1,2-Dichloroethene	156-60-5
1,2-Dichloropropane	78-87-5
1,3-Dichloropropane	142-28-9
2,2-Dichloropropane	590-20-7
1,1-Dichloropropene	563-58-6
Ethylbenzene	100-41-4
Hexachlorobutadiene	87-68-3
Isopropylbenzene	98-82-8
p-Isopropyltoluene	99-87-6
Methylene chloride	75-09-2
Naphthalene	91-20-3
n-Propylbenzene	105-65-1
Styrene	100-42-5
1,1,1,2-Tetrachloroethane	630-20-6
1,1,2,2-Tetrachloroethane	79-34-5
Tetrachloroethene	127-18-4
Toluene	108-88-3
1,2,3-Trichlorobenzene	87-61-6
1,2,4-Trichlorobenzene	120-82-1
1,1,1-Trichloroethane	71-55-6
1,1,2-trichloroethane	79-00-5
Trichloroethene	79-01-6
Trichlorofluoromethane	75-69-4
1,2,3-Trichloropropane	96-18-4
1,2,4-Trimethylbenzene	95-63-6
1,3,5-Trimethylbenzene	108-67-8
Vinyl chloride	75-01-4
o-Xylene	95-47-6
m-Xylene	108-38-3
p-Xylene	106-42-3
1,2,3,5-Tetramethylbenzene ¹	527-53-7
1,2,3,4-Tetramethylbenzene ¹	488-23-3
2-Ethyl-1-methylbenzene	611-14-3
1,2,3-Trimethylbenzene ¹	526-73-8
1,4-Dimethyl-2-ethylbenzene ¹	175-88-89

 $^{^{1}\}mathrm{Standards}$ for the quantification of this compound were added to the laboratory procedure of EPA Method 524.2

 $^{^2\}mathrm{This}$ compound co-elutes with 1,3-Dimethyl-4-ethylbenzene

Table 5.--Target compounds in water analyzed for volatile organic compounds by the purge and trap method

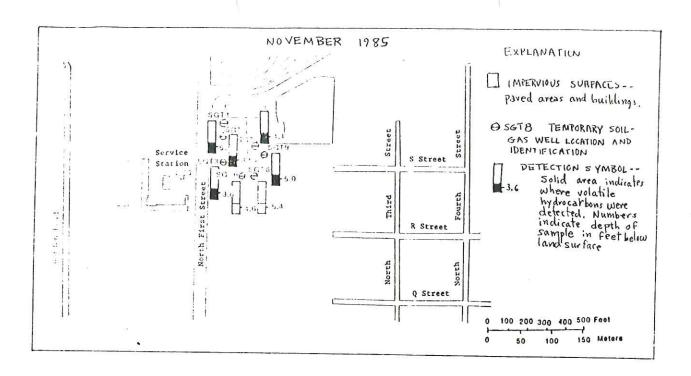
Chemical Abstract Services Registry Number

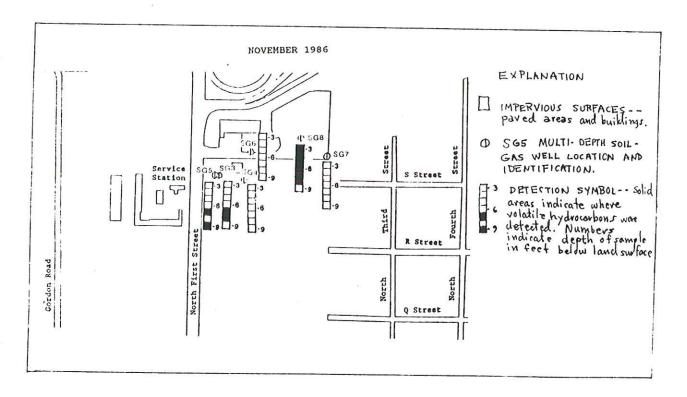
Ground-water Toxics Study

Benzene	71-43-2
Toluene	108-88-3
Ethylene bromide	106-93-4
Ethylbenzene	100-41-4
m-Xylene	108-38-3
o-Xylene	95-47-6
p-Xylene	106-42-3
n-Propylbenzene	105-65-1
1,2,3-Trimethylbenzene	526-73-8
1,2,4-Trimethylbenzene	95-63-6
1,3,5-Trimethylbenzene	108-67-8
t-Butylbenzene	98-06-6
Isobutylbenzene	538-93-2
sec-Butylbenzene	135-98-8
1-Isopropyl-4-methylbenzene	99-87-6
n-Butylbenzene	104-51-8
1,2,3,5-Tetramethylbenzene	527-53-7
1,2,3,4-Tetramethylbenzene	488-23-3
Naphthalene	91-20-3
2-Ethyl-1-methylbenzene	611-14-3
1,4-Dimethyl-2-ethylbenzene	175-88-89
1,3-Dimethyl-4-ethylbenzene	874-41-9

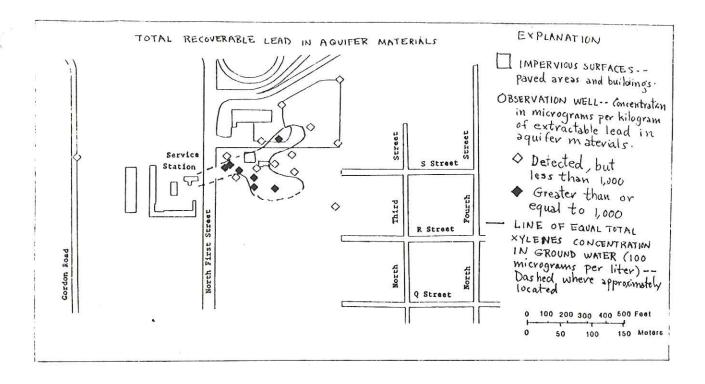
March 1989 Study

Benzene	71-43-2
Bromobenzene	108-43-2
Bromochloromethane	74-97-5
Bromodichloromethane	75-27-4
Bromoform	75-25-2
Bromomethane	74-83-9
n-Butylbenzene	104-51-8
sec-Butylbenzene	135-98-8
tert-Butylbenzene	98-06-6
Carbon tetrachloride	56-23-5
Chlorobenzene	108-90-7
Chloroethane	75-00-3
Chloroform	67-66-3
Chloromethane	74-87-3
2-Chlorotoluene	95-49-8
4-Chlorotoluene	106-43-4
Chlorodibromomethane	124-48-1
1,2-Dibromo-3-chloropropane	96-12-8
1,2-Dibromoethane	106-93-4
Dibromomethane	74-95-3
1,2-Dichlorobenzene	95-50-1
1,3-Dichlorobenzene	541-73-1
1,4-Dichlorobenzene	106-46-7
Dichlorodifluoromethane	75-71-8





November 1985 and multi-depth soil-gas samples collected November 1986 [Data from the ground-water toxics study].



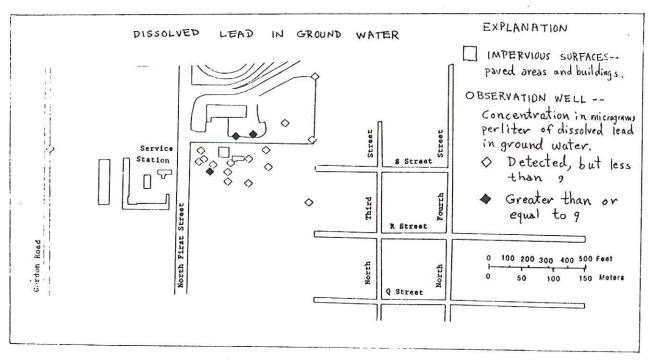
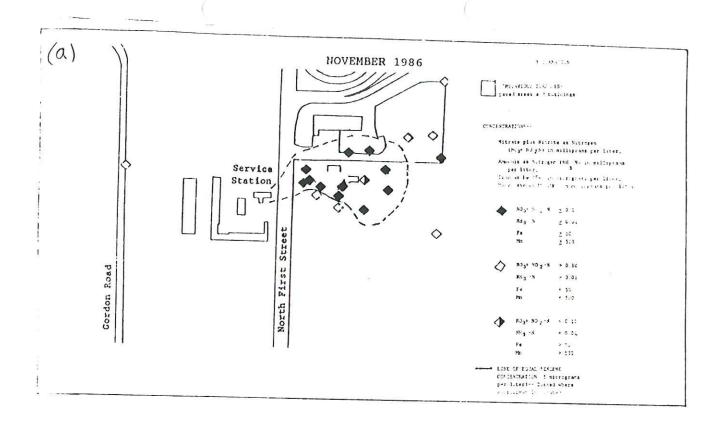


Figure 15. -- Concentrations of total-vecoverable, lead in aquifer material and dissolved lead in ground water povember 1956 [data from the ground-water toxics study].

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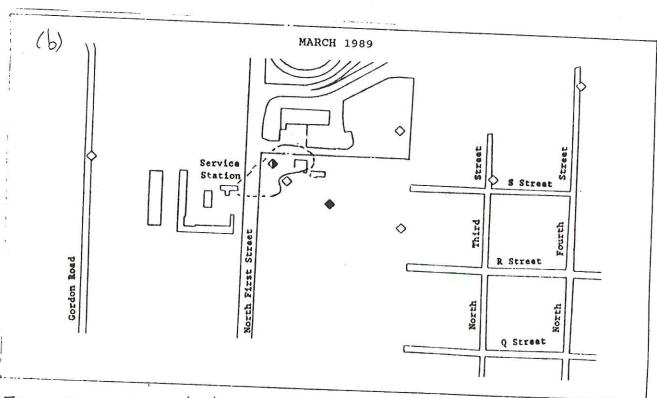
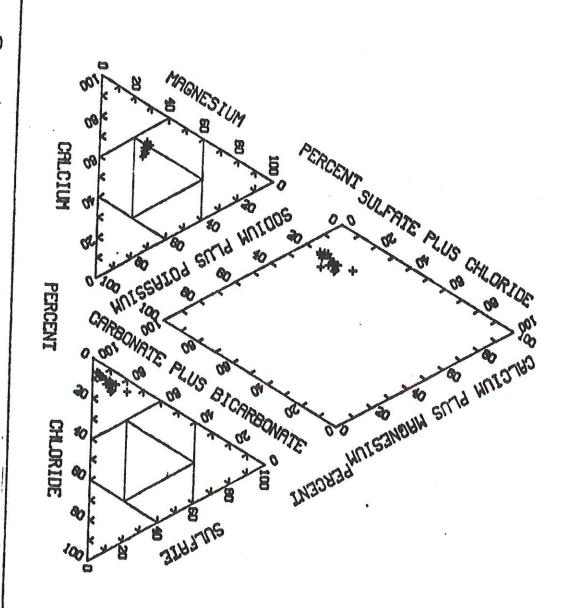


Figure 14. -- Concentrations of ivon, manganere, ammong and nitrate plus nitrite in ground water, November 1986 through March 1989 [data from (a) the ground-water toxics study and (b) 1989 study].

PREMINARY SUBJECT TO REVISIONS



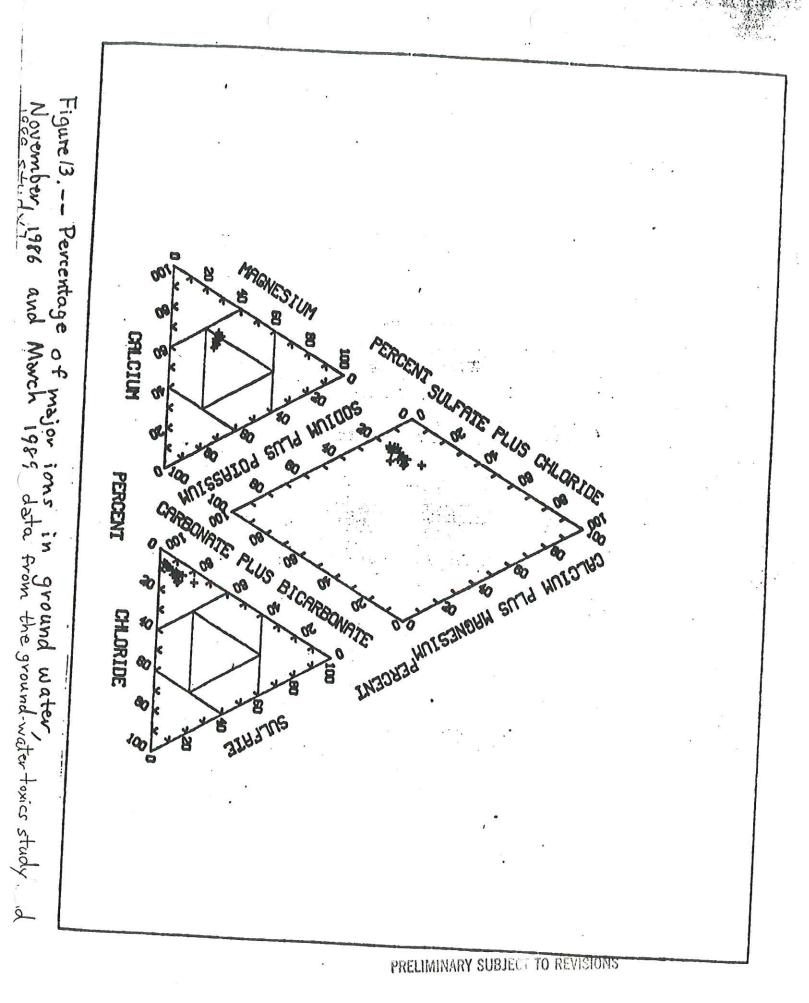


Table 12. -- Observed water levels in observation and domestic wells

-						•		
Well		Water	Well		Water	Well		Water
iden- tifier		level	iden- tifier	Date	level	iden- tifer	Date	level
M24	Nov 20, 1986	9.11	M25	Nov 20, 1986	9.35	M26	Nov 20, 1986	9.38
	Dec 17	9.40		Dec 17	9.66		Dec 17	9.65
	Jan 22, 1987	9.66		Jan 22, 1987	9.94		Jan 22, 1987	9.91
	Feb 18	9.58		Feb 18	9.81		Feb 18	9.84
	Mar 16	9.54		Mar 16	9.58		Mar 16	9.63
	Apr 22	9.05		Apr 22	9.26		Apr 22	9.33
M27	Nov 20, 1986	9.73	M28	Nov 20, 1986	13.69	M29	Nov 20, 1986	10.19
	Dec 17	9.91		Dec 17	14.24		Dec 17	10.37
	Jan 22, 1987	10.20		18	14.19		Jan 22, 1987	
	Feb 18	10.14		Jan 22, 1987			Feb 18	10.65
	Mar 16	9.92		Feb 18	14.13		Mar 16	10.56
	Apr 22	9.67		Mar 16	13.88		Apr 22	10.24
	Mar 16, 1989	9.21		Apr 22	13.35		Mar 15, 1989	10.84
	Mark Control of the C			Mar 15, 1989	13.97			
м30	Nov 20, 1986	9.94	м31	Nov 20, 1986	10.74	м33	Nov 20, 1986	9.15
	Dec 17	10.20		Dec 17	10.99		Dec 18	9.46
	Jan 22, 1987	10.32		Jan 22, 1987	11.19		Jan 22, 1987	9.64
	Feb 18	10.33		Feb 18	11.14		Feb 18	9.59
	Mar 16	10.23		Mar 16	10.92		Mar 16	9.44
	Apr 22	9.90		Apr 22	10.65		Apr 23	9.27
	Mar 14, 1989	10.47	10	Mar 15, 1989	11.31			
M3 4	Nov 20, 1986	8.19	м35	Nov 20, 1986	11.22	D32	Jul 28, 1986	8.15
	Dec 18	8.37		Dec 17	11.47	0505050	Sep 22	8.07
	Jan 22, 1987	8.51		Jan 22, 1987			Nov 20	11.61
	Feb 18	8.52		Feb 18	11.41		Dec 17	12.04
	Mar 16	8.33		Mar 16	11.44		Jan 21, 1987	12.36
	Apr 23	8.24		Apr 23	11.17		Feb 18	12.23
	Mar 14, 1989	8.65		7.53			Mar 16	11.94
	3000 00 00 00 00 00 00 00 00 00 00 00 00						Apr 23	9.09
м36	May 14, 1986	9.46	M37	May 14, 1986	9.05	M38	Nov 20, 1986	8.17
	Jun 23	9.08		Jun 23	8.78		Dec 17	9.41
	Jul 28	9.01		Jul 28	8.76		Jan 22, 1987	8.80
	Sep 22	8.71		Sep 22	8.45		Feb 18	9.34
*	Nov 19	10.64		Nov 20	11.34		Mar 16	9.13
	Dec 17	11.17		Dec 17	10.82		Apr 23	9.11
	18	11.17		Jan 22, 1987				
	Jan 20, 1987	11.36		Feb 18	10.73			
	Feb 17	11.29		Mar 16	10.56			
	Mar 16	12.28		Apr 22	10.35			
	Apr 22	11.94					ž.	
м39	Jan 20, 1987	11.02	M40	Jan 21, 1987	12.85		***	
	Feb 18	11.07	www.DE	Feb 18	11.89			
	Mar 16	10.81		Mar 16	11.73		<u>ii</u>	
	Apr 23	10.69		Apr 23	11.70			

Table 12. -Observed water levels in observation andestic wells

Well iden- tifier		Date	,	Water level	Well iden- tifier	Date	v	Water level	Well iden- tifer	Dat	0	Water level
M6.2	Nov	20,	1986	10.53	M7.1	Nov 19,	1986	11.16	M7.2	Mar 16	, 1987	11.33
	Dec			10.79		Dec 17		11.42		Apr 22		10.82
	Jan	20,	1987	10.98		Jan 20,	1987	11.67				
	Feb	17		10.89		Feb 17		11.56				
	Mar			10.72		Mar 16		11.38				
	Apr			10.38		Apr 22		10.97				
	Mar	17,	1989	11.03								
м8	Nov	20,	1986	11.32	м9	Nov 20,	1986	11.28	М10	Nov 2), 1986	11.03
	Dec	17		11.75		Dec 17		11.62		Dec 1		11.41
		20,	1987	11.92		Jan 20,	1987	11.70			1987	
	Feb			11.81		Feb 19		11.71		Feb 1		11.50
	W	18		11.82		Mar 16 Apr 22		11.53		Mar 1 Apr 2		11.32
	Mar Apr			11.64		npt 22		11.15		npt 2		10.95
		20	1006	10.80	W12	New 10	1006	11 12	W1.2	Nov. 1	1006	11 16
M11		20,	1986	10.89	M12	Nov 19, Dec 17	1986	11.13	M13	Dec 1	9, 1986 7	11.15
	Dec	20,	1987	11.23		Jan 20,	1987	11.63			, 0, 1987	
	Feb	Agencia en	1907	11.35		Feb 17	1,0,	11.57		Feb 1	Wight is contained to the	11.72
	Mar			11.19		Mar 16		11.40		Mar 1		11.53
	Apr			10.87		Apr 22		11.05		Apr 2		11.17
	Mar	17,	1989	11.56		Mar 18,	1989	11.69		Mar 1	6, 1989	11.90
M1 4	Nov	20,	1986	9.58	м16	Nov 19,	1986	10.99	M17	Nov 2	0, 1986	11.35
	Dec	17		9.88		Dec 17		11.42		Dec 1	7	11.73
	Jan	20,	1987	10.09		Jan 20,	1987	11.63		Jan 2	0, 1987	11.97
	Feb	17		9.92		Feb 17		11.52		Feb 1		11.86
		18		9.93		Mar 16		11.34		Mar 1		11.6
	Mar			9.76		Apr 22	1000	10.80		Apr 2		11.12
	Apr Mar	16,	1989	9.43		Mar 18,	1989	11.59		mar I	7, 1989	12.02
					12	25 00	0.00	tra 22	2.0	000 20	21 215/202	272 25
418		20,	1986	10.99	M19	Nov 20,	1986	11.38	M20		0, 1986	
	Dec		1007	11.36		Dec 17	1007	11.69		Dec 1		11.6
		20,	1987	11.58		Jan 20, Feb 17	1987	11.90		Feb 1	0, 1987 7	11.8
	Feb			11.46		Mar 16		11.61		Mar 1		11.5
	Apr			10.84		Apr 22		11.16		Apr 2		10.9
		17,	1989	11.70		Mar 15,	1989	12.08			7, 1989	
121	Nov	20	1006	11 49	M22	Nov 20,	1096	10.79	M23	Nov 2	0, 1986	10.1
121	Dec	20,	1300	11.49	744	Dec 17	1300	11.03	MZJ	Dec 1		10.1
		20,	1987	12.15		Jan 21,	1987	11.33			, 2, 1987	
	Feb		.,,,	11.90		Feb 17		11.13		Feb 1		10.5
	Mar			11.71		Mar 16		10.95		Mar 1		10.3
	Apr			11.31		Apr 22		10.47		Apr 2		10.0
						TO SHARE THE STATE OF THE STATE		response are conflicted for the late			6, 1989	

Table 12. Observed water levels in observation and co. estic wells

		_												
Well iden-		Dat	0	Water level	Well iden-		Date	9	Water level	Well iden- tifer		Date)	Water level
tifier					tifier				-	CITGI				
M10-85	Feb	20,	1985	9.72	M11-85	Feb		1985	10.94	M12-85	Feb		1985	11.52
		21		9.72			21		10.94			21		11.52
	May	11		9.09		May		(*)	9.96		May			10.68
	Jun			8.06		Jun			11.81		Jun			9.24
	Aug			8.34		Aug			7.83		Aug			9.82
		29		7.93			29		7.56			29		9.73
		30		7.24		520	30		6.72		-	30		9.61
	Sep			7.08		Sep			6.76		Sep			9.50
	Oct			7.72		Oct			9.47		Oct			10.12
	Nov			8.20		Nov			10.27		Nov			10.86
	Dec			8.55	59	Dec		04/08/09/09	10.92		Dec		20202	11.52
	Jan	24,	1986	9.23				1986	10.65				1986	11.15
	Feb	21		9.17		Feb			10.44		Feb			10.98
	Mar	20		8.83			200 (CO)	1986	9.98	195	Mar			10.53
	Apr	23		8.68		Apr			9.34		Apr			10.13
	May	14		8.22		May			8.64		May			9.53
	Jun	23		8.05		Jun			8.11			23		9.13
	Jul	28		8.05		Jul			8.01			28		9.08
	Sep	22		7.67		Sep	22		7.79			22		8.83
	Nov	20		9.34		Nov	19		10.58			20		11.06
	Dec	17		9.52		Dec	17		10.92			17		11.30
	Jan	22,	1987	9.68		Jan	20,	1987	10.83			11 St. 150g	1987	11.38
	Feb	18		9.70		Feb	17		11.01		Feb	18		11.50
	Mar	16		9.52		Mar	16		10.81		Mar	16		11.26
	Apr	22		9.37		Apr	22		10.38		Apr	23		11.01
	0.50					Mar	18,	1989	11.10					
M1	Nov	19,	1986	12.01	M2	Nov	20,	1986	10.55	мз	Nov	20,	1986	10.73
	Dec	17		12.69		Dec	17		10.84			: 17		11.02
	Jan	20,	1987	12.72		Jan	20,	1987	11.01		Jan	20,	1987	11.22
	Feb	17		12.55		Feb	17		10.94		Feb	17		11.16
	Mar	16		12.39		Mar	16		10.76		Mar	16		10.96
	Apr	22		12.08		Apr	22		10.48		Apr	22		10.67
м4	Nov	20,	1986	10.91	м5	Nov	19,	1986	10.94	M6.1	Nov	, 20,	1986	10.51
	Dec			11.07		Dec	17		11.27		Dec	: 17		10.89
			1987	11.28		Jan	20,	1987	11.50		Jar	20,	1987	11.04
	Feb			11.19			17		11.40		Feb	17		10.9
	Mar			11.01		Mar			11.20		Mai	16		10.76
	Apr			10.68		Apr	22		10.72		Apı	22		10.48
	1/0		1989	11.2		•								

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					-		-								
Well iden- tifier		Date	,	Water level	Well iden- tifier		Date	9	Water level	Well iden- tifer		Dat	0		ater evel
					B*************************************		_			-					
14-85	Feb	20.	1985	8.95	M5-85	Feb	20.	1985	5.39	M6-85	Feb	20,	198	5	7.55
		21		8.95			21		5.38			21			7.55
	May			7.91		May	10	•	5.17		May	10		1	7.25
	Jun			5.83		Jun	09		4.69	14	Jun	09		1	6.61
	Aug			6.12	=======================================	Aug	02		5.04		Aug	02			7.14
		29		6.31			29		5.13			29			7.48
		30		6.07			30		4.91			30			6.89
	Sep	21		6.04		Sep	21		4.89		Sep	21			6.88
	Oct	16		7.10		Oct	16		4.67		Oct	16			6.66
	Nov	15		8.09		Nov	15		5.23			15			7.88
	Dec	13		8.90		Dec	13	25	5.39			13			8.01
	Jan	24,	1986	8.69		Jan	21,	1986	5.05			24,	198		7.64
	Feb	21		8.58		Feb	21		4.90			21			7.36
	Mar	20		8.15				1986	4.85			: 20			7.25
	Apr	23		6.96		Apr			5.02			23			7.14
	May	14		6.07		May			4.79			14			6.70
	Jun	23		5.40		Jun			5.02			23			7.16
	Jul	28		5.07		Jul			5.10			. 28			7.34
	Sep			4.94		Sep			4.56		_	22			6.37
	Nov	20		8.55		Nov			5.30			/ 20			7.72
	Dec			8.98		Dec		03000000	5.49			: 17	2020	_	8.11
	Jan	21,	1987	9.26				1987	5.56			1 22,	198	17	8.31
	Feb	17		9.04		Feb			5.48			18			8.03
	Mar	16		8.92	(6)	Mar			5.32			16			7.87
	Apr	23		8.27		Apr			5.46		10.00	r 23			7.93
						Mar	13,	1989	5.64		Ma	r 13,	198	39	8.52
17-85	Feb	20,	1985	7.40	M8-85	Feb	20,	1985	9.47	M ^s	9-85	Feb	20,	1985	9.
		21		7.43			21		9.49				21		9.
	May			7.13		May	11		8.92			May	11		9.
	Jun			6.09		Jun	09		7.92			Jun	09		7.
	Aug			6.72		Aug	02		8.43			Aug	02		8.
	Deor-1-	29		6.79			29		8.50				29		8.
		30	(12)	5.63			30		7.33				30		8.
	Sep	21		6.09		Sep	21		7.93			Sep	21		8.
	Oct	16		6.40		Oct	16		8.38			Oct	16		8.
	Nov	15		7.42		Nov	15		8.99			Nov	15		9.
	Dec			7.66		Dec	13		9.29			Dec	13		9.
	Jan	24,	1986	7.14		Jan	24,	1986	9.17			Jan	24,	1986	9.
	Feb	21		7.07		Feb	21		9.07			Feb	21		9.
•	Mar			6.89		Mar	20,	1986	8.73			Mar			9.
	Apr			6.83		Apr	23		8.56			Apr	23		8 .
	May			6.13		May	14		8.08			May	14		7.
	Jun			6.40		Jun	23		8.04			Jun	23		7.
	Jul			6.63	.62	Jul			8.04	**		Jul	28		7
	Sep			5.84			22		7.45			Sep	22		7
	Nov			7.40		- valore Etc	20		9.07		1.60	Nov			9
	Dec			7.78			17		9.31			Dec			9
			1987	7.93				1987	9.48					1987	10
			54.785705						9.42				17		9
		18		7.75		Feb	18		2.76			. 00			
	Feb			7.75 7.62		Feb									
		16		7.75 7.62 7.65		Mar	16		9.22			Mar	16		9

MPC

Table 12.--Observed water levels in observation and domestic wells
[Water levels are in feet below land surface (table 2)]

Well iden- tifier		Date	0	Water level	Well iden- tifier		Date	9	Water level	Well iden- tifer		Date		Water level
M1-82		100000000000000000000000000000000000000	1985	11.37	M2-82		100	1985	11.48	M3-82		2.5	1985	10.05
	May			10.57		May			10.55		May		92	8.05
	Aug			8.84		Aug		1000	9.47 9.88		Aug		1986	8.61
			1986	10.00		May	- 3	1986	9.12		May		1900	7.96
	May			9.36 9.00		Jun			8.54		Jun			7.51
	Jun			8.91		Jul			8.40		Jul			7.45
	Jul			8.69		Sep			8.25		Sep			7.23
	Sep		()	11.12		Nov			11.01		Nov			9.76
	Nov			11.46		Dec			11.40		Dec			10.03
	Dec		1987	11.67				1987	11.60				1987	10.23
	Feb		1907	11.58		Feb	100	130.	11.46		Feb			10.15
	Mar			11.39		Mar			11.32		Mar			9.96
	Apr			11.05		Apr			10.86		Apr			9.67
	npı	••				10.70		1989	11.65				1989	10.16
M1-85	Feb May		1985	12.9	M2-85	Feb	20, 21	1985	6.22 6.27	M3-85		21	1985	7.98 8.07
	Jun	09		9.37		May	10		6.11		May			7.60
	Aug	02		9.84		Jun			5.37		Jun			6.6
		29		9.95		Aug			5.66		Aug			7.1
		30		9.69			29		5.72			29		7.2
	Sep			9.68			30		5.58			30		7.0
	Oct			10.91		Sep			5.57		Sep			6.9
	Nov			11.86		Oct			5.44		Oct			6.5
	Dec			12.69		Nov			6.29		Nov			7.2
		in the second	1986	12.24				1986	6.06			13	1000	8.0
	Feb			11.99		Feb			5.87				1986	8.1
	Mar			11.59		Mar			5.67		Feb			7.8
	Apr			10.58		Apr			5.67			20		7.7
	May			9.72				1986	5.67			23		7.4
	Jun			9.11		Jun			6.34			14		6.8
	Jul			9.00		Jul			6.60			23		7.1
	Sep			8.96		Sep			5.51			28		6.4
	Nov			12.48		Nov			6.62			22		8.9
	Dec			12.85		Dec		1007	7.04					8.6
		3.5	1987	13.17				1987	7.18			17	1987	8.6
	Feb			13.05			17		6.64			1 22,	1301	8.5
	Mar			12.75		Mar		9	6.66			16		8.4
	Apr		1000	12.25			23	1000	9.14			23		8.3
	Mar	13,	1989	13.33		mar	14,	1989	7.14		Whr	23		0,5

PRESENTED SURVEY TO REPRESENT

. Table 2.--Observed water levels in observation and domestic wells

						-	-			
Well		Water	Well			Water	Well			Water
iden- tifier	Date	level	iden- tifier		Date	level	iden- tifer		Date	level
M24	Nov 20, 1986	9.11	M25	Nov	20, 1986	9.35	M26	Nov	20, 1986	9.38
	Dec 17	9.40		Dec		9.66		Dec	17	9.65
	Jan 22, 1987	9.66		Jan	22, 1987	9.94		Jan	22, 1987	9.91
	Feb 18	9.58		Feb	18	9.81		Feb	18	9.84
	Mar 16	9.54		Mar	16	9.58		Mar	16	9.63
	Apr 22	9.05		Apr	22	9.26		Apr	22	9.33
M27	Nov 20, 1986	9.73	M28	Nov	20, 1986	13.69	M29	Nov	20, 1986	10.19
	Dec 17	9.91		Dec	17	14.24		Dec	17	10.37
	Jan 22, 1987	10.20			18	14.19		Jan	22, 1987	10.72
	Feb 18	10.14			22, 1987	14.19		Feb	18	10.65
	Mar 16	9.92		Feb		14.13		Mar		10.56
	Apr 22	9.67		Mar		13.88		Apr		10.24
	Mar 16, 1989	9.21		Apr		13.35		Mar	15, 1989	10.84
				Mar	15, 1989	13.97				
м30	Nov 20, 1986	9.94	м31	Nov	20, 1986	10.74	M33	Nov	20, 1986	9.15
	Dec 17	10.20		Dec	17	10.99		Dec	18	9.46
	Jan 22, 1987	10.32		Jan	22, 1987	11.19		Jan	22, 1987	9.64
	Feb 18	10.33		Feb	18	11.14		Feb	18	9.59
	Mar 16	10.23		Mar	16	10.92		Mar	16	9.44
	Apr 22	9.90		Apr	22	10.65		Apr	23	9.27
	Mar 14, 1989	10.47		Mar	15, 1989	11.31				
M34	Nov 20, 1986	8.19	M35	Nov	20, 1986	11.22	D32	Jul	28, 1986	8.15
	Dec 18	8.37		Dec		11.47		Sep		8.07
	Jan 22, 1987	8.51		Jan	22, 1987	11.71		Nov	20	11.61
	Feb 18	8.52		Feb	18	11.41		Dec	17	12.04
	Mar 16	8.33		Mar	16	11.44		Jan	21, 1987	12.36
	Apr 23	8.24		Apr	23	11.17		Feb	18	12.23
	Mar 14, 1989	8.65						Mar Apr		9.09
м36	May 14, 1986	9.46	м37	Mav	14, 1986	9.05	M38	Nov	20, 1986	8.17
	Jun 23	9.08		Jun		8.78		Dec		9.41
	Jul 28	9.01		Jul		8.76			22, 1987	8.80
	Sep 22	8.71		Sep		8.45		Feb		9.34
	Nov 19	10.64		Nov		11.34		Mar		9.13
	Dec 17	11.17		Dec	17	10.82		Apr	23	9.11
	18	11.17		Jan	22, 1987	10.78				
	Jan 20, 1987	11.36		Feb	18	10.73				
	Feb 17	11.29		Mar	16	10.56				
	Mar 16	12.28		Apr	22	10.35				
	Apr 22	11.94								
M39	Jan 20, 1987	11.02	M40	Jan	21, 1987	12.85				
company (De	Feb 18	11.07	SHIN SHASASA	Feb		11.89				
	Mar 16	10.81		Mar	16	11.73				

Table 3.--Physical properties of selected aromatic hydrocarbons [Solubilities at 20 °C unless otherwise indicated; mg/L, milligrams per liter; mm, millimeters; (K_{ow}), octanol-water partition coefficients; --, not available; from Weast, 1982, Verschueren, 1983, and MacKay and Shiu, 1982]

	Aqueous solubility				Vapor pressure	Log Kow	Molecular
Compound	(mg/L)			(mm	of Mercury)	weight
Benzene	1,780				76	2.13	78.11
Toluene	515				22	2.69	92.13
o-Xylene	175				5	2.77	106.17
m-Xylene	196				6	3.20	106.17
p-Xylene	198	(at	25	°C)	6.5	3.15	106.17
Ethylbenzene	e 152				7	3.15	106.17
Naphthalene	. 34.	4			0.05	3.37	128.17

Table 4.--Wells and well identifiers used during this report

[N/A, not available; land surface elevation is in feet above sea level; depth, in feet below land surface, indicates screened interval or bottom depth of an open-ended casing; letters in well identifiers in this report signify the following: M, observation well; T, temporary well; D, domestic well; SG, multidepth soil-gas well; SGT, temporary soil-gas well. All domestic wells were sampled at an outside spigot unless suffixed with a K (sampled at kitchen sink) or I (irrigation well, sampled at wellhead)]

	Site identifiers	3	Land		
This report	WATSTORE	Other reports	surface elevation	Depth	Comments
M1-82	13N/18E-12R01	1	1078.06	6.0 - 15.6	
M2-82	13N/18E-12R02	2	1077.93	6.6 - 16.1	Identified as 3-82 (Fish, 1987)
M3-82	13N/18E-12R03	3	1076.86	6.0 - 15.8	
M1-85	13N/18E-12R04	1-85, MW-1	1080.48	6.0 - 21.0	
M2-85	13N/19E-07N01	2-85, MW-2	1067.51	3.5 - 18.5	
M3-85	13N/19E-07N02	3-85, MW-3	1072.62	4.1 - 19.1	
M4-85	13N/18E-12R05	4-85, MW-4	1075.66	4.1 - 19.1	
M5-85	13N/19E-07N03	5-85, MW-5	1069.66	1.8 - 16.8	
M6-85	13N/19E-07N04	6-85, MW-6	1071.52	4.3 - 19.4	
M7-85	13N/19E-07N05	7-85, MW-7	1072.48	4.2 - 19.2	
M8-85	13N/19E-07N06	8-85, MW-8	1075.70	5.0 - 20.0	
M9-85	13N/18E-12R06	9-85, MW-9	1075.48	4.8 - 19.8	
M10-85	13N/18E-12R07	10-85, MW-1	1076.37	4.3 - 19.3	
M11-85	13N/18E-12R08	11-85, MW-11	1077.67	5.5 - 20.5	
M12-85	13N/18E-12R09	12-85, MW-12	1078.49	6.4 - 21.4	
м1	13N/18E-12R12	T1	1077.43	55.0 - 58.0	
M2	13N/18E-12R13	Т2	1077.65	28.0 - 30.0	SG1 also in same borehole
мз	13N/18E-12R14	Т3	1077.65	28.0 - 30.0	SG2 also in same borehole
M4	13N/18E-12R15	T4	1077.02	3.8 - 12.0	
м5	13N/18E-12R16	T5	1078.39	13.9 - 15.9	SG3 also in same borehole
M6.1	13N/18E-12R17	T6.1	1077.39	44.6 - 46.6	(Piezometers M6.1 and M6.2 are in the same hole)
M6.2	13N/18E-12R18	T6.2	1077.11	7.6 - 13.6	
M7.1	13N/18E-12R19	т7.1	1078.11	30.3 - 32.3	[Piezometers M7.1 and M7.2 are in the same hole]
M7.2	13N/18E-12R20	T7.2	1078.11	7.3 - 13.3	
М8	13N/18E-12R21	T8	1078.22	8.4 - 14.4	
м9	13N/18E-12R22	Т9	1078.07	7.0 - 13.0	
M10	13N/18E-12R23	T10	1077.81	8.3 - 14.3	
M11	13N/18E-12R24	T11	1077.65	8.4 - 14.2	
M12	13N/18E-12R25	T12	1078.09	7.4 - 13.4	
M13	13N/18E-12R26	T13	1078.09	30.5 - 32.3	SG4 also in same borehole
M14	13N/18E-12R27	T14	1076.14	6.8 - 12.8	
M16	13N/18E-12R28	T16	1078.09	7.9 - 13.9	
M17	13N/18E-12R29	T17	1078.36	7.7 - 13.7	
M18	13N/18E-12R30	T18	1077.70	7.1 - 13.1	
M19	13N/18E-12R31	T19	1078.12	7.8 - 13.8	
M20	13N/18E-12R32	T20	1078.26	7.2 - 13.2	
M21	13N/18E-12R33	T21	1077.70	56.3 - 58.3	
M22	13N/18E-12R34	T22	1077.50	6.7 - 12.7	
M23	13N/18E-12R39	В1	1077.10	6.5 - 12.5	
M24	13N/18E-12R40	B2	1076.16	7.6 - 13.6	
M25	13N/18E-12R41	В3	1076.08	30.3 - 32.3	SG6 also in same borehole
M26	13N/18E-12R42	B4	1076.58	8.0 - 14.0	
M27	13N/18E-12R43	B5	1076.79	9.0 - 18.0	5652 to 6 50 50 50 50
M28	13N/18E-12R35	S1	1077.03	54.0 - 56.5	SG7 also in same borehole
M29	13N/18E-12R36	S2	1076.99	7.7 - 16.8	
M30	13N/18E-12R37	S3	1076.89	7.8 - 16.8	
M31	13N/18E-12R38	S4	1077.74	8.6 - 17.4	
M33	13N/19E-07N08	H1	1075.13	55.0 - 57.0	
M34	13N/19E-07N09	Н2	1075.02	8.6 - 14.6	

Table 4.--Wells and well identifiers used during this this report--Continued

	Site identifier	s		Land			
This report	WATSTORE	Other reports		surface elevation		Depth	Comments
D8	13N/19E-07N25	H3-11-(I)			20		
D9	13N/19E-07N26	H4-07			20		
D10	13N/19E-07N27	H4-08			80		
D11	13N/19E-07N28	H4-11			65		
D12	13N/19E-07N29	H6-05			18		
D13	13N/19E-07N30	H6-04-(I)			25		
D14	13N/19E-07N31	H6-03-(I)				N/A	
D15	13N/19E-07N32	H6-01				N/A	
D16	13N/19E-07N33	H5-06				N/A	
D17	13N/19E-07N34	H5-05-(I)			28	2 5035	
D18	13N/19E-07N35	H5-04-(I)			28		
D19	13N/19E-07N36	H5-02			1757	N/A	
D20	13N/19E-07N02	IK6-06-(I)			30	2915:352	
D21	13N/19E-07N37	B2-05				N/A	
D22	13N/19E-07N38	B2-03			21	17.06.77	
D23	13N/19E-07N39	B2-01				N/A	
D24	13N/19E-07N40	B1-04			36		
D25	13N/19E-07N41	B1-01			26		
D26	13N/19E-07N42	B3-05				N/A	
D27	13N/19E-07N43	B3-03				N/A	N = 1
D28	13N/19E-07N44	B3-01			30	,	
D29	13N/19E-07N45	B4-06			38		
D30	13N/19E-07N46	B4-05			50	N/A	
D31	13N/19E-07N47	B4-01				N/A	<u>*</u>
D32	13N/18E-12R97	Mesa	1079.47			N/A	(Water levels only)
DUL	100,700 120,7		10.711.			.,, .,	(Macci levels only)
SG1	13N/18E-12R91	Т2	1077.43				Sampling tubes installed above the well screem M2)
SG2	13N/18E-12R92	Т3	1077.65				Sampling tubes installed above the well screen (M3)
SG3	13N/18E-12R93	Т5	1078.02				Sampling tubes installed above the well screen (M5)
SG4	13N/18E-12R94	T13	1078.09				Sampling tubes installed above the well screen (M13)
SG5	13N/18E-12R87	T15	1078.19				Multidepth soil-gas sampler only
SG6	13N/18E-12R95	В3	1076.08				Sampling tubes installed above the well screen (M25)
SG7	13N/18E-12R96	S1	1077.03				Sampling tubes installed above the well screen (M28)
SG8	13N/18E-12R88	\$5	1077.65				Multidepth soil-gas sampler only
SGT1	13N/18E-12R81	1-9				67	
SGT2	13N/18E-12R81	1-7				46	
	.13N/18E-12R79	1-4				59	
SGT4	13N/18E-12R78	1-2				to 5 (est	imated)
SGT5	13N/18E-12R82	2-5				47	
SGT6	13N/18E-12R83	3-2			4.	58	
SGT7	13N/18E-12R84	4-6			4.	10	
SGT8	13N/18E-12R85	4-2			5.	35	
SGT9	13N/18E-12R86	5-5			4.	96	

	Site identifier	· s	Land		
This report	WATSTORE	Other reports	surface elevation	Depth	Comments
м35	13N/18E-12R11	WS1	1078.63	57.0 - 59.0	
M36	13N/18E-12R44	T1, GS1	1077.85	6.0 - 13.0	Estimated screen interval
M37	13N/18E-12R45	B1, GS2	1077.53	6.0 - 13.0	Identified as GS1 (Fish, 1987
M38	13N/19E-07N07	3/R	1072.58	54.2 - 56.2	Latter south of the control of the c
M39	13N/18E-12J03	HWY1	1078.22	N/A	
M40	13N/19E-07M01	HWY2	1078.35	N/A	
Т1	13N/19E-07M04	8T1-1			
T2	13N/19E-07N10	8T1-2			
T3	13N/19E-07N11	8T1-3			
T4	13N/18E-12R46	8T1-4			
T5	13N/18E-12R47	8T1-5			
T6	13N/18E-12R48	8T1-6			
т7	13N/19E-07N12	8T2-2			
T8	13N/19E-07N13	8T2-3			¥
Т9	13N/19E-07N14	8T2-4			
T10	13N/19E-07N15	8T2-5			
T11	13N/19E-07N16	8T2-6			
T12	13N/19E-07N17	8T2-7			
T13	13N/19E-07N18	8T2-8			
T14	13N/18E-12R51	7-5			
T15	13N/18E-12R52	8-5			
T16	13N/18E-12R53	9-7.5			
T17	13N/18E-12R54	8-4			
T18	13N/18E-12R55	9-4			
T19	13N/18E-12R56	1.5-1.5			
T20	13N/18E-12R57	8-3			
	13N/18E-12R58	7-4			
	13N/18E-12R59	5-3			
	13N/18E-12R60	5-2			
	13N/18R-12R61	4-2			
	13N/18E-12R62	4-3			
	13N/18E-12R63	3-2			
	13N/18E-12R64	3-3			
	13N/18E-12R65	6-7			
	13N/18E-12R66	1-8			
	13N/18E-12R67	1-9			
	13N/18E-12R68	1-10			
	13N/18E-12R69	6-8			
ACC	13N/18E-12R70	6-9			
	13N/18E-12R71	4-8			
	13N/18E-12R72	4-9			
	13N/18E-12R73	11-8.5			
	13N/18E-12R74	11-9.5			
	13N/18E-12R75	11-7.5			
	13N/18E-12R76	9-8.5			
	13N/18E-12R77	9-9.5	1070		
	13N/18E-12R89 13N/18E-12R90	(1 m north of M36) (1.3 m south of M36)	1078 1078		
D1	13N/19E-07M03	H1-01		25	
	13N/19E-07N19	H4-03-(I)		20	
	13N/19E-07N20	H4-06-(K)		28	
	13N/19E-07N20	H4-06-(I)		13	
	13N/19E-07N22	H4-01		N/A	
	13N/19E-07N23	H3-08-(I), H3-07-(I)		70	

Table A7.--Concentrations of inorganic and dissolved-organic carbon quality-assurance samples, March 1989--Continued

Sample or well identi- fier	Date	Beryl- lium, dis- solved (µg/L as Be)	Cadmium, dis- solved (µg/L as Cd)	Chro- mium, dis- solved (µg/L as Cr)	Cobalt, dis- solved (µg/L as Co)	Copper, dis- solved (µg/L as Cu)	Iron, dis- solved (µg/L as Fe)	Lead, dis- solved (µg/L as Pb)	Lithium dis- solved (µg/L as Li)	dis- solved (µg/L
M18	03-17-89	<0.5	<1	<5	4	<10	7,300	<10	6	2,800
M18 (D)	03-17-89	<.5	<1	<5	<3	<10	7,200	<10	5	2,800
ER4	03-15-89	<.5	<1	<5	<3	<10	5	<10	<4	<1
Sample of well		Molyb- denum, dis- solved	Nickel, dis- solved	Silver, dis- solved	dis- solved	Vana- dium, dis- solved	- Ngarata (ma.	SOLUTION CONTRACTOR		
	Date	denum, dis-	dis-	dis-	tium, dis-	dium, dis-	dis-	dissolved		
of well identi-	Date	denum, dis- solved (µg/L	dis- solved (µg/L	dis- solved (µg/L	tium, dis- solved (µg/L	dium, dis- solved (µg/L	dis- solved (µg/L	dissolved organic (mg/L		
of well identi- fier		denum, dis- solved (µg/L as Mo)	dis- solved (µg/L as Ni)	dis- solved (μg/L as Ag)	tium, dis- solved (µg/L as Sr)	dium, dis- solved (µg/L as V)	dis- solved (µg/L as Zn)	dissolved organic (mg/L as C)		

Table A7.--Concentrations of inorganic and dissolved-organic carbon quality-assurance samples, March 1989

[Data from 1989 study, laboratory data analyzed by NWQL; ER, equipment-rinse blank, de-ionized water; D, duplicate sample; mg/L, milligrams per liter; or μ g/L, milligrams per liter]

Well or sample		Spe- cific con- duct-	Lab spe- cific con- duct-	pH (stan	Lab pH d- (stan	Temper	- Tur- bid-	Oxygen, dis-	Hard- ness	Hard- ness, non-
identi-		ance	ance	ard	ard	water	ity	solved	(mg/L as	carbonate
fier	Date	(µs/cm)	(µs/cm)				(NTU)	(mg/L)		(mg/L as CaCO;)
	11-10-00-730-50-50							1377		
M18	03-17-89	319	307	6.7	6.9	13.0	40	0.0	130	0
M18 (D)	03-17-89		307		6.7		33		130	0
ER4	03-15-89				7.2	20 1 2 4 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5	.3		0	0
-										
		Calcium	Magne- sium,	Sodium,		Sodium	Potas-	Alka	Alka-	Cu.) 5-1-
Sample		dis-	dis-	dis-		ad-	sium, dis-	Alka- linity,	linity, labor-	Sulfate dis-
or well		solved	solved	solved		sorp-	solved	field	atory	solved
identi-		(mg/L	(mg/L	(mg/L	Sodium	tion	(mg/L	(mg/L as	(mg/L as	(mg/L
fier	Date	as Ca)	as Mg)	as Na)	percent	ratio	as K)	CaCO ₃)	CaCO ₃)	as SO ₄)
M18	03-17-89	32	11	12	17	0,5	2.6	132	113	34
M18 (D)	03-17-89	32	11	12	17	.5	2.6		113	34
ER4	03-15-89	.03	.05	<.2			.1		2	<.2
		Chlo- ride,	Fluo- ride,	Silica, dis-	Solids, residue at	Solids, sum of consti-	gen,	gen,	phorus	
Sample		dis-	dis-	solved	180 °C	tuents,		dis-	dis-	dis-
or well		solved	solved	(mg/L	dis-	dis-	solved			
identi-		(mg/L	(mg/L	as	solved	solved	(mg/L	(mg/L	(mg/L	(µg/L
fler	Date	as Cl)	as F)	sio ₂)	(mg/L)	(mg/L)	as N)	as N)	as P)	as Ba
м18	03-17-89	7.0	0.2	38	209	227	<0.10	0.10	0.05	18
M18 (D)	03-17-89	7.0	. 2	38	208	227	<.10		.05	19

ER4

03-15-89

<.1

.1

<.01

<1

<.10

<.01

<.01

Table A6.--Comparison of field and laboratory determinations of specific conductance, pH, and alkalinity, November 1986 and March 1989

[Data from ground-water toxics study and 1989 study, laboratory data analyzed by NWQL; $\mu s/cm$, microsiemens per centimeter; mg/L, milligrams per liter; --, not analyzed]

			conductance s/cm	pH in stand	ard units	Alkal in mg/L	
Well identi- fier	Date	Field	Lab	Field	Lab	Field	Lab
M1-82	11-18-86	280	279	6.8	6.9	131	
M2-82	11-18-86	320	303	6.7	6.8	156	
M1-85	11-19-86 03-13-89	238 208	239 222	6.7 6.9	6.9 7.0	103 89	 90
M5-85	03-13-89	252	265	6.7	6.8	113	114
M9-85	11-19-86 03-15-89	254 249	254 260	6.5 6.6	6.9 6.7	108 112	111
M10-85	11-19-86	298	293	6.6	6.8	116	
M11-85	11-17-86 03-18-89	264 292	251 295	6.6 6.6	6.8 6.8	125 140	134
м4	11-18-86	313	295	6.6	6.8	151	
M7.2	11-17-86	352	336	6.4	6.6	185	
м8	11-17-86	247	245	6.6	6.8	105	
м9	11-17-86	279	272	6.6	6.9	133	
м11	11-18-86	307	298	6.6	6.9	148	
M12 M16	11-18-86 11-17-86	323 342	303 329	6.5 6.7	6.7 6.8	164 172	
M18	11-18-86 03-17-89	292 319	271 307	6.6 6.7	6.8 6.9	149 132	113
м19	11-18-86	257	251	6.6	6.9	105	~==:
M23	11-18-86	390	385	6.7	6.8	193	
M24	11-18-86	365	332	6.5	6.7	190	8 3
M29	11-19-86	259	258	6.6	6.8	120	
м30	03-14-89	268	284	6.6	6.6	128	122
м31	11-19-86	261	261	6.5	6.8	113	()

Table A5.--Concentrations of volatile organic compounds in quality-assurance samples, February 23 through March 17, 1989--Continued

Sample or well identi- fier	Date	1,2-Di- chloro- propane	chloro-	1,4-Di chloro benzen	- fluoro-	1,3-Di- chloro-	chloro-	Vinyl Chlo- ride	Tri- chloro- ethyl- ene	1,2-Di- chloro- ethene	Styrene
M8-85	03-14-89	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
M8-85 (FS1)	03-14-89	ND	ND	ND	ND	ND	ND	ND	ND	ND	8.6
M8-85 (FS2)	03-14-89	ND	ND	ND	ND	ND	ND	ND	ND	ND	7.0
M8-85 (LS)	03-14-89	ND	ND	ND	ND	ND	ND	ND	ND	ND	8.8
м18	03-17-89	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
M18 (D)	03-17-89	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
DT 1	02 22 00	MD	ND	NID	MD	MD	110	N.	No.		3 <u>2022</u> 23
BL1	02-23-89	ND ND	ND ND	ND	ND	ND	ND	ND	ND	ND	ND
BL2 BL3	02-23-89	ND	ND ND	ND ND	ND ND	ND	ND ND	ND	ND	ND	ND
BL4	02-23-89	ND	ND	ND	ND	ND ND	ND ND	ND	ND ND	ND	ND
BL5	03-06-89	0.3	ND	ND	ND	ND	ND ND	ND ND	ND ND	ND ND	ND ND
		\$5.3860		22277	150000	15070	0.55.550		.,	110	no.
ER1	02-23-89	ND	ND	ND	ND	ND	ND	ND	0.2	ND	ND
ER2	02-23-89	ND	ND	ND	ND	ND	ND	ND	.5	ND	ND
ER3	02-23-89	ND	ND	ND	ND	ND	ND	ND	. 2	ND	ND
ERB4	03-06-89	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
ERB5	03-13-89	. 3	ND	ND	ND	ND	ND	ND	ND	ND	ND
Sample or well		1,1-Di- chloro		1,3-Di- chloro-	ortho-	para-	1,2,3- Tri-	1,1,1,2- Tetra-	1,2- Di-		
identi-		pro-	pro-	pro-	Chloro-	Chloro-	chloro-	chloro-	bromo-	Bromo-	
fier	Date	pene	pane	pane	toluene	toluene	propane	ethane	ethane	benzene	
							225 (3)			Delizene	
M8-85	03-14-89	ND	ND	ND	ND	ND	ND	ND	ND	ND	
	03-14-89 03-14-89	ND ND	ND ND	ND ND	ND ND	ND ND	ND ND	ND ND	ND ND		
48-85 (FS1)										ND	
18-85 (FS1) 18-85 (FS2)	03-14-89	ND	ND	ND	ND	ND	ND	ND	ND	ND 8.7	
M8-85 (FS1) M8-85 (FS2) M8-85 (LS)	03-14-89 03-14-89	ND ND	ND ND ND	ND ND ND	ND ND ND	ND ND ND	ND ND ND	ND ND ND	ND ND ND	ND 8.7 7.1 7.7	
M8-85 (FS1) M8-85 (FS2) M8-85 (LS)	03-14-89 03-14-89 03-14-89	ND ND ND	ND ND	ND ND	ND ND	ND ND	ND ND	ND ND	ND ND	ND 8.7 7.1	
M8-85 (FS1) M8-85 (FS2) M8-85 (LS) M18 M18 (D)	03-14-89 03-14-89 03-14-89 03-17-89 03-17-89	ND ND ND	ND ND ND ND	ND ND ND ND	ND ND ND ND	ND ND ND ND	ND ND ND ND	ND ND ND ND	ND ND ND ND	ND 8.7 7.1 7.7 ND ND	
M8-85 (FS1) M8-85 (FS2) M8-85 (LS) M18 M18 (D)	03-14-89 03-14-89 03-14-89	ND ND ND	ND ND ND ND ND	ND ND ND ND ND	ND ND ND ND ND	ND ND ND ND ND	ND ND ND ND ND	ND ND ND ND	ND ND ND ND ND	ND 8.7 7.1 7.7 ND ND ND	
M8-85 (FS1) M8-85 (FS2) M8-85 (LS) M18 M18 (D) BL1 BL2	03-14-89 03-14-89 03-14-89 03-17-89 03-17-89	ND ND ND ND ND	ND ND ND ND	ND ND ND ND ND ND	ND ND ND ND ND ND ND	ND	ND ND ND ND ND ND	ND ND ND ND ND ND	ND ND ND ND ND ND	ND 8.7 7.1 7.7 ND ND ND ND ND	
M8-85 (FS1) M8-85 (FS2) M8-85 (LS) M18 M18 (D) BL1 BL2 BL3	03-14-89 03-14-89 03-14-89 03-17-89 03-17-89 02-23-89 02-23-89	ND ND ND ND ND ND	ND ND ND ND ND	ND ND ND ND ND	ND ND ND ND ND	ND ND ND ND ND	ND ND ND ND ND ND ND	ND ND ND ND ND ND	ND ND ND ND ND ND	ND 8.7 7.1 7.7 ND ND ND ND ND ND ND ND ND	
M8-85 (FS1) M8-85 (FS2) M8-85 (LS) M18 M18 (D) BL1 BL2 BL3 BL4	03-14-89 03-14-89 03-14-89 03-17-89 03-17-89 02-23-89 02-23-89 02-23-89	ND ND ND ND ND ND	ND ND ND ND ND ND	ND ND ND ND ND ND ND	ND	ND N	ND ND ND ND ND ND	ND ND ND ND ND ND	ND ND ND ND ND ND	ND 8.7 7.1 7.7 ND ND ND ND ND	
M8-85 (FS1) M8-85 (FS2) M8-85 (LS) M18 M18 (D) BL1 BL2 BL3 BL4 BL5	03-14-89 03-14-89 03-14-89 03-17-89 03-17-89 02-23-89 02-23-89 02-23-89 03-06-89 03-13-89	ND ND ND ND ND ND ND ND ND	ND N	ND N	ND N	ND N	ND ND ND ND ND ND ND ND ND ND	ND N	ND ND ND ND ND ND ND ND ND	ND 8.7 7.1 7.7 ND	
M8-85 (FS1) M8-85 (FS2) M8-85 (LS) M18 M18 (D) BL1 BL2 BL3 BL4 BL5 ER1	03-14-89 03-14-89 03-14-89 03-17-89 03-17-89 02-23-89 02-23-89 03-06-89 03-13-89	ND ND ND ND ND ND ND ND ND ND	ND N	ND N	ND N	ND N	ND N	ND N	ND N	ND 8.7 7.1 7.7 ND	
M8-85 (FS1) M8-85 (FS2) M8-85 (LS) M18 M18 (D) BL1 BL2 BL3 BL4 BL5	03-14-89 03-14-89 03-14-89 03-17-89 03-17-89 02-23-89 02-23-89 03-06-89 03-13-89 	ND ND ND ND ND ND ND ND ND ND ND ND	ND N	ND N	ND N	ND N	ND N	ND N	ND N	ND 8.7 7.1 7.7 ND	
48-85 (FS1) 48-85 (FS2) 48-85 (LS) 418 418 (D) 3L1 3L2 3L3 3L4 3L5	03-14-89 03-14-89 03-14-89 03-17-89 03-17-89 02-23-89 02-23-89 03-06-89 03-13-89	ND ND ND ND ND ND ND ND ND ND	ND N	ND N	ND N	ND N	ND N	ND N	ND N	ND 8.7 7.1 7.7 ND	
48-85 (FS1) 48-85 (FS2) 48-85 (LS) 418 418 (D) 3L1 3L2 3L3 3L4 3L5	03-14-89 03-14-89 03-14-89 03-17-89 03-17-89 02-23-89 02-23-89 03-06-89 03-13-89 	ND ND ND ND ND ND ND ND ND ND ND ND	ND N	ND N	ND N	ND N	ND N	ND N	ND N	ND 8.7 7.1 7.7 ND	

Table A4.--Comparison of means and standard deviations of standard hydrocarbon compound concentrations, November 1985

[Data from the ground-water toxics study, analyzed by OGC; concentrations in micrograms per liter; standard solutions prepared from materials supplied by the U.S. Environmental Protection Agency- Environmental Monitoring Services Laboratory, Cincinati, OH (EPA)]

		EPA	GW	TP
Standard solution	Compound	Concentration	Concentration	One standard deviation
I	Benzene	10,000	12,000	<u>+</u> 1,800
	Toluene	10,000	11,000	<u>+</u> 540
	m+p-Xylene	10,000	9,700	<u>+</u> 680
	o-Xylene	5,000	5,100	<u>+</u> 320
II	Benzene	10,000	12,000	<u>+</u> 800
	o-Xylene	10,000	9,500	<u>+</u> 560
III	Toluene	10,000	11,000	<u>+</u> 480
	m+p-Xylene	10,000	10,000	<u>+</u> 720

Table A3.--Mean and standard deviations of trip blanks, August 26-30 1985

[Data from the ground-water toxics study, analyzed by OGC; n, number of replicates; concentrations are in micrograms per liter].

Parameter	Benzene	Toluene	Ethyl- benzene	m+p Xylene		n-Propyl- benzene	1,3,5-Tri- methyl- benzene
Mean (n = 6)	0.87	0.49	0.032	0.041	0.025	0.0024	0.017
Standard deviation	± .11	<u>+</u> .10	<u>+</u> .015	± .015	<u>+</u> .0071	± .0047	<u>+</u> .0096
Parameter	1,2,4- Tri- methyl- benzene	Iso- butyl- benzene	sec- Butyl- benzene	n-Butyl- benzene	California and Carlotte and California	Tetra- methyl-	Naph-
Mean (n = 6)	0.053	0.0046	0.006	0.019	0.009	0.014	0.20
Standard deviation	± .017	<u>+</u> .0082	<u>+</u> .0089	± .011	<u>+</u> .014	<u>+</u> .016	<u>+</u> .29

Table A2. -- Concentrations of volatile organic compounds in quality-assurance samples, August 27, 1985

[Concentrations are in micrograms per liter; ND, below the limit of detection of 1 microgram per liter for the insurance company study (ICS), see text for discussion of limit of detections for Ground-Water Toxics Study (GWTS)].

Well	<u>Be</u>	nzene	To	luene	Total	xylenes
identi- fier	ICS	GWTS	ICS	GWTS	ICS	GWTS
M7-85	ND	ND	ND	ND	ND	ND
M8-85	96	ND	1	ND	9	ND
M10-85	ND	ND	ND	ND	ND	ND
M11-85	920	1,000	1,100	3,400	6,300	7,300

Table A1.--Concentrations of volatile organic compounds in quality-assurance samples,
May 1985 through June 1986

[Data from the insurance company study, analyzed by a private laboratory; concentrations are in micrograms per liter; ND, below the detection limit of 1 microgram per liter; D, duplicate sample]

Sample or well identifier	Date	Benzene	Toluene	Total xylenes
Field blank	5-10-85	ND	ND	ND
Field blank	5-11-85	ND	ND	ND
M11-85 M11-85 (D)	5-11-85 5-11-85	1,380 1,090	7,700 4,000 ND	12,990 14,900 ND
Lab blank	6-27-86	ND	ND	ND

Table 9.--Concentrations of inorganic compounds and dissolved organic carbon in ground water, November 1986 and March 1989--Cont.

Well identi- fier	Barium, dis- solved (µg/L as Ba)	Beryl- lium, dis- solved (µg/L as Be)	Cadmium, dis- solved (µg/L as Cd)	Chro- mium, dis- solved (µg/L as Cr)	Cobalt, dis- solved (µg/L as Co)	Copper dis- solved (µg/L as Cu)	dis- solved (µg/L	Lead, dis- solved (µg/L as Pb)	Lithium, dis- solved (µg/L as Li)
M1-82	11	<0.5	<1	.==	<3	<10	65	<10	5
M2-82	16	<.5	<1	:	<3	<10	4,000	<10	5
M3-82		(2)2							
M1-85	7	<.5	<1		<3	<10	3	<10	5
	8	<.5	<1	<5	<3	<10	15	<10	<4
15-85	9	<.5	<1	<5	<3	<10	14	<10	<4
16-85									
47-85									
18-85									
19-85	8	<.5	<1		<3	<10	<3	<10	5
	9	<.5	<1	<5	<3	<10	11	<10	<4
110-85	10	<.5	<1		<3	<10	<3	<10	6
111-85	13	<.5	<1		<3	<10	3,400	<10	<4
	16	<.5	<1	<5	<3	<10	3,700	10	<4
14	16	<.5	1		<3	<10	6,200	<10	4
16.2						22			
17.2	17	<.5	1		<3	<10	9,100	<10	5
18	8	<.5	<1		<3	<10	12	<10	4
19	12	<.5	<1		<3	<10	1,500	<10	4
11	21	<.5	<1		<3	<10	1,700	<10	4
112	14	<.5	<1		<3	<10	6,400	10	5
113									
114							122		
16	11	<.5	1		<3	<10	7,400	<10	6
17				"					
18	12	<.5	<1		<3	<10	8,100	<10	4
	18	<.5	<1	<5	4	<10	7,300	<10	6
19	10	<.5	<1		<3	<10	7	<10	5
20					1000				(*****)
23	22	<.5	<1		<3	<10	5,800	<10	5
24	20	<.5	<1		<3	<10	9,700	<10	5
26									
27									
29	15	<.5	<1		<3		1,300	<10	4
	10	<.5	<1	<5	<3	<10	7	<10	
30	10	\ · · J	V.1						
30 31	11	<.5	<1		<3	<10	10	<10 <10	< 4 5

Table 8.--Concentrations of volatile organic compounds in ground water, March, 1989

[Data from the 1989 study, analyzed by NWQL; concentrations are in micrograms per liter; ND, below the detection limit of 0.2 micrograms per liter, unless otherwise noted]

Well identi- fier	Benzene	Toluene	Ethyl- benzene	Total xylenes	Naph- thalene	1,3,5- Tri- methyl- benzene	2- Ethyl-1- methyl- benzene	1,2,4- Tri- methyl- benzene	1,2,3- Tri- methyl- benzene
M2-82	ND	ND	ND	ND	ND	ND	5,7	ND	1.7
M3-82	17	1.6	ND	1,500	19	280	240	300	200
M1-85	ND	ND	ND	ND	ND	ND	ND	ND	ND
M5-85	ND	ND	ND	ND	.2	ND	ND	ND	.2
M6-85	ND	ND	ND	ND	ND	ND	ND	ND	ND
M7-85	ND	ND	ND	ND	ND	ND	ND	ND	ND
M8-85	ND	ND	ND	ND	ND	ND	ND	ND	ND
M9-85	. ND	ND	ND	ND	ND	ND	ND	ND	ND
M11-85	23	ND	3.6	320	62	160	130	150	95
M4	ND	ND	ND	ND	ND	ND	ND	ND	ND
M6.2	ND	ND	ND	ND	ND	ND	ND	ND	ND
M11	ND	ND	ND	ND	ND	ND	ND	ND	ND
M12	ND	ND	ND	ND	ND	ND	ND	ND	ND
M13	, ND	ND	ND	ND	ND	ND	ND	ND	ND
M14	ND	ND	ND	ND	.2	ND	ND	ND	ND
M16	68	15	ND	820	130	60	79	49	86
M17	75	.3	ND	.5	44	ND	49	.5	. 3
M18	ND	ND .	. 2	.2	ND	ND	3.2	ND	. 3
M19	ND	ND	ND	ND	ND	ND	ND	ND	ND
M20	ND	ND	ND	ND	.3	ND	ND	ND	ND
M23	.3	ND	ND	ND	ND	ND	. 4	ND	ND
M26	ND	ND	ND	ND	.2	ND	ND	ND	ND
M27	.3	ND	ND	ND	ND	ND	. 4	ND	ND
M29	1.0	ND	ND	ND	ND	ND	ND	ND	ND
М30	ND	ND	ND	ND	ND	ND	ND	ND	ND
м31	ND	ND	ND	ND	ND	ND	ND	ND	ND
M34	ND	ND	ND	ND	ND	ND	ND	ND	ND

Table 7.--Concentrations of volatile organic compounds in ground water, August 1985 through November 1986--Continued

l,3-Di- methyl,4- ethyl- benzene	ł	1	1	ļ	ł	ŀ	1	1
1,4-Di- methyl- 2-ethyl- benzene	ł	1	1	1	ł	i	ł	ł
l,4-Di- methyl- ethyl- benzene	ł	1	}	1	l	ł	1	1
2-Ethyl 1-methyl- benzene	1	ĺ	1	1	1	ł	ł	1
l-Iso- propyl- 4-methyl- benzene	N ON	S	QN	Q	ND	QN	N	ΩN
t- Butyl- benzene	ND	N	QN	ND	ND	ND	ND	ND
Ethyl- ene- bromide	S	NO	NO	S	ND	ND	ND	Q
n- Butyl- benzene	ND	NO	ΩN	ΩN	ΩN	NO	Q	ND
sec- Butyl- benzene	ND	ND	ND	NO	ND	ND	ND	ND
Iso- butyl- benzene	NO	ND	ND	ND	ND	ND	NO	Q.
n- Propyl- benzene	N	ND						
Well identi- fier	D24	D25	D26	720	D28	D29	D30	D31

Table 7.--Concentrations of volatile organic compounds in ground water, August 1985 through November 1986--Continued

1,3-Di- methyl,4- ethyl- benzene	H B B B 0 8 8 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	1
1,4-Di- methyl- 2-ethyl- benzene	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Ī
l,4-Di- methyl- ethyl- benzene		!
2-Ethyl 1-methyl- benzene	0 to 0 d 2 d 4 4 6 C 6 d 5 d 5 d 5 d 5 d 5 d 5 d 5 d 5 d 5 d	1
l-Iso- propyl- 4-methyl- benzene		Q
t- Butyl- benzene		N
Ethyl- ene- bromide		S
n- Butyl- benzene		ND
sec- Butyl- benzene		ND
Iso- butyl- benzene		NO
n- Propyl- benzene		ND
Well identi- fier	127 128 130 131 131 133 133 134 135 136 137 138 139 139 140 100 101 101 101 101 101 101 101 101	D23

Table 7.--Concentrations of volatile organic compounds in ground water, August 1985 through November 1986--Continued

1,3-Di- methyl,4- ethyl- benzene		ł
1,4-Di- methyl- 2-ethyl- benzene	130 130 130 130 130 120 ND ND 120 120 120	Э
1,4-Di- methyl- ethyl- benzene	6 2 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8	E
1,4-Di. 2-Ethyl methyl. 1-methyl- ethyl- benzene benzen	110 110 110 110 140 550 ND 140 140 560 170 170 170 18 18 1,400	>
1-Iso- propyl- 4-methyl- benzene		
t- Butyl- benzene		
Ethyl- ene- bromide		
n- Butyl- benzene		
sec- Butyl- benzene		
Iso- butyl- benzene		
n- Propyl- benzene		
Well identi- fier	M18 M19 M19 M22 M22 M23 M34 M34 M35 M35 M35 M36 M37 M36 M37 M36 M37 M36 M37 M36 M37 M37 M36 M37 M37 M37 M37 M37 M37 M37 M37 M37 M37	

Table 7.--Concentrations of volatile organic compounds in ground water, August 1985 through November 1986--Continued

Well denti- fier M1-82	n- opyl- zene	Iso- butyl- benzene ND	sec- Butyl- benzene	Butyl-benzene	Ethyl- ene- bromide ND	t- Butyl- benzene ND	1-Iso- propyl- 4-methyl- benzene ND	2-Ethyl 1-methyl- benzene	1,4 met eth ben	1,4-Di- methyl- 2-ethyl- benzene	1,3-Di- methyl,4- ethyl- benzene	
M2-82	130	2 2	2 2	7: Q	2 2	2 2	2 2	110	45	1 1 1	111	
M3-82	8	18	l g	1 2	1 8	1 2	l l Q	190	97	1 1	1 1	
M1-85	<u>N</u>	I N I	<u>Q</u>	<u>R</u>	8	8	8	250 	2	76	111	
M2-85 M3-85	Q Q	88	ON ON	99	22	8 8 8	ON ON	11	11		11	
M5-85 M6-85			2 2 2	2 2 2	2 2 2	2 2 2	8 8 g	} }	1 1	11	1 1	
M7-85 M8-85	Q Q	99	2 2	99	999	2 2	9 9 9	1 1	11			
	1 1					1 1	1 1	8.0 ON	2		Q	
M9-85	Q I	Q I	<u>Q</u>	Q I	8	S I	ON	1 2	1 2		1	
M10-85	Ω	8	<u> </u>	811	Q	Q	Q I	1 8	111		I QN	
M11-85	8	811	911	1911	1211	Q Z	<u>2</u>	D I O C	S 5	120	111	
M12-85	QN I	Q I	Q I	ON I	Q	O I	ON I	3 5	2 5		h I I	
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	1 1			1 1	1 1	1 1	1	99 1	31	1	1	
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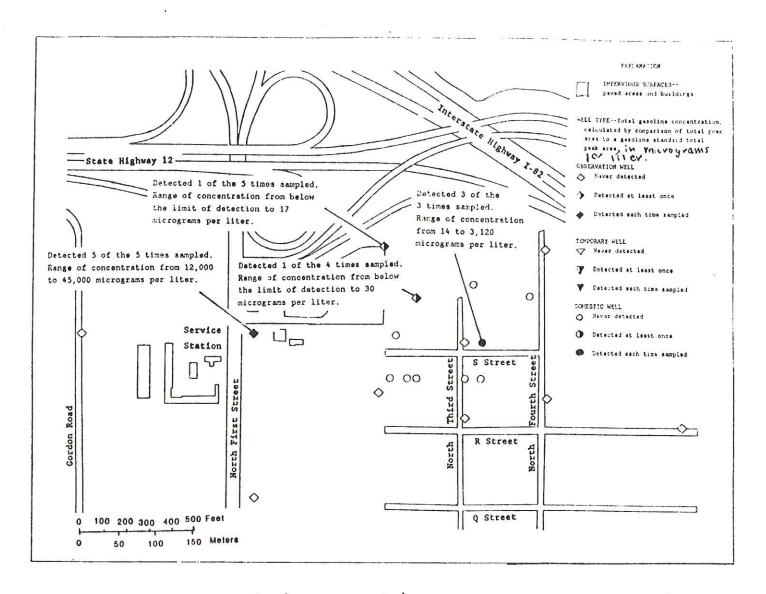
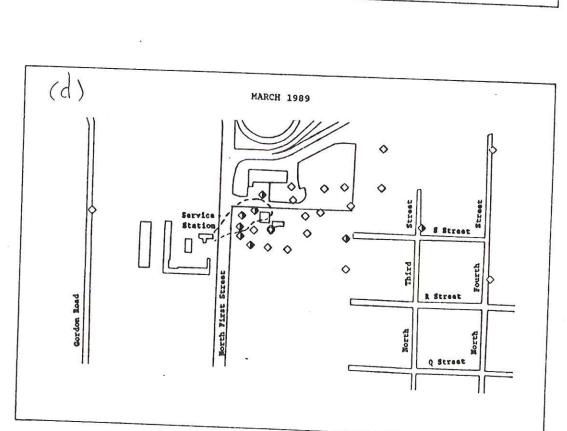
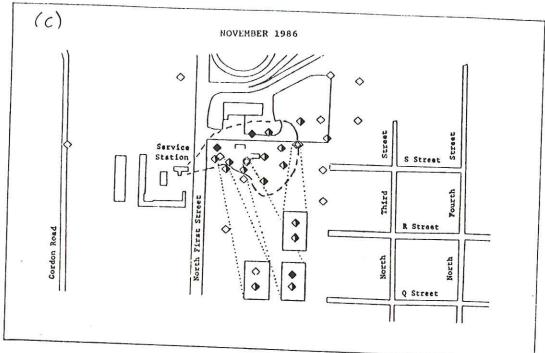
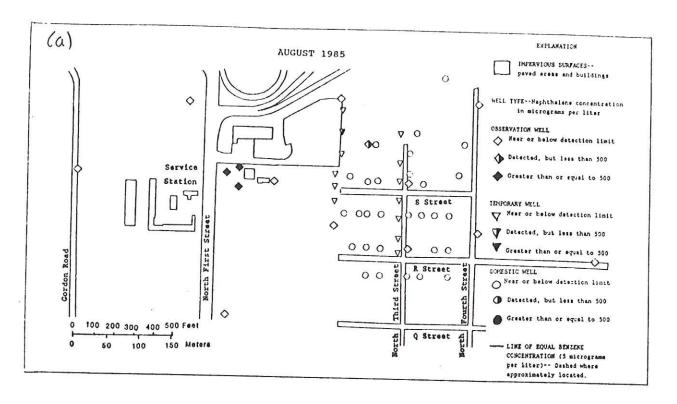


Figure 12. -- Concentrations of total gasoline in ground water, February 1985 through May 1986 [data from the insurance company study].







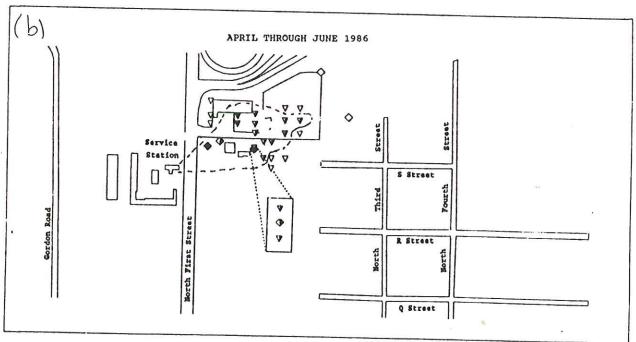
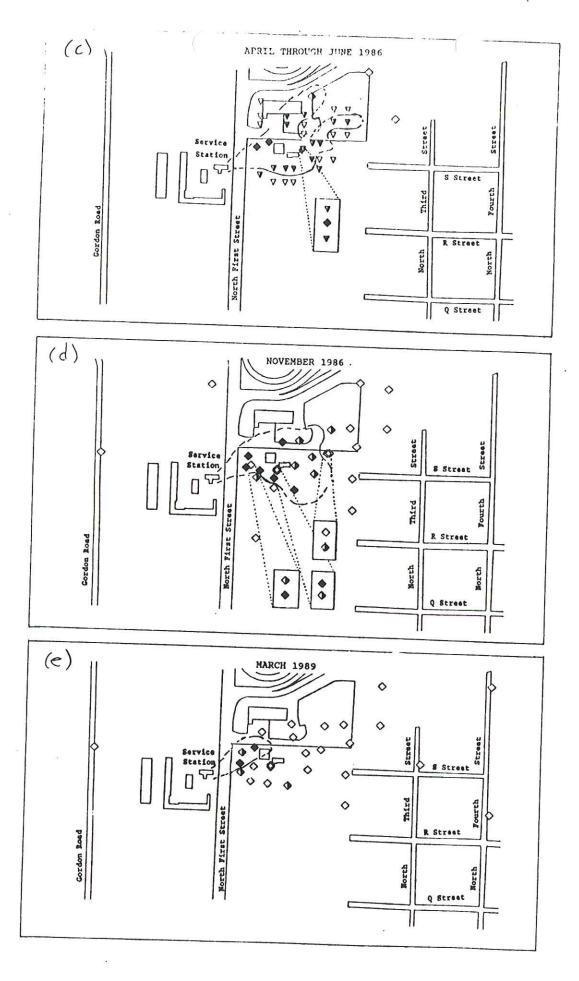
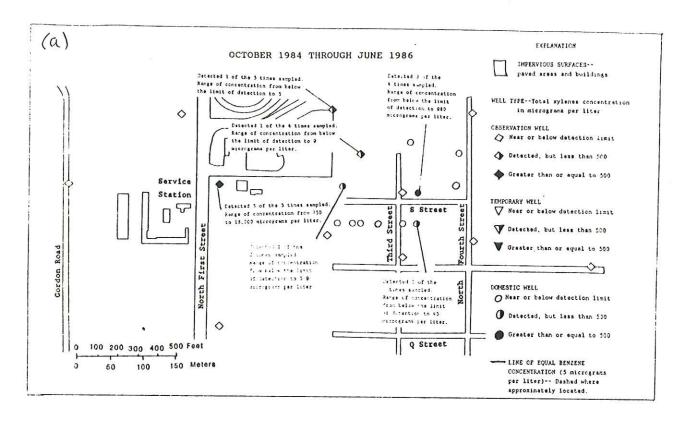


Figure 11. -- Naphtholone Concentrations in ground water,
August 1985 through March 1989 [data from
(a) - (c) the ground-water toxics study, and
(d) the 1989 study].





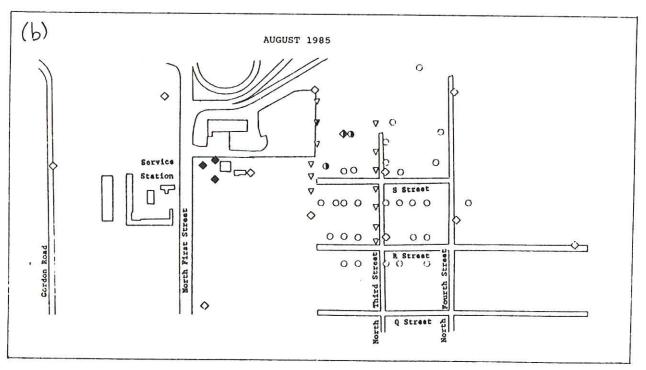
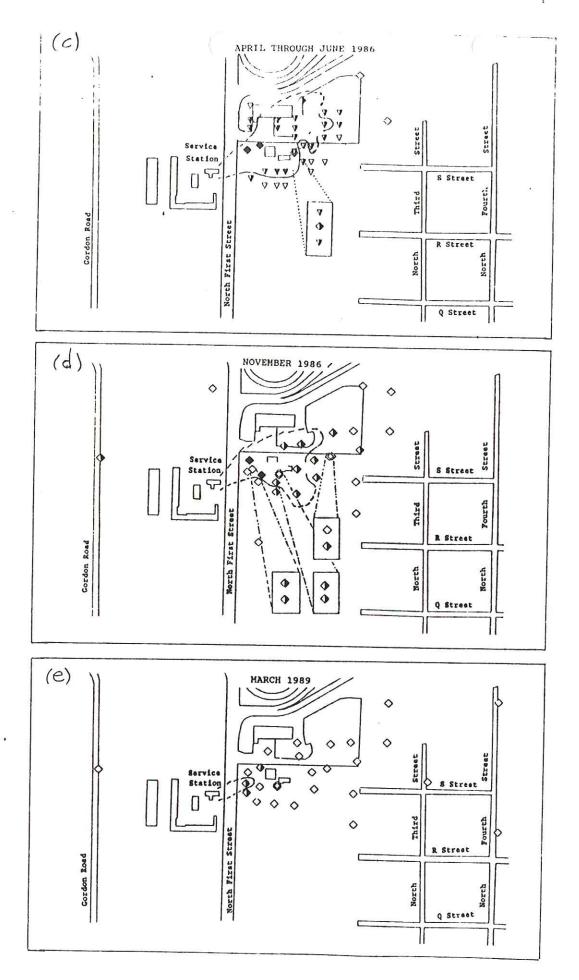
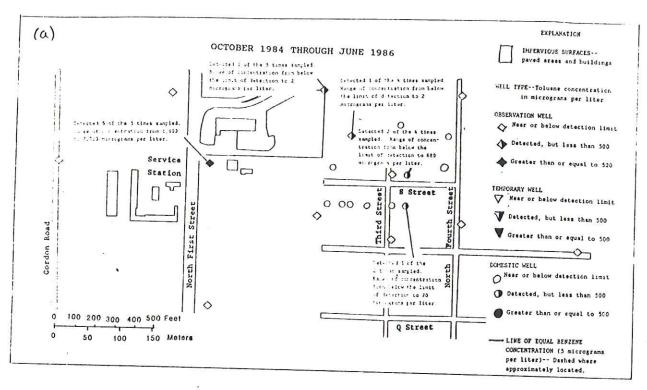


Figure 10. -- Concentrations of total xylenes in ground water, catober 1984 through March 1989[data from (a) the insurance company study, (b)-(d) the ground-water toxics study, and (e) the 1989 study].





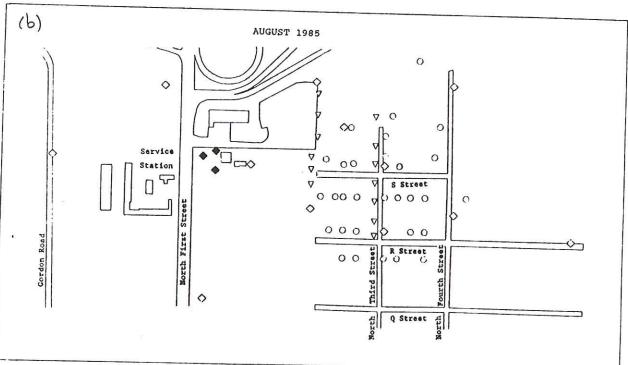
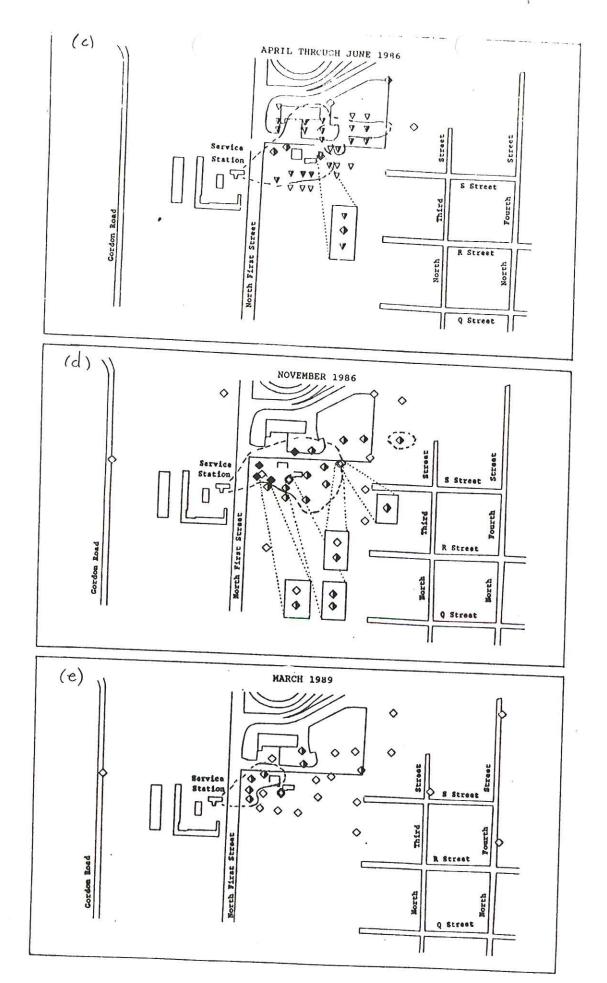
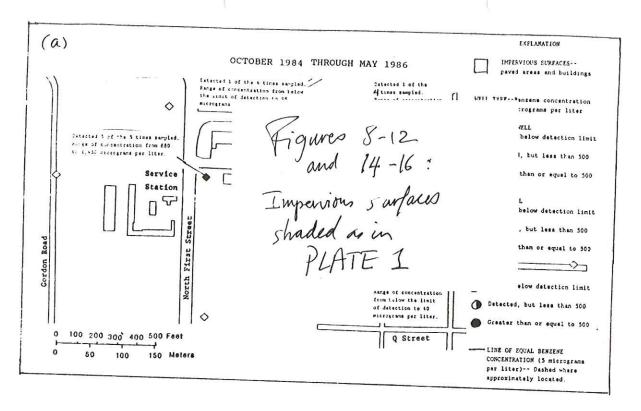


Figure 9. -- Concentrations of toluene in ground water October 1984 through March 1989 [data from (a) the insurance company study, (b)-(d) ground-water toxics study, and (e) the 1989 study.





