



GeoStrategies Inc.

GROUND-WATER SAMPLING REPORT

UNOCAL Service Station No. 5760
376 Lewelling/Usher
San Lorenzo, California

Report No. 7809-2

July 11, 1990



GeoStrategies Inc.

2140 WEST WINTON AVENUE
HAYWARD, CALIFORNIA 94545

REGISTERED

GENERAL CONTRACTORS

(415) 352-4800

July 11, 1990

Gettler-Ryan Inc.
2150 West Winton Avenue
Hayward, California 94545

Attn: Mr. John Werfal

Re: GROUND-WATER SAMPLING REPORT
UNOCAL Service Station No. 5760
376 Lewelling/Usher
San Lorenzo, California

Gentlemen:

This Ground-water Sampling Report has been prepared by GeoStrategies Inc. (GSI) and presents the results of the March 20, 1990 ground-water sampling and chemical analyses for the above referenced location (Plate 1). There is currently one ground-water monitoring well on-site (Plate 2).

The underground storage tanks were replaced at this site during November and December 1987. Well U-1 was installed in February 1988 in response to observed contamination during the underground tank replacement. Woodward-Clyde Consultants documented the well installation in a report dated March 25, 1988.

Water-levels were measured and the well was inspected for floating product on March 20, 1990, the same day the ground-water sampling was performed. The ground-water sample was collected and analyzed according to current State of California Water Resources Control Board (SWRCB) guidelines. Depth to groundwater was 19.72 feet below ground surface. Floating product was not observed in the well this quarter.

GeoStrategies Inc.

Gettler-Ryan Inc.
June 11, 1990
Page 2

The ground-water sample and a trip blank were analyzed at International Technology (IT) Analytical Services, a State-certified environmental laboratory located in San Jose, California. The IT certified analytical report is included with the Gettler-Ryan Inc. (G-R) Ground-water Sampling Report attached to this letter. Chemical analyses of sampled groundwater identified Total Petroleum Hydrocarbons calculated as Gasoline (TPH-Gasoline) at a concentration of 36,000 parts per billion (ppb) using EPA Method 8015 (Modified). Benzene was detected at a concentration of 2,100 ppb using EPA Method 8020. Plate 3 represents the TPH-Gasoline and benzene concentration map prepared from data collected this quarter. The concentration map indicates that additional monitoring wells are necessary to provide further delineation of the dissolved hydrocarbons.

GSI recommends that ground-water monitoring and sampling continue in accordance with the existing site monitoring plan. In addition, due to the dissolved hydrocarbon concentrations detected in Well U-1, GSI also recommends the installation of three additional monitoring wells (Plate 2). These wells will be installed according to current RWQCB and local agency guidelines.

Two wells should be installed in the apparent downgradient direction from the existing underground storage tanks. These wells will provide information regarding the extent of downgradient hydrocarbon migration. A third well should be installed along the site boundary in the apparent upgradient direction. This well will provide background information on water quality in the shallow aquifer. The proposed wells will also permit an evaluation of ground-water flow direction and hydraulic gradient. GSI Field Methods and Procedures are attached to this report.

GeoStrategies Inc.

Gettler-Ryan Inc.
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Page 3

If you have any questions, please call.

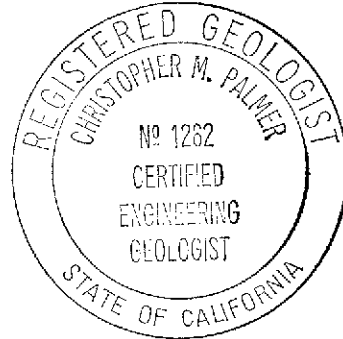
GeoStrategies Inc. by,

Ellen C. Fostersmith

Ellen C. Fostersmith
Geologist

Jeffrey L. Peterson

Jeffrey L. Peterson
Senior Hydrogeologist
R.E.A. 1021



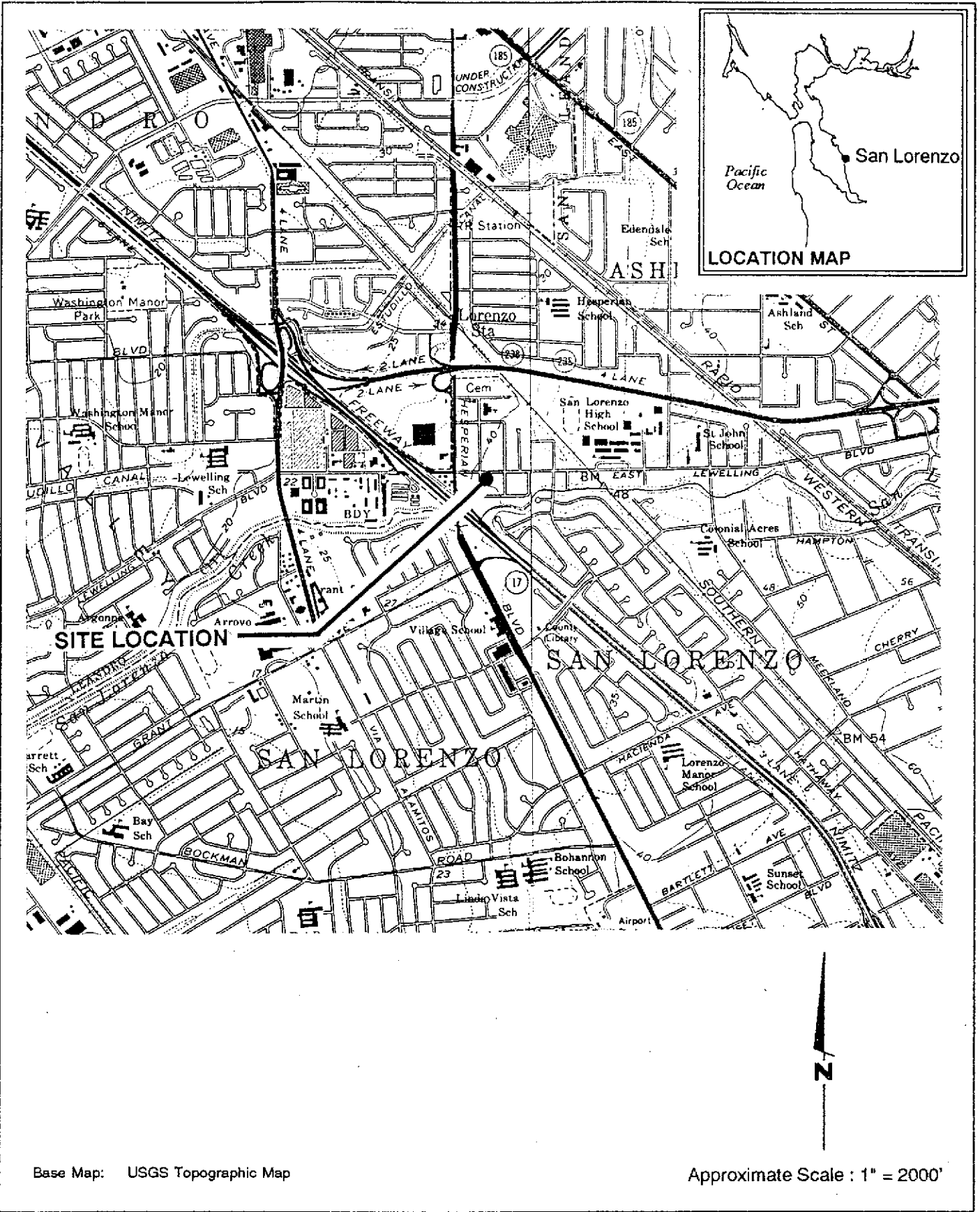
Christopher M. Palmer

Christopher M. Palmer
C.E.G. 1262, R.E.A. 285

ECF/JLP/mlg

Plate 1. Vicinity Map
Plate 2. Site Plan
Plate 3. TPH-Gasoline/Benzene Concentration Map

