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GETTLER-RYAN INC.
GENERAL CONTRACTORS

GSI

GeoStrategies Inc.
2140 WEST WINTON AVENUE
HAYWARD, CALIFORNIA 94545
(415) 352-4800

June 18, 1991

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

Attn: Mr. Keith Bullock

Re: WORK PLAN
UNOCAL Service Station No. 3690
14999 Farnsworth Street
San Leandro, California

Gentlemen:

This Work Plan by GeoStrategies Inc. (GSI) describes a scope of investigation for the installation of three monitoring wells for the above referenced site (Plate 1). The scope of investigation was prepared at the request of UNOCAL. Field work and laboratory analysis methods will be performed to comply with current State of California Water Resources Control Board (SWRCB) guidelines. Field Methods and Procedures are presented in Appendix A.

SITE BACKGROUND

In May, 1990, Applied Geosystems (AGS) drilled four exploratory soil borings (B-1 through B-4) at locations shown on Plate 2. Soil and groundwater samples collected from these borings were analyzed for Total Petroleum Hydrocarbons calculated as Gasoline (TPH-Gasoline) according to EPA Method 8015 (Modified), Benzene, Toluene, Ethylbenzene and Xylenes (BTEX) by EPA Method 8020. In addition, soil and groundwater samples from soil boring B-4 were analyzed for Total Petroleum Hydrocarbons calculated as Diesel (TPH-Diesel) by EPA Method 8015 (Modified), Total Oil and Grease (TOG) by EPA Method 503E, and Volatile Organic Compounds (VOCs) by EPA Method 8010 (soil) and 601 (water).

Gettler-Ryan Inc.
June 18, 1991
Page 2

TPH-Gasoline was detected in the 10-foot depth soil samples from borings B-2 (2,400 parts per million (ppm)), B-3 (6.8 ppm), and B-4 (20 ppm). Benzene was detected in the [redacted] soil sample from boring B-2 (0.65 ppm), and reported as none detected (ND) in soil samples collected from borings B-1, B-3, and B-4. TOG was detected in the [redacted] soil sample from boring B-4 at 200 ppm, and TPH-Diesel was detected in the [redacted] soil sample from boring B-4 at 2,400 ppm. VOC's were detected in the [redacted] soil sample from boring B-4: 1,1-Dichloroethene (1,1-DCE; 0.8 parts per billion (ppb)), Methylene Chloride (1.8 ppb), 1,1-Dichloroethane (1,1-DCA; 30. ppb), 1,1,1-Trichloroethane (1,1,1-TCA; 66. ppb), Trichloroethene (TCE; 30. ppb), and Tetrachloroethene (PCE; 47. ppb).

TPH-Gasoline was detected in groundwater samples from borings B-1 (180 ppb), B-2 (37,000 ppb), B-3 (1,400 ppb), and B-4 (670 ppb). Benzene was detected in groundwater samples collected from borings B-2 (90 ppb) and B-4 (3.5 ppb). TPH-Diesel and TOG were detected in groundwater from boring B-4 at concentrations of 10,000 and 15,000 ppb, respectively. VOC's were detected in groundwater samples from boring B-4: 1,1-DCE (1.5 ppb), 1,1-DCA (7.0 ppb), 1,1,1-TCA (58. ppb), TCE (5.4 ppb), and PCE (13. ppb).

HYDROGEOLOGY

The site is located within the San Francisco Bay plain approximately 1.5 miles east of the San Francisco Bay and approximately 2,000 feet north of Estudillo Canal. The area is underlain by Holocene-age fine-grained alluvium consisting of unconsolidated, moderately sorted fine sand, silt, and clayey silt with a few thin beds of coarse sand (Helley and others, 1979). AGS boring logs indicate the site is generally underlain by clay with varying amounts of silt and sand to 10 feet. From approximately 10 to 12 feet, a sand layer with varying amounts of silt and gravel was observed. A predominantly silty clay was noted from 12 feet to the total explored depth of 15 feet below grade.

First encountered groundwater in soil borings B-1 through B-4 was approximately 10 feet below grade.

TECHNICAL RATIONALE

As requested by UNOCAL, GSI proposes to install three groundwater monitoring wells on-site to further evaluate the extent of petroleum hydrocarbons in the soil and groundwater (Plate 2). These wells will also provide additional information about subsurface hydrogeology. Following installation and development of the three wells, groundwater samples will be collected to evaluate the extent of hydrocarbons in the shallow aquifer zone.