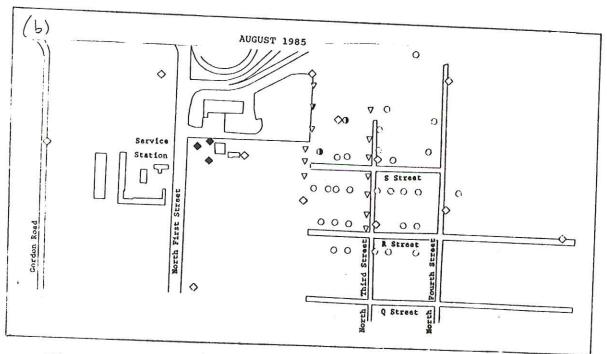
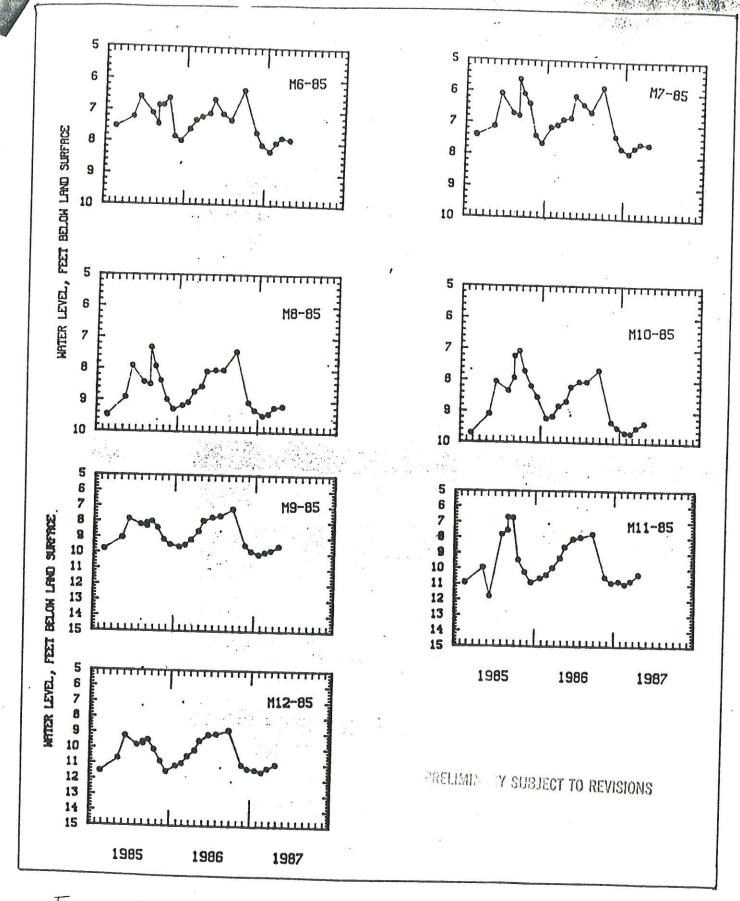


Figure 8 .-- Concentrations of benzene in ground water, October 1984 through March 1987 [data from (a) the insurance company study, (b-d) ground-water toxics study, and (e) 1989 study].

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FIRURE 7. - CONTINUED

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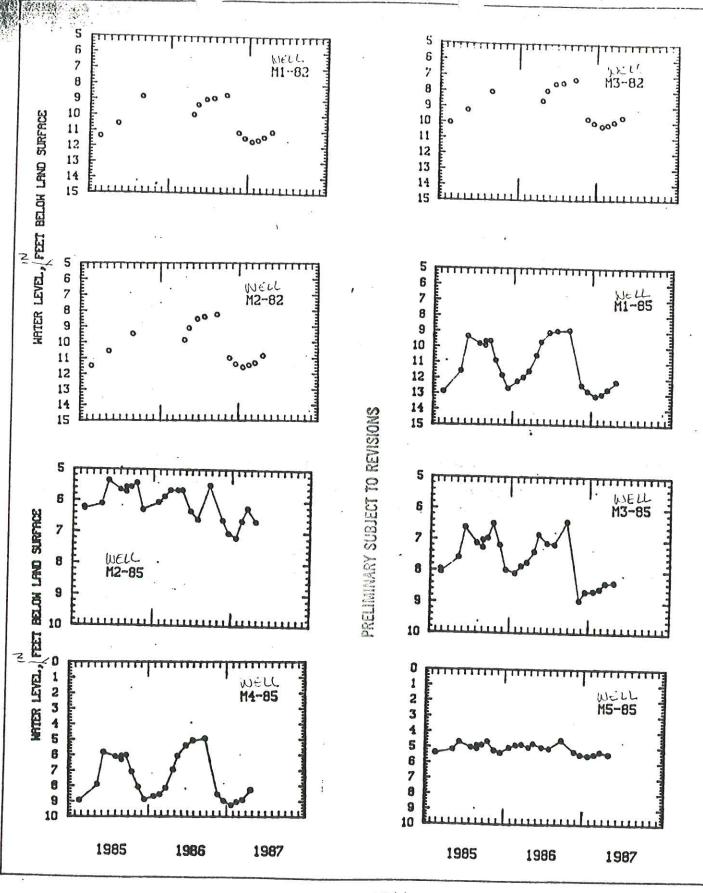
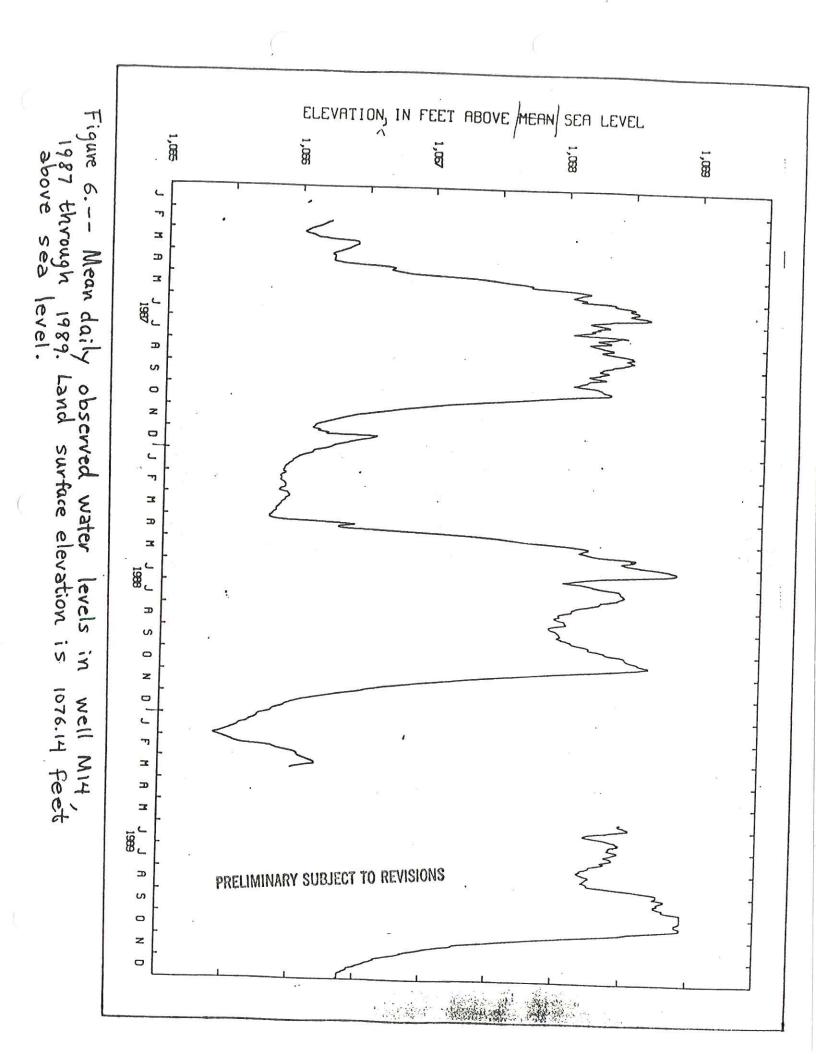


Figure 7. -- Observed water levels (for) observation wells with a 2-year period of record collection (E wells with water-level measurements made at intervals greater than zmonths are shown as points without a connecting ling.)



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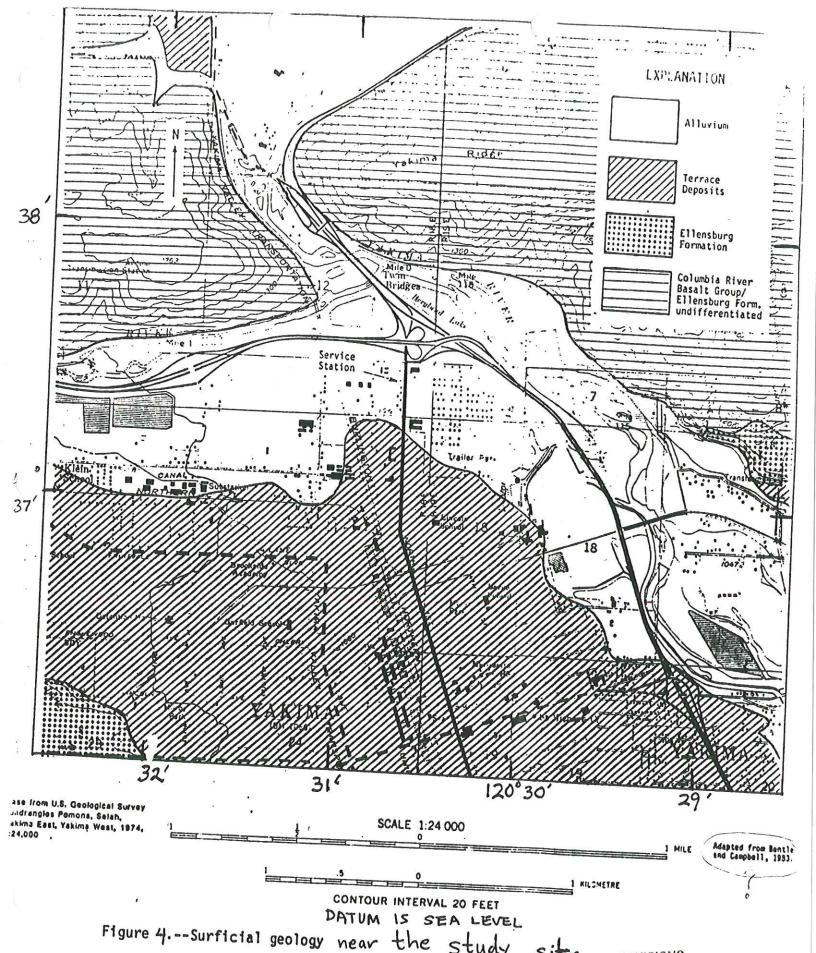
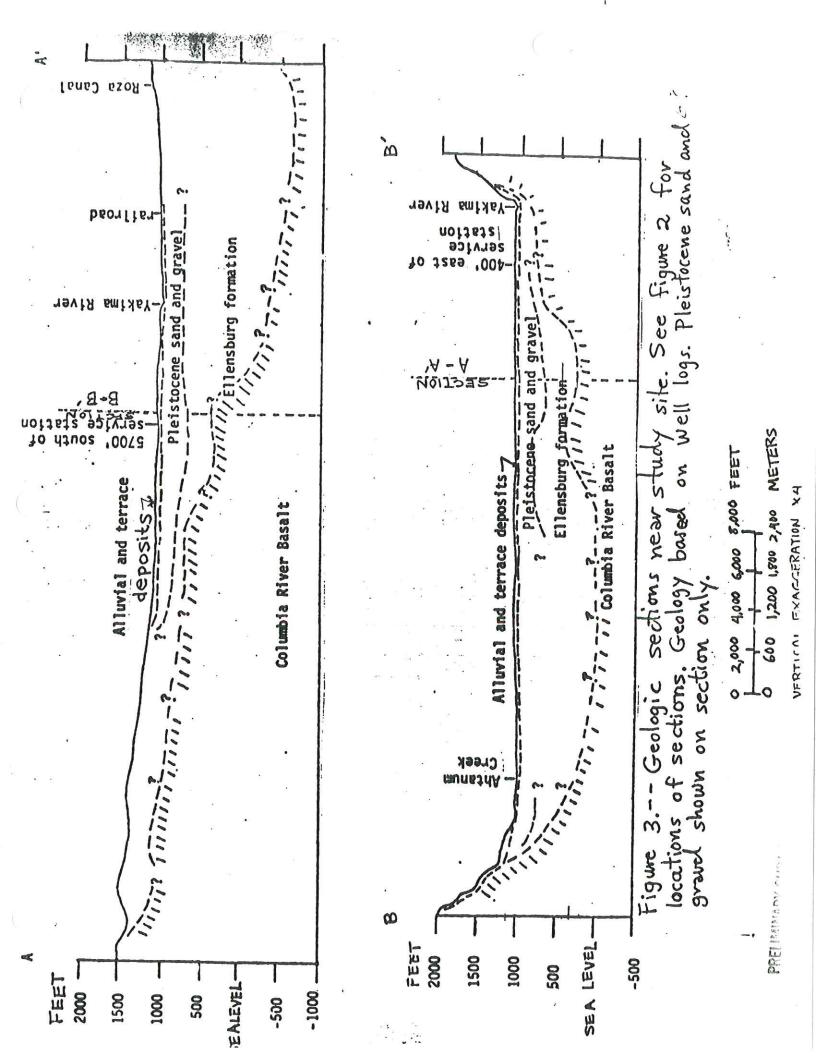
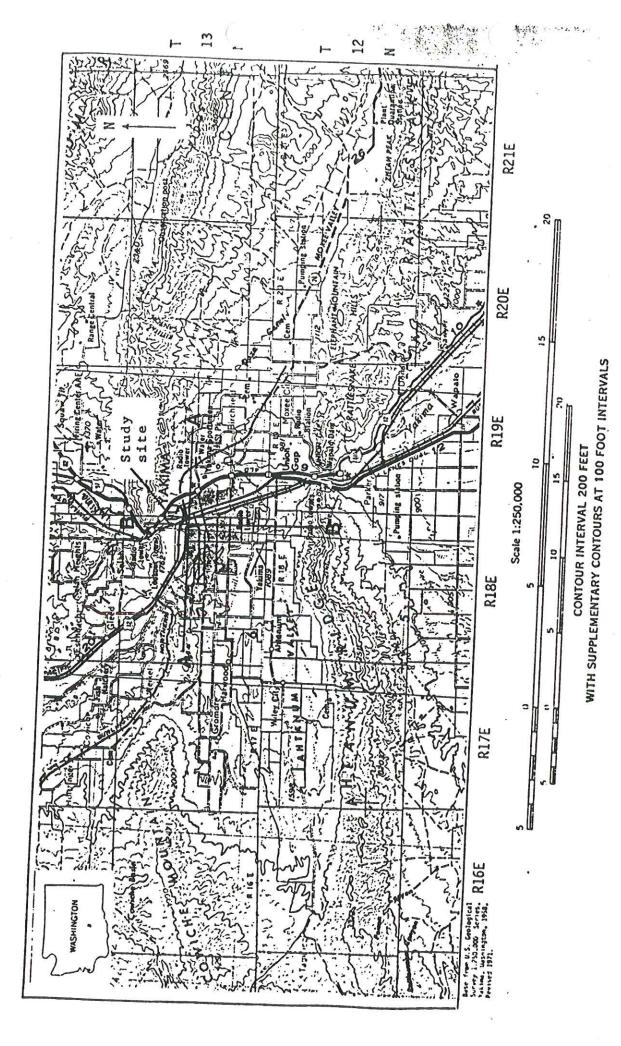


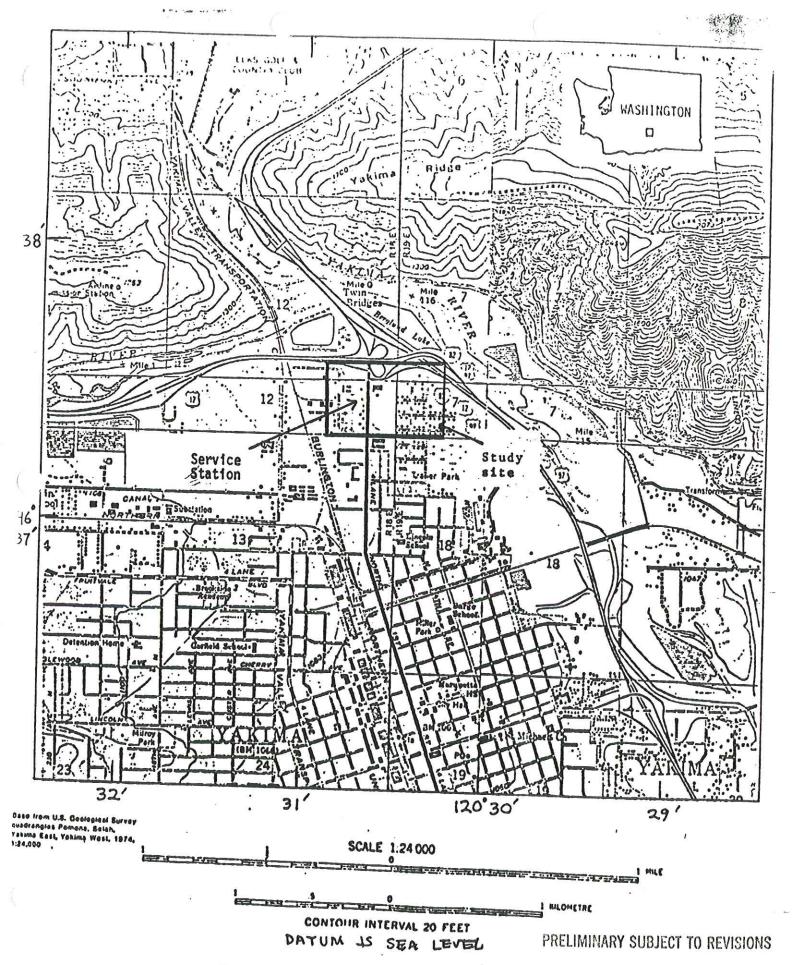
Figure 4. -- Surficial geology near the PRELIMINARY SUBJECT TO REVISIONS





Cross-sections A-A' and B-B' Figure 2.--Subbasin formed by the Ahtanum and Moxee Valleys, Washington.

PRELIMINALLY SUBJECT TO REVISIONS



fuel leak site at Yakima, Washington.

Dec. 7, 1990 Mike, Din enclosing 3 data packets of lithology for the Yakerina bas wells, a summing of the USG data, and a copy of Plate 1. The US68 wells (which were drilled by a contractor & prob. should have been filed by him) are referenced by their field names, which are X-ref. in Table 2 (end.). Field-nance term; nology used Bx (Bekins), SX (supeway), TX (Thunderbird property), etc. I would apprenate it if you return Plate I with your veriew of the report, and please feel free to call if you have any Fick Wagne USGeological Sinny Tauna, WA P.S. Also enclosed is a key for USGS wells.

Tiger No. 1st St.

Friday,

(rummary notes for visual chamenation of Yakima Gar & Oil Spell Samples

Field logs were compiled by Tacoma USGS personnel during krilling in Eept-Oct 1986. The bulk of the holes were logged by RC Jane, however, at least four others logged indurable Roles, resulting in some differences in log format and descriptions

Hole were drilled by a private contractor using a rotary drill rig equipped with a down hole kammer. Individual Roles were winch drameter where by a 6 such diameter pasing was advanced by bruin at two food intervals. Samples were blown out when brill but was advanced two below bottom of casing and drive shoe. Samples taken from above the water table were generally winonowed of fines by high air pressure and thus blown away. Samples from the interval thus are biased. (familes below the water table were winnowed of fines funes by water) pop 1/30/87

Visual elemination was make in the office using 2 to 3 power magnifying glass-fluorescent light combination supplemented by (10x) hand lenses and 10-20 power binocular microscope.

Visual elam led to extensates of the proportions of clay silt, rand, and growel size material; median size of the gravel and sand fractions. Samples were matched for gross solds to the GAN color chart and resorded. Estimates of the composition of both clasts and sand fraction were attempted but not generally maintained. In general quarty and fellopas (right color) sometimed make up less than 20% of typical sample; quarty in 10%, feldopas 5-10%, quarty oppeared to be secondary in white to right polored translucent grains. Feldopas appeared to be secondary in white to gight polored translucent grains. Feldopas appeared to be dethic

were distributed in the ranges given below

Cobr

Bosalt 60-80% _ andesite (Destinctive dark green clasts) Mofie to intermediate andesite buccia 5-15% Sundatone (volcanic?) 2-5/0 Clayetone (slate) 2-5 % Jelsic. Granite 3-10% L Quartzo feldepathie (MRFS).

References to the rounding and angustarity of rock ships in sample and the proportion of each in sample were also notel. In general angular ships indicated slasts originally in the pebble and sobble size range The quester proportion of angular chips to rounded ships probably indicates, the source sediments were greater than 32m in size (upper part of pebble (range) to cobbles,

Many of the Roles were duelled much deeper than the final completed holes. In such paser native materials taken from the lole were used to refile the test hale to the screen depth. If then holes were in the plume it is possible the lower part of the lite is contaminated by materials from upper part of hole.

Table 2.--Wells and well identifiers used during this this report

[N/A, not available; land surface elevation is in feet above sea level; depth, in feet below land surface, indicates screened interval or bottom depth of an open-ended casing; letters in well identifiers in this report signify the following: M, observation well; T, temporary well; D, domestic well; SG, multi-depth soil-gas well; SGT, temporary soil-gas well. All domestic wells were sampled at an outside spigot unless suffixed with a K (sampled at kitchen sink), or I (irrigation well, sampled at wellhead)].

	Site identifi	Lers	Land		
This report	WATSTORE	Other reports	surface elevation	Depth	Comments
M1-82 M2-82 M3-82 M1-85 M2-85 M3-85 M4-85 M5-85 M6-85 M9-85 M9-85 M10-85 M11-85 M12-85 M12-85 M12-85 M12-85 M12-85	13N/18E-12R01 13N/18E-12R02 13N/18E-12R03 13N/18E-12R04 13N/19E-07N01 13N/19E-07N02 13N/19E-07N03 13N/19E-07N05 13N/19E-07N05 13N/19E-07N06 13N/19E-07N06 13N/18E-12R06 13N/18E-12R07 13N/18E-12R08 13N/18E-12R12 13N/18E-12R13 13N/18E-12R13 13N/18E-12R14 13N/18E-12R15 13N/18E-12R15 13N/18E-12R16 13N/18E-12R16 13N/18E-12R16 13N/18E-12R16	1 2 3 1-85, MW-1 2-85, MW-2 3-85, MW-3 4-85, MW-3 4-85, MW-4 5-85, MW-6 7-85, MW-7 8-85, MW-9 10-85, MW-1 11-85, MW-1 11-85, MW-12 T1 T2 T3 T4 T5 T6.1	1078.06 1077.93 1076.86 1080.48 1067.51 1072.62 1075.66 1069.66 1071.52 1072.48 1075.70 1075.48 1076.37 1077.67 1078.49 1077.65 1077.65 1077.65 1077.65	6.0 - 15.6 6.6 - 16.1 6.0 - 15.8 6.0 - 21.0 3.5 - 18.5 4.1 - 19.1 1.8 - 16.8 4.3 - 19.4 4.2 - 19.2 5.0 - 20.0 4.8 - 19.8 4.3 - 19.3 5.5 - 20.5 6.4 - 21.4 55.0 - 58.0 28.0 - 30.0 28.0 - 30.0 28.0 - 30.0 3.8 - 12.9 44.6 - 46.6	Identified as 3-82 (Fish, 1987) SG1 also in same borehole SG2 also in same borehole SG3 also in same borehole [Piezometers M6.1 and M6.2
M6.2 M7.1	13N/18E-12R18 13N/18E-12R19	T6.2 T7.1	1077.11 1078.11	7.6 - 13.6 30.3 - 32.3	are in the same hole) [Piezometers M7.1 and M7.2 are in the same hole]
M7.2 M8 M9 M10 M11 M12 M13 M14 M16 M17 M18 M19 M20 M21 M22 M23 M24 M25 M26 M27 M28 M29 M30 M31 M33 M34 M35	13N/18E-12R20 13N/18E-12R21 13N/18E-12R21 13N/18E-12R23 13N/18E-12R23 13N/18E-12R25 13N/18E-12R26 13N/18E-12R27 13N/18E-12R27 13N/18E-12R28 13N/18E-12R30 13N/18E-12R30 13N/18E-12R31 13N/18E-12R31 13N/18E-12R32 13N/18E-12R34 13N/18E-12R34 13N/18E-12R41 13N/18E-12R41 13N/18E-12R42 13N/18E-12R43 13N/18E-12R43 13N/18E-12R35 13N/18E-12R35 13N/18E-12R36 13N/18E-12R37 13N/18E-12R38 13N/19E-07N08 13N/19E-07N09 13N/19E-07N09	T7.2 T8 T9 T10 T11 T12 T13 T14 T16 T17 T18 T19 T20 T21 T22 B1 B2 B3 B4 B5 S1 S2 S3 S4 H1 H2 WS1	1078.11 1078.22 1078.07 1077.81 1077.65 1078.09 1078.09 1076.14 1078.36 1077.70 1078.12 1078.26 1077.70 1077.50 1077.10 1076.16 1076.08 1076.58 1076.79 1077.03 1076.99 1076.89 1077.74 1075.13 1075.13 1075.02 1078.63	7.3 - 13.3 8.4 - 14.4 7.0 - 13.0 8.3 - 14.3 8.4 - 14.2 7.4 - 13.4 30.5 - 32.3 6.8 - 12.8 7.9 - 13.7 7.1 - 13.1 7.8 - 13.8 7.2 - 13.2 56.3 - 58.3 6.7 - 12.7 6.5 - 12.5 7.6 - 13.6 30.3 - 32.3 8.0 - 14.0 9.0 - 18.0 54.0 - 56.5 7.7 - 16.8 7.8 - 16.8 8.6 - 17.4 55.0 - 57.0 8.6 - 14.6 57.0 - 59.0	SG4 also in same borehole SG6 also in same borehole SG7 also in same borehole
M36 M37 M38 M39 M40 T1 T2 T3 T4 T5 T6 T7 T8 T9 T11 T12 T13 T14 T15 T16 T17 T18 T19	13N/18E-12R44 13N/18E-12R45 13N/19E-07N07 13N/18E-12J03 13N/19E-07M01 13N/19E-07M01 13N/19E-07N10 13N/19E-07N11 13N/18E-12R46 13N/18E-12R47 13N/18E-12R48 13N/19E-07N12 13N/19E-07N14 13N/19E-07N15 13N/19E-07N16 13N/19E-07N17 13N/19E-07N18 13N/19E-07N18 13N/19E-07N18 13N/19E-07N18 13N/19E-07N18 13N/19E-07N18 13N/19E-07N18 13N/19E-07N18 13N/19E-12R51 13N/18E-12R51 13N/18E-12R53 13N/18E-12R54	T1, GS1 B1, GS2 3/R HWY1 HWY2 8T1-1 8T1-2 8T1-3 8T1-4 8T1-5 8T1-6 8T2-2 8T2-3 8T2-4 8T2-5 8T2-6 8T2-7 8T2-8 7-5 8-5 9-7.5 8-4 9-4 1.5-1.5	1077.85 1077.53 1072.58 1078.22 1078.35	6.0 - 13.0 6.0 - 13.0 54.2 - 56.2 N/A N/A	Estimated screen interval Identified as GS1 (Fish, 1987)

	Site identif	lers		Land			
his report	WATSTORE	Other reports		surface elevation		Dept	h Comments
T20	13N/18E-12R57	8-3 7-4					
T21 T22	13N/18E-12R58 13N/18E-12R59	5-3					
T23	13N/18E-12R60	5-2					
T24	13N/18R-12R61	4-2					
T25 T26	13N/18E-12R62 13N/18E-12R63	4-3 3-2					
T27	13N/18E-12R63	3-3					
T28	13N/18E-12R65	6-7					
T29	13N/18E-12R66	1-8					
T30 T31	13N/18E-12R67 13N/18E-12R68	1-9 1-10					
T32	13N/18E-12R69	6-8					
T33	13N/18E-12R70	6-9					
	13N/18E-12R71	4-8					
	13N/18E-12R72	4-9					
	13N/18E-12R73 13N/18E-12R74	11-8.5 11-9.5					
	13N/18E-12R75	11-7.5					
	13N/18E-12R76	9-8.5					
	13N/18E-12R77	9-9.5	6 1/261	1070			
	13N/18E-12R89 13N/18E-12R90	(1 m north (1.3 m sout		1078 1078			
	13N/19E-07M03	H1-01	11 01 1130)	1076	25		
	13N/19E-07N19	H4-03-(I)			20		
	13N/19E-07N20	H4-06-(K)			28		
	13N/19E-07N21 13N/19E-07N22	H4-06-(I) H4-01			13	11/2	
20	13N/19E-07N23	H3-08-(I),	H3-07-(I)		70	N/A	
19(2)	13N/19E-07N24	H3-10-(I),			20		
	13N/19E-07N25	H3-11-(I)			20		
312 B	13N/19E-07N26	H4-07			20		
	13N/19E-07N27 13N/19E-07N28	H4-08 H4-11			80 65		
	13N/19E-07N29	H6-05			18		
	13N/19E-07N30	H6-04-(I)			25		
	13N/19E-07N31	H6-03-(I)				N/A	
	13N/19E-07N32 13N/19E-07N33	H6-01 H5-06				N/A N/A	
	13N/19E-07N34	H5-05-(I)			28	M/M	
	13N/19E-07N35	H5-04-(I)			28		
	13N/19E-07N36	H5-02			212	N/A	
	13N/19E-07N02 13N/19E-07N37	IK6-06-(I) B2-05			30	N/A	
	13N/19E-07N38	B2-03			21	N/A	
	13N/19E-07N39	B2-01				N/A	
	13N/19E-07N40	B1-04			36		
	13N/19E-07N41 13N/19E-07N42	B1-01 B3-05			26	N/A	
	13N/19E-07N43	B3-03				N/A	
028	13N/19E-07N44	B3-01			30		
	13N/19E-07N45	B4-06			38	-2-2002-000	
	13N/19E-07N46 13N/19E-07N47	B4-05 B4-01				N/A	
	13N/18E-12R97	Mesa	1079.47			N/A N/A	(Water levels only)
	13N/18E-12R91	Т2	1077.43			.,,	Sampling tubes installed
GG2	13N/18E-12R92	Т3	1077.65				above the well screem M2) Sampling tubes installed above the well screen (M3)
	13N/18E-12R93	Т5	1078.02				Sampling tubes installed above the well screen (M5)
	13N/18E-12R94	Т13	1078.09				Sampling tubes installed above the well screen (M13
	13N/18E-12R87	Т15	1078.19				Multi-depth soil-gas sampler only
	13N/18E-12R95	В3	1076.08				Sampling tubes installed above the well screen (M25
	13N/18E-12R96	S1	1077.03				Sampling tubes installed above the well screen (M28
	13N/18E-12R88	S5	1077.65		100-71		Multi-depth soil-gas sampler only
	13N/18E-12R81 13N/18E-12R81	1-9 1-7			5.		
	13N/18E-12R81 13N/18E-12R79	1-7			3. 3.		
	13N/18E-12R78	1-2					(estimated)
GT5	13N/18E-12R82	2-5			3.	47	
	13N/18E-12R83	3-2			4.		
	13N/18E-12R84 13N/18E-12R85	4-6 4-2			4.		
	13N/18E-12R86	5-5			5.	96	

APPENDIX I BORING LOGS

DN BOX	120-12955 TIGER (JII #3	- YAKI	MA. WASH	VERTICAL LINGTON_	. SOMEL							
PROJECT	1 110; K 1	DES	CRIPTION C	F MATERIAL		GEOLOG	ic			SAN	IPLE	сом	MENTS
IN FEET	SURFACE ELE	VATION _	1080	.5		ORIGIN		N	WL	NO	TYPE		
	SILTY SAND	W/A G	GRAVEL Tabove 4	',(brown	isn	COARSE ALLUVI	JM -						
	gray, mois	t to w	et	(SM)		-						经 素
-							-						
-							-			1	СТ		
							-						*
						ı	-						
		::			,		-						
-							}			2	СТ		8 v
							ţ		V				
13 ·	SAND W/A GRAVEL BE	10W 19	'. medi	um to co	arse								
	grained,	browni	sh gray	, waterb	earing			3 %		3	ст		
	1						}						
	1							•					
	 *Drilling	, slurr	y			C		•					
	-			×				-					
21		E	nd of B	oring									
	bo	ring.	See att	install ached									
127] "1	nstall ell" sh	ation o	f Monito	ring								
	A CONTRACTOR OF THE PARTY OF	WA	TEN LEVEL I	PEASUREMEN	ITS.			START		1-1	17-84	COMPL	ETE
DATE	TIME	BAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	BAILED	DEPTHS	WATER	METHO			0-17		<u> </u>
11-1	18 3:00	17'	17'		to		91 *			СТ	(Cabl	le Tool)	0-21'
$\frac{11-1}{11-2}$	18 4:15	21'	17' Sée Not	p	to		911*						
11-2	9.00		Jee not	-	10			CREW	CHIE	F	Ma	son	`

****		12	0-12955			VERTIC	M SCALE	1" =	3 '		В	ORING	NO	2-85
	PROJEC		1	THE COLD IN COLUMN 2 IS NOT THE OWNER.	#3 -	YAKIMA				<u> </u>	SAN			
	DEPTH IN FEET	SURFACE	E ELEVATION	10	67.5'		GEOLG		N	WL		TYPE	COM	MENTS
To the			EAN CLAY		TTLE GRA	AVEL, CL)	MIXED							
														.000
			¥								1	СТ		
	6 -	à							-				÷	
	0 -	CLAYEY dark br	SAND W// own	A LITTLE	GRAVEL (:	sc)	ē		•	V				
	-	et e				š			•		2	СТ		
	10 -		SAND W/A sh gray,		GRAVEL,	SM/SC)			-		3	СТ		
	12 .		SAND W/		CDAVEL				•					
		brownis	sh gray and gree	with a 1	little r about 1	eddish			•		4	СТ		
	-													
						· · ,			•					
									-					
	2.0 -		End	of Bori	ng				-					
		Note:	boring.	See at: lation (l instal tached of Monit									đ.
				_										
1					MEASUREMEN	гт 8			START	De La Car	7-8			1-8-85
	1-7	3:00	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	BAILED D	EPTHS	WATER LEVEL	метно			0-19' Cable	Tool)	<u>e</u> 8:00
	1-8	8:00 2:00	20'	19' SEE NOT		10		NMR						
	1-8	2:00				10			CREWO			Maso	on	(96)4
	8 E - Y -	18(84-8)-1)	= BIZ CROKM	THAMPUR S	OLEX	PLOA	CONSULA VOISSENDO	ST PA	JL BAR	v 5511	4		

1. 1),OB NO	120)-1295!		v	VERTICA AVIMA L	L SCALE	1" =	3'		В	ORING	NO3-85
46		SURFACE ELI	DE	SCRIPTION	OF MATERIAL	STUDENT TO SEE STORY	GEOLG ORK	xaic		WL	SAM		COMMENTS
		LEAN CLAY,				.)	FINE ALLU	/IUM -					
			a		<i>\$</i> -						1	СТ	
					9								
	-								-				·
	-									V			
	9 -	CLAYEY SAN	ND W/GI	RAVEL, E	rown		MIXE	D .	•				
	-				(S)	C)	ALLU		-		2	СТ	
									-				
			•						-				
	15 - 16 -	SILTY SANI gray, wet SAND W/SII				M)	COAR	SE VIUM			3	СТ	
	ŝ	coarse gra	ained,	brownis	sh gray,	P-SM)	•	ŝ	ŀ				
			Ð						-		4	СТ	
	21 -	-	nd of	Poning	,								
		Note: Mo bo	nitori ring.	See att	install ached				-				
			11" sh	eet.	f Monito				-		1-9	-85	сомрьете1-10-85
	DATE		AMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	BAILED DE	PTHS	WATER LEVEL	START.	D	6DC	0-1	0.00
	1-9 1-10	12:30	-	SEE NOTE		to to			CHEWO			Masi	
Local Control	8 E - Y -	18(84-8)-8		BB2 CPCNA44	HAVE S	O¥ EXI	>LO19	ation			N 551		

~ j.	MANG)	ZU-12955)		VERTIC	AL SCAL	E1	= J'		6	IORING	00 H-05	
	PROJE	CT					SHING	TON		T	NAME OF THE OWNER.		y-2-7	
ane and	DEPTH IN FEET	SURFA	CE ELEVATIO	DESCRIPTIO	1075.7'			NOGIC RIGIN	и	WL		TYPE	COMMENTS	
	-		LEAN CLA	and the same of th	ITTLE GR	RAVEL,	MIXE	D VIUM						
									ŀ		1	СТ		
	4 -	CLAYEY	SAND W/	GRAVEL,	brown	(50)			•				,	
					.(SC)					2	СТ	(9	
	7 -	SILTY grayis	SAND W/A h brown,	LITTLE	GRAVEL,	SM)	COAR ALLU	SE VIUM	+					
		÷				n g				V	3	СТ		
	11.	SAND W	/SILT AN	D GRAVE	L, grayj	sh			-					
		brown,	waterbe	aring	(2h-2W)								
			<u>(*</u>)											
			B				9 . s				4	СТ		
						65		20	-					
							•							
	21 -		End of	Boring					+					
		Note:	Monitor boring.	ing well See att lation o	l instal									
7			VyA	TER LEVEL	WEASUREN'EI	NTS	*******		START.	1-1	3-0	5	COMPLETE 1-14	
	DATE	YMAE	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	BAILED DE	PTHS	WATER	ME THOS				[e_8	: 3
21						to to				L1	(L	able	Tool) 0-21'	
20.5	1-14	2:00		SEE NO	E	10			CREWC	HIEF	*****	Maso	n `	
		0(84-8)-	9	→ BEZ CRONW	III AVENUE ST	ONEX	200	TODGE	ST PAL					

i .	JOB NO		120-1295	5		VERTIC	L SCALE	1" =	3'		В	ORING !	NO
	PROJEC	Υ	TIGE	ROIL	#3 - YAK	IMA, WA	SHINGI	UN			241	APLE	ACTION OF THE PROPERTY OF THE
	DEPTH IN FEET	SURFAC	E ELEVATION	10	069.71		JO30		N	WL	NO	TYPE	COMMENTS
		CLAYEY brown	SAND W//	A LITTLE	GRAVEL,	(sc)	MIXE				1	ст	,
	4		SAND W/A n brown,		o wet	SM)	COARS		-	V	2	СТ	The state of the s
	10 -	SILTY :	SAND W/G	RAVEL, E	orownish (S	SM)	•						
で 別 国	14 -	SAND W/	SILT AND	A LITTI	E GRAVEI	- 5					3	СТ	
	10 -	medium brown,	to fine waterbe	grained	1, grayı	sn SP-SM)		si	<u>-</u>		4	СТ	
	18 -	Note:	Monitor	See at	l instal tached of Monit					,			
											10	05	1 15 05
1		7		r	SASUREMEN	(T 8			START	State State State	STATISTICS.	-85	COMPLETE 1-15-85
	DATE	THAT	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	BAILED DI	EPTHS	LEVEL	WETHO		-	0-17' Cable	© 2:00 Tool) 0-18'
?						to			1				,001/010
18	7-16	9:00		SEE NO	E	10		-3	CREWO	HIEF		Maso	on
(28	8 E - V - 1	18(84-8)-	8	- 667 CROMM	CLLAVENUE S	OFEX	PLOA	TOUS	ST PA	UL M.	551	14	

	JOB NO)	TIGE	R OIL	#3 – YAK	IMA, WAS	HINGT	ON					
Praise.	DEPTH IN FEET		E ELEVATION	DESCRIPTION	n of materi.)71.41	AL .	GEO	LOGIC	N	WL	-	TYPE	COMMENTS
	60	<u>Y</u>	AY W/A L		RAVEL,	EL)	FINE	: JVIUM					
						2					1	СТ	e
													1
	6		EAN CLAY	/ W/A LI	TTLE GRA	VEL,	MIXE						*
1		brown			(0	L/SC)	ALLU.	MUIVI		V			
			Ĩ								2	СТ	
	13		SAND W/A		GRAVEL,	SM)	COAR	RSE JVIUM					
5	_		J			,	t ≘		-		3	СТ	
						*							
									-		4	СТ	
	21 -		F 1	. p. '	.e.			and the second s	- -				
			Monitori boring.	See att	install	4			-				
		1	-		REASUREMEN	rts			START	1	<u> </u> -17	-85	COMPLETE 1-18-85
	DATE	3 mar	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	BAILED DE	PTHS	WATER LEVEL	METHOL	- 6	DC_	0-19'	@10:00
	1-18	8 1:00		SEE NO	T E	10 10			CREW C			Masor	Tool) 0-21'
	8 E - V -	18(84-8)-	8	- 867 CRONN	III AVENUE S		PLOR	CODE	ST PAL				

w. William respond to the property of the property of the state of the property of the propert

JOB NO	12	0-12955			VERTICA	LSCALE	1., =	2.		В	ORING	NO ON
PROJECT		IIGE	R OIL #	3 - YAK	IMA. WAS	HINGI	ON	7001180	Γ	SAL	IPLE	
DEPTH IN FEET	SURFACE	ELEVATION	ESCRIPTION 107	2.5'		GEOL		N	WL		TYPE	COMMENTS
	CLAYEY	SAND W/F	A LITTLE orownish	GRAVEL, gray	sc)	MIXE	D JVIUM -					
										1	СТ	
								•	VZD:			ű.
					,	•	20	-			CT.	
		3*1		a				-		2	СТ	
12	SILTY S		RAVEL, b	rownish (S	SM)	COAF	RSE UVIUM					
	g. ay, ,				,					3	СТ	
						and a	¥				- 1	
18	medium	to fine	D A LITT grained	l, grayi	EL, sh SP-SM)	,		-		4	.CT	
20-	brown,		aring of Bori ing well	ng				_				
		boring.	See att lation c	ached								
	CONTRACTOR OF COMPANS					<u></u>	reasons to terrore	START	1-	21-	85	сомрібтв1-22-8
-	TI		TER LEVEL M				WATER	-	ACCOUNT TO SE	- regularization	ura nacredomia se	1 00
DATE	TIME	SAWED DEPTH	CASING DEPTH	CAVE-IN DEPTH	BAILED DE	PTHS	LEVEL	METHO			0-181	Tool) 0-20'
					to to			-		1 (cable	2 1001) 0-20
1-22	3:30		SEE NOTE		10			CREW	CHIEF	M	lason	
-	0(84-8)-	****	M2 CROLANT	LLAVINA C	Of EXP	CO2	abon	S1 PA	UL M	N 551	14	

JOB NO	-	120-129		**************************************			1" =	3 *		8	ORING	мοо	-00
DEPTH	and the second second	TIGE D E ELEVATION	ESCRIPTION	#3 - YAK OF MATERIA 075.81	The section of the se	BLNG LI GEOLG ORK	ogic	N	WL		TYPE	CON	MENTS
FEET	Y Y	SAND W/A		GRAVEL,	sc)	MIXED)			110	.,,,,		,
30 1							-			1	СТ		×
							-	•					
6 -		AND W/A bbles, m		wet, br	ownish SM/SC)	COARS ALLUV						e e	
					8				V		0.7		
	1									2	СТ		
14													
	pilly 5 brownis	AND W/GR h gray,	AVEL, a wet	few cob	SM)	٠		- -		3	СТ		a
					30 3								
				÷		-10		-	2	4	СТ	Slight odor	gasoilne
22	Note:	End of	Boring	inctal	lod in			-					
	Hore:	"Instal	lation c	instal ached of Monito	oring We	 11"_sh	ieet.	START	2.	-13	-85	COMPL	2-14-85
DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	BAILED DE	PTHS	WATER	METHO	10 o		0-20'	· Too1)	@1:00
72-14	4 3:00		SEE NOTE		10 10 10			CHEWO			Maso		
 8 E - V -	18(84-8)-	9	- BIZ CROWN	FILAMMA S	ONEXE	PLOP:	CODE WARREN	ST PA	UL MN	\$ 551	14		

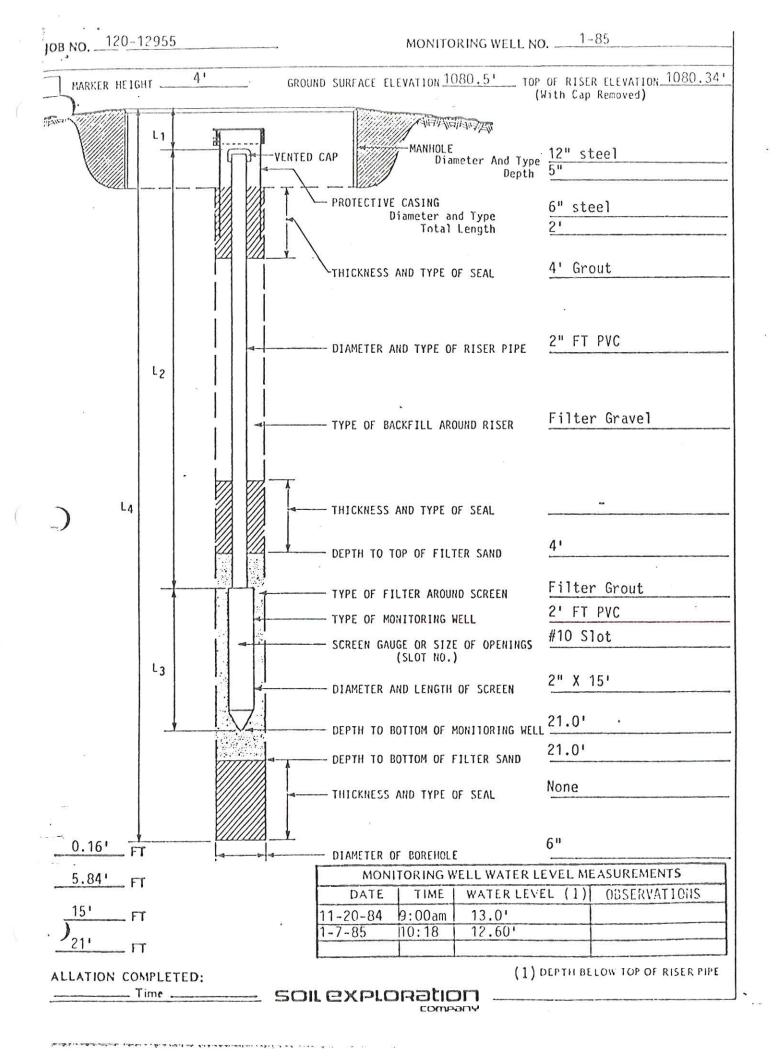
oa NO		20-1295			VERTICAL	SCALE	<u> </u>	3 1		8	ORING	мо ом
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PTH IN	e in the	ELEVATION	1075.8	OF MATERIAL		GEOLO	aic aic	N	WL	-	TYPE	COMMENTS
)ET		NY, dark		(CI	_)	FINE	/IUM	-		. 1	СТ	
	CLAYEY brown	SAND W/G	RAVEL, Ç	grayish (S	c) .	MIXE ALLU				2	СТ	*
)12	SILTY S gra y , w	AND W/GR et	RAVEL, bi	rownish (S	м)	COAR ALLU				3	СТ	
17 -	SAND W/ grained bearing	SILT ANI I, brown	O GRAVEL ish gray	, water-	op-SM)		ė.			4	CT-	
21 -	Note:	Monitor boring.	See att lation o	install								
-		WA	TER LEVEL A	MEASUREMEN	NY8	<u> </u>		STAR	11-	23-	85	COMPLETE 1-24-8
)	TIME	SAMPLED	CASING DEPTH	CAVE-IN DEPTH	BAILED D	EPTHS	WATER	METH	10D	6DC	0-20	0' @_1:00
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					10							
1-24	3:00		SEE NOT		10			CREV	v CHIEF		Ma	son
	18(84-8)-			TIL AVENUE S		PLOR	NODG		MUL M			son

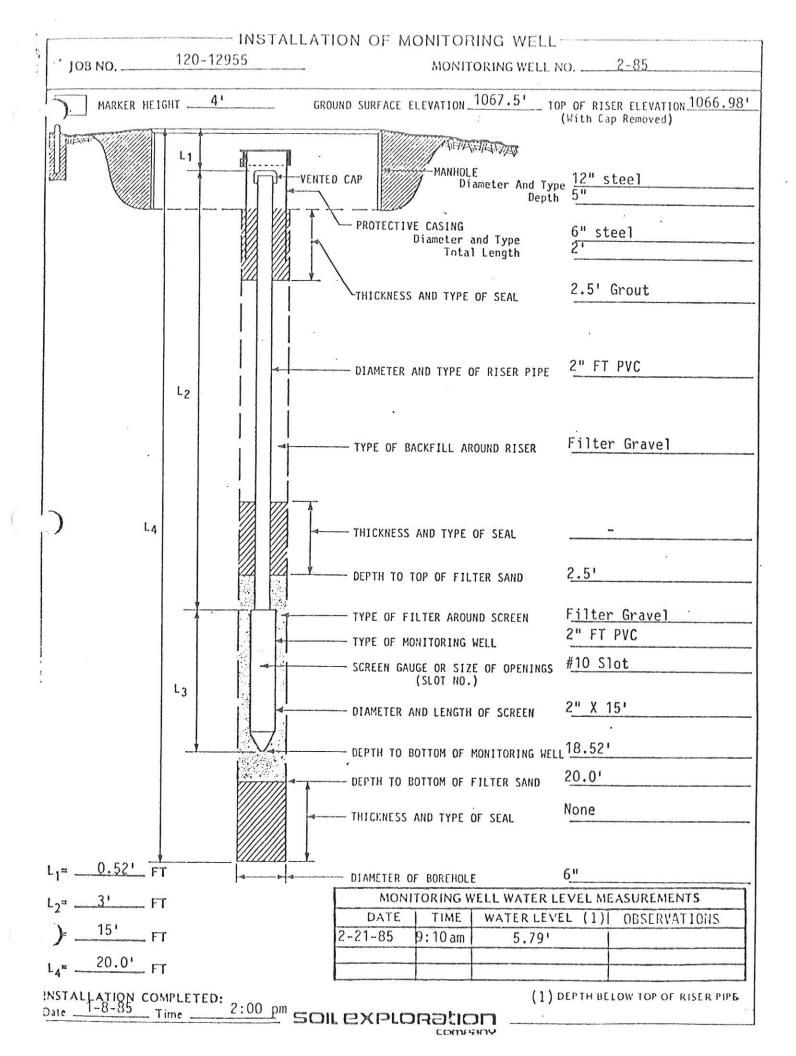
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THE SUBJECT HEAVEN 1076.3 COMMENTS CLAYEY SAND M/GRAVEL, COBBLES MIXED MIXED ALLUVIUM 7 SILTY GRAVEL, brownish gray, (GM) ALLUVIUM 14 SAND W/SILT AND GRAVEL, brownish gray, wet (SP-SM) 18 SILTY SAND W/A LITTLE GRAVEL, brownish gray, waterbearing 18 SILTY SAND W/A LITTLE GRAVEL, brownish gray, wet (SM) 20 CT 19 Note: Monitoring well installed in boring. See attached "Installation of Monitoring Wilstallation of Monitoring well installed in boring. See attached "Installation of Monitoring well installed in boring. See attached "Installation of Monitoring well installed in boring. See attached "Installation of Monitoring well installed in boring. See attached "Installation of Monitoring well installed in boring. See attached "Installation of Monitoring well installed in boring. See attached "Installation of Monitoring well installed in boring. See attached "Installation of Monitoring well installed in boring. See attached "Installation of Monitoring well installed in boring. See attached "Installation of Monitoring well installed in boring. See attached "Installation of Monitoring well installed in boring. See attached "Installation of Monitoring well installed in boring. See attached "Installation of Monitoring well installed in boring. See attached "Installation of Monitoring well installed in boring. See attached "Installation of Monitoring well installed in boring. See attached "Installation of Monitoring well installed in boring. See attached "Installation of Monitoring well installed in boring. See attached "Installation of Monitoring well installed in boring. See attached "Installation of Monitoring well installation of Monitoring well installed in boring. See attached "Installation of Monitoring well installation of M		PROJEC	7	II	GER OIL	#3 - Y/	AKIMA, WA	SHIM	GTON		1	·		
AND BOULDERS, brownish gray (may be fill) 7 SILTY GRAVEL, brownish gray, wet 14 SAND W/SILT AND GRAVEL, brownish gray, waterbearing (SP-SM) 25 CT 16 SILTY SAND W/A LITTLE GRAVEL, brownish gray, wet (SM) 21 End of Boring Note: Monitoring well installed in boring. See attached "Installation of Monitoring Well" sheet. 3 CT 4 CT 21 That Advents Cassing Cave Cave Authority See Compare 1-28-85. AND W/ATTRIEVEL MEASUREMENTS 5 STANT 1-25-85. COUNTILE 1-28-85.	J.	IN	SURFA	CE ELEVATION						, N	WL	-	1	COMMENTS
7 SILTY GRAVEL, brownish gray, (GM) 14 SAND W/SILT AND GRAVEL, brownish gray, waterbearing (SP-SM) 18 SILTY SAND W/A LITTLE GRAVEL, brownish gray, waterbearing (SP-SM) 2 CT 18 SILTY SAND W/A LITTLE GRAVEL, brownish gray, wet (SM) 21 End of Boring Note: Monitoring well installed in bring. See attached "Installation of Monitoring Well" sheet. WATELEVEL MEASUREMENTS DATE THE GRAVEL GRAVEL GRAVEL STANT 1-25-85 COMPLETE 1-28-85. WATELEVEL MEASUREMENTS TO STANT 1-25-85 COMPLETE 1-28-85. COUNCIL 1-28-85. CO			AND B	OULDERS,	browni	sh gray		MIX	ED	-				
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gray, waterbearing (SP-SM) 3 CT 18 SILTY SAND W/A LITTLE GRAVEL, brownish gray, wet (SM) 4 CT 21 End of Boring Note: Monitoring well installed in boring. See attached "Installation of Monitoring Well" sheet. WATER LEVEL MEASUREMENTS START 1-25-85 COMPLETE 1-28-85 DATE TIME SAMPLED CASENG CAVEIN BALLED DEPTHS LEVEL WITHOUT GEPTH CEPTH 10 CT (Cable Tool) 0-21' 1-29 11:30 SEE NOTE 10 CREW CHEE MASON												2	СТ	
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End of Boring Note: Monitoring well installed in boring. See attached "Installation of Monitoring Well" sheet. WATER LEVEL MEASUREMENTS START 1-25-85 COMPLETE 1-28-85 DATE TIME SAMPLED CASING CAVE IN BAILED DEPTHS LEVEL METHOD 6DC 0-20' @3:00 T-29 11:30 SEE NOTE 10 CREW CHIEF MASON		18	SILTY browni	SAND W// sh gray,	A LITTLE , wet							. 4	СТ	
boring. See attached "Installation of Monitoring Well" sheet. WAYER LEVEL MEASUREMENTS START 1-25-85 COMPLETE 1-28-85 DATE TIME SAMPLED CASING CAVE-IN BAILED DEPTHS WATER LEVEL METHOD 6DC 0-20' @ 3:00 T-29 11:30 SEE NOTE 10 CREW CHIEF MASON														
DATE TIME SAMPLED CASING CAVE-IN BAILED DEPTHS WATER LEVEL METHOD 6DC 0-20' @ 3:00			Note:	boring. "Instal	See att	ached								
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1-29 11:30 SEE NOTE 10 CREW CHIEF Mason	atra)	DATE	TIME		CASING DEPTH	CAVE-IN LYPTH	BAILED DE	PTHS	WATER	METHOD	6D(0.	-20'	@ <u>3:00</u>
1-29 11:30 SEE NOTE 10 CREW CHIEF Mason	-34										CT	(Ca	able	Tool) 0-21'
10.3011		1-29	11:30		SEE NOT	E								
BE-V-18(84-8)-8 MICROMILLAYING SOIL EXPLORATION ST PAUL UN SSIIA													Masor) * -

.	ON BOL	1: :r	20-12955	R OIL #	3 - YAK	VERTICAL IMA. WAS	L SCALE HINGT(ON O	3		В	ORING	NO	-
	0.50711	SURFACE	DI	SCRIPTION	OF MATERIA	L	GEOLG	овк	Ņ	WL		TYPE	COMMENTS	
	1		LAY W/SA		k brown	L-ML)	FINE	VIUM						
			,m								1	ст	٠	
													9	
	6 -	CLAYEY	SAND W/G	SRAVFI .	brownish		MIXE	D	•				8	
	-	gray	o, ,,, o	,	(S	C/SM)		MUIVI	•					
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K.									•	W				
	12 -		AND W/A h gray,			SM/SP)	COAR	RSE JVIUM						
											3	СТ	Slight gasoline	
							D)		•				odor	The Control of the Co
	18	SAND W	VSII T ANI	TILAC	LE GRAVE	; ;1								
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	22	Note:	Monitor	f Boring	install	led in								
				lation o	acned of Monito	oring We]" s!	neet.	START	$\frac{1}{1}$	-29	-85	COMPLETE 1-30-8!	5
	DATE	34M.A.	\$AMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	BAILED DE	PTHS	WATER	METHO			0-20 (Cab	0' @ 3:00 le Tool) 0-22'	===
	7-31	11:00		SEE NOT	E	10 10		2000	CREW				son -	
MACH	8 F - V -	10(64-0)-	0	- 882 CHOKAM	III ANTHAN S	OILEXE	SON	CODE			N 551	14		

	ON BOL	Annual Control of the	120-1295	D 011 #	13 - YAK	VERTICA ZAW AMI	L SCALE	<u> 1" =</u>	5,		В	ORING	NO OJ
	DEPTH IN FEET	SURFAC		ESCRIPTION	OF MATERIA		GEOL ORK	ogic	N	WL		TYPE	COMMENTS
	7661	1	.AY, darl		AND DESCRIPTION OF THE PERSON NAMED IN	CL)	FINE	NVIUM					
*	-		#		£						1	СТ	5
	5 -		SAND W/Osh gray	GRAVEL,		obbles, SC)	MIXE	D JVIUM	•		2	СТ	Very slight gasoline odor
		in the second				ž			•				
			:*										
									-	V			
			36								3	СТ	Very slight
			e F		,				-				gasoline odor
	47	,											
	17 .	SILTY S brown,	SAND W/GI wet	RAVEL, g	rayish (S	GM)	COAF ALLU	JVIUM JVIUM					
	-						ř		-		4	СТ	
1	22 -								-				
		1	Monitori	See att.	install ached								
		1	"Install	ation o	f Monito		[1" sh	eet.	START	2	<u>-19</u>	-85	COMPLETE 2-20-85
1	DATE	SAMT	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	BAILED DE	PTHS	WATER LEVEL	метно			0-20 Cab1	e Tool) 0-22'
- 1	2-20	2:00		SEE NOT		10			CREW				son
MICHOMILAVINE SOIL EXPLORE						SOUN	ST PAUL MN 55114						

APPENDIX VI
MONITORING WELL CONSTRUCTION SHEETS

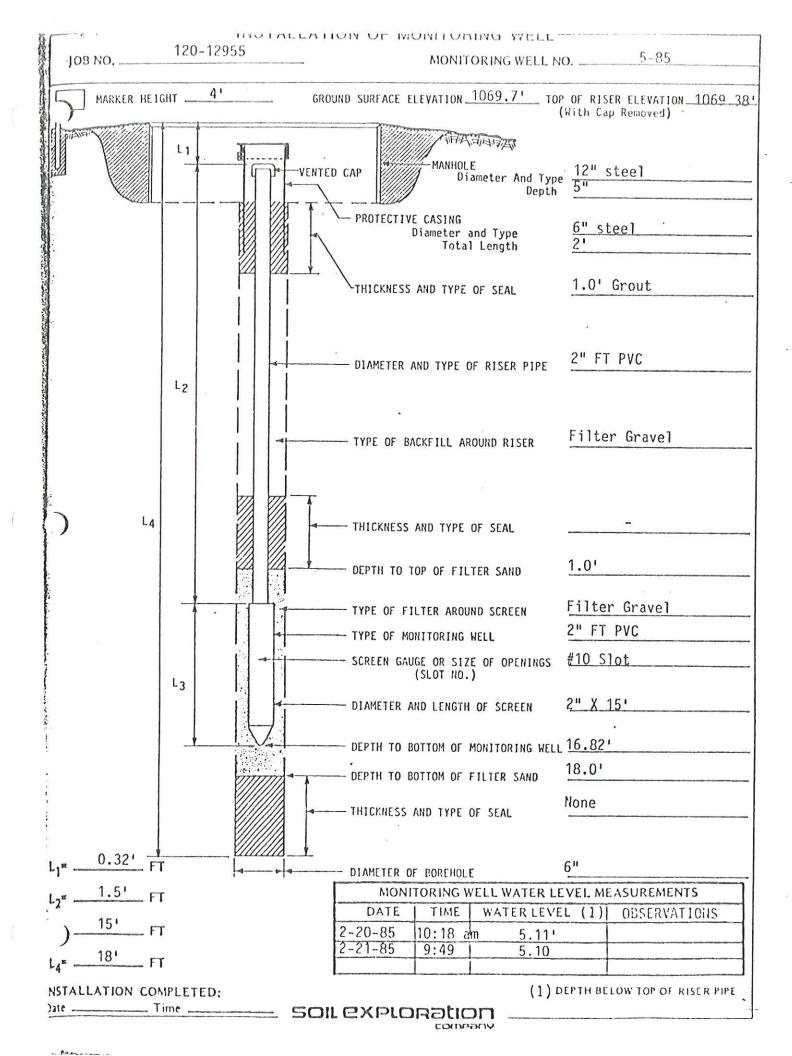




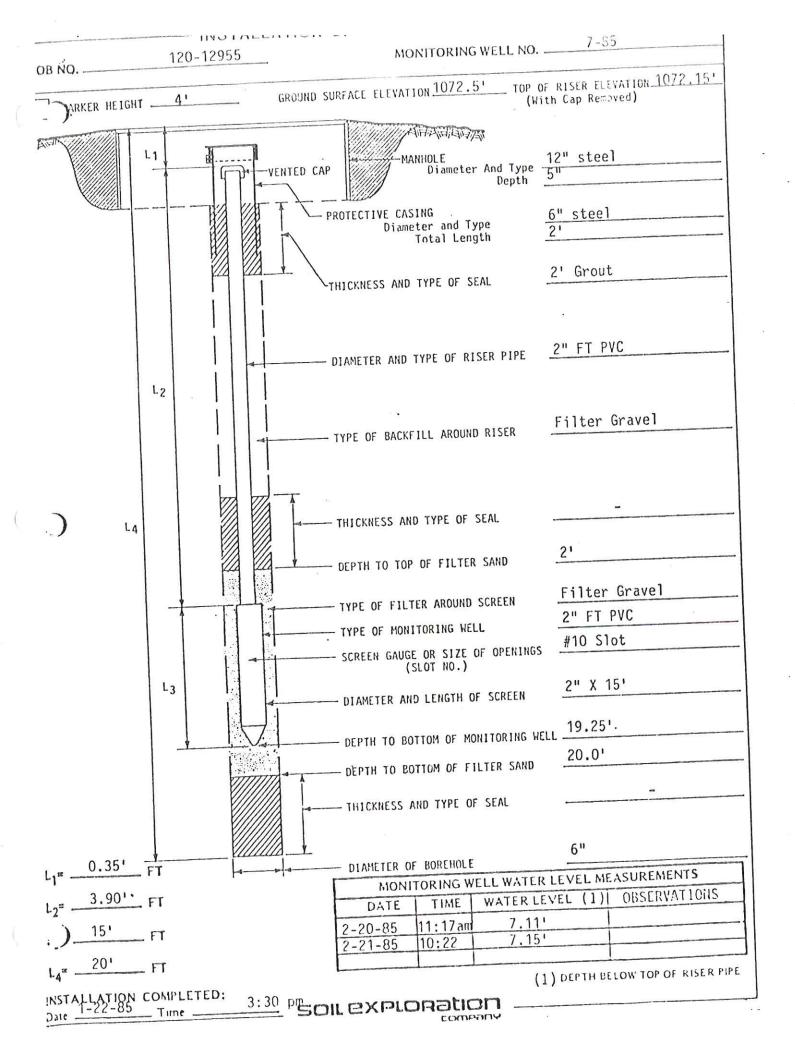
garante de la contracta de la		INSTALL	ATION OF MONITORING WELL-
јов NO	120-12955		MONITORING WELL NO. 3-85
MARKER HEIG	HT4'		GROUND SURFACE ELEVATION 1072.6' TOP OF RISER ELEVATION 1072.18' (With Cap Removed)
TIEN I	L1 .	VE	PROTECTIVE CASING Diameter and Type Total Length THICKNESS AND TYPE OF SEAL MANHOLE Diameter And Type Depth 6" steel 2' Thickness and Type of SEAL 3' Grout
	L ₂		DIAMETER AND TYPE OF RISER PIPE S" FT PVC
			TYPE OF BACKFILL AROUND RISER Filter Gravel
) L4			THICKNESS AND TYPE OF SEAL DEPTH TO TOP OF FILTER SAND
	 		TYPE OF FILTER AROUND SCREEN Filter Gravel
			TYPE OF MONITORING WELL 2" FT PVC SCREEN GAUGE OR SIZE OF OPENINGS #10 Slot (SLOT NO.)
	L ₃		DIAMETER AND LENGTH OF SCREEN 2" X 15'
			DEPTH TO BOTTOM OF MONITORING WELL 19.12'
			THICKNESS AND TYPE OF SEAL None
. 0.42' FT			——— DIAMETER OF BOREHOLE 6"
3.70' FT			MONITORING WELL WATER LEVEL MEASUREMENTS
`\ 151			DATE TIME WATER LEVEL (1) OBSERVATIONS
21'			2-21-85 9:28 am 7.69'
; FT			
ALLATION COMP		1:00 pm	(1) DEPTH BELOW TOP OF RISER PIPE

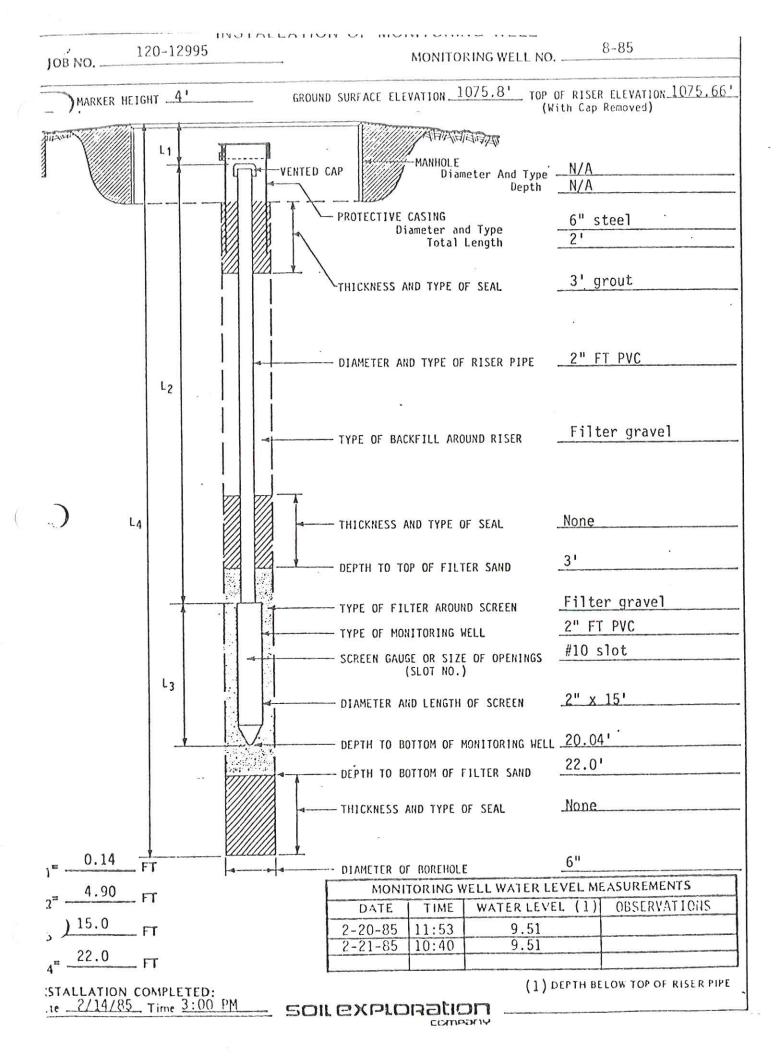
COMPANY

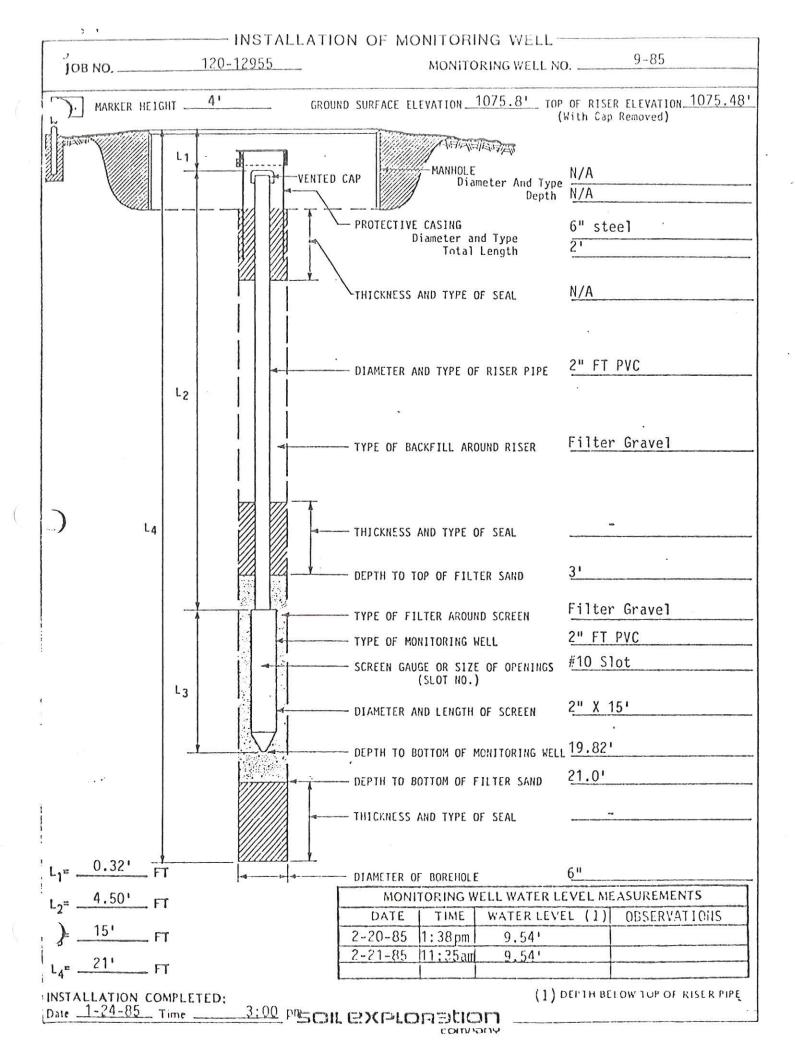
		INSTALLATI	ON OF MO				and the second s
JOB NO	120-12955			MONITOI	RING WELL NO)	4-85
MARKER HETO	GHT4'	GROU	UND SURFACE ELE	VATION_1	075.7' тор (1	OF RISER With Cap	R ELEVATION 1075.74' Removed)
	L1	VENTE	САР	-MANHOLE Diam		<u>N/A</u> N/A	
			PROTECTIVE Di	CASING iameter an Total	d Type Length	6" ste 2'	el
			THICKNESS A	AND TYPE O	F SEAL	3' Gro	ut
			DIAMETER AN	ND TYPE OF	RISER PIPE	2" FT	PVC
	L ₂		(4.3%)				
			TYPE OF BAC	CKFILL ARO	UND RISER	Filter	Gravel
		!					
)			THICKNESS /	AND TYPE O	F SEAL	L	-
			DEPTH TO TO	OP OF FILT	ER SAND	31	
	+		TYPE OF FI	TER AROUN	D SCREEN		Gravel
			- TYPE OF MOI	NITORING W	IELL	2" FT	
		11-11-	SCREEN GAUGE OR SIZE OF OPENINGS (SLOT NO.)			#10 Slot	
	L3		DIAMETER A	ND LENGTH	OF SCREEN	2" X 1	5'
						19.94	
		I I	DEPTH TO B	OTTOM OF M	MONITORING WEL		
*			DEPTH TO B	OTTOM OF F	ILTER SAND	21.0'	
			THICKNESS	AND TYPE O	OF SEAL		
	<u>, </u>					CII	
-1" -0.04' F	T	4	DIAMETER O			6"	
2= 4.90' F	7						EASUREMENTS
)15'			DATE	12:00	9.00'	cr (1)	OBSERVATIONS
•			2-20-85	12:00	9.00'		
L ₄ =21'	T						
STALLATION CO	OMPLETED:	2:00 pm 50	II GXbro	ratic	on	DEPTH BE	LOW TOP OF RISER PIPE,
			IL CVICE	COMP	any		



)B NO	120-12	955	MONITORING WELL NO	6-85
MARKER HEIGHT	r. <u>41</u>	GROU	ND SURFACE ELEVATION 1071.4' TOP	OF RISER ELEVATION 1071.12' With Cap Removed)
,se ²	L ₁	VENTED	Depth PROTECTIVE CASING Diameter and Type	12" steel 5" 6" steel
			Total Length THICKNESS AND TYPE OF SEAL	2' Grout
ĸ	L ₂		DIAMETER AND TYPE OF RISER PIPE	2" FT PVC
			TYPE OF BACKFILL AROUND RISER	Filter Gravel
) L4			THICKNESS AND TYPE OF SEAL DEPTH TO TOP OF FILTER SAND	2'
	- A		TYPE OF FILTER AROUND SCREEN TYPE OF MONITORING WELL SCREEN GAUGE OR SIZE OF OPENINGS (SLOT NO.)	Filter Gravel 2" FT PVC #10 Slot
	L3		DIAMETER AND LENGTH OF SCREEN	2 <u>" X 15'</u>
	<u> </u>		— DEPTH TO BOTTOM OF MONITORING WEL DEPTH TO BOTTOM OF FILTER SAND	21.0'
			THICKNESS AND TYPE OF SEAL	
0.28' FT			DAMESTER OF PORTION F	6"
г Г		4	DIAMETER OF BOREHOLE MONITORING WELL WATER L	EVEL MEASUREMENTS
FT			DATE TIME WATER LEV	the second secon
15' FT			2-20-85 10:42 am 7.1	THE RESERVE THE PROPERTY OF THE PERSON NAMED IN COLUMN TWO IS NOT THE PERSON NAMED IN COLUMN TWO IS NAMED IN COLUMN TWO I
121			2-21-85 10:07 7.1	
FT				
FrAIBA CON	APLETED:	1:0 <u>0</u> pr		DEPTH BELOW TOP OF RISER PIPE
	ıme	50	IL EXPLORATION	

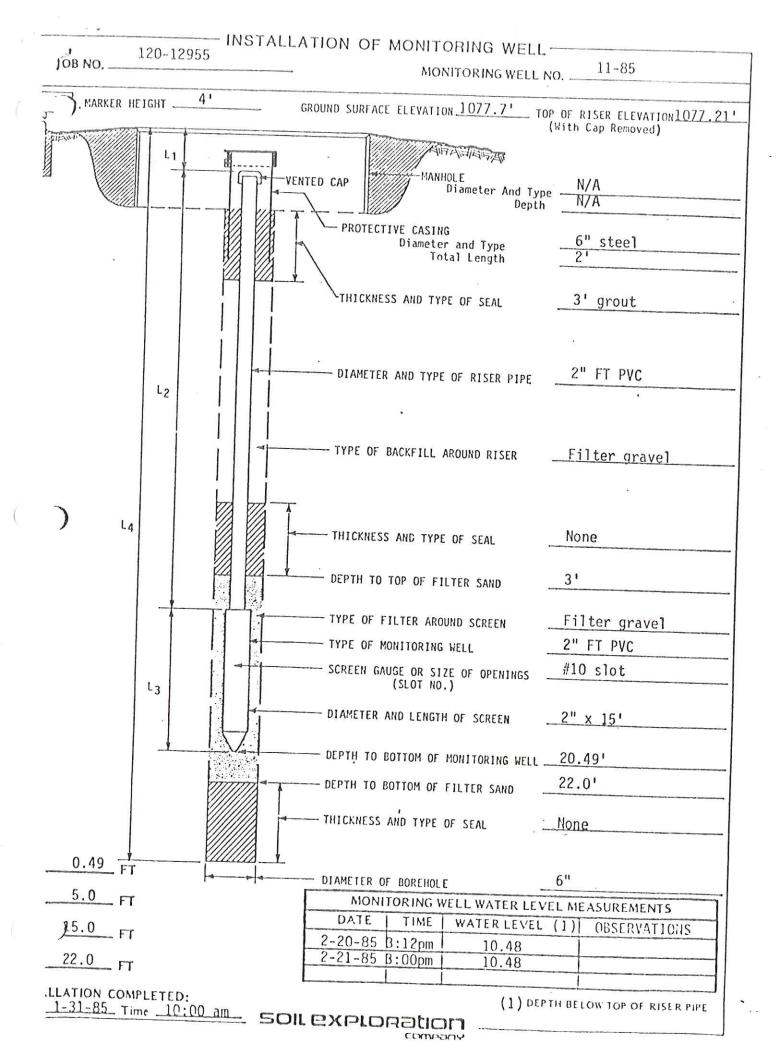


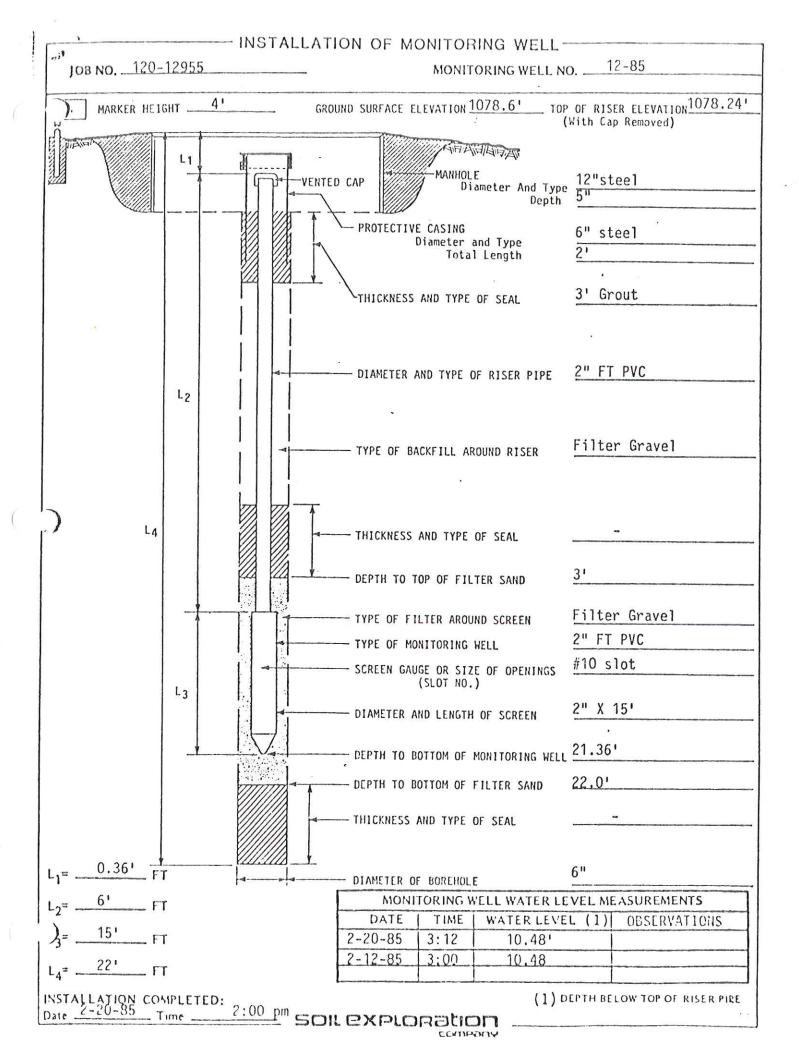




	-	- INSTALLATION OF MONITORING WELL
JOB NO	120-129	MONITORING WELL NO10-85
ARKER HEIGH	IT	GROUND SURFACE ELEVATION 1076.3' TOP OF RISER ELEVATION 1076.03' (With Cap Removed)
200	L ₁	VENTED CAP MANHOLE Diameter And Type Depth PROTECTIVE CASING Diameter and Type 6"steel
		Total Length 2'
		THICKNESS AND TYPE OF SEAL 3' Grout
	L ₂	DIAMETER AND TYPE OF RISER PIPE 2" FT PVC
		TYPE OF BACKFILL AROUND RISER Filter Gravel
) L ₄		THICKNESS AND TYPE OF SEAL DEPTH TO TOP OF FILTER SAND 3'
	+	TYPE OF FILTER AROUND SCREEN Filter Gravel
		TYPE OF MONITORING WELL 2" FT PVC
	L ₃	SCREEN GAUGE OR SIZE OF OPENINGS #10 Slot (SLOT NO.)
	3	DIAMETER AND LENGTH OF SCREEN 2" X 15'
	_ •	DEPTH TO BOTTOM OF MONITORING WELL 19.27'
		DEPTH TO BOTTOM OF FILTER SAND 21.0'
		THICKNESS AND TYPE OF SEAL
0 271		
0.27' FT		DIAMETER OF BOREHOLE 6"
Fr		MONITORING WELL WATER LEVEL MEASUREMENTS
)5'		DATE TIME WATER LEVEL (1) OBSERVATIONS
A A.		2-20-85 P:12 pm 9.38'
FT		2-21-85 112:45 9,38
LLATION COMP	LETED:	11:30 SOIL EXPLORATION (1) DEPTH BELOW TOP OF RISER PIPE

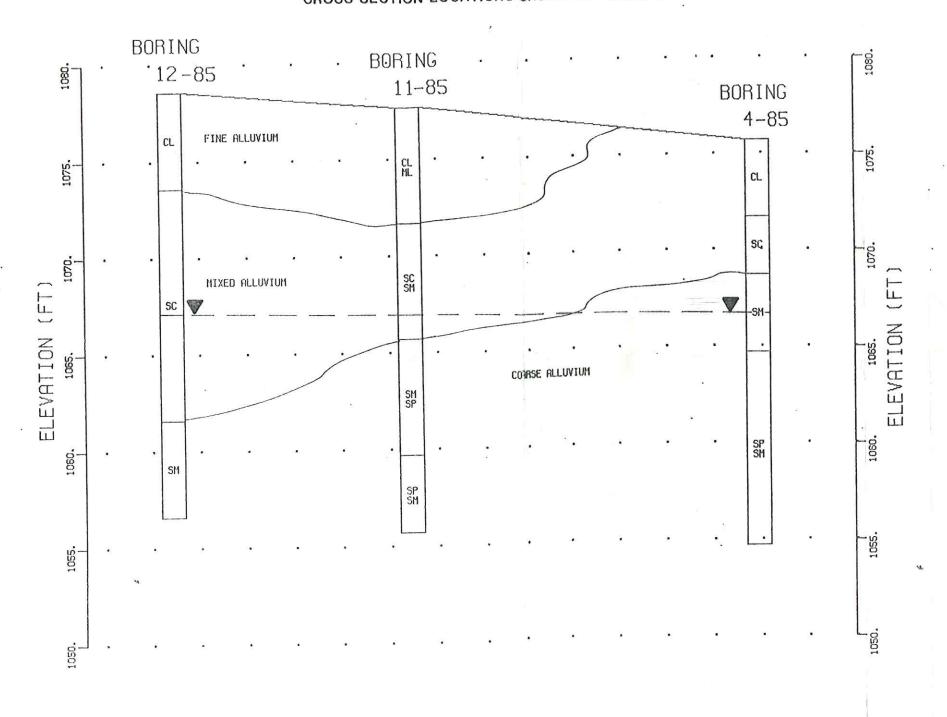
COUNTINI





A ← → A'

CROSS SECTION LOCATIONS SHOWN ON FIGURE #2



NOTE: EXCEPT AT BORING LOCATIONS THE GROUND SURFACE, WATER LEVEL, AND BOUNDARIES BETHEEN SOIL LAYERS ARE INFERRED.