Historical Analytical Table
Gettler-Ryan Inc. Ground-water Sampling Report
GeoStrategies Field Methods and Procedures



Base Map: USGS Topographic Map

Approximate Scale : 1" = 2000'



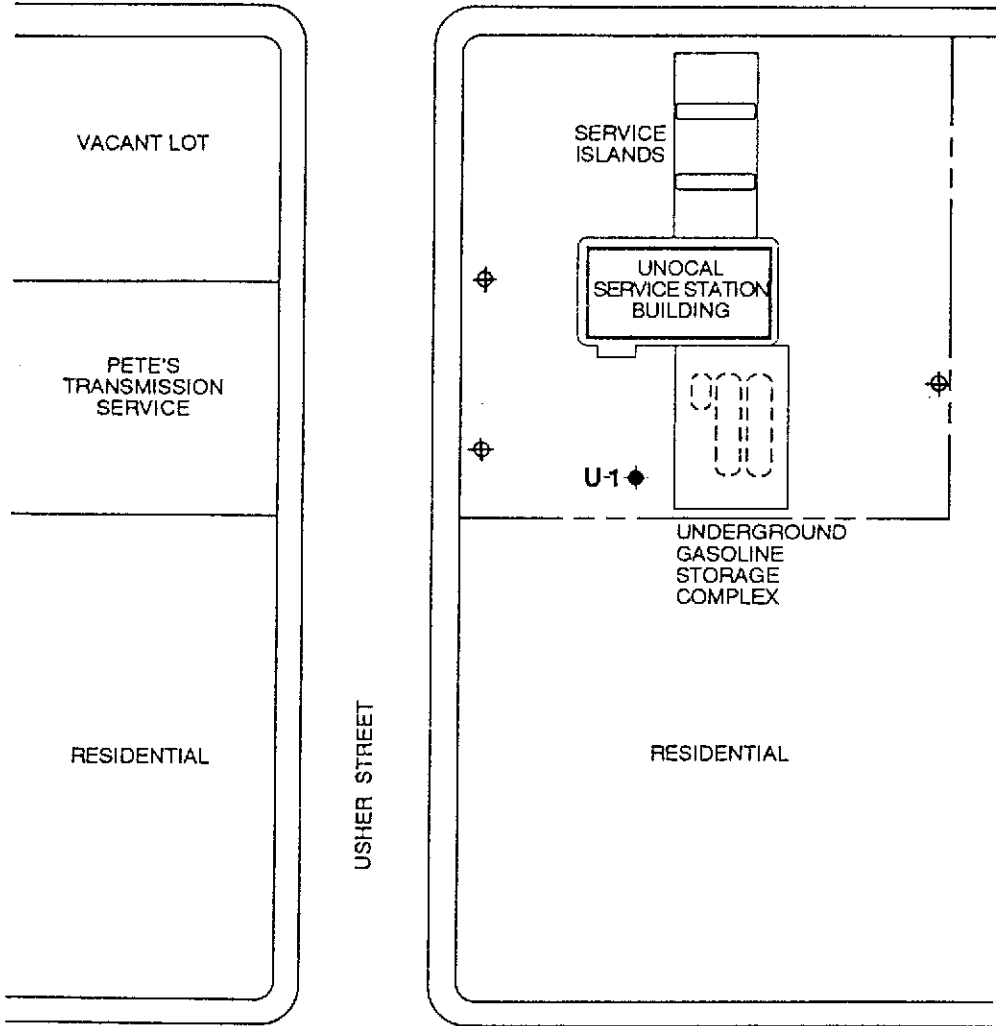
GeoStrategies Inc.

Vicinity Map
 UNOCAL Service Station #5760
 376 Lewelling Boulevard
 San Lorenzo, California

PLATE

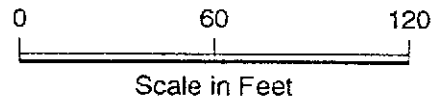
1

LEWELLING BOULEVARD



EXPLANATION

- ◆ U-1 Approximate ground-water monitoring well location
- ⊕ Proposed ground-water monitoring well location



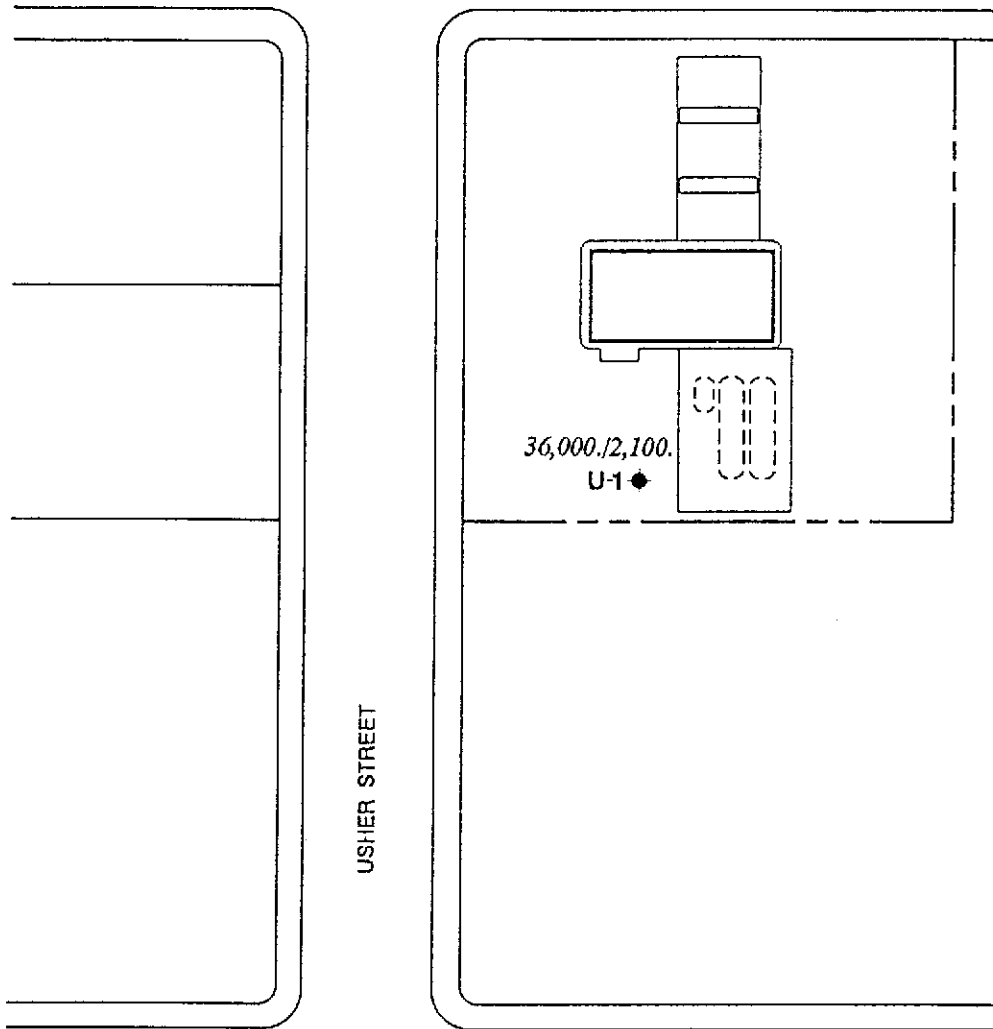
GeoStrategies Inc.