The technical rationale for this investigation includes the following:

- Soil samples collected from on-site borings B-2, B-3 and B-4 had reported concentrations of TPH-Gasoline ranging from 6.8 to 2,400 ppm.
- Ground-water samples collected from on-site borings (B-1 through B-4) contained detectable concentrations of TPH-Gasoline ranging from 180 to 37,000 ppb and benzene ranging from ND to 90 ppb. However, there are currently no monitoring wells at the site.
- Soil and ground-water samples collected from boring B-4 (nearest the waste oil tank) had detectable concentrations of TPH-Diesel, TOG, and VOC's.
- The three proposed wells will be needed to further evaluate the vertical and horizontal distribution of hydrocarbons in soil and shallow groundwater and to calculate the local groundwater flow direction and hydraulic gradient. Regional groundwater flow patterns and local topography suggest that shallow groundwater beneath the site flows to the southwest.

SCOPE OF INVESTIGATION

Three soil borings will be drilled using hollow-stem auger drilling equipment to an estimated depth of approximately 20 feet below first encountered ground-water, unless an aquitard is reached at a shallower depth. Soil samples will be collected by a California Modified split-barrel sampler equipped with pre-cleaned liners, and advanced ahead of the drill bit. Soil samples will be collected at five-foot intervals and at significant lithologic changes, at a minimum, for lithologic identification, field head-space analysis, physical testing, and chemical analysis. The borings will be logged by a GSI geologist using the Unified Soil Classification System (ASTM-D2488-84) and the Munsell Soil Color Chart.

Selected soil samples collected above the saturated zone will be submitted for laboratory chemical analysis. Additional samples may be selected for chemical analysis. Soil samples will be collected in clean brass or stainless steel liners, covered on both ends with aluminum foil and plastic end caps. Soil samples will then be labeled, placed in a cooler with blue ice and transported, under Chain-of-Custody, to a California State-certified analytical laboratory. Soil and groundwater samples collected from the exploratory borings and the wells will be analyzed for Total Petroleum Hydrocarbons calculated as Gasoline (TPH-Gasoline) according to EPA Method 8015 (Modified) and BTEX according to EPA Method 8020, and Volatile Organic Compounds (VOCs) according to EPA Method 8010 (soil) and 601 (water). Soil and ground-water samples collected from the exploratory boring and well nearest the waste oil tank will be analyzed for TOG by EPA Method 5520 D&F (soil) and C&F (water).

The three monitoring wells will be constructed in the borings using 2-inch-diameter Schedule 40 PVC casing. The well screens will extend a minimum of 2 feet above the equilibrated water-level. The annular sandpack will be placed from the total depth of the designed well and will extend a minimum of 2-feet above the well screen. A minimum 1-foot bentonite seal, followed by a cement-grout seal to one-half foot below ground surface, will be placed above the sandpack. The well screens will be emplaced so that well designs are compatible with subsurface geologic conditions. Well screens will not be installed in a manner that could potentially permit cross contamination of adjacent aquifers. Locking well caps and locks will be installed on the ground-water wells to provide well-head security.

Upon completion of field work and receipt of chemical analytical data, a report will be prepared presenting the field and laboratory data, including copies of the exploratory boring logs, chemical analytical reports, and a brief site history. This report will be prepared under the supervision of a State of California Registered Geologist.

If you have any questions, please call.