FIGURE #3

SOIL PROFILE

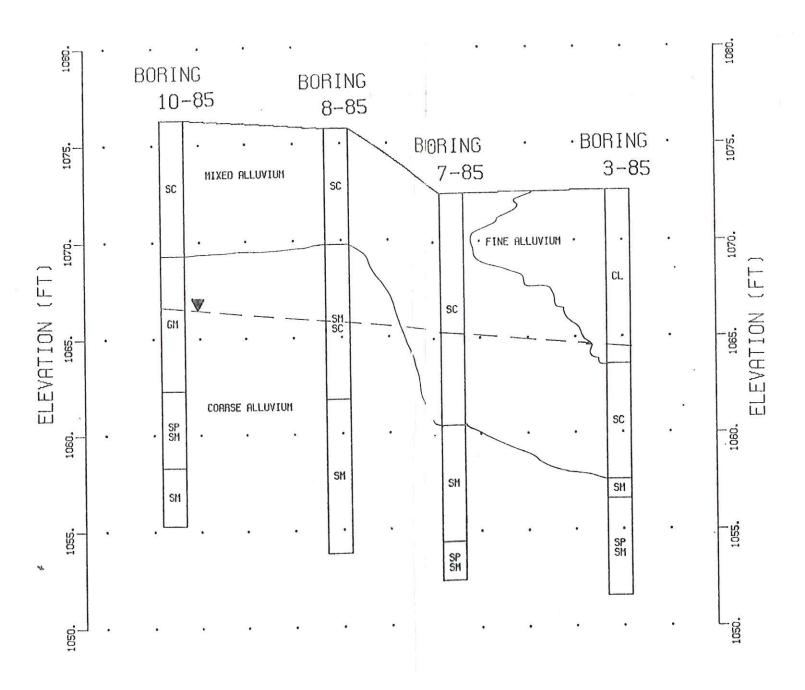
GASOLINE SPILL INVESTIGATION
YAKIMA, WASHINGTON
W.O. 120-12955

SOIL EXPLORATION COMPANY

SCALE: VERT: 1 IN = 5. FT HORZ: 1 IN = 200. FT

B ← B'

CROSS SECTION LOCATIONS SHOWN ON FIGURE #2



NOTE: EXCEPT AT BORING LOCATIONS THE GROUND SURFACE, WATER LEVEL, AND BOUNDARIES BETWEEN SOIL LAYERS ARE INFERRED.

FIGURE #4

SOIL PROFILE

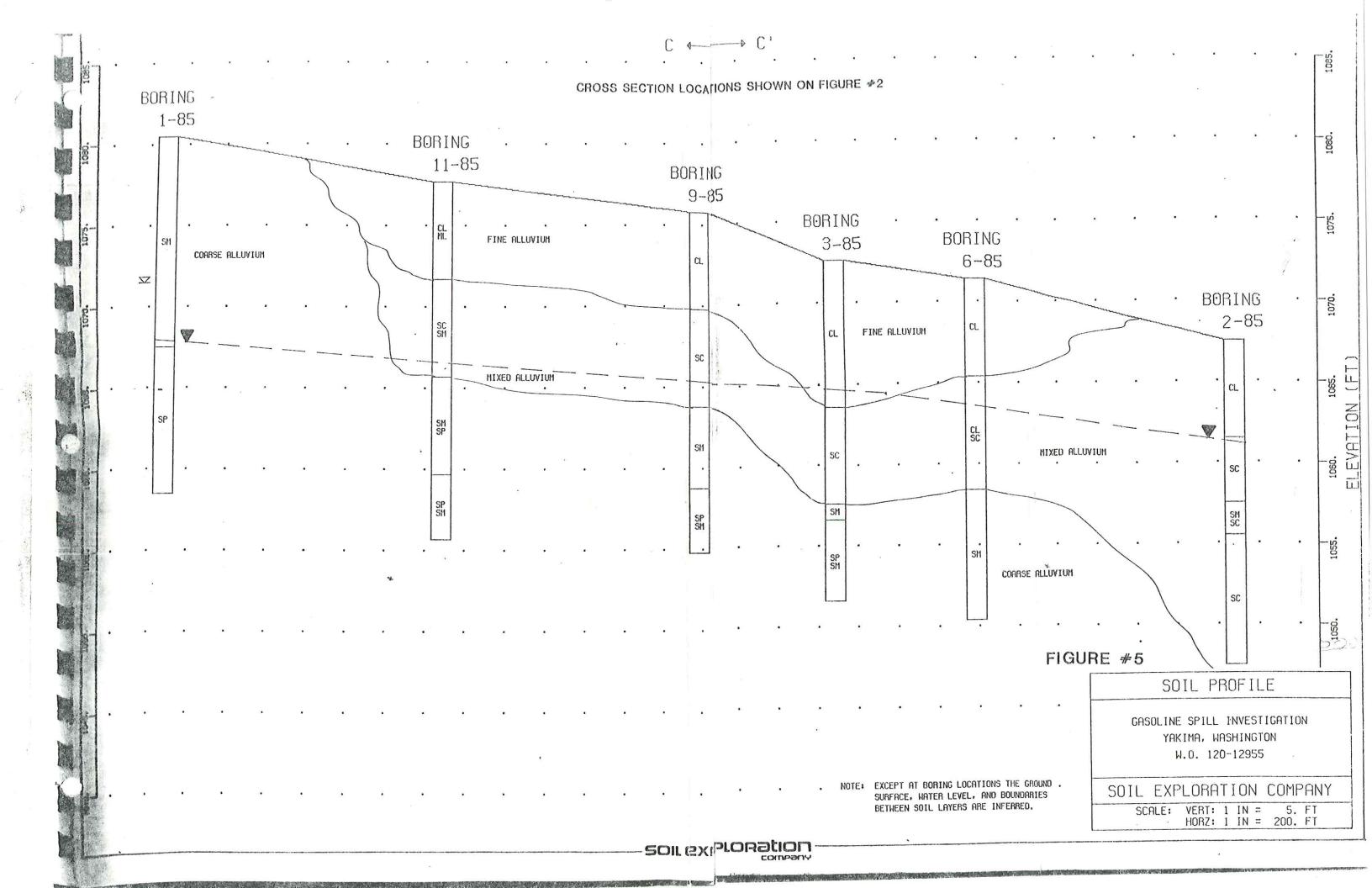
GASOLINE SPILL INVESTIGATION
YAKIMA, WASHINGTON
W.O. 120-12955

SOIL EXPLORATION COMPANY

SCALE: VERT: 1 IN = 5. FT HORZ: 1 IN = 200. FT

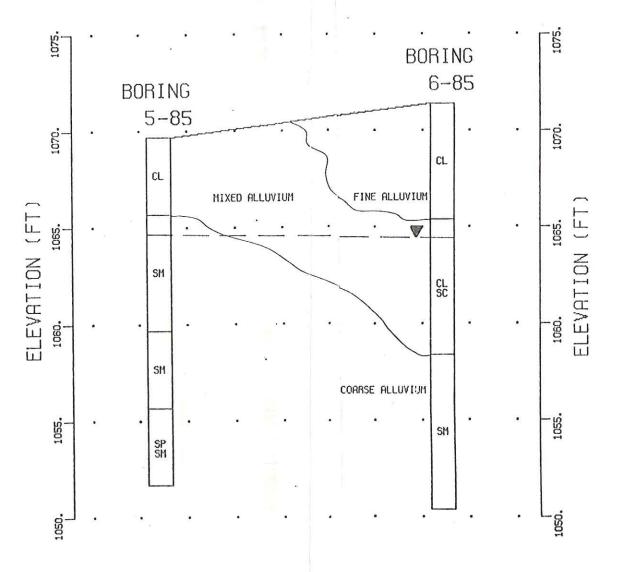
-SOIL (2)

ORATION



☐ · ← ☐ '

CROSS SECTION LOCATIONS SHOWN ON FIGURE #2



NOTE: EXCEPT AT BORING LOCATIONS THE GROUND SURFACE, WATER LEVEL, AND BOUNDARIES BETWEEN SOIL LAYERS ARE INFERRED.

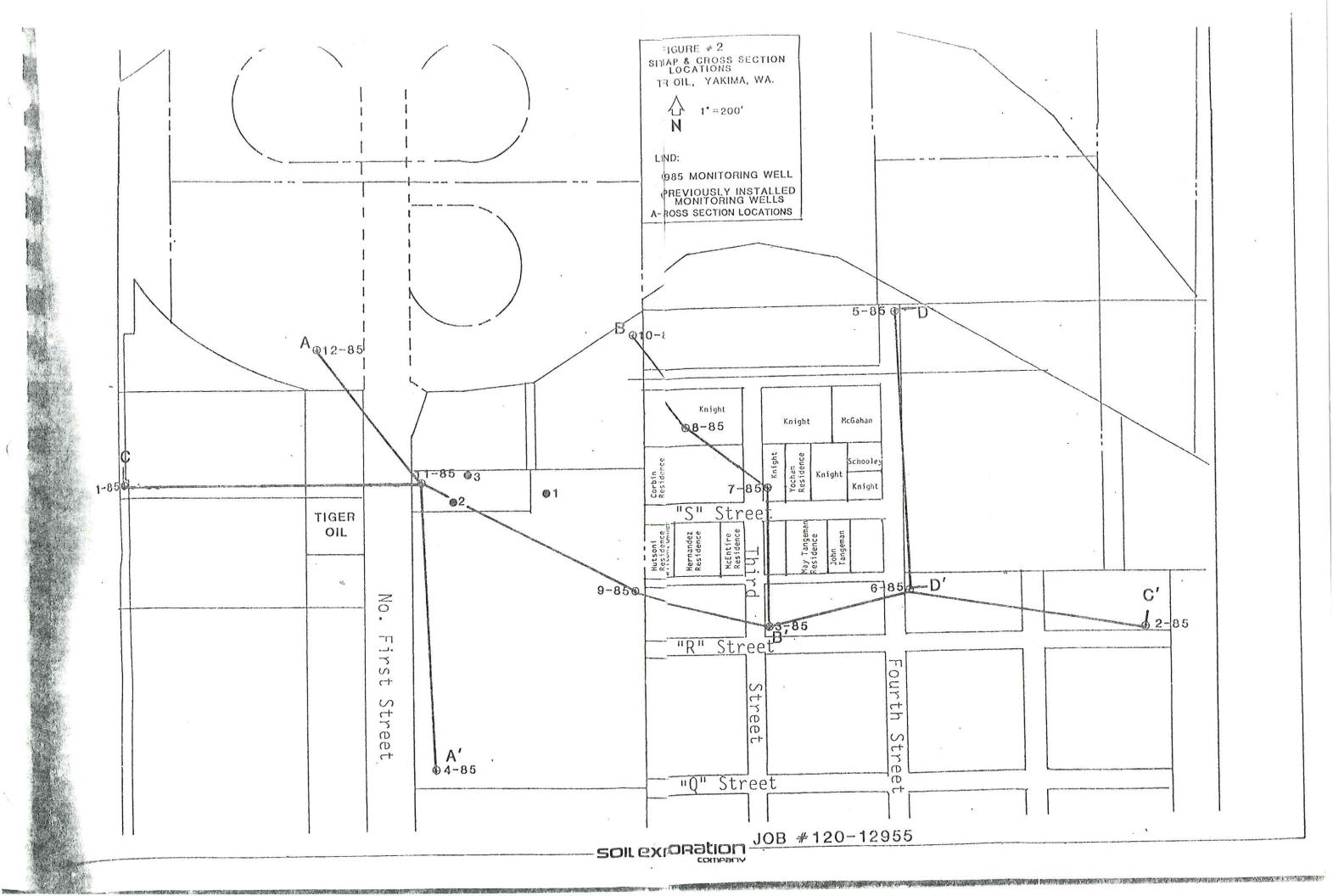
FIGURE #6

SOIL PROFILE

GASOLINE SPILL INVESTIGATION
YAKIHA, WASHINGTON
W.O. 120-12955

SOIL EXPLORATION COMPANY

SCALE: VEAT: 1 IN = 5. FT NORZ: 1 IN = 200. FT



	Location	34K)	MA U	ASHIN	GTON		_ Da	rte <u>9-2</u>	9-86		Local w	ell numt	oer	, , ,	ELJ	135
	County	-14	-		M	op			S	cale		_ Lat		Lon		
	District .				Pr	ojact nu	mber						_ Ahi	tude		
)	Orillor	itholog					Helpi	N			G	eologist				
		gororar.	ic Syn	nbois				Abbrev	iations						Rgo.	77
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						sand	8	clayey		medium	m			-		1
		Т				gravel	9	silty	sty	Coarse	co		-		LII	
	Scale Semole	Graphic log	Drill			:	Lith	ologic descr	iption				Sumr	nary log		
		10	100	+++	0-2	o See	: 1	09 T-5°								
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1	5			2 7	22-2	4' San	al, f	ine To meday, are to clay, are to contine to ver less that ine to ver dark by	carse	e, graves	to 38	"				
1				SAR	24-2	6 San	ray.	ine to a	parse	gravel-	to A	Clay				
3			21.8		26- 2	8. San	buf	ine to ve less than	y coa	rse, grav	el to ka	"				
٢			2716	NATUR	28-3	or San	7,4	ine to ver	y coa	rse, grav	e/10)	- زدیم				
				SAND.	30-3	2 Sa	ne	Gno to w	own,		1 4 1	7 7/4				
34			36.3		34-36	Sal	clay	Tight be	own-	ray ish	21 10 74	-40,				1
	日日				a. 1	9,	ebbl	es up to	Fragm.	ensof	Bbles	and				
	日			2'FT	36	Sa 1	ud it	Fine to verifie to coarse	Ery co	arse mo	Stly "	ned-				I
	日					+1	ragn	nents; cla	ix, 119	ht brow	n to 9	rayish.				
				PVC SCREEN	 											- 1
																1
		1														ı
	日															
									-							1
												- 1		100		
							-									
- Contraction																
-								1 19 <u>00</u> 1000 1								
							-				-	-				
Ì		1														-

														T-6.2		
		Location _						_ Dat				Local well i	number	1-6.2		
		County _				M	ар			s	ale	(.at	Lon	9	
(District	-			Pr	oject ne	ımber					/	Altitude		
)	Driller		Symb				Helpe	r			Geol	ogist D	S. Peter	300	
			Toroga	Synt	7018		clay	12	Abbrev cobbles	istions/	sandy				Rgs.	ī
					P	_	silt	st	boulders	b	fine'	f		Twsp.		So
							sand grave		clayey silty	cly. sty	medium coarse	m				-
		e 9	. <u>9</u>	6	Τ,	Γ		Litho	ologic desc				1.0	eq .		
		Depth Scale Semple	Graph Iog	Drill	-2.2'		v o		• • • • • •	. ip tion		*	31	ummary log .		
		旧日					See	T- Z	FOR	LOG	151		7		~~~	-
		5			BEN TON/TE											
	III			7.0	48											
		10		1.65	0						de select services					
					SAND BEN								- 1	v		
		目目		13.65	6'0F											
					0.01 SLOT								-1			
				_	PVC SCREEN											
					NATURAL	1 11	EZOME	FIER	S T-6	1 7-	6,Z AR	E IN				
					13.65 TO						NO BEN					
	Citize !			-	32.95	. ,	1	N INT	ERVAL O	BETWE	NO BEN EN 32.9.	TONITE 5 FT AND T HEAD SITE_FO	1)			
	ĺ	目			}			-QR INTE	INTERY RYAL.)	AL 19	COMPO	SITE FO	R			
					•											
	I	目目		- 1												
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	-	目目			Γ			-					-			
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		日日					** an									
	\rangle															
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		日							ř							
				100												

T-6. FIELD LOG REWRITTEN BY JBG

Lecation				Date		Local well numbe	REWRITTEN BY.
							Long.
District _			Project r	number			Altitude
Driller				Helper		Geologist _	D.B. Sapik
	ithologic Syr	nbols	clay	Abbri	eviations cob sandy	sdy	Twap.
			send grav	s clayey	cly mediu	f m m co	
Scale Sample	Graphic log Drill	- 1.35°		Lithologic des	scription	3	Summary log
PH		+++	See T-	-Z for 0-30	1		
							`
5	(16)						
	1 1		١.				
10							
		LL ASING	İ				
15		177					
		141				*1	
20		SAND " PVC					
		7 2 11				1.	
25		\$ 4					
		" GE				= 240	2
30		1141	3.				
		18	30-32 ' 6 ra	arge clasts to	ght brown .	edium to	Gravel, sand and clay 30-32' Sand, gravel clay 32.48
35	32	PA Ing	82-34' Sai	nd fine to co ark brown ar	arse gravel	to 1/8"; Clay	Sand, gravel clay 32.48
		12 1	34-36 Sa	nd, fine to co	darse garvel	to 1"; clay	Í
40	37.9	5 A G	36-38 Sa	nd medium t	o codrse gran	vel to /4 , clay	
			40-42'	lax, gray	very coarsely	gravel torz	
	del	24 NB	42-44' 50	gray medium	o coarse, gra To coarse, ara	velto 4", clex	
45	44.6		44-46 3	and fine to c	oarse, grave	1 70 1/2", clay	
	1010	5 3149	46-48' 8	and fine to c	oarse, gravel	vel to 1/2", clay vel to 1/2", clay 1 to 1/2", clay to 1/2", clay	
		2'0F		gray.	. Dr. 1000 - 1000 - 1000 - 1000 - 1		
		PVC				I	
		SCREEN					
		1 1				970	
			tit too and are				
日					580		
日							
日							
目							
日			-				
the same of the same of	1	1 1				1	1

T-5 FELD OF

Lecetion	Date Local well numb	Der
County		
District	Project number	Altitude
Driller Lithologic Symbols	Helper Geologist	D.S Sapik & S Peterson
Entitiologic Symbols	Abbreviations clay c cobbles cob sandy sdy	Rgn.
	silt at boulders b fine f	Twsp. Sec.
	gravel g silty sty coarse co	
90	The state of the s	
Scale Sample Graphic Log Drill ertion	Lithologic description	Summary log
	0-2' Clay & silt with some gravel to 14".	Tay and 6, H, gravelly 0-2
5	2-5 Fine sand to gravel (Max 1/2")	Sandaid gravel 2-5'
	6-7 Gravel (/4") to cobbles (rock chips) To Gravel to 1/4" with fine sand.	Grave sundy cobbly 5.9.2
10 CORE 8.2.9.3	82 to 92' Cobbly coarse gravel with	
	8.2 to 9.2' Cobbly coarse gravel with	sendant gravel 9-2-14
15	10-17 Very charse and rad medium	Dieselorsewersmell
	12-14 Med ium sand stravel, black and gray. Sewer like smell and heavy gas smell.	Silt clayer, gravelly 14-16 Gas smell) Gravel silty sandy 16-18 - 1601 smell) 17-18 much
20 2'FT	smell.	Water
0.010 SLOT	14. Clayer silt, grey with much medium gravel, black. Sas smell.	
SCRFEN	16-18' Gravel, very to coarse, comented 314 to sand, medium, matrix - 6as	
	18-20 Same as above; 17-18 much water	
	LOG INDICATES BOREHOLE DEPTH 18'	
	DIAGRAM IN FIELD BOOK SAYSIT'	1
	PLUS 2 FT OF SCREEN SUGGESTS	
	DEPTH OF CASING ONLY 15.5 FT. TO	
		*
	100 No. 500 No	

Location			D	te			Local wel	I number		
County _		M	ар		Sca	le		Lat	Long.	
District _		Pr	oject numbe	r				AI	titude	
Oriller			Help	er			Geo	ologist Di	3. Sapik	
	thologic Symbo	Ols		Abbrev	iations			•	B)0.
		L	remember 200	boulders		sandy fina	edy f		Twsp.	
				clayey	cly	medium				
			gravel g			coarse	co			
Depth Scale Semple	Graphic log Drill action	}—{+.5°	Lith :	ologic descr	iption		eri	Sur	nmary log	
		276.2	Same o	25 T-3				1		
5		10 V								
10	12'	NATURAL BACK							ž	
	16'									
		B.H. DEPTH								
月目								1	*	
		1 00	LL LOCAT RING DRI ROUGH T	LLING	tik Pi	PESS D	FIFAC	(T)		
			5 5 5 7 1	- ~ 5~	T HOL	<u> </u>		-		
						;-				
								_		
								_		
				-						
								-		

Location	Date Local well num	i-3 FELD LOG
	Map Scale Lat.	
	Project number	
	Helper Geologist	D.B Sapik ?
	Abbreviations clay c cobbles cob sandy sdy silt st boulders b fine f sand s clayey cly medium m gravel g silty sty coarse co	Twsp.
Scale Scale Sample Graphic log Drill action	Lithologic description	Summary log
	0-6'. Clay to medium sand	velay condy = 0-6
	8-10' Sand	bravel 6.8
10		Sand 9-10
25	10-12' Sand and grave 12-14' Sand and grave - hard drilling 14-16' Sand and grave (clasts > than 1") (hard drilling; large chips) 16-18' Sand and grave , rounded pebbles up to 1" at 17" 18:22 Fine sand to grave 22-24' Coase sand and grave , some chips 24-26' Clay, fine to coarse sand 26-28' Clay, fine sand, grave to 1/4" 28-30' Medium sand, clay, grave to 1/2"	Sand , clayer, gravelly. 28.30

Location	YAKIMA WASH	Date Local we	Il number
County		Map Scale	Lat. Long.
District _		Project number	Altitude
Driller	Ithologic Symbols	Helper Ge	
	Symbols Symbols	Abbreviations clay c cobbles cob sandy sdy slit st boulders b fine f	Twep.
		sand s clayey cly medium m gravel g silty sty coarse co	Soc
Depth Scale Sample	Graphic log Drill action	Lithologic description	Summary log
5 7// 10 7/// 10 7//// 10 7///// 10 7///// 10 7/////// 10 7////// 10 7/////// 10 7//////// 10 7////////////////////////////////////	BEINGUSED FOR DG-C MULTILEVEL SAMPLES 7-8 10 12 14 16 18 20 BENTON 17 SEAL OUEST NAY ABLE SOT BRIOG-PVC ED SCREEN JOINT		erand, silty, gravelly Clay and silt, sandy Sound, silty, gravelly.
	MAY LEAK		

L	ocatio	m.	o.k.in	na 11.	1:h			Da	te		l	_ocal	well numbe	r
C	ounty		8			M	ю			Sc	ale		Let	Long.
D	istric	t				Pr	oject nu	mber	-					Altitude
D	riller	-					+	telpe	и				Geologist .	D.S. Peterson
Г			hologic	Symbo	ols		alau		Abbrev	iations	57 /AP			(1)
L		لـ					clay silt	e st	cobbles boulders	cob	sandy fine	8dy f		Twsp.
							sand	8	clayey	dy	medium	m		
	_			·	CONST	UCT	gravel	9	sitty	8 ty	coarse	co		<u>Lilil</u>
Ę	9	aldu	aphic log	_ 60	1.5 L	1	5 3 0	Lith	ologic desc	ription			1	Summary log
2	Segie	Semply	Graphi log	Drill	F.5 L									
			147						ry silty a		•		aples	Silt, clayey
1	F	1				3-6	'. Incr	Cas 1	ng pebb	les	No samp	les -		.,,,,,,,,,
1	E	1	•						with very				fine gra-	Gravel, cobbly and sandy
		1			56	v	70.		A)*					***************************************
10		F			0	10.	- Chai	nae,	much si eve) also sitt, dar	Hand Cobbi	fine sail	id w prese	ith med-	Silt, sundy gravelly and cobbly.
1					cott,		Chi	חשם	sift, dar	ker sai	nds).			Copping.
15	1	F			W. 74	151	-San	2,7	ine to ve 1, some c to much	7,500	rse, clay	7511	t, Fine.	Sand, clayey, sitty and grovelly
ı	F	1				17'	chan	ge	to much	more s	ilt and	fine	sand.	Sand, silty.
2		F			t, 11ed	20'	- 5.17	fine	to very	509-50	sand i	ery	Fine -	. S. It, sandy gravelly
		1			ck t	l	77	4001	Some Col	o Dies .	Clay			, , ,
)/2	E	1			80	75'	- Medic	ms	and to f	ine gr	avet som	231	H	Sand and gravel, silly.
					0	28 '	Weter	r ch	and to forth dark ganged in to reddi	color	from 1	ght	muddy _	
90	F				710N									Silt, sandy, gravelly
	E	1			DUCT		gra fe	dep	gravel constructions mudd	ble dar	k colors	, Mar	fice	
35		L			ROD	A STATE OF THE STA			dium Sand					Sand, silty, gravelly
	E				PROI	35	51177	,,, с	BIOM GANO	720.116	. Cray and	,	7.200	
*		Н			PVC	7.7	7 84.77	·-		-,- #		7 (7		
		П				170	Glay	(3)	to coarse (brown an	d bla	ck). Wate	r tu	rhing	
45	E	Н			14	L						, - -		
		П				45	grave	ome = 1 (9	fine to iravel cla	medit	eckand g	and	pebble	Silf, sundy gravelly
50	E										***			
r		H				30'	Grave	elc	lo coarse lasts mos	sand Hly re	and fine	gra	ve/	
	F			Benton -			blue			•	\$1/		.	
53	E			1,000	Send	\$ 55'	fine	900	Trum sand	k.			k, and	Sand sally, gravely
ĺ		H			3' 0.0	58'	Same	as	above,	botto	m of he	o/e	F	Bollon of note
					Slot PW	-	-			e em 201	Es 200 200	-		
					scree	4								
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1							7							
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	1	L			1	1							I	

9-380 (Rev. 9-67)

UNITED STATES DEPARTMENT OF THE INTERIOR File No. 20/2 **GEOLOGICAL SURVEY**

YAKIMA OIL & GAS SPILL

NELL	ALTITUDE OF LSD NGVD	ALTITUDE OF MP NGVP	DEPIHOE HULE AT TIME OF DRILLING	ALTITUDE OF BOTHM AT TIME OF DRILL	DEPTH TO BOT- TUN OF SCREEN	ALTITUDE OF BIT- TUM OF SCREEN	TO TOD	ÁLTITVUG ØF TUF OF KKLEN	OF	POSTON OF BELL! ONITE SEAL		
T-15			18.3								Soil Not fin	15/00
7-16			18.3		13.9		7.9		60	4.8		
T-17			18.3		13.7		7.7		6.0	4.9		
T-18	waterstate by annual or		18.3		13.1		7.1		6.0	4.7		
T-19			18.3		13.8		7.8		6.0	5.7		
T-20			18.3		13.2		7.2		6.0	6.23		
T-2!			58.3		58.3		56.3		2:0	51.3		
T-22			18.3		12.7		6.7		6.0	6.6		
B-1			18.3	NO 5-16-	12.5		6.5		6.0	5.5		
B-2			18.7	DITTO	13.6		7.6		6.0	5,0	THE RESERVE	
B-3			38.0		37.3		30.3		2.0	15.5		
B-4			18.4		14.0		8.0		6.0	4.0		
B-5			18.3		180		90.		90.	6.0		
5-1			52.0		57 ±		50		2.5			
3-2			18.3		16.85		7.7		9.0	7.57		
5-3			18.3		16.8		7.8		9.0	5.6		
5-4			17.4		17.4		8.65		9.0	4.8		
5-5			18.3		210.5						Soil Go	Well
H-1			<i>5</i> 8.		57.02		55.02		2	49.0		
H-Z			183	a coassan	14.60		860	-	6.0	5.5		
GS-1			.< ^		14. ?		1.7.0			r 6.0		
65-2			17		13		6.0			n3+		
3/R			58,5		56.21		54.21		2.0	46.0		
MESA												
1151			58.		5798		55.48		2.0	50.0		Print Printernal
		7				-						
												E-Marie Marie III
		AT HER WHAT WITH									***************************************	NATIONAL PROBLEMS

9-280 (Rev. 9-67)

UNITED STATES DEPARTMENT OF THE INTERIOR GEOLOGICAL SURVEY

File No. 10 = 2

YAKIMA OILÉGAS SPILL

yleil Number	Altilude of LSD (NGVD)	1.11.tode of MP NGVI)	DEPTH OF HOLE AT TIME OF DEILL- ING (FT)		DEPTH TO BOTTOM SEREEN	ATTITUDE OF BOTTOM OF SCREEN	DEPTH TO TUP OF SCREEN	ALTITUDE OF TOP OF SCREEN	OF	BOTUN OF BENTUNTE SEAL		
1-85	CONTRACTOR OF STREET	1080.349	21.0		18.52		5.84		15.0	NONE		
2-85	1000.18	7.00.011	20.0		20		3.0		15.0) 		
3-85			21.0		19.12		3.7		15.0	-		
4-85			21.0		19.94		4.9		15.0	<i>)</i> -		
5-85			18.0		16.82		1.5		15.0	_		
6-85			21.0		19.28		4.0		15.0	-	THE PRINCE	
7-85			20.0		19.25		3.9		15.0	-		
8-85			22.0		20.04		4.9		15.0	_		
9-85			21.0		19.82		4.5		15.0	_		
10-85			21.0		19.27		4.0		15.0	_		
11-85	THE STATE OF THE S		22.0		20.49	ACCOMMODISTICS	5.0		15.0	_		
12-85			22.0		21.36		6.0		15.0	_		
1-82										-		
2-87										-		
3-82										_		
T- 1			56.0		58.0		55.0		3.0	54-55		
T-2			32.0		33.3		29.0		2.0	27	JOINT B	E WALLS
T. 3			33.0		30.3		28 0		2.3	26	U1121 8	FT - (AU
T-4			16.0		12.0		3.7		8.7	3.5	WELL TOO	CLOSE DIE COMM
T-5			20 0		15.5		13.5		7.0	17,5		
T-6.1			480		46.65		44.6-		2.0	37.95		
T.6.Z			(32 95)	115 = 9606=	13.65		7.65		6.0	-		
T-7.1			363		£7.3		33.3		2.0	25.5		
T-7.Z			14.		13.3		7.3		6.0			
T-8			18.3		14.35		8.35		6.0	_		
7.9	14 alternation share		18.3		13.04		7.04		6.0	5.0		
T-10			12.3		14.3		8,3		6.0	5.3		
T-11			18.3		14.2		8.2		6.0	5.6		
T.12			18.3		13.4		7.4		6.0	6.2		7
T-13			36.		32.2		30.5		.2.0	Not	1 dic	
7-14			18.3		12.8		68		6.0	4.1		

3-7 FIELD LOG

	Location		Date	10-10-86	Local well number	
	County _		Map	Scale	Lat	Long,
	District _		Project number _			Altitude
)	Driller		Helper		Geologist	Ron Lane
	Li-	thologic Symbols		Abbreviations		Rge.
				cobbles cob sendy boulders b fine	sdy ¢	Twsp.
			CARROLL OF THE PARTY OF	clayey cly medium	m m	
				silty sty coarse	со	
	Depth Scale Sample	Graphic log Drill action	Lithol	logic description		Summary log
		0,35	0-2' Clayey	silty fine sand, bro	wn.	Soud fine , clayer, silly 0-9
		2	4-9' Clayer	silty fine to med sa e grave ((to a") brown SUTY fine to medive	nd and	
	5		Brown	7.		
	10		9'-10' Fine 7	to coarse sand gra	他/方生。-	Sundano gravel 9-36
			10'-16' fine to	to coarse sand, gra	yand ZsiH.	· · · · · ·
	15		W. 111	but with coarser quals in 34 to 1" range, if coarse grave to be		
			me	nts in 34 to l'range in course gravel to cobi	bly gravel.	
	20					
			24 201 6	11 1/2		
1	25		And	but more sand le	s grave	
1			clayey		, ,	
	30		28-36 Silty 4	line to coarse sand Vet brownist gray in regraved and cobbles	gravel	
			Coal	rse gravel and cobbles	7,70 47 11	
	35					
			36 - 44 Clayey s	illy fine to coarse =	and, very	Sand, fine occarse; clayey Sitty. 36-44
	40		H ₁ 0 7	ilty fine to coarse e gravel (To 1/1") browni temperature is 15°C, driving is easier	Drilling_	31/17. 36-44
		41.0	and	driving is easier.	7	
	45	BELIEN		and the second s		Sand and gravel cobbly 44-56
		46.0 H	144 383 AL ABAL	re but drilling is ha se grave I and cobble	rder	Dana and gravel cooply 77-50;
			coar	SE GLUNG I KING COBBIE		8
	50	PACK		are in the time the first time the green green and		
						g.
-	55	54.21		NO 100 800 800 800 800 800 800 800 800 800		
		58.3				
				THE NAME OF STREET OF STREET STREET		
	HI					
		-				
-						
1	L	1 1	1			

	Location .						D	ate			Local well numb	H · Z · · · · · · · · · · · · · · · · ·) 5
	County _				M	ıp			S	cale	Lat	Long	
	District												~~~
	Driller						Help	790			Geologist	GLTIJCE	
	Lit	hologic	Symb	ols		clay silt	c st	Abb cobble boulde	reviations s cob rs b	sandy fine	sdy f	Twsp.	Sec
						grav		clayey silty	cly	medium coarse	m co		
	Depth Scale Sample	Graphic log	Drill	TOP OF PVC CSC Q.S. BELOW LS D.					escription		a	Summary log	
			0.5	NI NI	0					some s		Soil, Silt sandy	0-4
	5		3,5	PACK ®						the silt	d brown old sand. bles) oarser	Gravel, cobbly, silly sandy	4-12
	15		14.6	SAND	12 - 1	6'	brave H20	/ sand	l some Hings	between	brown . 12.14'	sand and gravel	12-18
	E		18	FILL			54	and the	(50/50	revious (i	t. Mone 2-16')		
$\left(\cdot \right)$												•	
-59								-					
						-							
	-							-					
•						-							
E.		1							-				
						-							
,								-	3 (9-2)		t the time the tale and t	e	
								en interior					

H.1 FIELD LOS

L	cation	n _							Dat	e <u>//3 - /</u>	3-86		Local	well numb	er	
Co	ounty					_	Мар .				Sc	ale		Lat	Long	
D	istrict	-													_ Altitude	
D	riller _			0 1				1	Helpe	r				Geologist	JLE & GLT	
Г		7	nologic	Symbo	DIS		7 cl	ay	c	Abbrev cobbles	iations cob	sandy	sdy		Twsp.	1
_		J	L					it	st	boulders	Ь	fine	f		,.	Sec.
								end ravel	s G	clayey	cly	medium coarse	m			
Γ	T	60	v		TOP OF	Т							-		Summary log	
the state of	Scale	Sample	aphi	Drill	PVC CSG- 0,45	·	a ,		Little	ologic desc	ription			l	Summary Tog	
É	S	ß	<u>ა</u>	0.45		1	2-6	7 5	. 14	with s	om e	sand			Silt, sandy	0-6
1				2.6	C	4	, ,			w / / / 3	om e	Jung		1	1311, SAROY	
5						+	- 21	- 2		-/ - Some		J 5.17		z		
1						- 1				bles			1121		Gravel cobby sandy	6-12
10						8	-101	<	066	le grav	ie/s	ome sa	nd	ارر در-	,	
						10	0-12	' '	000	ly grav	erw	<17 SA1	14 4	Ma 5/17.	sand and gravel, sil	1. 12.7'
14						14	4-16	_5	and	el, sand	rave	some	51/	·	sand and graver, sir	17 12 2
1		1				10	6 -18	' 5	ano	1 some	grav	eland	s.//	' ·		
2						18	3-20	' 6	rave	1, sand	son	ne silt				
14		11				2	20-25	11 3	les	d, some	Then	vel and	1511	/ / .	Sand, silty, gravelly	20 - 30
1					8	- 1				1, some						
2	\equiv				UTTING	2	6-30	 د	Sang	d, some	grav	eland	51/1	1. Color		
					(9)				to	d, some	irr ci	iangea.	rron	n prown		
3					7713	3	0-36	7 7	Grai	veland It (may	sand	t, black	k, 5	ome	Gravel and sand, silty	30-30
	E				DR	1				1000		- 10-4		1		
36					74.	3	6-41	7-6	rav	el, blac	k,50	me san	J, 9	ray	Gravel, sandy silly	36-40
					TURA				SI	14.			- 1		oraver, suray arry	20 15
14		1			NA	14	0-4	27 3	and	Tandara	ve7 (50/50)	Tack	Some	Sand and grave silly.	40-42
				100		4	12-4	9' 5	Sein	d, black	(, 5 o	me gra	ve/	gray	Sand, gravelly	42-44
4			3	44.0		-4	14-50		S ,	14				,	Gravel, silty, sandy	44.52
				//0	PACK BENTON	176			91	reliblace nd gray national	silt.	Some 1	arge		/	
50				49.0	4					1, black						
	E					1.				ilt. black :					Sand, gravelly, silty	52-56
S				55.07	AND	-										
				59.02	SAMD	- 5	6-50	5 2	M	, black	abi	t of si	17.	, one i	Sand and gravel, silty	56-58
						-									,	
1						_										
)										(3)						
1																
										*						

Lecation	Date	Local well number	
County	Mep	Scele Let	Long.
District	Project number		Altitude
Oriller	Helper	Geologist	Ron C. Lane
Lithologic Symbols	Abbrevia	rtions cob sandy sdy	Twop.
	1000 1 1000 10 10 10 10 10 10 10 10 10 1	b fine f	Sec.
		cly medium m	
			Name of the last o
Scale Scale Scale Grephic Log Drill	Lithologic descri	ption	Summary log
Scale Semple Grephic log Drill action			black top and fill 0-1
	0-1' Black top and for	o coarse sand, dark br-	Sand fine to course silty, 1-4
5	2-4' same as above	o coarse sand, dark br-	Sand and grovel, couply, 4-18 silty, clayey.
	4-6 Medium to coarse ments to x ")	gray, Drill sounds as if	silty, clayey.
	6-8' Same as above	e. Some silterselodor	
10	8-10' Same as above	e sand and gravel (frag- gray. Drill sounds as if el. Strong diesel odor. e. Some silt or clay. blowing from hole) , Color changing to sand and gravel, fragment	,
	10-12 Fine to coarse	sand and gravel, frogments	
15	12-14 Same 05 0 hou	h Brown.	
18.3	14-16' Silty fine to a	h brown Coarse sand and gravel ayish brown; saturated eef	<i></i>
B.H.	about is f	eef.	•
	16-18' Same as a bo	ive	
	Lost hole trying to	set casing - redull-	
	ed. OGC person	inell finished	
	,		
		Up total Dates after Annu Con Long Stee Con Stee Co Stee Co	
		and the say and the San San San Sa Sa	
		enter to the tea on the tea tea tea to the tea	
		to the the star was the tip throw the tip	
	,		

Locatio	20						Date	e		L	mun Itew Isoa	ber
Counts	, .				. Mai	p			Sc	ale	Lot.	Long.
Dissele	. –				Pro	lart nu	mher					Altitude
						ו	Helper	7			Geologis	Ron C Lane
Griner	Lit	hologic	Symbo		_			Abbrev	iations			
						clay silt	c st	cobbles boulders	cob	sandy fine	sdy f	Twap.
	\neg				7	sand	8	clayey		medium	m	
(Mary 1997)	J					gravel	8	silty	sty	COSTSO	co	BE
e .	ole	, je	Ę				Lithe	ologic desc	ription			Summary log
Depth Scale	Sample	Graphic log	Drill			•			**			7.77
	1		0.25		1-	-/' Z'	Black	Ktop a	nd fine	sand to	gravel(=1/2	Asphalt and fill Sans, fine cluye, silly 1-4 Sand and acase (cont.) 4-19
IE	\exists		4.2.			4'	Sam	rk brown	sh g	ray .		- Sand and gravel (cobbly) 4-18
5			4.8	ПП	4-	6	Med	ium Fo	Coarse	senda	some silt in wind)	Jung and of the (1000)
IE	7		2.65	- 03		8'	and	I clay	blows	saway	in wind)	·
10	3			1100	0	101	Sar	ne as a	bove		estan has	·
1=	=			= 25		-12	-	hanged	to re	daish bi	color has own and	
15	3			- OX	12	-747	3,7	y fine	Fo coa	rse sand	land grave h brown, el odor	-
	1		10.07.4	<u> </u>			e	aturate	dark	eselfu	el odor	
	7		BH		-14	-16-	Su	me as	above	' 1e.		
IE	3				100	-70	0 11	,,,,				
1 =												-
y E	=											=
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	=			ĺ								
IE	3											4
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IE	\exists											
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1 =						9 No. 800						
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Locat	ion									Da	97					Loc	al well no	umbe		
Coun	tv .						Ma	р_				umad til tim me		Sc	ale		L	nt	Long	
									t nu	mber				ature tro					Attitude	
Drille									_ 1	Helpi	OF _						Geolo	gist ,	Ron Lane	
		itholog	jic S	ymbo	als_	_	7	-1				Abbr	evla	tions	sandy		dy		Twop.	
			-30		L	-		cli si		e st		obbles		cob b	fine	f	ay .			Sec.
	_	Г	-			-		88	nd	8		ayey	•	cly	mediun					
	-		_					Or	avel	9	8	ilty .		8 by	COSTSS	C	0		R	
6	. 6	S Sign		6						Lith	olo	ogic de	scri	ption					Summary log	1
Depth	e la la	Graphic	- 10	Drill					-									4	Alection till:	0-1
TE	3	Topo	: 1	20.1Z	П	CEM	0-	1',	B.	lack	k =	lop a	7	par ne s	king lo	t t	1 104	",	Blacktop-till. Sand, fone, silty, claye	7 7-5
L					1 1	FILL	2.	5'	5	dai	rk e_a	browl as a	60	ve	ments sand	r		-		5-16
5	-			4.2 5.6 6.5 7.8	N	B	5.	- 6	, G	me	eT,	gray	, +	ragi	ments	10	/z"and		gravel, sandy	3-70
IE	\exists			7.8		PACK	68													
10						400	10	-15	2 -	jrav	gi	(15	") 9	ray	sh, sil	+ 1	s fine	חמ	*	1
LE	3		١	14.0		E SAUP PACK	12	1	r	Dam	le.	as,	00	ove	. Du I	3001	oracic	9		1
15			1	16.8			14	-10	6	Frai	ve	1(4)	٤")qra	yish ar sand, coarse (< ½),	, d	silt wit	th.]	Sand, silty, gravelly	1 16-18
IF	=		1	18.3 BH	TAU	FILL	16	78		Tire	210	ed C	oa.	to	corre	SO	and da	rkt	Juna, s. 117) protein	70 1
IE	-			חט			- 10	70		3, 13	oro	wn,	ano	ivel	(全人)	gro	ry-prow	nīsk,		
1										•	sa:	+ Uva†	ed	•						
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	Locatio	on					_ Da	te		-	Local well nun	nber	
	County				M	вр	-		S	alo	Let.	Lon	9
-	Distric	t			_ Pr	oject nu	mber		-			Altitude	
	Oriller	Litholo	gic Symb	nole.			Helpe)r			Geologis	Ron Lan	e
			gre dynns	013		clay	c	Abbrev	iations cob	sandy	8dy	Twsp.	Rge.
				paradinos		silt	88	boulders	Ь	fine	f	i wap.	Sec
	L					sand gravel	8	clayey	cly. sty	medium coarse	m co		
		e .º	T 6		T		Lith	ologic desc				- Cummantulan	
	Depth	Sample Graphic loa	Drill					arogro acio	ription			Summary log	
		Top of	0.15	S) CEA	0-1	Blac	ktop	of park	ing lot	and fil	7.	Blacktop on	4 1.11 0-1
	IE	Cso	2.0	S WAT	2-4	1 Sam	y cla	t fragmen	e San Hs to	d, dark 12". Col	brown bble gravel z',clean.	1	1 4:11 0-1 1 and clayer 1-3 1/2
	5]	5.8	PVC B	4-6	- 20 B	ble a	gravel, fr	agmer	13 to 9	ziclean.	Gravel, cobbly	sondy 3/2-7
		11	7.5 7.7	= 3	6-8	upp	er c	is abou	e gra	y.	rayish brown	Sond and grave	7-18
	10	∇		1 = 1 4	18-10	_'	arse Fraar	sand ;	rave	dull an	with	, '	
				SA	10-12	?' San	me a	s aboy	e buy	wet,	lark gray gravel (< k") bon odor.		1 1
	15		14.0	E	12-1	4' Sil	t and	d brown	finesa	nd and	grave / (K)		
			16.85	NAT F.	1000 00			A STATE OF THE PARTY OF THE PAR		114.000	porr odor .,		
			10.5		16 -	18' 50	me_	as abou	e				
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	Location					_ Da	te			_ocal well numb	SI FIELD LOG
											Long.
											_ Altitude
	Driller				*						DS. Peterson
	Lithologic	Symbo	ds_				Abbrev	iations			Rgs.
					clay silt	c st	cobbles boulders	cob	sandy fine	sdy f	Twop.
					sand	8	clayey	cly	Section 5	m	
					grave	9	silty	8 ty	COSLES	со	
	Depth Scale Semple Graphic Iog	Drill					ologic desc			÷1	Summary log
				0-4	Soil	1 501	Hy clay	ey.			Asphalt Surface Soil, silty clayey 0-7'
	5			6-8	T Silt Gra	and vel,	gravel,	Fine,	dark. I clasts	to 15mm.	Gravel 7.8.
	10 1/1			8-1	0'8an 1' Sai	th q	edium To pravel Fi as above	coar.	se claye	to 15mm.	Sand, clayer, gravelly 8-16
	15			12-1	16'SI	ty_	de a pove brown w e dark w coarse w	ater)	sand, or gand, or gravel, fi trine gr	der Sangle nedium To. ine black. avel; parse sand exel	Gravel, silty sandy. 16-20'
	20 777			17.5	Way	er d	ark brow	black n. Ver	y silty s	sarse sand	<u>.</u>
				20-2	2 52	nd a	nd, grave	1,511	y; water	less brown	. Sand and grave / silly 20-22
(
	25	-									
	30		2								
		- 1	CASING								
		1	0								
	35 W XX	1	2/2		-	-	- 60 600 501				
			2.1								*
	40										
	15										1
	45			_					Min our eye som		
										1	
9	50	-	 		-			-			
		1	AME		2		8				
į	35	56.5	SAND		-					-	
	11/1/2	707	SAND 2 FT								
	ω	1	0.010 SLOT		-						
		- 1	PVC SCREEN							1	
£ .		1				-		-			
			*	(2)							
		1			-				Serve Served was Some		
		1		ı						1	

ι	.oc	etion						_ De	te	86		Local w	ell numb	B.S. FIELD LO	6
(Cou	ınty				Ma	ıp			Sc	ale		_ Lat	Long	
(Dis	trict .	to the same of the			_ Pro	oject nu	mber						_ Altitude	
0	Dril	ller						Helpe	If				Seologist	Ron Lane	
r	*********		ithologi	c Symbo	ols		clay	e	Abbrev	lations/	sendy	sdy	, E-120 Julii - 121/120	. Kiga	777
L	_		L				silt	st	boulders	cob b	fine	f		Twep.	Sec
[-						send gravel	8	clayey		medium	m			
Г	1	1	J.	T			Augagi			sty	coarse	co	T	R	
	Teba Teba	Scale		Drill				Lith	ologic desc	ription				Summary log	
COLUMN			TOP OF CSG	2.0	N CEM	0-	z' (Claye	y silt,	dark	brown.	//> /		5. It, clayey	0-3
1	5			4.0	200	4-	4' C	cob	silt som les ind 3) frag 1 to cou	COUR	se grav	e [col	k brown.	Gravelcobbly	3-6
				6.0	8.85	,	4. 1	31	5) frag	men-	ts fo 1/2	1, 500	ne	Sand and graves	6-17
	10	\exists		9.0	ا م ا ت	8-1	8' 0' -	Sen	sand i	o qra	vel(<)	, /4") <u>.</u>	gray,	7	~ . ,
ď	ŀ			(3,5	SAUD	10 -	17	Fine	sand.	to 1/2"	gravel	some	2	z 4	
-	5		1	1915	= "			dry	gments	>1/2	", gray	ish b	rown		
ľ	3		l		11/2	12-	14'- 16'	Sin	ne as a	bove	"grave	lara)	rish -	Sand, fine to coarse	
-	E		, /t	0 18.3 BH				br	an abou	frag.	ments n	nore.	sand	Jan a, time to Evanse	gravelly 17-18
	ŀ					16 -	18'	San	ne as a sand own . No an about me as point, plus and at 1	a bou	e, but n	nore to c	oarse	•	
	E	\equiv				18'	to BH	5. []	ne to co ravel, s	7+ an XIrse	sand S	ome t	fine		
1	E							· 7	ravel, s	atura	ted.				
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1	E	Statute S			ľ	-		-							
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1	E							ii.							
	E					-	-				BOOK BOOK BOOK BOOK				
	F														
ghit rose	-				•										

	Lecation	١					. Da	te			Local	well numb	er			
	County	-			Ma	P			S	cale		_ Lot		Lon	9	
	District				_ Pro	oject nu	mber	***************************************	-				Ahin	ıdə		
)	Driller_	11.1		•		ا	Helpa	ir				Geologist	Ron	Lane	-	
		Litholog	ic Symb	OIS	\neg	clay	c	Abbrev cobbles			ech.		10 .0 0	T	Rgs	
		J [_				sile	st	boulders	cob b	sandy fine	sdy f			Twsp.		i Sec
						sand	8	clayey	cly	medium	m			•	-i	
	\Box	Т	Т		r	gravel	9	silty	sty	coarse	co			R	Li	_نــــــــــــــــــــــــــــــــــــ
	ह ह	Sample Graphic log	Drill				Lith	ologic desc	ription		29	1	Summ	ary log		
	Scale Scale	3 P -			<u> </u>											
			7:0 - 15	i cen	1-4	Silty	clay	and parking, fine to Y, dark gra	medio	m sand	and q	rave /	Blackto	ilty sa	ndy grav	0-1 ully 1-4
	3	1.	磊												vel	
				96.2"	6-8	1 Grav	el (1	returns = t	ragmo	nts to 1/2	") /19/	st gray				6-18.4
	/0		8.0	PACK B	8-10	, Drill Sam	e a	returns = f nds as r s above	but	finer. M	ediun	sand	0/2/	1)000	1)>4"0/	B 70.7
	10			Fal	14 /	76 %	4114	ragments.								
		ł		SANE	12-1	4' San	100	is above ler, but nd rang ples, no c is above			J					
	15	1		MAT: FILL	15.7-	16 NO	imi Sai	nd rang	e, sa	In fine	park	brown				
			18.4		16-R	s' Sa,	ne a	es above	nang	es, No 00	tor.					
			BH.										2			
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1				1												
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	Lecation						Dat	e		ι	ocal w	ett numbe	or	
	County								So	ale		_ Lot	Long, _	
	District				Pro	oject nur	nber						_ Altitude	
)-	Oriller _					F	telpe	r				Geologist .	Ron Lane	go
		Litholog	ic Symbo	ols		clay	e	Abbrev cobbles	iations cob	sandy	sdy		Twep.	
		J				silt	st	boulders	ь	fine	f		,	Soc.
						sand	8	clayey	dy	medium coarse	m			
	П	Т	1		Т	gravel	9		sty			T		
	4 9	Semple Graphic Iog	THE SECOND			(• i	Lithe	ologic desc	ription				Summary log .	
	Scale Scale	3 5	TC; A4		0-2		- /	clavay e	11 1	- 6 h			Sand, silty, claye)	0-3'
			7.67		2-	4	x.fi	ne to coar	se, sa	nd, fragm	ents to	12"	•	3-8'
	5				4 =	6_ 95	rill a	fragme	ble 9/0	nd fragmine / 1/2" most nd some / s if in c	1 < 14 M	Sime	Grave 1, cobbly	3-8 -
			İ	?	6-8					s if in a	obble	grave!		
	10	∇	10.0	ШL	8-11	2' _ Sil	ty f	ine to coa	rse_sa	nd to gradiesal a	ave/. F	ragment	Sand und grave 1	8-36
	"		10.0	FIL		10	٠.					700	•	
			13.5	CE	10-1	14' 511	Stroi	ne gas ador	ad to	gravel, to r decre	reame	nts to 1/2		
	15		15.5	3	14 -	16' 5.	96 F.K	gray go	to fu	r' de cre ne gravel	(ZK	deck		
				2	650		2 /			ve to 14				
	20			10 3		20' 5,	Froi	fine to e	oarse	sand, gr	avel (f	ragment	50 • 3	
`	IE			0, X Z "	20-	22' 51	to.	12"), dari	k brou oarse	on. sandan	darav	e/,		
),	25			30.0	22-	/	ctas	\$ 75 12" as abov	y dark	sandan S brown. re sand,	Less o	ravel		
•					24-	26' 8	and	as abo	ve.		,			
	30		303		222	~~ = =	147.6	ine to coa	rse sa	and fir	e grav	e1(247)		
			32.8	NAT.	29-	30' 5	ane to	as above	e but	iesel fuel at 30' dis	stinct	change		
	35			FILL			348	ong odor	24 Du	ganic dec	ay		Sand fine to con	se 36-38
			38.0 BH		-		(4	16/2 Tak	19e),	dull grayi	sh br	own =		
	IE		PH			34' S	eme	as abou	1E			-		
					36-	38' F	ine	to coar	se sa	nd, most	ly me	dium k aray		
							-					- LZ		
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200	IE													
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B-2 FIELD ...

Location	YAKIMA, WASI	Date	Local well numb	er
County .	·	Mep	Scale Lat	Long.
District _		Project number		Altitude
		Helper	Geologist	Ron Lane
	Ithologic Symbols	A STATE OF THE STA	vistions cob sandy sdy	Rge.
L		silt at boulders		Twep.
		send s clayey		
ПТ	T T. T.	gravel g silty	sty coarse co	4
Scale Sample	Graphic log Drill action	Lithologic desc	cription	Summary log
Scale Scale	P E E	1	.,	
	Z.1 2	0-2' Park brown C	but grave to 14" fragment	Silticloyey 0-3
5	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	to 14". Cobble action (ross	but grave to 14" fragments and coarse gravel drill sible parking lost fill?) coarse, mostly fragments if till hilling cobbles. Jome and silf) being blown away coarse, fragments to 1/2" cobbles. Still and clay 54 th -	Gravel, cobbly crayel silty 3-8.
	7.6	4-6 Sand, Fine Food	coarse, mostly fragments	
	1111 Stor	6-8' Sand fine to	coarse, fragments to 1/2"	Sand and grovel, silty & -18.7
10		being blown	cobbles. Still and clay still	
	14.13.6	8-10' Sand, fine to co	arse, dark gray and No clay in exhaust (returns)	
15	NATUR	10-12 5.1+, sand, fin	e to coarse, gravel with .	
	18.7	12-14 ! fragments to	e to coarse, gravel with . Yh "dark gray, saturated ove but tow fines more nen'ts.	
	BH	14-16 Same of Ab	nealts.	
月月		and less	que, but much more, fines gravel fragments	·
1		16-11.5' Silf coarse	sand gravel with frag-	
18		19.5-18.7' Similar to	above but lacks fines, . Much evidence of	
		dark Drown	. Much evidence of '	
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Lecation	YAKIMA, WAS	NINGTON DateLocal well number	RT 1 FF M2
County _		Map Scale Lat	Long.
District _		Project number	Altitude
Driller		Helper Geologist .	. Rge,
	thologic Symbols	Abbreviations clay c cobbles cob sandy sdy	Twep.
		silt st boulders b fine f	1 Sec.
		sand s clayey cly medium m gravel g silty sty coarse co	
П			
Depth Scale Sample	Graphic log Drill action	Lithologic description	Summary log
888	TAD DERLA 2 -	0-2' Light brown very time sand and silt.	sand very time and silt 0-4
	2.0		Sand yely line and say
5	1 42 7	B 4-6 Gray fine-coarse sand and gravel, frag	Sandand gravel 4-9
	6.5 X	6-8' Same except gravel to 1/4"- 7/6" Fragments	<i>x</i> ,
10	6.5 XX 6.XZ" 0.01 SLOT PVC SCREGIS	8-9' Sand, medium to coarse, some fine, less sand	Sandymedismen cooise 4.13
	SCREGAIN =	2-4 Light brown tine sand and silt some brown clay. 4-6 Gray fine-coarse sand and gravel, fragments to 14". Drill sounds tike coarse gravel or cobbles: 6-8' Same except gravel to 14"- 3/6". Fragments from to 20" 8-9' Sand medium to coarse, some fine, less sand than above, gravel > 16" more gravel than above Fe in fragments 9-10' Sand medium to coarse, brown to gray, very little fine gravel to 14", No fragments. 2-2-2-2-2-2-2-2-2-2-2-2-2-2-2-2-2-2-2	Sandand gravel 10-11.4
15	BACK	little fine gravel to 4", No tradments.	
1"	PRIL	10-12 Sand fine to coarse, gray, with clay and.	
	18.3	boulders.	
		clay, gray brown.	•
		14-16 Sand, fine to coarse and gravel to 1/2", some	
18		14-16 Sound, fine to coarse and gravel to 1/2", some fragments, clay silt gray 16-18.4 Sand, fine silt and gravel to 14", brown- 1sh gray to grayish brown	
		1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	
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	Lo	cetic	n.						_ Da	te			Local v	vell numb	T-22 F/	ELD LO	6
															Long		
. /	Dla	tric	<u> </u>	-			Pr	oject nu	ımber		-				_ Altitude		
- /	Dri	ller	1 1	halas	la Cumb			-	Helps	и			(Geologist	Ron C.Lar	ne	
	Г	-	ה	uiolog	ic Syme	2018	\neg			100101	ia tions					Rge.	
	_							clay silt	e st	cobbles boulders	cob b	sandy fine	edy f		Twsp.	-t	
								sand	8	clayey	cly	medium	m		-		
					T	ITARAE	1	gravel	9	silty	sty	COBTSO	co				E Street Court Court Court
	Depth	Scale	Sample	Graphic log	Drill	TOP OF PVC CSC -0.43'	5	3 7 3(4))	Lithe	ologic desc	ription				Summary log		0
				ŧ	2.5	B. OH	0-7	1' Silt	y cla	ayey fine	sanc	, brown			Sand, silty, c	layey	0-7
	5	Arterial Marie	1	89.1		В											
	10				6.66.7	SAWD	7-12	' Sil	ty c	layey firsh gray	ne sa	nd tog	rave/ ting c	(b) (b) obbles	Sand and gro	ave l, silty	7-18.3
19					12.7	NAT.	12-1	41 SI	Hy f	ay Drill ds abo	d to	gravel,	brow graye	inish	*		
	15				18.3	FILL	16 -	185 80	colo	but re	ddish	brow.	1 .	<u>own</u> .			
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	Location						_ Da	te			Local v	vell numb	T-22 F	IELD LOC	•
													Lon		
Α,	District _				_ Pro	oject ne	umber				-		_ Altitude		
	Ph. 111	thologic 5											Ron C.La	ne	
+:		unologic		018		clay silt sand grave	\$8 8			sandy fine medium coarse	sdy f m co		Twsp.	Rge.	
	Depth Scale Sample	Graphic log	action	TOP OF PVC CS6 -0.43'			Lith	ologic desc	ription				Summary log		PARTICULAR SECTION SEC
	5		2.5	N F	 7·12	 ' Sıl	ty c	layey f	ine sa	d, brown		(なな") - obbles	Sand, silty, c	, ,	
	IS		12.7	NAT.	12 -14 [41 16 -1	4' Si ' <u>6'</u> Si '83'So	Ity fame	ine sanday. Dri	d to	gravel, d fine of type grayis h brown	brow brow	inish own.	,		
			10.3		/6 -/	785 Sc	ame	but re	ddisi	h brown					

Location								_ Da	ite			Local w	vell num	7-27 F		/5	
County Me					ар		The second state of	s	cale		_ Lat.	Lon	n.				
	Dia	strict					_ Pr	oject n	umbe						Altitude		
)			itholog											97.80	Ron C Lan		
			goloriti	ic Sym	bols		\neg			Abbr	evistions				1.1	Rge.	
					_	-		clay silt	C St			sandy fine	sdy f		Twsp.		I - Sec
								sand	8	clayey		medium	m		***********		
			Т	T	Trop	OF		grave	9	silty	sty	COBISS	CO				
	Depth	Scale	Graphic	Drill	C50	C C C		22	Lith	ologic des	cription				Summary log		
	<u>ద</u>	8 8	8 -	P 8	OF	1	0.5		- 7.7	· ·							
				1.9	5 C	В	0-5	, 2,	114	Clayey	fine s	and, bro	wn.		Sand, silty, c	layey	0-5
	5				11		-,	-						1 Balleria (1000) 470			
			l		\prod		5 6	0' 3	rave i	, cobbl	y (Drill	rig) Frag	ments	78 K"	Sand and grave cobbly	, ,,	5-6
	10						10 -	18'_s	gray	sh brow	ownish	bly drilli	ing ingurate	かり	Sand and grave	el, silly	6-18
	1				7	П			bet	ween i	2 and i	+ feet	P P P.				
1	15	\exists			FILL	П								l			
- 1				l	RAL	П	-							:			
	20				ATUR	П	18-2	4' 5	11/	fine to	Marea	sand	amiel	(+ V)	Sand and grave	1	8-58;
ľ	E				Z				qra	yish bro	wn . No	cobbles	gravei	(7.57)	Sand and grave (more clay is a below 32'	amples	. 00,
1	ţ	\exists			NV		24-	26'5	iltu	fine to	C00-1	e sand	0 54 15	1/4 48	011000 32		
1	25				5				-Br	owntsh	gray	vish brow	grave	(10-3)			
	E				U		26 –2 28 – 2	18 S	am (Exce	pt gra	yish brow	un				- 1
F	30				21712	1 1						ownish q					- 1
1	E				DRI		32 -3	8.3 5	ame	y to b	of more	gray/bi	olor o	dull			
3	5	_				-			pla	×		1.77					
	E				2												
4	OF				2" PVC	-											- 1
	E	\exists															
4.	5	\angle				+									*		
	E	41			SAND PACK BENTONITE	72											
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	E		l	58.3	等												İ
	F	71		50.5	31.05	_		-			~ ~				NET THE PERSON NAMED IN COLUMN DESCRIPTION OF		
	E	3			2' OF 0.01 SLOT												
			- 1		PVC	- 1											
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Count	٧.				M	ар			S	cale	Lat.	Long	
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Driller		thologi					Helpe	и			Geologis	Ron C, Lane	
	٦'	Ulologi	c Symi	DOIS		clay		Abbrev cobbles	istions/			Rge.	
		- Lance		L		silt		boulders	cob b	sandy fine	sdy f	Twep.	- i Sec.
						sand gravel	8	clayey	2.50	medium	m		
П	0	Q	T	72000	T	Signal		silty	sty	coarse	<u>co</u>		
Depth	gme	Graphic log	Drill	PVC (S	6	198	Litho	ologic descr	ription		=	Summary log	
0 8	S	Ō	0,3	LOW LS.		2' 511	1 2 2	augu T		,			
			2.0		2'-	4' 5:1	ty cl	ayey, fin	e to a	oarse so	andand wid be	Sand, fine, s. Ity, clayer	
5		10	5.2	FI	4-1	C 37	Co 6	bles	- 1-1-	· /2") (0)	v/d be	Sandand grove silty clayey cobily	2-11.5
	1		7.2	NEW TOWN	6-8	s' Sa	Still	present	Da	ravel to	Z", Coboles's as if in gray beaun.		- 1
10	11			SAUD PAC	8-1	10' Su	Sobb	les. Lo	coars	e sand	aray brown		1
IE				NE	10-1	1.5'	Cobb	gravel les. Frag	s are	"basaltic	lack,		
15	11		13.2	NATUR	11.5	-12'5	14	sandy	e grave i	(でき")	grayish	sand and gravels, 1ty	11.5-18
	1			FILL	12 -	14' Sa	and,	finetoe	coarse	1 gravel	(to 2")		ı
	11		18.3		14 -	18' 5.	13f	eet abo	ve, sa	TURKTEE	grayish (to by) at about		
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	Co	nuth	·			M	lap			S	cale		Lat Long.			
1	Dis	District Pro						numbe	r					Altitude		
)	Dri	lier		ic Symb				Help	07			G	eologis1	Ran Clai	ne	
	Г	一	Juliolog	ic Symp	2018	\neg	clay		Abbrev	iations/					Rge	777
			_		L		silt	E St	cobbles boulders	cob	sandy fina	sdy f		Twee	·	- i Sec
							sand		clayey	cly	medium	m		***	- 17-	
		Τ.	T	T	TOP OF	el .	grave	01 9	silty	sty	COBISE	co				
	Depth	Scale	Graphic log	Drill	PVC CSE		. :	Lith	ologic desc	ription				Summary log		
	å	8 8	9	and the same of the same of	BELOW LSD										*2	
	1		,	2.0	111 11	0-	21 8	Bilty	clayey	fine :	sand, lie	int br	own:	Sand, silty o	layer	0-2
	5			4.7	FILL	4	6' 6	Dril	to coars I sound or and to Il sound as abo	e sai	in sobbl	vel (To	el,	Sand and gr	avel	2-9,5
	Ť			4.7 5.7	B	Ţ.	-01	Dri	ll sound	as if	in coppl	es es	a bove			*
	"F			7.8	PACK	8-	9.5'	Sam	e as at	ove.						
	10				9 =	95	-11	C	I	· i	ains br	rown c	Tavor	Sandund gr clayey and	ave I	9.5 - 18
	E			13.8	8	10 -	12!	San	ne asa	still	sounds	cobbly	/-/	ciayey and	181144.	
	5	\exists			HAT	12.	14_	51 H	X sandy	grast, b	vel (to)	2") gr	ave!			
1	F			18.3		14 -	-16'	Silt	y fine to	coar	se sand	gray	el L			
1	E					1/4-	10.7-	- e L	the as a sy sandy fine to the moly fine to	T T		MIEC	all			
	F					10-	. 10	b	ilar bu	gray	or is re	adish	1	•		
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Location .					Dat	te			Local	well numb	er	
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District _			Pro	oject nui	mber						_ Altitude	
Driller	thologic Sym	hala		}	Helpe	r				Geologist	Ron C Lane	
	niologic sylli	DOIS	\neg	clay	c	Abbrev cobbles	iations cob	sandy	sdy		Twsp.	
				silt	st	121 2 2	b	fine	f		1 Wash.	Sec
				sand gravel	s g	clayey is	cly sty	medium coarse	m co			T
	o	T	Π							Т		
Depth Scale Semple	Graphic log Drill				Litino	ologic desci	iption				Summary log	
0 0 0	TC OI	The	0-	2 ' 51	Ity .	clayey f	ine s	and, bro	wn ·		Sand, silty clayey	9-8
	2.	BEN	2'-	4' Sa	me	as abou	ie (c	layey 10	(eg mu		F-112 / F-17 - 17 - 17 - 17 - 17 - 17 - 17 - 17	
5	5.	1 HF	-4-	6 _5a	me.	as abou	indy	ts of cl	ay_ co	ould be		
	7.	LACK	6-	8' S	am e	as abo	ve.	·			C. Talt. days	6-16-
10		9	8 -	10' S	ine	us ab	hble.	but dri	11 50	unds	Sand silty clayed and Cobble grave	
	13.	184	10-	n' 5	pre	own.	(7.000	7,2,	,	Sand and gravel	10 - 18
15		NAT		(:	freq	ments	- Kz	Derul_	soun	d like.		
	18,		12 -	14' S	and	coorse	grave	evel (to	とりま	ome		
	10.,	,		= -/	gre	clayey ments of cobble cobble cobble clayey clayey rownish	at	sand, k	orow 	nish =		
			14'	-18 3	148	rownish	fine gray,	as abou	e gra	it,	•	
					- 2	iore fine It 18't w eddish	s and	color be	came	ments		
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Location	Date Local well numb	1-11 FIELD COG
County	MapScaleLat	Long.
District	Project number	_ Akitude
Driller	Helper Geologist	Ron C. Lane
Lithologic Symbols	Abbreviations clay c cobbles cob sandy sdy	Twep.
	silt st boulders b fine f	l l Suc.
	gravel g silty sty coarse co	
	T	
Scale Semple Graphic Graphic Control of the Control	Lithologic description	Summary log
	0-2' Claver silty fine sand gravel to 1"	gand clarax C. H. arrelly
2.5 S. Natr		Sand, closey, Silty, gravelly,
5 49 8		Sandano'gravel 4-18
7.7	4-6 Fine to course sand, grave (fo %") grayish brown Drill sound like cobble gravel. 6-10' Same as above.	I
10	6-10' Same as above.	y
7.7	10'-12' Med to coarse sand (less than above) gravel with frags / (more than above) 12'-14' same as above, saturated	
115 NAT	I'le -II - Jame as a pore, satisfated - I'!	
FILL	14'-16' Silty fine to coarse sand and 'gravel (to &") brownish gray. 16-18 Same as above but gravel to 1"+.	
18.3	16-18 Same as above but gravel to 1"+.	
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Lecation		Date		Local well numbe	
County		. Map	Scale	Lot	Long.
District		Project number			Altitude
Driller	o O combala	Helper		Geologist .	Ron C. Lane
Limologi	c Symbols	clay e cob	Abbreviations bles cob sandy liders b fine	sdy f	Twsp
		gravel g silty	yey cly medium	m co	
Depth Scale Semple Graphic log	Drill	Lithologic	c description		Summary log
5	4	1.5'9.5' gravel, fra	y fine sand, graver n Drill sound like above gments to 4", fines	and, cobbles	Sand fine, silty clayer 0.4.5 Gravel, sandy, cobbly 4.5-9.5
10	70	0-12 Silty fine 15h gray than abo	d to grave/(> ±" h gray + H20-at a e sand to £"gra y, saturated Mor	bout 10' vel, brown- efines	Sand and gravel 4.5-18
	18.0 //	z-16 Same as 16-18' Same a ments	s above but sor s in 3/4 to 1" Size	me trag-	
	To be comp- leted by OSC				
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		THE RESIDENCE AND ADDRESS AND			
		50 th 500 600 for tow pa as		,	
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Location	Date 12-23-86 Local well number	r
County	Map Scale Lat	Long
District	Project number	Altitude
Driller	Helper Geologist .	Ron C. Lane
Lithologic Symbols	Abbreviations clay c cobbles cob sandy sdy	Twsp.
	silt st boulders b fine f	Soc
	sand s clayey cly medium m gravel g silty sty coarse co	
· [] []	T T	4
Scale Sample Graphic Iog Drill	Lithologic description	Summary log
Scale Samp Scale Crapt Capt I og Log		
1.7 8 3	0-2' Clayer silty time sand, brown 2'-4' Same	Sand, silty clayer 0.7
5 4.1 WE E	4-6' Same but much more clay (lumps)	
6.8	6-8' Clayey silty fine sand as above, medium to coarse sand, grave!	
	H-6' Same but much more clay (lumps) 6-8' Clayey silty fine sand as above medium to coarse sand, gravel (with fragments to 15") gray. Drill sounds like cobble grave!	Sand and grove! 7-18
	(with fragments to 1/2") gray. Drill sounds like cobble grave! 8-10' Fine to coarse sand and grave! (Fragments to 1/2"+) gray.	*
12.8 NATURAL	10-12' fine sand to gravel (1/2"), grayish brown	on water
15 FILL	10-12' fine sand to gravel (1/2"), grayish brown 12-14' Same as above. Saturated gasoline. 41-18' Same as above.	
18.3	41-18' Same as above.	
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Location		Date	Local well	number
County		Map	Scale	Lat Long
District		Project number		Altitude
Driller		Helper		logist Ron C. Lane
Lithologi	c Symbols	Abbrev	viations cob sandy sdy	Twsp.
		silt st boulders	b fine f	Suc
		gravel g silty	cly medium m sty coarse co	
00		Tiple de de de de		Currentiles
Scale Sample Graphic log	TOP OF CSG. 0.45 P. O.45	Lithologic desc	ription	Summary log
රී ගී ශී ලි	D & SERVIT	10-1' Black top.		Blacktop 0-1
		11-Z' Clayer Silly fin	ie sand don't beause	Sand, clayey, silly 1-5
5		14-5' As above fine	cand.	Gravel, sandy 5-6
		6-8' Fine sand to gr	qments are sandsize to nill abunds cobble grave avel, fragments to 1". Son brownish gray. Brill son pavel.	ne Sand and gravel, 6-14 unds clayey, silty.
10	10.0	8-10' Same as above	ravel.	ones chercy, orry
		10-12' Same as above	but brownish gray, str	ong
/5 □ □	77113	No Hio vet	Out more sill and cla	Sand, silty, gravelly 14-36
	1 1 1 1	14-16' Silty fine to w	parse sand, gravel fragnish dark brown. H2O at	neak
20	NATURAL	16-18' Same as above		
	1 22 1	20-26' Same as above		•
) 25	28.0	26-28' Same as above	with more sittand ?	ine
	28.0	26-28' Same as above sand Color brown: 28-30' Silt to arayel	less medium to gray	
30	30.5 ON W	30-32 Same as ab	(to 1/2") as above, me	edium
	32.2 NAT.			
35	36.0	32-34' Same as abo 34-36 ' Same as a	bove, grayesh brows	7
	30.0			
			e de fille diese dies dem dem des des des des des des	
			8.9	
		ES No. 275 Tot to test the ESS T	n dis and die een den der tier den ges	. =
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District _		Projec	t number			_ Altitude
Driller					Geologist	Rge
	ithologic Symb		Abbrev ay c cobbles	istions cob sandy	sdy	Twep.
		si	It st boulders	b fine	f	Sec.
			and s clayey ravel g silty	cty coarse	m co	
	ه ا	TOP OF	Lithologic desc			Summary log
Depth Scale	Graphic log Drill action	-0.45'	Elthologic desc	ription		Comment to a
0 0	70 0	E 0-1	Blacktop and +	GII.	1 1 1	Blacktop and fill 0-1
	2.0	1-2, CFP	Silty clayey for Same as abov	ne sand, mediv e ·	m dark brown.	Sand, fine, silty, cloyer 1-6
5	5.3	H H 4-47	Same as about			
	7.4	6-8'	Coarse sand to	gravel (To la"	cobble	Sand and gravel, silty 6.18
10		PACK PACK 10-15,	Fine to coarse like cobble grifting to coarse grayish brown.	sand and gra ownish gray. I	rillsounds	Gasoline
	13.4	10-12	Fine to coarse.	sand, (fragment	(s to 1"),	reported
15	""	77	Grayish brown Strong gasorin Silty fine to coo dark grayish strong gasorin Similar to above	e odor .	rate cobbles.	
	17.4 18.3 8 H.	CAVE 0 12-14	Silty fine to coo	brown Saturat	rel to 36")	
	BH.	14-16	Similar to above	e Buf dark gr	ayish brown	
		16-18	Similar to above and black, sa Medium to coar. Sand and Silv	turated se sand and s	ome fine	,
			brown.	gravel to 1	", reddish	
			2.00.7.			
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T-11 F ELD LOS Date 10-6-86 Local well number County _____ Map _____ Scale ____ Lat. ___ Long. ____ Project number _____ District __ _ Altitude __ Geologist ___ Driller _ Ron C. Lane Helper __ Lithologic Symbols **Abbreviations** clay cobbles cob ระกตัง sdy Twsp. silt boulders b fine sand medium m clayey ' dy gravet silty coarse Graphic log Lithologic description Summary log TOP OF CSG -0.45 Semple Drill 0-2' Silty clay fine sand, dark brown Clay, silty, sandy 0-2 Silty fine to medium sand tan to light brown. Sand, fine to medium, silty, gravelly 2-6 3,2 Sand as above, tin with gravel to 4" 6-81 Gravel (to 4 ")gray, some fan sand. Gravel, sandy 6-8 6.6 8.2 8-10' Silty fine to coarse sand, tannish gray.

- gravet with fragments to F" gray.

10-12' Fine to coarse sand and gravel(to 4")

- gray is brown Sand and grovel 8-18 12-14' Fine to coarse sand, gravel (to 4) brown13h gray.
14-16' Fine to coarse sand and gravel, grayish
Drown saturated. 14.2 15 NATURAL 18.3 16-181 Similar to above but more reddish especially H20.

Location	Date0 - 3 - 96 Local well numb	er
County	Map Scale Lat	Long.
District	Project number	_ Altitude
DrillerLithologic Symbols	Helper Geologist	RC Lane
Limologic Symbols	Abbreviations clay & cobbles cob sandy sdy	Rge.
	silt at boulders b fine f	Twep
	sand s clayey cly. medium m	
Scale Sample Scale log log Drill action	Lithologic description	Summary log
1.6	0-2' Silty, clayey, fine sand, dark brown. 2-4' Silty, clayey fine to coarse sand and grave!	Sand, fine, self, cloyer 0-2
5 5.3	2-4' Silty , clayey fine to coarse sand and grave! fragments to K.". Drill sounds like cobble graves.	Sand and gravel, selly clayer 2-16
8.3 %	4-6' same as above but brownish gray very little self or other fines	
8.3	8-10' Same as above	
10	10-13.5' Silty clayey fine to coarse sand, grave! (Fragments to &") grayish brown. 13.5-18.3' Silty fine to coarse sand, grave! grayish brown, saturated.	Santi, clasey, silly, gravelly 10-13.5
14.3	13.5-183' Silts fine to coarse sund, gravel	10-13.5
15 UAT FILL		Sand, silty grovelly 13.5-18
10.3	-	
	5	
	- 1	

T-9 FIELD LOG _____ Date _____ Local well number Location ___ _____ Map _____ Scale ____ Lat. ___ Long. ____ County __ District ___ Project number _____ Altitude ____ Geologist Ron C. Lane Driller_ _ Helper ___ Lithologic Symbols **Abbreviations** clay cobbles cob sandy sdy Twsp. silt Sec. boulders fine b send clayey dy medium m gravel g silty COGTSS Graphic log Lithologic description Sempl Summary log Drill CSG -0.41 0-2' silty clayer, fine to medium sand, Sand, silty, clayer 2-6' Silty, clayey fine to medium sand dark brown; gravel fragments to 30". Sounds - Like cobble grave to coarse sand, grave ... fragments to 34" (cobble grave) Sand, gravelly, silly cloyey 6-18 7.04 Same as above 8-10' Same as above Same as above NAT. Same as above FILL. Same as above. 18.3

T-8 T. T. - 92

	Lecation	Date	Local well number
	County	Map Scale	Let Long
	District	Project number	Aktitude
i	Driller	Symbols Abbreviations Clay c cobbles cob sandy silt st boulders b fine sand s clayey cly medium	Geologist Ron C. Lane Rge. Twsp.
		gravel g silty sty coarse	
	10 10	Lithologic description TOC -0.45 Description O-2' Desilling with water and day Sity clayey fine sand, day 2-4' Sity clayex fine to coars brown gravel with fra 4-6' Same as above but frag 6-8' Same as above, but color 8-10' Same as above. 10-18.3' Same as above. 10-18.3' Same as above.	Summary log Set brown Set Sand Solly, cloyer Set Sand and gravet, cloyer Solly, cobbby Solly, cobbby Solly, cobbby Solly, cobbby Solly, cobbby

Location					Da	rte		ι	_ocal well num	7-7-2 ber
										Long.
District .				_ Projec	t numbe	·	- tra-core	-		Altitude
Driller	ithologi	c Symb	aloc	and the same of th	sy c	cobbles	cob	sandy		Rgo.
<u>. </u>				88		boulders clayey silty		fine medium coarse	f m co	
Depth	Graphic log	Drill		6 ¥	Lith	ologic desc	ription		78°	Summary log
				SEE	L06	T-5 0-	20'	********		1
		4.8	11 PVC CSE.							
目	6'01	7.3 F 0.01	7][[]							
目		SLOT PVC SCR.	SAND IIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIII				-			ž
		14.0	S. I.							
目			SANDE :: NATURAL CUTTINGS ::							
			VATU							•
目										
目						-				
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目						Book Stree Book Spine :				
								the to the tipe		*
目										
目								-		2 4
E						## (mm #mm)				
										-

	Location	Date	1-12-87	Locai well numbe	7-6 SAH	
	County					
7	District					
	Driller					
	Lithologic Symbols		Abbreviations		ſ	Rge.
			cobbles cob sandy boulders b fine	sdy	Twsp.	
			boulders b fine clayey cly medium	f m		
			silty sty coarse	со		
	Scale Sample Graphic Log Drill		ogic description		Summary log	
	5 10 15 20 25 30 7 35 35	34-36 Gravel (70 2/1 6 70 1/2 / 6	(10%), sand, (30%) lowish brown 10 x R ste to 17cm Most not and subround Gr int; sand 0.75mm. Mai artz and fedispars (3 r is raptic (basalt) a. terial 10%) gravelly (30%); olive (ian; 4mm; sand (ian; 4mm; sand (ian; 4mm; sand (ian; 4mm; sand (ian; 4mm; sand (ian; 4mm; sand (ian; 4mm; sand (ian; 4mm; sand (ian; 4mm; sand (ian; 4mm; sand (io), gravelly; olive black (io), gravelly; olive black (io), gravelly; as above	list (25%) ielsic), Remain- no Isthic listy yellowish ests to 1.5cm, fravel Smm. ie black (57 - com; 50 9 s vel'median, e black (572/1, o angular. is sign. it (57 2/1, WET). it (57 2/1, WET). o olive black	See T-2 Gravel, sandy Sand, gravelly Gravel, sandy	32 - 34
	40	46-48 Water san	mple has colloidal command be clay and a	loud cream_ olloide I gel.		
	45				Sand, gravelly	42 - 48
a S						
į						Pes
				,		
		1		ı		

	Location _		Da	re _ 1 - 12 - 5 ?	Local well	number
	County _		Map	Sc	ale	LatLong
	District					Altitude
)	Driller	hologic Symbols	Help	er	Geo	logist <u>TB GONTHIER</u> Rge
1		nologic Symbols	clay c	Abbreviations cobbles cob	sandy sdy	Twsp.
			silt st	boulders b	fine f	Sec.
			sand s	clayey cly silty sty	medium m coarse co	
		o I I	T			Cummery lon
	Scale Sample	Graphic log Drill action		ologic description		Summary log
			0-2' Mud (70 organ WZT)	is, earthy odor, o	(10%) grave ly (15%) lusky brown (54)	Mud, silty, Bundy, gravely . 0-2 Gravel, silty, sandy 2 - 12
	5		_		sandy 40% Terk	
	10	3 cones	Zem SiH.	,60% angular c bravel median	sandy (0% derk 4/2 DRY) : Clasts hips : Coated with 9 mm; sand 10mm	m.
		4 1 8 2	4-6' Grave/(55	5/0) 51Hy (25%) SE	andy (20%) dusk ye	How Jot -
	15 /	19 1	4cm.	of basalt. Gra	n allare angular	ds b sand, 12-14 Gravel, 51/4, sandy 14-20
		1	Sand	? .	•	
	20	2 SAMPLES Butgaile	8-10' Jar MT.	are basaltic.	x (N3, DRY). Cla angula chips.	t clay, bentonite 20-22
	- VIII	3	F.4-9.7' Core s	imple Gravel	(00%) ingular frag	aments
)			loy	R 5/2 DRY). CI	(00%) inquiar frage yellowish brown asts to 5cm rov bosatic but flittic types.	nood
1			8.7-90 'Gre sa	male Gravel &	flithic types.	sku
			Yellow	bulkare angu	010, sind, 100%) dus 5/2 DRY . Casts	70_ are.
			are	more intact roughly of littic type imple; as above	plan however the anded pubbles pres es present	ent.
			10-12' Grave 1	70%) muddy 5%.	sitt (5%) sandy 60.	
			0//06 9	144/15 Y 4/1 WE	remainder round	Tout I mere are discrepanieses
			0.50	1 467		The second secon
			12-14 Dang (70	(104) Francl' x 30	olo: queky yella ETY. Glasts to median, 3mm. s	km. to be bentonit is only sind site that had contente or
			1 0.57	791 //97 .	-	Uppa clay M Znjire surtet
	-/-		dusk Class	y yellowis bro	o) si /ty 5%) · sandy	(3)/2;
			San	d 0.5 mm, 1805	sible petrolewn	(n)
			14 - 18 Grave / (5	590) as above	but only dimp	
-	目				ut wet + less noble	
			20-27' Clay (beatonite) , a	rayish yellow 4	reen
			gre	64 7/2, WET). S easy.	ticky, dense, ples	+.c,
		*				
1						
				×		

						T-3 cample :	•
		Location	Date		Local well nur	nber	
			Map				
			Project number .				
		Driller	Helper				
	/	Lithologic Symb	ols	Abbreviations		Rge.	-
			clay c	cobbles cob	sandy sdy	Twsp.	
				boulders b	fine f	1	I Sec
			L	clayey cly	medium m		
			gravel g	silty sty	coarse co		لنا
		E 9 2 5 5	Lithol	logic description		Summary log	
		Scale Sample Graphic log Drill				Production and an extension of building	
		//M81	0-2' Sand very +	ine (40%) 5.1+135	70), Clay (2590), Clark /2; DRY) clayey (10%), grayish asts up to 1 cm,	Sand, Clayey 31 17y	5.2
			2-41 5.14 (60%)	, gravelly (3090),	layey (10%), grayish	Silt, clayer, gracelly	2.4
		5	brown (5)	VR 3/2, MOIST). CI	asts up to 1cm,	Gravel, silty, sandy	
			4-6 Gravel (65 Drown (16	10) sandy (30 %) si VR 4/2) RY). Clas	ltr(570); Dark yellowsh ts to mem basaltic igular, Sandimedian,		
		10	very fine		y meri sen d'median;	Sand, gravelly	8.15
			6-8' Gravel (65°,	6), Sandy (30%) s	1/4 (10 %); (10YR 4/2, DRX	Gravel, sandy	10-12
			165 (basi	11tic) ghavelm	dian, +mm; sand	Sand, gravelly	12-16
		15	R-10' Sand (60% Moist).	gravelly (40%)	ilty lo 9,5 LIOVR 4/2, DRY ir lo 9,5 LIOVR 4/2, DRY ir lo 100 100 maric role an dian, 4mm; sund ried of mary (54R 3/2, subround to angula	:	,,,
			basaltie 5mm	Presence of light	3mm, Sand median I feldspars and gives salt and pepper	Gravel, sandy	16-18
		20 1/1	flecks	y quarte grains	gives salt and pepper	Sand, gravelly	18-22
		7/	10-12' Grave/160' MOIST). C	10) sandy (4090)	olive gray (543/2,		
(26	Subround Basaltic	led . Gravel media clasts os 10,35	Olive gray (54 3/2) n angular and 1 5mm., sand 1mm., 10 other 1e felsic = Olive gray (54 3/2) angular and rounded, ther 30 90, Gravel 5 mm.	Gravel, sand	22-32
)	25 ///	12-14' Sand (60%)	() ; gravelly (40%);	Olive gray (54 3/2,		
			mafic	clasts to 1cm	angular and rounded.		-
		30					
		1// 10/2/4	16-18' Grave 1/20	%) sandy 90%,	Olive gray (5 y 3/2 Moist seltic, 05 % . Franci)	
			median	5 mm , sand med a	n 1mm.	-	
			10-201 Sand 60%	o) gravelly (40%)	Univegray (58 372, MOIST)		
			base/fi	c . Gravel med	3mm 'sand 5mm.		
			1 (1015/).0	10575 UDTA 201	m, mostly rounded		1
			(>70%)	Grave! median	lar chips, basatic		i
			24 Grave 1 (75	20) 35 andy (35 90) 3	olive grax (513/2)		1
	- 1		WEI) CI	15 TC 10 115CM C	amina - 1111 en Allan		l
	- 1		MRFE 20 Send, 11	% , other . 20%	c granitic and). Stavel med somm,		l
			24-26 Grave 1 (50	(6) sandy 5091	olive gray (5 y 3/z, MOI-]
	- [31 / 1 (105	is to 1cm do	rel median, 3mm;		1
			Sand,	25 mm.			
	-		16-28 Gravel (75° Glive Floy)	10) Clayey (5-10%)	sandy (20%) grayish, to 1cm, dominantly		
			angular.	READILY COOTES	with welclay. Sand, 0.25 mm.	Ŋ e ?	1
	1		28-301 Grave [(55%	Jandy 45%	Olive gray 15 v 3/2.		
			Moisi	575 70 2cm. c	iom imant sub round	35	1
					n 5mm ; Sand, Imm.		
	V		50-32 GraveT(75	10) sendy [20%)sitty(5%); olive		
	1		basalte	80%. Gravel med	to 3 cm, angular	*	l
							l
				*			l

-								_ 00	(e			Local	well numb	er	
														Long.	
														Altitude	
									r					J.B. GONTHIER	
		<u>ן</u>	T T	Jayribo),,		clay	c	Abbrev cobbles	iations cob	sandy	sdy			ī
		7			<u> </u>		silt	st	boulders	b	fine	f		Twsp.	Sec
L		J	<u> </u>				sand gravel	8	clayey silty	cly sty	medium coarse	m co			-
		9	ပ္			T	g. u. v.	Lieba			COGISE				J
Depth	Scale	Sample	Graphic log	Drill				Little	ologic desci	noirgi				Summary log	
٩	S	S	<u>o</u>	0 6		0-6	No Sa	mple.	<u> </u>		************	•			
								,							
5								-							
		-				6-8	' Siff,	clay RY).	ey, sandy	; derk ;	rellowish	brown	(10 x 42)	Silt, clayer, sandy	
io		711	4.474			10 -	-Grav	ellow	10) Sindy	(8%)	silty (7)	(10)	dusky	Grovel, sandy	
			N A Maria			1. .	, i	grain	ish brown 2 cm, and size, sml	ular,	Dasalfic	80 %)	Medan	Sand; gravelly, bilty.	
15			N.H			12'								Gravel, sandy	
			and the same			14'	, 1	Podr	yellowish ar basal softed.	tic 70%	o, mafic	Volcar	ics 20%.	Sand, gravelly	
20		07					ontu	PRY)	5%) sandy	(45%) 5.50	olive l	olack	(5Y 2/1)	sana, graveny	
						16 '	,	75 m	Masts for my basalt	12 709	0,3090	othe	r. Send		
25	7	//Z §	macotor()				Grav	el (5 (5y R	in 0.5mm 0%), sitty 27, Moist Hic, angu ian 2 m ise (60%) k (5VR 2, , rounded y sorte	(5%) S	endy 45%	j 0/1	re gray		
			1	1				basa	lfic, angu	las to	sub rounce	Gra 0.5m	vel m.		
30		Z (ii	Chart			18'	Sand	,coar	se (60%)	gravell	y (40 %)	brown	ish -	9	
	7	72	West.	ı				Icm	rounded	to an	igular, 6	0%	basaltic	Grarel, sandy	
						20'_	San	J'INE	JOW (TO T	grave	11y (30/0)	Ollo	place		- 1
								10	/I, MOIST)						- 1
	=					25	. , 7	_Co	saltic 5	e feid	spar da	Sand 1 gt	1.25%		
				12.		25	and S		m (70%) 9 , MOIST), C						
	7					30′_	22110	medi	01010	sand m gravel	edian 18	Samo	as		
						321	Grav	e/ 9	5%), Sand	(20°/0)	siltx 5%)	,0110	e b.ack.		
1	_							13.3 V	19th vel 6	mmis	and 25 m	oasal Al	tic.		
IE															- 1
				1											
														9	
1 =				- 1		s									
IE	3			- 1									1		- 1
	=														
) E						36					red vii.		and seeds soots		
1=															
									i						
					1										

	Lecation			Date _12/12/8	۶	ocal well numb	TI-SAMPLE LIS
	County _		Map				Long
1	District _			ber			_ Altitude
)	Driller			elper		Geologist	I GONTHIER
,		chologic Symbo		st boulders b	ions ob sandy	SOV MRF=	Hele marphotosp. Forgenats Sec.
	Depth Scale Semple	Graphic log Drill action	L	ithologic descript	tion	S.	Summary log Log by Ron Lane
	5		Gravel, sandy, Frauel, sandy, Fround to see the present of the salt of the s	pebble, some fine lar (many closts is lar (many closts is site (10"/10), MRE pebbles to Isman for some fily sorted; sub a forward for as if crushed for wery fine; con an angular); sub a forward for wery fine; con angular); sub a forward for wery fine; con angular); sub a forward for wery fine; con forward for wery fine; con forward for wery fine; con forward for wery fine; con forward for wery fine; con forward for sorted range (1); clasts to 90 best forward forwar	lasts 80% page lasts 80% page lasts 80% page lasts 80% page lasts 80% page lasts lang sol get and felo entry coarse as entry	angular to cen by drill lograndic ler Totasts H, andeste; (wet) Aub Clasts are ispar 20 to 25%. Ind, qiayish are music are music are music les to zomm ed; sand diorite; les to zomm ed; sand fz, 20; Fettspar; pebbles to ub round; or igneous; (wet) sub ash (light) Tany bipken my, modian my, modian my, to sub r. Claste lar to sub r. Claste lar to sub	Large cobbles, record & figure: Sult and fine sol will agrave! Sand, florizo, clay ist, francisme cobbles Stand, florizo, clay ist, francisme cobbles Stand forme cobbles Stand for very same cob. Med solor change to it or is red Schoomie fine to vers a and fg. Mud becomes brown again fine to co. sand some fine grave! clayey and sty (sity med and) Sulty fine to co s some croken Cobbles some clay, water blue alt some fine to med grave! when stand for co sand w grave! mostly fine filty med sand, fine grave!