Site Plan
 UNOCAL Service Station #5760
 376 Lewelling Boulevard
 San Lorenzo, California

PLATE

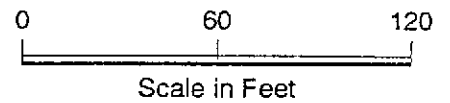
2

LEWELLING BOULEVARD



EXPLANATION

- ◆ U-1 Approximate ground-water monitoring well location
- 36,000, 12,100. TPH-G (Total Petroleum Hydrocarbons calculated as Gasoline)/Benzene concentrations in ppb measured on March 20, 1990



GeoStrategies Inc.

TPH-G/Benzene Concentration Map
UNOCAL Service Station #5760
376 Lewelling Boulevard
San Lorenzo, California

PLATE
3

JOB NUMBER
7809

REVIEWED BY RG/CEG
CMP 06/12/92

DATE
5/90

REVISED DATE

REVISED DATE

GeoStrategies Inc.

CHEMICAL ANALYTICAL DATA

=====

ANALYTICAL LOG

SAMPLE DATE	SAMPLE POINT	TPH (PPB)	BENZENE (PPB)	TOLUENE (PPB)	E.B. (PPB)	XYLENES (PPB)
09-Feb-88	U-1	93000.	3600.	11000.	N/A	20000.
20-Mar-90	U-1	36000.	2100.	5500.	1900.	9300.
20-Mar-90	TB	<50.	<0.5	<0.5	<0.5	<1.

GeoStrategies Inc.

GROUNDWATER SAMPLING REPORT



April 6, 1990

GROUNDWATER SAMPLING REPORT

UNOCAL
Post Office Box 8175
Walnut Creek, California 94596

Referenced Site: UNOCAL Service Station #5760
376 Lewelling/Usher
San Lorenzo, California

Sampling Date: March 20, 1990

This report presents the results of the quarterly groundwater sampling and analytical program conducted by Gettler-Ryan Inc. on March 20, 1990 at the referenced location. The site is occupied by an operating service station located on the northeast corner of Lewelling Blvd. and Usher Street. The service station has underground storage tanks containing leaded, unleaded and super unleaded gasoline products.

There is currently one groundwater monitoring well on site at the location shown on the attached site map. Prior to sampling, Well U-1 was inspected for total well depth, water levels, and presence of separate phase product using an electronic interface probe. A clean acrylic bailer was used to visually confirm the presence and thickness of separate phase product. Groundwater depth was 19.72 feet below grade. Separate phase product was not observed in Well U-1.

The well was then purged and sampled. The purge water was contained in drums for proper disposal. Standard sampling procedure calls for a minimum of four case volumes to be purged from each well. Well U-1 was purged while pH, temperature, and conductivity measurements were monitored for stability. Details of the final well purging results are presented on the attached Table of Monitoring Data. In cases where a well dewatered or less than four case volumes were purged, groundwater samples were obtained after the physical parameters had stabilized. Under such circumstances the sample may not represent actual formation water due to low flow conditions.

Samples were collected, using Teflon bailers, in properly cleaned and laboratory prepared containers. All sampling equipment was thoroughly cleaned after each well was sampled and steam cleaned upon completion of work at the site. The samples were labeled, stored on blue ice, and transported to the laboratory for analysis. A trip blank, supplied by the laboratory, was included and analyzed to assess quality control. Analytical results for the trip blank are included in the Certified Analytical Reports (CAR's). Chain of custody records were established noting sample identification numbers, time, date, and custody signatures.

The samples were analyzed at International Technology Corporation - Santa Clara Valley Laboratory located at 2055 Junction Avenue, San Jose, California. The laboratory is assigned a California DHS-HMTL Certification number of 137. The results are presented as a Certified Analytical Report, a copy of which is attached to this report.



Tom Paulson
Sampling Manager

attachments

TABLE OF MONITORING DATA
GROUNDWATER WELL SAMPLING REPORT

<u>WELL I.D.</u>	U-1
Casing Diameter (inches)	3
Total Well Depth (feet)	27.8
Depth to Water (feet)	19.72
Free Product (feet)	none
Reason Not Sampled	----
Calculated 4 Case Vol.(gal.)	15.4
Did Well Dewater?	no
Volume Evacuated (gallons)	15.5
Purging Device	Bailer
Sampling Device	Bailer
Time	14:17
Temperature (F)*	67.9
pH*	7.0
Conductivity (umhos/cm)*	4140

* Indicates Stabilized Value

LEWELLING BOULEVARD

VACANT LOT

PETE'S
TRANSMISSION
SERVICE

RESIDENTIAL

USHER STREET

SERVICE
ISLANDS

UNOCAL
SERVICE STATION
BUILDING

U-1 ◆

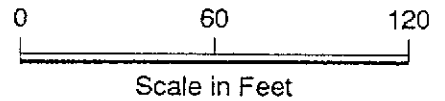
UNDERGROUND
GASOLINE
STORAGE
COMPLEX

RESIDENTIAL



EXPLANATION

◆ U-1 Approximate groundwater monitoring well location



GeoStrategies Inc.