GeoStrategies Inc. by,

Thomas D. Leavitt
Geologist

David H. Peterson
Senior Geologist
C.E.G. 1186

REGISTERED GEOLOGIST
DAVID H. PETERSON
No. 1186
CERTIFIED
ENGINEERING
GEOLOGIST
STATE OF CALIFORNIA

TDL/DHP/mlg

Plate 1. Vicinity Map
Plate 2. Site Plan

Appendix A: Field Methods and Procedures

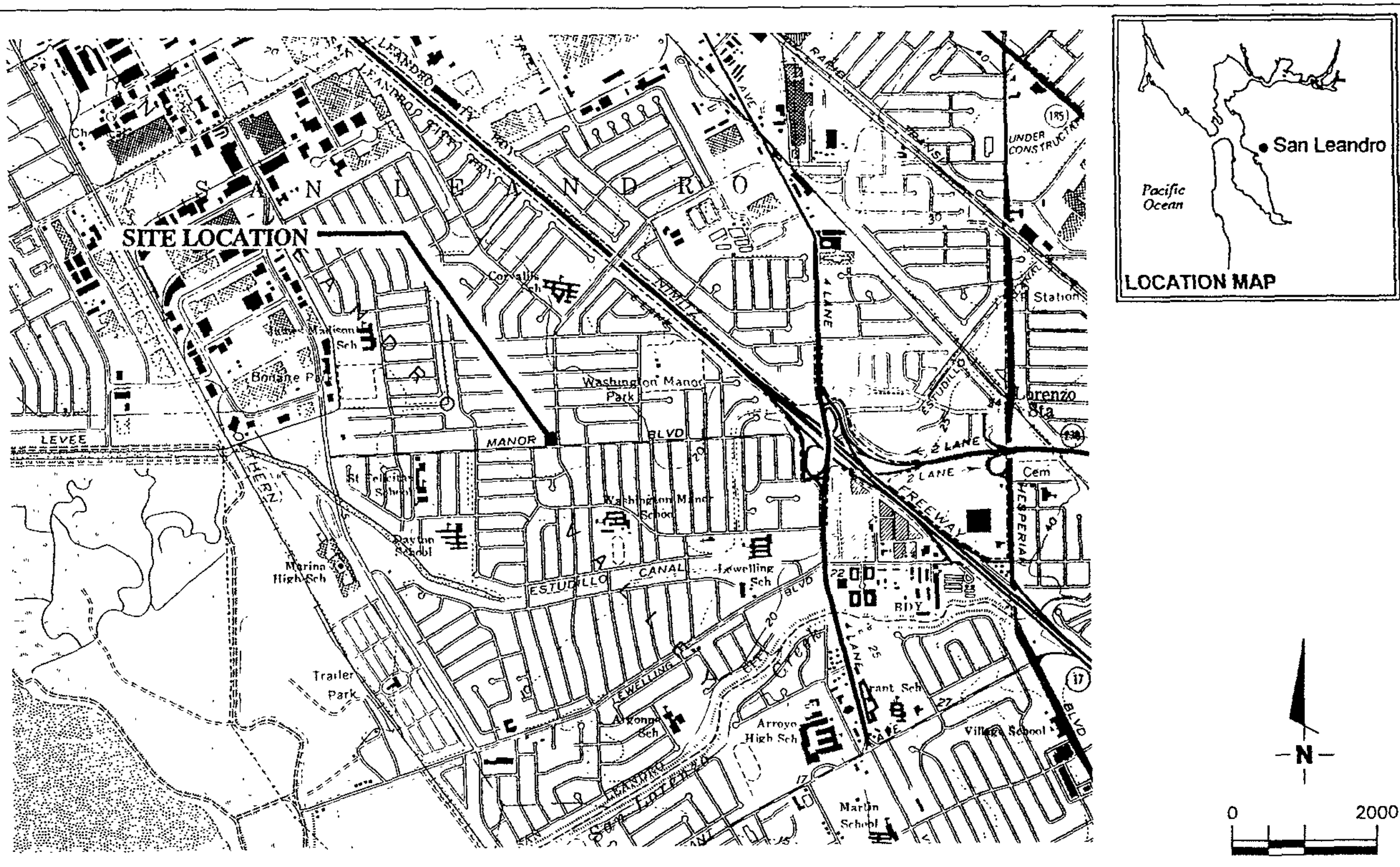
QC Review:

References Cited

Applied GeoSystems, 1991, Report Predivestment Limited Subsurface Environmental Assessment: Job No. 10004-1, dated April 30, 1990.

Helley, E.J., and others, 1979, Flatland deposits of the San Francisco Bay Region, California: U.S. Geological Survey Professional Paper 943, 99 p.