Location County District Oriller Lithologic Symbols CLAY SILT GRAVEL Graphic log Drill action Sea 100% 100% Gravel granule-to pebble, gross h black, angular to subround (Many clasts appear to be oroken by drill bit) porty sorted Clasts 60% bisais it regrandic 3 30% MRFs (2).

Growel, granule some pebbles black (wet), angular Colosts appear as it crushed rock, clasts 80% bisett, andrete, granitic 10%, MRF 5% 5 1 国家国家的 Grarel, Sundy 10 Z Gravel, sandy, some publies (5-10%), slive diet (wet) Aub round to sub ongular, poorly sorted. Longe clasts are mostly bosalic, in timer ground so gtz and felisper 201025%. Granlic precent 700. 3 1000 100 15 GAREL, granule to peoble, some fine-to very coorse sand, grayish.
black angular (many closts broken). Closts are mulie
basalis sades to (10/16), MRF's (2.70). 4 20 Gravel, sandy, pethles to ismm, sand very coarse to fine (25%) postly sorted; subanqular to subvound; Clasts' 50% bosaltic, 25% granific to diorite, 26% MRF. 15 5 (1111 Gravel, sandy; dark brown - to oliver syl round; poorly sorted sand fraction 50 90 guartz, alasts are boself 50 90 granitic (25:30 %) MAFS 6 情報即有 30 Gravel, sendy; dark brown to olive (wet); pebbles to zomm (many angular as if crushed); poorly sorted; sand (45%) coarse to very fine; consists of 50% qtz, 20 Fellspar Clasts 51%, bosall, 25% quantic, 25 ART. 7 (2)14 35 Sand, gravellex; durk brown to olive (wet). pertiles to 20 mm (sour angular) isob angular to sub round; party sorted; Chasts 50% baso 25% co. igneous; 8 4:1 40 Sand squarelly 45 9 福斯州 Grovel, sandy (sand about 80%) derk gray (wel)
puties to a 30 mm, postly soited, angular to sub
room, Clasis 30% basettic, 20/greatic, 10/cash (11911) Gravel, sandy Gravel, sampy 12590, durk gray, dry, angular, many bioken fragments, portly sorted Range from sitt to 2 cm, median about 2 may. Clasts 60% be salve; 10% grandic, 20% MRA 10% of abbroic 50 10 (11) Sand, gravelly Sand about 55 70, derk gray for gular to sub round; poxily sovied, angular to sub angular. Claste 70% baselic, granitic, 10%; 20% MRT.

(11) Sand, gravelly slightly silty; dark gray (dry) angular to sub angular to sub angular. Claste 70% baselic, granitic, 10%; 20% MRT.

(11) Sand, gravelly slightly silty; dark gray (dry) angular to sub angular, poor ly sorted; Clasts 70% baselic, 70 Masic granite, 10% MRT. IL PH Sand, gravelly. 12 114 58 Sand, gravelly, slightly sitty; med grain size about 2mm, dark gray; poorly sorted than size 2.5cm).
- clasts to % besattie, in forces - + Het 520%.

: ample only been been trucker

Location	Date	Lo	ca' wel' numbe	r	
County					
District					
				J.C. SUNTHIE	ER
Lithologic Symbols	Abbre clay c cobbles silt st boulders	eviations cob sandy s s b fine 1	sdy f	Twsp.	Sec.
	sand s clayey gravel g silty	017	m co		
Scale Sample Graphic Log Drill action	Lithologic des	cription		Summary log	
	20. 18 20 de 20 18 20 de 20 20 20 de 20 20 de 20 20 de 20 20 de 20 20 de 20 20 de 20 20 de 20 20 20 de 20 20 20 20 20 20 20 20 20 20 20 20 20	elly 15%) Clasts (Imm Matrix 3 (Imm Matrix 3 (Imm Matrix 3) (Imm Matrix 3 (Imm Matrix 3) (Imm Matrix 3 (Imm Matrix 3) (Imm Matrix 3) (Imm Matrix 3) (Imm Matrix 3) (Imm Matrix 40 for 1) (It 3 cm mostare (It 4 cm mostare (It 4 cm mostare (It 4 cm mostare (It 4 cm mostare (It 4 cm mostare (It 4 cm mostare (It 4 cm mostare (It 4 cm mostare (It 4 cm mostare (It 4 cm mostare (It 4 cm mostare (It 4 cm mostare (It 4 cm mostare (It 4 cm mostare (It 4 cm mostare (It 4 cm mostare (It 4 cm most	aveloning aveloning of the state of sta		

Friday, Dec. 7 1990

Mike,

60

Ca 8. 2	Date	Local well n	umber
County	Map	Scale L	at Long
District	Project number		Altitude
Driller			ogist JB. SONTHIER
Lithologic Symbol	clay c cobbles silt st boulders sand s clayey gravel g silty	s b fine f cly medium m	Twsp. Sec.
Scale Sample Graphic Log Drill action	Lithologic des	scription	Summary log
	36-32' Gravel Sandy angular C 37-40' Grovel (70%) (54 2/1), w are angular C Gravel Singhtly 40-42' Gravel Sandy ler Chips 44-46' Gravel Sandy chips as 1 46-48' Gravel Sand 50-52' Gravel Sand 50-52' Gravel Sand 52-54' Gravel Sand 52-54' Gravel Sand 52-54' Gravel Sand 52-58' Gravel Sand 56-58' Gravel Sand 56-58' Gravel Sand 56-58' Gravel Sand 56-58' Gravel Sand 67-56' Gravel Sand 67-56' Gravel Sand 67-56' Gravel Sand 67-56' Gravel Sand	y (us above) fewer and y (us above), angular y (us above). y (us above) y (us above)	ok Office.

J --- VI ---

Location			Da•	ę		L	oca! well numb	e'	
								Long.	
District		Proje	ct number					_ Altitude	
		115	Helpe	r			Geologist	J.B. GONTH	HER
	Lithologic Syn	nbols	clay c	Abbrevia cobbles boulders	ations cob b	sandy fine	sdy f	Twsp.	Sec.
]]]	sand s gravel g	clayey silty	cly sty	medium coarse	m co		
Depth Scale	Sample Graphic log Drill	000000000000000000000000000000000000000	Litho	ologic descri	iption			Summary log	
<i>y</i> S		2-4 1	No san	aple Tar	mar	ked buy	MT.	Mud, sandy silt,	
/0		6-8-	Gravel (5) gray (5) 80% a bacalt	15%) mud sy 4/1, we re angul	dy(5) ar ch	lasts to	gray (564 (20%); olive zcm; 30% ore a rel median 8%; derk Clasts 80% are	invel, sendy	6-52
20 = 25		10-12 12-14	Gravel a Gravel a	s above si is above ips.	9590	of clasts	areangu-		
30		14-16	3' Grave 1 blech	as above (65%),51 15 x R 3/	ndy (15%); b	ts to zem,		
35		18-20	- torab	ermedia	77 -31	nm San	0% are tic (15%). d 5.5mm.	sand and grave Gravel, sondy	34-57
A3			2 Grovel - (5/4, are and	(85%), SX Ti TWET). angular co	clast chips	(15%); 0 s to 1.5 10% ar	live gray		
20		22-20	felsi 4 'Fravel WET rou	Z	idy (3 + 0 1 d so	5%) sin	re gruy(544/, 15% are		
55	2 A	26-2	6 5-ravel 8'Gravel 155- 10%	25 20 20 SI, 2/1 WE are 2090	oove ad(20 1) Di ular	lasts Fo	onish black		
		30-32	(51) 70% 6n 76n 76n 76n 60-	rock med 1712 (1),54 20 NET) 20 O Jest	Cla r chi	5/5 /0% P 5 60% 2.5mm; 140%) 15 5 15 1. 16 7	scm: 6510 are basatic, sand o.5m alive bleck scm 0% basatic		

H-1 : + + = . -

Location	Da	:e ?	Local well nur	nber
County	Map	Sc	ale Lat.	Long.
District				Altitude
Driller	Helpe	er	Geologi	st JB GONTHIER
Lithologic Symbo	clay c	Abbreviations cobbles cob boulders b	sandy sdy fine f	Twsp. Sec.
	sand s gravel g	clayey cly silty sty	rnedium m coarse co	
Scale Scale Sample Graphic log Drill action	Lith	nologic description		Summary log
Deg	(564 2, 40 + 5 5 5 mm; 40 - 42' 6 rave! (112, 42 + 44 6 rave! (115) 6 15% 6 15	(10%) Sendy (30%)	190); Preenish olders 10); Preenish older 10); Prayish black 25cm; Dyoansular 25cm; Dyoansular 25cm; Dyoansular 25cm; Dyoansular 25cm; Amarication 25cm; Provided to 25cm; Provided to 25cm; Provided to 25cm; Provided to 25cm; Provided 25cm; P	
				-

41-500,000

Location	Date	-0-81	Local well numb	per
County	Map	Scale	Lat	Long.
	Project number			
DrillerLithologic Symbols	Helper Abb clay c cobble silt st boulde send s clayey gravel g silty	oreviations es cob sandy ers b fine	s dy f	TE SONTHIER Rge. Twsp. Sec
Scale Sample Graphic log Drill	Lithologic d	W 8594		Summary log
5 10	(lore 2/2	andy dusky proportets. dusky je low gravelly (5%) dusky 2/2, WET). 1/2/2, WET). (185) 1/2/2, WET). (185) 1/2/2, WET). (185) 1/2/2, WET). (185) 1/2/2, WET). (185) 1/2/2, WET). (185) 1/2/2, WET). (185) 1/2/2, WET). (185) 1/2/2, WET). (185) 1/2/2, WET). (185) 1/2/2, WET). (185)	ish brown isky yel'owish	Mud, sitty sandy gravelly 0-6 -ravel, sandy sitty 6-10
15	10-12' Gravel, as a	are unquiar a	n.ps.	Sand, gravely 16-18
20 7	12-14 Ditto more	mud 3/0 5 to	L rellowish	Gravel, sandy silly 18-20 Sandigravelly 20-2:
30 35 40 45 50 7	100 Med 2 m sand US m are angular colored and 3 mm; sando 3 mm; sando 3 mm; sando 30-32'- Gravel (80 %) (56 2/1), WE intermedia 6 mavel media 6 mavel media 6 mavel (50 media 6 mavel media 6 mavel (80 %) are 1 media 6 mavel (80 %) are 1 mm; sando 10 % are 1 mm; sando 10 % are 1 mm; sando 10 % are 1 mm; sando 10 % are 1 mm; sando 10 % are 1 mm; sando 10 % are 1 mm; sando 10 % are 1 mm; sando 10 % are 1 % mm; sando 10 % are 1 % mm; sando 10 % are 1 % mm; sando 10 % are 1 % mm; sando 10 % are 1 % mm; sando 10 % are 10 % are 10 % mm; sando 10 % are 10 % mm; sando 10 % are 10 % are 10 % mm; sando 10 % mm; sando 10	clasts to 2cm of subround (28%); of clasts to 2cm of subround (45%); of subround (45%); definition of subround (45%); definition of subround (45%); definition of subround (45%); definition of subround (45%); green of subround (40%); subround (40%); subround (40%); clasts of subround (40%); clasts of subround (40%); definition of subro	lerk gray Imostly Imostly Imostly Imostar, 5mm I ropk types I ropk types I ropk types I bout 50 10 Interinediate el medisn Ish black In majic To Iar Chips Iso 3cm, Sular chips Sular chips Music to Taylist black Music to Music to Taylist black Music to M	6-rave 1, sandy 26-58

	Location	Date 1-9-87 Local well numb	per
	County	Map Scale Lat	Long
	District	Project number	Altitude
	DrillerLithologic Symbols	Helper Geologist Abbreviations	Rge.
		silt st boulders b fine f sand s clayey cly medium m	Twsp.
	Scale Sample Graphic log Drill action	gravel g silty sty coarse co Lithologic description	Summary log
		0-1' No recovery 1-2' Mud, silty 60%) sandy(5/0), organic skue black (564 2/1, MOIST.)	No Sample 0-1 Mud, silly, sandy 1-4
	5	12-4 Mud as above - 2-4 Mud as above - 4-6 Gravel (95%), silty (5%); dark gray (N3 DRY). Claster to 2cm, 20%	Gravel, sandy 4-18
	15	cobbles. Gravel median nmm. (6-8' Gravel (70%), sandy (30%), dark gray, [N3,DRY), @lasts to 25 cm 150%, are angular chips, remainder. Is round and subround.	
		8-10 Gravel as above.	
1		10-12 Gravel as above 12-14 Gravel as above.	
/		14-16 Gravet (70%), 51/4 (5%) sandy 25%; olive gray (544/1) WET), Chasts to 2cm 180% oure arroular chips	
		Median 7mm; sand 0.125mm. 16-18' Gravel (80 %) silty 3% sandx(17%)	
		orive gray (574/1) WET). Clasts to 3cm; 60% are angular ch.ps. Gravel median, 1cm; sand 0.25mm	
			-

District Project number Geologist Jis Geologist Jis Geologist Lithologic Symbols Clay c cobbles cob sandy sdy Typp. Lithologic Symbols slit at boulders befine the sand a clayer dy medium moral gravel g silty sty coarse co Lithologic Gymbols Lithologic Gymbols Lithologic description Lithologic description Lithologic description Lithologic description Lithologic description Lithologic description Summary log D-1		Location	Date 1-9-87	Local well number	
Driller Lithologic Symbols Abbreviations Clay c cobbles cob sandy sdy silt st boulders b fine f sand s clayey cly medium m gravel g silty sty coarse co Lithologic description Summary log Lithologic description Summary log Lithologic description Summary log Lithologic description Summary log 1-2 ' S. It classes, sandy, gravelly (10%). Slive, black (5549 21, pamp); i Strong earthy odor 2-4' Silt (50%) clayey sandy(20%) gravelly 30%; olive gray (5 y 4/1, pamp) Closts To Zong, several are as phalt convered and analysis. Stavel and dian 8 mm. Sand closs mm. 4-6' Gravel (85%), Sandy (15%), medium dark gray (N3, DRY). Clasts to 2cm; 50% ore angular chips, formainder trounded and soborous. Let' Gravel (80%) as above clasts coarser (10-11' bravel(85%)) sandy (15%) as above. 10-11' bravel(85%) sandy (15%) as above. 10-11' bravel(85%) sandy (15%) as above. 10-11' bravel(85%) standy (15%) as abov		County	Map Scale	Lat	Long.
Lithologic Symbols Clay c cobbles cob sandy sdy silt st boulders b fine f sand s clayey cly medium m gravel g silty sty coarse co Lithologic description Summary log Lithologic description Summary log 1-2. Silt claye; sandy, travelly (107.1) olive, black (564 21, DAMP); Silt (sot) claye; sandykotopyarelly 30 to; slive gray (57 4/1, DAMP); To Zan, several are as phalt covered. and angular fravel median 8 mm. Sand olos mm. 4-6 Gravel (850), Sandy (15'w); medium dark gray (N3, DRY). Clasts to 2 cm; 50? o re angular chips, cmainder rounded and sobround travelnedan Let Gravel (85'r), sandy (15'w); as above. 6-10' Stavel for a sabove clasts coarser ([cm] 1 10-11' bravel (55') a sandy (15'w), as above. 6-10' Stavel for a sabove clasts coarser ([cm] 1 10-11' bravel for 3 sandy (15'w), clasts to 2.6 Cm, 85'70 angular chips, Gravel Median Ich; sand (125 mm. 14-16' Cravel (80'x) as and (125 mm. 14-16' Cravel (80'x) as and (125 mm. 14-16' Cravel (80'x) sandy (16'm), alive gray (5' 2/1) WET). Clasts to 2cm; 50're are angular chips. Gravel The dian Ich; sand (125 mm. 14-16' Cravel (80'x) sandy (16'm), alive gray (5' 2/1) WET). Clasts to 2cm; 50're are angular chips. Gravel The dian Ich; sand (125 mm. 14-16' Cravel (80'x) sandy (16'm), alive gray (5' 2/1) WET). Clasts to 2cm; 50're are angular chips. Gravel The dian Ich; sand (125 mm. 14-16' Cravel (10'x) sandy (16'm), alive gray (5' 2/1) WET). Clasts to 2cm; 50're are angular chips. Gravel		District	Project number	Alı	titude
clay c cobbles cob sandy sdy Silt st boulders b fine f sand s clayey cly medium m gravel g silty sty coarse co Lithologic description Summary log Lithologic description Summary log O-1' No recovery 1-2' S.It claye; sandy, gravelly (10%) Strong earthy odor 30' olive, black (5 4 4 7, 1, DAMP); ') Strong earthy odor 30' olive gray (5 7 4/1, DAMP); ') Strong earthy odor Carl 300 of olive gray (5 7 4/1, DAMP); ') Sand close mm. 4-6' Gravel (85%) Sandy (85%), amedium - dark gray (N3, Day), Clasts to 2cmm 50% are angular chips, conainder Trunded and Subround, Cravel median L-8' Gravel (80%), as above clasts coarser [10-12' bravel (85%) Sandy (15%), as above. more rounded clasts. [2-14' Gravel (80%) as above clasts coarser [10-12' bravel (80%) sandy (105%) as above. [10-12' bravel (80%) sandy (105%) advice gray [10-12' bravel (80%) sandy (105%) advice gray [10-12' bravel (80%) sandy (105%) advice gray [10-12' bravel (80%) sandy (105%) advice gray [10-12' bravel (80%) sandy (105%) advice gray [10-12' bravel (80%) sandy (105%) advice gray [10-12' bravel (80%) sandy (105%) advice gray [10-12' bravel (80%) sandy (105%) advice gray [10-12' bravel (80%) sandy (105%) advice gray [10-12' bravel (105%) sandy (105%) advice gray [10-12' bravel (105%) sandy (105%) advice gray [10-12' bravel (105%) sandy (105%) advice gray [10-12' bravel (105%) sandy (105%) advice gray [10-12' bravel (105%) sandy (105%) advice gray [10-12' bravel (105%) sandy (105%) advice gray [10-12' bravel (105%) sandy (105%)		Driller		Geologist	
Lithologic description Summary log O-1' No recovery 1-2' Siff claye; sandy, gravelly (10%) 3/10, black (564 21, DAMP); Strong earthy oder 2-4' Siff (50%) clayer sandy (0%) gravelly 30'10; olive gray (5 y 4/1, DAMP); Total angular for vel median 8 mm, 4-6' Gravel (85%) Sandy (15%), medium Tark gray (N3, DRY). Clasts to 2 cm, 50% are angular chips; cmaindet rounded and subround. Gravel median L-8' Gravel (80'10) as above. 8-10' Stavel (80'10) as above. 8-10' Stavel (80'10) as above. 10-11' Gravel (55 10) Sandy (15%); olive gray (5741, wer). Clasts to 2.56 Cm, 52 to angular chips; Gravel 12-14' Gravel (60'0) sandy (10'0); olive gray (5741, wer). Clasts to 2.56 Cm, 52 to angular chips: Gravel 14-16' Gravel (60'0) sandy (10'0), alive gray (5721, wet). Clasts to 2.57 Median 1ch; sandy (15%), alive gray (5721, wet). Clasts to 2cm, 50% are angular chips. Gravel		Lithologic Symbols	clay c cobbles cob sandy silt st boulders b fine sand s clayey cly medium	f m	
10-1' No recovery sandy, gravelly 10%) 11-2' Sity clayer, sandy, gravelly 10%; 2-4' Sity (50%) clayer sandy (20%) gravelly 30%; olive gray (5 y 4), 5 Amp): Closts 4-2cm, several arc asphalt covered. and angular bravel median 8 mm. Sand 0.08 mm. 4-6' Gravel (85%) Sandy (15%); medium dark gray (N3, Day). Clasts to 2cm; 50% ore angular chips, remainder rounded and subround. Cravel median 6-10' Gravel (90%) as above. 8-10' Stavel (90%) as above. 8-10' Stavel (90%) as above. 10-12' Gravel (90%) as above. 12-14' Gravel (90%), sindy (15%) as above. more rounded clast. 12-14' Gravel (90%), sindy (15%), as above. median ich; sand 1,25mm. 14-16' Gravel (60%), sendy (10%), alive gray (54 24), wet). Clasts to 2cm, 50% are angular chips. Gravel Median 155mm. 14-16' Gravel (60%), sendy (10%), alive gray (54 24), wet). Clasts to 2cm, 50% are angular chips. Gravel	,	Scale Sample Graphic log Drill action	Lithologic description	Sun	nmary log
		5	Jolo; olive gray (5 y 4/1, p) to 2cm, several are asph and angular . Gravel mo sand olormm. 4-6' Gravel (85%) Sandy (5%). A Bark gray (N3, Day). Clas 50% ore angular chips rounded and subrounds 8mm. Sand 0.85 mm. 6-10' Gravel (80%) as above clasts (tcm). 10-12' Gravel (85%) Sandy (15%) as a more rounded clast 12-14' Gravel 80% of 514 (5%) Sand olive gray (5 y 4/1, wet). Cla cm, 85% angular chips: median Icm; sand 125m 14-16' Gravel (60%) Sandy (40%), al (5 y 2/1, wet). Clasts to 50% are angular chips. median T. 5 mm T. 524 d 50%	coarser bove. dy (5%); sts to 2:5 Grave/ med very coarser	<i>K</i> *

Location	Date Local well n	S-3 SAMPLE LOG
County	Map Scale L	at. Long.
District	Project number	Altitude
Driller	Helper Cools	roies JB GONTH HEIZ
Lithologic Symb	Abbreviations	Rge.
	clay c cobbles cob sandy sdy	Twsp
	silt st boulders b fine f	Se
	gravel g silty sty coarse co	
Scale Sample Graphic log Drill	Lithologic description	Summary log
777	0-1' No recovery	Ne sample '0.
	1-2' Silt, clayex sandy gravelly, olive gray (5x4/1) DIMP) Clasts to zem; 30ft	Ne sample "0-1 Silt, clayey sor you a 14 1-4
5	Clasts are as pho like all are areal	fravel/silty , sero. 4-16
	1 1 (<i>F</i> ://:1.	- 1
10	2-4' As above none grave strong out	y
	4-6 Gravel (60%) SI 14 x (30%) sandy 10%. of	re
15	4-6 Gravel (60%) SI Hx (30%) sandy 10%. of black (5 V 2/1, DRY - DAMP. Clast 7 2cm; 60% angular chip. Some clasts as phaltic.	6
	clasts as phaltic.	
	6-8 Gravel (8590). sandy (15%); dark gray (N3, DRY). Clasts to 2.5cm: 75% are angular chips & Gravel media 1cm; sand 1.0mm. 8-10 Gravel os above slightly mare change	Sano and gravel 16-18
	are angular chips & Gravel media	10
	8-10 Gravel as above slightly more send	,
HI I I	10-12' As above	
	12-14 Grave (8590) 51/4/21/2011 (129).	
	Olive gray (5x4/L) DRY)	_
	50 % are angular chips. bravel	
	12-14 Gravel(85% o) Silty (2%) Sandy (13%); Olive gray (5x4/1) DRY); Clasts to 25cm; Silt coafed. Bo 90 are angular chips. Gravel Median 1cm; sand 0.5mm.	
	14-16 Gravel as above wet, olive black	
	16-18 5 and (50 %) and grave (50%); of we black	!
	(5V Z/1, WET). Clasts up to 2,5cm;	- [
	(58 Z/1, WET). Clasts up to 2,5cm; bo lo are angular chips. Gravel median 6mm, sand 0.75mm.	1
		-
		4
		1
	*	

Location	Date Local	well number
County	Map Scale	Lat. Long.
District	Project number	Altitude
Driller	Helper	Geologist TB GONTHIER
Lithologic Symbols	Abbreviations clay c cobbles cob sandy sdy silt st boulders b fine f sand s clayey cly medium m gravel g silty sty coarse co	() ()
oth mple	Lithologic description	Summary log
Scale Scale Graphic Jog Depth Scale Oraphic Oraphic Drill action	0-1' No sample -Blactop (AspHALT). 1-2'. Silt clayed sindyst, i) dusky ye brown (10 x 2/z) DRY). 1-4' Silt and gravel dusky yellowid (10 yr 2/z) DRY), Clasts to 2cm, broken; mixed lithic types. 4-6' Gravel (95%) gilty, sandy, medium dai (N4, DRY). Clasts to 2.5cm, 80%, angular chips, brealtic, Grave 1-12-6 Gravel as a bove 4-10' Gravel as a bove 40-12-6 Gravel (95%), silty J lo sandy (2') gray, Silt covered clasts (5'y 4 to DAMP). Clasts to 2cm 190%, angular fragments of larger of Gravel (85%) yardy (15%); olive black 2/1, WET). Clasts to 3cm 195%, and agalar chip or tragments. Gravel (12-14' Gravel (90%), sandy (100%) live black 2/1 wet). Clasts 16 2.5cm, 60 angular. Gravel median, 8mm, 14-16' Gravel (70%), sandy (30%); olive black 2/1 wet). Clasts 16 2.5cm, 60 angular. Gravel median, 8mm, 15-18' Gravel (70%), sandy (30%); olive black (15 y 2/1, wet). Clasts 6 ra.e/medicin; sand 0.5 mm.	oare elmed- la) jolive ali, DRY claste. claste. claste. selmedan losy re velmedan losy sand lack

				(5-1, SAMPLE 25G)
	Date			1
County	Map	Scale	Lat	Long
District	Project number			_ Altitude
Driller		7 mark 12 mm 1 mm	Geologist	GONTHIER Rge.
Lithologic S	clay c	Abbreviations cobbles cob sai	ndy sdy	Twip.
		boulders b fin	ne f	
	send s gravel g	0.0707	edium m arse co	
Scale Sample Graphic log	actio	ologic description		Summary log
	24-36' Gravel (WET), Clas Gravel m 32' Sand (807 5 yr 2/1 round, 25 mm 36-36' Gravel (8 38-40' Gravel (8 38-40' Gravel (8 38-40' Gravel (5 y 2/1)	olo) sondy (20%) ilests to 3.5cm mc. Gravel median, (30%) sandy (30%) sandy (25%); Clasts to 1.0 mm. (15%) sandy (20%); Sandy (20%); Sandy (20%); Clasts to 1.0 mm. (20%) sandy (20%); Clasts to 1.0 mm. (20%) sandy (25%); Clasts to 1.0 mm. (20%), Sandy (25%); 21, wet). Clasts to 1.0 mm. (20%) gravelly (40%), WET). Clasts to 1.5 median, com: (55%) gravelly (40%), wet) sandy (40%), wet) sandy (40%), Sandy (40%), wet) sandy (40%), Sand	olive black 2.5cm, 5090 velmedian (5mm); olive black (5/2/1, 5090 anquiar, of, 4mm; Sand; olive black 2cm, mostly an 4mm; Sand qreenish black olisem, > 50% ovel median, 5mm; of); greenish black olisem, > 50% ovel median, 5mm; of); greenish olack 3cm, angular basaltic. 1; sand 10 mm. of); greenish olack 3cm, angular 501; basaltic 150, qreenish clasts to 3cm, angular 5%; of greenish (lasts to 3cm, angular 5%); greenish (lasts to 3cm, angular 5%); greenish (lasts to 3cm, angular 5%); greenish (lasts to 3cm, angular 5%); greenish (lasts to 3cm, angular 5%); greenish (lasts to 3cm, angular 5%); greenish (lasts to 3cm, angular 5%); greenish (lasts to 3cm, angular 5%); greenish (lasts to 3cm, angular 5%); greenish black 100 mm.	misially?

Location	Date Local well nur	nber
County	Map Scale Lat.	Long,
District	Project number	Altitude
Driller	Helper Geologi	J. B GONTHIER
Lithologic Symbols	Abbreviations	Rge.
	clay c cobbles cob sandy sdy silt st boulders b fine f	Twsp Sec
	sand s clayey cly medium m	
	gravel g silty sty coarse co	
Depth Scale Sample Graphic log Drill	Lithologic description	Summary log
	0-6 Hosemple.	Soil silty closes
5	6-8' Gravel, silly; olive gray (54 3/2, DAMP), Clasts up to 2.5cm most rolled in sort silly soil before being blown from hole. Gravel medienn 5mm. Silt covers clasts.	Gravel, 5.114, 521.5. 6-175
10	8-10 Grave 15070 51 Hy (10%) Sandy 4070; grayisholive (1044/2,dry) Clasts To 2.5 cm, rounded and	
20	10-12' Gravel 60%, sandy 35%, solly \$ 70); olive gray. (5 y 4/1) DRY). Clasts to zem, angular 60% Subround 15 % - 30%, basaltic. Gravel Median, 4mm, sand 5	Sundigravelly 17.5-26
25	12-14 Gravel 70%, sandy (25%) jolive gray (573/2, WET). Clasts to Z.cm, angular 50%, sub round 50%, basaltic. Gravel median, 5 mm, sand .5 mm. 14-16 Gravel (10%), sandy (25%); Blive gray (543/2, WET) Clasts to Q.cm, angular 70%, casaltic. Gravel median, 8 mm; sand .25 mm.	Gravel, on Hy, sandy 26-37
35	16-17 Grave (60%) Silty (5%) sandy (15%); Olive gray (543/2, WET). (lasts up to 3cm angular 50%, basaltic 70%. Gravel median 17.5 Grave! (65%), sandy (35%), olive gray (543/2) WET). (lasts to 3cm mostly rounded to	- 32 nd, grave //y 31-38'
16	18-22 Sand (50 90), gravelly (45%); 3 live gray (573/2 WET) Claste to 1.5cm, mostly rounded, basaltic . Grave I median, 3mm; Sand	Gravel, son d
50	22-24' Sand (60%), gravelly (40%): olive gray (51 3/2 WET). Clasts to 1.5 cm, mostly reunded to subround, basaltic. fravel median, 3 mm, sand 0.18mm. 24-26. Sand (75%), gravelly (25%); slive gray (573/2, WET). Clasts to 7mm, subround, basaltic.	Sund, gravely 48-50°
55 77	26-26' Grave (6070) sandy (3090) slive dray (543/6) bet). (lasts to 3cm., angular and sahound, basaltic 45 % granitic 30%, MRFs 25%, Gravel redian, 4mm	sandigrevelij 57-58
	Sand, 1.0mm. 28-30 Gravel (80%) Sandy (20°/0), olive gray (57 4/1, NET) Clasts to 2 cm, 5 ubround some angular. basaltic. bravel median, 5 mm; Sand 1.0mm. 30-32 Gravel (80%), Sandy (20°/0); olive gray (5×4/1, NET). Clasts to 2 cm. 40% angular remainder sub-round to round, basaltic frazel median 5 mm, sand, 5 mm 32-34 Frazel (60%), Sandy (40%). Olive black (5×21, LET) (25ts to 2 cm. 60% inquiar, costa- Grapel median 5 mm (40%).	En Hune : nole

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Location		Date		Loca! well numb	er	
County _		Map	Scale	Lat	Long.	
District _		Project number				
Driller		Helper		Geologist	JB GONTHIEL	
Li	thologic Symbols	Abbrev	viations		nge	
		clay c cobbles	cob sandy b fine	sdy f	Twsp +	Sec
	(1)	sand s clayey	cly medium	m		
		gravel g silty	sty coarse	CO	لنا	لنــ
Depth Scale Sample	10 Pr - 10	Lithologic desc	ription		Summary log	
Scale Samp	Graphic S. log Drill action					
	39書班	0-2 , Jar full at F20 sediment loyere	d 30% clay, 30	ed intat,	Sand very fine, clayer	0-8
	2 1 111	2-4 (Same as above 420) fine to time sail Tew closes to	(50%) modium	(30%) Very	,	
5		4-6 Sono very fine to	ned wm. clarera	nd silty. Jer		
		4-6 Sond very fine to full of H20 son brown (5xis 5/2	veter.	e yellowich -	Gravel, sandy	8-26
10		6.8 3.74 ard very fins	and . Fir full &	7 70,5	orar (1, sandy	
	0 111	8-10 Grovel and sand , E	layey and silty;	becond theo.		
15	, (M)			E//		
		10-12 Grave 90 sandy to 20m , 90 % meo an 7-80	angular, matic	80%. Grave		
20		12.14 Grave 165%, Sorroy	13590; clive blac	ck(51 2/1,UET)		
	4 1	Sul round and	cm. (1) , 50 % 00	ic Gravel medio	n	
25		3: 1, tels c.	omm. Majny		Sand, granelly	
	W-1478	14-16 Grave (65/1) Sanov (62/1 WET) 15-00-falsic, on 5/10-falsic, on 5/10-falsic, on 5/10-falsic, on 6/10-falsic, on 6	(36%) greenisi	1 85 Tomafic	Gravel, sandy	26-29
	7.01	Silv, Gravel m	aular 5010 and ledian 5mm, sai	ndosam.	0.000,3000	00 00
30		16-18 Grave (75%) Sand (56 2/1, WET) . CI	by 125% Green	isk Elack		
	1911/191	60% maric 40 gravel 8 mm: ; 5	1. felsic, Grav	el mesian		
35		18-20 Grave 1 (25-6) silts	1690) sand1 (23	3 % greenish		21 111
	1 1	well rounded, m	et) Clasts upto afic 70%. Grove, 35 mm.	Inedian	sand, gravelly	36-44
40		20-22 gravel (859) san	dy (15%) - dark	greenish		
		20-22 Gravel 18590) san gray (56 3/1) wi Schoongvlar 5	v lo rounded. o	revelmedan		
15	10.11	22-24. Gravel (8590), San	ntm ·		Francel, sandy	44-58
	8,	(56 2/1, WFT) C angular, basal	lasts to 2cm		,	
50	LAND I	9:5 mm. Moto	1x 20 % Felsic	Amm; sand		
	1	24-26 Gravel (80%) Silt	(56 3/1. WET) : C	lasts to		
55	211/1	intermediate a	lar, 65 90 basal	Inedian,		
	1 12 18	76-88 Sand (6090), arave	11x(40%); greeni	sh black,		
	1 1	(563/1, WET) C	lasts to zem G Fravelmedian an	few), subround,		
	god gra	C.7mm.				
		28-30 Grave / 70%, Site brownist grax	(563/1, WET), C. augular, Grav	la sts to 4cm		
		Enin sind is	imm, Water Tuib	, d		
		32 Gravel 70% san Class & a cm	1dy (30%) : (56 3	(, WET).		
		witer less took	o than who -	and is am.		
		35-6- 1716 350 581	ndy (159.) · (=6)	3/1, WET).		
	1 1	1 = 5 m h	is are afautor	15: - 108/11		1

· ibt i	 01	100	

H.2 Date ______ Local well number Location ___ County _____ Map _____ Scale ____ Lat. ___ Long. ____ District _____ Project number _____ Altitude ___ Geologist J- B S-31, WER _ Helper _ Lithologic Symbols **Abbreviations** clay cobbles cob sandy sdy Twsp. silt st boulders b fine f 1 Sec. sand 1 clayey medium m gravel g silty sty coarse Graphic Lithologic description Drill action Summary log 0-2' Soil Muddy Silt; Busky yellowish Drown (04R 2/2', WET)! Organic much Organic debris and rootlets!

2-4' Mud, silty dusky yellowish brown (10 x R 2/2', Misst). Plastic.

4-6 Gravel (40%), middy (15%), sandy 36%, cark yellowish brown (10 x R 4/2, WET).

Lasts to 2cm ynostly chlp?

Gardyellowish brown (10 x R 3/2', WET).

Lasts to 3cm x pout 50% are and (15%).

Clasts to 3cm x pout 50% are

and Lobbles, fravel medien 1 cm;

Sond (0.125 mm).

8-10' Srovel (70%) silty (5%) sandy (25%);

dusky yellowish brown Tiox R 2/2 Moist).

Clasts to 3cm more than 50%.

Clasts to 3cm more than 50%.

Clasts to 3cm more than 50%.

Clasts to 3cm more than 50%.

Clasts to 3cm more than 50%.

Clasts to 3cm Gravel ynedian 3 mm.

Sand, 125 mm.

Gravel (75%) silty (5%) sandy (20%). Mud, silly 0-4 Gravel claser selfy 4-18 機器 Sandy 15 Clasts 1 3cm. Grave 1 Median, 3mm, sand 125mm.

14-16 Grave (1590) 51/4 (5%) sandy (20%).

Clasts to 3cm, 30% are angular chips

basaltic Ima (c) 16-18' Gravel, (75%) silty (3%), sendy (22%).

dark yellowish brown (10x 3/2, wet),

Clasts to 3cm 50% angular chips
others are rounded. 50% are basaltic
25% felsic, 25% intermediate bravel median , 6 mm; sond . 25 mm .

	Loc	catic	on.						_ Da	te			Local w	ell numb	er	
	Cor	unty	<i>(</i>				Ma	эр			Sc	cale		_ Lat	Long	
	Dis	tric	t _				Pro	oject nu	ımber	-					_ Altitude	
)	Dri	iller							Helpe				c	Seologist		-
				thologic	c Symbo	ols		clay	c st	cobbles boulders		sandy fine	sdy f		Twsp.	Sec
	L			L				sand gravel	s I g	clayey silty	cly sty		m co			
	Depth	Scale	Sample	Graphic log	Drill				Lith	ologic descr	ription				Summary log	
			ř	8			0-2	' 5.1	Black	layey (4 ck (54 R)	70/15 2/1,1 00ga	DAMP), C	%); or	ownish 1-2cm	S.H, clayey, sandy Sand, s. Ity, gravelly	0-Z 2-4
	5						2-4	- San	d (be cellou Class	or silty with bro its to 2e	in Gan	velly 130 oyk 3/2 in quar	DAY	tark I median	Gravel, sandy	4-16
							4-6	Grave gra	el 18 cm j	14,0RY).	class class	%); med 6+5 and p8 80 90	lund.	ark to	2 / 14	
	15						6-8	Grav.	edia el a	n TismA	i ; sai	nd 0.5 m	M.		Sand, silty, gravelly	16-18
			1							above silfand is above						
										90%; 311 (544/1) angulat						
							 14-11	To Sand	(5)	sand 0. (d) silty (125 m	gravely	(35%)	ohve		
								50 31	MM!	angular sand o	chips	. brave	1 medi	ian	are	
	4 4 4								2cm	gray (5) angul	ar 4/1	NET) .C	chave.	sto		
							11.5	sangi oli	CO I	Zo) ₁ 21 [ty. ré j (54 A	1/1,4	ost), 3	and m	edian		
-						1			-							
								man man								
1					~			to the sec	-							
								-				Error 12:00 12:00 10:00				

	Location			D	ate <u>1-12</u>	2-87		Local wel	Inumbe	"	
	County		Ma	Р		Sc	ale		Lat	Long	
	District		Pro	oject numbe	r					Altitude	
)	Driller			Help	er			Ge	ologist .	J.B.GONTHIER	
5	Litholog	gic Symbols		olay o	Abbrev					Rge.	7
				clay c	cobbles boulders	cob	sandy fine	sdy f		Twsp.	Sec
				sand s	clayey	cly	medium	m			
		ТТ	- 1	gravel g	silty	sty	coarse	со			
	Scale Sample Graphic	Drill		Litl	nologic descr	iption				Summary log	
	2 8 8 8	P 8									
	1/1	H i	1-2	NO 511	aple- BU	(L) sar	p 1dy 5.10%	a rave	elly	4 11 11 1	-1
	5	3		590 A	plive bla	ck 15	141, DAR	10), Clac	15'_		-6
		ill in the second	2-4	1 5111, cl	e gray (5)	, sand	y(8%) 9r	aucly &	5%)	Grave I sandy, (silly) 6.	
	10			9.5	mm.	ips?	brasel n	ned ia 4			
			4-6'	Sanden	dgravel (s /1,DMMP).	09 09	ch); ali	ve grax	1./		
		1		(80%	o). Grave	l med	ian 31	mm; sa	<i>yuler</i>		
	15	1		13. 14	eta Ma			Section of the contract of			
	100		1 0	Clast	(00%) med 5 +0 7.5	cmj 4	0% 160	unded.	=		-20'00-
			8-10	Fravell	75%) Sand	14 (5%	c) · med	ium dae	*		
				75%	(N4, URY) angular	Clas.	15 to ZI	5 CM .	1.		
)				- san	1 osma	i,					
					las abou		irser g	rained	′.		
					lasabo						
1			15.7-	-16 Grave	2/(45/0).	muddy	(5%)19	siltalion.) · .		
ı				sa	e 1(45/0). My 40% ET) ([12] Tedian 5	5 7	E bldck	C 54 2	14		
1			1, ,,		redian 5	mm;	sand, 4	5mm.	ver		
١				GALVE	(BO10) 80	indy 2	0%0) 01	(vc blace	6		
١	日			50	4 i, WE	1). Ui	asts to	edian	,		29
I				7.	5 mm; 5	and	0,5 mm				
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B-3 : 41: - 5 . . .

	Loca	tion						_ Dat	te	2-87		Local w	ell numbe	D- 5 C	
)	Drill	0f						Helpe	rf				Geologist	J.B.60A	THIER
			thologic	Symbo	ols	\neg	clay	•	Abbrev						Rge.
	L	J	-				silt		cobbles boulders		sandy fine	say f		Twsp.	Sec
							send		clayey					-	
	П	1.	ſ	Г	Γ	Т	gravel				coarse	co			<u>Lilil</u>
	Depth	Semple	Graphic log	Drill				Lith	ologic desc	ription				Summary log	
	8	8 8	5 -	2 %					,,	~	,				
	E	\exists				34-	36 3	and	mm sa	7%)	Olive b	ddylz ld gle	10)		
	lE					L _			M 50%	SAN DE	lar bra	siely	nedian,		
	E	\exists	Ø			31-	261 5	6 Ld	mm sa	nd o	4mm.				
	E							bla	(85%) gr ck (562 5cm, G	L', WE	T). Clas	te t	0		
	E							2	5cm + 6	ravel.	nedian	ICM	, 5	128	
	E	3													
	E	3				Γ		-			:				
	F														
1	E	3													
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	Location	Dat	e 1-12-87	Local well numb	er
					Long
	District				
)	Driller				
7	Lithologic Symbols	clay e	Abbreviations cobbles cob sandy boulders b fine	sdy f	Twsp
		sand s gravel g	clayey cly medium silty sty coarse	n m co	
	Depth Scale Sample Graphic log Drill action	Litho	logic description		Summary log
		0-2 Silt, my	ddy sandy brownis	h black	Silt, muddy sandy O-Z
	5	break	explosively.	10 4cm	Grave ((silty upper part) sandy 2-6
	(0	Clast basal	s to 1.5cm; very tic. fravel median 1	anguler chip	Gravel, sandy (strong diesei 6-10 oil odor)
		4-6' Gravel 85	10, sandy, (15%); med	um dark gray	Gravel smdy . 10-12
	15 10	6-8 Gravel a	(o sandy (15%); med (). Clasts to 2 cm rehips of larger rebasaltic drave sabove very stron very muddy looking	g diesel fuel	Gravel, <u>Silty</u> , sandy 12-20
	20	1-10 brayer	as above, very sto	visto	Sandand gravel 20-22
		10-12 Grave 15	15%), silfy; alive grate to 1.5cm, 190% anguered. Gravel median	y (5 y 4/1, DRy).	Sund, gravelly 22-30
)	25	To mm	ered. Grave I median	Emm, sand	Sund, gravelly 22-30
	2	12.14 bravel 40 black	%, self y(25%), sandy((54 z/1, WET). Clast	35%); olive s to 1.5cm;	
		Trave.	I mealing the wine i child		Gracel, sandy 30-32
	35		170), silty (5%) sand	16,10).	sand, gravelly 32-38
		16-18 GraveTa			
1		18-20 Gravel a	and sand (50%); of	live black	
		(5 Y Z/	in, WET) · Clasts to	115cm	
		(54 2/	of small x (20%); all of gravell x (20%); all is wet) · Glasts to 30 ar bravelmedian 5 m	m 50%	
		24-16 Find (55°), WET). Grave	clasts to 3cm. 50% median, 6mm; sai	lack (542/1) canqular d 6.75 mm.	
		26-28 Sand (76) (542) Grave	Posqravelly (25%) of 11, WET) . Clast's t. 1 median amm; S	end DIGMAN	
		28-30 Sand a	5 6), sill, 21, sand (5 2/1, WET). Cla		
1		Media	in commission of	s, Gravel	
1		32-34 Sand (75)	10) gravelly (28%) w black (54 2/1 25 050m, 5) 10 en 2 2	ater muddy	
		med	Andrew Jel		

	Location		_ Date	L	ocai well numb	B-Z SAMPLE	Los
	County	Map		Scale	Lat.	Long	
	District	Project nu	ımber			_ Altitude	
	Driller		Helper		Geologist	GONTHIER	
	Lithologic Symb	ols clay silt sand gravel	Abbrevi c cobbles st boulders s clayey	ations cob sandy b fine cly medium	sdy f m co	Twsp.	ge.
	Scale Sample Graphic log Drill		Lithologic descri	ption		Summary log	valence at the second se
	5	2-4' Mix	rewn (104R 2/2) Lllc, 91Ty . Clests of above soil 13/2, DRY&DAMP	silt; dusky ye Moist). Belled up broken from o and gravel, alwa) Clasts to 2c	llowish onto 5mm Iscuhere. gray m, angular	gravel, sandy	3-14
	10	4-6 Gra gra 50 70	y (No, DRY) - To lo, sub round an 10, sub round an	(20%); Medium lusts to 20m; dround 50%; lo; lo/MRF, Gr	angular - basaltic ovel, med -	¥	
		6.81 - Gra (5)	15/2, DRY). Cla -70/0, basaltic	d(20%); light o sts up to 2.5 cm Gravel 5 mm	Jue gray.	Sand, gravelly Fravel, sandy Sand gravelly	14-16 16-175 17:5-18:7
()		4	ne sand, up to	Gravel media,	round , icm; sand		1115 -1511
		10-12' Grav up Gr 12-14' Grav	el 60%, silty le to 1cm, subravel median 40 avel (60%) silt	5%), sandy (35%), ounded 60-70%, mm 's and . Smm y (10%), sandy (30%	clasts; basaltic		=
		14-16' Sand	gray (54 3/z, wet rounded to sub- frauel median (4 (55-%), gravel	y (10%), Sandy (30%) Clasts up to round 70%, bas mm); Sand 8 mm 14 45% Olive Clasts to 1,500	saltié.		
		16-17.51 Gra	rand, imm.	(5%) sandv (25	1) olive		
		971	1 (6 y 3/2, WET). Clasts to 30 besaltic , Grave [Y(251/0); olive as to 3cm ler avel median 3	ems,		
£.		S	ost rounded. Gr and Imm.	avel median 3			
				· · · · · · · · · · · · · · · · · · ·			
		No. No. to too game					

Location	Date	Local well numb	er	
County	Map Scale	Lat	Long.	-
District	Project number		Altitude	
Driller	Helper	Geologist	SONTHIER	0
Lithologic Symbols	Abbreviations clay c cobbles cob sandy silt st boulders b fine sand s clayey cly medius	sdy f	Тизр.	Rge.
	gravel g silty sty coarse	co	F	
Depth Scale Sample Graphic log Drill action	Lithologic description		Summary log	,
	0-2' S.H (60%), sandy (40%), dusky yell 2/z, Mast); Contains rootlets as Sand median in very fine sand into anovar platy fragments	owish brown (10YR and wood fragment range, Clods	s. 1t, sandy	0-4
5	2-4. Silt, 60% , gandy (40%), darte yellow	ist brown (IOYR4)	Sand, gravelly	4-6
	2-4. Silt 60% gandy (40%), dark yellow. DAY). Three or four clasts to 1cm. 15 very fine sand. No organic del	Sandmedian bris.	Gravel, sandy	6 - 12
10 7/1	4-6' Sand (70%) gravelly (20%); olive q Moist). Clasts to Icm, angrian Dasaltic > 70%. Gravel med un (2	and Cand	æ	
	6-8' Gravel (50%), Sandy (50%); 011V	e black (542/1,	Sard, gravelly	
5 - 7	6-8' Gravel (50%), Sandy (50%), Oliver - Moist) Clasts to Ecm, rounded has Hic. Gravel median, 5mm	sand imm.	Gracel sandy	14 - 18 '
	p. p Graver (00 10) Sendy (10%). Oliv	e 0 ack (542/1,		
	9-10' Gravel (10%), sandy (30%); oliv	misand IMM. e black (542/1)		
	9-10' Gravel (10%), sandy (30%); oliver WET) Clasts to lizem, anguanded 50%, basa Higgs	lar 50% to Gravel-median		
1目	10-12 Gravel 17590) Sandy 2590; Oli WET Clasts to 10m., 75% Chips 1510 besaltic Gravel	ve black (syz), are angular		
	12-14' Sand (55%), gravelly (45%); o (5x2/1, moist), clast to basaltic, Gravel median,	live black		
	basaltic, Gravel median,	1.5cm, rounded,		
	14-16 Gravel (70%), siltx (540) Sandy black (542/2, WET). Clasts to angular 350%, subround 30 7 10 10, gravel Thedran 5 m	1.5cm		
	16-18' Gravel (70%), 51Hy (5%), 5endy (Olive (10 y 4/2, WET), Clasts 60%, round to subround 50%	m; sand osmm. (25%), grayish		
	8 mm; Sand 0.5 mm.	. Grave medan,		
	, , ,			

	Location	Date Local we	ell number
	County	Map Scale	_ Lat Long
-,	District	Project number	Altitude
	Driller	Helper G	eologist J.B. GONTHIER
	Lithologic Symbols	Abbreviations	Rge
		clay e cobbles cob sandy sdy silt st boulders b fine f	Twsp 1 - 1 - Sec.
		sand s clayey cly medium m	
		gravel g silty sty coarse co	
	de e e e e e e e e e e e e e e e e e e	Lithologic description	Summary log
	Scale Scale Semple Graphic log Drill scrtion		A) I
		0-2 Soil dusky ye llowish brown (10 x 2) much organic debris mostly gras	12) WET) Soil, organic 0-2
		0-2 Soil dusky yellowish brown (10xR 2) much organic debris hostly grass 2-4' Mud silty, sandy, dark yellowish brow (10xR 4/2, NETY) minor organic deb	m Mudysilly sand 2-6
	5	4-6' Mud, sily; dark yellowish brown (104)	24/2
		6-8' Grave (85%) silty (3%) sandy (12%); (du	Gravel, sandy wooly 6-18
	10	6-8' Grave (85%) silty (3%) sandy (12%): (du yellowish brown (10 x R 3/2 wet). up to zem, mostly stagments of bas pebblos orcobbles, HU nouddy.	Classic A Tric
		8-10' Gravel, (98%); dark dusky brown 598 3	42, WET
	15	8-10' Gravel (98%); dark dusky brown (54R 2 clasts to sem, mostly chips from pe and cobbles, basattic, some interm volcanics.	ed asp
		10-12 Grave 1/90%) silty (3'h) sendy (7%); dus yellowish brown (10 yr 2/2, weit). La 2 cm; plastly chips from basalt pe and cooles	KHS 70
		and orbles	ebb/es_
4.0		12-14' Grave (15%), 51 ty (B 10) sandy (17%), dar yellowish brown (10 x R 4/2, MOIST). Clared in silt and sand, clasts up to mostly sub round to poond; few an	k_
(rolled in silt and sand clasts up to	3 CM;
		Grave median 7mm, And 0.25. 14-16' Grave (15%) Si Hy (4%) SAND (121%); de yellowish brown (10xx13/2 /WET). Clay to 3cm; about 80% a hoular from health (80%), 20%. Clay Corvel of	rk
		yellowish brown /10xx/3/2 WETY Clasto 3cm; about 80% ahgular fro	sts
		Dear Closed to Fersion Charles	"COMA
		16-18' Grave (50%), sitty (7%) sandy 43%. Hzu mudy: dack yellowish brown (10 XR 3/2, wet). Clasts to Dcm, m subround to round few angular f ments; baselic 60%; 30% ofel NRFS (10 %). Gravel, median, 500 Sand 0.5mm.	6; _]
		(10 XR 3/2 WET). Clasts to Dcm, me	ostly
		ments; baseltic 60%; 30% fel	cik
		Sand 0.5mm.	·····-
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			(6)
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T-21 SAMME -:-_____ Date _____ Local well number ____ Location _ ______ Map ______ Scale _____ Lat. ____ Long. ____ Project number _____ __ Altitude ___ Geologist JB GONTHIER Driller _ _ Helper ____ Lithologic Symbols Abbreviations clay cobbles cob C sandy sdy Twsp. st boulders b silt fine Sec. f sand clayey dy medium m gravel g silty coarse CO Graphic log Semple Drill Lithologic description Summary log Scale 58-581 Grave (10%), siltx (10%) sandy (20%);
olive black (58 Z/1, WET). Clasts to
2cm, few angular chip accet (40%);
most 60%; 806 round to round.
Grave I median gam; sand 0.35 mm.

	Lo	cation						_ Da	te			Local	well numb	er	
	Co	unty				M	ар			So	cale		Lat	Long)
	Dis	strict	-			Pr	oject nu	mber		-				_ Altitude	
	1	iller _												JB GONT	HIER
	Г			ic Symb	OIS		clay		Abbrev cobbles						Rge.
	_		,				silt	e st	boulders	cob b	sandy fine	sciy		Twsp.	Sec.
							sand	8	clayey	cly	medium	m			
	Г	П		Т	1	T	gravel	9	silty	sty	coarse	co			<u>Lili</u>
	Depth	Scale	Graphic log	Drill				Lith	ologic desc	ription				Summary log	
	Ħ					1	-		· · ·						
	П					30-3	Z" Gra	velz	10% , Sand	y [30%) jarea	ush i	black -		
							0	ngul	10% , 5and 3/e, WET) archips; 14, 3-4m	basal	1 to 20	, 600	ivel		
						343	6' 6ra	w/	80 %), sand 3/2 .WET)	1 /20%	(a) ; green	man	black		
J		- The Laboratory					:	35% 4mm	80 %, sand 3/z, WET) angula ; sand on as above	r chip	s - grave	Ned	lien .		
						36-3	38 'Gra	rel	as above	silty					
		*******				38-4	10 Sa	end	60%, 9 11, WET) nd; 50% c to 1917 Sand	raveli	y Slive	blac	k 7		
							(7	o toy	nd; 50%	basalt	15 (35%) It	ic,		1
								3mm	Sand	INMM	. Matinx	10%	quertz		į
اعت	[40-4	2' Gra	re 18	0%) Sand	r. x (zo%	1 · brown	ush h	bet		I
	F							54R	2/1, WES). Cla	5/s To 2	2.5cm	7 - 5		
	Ē						6	Prave 10%	median pyartz,	1mm	sand 1.	lo are Smm	Matrix Mainder		
						42 -	44 Gra	ve Th	70%), 51/1 awish brown 3cm, 60	y (5%)	sandyk	5/6/3	lusky		
l	F							to	3cm, 60	% are	angular	Chip	si si		
	E							San	d (15 mm	1. Mar	rix 5 to	10%	eacl		
	E					14-4	6' Gra	ve/(30/0) sand	1 (20%)	; olive bi	lack (572/1		
	F	7													
1	E	=						Mat	velmedia rix 5 to 10 Ispar.	10 Ca	the of qua	erte a	and l		
	F					46-4	18 F Gra	vel	55% 32	idy (4570): UK	ter t	urbid;		
-	E						-	037	yellowi	sn ore	WA (10)	1 P 2/2	. 111		
					ł			Ch 14	s to 40 s. Grave	med,	3099 a	1 50	nd -		
	E				-7	10. 1	,	Sin	en sand glar clas	Ston'e	. pernap	stro	in		
	E					48 -5 50 -5	o Gra	ave	sandy (esabo	ove class	4-1-	7.00		1
						52-5	4' Sar	1d 7	5/0, 5/11	V 15%	100011/	600	;). l		
-	E							test	yellowis	4 prou	anaula	3/2)	VET).		
1	E							grave	I Icm.	d med	turbil 0.2	25011	0		
						54-5	6 204	d (50	(10), gra	rellx (45%); 7	lus ky	N.		
	E						(LIAS	omist is	m r.	ONLINE .	Jers	ons		
	E	$\exists \bot$						-00	sparar	01.	** ***********************************	- 11			i

	Location		Date	Local well nu	T-ZI SAMPL mber	E WG
					t Long	
(-					Altitude	
)	Driller				ist _ J B GONTHIER	
	Lithologic Symb	DIS	Abbreviation	ns	Rge.	
		clay	c cobbles cob	sandy sdy fine f	Twsp.	 Se
		sand	s clayey cly	1975		
		gravel	g silty sty	coarse co	Li	<u> </u>
	Scale Sample Graphic log Drill		Lithologic descriptio	n	Summary log	
	S S S S S S S S S S S S S S S S S S S	4 27 70				
		0-2' (Pla-	shibrown (10 x R 2/	layer dusky Yellow 2 VET) dusky yellowish (sandy bo ?)	soil, mud, silly sandy	0-4
	5	2 / Mu	10 / 1/ X (3/0) / 00000 (16 x R Z/Z	WET) (sandy bo 10)	& Gravel, sandy	4-38
		15/	brown / 10 x R 3/2	y (20.70) dark yellow	Grave , sandy	4 -30
	10	6-P' Grav	el (15 % o) muddy	(10%) SEND VISTO		
		d'a	erk yellowish br	stare angular chias	1	
	15	B	asaltic (65%) and	maker little	1	
		8-10' Grave 1	(80%), sitty (3%)5	andy (17%), dusky XR 2/2; WET). Clasts lar (80%) chips, 80% lic Intermediate to felse	1	
	20	to	zem, most asqu	lar (50%) chips, 80%		
		10-12 Grave	revelmedian, 3m	m sand 15mm.		
()		bri 60	-90% are argula	m; sand 1.5mm. dusk; yellowish), clasts to 2cm. chips; basalt.c.		
)		12-14' Grave	(65%) sandy (35%) Jusky yellowsk	-	
		50% dar	on (10 412 2/2), WET of are angular chip)	b) · dusky yellowsk -) · Clasts to 3cm. s. posattic totler hedian, 4mm; Sand	=	
	30	14-16' Graves	mm.	(a) dusky rellowish	1	
		Ana	un(10 9 K 2/2, WET). (10575 TO 4 CM, 85 /0		
	35	0.12	ic. GHEVET media	14 6-7mm; SAND		
		16-18' Grave 1 brown	(60%) Sandy (40%	b); dusky yellowish clasts to zem;	Codd and the	3:-76
	90	60/00	inquier chios! bu	ealtic 703 . 20%	Sand gravelly bravel, sandy	38-40 40-52
					. , , , , , ,	
	45	rour	ded to sub roun	dusky yellowish off up to som; d 65% basalfic - ravel median, 4mm;		
		20-22 SANG	105mm.	(35%), dark yellowish		
	50	Dr	OWN 710 YR 4/2 W	VET). Clasts up to		
		Con	19 00 10 1010	VET). Clasts up to obsound (80%), basalta lithic Gravel median	Sand, gravelly	52-56
989 5 9 .	55	1 771	M, Sana (13514M	1	, ,	
		bro	w (10 x R 3/2, 6	(6) Dark yellowish wet Clasts to 3cm	Gravel, silty soudy	56-58
		70	10 are ungular a	11 bs , 70 10 basalic.	•	
		24-26' snev	el (70%), sandy (o intermediate. 30 /b) greenisk black erts 16 3cm; 15 %		
(,)		Va	Saire 30-4070	ire angular chine		1
),		371	" - Media w- ani	M SEALO D. 45 MAI		1
		LSX	All the DEST	nps, basate (33)		
		22-2	China an anim	and of man.		1
		1 2 2 7 7 10 7 6	2/35 100 y = 1	in the second		

Location	Date2-87	Local well number
County	Map Scale	Lat Long
District	Project number	Altitude
Driller	Helper	Geologist J E. GONTHIER
Lithologic Symbols	Abbreviations	sdy Twsp.
	silt st boulders b fine	f Sec
	sand s clayey cly medium	1 1 1
	gravel g silty sty coarse	co Lili
Scale Sample Graphic Iog Drill	Lithologic description	Summary log
Scale Samp Graph Tog Drill action	1 al C /8 /0a \$ 3 ca - 1 . ha 9 3 a. a. a//.	(10%), dusky Silt, sandy, gravelly 0-2
	0-2' S. 19 (80 %) Sendy 10%) gravelly yellow (5 y 5/4) DRY). Clas	to to ICM!
5 7	2-4' Sand (45%) SITTX (25%) gra	enelly (30/0).
	119ht of we gray (54 3/2)	ded stangular
	chips Sand median, Oil	25 mm , graves
b // 18,000 h	4-6 Grave 1 70%, 51 17 x (1070) sandy! gray (564 2/1; Dry to MOIST).	20%); alive Clasts to
	most are basa (tic 60 70)	1. Stavel
15	1-8' Gravel (85%), sandy (15%); shu	5, .
	1001/200/1000	14 . 010. 1
	8-10' Gravel (85%), Sandy (15%). Chast	BIO at B misand osimum
	8-10' Gravel (35%) , sandy (15%): dar gray (56 4/1, My). Chest	to 2cm,
) 	Grave I median, 1cm; san	DASALTIC
	10-12' Grave as above slightly	coarser.
	12-141 Gravel (15%) sundy : olive	black
	12-141 Gravel (15%) sandy olive (5 × 2/1 WET). Clusts Com: 30% are angular Gravel Median, fmm; Sa	- chips , bester.
andrews a	14-16 Grave (55%), sand y(45%);	olvegray
	(54 2/1, WET) Clasts to	2,5cm i
	most 65 10 subround to Grove median domm;	Sana O. Sman.
	Light office gray (5 x 5/2) w	VET). Closts To
	16-18 ' Crave [60%), muddy 115%) s Light office gray (5 x 5/2) w 3 cm, 75 to 80% are 9 ng 	ular chips, edian 3mm;
	sand 0.125.	
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And the second s	of the second se	

	Loc	atio	n _						Da	te		l	ocal w	ell numb			4	
	Сол	unty	_				Ma	р			Sc	ale		_ Lat		Long		
\	Dis	trict	_				_ Pro	ject nu	mber						_ Altitu	de		
)	Dri	ller _							Helpe	r			G	ieologist	JB	SONT	HIER	
			Lit	hologic	Symbo	ls 	_			Abbrev	iations						(T	T
			٦					clay silt	C St	cobbles boulders	b b	sandy fine	s dy f			Twsp.		Sec
								sand	8	clayey	cly	medium	m					
	П						Γ	gravel	9	silty	sty	coarse	со	— Т				
	Ę	910	Sample	Graphic log	Drill				Lith	ologic desc	ription				Summ	ary log		
	Depth	Scale	Š	<u> </u>	E 8				16.	e \	/		7/29		- 77		• //	
	П	_					0-2	. 517	live	gray (54) gray (54) are an sand o	5/2,7	gravelly	1070) 15ts t	0 2CM	Silt, sun		· 1/4	0-Z 2-18
	5		\vdash						MM.	sand o.	be am	gravell	ned 14	4 6.5	Gravel,	sa na y		2-18
			H				2-4	grav 5	10/6	(570) , Sano	X(590)	s to 3ci	154 bl n.90%	ack				
								q.	ngula edia	PliDRY) or chips, n,75 ma	70% od	re basa	Itic.	Gravel				
	10						4-6	Grave	1(95	(6); sano	75%) medu	m da	rk.	Ø:			
			Ц	194				a	re a	ngular desitie	44.RS	:85 /g a	re pas	selfic				
	15		Н						redi	an 4mm	1 san	d, 1.5 m	# <u>.</u>					
			H	Trans.			6-8	orav	ray	15%), Ben	Clast.	10/1; me	1, 90%	fart Lre				
			П					9	inde	an 4mm 5%), Ban NADRY), Lat Chip sitic, Gr	evel m	e basar redian 3	MM;S	and				
1										320				- 1				
)								151	(4/	95%), SAI	lasts	to zem	- 40%	ore				
e iii								a	ngul	DRY).Co	, 75%	are basa	Hick.	nd				
		-					10-12	Gra	501.	m	1460%) Alue	arayl	544/				
	1		П					1	RY	(Clasts - 80% a	10 1.5	cm, 70%	are	angular				
	lŀ							,	Far	et media	H, 4m	m : sand	t lon	MM,				
							12-14	t'Gra	ve/	etnedia (9890), sit) Clasts planch	14(2%), olive	groy/	544/1				
		_					.,-		angi	lar chi	PS 1 4	Lares	JECO	vered				
	1						14-1	9	ruyi	1 (70%), n	. gree	1156X	3/2 W	20/0), IET)				
	1	7							las	ests to 2	cm,	10 10 ar	eang	vlar				
Ü	ļ						À		STIN	7 175								
							16-1	8 6 ra	ve/	(85%) s	14x C	570) Sano	dx 10	ر ده/				
5									Olivi 3cn	c gray 15	44/1	NET).	Chip	5 70				
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	-	10/07	22 IV 2255 Nov.	T 17 SAMPLE 103-
Location				
County	Map	Scale	Lat	Long.
District	Project number			_ Altitude
Driller	Help		Geologist	
Lithologic Symbols		Abbreviations		Rge.
		cobbles cob sandy boulders b fine	sdy f	Twsp Sec
	sand s	clayey cly medium		
	gravel g	silty sty coarse	co	
Scale Scale Sample Graphic log Drill action	Lith	ologic description		Summary log
	0-2' Mud, 51	lty; dusky brown (5xR	2/2, WET),	Mud, silty isandy. 0-4'
	2-4' Mud so	Hy (N)) sandy (10%) · (54 organ ic debid,	R 3/2, WET)	
5	4-6' sravel	brown (10/R 2/2 WET CAR 2036). du	sky yellow -	Grarel, sandy 4-18'
(0)	Z.5	of most are angul	median .	
	1 XM	M 'SANA A h wards		*
15 - 1/1	ZCI	1), Sandy (30%); dusk in (104R 2/2, WET). C m. Bata are angular L a. Core medien	hips: 80%	
		mm. 10/0), sandy 20/0, as a		
	10 12 6m 49 1	+ 3.5 cm - 10 183		
	(5 × 2/	15%, sandy(5%), oliv i, wet). Clasts up to 20 ir chips, 80% are ba I median, 7.5cm; sand	e black em; 90% are	
	Grave	In chips, Sulo are ba	saltici	
1811	12-14' Gravel	(90%) sandy(10%); oliv 1, wet) - Clasts to	eblack	
	(5 x 2	i, wet)- Clasts to	2cm, 80 /s_	
			(x(20%):	
	dusk	(70%) muddy (5%) sand y yellow green (50 sto 150m, allere	44/2, WET)	
	Chip:	Gravel median, 4	mm; sand	
	16-18 Grave 1	s to 1.5 cm, all are some of the comments of t	dx(2590);	
	Class	yollow green (564) to to 3cm, 60% ars. Gravel med (5mm	4/2, WET)	
	chip:	s. Gravel med (5mm); sand ording.	
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	Loc	Btion						Da	16			Loca'	we! numb		
	Cou	nty				Ма	P			Sc	ale		Lat	Long.	
	Dist	trict				Pro	oject nu	mber						Altitude	
)	Dril							Helpe	er				Geologist	J.B. GONTHIE	R
	_		Lithologic	Symb	ols				Abbrev	iations	12.7			rige.	· —
			J				clay silt	c st	cobbles boulders	cob b	sandy fine	8 city		Twsp.	Sec
							sand	8	clayey	cly	medium	m			
							gravel	9	silty	sty	coarse	CO		<u>L</u>	<u> </u>
	Depth	Scale	Sample Graphic log	Drill					ologic descr					Summary log	
			7			0-2	' Gra	ve 10	(5%), silt wish brown ts to 4co silt cover 90), sand s to 2ch , 80% pare sand of	y 60%) sandy 1 YR 4/Z,	5 % ; DIZY	derk).	Gravel, silty, Sandy	0-18'
	5					- 7/		ind	silt cover	edia	satic (10/10.			7.
		\exists				2-7	Grave (1451	s to zer	(10/0)	to 40%	are a	ingylar	e.	
	10					:	1	no	sand o.7	5 mm	141c.600	vel m	edian,		
			7.			6-B	Grav	1,5	andy (as	above	ý i		1		
	15		-			8-10	o' Gra	e,	90%),50 (542/1	es ab	ove).	B70 B20			
		二				10-12	' Gra	e / C	90%),5a (5 y 2/1	nd (10)	Diesel	oits	mell.		
	1		-			12'-1	4' Gra	ve/	(65%), sa. Zi, humi) angular m; san a	nd y (3)	5 (0) : 9/10	re bla	ick.		
							2	0 /0 3m	m j San a	chis	mm.	/me	edian		
1						14-11	b' Gro	vel,	sandy a	sabo	ve.				
.)	E														
3						16-1	81 Gra	vel x 2/	(90%) Sand	14 (30)	(a) alive	blac	60%		
	E						an	gula	er chips	. 6 ra	vel med	lia a	1cm;		
	-						54	na «	6mm.						
	E														
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	Dri	ller _						Helpe	er				Geologist	J.B. GONT	HIER
	Г		Litholog	gic Symb	ols		clay		Abbrev	iations					Rge.
	L_		J [silt	c st		cop p	sandy fine	sdy f		Twsp.	Sec.
							sand	8	, .,	cly	medium	m		•	
	П		T		Τ	Т	grave	g	silty	sty	coarse	co			<u>لنانا</u>
	Depth	Scale	Graphic log	Drill				Lith	ologic desc	ription				Summary log	
	Å	3	8 B	D &		10-7	. 51	+	Ave.v ou	dam	10/10 Ens	a (2)(1)	1 lote	Silt, clarerin	ravelly 0-4'
							٠	lasty	rellowish to Ch	Drown	ella som	1/2 /1	40157),	2.1., 2, 2, 7,	
	5	\exists		T							y, ducky			Gravel, Sandy	4-12'
						1-1	1 6-0	brown	ENY CON	/Z,M	8157)	le am	1/1/3		
	10			D		1	'	DRY)	Clasts 1	0 11	(1); der	stare	angu-		DIESEL FUEL
		1		D		4-6	, Cr.	sand	oits nim	altic	. Gravel A	resian	3444		ODOR TVR61D SAMPLE
	15			P		2 4	_ = ====	3/19	htly coar	ser gr	1540 es	kips	30.90%		
		T'	1 1 19	1.00		8-10	Gra (vel 564	sandy as	abov T),	e, green	ish i	black -		
	E					10-12	Gr.	avel tuch	(70%0) mu	ddy(10	10) send 17) smell 10 1.5 2 mm; s (10/) si above.	(20%)	very		
	E		-					dark	gray C	lasts vlar	10 1.5	tem,	80+		
1	=					12-1	4'0	Gra	160%) 1	ran E	2 mm; s	and 1/1/5.	10%)		
	E														
	F					14-16	6 6	avel	(as al	ove)	Clasts	to 3	cm.		
	E							less	turgid	perha	but sl	or le	255		
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5 brown (OYR 3/2, DRY). 2-4' Silt, clayey and sondy (3%) moderate 5 brown (SYR 3/2, DAMP)					e:
Helper Geologist JA 65NITHER Lithologic Symbols Abbreviations Clay c cobbles cob sendy sdy silt st boulders b fine f sand s clayery cly medium m gravel g silty sty coarse co Lithologic description Summary log Lithologic description Summary log O-2' Silt, clayery and sandy; dark yellowish brawn (to YR 3/2, DRY). 2.4' Silt, clayer and sandy (3/3), moderate Brown (5YR 3/2, DAMP) 4-b' Silt, clayery and sandy, as above 31/5/11/11/12 darker and thore moist. C-8' Gravel (60%), sandy (18' [c]] same will; dark yellowish brown (10 yR 3/2, DAY). (Clasts 70 Zem, about 35% about 55% all yellows (10 yR 3/2) Sond 56.5' mm. Sond (5.5') silty (5/3), sandy (18' [c]) same will; dark yellowish brown (10 yR 3/2, DAY) (clasts 10 3.5' mm. Sond (5.5') sand (18' [c]) sand (18' [c]) sand (18' [c]) Intervel (18' [c]) sand (18' [c]) sand (18' [c]) sand (18' [c]) Intervel (18' [c]) sand (18' [c]) sand (18' [c]) sand (18' [c]) Intervel (18' [c]) sand (18' [c]) sand (18' [c]) sand (18' [c]) Intervel (18' [c]) sand (18' [c]) sand (18' [c]) sand (18' [c]) Intervel (18' [c]) sand (18' [c]) sand (18' [c]) sand (18' [c]) Intervel (18' [c]) sand					
Lithologic Symbols Clay c cobbles cob sandy sdy silt st boulders b fine f sand s clayey cly medium m gravel g silty sty coarse co Lithologic description Summary log Lithologic description Summary log Co-2' S.14, clayey and sandy: dark yellowish brown (by R 3/2, Dey). 2.4' S.14, clayey and sandy (sd.); moderate Srown (578 3/2, Dany) 4-6' S.14 clayey and tandy, as above stiffely darker and tandy, as above stiffely darker and tandy, as above yellowish brown (by R 3/2, Day). Sold Sold Sold Sold Sold Sold Sold Sold					50
clay c cobbles cob sandy sdy silt st boulders b fine f sand s clayery cly medium m gravel g silty sty coarse co Lithologic description Summary log Lithologic description Summary log O-2' S.I.I., clayery and sandy; dark yellowish brown (0 y R 3/z, DRY). 2.4' S.I.I., clayer and sandy as sandy (3/2), moderate - brown (5/R 3/z, DANP) 4-6' S.I.I., clayer and sandy, as above 3115H1/I darker and more moist. C-8' Gravel (20%), sandy (18 %) [sme 11]; dark yellowish brown (10 y R 3/z, DRY). Clasts 72 m good 55% angular chaps. - sand, 8.125 mm. 8-10' Gravel (20%), sandy (18 %) sandy (3/3%) clast yellowish brown (10 y R 3/z, DRY). (kats to 35 cm, 40 % 60% angular chaps. 10-12' Gravel (30%), Sand (15%) sandy (3/3%) dark yellow Is brown (10 y R 3/z, DRY) by strauel median Small sand (0.12 mm) is frauel median Small sand (0.12 mm) is frauel median Small sand (0.12 mm) is frauel median Gravel median, small sand 0.5 mm. 12-14' Gravel (55%), sandy (40%), allow black (57 21) WET). (Lasts to 1.5 cm, 85% are angular chaps, basaltic. - Gravel median, small sand Tomm. 16-18' Gravel (105%), sandy (20%), allow black Sy are angular chaps, basaltic. - Gravel median, small sand Tomm.	riller			Geologist	J& GONTHIER
Lithologic description Summary log Lithologic description Summary log O-Z' SIH, clayey and sandy. dark yellowish brown (10 x R 3/z, Dxy). 2.4' SiH, clayey and sandy (3'z). moderate brown (5 x 3/z, Dxmp) 4-6' SiH clayey and sandy, as above 315HIY darker and more most. C-S' Gravel (80 20, 3 and y (18 20) 5 me silly dark yellowish brown (10 x R 3/z, Dxy). clasts to 2 cm, about 35% and villar things. Sand, 8.125 mm. 8-10' Gravel (60 20). 9 1.44 (59) 3 and y(35%); but yellowish brown (10 x 8 3/z, Dxy). Clasts to 3.5 cm, 40 80 60 70 algular chips. To Tavel (80 %), Sand (15%) silf (80) dark yellow 18 brown (10 x 2/z, Dxy). Expanding 10-12' Gravel (80%), Sand (15%) silf (80), Gandy 10), dark yellow 1sh brown (10 x 8 3/z, WET). Gravel median, 5 mm; 5 and 0.5 mm. 14-16' Gravel (60%), sandy (40%), silvy (60), Gandy 10), dark yellow 1sh brown (10 x 8 3/z, WET). Gravel median, 5 mm; 5 and 0.5 mm. 14-16' Gravel (60%), sandy (40%), silvy (60%), Gandy 10, 85% are angular chips, basaltu. Gravel median 3 mm; 5 and 5 incm. 16-18' Gravel (75%) sandy (45%) and 5 incm.		clay c cobb silt st boul sand s claye	oles cob sendy ders b fine ey cly medium	f m	Twsp.
0-2' Sitt, clayey and sandy: dark yellowish brown (10 x 3/2) DRY). 2-4' Sitt, clayey and sandy (3/5): moderate - Brown (5 x 3/2) DAMP) 4-6' Sitt clayey and sandy (3/5): moderate 4-6' Sitt clayey and sandy (3/6) sandy (3/6) sandy 4-6' Sitt clayey and sandy (3/6) sandy (3/6) sandy 4-6' Sitt clayey and sandy (3/6) sandy (3/6) sandy 4-6' Sitt clayey and sandy (3/6) sandy (3/6) sandy 4-6' Sitt clayey and sandy (3/6) sandy (3/6) sandy 4-6' Sitt clayey and sandy (3/6) sandy (3/6) sandy 4-6' Sitt clayey 4-6' Sitt clayey 4-6' Sitt clayey 4-6' Sitt clayey 4-6' Sitt clayey 4-6' Sitt clayey 4-6' Sitt clayey 4-6' Sitt clayey 4-6' Sitt clayey 4-6' Sitt clayey 5-7-7-7-7-7-7-7-7-7-7-7-7-7-7-7-7-7-7-	- <u>a</u> <u>o</u> <u>c</u>		And with the trepton of the helicitudes.	T	Summary log
4-6' S. It clayer and sandy, as above stravel, sondy 6 3 tight I y darker and more moist. 6-8' Gravel (80%), sandy [18 %] same sill] dark yellowish brown (10xR 3/2, DRY). Clasts to 2cm, about 35% angular chips, most are bissell.c. Grovel median, 6mm; 5and, 5. [25 mm. 8-10' Gravel (60%), 91 tty (5%), sind y(35%); dut yellowish brown (10xR 3/2, DAMP). Clasts to 35 cm, 40 to 60% and year chips. 6-12' Gravel (80%), Sand (15%) silf (5%), dark yellow 15h brown (10xR 3/2, DRY) & Gravel median 5mm; sand (0.125 mm). 12-14' Gravel (65%), muddy (10%), silf, (0%), sandy sol, dark yellow the brown (10xR 3/2, WET). Gravel median, 5mm; sand 0.5 mm. 14-16' Gravel (60%), sandy (40%), a live black (5y 2/1, WET). Clasts to 1.5 cm, 85% are angular chips, basalt.c. 6-18' Gravel (75%), sandy (30%), a live black (5y 2/1, WET). Clasts to 1.5 cm, 85% are angular chips, basalt.c. 6-18' Gravel (75%), sandy (30%), a live black	Scale Samp Graph Tog Tog	90	2 100		outmany rog
4-6' S. It clayey and sandy, as above stravel, soudy 4-6' S. It clayey and sandy (18 %) sme shill; dark stightly darker and more moist. 6-8' Gravel (80%), sandy (18 %) sme shill; dark yellowish brown (10 yr 3/2) DRY). Clasts to 2cm, about 35% angular chips, most are bisell.c. Grovel median, 6mm; Sand, 5. [25 mm. 8-10' Gravel (60%), 91 tty (5%), sind y(35%); dut yellowish brown (10 xr 3/2, DAMP). Clasts to 35 cm, 40 % 60% and yolar chips. Fravel median from Sand 0.725. 10-12' Gravel (80%), Sand (15%) si ft (5%), dark yellow 15h brown (10 xr 3/2, DRY) r Gravel median Smm; sand (0.725 mm.) 12-14' Gravel (65%), muddy (10%) silly (0%) (4ndy so), dark yellow ish brown (10 xr 3/2, WET). Gravel median, 5mm; sand 0.5 mm. 14-16' Gravel (60%), sandy (40%), a live black (5y 2/1, WET). Clasts to 1.5 cm, 85% are angular chips, basalt.c. Travel median 4mm; 3and 1.5 mm.		0-2' Silt clayey A	Ind sandy; dark ye	llowish	5.14, clayey and sandy 0-6
4-6' S. It clayey and sandy, as above stightly darker and more moist. 6-8' Gravel (80%), sandy (18%) [sme sit]; dark yellowish brown (10 y R 3/2, DRY). Clasts to zem, about 35% angular chips, most are beselt. Grovel median, smin; 8-10' Gravel (60%), 91ty (5%) sind x(35%); dark yellowish brown (10x R 3/2, DAMP). Clasts to 3.5 cm, 40 to 60% angular chips. Gravel median from, Sand 0.125; 10-12' Gravel (80%), Sand (15%) of the yellow 15% brown (10x R 3/2, DMY) of Gravel median 5 mm; sand 0.125 mm; 12-14' Gravel (80%), Sand (10%), 51 ft y 6%) sandy 10% dark yellow 13h brown (10x R 3/2, WET). Gravel median, 5 mm; sand 0.5 mm. 14-16' Gravel (60%), sandy (40%), olive black (54 2/1, WET). Clasts to 1.5 cm, 85% are angular chips, basaltic.	5	2.4 Silt, clayey	and sandy (3%); n	noderate	
		4-6' S. 1+ clayey	and sandy, as a darker and mor	bove e moist.	Gravel, sandy 6-18
Yellowish brown (10xR 3/2, DAMP). Clasts to 3.5 cm, 40 to 60 % and ular chips. Fravel median (772m, 3 and 0.125. 10-12' Gravel (80%), Sand (15%) siff (5%) dark yellow 15h brown (10xR 3/2, DRY) r Gravel median 5mm; Sand (0.125 mm 1: 12-14' Gravel (65%) muddy (10%) siffy (0%) sandy 10%, dark yellow th brown (10xR 3/2, WET). Gravel median, 5mm; sand 0.5 mm. 14-16' Gravel (60%), sandy (40%), a live black (5y 2/1, WET). Clasts to 1.5 cm, 85% are angular chips, basaltic	10	6-81 Gravel (80%), yellowish	Sandy (18 %) [some sill] brown (10 y R 3/5) DA	; dark (Y) Clasts	•
Yellowish brown (10xR 3/2, DAMP). Clasts to 3.5 cm, 40 to 60 % and ular chips. Fravel median (772m, 3 and 0.125. 10-12' Gravel (80%), Sand (15%) siff (5%) dark yellow 15h brown (10xR 3/2, DRY) r Gravel median 5mm; Sand (0.125 mm 1: 12-14' Gravel (65%) muddy (10%) siffy (0%) sandy 10%, dark yellow th brown (10xR 3/2, WET). Gravel median, 5mm; sand 0.5 mm. 14-16' Gravel (60%), sandy (40%), a live black (5y 2/1, WET). Clasts to 1.5 cm, 85% are angular chips, basaltic	15	most age	about 35% angular boselfic. Gravel medicates	chips	
dark yellow ish brown (10 x 3/2, WET). Gravel median, 5mm; sand 0.5 mm. 14-16 'Gravel (60%), sandy (40%), a live black (54 2/1, WET). Clasts to 1.5cm, 85% are angular chips, basaltic Travet median 4mm; 3and Tiomm.		8-10 Gravel (60%) Xellowish L to 3.5cm); 811ty (5%) SIND X((35%) ; dark MP). (lasts =	
dark yellow ish brown (10 x 3/2, WET). Gravel median, 5mm; sand 0.5 mm. 14-16 'Gravel (60%), sandy (40%), a live black (54 2/1, WET). Clasts to 1.5cm, 85% are angular chips, basaltic Travet median 4mm; 3and Tiomm.		10-12' Gravel (80%), 5	medien 770m, sand (sand (15%) si H (5%)	derk yellow	
dark yellow the brown (10 x 8 1/2, WET). Gravel median, 5mm; sand 0.5 mm. 14-16 'Gravel (60%), sandy (40%), a live black (5 y 2/1, WET). Clasts to 1.5cm, 85% are angular chips, basaltic		15h brown	(104 R 3/2) DRY) - GV	avelmodian	
14-16 Gravel (60%), sandy (40%), alive black (54 2/1, WET). Clasts to 1.5cm, 85% are angular chips, baseltic		12-14 Gravel 6570) darkyellow Gravel med	muddy (10%) silly (0, ish brown (10xR 3) ian ,5mm; sand 0,5	(e) GANGY 10)	
16-18 (cove (1590) sandy (15%) alue black		14-16 Gravel (60%)), sandy (40%), a live	black	
16-18' (cove (7590) sandy (25%) alice black		Gravet m	edian Amm sand	asaltic Tiomm.	
809a are anquier chips, basaltich Grevel, median, Icm; gand o.5 mm.		16-18 (corve (7590)	Sandy (25%) elive	6/21/2	
		809a ac Gravel m	edian, Icm; gand	osmm.	
			- 500 cm gat ton com se son s		
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		Location					D	ate/_	9-86		Local w	ell numi	7-/3 SA. Der	MPLE LUB
		County _			-	Мар			S	cale		Lat.	Lon	0
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)	Driller	نه داد ځ	- 0 - 1			Help	er			G	eologist	JB GONTH	HER
			mologi	c Symb	ols	clay							0010///	Rge.
						silt		cobbles boulders		sandy fine	sdy f		Twsp.	Sec
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		Depth Scale Sampl	Graphic log	Drill action			Lith	ologic desc	ription				Summary log	
		O S S	Ō	O ®	25	·-30'	Grave	16091	andd.	ting) -	1/ /-0.	,		
					"	00	Sone	1(1090) (14(1590) 3cm, mos	Similar	to a bou	e; e a s	75		
					20	327	Sub	angular	100 lor	es -	1 - 1 - 0			
						,,,	011	el 90% si ve bleck 2 cm 7 avel med las abo	154	WE WE	7. Cla	6)1 5 × 5		
							- 61	avel med	ian)	6mm 5 5	and,	0.35		
					3z-	34'	Grave	1 as abo	ve; les	5 51/1.	./:			_
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		日			20	en '	ch , me	dian 4	Same	boulder	> 6 ra	rel		
					36	28 _ C	ravel_	(+590) sand Y 2/1, WET	14 (35). CIA	10) aliv	e blac	k .		
(1						61	revel, medi	rehip	s VETIAL M Sand	ble sha	mm.		
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	County					Ma	р			Sc	ale		Lat	Long		
1	District					_ Pro	ject nu	mber						Altitude		
)	Driller_							Halpe	r				Geologist .	J.B GONTH	ER	
		Lith	ologic	Symbol	ls		ola.	_	Abbrev						Rge.	$\overline{\Box}$
		J					clay silt	c st	cobbles boulders	cop	sandy fine	sdy f		Twsp.		Sec.
							sand	8	clayey	cly	medium	m		to the country		T
	П		Т		-		gravel	9	silty	sty	coarse	co			<u> </u>	<u> </u>
	the se	Sample	2 B	Drill				Lith	ologic descr	ription				Summary log		
	Depth	\$ 6	5	E g		,	, ,		-/-							
		7/4	Maria V			1-2	bra	san vel	75%),511	1+110	%) Sandy	115%). dark -	Asphalt Gravel, silly, Sand	y (Fill?)	1-2
	5					L _	·	e 110 Clas	75%) \$11 wish brow ts_to_3	un (10) 2:5 cm	R 3/2 I	aud	ed	Sild, sandy Sund, silty, grav	vell v	4-6
						1		Grav	cimediai	n, icm	, sand	0:08/	1M.	Gravel, sondy,		and the second second
	10	7//				2-4	3,7	brow	5%) sand	13 VE	of fine	sand	21.125	silty	1/	
	' [']							em,	CIOXR .	1/2,MI	1157)		7			
						4-6	dana	d (sk	10%), 51/2 yellow	ty (10%	grave//	1 (40 %	13/2			
	15	4				1.81	f	TRY)-'	1.60	a) dock	OFAV	(A13 DOIL			
						60	CI	asts	80%) sand to 200 most of	1,85	loarea	ngula	The spring			
	20	111					6	rave	most of	Thes	m; sand	1.75	mm.			
						8-10	Grav	el (95 90), san 4/1, DR)	dy 105	%), 3/14	e gra	y F	Sand, silty, 9	rave lly	27-24
)	25	1/4					- 1 5	170	are and	Vara	hio 5 :	basa	17:0	Sand and gra	ve lly	24-26
		1		1			61	rave	are ang	n. 12	m.	,	, ,	Gravel, sundy,	nuddy,	26-32
	30						91	ve lla	85 70) SAM	dy (15	10); med	7 CM	dark			1
	日	4	1300				9	o al	85%) sam	lar ch	ips the	spai	~			l
	35	1				73 - 77	17.5	and	1.0 nim	-' -, -	20F					
	日		1			111 11	. 1 /h	re7((0) (0)	andyl	-0, (as	ab	ove)			I
1								sano	(70%), M) ver	x turgi	X (10)	esel =			
	Ħ			İ												ļ
1						16-18	'_ Gr	ang	10000) (20%)	PSd	1 y (5%)	51/4	2 (10%)			
						10-70	16.	541	1dy (20 %	(as	above) ´	,			
1						18-20	g	ray	090 51/4/ (544/2	13%). WET	sundy (17), Class	(s) ; (c)	1.5			
	目						-	20 6	70% an	e and	ruler ch	ips	;			
-				2		-		41	nm; san	d 0.5	mm.	ea m	"			1
-					200				ove sli			7.2				
1				-		22'-2	4' Sa.	nd s brow	590,511 2415h b	lack	(5 YR Z/	IX (4	(2%);			
1					1		-	CIA	sfs To 2	cm;	anquitar	chi	p6 -			
						24-20	Sa	nd (ofs To z media	grave	150%):	alive	black			
1					-		(d /.	gare an	= 1 -	JUSTI	061	SCM			
4								med	Lian 7.5	mm	sand,	35 m	7.			
					}		<i>+</i>	Jek.	Spac -		7	- re	AAd			
			!	1	1	0-28	ora	1197	(70%) pm.	15114	· sraz	17/0,	santy 4/2			
	且	ļ.		!_				WE	(0). Lian T) (115+	5 %	2.00 11	ila	ER O			I