Site Plan
Unocal Service Station #5760
376 Lewelling Boulevard
San Lorenzo, California

PLATE

1

CERTIFICATE OF ANALYSIS

GETTLER

Date: 04/10/90

Gettler-Ryan
2150 West Winton
Hayward, CA 94545
Tom Paulson

Work Order: T0-03-236

P.O. Number: 3809

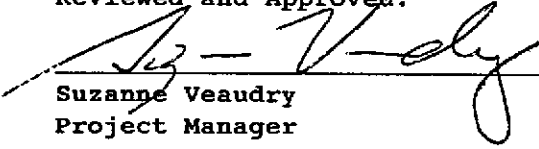
This is the Certificate of Analysis for the following samples:

Client Work ID: GR3809, Unocal, 376 Lewelling, San Lorenzo,
Date Received: 03/21/90 CORRECTED REPORT
Number of Samples: 2
Sample Type: water

TABLE OF CONTENTS FOR ANALYTICAL RESULTS

<u>PAGES</u>	<u>LABORATORY #</u>	<u>SAMPLE IDENTIFICATION</u>
2	T0-03-236-01	U-1
2	T0-03-236-02	Trip Blank

Reviewed and Approved:


Suzanne Veaudry
Project Manager

American Council of Independent Laboratories
International Association of Environmental Testing Laboratories
American Association for Laboratory Accreditation

Company: Gettler-Ryan, CORRECTED REPORT

Date: 04/10/90

Client Work ID: GR3809, Unocal, 376 Lewelling, San Lorenzo

Work Order: T0-03-236

TEST NAME: TPH Gas & BTEX

SAMPLE ID: U-1

SAMPLE DATE: 03/20/90

LAB SAMPLE ID: T003236-01

SAMPLE MATRIX: aqueous

RECEIPT CONDITION: Cool pH < 2

TPH ANALYSIS DATE: 03/26/90

RESULTS in Micrograms per Liter:

PARAMETER	DETECTION LIMIT	DETECTED
Low Boiling Hydrocarbons, calculated as Gasoline	2,500.	36,000.
Benzene	20.	2,100.
Toluene	20.	5,500.
Ethylbenzene	20.	1,900.
Xylenes (total)	50.	9,300.

TEST NAME: TPH Gas & BTEX

SAMPLE ID: Trip Blank

SAMPLE DATE: not spec

LAB SAMPLE ID: T003236-02

SAMPLE MATRIX: aqueous

RECEIPT CONDITION: Cool pH < 2

TPH ANALYSIS DATE: 03/26/90

RESULTS in Micrograms per Liter:

PARAMETER	DETECTION LIMIT	DETECTED
Low Boiling Hydrocarbons, calculated as Gasoline	50.	None
Benzene	0.5	None
Toluene	0.5	None
Ethylbenzene	0.5	None
Xylenes (total)	1.	None

Company: Gettler-Ryan, CORRECTED REPORT

Date: 04/10/90

Client Work ID: GR3809,Unocal, 376 Lewelling, San Lorenzo

Work Order: T0-03-236

TEST CODE TPHV_W TEST NAME TPH Gas & BTEX

The method of analysis for low boiling hydrocarbons is taken from EPA Methods 8015, 8020 and 5030. The sample is examined using the purge and trap technique. Final detection is by gas chromatography using a flame ionization detector as well as a photoionization detector. The result for total low boiling hydrocarbons is calculated as gasoline and includes benzene, toluene, ethylbenzene and xylenes.

COMPANY Unocal # 5760 JOB NO.

JOB LOCATION 376 Lewelling

CITY San Lorenzo PHONE NO. 783-7500

AUTHORIZED Tom Paulson DATE P.O. NO. 3809

SAMPLE ID	NO. OF CONTAINERS	SAMPLE MATRIX	DATE/TIME SAMPLED	ANALYSIS REQUIRED	SAMPLE CONDITION LAB ID
U-1 Trip Blk	3 1	liquid ↓	3-20-90/14:20 —	THC (gcs) BTXE ↓	OK/cool ↓

RELINQUISHED BY: John P. Zweryffs RECEIVED BY: [Signature] 3/21/90 07:30

RELINQUISHED BY: [Signature] 3/21/90 15:06 RECEIVED BY:

RELINQUISHED BY: RECEIVED BY LAB: [Signature] 3/21/90 1506

DESIGNATED LABORATORY: IT (SCV) DHS #: 137

REMARKS: Normal TAT Sweets

DATE COMPLETED 3-20-90 FOREMAN John P. Zweryffs

ORIGINAL

GeoStrategies Inc.

FIELD METHODS AND PROCEDURES

FIELD METHODS AND PROCEDURES

EXPLORATION DRILLING

Mobilization

Prior to any drilling activities, GeoStrategies Inc. (GSI) will verify that necessary drilling permits have been secured.

Utility locations will be located and drilling will be conducted so as not to disrupt activities at a project site. GSI will obtain and review available public data on subsurface geology and if warranted, the location of wells within a half-mile of the project site will be identified. Drillers will be notified in advance so that drilling equipment can be inspected prior to performing work.

Drilling

The subsurface investigations are typically performed to assess the lateral and vertical extent of petroleum hydrocarbons present in soils and groundwater. Drilling methods will be selected to optimize field data requirements as well as be compatible with known or suspected subsurface geologic conditions.

Monitoring wells are installed using a truck-mounted hollow-stem auger drill rig or mud-rotary drill rig. Typically, the hollow-stem rig is used for wells up to 100 feet, if subsurface conditions are favorable. Wells greater than 100-feet deep are typically drilled using mud-rotary techniques. When mud rotary drilling is used, an electric log will be performed for additional lithological information. Also during mud rotary drilling, precautions will be taken to prevent mud from circulating contaminants by using a conductor casing to seal off contaminated zones. Samples will be collected for lithologic logging by continuous chip, and where needed by drive sample or core as specified by the supervising geologist.

Soil Sampling

Shallow soil borings will be drilled using a truck-mounted hollow-stem auger drilling rig, unless site conditions favor a different drilling method. Drilling and sampling methods will be consistent with ASTM Method D-1452-80. The auger size will be a minimum 6-inch nominal outside-diameter (O.D). No drilling fluids will be used during this drilling method. The augers and other tools used in the bore hole will be steam cleaned before use and between borings to minimize the possibilities of cross-contamination between borings.

Soil samples are typically collected at 5-foot intervals as a minimum from ground surface to total depth of boring. Additional soil samples will be collected based on significant lithologic changes and/or potential chemical content. Soil samples from each sampling interval will be lithologically described by a GSI geologist (Figure 1). Soil colors will be described using the Munsell Color Chart. Rock units will be logged using appropriate lithologic terms, and colors described by the G.S.A. Rock Color Chart.

Head-space analyses will be performed to check for the evidence of volatile organic compounds. Head-space analyses will be performed using an organic vapor analyzer; either an OVA, HNU, or OVM. Organic vapor concentrations will be recorded on the GSI field log of boring (Figure 1). The selection of soil samples for chemical analysis are typically based on the following criteria:

- 1) Soil discoloration
- 2) Soil odors
- 3) Visual confirmation of chemical in soil
- 4) Depth with respect to underground tanks (or existing grade)
- 5) Depth with respect to ground water
- 6) OVA reading

Soil samples (full brass liners) selected for chemical analysis are immediately covered with aluminum foil and the liner ends are capped to prevent volatilization. The samples are labeled and entered onto a Chain-of-Custody form, and placed in a cooler on blue ice for transport to a State-certified analytical laboratory.

