gettler — ryan inc.

general contractors

90 MAY 17 AM 10:42

May 11, 1990

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

Reference: Shell Service Station
1800 Powell Street
Emeryville, California

Gentlemen:

As requested by Shell Oil Company, we are forwarding a copy of the Quarterly Report dated April 26, 1990 prepared for the above referenced location. The enclosed report presents the results of the first quarter 1990 ground-water sampling.

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

Sincerely,

John P. Werfal
Project Manager

JPW/ch

enclosure

cc: Mr. Tom Callaghan, Regional Water Quality Control Board

1992 national avenue • hayward, california 94545-1787 • 783-7500

GeoStrategies Inc.

QUARTERLY REPORT

JANUARY - MARCH 1990

Shell Service Station
1800 Powell Street
Emeryville, California

Report No. 7605-6

April 26, 1990

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

April 26, 1990

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

Attn: Mr. John Werfal

Re: QUARTERLY REPORT
Shell Service Station
1800 Powell Street
Emeryville, California

Gentlemen:

This quarterly report has been prepared for the above referenced site, for the January through March, 1990 quarter.

If you have any questions, please call.

GeoStrategies Inc. by,

David A. Ferreira
Geologist

for

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

REGISTERED GEOLOGIST
CHRISTOPHER M. PALMER
№ 1262
CERTIFIED
ENGINEERING
GEOLOGIST
STATE OF CALIFORNIA

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

DAF/JLP/kjj

Report No. 7605-6

1.0 INTRODUCTION

This quarterly report has been prepared by GeoStrategies Inc. (GSI) for the Shell Service Station located at 1800 Powell Street in Emeryville, California (Plate 1).

This report describes the results of the first quarterly ground-water sampling for 1990 performed by Gettler-Ryan Inc. (G-R), on January 4, 1990, in accordance with the quarterly sampling plan for the site. The G-R Sampling Protocol is presented in Appendix A. Field work and laboratory analytical methods were performed in compliance with current State of California Water Resources Control Board (SWRCB) procedures for conducting environmental investigations relating to leaking underground fuel tanks. Field and chemical analytical data were collected between January 1, and March 31, 1990.

3.0 SITE HISTORY

Prior to August 1983, five tank backfill wells (A through E) and six ground-water monitoring wells (S-5 through S-10) were installed at the site. Boring logs and well construction details are not available for these wells.

In October 1988, monitoring wells S-5 through S-10 were sampled by G-R and analyzed for Total Petroleum Hydrocarbons calculated as Gasoline (TPH-Gasoline), and Benzene, Toluene, Ethylbenzene, and Xylenes (BTEX). TPH-Gasoline concentrations ranged from 0.05 to 700 parts per million (ppm). Benzene concentrations ranged from 0.0011 to 37 ppm. Well S-9 contained separate-phase petroleum hydrocarbons (floating product). The results of this sampling event are presented in the G-R report dated December 6, 1988. Bi-weekly monitoring of Well S-9 by G-R reveals a range of floating product thickness from approximately 1.20 to 1.30 feet in measured thickness, through January 1989. The floating product appears as a black, highly viscous substance. This floating product may include dissolved constituents from the man-made fill material (e.g. tar paper).

In February, G-R conducted ground-water sampling for the first quarter of 1989. Wells S-5 and S-6 contained a sheen of floating product, and Well S-9 had 1.3 feet of floating product. TPH-Gasoline and benzene were detected in all wells sampled. The results of this sampling event are presented in the GSI quarterly report dated April 14, 1989.

In April, G-R conducted ground-water sampling for the second quarter of 1989. Well S-9 contained 1.25 feet of floating product. The results of this sampling event are presented in the GSI quarterly report dated July 13, 1989.

On October 10, 1989, GSI issued an interim ground-water sampling report summarizing the third quarterly sampling conducted by G-R in July, 1989. Well S-9 contained floating hydrocarbon product (1.20 feet in measured thickness). TPH-Gasoline and benzene were detected in all wells sampled.

On October 27, 1989, GSI issued a work plan proposing the installation of three additional ground-water monitoring wells and the abandonment of Wells S-6 and S-7. In addition, the work plan proposed that an in-situ ground-water sampling or a soil vapor survey be performed at the site to aid in the placement of future monitoring wells.

On October 25, 1989, G-R sampled all site monitoring wells. On November 8, and 9, 1989, GSI installed three ground-water monitoring wells (S-12, S-13 and S-14). Wells S-6 and S-7 were abandoned on November 10, 1989. On November 17, 1989, G-R sampled Wells S-12, S-13, S-14. The findings of the investigation are presented in the GSI Quarterly report dated February 2, 1990.

A preliminary review of historical land usage at the site revealed that prior to the occupancy by the Shell Service Station, the site was at one time a city dump, and that a roofing company occupied at least part of the site. Tar paper, wood fragments, and cement were identified during drilling activities by GSI and findings were presented in the GSI report dated February 2, 1990.

On January 4, G-R performed the first quarterly sampling for 1990. The results are presented below.

No additional site history data is available to GSI.

4.0 GROUNDWATER LEVEL MONITORING

4.1 Potentiometric Data

Prior to ground-water sampling, water-levels were measured in each well using an electronic oil-water interface probe. Static water levels were measured from the surveyed top of the well box and recorded to the nearest $\pm$0.01 foot (Table 1). Plate 2 presents the location of each well at the site.