	Location	-		Date	Local well numbe	1
	County .		Map	Scale	Lat	Long,
	District _		Project numb	er		Altitude
)	Driller		Hel	per	Geologist .	JB GONTHIER
		ithologic Symb		Abbreviations	ali, ak.	Rge.
				cobbles cob sails boulders b fin	ndy sdy o f	Twsp
			sand s	100 100	edium m	
			gravel g	silty sty co	arse co	
	Depth Scale Semble	Graphic log Drill action	Lit	thologic description		Summary log
	Scale Samo	Gra or Dri				
		343.30	1-2' Silt	cample	(5%); derk yellow	No Sample (Asphalt) 0-1 Siltyclayer, sandy 2-4
	5	1 14 14	2-4' Silf	brown (10 y R 3/2; Clodded some a ellowish brown	moist, dark -	Gravel, sandy willy 4-18
			4-1 Gray	rellowish brown (10 y R'3/2, MOISI	0 milety suray 15/11/ 4-12
			3	vel (90%); sandy (10 ray (N4, BRY). clast 18 20 % are an	ovlar bashli	
	10		0	hips brave medicomm.	an 5mm; sand	×
				el as above sligi	htly coarser.	STRUMG DIESEL
	15		8-12 Grave	las above chips	much smaller	
		1211.48.8	12-14 Grave	werer. (20%) 41 Hu 15%	Jandsand Gog	
			da	esel oder, turgid	looking olive	
			97	mulsion of slay and	Joil. Like an	
)			14-16 arav	werer (10%) sitty (5%) ese Tioder, turgid ey. Clasts to 113 mulsion of clay and el (80%), sandy (20 2/1, WET), Clasts estare angular evel median 8 mm el as above , larges es angular.	ogo); slive black	
		-	ne Gra	stare angular	basalt chip.	
			16-18 Grave	elas above parq	etclasts,	
			/ /	es anywar.		
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	Lo	catio	n						D	ate			Local w	ell numbe	7-1/ 50M)	PLE LOG	۲
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		iller .	-		c Symbo					er					J.B. GONTI		
]					clay silt	st	cobble boulds	s cob	sandy fine	sdy f	25	Twsp.		Sec
			,,,,			L		grav		silty	cly sty	coarse	co				
	Depth	Scale	Semple	Graphic log	Drill				Lith	nologic de	escription				Summary log	-	
				1			0-2	50	011,5 (54	R 2/1)	ganic; DRY).	brownis	h blac	k	Silt, clayey	organic	0-5
	5						Z-4 		· H , C - Ye Son	How 15	to) sand	dy(5%)	dark 4/2,	DRX):	Gravel, claye Sandy	r, silly,	- 101
	10						4-6	´ Si	1 (50 p	% and n_ (10 x.	90% a	DRXX C	lasts	llowist	SKNOY		3 - N
	15						6-8	· 61	bravel 13h-	(80%)	tian i	reango cm.	y(17/v)	brown			
							8-10	Gr	avel,	asabo	ve 3/191	htly fine	er	-			
1							12-1-	4 G1	ave/	as ab	elayey,	Hysend	 1 y (20%),			
J									Very (54 de la contraction de	turgid 4/1, WE PS. Gra Smm.	appeal T). Cla	thy send ing of sts to 1 dian 7	INE gra	angular sand			
			-				16-18	5'-6-1	dusky or mu	(10%) cl	(SYR 2) (SYR 2) Ebrown	b) silfy(3) /z, WET, Clasts re_broke n; sand	10) Sand Water 10 115	y/ZAZ, rusty			
						-			Gravi	elmedia	asts an	re_bloke n; sund	0.125 M	101.			
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T 10 5- -- --______ Date ______ Local well number _ Location _ County _____ Map _____ Scale ____ Lat. ___ Long. ____ District ______ Altitude _____ Driller Helper Geologist JB GONTHIER Lithologic Symbols Abbreviations clay cobbles cob sandy sdy Twsp. silt boulders fine sand clayey cly medium m gravel silty stv Coarse CO Lithologic description Drill action Summary log 0-2' Silt clayey and sandy. some rootlets derk yellowish brown (104 4/2 PRY). Silt, clayey, sandy 2-4' Gravel (75%) silty 10%) Sandy (15%) dark Clasts to Zem) 60% are angular chips, Gravel median 1 mm; sand Gravel, silty, sandy 2-18 4-6'Grave [8570], sandy [1570]: medium gray
(N3, DRY): Clasts 7.5cm, 70% are
angular chips, basaltic. France
[median 5mm; sand 1.0mm.
6-8'Grave as above tower angular clasts
50% are rounded. 8-10' Gravel as above more angular chips
slightly coarser.

10-12' Grave [as above slightly finer.

12-14' Gravel (50') silty (20%) sandy (30%): olive
gray (5x 4/1, DRY). clasts to 2cm;
Who rounded to subround, sitt covered,
Gravel median 1.5 mm; sand 0.125mm.

14-16' Gravel as above, wet, less silt, more sand 16-18 Gravel as above

	Location		Date	Local we	ell number
	County _		Map	Scale	Lat Long
	District _		Project number		Altitude
)	Driller		Helper	G	eologist _TB GONTHIER
	Li	thologic Symbols	Abbre	viations	Rge.
			clay c cobbles	cob sandy sdy b fine f	Twsp + - + - Sec.
			sand s clayey	cly medium m	
			gravel g silty	sty coarse co	
	the st	o no	Lithologic desc	cription	Summary log
	Depth Scale Sample	Graphic log Drill æction			
		The	0-21 Mud, silty and brown (10YR 2	Yz, MOIST)	gravelly sandy 0.5
	5	1 (188)	2-4' Mud, silty sa dvskyellow	ndy gravelly (20%)	MAKE
		11 111	4-6' Grave (60%), 1	muddx 10%, 51/4, 5% 5%	andy Grovel, muddy, silly 5-6 Sand, muddy, silly, gravelly 6-12
			4-6' Grave (60%), 1. 25%; dusk WETY Clast	yellowish brown (10)	1R 2/2 Sand, muddy, silty, grovelly 6-12
	10		or sub roun	d other angular. an, 1cm; gand 0.15,	<u>na_ </u>
			6-8' Sand (40%)) mind	dy B%) SIHY(10%) Grav	mm. Gravel, sandy 12-18'
	15	[] [] [] [] [] [] [] [] [] []	(38 %); du	sky yellowish brown	THYR
		1111	2/2 WET) Gravel med	clasts to 2.5 cm, à	inquior.
			(3870); du 2/2 WET) 2/2 WET) 6-10' Send 4070; mu evlly (3070)	ddy (157.) 51/4 1570	712-
			L/0XK 2/2	WEI / Clasts to 1.) CM
			sandoil	Travel median (icm);
		1 1	10-12' Sand (6090) s.l. dusky yellow Clasts to Ich	4x (5%) gravelly (35%));
			Clasts to Ich	1, Gravelmedian (3.	nn)
1			sano is nim.		1
I			12-14' Grave (80%), SA ISH brown (OYR Z/Z, WET) Clas	ts to
1			median Bu	angular chips; 6rac m; Sand .0.2mm.	vē Ī
1			14-16 Grave (60%) 51	and y(40%) . ducky	
1			yellowish bi	OWN (10YR Z/2 . WE	ラ ・
1			Chips other	2.5 cm , 60% angular	
			Sand ismi	rs are subround and avelmedian 6mm	~ -
I			16-18' Grave /(75-10), SA.	ndy(25%); dusley yell	rwish
١			gravel media	Pare Digusts to	6.2.
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	Location	Da	ite /- 2-87	Local well nur	T-7 5AA	IPLE LOG
		Map				
(-	District	Project number	r		Altituda	
	Driller Lithologic Symb	Helps	er	Geologi	st	
	Lithologic Symb	clay c	Abbreviations cobbles cob boulders b clayey cly silty sty	sandy sdy fine f medium m coarse co	Twsp.	Rge.
	Depth Scale Sample Graphic Log Drill	Lith	ologic description		Summary log	Content Acceptant in American content of the Conten
	25	22-24' Gravel 24-26' Gravel 24-26' Gravel 25-30' Gravel 25-30' Gravel 30-32' Gravel 37-34' Gravel 37-34' Gravel 37-36' Gravel 34-36' Gravel as	thic particles (5570), sandy (4) (5570), sandy (4) win (10712 Z/2, vi m; 5070 are angli les, Gravel medi as above Cla (6670), sandy (35) in (1078 A/2, vi m, sand 75 mm. as above excep 5510, sandy 450 (1078 Z/2, wet) angular fragment les. Gravel medi nm. s above, oth listed (36)	dusky yellowish br.). Clasts to 1.5cm. Tavel Median 5mm; and 20% is quarts and pepper; remaind of sol). Jusky yellowish elar chips of larger an 4mm; sand as sts to 1.5cm. (sts to 1.5cm. (sts to 1.5cm. fragments of greavle e bosalfic, 20% are fragments of greavle e bosalfic, 20% are ics. 6ravel median th 3% omod. (DXR 2/2) Co; dusky yellowish Clests to 3cm Is of 1 to 2cm an 6mm, 3and 38' Grovel 70%, yellowish brown sts to 2cm; vel median 5mm;	Sand, gravelly Grave I sandy	

	Loc	catio	n _						_ Da	te			Local w	ell numb	er		, , ,	
)		ller .								er						60Ni	THIER	
	Г		Liti	hologic	Symb	ols				Abbrev	iations						Rge.	77
			J			L		clay silt	c st	cobbles boulders	cop	sandy fine	sdy f			Тивр.		- I - Sec
				·				sand	8	clayey	dy	medium	m		: <u>-</u>			
			П		Γ			gravel	9	silty	sty	coarse	co				للنا	<u> </u>
	Ę	9	Sample	Graphic log	_ 6				Lith	ologic desci	ription			Ì	Summar	y log		
	Depth	Scale	Sal	Gra C	Drill action													
			1/1				υ-	2' Muo	1,sil	ty sendy;	some	rown: 110	roulle	13 115	Mud, SIH	y , se 1:0	Korgan	12 0-3
							2-4	t' Gra	vel	35% mu 2; Ausk 2R 3/2, V	ddy	30%) 5/4	20%	SANdy	Gravel,			
	5			- 14	*		-		(10)	R 3/2,	UET)	. Clasts	to 3	cm,		,	,	
							4-6	1 600	und	quiar.	a. 1.	hoo/) -	460					
	10		///					7	710	183/2W	ET) d	45 kx y	ellow	154				
		-		1					bro	175%) Si R 3/2 Wil own. Cla gylar chi dian 10	sts t	o Zcm	1 98%	are -	Sand an	daras	el silty	12-14
	15						7 - 0	72-	Me	dien 10	m 15	end o.C.	5 m	n	bravel, sa			
	1		1	r fail			6-8	(5	-x-	2/1 WET	dy(15	10) ohi	ie bla 2cm.	ck !		/		11 12
	1							7	0%0	are an	gular	basa/	+ ch	P				
	-						8-10	'Gra	vel:	65% san 2/1 wer are an etmetia 50% s1/1	1,5%	nm; sai	40,00	5.				
1	E							Ь	lack	(5 × 2/1	WET	, clasts	לנילבי	cm:				
/	-							B	oge i	angular r	emain	der subi	ound,	Gravi				
	ŀ			İ			10-1	2' 6ra	rel	(50%) :	altu(5	90) < and	1.	%)				
	F		1	ı			12 - 14	1150	25	(609 d),91		1491.	ZU.					
	E						12 /	, , ω	(5y	2/1, WE	T) Cla	sts to	ive di 3cm , s	ome				•
-				l					~ a	401 . 1								
1	F						14-11	' Gra	vel	1(15%) SI 2/1, WET Tare and bbles. Grand, 0.5 min	endy (350/0); 0	slive b	lack				
1	F	\exists							57	2/1, WEY	Cla	575 to .	3cm					
1	E	\exists							pe	bbles Gr	avel	median	From	o mm.;				
1	F	7					16-18	1 6r	sai a ve	1, 95 a	bove	<u></u>						
1	F			1														
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United States Department of the Interior



GEOLOGICAL SURVEY

Water Resources Divison
Pacific Northwest District
Washington Office
1201 Pacific Avenue - Suite 600
Tacoma, Washington 98402

Mr. Peter Kmet, Supervisor
Washington State Department of Ecology
Landfill Site Cleanup Section
Hazardous Waste Investigations and
Cleanup Program
7272 Cleanwater Lane
Olympia, Washington 98501

Dear Pete:



Enclosed is a preliminary copy of a report titled "Contamination of Ground Water by Gasoline and Diesel Fuel at a Site in Yakima" by R. J. Wagner and J. C. Ebbert. This is a provisional draft subject to revision and therefore, the information is not available to the public, pending approval of the Director of the U.S. Geological Survey. We would like to have someone from DOE review the report. Recently, Mike Cochran, from your Yakima office, has expressed interest in the findings in this report. Perhaps he would be an appropriate person to do the review. Please include all attached forms when you return the report. Thank you.

Sinceraly yours,

Charles H. Swift, III Acting State Chief

Enclosures

CONTAMINATION OF GROUND WATER BY GASOLINE AND DIESEL FUEL AT A SITE IN YAKIMA, WASHINGTON

U.S. GEOLOGICAL SURVEY

Water-Resources Investigations Report __-__

Prepared in cooperation with STATE OF WASHINGTON DEPARTMENT OF ECOLOGY

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By Richard J. Wagner and J. C. Ebbert

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Tacoma, Washington 1990 DEPARTMENT OF THE INTERIOR

MANUEL LUJAN, JR., Secretary

U.S. GEOLOGICAL SURVEY

Dallas L. Peck, Director

For additional information write to:

District Chief U.S. Geological Survey Section 1201 Pacific Avenue - Suite 600 Tacoma, Washington 98402 Copies of this report can be purchased from:

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CONVERSION FACTORS

For the convenience of readers who may prefer to use metric units rather than the inch-pound units used in this report, values may be converted by using the following factors:

Multiply inch-pound units	By	To obtain metric units
	20.5	
inch (in.)	25.4	millimeter (mm)
foot (ft)	0.3048	meter (m)
mile (mi)	1.609	kilometer (km)
square mile (mi')	2.590	square kilometer(km ²)
gallon (gal)	3.785	liter (L)
micromho per centimeter at 25 degrees Celsius (μmho/cm at 25 °Celsius)		microsiemen per centi- meter at 25 degrees Celsius (µS/cm at 25 °C)

<u>Sea Level</u>: In this report "sea level" refers to the National Geodetic Vertical Datum of 1929 (NGVD of 1929(--a geodetic datum derived from a general adjustment of the first-order level nets of both the United States and Canada, formerly called Sea Level Datum of 1929.

Degrees Celsius (°C) $^{\circ}F = 9/5 ^{\circ}C + 32$ to Degrees Fahrenheit (°F)

Preliminary, Subject to Revisions, 10/24/90

CONTAMINATION OF GROUND WATER BY GASOLINE AND DIESEL FUEL AT A SITE IN YAKIMA, WASHINGTON

By Richard J. Wagner and J. C. Ebbert

ABSTRACT

Following the discovery by the Washington State Department of Ecology of a gasoline and diesel-fuel leak at a service station in Yakima, Washington, an unsuccessful attempt was made at recovering the petroleum product. Several studies were designed to monitor the petroleum compounds dissolved in ground water, and from 1985 through 1989, data were collected from observation wells that were drilled near the site of the leak. From February 1985 to November 1986, petroleum-related compounds dissolved in ground water were found consistently, and at relatively large concentrations, in wells near the service station. Petroleum-related compounds were also found sporadically, and in smaller concentrations, in domestic wells as far as 1,500 feet downgradient of the service station. Sampling results from data collected in March 1989 indicate that concentrations of petroleum-related compounds dissolved in ground water have decreased in magnitude and areal extent.

INTRODUCTION

In 1980, 1981, and 1982, the residents of a neighborhood in the northeast part of Yakima, Washington, complained to the Washington State Department of Ecology (WDOE) about the odor and taste of gasoline in water from their domestic or irrigation wells, which are open to a shallow, unconfined groundwater system. The WDOE investigated the complaints and determined that the source of the gasoline and diesel fuel was leakage near the land surface from improperly installed pump delivery lines at a service station located on North First Street (fig. 1). New delivery lines and storage tanks had been installed at the station in May and June 1979. Leak tests, reported to have been performed at that time and again in December 1980, did not reveal any leaks. Additional tests, conducted in September 1982 as a result of the complaints from private well owners, revealed leaks in the delivery lines, which were repaired immediately.

An audit of gasoline and diesel fuel inventory records, conducted by representatives of the service station, indicated that about 5,970 gallons of

leaded gasoline and 1,740 gallons of diesel fuel were lost during the period from September 1981 through October 1982. This represents an average leakage rate of 550 gallons of product per month. If the leak began shortly after the December 1980 test, then about 12,000 gallons could have been lost during the 22-month period from the time of the test to the repair of the leaks. If the December 1980 test was invalid, and the system leaked during the entire 40-month period from the time of installation, then the product loss may have been as much as 22,000 gallons.



An insurance company, representing the service station, initiated an attempt to recover the lost gasoline and diesel fuel in 1982-83 because of the potential to further contaminate drinking water. At least 13 observation wells and two recovery wells were installed on, or adjacent to, the service station property. Three of the observation wells contained several inches of free product, pure gasoline or diesel fuel, floating on top of the water. The recovery operation was discontinued because only 40 gallons of free product were recovered. All but three of the wells were subsequently destroyed. In the summer of 1985, most homes having affected wells were connected to alternate water supplies.

Purpose and Scope

The purpose of this report is to present and compare current and past distributions and concentrations of petroleum-related compounds in ground water near the site of the gasoline and diesel-fuel leak on North First Street in Yakima, Washington. This report presents data collected during a March 1989 sampling study, during 1985 to 1987, as a part of the Ground-Water Toxics Study, and during 1985 through 1986 as a part of the insurance company study. Data collected by the three sampling studies are presented in tabular form. Comparisons are made by presenting distributions of selected compounds in map formats. Sampling procedures and laboratory methods that were used by the three studies are also described.

Description of the Study Area

The City of Yakima is the commercial center for the Yakima River valley, a major agricultural area within south-central Washington. The service station on North First Street where the gasoline and diesel-fuel leak occurred, is located approximately 2,000 feet southwest of the Yakima River (fig. 1). Land use in the vincinity of the service station consists of some orchards and vacant lots interspersed among commercial and residential properties.

The general direction of ground-water flow is eastward from the service station to the river. The subsurface geologic materials immediately underlying the area consist predominantly of coarse-grained alluvial deposits. The water table is approximately 10 feet below land surface. Additional information on the geohydrology is given in the section "Geohydrologic Setting".

Annual precipitation in the valley is about 8 inches (U.S. Department of Commerce, 1987), with more than half of this occurring during the winter months as snow. Potential evapotranspiration, using a modified Blaney-Criddle calculation (U.S. Department of Agriculture, 1970), is approximately 38 inches annually. Consequently, crops require extensive irrigation. Most irrigation water is diverted surface water, but some is pumped ground water. The main municipal water supply for the city of Yakima is surface water; however, some individual residences and small water purveyors rely on ground water.

Geohydrologic Setting

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The study area in Yakima, Washington, is located in the Ahtanum-Moxee subbasin (fig. 2), which lies along an east-west oriented alluvial valley between two similarly oriented basalt ridges: Cowiche Mountain and Yakima Ridge on the north, and Ahtanum Ridge and Rattlesnake Hills on the south. The valley lies along a broad structural syncline, is approximately 7 miles wide and 40 miles long, and has a relatively flat alluvial surface that ranges between 1,000 and 1,500 feet in elevation. The basalt ridges on either side of the valley were formed by anticlinal upwarp, are much narrower than the valley, and range between 2,000 and 3,000 feet in elevation. Perennial east-west oriented streams flow along the valley from both directions towards the valley center and empty into the perennial north-south, through-flowing Yakima River. A significant summer inflow of water into the higher parts of the valley comes by way of irrigation canals fed by dam-regulated flow along the Yakima River and its tributaries upstream of the study area.



Folded and faulted basalts are exposed along the anticlinal ridges and are found at depths of 300 to 1,000 feet beneath the snyclinal valley (fig. 3). The basalt flows belong to the Columbia River Group (table 3), and they are interbedded with, and underlie, a thick section of clastic rocks of debris-flow, lacustrine, and fluvial origin located along the valley axis.

The oldest of these clastic units, the Ellensburg Formation (table 3), is from 100 to perhaps 1,000 feet thick in the valley and is dominated by semiconsolidated laharic (volcanically generated debris flow) fine to coarse clastics. Above these beds lie about 100 to 500 feet of Pleistocene glaciofluvial fine-grained lake, and coarser-grained river-laid clastics.

Above these, and comprising much of the surficial material at and near the study site, are 50 to 75 feet of Holocene unconsolidated alluvial sands and gravels laid down beneath the present flood plain by the Yakima River and beneath adjacent terraces by streams older, and perhaps larger, than the present Yakima River. The clasts within these two recent alluvial deposits are dominantly of volcanic (andesitic and basaltic) composition.

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The shallow stratigraphy of the study site was determined by descriptive geologic logs from recent drilling of observation wells (fig. 4). In general, alluvial the lithologic descriptions show an upper 15- to 20-foot-thick depositional unit beneath the present flood plain, with about 5 feet of clay, silt, and sand at the surface (overbank deposits), and 10 feet of sandy, coarse gravels and cobbles below the overbank deposits. The lower contact of this upper unit is indistinct, but it overlies 30 to 50 feet of lower, older gravels and sands, probably deposited in similar environments. At normal stages of flow, the Yakima River is flowing within the upper fluvial unit, and perhaps within the top of the gravel layer of these fluvial deposits. There is a good permeable connection between the Yakima River and the adjacent water-table aquifer within these recent fluvial deposits. The ground-water-quality data at the site indicate that the leaked gasoline and diesel fuel, and the dispersed dissolved compounds downgradient of the leak, are wholly contained within the upper and lower Holocene alluvial deposits.

There is upward ground-water flow from the basalts through the Ellensburg clastics into Holocene alluvium and into the perennial drainages, including the Yakima River (fig. 4). Locally, the ground-water flow is generally eastward flow (fig. 5) from the leak site toward the Yakima River. In

general, the water table lies 7 to 12 feet beneath ground level. The upper sand, silt, and clay of the alluvium is unsaturated, and the lower parts of the coarser-grained alluvium is saturated.

Continuous hydrographs of two water-table wells document annual fluctuations of 2 to 3 feet, and there are two unequal annual peaks.

One peak is in early spring, coincident with maximum vertical recharge from precipitation, and a second peak is in the late summer and early fall, coincident with upgradient recharge from irrigation returns and canal leakage (fig. 6 and table 12).

Data Collection

Three studies have been conducted since the gasoline and diesel fuel recovery program was discontinued. The first study, under the general direction of the insurance company, consisted of several phases with different contractors. Three wells still remained from the original recovery program at the end of 1984 (M1-82 through M3-82, pl. 1). In December 1984, 12 new observation wells (M1-85 through M12-85, pl. 1) were drilled. Beginning in February 1985, water levels were measured, and selected observation and domestic wells were sampled at 3-month intervals to determine the direction of ground-water flow and concentrations of petroleum-related compounds in ground water.

The second study, which started in 1985, was conducted by the U.S.

Geological Survey (USGS) and the Oregon Graduate Center (OGC) as part of the

U.S. Geological Survey Toxic Waste--Ground-Water Toxics Study. This study was

initiated to determine the transport and fate of gasoline and diesel fuel in a subsurface environment. The study was aborted in 1987, and no data or results were published. During this USGS study, ground-water samples were collected on three different occasions, and soil-gas samples and samples of aquifer material were collected one time each. In August 1985, water samples were analyzed for petroleum-related hydrocarbons. In November 1985, soil-gas samples were collected, using driven probes, and analyzed for petroleumrelated hydrocarbons. From April through June of 1986, water samples were collected from selected domestic and observation wells, and from temporary wells driven to the water table and pulled out after sampling. In late summer and early fall of 1986, 32 observation wells and 8 multilevel soil-gas sampling tubes were installed. In November 1986, water samples were collected above. from the new, larger network of observation wells. All samples were analyzed formy, rue 1 billiered for volatile hydrocarbons and dissolved oxygen, and selected samples were analyzed for trace metals and common ions. In November 1986, samples of ground water and aquifer material were collected from selected observation wells and analyzed for lead. During the Ground-Water Toxics Study, water levels were measured monthly over the 2-year period from February 1985 to April 1987. Water-level recorders, which were installed in M8 and M14, have operated continuously from January 1987 to the present (1990).

The third study was conducted in cooperation with WDOE to determine the current distributions and concentrations of petroleum-related compounds in ground water. In March 1989, ground-water samples were collected from 27 observation wells and were analyzed for volatile hydrocarbons. Samples from six wells were analyzed for trace metals and common ions. Water levels were measured at the time the samples were taken.

The results and additional information on the conduct of this, and the other two sampling programs, are given in the sections "Sampling Studies, Field Techniques, and Laboratory Procedures," and "Chemistry of Ground Water, Soil Gas, and Aquifer Materials".

Processes Affecting the Fate and Distribution of Petroleum Hydrocarbons in a Subsurface Environment

Both gasoline and diesel fuel are petroleum products and are mixtures of numerous organic compounds with different physical and chemical properties.

The fate and distribution of the individual compounds in a subsurface environment are governed to a large extent by these properties. For example, the aromatic hydrocarbons are the most water-soluble components of gasoline and diesel fuel and are relatively easily dissolved and transported in ground water. Selected properties of some of the major compounds in gasoline and diesel fuel are given in table 1.



After the spill or leak of a liquid petroleum product, some of it will flow through the unsaturated zone to the water table by gravity, and some of it will be held in the unsaturated zone by surface tension. The petroleum that reaches the water table will float and spread on top of the water table because it is less dense than water. The transport of hydrocarbon compounds by ground water initially will be limited to those which can be dissolved in ground water at the petroleum-water interface. Once dissolved in ground water, compounds may be transported by advection and dispersed horizontally and vertically in the ground water.

Seasonal variations in the water-table elevation can increase dispersion and dissolution of hydrocarbon compounds in the ground water. When the water table rises, some of the petroleum will remain trapped in the interstitial pores by surface tension below the rising interface (Schwille, 1981). When the water table falls, some water is trapped above the falling interface. This sequence of events substantially increases the vertical distance over which the petroleum is dispersed and provides additional surface area for the dissolution of hydrocarbon compounds into ground water. During periods of ground-water recharge, downward percolating ground water can dissolve hydrocarbons from the petroleum trapped in the unsaturated zone.

The relative proportions of various petroleum hydrocarbons dissolved in the ground water also are affected by volatilization, biodegradation, and sorption. The low-molecular-weight hydrocarbon compounds can volatilize from the petroleum product or from the ground water and diffuse into the unsaturated zone. The presence of hydrocarbon gases in the unsaturated zone is sometimes used to indicate the presence of petroleum hydrocarbons in ground water.

Some hydrocarbons preferentially sorb to soil particles. These compounds are not as readily transported as those in the gas phase or the ground water.

Some sediment characteristics that affect sorption are grain size and organic content.

A variety of naturally occurring soil microbes can, under favorable conditions, degrade hydrocarbon compounds found in gasoline and diesel fuel. Biodegradation is most efficient under aerobic conditions with sufficient

supplies of nitrogen and phosphorus, a near-neutral pH, and warm soil temperatures. Under these conditions, some hydrocarbon compounds can be completely degraded into carbon dioxide and water (Atlas, 1981). Anaerobic biodegradation of petroleum hydrocarbons also has been observed, but generally at lower rates than aerobic biodegradation (Healy and Daughton, 1986).

Acknowledgments

Clar Pratt, Alan Newman, and William Meyers of the WDOE provided much background information about the Yakima site. Dr. James F. Pankow, professor at the Oregon Graduate Center (OGC) and director of the OGC Water Research Laboratory in Portland, Oregon, provided technical advice, as well as planning and executing much of the reconnaissance sampling. J.R. McPherson and Lorne M. Isabelle of OGC analyzed the volatile organic compounds in the 1985-86 reconnaissance water samples, and William Fish coordinated the program for the analysis of lead in the aquifer material and in water. Mark S. Mason, of Soil Exploration Company, St. Paul, Minnesota, provided information about their drilling program. Michael Schroeder and the staff at the U.S. Geological Survey National Water Quality Laboratory (NWQL) provided technical advice and assistance for the 1989 sampling. Brooke Connor and Donna Rose of NWQL analyzed the volatile organic compounds sampled in 1989. Valuable assistance for the quality assurance program used during the 1989 reconnaissance was provided by Mark Sandstrom of the NWQL Methods Research and Development Section.

Appreciation also is extended to the many property owners who granted access to land, private wells, and monitoring wells during the samplings.

Well-Identification System

<"/

Wells in this report are referenced by identification numbers that are listed in table 2. Their locations are shown on plate 1. The table cross-references these identification numbers with the station name stored in WATSTORE, the U.S. Geological Survey computer data base, and identifiers used in correspondence and progress reports during previous studies. The identification numbers in this report are prefixed by an M for observation wells, D for domestic wells, T for temporary wells installed for the collection of water samples, SG for multidepth soil-gas wells, and SGT for temporary wells installed for the collection of soil-gas samples. The temporary water wells and soil-gas wells were removed immediately after sample collection.

SAMPLING STUDIES, FIELD TECHNIQUES, AND LABORATORY PROCEDURES

Field and laboratory methods used during the three studies were, in general, quite similar, and the methods are detailed for comparative purposes. Field and laboratory methods are discussed separately, and quality assurance procedures and results are given in Appendix A.

Ground-Water Sampling

Insurance Company Study

Men were nator samples
what there
sollected, is. Twelve observation wells were installed using a cable-tool drilling rig. Wells were constructed with 2-inch diameter, flush-threaded, PVC (polyvinyl chloride) casing and 15 feet of PVC screen, 10 feet of which extended below the water table. Water samples were collected from the wells using bottomfilling Teflon bailers. A minimum of three casing volumes of water are pumped from a well before a ground-water sample was collected. Water samples from domestic wells were collected from cold-water faucets that were allowed to run at a rate of about 1 gallon per minute for a 30-minute period prior to sampling. The samples were non-filtered and non-aerated. All samples were preserved on ice and transported into a private laboratory for analysis.

in ited to it here well were committed. It the BTIEX was At 10,100 July Table I MAN 101 be depressed it well streams Ground-Water Toxics Study

The Ground-Water Toxics Study included three water-sampling periods with different objectives. The first sampling was done (August 1985) to determine the farthest extent of dissolved hydrocarbon movement in the ground water.

The second sampling (April through June 1986) with additional temporary wells to better delineate the extent of dissolved hydrocarbons and to determine appropriate sites for 34 additional observation wells. In the third sampling period (November 1986), samples were collected from some of the new observation wells.

The additional 34 observation

method. The wells were constructed of 2-inch PVC casing, with 3- to 5-foot lengths of 0.10-inch slotted PVC screen at the bottom. Most screens were set so that the middle part of the screen was close to the surface of the water table at the time of drilling. Sections of PVC casing were welded together rather than cemented to prevent contamination by solvents used in the cement. The annulus around each screen was packed with sand to a depth of several feet above the screen and then sealed to the surface with bentonite or a bentonite and cement mix. Several deeper wells that were drilled below the water table were packed with sand several feet above the screen, backfilled with clean cuttings, and then surface sealed with a bentonite and cement mix. The wells were developed by pumping.

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In the spring of 1985, staff of the Oregon Graduate Center collected ground-water samples from 28 temporary wells. The wells were installed by jackhammering a steel drive tube to a depth 2 feet below the water table and then removing the tube with a railroad jack. A 3-foot length of 3/8-inch flexible tubing was attached to the top of a 3/8-inch stainless steel pipe and lowered down the hole to collect a sample, a vacuum was applied when the pipe was a few inches below the water table, the flexible tubing was then bent and clamped, and the pipe was lifted out of the hole. Two 14-mL (milliliter)

sample vials were filled. The sample vials were filled by slowly releasing the clamp, and the vials were stored on ice for later analysis. Some modifications to this sample collection procedure were made during the course of the study. To prevent borehole collapse upon removal of the steel drive tube, a perforated tip was attached to the end of the tube and the tube was left in the hole during sample collection. Also, samples were collected by securing the sample vial at the end of a thin stainless steel rod and lowering the vial to the water table directly through the driven hollow tube. All downhole tools that were used in this phase were cleaned with a methanol solution and dried with an electric hair dryer.

Bottom-filling glass bailers were used to collect water samples from observation wells for the analysis of volatile hydrocarbons. Before each sample was collected, five casing volumes were pumped from the well. Prior to sampling each well, the bailer was rinsed with a 10-percent methanol solution and an acetone-hexane mixture (60 to 40, by volume). Remaining solvent residues were then removed from the bailer by baking in an oven, by heating with an electric hair dryer, or by aspirating with a vacuum pump. The cleaned sampler was then rinsed by bailing three times from the well. A sample vial was filled from the fourth bailing and packed in ice until analysis. The technique used to collect samples from domestic wells was similar to that used during the insurance company study. All volatile hydrocarbon water samples collected were analyzed by the staff from the Oregon Graduate Center.

1989 Study

The procedure used to sample observation wells in the 1989 study was nearly identical to that used during the Ground-Water Toxics Study. One difference was that the bailer was rinsed with organic-free water after the acetone-hexane rinse. Also, the bailer was routinely baked in an oven at 105 °C for 1/2 hour after the organic-free water rinse. Results of tests to check the adequacy of the cleaning procedure are given in Appendix A.

Samples collected were analyzed by the U.S. Geological Survey National Water Quality Laboratory (NWQL) in Arvada, Colorado. Field quality-assurance procedures included duplicate samples, field blanks, and field-spiked samples with known amounts of target compounds. These procedures are described in Appendix A.

Ground-Water Analysis Methods

All three studies utilized similar gas-chromatographic techniques for determining concentrations of volatile hydrocarbons in ground-water samples. Differences in techniques are noted below and references are given for more details. Analyses performed by Oregon Graduate Center produced concentrations that were blank-corrected, as referenced in Appendix A. Analyses performed by the other studies were not blank-corrected.

Insurance Company Study

Samples were analyzed for benzene, toluene, and total xylenes (the sum of the meta, para, and ortho isomers), and a value was calculated for total hydrocarbons expressed as gasoline. Samples were analyzed using a Tekmar LSC-2¹ liquid sample concentrator linked to a Perkin-Elmer Sigma 300 gas chromatograph with flame ionization detection (FID), on a 6-foot stainless steel column with SP-1000 100/120 mesh packing. Total xylenes, benzene, and toluene were identified by retention time and quantified by comparison with known standards using an SP-4000 data system. Total gasoline concentrations were calculated by comparison of total peak area to a gasoline standard total peak area.

Ground-Water Toxics Study

The analytical method utilized by Oregon Graduate Center was purge and trap with whole-column cryotrapping. This method was employed with fused-silica, capillary-column gas chromatography (GC), as developed by Pankow and Rosen (1984) and optimized by Pankow (1986). Both FID and mass spectrometric (MS) detection were utilized. The purge and trap device used was a Chemical Data Systems Model 320 concentrator. The GC/MS used was a Hewlett-Packard

¹Use of brand, firm, or trade names is for identification purposes only and does not endorse use of any product by the U.S. Geological Survey

5790A GC interfaced to a Finnigan 4000 MS/DS (data system) system. The carrier flow from the capillary column exiting the GC was split, approximately half of the flow directed into the MS source, and the remainder to a FID housed in a Hewlett-Packard 5700A GC.

Normally, a 5.0-mL aliquot of sample was loaded into the sparging vessel and each aliquot was spiked with 10 μ L (microliter) of an internal standard solution in methanol. In the case of highly contaminated samples, smaller sample aliquots were loaded into the sparging vessel and organic-free water was added to produce 5.0 mL of diluted sample for analysis. Samples were analyzed for a set of 18 target compounds (table 4) known to be components of gasoline and diesel fuel. During sample analysis, standards containing known concentrations of target and internal standards compounds were routinely run. Replicates of the samples were run back, a day apart, and in one case, 6 days apart.

Sample concentrations were computed based on the appropriate sample and standard peak areas and were blank-corrected using replicate values of blanks, duplicates, and standards. The internal-standard compounds served to compensate for any variations in the purging efficiencies and the system response. The response factors were assumed to be linear over the concentration range of interest.

1989 Study

The method utilized by the NWQL to analyze samples was purge and trap.

This method was employed with gas chromatography and electron impact mass spectrometry (GC/MS) as per EPA Method 524.2 (U.S. Environmental Protection

Agency, 1988a), and the list of volatile organic compounds targeted by this analytical method was modified by adding standards for the quantification of five compounds in addition to those targeted by EPA Method 524.2 (table 4). The purge and trap device used was a Tekmar LSC 2000 with an ALS 2016 and ALS 2032. The 25-mL sample was purged for 11 minutes at ambient temperature with a gas flow of 40 mL per minute, desorbed at 180 °C for 4 minutes onto a 30 meter x 0.53 mm ID DB-624 megabore column, and baked at 225 °C for 15 minutes. The gas chromatograph was a Varian 3400. The temperature program of the GC was an increase from 10 °C to 160 °C, at a rate of 6 degrees per minute, with 10 °C held for five minutes, and 160 °C held for one minute. The megabore column was coupled directly to the mass spectrometer, which was set to analyze from 45 to 300 atomic mass units with a scan time of 1 second. A Finnigan Incos 50 MS/DS was used to run most of the samples, and a Hewlett-Packard HP5996A MS/DS was used for those samples on which a library search was performed. Ten percent of the samples were run in duplicate, and 10 percent of the less-contaminated samples were spiked with a solution containing the target compounds. Additional quality assurance measures included daily blanks, daily instrument tuning, and quality control check samples.

A library search was performed on selected analyses in an attempt to identify non-target compounds. Spectra corresponding to gas-chromatographic peak maxima were compared with National Bureau of Standards library reference spectra using a computer library search. The best library matches were selected according to a "reliability factor"—a parameter used by the library search algorithm to indicate the quality of the match between the sample and library spectra. The best computer matches were compared with the sample spectrum manually to attempt the best possible tentative identification.

Soil Gas

Samples of soil gas, the gas in the pore spaces in the soils and sediments above the water table, were collected from temporary-driven sampling tubes and from permanent wells in which multidepth sampling tubes were installed. Samples from the temporary-driven wells were taken from locations with the lowest expected concentrations and then from locations where larger concentrations were expected. A 6-foot-long stainless steel casing tube was driven to a depth of 5.5 feet below land surface and then backed out a few inches. Then, a 7-foot stainless steel sampling tube was inserted 1 inch beyond the bottom of the casing tube. Two hundred mL of soil gas were drawn through the sampling tube with a vacuum pump. A Tenax-GC sample cartridge was then placed in line and the system was pumped for about 12 minutes at a rate of about 40 mL per minute. The sample cartridge was then removed, the ends were capped, and the sample was stored in an organic-free environment prior to analysis.

Sampling techniques and analytical methods for multidepth wells were the same as for the temporary driven wells. The stainless steel sampling tubes each extended to a specified depth, were surrounded with sand, and were sealed from each other with concrete.

Soil-gas analysis was done by adsorption/thermal desorption with whole-column cryotrapping, using FID and MS detection. The Tenax-GC cartridges needed no sample preparation prior to desorption. The cartridge was placed in the desorption apparatus and purged for 10 minutes with a backflow of helium to remove the oxygen and most of the methanol. The cartridge was desorbed at

250 °C for 10 minutes at 30 psi, with the column temperature held at -80 °C.

After desorption, the column temperature was raised rapidly to 0 °C, and then raised to 250 °C, at 10 °C per minute for the data acquisition. Additional details are given by Ligocki and Pankow (1985).

Aguifer Materials

In November 1986, samples of both solid aquifer material and water were collected from selected observation wells. Concentrations of lead dissolved in water, and lead adsorbed onto the surface of the less-than-63-µm (micrometer) fraction of the aquifer material, were determined. Because samples of aquifer material could not be obtained easily by coring, due to the cobblely nature of the deposits, samples of fine-grained aquifer materials that had passed through well screens after installation of the well were obtained by placing a pump intake near the bottom of the well. Approximately 5 gallons of sediment-laden water were pumped from each undeveloped well and collected in a clean plastic bucket. The sediment was separated by settling, dewatered by filtering into a firm cake, placed in a polyethylene bag, and stored on ice. The firm cake was then processed by mixing with water and wetsieving through a 63-μm polypropylene sieve. The less-than-63-μm fraction was filtered to a moist cake, subsampled, and digested by a weak method. The samples were then analyzed in the same manner as the filtered ground water (Fish, 1987). After developing the well by pumping at 10 gallons per minute for 20 to 30 minutes, ground-water samples were collected by pumping through acid-washed Tygon tubing and filtering through acid-washed 0.1 µm (pore-size) membrane filters into acid-washed polypropylene bottles.

CHEMISTRY OF GROUND WATER, SOIL GAS, AND AQUIFER MATERIALS

Common Constituents and Trace Metals in Ground Water



The shallow ground water near the study site is predominantly of the calcium-magnesium bicarbonate type (see fig. 7 and table 5). Specific conductance values ranged from 208 to 390 µS/cm (microsiemens per centimeter) at 25 °C, and values of pH ranged from 6.3 to 6.9. Dissolved-oxygen concentrations were low, with a median value of 0.6 mg/L (milligrams per liter). Dissolved oxygen concentrations upgradient of the spill site (M1-85) ranged from 6.3 to 6.8 mg/L; whereas the ground water contained little or no oxygen at sites M2-82, M3-82, M11-85, M12, M16, and M18. Concentrations of metals were generally less than 0.10 mg/L and did not exceed the MCL (Maximum Contaminant Level) for drinking water, except for dissolved manganese, which exceeded the secondary MCL at 15 sites (U.S. Environmental Protection Agency, 1988b).

Organic Compounds in Ground Water

Insurance Company Study



During the insurance company study, at least one of the three target compounds (benzene, toluene and total xylenes) was detected at least once in four of the 21 wells (figs. 8 to 12 and table 6). Target compounds were detected consistently, and at relatively large concentrations, in water from well M11-85, located about 150 feet from the leak site. Target compounds were consistently detected in only one domestic well, D10, located about 1,200 feet

downgradient, but concentrations were smaller than in M11-85. Target compounds were detected in wells M8-85 and M10-85, located about 900 feet downgradient of the leak site, but the occurrences were sporadic and concentrations were relatively small. The wells used in this study were too widely separated to define in detail the distributions of hydrocarbon compounds in ground water.

Ground-Water Toxics Study

During the Ground-Water Toxics Study, ground-water samples were analyzed for up to 23 aromatic hydrocarbons, primarily alkylated-benzenes (table 4). All but six of the compounds were identified in ground water. Concentrations of compounds found during the different sampling periods of this study are given in table 7. Because of changes in analytical methods during the course of the study, not all of the target compounds were analyzed in each of the sampling periods. Furthermore, the method for reporting analytical results when concentrations were near background or detection levels differed among sampling periods.

Data for benzene, toluene, naphthalene, and total xylenes are shown in figures 8 through 11. These four compounds are some of the more water-soluble aromatic compounds in gasoline (table 1), and their presence and concentrations compare well with the presence of other target compounds. Concentration isopleths of 5 μ g/L (micrograms per liter) are shown for each of the four compounds, and the symbols identify locations where concentrations are greater or less than 500 μ g/L. A value of 5 μ g/L was chosen as the isopleth concentration because it is an order of magnitude greater than the

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level of detection for most compounds and, consequently, there is a high certainty of detection at this concentration, eliminating any doubt of trace detections at or near the detection level. The isopleth concentration is significant because it is also the drinking water MCL for benzene (U.S. Environmental Protection Agency, 1988c). An MCL does not exist for toluene, naphthalene, or total xylenes, but there is a proposed MCL for tolupe of 2,000 µg/L and a secondary MCL for total xylenes of 10,000 µg/L.

During the first sampling period in August 1985, detectable concentrations of benzene, toluene, naphthalene, and total xylenes were identified in samples from 5 of 15 insurance company observation wells, 1 of 13 temporary wells, and 2 of 31 domestic wells (table 7). Although petroleum-related compounds were detected as far as 1,000 feet from the service station, concentrations of individual compounds exceeded 500 µg/L only in samples from the three wells closest to the service station (figs. 8 to 11). A petroleum sheen was noted on samples from two of these three wells (M3-82 and M11-85), indicating the presence of free product.

During the second sampling, from April through June 1986, detectable concentrations of benzene, toluene, naphthalene, or total xylenes were found in the samples from 5 of 6 insurance company observation wells and at all 29 of the temporary wells. Observed concentrations of benzene, toluene, naphthalene, and total xylenes (figs. 8 to 11) indicate that some of the dissolved compounds had migrated in an east-north easterly direction.

During the third sampling in November 1986, benzene, toluene, naphthalene, or total xylenes were detected in samples from 5 of 8 insurance company observation wells and in 18 of the 23 observation wells installed during this study (pl. 1 and table 2). Concentrations of some of these four compounds exceeded 500 µg/L at eight of the observation wells within 400 feet of the service station (figs. 8 to 11).

The vertical distribution of hydrocarbons dissolved in ground water was justices investigated. Observation wells which penetrated deeper :also investigated. Observation wells which penetrated deeper into the aquifer, M2, M6.1, M7.1, and M13 (pl. 1 and table 2) were sampled in November 1986. Observation wells M6.1 and M7.1 are paired with shallow wells, M6.2 and M7.2, respectively. Observation wells M6.1 and M6.2 were installed in the same hole about 1,300 feet downgradient of the service station, with M6.1 extending to 46 feet below land surface and the latter well screened at the water table. Observation wells M7.1 and M7.2 are a similar pair installed in a hole about 500 feet downgradient from the service station. Benzene, toluene, naphthalene, total xylenes, ethyl benzene, and other alkyl benzenes were detected in all the deeper observation wells that were sampled. Concentrations of dissolved hydrocarbons in the ground water from observations wells M2 and M6.2 were less than 1 $\mu g/L$; whereas, observation well M7.1 had a concentration of 3.2 μ g/L total xylenes. Concentrations of dissolved hydrocarbons in ground water from observation well M13 ranged from 0.5 to 47 µg/L. The concentrations of dissolved hydrocarbons in ground water from deeper wells range from one to more than three orders of magnitude smaller in comparison to the concentrations of hydrocarbons dissolved in ground water from observation wells at the water-table surface. The major portion of the leaked gasoline and diesel fuel dissolved in the ground water appears to be

> stimate the volume discoved to the volume

near the surface of the water table. Further, the migration of dissolved hydrocarbons in the ground water is preferentially in a horizontal downgradient direction.

1989 Study

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Concentrations of volatile organic compounds in ground-water samples collected in 1989 indicate that there are still dissolved components of gasoline and diesel fuel in the ground water (table 8, figs. 8 to 11).

Concentrations of benzene, toluene, naphthalene, and total xylenes greater than the detection limit of 0.2 µg/L were found in ground-water samples from 11 of the 27 sampled wells. Concentrations exceeded 500 µg/L for only total xylenes at two wells, M3-82 and M16. Significant amounts of toluene and other alkyl benzenes were also found at these two wells and at M11-85, but concentrations for all compounds were less than 500 µg/L.

In March 1989, concentrations of petroleum-related compounds in ground Month? Addate:
water were less than in 1985 and 1986 (tables 6 and 7, figs. 8 to 11).

Consequently, the concentrations of petroleum-related products dissolved in ground water appear to be decreasing, and the area within specific concentration isopleths also appears to be decreasing. However, one should not ignore the fact that concentrations probably change seasonally because of the seasonal rise and fall of the water-table elevation, and the above conclusion is based on a single sampling in 1989.

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Lead in Ground Water and Aquifer Materials



Concentrations of lead in the filtered ground-water samples ranged from 1.4 to 10.1 µg/L (table 9). These concentrations are less than the EPA drinking-water MCL of 50 µg/L (U.S. Environmental Protection Agency, 1988c). Samples of aquifer material contained lead with concentrations 30 to 10,000 times greater than in ground-water samples on a per weight basis (table 9). Because of the large affinity of the divalent lead ion for sediment, it is not unusual to find small concentrations of lead in ground water and large concentrations of lead in sediments. As a result of this affinity, inorganic lead is relatively immobile in ground water.

There is little or no correlation between concentrations of lead in soil and in ground water (correlation coefficient = -0.19). Fish (1987) used these concentrations to calculate apparent distribution coefficients, which were then used to calculate values of retardation factors. A distribution coefficient is the equilibrium concentration of a solute sorbed to the aquifer material and divided by the concentration in solution; a retardation factor is the ratio of the average velocity of water to the average velocity of a solute where movement is retarded by sorption to the soil matrix (see for example, Freeze and Cherry, 1979, p. 404). Fish (1987) obtained retardation factors that ranged from 136 to 31,600. Because this variability did not match any apparent variability in the aquifer materials, he concluded that a simple adsorption or ion-exchange model does not explain the distribution of lead between the solid and aqueous phases. Calculations by Fish (1987) indicate that the observed concentrations of lead in the ground water were near the limit of solubility for PbCo. Therefore, precipitation of PbCo, may control

the concentration of lead in ground water. Because the area with elevated concentrations of lead in the aquifer materials is similar to the area with elevated levels of aromatic hydrocarbons dissolved in ground water (fig 13), the source of the lead is probably lead additives in gasoline, tetraethyl and tetramethyl lead.

The source of the lead is probably lead additives in gasoline, tetraethyl and tetramethyl lead.

The source of the lead is probably lead additives in gasoline, tetraethyl and tetramethyl lead.

The source of the lead is probably lead additives in gasoline, tetraethyl and tetramethyl procedure way and allow if under its lead in the source of allow if under its lead in the source of allow if under its lead in the similarity between spatial distributions of lead in the aquifer as a similar its materials and some of the aromatic compounds dissolved in ground water

suggests that some of the lead has moved in approximately the same direction as some of the aromatic compounds dissolved in the ground water (Fish, 1987).

Consequently, the lead is, or has been, more mobile than the retardation factors imply. There are several possible modes of transport. Shortly after the gasoline leak, the lead could have been transported as part of the free product. It could have been transported by ground water when in the more soluble alkyl lead phase, which subsequently degraded to inorganic lead that precipitated out of solution. The lead in the aquifer materials also could

Soil Gas

have been transported by collodial-size particles (Fish, 1987).

In November 1985, soil-gas samples were collected from seven temporary wells, SGT1 through SGT3 and SGT6 through SGT9 (fig. 14). Although plans were made to collect samples from about 25 wells, problems with frozen ground and cobbly soil resulted in fewer samples collected than planned. Also, because of problems with internal standards, concentrations of compounds detected in the soil-gas samples were qualitative and not quantitative.

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In November 1986, soil-gas samples were collected from six multidepth soil-gas tubes (fig. 14, table 11). Target compounds (table 10) and mixed alkanes were detected at some depths at three of the six wells, SG3, SG5, and SG8 (fig. 14). With the exception of toluene and several alkyl benzenes that were found at mid-depths of 3 to 6 feet below land surface in SG8, most compounds were detected only close to the water table, at the deepest levels from which samples were withdrawn (table 11). This is consistent with the steep concentration gradients of concentrations in soil gas near the water table that have been found by others (see for example, Hult and Grabbe, 1985).

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Target compounds (table 10) were detected in samples from wells SGT2 and SGT7. Also, chromatographs for samples from wells SGT1, SGT3, and SGT9 contained peaks that are indicative of likely degradation products of aromatic hydrocarbon compounds (J.R. McPherson, Oregon Graduate Center, Beverton, Oregon, verbal commun., 1989). Soil gas from wells SGT6 and SGT8 did not contain detectable amounts of hydrocarbon compounds. Although gas samples were collected from wells SGT4 and SGT5, difficulties with collection and analyses of samples from these two wells preclude making any statements about the presence or absence of hydrocarbon compounds in soil gas at these two sites. These two wells are not shown in figure 14.

SUMMARY AND CONCLUSIONS

An estimated 12,000 to 22,000 gallons of gasoline and diesel fuel were leaked to unsaturated sediments and shallow ground water from an improperly installed delivery line at a service station in Yakima, Washington. Data indicate the fuel leak is contained within unconsolidated sediments and shallow ground water 7 to 12 feet below land surface.

Unsuccessful attempts in 1982-83 at recovery of fuel in the ground were followed by a study in 1985, under the direction of an insurance company, to monitor the presence of dissolved hydrocarbons in ground water. From August 1985 through November 1986, in a separate study by the U.S. Geological Survey, dissolved hydrocarbons and lead were determined in ground water and soil gas was determined in the unsaturated sediments. The gasoline leak in Yakima was selected to be a part of a national study of ground-water sites contaminated by toxic compounds, but the study was aborted before an interpretive phase was completed. Fine-grained sediments in the aquifer were also analyzed for lead. In this study, data were collected in March 1989 to determine the concentrations and areal extent of dissolved hydrocarbons in ground water, and results from these two previous studies were compiled and analyzed.

All three studies utilized similar gas-chromatographic techniques for determining concentrations of volatile hydrocarbons benzene, toluene, naphthalene, and total xylenes in shallow ground water for five sampling periods beginning in 1985. A large concentration of 600 µg/L toluene and 980 µg/L of total xylenes was found in one domestic well about 1,200 feet downgradient of the leak, but water in other domestic wells sampled beginning

in 1985 had hydrocarbon concentrations that were all less than 500 µg/L. Samples collected from 1985 to 1986 indicate dissolved hydrocarbons in observation wells commonly exceeded 500 µg/L at distances of 150 to 500 feet downgradient from the gasoline leak. Soil-gas samples taken in November 1986 indicated dissolved hydrocarbons were detected only close to the water table.

In March 1989, concentrations of dissolved hydrocarbons apparently had decreased in magnitude and areal extent in shallow ground water near the water table. Concentrations of dissolved hydrocarbons were less than 500 µg/L and did not exceed distances of 300 to 750 feet from the source of the leak. Isopleths of 5 µg/L of each of the four hydrocarbons plotted on areal distribution maps also support the decrease in dissolved hydrocarbons. In contrast, during the sample periods of November 1986 and earlier, hydrocarbon concentrations of 5 $\mu g/L$ ranged from 600 to 1,000 feet from the source of the leak. Sampling in March 1989 showed the 5 µg/L isopleth no farther than 350 feet from the original source of the leak. In general, however, dissolved components of gasoline and diesel fuel remained in ground water and about 40 percent of the observation wells sampled had benzene, toluene, and naphthalene concentrations that were greater than the detection limit of 0.2 µg/L. The decrease in dissolved hydrocarbons in the shallow ground water since 1985 and 1986 are due to natural dispersal, volatilization, or biodegradation. Concentrations of dissolved lead in ground water were small for the five sample periods from 1985-1989. These concentrations were 1.4 to 10.1 μ g/L and less than the MCL of 50 μ g/L for drinking water. Lead has a high affinity for soils and is relatively immobile in ground water. However, concentrations of lead in aquifer sediments suggest lead has moved in the aquifer in the same direction as the dissolved hydrocarbons have moved.

Preliminary, Subject to Revisions, 10/24/90

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APPENDIX A: QUALITY ASSURANCE

The quality of the data from all three studies cited in this report appears to be good. Differences between concentrations in duplicate samples are within reasonable limits and concentrations of standards, spiked samples, and blank samples were satisfactory (see tables A1 to A6).

Insurance Company Study

The quality assurance portion of the insurance company study consisted of field blanks, lab blanks, and duplicate samples. Concentrations of benzene, toluene, and total xylenes in field and laboratory blanks were less than the detection limit of 1 microgram per liter (table A1). Replicate analyses of a sample from observation well M11-85 indicate good reproducibility for all compounds except toluene. On August 27, 1985, personnel from the insurance company study and the ground-water toxics study independently collected samples from four wells and the samples were analyzed by their respective laboratories (see table A2). The agreement between the two sets of results is good except for the concentration of benzene in the samples from well M8-85, and perhaps the concentration of toluene in the samples from M11-85. Differences between other concentrations can easily be attributed to variabilities in sample collection and analysis.

Ground-Water Toxics Study

The quality assurance during the ground-water toxics study consisted of collecting duplicate samples, doing replicate analysis, and analyzing trip-





blank samples. Organic-free blank water for trip blanks and sample dilutions was prepared in the laboratory. The replicate analyses of trip blanks and duplicate samples were used for the calculation of statistical limits of detection. Mean and standard deviation of concentrations detected in the trip blanks are listed in table A3. Sample results were correspondingly blank-corrected. Concentrations determined for mixtures of standard solutions supplied by the U.S. Environmental Protection Agency are compared with concentrations in the standards (table A4).

1989 Study

Organic Constituents

The quality assurance during the 1989 study consisted of collecting duplicate samples and equipment-rinse samples, using blank-water samples and trip-blank samples, and spiking samples with identical concentrations of target compounds in the field and in the laboratory. The blank water used during the current program was commercially available, organic-free water. Equipment-rinse samples consisted of 40 mL of this water that was passed through the sampler after cleaning. Tests were made to check the adequacy of the cleaning procedure prior to field sampling and also during the sampling period.

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Samples of the blank water, blank water from an equipment rinse, and blank water from an equipment rinse after baking the sampler were analyzed for volatile hydrocarbon compounds (table A5). The blank water contained relatively small concentrations of methylene chloride and chloroform.

Compounds tentatively identified using a NBS library search routinely were hexane and methylcyclopentane. Equipment-rinse blanks contained small concentrations of benzene, toluene, total xylenes, and larger concentrations of methylene chloride and chloroform. The equipment-rinse blanks also contained relatively large concentrations of compounds that were tentatively identified as hexane, methylcyclopentane, 3-methylpentane, and acetone. Equipment-rinse blanks that were passed through the sampler after it was baked at 105 °C contained only small concentrations of chloroform, dichlorobromomethane, dibromochloromethane, and 1,2-dichloropropane. This poses no problem with the interpretation of petroleum-related hydrocarbons in the ground-water samples.

Trip blanks were collected with the intention of analyzing the samples only if a problem was suspected in collection or processing techniques.

Because no anomalous results were found, the trip blanks were not analyzed.

Sample results for the 1989 study are not blank-corrected.

One set of replicate samples from observation well M8-85 was spiked in the field with target compounds to check the effective recovery of compounds from a field-matrix sample. An extra sample also was sent to the laboratory for spiking in the laboratory (table A5). The difference in recovery between the field spikes and the lab spikes ranges from +25 to -7 percent, with an average difference for FS1 of 4 percent and an average of 12 percent for FS2. These differences are considered to be normal.

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Inorganic Constituents

Various sums, differences, and ratios, based on aquatic chemistry principles, were computed for each inorganic sample. These computations check the consistency between constituent concentrations in a sample and provide a gross check in the accuracy and completeness of the analysis. Two of the most useful computations are the cation-anion balance and calculated dissolved-solids concentration, which are defined in the following paragraphs.

The cation-anion balance is the difference, in percent, between the sums of the concentrations of cations and anions, expressed in milliequilevants.

Ideally, this value is zero, but non-zero values occur when a cation or anion concentration is in error, or when the concentration of a significant ion (often a metal) is not determined. The acceptable difference varies with the total sum of cations and anions. The differences ranged from 0.0 to 5.97 percent.

Calculated solids is the dissolved-solids concentration determined by summing the concentrations of cations, anions, silica, and other major dissolved constituents. This value is theoretically equal to the dissolved-solids concentration determined in the laboratory by residue upon evaporation. Differences usually are due to errors in analyses of the various cations or anions (which may be verified by the cation-anion balance), or errors in the laboratory-determined dissolved-solids concentration. For analyses at the study site, differences between the calculated and analyzed dissolved solids ranged from 2 to 9 percent.

The primary controls on field values of pH, specific conductance, dissolved oxygen, and temperature are proper instrument calibration and field procedures. However, pH and specific conductance also are determined in the laboratory. Differences between laboratory and field specific conductances were less than 5 percent in all cases (table A6).

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Field and laboratory pH differed by more than 0.2 units for only three out of 18 samples and none of these differences are more than 0.5 units.

Because pH and specific conductance can change during the time between the field and laboratory determinations, these comparisons must be considered approximations at best, but the good agreement generally serves to confirm the field values.

Field determinations of bicarbonate and carbonate concentrations were checked by calculating alkalinities from them and comparing the results to laboratory-determined alkalinities. Field and laboratory alkalinities differed by more than 5 percent for only one of six samples.



Duplicate samples were collected and analyzed for both inorganic and organic constituents during the current study (table A7). Dissolved zinc is the only constituent where duplicate sample results do not agree. The ground water sampled at the site contained particulate matter which could be variable from one sample to another (see turbidity values, table A6). Upon acidification, colloidal zinc would be transformed into the dissolved state.

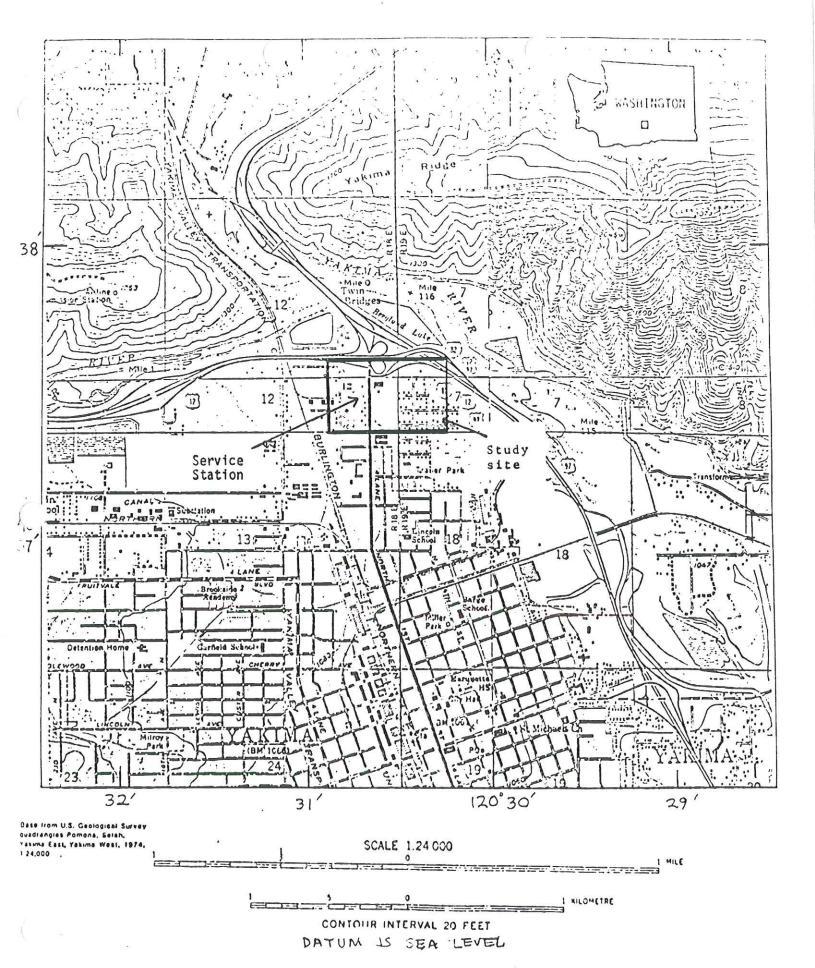
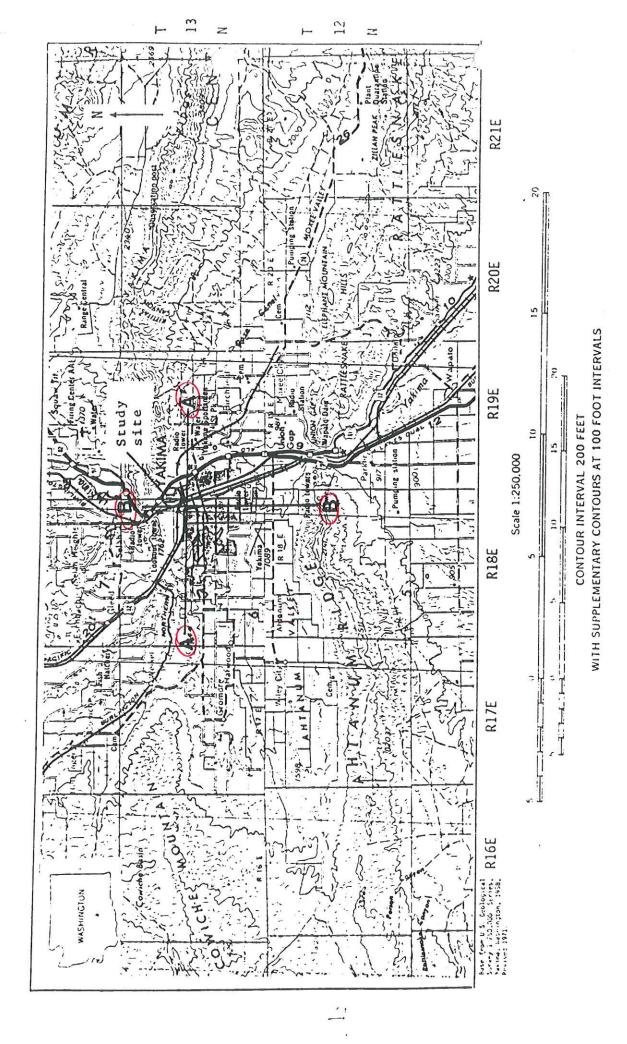
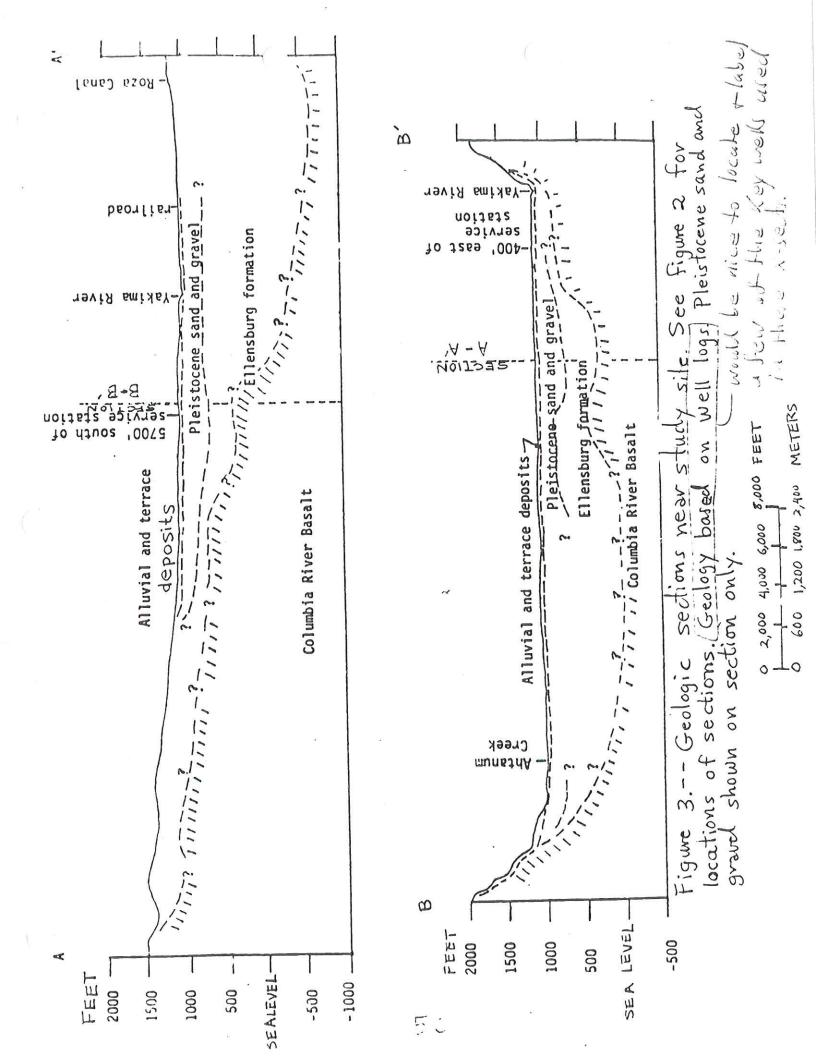
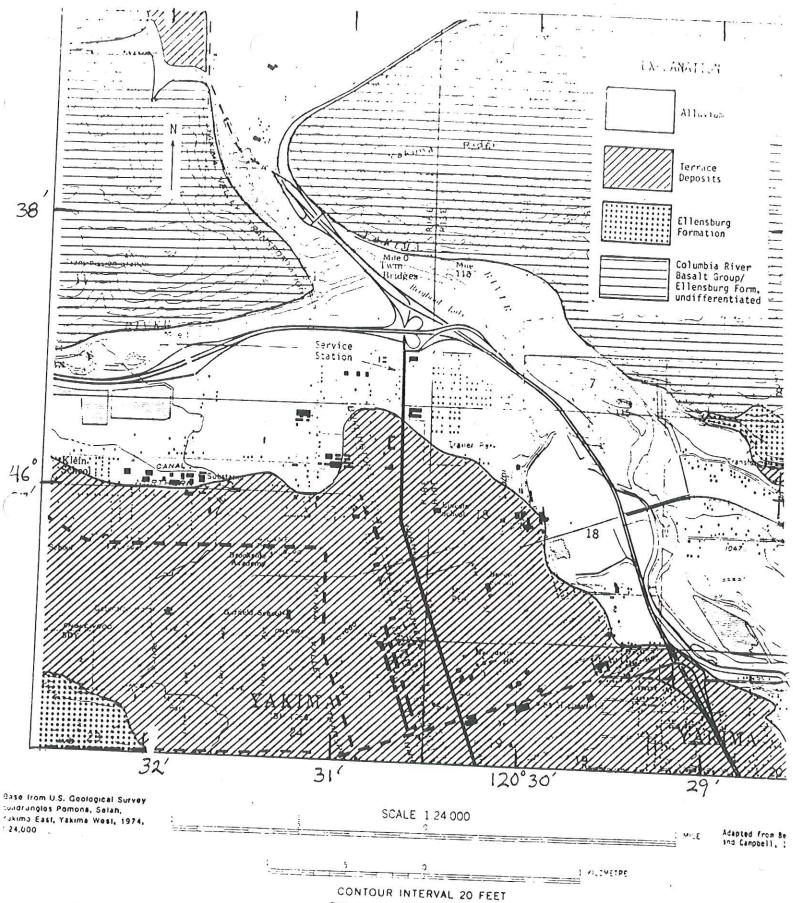


Figure 1.--Location of the gasoline and dieselfuel leak site at Yakima, Washington.



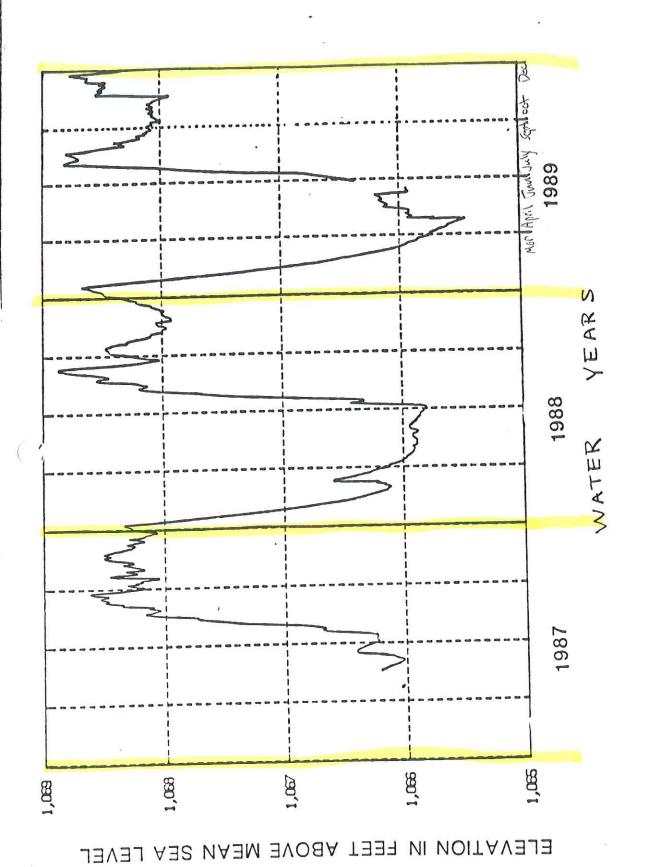
Cross-sections A-A' and B-B' Figure 2.--Subbasin formed by the Ahtanum and Moxee Valleys, Washington. shown on figure 3.





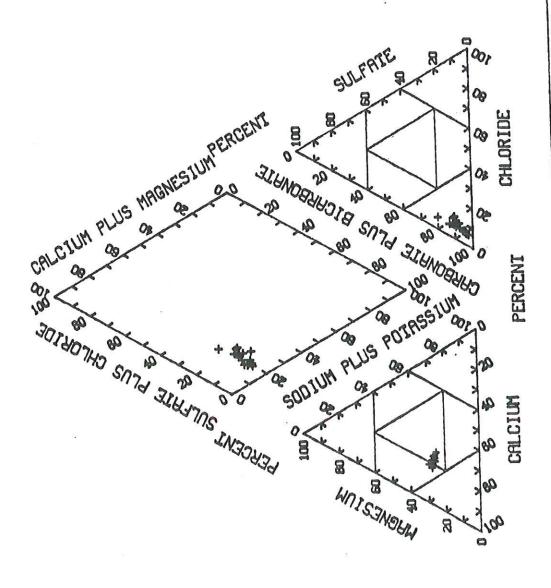
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Figure 4. -- Surficial geology near the Study site

of the terminal to July, 1986 at the study site

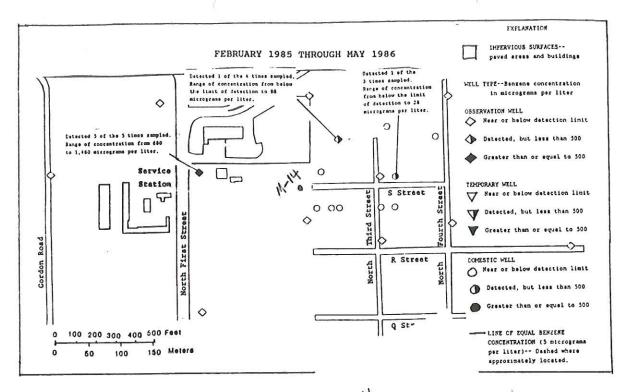


1989. Water year ending septem I mul surface elevation is 1076.14 foot shove cealeve Figure 6 .-- Mean daily observed water levels

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ground water, , , major ions ch 1989. March Figure 7. -- Percentage Jana Jana



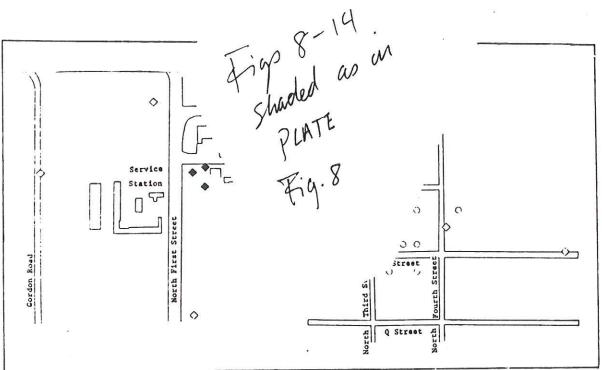
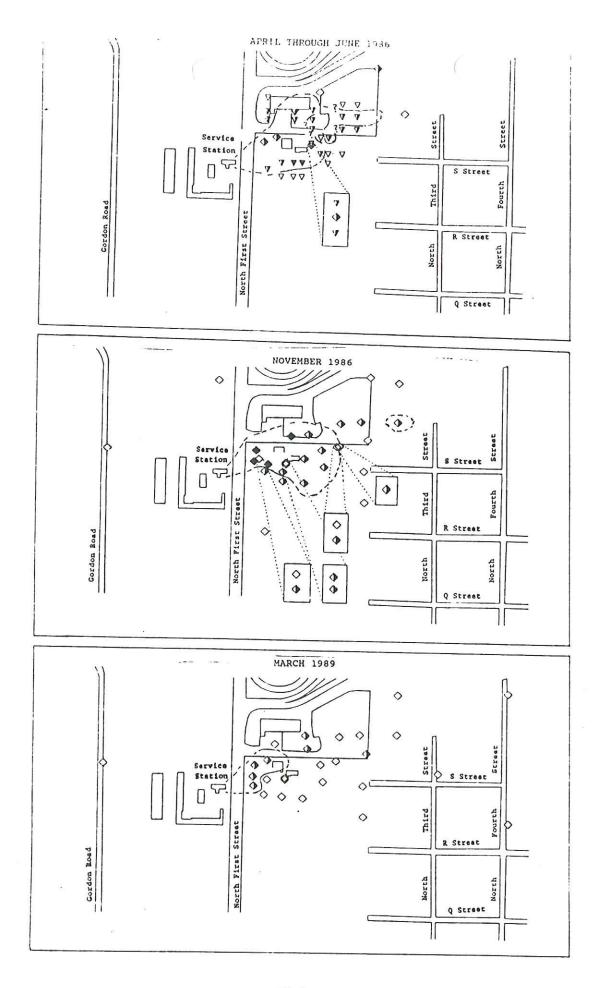
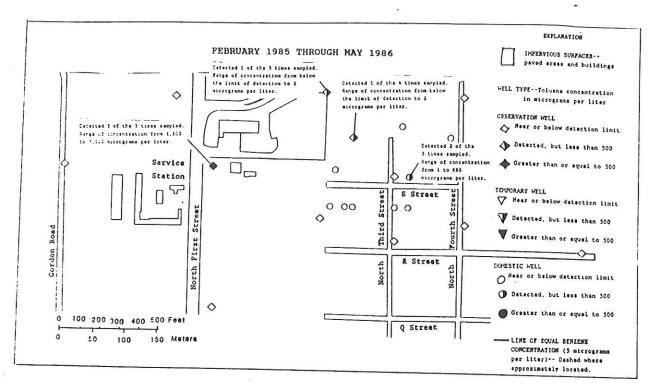


Figure 8. -- Concentrations of benzene in ground water, February 1985 through March 1989.