Soil cuttings are stockpiled on-site. Soils are sampled and analyzed for site-specific chemical parameters. Disposition of soils is dependent of chemical analytical results of the samples.

Soil Sampling - cont.

Soil borings not converted to monitoring wells will be backfilled (sealed) to ground surface using either a neat cement or cement-bentonite grout mixture. Backfilling will be tremied by continuously pumping grout from the bottom to the top of the boring where depth exceeds 20' or as required by local permit requirements.

All field and office work, including exploratory boring logs, are prepared under the direction of a registered geologist.

Monitoring Well Installation

Monitoring well casing and screen will be constructed of Schedule 40, flush-joint threaded polyvinylchloride (PVC). The well screen will be factory mill-slotted unless additional open area is required (eg. conversion to an extraction well in a low-yield aquifer). The screen length will be placed adjacent to the aquifer material to a minimum of 2-feet above encountered water. No screen shall be placed in a borehole that potentially creates hydraulic interconnection of two or more aquifer units. Screen slot size and well sand pack will be compatible with encountered aquifer materials, as confirmed by sieve analysis.

Monitoring wells will be completed below grade (Figure 2) unless special conditions exist that require above-grade completion design. In the event a monitoring well is required in an aquifer unit beneath an existing aquifer, the upper aquifer will be sealed off by installing a steel conductor casing with an annular neat cement or cement-bentonite grout seal. This seal will be continuously tremie pumped from the bottom of the annulus to ground surface.

The monitoring well sand pack will be placed adjacent to the entire screened interval and will extend a recommended minimum distance of 2-feet above the top of the screen. No sand pack will be placed that interconnects two or more aquifer units. A minimum 2-foot bentonite pellet or bentonite slurry seal will be placed above the sand pack. Sand pack, bentonite, and cement seal levels will be confirmed by sounding the annulus with a calibrated weighted tape. The remaining annular space above the bentonite seal will be grouted with a bentonite-cement mixture and will be tremie-pumped from the bottom of the annular space to the ground surface. The bentonite content of the grout will not exceed 5 percent by weight. A field log of boring and a field well completion form will be prepared by GSI for each well installed.

Decontamination of drilling equipment before drilling and between wells will consist of steam cleaning, and/or Alconox wash.

Well Development

All newly installed wells will be properly developed within 48 hours of completion. No well will be developed until the well seal has set a minimum of 12 hours. Development procedures will include one or more of the methods described below:

Bailing

Bailing will be used to remove suspended sediments and drilling fluids from the well, where applicable. The bailer will be raised and lowered through the column of water in the well so as to create a gentle surging action in the screened interval. This technique may be used in conjunction with other techniques, such as pumping, and may be used alone if the well is of low yield.

Pumping

Pumping will be used in conjunction with bailing or surging. The pump will be operated in such a manner as to gently surge the entire screened interval of the well. This may involve operating the pump with a packer type mechanism attached and slowly raising and lowering the pump, or by cycling the pump off and on to allow water to move in and out of the screened interval. Care will be used not to overpump a well.

Surging

Surging will be performed on wells that are screened in known or suspected high yield formations and/or on larger diameter (recovery) wells. A surge block will be raised and lowered through the entire screened interval, forcing water in and out of the well screen and sand pack. Pumping or air lifting will be used in conjunction with this method of development to remove any sediment brought into the well during surging.

Air Lifting

Air lifting will be used to remove sediment from wells as an alternative to pumping under certain conditions. When appropriate, a surge block designed for use with air lifting will be used to agitate the entire screened interval and water will be lifted out of the well using forced air. When air lifting is performed, the air source will be either nitrogen or filtered air and the procedure will be performed gently to prevent any damage to the well screen or casing and to insure that discharged water is contained.

Well Development - cont.

All well developing equipment will be thoroughly decontaminated prior to development using a steam cleaner and/or Alconox detergent wash and clean water rinse. During development procedures, field parameters (temperature, specific conductance and pH) will be monitored and recorded on well development forms (Figure 3). Equilibration requirements consist of a minimum of three readings with the following accuracy standards:

pH	± 0.1 pH units
Specific Conductance	± 10% of full scale reading
Temperature	± 0.5 degrees Celsius

The wells will be developed until water is visibly clear and free of sediment, and well purging parameters stabilized. A minimum of 8 to 10 well volumes will be purged from each well, if feasible. If well purging parameters have not stabilized before 10 casing volumes have been removed, well development will continue until purging parameters have stabilized and formation water is being drawn into the well. The adequacy of well development will be judged by the field technician performing the well development and based on known formation conditions.

Well Surveying

Monitoring wells will be surveyed to obtain top of box elevations to the nearest ±0.01 foot. Water level measurements will be recorded to the nearest ±0.01 foot and referenced to Mean Sea Level (MSL). If additional wells are required, then existing and newly installed wells are surveyed relative to MSL.

GROUND-WATER SAMPLING AND ANALYSISQuality Assurance/Quality Control Objectives

The sampling and analysis procedures employed by Gettler-Ryan Inc. (G-R) for ground-water sampling and monitoring follow specific Quality Assurance/Quality Control (QA/QC) guidelines. Quality Assurance objectives have been established by G-R to develop and implement procedures for obtaining and evaluating water quality and field data in an accurate, precise, and complete manner so that sampling procedures and field measurements provide information that is comparable and representative of actual field conditions. Quality Control (QC) is maintained by G-R by using specific field protocols and requiring the analytical laboratory to perform internal and external QC checks. It is the goal of G-R to provide data that are accurate, precise, complete, comparable, and representative. The definitions for accuracy, precision, completeness, comparability, and representativeness are as follows:

- Accuracy - the degree of agreement of a measurement with an accepted referenced or true value.
- Precision - a measure of agreement among individual measurements under similar conditions. Usually expressed in terms of the standard deviation.
- Completeness - the amount of valid data obtained from a measurement system compared to the amount that was expected to meet the project data goals.
- Comparability - expresses the confidence with which one data set can be compared to another.
- Representativeness - a sample or group of samples that reflects the characteristics of the media at the sampling point. It also includes how well the sampling point represents the actual parameter variations which are under study.

As part of the G-R QA/QC program, applicable federal, state, and local reference guidance documents are followed. The procedures outlined in these regulations, manuals, handbooks, guidance documents, and journals are incorporated into the G-R sampling procedures to assure that; (1) ground-water samples are properly collected, (2) ground-water samples are identified, preserved, and transported in a manner such that they are representative of field conditions, and (3) chemical analysis of samples are accurate and reproducible.

Guidance and Reference Documents Used to Collect Groundwater Samples

These documents are used to verify G-R sampling procedures and are consistent with current regulatory guidance. If site specific work and sampling plans are required, those plans will be developed from these documents, and newly received applicable documents.