ILLUSTRATIONS



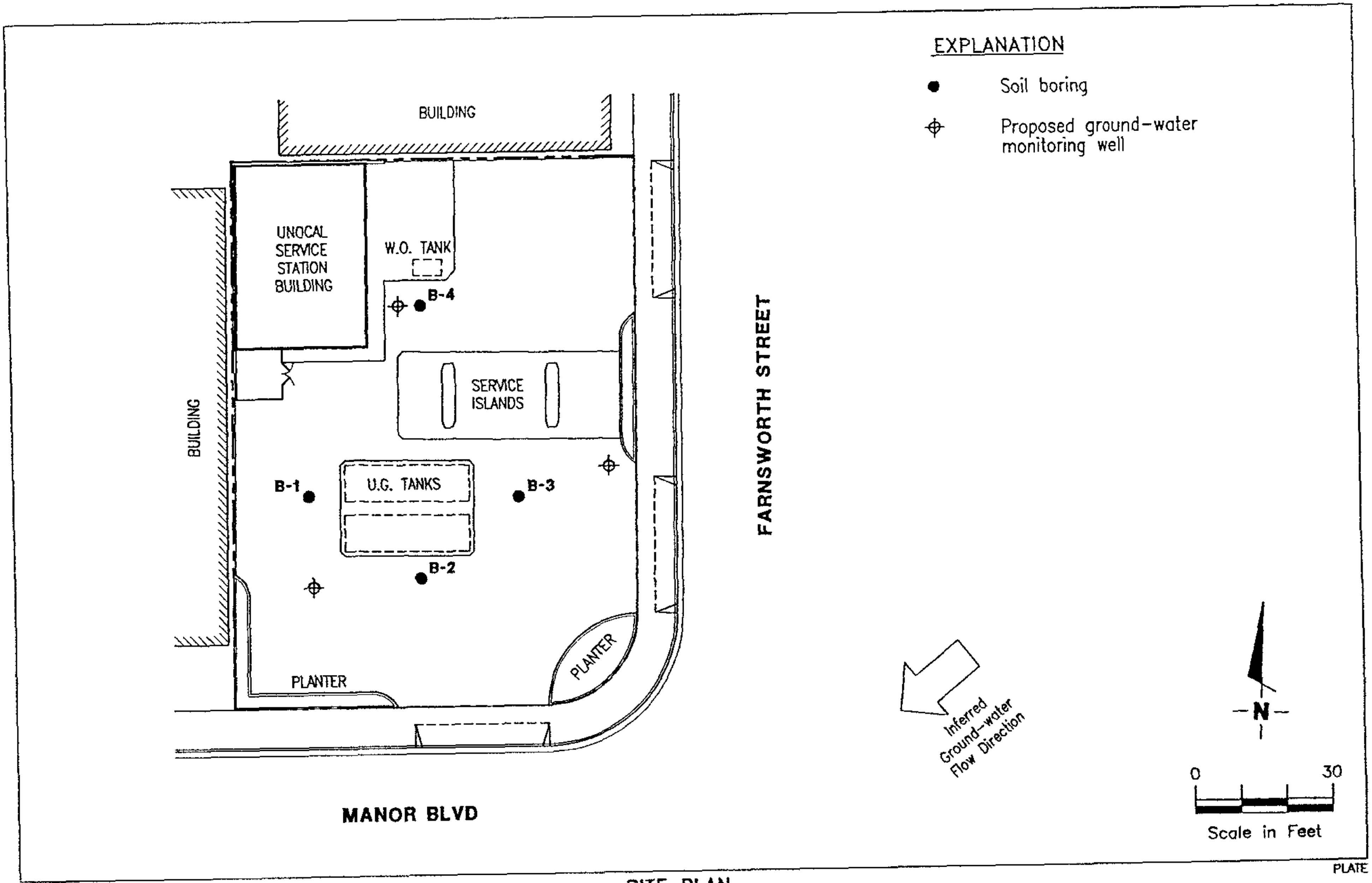
Base Map: USGS Topographic Map

GSI GeoStrategies Inc.

VICINITY MAP
UNOCAL Service Station #3690
14999 Farnsworth Street
San Leandro, California

PLATE 1

JOB NUMBER	REVIEWED BY	DATE	REVISED DATE
7819		5/91	



GeoStrategies Inc.

SITE PLAN
UNOCAL Service Station #3690
14999 Farnsworth Street
San Leandro, California

PLATE
2

JOB NUMBER	REVIEWED BY	DATE	REVISED DATE
781901-1	DHP	5/91	

APPENDIX A

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.