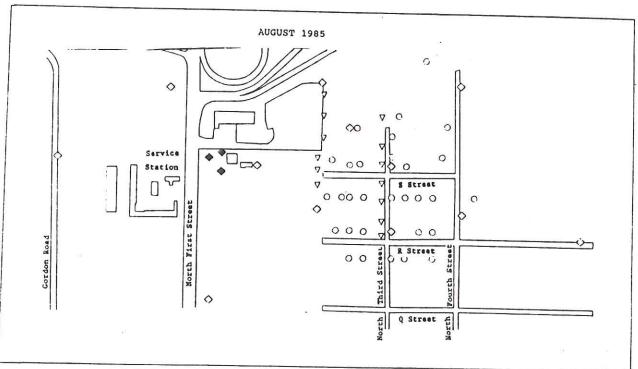
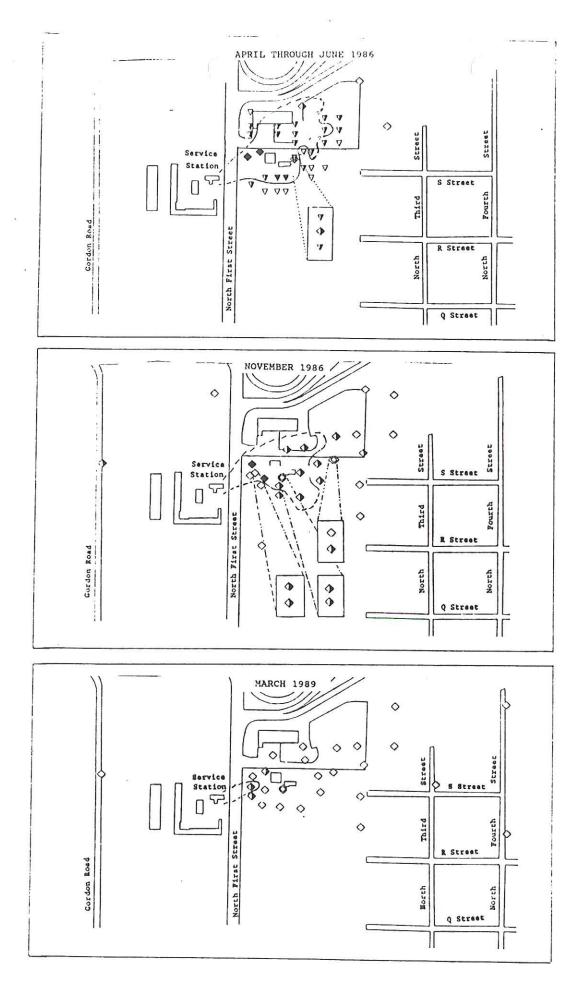
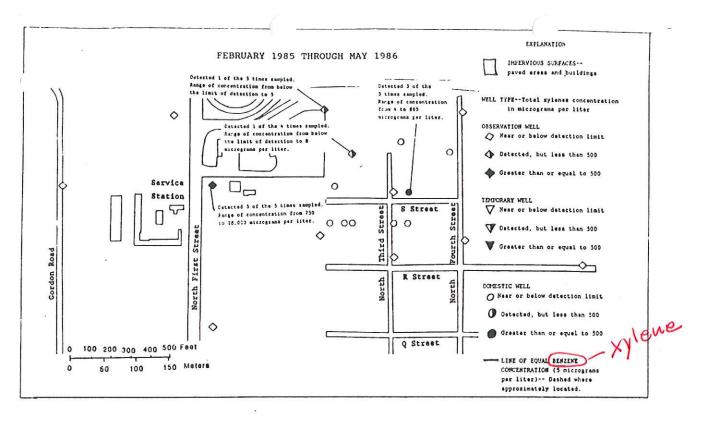


Figure 9. -- Concentrations of toluene in ground water, February 1985 through March 1989.





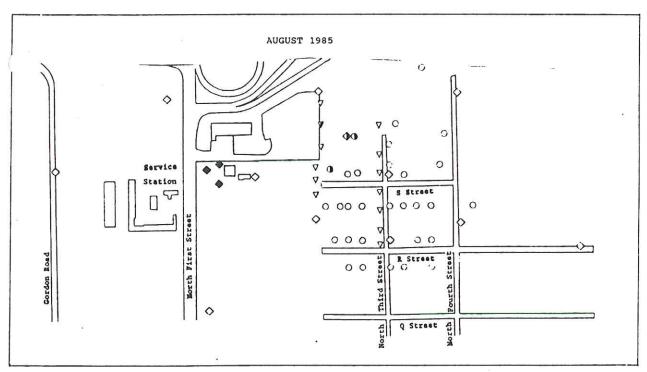
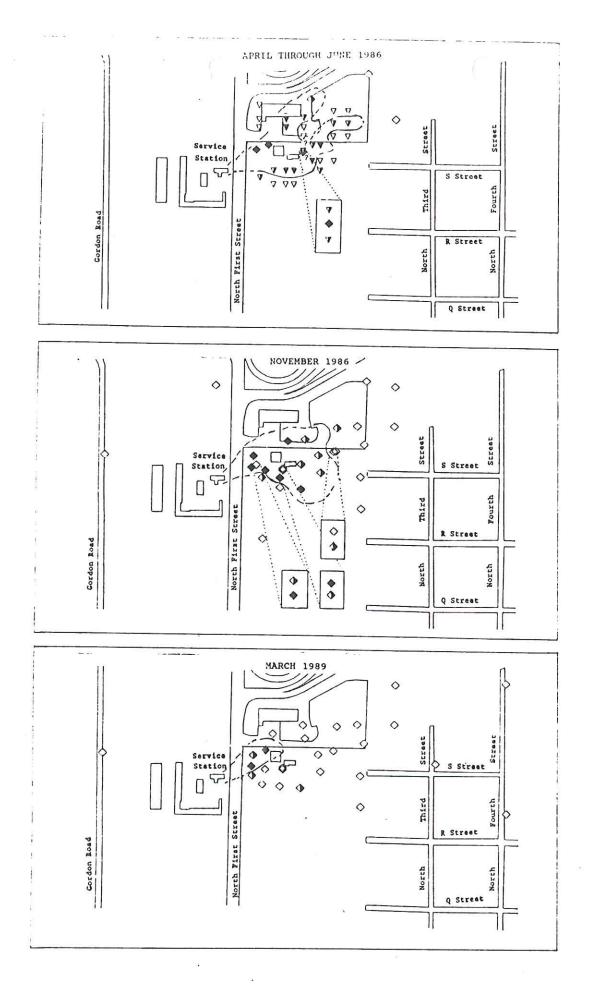
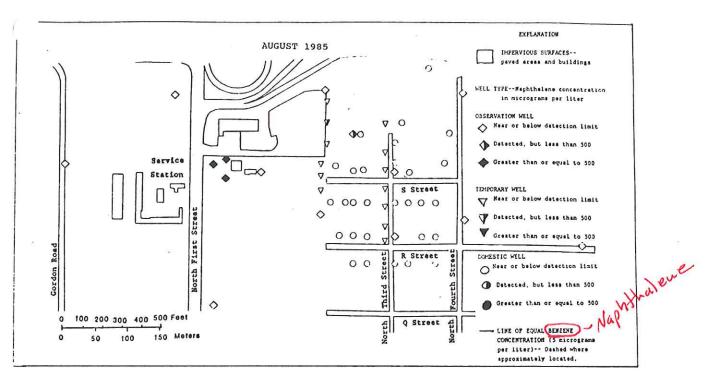


Figure 10. -- Concentrations of total xylenes in ground water, February 1985 through March 1989.





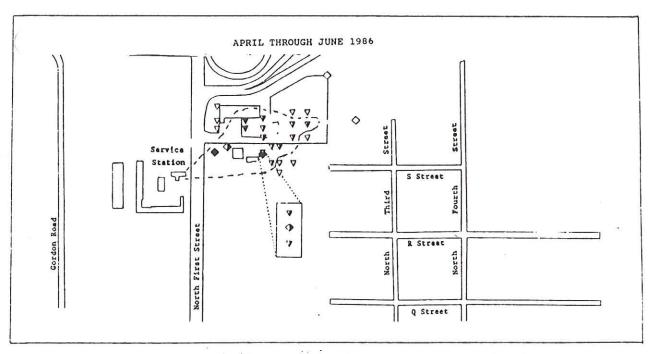
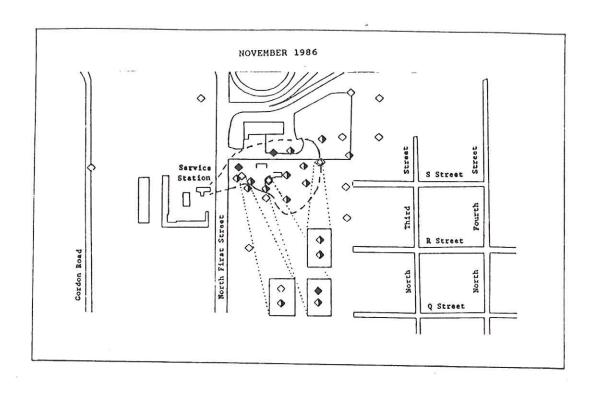
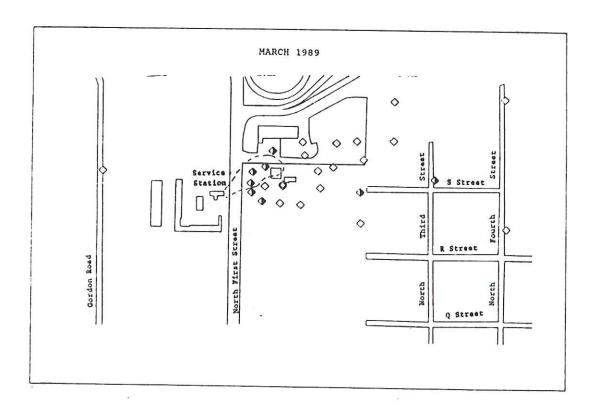


Figure 11. -- Naphthalene concentrations in ground water, August 1985 through March 1989.





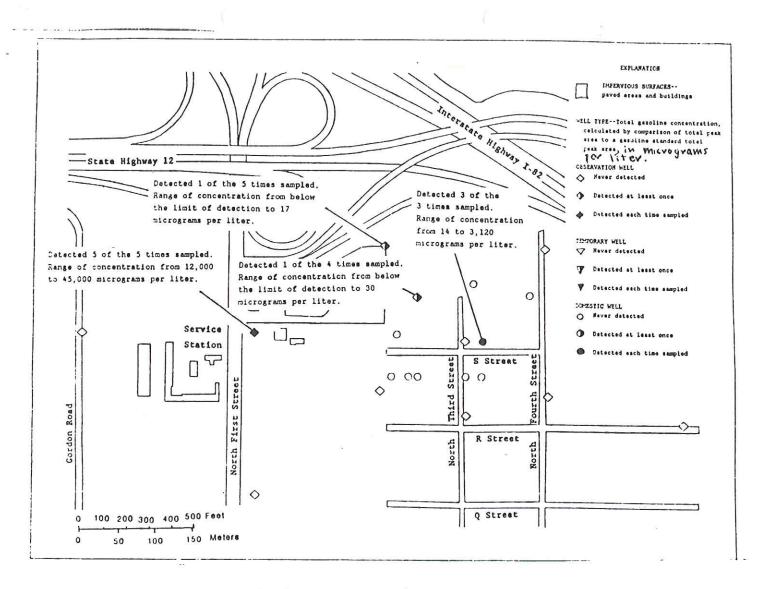
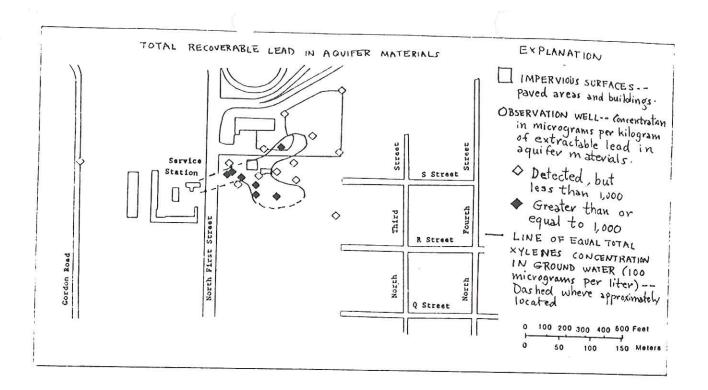


Figure 12. -- Concentrations of total gasoline in ground water, February 1985 through May 1986.



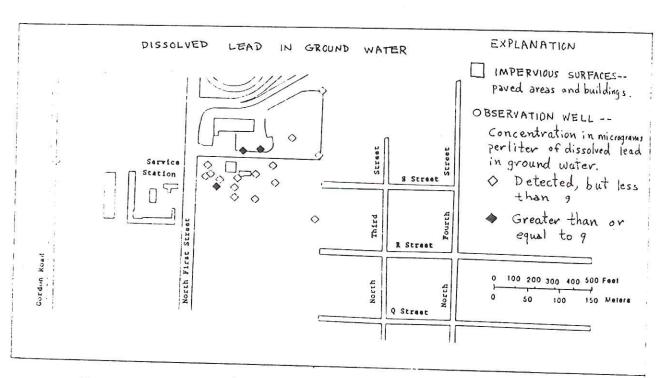
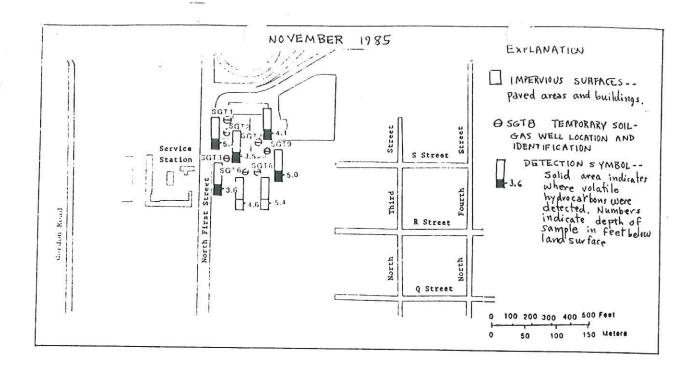


Figure 13. -- Concentrations of total-recoverable, lead in aquifer material and dissolved lead in ground water, November 1986.



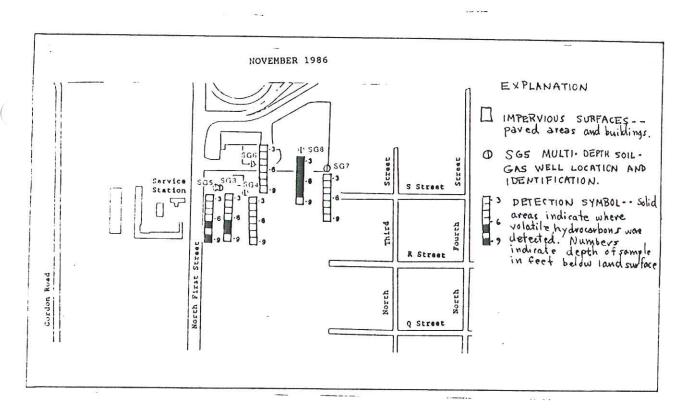


Figure 14. -- Locations of temporary soil-gas samples collected November 1985 and multi-depth soil-gas samples collected November 1986.

Table 1.--Physical properties of selected aromatic hydrocarbons

[Solubilities at 20 °C unless otherwise indicated; mg/L, milligrams per liter; mm, millimeters; (K_{OW}), octanol-water partition coefficients; --, not available; from Weast, 1982 and Verschueren, 1983]

	Aqueous solubili				Vapor pressure	Log K _{ow}	Molecular
Compound	(mg/L)			(mm	of Mercury)	weight
Benzene	1,780				76	2.13	78.11
Toluene	515				22	2.69	92.13
o-Xylene	175				5	2.77	106.17
m-Xylene					6	3.20	106.17
p-Xylene	198	(at	25	°C)	6.5	3.15	106.17
Ethylbenzen	152				7	3.15	106.17
Naphthalene	34.	4			0.05	3.37	128,17

PRELIMINARY SUBJECT TO REVISIONS

[N/A, not available; land surface elevation is in feet above sea level; depth, in feet below land surface, indicates screened interval or bottom depth of an open-ended casing; letters in well identifiers in this report signify the following: M, observation well; T, temporary well; D, domestic well; SG, multidepth soil-gas well; SGT, temporary soil-gas well. All domestic wells were sampled at an outside spigot unless suffixed with a K (sampled at kitchen sink) or I (irrigation well, sampled at wellhead)]

	Site identifiers	1	Land		
This report	WATSTORE	Other reports	surface elevation	Depth	Comments
M1-82	13N/18E-12R01	1	1078.06	6.0 - 15.6	
M2-82	13N/18E-12R02	2	1077.93	6.6 - 16.1	Identified as 3-82 (Fish, 1987
M3-82	13N/18E-12R03	3	1076.86	6.0 - 15.8	1, 44,1, 1,70
M1-85	13N/18E-12R04	1-85, MW-1	1080.48	6.0 - 21.0	
M2-85	13N/19E-07N01	2-85, MW-2	1067.51	3.5 - 18.5	
M3-85	13N/19E-07N02	3-85, MW-3	1072.62	4.1 - 19.1	
M4-85	13N/18E-12R05	4-85, MW-4	1075.66	4.1 - 19.1	
M5-85	13N/19E-07N03	5-85, MW-5	1069.66	1.8 - 16.8	
M6-85	13N/19E-07N04	6-85, MW-6	1071.52	4.3 - 19.4	
M7-85	13N/19E-07N05	7-85, MW-7	1072.48	4.2 - 19.2	
M8-85	13N/19E-07N06	8-85, MW-8	1075.70	5.0 - 20.0	
M9-85	13N/18E-12R06	9-85, MW-9	1075.48	4.8 - 19.8	
M10-85	13N/18E-12R07	10-85, MW-1	1076.37	4.3 - 19.3	
M11-85	13N/18E-12R08	11-85, MW-11	1077.67	5.5 - 20.5	
M12-85	13N/18E-12R09	12-85, MW-12	1078.49	6.4 - 21.4	
м1	13N/18E-12R12	т1	1077.43	55.0 - 58.0	
M2	13N/18E-12R13	T 2	1077.65	28.0 - 30.0	SG1 also in same borehole
м3	13N/18E-12R14	Т3	1077.65	28.0 - 30.0	SG2 also in same borehole
M4	13N/18E-12R15	T4	1077.02	3.8 - 12.0	
M5	13N/18E-12R16	T5	1078.39	13.9 - 15.9	SG3 also in same borehole
M6.1	13N/18E-12R17	т6.1	1077.39	44.6 - 46.6	[Piezometers M6.1 and M6.2 are in the same hole]
M6.2	13N/18E-12R18	T6.2	1077.11	7.6 - 13.6	,
M7.1	13N/18E-12R19	T7.1	1078.11	30.3 - 32.3	[Piezometers M7.1 and M7.2 are in the same hole]
M7.2	13N/18E-12R20	T7.2	1078.11	7.3 - 13.3	The state of the state of
м8	13N/18E-12R21	Т8	1078.22	8.4 - 14.4	
м9	13N/18E-12R22	Т9	1078.07	7.0 - 13.0	
M10	13N/18E-12R23	Т10	1077.81	8.3 - 14.3	
M11	13N/18E-12R24	T11	1077.65	8.4 - 14.2	
M12	13N/18E-12R25	T12	1078.09	7.4 - 13.4	
M13	13N/18E-12R26	T13	1078.09	30.5 - 32.3	SG4 also in same borehole
M14	13N/18E-12R27	T14	1076.14	6.8 - 12.8	
M16	13N/18E-12R28	T16	1078.09	7.9 - 13.9	
M17	13N/18E-12R29	T17	1078.36	7.7 - 13.7	
M18	13N/18E-12R30	T18	1077.70	7.1 - 13.1	
M19	13N/18E-12R31	T19	1078.12	7.8 - 13.8	
M20	13N/18E-12R32	T20	1078.26	7.2 - 13.2	
M21	13N/18E-12R33	T21	1077.70	56.3 - 58.3	
M22	13N/18E-12R34	T22	1077.50	6.7 - 12.7	
M23	13N/18E-12R39	81	1077.10	6.5 - 12.5	
M24	13N/18E-12R40	B2	1076.16	7.6 - 13.6	
	13N/18E-12R41	В3	1076.08	30.3 - 32.3	SG6 also in same borehole
M26	13N/18E-12R42	84	1076.58	8.0 - 14.0	recover Walderson Dir Colonies (District State)
M27	13N/18E-12R43	85	1076.79	9.0 - 18.0	
	13N/18E-12R35	S1	1077.03	54.0 - 56.5	SG7 also in same borehole
	13N/18E-12R36	S 2	1076,99	7.7 - 16.8	The same solutions
	13N/18E-12R37	S 3	1076.89	7.8 - 16.8	
	13N/18E-12R38	S 4	1077.74	8.6 - 17.4	
	13N/19E-07N08	н1	1075.13	55.0 - 57.0	
	2017년 내전11 - 현재(14)	93951			

This report WATSTORE M35 13N/18E-12R11 M36 13N/18E-12R44 M37 13N/19E-07N07 M39 13N/19E-07N07 M39 13N/19E-07M01 T1 13N/19E-07M04 T2 13N/19E-07N10 T3 13N/19E-07N11		rs	Land		
This report	WATSTORE	Other reports	surface elevation	Depth	Comments
	13N/18E-12R11	WS1	1078.63	57.0 - 59.0	
	13N/18E-12R44	T1, GS1	1077.85	6.0 - 13.0	Estimated screen interval
	13N/18E-12R45	B1, GS2	1077.53	6.0 - 13.0	Identified as GS1 (Fish, 1987)
		3/R	1072.58	54.2 - 56.2	(12011) 1707
		HWY1	1078,22	N/A	
M40	13N/19E-07M01	HWY2	1078.35	N/A	
Tl	13N/19E-07M04	8T1-1			
T2	13N/19E-07N10	8T1-2			
T3	13N/19E-07N11	8T1-3			
T4	13N/18E-12R46	8T1-4			
T5	13N/18E-12R47	8T1-5			
T6	13N/18E-12R48	8T1-6			
T7	13N/19E-07N12	8T2-2			
T8	13N/19E-07N13	8T2-3			
Т9	13N/19E-07N14	8T2-4			
T10	13N/19E-07N15	8T2-5			
T11	13N/19E-07N16	8T2-6			
T12	13N/19E-07N17				
T13	13N/19E-07N18	8T2-7 8T2-8			
T14	13N/18E-12R51				
T15	13N/18E-12R52	7-5			
T16	13N/18E-12R53	8-5			
T17	13N/18E-12R54	9-7.5			
T18		8-4			
	13N/18E-12R55	9-4			
T19	13N/18E-12R56	1.5-1.5			
T20	13N/18E-12R57	8-3			
T21	13N/18E-12R58	7-4			
T22	13N/18E-12R59	5-3			
T23	13N/18E-12R60	5-2			
T24	13N/18R-12R61	4-2			
T25	13N/18E-12R62	4 – 3			
T26	13N/18E-12R63	3-2			
T27	13N/18E-12R64	3-3			
T28	13N/18E-12R65	6-7			
	13N/18E-12R66	1 - 8			
	13N/18E-12R67	1-9			
	13N/18E-12R68	1-10			
	13N/18E-12R69	6-8			
	13N/18E-12R70	6 - 9			
T34	13N/18E-12R71	4 - 8			
T35	13N/18E-12R72	4-9			
T36	13N/18E-12R73	11-8.5			
T37	13N/18E-12R74	11-9.5			
	13N/18E-12R75	11-7.5			
	13N/18E-12R76	9-8.5			
	13N/18E-12R77	9-9.5			
	13N/18E-12R89	(1 m north of M36)	1078	2	
	13N/18E-12R90	(1.3 m south of M36)	1078		
D1	13N/19E-07M03	H1-01		25	
	13N/19E-07N19	H4-03-(I)			
	13N/19E-07N20	H4-06-(K)		20	
1000000	13N/19E-07N20			28	
1990020		H4-06-(I)		13	
	13N/19E-07N22	H4-01		N/A	
	13N/19E-07N23	H3-08-(I), H3-07-(I)		70	
07	13N/19E-07N24	H3-10-(I), H3-09-(I)		20	

Site identifiers		8		Land			
This report	WATSTORE	Other reports		surface elevation		Depth	Comments
D8	13N/19E-07N25	H3-11-(I)			20		
	13N/19E-07N26	H4-07			20		
	13N/19E-07N27	H4-08			80		
	13N/19E-07N28	H4-11			65		
D12	13N/19E-07N29	H6-05			18		
D13	13N/19E-07N30	H6-04-(I)			25		
D14	13N/19E-07N31	H6-03-(I)		•	23	N/A	
D15	13N/19E-07N32	H6-01				N/A	
D16	13N/19E-07N33	H5-06				N/A	
D17	13N/19E-07N34	H5-05-(I)		3	28	N/A	
D18	13N/19E-07N35	H5-04-(I)			28		
D19	13N/19E-07N36	H5-02			20	M/A	
	13N/19E-07N02	IK6-06-(I)		5	30	N/A	
	13N/19E-07N37	82-05		,	-0	N/A	
D22	13N/19E-07N38	82-03		•	21	MAM	
D23	13N/19E-07N39	B2-01		2	. 1	N/A	
D24	13N/19E-07N40	B1-04		2	36	MAM	
D25 1	13N/19E-07N41	81-01			26		
026	3N/19E-07N42	B3-05		2	0	****	
D27 1	3N/19E-07N43	B3-03				N/A	
D28 1	3N/19E-07N44	B3-01				N/A	
D29 1	3N/19E-07N45	B4-06			0		
	3N/19E-07N46	B4-05		3	8		
	3N/19E-07N47	B4-01				N/A	
	3N/18E-12R97	Mesa	1079.47			N/A N/A	(Water levels only)
SG1 1	3N/18E-12R91	Т2	1077.43				Sampling tubes installed
SG2 1	3N/18E-12R92	Т3	1077.65				above the well screem M2) Sampling tubes installed
SG3 1	3N/18E-12R93	Т5	1078.02				above the well screen (M3) Sampling tubes installed
SG4 1	3N/18E-12R94	T13	1078.09				above the well screen (M5) Sampling tubes installed
SG5 1	3N/18E-12R87	T15	1078.19				above the well screen (M13 Multidepth soil-gas sampler
SG6 1.	3N/18E-1-2R95	83	1076.08				only Sampling tubes installed
SG7 1:	3N/18E-12R96	Sl	1077.03				above the well screen (M25) Sampling tubes installed
SG8 1:	3N/18E-12R88	\$5	1077.65				above the well screen (M28) Multidepth soil-gas sampler
	3N/18E-12R81	1-9		4	5.6	7	only
	3N/18E-12R81	1-7			3.4		
	N/18E-12R79	1-4			3.5		8 ¥
	N/18E-12R78	1-2				o 5 (est	imated
	N/18E-12R82	2-5			3.4		Imac ed)
	N/18E-12R83	3-2			1.5		
	N/18E-12R84	4-6			1.1		
	N/18E-12R85	4-2			. 3		
GT9 13	N/18E-12R86	5-5			. 9	•	

Table 3 .-- Major hydrogeologic units in the Ahtanum-Moxee subbasin. Washington

System	Series	Group	Formation	Hydrogeologic description
ыгу	Holocene			Alluvium and terrace deposits consisting principally of unconsolidated stream deposits of silt, sand, and gravel, with cobbles throughout. Locally lacustrine, paludal, and eolian deposits occur. Generally, deposit is a thin mantle less than 50 feet thick, but known to reach 165 feet thick at one point in subbasin. Estimates of porosity range from 15 to 25 percent and from 0.4 to 86 feet per day hydraulic conductivity.
Quaternary	Pleistocene			Coarse sand and gravel deposits including large amounts of cemented mixture of basaltic gravel, sand, silt, and clay. Locally contains discontinous and unconsolidated bodies of glacial fluvial and lacustrine deposits. Up to 500 feet in thickness. In general unit has low permeability except in unconsolidated sections.
ıry	Pliocene		Ellensburg	A thick sequence of stream- and lake-deposited silt, sand, and gravel which is composed chiefly of volcanic ash, pumice, and hornblende andesite. Thickness exceeds 1,000 feet in some parts of subbasin. It has moderate to high porosity and low to medium permeability, and provides a large amount of effective storage. Permeable strata form important aquifers. Unit includes all conformably underlying sediments of similar lithology that intertongue with flows of the Columbia River Basalt.
Tertlary	Micocene to Pliocene		Saddle Mountains	Sequence of dark lava flows which contains some interbedded lake- and stream-deposited materials. Individual lava flows range from less than 20 to over 200 feet in thickness. The maximum thickness of the Columbia River Basalt exceeds 4,000 feet in the Yakima River
		Columbia River Basalt	Wanapum Grande Ronde	Basin. Water generally moves along the interflow zones, which are more permeable than the massive centers of the flood. The porosity of this formation probably ranges from 5 to 10 percent, and its permeability ranges from low to very high. Provides a large quantity of effective ground-water storage and includes some important aquifers.

Chemical Abstract Services Registry Number

Compound

Ground-water Toxics Study

Desgage	71-43-2
Benzene	108-88-3
Toluene	106-93-4
Ethylene bromide	100-41-4
Ethylbenzene	108-38-3
m-Xylene	95-47-6
o-Xylene	106-42-3
p-Xylene	105-65-1
n-Propylbenzene	-
1,2,3-Trimethylbenzene	526-73-8
1, 2, 4-Trimethylbenzene	95-63-6
1,3,5-Trimethylbenzene	108-67-8
t-Butylbenzene	98-06-6
Isobutylbenzene	538-93-2
sec-Butylbenzene	135-98-8
1-Isopropyl-4-methylbenzene	99-87-6
n-Butylbenzene	104-51-8
1,2,3,5-Tetramethylbenzene	527-53-7
1,2,3,4-Tetramethylbenzene	488-23-3
Naphthalene	91-20-3
2-Ethyl-1-methylbenzene	611-14-3
1,4-Dimethyl-2-ethylbenzene	175-88-89
1, 3-Dimethyl-4-ethylbenzene	874-41-9

March 1989 Study

Benzene	71-43-2
Bromobenzene	108-43-2
Bromochloromethane	74-97-5
Bromodichloromethane	75-27-4
	75-25-2
Bromoform	74-83-9
Bromomethane	104-51-8
n-Butylbenzene	135-98-8
sec-Butylbenzene	98-06-6
tert-Butylbenzene	56-23-5
Carbon tetrachloride	108-90-7
Chlorobenzene	75-00-3
Chloroethane	67-66-3
Chloroform	74-87-3
Chloromethane	
2-Chlorotoluene	95-49-8
4-Chlorotoluene	106-43-4
Dibromochloromethane	124-48-1
1,2-Dibromo-3-chloropropane	96-12-8
1,2-Dibromoethane	106-93-4
Dibromomethane	74-95-3
1,2-Dichlorobenzene	95-50-1
1,3-Dichlorobenzene	541-73-1
1,4-Dichlorobenzene	106-46-7
Dichlorodifluoromethane	75-71-8

Table 4.--Target compounds in water analyzed for volatile organic compounds by the purge and trap method--Continued

Compound	Chemical Abstract Services Registry Number
1,1-Dichloroethane	75-34-3
1,2-Dichloroethane	107-06-2
1,1-Dichloroethene	75-35-4
cis-1,2-Dichloroethene	156-59-4
trans-1,2-Dichloroethene	156-60-5
1,2-Dichloropropane	78-87-5
1,3-Dichloropropane	142-28-9
2,2-Dichloropropane	590-20-7
1,1-Dichloropropene	563-58-6
Ethylbenzene	100-41-4
Hexachlorobutadiene	87-68-3
Isopropylbenzene	98-82-8
p-Isopropyltoluene	99-87-6
Methylene chloride	75-09-2
Naphthalene	91-20-3
n-Propylbenzene	105-65-1
Styrene	100-42-5
1,1,1,2-Tetrachloroethane	630-20-6
1,1,2,2-Tetrachloroethane	79-34-5
Tetrachloroethene	127-18-4
Toluene	108-88-3
1,2,3-Trichlorobenzene	87-61-6
1,2,4-Trichlorobenzene	120-82-1
1,1,1-Trichloroethane	71-55-6
1,1,2-trichloroethane	79-00-5
Trichloroethene	79-01-6
Trichlorofluoromethane	75-69-4
1,2,3-Trichloropropane	96-18-4
1,2,4-Trimethylbenzene	95-63-6
1,3,5-Trimethylbenzene	108-67-8
Vinyl chloride	75-01-4
o-Xylene	95-47-6
m-Xylene	108-38-3
p-Xylene	106-42-3
1,2,3,5-Tetramethylbenzene ¹	527-53-7
1, 2, 3, 4-Tetramethylbenzene	488-23-3
2-Ethyl-1-methylbenzene ¹	611-14-3
1,2,3-Trimethylbenzene ¹	526-73-8
1,4-Dimethyl-2-ethylbenzene ¹ ,	175-88-89

 $^{^{\}mathrm{l}}$ Standards for the quantification of this compound were added to the laboratory procedure of EPA Method 524.2

 $^{^2\}mathrm{This}$ compound co-elutes with 1,3-Dimethyl-4-ethylbenzene

Table 5.--Concentrations of inorganic compounds in ground water. November 1986 and March 1989 [Concentrations are in mg/L, milligrams per liter or μg/L, micrograms per liter, unless otherwise noted: --, not analyzed].

Well identi- fier	Date	Time	Spe- cific con- duct- ance (µs/cm)	pH (stand- ard units)	Temper- ature (°C)	Tur- bid- ity (NTU)	Oxygen, dis- solved (mg/L)	Hard- ness (mg/L as CaCO ₃)	Hard- ness, noncarbonate (mg/L as CaCO ₃)
M1-82	11-18-86	1215	280	6.8	15.0		<0.5	120	0
M2-82	11-18-86	1430	320	6.7	14.0		<0.3	130	0
M1-85	11-19-86	1230	238	6.7	14.5		5.7	100	0
	03-13-89	1015	208	6.9	11.5	1.7	8.5	88	0
M5-85	03-13-89	1715	252	6.7	9.5	27	3.1	110	0
M9-85	11-19-86	1130	254	6.5	14.0		0.4	100	0
117 00	03-15-89	1515	249	6.5	13.0	5.2	0.2	100	0
M10-85	11-19-86	1000	298	6.6	14.5	-	2.2	120	5
M11-85	11-17-86	1155	264	6.6	16.0		0.0	100	0
1111 03	03-18-89	1530	292	6.6	15.0	19	0.2	120	0
м4	11-18-86	1110	313	6.6	15.5		1.2	110	0
M7.2	11-17-86	0945	352	6.4	15.5		0.0	140	0
м8	11-17-86	1450	247	6.6	14.5		1.7	100	0
м9	11-17-86	1555	279	6.6	15.0		0.0	110	0
M11	11-18-86	1000	307	6.6	15.0		0.3	120	0
M12	11-18-86	1345	323	6.5	16.0		0.0	130	0
M16	11-17-86	1115	342	6.7	16.0		0.0	140	0
M18	11-18-86	0930	292	6.6	15.0		0.7	120	0
	03-17-89	1030	319	6.7	13.0	40	0.0	130	0
M19	11-18-86	0805	257	6.6	15.0		2.7	100	0
M23	11-18-86	1630	390	6.7	16.0		0.7	170	0
M24	11-18-86	1430	365	6.5	15.0		0.0	140	0
M29	11-19-86	0830	259	6.6	14.5		0.3	110	0
м30	03-14-89	1730	268	6.6	12.0	0.4	0.8	120	0
м31	11-19-86	0930	261	6.5	15.0		0.3	110	0

PRELIMINARY SUBJECT TO REVISIONS

Table 5.--Concentrations of .norganic compounds in ground water. November 1986 and March 1989--Cont.

		Magne-				Potas-		5 3
	Calcium,	sium,	Sodium		Sodium	sium,	Alka-	Sulfate,
	dis-	dis-	dis-		ad-	dis-	linity,	dis-
Well	solved	solved	solved		sorp-	solved	field	solved
identi-	(mg/L	(mg/L	(mg/L	Sodium	tion	(mg/L	(mg/L as	(mg/L
fier	as Ca)	as Mg)	as Na)	percent	ratio	as K)	CaCO ₃)	as SO ₄)
M1-82	31	10	13	19	0.5	3.3	131	8.5
M2-82	34	11	12	16	0.5	3.3	156	5.8
M1-85	26	8.5	11	19	0.5	2.3	103	12
252/1215	23	7.5	12	22	0.6	2.4	89	11
M5-85	29	9.5	13	20	0.6	2.2	113	12
M9-85	27	8.9	12	20	0.5	2.6	108	12
	27	8.9	12	20	0.5	2.5	112	12
M10-85	32	10	14	20	0.6	2.6	116	15
M11-85	27	8.9	11	18	0.5	2.7	125	19
	31	10	12	18	0.5	2.3	140	11
M4	30	9.6	17	24	0.7	3.7	151	16
M7.2	37	12	13	16	0.5	3.4	185	2.3
м8	27	8.9	12	19	0.5	3.3	105	13
M9	29	9.6	12	18	0.5	3.2	133	13
M11	33	10	14	19	0.6	3.5	148	8.3
M12	35	11	1 3	17	0.5	3.5	164	4.0
M16	38	12	1 4	17	0.5	3.8	172	7.6
M18	30	9.8	12	18	0.5	3.3	149	5.5
	32	11	12	17	0.5	2.6	132	34
М19	26	8.7	13	21	0.6	2.7	105	14
M23	45	14	15	16	0.5	3.9	193	8.4
M24	38	12	15	18	0.6	3.7	190	2.9
M29	28	8.8	13	20	0.6	3.5	120	14
M30	31	10	13	19	0.5	2.7	128	11
M31	28	9.1	12	19	0.5	2.6	113	12

PREPARABLY SUBJECT TO REVISIONS

Table 5.--Concentrations of inorganic compounds in ground water. November 1986 and March 1989--Cont.

					Solids,	Solids,	Nitro-	Nitro-	Phos-
	Chlo-	Fluo-		Silica,	residue	sum of	gen,	gen,	phorus
	ride,	ride,	Bromide,	dis-	at	consti-	NO2+NO3	ammonia, dis-	ortho,
	dis-	dis-	dis-	solved	180 °C,	tuents,	dis-	solved	solved
Well	solved	solved	solved	(mg/L	dis- solved	dis- solved	(mq/L	(mg/L	(mg/L
denti-	(mg/L	(mg/L	(mg/L	as		(mg/L)	(mg/L as N)	as N)	as P
fier	as Cl)	as F)	as Br)	sio ₂)	(mg/L)	(mg/L)	as 11)	as 117	as r
M1-82	6.2	0.2	0.026	37		190	<0.10	<0.01	0.03
M2-82	6.9	0.2	0.032	40		213	<0.10	0.09	<0.01
M1-85	5.4	0.2	0.034	26		157	0.68	<0.01	0.02
00	6.2	0.2		25	136	145	0.91	<0.01	0.02
M5-85	6.5	0.2		33	166	176	0.64	<0.01	0.02
M9-85	5.8	0.2	0.033	33		169	0.49	<0.01	0.02
	6.7	0.2	1.55	32	168	171	0.50	<0.01	0.06
M10-85	8.6	0.2	0.039	30		190	1.8	<0.01	0.02
M11-85	6.1	0.2	0.039	40		196	<0.10	0.06	0.02
1112	7.1	0.2		36	186	200	0.10	0.08	0.06
м4	7.2	0.2	0.037	43		227	<0.10	0.15	<0.01
M7.2	7.1	0.2	0.019	44		242	<0.10	0.16	<0.01
м8	5.6	0.2	0.034	32	-	170	1.1	<0.01	0.02
м9	6.1	0.2	0.027	34		190	<0.10	0.03	<0.01
M11	6.7	0.2	0.031	39		210	<0.10	0.03	0.02
M12	6.4	0.2	0.020	43		224	<0.10	0.13	<0.01
M16	7.9	0.2	0.030	44		242	<0.10	0.12	<0.01
M18	6.0	0.2	0.026	41		208	<0.10	0.11	<0.01
	7.0	0.2	3 00	38	209	227	<0.10	0.10	0.05
M19	5.6	0.2	0.028	32		171	1.3	<0.01	0.04
M23	10	0.2	0.029	50		274	<0.10	0.07	<0.01
M24	7.7	0.2	0.019	48		255	<0.10	0.18	<0.01
M29	6.3	0.2	0.033	34		183	<0.10	0.01	0.02
M30	6.9	0.2	()	32	172	188	0.93	<0.01	0.05
M31	6.7	0.2	0.033	32		174	0.54	<0.01	<0.01

Table 5 .-- Concentrations of inorganic compounds in ground water. November 1986 and March 1989--Cont.

Well denti- fier	Barium, dis- solved (µg/L as Ba)	Beryl- lium, dis- solved (µg/L as Be)	Cadmium, dis- solved (µg/L as Cd)	Chro- mium, dis- solved (µg/L as Cr)	Cobalt, dis- solved (µg/L as Co)	Copper, dis- solved (µg/L as Cu)	Iron, dis- solved (µg/L as Fe)	Lead, dis- solved (µg/L as Pb)	Lithium, dis- solved (µg/L as Li)
M1-82	11	<0.5	<1		<3	<10	65	<10	5
M2-82	16	<0.5	<1		<3	<10	4,000	< 10	5
M1-85	7	<0.5	<1		<3	<10	3	<10	5
	8	<0.5	<1	< 5	<3	<10	15	< 10	< 4
M5-85	9	<0.5	<1	<5	<3	<10	14	<10	< 4
M9-85	8	<0.5	<1		<3	<10	<3	<10	5
	9	<0.5	<1	<5	<3	<10	11	< 10	< 4
M10-85	10	<0.5	<1		<3	<10	<3	<10	6
M11-85	13	<0.5	<1		<3	<10	3,400	< 10	<4
	16	<0.5	<1	< 5	<3	<10	3,700	10	< 4
M4	16	<0.5	1		<3	<10	6,200	<10	4
M7.2	17	<0.5	1		<3	<10	9,100	<10	5
M8	8	<0.5	<1		<3	<10	12	< 10	4
м9	12	<0.5	< 1		<3	<10	1,500	<10	4
M11	21	<0.5	<1		<3	<10	1,700	<10	4
M12	14	<0.5	<1		<3	<10	6,400	10	5
M16	11	<0.5	1		< 3	<10	7,400	< 10	6
M18	12	<0.5	< 1		<3	<10	8,100	< 10	4
	18	<0.5	<1	< 5	4	< 10	7,300	<10	6
M19	10	<0.5	<1		<3	<10	7	<10	5
M23	22	<0.5	< 1		<3	<10	5,800	<10	5
M24	20	<0.5	<1		<3	<10	9,700	< 10	5
M29	15	<0.5	< 1		<3	<10	1,300	<10	4
м30	10	<0.5	< 1	<5	<3	<10	7	< 10	< 4
M31	11	<0.5	<1		<3	<10	10	<10	5

Table 5.--Concentrations of inorganic compounds in ground water, November 1986 and March 1989--Cont.

Well identi- fier	Manga- nese, dis- solved (µg/L as Mn)	Molyb- denum, dis- solved (µg/L as Mo)	Nickel, dis- solved (µg/L as Ni)	Silver, dis- solved (µg/L as Ag)	Stron- tium, dis- solved (µg/L as Sr)	Vana- dium, dis- solved (µg/L as V)	Zinc, dis- solved (µg/L as 2n)	
M1-82	1,600	<10			120	<6	5	
M2-82	1,900	<10			140	<6	8	
M1-85	<1	<10			95	<6	8	
111 00	16	<10		<1	87	<6	130	
M5-85	2	<10		<1	110	<6	52	
M9-85	28	<10			100	<6	<3	
.,,,	85	<10	<10	<1	100	<6	100	
M10-85	<1	<10			120	< 6	<3	
M11-85	2,400	<10			110	< 6	6	
	1,900	<10	<10	<1	130	<6	5	
M4	3,400	<10			140	<6	7	
M7.2	2,300	<10			150	< 6	10	
м8	3	<10		-	100	< 6	10	
м9	1,300	<10			120	< 6	10	
M11	4,700	<10			140	<6	11	
M12	2,500	<10)		150	<6	9	
M16	3,000	<10			170	<6	6	
M18	2,300	<10			130	< 6	5	
	2,800	<10	<10	< 1	150	<6	69	
M19	26	<10)		100	<6	<3	
M23	5,600	<10)		200	<6	7	
M24	3,700				170	< 6	4	
M29	1,900				120	<6	7	
M30	14			2	120	< 6	5	
M31	840				110	< 6	<3	

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Table 6.--Concentrations of atile organic compounds in ground water, february 1985 through June 1986

[Concentrations are in micrograms per liter; ND, below the detection limit of 1 microgram per liter].

Well identifier	Date	Benzene	Toluene	Total xylenes	Total hydrocarbons (as gasoline)
M1-85	2-21-85	ND	ND	ND	ND
	5-10-85	ND	ND	ND	ND
M2-85	2-21-85	ND	ND	ND	ND
	5-10-85	DИ	ND	ND	ND
M3-85	2-21-85	ND	ND	ND	ND
	5-11-85	ND	ND	ND	ND
M4-85	2-21-85	ND	ND	ND	ND
	5-11-85	ND	ND	ND	ND
M5-85	2-21-85	ND	ND	ND	ND ND
	5-10-85	ND	ND	ND ND	ND
M6-85	2-21-85	DИ	ND ND	ND	ND
	5-10-85	ND ND	ND	ND	ND
M7-85	2-21-85	ND	ND	ND	ND
	5-11-85 8-27-85	ND	ND	ND	ND
	12-16-85	ND	ND	ND	ND
	6-20-86	ND	ND	ND	ND
M8-85	2-21-85	ND	ND	ND	ND
M0-03	5-11-85	ND	ND	ND	ND
	8-27-85	96	1	9	230
	6-20-86	ND	ND	ND	ND
M9-85	2-21-85	ND	ND	ND	ND
112 00	5-11-85	ND	ND	ND	ND
	12-16-85	ND	ND	ND	ND
	6-20-86	ND	ND	ND	ND
M10-85	2-21-85	ND	ND	ND	ND .
	5-11-85	ND	2	5	17
	8-27-85	ND	ND	ND	ND
	12-16-85	ND	ИD	ND	ND
	6-20-86	ND	ND	ND	ND
M11-85	2-21-85	1,460	5,300	6,260	23,400
	5-11-85	1,240 ^a	5,850a	13,940 ^a	33,000ª
	8-27-85	920	1,100	6,300	12,000
	12-16-85	710	1,100	750	28,000
	6-20-86	680	7,000	18,000	45,000
M12-85	2-21-85	ND	, ND	ND	ND
M12-03	5-10-85	ND	ND	ND	ND
D3	2-19-85	ND	ND	ND	ND
03	3-25-85	ND	ND	ND	ND
	5-10-85	ND	ND	ND	ND
	6-25-85	ND	ND	ND	ND
	7-25-85	ND	ND	ND	ND
	12-16-85	ND	ND	ND	ND
	6-20-86	ND	ИD	ND	ND
D5	2-19-85	ND	ND	ND	ND
D6	2-19-85	ND	ND	ND	ND
010	2-19-85	ND	ND	5	14
	3-25-85	28	680	980	3,120
	5-10-85	ND	1	4	17
D12	2-19-85	ND	ND	סא	ND
013	2-19-85	ND	ND	ND	ND
D14	2-19-85	ND	ND	ND	ND
D16	2-19-85	ND	ND	ND	ND
D17	2-19-85	ND	ND	ND	ND

a Average of two values

present at proper retention time, but only one or two characteristic ions were present; NAB, concentration not above background (compound's characteristic ions were identified, but quantitative level was not greater than the average of travel blanks plus three standard deviations of the travel blanks); T, concentration is more than twice blank level, but less than twice the blank level plus three blank level standard deviations]. [Concentrations are blank-corrected and are in micrograms per liter; ND, concentration is below limit of detection, see text and table A3; 0 indicates compound detected, but not above blank levels; --, compound not specifically analyzed for; NQ, compound peak

M7.1	M6.2	M6.1	Z.	М2		M12-85			M11-85			M10-85		88-6W			M8-85	M7-85	M6-85	M5-85	M4-85	M3-85	M2-85		M1-85		M3-82		M2-82		M1-82	fier	Tdent1-	MOLL			
11-20-86	11-20-86	11-20-86	11-18-86	11-20-86	11-20-86	08-27-85	11-17-86	05-13-86	08-27-85	11-19-86	06-25-86	08-27-85	11-19-86	08-27-85	11-20-86	06-25-86	08-27-85	08-27-85	08-26-85	08-27-85	08-26-85	08-26-85	08-26-85	11-19-86	08-26-85	05-13-86	08-28-85	11-18-86	08-27-85	11-18-86	08-28-85	Date					
NAB	16	NAB	23	0.7	NAB	ND	570	240	1,000	NAB	0.4	ND	NAB	ND	6.	0	ND	NAB	ND	280	800	1100	3,300	170	ND	Benzene											
0.32	2.9	z							3,400										ND						ND	1,500	2,600	3200	11,000	6.5	ND	Toluene					
NO		NO	90	NO	NO	ND	2700	1,600	220	ND	0	ND	ND	ND	0.1	0	ND	NO	ND	240	150	1700	910	530	ND	benzene		Erhvl-									
3.2	2.5	Z O	15	NO	NO	ND	7900	11,900	7,300	NAB	0	ND	NO	NO	NO	0	1.0	ND	ND	ND	ND	ND	ND	NO	ND	3,800	8,200	4400	10,500	110	ND	Tenes	•	xvl-	Total		
NO	8.6	0.8	32	NO	NO.	ND	530	950	440	NAB	ND	ND	ND	ND	NO	ND	3.0	NO	ND	280	740	230	400	130	2.8	Charene		Naph-									
0.52	0.9	NO	1.9	NO	ND	1	320	780	l	ND	ND	1	ND	1	ND	н	i	1	;	;	ł	ŀ	1	ND	1	230	ţ	180	ł	13	1	benzene			Tri-		
0.1	3.4	0.0	17	0.1	NO	ND			1,200			ND	NO	ND	ND	ND	0.1	ND	ND	ND	ND	ND	ND		ND				1,500			0.00			Tri-		
	NO		20	0.0	ND	ND	330	780	420	NAB	N	ND	ND	ND	ON	ND	ND	ND	Z Z	N	NO	N	N	S	ND	310	930	012	620	33	25	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	ל מחסים ה	methyl- m	Tri- T	1,3,5-1	
2			;	1	ŀ		1							ND			0.2	_						; ;					55	9 1	5.6		bonzone	methyl-	etra-	,2,3,4-	
O	2.1	NO	7.2	NO	NO	ND	8.8	190	81	ND	ND	N	NU	ND	Z		0.65	200	i o	2	Š	Š	3	3 6	2	100	000	300	7.30	200	38.6		benzene	methyl-	Tetra-	1,2,3,5-	

ND ND ND ND ND ND ND ND ND ND ND ND ND N	NO NO NO NO NO NO NO NO NO NO NO NO NO N	20	NAB NO NO NO NO NO NO NO NO NO NO NO NO NO	NQ 590 4,800 46 ND 0.17 ND ND ND ND ND ND ND ND ND ND ND ND ND	220 NO NO NO NO NO NO NO NO NO NO NO NO NO N	N N N N N N N N N N N N N N N N N N N	4 8 8 8 8 8 8 8 8 9	08-30-85 08-30-85 08-30-85 08-30-85 05-13-86	T10 T11 T12 T13
R N N N N N N N N N N N N N N N N N N N	7 2		NAB 0.5	NQ 590 4,800 46 ND ND ND ND ND ND ND ND ND ND ND ND ND	220 NO NO NO NO NO NO NO NO NO NO NO NO NO N	N N N N N N N N N N N N N N N N N N N	N N N N N N N	08-30-85 08-30-85 08-30-85	T10 T11 T12 T13
N N N N N N N N N N N N N N N N N N N	7 2		NAB 0.5	NQ 590 4,800 46 NO 0.17 NO NO NO NO NO NO NO NO NO NO NO NO NO	220 NO NO NO NO NO NO NO NO NO NO NO NO NO N	N N N N N N N N N N N N N N N N N N N	N N N N N N	08-30-85 08-30-85 08-30-85	T10 T11 T12
A M M M M M M M M M M M M M M M M M M M	7 2		0.5 NAB NAB NAB NAB NAB NAB NAB NAB NAB NAB	900 4,800 46 46 ND ND ND ND ND ND ND ND ND ND ND ND ND	220 NO NO NO NO NO NO NO NO NO NO NO NO NO N	N N N N N N N N N N N N N N N N N N N	N N N N N	08-30-85	T10
A M M M M M M M M M M M M M M M M M M M	7 2		0.5 NAB NO NO NO NO NO NO NO NO NO NO NO NO NO	900 4,800 46 46 ND 0.17 ND ND ND ND ND ND ND ND ND ND ND ND ND	220 NO NO NO NO NO NO NO NO NO NO NO NO NO N	N N N N N N N N N N N N N N N N N N N	N N N N	08-30-85	110
A A A A A A A A A A A A A A A A A A A	7 2		0.5 NAB NO NO NO NO NO NO NO NO NO NO NO NO NO	NQ 590 4,800 46 ND ND ND ND ND ND ND ND ND ND ND ND ND	220 NO NO NO NO NO NO NO NO NO NO NO NO NO	8 8 8 8 8 8 8 8	N N N		
A S S S S S S S S S S S S S S S S S S S	7 2		0.5 NAB 0.5 ND ND ND ND ND ND ND	900 4,800 46 46 ND 0.17 ND ND ND ND	220 NO NO NO NO NO NO NO NO NO NO NO NO NO	8 8 8 8 8	N N	08-30-85	19
A N N N N N N H	7 2		NAB 0.5	NQ 590 4,800 46 ND 0.17 ND ND ND ND ND ND ND ND ND ND ND ND ND	220 NO NO NO NO NO NO NO NO NO NO NO NO NO	N N N N N	ND	08-30-85	18
8888884	7 2		NAB 0.5 ND ND ND ND ND ND ND ND ND ND ND ND ND N	NQ 590 4,800 46 ND 0.17 ND ND ND ND ND ND ND ND ND ND ND ND ND	220 NO NO NO NO NO NO NO NO NO NO NO NO NO	N N N N		08-29-85	17
8 8 8 8 ₄ 1			NAP	NQ 590 4,800 46 ND 0.17 ND ND ND ND ND ND	220 NO NO NO NO NO NO NO NO NO NO NO NO NO	N N N	ND	08-29-85	T6
88884			NAB 0.5	NQ 590 4,800 46 ND 0.17 ND ND ND	220 NO NO NO NO NO	N N	ND	08-29-85	15
N N N H			NAB 0.5 ND 11	NQ 590 4,800 46 ND 0.17	NO 220 NO NO NO NO NO NO NO NO NO NO NO NO NO	ND	ND	08-29-85	T4
N N H			NAB 0.5 ND	NQ 590 4,800 46 ND 0.17	220 220 ND 7		ND	08-29-85	13
8 + 1			NAB 0.5 ND 460	NQ 590 4,800 46	220 ND ND 7	ND	2.3	08-29-85	12
i ы ¦			NAB 0.5 ND 460	NQ 590 4,800	NQ 220 ND 7	ND	ND	08-29-85	T1
, !			0.5 ND 11	4, 800	NQ 220 ND	6	н	04-30-86	M37
			NAB 0.5	NQ 590	NQ 220	320	370	06-25-86	
710			NAB 0.5	NO	NO .	210	150	04-30-86	M36
, ,		8	NAB 0.5			NAB	NAB	11-20-86	M34
		;	NAB	0.11	0	0.1	0.4	11-19-86	M31
200		S		NO	NO	NAB	1.5	11-20-86	M30
1	÷	N O	1.1	ON	NO	0.1	NAB	11-19-86	M29
!	•		770	9,600	3,000	280	1,600	11-18-86	M24
1 1		É	160	200	490	17	250	11-18-86	M23
1	NO		NO	O	NO	NAB	NAB	11-20-86	M22
1	.02		NO	0.01	0.05	0.02	0.4	11-18-86	M19
1	200		94	500	430	17	150	11-18-86	M18
027			770	9,600	3,000	280	1,600	11-18-86	M24
1		i C	160	200	490	17	250	11-18-86	M23
1	NO		NO	NO	NO	NAB	NAB	11-20-86	M22
1	.02		O	0.01	0.05	0.02	0.4	11-18-86	M19
			94	500	430	17	150	11-18-86	M18
			180	4,000	1,400	980	1,500	11-17-86	M16
3 2			NO	NO	NO	NAB	NAB	11-20-86	MIA
1	·		7.9	7.3	47	0.5	34	11-20-86	M13
	2, 100 640		550	5,900	1,900	490	380	11-18-86	M12
260		4	110	53	190	2.2	100	11-18-86	M11
			5 8	500	180	51	130	11-17-86	6W
1 1	V - 1		0.4	0.05	0.1	NO	1.3	11-17-86	88
		1 50	480	8500	3000	7100	1700	11-17-86	M7.2
:									
benzene benzene benzene	benzene benz	benzene k	thalene	lenes	benzene	Toluene	Benzene	Date	fier
•	meco	mechyl- mechyl-	Naph-	×y1-	Ethyl-				identi-
Terra Terra	' !			Total					Well
70.00									

Table 7.--Concentrations of volatile organic compounds in ground water. August 1985 through November 1985--Continued

013	D12	011	010	D9	D8	07	D6	DS	D4	D3	D2	D1	T42	T41	T40	T39	BET	T37	T36	T35	T34	T33	T32	T31	T30	T29	T28	T27	T26	T25	T24	T23	T22	T21	T20	T19	T18	T17	T16	fier	identi-	Well		
08-27-85	08-28-85	08-27-85	08-27-85	08-28-85	08-27-85	08-27-85	08-27-85	08-27-85	08-27-85	08-27-85	08-27-85	08-27-85	06-25-86	06-25-86	06-25-86	06-25-86	06-25-86	06-25-86	06-25-86	06-25-86	06-25-86	06-25-86	06-25-86	06-25-86	06-25-86	06-25-86	06-25-86	04-30-86	04-30-86	04-30-86	04-30-86	04-30-86	04-27-86	05-13-86	05-13-86	04-30-86	05-13-86	05-13-86	06-25-86	Date				
ND	ND	ND	ND	ND	ND	ND	26	ND	ND	ND	10	ND	16	30	н	120	0.7	0	31	110	240	31	3.1	0	1.5	1.0	0.9				0		670			15	н	ы	1.2	Benzene				
ND	N O	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.8	0.4	0.2	43	н	0.05	1	4 ω	92	0.3	0.2	н	0.08	0.1	0.05	۵	0	2,100	0	н	1,600	2.8	н	0.6	0	0	0.06	Toluene			255	
ND	ND	ND	ND	ND	ND	ND	4.7	ND	ND	ND	ND	ND	0.6	0.1	н	110	н	0	8.7	13	280	0.09	0.3	0	ы	н	0.05	2	0	2,200	0	ы	260	<u>ن</u> 80	0.03	н	н	ND	0.1	benzene	ECHYL	5 to 1		
ND	ND	ND	ND	ND	ND	ND	3.53	ND	NO	ND	1.2	ND	0.5	22.2	H	420	0	0	89	2,620	4,200	36.2	0	0	0	0	н	7	н	11,300	н	ы	4,900	970	0.12	0.8	0.04	0	н	Lenes	> 4	זיים די	1	
S	ND	ND	ND	ND	ND	ND	12	ND	ND	ND	1.0	ND	66	74	0	280	0	0	63	770	970	2	2.1	н	н	0	0.4	-	1	•	ŀ	;	1	300	0	1	0	ND	1.6	chatene	1000	Z Z		
!	i	;	ł	;	1	!	!	1	!	l	1	l	19	2.4	0	76	NO	ND	7.3	420	820	11	0	ND	ND	0	0	0	0	660	н	0	370	39	ND	0	ND	ND	н	Denzene			1 1	1,2,3-
5	ND	1.4	NO	н	н	0	350	0	ND	49	1,900	3,400	11	0	ND	0	0	0	0	H	3,800	н	н	1,600	820	н	0	0	0	н	per pente			1	1,2,4-									
, i	N	ND	0.5	36	0	81	ND	ND	ND	590	1,100	0.9	0	ND	ND	0	0	80	н	1400	H	н	720	420	ND	0	o o	ND	0			methyl- methyl-	1	1,3,5-										
5 6	Z S	ND	ND	ND	ND	N	0.4	ND	N	N	ND					1	1	;	1	1	1	1	1	1	!	1	!						410							Someone Someone	,	ethvl-	101731	1,2,3,4-
5	ND	ND	ND	ND	ND	ND	1.5	ND	ND	ND	0.26	ND	0.8	10	ND	97	ND	ND	15	230	930	15	0.2	ND	ND	0	н	14	н	410	н	0	330	94	NO	d	N D	NU	0.4	- 1	no honzono	methyl-		1,2,3,5-

Table 7.--Concentrations of volatile organic compounds in ground water. August 1985 through Noxember 1986--Continued

Table 7.--Concentrations of volatile organic compounds in ground water. August 1985 through November 1986--Continued

Well identi-				Ethyl-	Total	Naph-	Tri- methyl- me	Tri- methyl- m	Tri- methyl- me	ri- Tetra- Tetra- yl- methyl- methyl-	Tetra- methyl-
fier	Date	Benzene Toluene	Toluene	benzene	lenes	ě	benzene	zer		benzene benzene	e benzene
D14	08-28-85	N	ND	ND	ND	ND	i	ND	ND	ND	ND
D15	08-27-85	ND	ND	ND	ND	ND	ł	ND	ND	ND	ND
D16	08-27-85	ND	ND	ND	ND	ND	1	ND	ND	ND	ND
D17	08-27-85	ND	ND	ND	ND	ND	1	ND	ND	ND	ND
D18	08-27-85	ND	ND	ND	ND	ND	1	ND	ND	ND	ND
D19	08-28-85	ND	ND	ND	ND	ND	I	ND	ND	Ŋ	ND
D20	08-28-85	ND	ND	ND	ND	ND	!	ND	ND	ND	ND
D21	08-27-85	ND	ND	ND	ND	ND	1	ND	ND	ND	ND
D22	08-28-85	ND	ND	ND	ND	N	ì	ND	N	ND	ND
D23	08-28-85	ND	ND	ND	ND	ND	1	ND	ND	ND	ND
D24	08-28-85	ND	ND	ND	ND	ND	1	ND	ND	ND	ND
D25	08-28-85	ND	ND	ND	ND	ND	1	ND	ND	ND	ND
D26	08-28-85	ND	ND	ND	ND	ND	i	ND	ND	ND	NO
D27	08-28-85	ND	ND	ND	ND	ND	1	ND	ND	ND	ND
D28	08-28-85	ND	ND	ND	ND	ND	}	ND	ND	NO	ND
D29	08-28-85	ND	ND	ND	ND	ND	1	ND	ND	ND	ND
D30	08-28-85	ND	ND	ND	ND	ND	1	ND	ND	ND	ND
D31	08-28-85	ND	ND	ND	ND	ND	ŀ	ND	ND	NO	ND

Table 7.--Concentrations of volatile organic compounds in ground water, August 1985 through November 1986--Continued

FILE	K .	M13	M12	MIL	M9	MS	M/.2	M/.1	M6.2	M6.1	X	MZ		M12-85			M11-85			M10-85		M9-85			M8-85	M7-85	M6-85	M5-85	M4-85	M3-85	M2-85		M1-85		M3-82		M2-82		M1-82	1	rdenti-	WOLL	,	
		ŀ	ŀ	!	ļ	1	;	1	1	}	;	1	1	ND	!	Ī	ND	1	1	ND	;	ND	l	1	ND	ND	ND	ND	ND	ND	ND	1	ND	1	ND	;	130	1	N N	Seriesine	- Tydora			
i		ŀ	;	ŀ	ł	1	1	1	ł	;	1	l	1	ND	1	1	ND	1	ŀ	ND	1	ND	1	i I	ND	ND	ND	ND	ND	ND	ND	ł	ND	1	ND	!	ND	ļ	N N	2000	benzene		•	
ł		ľ	1	1	1	1	ł	;	ì	ł	1	1	ì	ND	ŀ	;	ND	1	1	ND	I	ND	1	i	ND	ND	ND	ND	ND	ND	N	1	ND	ļ	ND	ì	ND	1	ND		benzene	3ec-		
ł		ľ	1	1	1	1	1	1	ł	1	1	ţ	1	ND	1	!	ND	ŀ	1	ND	!	ND	!	ł	ND	ND	ND	ND	ND	ND	ND	ľ	ND	1	ND	1	ND	1	1.2		persene	Butul	•	
ł		Ė	1	1	į	1	1	I	i	ł	1	ŀ	ì	ND	i	1	ND	1	i	N N	1	ND	1	1	ND	ND	ND	ND	ND	N	ND	1	ND	!	ND	i	ND	1	N N		bromide	e criy L	5 7 7 7 1	
1		l	ŀ	ł	ł	l	}	!	1	1	1	1	1	ND	1	1	ND	1	l	ND	1.	ND	I	1	ND	ND	ND	ND	ND	ND	ND	1	ND	1	ND	I	ND	ł	ND		benzene	Butyl-	ĭ	
1		!	į	;	;	ł	1	1	1	1	;	į	1	ND	ľ	1	ND	1	1	ND	1	ND	Î	1	ND	ND	ND	ND	ND	ND	ND	¦	ND	ł	ND	1	ND	ŀ	N		benzene	4-891741-	1 130	1 1 1 0 1
NO		8.7	500	56	66	0.05	340	0.44	19	NO	19	0.2	ND	1	300	680	1	ND	ND	1	NO	1	NO	0.8	!	!	!	1	ŀ	!	1	ND	I I	250	1	190	1	110	t t		benzene	1-methyl-	2-5150	
ND		٧,	380	23	31	0.05	160	ND	4.4	NO	14	NO	ND	1	120	!	1	ND	!	1	ND	1	ND	!	!	1	!	1	1	!	1	ND	1	!	!	97	1	45	í I		benzene	ethyl-	1077	1 4-0;-
														1			}	1	N D	1	i	ļ	1	ND	1	!	1	1	1	!	ł	1	1	76	ŀ	1	1	ŀ	1		benzene	2-ethvl-	# PT hv -	1 4-01-
;		1	•	1	1	ł	!	1	ŀ	ì	ł	1	1	1	i i	1	1	!	NO	1	1	ľ	1	ND	L	İ	1	1	E	1	1	i i	1	ı	i	1		1	i i				methyl 4-	1.3-Di-
																																								- 1				

Table 7.--Concentrations of volatile organic compounds in ground water. August 1985 through November 1986--Continued

1-Iso-

1,4-D1-

1,4-Di-

methyl,4-1,3-Di-

	T26	T25	T24	T23	T22	121	T20	119) <u>-</u>	3 -	1 1	J .	1 t	71.6	T12	T11	TIO	19	Te	17	16	15	14	13	12	11	· M37	M36	M36	M3 4	M31	M30	M29	M24	M23	M22	M19	8 T.W.	. M16	fier	identi-	Well	
	;	ł	1	1	1	;	}	1	1	1		1	1	20	ij	NB	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ŀ	1	1	1	;	!	1	l	ŀ	1	1	1	1	benzene	Propyl-	7	
		ł	1	1	ŀ	ŀ	1	1	;	1	;		1	2	i S	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ŀ	ŀ	1	1	1	1	1	ł	1	1	1	ŀ	1	benzene	buty1-	Iso-	
		!	1	1	ł	!	1	1	1	!	1		1	2	i 8	ND	ND	ND	ND	ND	ND	N	ND	ND	ND	ND	1	ł	1	1	!	!	1	I.	!	3	1	I I	1	benzene	Buty1-	sec-	
		1	1	i	1	-	!	1	ł	1	1	1	1	Ž	N N	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ļ	ŀ	!	1	1	1	1	1	!	1	!	1	1	benzene	Buty1-	ם ו	
}		ŀ	l	1	1	ł	1	1	ļ	!	ļ	1	!	Z	N N	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1	¦	1	1	1	Ĭ	1	1	1	1	1	ļ	1	bromide	ene-	Ethyl-	
ł	317	!	ŀ	ţ	1	1	ł	1	1	1	}	1	1	N	N N	ND	ND	ND	ND	ND	ND	ND	N	ND	ND	ND	ŀ	l	1	1	!	ŀ	1	l	1	1	ŀ	1	1	benzene	Buty1-	7	
ł	1	1	!	I.	1	1	i	i	i	I	ł	ł	1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	;	l	l	1	l	1	1	1	1	1	ţ	1	!	benzene	4-methyl-	propyl-	1 100
o	1,400	1 400	0	н	830	320	0.03	18	0.03	ND	0.4	170	50	1 1	1	;	ł	!	1	ŀ	ļ	1	;	1	i	i	ω	560	140	ND	0.2	ND	NO	550	140	ND	NO	110	110	benzene	1-methyl-	2-Ethyl	
ł	ŀ		1	;	1	ŀ	1		!	1	1	1	1	1	ŀ	1	1	1	1	1	1	i	i	ł	ł	1	ļ	1	1	ND	ND	ND	ON	280	59	NO	ND	76	37	benzene	ethyl-	methyl-	
0	087	,	- 1 -	0	120	77	ND	0	ND	ND	0.2	49	7.8	1	1	1	!	i	!	i	ŀ	!	i	1	:	1	н	130	60	!	;	!	!	1	į	!	1	1	1	benzene	2-ethyl-	methyl-	
1	1		;	!	1	1	1	1	1	ł	0.1	1	1	1	1	1	i	}	:	ł	ł	1	ł	ł	1	ł	i	110	1	1	1	1	1	-	1		I	1	1			methyl,4-	

DZ3	220	120	52.	D19	D18	D17	D16	D15	D14	D13	D12	D11	D10	D9	D8	70	D6	DS	D4	D3	D2	10	T42	T41	140	T39	T38	T37	136	T35	T34	T33	T32	131	T30	T29	T28	127	fier	identi-	Well	
ND	ND	ND	NO	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.7	ND	ND	ND	0.11	ND	1	ļ	1	1	1	Ī	1	1	1	1	i	1	į.	1	1	ŀ	benzene	Propyl-	7	
N	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.32	ND	ND	ND	0.38	ND	1	I	1	1	!	I	1	1	1	ŀ	1	;	1	1	ŀ	1	benzene	butyl-	Iso-	
ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.70	ND	ND	ND	0.93	ND	1	1	1	1	!	l	i	1	1	ŀ	ŀ	i	Ī	;	;	1	benzene	Butyl-	sec-	
ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND		ND	ND	ND		ND	1	ĺ	!	1	ŀ	ĺ	l	1	!	Î	1	}	ŀ	!	1	ŀ	benzene	Butyl-	יכ	
ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND		ND				ND	ND	1	1	1	1	ì	1	1	1	!	l	1	!	. 1	ı	!	l	bromide	ene-	Ethyl-	
ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1	1	1	1	1	1	i	1	1	1	1	1	Ē	1	1	I	benzene	Butyl-	7	
N O	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1	1	i	!	!	1	i	į	1	1	Ī	1	1	1	1	1	benzene	4-methyl-	propyl-	1-150-
ł	;		í	i	1	1	ŀ	1	I I	İ,	;	ļ	Ì	1	ſ	l	1	!	ŀ	1	;	i	110	56	0	170	ND	0	77	470	740	110	2	ND	0	0	H	170	benzene	l-methyl-	2-Ethyl	
I	l	i	l	i	i	ľ	!	1	!	ı	1	ļ	1	1	1	I	1	ł	t I	1	l	1	1	1	1	Ĺ	ŀ	!	1	-	1	i		!	1	ŀ	1	1	benzene	ethyl-	methyl-	1,4-Di-
1	1	!	ŀ	1	1	1	ŀ	}	ľ	1	1	1	!	1	1	-	I	ł	1	ĺ	1	ł	0	1.8	N	55	NO	N N	12	140	510	1	N	ND	ND	0	0.02	0	benzene benzene	2-ethyl-	methyl-	1,4-Di-
1																																							benzene	ethyl-	methyl, 4-	1,3-Di-

Table 7.--Concentrations of volatile organic compounds in ground water. August 1985 through November 1986--Continued

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Table 7.--Concentrations of volatile organic compounds in ground water, August 1985 through November 1986--Continued

D31	D30	D29	D28	D27	D26	D25	D24	Well identi- fier
ND	ND	ND	ND	ND	ND	ND	ND	n- Propyl- benzene
ND	ND	ND	ND	ND	ND	ND	ND .	Iso- butyl- benzene
ND	ND	ND	ND	ND	ND	ND	ND	sec- Butyl- benzene
ND	ND	ND	ND	ND	ND	ND	ND	n- Butyl- benzene
ND	ND	ND	ND	ND	ND	ND	ND	Ethyl- ene- bromide
ND	ND	ND	ND	ND	ND	ND	N N	t- Butyl- benzene
ND	ND	ND	ND	ND	ND	ND	ND	1-Iso- propy1- 4-methy1- benzene
1	1	;	!	1	ŀ	E.	1	2-Ethyl 1-methyl- benzene
i	ì	i	1	i	I I	1	I	1,4-Di- methyl- ethyl- benzene
i	į	1	!	I	!	ļ	1	1,4-Di- methyl- 2-ethyl- benzene
ŀ	i	ı	!	Í	1	!	i	1,4-Di- 1,3-Di- methyl- methyl,4- 2-ethyl- ethyl- benzene benzene

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Table 8.--Concentrations of volatile organic compounds in ground water. March, 1989

[All concentrations are in microgram per liter; ND, below the detection limit 0.2 micrograms of 0.2 micrograms per liter, unless otherwise noted]

Well identi- fier	Benzene	Toluene	Ethyl- benzene	Total xylenes	Naph- thalene	1,3,5- Tri- methyl- benzene	2- Ethyl-1- methyl- benzene	1,2,4- Tri- methyl- benzene	1,2,3- Tri- methyl- benzene
M2-82	ND	ND	ND	ND	ND	ND	5.7	ND	1.7
M3-82	17	1.6	ND	1500	19	280	240	300	200
M1-85	ND	ND	ND	ND	ND	ND	ND	ND	ND
M5-85	ND	ND	ND	ND	0.2	ND	ND	ND	0.2
M6-85	ND	ND	ND	ND	ND	ND	ND	ND	ND
M7-85	ND	ND	ND	ND	ND	ND	ND	ND	ND
M8-85	ND	ND	ND	ND	ND	ND	ND	ND	ND
M9-85	ND	ND	ND	ND	ND	ND	ND	ND	ND
M11-85	23	ND	3.6	320	62	160	130	150	95
M4	ND	ND	ND	ND	ND	ND	ND	ND	ND
M6.2	ND	ND	ND	ND	ND	ND	ND	ND	ND
M11	ND	ND	ND	ND	ND	ND	ND	ND	ND
M12	ND	ND	ND	ND	ND	ND	ND	ND	ND
м13	ND	ND	ND	ND	ND	ND	ND	ND	ND
M14	ND	ND	ND	ND	0.2	ND	ND	ND	ND
м16	68	15	ND	820	130	60	79	49	86
м17	75	0.3	ND	0.5	44	ND	49	0.5	0.3
M18	ND	ND	0.2	0.2	ND	ND	3.2	ND	0.3
M19	ND	ND	ND	ND	ND	ND	ND	ND	ND
M20	ИД	ND	ND	ND	0.3	ND	ND	ND	ND
M23	0.3	ND	ND	ND	ND	ND	0.4	ND	ND
M26	ND	ND	ND	ND	0.2	ND	ND	ND	ND
M27	0.3	ND	ND	ND	ND	ND	0.4	ND	ND
M29	1.0	ND	ND	ND	ND	ND	ND	ND	ND
м30	ИD	ND	ND	ND	ND	ND	ND	ND	ND
м31	ND	ND	ND	ND	ND	ND	ND	ND	ND
M34	ND	ND	ND	ND	ND	ND	ND	ND	ND

Table 8.--Concentrations of volatile organic compounds in ground water, March, 1989--Cont.

Well identi- fier	1,2,3,5- Tetra- methyl- benzene	1,4-Di- methyl- 2-ethyl- benzene	1,2,3,4 Tetra- methyl- benzene	p-Iso- propyl- toluene	Iso- propyl- benzene	Di- bromo- methane	Di- chloro- bromo- methane	Carbon tetra- chlo- ride		1,3-Di- methyl- 2-ethyl- benzene
M2-82	ND	ND	0.9	ND	ND	ND	ND	ND	ND	0.8
M3-82	150	100	58	2.1	ND	ND	ND	ND	ND	4.7
M1-85	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
M5-85	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
M6-85	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
M7-85	ND	ND	ND	ND	ND	ND	ND	0.2	ND	ND
M8-85	ND	ND	ND	ND	ND	ND	ND	0.3	ND	ND
M9-85	ND	ND	ND	ND	ND	ИD	ND	ND	ND	ND
M11-85	140	13	50	11	2.3	ND	ND	ND	0.8	2.0
M4	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
M6.2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
M11	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
M12	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
M13	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
M14	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
M1 6	36	20	14	3.5	ND	ND	ND	ND	ИD	1.1
M17	ND	3.1	4.0	0.2	7.5	ND	ND	ND	1.4	2.0
M18	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.8
M19	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
M20	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
M23	ND	ND	ND	ND	ND	ND	ND	ND	ND	0,4
M26	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
M27	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.3
M29	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
м30	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
м31	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
M34	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

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Table 8.--Concentrations of volatile organic compounds in ground water, March, 1989--Cont,

			Chloro-						Methyl	-	
Well	1,2-Di-		d1-					Methyl-		n-	n-
identi-	chloro-	Bromo-	bromo-	Chloro-	Chloro-	Chloro-	Methyl-	chlo-	chlo-	Propyl-	Butyl-
fier	ethane	form	methane	form	benzene	ethane	bromide	ride	ride	benzene	benzen
M2-82	0.7	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
M3-82	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
M1-85	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
M5-85	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
M6-85	ND .	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
M7-85	ND	ND	ND	2.5	ND	ND	ND	ND	ND	ND	ND
M8-85	ND	ND	ND	5.3	ND	ND	ND	ND	ND	ND	ND
M9-85	ND	ND	ND	0.8	ND	ND	ND	ND	ND	ND	ND
M11-85	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
M4	ND	ND	ND	82	ND	ND	ND	ND	6.3	ND	ND
M6.2	ND	ND	ND	27	ND	ND	ND	ND	0.8	ND	ND
M1 1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NO
M1 2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
M1 3	ND	ND	ND	0.2	ND	ND	ND	ND	ND	ND	ND
M1 4	ND	ND	ND	0.4	ND	ND	ND	ND	ND	ND	ND
M1 6	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
M1 7	0.3	ND	ND	4.5	ND	ND	ND	ND	ND	0.2	0.5
M18	ND	ND	ND	0.5	ND	ND	ND	ND	ND	ND	ND
M1 9	ND	ND	ND	0.8	ND	ND	ND	ND	ND	ND	ND
M20	ND	ND	ND	1.4	ND	ND	ND	ИD	ND	ND	ND
M23	ND	ND	ND	1.8	ND	ND	ND	ND	ND	ND	ND
426	ND	ND	ND	0.7	ND	ND	ND	ND	ND	ND	ND
427	ND	ND	ND	0.4	ND	ND	ND	ND	ND	ND	ND
429	ND	ND	ND	1.4	ND	ND	ND	ND	ND	ND	ND
430	ND	ND	ND	0.9	ND	ND	ND	ND	ND	ND	ND
131	ND	ND	ND	2.4	ND	ND	ND	0.6	ND	ND	ND
134	ND	ND	ND	2.2	ND	ND	ND	ND	NO	ND	ND

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Table 8.--Concentrations of volatile organic compounds in ground water, March, 1989--Cont.

							The state of the s		
	Tetra-	Tri-		1,1-Di-	1,1,1-	1,1,2-	1,1,2,2		
Well	chloro-	chloro-	1,1-D1-	chloro-	Tri-	Tri-	Tetra-	1,2-D1-	1,2-D1-
identi-	ethyl-	fluoro-	chloro-	ethyl-	chloro-	chloro-	chloro-	chloro-	chloro-
ſler	ene	methane	ethane	ene	ethane	ethane	ethane	benzene	propane
M2-82	ND	ND	ND	ND	ND	ND	ND	ND	ND
M3-82	ND	ND	ND	ND	ND	ND	ND	ND	ND
11-85	ND	ND	ND	ND	ND	ND	ND	ND	ND
45-85	ND	ND	ND	ND	ND	ND	ND	ND	ND
46-85	ND	ND	ND	ND	ND	ND	ND	ND	ND
					110	110	ND	NU	ND
47-85	ND	ND	ND	ND	ND	ND	ND	ND	ND
M8-85	ND	ND	ND	ND	ND	ND	ND	ND	ND
49-85	ND	ND	ND	ND	ND	ND	ND	ND	ND
411-85	ND	ND	ND	ND	ND	ND	ND	ND	ND
14	ND	ND	ND	ND	ND	ND	ND	ND	ND
16.2	ND	ND	ND	ND	ND	ND	ND	ND	ND '
11 1	ND	ND	ND	ND	ND	ND	ND	ND	ND
11 2	ND	ND	ND	ND	ND	ND	ND	ND	ND
11 3	ND	ND	ND	ND	ND	ND	ND	ND	ND
11 4	ND	ND	ND	ND	ND	ND	ND	ND	ND
11 6	ND.	ND	ND	ND	ND	ND	ND	ND	ND
11.7	ND	ND	ND	ND	ND	ND	ND	ND	ND
118	ND	ND	ND	ND	ND	ND	ND	ND	ND
11 9	ND	ND	ND	ND	ND	ND	ND	ND	ND
120	ND	ND	ND	ND	ND	ND	ND	ND	ND
12 3	ND	ND	ND	ND	ND	ND	ND	ND	ND
26	ND	ND	ND	ND	ND	ND	ND	ND	ND
27	ND	ND	ND	ND	ND	ND	ND	ND	ND
29	ND	ND	ND	ND	ND	ND	ND	ND	ND
30	ND	ND	ND	ND	ND	ND	ND	ND	ND
131	ND	ND	ND	ND	ND	ND	ND	ND	ND
134	ND	ND	ND	ND	ND	ND	ND	ND	ND

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Table 8. -- Concentrations of volatile organic compounds in ground water, March, 1989--Continued

Well identi- fier	1,3-D1- chloro- benzene	1,4-Di- - chloro	Di- chloro- di- fluoro- methane	trans- 1,3-Di- chloro- propene	cis- 1,3-Di- chloro- propene	Vinyl chlo- ride	Tri- chloro- ethyl- ene	1,2-Di- chloro- ethene	Styrene
M2-82	ND	ND	ND	ND	ND	ND	ND	ND	ND
M3-82	ND	ND	ND	ND	ND	ND	ND	ND	ND
M1-85	ND	ND	ND	ND	ND	ND	ND	ND	ND
M5-85	ND	ND	ND	ND	ND	ND	ND	ND	ND
M6-85	ND	ND	ND	ND	ND	ND	ND	ND	ND
M7-85	ND	ND	ND	ND	ND	ND	ND	ND	ND
M8-85	ND	ND	ND	ND	ND	ND	ND	ND	ND
49-85	ND	ND	ND	ND	ND	ND	ND	ND	ND
411-85	ND	ND	ND	ND	ND	ND	ND	ND	ND
44	ND	ND	ND	ND	ND	ND	ND	ND	ND
16.2	ND	ND	ND	ND	ND	ND	ND	ND	ND
11.1	ND	ИD	ND	ND	ND	ND	ND	ND	ND
11 2	ND	ND	ND	ND	ND	ND	ND	ND	ND
11 3	ND	ND	ND	ND	ND	ND	ND	ND	ND
11 4	ND	ND	ND	ND	ND	ND	ND	ND	ND
11 6	ND	ND	ND	ND	ND	ND	<0.3	ND	ND
117	ND	ND	ND	ND	ND	ND	ND	ND	ND
118	ND	ND	ND	ND	ND	ND	ND	ND	ND
11 9	ND	ND	ND	ND	ND	ND	ND	ND	ND
120	ND	ND	ND	ND	ND	ND	ND	ND	ND
123	ND	ND	ND	ND	ND	ND	ND	ND	ND
126	ND	ND	ND	ND	ND	ND	ND	ND	ND
27	ND	ND	ND	ND		ND	ND	ND	ND
29	ND	ND	ND	ND	ND	ND	0.3	ND	ND
30	ND	ND		ND		ND	ND	ND	ND
31	ND	ND	ND	ND	ND	ND	ND	ND	ND
134	ND	ND				ND		ND	ND

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Table 8.--Concentrations of volatile organic compounds in ground water, March, 1989--Continued

Well identi- fier	1,1-Di- chloro- pro- pene	2,2-Di- chloro- pro- pane	1,3-Di- chloro- pro- pane	ortho- Chloro- toluene	para- Chloro- toluene	1,2,3- Tri- chloro- propane	1,1,1,2- Tetra- chloro- ethane	1,2- Di- bromo- ethane	Bromo- benzene	
M2-82	ND	ND	ND	ND	ND	ND	ND	ND	ND	
M3-82	ND	ND	ND	ND	ND	ND	ND	ND	ND	
M1-85	ND	ND	ND	ND	ND	ND	ND	ND	ND	
M5-85	ND	- ND	ND	ND	ND	ND	ND	ND	ND	
M6-85	ND	ND	ND	ND	ND	ND	ND	ND	ND	
M7-85	ND	ND	ND	ND	ND	ND	ND	ND	ND	
M8-85	ND	ND	ND	ND	ND	ND	ND	ND	ND	
M9-85	ND	ND	ND	ND	ND	ND	ND	ND	ND	
M11-85	ND	ND	ND	ND	ND	ND	ND	ND	ND	
14	ND	ND	ND	ND	ND	ND	ND	ND	ND	
16.2	ND	ND	ND	ND	ND	ND	ND	ND	ND	
11 1	ND	ND	ND	ND	ND	ND	ND	ND	ND	
11 2	ND	ND	ND	ND	ND	ND	ND	ND	ND	
41 3	ND	ND	ND	ND	ND	ND	ND	ND	ND	
11.4	ND	ND	ND	ND	ND	ND	ND	ND	ND	
41 6	ND	ND	ND	ND	ND	ND	ND	ND	ND .	
417	ND	ND	ND	ND	ND	ND	ND	ND	ND	
118	ND	ND	ND	ND	ND	ND	ND	ND	ND	
11 9	ND	ND	ND	ND	ND	ND	ND	ND	ND	
120	ND	ND	ND	ND	ND	ND	ND	ND	ND	
123	ND	ND	ND	ND	ND	ND	ND	ND	ND	
126	ND	ND	ND	ND	ND	ND	ND	ND	ND	
127	ND	ND	ND	ND	ND	ND	ND	ND	ND	
129	ND	ND	ND	ND	ND	ND	ND	ND	ND	
30	ND	ND	ND	ND	ND	ND	ND	ND	ND	
31	ND	ND	ND	ND	ND	ND	ND	ND	ND	
134	ND	ND	ND	ND	ND	ND	ND	ND	ND	

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Table 9.--Concentrations of extractable lead in aquifer materials and dissolved lead in ground water, November 1986

[μ g/kg, micrograms per kilogram; μ g/L, micrograms per liter; soil extracts are for the size fraction less than 63 micrometers; NS, not sampled].