- | | |
|--|--|
| U.S.E.P.A. - 330/9-51-002 | NEIC Manual for Groundwater/Subsurface Investigation at Hazardous Waste Sites |
| U.S.E.P.A. - 530/SW611 | Procedures Manual for Groundwater Monitoring at Solid Waste Disposal Facilities (August, 1977) |
| U.S.E.P.A. - 600/4-79-020 | Methods for Chemical Analysis of Water and Wastes (1983) |
| U.S.E.P.A. - 600/4-82-029 | Handbook for Sampling and Sample Preservation of Water and Wastewater (1982) |
| U.S.E.P.A. - 600/4-82-057 | Test Methods for Organic Chemical Analysis of Municipal and Industrial Wastewater (July, 1982) |
| U.S.E.P.A. - SW-846#, 3rd Edition | Test Methods for Evaluating Solid Waste - Physical/Chemical Methods (November, 1986) |
| 40 CFR 136.3e, Table II (Code of Federal Regulations) | Required Containers, Preservation Techniques, and Holding Times |
| Resources Conservation and Recover Act (OSWER 9950.1) | Groundwater Monitoring Technical Enforcement Guidance Document (September, 1986) |
| California Regional Water Quality Control Board (Central Valley Region) | A Compilation of Water Quality Goals (September, 1988); Updates (October, 1988) |
| California Regional Water Quality Control Board (North Coast, San Francisco Bay, and Central Valley) | Regional Board Staff Recommendations for Initial Evaluations and Investigation of Underground Tanks: Tri-Regional Recommendations (June, 1988) |

Guidance and Reference Documents Used to Collect Groundwater Samples (cont.)

Regional Water Quality Control Board (Central Valley Region)

Memorandum: Disposal, Treatment, and Refuse of Soils Contaminated with Petroleum Fractions (August, 1986)

State of California Department of Health Services

Hazardous Waste Testing Laboratory Certification List (March, 1987)

State of California Water Resources Control Board

Leaking Underground Fuel Tank (LUFT) Field Manual (May, 1988), and LUFT Field Manual Revision (April, 1989)

State of California Water Resources Control Board

Title 23, (Register #85.#33-8-17-85), Subchapter 16: Underground Tank Regulations; Article 3, Sections 2632 and 2634; Article 4, Sections 2645, 2646, 2647, and 2648; Article 7, Sections 2670, 2671, and 2672 (October, 1986: including 1988 Amendments)

Alameda County Water District

Groundwater Protection Program: Guidelines for Groundwater and Soil Investigations at Leaking Underground Fuel Tank Sites (November, 1988)

American Public Health Association

Standard Methods for the Examination of Water and Wastewaters, 16th Edition

Analytical Chemistry (journal)

Principles of Environmental Analysis, Volume 55, Pages 2212-2218 (December, 1983)

Napa County

Napa County Underground Storage Tank Program: Guidelines for Site Investigations; February 1989.

Santa Clara Valley Water District

Guidelines for Preparing or Reviewing Sampling Plans for Soil and Groundwater Investigation of Fuel Contamination Sites (January, 1989)

Guidance and Reference Documents Used to Collect Groundwater Samples (cont.)

Santa Clara Valley Water District	Investigation and Remediation at Fuel Leak sites: Guidelines for Investigation and Technical Report Preparation (March 1989)
Santa Clara Valley Water District American Petroleum Institute	Revised Well Standards for Santa Clara County (July 18, 1989) Groundwater Monitoring & Sample Bias; API Publication 4367, Environmental Affairs Department, June 1983
American Petroleum Institute	A Guide to the Assessment and Remediation of Underground Petroleum Releases; API Publication 1628, February 1989
American Petroleum Institute	Literature Summary: Hydrocarbon Solubilities and Attenuations Mechanisms, API Publication 4414, August 1985
Site Specific (as needed)	General and specific regulatory documents as required.

Because ground-water samples collected by G-R are analyzed to the parts per billion (ppb) range for many compounds, extreme care is exercised to prevent contamination of samples. When volatile or semi-volatile organic compounds are included for analysis, G-R sampling crew members will adhere to the following precautions in the field:

1. A clean pair of new, disposable gloves are worn for each well being sampled.
2. When possible, samples are collected from known or suspected wells that are least contaminated (i.e. background) followed by wells in increasing order of contamination.
3. Ambient conditions are continually monitored to maintain sample integrity.

When known or potential organic compounds are being sampled for, the following additional precautions are taken:

1. All sample bottles and equipment are kept away from fuels and solvents. When possible, gasoline (used in generators) is stored away from bailers, sample bottles, purging pumps, etc.
2. Bailers are made of Teflon or Stainless Steel. Other materials such as plastic may contaminate samples with phthalate esters which interfere with many Gas Chromatography (GC) analyses.
3. Volatile organic ground-water samples are collected so that air passage through the sample does not occur or is minimal (to prevent volatiles from being stripped from the samples): sample bottles are filled by slowly running the sample down the side of the bottle until there is a positive convex meniscus over the neck of the bottle; the Teflon side of the septum (in cap) is positioned against the meniscus, and the cap screwed on tightly; the sample is inverted and the bottle lightly tapped. The absence of an air bubble indicates a successful seal; if a bubble is evident, the cap is removed, more sample is added, and the bottle is resealed.
4. Extra Teflon seals are brought into the field in case seals are difficult to handle and/or are dropped. Dropped seals are considered contaminated and are not used. When replacing seals or if seals become flipped, care is taken to assure that the Teflon seal faces down.

Sample analysis methods, containers, preservatives and holding times are shown on Table 1.

Laboratory and field handling procedures of samples are monitored by including QC samples for analysis with every submitted sample lot from a project site. QC samples may include any combination of the following:

- A. Trip Blank: Used for purgeable organic compounds only; QC samples are collected in 40 milliliter (ml) sample vials filled in the analytical laboratory with organic-free water. Trip blanks are sent to the project site, and travel with project site samples. Trip blanks are not opened, and are returned from a project site with the project site samples for analysis.
- B. Field Blank: Prepared in the field using organic-free water. These QC samples accompany project site samples to the laboratory and are analyzed for specific chemical parameters unique to the project site where they were prepared.
- C. Duplicates: Duplicated samples are collected "second samples" from a selected well and project site. They are collected as either split samples or second-run samples collected from the same well.
- D. Equipment Blank: Periodic QC sample collected from field equipment rinsate to verify decontamination procedures.

The number and types of QC samples are determined as follows:

- A. Up to 2 wells - Trip Blank Only
- B. 2 to 5 Wells - 1 Field Blank and 1 Trip Blank
- C. 5 to 10 Wells - 1 Field blank, 1 Trip Blank, and 1 Duplicate
- D. More than 10 Wells - 1 Field Blank, 1 Trip Blank, and 1 Duplicate per each 12 wells
- E. If sampling extends beyond one day, quality control samples will be collected for each day.