April 20, 1990

GROUND-WATER SAMPLING AND ANALYSIS

Quality 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	Revised Well Standards for Santa Clara County (July 18, 1989)
American Petroleum Institute	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 ± 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 centrifigal 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

Parameter	Analytical Method	Reporting Units	Container	Preservation	Maximum Holding Time
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 Toluene Ethylbenzene Xylenes (BTEX	EPA 8020	mg/l ug/l	50 ml. vial glass, Teflon lined septum	cool, 4 C HCl to pH<2	7 days (w/o preservative) 14 days (w preservative)
Oil & Grease	SM 503E	mg/l ug/l	1 l glass, Teflon lined septum	H2SO4 or HCl 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)
Halogented 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 HCl to pH<2	14 days (maximum)
Semi-Volatile Organics	8270	mg/l ug/l	1 l amber glass, Teflon lined septum	cool, 4 C	7 days extract 40 days (maximum to analyze)
Specific Conductance (Field test)		umhos/cm			
pH (Field test)		pH units			
Temperature (Field test)		Deg F			

GSI GeoStrategies Inc.

FIELD EXPLORATORY BORING LOG

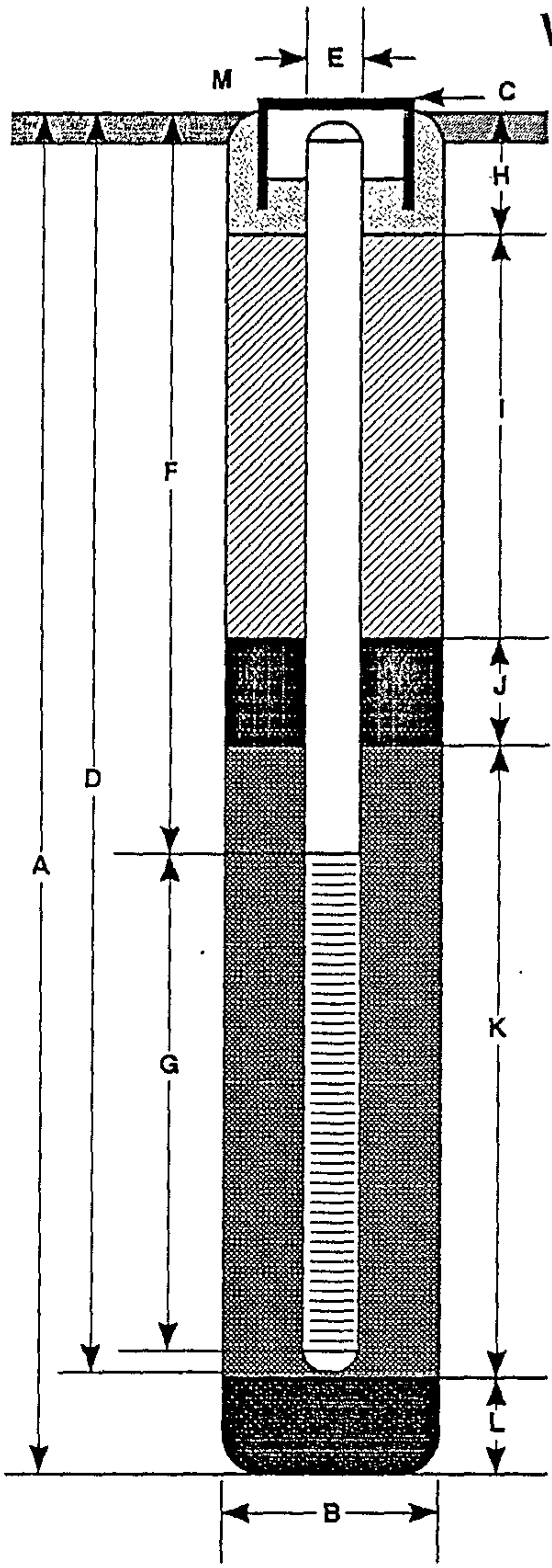
FIGURE 1

Field location of boring:	Project No.: / Date: / Boring No.:
	Client:
	Location:
	City: / Sheet
	Logged by: / Driller: / of
Drilling method:	Casing installation data:
Hole diameter:	Top of Box Elevation: / Datum:

Water Level				
Time				
Date				

PID (ppm)	Blows/ft. or Pressure (psi)	Type of Sample	Sample Number	Depth (ft.)	Sample	Well Detail	Soil Group Symbol (USCS)	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

GSI 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________ = WaterColumn______________

Product thickness____

____________ x ____________ x _________ x 0.0408 = ______________gals

Water Column   Diameter (in.)   #Vol

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.