		Extractable
	Dissolved	lead in
Well	lead in	aquifer
identi-	ground water	materials
fier	(µg/L)	(µg/kg)
M1-82	1.8	310
M2-82	2.8	7,610
M1-85	1.4	270
M9-85	1.8	310
M10-85	1.5	40
M11-85	5.3	590
M4	6.0	410
м7	7.2	6,100
м8	9.3	540
м9	5.3	4,870
M11	1.8	200
M12	3.9	890
M16	3.4	20,270
M18	2.4	6,890
M19	1.4	19,150
M23	9.2	4,360
M24	10.1	340
M29	7.4	520
M31	2.4	330
M37	NS	890

Table 10.--Target compounds for the analysis of volatile organic compounds in soil gas, November 1986

Compound	Chemical Abstract Service registry number
Benzene	71-43-2
Toluene	108-88-3
n-Octane	111-65-9
Ethylbenzene	100-41-4
m-Xylene	108-38-3
o-Xylene	95-47-6
1,3,5-Trimethylbenzene	108-67-8
n-Decane	124-18-5
1,2,4-Trimethylbenzene	95-63-6
1,2,3,5-Tetramethylbenze	ne 527-53-7
1,2,3,4-Tetramethylbenze	ne 488-23-3
n-Dodecane	112-40-3
Naphthalene	91-20-3

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Table 11. -- Concentrations of volatile organic compounds in soil gas. November 1986

[All concentrations are in parts per billion, by volume; ND, below limit of detection; NQ, not quantified due to high background noise; L, low concentrations of alkanes, not quantified; H, high concentrations of alkanes, not quantified (if quantified, applies to target compound n-Octane); depth in feet below land surface of soil-gas sample tubes; water levels are in feet below land surface, water level from M16 is used for SG5; land-surface available from table 2].

Well identi- fier	Depth	Benzene	Tolue	Ethyl- ne benzene		l Naph- es thalene	1,3,5- Tri- methyl- benzene	Water- level
SG3	7	ND	ND	ND	ND	6,500	ND	10.9
	8	5,340	4,470	610	9,960	14,600	2,970	10.7
SG4	2	ND	ND	ND	ND	ND	ND	11.1
	4	ND	NO	ND	ND	360	ND	
	6	ND	ND	ND	ND	ND	ND	
	8	410	ND	ND	450	750	460	
SG5	1	ND	ND	ND	ND	ND	ND	10.9
	2	ND	ND	ND	ND	ND	ND	2.7.4.5
	3	ND	ND	ND	ND	ND	ND	
	4	ND	ND	ND	ND	ND	ND	
	5	ND	ND	ND	ND	ND	ND	
	6	ND	ND	ND	ND	ND	ND	
	7	ND	ND	ND	210	ND	430	
	9	230,000 3	00,000	83,000	160,000	ND	26,000	
SG6	5	ND	ND	ND	ND	ND	ND	9.3
SG7	6	ND	ND	ND	ND	ND	ND	13.69
	7	סא	ND	ND	ND	ND	ND	
SG8	1	ИО	ND	ND	ND	ND	ND	
	2	ND	ND	ND	ND	ND	ND	
	3	ND	230	ND	ND	ND	ND	
	4	540	ND	ND	ND	ND	ND	
	5	ND	ND	ND	ND	ND	ND	
	6	ND	570	ND	ND	ND	ND	
	7	ND	ND	ND	ND	ND	ND	
	8	ND	ND	ND	ND	ND	ND	
	9	***(Sample t	tube clogge	d/In wa	ter) * * *		

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Table 11. -- Concentrations of volatile organic compounds in soil gas. November 1986--Cont.

Well identi- fier	Depth	2-Ethyl 1-methy benzene	1,2,4- - Tri- l- methyl- benzene		1,2,3,5- Tetra- methyl- benzene	1,4-Di- methyl-2- ethyl- benzene	1,3-Di- methyl,4- ethyl- benzene	Mixed alkanes (or n- Octane)
sg3	7	ND	ND	ND	580	790	ND	
BIEG	8	1,720	7,030	2,470	5,920	8,620	ND	ND 940
SG4	2	ND	ND	ND	ND	ND	ND	NO
	4	ND	30	130	750	1,260	ND	ND
	6	ND	ND	ND	ND	ND	ND	ND
	8	ND	ND	ND	ND	ND	ND	ND ND
SG5	1	D	ND	ND	ND	ND	ND	ND
	2	ND	ND	ND	ND	ND	ND	ND
	3	ND	ND	ND	ND	ND	ND	ND
	4	ND	ND	ND	ND	ND	ND	ND
	5	ND	ND	ND	ND	ND	ND	ND
	6	ND	ND	ND	ND	ND	ND	ND
	7	ND	ND	ND	ND	ND	ND	ND
	9	5,820	56,500	25,200	3,950	9,180	ND	NQ
SG6	5	ND	ND	ND	ND	ND	ND	L
SG7	6	ND	ND	ND	ND	ND	ND	ND
	7 .	ND	ND	ND	ND	ND	ND	ND
\$G 8	1	ND	ND	ND	ND	ND	ND	ND
	2	ND	ND	ND	ND	ND	ND	ND
	3	ND	ND	ND	390	320	ND	L
	4	ND	ND	ND	120	ND	ND	н
	5	ND	ND	ND	160	ND	ND	н
	6	ND	ND	ND	150	ND	ND	L
	7	ND	ND	ND	ND	ND	ND	L
	8	ND	ND	ND	ND	ND	ND	L
	9	• •	 (Sample 	tube clogo	ged/in wate	r) * * *		

PRELIMINARY SUBJECT TO RESISTANCE

Table 12.--Observed water levels in observation and domestic wells

(Water levels are in feet below land surface (table 2))

			-								
Well iden- tifier	Date	Water level	Well iden-	Dat	9	Water level	Well iden-		Dat	ө	Wate:
CILIGE			tifier	A			tifer				
41-82	Feb 21, 1985	11.37	M2-82 Fe	b 21,	1985	11.48	M3-82	Feb	21.	1985	10.05
	May 11	10.57	Ma	y 11		10.55		May	- 5		9.23
	Aug 29	8.84	Au	g 29		9.47		Aug		*	8.05
	Apr 23, 1986	10.00	Ap	r 23,	1986	9.88		-		1986	8.6
	May 14	9.36	Ma	y 14		9.12		May			7.9
	Jun 23	9.00	Ju	n 23		8.54		Jun	23		7.5
	Jul 28	8.91	Ju	1 28		8.40		Jul	28		7.4
	Sep 22	8.69	Se	p 22		8.25		Sep	22		7.23
	Nov 19	11.12	No	v 19		11.01		Nov	19		9.70
	Dec 17	11.46	De	c 17		11.40		Dec	17		10.03
	Jan 20, 1987	11.67	Ja	n 20,	1987	11.60		Jan	22,	1987	10.23
	Feb 17	11.58	Fe	b 17		11.46		Feb	17		10.15
	Mar 16	11.39	Ma	r 16		11.32		Mar	16		9.96
	Apr 22	11.05	Ap	r 22		10.86		Apr	22		9.6
			Ma	r 18,	1989	11.65		Mar	18,	1989	10.1
1-85	Feb 21, 1985	12.9	M2-85 Fe	b 20,	1985	6.22	M3-85	Feb	20	1985	7.98
	May 10	11.58		21		6.27			21	4,00	8.0
	Jun 09	9.37	Ma	y 10		6.11		May			7.6
	Aug 02	9.84	Ju	n 09		5.37		Jun			6.6
	29	9.95	Au	g 02		5.66		Aug			7.1
	30	9.69		29		5.72			29		7.2
	Sep 21	9.68		30		5.58			30		7.0
	Oct 16	10.91	Se	21		5.57		Sep			6.9
	Nov 15	11.86	Oc	16		5.44		Oct			6.5
	Dec 13	12.69	No	/ 15		6.29		Nov			7.2
	Jan 24, 1986	12.24	Jai	24,	1986	6.06		Dec			8.0
	Feb 21	11.99	Fel	21		5.87				1986	8.1
	Mar 20	11.59	Max	20		5.67		Feb			7.8
	Apr 23	10.58	Ap	23		5.67		Mar			7.7
1	May 14	9.72	May	14,	1986	5.67		Apr			7.4
	Jun 23	9.11		23		6.34		May			6.8
9	Jul 28	9.00	Jul	28		6.60		Jun			7.1
	Sep 22	8.96	Sep	22		5.51		Jul			7.1
1	Nov 20	12.48	535	20		6.62		Sep			6.4
ı	Dec 17	12.85		: 18		7.04		Nov			8.9
,	Jan 21, 1987	13.17		22,	1987	7.18		Dec			8.6
1	Feb 18	13.05		17		6.64				1987	8.6
	Mar 16	12.75		16		6.24		Feb			8.5
	Apr 23	12.25		23		6.66		Mar			8.4
	Mar 13, 1989	13.33	101.	14,	1989	9.14		Apr			8.3

Table 12. -- Observed water levels in observation and domestic wells

					-	_				-			_		
Well iden- tifie		Dat	9	Water level	Well iden- tifier		Date	9	Water level	Well iden- tifer		Dat	e		ater
					-				-				_		
44-85	Feb	20,	1985	8.95	M5-85	Feb	20,	1985	5.39	M6-85	Feb	20,	198	5	7.55
		21		8.95			21		5.38			21			7.55
	May	11		7.91		May	10		5.17		May	10			7.25
	Jun	09		5.83		Jun	09		4.69		Jun	09			6.61
	Aug	02		6.12		Aug	02		5.04		Aug	02			7.14
		29		6.31			29		5.13			29			7.48
		30		6.07			30		4.91			30			6.89
	Sep			6.04		Sep			4.89		Sep				6.88
	Oct			7.10		Oct			4.67		Oct				6.66
	Nov			8.09		Nov			5.23		Nov				7.88
	Dec		1006	8.90		Dec		1006	5.39			13	100		8.01
			1986	8.69				1986	5.05				198	6	7.64
	Feb			8.58		Feb		1006	4.90			21			7.36
	Mar			8.15				1986	4.85			20			7.25
	Apr			6.96		Apr May			5.02			23			7.14
	May Jun			6.07		Jun			4.79			14 23			6.70
	Jul			5.40		Jul			5.02						7.16
	Sep			4.94		Sep			4.56			28			7.34
	Nov			8.55		Nov			5.30			20			7.72
	Dec			8.98		Dec			5.49			17			8.11
			1987	9.26				1987	5.56				198	17	8.31
	Feb		1 70 7	9.04		Feb		1707	5.48			18	130		8.03
	Mar			8.92		Mar			5.32			16			7.87
	Apr			8.27		Apr			5.46			23			7.93
				3.13.				1989	5.64				198	39	8.52
7-85	Feb		1985	7.40	M8-85	Feb		1985	9.47	M9-	85	Feb		1985	9.
		21		7.43			21		9.49				21		9
	May			7.13		May			8.92			May			9
	Jun			6.09		Jun			7.92			Jun			7
	Aug	29		6.72		Aug	29		8.43 8.50			Aug	29		8
		30	8	5.63			30		7.33				30		8
	San					San			7.93			San			8
	Sep Oct			6.09		Sep Oct			8.38			Sep			
				6.40		Nov			8.99			Nov			9
	Nov			7.42		Dec			9.29			Dec			9
			1986	7.14				1986	9.17					1986	
			1 300	7.07			21		9.07				21		9
	Feb			6.89		-		1986	8.73			Mar			9
	Apr			6.83		Apr		1700	8.56			Apr			8
	May			6.13		May			8.08			May			7
	Jun			6.40		Jun			8.04			Jun			7
	Jul			6.63		Jul			8.04	a - c		Jul			7
	Sep			5.84		Sep			7.45	22		Sep			7
	Nov			7.40		Nov			9.07			Nov			9
	Dec			7.78		Dec			9.31			Dec			9
			1997	7.78				1987	9.48					1987	10
			1987					1 70 /						1 30 /	9
	Feb			7.75		Feb			9.42			Feb			
	Mar			7.62		Mar			9.22			Mar			9
	Apr		1000	7.65		Apr		1000	9.18			Apr		1000	9
	Mar	14,	1989	8.05		mar	14,	1989	9.59	/4		MAI	15,	1989	10

Table 12.--Observed water levels in observation and gomestic wells

	_													
Well iden- tifier		Dat	e	Water level	Well iden- tifier		Date	9	Water level	Well iden- tifer		Date)	Water level
M10-85	Feb	20,	1985	9.72	M11-85	Feb	20,	1985	10.94	M12-85	Feb	20,	1985	11.52
		21		9.72			21		10.94			21		11.52
	May			9.09		May			9.96		May			10.68
	Jun			8.06		Jun			11.81		Jun			9.24
	Aug			8.34		Aug			7.83		Aug			9.82
		29		7.93			29		7.56			29		9.73
	•	30		7.24		C	30		6.72		C	30		9.61
	Sep			7.08		Sep			6.76		Sep			9.50
	Oct			7.72 8.20		Oct Nov			9.47		Oct Nov			10.12
	Nov			8.55		Dec			10.27		Dec			11.52
	Dec		1986	9.23				1986	10.65				1986	11.15
	Feb	200000000000000000000000000000000000000	1300	9.17		Feb	0.4000000000000000000000000000000000000		10.44		Feb	100000000000000000000000000000000000000	1700	10.98
	Mar			8.83				1986	9.98		Mar			10.53
	Apr			8.68		Apr		1,000	9.34		Apr			10.13
	May			8.22		May			8.64		May			9.53
	Jun			8.05		Jun			8.11		Jun			9.13
	Jul			8.05		Jul			8.01		Jul			9.08
	Sep			7.67		Sep			7.79		Sep	22		8.83
	Nov			9.34		Nov			10.58		Nov	20		11.06
	Dec	17		9.52		Dec	17		10.92		Dec	17		11.30
	Jan	22,	1987	9.68		Jan	20,	1987	10.83		Jan	20,	1987	11.38
	Feb	18		9.70		Feb	17		11.01		Feb	18		11.50
	Mar	16		9.52		Mar	16		10.81		Mar	16		11.26
	Apr	22		9.37		Apr	22		10.38		Apr	23		11.01
						Mar	18,	1989	11.10					
м1	Nov	19,	1986	12.01	M2			1986	10.55	мз			1986	10.73
	Dec			12.69		Dec			10.84			17		11.02
	Jan	20,	1987	12.72				1987	11.01				1987	11.22
	Feb			12.55		Feb			10.94			17		11.16
	Mar			12.39		Mar			10.76			16		10.96
	Apr	22		12.08		Apr	22		10.48		Apr	22		10.67
M4			1986	10.91	м5		10000	1986	10.94	M6.1			1986	10.51
	Dec			11.07		Dec			11.27			17		10.89
			1987	11.28				1987	11.50				1987	11.04
	Feb			11.19		Feb			11.40			17		10.95
	Mar			11.01		Mar			11.20			16		10.76
	Apr			10.68		Apr	22		10.72		Apr	22		10.48
	Mar	17,	1989	11.2										

Table 12.--Observed water levels in observation and domestic wells

Well iden- tifier		Date		ater evel	Well iden- tifier	Date	18	Water level	Well iden- tifer	Dat	0	Water level
M6.2	Nov	20, 1	986 10	.53	M7.1	Nov 19,	1986	11.16	M7.2	Mar 16	, 1987	11.33
	Dec	17	10	.79		Dec 17		11.42		Apr 22		10.82
	Jan	20, 1	987 10	0.98		Jan 20,	1987	11.67				
	Feb			.89		Feb 17		11.56				
	Mar			72		Mar 16		11.38				
	Apr Mar	17, 1		.03		Apr 22		10.97				
							202020	9121 172021				
М8	Dec	20, 1		.32	м9	Nov 20,	1986	11.28	M10	Nov 20		11.03
		20, 1		.75		Dec 17 Jan 20,	1997	11.62		Dec 17		11.41
	Feb			.81		Feb 19	1307	11.71		Jan 20 Feb 17		11.61
		18		.82		Mar 16		11.53		Mar 16		11.30
	Mar	16		.64		Apr 22		11.13		Apr 22		10.95
	Apr	22	11	.14						57.0		20 100 10
M11	Nov	20, 1	986 10	.89	M12	Nov 19,	1986	11.13	M13	Nov 19	, 1986	11.15
	Dec	17	. 11	.23		Dec 17		11.46		Dec 17		11.58
		20, 1	987 11	.45		Jan 20,	1987	11.63		Jan 20	, 1987	11.83
	Feb			.35		Feb 17		11.57		Feb 17		11.72
	Mar			.19		Mar 16		11.40		Mar 16		11.53
	Apr	17, 19		.56		Apr 22	1000	11.05		Apr 22		11.17
	ria L	.,, .	,0, 11	.50		Mar 18,	1909	11.69		Mar 16	, 1989	11.90
M14		20, 19		.58	M16	Nov 19,	1986	10.99	M17	Nov 20	, 1986	11.35
	Dec			.88		Dec 17		11.42		Dec 17		11.73
	Feb	20, 19		.09		Jan 20,	1987	11.63		Jan 20		11.97
		18		.92		Feb 17 Mar 16		11.52		Feb 17		11.86
	Mar			.76		Apr 22		10.80		Mar 16 Apr 22		11.64
	Apr			.43		Mar 18,	1989	11.59			, 1989	12.02
	Mar	16, 19	989 10	.14		\$95,00°T\$() ************************************					,	
M18	Nov	20, 19	86 10	.99	M19	Nov 20,	1986	11.38	M20	Nov 20	, 1986	11.21
	Dec			.36		Dec 17	.,,,	11.69	1120	Dec 17		11.62
	Jan	20, 19		.58		Jan 20,	1987	11.90		Jan 20		11.88
	Feb	17	11	.46		Feb 17		11.77		Feb 17		11.75
	Mar	16	11	.26		Mar 16		11.61		Mar 16		11.53
	Apr			.84		Apr 22		11.16		Apr 22		10.92
	Mar	17, 19	989 11	.70		Mar 15,	1989	12.08		Mar 17	, 1989	12.00
421	Nov	20, 19	86 11	.49	M22	Nov 20,	1986	10.79	M23	Nov 20	, 1986	10.10
	Dec			.88		Dec 17		11.03	29/5/7/	Dec 17		10.39
	Jan	20, 19	187 12	.15		Jan 21,	1987	11.33		Jan 22		10.60
	Ceb		11	.90		Feb 17		11.13		Feb 18		10.53
	Mar			.71		Mar 16		10.95		Mar 16		10.32
	Apr	42	11	.31		Apr 22		10.47		Apr 22		10.02
										Mar 16	, 1989	10.64

Table 12. -- Observed water levels in observation and numestic wells

							Mahan	11-11				54.0
Well iden- tifier	Date	Water level	Well iden- tifier		Date	9	Water level	Well iden- tifer		Date	9	Water level
-										-		
M24	Nov 20, 1986	9.11	M25	Nov	20,	1986	9.35	M26	Nov	20,	1986	9.38
	Dec 17	9.40		Dec	17		9.66		Dec	17		9.65
	Jan 22, 1987	9.66		Jan	22,	1987	9.94		Jan	22,	1987	9.91
	Feb 18	9.58		Feb			9.81		Feb			9.84
	Mar 16	9.54		Mar			9.58		Mar			9.63
	Apr 22	9.05		Apr	22		9.26		Apr	22		9.33
127	Nov 20, 1986	9.73	M28			1986	13.69	M29			1986	10.19
	Dec 17	9.91		Dec			14.24		Dec			10.37
	Jan 22, 1987	10.20			18		14.19				1987	
	Feb 18	10.14				1987	14.19		Feb			10.65
	Mar 16	9.92		Feb			14.13		Mar			10.56
	Apr 22 Mar 16, 1989	9.67 9.21		Mar			13.88		Apr		1000	10.24
	Mat 10, 1909	3.21		1070		1989	13.33		Mat	13,	1989	10.84
				10000000) =2151 1.	TACE OF THE	BIROT-ION					
430	Nov 20, 1986	9.94	M31	Nov	20,	1986	10.74	м33	Nov	20,	1986	9.15
	Dec 17	10.20		Dec			10.99		Dec			9.46
	Jan 22, 1987	10.32		Jan	22,	1987	11.19		Jan	22,	1987	9.64
	Feb 18	10.33		Feb	18		11.14		Feb	18		9.59
	Mar 16	10.23		Mar	16		10.92		Mar	16		9.44
	Apr 22	9.90		Apr	22		10.65		Apr	23		9.27
	Mar 14, 1989	10.47		Mar	15,	1989	11.31					
M34	Nov 20, 1986	8.19	м35	Nov	20	1986	11.22	D32	Jul	28	1986	8.15
.5 1	Dec 18	8.37		Dec		.,,,	11.47	552		22	1,00	8.07
	Jan 22, 1987	8.51				1987	11.71		Nov			11.61
	Feb 18	8.52		Feb			11.41			17		12.04
	Mar 16	8.33		Mar			11.44				1987	12.36
	Apr 23	8.24		Apr	23		11.17		Feb			12.23
	Mar 14, 1989	8.65							Mar	16		11.9
									Apr	23		9.09
136	May 14, 1986	9.46	M37	May	14,	1986	9.05	M38	Nov	20,	1986	8.17
	Jun 23	9.08		Jun	23		8.78		Dec	17		9.41
	Jul 28	9.01		Jul	28		8.76		Jan	22,	1987	8.80
	Sep 22	8.71		Sep			8.45		Feb	18		9.3
	Nov 19	10.64		Nov			11.34		Mar			9.13
	Dec 17	11.17		Dec			10.82		Apr	23		9.1
	18	11.17				1987	10.78					
	Jan 20, 1987	11.36		Feb			10.73					
	Feb 17	11.29		Mar			10.56					
	Mar 16 Apr 22	12.28		Apr	22		10.35					
	32.00 State	SHECKE RECEIVED							09			
м39	Jan 20, 1987	11.02	M40	Jan	21,	1987	12.85					
	Feb 18	11.07	2000 B	Feb		8280E	11.89					
	Mar 16	10.81		Mar			11.73				*	
	Apr 23	10.69		Apr			11.70					

Table A1.--Concentrations of volatile organic compounds in quality-assurance samples.

May 1985 through June 1986

[Concentrations are in micrograms per liter; ND, below the detection limit of 1 microgram per liter].

Sample or well identifier	Date	Benzene	Toluene	Total xylenes
Field blank	5-10-85	ND	ND	ND
Field blank	5-11-85	ND	ND	ND
M11-85 M11-85	5-11-85 5-11-85	1,380 1,090	7,700 4,000	12,990 14,900
Lab blank	12-16-85	ND	ND	ND
Lab blank	6-27-86	ND	ND	ND

Table A2.--Concentrations of volatile organic compounds in quality-assurance samples, August 27, 1985

[Concentrations are in micrograms per liter; ND, below the limit of detection of 1 microgram per liter for the insurance company study (ICS), see text for discussion of limit of detections for Ground-Water Toxics Study (GWTS)].

		200				
Well identi-	Be	enzene	To	oluene	Total	xylenes
fier	ICS	GWTS	ICS	GWTS	ICS	GWTS
M7-85	ND	ND	ND	ND	ND	ND
M8-85	96	ND	1	ND	9	ND
M10-85	ND	ND	ND	ND	ND.	ND
M11-85	920	1,000	1,100	3,400	6,300	7,300

Table A3.--Mean and standard deviations of trip blanks, August 26-30 1985

[Concentrations are in micrograms per liter].

Parameter	Benzene	Toluene	Ethyl- benzene	m+p Xylene	o- Xylene	n-Propyl- benzene	1,3,5-Tri- methyl- benzene
Mean	0.87	0.49	0.032	0.041	0.025	0.0024	0.017
Standard deviation	<u>+</u> 0.11	<u>+</u> 0.10	<u>+</u> 0.015	<u>+</u> 0.015	<u>+</u> 0.0071	±0.0047	<u>+</u> 0.0096
Parameter	1,2,4- Tri- methyl- benzene	Iso- butyl- benzene	sec- Butyl- benzene	n-Butyl- benzene	1,2,3,5 Tetra- methyl- benzene	Tetra- methyl-	Naph-
Mean	0.053	0.0046	0.006	0.019	0.009	0.014	0.20
Standard deviation	<u>+</u> 0.017	<u>+</u> 0,0082	<u>+</u> 0.0089	<u>+</u> 0.011	<u>+</u> 0.014	<u>+</u> 0.016	<u>+</u> 0.29

Table A4. -- Comparison of means and standard deviations of standard hydrocarbon compound concentrations. November 1985

[Concentrations in micrograms per liter; standard solutions prepared from materials supplied by the U.S. Environmental Protection Agency-Environmental Monitoring Services Laboratory, Cincinati, OH (EPA)]

		EPA	GW	TP	
Standard solution	Compound	Concentration	Concentration		standard viation
I	Benzene	10,000	12,000	<u>+</u> 1	,800
	Toluene	10,000	11,000	<u>+</u>	540
	m+p-Xylene	10,000	9,700	<u>+</u>	680
	o-Xylene	5,000	5,100	<u>+</u>	320
II	Benzene	10,000	12,000	<u>+</u>	800
	o-Xylene	10,000	9,500	±	560
III	Toluene	10,000	11,000	±	480
	m+p-Xylene	10,000	10,000	<u>+</u>	720

Table A5. -- Concentrations of volatile organic compounds in quality-assurance samples. February 23 through March 17, 1989

[Equivalent spikes containing benzene, toluene, ethylbenzene, m-xylene, naphthalene, 1,3,5-trimethylbenzene, 1,2,4-trimethylbenzene, p-isopropyltoluene, 1,2,3-trichlorobenzene, 1,2,4-trichlorobenzene, n-butylbenzene, styrene, and bromobenzene: FS1 and FS2 are field and LS is laboratory; D, duplicate sample; BL, blank-water sample; ER, equipment-rinse sample; ERB, baked-equipment rinse sample; concentrations are in micrograms per liter; ND, below the detection limit of 0.2 micrograms per liter)

or well identi- fier	Date	Benzene	Toluene	Ethyl- benzene	Total xylenes	Naph- thalene	1,3,5- Tri- methyl- benzene	2- Ethyl-1- methyl- benzene	1,2,3- Tri- methyl- benzene	1,2,4- Tri- methyl- benzene	1,2,3,5 Tetra- methyl- benzene
M8-85	03-14-89	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
M8-85 (FS1)	03-14-89	6.6	6.9	7.6	7.4	9.8	7.7	ND	ND	7.6	ND
M8-85 (FS2)	03-14-89	5.2	5.2	5.9	5.8	9.4	6.5	ND	ND	6.4	ND
M8-85 (LS)	03-14-89	8.6	8.2	8.7	8.3	9.4	8.7	ND	ND	8.5	ND
M18	03-17-89	ND	ND	0.2	0.2	ND	ND	3.2	0.3	ND	ND
M18 (D)	03-17-89	0.4	ND	0.4	0.3	ND	ND	5.4	0.4	ND	ND
BL1	02-23-89	ND	ND	ND	ND	ND	NO.			2412	X10450
BL2	02-23-89	ND	ND	ND	ND	ND	ND ND	ND ND	ND	ND	ND
BL3	02-23-89	ND	ND	ND	ND	ИD	ИD	ND	ND ND	ND ND	ND
BL4	03-06-89	ND	ND	ND	DN	ИD	ND	ND	ND	ND	ND ND
BLS	03-13-89	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
ER1	02-23-89	0.2	0.2	ND	0.1ª	מא	ND	ND	ND	ND	ND
ER2	02-23-89	0.4	0.4	ND	0.3	ND	ND	ND	ND	ND	ND
ER3	02-23-89	0.2	0.2	ND	ND	ND	ND	ND	ND	ND	ND
RB4	03-06-89	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
ERB5	03-13-89	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Sample or well identi- fier	Date	7	1,2,3,4- Tetra- methyl- benzene	p-Iso- propyl- toluene	propyl	Di- - bromo-	Di- chloro- bromo- methane	chlo-	sec- Butyl-	1,2,3- Tri- chloro-	1,2,4- Tri- chloro
or well identi- fier		methyl- 2-ethyl- benzene	Tetra- methyl- benzene	p-Iso- propyl- toluene	propyl	- bromo- methane	chloro- bromo- methane	tetra- chlo- ride	sec- Butyl- benzene	Tri- chloro- benzene	Tri- chloro benzen
or well identi- fier	03-14-89	methyl- 2-ethyl- benzene	Tetra- methyl- benzene	p-Iso- propyl- toluene	propy)	- bromo- methane	chloro- bromo-	tetra- chlo-	sec- Butyl-	Tri- chloro-	Tri- chloro
or well identi- fier 48-85 48-85 (FS1)	03-14-89	methyl- 2-ethyl- benzene ND	Tetra- methyl- benzene	p-Iso- propyl- toluene ND	propyl benzene ND	Dromo- methane	chloro- bromo- methane	tetra- chlo- ride	sec- Butyl- benzene ND	Tri- chloro- benzene ND 9.4	Tri- chloro benzen ND 8.8
or well identi- fier 48-85 48-85 (FS1) 48-85 (FS2)	03-14-89 03-14-89 03-14-89	methyl- 2-ethyl- benzene ND ND	Tetra- methyl- benzene ND ND	p-Iso- propyl- toluene ND 6.6 5.8	Propyl Denzene ND ND ND	ND ND ND	chloro- bromo- methane ND ND	tetra- chlo- ride 0.3	Sec- Buty1- benzene ND ND	Tri- chloro- benzene ND 9.4 8.2	Tri- chloro benzen ND 8.8 7.1
or well identi- fier 48-85 48-85 (FS1) 48-85 (FS2)	03-14-89	methyl- 2-ethyl- benzene ND	Tetra- methyl- benzene	p-Iso- propyl- toluene ND	propyl benzene ND	Dromo- methane	chloro- bromo- methane	tetra- chlo- ride	sec- Butyl- benzene ND	Tri- chloro- benzene ND 9.4	Tri- chloro benzen ND 8.8
or well identi- fier 48-85 48-85 (FS1) 48-85 (FS2) 4*-85 (LS)	03-14-89 03-14-89 03-14-89	methyl- 2-ethyl- benzene ND ND	Tetra- methyl- benzene ND ND	p-Iso- propyl- toluene ND 6.6 5.8	Propyl Denzene ND ND ND	ND ND ND	chloro- bromo- methane ND ND	tetra- chlo- ride 0.3	Sec- Buty1- benzene ND ND	Tri- chloro- benzene ND 9.4 8.2	Tri- chloro benzen ND 8.8 7.1
or well identi- fier 48-85 48-85 (FS1) 48-85 (FS2) 4*-85 (LS)	03-14-89 03-14-89 03-14-89 03-14-89	methyl- 2-ethyl- benzene ND ND ND ND	Tetra- methyl- benzene ND ND ND ND ND	p-Iso- propyl- toluene ND 6.6 5.8 7.9	ND ND ND ND	ND ND ND ND	chloro- bromo- methane ND ND ND	0.3	SEC-Buty1-benzene ND ND ND ND ND ND	Tri-chloro-benzene ND 9.4 8.2 8.1	ND 8.8 7.1 7.9
or well identi- fier 48-85 48-85 (FS1) 48-85 (FS2) 44-85 (LS) 418 418 (D)	03-14-89 03-14-89 03-14-89 03-14-89 03-17-89	methyl- 2-ethyl- benzene ND ND ND ND ND	Tetra- methyl- benzene ND ND ND ND ND ND ND ND ND N	p-Iso- propyl- toluene ND 6.6 5.8 7.9	ND ND ND ND	ND ND ND ND ND ND ND ND ND ND ND ND ND N	chloro- bromo- methane ND ND ND ND ND	0.3 ND ND ND ND ND ND ND ND ND	ND ND ND ND ND ND ND ND ND ND ND ND ND N	Tri- chloro- benzene ND 9.4 8.2 8.1 ND ND	ND 8.8 7.1 7.9 ND ND
or well identi- (ier 48-85 48-85 (FS1) 48-85 (FS2) 4*-85 (LS) 418 418 (D)	03-14-89 03-14-89 03-14-89 03-14-89 03-17-89 03-17-89	methyl- 2-ethyl- benzene ND ND ND ND ND ND	Tetra- methyl- benzene ND ND ND ND ND ND ND ND ND N	p-Iso- propyl- toluene ND 6.6 5.8 7.9 ND	ND ND ND ND ND	ND ND ND ND ND ND ND ND ND ND ND ND ND N	chloro- bromo- methane ND ND ND ND ND ND	tetra- chlo- ride 0.3 ND ND ND ND ND ND ND ND ND	ND ND ND ND ND ND ND ND ND ND ND ND ND N	Tri- chloro- benzene ND 9.4 8.2 8.1 ND ND	ND 8.8 7.1 7.9 ND ND
or well identi- fier 48-85 48-85 (FS1) 48-85 (FS2) 4*-85 (LS) 418 418 (D)	03-14-89 03-14-89 03-14-89 03-14-89 03-17-89 03-17-89 02-23-89 02-23-89	methyl- 2-ethyl- benzene ND ND ND ND ND	Tetra- methyl- benzene ND NO NO NO ND ND ND ND ND ND	P-Iso- propyl- toluene ND 6.6 5.8 7.9 ND ND ND	ND ND ND ND ND ND ND ND ND ND ND ND ND N	ND ND ND ND ND ND ND ND ND ND ND ND ND N	chloro- bromo- methane ND ND ND ND ND ND ND ND ND N	tetra- chlo- ride 0.3 ND ND ND ND ND ND ND ND ND ND ND ND ND	ND ND ND ND ND ND ND ND ND ND ND ND ND N	Tri- chloro- benzene ND 9.4 8.2 8.1 ND ND ND	ND 8.8 7.1 7.9 ND ND ND ND ND ND
or well identi- (ier 18-85 18-85 (FS1) 18-85 (FS2) 1*-85 (LS) 118 118 (D) 111	03-14-89 03-14-89 03-14-89 03-14-89 03-17-89 03-17-89	METHYI- 2-ethyI- benzene ND ND ND ND ND ND ND	Tetra- methyl- benzene ND ND ND ND ND ND ND ND ND N	p-Iso- propyl- toluene ND 6.6 5.8 7.9 ND	ND ND ND ND ND ND ND ND ND ND ND ND ND N	ND ND ND ND ND ND ND ND ND ND ND ND ND N	chloro- bromo- methane ND ND ND ND ND ND ND ND ND N	tetra- chlo- ride 0.3 ND ND ND ND ND ND ND ND ND ND ND ND ND	ND ND ND ND ND ND ND ND ND ND ND ND ND N	Tri- chloro- benzene ND 9.4 8.2 8.1 ND ND ND ND ND ND ND	ND 8.8 7.1 7.9 ND ND ND ND ND ND ND ND ND N
or well identi- fier M8-85 M8-85 (FS1) 48-85 (FS2) 4*-85 (LS) 418 418 (D) 311 312 314	03-14-89 03-14-89 03-14-89 03-14-89 03-17-89 03-17-89 02-23-89 02-23-89 02-23-89	MET HY1- 2-ethy1- benzene ND ND ND ND ND ND ND ND	Tetra- methyl- benzene ND ND ND ND ND ND ND ND ND N	P-Iso- propyl- toluene ND 6.6 5.8 7.9 ND ND ND ND	ND ND ND ND ND ND ND ND ND ND ND ND ND N	ND ND ND ND ND ND ND ND ND ND ND ND ND N	chloro- bromo- methane ND ND ND ND ND ND ND ND ND N	tetra- chlo- ride 0.3 ND ND ND ND ND ND ND ND ND ND ND ND ND	ND ND ND ND ND ND ND ND ND ND ND ND ND N	Tri- chloro- benzene ND 9.4 8.2 8.1 ND ND ND	ND 8.8 7.1 7.9 ND ND ND ND ND ND
or well identi- fier 48-85 48-85 (FS1) 48-85 (FS2) 4*-85 (LS) 418 418 (D) 311 312 314	03-14-89 03-14-89 03-14-89 03-17-89 03-17-89 02-23-89 02-23-89 02-23-89 03-13-89	MET HYI- 2-ethyI- benzene ND ND ND ND ND ND ND ND ND N	Tetra- methyl- benzene ND ND ND ND ND ND ND ND ND N	P-Iso- propyl- toluene ND 6.6 5.8 7.9 ND ND ND ND ND ND ND ND ND N	ND ND ND ND ND ND ND ND ND ND ND ND ND N	ND ND ND ND ND ND ND ND ND ND ND ND ND N	ND ND ND ND ND ND ND ND ND ND ND ND ND N	O.3 ND ND ND ND ND ND ND ND ND ND ND ND ND	ND ND ND ND ND ND ND ND ND ND ND ND ND N	Tri- chloro- benzene ND 9.4 8.2 8.1 ND ND ND ND ND ND ND ND ND N	ND 8.8 7.1 7.9 ND ND ND ND ND ND ND ND ND N
or well identi- fier M8-85 M8-85 (FS1) M8-85 (FS2) M18-85 (LS) M18 M18 (D) M18 M18 M18 M18 M18 M18 M18 M18 M18 M1	03-14-89 03-14-89 03-14-89 03-17-89 03-17-89 02-23-89 02-23-89 02-23-89 03-06-89 03-13-89	METHYI- 2-ethyI- benzene ND ND ND ND ND ND ND ND ND N	Tetra- methyl- benzene ND ND ND ND ND ND ND ND ND N	P-Iso- propyl- toluene ND 6.6 5.8 7.9 ND ND ND ND ND ND ND ND ND N	ND ND ND ND ND ND ND ND ND ND ND ND ND N	ND ND ND ND ND ND ND ND ND ND ND ND ND N	ND ND ND ND ND ND ND ND ND ND ND ND ND N	O.3 ND ND ND ND ND ND ND ND ND ND ND ND ND	ND ND ND ND ND ND ND ND ND ND ND ND ND N	Tri- chloro- benzene ND 9.4 8.2 8.1 ND ND ND ND ND ND ND ND ND N	ND 8.8 7.1 7.9 ND ND ND ND ND ND ND ND ND N
or well identi- (ier 48-85 48-85 (FS1) 48-85 (FS2) 4*-85 (LS) 418 418 (D) 8811 8812 813 814	03-14-89 03-14-89 03-14-89 03-17-89 03-17-89 02-23-89 02-23-89 02-23-89 03-13-89	METHY1- 2-ethy1- benzene ND ND ND ND ND ND ND ND ND N	Tetra- methyl- benzene ND ND ND ND ND ND ND ND ND N	P-Iso- propyl- toluene ND 6.6 5.8 7.9 ND ND ND ND ND ND ND ND ND N	ND ND ND ND ND ND ND ND ND ND ND ND ND N	ND ND ND ND ND ND ND ND ND ND ND ND ND N	ND ND ND ND ND ND ND ND ND ND ND ND ND N	O.3 ND ND ND ND ND ND ND ND ND ND ND ND ND	ND ND ND ND ND ND ND ND ND ND ND ND ND N	Tri- chloro- benzene ND 9.4 8.2 8.1 ND ND ND ND ND ND ND ND ND N	ND 8.8 7.1 7.9 ND ND ND ND ND ND ND ND ND N
or well identi- (ier 48-85 48-85 (FS1) 48-85 (FS2) 4*-85 (LS) 418 418 (D) 841 841 841 841 841 841 841 84	03-14-89 03-14-89 03-14-89 03-17-89 03-17-89 02-23-89 02-23-89 02-23-89 03-06-89 03-13-89	METHYI- 2-ethyI- benzene ND ND ND ND ND ND ND ND ND N	Tetra- methyl- benzene ND ND ND ND ND ND ND ND ND N	P-Iso- propyl- toluene ND 6.6 5.8 7.9 ND ND ND ND ND ND ND ND ND N	ND ND ND ND ND ND ND ND ND ND ND ND ND N	ND ND ND ND ND ND ND ND ND ND ND ND ND N	ND ND ND ND ND ND ND ND ND ND ND ND ND N	O.3 ND ND ND ND ND ND ND ND ND ND ND ND ND	ND ND ND ND ND ND ND ND ND ND ND ND ND N	Tri- chloro- benzene ND 9.4 8.2 8.1 ND ND ND ND ND ND ND ND ND N	ND 8.8 7.1 7.9 ND ND ND ND ND ND ND ND ND N
18-85 (FS1) 18-85 (FS1) 18-85 (FS2) 1*-85 (LS) 118 118 (D) 112 112 113 114 115	03-14-89 03-14-89 03-14-89 03-17-89 03-17-89 02-23-89 02-23-89 02-23-89 03-06-89 03-13-89	METHY1- 2-ethy1- benzene ND ND ND ND ND ND ND ND ND N	Tetra- methyl- benzene ND ND ND ND ND ND ND ND ND N	P-Iso- propyl- toluene ND 6.6 5.8 7.9 ND ND ND ND ND ND ND ND ND N	ND ND ND ND ND ND ND ND ND ND ND ND ND N	ND ND ND ND ND ND ND ND ND ND ND ND ND N	ND ND ND ND ND ND ND ND ND ND ND ND ND N	O.3 ND ND ND ND ND ND ND ND ND ND ND ND ND	ND ND ND ND ND ND ND ND ND ND ND ND ND N	Tri- chloro- benzene ND 9.4 8.2 8.1 ND ND ND ND ND ND ND ND ND N	ND 8.8 7.1 7.9 ND ND ND ND ND ND ND ND ND N

Table A5.--Concentrations of volatile organic compounds in quality-assurance samples. February 23 through March 17, 1989--Continued

Sample or well identi- fier	Date	1,3-Di- methyl- 2-ethyl- benzene	1,2-Di- chloro- ethane	Bromo- form	Chloro- di- bromo- methane		Chloro- benzene	Chloro- ethane	Methyl- bromide	Methyl- chlo- ride	Methyl- ene chlo- ride
M8-85	03-14-89	ND	ND	ND	ND	5.3	ND	ND	ND	ND	ND
M8-85 (FS1)	03-14-89	ND	ND	ND	ND	1.4	ND	ND	ND	ND	ND
M8-85 (FS2)	03-14-89	ИD	ND	ND	ND	1.4	ND	ND	ND	ND	ND
M8-85 (LS)	03-14-89	ND	ND	ND	ND	ND	ND	ИD	ND	ND	ND
M18	03-17-89	0.8	ND	ND	ND	0.5	ND	ND	ND	ND	ND
M18 (D)	03-17-89	0.9	ND	ND	ND	ND	ND	ND	ND	ND	ND
BL1	02-23-89	ND	ND	ND	ND	1.4	ND	ND	ND	ND	0.4
8L2	02-23-89	ND	ND	ND	ND	1.5	ND	ND	ND	ND	0.6
BL3	02-23-89	ND	ND	ND	ND	1.6	ND	ND	ND	ND	0.5
BL4	03-06-89	ND	ND	ND	ИD	1.3	ND	ND	ND	ND	ND
BL5	03-13-89	ND	ND	ND	0.2	3.7	ND	ИD	ND	ND	0.2
ER1	02-23-89	ND	ND	ND	ND	61	ND	ND	ND	ND	2.6
ER2	02-23-89	ND	ND	ND	ND	148	ИD	ND	ND	ND	5.3
ER3	02-23-89	ND	ND	ND	ND	57	ND	ND	ND	ND	2.7
ERB4	03-06-89	ND	ND	ND	ND	1.3	ND	ND	ND	ND	ND
ERB5	03-13-89	ND	ND	ND	0.2	3.2	ND	ND	ND	ND	ND
Sample or well identi- (ier	Date	n- Propyl-	n- Butyl- benzene	Tetra- chloro ethyl- ene	- chloro- fluoro-	1,1-D1- chloro-	1,1-D1- chloro- ethyl- ene	· 1,1,1- · Tri- chloro- ethane	1,1,2- Tri- chloro-		1,2-Di- chloro-
		benzene	Delizene	GIIG	methane	ethane	GIIG	Genone	ethane	ethan	benzene
		Denzene	Delizene		mechane	ethane			ethane	etnan	benzene
M8-85	03-14-89	ND	ND	ND	ND	ND	ND	. אם	ND	ND	ND
M8-85 (FS1)	004100000			ND ND	ND ND	ND ND	ND ND	. ND ND	ND ND	ND ND	ND ND
	03-14-89	ND	ND 6.2 5.4	ND ND ND	ND ND ND	ND ND ND	ND ND ND	. ND ND ND	ИО ИО ИО	ND ND ND	ND ND ND
M8-85 (FS1)	03-14-89	ND ND	ND 6.2	ND ND	ND ND	ND ND	ND ND	. ND ND	ND ND	ND ND	ND ND
M8-85 (FS1) M8-85 (FS2)	03-14-89 03-14-89 03-14-89	ND ND ND	ND 6.2 5.4	ND ND ND	ND ND ND	ND ND ND	ND ND ND	ND ND ND ND	ND ND ND ND	ND ND ND ND	ND ND ND ND
M8-85 (FS1) M8-85 (FS2) M8-85 (LS)	03-14-89 03-14-89 03-14-89 03-14-89	ND ND ND	ND 6.2 5.4 8.2	ND ND ND	ND ND ND	ND ND ND	ND ND ND	. ир ир ир	ND ND ND	ND ND ND	ND ND ND
M8-85 (FS1) M8-85 (FS2) M8-85 (LS) M18	03-14-89 03-14-89 03-14-89 03-14-89	ND ND ND ND	ND 6.2 5.4 8.2	ND ND ND ND	иD иD иD иD	ND ND ND ND	ND ND ND	ND ND ND ND	ND ND ND ND	ND ND ND ND	ND ND ND NO ND
M8-85 (FS1) M8-85 (FS2) M8-85 (LS) M18 M18 (D) BL1	03-14-89 03-14-89 03-14-89 03-14-89 03-17-89	ND ND ND ND	ND 6, 2 5, 4 8, 2 ND ND	ND ND ND ND	ND ND ND ND	ND ND ND ND	ND ND ND ND	ND ND ND ND ND ND	ND ND ND ND	ND ND ND ND	ND ND ND NO
M8-85 (FS1) M8-85 (FS2) M8-85 (LS) M18 M18 (D)	03-14-89 03-14-89 03-14-89 03-14-89 03-17-89 03-17-89	ND ND ND ND ND	ND 6, 2 5, 4 8, 2 ND ND ND	ND ND ND ND ND	ND ND ND ND	ND ND ND ND	ND ND ND ND	ND ND ND ND ND ND ND	ND ND ND ND ND ND ND ND ND	ND ND ND ND ND ND ND ND	ND ND ND ND ND ND ND ND
M8-85 (FS1) M8-85 (FS2) M8-85 (LS) M18 M18 (D) BL1 BL2	03-14-89 03-14-89 03-14-89 03-14-89 03-17-89 03-17-89 02-23-89 02-23-89	ND ND ND ND ND ND	ND 6.2 5.4 8.2 ND ND ND ND ND	ND ND ND ND ND ND ND ND	ND ND ND ND ND	ND ND ND ND ND	ND ND ND ND ND	ND ND ND ND ND ND ND ND ND ND ND	ND ND ND ND ND	ND ND ND ND ND ND ND ND ND	ND ND ND ND ND
M8-85 (FS1) M8-85 (FS2) M8-85 (LS) M18 M18 (D) BL1 BL2 BL3	03-14-89 03-14-89 03-14-89 03-14-89 03-17-89 03-17-89 02-23-89 02-23-89 02-23-89	ND ND ND ND ND ND ND ND ND ND	ND 6, 2 5, 4 8, 2 ND ND ND ND ND ND ND ND ND ND ND ND ND	ND ND ND ND ND ND ND ND ND ND ND ND ND	ND ND ND ND ND ND	ND ND ND ND ND ND	ND ND ND ND ND	ND ND ND ND ND ND ND ND ND ND ND	ND ND ND ND ND ND ND ND ND	ND ND ND ND ND ND ND ND	ND ND ND ND ND ND ND ND
M8-85 (FS1) M8-85 (FS2) M8-85 (LS) M18 M18 (D) BL1 BL2 BL3 BL4 BL5	03-14-89 03-14-89 03-14-89 03-17-89 03-17-89 02-23-89 02-23-89 02-23-89 03-06-89	ND ND ND ND ND ND ND ND ND ND ND ND ND N	ND 6.2 5.4 8.2 ND ND ND ND ND ND ND ND ND ND ND ND ND	ND ND ND ND ND ND ND ND ND ND ND ND ND N	ND ND ND ND ND ND	ND ND ND ND ND ND ND ND ND ND ND ND ND	ND ND ND ND ND ND ND ND ND ND ND	ND ND ND ND ND ND ND ND ND ND ND ND ND N	ND ND ND ND ND ND ND ND ND ND ND	ND ND ND ND ND ND ND ND ND ND ND ND ND N	ND ND ND ND ND ND ND ND ND ND ND ND ND N
M8-85 (FS1) M8-85 (FS2) M8-85 (LS) M18 M18 (D) BL1 BL2 BL3 BL4 BL5	03-14-89 03-14-89 03-14-89 03-17-89 03-17-89 02-23-89 02-23-89 02-23-89 03-13-89	ND ND ND ND ND ND ND ND ND ND ND ND ND N	ND 6.2 5.4 8.2 ND ND ND ND ND ND ND ND ND ND	ND ND ND ND ND ND ND ND ND ND ND ND ND N	ND ND ND ND ND ND ND ND ND	ND ND ND ND ND ND ND ND ND ND ND ND ND N	ND ND ND ND ND ND ND ND ND ND ND ND ND N	. ND ND ND ND ND ND ND ND ND ND ND ND ND	ND ND ND ND ND ND ND	ND ND ND ND ND ND ND ND ND ND ND ND ND	ND ND ND ND ND ND ND ND ND ND ND ND ND N
M8-85 (FS1) M8-85 (FS2) M8-85 (LS) M18 M18 (D) BL1 BL2 BL3 BL4 BL5	03-14-89 03-14-89 03-14-89 03-14-89 03-17-89 03-17-89 02-23-89 02-23-89 02-23-89 03-13-89 02-23-89	ND ND ND ND ND ND ND ND ND ND ND ND ND N	ND 6.2 5.4 8.2 ND ND ND ND ND ND ND ND ND ND ND ND ND	ND ND ND ND ND ND ND ND ND ND ND ND ND N	ND ND ND ND ND ND ND ND	ND ND ND ND ND ND ND ND ND ND ND ND ND N	ND ND ND ND ND ND ND ND ND ND ND ND ND N	. ND ND ND ND ND ND ND ND	ND ND ND ND ND ND ND ND	ND ND ND ND ND ND ND ND ND ND ND ND ND N	ND ND ND ND ND ND ND ND ND ND ND ND ND N
M8-85 (FS1) M8-85 (FS2) M8-85 (LS) M18 M18 (D) BL1 BL2 BL3 BL4 BL5 ER1 ER2 ER3	03-14-89 03-14-89 03-14-89 03-17-89 03-17-89 02-23-89 02-23-89 03-13-89 02-23-89 02-23-89	ND ND ND ND ND ND ND ND ND ND ND ND ND N	ND 6.2 5.4 8.2 ND ND ND ND ND ND ND ND ND ND ND ND ND	ND ND ND ND ND ND ND ND ND ND ND ND ND N	ND ND ND ND ND ND ND ND ND	ND ND ND ND ND ND ND ND ND ND ND ND ND N	ND ND ND ND ND ND ND ND ND ND ND ND ND N	ND ND ND ND ND ND ND ND ND ND ND ND ND N	ND ND ND ND ND ND ND ND ND ND ND ND ND N	ND ND ND ND ND ND ND ND ND ND ND ND ND N	ND ND ND ND ND ND ND ND ND ND ND ND ND N
M8-85 (FS1) M8-85 (FS2) M8-85 (LS) M18 M18 (D) BL1 BL2 BL3 BL4 BL5 ER1 ER2	03-14-89 03-14-89 03-14-89 03-14-89 03-17-89 03-17-89 02-23-89 02-23-89 03-06-89 03-13-89 02-23-89	ND ND ND ND ND ND ND ND ND ND ND ND ND N	ND 6, 2 5, 4 8, 2 ND ND ND ND ND ND ND ND ND ND ND ND ND	ND ND ND ND ND ND ND ND ND ND ND ND ND N	ND ND ND ND ND ND ND ND ND ND ND ND ND N	ND ND ND ND ND ND ND ND ND ND ND ND ND N	ND ND ND ND ND ND ND ND ND ND ND ND ND N	. ND ND ND ND ND ND ND ND ND ND ND ND ND N	ND ND ND ND ND ND ND ND ND ND	ND ND ND ND ND ND ND ND ND ND ND ND ND N	ND ND ND ND ND ND ND ND ND ND ND ND ND N

Table A5.--Concentrations & volatile organic compounds in quality-assurance samples. February 23 through March 17, 1989--Continued

Sample or well identi- fier	Date	1,2-Di- chloro- propane	chloro-	1,4-Di- chloro- benzene	fluoro-	1,3-Di- chloro-	chloro-	Vinyl Chlo- ride	Tri- chloro- ethyl- ene	1,2-Di- chloro- ethene	Styrene
M8-85	03-14-89	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
M8-85 (FS1)	03-14-89	ND	ND	ND	ND	ND	ND	ND	ND	ND	8.6
M8-85 (FS2)	03-14-89	ND	ND	ND	ND	ND	ND	ND	ND	ND	7.0
M8-85 (LS)	03-14-89	ND	ND	ND	ND	ND	ND	ND	ND	ND	8.8
M18	03-17-89	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
M18 (D)	03-17-89	ND	ND	ND	ND	ND	ND	ND	ND	ND .	ND
3L1 .	02-23-89	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
BL2	02-23-89	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
BL3	02-23-89	ND	ND	ND	סא	ND	ND	ND	ND	ND	ND
BL4	03-06-89	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3L5	03-13-89	0.3	ND	ND	ND	ND	ND	ND	ND	ND	ND
ER1	02-23-89	ND	ND	ND	ND	ND	ND	ND	0.2	ND	ND
ER2	02-23-89	ND	ND	ND	ND	ND	ND	ND	0.5	ND	ND
ER3	02-23-89	ND	ND	ND	ND	ND	ND	ND	0.2	ND	ND
							NO.	NO.			
RB4 RB5	03-06-89	ИD 0.3	ND ND	ND ND	ND ND	ND ND	ND ND	ND ND	ND ND	ND ND	ND ND
r well		1,1-D1- chloro pro-	2,2-D1- chloro- pro-	1,3-Di- chloro- pro-	ortho- Chloro-	para- Chloro-	1,2,3- Tri- chloro-	1,1,1,2- Tetra- chloro-	1,2- D1- bromo-	Bromo-	
or well denti-	Date	chloro	chloro-	chloro-		1,000	Tri-	Tetra-	D1-	Bromo- benzene	
r well denti- ler	Date 03-14-89	chloro pro-	chloro- pro-	chloro- pro-	Chloro-	Chloro-	Tri- chloro-	Tetra- chloro-	Di- bromo-		
r well denti- ier 8-85		chloro pro- pene	chloro- pro- pane	chloro- pro- pane	Chloro- toluene	Chloro- toluene	Tri- chloro- propane	Tetra- chloro- ethane	Di- bromo- ethane	benzene	
er well denti- ler 8-85	03-14-89	chloro pro- pene	chloro- pro- pane	chloro- pro- pane	Chloro- toluene	Chloro- toluene	Tri- chloro- propane	Tetra- chloro- ethane	D1- bromo- ethane	ND	
er well denti- ler 8-85 8-85 (FS1) 8-85 (FS2)	03-14-89	chloro pro- pene ND	chloro- pro- pane ND	chloro- pro- pane ND	Chloro- toluene ND	Chloro- toluene ND	Tri- chloro- propane ND	Tetra- chloro- ethane ND	D1- bromo- ethane ND	ND 8.7	
er well denti- ler 18-85 (FS1) 18-85 (FS1) 18-85 (ES2) 18-85 (LS)	03-14-89 03-14-89 03-14-89	chloro pro- pene ND ND	chloro- pro- pane ND ND	chloro- pro- pane ND ND	Chloro- toluene ND ND	Chloro- toluene ND ND	Tri- chloro- propane ND ND ND	Tetra- chloro- ethane ND ND ND	D1- bromo- ethane ND ND	ND 8.7 7,1	
r well denti- ier 8-85 8-85 (FS1) 8-85 (FS2) 8-85 (LS)	03-14-89 03-14-89 03-14-89 03-14-89	chloro pro- pene ND ND ND	chloro- pro- pane ND ND ND	chloro- pro- pane ND ND ND ND	Chloro- toluene ND ND ND ND	ND ND ND ND ND	Tri- chloro- propane ND ND ND ND ND	Tetra- chloro- ethane ND ND ND ND	D1- bromo- ethane ND ND ND	ND 8.7 7.1 7.7	
r well denti- ler 18-85 (8-85 (FS1) 18-85 (FS2) 18-85 (LS)	03-14-89 03-14-89 03-14-89 03-14-89	Pro- pene ND ND ND ND ND	chloro- pro- pane ND ND ND ND	chloro- pro- pane ND ND ND ND ND	Chloro-toluene ND ND ND ND ND ND ND ND	Chloro-toluene ND ND ND ND ND ND ND ND ND	Tri- chloro- propane ND ND ND ND ND ND ND	Tetra- chloro- ethane ND ND ND ND ND ND	D1- bromo- ethane ND ND ND ND	ND 8.7 7.1 7.7 ND	
r well denti- ler 18-85 (8-85 (FS1) 18-85 (FS2) 18-85 (LS) 118 118 (D)	03-14-89 03-14-89 03-14-89 03-14-89 03-17-89 03-17-89 02-23-89 02-23-89	Pro- pene ND ND ND ND ND ND ND ND ND N	Chloro- pro- pane ND ND ND ND ND ND ND ND ND N	Chloro- pro- pane ND ND ND ND ND ND ND ND ND N	Chloro-toluene ND ND ND ND ND ND ND ND ND N	Chloro-toluene ND ND ND ND ND ND ND ND ND N	Tri- chloro- propane ND ND ND ND ND ND ND ND ND N	Tetra- chloro- ethane ND ND ND ND ND ND ND ND ND N	D1- bromo- ethane ND ND ND ND ND ND ND ND ND N	ND 8.7 7.1 7.7 ND ND ND ND	
18-85 (FS1) 18-85 (FS1) 18-85 (FS2) 18-85 (LS) 118 (D) 111	03-14-89 03-14-89 03-14-89 03-14-89 03-17-89 03-17-89 02-23-89 02-23-89 02-23-89	chloro pro- pene ND ND ND ND ND ND ND ND ND N	chloro- pro- pane ND ND ND ND ND ND ND ND ND N	Chloro- pro- pane ND ND ND ND ND ND ND ND ND N	Chloro-toluene ND ND ND ND ND ND ND ND ND N	Chloro-toluene ND ND ND ND ND ND ND ND ND N	Tri- chloro- propane ND ND ND ND ND ND ND ND ND N	Tetra- chloro- ethane ND ND ND ND ND ND ND ND ND N	D1- bromo- ethane ND ND ND ND ND ND ND ND ND N	ND 8.7 7.1 7.7 ND ND ND ND ND ND ND ND ND	
r well denti- ler 18-85 (FS1) 18-85 (FS2) 18-85 (LS) 118 118 (D) 111 112 113 114	03-14-89 03-14-89 03-14-89 03-17-89 03-17-89 02-23-89 02-23-89 02-23-89 03-06-89	chloro pro- pene ND ND ND ND ND ND ND ND ND N	chloro- pro- pane ND ND ND ND ND ND ND ND ND N	chloro- pro- pane ND ND ND ND ND ND ND ND ND N	Chloro-toluene ND ND ND ND ND ND ND ND ND N	Chloro-toluene ND ND ND ND ND ND ND ND ND N	Tri- chloro- propane ND ND ND ND ND ND ND ND ND N	Tetra- chloro- ethane ND ND ND ND ND ND ND ND ND N	D1- bromo- ethane ND ND ND ND ND ND ND ND ND N	ND 8.7 7.1 7.7 ND ND ND ND ND ND ND ND ND ND ND ND	
r well denti- ler 18-85 (FS1) 18-85 (FS2) 18-85 (LS) 118 118 (D) 111 112 113 114	03-14-89 03-14-89 03-14-89 03-14-89 03-17-89 03-17-89 02-23-89 02-23-89 02-23-89	chloro pro- pene ND ND ND ND ND ND ND ND ND N	chloro- pro- pane ND ND ND ND ND ND ND ND ND N	Chloro- pro- pane ND ND ND ND ND ND ND ND ND N	Chloro-toluene ND ND ND ND ND ND ND ND ND N	Chloro-toluene ND ND ND ND ND ND ND ND ND N	Tri- chloro- propane ND ND ND ND ND ND ND ND ND N	Tetra- chloro- ethane ND ND ND ND ND ND ND ND ND N	D1- bromo- ethane ND ND ND ND ND ND ND ND ND N	ND 8.7 7.1 7.7 ND ND ND ND ND ND ND ND ND	
Sample or well identi- (ler 18-85 (8-85 (FS1) 18-85 (FS2) 18-85 (LS) 118 118 (D) 118 112 113 114 115 115 117 118 118 118 118 118 118 118 118 118	03-14-89 03-14-89 03-14-89 03-17-89 03-17-89 02-23-89 02-23-89 02-23-89 03-06-89	chloro pro- pene ND ND ND ND ND ND ND ND ND N	chloro- pro- pane ND ND ND ND ND ND ND ND ND N	chloro- pro- pane ND ND ND ND ND ND ND ND ND N	Chloro-toluene ND ND ND ND ND ND ND ND ND N	Chloro-toluene ND ND ND ND ND ND ND ND ND N	Tri- chloro- propane ND ND ND ND ND ND ND ND ND N	Tetra- chloro- ethane ND ND ND ND ND ND ND ND ND N	D1- bromo- ethane ND ND ND ND ND ND ND ND ND N	ND 8.7 7.1 7.7 ND ND ND ND ND ND ND ND ND ND ND ND	
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Table A5.--Concentrations of volatile organic compounds in quality-assurance samples, February 23 through March 17, 1989--Continued

Sample	Tentatively	- Addition 1	ed Ordana	- Compoun
or well		Methyl-	3-	
identi-		cyclo-	Methyl-	
fier	Hexane	pentane	-	Acetone
M8-85	ND	ND	ND	ND
M8-85 (FS1)	ND	ND	ND	ND
M8-85 (FS2)	ND	ND	ND	ND
M8-85 (FS3)	ND	ND	ND	ND
м18	ND	ND	ND	ND
M18 (D)	ND	ND	ND	ND
BL1	0.7	1.2	ND	ND
BL2	1.0	0.9	ND	ND
BL3	0.9	1.0	ND	ND
BL4	ND	ND	ND	ND
BL5	ND	ND	ND	ND
ER1	6	57	2,4	0.5
ER2	18	166	5.9	0.6
ER3	57	57	2.5	0.7
ERB4	ND	ND	ND	ND
ERB5	ND	ND	ND	ND

 $^{^{\}rm a}$ Laboratory quantified compound detection, even though below the reported detection limit of 0.2 micrograms per liter.

 $^{^{\}mathrm{b}}$ Tentatively identified organic compound: the reported concentration generally is accurate to one order of magnitude.

Table A6.--Concentrations of inorganic and dissolved-organic carbon quality-assurance samples.

March 1989.

[ER, equipment-rinse blank, de-ionized water; D, duplicate sample; mg/L, milligrams per liter; or $\mu g/L$, milligrams per liter]

Well or sample identi- fier	Date	Spe- cific con- duct- ance (µs/cm)	Lab spe- cific con- duct- ance (µs/cm)	pH (stand ard units)	ard	Temper- l- ature water (°C)	Tur- bid- ity (NTU)	Oxygen, dis- solved (mg/L)	Hard- n ness n (mg/L c as (ard- ess, on- arbonate mg/L as aCO:)
M18 M18D	03-17-89 03-17-89	319	307 307	6.7	6.9 6.7	13.0	40 33	0.0	130 130	0
ER4	03-15-89				7.2		0.3		0	0
Sample or well identi- fier	Date	Calcium dis- solved (mg/L as Ca)	Magne- sium, dis- solved (mg/L as Mg)	Sodium, dis- solved (mg/L as Na)	Sodium percent	Sodium ad- sorp- tion ratio	Potas- sium, dis- solved (mg/L as K)	Alka- linity, field (mg/L as CaCO ₃)	Alka- linity, labor- atory (mg/L as CaCO ₃)	Sulfate, dis- solved (mg/L as SO ₄)
M18 M18 (D) ER4	03-17-89 03-17-89 03-15-89	32 32 0.03	11 11 0.05	12 12 <0.2	17 17	0.5	2.6 2.6 0.1	132	113 113 2	34 34 <0.2
Sample or well identi- fier	Date	Chlo- ride, dis- solved (mg/L as Cl)	fluo- ride, dis- solved (mg/L as f)	Silica, dis- solved (mg/L as SiO ₂)	Solids, residue at 180 °C dis- solved (mg/L)	Solids, sum of consti- tuents, dis- solved (mg/L)	gen, NO ₂ +NO	gen, 3, ammonia dis-	Phos- phorus a, ortho, dis- solvec (mg/L as P)	Barium dis-
	03-17-89	7.0	0.2	38	209	227	<0.10	0.10	0.05	18

Table A6.--Concentrations of inorganic and dissolved-organic carbon quality-assurance samples.

March 1989--Continued

Sample or well identi- fier	Date	Beryl- lium, dis- solved (µg/L as Be)	Cadmium, dis- solved (µg/L as Cd)	Chro- mium, dis- solved (µg/L as Cr)	Cobalt, dis- solved (µg/L as Co)	Copper, dis- solved (µg/L as Cu)	Iron, dis- solved (µg/L as Fe)	Lead, dis- solved (µg/L as Pb)	Lithium, dis- solved (µg/L as Li)	Manga- nese, dis- solved (µg/L as Mn)
M18	03-17-89 03-17-89	<0.5 <0.5	<1 <1	<5 <5	4 <3	<10	7,300	<10	6	2,800
M18 (D)	03-17-89	<0.5	<1	<5	<3	<10	7,200	<10	5 <4	2,800 <1
		Molyb-			Stron-	Vana-				
Sample of well		denum, dis- solved	Nickel, dis- solved	Silver, dis- solved	tium, dls- solved	dium, dis- solved	Zinc, dis- solved	Carbon, dissolved organic		
ldenti- fier	Date	(μg/L as Mo)	(µg/L as Ni)	(µg/L as Ag)	(µg/L as Sr)	(μg/L as V)	(μg/L as Zn)	(mg/L as C)		
M18 M18 (D)	03-17-89 03-17-89	<10 <10	<10 <10	<1 <1	150 150	<6 <6	69 230	1.9		
ER4	03-15-89	<10	<10	<1	<1	<6	<3	0.3		

Table A7.--Comparison of field and laboratory determinations of specific conductance, pH, and alkalinity. November 1986 and March 1989

[µs/cm, microsiemens per centimeter; mg/L, milligrams per liter; --, not analyzed]

		Specific conductance in µs/cm		pH in standard units		Alkalinity in mg/L as CaCO ₃	
Well identi- fier	Date	Field	Lab	Field	Lab	Fleld	Lab
M1-82	11-18-86	280	279	6.8	6.9	131	(503)
M2-82	11-18-86	320	303	6.7	6.8	156	
M1-85	11-19-86 03-13-89	238 208	239 222	6.7 6.9	6.9 7.0	103 89	90
15-85	03-13-89	252	265	6.7	6.8	113	114
M9-85	11-19-86 03-15-89	254 249	254 260	6.5 6.6	6.9 6.7	108 112	111
110-85	11-19-86	298	293	6.6	6.8	116	
411-85	11-17-86 03-18-89	264 292	251 295	6.6 6.6	6.8 6.8	125 140	134
14	11-18-86	313	295	6,6	6.8	151	
7.2	11-17-86	352	336	6.4	6.6	185	
8	11-17-86	247	245	6.6	6.8	105	
9	11-17-86	279	272	6.6	6,9	133	(44)
11	11-18-86	307	298	6.6	6.9	148	75
12	11-18-86 11-17-86	323 342	30 3 32 9	6.5 6.7	6.7 6.8	164 172	
118	11-18-86 03-17-89	292 319	271 307	6.6 6.7	6.8 6.9	149 132	113
19	11-18-86	257	251	6.6	6.9	105	:=:=::::::::::::::::::::::::::::::::::
23	11-18-86	390	385	6.7	6.8	193	
2 4	11-18-86	365	332	6.5	6.7	190	
29	11-19-86	259	258	6.6	6.8	120	-
30	03-14-89	268	284	6.6	6.6	128	122
31	11-19-86	261	261	6.5	6.8	113	



United States Department of the Interior

GEOLOGICAL SURVEY

Water Resources Division Pacific Northwest District Washington Office 1201 Pacific Avenue - Suite 600 Tacoma, Washington 98402

May 5, 1987

Mr. Clar Pratt Ecology 3601 W. Washington

Washington State Department of Yakima, Washington

Dear Mr. Pratt:

I have enclosed the additional materials pertaining to the Yakima Gasoline study that you requested during our meeting of April 22. Included are the logs for the observation wells that we installed during September of 1986 and the site and background information that we included in the work plan for the study.

Because we are no longer funded to work at the site, we must remove the observation wells. Please let me know which, if any, of these wells that you would like left in place. At that time, we will transfer responsibility for the ultimate removal of wells left in place to the Department of Ecology.

Please call me at (206) 593-6510 if you have any questions.

Sincerely,

Hydrologist

Enclosure

DESCRIPTION OF THE YAKIMA STUDY SITE

Yakima is the commercial center for a major agricultural area within south-central Washington. The service station on North First Street where the gasoline and diesel-oil leak occurred is located approximately 2,000 feet southwest of the Yakima River (see fig. 1). Land use in the vicinity of the service station is mixed commercial, residential, and vacant. The subsurface zone immediately underlying the gasoline and diesel oil spill consists of alluvial deposits. Depth from the ground surface to the water table is approximately 10 feet.

Background

In 1980, 1981, and 1982, complaints about the odor and taste of gasoline in water from domestic wells located up to 1,000 feet east of the service station were reported to the State of Washington Department of Ecology (WDOE). The WDOE investigated the reports and determined that the source of contamination was a service station located on North First Street (see fig. 1). More than a dozen households reported contamination of domestic and irrigation supplies, and starting in 1982, outside sources of drinking water were provided for some residents.

New storage tanks and product delivery lines were installed at the station in May and June 1979. Because of improper installation, some of the delivery lines leaked near the ground surface where the lines connect to the dispensers. Leak tests were reported to have been performed at that time,

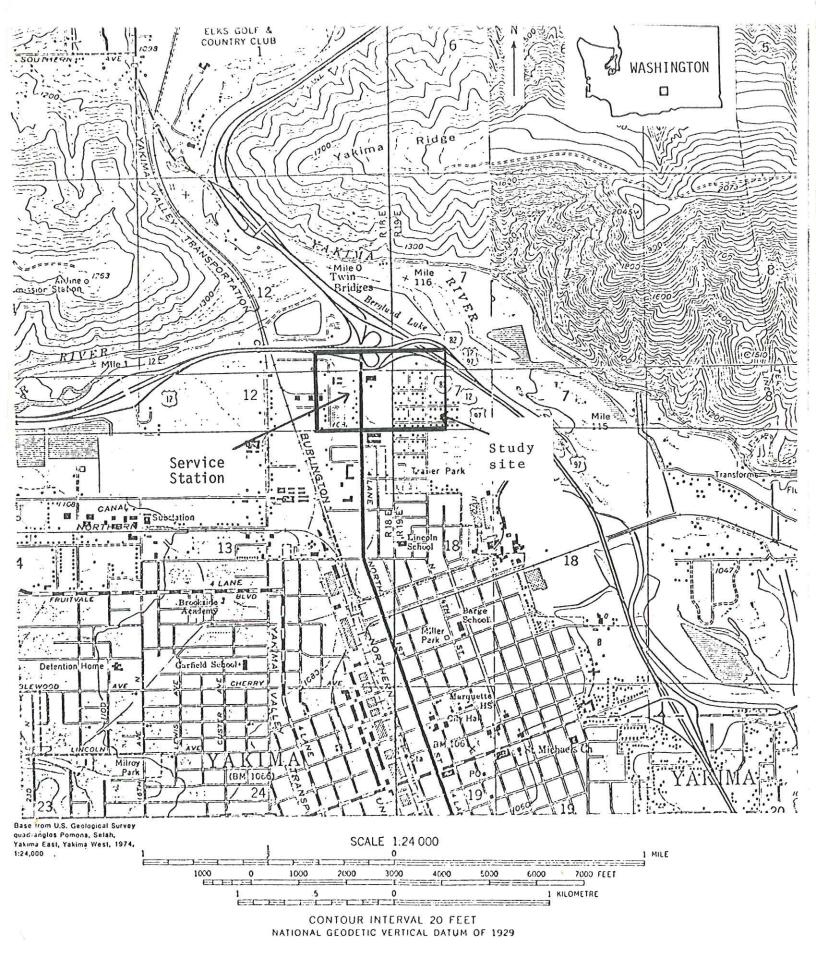


Figure 1.--Location of the gasoline and dieseloil spill site at Yakima, Washington.

and no leaks were found. In December 1980, an air-pressure test of the system was conducted as part of routine testing and again no leaks were reported. As a result of the complaints from private well owners, hydrostatic pressure tests were conducted in September 1982. These tests revealed leaks in the delivery lines, which were repaired immediately.

An estimate of the volume of product lost for the period from September 1981 through October 1982 was made from an audit of inventory records. The audit indicated a total loss of 5,970 gallons of leaded gasoline and 1,740 gallons of diesel oil, or an average combined loss of 550 gallons per month. If the 1980 air-pressure test was accurate, a potential loss of about 12,000 gallons could have occurred during the 22-month period from the time of the pressure test to the correction of the leaks. If the pressure test was inaccurate, then the product loss may have been as much as 22,000 gallons during the entire 40-month period from the time of installation of the tanks and delivery lines to the repair of the lines.

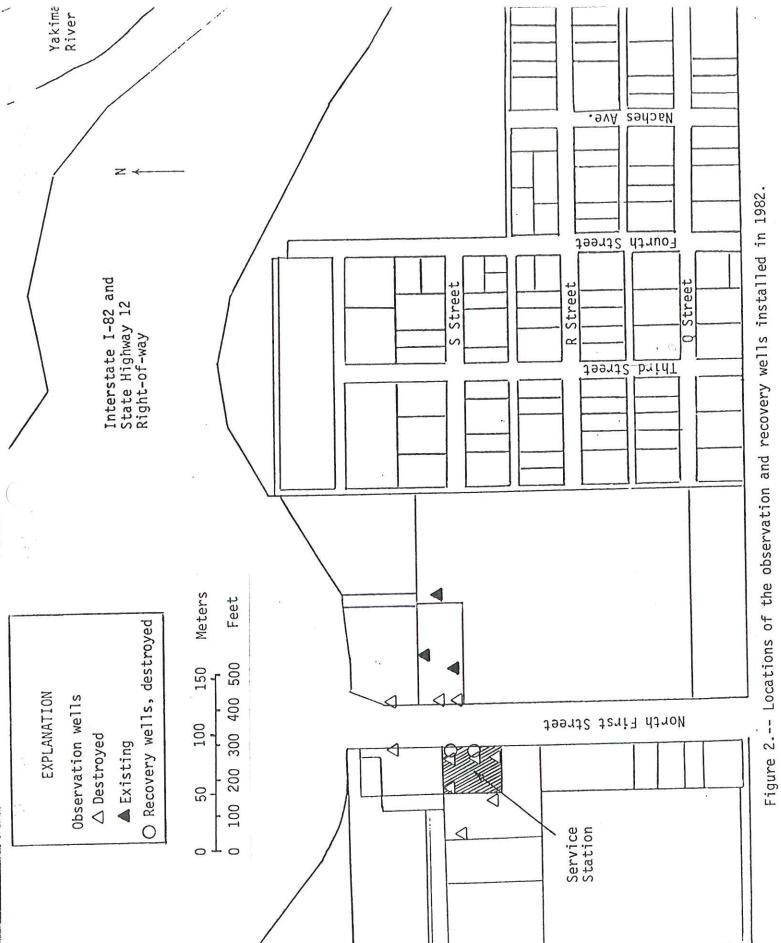
Because of the threat to drinking water, the insurance company representing the service station made an attempt to recover the gasoline and diesel oil in 1982-83. At least 13 observation wells and two recovery wells were installed on or adjacent to the service station property in 1982 (fig. 2). Three of the observation wells contained several inches of free product. The recovery operation was discontinued after 2 months because only 40 gallons of free product were recovered, at a reported cost of \$100,000. All but three of the wells were subsequently destroyed.

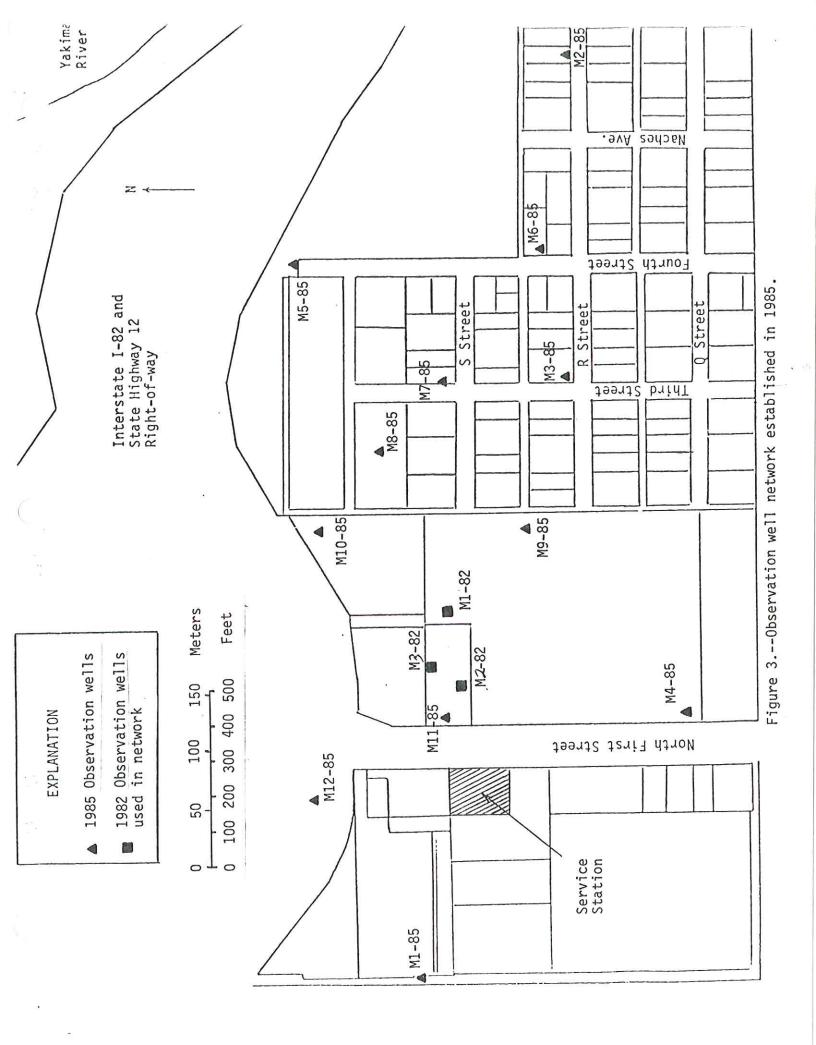
fig 2/

In 1985, the insurance company began a ground-water monitoring program.

From December 1984 to February 1985, 12 observations wells were added to the three remaining from 1982 (fig. 3). At 3-month intervals beginning in February 1985, water levels were measured and selected wells were sampled to determine concentrations of hydrocarbon compounds in ground water. This monitoring program lasted for about 1 year, and these wells are now used by the U.S. Geological Survey.

In the summer of 1985, most homes having affected wells were connected to city water supplies at a cost to the city of about \$175,000. Because of the cost of the unsuccessful cleanup effort, and because uncontaminated drinking water supplies were secured, no further remedial action is anticipated.





Results of Reconnaissance Investigations

Reconnaissance investigations to determine the approximate areal extent of the gasoline and diesel oil contamination in ground water were conducted by the U.S. Geological Survey and the Oregon Graduate Center (OGC). Results indicate that the more water-soluble compounds in gasoline and diesel oil, the aromatic hydrocarbons, have migrated approximately 1,000 feet from the station, generally in an east-north easterly direction.

In August 1985, ground-water samples at the water table were collected from the 15 previously installed observation wells and from 14 temporary holes. The site numbers for the observation wells and temporary holes have the prefix letters M and T, respectively, in figure 9. All the observation wells were constructed with PVC casing and screens. The temporary holes were installed by driving a steel rod to the water table using a jackhammer. Ground-water samples were collected from the temporary holes by bailing through a stainless steel tube that was inserted after removal of the drive rod. Additionally, 31 domestic wells, shown with the prefix letter D in figure 9, were sampled. Typically these extend 10 to 20 feet below the water table with an open-end steel casing. Therefore, hydrocarbon concentrations in the domestic wells may not be the same as those at the water table.

Ground-water samples were analyzed for 17 aromatic hydrocarbons, primarily alkylated benzenes (table 2). Fourteen of the compounds were identified in samples from eight of the sampling sites. Of these compounds,

W 1

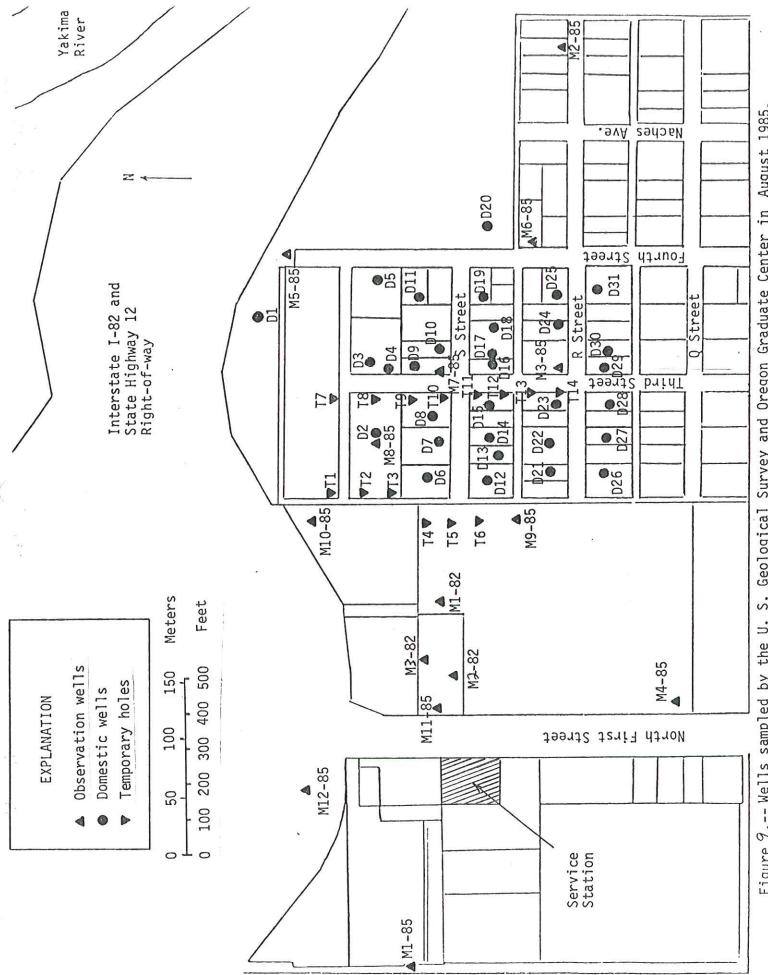


Figure 9.-- Wells sampled by the U. S. Geological Survey and Oregon Graduate Center in August 1985.