Additional QC is performed through ongoing and random reviews of duplicate samples to evaluate the precision of the field sampling procedures and analytical laboratory. Precision of QC data is accomplished by calculating the Relative Percent Difference (RPD). The RPD is evaluated to assess whether values are within an acceptable range (typically $\pm 20\%$ of duplicate sample).

SAMPLE COLLECTION

This section describes the routine procedures followed by G-R while collecting ground-water samples for chemical analysis. These procedures include decontamination, water-level measurements, well purging, physical parameter measurements, sample collection, sample preservation, sample handling, and sample documentation. Critical sampling objectives for G-R are to:

1. Collect ground-water samples that are representative of the sampled matrix and,
2. Maintain sample integrity from the time of sample collection to receipt by the analytical laboratory.

Sample analyses methods, containers, preservation, and holding times are presented in Table 1.

Decontamination Procedures

All physical parameter measuring and sampling equipment are decontaminated prior to sample collection using Alconox or equivalent detergent followed by steam cleaning with deionized water. Any sampling equipment surfaces or parts that might absorb specific contaminants, such as plastic pump valves, impellers, etc., are cleaned in the same manner.

Sample bottles, bottle caps, and septa used for sampling volatile organics are thoroughly cleaned and prepared in the laboratory. Sample bottles, bottle caps, and septa are protected from all potential chemical contact before actual usage at a sample location.

During field sampling, equipment placed in a well are decontaminated before purging or sampling the next well. The equipment are decontaminated by cleaning with Alconox or equivalent detergent followed by steam cleaning with deionized water.

Water-Level Measurements

Prior to purging and sampling a well, the static-water levels are measured in all wells at a project site using an electric sounder and/or calibrated portable oil-water interface probe (Figure 4). Both static water-level and separate-phase product thickness are measured to the nearest ± 0.01 foot. The presence of separate-phase product is confirmed using a clean, acrylic or polyvinylchloride (PVC) bailer, measured to the nearest ± 0.01 foot with a decimal scale tape.



Water-Level Measurements (continued)

The monofilament line used to lower the bailer is replaced between wells with new line to preclude the possibility of cross-contamination. Field observations (e.g. well integrity, product color, turbidity, water color, odors, etc.) are noted on the G-R Well Sampling Field Data Sheet shown in Figure 4. Before and after each use, the electric sounder, interface probe and bailer are decontaminated by washing with Alconox or equivalent detergent followed by rinsing with deionized water to prevent cross-contamination.

As mentioned previously, water-levels are measured in wells with known or suspected lowest dissolved chemical concentrations to the highest dissolved concentrations.

Well Purging

Before sampling occurs, well casing storage water and interstitial water in the artificial sand pack will be purged using (1) a positive displacement bladder pump constructed of inert, non-wetting, Teflon and stainless steel, (2) a pneumatic-airlift pumping system, (3) a centrifugal pumping system, or (4) a Teflon or Stainless steel bailer (Figure 5). Methods of purging will be assessed based on well size, location, accessibility, and known chemical conditions. Individual well purge volumes are calculated from borehole volumes which take into account the sand packed interval in the well annular space. As a general rule, a minimum of 3 and a maximum of 10 borehole volumes will be purged. Wells which dewater or demonstrate slow recharge periods (i.e. low-yield wells) during purging activities may be sampled after fewer purging cycles. If a low-yield (low recovery) well is to be sampled, sampling will not take place until at least 80 percent of the previously measured water column has been replaced by recharge, or as per local requirements. Physical parameter measurements (temperature, pH, and specific conductance) are closely monitored throughout the well purging process and are used by the G-R sampling crew as indicators for assessing sufficient purging. Purging is continued until all three physical parameters have stabilized. Specific conductance (conductivity) meters are read to the nearest ± 10 umhos/cm, and are calibrated daily. pH meters are read to the nearest ± 0.1 pH units and are calibrated daily. Temperature is read to the nearest 0.1 degree F. Calibration of physical parameter meters will follow manufacturers specifications. Monitoring wells will be purged according to the protocol presented in Figure 5. Collected field data during purging activities will be entered on the G-R Well Sampling Field Data Sheet shown in Figure 4. Copies of the G-R Field Data Sheets will be reviewed by the G-R Sampling Manager for accuracy and completeness.

DOCUMENTATION

Sample Container Labels

Each sample container will be labeled by an adhesive label, noted in permanent ink immediately after the sample is collected. Label information will include:

- Sample point designation (i.e. well number or code)
- Sampler's identification
- Project number
- Date and time of collection
- Type of preservation used

Well Sampling Data Forms

In the field, the G-R sampling crew will record the following information on the Well Sampling Data Sheet for each sample collected:

- Project number
- Client
- Location
- Source (i.e. well number)
- Time and date
- Well accessibility and integrity
- Pertinent well data (e.g. depth, product thickness, static water-level, pH, specific conductance, temperature)
- Calculated and actual purge volumes

Chain-of-Custody

A Chain-of-Custody record (Figure 6) shall be completed and accompany every sample and every shipment of samples to the analytical laboratory in order to establish the documentation necessary to trace sample possession from time of collections. The record will contain the following information:

- Sample or station number or sample identification (ID)
- Signature of collector, sampler, or recorder
- Date and time of collection
- Place of collection
- Sample type
- Signatures of persons involved in chain of possession
- Inclusive dates of possession

Samples shall always be accompanied by a Chain-of-Custody record. When transferring the samples, the individual relinquishing and receiving the samples will sign, date, and note the time on the Chain-of-Custody record. G-R will be responsible for notifying the laboratory coordinator when and how many samples will be sent to the laboratory for analysis, and what types of analyses shall be performed.

TABLE 1

SAMPLE ANALYSIS METHODS, CONTAINERS, PRESERVATIONS, AND HOLDING TIMES

<u>Parameter</u>	<u>Analytical Method</u>	<u>Reporting Units</u>	<u>Container</u>	<u>Preservation</u>	<u>Maximum Holding Time</u>
Total Petroleum Hydrocarbons (gasoline)	EPA 8015 (modified)	mg/l ug/l	40 ml. vial glass, Teflon	cool, 4 C HCl to pH<2	14 days (maximum)
Benzene	EPA 8020	mg/l	50 ml. vial	cool, 4 C	7 days (w/o preservative)
Toluene		ug/l	glass, Teflon	HCl to pH<2	14 days (w preservative)
Ethylbenzene			lined septum		
Xylenes (BTEX)		mg/l	1 l glass, Teflon		
Oil & Grease	SM 503E	ug/l	lined septum	H2SO4 to pH<2	28 days (maximum)
Total Petroleum Hydrocarbons (Diesel)	EPA 8015 (modified)	mg/l ug/l	40 ml. vial glass, Teflon lined septum	cool, 4 C	14 days (maximum)
Halogenated Volatile Organics (chlorinated solvents)	8010	mg/l ug/l	40 ml. vial glass, Teflon lined septum	cool, 4 C	14 days (maximum)
Non chlorinated solvents	8020	mg/l ug/l	40 ml. vial glass, Teflon lined septum	cool, 4 C HCl to pH<2	14 days (maximum)
Volatile Organics	8240	mg/l ug/l	40 ml. vial glass, Teflon lined septum	cool, 4 C	14 days (maximum)
Semi-Volatile Organics	8270	mg/l ug/l	40 ml. vial glass, Teflon lined septum	cool, 4 C	14 days (maximum)
Specific Conductance (Field test)		umhos/cm			
pH (Field test)		pH units			
Temperature (Field test)		Deg F			