Volume Factor (VF)			
	2" = 0.17	6" = 1.50	12" = 5.80
	3" = 0.38	8" = 2.60	
	4" = 0.66	10" = 4.10	

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

Sampling Crew Reviews Project Sampling Requirements/Schedule

Field Decontamination and Instrumentation Calibration

Check Integrity of Well (Inspect for Well Damage)

Measure and Record Depth to Water and Total Well Depth (Electric Well Sounder)

Check for Floating Product (Oil/Water Interface Probe)

Floating Product Present

Confirm Product Thickness (Acrylic or PVC Bailer)

Collect Free-Product Sample

Dissolved Product Sample Not Required

Record Data on Field Data Form

Floating Product Not Present

Purge Volume Calculation

$V = \pi (r/12)^2 h(\_\% \text{ vol})(7.48) = \_\_\_/\text{gallons}$

V = Purge volume (gallons)
π = 3.14159
h = Height of Water Column (feet)
r = Borehole radius (inches)

Evacuate water from well equal to the calculated purge volume while monitoring groundwater stabilization indicator parameters (pH, conductivity, temperature) at intervals of one casing volume.

Well Dewaters after One Purge Volume (Low yield well)

Well Recharges to 80% of Initial Measured Water Column Height in Feet within 24 hrs. of Evacuation.

Measure Groundwater Stability Indicator Parameters (pH, Temperature, Conductivity)

Collect Sample and Complete Chain-of-Custody

Preserve Sample According to Required Chemical Analysis

Transport to Analytical Laboratory

Well Readily Recovers

Record Groundwater Stability Indicator Parameters from each Additional Purge Volume
Stability indicated when the following Criteria are met:

pH :	± 0.1 pH units
Conductivity:	± 10%
Temperature:	1.0 degrees F

Groundwater Stability Achieved

Collect Sample and Complete Chain-of-Custody

Preserve Sample According to Required Chemical Analysis

Transport to Analytical Laboratory

Groundwater Stability Not Achieved

Continue Purging Until Stability is Achieved

Collect Sample and complete Chain-of-Custody

Preserve Sample According to Required Chemical Analysis

Transport to Analytical Laboratory

Gettler - Ryan Inc. ENVIRONMENTAL DIVISION

Chain of Custody
FIGURE 6

COMPANY ______________________ JOB NO. __________

JOB LOCATION ______________________

CITY ______________________ PHONE NO. __________

AUTHORIZED ______________________ DATE __________ P.O. NO. __________

SAMPLE ID	NO. OF CONTAINERS	SAMPLE MATRIX	DATE/TIME SAMPLED	ANALYSIS REQUIRED	SAMPLE CONDITION LAB ID

RELINQUISHED BY: ______________________ RECEIVED BY: ______________________

RELINQUISHED BY: ______________________ RECEIVED BY: ______________________

RELINQUISHED BY: ______________________ RECEIVED BY LAB: ______________________

DESIGNATED LABORATORY: ______________________ DHS #: __________

REMARKS: ______________________

DATE COMPLETED ______________________ FOREMAN ______________________

gettler — ryan inc.

91 JUL -1 AM 11:17

June 28, 1991

Ms. Pam Evans
County of Alameda
Department of Environmental Health
Hazardous Materials Division
80 Swan Way, Room 200
Oakland, California 94621

Reference: UNOCAL Service Station No. 3690
1499 Farnsworth Street
San Leandro, California

Ms. Evans:

As requested by Mr. Rick Sisk of UNOCAL Corporation, we are forwarding a copy of the Work Plan Report dated June 18, 1991 for the above referenced location. This Work Plan describes a scope of investigation for the installation of three ground-water monitoring wells.

Please do not hesitate to call should you have any questions or comments.

Sincerely,

Keith E. Bullock

Keith E. Bullock
Project Manager

enclosure

cc: Mr. Rick Sisk, UNOCAL Corporation
Mr. Richard Hiett, Regional Water Quality Control Board

2150 west winton avenue • hayward, california 94545-1210 • (415) 783-7500