TABLE 2.—Concentrations of aromatic hydrocarbons compounds in ground water sampled during August 1985^{\perp}

[concentrations in micrograms per liter]

				Site nu	mber			
Compound	M8-85	M11-85	M1-82	M2-82	M3-82	T-1	D-2	D-6
Benzene	ND	1,000	ND	3,300	800	2.3	10	26
Toluene	ND	3,400	ND	11,000	2,600	ND	ND	ND
Ethylene bromide	ND	ND	ND	ND	ND	ND	ND	ND
Ethyl benzene	ND	220	ND	910	150	ND	ND	4.7
m+p-Xylene	ND	5,200	ND	7,500	5,700	ND	ND	.33
o-Xylene	1.0	2,100	ND	3,000	2,500	.17	1.2	3.2
n-Propyl benzene	ND	ND	ND	130	ND	ND	.11	1.7
1,3,5-Trimethyl benzene	ND	420	25	620	930	ND	ND	ND
1,2,4-Trimethyl benzene	.13	1,200	ND	1,500	2,400	ND	1.4	5.9
t-Butyl benzene	ND	ND	ND	ND	ND	ND	ND	ND
Isobutyl benzene	ND	ND	ND	ND	ND	ND	.38	.32
sec-Butyl benzene	ND	ND	ND	ND	ND	ND	.93	.70
1-Isopropyl-4-methyl benzene	ND	ND	ND	ND	ND	ND	ND	ND
n-Butyl benzene	ND	ND	1.2	ND	ND	ND	.29	.45
1,2,3,5-Tetramethyl benzene	.66	81	8.6	130	380	ND	.26	1.5
1,2,3,4-Tetramethyl benzene	.2	46	5.6	55	180	ND	ND	.40
Naphthalene	3.0	440	2.8	400	740	ND	1.0	12

lwells sampled by the U.S. Geological Survey and the Oregon Graduate Center. Only those wells where compound concentrations were above quantifiable limits appear in the table. ND indicates a concentration below quantifiable limits.

detectable concentrations of benzene and naphthalene were found farthest from the service station, and their concentrations in ground water are shown in figure 10. Although benzene and naphthalene were detected in water collected approximately 1,000 feet northeast of the station, concentrations exceeded 100 ug/L (micrograms per liter) in only the three wells closest to the service station. A petroleum sheen was noted on samples from two of the three wells indicating the presence of free product. The migration of aromatic hydrocarbons in the direction of the Bekins and Safeway properties (fig. 10) is of interest because these two properties are partially paved. The pavement may affect the movement and concentrations of volatile organic compounds in the unsaturated zone under these areas.

In November 1985, the OGC collected and analyzed gas samples from depths of 3.5 to 5.7 feet in the unsaturated zone. Due to complications, including a severe snowstorm, only nine samples were collected, and all were on the Bekins property or on the northwest corner of the Thunderbird property (fig. 11). Preliminary results indicate the possible presence of volatile organic compounds in all but two of the samples, and those were collected from the most southerly locations (fig. 11). These data support the conclusions drawn from the ground-water data, which indicate that the direction of migration is toward the east-northeast from the service station. This

direction of movement is consistent with the direction of ground-water flow,

During the period April through June 1986, additional reconnaissance samples were collected to better define concentrations of aromatic-hydrocarbon compounds in ground water under the Bekins, Safeway, and

as indicated by the water-level data (fig. 8).

fig"

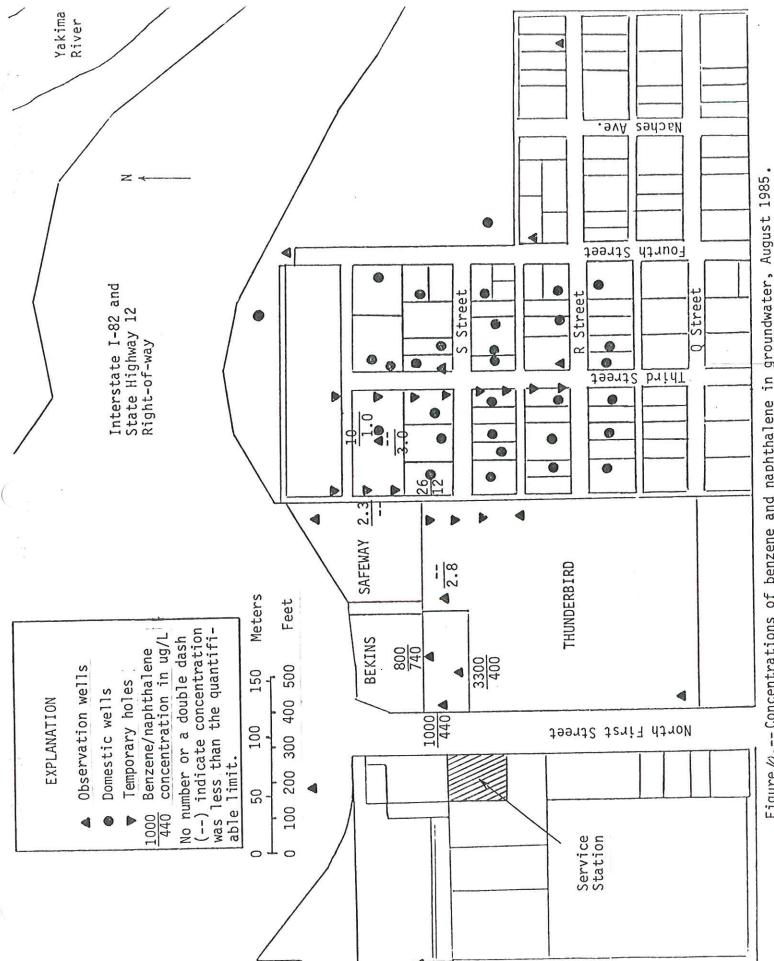
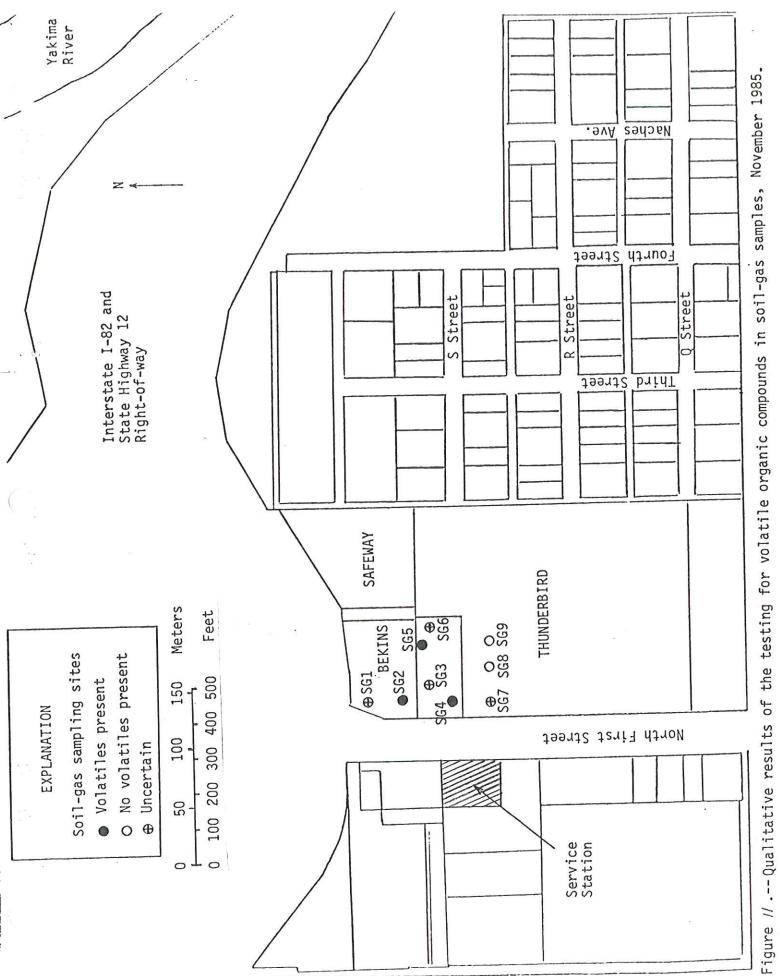
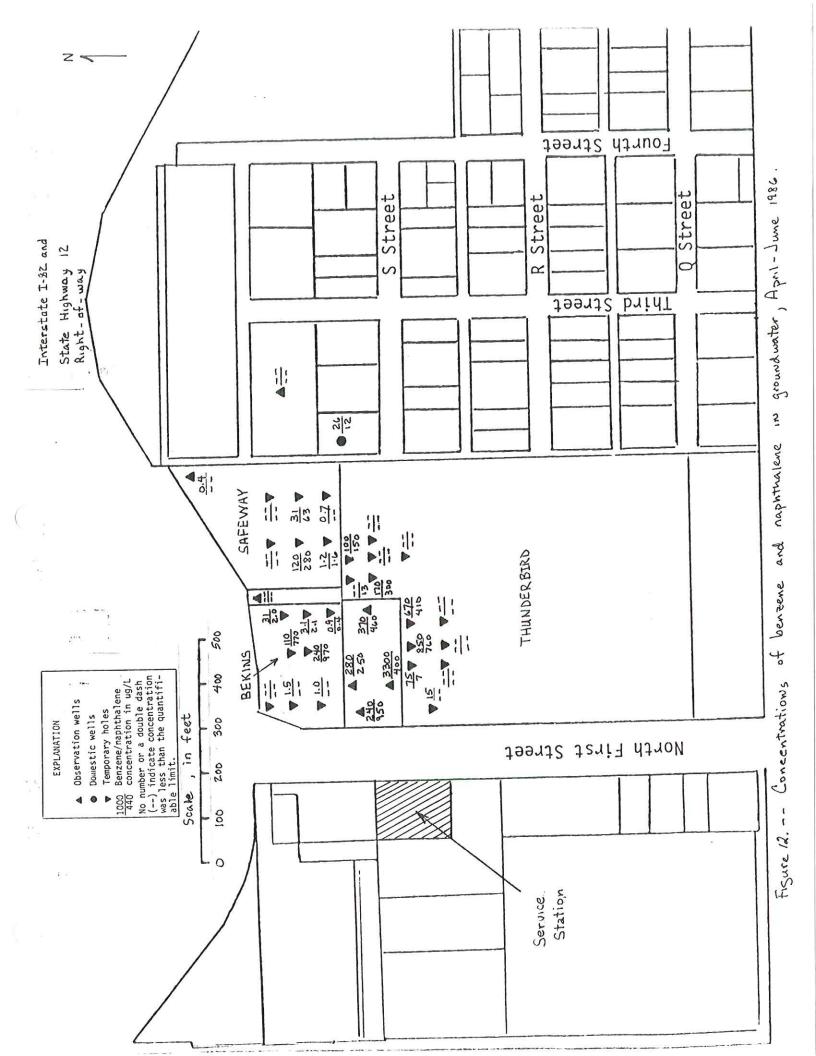


Figure ho .-- Concentrations of benzene and naphthalene in groundwater, August 1985.



Thunderbird properties. The data, as represented by concentrations of benzene and naphthalene (fig. 12), support previous conclusions that some of the dissolved hydrocarbon compounds are migrating in an east-north easterly direction. The need to install observation wells on the Bekins and Safeway properties was also established.

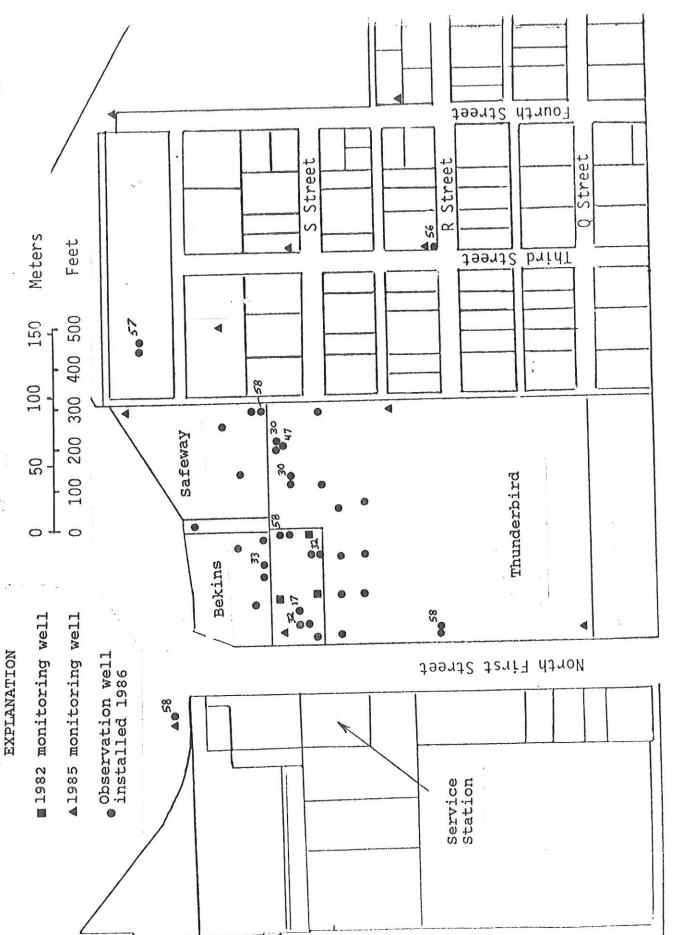


Installation of observation wells and Soil-Gas Sampling Devices

In September 1986, 34 observation wells and eight soil-gas sampling devices were installed at the Yakima site. The resulting network of observation wells (fig. 13) also includes those previously installed by consultants. Some of the 34 wells installed by the U.S. Geological Survey were screened below the water table to investigate the downward migration of hydrocarbon compounds and to determine vertical head gradients.

fig14)

The soil-gas sampling devices (fig. 14) were installed by the Oregon Graduate Center for the collection of data to determine fluxes of volatile-hydrocarbon compounds, oxygen, carbon dioxide, and methane in the unsaturated zone. This element of research as well as others are described in the following sections.



Observation-well network as of October 1986. All wells are screened at the water table unless the depth, in feet, is otherwise indicated. Figure 13. --

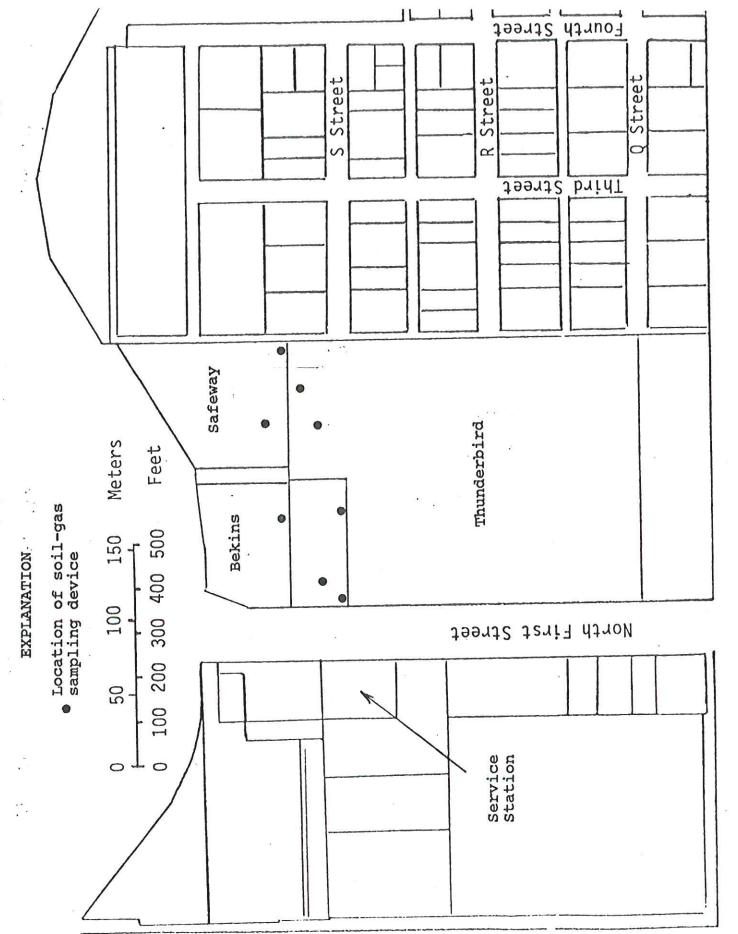


Figure 14.-- Soil-gas sampling devices installed during September 1986.

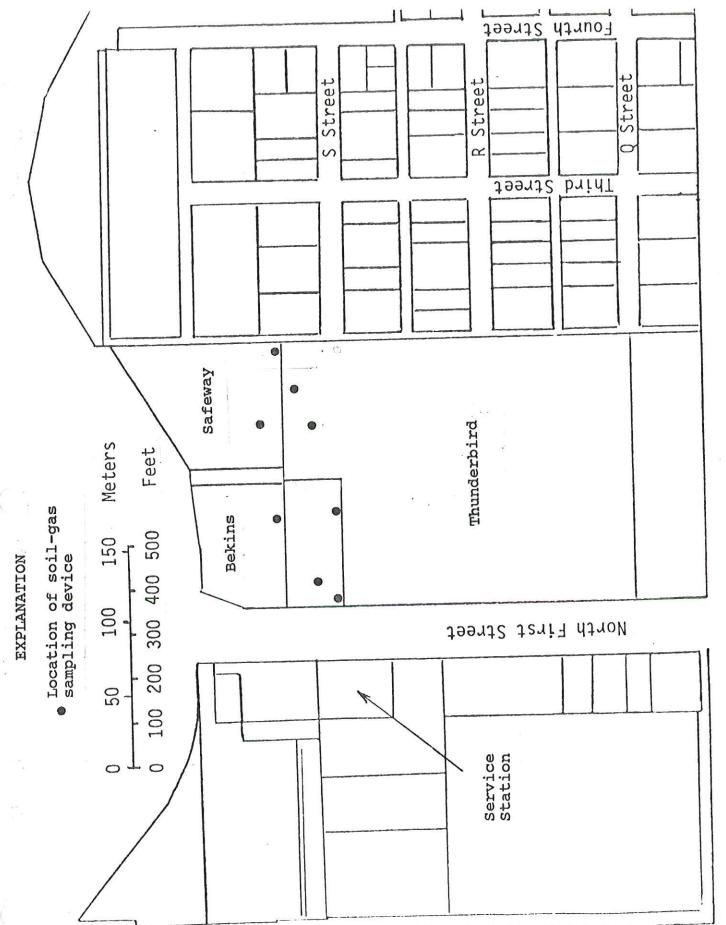


Figure 14.-- Soil-gas sampling devices installed during September 1986.

Lecation .		Date 10-1-96 Local well numb	por
County _		Map Scale Lat	Long
District _		Project number	Altitude
Driller	halada Ounh	Helper Geologist	Ron Lane
	thologic Symbo	Abbreviations clay e cobbles cob sandy sdy	Twep.
		silt at boulders b fine f	Sec.
		gravel a sity sty coarse co	
9	.9 _	Lithologic description	Commedia
Depth Scale Sample	Graphic log Drill action	Edition of the description	Summary log
	TOP OF #0.15	CEM O-Z' Clayey silt, dark brown.	Silt clayer 0-3
	2.0	I INTERPOLATE CLASSICAL AND ALL ALL P' J. J. J. J. J. J. J. J. J. J. J. J. J.	
5	6.0	4-6' Cobles ind coarse grave (Cobbles) at 5) fragments to 1/2", some sit to coarse sand, gray.	
	9,0	6-8' Same	Sandaria gravel 6-17
10	110		*
	13.5	freaments > 12 daysh brown	
15		12-14' Sime as above	
	18.0 18.3	brown, No fragments more send	Sand, fine to coare, gravelly 17-18
	ВН	14-16' Fine sand to 12" gravel, grayish trown. No fragments more sand than above but more moist, plus brown fine to coarse sand of 17+ and beyond	
		Moist, plus brown fine to coarse	'
		18' to BH = ne to coarse sand some fine	
			İ
			*
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			e.
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Lecation .						_ Da	te			Local v	vell numb	or
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District _				Pr	oject nu	mber						Altitude
Driller						Helpe					Geologist	DS. Peterson
FI	thologic	Symb	iols [olev		Abbrev	1,000	7121			Rge.
			_		clay silt	c st	cobbles boulders	cob	sandy fino	sdy f		Twep.
					sand	8	clayey	dy	medium	m		
			т —		gravel	8	silty	8 ty	coarse	co		
Depth Scale Sample	Graphic log	Drill	11		e v		ologic descr					Summary log
	2			0-4	Soil	SUR	face by claye	y				Asphalt surface Soil, silty clayey 0-7'
5 7/0				6-8	T 5.11	and	gravel, f	sine,	dark.			
10				8-1	Grav O'Sand	1, me	coarse, roughly to ravel Fines above	unded coars	clasts se claye	to 15 ey, br	own;	Szid, clayer, generally 2-16
15				12-1	l'San 4'San 16'Sil	ie a	s above	but i	wet. Wa	ter S	angle	
				16 -	17'9rav	drse el f rk 9	s above brown will ark we brown to be the brown to be the brown to be the brown to be different fire.	th sill	ravel fine gr	ine b	lack.	Gravel, silly saidy. 16-20
20				20-2	2 San	dan	ecy fine.	te ca	arse ge	arse Arel	brown	Sand and gravelsily 20-22
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H												

9-230 (Rev. 9-57)

DEPARTMENT OF THE INTERIOR GEOLOGICAL SURVEY

File No. 1012

YAKIMA OILÉGNS SPILL

Vleil Number	Altitude of LSD (NGVD)	MY MY NEVID	DEPTH OF HOLE AT TIME OF DELL- ING- (FT)		NEPTH TO BOTTOM SEREEN	ATTITUDE OF BOTTOM OF SCREEN	DEPTH TO TUP OF SCREEN	ALTITUDE OF TOP OF SCREEN	OF	BOTUL! OF RENTULTE SEAL	9	
1-85	1080.48	1280.349	21.0		18.52		5.84		15.0	NONE		
2-85			20.0		20		3.0		15.0	1		
3.85			21.0		19.12		3.7		15.0			
4-85			21.0		19.94		4.9		15.0	J.		
5-85			18.0		16.82		1.5		15.0			
6.85			21.0		19.28		4.0		15.0	_		
7-85			20.0		19.25		3.9		15.0	-		
8-85			22.0		20.04		4.9		15.0	-		
9-85			210		19.82		4.5	it.	15.0			
10-85			21.0	•	19.27		4.0		150			
11-85			22.0		20.49		5.0		15.0	_		
2-85			22.0	0	21.36		6.0		15.0	_		
1-82										-		
2-82									- 24	_		
3-82										_		
T- 1			580		58.0		550		3.0	54-55		
T-2			37.0		35.5		28.0		2.0	27	JEINT B	NPLERS
T. 3			33.0		35.)		280		£ 3	26	U11:1 8	FT - 1'A
T-4			16.0		12.0		3.7		8.7	3,5	WELL TOO 70 1	CLOSE OUL COM!
T-5			20 5		15.5	Section Addition assured	135		7.0	17.5		
T-6.1			483		46.65		44.65	,	2.0	32.95		
T.6.2			(32 95)	1100 =>	13.65		7.65		6.0	-		
T-7.1			363		£ 7.3		31.3		2.0	25.5		
T-7.Z	8		14.		13.3		7.3		6.0			
T-8			18.3		14.35		8.35		6.0	_		
7.9			18.3		13.04		7.04		6.0	5.0		
T-10			12.3		14.3		8,3		6.0	5,3		
T-11			18.3		14.2		8.2		6.0	5.6		
T.12			18.3		13.4		7.4		6.0	6.2		
T-13			36.		32.2		30.5		. 2.0	No-1	Sinish	Lw. 11
7-14			18.3		12.8		68		6.0	4.1		

DEPARTMENT OF THE INTERIOR File No. 2012 GEOLOGICAL SURVEY

YAKIMA OIL & GAS SPILL

WELL HUMBER	ALTITUDE N LSD NOVD	ALTITUDE OF MP NGVP	DEPIHOR HULE AT TIME OF DRILLING	ALTITUDE OF BOTHN AT TIME OF DRILL	DEPTH TO BUT- TUN OF SCREEN	NUTTURE OF BIT. TUN OF SCREEN	DEPTH TO TOP OF SCN'EFN	ALTITUDE OF SCREEN	OF	(35TTON UF BEIJ!. ONITE SEAL		
T-15			18.3								Not fin	100 al
7-16			183		13.9		7.9		60	4.8		
1-16												
T-17			18.3		13.7		77		6.0	4.9		
T-18		77 77 78 55 55 55	18.3		13.1		71		6.0	4.7		
T-19			18.3		138		7.8		6.0	5.7		
T-25			18.3		13.2		7.2		6.0	6.23		
T-2!			58.3		58.3		56.3		2.0	51.3		
T-22			18.3		12.7		6.7		6.0	6.6		
B-1			183	No 5-12-	125		6.5		6.0	5,5		
B-2			18.7	DITO	13.6		7.6		6.0	5,0		
B·3			38.0		37.3		30.3		2.0	15.5		
B-4			18.4		14.0		8.0		6.0	4.0		
B·5			18.3		180		90		90.	6.0		
5-1	17		52.0		57 ±		50		2.5			
3-2			18.3		16.25		7.7		9.0	7.57		
5-3			18.3		16.8		7.8		9.0	5.6		
5-4			17.4		17.4		8.65		9.0	4.8		
5-5			18.3		210.5						Soil Ga	per
H-1			<i>5</i> 8.		57.02		55.02		2	49.0		
H-Z			183		14.60		8.60		6.0	5.5		
GS-1			15.0		14. 7		127.0		7,0	n 6.0		
65-2			17		13		6.0		7.0	13+		
3/R			58,5		56.21		54.21		2.0	46.0		
MESIA							<u> </u>					
1151			58.		5798		55.98		2.0	50.0		
				1			3					

District Project number Altitude Project number Goologist DS Refersors Clay c cobbles cob sandy sky Twap. Twap. Clay c cobbles cob sandy sky Twap. Clay c cobbles cob sandy sky Twap. Clay c cobbles cob sandy sky Twap. Clay c cobbles cob sandy sky Twap. Clay c cobbles cob sandy sky Twap. Clay c cobbles cob sandy sky Twap. Clay c cobbles cob sandy sky Twap. Clay c cobbles cob sandy sky Twap. Clay c cobbles cob sandy sky Twap. Clay c cobbles cob sandy sky Twap. Clay c cobbles cob sandy sky Twap. Clay c cobbles cob sandy sky coorse co Summary log Summary log Summary log Carlo cobbles cob sandy sky twap. Summary log Summary log Summary log Summary log Carlo cobbles cob sandy sky twap. Summary log Summary log Summary log Summary log Carlo cobbles cob sandy sky twap. Summary log	Location	'o.k.ma 11/1:	<i>h</i>	_ Date	Local well numb	er
Driller Lithologic Symbols Clay c cobbles cob sandy sdy silt st bouldors b fine f sand s clayey dy medium m gravel g silty sty coarse co Lithologic description Lithologic description Lithologic description Lithologic description Lithologic description Summary log Summ	County _		Map	S	cale Lat	Long.
Lithologic Symbols clay c cobbles cob sandy sdy silt st boulders b fine t sand s clayey cly medium m gravel g silty sty coarse co Lithologic description Lithologic description Lithologic description Summary log Lithologic description Summary log Lithologic description Summary log Lithologic description Summary log Lithologic description Summary log Lithologic description Summary log Lithologic description Summary log Lithologic description Summary log Lithologic description Summary log Lithologic description Summary log Summary log Summary log Lithologic description Summary log Summary log Lithologic description Summary log Summary log Summary log Summary log Summary log Silf, clayer Silf, silf, clayer Silf, silf, clayer Silf, silf, clayer Silf, silf, clayer Silf, silf, silf, clayer Silf, silf, silf, silf, silf, clayer Silf, silf	District _		Project n			
Lithologic Symbols clay c cobbles cob sandy sdy silt st boulders b fine t sand s clayey cly medium m gravel g silty sty coarse co Lithologic description Lithologic description Lithologic description Summary log Lithologic description Summary log Lithologic description Summary log Lithologic description Summary log Lithologic description Summary log Lithologic description Summary log Lithologic description Summary log Lithologic description Summary log Lithologic description Summary log Lithologic description Summary log Summary log Summary log Lithologic description Summary log Summary log Lithologic description Summary log Summary log Summary log Summary log Summary log Silf, clayer Silf, silf, clayer Silf, silf, clayer Silf, silf, clayer Silf, silf, clayer Silf, silf, silf, clayer Silf, silf, silf, silf, silf, clayer Silf, silf			And in case of the last of the	Helper	Geologist	D.S. Peterson
Lithologic description Summary log Lithologic description Summary log Description Descripti		thologic Symbol	clay slit	Abbreviations c cobbles cob st boulders b s clayey cly.	sandy sdy fine f medium m	Twsp.
0.31. Soil, very silty and clayer the samples 0.31. Soil, very silty and clayer the samples 0.71. Cobbles with very coarse sand and fine gra- yell 10. Chanea, much ett and fine sand with mid cobbly ana sand; 10. Chanea, much ett and fine sand with mid cobbly ana sand; 10. Chanea, much ett and fine sand with mid cobbles with very coarse, ellay, silt, fine. 10. Silt, sand; gravitly and 10. Chanea to much more silt and fine sand. 10. Sand, silty: 10. Chanea to much more silt and fine sand. 10. Sand, silty: 10. Silt, fine to very coarse, ellay, silt, fine. 11. Chanea to much more silt and fine sand. 12. Silt, fine to very coarse sand fine gravel come cobbles clay 12. Where chanead is color from light modely brown to teddish brown 12. Silt, sing fine for very coarse sand and fine gravel, gravel variains quarts, hadice 13. Valer turns middly brown again. 14. Sand silty, gravelly 15. Silt, sing fine to mid time gravel. 16. Silt, sing fine to mid time gravel. 17. Silt, sing fine to mid time gravel. 18. Silt, sing fine to coarse sand and fine gravel. 18. Silt, sing fine to coarse sand and fine gravel. 18. Silt, sing fine to coarse sand and fine gravel. 18. Silt, sing fine to coarse sand and fine gravel. 18. Silt, sing fine to coarse sand and fine gravel. 18. Silt, sing fine to coarse sand and fine gravel. 18. Silt, sing fine to coarse sand and fine gravel. 18. Silt, sing fine to coarse sand and fine gravel. 18. Silt, sing fine to coarse sand and fine gravel. 18. Silt, sing fine to coarse sand and fine gravel. 18. Silt, sing fine to coarse sand and fine gravel. 18. Silt, sing fine to coarse sand and fine gravel. 18. Silt, sing fine to coarse sand and fine gravel. 18. Silt, sing fine to coarse sand and fine gravel. 18. Silt soid, gravely 18. Silt soid, gravely 18. Silt soid, gravely 18. Silt soid, gravely 18. Silt soid, gravely 18. Silt soid, gravely 18. Silt soid, gravely 18. Silt soid, gravely 18. Silt soid, gravely 18. Silt soid, gravely 18. Silt soid, gravely 18. Silt soid		.g _ 5				Summary log
20 3.1. Soil, very sitty and clayery to samples 3.4. Increasing pebbles the samples 6.7. Cobbles with very coarse sand and fine grave 10. Channel much sill and fine sand with mid- wing gravely pitos cobbles still present 15. Send, fine to very coarse, clay sill, fine. 3. Sand, object sitty and gravely and gravely 17. Channel of much more silt and fine sand. 18. Send, fine to very coarse, clay sill, fine. 3. Sand, object sitty 20. Sill, sand to fine from the sand. 21. Channel to much more silt and fine sand. 22. Sill, sand gravely 23. Sill, sand gravely 25. Sill, sand for fine for very coarse sand and fine gravel channel obbles, clay y 26. Weter channel obbles, clay y 27. Medium sand to fine gravely some 31H. 28. Weter channel obbles, clay y 29. Weter channel obbles, clay y 20. Sill, sand gravely 20. Sill some fine for rery coarse sand and fine gravel, sand were file class a quart, matica 34. Water turns muddy brown again 36. Sill, sand y, gravelly 36. Sill, sand y, gravelly 36. Sill, sand y, gravelly 36. Sill, sand y, gravelly 36. Sill, sand y, gravelly 37. Sill, some fine for medium sand and fine gravel. 38. Sill, sand y, gravelly 38. Sill, sand y, gravelly 39. Sill, sand y, gravelly 30. Sill, sand y, gravelly 30. Sill, sand y, gravelly 30. Sill, sand y, gravelly 30. Sill, sand y, gravelly 30. Sill, sand y, gravelly 30. Sill, sand y, gravelly 30. Sill, sand y, gravelly 30. Sill, sand y, gravelly 30. Sill, sand y, gravelly 30. Sill, sand y, gravelly 30. Sill, sand y, gravelly 30. Sill, sand y, gravelly 30. Sill, sand y, gravelly 30. Sill, sand y, gravelly 30. Sill, sand y, gravelly 30. Sill, sand y, gravelly 30. Sill, sand y, gravelly 30. Sill, sand y, gravelly 30. Sill, sand y, gravelly 31. Sill, sand y, gravelly 32. Sill, sand y, gravelly 33. Sill, sand y, gravelly 34. Sill, sand y, gravelly 35. Sill, sand y, gravelly 36. Sill, sand y, gravelly 36. Sill, sand y, gravelly 37. Sill, sand y, gravely 38. Sill, sand y, gravely 39. Sill, sand y, gravely 39.	Scale Samp	Pog Iog	+.5 'LSD :	zamorogio decompano.		,
I promet it is the second of t	5 10 5 5 5 5 5 5 5 5 5	Benjou - Boot Hill Hall Hold - Block Fills And And And And And And And And And And	3-6', Ind 6-7' Cob 10' Siling 10' Silin	and in much and and and fine to very coarse fine to very coarse ravel some cobbles fine to very coarse favel some to bles fine to very coarse ravel some cobbles fine to very coarse ravel some to bles fine to very coarse ravel some to fine to very coarse ravel some to bles fine to very coarse ravel some fine to very coarse ravel some fine to very coarse fine to very coarse sand or turns muddy brungly medium sand, some fine to coarse sand of the co	I/o samples se sand and fine gra- les sand with med- les still present. les still present. silt and fine sand. se sand very fine or from light muddy coarse sand and fine as quarte, matics or squarte, matics own again e clay and fine gravel. t, some tobbles some ack). Water turning um sand and pebble lack and green). d and fine gravel afia. Water very k gray to black, and	Gravel, cobbly and sandy S. It, sandy gravelly and cobbly. Sand, clayey, sitty and gravelly Sand, silty. Sand and gravely Sand and gravely. S. It, sandy, gravelly Sand, silty, gravelly Sand, silty, gravelly Sand, silty, gravelly

T-2 --- 25

District Project number Helper Lithologic Symbols Clay c cobbies cob sendy stdy silt st boulders b fine f send a clayer cly medium m gravel g sitty sty coarse co Lithologic description Lithologic description Summary log Lithologic description Summary log Lithologic description Summary log Type Q 1 B	Location	YAKIMA K	X45H	Date	e	اما	cal well numbe	7-0-
Driller								
Clay c cobbles cob sandy sdy silt st boulders b fine f sand a clayer dy medium m gravel g silty sty coarse co Lithologic description Summary log Lithologic description Summary log Lithologic description Summary log Lithologic description Summary log Lithologic description Summary log Lithologic description Summary log Summary log Lithologic description Summary log Summary log Lithologic description Summary log Summary log Lithologic description Summary log Summary log Lithologic description Summary log Summary log Summary log Lithologic description Summary log Summary log Lithologic description Summary log Summary log Lithologic description Summary log Summary log Lithologic description Summary log Summary log Lithologic description Summary log Summary log Summary log Lithologic description Summary log Summary log Summary log Lithologic description Summary log Sum	District _			_ Project number				Altitude
Clay c cobbles cob sandy sdy slit st boulders b fine f sand a clayey cly medium m gravel g silty sty coarse co Lithologic description Summary log Summary log Lithologic description Summary log Summary log Lithologic description Summary log Lithologic description Summary log Lithologic description Summary log Summary log Lithologic description Lithologic description Lithologic description Lithologic description Lithologic descripti	Driller			Helper	·		Geologist	D.S Peterson
TOP 8' BEING USED FOR DOC MULTICEUEL SAMPLES 7-8' Cobbles (dulling much harder) fragmented gravel 7-8' Cobbles (dulling much harder) fragmented gravel 7-8' Cobbles (dulling much harder) fragmented gravel 7-8' Cobbles (dulling much harder) fragmented gravel 7-8' Cobbles (dulling much harder) fragmented gravel 7-8' Cobbles (dulling much harder) fragmented gravel 7-8' Cobbles (dulling much harder) fragmented gravel 7-8' Cobbles (dulling much harder) fragmented gravel 7-8' Cobbles (dulling much harder) fragmented gravel 7-8' Cobbles (dulling much harder) fragmented gravel 7-8' Cobbles (dulling much harder) fragmented gravel 7-8' Cobbles (dulling much harder) fragmented gravel 7-8' Cobbles (dulling much harder) fragmented gravel 7-8' Cobbles (dulling much harder) fragmented gravel 7-8' Cobbles (dulling much harder) fragmented gravel gravel gravel 7-8' Cobbles (dulling much harder) fragmented gravel gr		thologic Symb	ools	silt st	Abbreviations cobbles cob boulders b clayey cly	sandy so fine f medium n	sdy F	_ (19
TOP 8' BEING USED FOR DOC MULTICEUEL SAMPLES 7-8' Cobbles (dulling much harder) fragmented gravel 7-8' Cobbles (dulling much harder) fragmented gravel 7-8' Cobbles (dulling much harder) fragmented gravel 7-8' Cobbles (dulling much harder) fragmented gravel 7-8' Cobbles (dulling much harder) fragmented gravel 7-8' Cobbles (dulling much harder) fragmented gravel 7-8' Cobbles (dulling much harder) fragmented gravel 7-8' Cobbles (dulling much harder) fragmented gravel 7-8' Cobbles (dulling much harder) fragmented gravel 7-8' Cobbles (dulling much harder) fragmented gravel 7-8' Cobbles (dulling much harder) fragmented gravel 7-8' Cobbles (dulling much harder) fragmented gravel 7-8' Cobbles (dulling much harder) fragmented gravel 7-8' Cobbles (dulling much harder) fragmented gravel 7-8' Cobbles (dulling much harder) fragmented gravel gravel gravel 7-8' Cobbles (dulling much harder) fragmented gravel gr	Scale Sample	Srephic log Drill	200	Litho	logic description			Summary log
	5 77. 10 77. 10 77. 115 77. 20 77. 20 77.	TOP 8 ' BEING USED FOR DGC MULTILEVEL SAMPLES BENTON ITE SEAT OUST ABLE MAY HAVE BRICK ED JOINT MAY	AND SCREEN	1-8' Cobbles (gravel. 107 Silty fine to fine quartz, 9 12' Medium t - fine gra 14' Silty san darker 16' Some as 18' Clay and 20' Same a 20' Same a 25' Silty san very fi 30' Same a 32' Same a	drilling much he to very coarse gravel clasts are to coarse sand avel, black and with fine than above s above dsilt with se black is 18'. and (coarser the ine grave) as above s above	sand with rains gene e baseltic, some silt, to coarse	very fine rally and gravel. t brown) with	fractisearty sand, silly, gravelly clay and silt, sandy sound, silly, gravely.

Location	Date Local well num	ber
County	Scale Lat.	Long
District	Project number	_ Altitude
Driller	Helper Geologis	D. 13 Sapik ?
Lithologic Symbols	Abbreviations clay c cobbles cob sandy sdy silt st boulders b fine f sand s clayey cly medium m gravel g silty sty coarse co	Twep.
Scale Sample Graphic log Drill action	Lithologic description	Summary log
	0-6'. Clay to medium sand	Clay Landy " 0-6
20 25 Sand Back Box 20 35 Box 2 35 Box	8-101 Sand 10-12' Sand and grave! 12-14' Sand and grave! - hard drilling 14-16' Sand and grave! (clasts > than 1") (hard drilling; large chips) 16-18' Sand and grave!, rounded pebbles up to 1" at 17' 18:22 Fine sand to grave! 22-24' Coase sand and grave!, some chips 14-26' Clay, fine to coarse sand 26-28' Clay, fine sand, grave! to 1/4" 28-30' Medium sand, clay, grave! to 1/2"	breved 6.8 Saila Surd 2010

Lo	cation						_ Dar	te			Local	well numb	er
Co	ounty _		•		_ Me	ıp			s	cale		Lat	Long
Di	istrict _					oject nu	mber						_ Altitude
Dr	riller						Helpe	N				Goologist	Ron C. Lane
		Ithologic	: Symbo	ols		clay slit sand gravel	e st s	Abbrev	viations cob b	sandy fine medium coarse	sdy f		Twep.
Depth	Scale	Graphic log	Drill	Top of		8 2		nologic desc					Summary log
5	目		3.1 5.3.8	=	2.6	; s;	Tty grave Cobb	clayey fi el fragme bly grave clayey s yangore o 6 Bro e as above	ne to ints to Sand c Dr. wnist	medium:	sand y Di Fine le gra	brown's sounds	Sand, sitty clayer growing cobbly
10	昌							e as abou					Sand, sitty gravelly 14-12
15			13.9	NAT	14 -	18_t	gran	to coars	F broi	unish gre	ne s	'_/YY -:	
			10.5										•
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Location _						_ Dat	•		t	ocal well no	umbe	r
County _				_ Ma	р			Sc	ale	u	nt	Long
District				_ Pro								Altitude
Driller		Symbo				Helpe	r			Geolo	gist .	Ron C. Lane
Litt	lologic	: Symbo	OIS	\neg	clay	c	Abbrevi	istions cob	sandy	sdy		Twsp.
					silt	st	boulders	b	fine	f		I Sec.
					send gravel	8 Q	clayey	cly	medium	m co		
0	ပ္		TIND DE				ologic descr				7	Summary log
Depth Scale Sample	reph	Drill	TOP OF PIC CS6 10.42 H		95 10 4 9		Nogio desci	iption				outmany roug.
0 8	<u>o</u>	00	CEM B.	0-	2' 6	laye	silty f	ine s	and, gri	avel to 1'	" •	Sand, clarey, silly, gravelly, o-4.
		2.5	NAT	2-	41 5	Dril Same	sound as abo	s like	e cobble	e grave/		·
5		4.2 49	F B		-7 - F	ine	70 cours	e 50	nd, grave	d like	2 -	Sandandgravel 4-18
		7.7	25			CO!	bble an	avel.		d like		
10			SAWA	10'	-10 -12' 1	<u>sam</u> Mod	e as a	bove.	nd (less	than abou	(e)	,
		13.7	N		12 1	gr.	avel wit	h frac	15 /2 (more	than about than about obble gran	ve)	
15		1,21	NAT FILL	-12'	- <u>/</u> 4	Sam	e as ab	COOK.	Saturat.	and		
		18.3		14	10	of gr	fine to	为")	brawnis	h gray. Icl to 1".	_	
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Location	Date	Local well numb	er
County	Map	Scale Lat	Long
District	Project number		_ Altitude
Driller	Helper	Geologist	Ron C Lane
Lithologic Symbols	Abbri	eviations	Rge.
	clay c cobbles		Twep. Sec.
	sand s clayey		
	gravel g silty	sty coarse co	
Depth Scale Semple Graphic log Drill	Lithologic des	cription	Summary log
Scale Semple Semple Graphin			
2.0	cen 0-2 Silty clayey 2'-4' Same as ab		Sand, silty clayey 0-8
5 41			
5.7	6-8' Same as ab	ove lots of clay could be sandy clay.	
7.1	8:-10' Same as ab	bove but drill sounde	Sand silty clayer or 8-10 Cobble grave
10	like in c	bove but drill sounds	Sand and grovel 10-18
13.1	10-12' Silty claye	y, fine sand to gravel	/
15 N	u (fragments)	y fine sand to gravel to 12") Drul sound like gravel grayish brown.	
18.3	12-14 Sand coors	e gravel (to 12") some	
	14 = 18 - gray We	tat 14'	
	brownish	se gravel (to 1/2) some nediom sand, brownish = 1 at 14 y fine sand to gravel grav, as above but es and larger fragments.	•
' 	At 18 t	water color became	
	readish	Dioun	
			p.
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Location _						_ Dat	0		!	Local	well numb	er	
County _				M	p			Sc	ale		Lat	Long,	
District				Pr	oject nu	mber						_ Altitude	
Driller	hologic S	0	-1-			Helpe					Geologist	Pon Clane	
	nologic	Эуть	OIS	\neg	clay	ε	Abbrev cobbles	intions cob	sandy	sdy		Twsp.	III
		_			silt	st	boulders	b	fine'	f			Sec
					sand gravel	s O	clayey silty	cly. sty	medium coarse	m co			·
e 9	.g.	c	TOP O				ologic descr	<u> </u>		×	T	Summary log	
Depth Scale Semple	Graphic log	oction action	O.33 BELOW LSD		6 2								
H		2.0	шш	0-	21 8	1144	clayey.	fine :	sand, lie	int b	rown!	Sand, silty clayer	
5			I FA	4-	6' F	Drill	sound and to	as if	in cobbl	e gra	vel s above	sand and grovel	2-75
		4.7 5.7		ſ _b .	8, 8	Drill	as abo	as if	in cobbl	eś			
10		7.8	PAC	9.	9.5	Sami	e as al	OVE			}	5 1 1 1 C 6 1 1 1 5 1	0.6 - 0
			SAMP PO	9.5	-10'	Simi	lar but	cont	ains bi	rown	clayey	clayer and grave I	9.55-,5
15		13.8	MAT	10 -	- 12 ' i4_'	Sam	H. Drill me as a y sandy 14 mol / fine to 0 34") b	bove	vel (+0)	(ال يمل	grave		
			FILL	14 -	-16'	Silty	14 mol	st, b	rownish se sand	gray	ivel !		
	Ì	18.3				_ L ⁴	0 34") b	rowni	sh. Satu	tate	dat		
				16-	-187	Sim	lar bu rownish	t col	or is re	eddis	·h]	•	
	-			L.				1.7					
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Location						Dat	0		ι	_ocal	well numbe	er
County .				_ Ma	р			Sc	ale		Lot	Long
District _												
Driller	ithologi	o Symb	ole		ا	Helpe	r				Geologist	Ron C, Lane
	Turologi	C SYMB		\neg	clay	c	Abbrev cobbles	eob	sandy	sdy		Twsp.
	_			_	silt	st		b	fine'	f		Sec.
	L				sand gravel	8	clayey silty		medium coarse	m co		
Depth Scale Semple	Graphic log	Drill	TOPOF PVC (SG. 0.3 BE- LOW LSD	1	3. S	Litho	ologic descr	iption				Summary log
	1	0,3	In		2' 511	Y C	layey fin	e sanc	, brown.		4 11 1	Sand, fine, silty icioney, 6-2
		2.0	I NAT	2	4 311	rave	layey fin layey, find li (fragmo bles	ents t	10 K") (0	V/d	be	Sandand Grove silty 5- 5
5		5.2	¥ .8	4-	6, 3a.	2011	bles present des above fine to gravel as above gravel as above fine to yish brock es as above fine to yish brock es as above	but o	graveT to	K";	COPPLES.	, ,
		7.2	SAUD PAC	8-	8' 5a. 10' s.	me Spbb	les above	2. Dri	11 sound	sas	tin	
10			SAW	٠ - ك		and	gravel bles. Fra	(To K	") 978/th	black	-	
		13.2	NATUR	10-	/1.5 S -/2'S	ame	sandy	e grave	1(70 2")	gra	yish	Eand and gravel, sitty 11 = ?
15			FILL	15 -	-14' 5	-bro	fine to	coars	grave	1/40.	生少」	
		18.3		14 -	-18' 5	13t	eel abo	un, so ve	17004764	at a	Bou	
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	1											(4)
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			1									
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Location							Dat	е		(Local we	ell numb	er		
County					_ Map				Sc	ale		_ Lat	Long.	-	
					_ Proje	ct nu	mber						_ / #1/1000		
Driller						١	Helpe	r			G	eologist	Ron C Lane	Rge	
L	ithologic	Symbo	ols		_			Abbrev cobbles	iations	sandy	sdy		Twsp.		
			_		-	clay silt	C St	ponigara	cob b	fine	f		, ,,,,,,		Sec.
						sand .	8	clayey	dy	medium	m co		E -Epotinisms	<u></u>	
			The	OF.		gravel		silty	sty	coarse			R		
Depth Scale	Graphic log	Drill	C50	_	8			ologic desc					Summary log		
		1.5	0		0.5	S.	17y 0	clayey t	fine s	and, bro	own.		Sand, silly, ci	ayey	0.5
		2.5	C	B											
5					3-67	9	are	T, cobbly	(Dni	Trig) Fra	gments	78 K"	Gravel, cobbly	.1 . 11	5-6
					6-10	' Su	lly f gray	ine to co ish brown but bro lween 12	n. Cob	bly drill	avel (to	ラン	Sand and grave	7,51144	6-15
10					10 - 18	20	ber	ween 12	andi	4 Feet	GI VINI		*		
			דונר												
15			4									:	•		
			ATUR					<i>c</i> ,				11. 10	Sandand grove	1	18-55:
20			1 X X		18-2	4'_ 5	ilty	fine to ayish brown	coars	e Sand,	, grave	(702)	more Ciay or s	iamples	
				-									Marie and Outer Section		
25			OTT INC		24-	26' 5	14	fine to rownish e exce	Coar gray	se sand	grave	el (to 1/2)	E		
			5		26-2	8 5	am	é exce	pt gr	ayish bro	nwa				
30			11		28-3	2'5	am	e. exce	1 b	rownish	gray				
			DRI		32 -5	8.3'5	Sam	e,exce	pt mo	re clay,	color	dull			
35			ľ				gr	e, exce ay to bl	ackisi	gray/	brown 	15 N 		8	
							'	,							
				2											
40				4						1			-		
													(a)		
45			4	1			-								
			SAND PACK BENTONITE	CENEN											
50			K BE	3											
			PAC							e w			J		
35			AND				-								
		58.3	3 - 7	3-										-	WC-123-12-00
			2'	OF			-						1		
			SI	OI OT VC											
			SC	REE									1		
,日															
													1		
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Location	•						_ Dat	te		।	Local	well numb	1-22 -1		
County .					Map				Sc	ale		Lot	Long)	
District _													_ Altitude		
Driller							Helpe	и	7150 FE			Geologist	Ron C.Lai	Rgs	
	thologic	c Symb	Ols			clay	c	Abbrev	iations cob	sandy	sdy		Twsp.		
						silt	st	boulders	b .	fine'	f			1	
						sand gravel	S	clayey silty	ely sty	medium coarse	m			1-	
	10	T	TOP C	OF.		g. a. a.		ologic desc	-			T	Summary log		
Depth Scale	Graphic log	Drill	0.43	× ′		•	FILL	ologic desc	ription				Sommery rog		
8 8 8	Ö	Q R	B	-	0-7	Silt	y cl	ayey fin	e san c	, brown			Sand, silty, c	inyey	3-7
		2.5	N	F			,	/ /				1		, ,	
5		,	B	-							-				
1目		6.66.7	-		7-12	Sil	ty c	layer fish gray	ine sa	nd tog	rave	(B)	Sand and gr	arel, selly	7-183
10			SAND	ACK-								,-	ž		
		12.7	Ш		12-14	f' SI	14y 1	fine san ray Dri as abo	d to	gravel,	, bro	wnish			
15			NAT.	1	14/	6' S	ame Col	dsabo	ve_bu	it grays	\$ h L	hown.			
		18.3			16 -1	83 Sc	ame	but re	eddisi	h brown	7 .				
		10.5		-											
													•		
				-											
												1			
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					6.			200							
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	Location		D	ate	Local well num	ber
	County		Map	\$c	cale Lat.	Long
	District		Project numb	07		Altitude
	Driller		Hel	per	Geologis	Ron C.Lane
	Lithologi	ic Symbols		Abbreviations		
w			clay c	cobbles cob t boulders b	sandy sdy fine f	Twsp.
			sand s	clayey cly	medium m	
		1 TOPOF	gravel g		coarse co	
	Scale Sample Graphic log	TOP OF PYC CSC	÷	hologic description		Summary log
	FH	B. 0	0-7' Silty 0	layey fine sand	i, brown.	Sand, silty, clayer 0.7
		2.5 N F				
	5	6.66.7 B	7 12' 6.14.	alian Cons	1 to 200// to 1/1	
		I INFI	brow	nish gray. Dr	and to grave (to &")	Sand and gravel, selly 7-18-3
	10	3AND - IIII		Con soud to	gravel; brownish of time gravel. It grayish brown h brown	*
		12.7 NAT.	171-111 60	gray Drill is i	of fine gravel.	
	15	FILL	14-16 Sam	olor a sold o	L house	,
		18.3	16 -183 Sam	e but readist	n prown	
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Lecation	YAKI	MA, U	JASHIM	STEX	<i>)</i>	Dat	e		ι	ocal we	II numbe	r	
												Long	
District _				_ Pro	oject nur	mber						Altitude	
Driller					F	lelpe:	r			Ge	ologist .	B=-	
L	ithologic	Symbo	alc		clay silt	c st	Abbrev cobbles boulders	eob b	sandy fine	sdy f		Twep.	Sec
					sand	8	clayey	cly	medium	m			
					gravel	9	silty	sty	COBLEG	CO			
Depth Scale	Graphic log	Drill			÷	Litho	ologic descr	iption				Summary log	
	700 OF	71 4 0	By.	0-2					ind and s			sand very fine prosift	c-4
		2.0	CUT.	2-	4 Light	brow	un fine sa	ndan	d silt some	e brown	clay.		4.0
5		5.3	× S	-4-	a crax	ents	to 14"	Drill s	d silt some dand grid ounds Tike some fine gray with brown to brown to brown, to coboles	e coar.	se -	Esnd and grave i	4- "
		6.5 6'X2"		6-	8' San	ie e	cent gra	vel to	14"-18	Frage	MENTS	Sava inta in - 2 coarse	9.,.
10		O.OJ SLOT PVC SCREGN	SAUD PACK	-8-	- Jani	n ab	ive , grave	124	"more gra	vel that	abore	said and grave	10-114
		12.5	BACK	9 -	10' San	d mo	ediom to come arave	coarse	brown to	gray, V	ery	SECRETORS ADMITS	
15			FILL -	- 10-	12 San	d. F	ne to coo	rse,	gray, wit	H Claj	and.		
		18.3	CUTTING		51	0 1/2	". Drill'h	177 In	cobbles	and	^/ -		
				- T2	747 50	ad,	fine to	oarse	, very Tith	le gra	vel,		
				14	-16 Sa	cla,	y, gray of	rown. arse a	ndgravel	101/2"	some		
					±	ragn	fine silv	lax/s	ndgravel ilt gray gravel to ish brown	5 /41 br	own -		
						154	gray to	gray	ish brow	on.			
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18													
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	Location	YAK	IMA.	NASH		0	ate			Local well numb	er
	County	·			_ Map			So	ale	Lot	Long
	District .				_ Projec	ct numb	or				_ Altitude
	Driller	ithologi	c Symbo	ols	Cl	Hel	1025276	viations cob		Geologist	Ron Lane
20 W					84	ilt s and s ravel g	0,0,0,		fine' medium coarse	f m co	Sec
	Depth Scale Semple	Graphic	Drill				thologic desc				Summary log
	5 10 15		100 2. 1 20 2 10:5 0:0 32. 45. 5. 5. 5. 5. 5. 5. 5. 5. 5. 5. 5. 5. 5	ANTUR-	8-10' 10-12' 12-14' 14-16' 16-17,	Sand Sand	tine to cover to yand, fine to cover to yand, fine to cover to yand, fine as about the as a about th	and good and good and sill still had sill coarse of the sill coarse of	mavei to large gravei to large gravei to lark grave gravei to much job ark gravei to much j	fragments fragments fragments fragments foles. some lown away nots to 1/11 fragments to y 11 fragments what with what with we are wore fines with frag- ks fines, ce of	Said and grover, strify & -187

Location					c	ate			ι	ocal w	ell numb	er		
County								_ Sca	le		_ Lat	Long		
District .					t numb	or						_ Altitude		
Driller					Hel	per					Seologist	Ron Lane	D _C m	
	Ithologic	Symbo	As	–			bbrevia		eendu	sdy		Twsp.	Rge	$\overline{\Box}$
	<u> </u>				ay c	cobb t boul		10000	sandy fine	f		I mah.		Sec.
						s clay	ey (dy	medium	m		A ndrews register		
		1		9	ravel (g sifty		sty	COSTSS	co	— Т	Ą		 -
£ 9 3	2 5 B				Li	thologic	descrip	otion				Summary log		
Scale Scale	Graphic log	Divill										C - 17 : 614		0-3'
日		7.6:04	FTT	2-4'	Sand	, claye	y silt	, der	k brown	ents to	y"	Sand, silty, cla	/e/	0-3
日日				4-6	grav	Il sound	quent	es grav	d fragming most	< 14 M	Same	Grave 1.cobbly		3-8 -
5	58		?		· me	dium t	1 sour	se sar	if in a	obbb	gravei			
1日	∇			8-10'	Sa m	o ne n	have				1-	Sand and gro.	iel 1	P-35
10		10.0	VAT FILL		10.				d to gradiesal a	10		•		
		13.5	CEN	110-12'	5,11, y	fine to	coars	e san	anvelt	tine qu	ntsto%			
15		15.5	PIW	12_14_	- Bi	rk gra	y gas	odor	gravel, f	asing				
IĦ			000	14-16	, Silty	tine s	and I	o tine	gravel	(< 4.	b, aurk			
20			JA X	16-18	- Sam	rown	40 co	grav	el to 16	avel (F	ragment			
			X Z J	20-22	, 5117	とれり,	dark	brow	sand, gr	d 0-0.	_/			
. 25		8	OA		/04	rasts to	5 72"5	dirk	sand an brown.	Less a	soor -			
			30.	22-24	, San	e as a ne as	above	, more	e sand,	,,,				
30		303		26-28					Jand fir	e grav	e1647			
		32.8		29-30	, San	k brown	above	ng di	d and fire escl fuel at 30' dis	stinct.	change			
35			FILL		3	trong a	dor o	forg	anic dec	ay-		Sand, fine to co	2000	36-38
日日		38.0		30-32	' 5,14	y fine:	sand "Tang	to coo	anic dec arse san lull grayi	d qua	ve/			
		BH		32-54	- Sen	ne_as	above							
				34-36	San	ne as	RDOVE	e gan	d, most	ly me	djum .	2		
						to coar	ye 3a i 	nd, n	o grave	dar	K gray	· ·		
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					- a-sa 15		economic Feet	MOR 155	3940 - 252					
日日														
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Lecation	Date	Local well number
County	Mep	Scale Lat Long
District	Project number	Altitude
Driller	Helper	Geologist Ron Lane
Lithologic Sy	mbols Abbre clay c cobbles slit st boulders	reviations Rgs
	sand s clayey gravel g silty	cly medium m
Depth Scale Sample Graphic log	Lithologic desc	
3	15 Cem 1-4' Side Ktop and parking 10-12' Same as above 10-12' Same as above 10-12' Same as above 115-7-16 No samples, no controlled to the samples of the same as above 16-8' Same as above 16-8' Same as above 16-8' Same as above 16-8' Same as above 16-8' Same as above 16-8' Same as above 16-8' Same as above 16-8' Same as above 16-8' Same as above	king let fol. To medium sand and grave To medium sand and grave To medium sand and grave To medium sand sand To medium sand

Location					_ Dar	te			Local well numb	per
County			Ma	р			Sc	ale	Lat	Long
District	~		_ Pro	oject nu	mber					Altitude
Driller	01			-	Helpe				Geologist	Ron C. Lane
Lithologic	Symbo	OIS	\neg	clay	c	Abbrev cobbles	iations cob	sandy	sdy	Twop.
				silt	st	boulders	b	fine'	•	Sec
				sand gravel	8	clayey silty	cly.	medium coarse	m co	
9.9	_	<u> </u>	Т		Lith	ologic descr				Summary log
Depth Scale Sample Graphic	Drill			:		•				,
			6-2	' S./	rk b	layey fin brown Dr 25 above	e san	digrave	cobble"	Sind time, silty clayer 0-4.5
5			2-4	1.5' 5a	me s	as above	e -, -, -			Gravel, sandy, cobbly 4.5-9.5
			, ,					114	and, cobbles	Graver, sand y, county 15 115
10			9.5-	10' F	INE FOW	sand to	aya h	ve/ (> = 1	dark box = 10' vel, brown- efines	'Sand and gravel 4.5-18
			10-	15, 8	ilty	fine sai	d to	12"gra	vel, brown -	cana una graver 113 10
15				· - - c	than	above . 6	ome co	bbles.		
	10.4		16-	18' 3	Sam	e as abo	bove.	but so	me frag-	
	18.0	To be			me	en75 /A	=			
		comp- leted								•
		by osc								
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Location _				Date		_ Local well num	ber
County _			Map		Scale	Lat.	Long
District	***************************************						Altitude
			H	telper		Geologis	t Ron Lane
	thologic Symbol	OIS	clay	c cobbles st boulders	riations cob sandi b fine	y sdy f	Twsp. Sec.
			sand gravel	s clayey g silty	cly medi- sty coars		
	0	ГТ					Cummertiles
Depth Scale Sample	Graphic log Drill action	lan	•	Lithologic desc			Summary log
#S	Top of 2.0 5.8 7.5 7.7 14.0 16.85 18.3		1-16' San	er as abou er fine to c erse sand	e gray. coarse sand aravel to light dull e, but we comedium s finesand a ted. Hydra	fill. rk brown Cobble gravel 72 ", clean. gray sh brown gray that are gray and gray carbon odor.	Sandy for standing 1-32 Grand grove 7-18
		-					

Location _						Dat	e		ι	.ocal	well numbe	ır		
County _				_ Ma	р			Sc	ale		Lat	Long.		
District				_ Pro	ject nu	mber	-					Altitude		
Driller					١	Helpe	r				Geologist	Ron Lane	Rge	
Lit	hologic	Symbo	48	\neg	clay	c	Abbrev	lations cob	sandy	sdy		Twsp.		
					silt	88	boulders	Ь	fine	f		1102		Soc.
					sand	8	clayey		medium	m co		-		·-
					gravel		silty -	sty	Coarse			R		
Depth Scale Sample	Graphic log	Drill action				Lithe	ologic desc	ription			1	Summary log		
Depth Scale Samp	Gra	Drill action							la#	£. [1		ALUTTOR-TILL		0-1
	Too of	20.12	CEM	0-	2' 5.	lack Ity,	clayey t	ine so	nents for	vel	to 4",	Bucktop-till Sand, fone, silt;	clayey	7-5
5		4.2	I I IFIU	2.	5' 5	dar	as ab	ove _	, - r	. . .	,- +	gravel, sandy		5-16
		4.2 5.6 6.5		5-	6' 61	med.	1 gray;	tragn crse	sand.	0 /2	"and	· · · · ·		J / J
		7.8	PACK	6.	-10' 5	same	e as al	oove			fine brown ated twith. n. Sat. d. dark brownish,			
10			SAUD PAC	10	-12 g	rave	1 (< 15") I mediu	gray 1	nd, gras	to-	fine brown	,		
		14.0	LES'	12	-14' 5	ame	e as al	pove	but so	atur	rated			
15		16.8	NAT. FILL	14	-16-6	rav	e1(=1/2)	Jara;	yishand	Isil	+ with	Sand, silty,	and the	11. 10
IFI		18.3 BH	NAT. FILL	14	J9' (Ura	ted (erse.	sandi	can	1 dark	Samo, 5117)	ruberry	16 /6
		ып		- '-	_°_ ≥	bi	rown, 91	ave 1	(= 12), 9	ray.	brown ish,	. •		
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	Lecation						Local well number				
		_ Ma	р			So	ale	Lot	Long.		
	District			_ Pro	ject nu	ımber					_ Altitude
(Driller					Helpe	r			Geologist	Ron C Lene
. 300	Lithologi	c Symbo	ds_	_			Abbrev	iations			
					clay silt	e st	cobbles boulders	cob b	sandy fine	sdy f	Twep.
					sand	8	clayey	dy	medium	m	
e					grave	1 0	silty	8 ty	COSTSS	CO	
	Depth Scale Sample Graphic Log	Drill			*		ologic desc	¥.			Summary log
	H	0.25	T	100	-/' Z'	Black	ktop a clayey	nd fine	sand to	grave 1 (= 1/4)	Asphalt and it
	5	4.2	∃ ⊨	Contractor	4'	Sam	e as a	bove			Sand and grave (cookly) 4-18
		4.85		4-	6'	Med	Jum to	coarse ble Fro	senda aments p away	on aravel some silt in wind),	
	10		100	2-	10'	Sam	e as ab	bove.			× .
			1 20	10	-12	Jan	ie as a	pove	excepte	20/or has	
	15		19.00	12	-747	3,74	y fine t	o coal	se sano	land grave h brown, elodor	
		18.07.4 BH		14.	-10'	50	tura tec	die	selfu	el odor	
				16	-18 -18	Sa	me as	abov	' · e.		•
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Lecation	Date	Local well number	or
County	Map Sca	le Let	Long.
District	Project number	7.5	Altitude
DrillerLithologic Symb	Helper	Geologist	Ron C. Lane
Elitiologic Symb	, assistiations	sandy sdy	Twop.
	silt st boulders b	fine f	Sec.
		medium m coarse co	
Depth Scale Semple Graphic log Drill	Lithologic description		Summary log
S	0-1' Black top and fill 1-2' Sity clayer fine to coar 2-4' Same as above. 4-6' Medium to coarse sand ments to x") gray. In cobble gravel, 5t 6-8' Same as above. Son Irock powder blowin 8-10' Same as above. Colo 10-12' Fine to coarse; Sand a 12-14' Same a's above. 14-16' Sity fine to coarse 14-16' Sity fine to coarse 16-18' Same as above Lost hole trying to get ed. NGC personnell f	and gravel (Frag- Drill sounds as if rong diesel odor. ne silt or clay, g from hole) r changing to and gravel, Fragmonk in. sand and gravel brown; saturated	Sand the tocarre suty: 1-4 Clayey Sand as do only cobbly, 4-14 Silty clayey.

H-1 FIELD LOS

Location _				Date	3-3	3-86	L	_ocal v	vell numb	er
County _	,		Мар			Sc	ale		_ Lat	Long,
District			Project i							Altitude
Driller				Helper					Geologist	JLE & GLT
L	hologic Sy	mbols	clay	c	Abbrev cobbles	iations cob	sandy	sdy		Twsp.
		J L	silt	st	boulders	b	fine	f		Sec
			grav	21	clayey	cly sty	medium coarse	m		
	0	TOP OF							T	Summary log
Depth Scale Sample	Graphic log Drill	5 CSG P. 0.45	- :	Litio	logic desci	iption				Commery Tog
8 8 8	5 5	0.45 C		5,11	with so	ome	sand			Silt, sandy 0-0
		20		2			<i>2</i>			\\\
5			7-21-	Grave	1 Some	SAN	d silt	ana	7	
			•				dsilt			Gravel cobby sangy 6-12
10			2-10'	6066	Le grav	10/5	ome san	nd.	-,,-	8
			10-12	(00b)	ly grave	some	silt	ig um	a >///.	Sand and gravel silly 12-2
15	· ·		12-14'	Sand	land 9	ravel	some	5//		yang king gravei, ani
			16-18'	Sand	some	grav	elands	51/1		
20			18-20'	Grave	1, sand	500	ne 51/1		, 🕂	
			20-24'	Sand	sand	Than	vel and 16-18'	5//7	<i>'</i> .	Sand, Silty, grovelly 20-30
		5 9/	24-26	Sand	some	sma	11 grave	Land	(51/4.	
25		CUTTING	26-30	Sand	some	grav	eland	silt.	Color	
		3								
30		DRILL	30-36	Grav	el and	sand	T, Black	1,50	me	Grovel and sond, sili, 30-30
		7					•4. 500.0			
35		242	36 -41	Grave	el, blace	k,50	me sand	1, gr	ay	Gravel, sundy silty 36.45
		NATURI		51	ΙΤ.					, ,
40		8	40-42'	Band	andara	ve7 (50/50) 6	Tack	some	Sand and grave silly. 40-+=
	4	9.0	42 - 44'	Sand	black	500	me gra	ue/,	gray	Sand, gravely 42-44
45	1 '		44-50				ne blace Some le			Gravel, silty, sandy 44.52 cobbly
	40	PACK BENTON	ķ , , , , ,	γ	atterial	also	some "	ryer		
50	1	ACK.	50-52	Gravel	black	SOW	e black	sen	d, gray	
		1 1	52-56'	Sand	black s	iome	gravel,	51/4	4	Sand, gravelly, silt, 52-56
35	5.	5.62 V	The second services of the second				rel (lard			Sand und gravel silty 56.5%
	5	7.02		M	aterial)	a bi	t of sil	/ / .	-	Sand und gravel sulty 56.52
	1									
,日日										

Location		Date	·	Local well numb	H-2 : OF
					Long
					Altitude
Driller				Geologist	
Lithologi	C Symbols	clay c silt st sand s gravel g	Abbreviations cobbles cob sar boulders b fin clayey cly me	ndy sdy	Twsp. Sec.
Depth Scale Sample Graphic log	III DE CELON PS D.	Lithol	logic description		Summary log
5	SAND PACK BY	0-4' Soil, b 4-'6' Gravel, 6-8' Gravel, 8-12' Gravel, grave 12-16' Fravel Hzdi	some silt som some silt and robbly a iltile hard drilling (I al 10-12' may sand some si n cuttings bets nd gravel, some d than in previous ples (50/50)	sond brown - silf old sand. (sbbles;) be coarser	Gravel, cobbly, silty 4-12 sandy Sand and gravel 12-12

.

Location .			Dat	10-10-80	Local	well numbe	3-K - EEF 100
County _		N	Map	s	cale	Lat	Long,
District _		F	Project number	-			Altitude
Driller			Helper			Geologist	Ron Lane
	thologic Symt	POIS	clay c silt st sand s	Abbreviations cobbles cob boulders b	sandy sdy fine f medium m		Twsp.
			gravel g	clayey cly silty sty	coarse co		
Depth Scale Sample			•	ologic description			Summary log
5	2.	4	-4' Clayey Som -9' Clayey Brow	silty fine silty fine to coarse siayish brown, s	o med. sand a a") brown. medium sar	1	Sand fine , clayey, silly 0-9 Sans in a grave 1 9-36
20		76-	-24 Same me as	but with co ends in 34 to in if coarse grand	parser gravel "range polling of to cobbly gl	frag	
30		1 1 1 1		but more so a grave! to		- 4	
46	41.6		-44 Clayey : 11.1116 H10 and	silly fine to gravel (To x temperature) driving is	coarse sand, ") brownish on 15 15°C, Drill asier	very ay ing	Sand, fine is source; clayey \$114y. 36-44
4/5	46.0		158.3 As abo	ve but drilli rse grave lan	ng 15 harder d cobbles.		Sand and gravel cobbly 44-56.
55	54:21 56:21 58:3						

Lecetion	Date	10-6-86	Local well numb	er
County			Lat	Long
District	Project number			_ Altitude
Driller	Helper		Geologist	Ron C Lane
Lithologic Sym	clay e	Abbreviations cobbles cob sandy boulders b fine clayey cly medium	sdy f n m	Twsp.
	gravel g	silty sty coarse	co	
Scale Scale Scale Graphic Log Drill	-0.45'	ologic description		Summary log
s 2.3, 5.6	0-2' Silty class of the silty fine to gray in the silty fine to gray in the silty fine to gray in the silty file in the	ay fine sand, dark be to medium sand ton above, ten, with gray, some to line to coarse sand, it with fraginants to coarse sand and gray to coarse sand and gray to coarse sand and gray to coarse sand and gray to above but more ecially Hzo.	to light brown. avel to 4" annish gray rellto 4" (to 4") brown- ravel, grayish	Sand, fine to medium, 2-6. Sand, fine to medium, 2-6. Silty, gravelly Gravel, sandy 6-8. Sand and gravel 8-18.

Lecation			Dat	te		l	ocal well nu	mber _		
County		Ma	р		Sc	alo	Lo	i	Long	
District		Pro	oject number					A	ltitude	
Driller	-1		Helps				Geolog	ist		
Lith	ologic Symb	ools	clay c	Abbrevi cobbles boulders	iations cob b	sandy fine	sdy f		Twsp.	Rge.
			sand s gravel g	clayey	cly sty	medium coarse	m co		-	
Depth Scale Sample	log Drill	TOP OF CSE -0.45'		ologic descr				Su	mmary log	
5	2.0 5.3 6.2	1-2 7714 2-4 4-6	Black to Silty C Same	as above	e 58 n c			n. 's.		tycloyey 1-6
10	134	PACK PACK 1-01	Coarse well so well so some like of Fine to grayish	coarse s silt, bro cobble gra coarse s	wnish vel.	and gray. Dr gray. Dr	el (to 2").		no and gr	vascline oper reported
15	17·4 18.3 BH.	CAVED	dark	gray rsh	brown	.Saturate	dand)			
		16-18	Similar , and d Medium Sand brown	plack, sat to coarse and silt	urate sano grav	dandson	me fine reddish	-		
								-	·	¥
						,-				
		•								
										91

	Location .						_ Dø	te		l	Local well nur	nber	7-13 \$1220 2	
	County _				Ma	P			Sc	ale	Lat.		Long	
	District _				Pro	oject nu	mber						Altitude	
	Driller		L			1	Helpe				Geologi	st _	Ron C. Lane	
	L FI	hologic	Symb	Ols	\neg	clay	c	Abbrev cobbles	lations cob	sandy	achi		Tues Hgs	77
		L				silt	8t	boulders	b	fine'	sdy f		Twsp.	_ i _ Sec
F +						sand	8	clayey	cly	medium	m			
				T		gravel	9	silty	8 ty	coarse	co			للـــــــــــــــــــــــــــــــــــــ
	Depth Scale Sample	Graphic log	Drill	TOP OF CSG 0.45 BELOW L	SID.	#. (10)		ologic desci	ription			,	Summary log	
			ě	lП	0-1	· B1a · C19	ckto	Silty fine	e Sand	,			Blacktop Sand clayey, silty	0-1
	5				2-4	Cla	yey	silly fin	e sand	d, dark bri	own		, , , , , ,	1-5
	I'HI				5-6	1 Gn	some	gray (frag	ments	nds cobb	de gravel.	<u>" </u>	Gravel, sandy Sand and gravel,	5-6
			/n .		6-8	rin	e sa Clay	and Jo gra	brown ravel.	agments t	dsize to 1/2 le grave!. Some Drill sounds		cloyer, silly.	.
	10		1010		10-12	L' Sar	ne a me i	as above	, but E	brownish q	gray, strong		8	
	15	▽		7713	12-14	- 541	me	As above	OUTM	nore sill	and clay	-	Sand, silty, gravelly	14-3.
		1			14-16	6' Sil	ty f	ine to co	arse s	and, gra:	vel fragment H20 at 15	#	, , , , ,	
	20			NATURAL	16-18	3' San	ne a	s above	-1-4-	7	eddish brown			
		1	23.0		20-2	6' Sa	me	as above	, OUT C	olor 13 re	edd:5A grown			
- XX	25		23,0	6	ا ا	5.5 ₆ 5		,	₀					
ia somete			71.0	BENTONITE	26-2	8' Sa.	sand	25 above	kss n	more si	7 tand fine to gray			
	30		20.0		28-3	0' 51	1+ to	gravel	(to 1/2	") as ab	ove mediu	4	*	
			27 2											
	35			NAT. FILL	32 - 3 34-3	14'Sa	ame	as above	ve, co,	lor gray	brown _brown		2	
			36.0											
		1												
			1					6		⊨ F ⊘				
		l											•	
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5 ⁷ 5 10 ₂₀ 5														
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18			- 1									1		
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T-14 11212 WO

Location	Date 12-23-85 Local well number	r
County :	Map Scale Lat	Long
District	Project number	Altitude
Oriller	Helper Geologist .	Ron C. Lane
Lithologic Symbols	Abbreviations clay c cobbles cob sandy sdy	Twsp.
	silt at boulders b fine f	Sec.
	sand s clayey cly medium m gravel g silty sty coarse co	───├┤╌┤ ╌ ┆╌┤──
		8
Scale Scale Sample Graphic log Drill	Lithologic description	Summary log
	0-2' Clayer silty time sand, brown	Sand, silty clayer 0.7
1.7 8 3 8	2'-4' Same	Variation of the second
5.3	H-6' Same but much more clay (lumps)	
4.1 S 3 d 1.1 S	H-6' Same but much more clay (lumps) 6-8' Clayey silty fine sand as above, medium to coarse sand, gravel (with fragments to 12") gray. Drill sounds like cobble gravel	Sand and grove 7-12
10	sounds like cobble gravel	,
12.8	8-10' Fine to coarse sand and grave/ (Fragments to 12"+) gray.	Gasoline sheer
15 NATURA	10-12' fine sand to gravel (1/2"), grayish brown 12-14 Same as above. Saturated gasoline. steen on H20.	on water
18.3	sheen on H20. 44-18' Same as above.	
18.35	in same as above.	
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Location _						_ Da1	te			Local	well numb	er	
County				_ Ma	ip			Sc	cale		Lat	Long)·
Driller					}	Helps	и				Geologist	DB. Sapik	Ron
	yologic	: Symbo	Ols	\neg	clay			lations cob	sandy			Twsp.	1 1 1 1
				_	silt	st	boulders	b	fine	f		((#6 3.3 %)#02.	Sec
					sand gravel		clayey silty		medium coarse	m			- - - - - -
<u> </u>	. <u>y</u>	-					ologic desc					Summary log	
Scale Sempl	Graphic log	Drill	1.5					iptio.				901111131 / 129	
			2.PK		Sam	e 9	25 T-3					1	
5	ě		12			_							
			Z 00 \Z		×	104	(E) =		Œ				
10			NOTO 10000 TURNS TURNS TO 10000 TURNS TURNS TO 10000 TURNS T						-			×	
	ļ	12'	NATURAL										
			BACK		_						,		
		16'	B.H.										
			DEPTH										
日日	•											•	
				ן עו	5, T Z	17.47	TED 2'	FROM	7-37	ا راستي	TIDSE)	2 - 1	
日日				DV	IRING	DR	PILLING	AIR .	PRESS	REL	EASED		
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T-5 FELD 200

Lecation	Date Local well numb	per
County	Map Scale Let	Long
District	Project number	Ahitude
Driller Lithologic Symbol		25 Sapik & S Petersor
Elulologic Symbol	Abbreviations Clay c cobbles cob sandy sdy	Twsp.
	silt at boulders b fine f	Sec.
	gravel g silty sty coarse co	
Depth Scale Semple Graphic log Drill	Lithologic description	Summary log
	0-2' Clay & silt with some gravel to 14".	-11 ars 6 7 gravelly 0-2
	2-5 Fine sand to gravel (Max 1/2")	Sandoin and 2-5'
5 - Thecore	6-7 Gravel (1/4") to cobbles (rock chips) 7 Gravel to 1/4" with fine sand.	(novel sur, sobbly Engl
10 8.2.9.3	1. 11/10 clayey fine sand.	2000 9.2-14
	I have the second and and and in a many	Sies of Sistement
15	Some silt and fine sand; light brown Water (matic clasts) 12-14 Medium sand and gravel, black and gray, sewer like smell and healy gas mell.	Sett close sproselly 14-16
	gray. Sower like smell and healy gas mell.	water 17-18 much
20 0	010 14. Clayer s. It, grey with much medium gravel, black. fas smell.	
	PUC 16-18' Fravel, very to coarse, cemented	
	smell	
	18-20 Same as above; 17-18 much water	
	LOG INDICATES BOREHULE DEPTH 18' DIAGRAM IN FIELD BOOK SAYSIT'	
	PLUS 2 FT OF SCREEN SUGGESTS	
	DEPTH OF CASING ONLY 15.5 FT. TO BOTTOM	
		4
		<u> </u>

T-6,1 PENRITTEN BY JBG

Lecation _							Dat	te		١	Local v	vell number	PEWRIT	TEN BY J
County					Mag				s	cale		_ Lat	Long	
District				_	Pro	ject nu	mber						Altitude	
Driller							Helpe	r			(Geologist _	D.B. Sapik	
	hologic S	ymbo				clay silt sand	e st	Abbre- cobbles boulders clayey	viations cob b cly	sandy fine medium	sdy f m		Twep.	Sec.
				_		gravel	9	silty	sty	coarse	co		<u> </u>	كناح
Depth Scale Semple	Graphic log Drill	action	-1.35	-		• :		ologic desc					Summary log	
	•		\prod	13	see	T-Z	for	0-30	′				1	
5				-			-			:				
15		- 1	" PVC CASING									;		
25		1	2" 9F 2"	-										
30			467	3	0-32	Grav	127	clasts to	341	sand, me	dium	70-	Gravel, sand one clay	30-32
	3	328	1 3	- 2	32-3	y' San	d f	ne to co	arse;	sand me	18"	Clay	Sand, gravel clay	32.48
46	3	7.95	I BENTO	3 3	6-3 8-3 8-4	6 Sar 19 88 San 10_52	afint b	ine to contrown and inedium to brown a serie to	d graind graind grand	grave t rse grave yersely s	ol"j eltok grave	clay clay tore;		
45		4.65	1 = 1	4	-2-4 -4-4	14. Sa 16. Ja	ngh!	medium Locown fine to c	la coa	rse, grav rax, gravel	RI TO 70 1/3	", Clay		
	14	6.65	3189		96-4	18' 54	gray	fine to c	coarse	, gravel	tox	", clay		
			2' OF O,010 SLOT PVC SCREE				gra)			5 8				
				_										

	Lecation _				Date		Local well numb	7 - 6 · 2 er	
	County			Мар		Scale	Lat	Long.	
	District			Project nun	nber			_ Altitude	
(Driller							D.S. Peters	son
	Litt	nologic Symb	ols	ا ماما		vistions			Rge.
				clay silt	at boulders	cob sandy b fine	sdy f	Twsp.	Sec
				sand	8 clayey				
	ПП		Т	gravel	g silty	sty coarse	co	Pl	لنلنا
19	Depth Scale Sample	Graphic log Drill action	-2.2'		Lithologic desc	ription		Summary log .	
	883	P - P		·	- 2 - 200				
		·	3//0	See	T-Z FOR	L0G		1	
	5	*	EN 724						
	THI	7.0	SAND BEN		***				
	10	7.65							
			S						
		13.65	6'0F-						
		1	0.01						
26			PVC						
			SCREEN- NATURN	PIEZOME	TERS T-6	1 T-6,Z AI	ZE IN	•	
(13.65	SAME	6" ? HO	LE.			
1.			TO -	[NOTE : BE	CAUSE THE	RE IS NO BE	VIONITE		
9.7				7	O IT IS P	BETWEEN 32.	95 FT AND AT HEAD		
514 (40)			F	/	NTERVAL.)	MAL IS COMP	OSTIE FUR		
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Location	HAKM	A WA.	SHING	TON		Dan	9-2	9-86	(Local	well numbe	·	
County _				Ma	ю			Sc	ale		Lat	Long	
District _				_ Pn	oject nui	mber						Altitude	
Driller					1	telpe	r				Geologist _		Ron
	lthologic	Symb	OIS		clay silt sand	c	cobbles boulders clayey	cob b	sandy fine medium	sdy f m		Twsp.	Soc
					gravel	9	silty	sty	COULES	co		- Bg	لنلنا
Depth Scale	Graphic log	Drill			**		ologic desc	ription				Summary log	
\$ 10 15 20 25 30 36 10 10 10 10 10 10 10		14.0° 20.7 21.8 29.8 36.3	C CASI	20-2 22-2 24-26-3 32-3 34-3 36-1			fine to me fine to ve fine to war fine to	coarse or coarse	coarse, gravel e, gravel arse, gravel arse, gravel gray ish rese clay oarse, may avel to ght brow	vel to ve	to 1/2"; The stand of the stan	. Sand and grow	20-36

Location						. Da	te			Local	well numb	1 - 11A	
County _				_ M	ip			So	ale		Lat	Lon)
District _				_ Pro	oject nu	mber						_ Altitude	
Driller	ah alaal	c Symb	-1-			Helpo	r				Geologist		
	thologi	c Symb	1018	\neg	clay	c	Abbrev cobbles		sandy	8dy		Twsp.	Rgo.
					silt	st	boulders	b	fine'	F		i wep.	! Sec
لــــا					sand gravel		clayey silty	cly sty	medium coarse	m co		-	
П.	U	Τ_	T	Γ					COULS			8	
Scale Sample	Graphic log	Drill				Litti	ologic desci	ription				Summary log	
000	Ğ	0 8	10	Si	EE LO	16- 7	-5 0-2	20'	-				
			BENT.				. =					•	
	120	4.8	100		~	_				_			J*
	1100	.7.3	7										
	601	SLOT	SANDE SAND BE									*	
		SCR.	SAR = 2										
		14.0-	w S										
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Lecation _					D	ote		1	ocal watt num	ber
County _				_ Map _			Sc	ale	Lot	Long
District				_ Project	numbe	r				Altitude
Driller					_ Help	er			Geologisi	Ron C. Lane
List	hologic	Symbo	ols	cia sil	y c	Abbrev cobbles boulders clayey silty	ristions cob b	sandy fine medium coarse	sdy f m co	Twsp.
Depth Scale Semple	Grephic log	Drill	TOC0.65	<u> </u>		nologic desc		Course		Summary log
888	5	E B			De //	. 22 W. Th	wat	0 L	•	'C / - / / / /- ?
		3. F	X 20 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7	2-41	Silty of Sity San San	clayer fi clayer from gra own gra Tobbi e as abo me as ab	ne san ne to vel w tes-or sue Bu	the frage to frage	k brown sand dark ments 40 - ments = 34 ments	Sandand gravet, clayer 3-183 Sundand gravet, clayer 3-183 Silty cobbly
15		14.35	ON S	16 -18.3		mers a	bove			ec.
		18.3								•
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	Date Local well number
County	Map Scale Lat Long
	Project number Altitude
Driller Lithologic S	Melper Geologist Ron C. Lan e Abbreviations Geologist Ron C. Lan e Rge
	gravel g silty sty coarse co
Scale Scal	Lithologic description Summary log Sumsymmary log

Location			Date 3 - 3	-96	Local well numb	er
County		Map		Scale	Lat	Long
District		Project nur	mber			Altitude
Driller	lania O unb ala	P	telper		Geologist	RC Lane
	ogic Symbols	clay silt sand	Abbrev c cobbles st boulders s clayey	iations cob sandy b fine	sdy f m	Twsp. Sec
		gravel		sty coarse	со	
Depth Scale Semple Graphic	Do Top of Costs.		Lithologic descr			Summary log
	1.6	2-41 511	y, clayey, fin	e sun d, dark e e to coarse san	dandarax!	Sand fine ser 7, cloyer 0-2
5	5.3		agments to K	e to coarse san ". Drill sounds	like cobble	Sand am a gravet self clayer 1-10
	8.3 2 =	6-8' San	ne as above The sill or o ne as above me as above	out brownish ther fines	gray . Very	
10	24 WP	10-13.5 5.17	ly clayey fin	to coarse sand	gravel	Sand, course syperovery
		13.5 - 18.3 ' 5	ilts fine to c	oarse sand, garse sand, garse sand, garse sand, garse	nevel _	10-13.5
	FILL		-diaktor ocom	a, saturated_		Sand, silty grovelly 13.5-18
	16.3 BH				=	
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