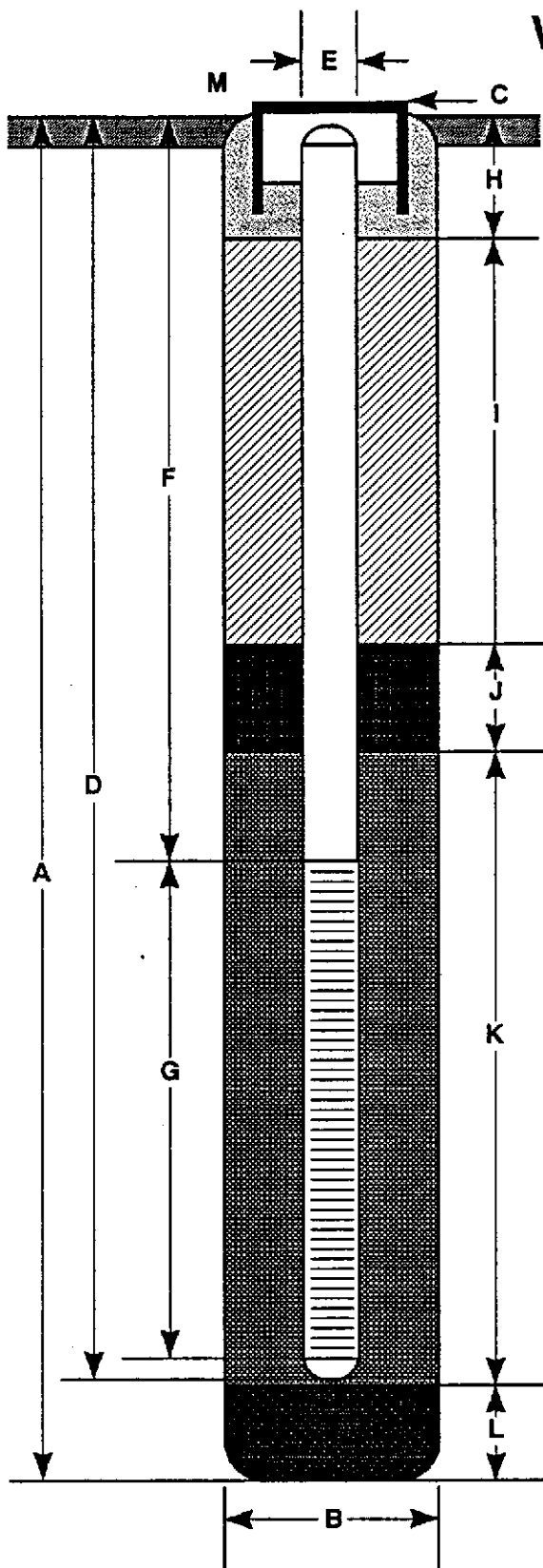
FIELD EXPLORATORY BORING LOG

FIGURE 1

Field location of boring:								Project No.:		Date:		Boring No:	
								Client:					
								Location:					
								City:		Logged by:		Driller:	
Drilling method:								Casing installation data:					
Hole diameter:								Top of Box Elevation:		Datum:			
PID (ppm)	Blows/ft. or Pressure (psf)	Type of Sample	Sample Number	Depth (ft.)	Sample	Well Detail	Soil Group Symbol (USCS)	Water Level					
								Time		Date			
								Description					
Remarks:													

WELL CONSTRUCTION DETAIL

FIGURE 2



- A Total Depth of Boring _____ ft.
- B Diameter of Boring _____ in.
Drilling Method _____
- C Top of Box Elevation _____ ft.
 Referenced to Mean Sea Level
 Referenced to Project Datum
- D Casing Length _____ ft.
Material _____
- E Casing Diameter _____ in.
- F Depth to Top Perforations _____ ft.
- G Perforated Length _____ ft.
Perforated Interval from _____ to _____ ft.
Perforation Type _____
Perforation Size _____ in.
- H Surface Seal from _____ to _____ ft.
Seal Material _____
- I Backfill from _____ to _____ ft.
Backfill Material _____
- J Seal from _____ to _____ ft.
Seal Material _____
- K Gravel Pack from _____ to _____ ft.
Pack Material _____
- L Bottom Seal _____ ft.
Seal Material _____
- M _____

Note: Depths measured from initial ground surface



GeoStrategies Inc.

Well Construction Detail

WELL NO. _____

JOB NUMBER _____

REVIEWED BY RG/CEG

DATE _____

REVISED DATE _____

REVISED DATE _____

WELL DEVELOPMENT FORM

FIGURE 3

Page _____ of _____

(to be filled out in office)

Client _____ SS# _____ Job# _____

Name _____ Location _____

Well# _____ Screened Interval _____ Depth _____

Aquifer Material _____ Installation Date _____

Drilling Method _____ Borehole Diameter _____

Comments regarding well installation: _____

(to be filled out in the field) Name _____

Date _____ Development Method _____

Total Depth _____ - Depth to liquid _____ = Water Column _____

Product thickness _____

Water Column x Diameter (in.) x #Vol x 0.0408 = _____ gals

Purge Start _____ Stop _____ Rate _____ gpm

Gallons	Time	Clarity	Temp.	pH	Conductivity
0	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____

Total gallons removed _____ Development stop time _____

Depth to liquid _____ at _____ (time)

Odor of water _____ Water discharged to _____

Comments _____

GETTLER-RYAN INC.

General and Environmental Contractors

WELL SAMPLING FIELD DATA SHEET

FIGURE 4

COMPANY _____ JOB # _____
LOCATION _____ DATE _____
CITY _____ TIME _____

Well ID. _____ Well Condition _____

Well Diameter _____ in. Hydrocarbon Thickness _____ ft.

Total Depth _____ ft.

Depth to Liquid- _____ ft.

(# of casing volumes) _____ x _____ x(VF) _____ = (Estimated Purge Volume) _____ gal.

Purging Equipment _____

Sampling Equipment _____

Starting Time _____ Purging Flow Rate _____ gpm.

(Estimated Purge Volume) _____ gal. / (Purging Flow Rate) _____ gpm. = (Anticipated Purging Time) _____ min.

Time	pH	Conductivity	Temperature	Volume
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____

Did well dewater? _____ If yes, time _____ Volume _____

Sampling Time _____ Weather Conditions _____

Analysis _____ Bottles Used _____

Chain of Custody Number _____

COMMENTS _____

FOREMAN _____ ASSISTANT _____

Monitoring Well Sampling Protocol Schematic