Ground-water elevation data for the quarterly sampling have been plotted and contoured and are presented on Plate 3. Static ground-water elevation data for newly installed Wells (S-12, S-13 and S-14) were used to construct the potentiometric map. Due to the uncertainty of well construction of previously installed Wells S-5 through S-10, data from these wells were not used. Depth to groundwater in the uppermost water-bearing strata ranged from 8.48 to 9.80 feet below existing grade for this quarterly sampling event. Potentiometric data indicate that the shallow groundwater beneath the site flows to the south with an approximate hydraulic gradient of 0.005. The suspected effects of tidal fluctuations on ground-water flow are unknown.

4.2 Floating Product Measurements

Each well was monitored for floating product using an electronic oil-water interface probe. Sampled wells were inspected with a clean, clear acrylic bailer to visually confirm interface probe results and to check for the presence of a product sheen. Black viscous floating product was present in Well S-9 during the quarterly sampling. Due to the viscous nature of the observed product, an accurate thickness could not be measured. A sheen of floating product was visible in Well S-8. Floating product was not observed in any of the other monitoring wells sampled this quarter.

5.0 CHEMICAL ANALYTICAL DATA

Ground-water samples were collected by G-R on January 4, 1990. The ground-water samples were analyzed for TPH-Gasoline according to EPA Method 8015 (Modified) and Benzene, Toluene, Ethylbenzene, and Xylenes (BTEX) according to EPA Method 8020. Chemical analyses were performed by International Technology (IT) Analytical Services, a State-certified environmental laboratory located in San Jose, California. The IT Analytical Services certified analytical report for ground-water sampling performed during the first quarter of 1990 is presented in Appendix B.

Detectable concentrations of TPH-Gasoline were identified in Wells S-5, S-8, S-10 and S-13 at concentrations ranging from 1.3 ppm (Well S-5) to 2.8 ppm (Well S-13). Benzene was reported in Wells S-5, S-8, S-10, S-12, S-13 and S-14 at concentrations above the current Maximum Contaminant Level (MCL) set by the State of California Regional Water Quality Control Board (RWQCB). Benzene concentrations ranged from 0.003 ppm (Well S-14) to 1.4 ppm (Well S-13). Water quality data for this quarter are presented in Table 1. A TPH-Gasoline and Benzene Concentration Map (Plate 4) has been prepared using the quarterly ground-water analytical data.

As shown on Plate 4, the hydrocarbon plume has not been adequately delineated. Additional field investigations will be required to evaluate the areal extent of hydrocarbon migration and establish an ND (no detection) boundary.

The historical chemical analytical data have been tabulated and are presented in Appendix C.

5.1 Quality Control

Quality Control (QC) samples for the quarterly ground-water sampling consisted of a field blank, a trip blank and a duplicate sample. The field blank was prepared in the field using organic-free water provided by the IT Analytical Services to evaluate field sampling procedures and ambient site conditions. The trip blank was prepared by IT Analytical Services using organic-free water to evaluate field and laboratory handling procedures. The duplicate sample was submitted to the laboratory to assess laboratory analytical precision. Precision of QC data was evaluated by calculating the Relative Percent Difference (RPD) between duplicate sample (SD-14) and Well Sample S-14. The RPD was 0% for both TPH-Gasoline and benzene. The chemical analytical results indicate that proper field and laboratory handling techniques were followed and that no hydrocarbons were introduced into the samples during handling, transport, or from ambient site conditions.

QC procedures during field sampling are summarized in the G-R sampling protocol in Appendix A. The G-R Ground-water Sampling Report, Chain-of-Custody Form and the IT Analytical Services Certified analytical report for the quarterly sampling are presented in Appendix B.

6.0 SUMMARY

A summary of activities and findings associated with this quarterly report are presented below:

- Water levels were measured in selected wells and the data were used to construct a potentiometric map. Potentiometric data indicate that the shallow groundwater beneath the site flows to the south with an approximate hydraulic gradient of 0.005.

- A black viscous product was detected in Well S-9 during the quarterly sampling. Due to the viscous nature of the product an accurate thickness could not be measured.

- o TPH-Gasoline concentrations were reported as ND for ground-water samples from Wells S-12 and S-14. Detectable concentrations of TPH-Gasoline were reported in Wells S-5 (1.3 ppm), S-8 (1.9 ppm), S-10 (1.7 ppm), and S-13 (2.8 ppm).

- o Detectable concentrations of benzene were reported in Wells S-5 (0.52 ppm), S-8 (1.3 ppm), S-10 (0.36 ppm), S-12 (.024 ppm), S-13 (1.4ppm), and S-14 (0.003 ppm). These concentrations are above the current RWQCB MCL for benzene.

- o The dissolved hydrocarbon plume has not been adequately delineated. Additional field investigations will be necessary to evaluate the vertical and lateral distribution of hydrocarbons at the site.

7.0 PLANNED SITE ACTIVITIES

The following activities are planned for the second quarter, April 1 to June 30, 1990:

- o All scheduled wells will be sampled and analyzed for TPH-Gasoline and TPH-Diesel according to EPA Method 8015 (Modified) and BTEX according to EPA Method 8020.

- o Water levels will be measured monthly and selected data will be used to prepare a potentiometric map across the site. The local shallow ground-water gradient will be calculated.

- o Ground-water chemical data will be used to construct concentration maps for TPH-Gasoline, benzene, and TPH-Diesel. The areal extent of hydrocarbons will be evaluated based on these data.

- o Perform in-situ ground-water sampling outlined in the October 27, 1989 work plan prepared by GSI, upon receipt of right-of-entry from adjacent property owners.

- o Conduct a review of historical land uses to identify potential contaminant sources possibly related to the fill material composition (i.e. incorporated refuse).

- GSI will perform a tidal study to assess the degree of influence, if any, tides exhibit on water levels in the monitoring wells. The tidal study will include monitoring water levels in selected wells for a minimum period of 72 hours using a portable electronic datalogger/transducer system to record water-level data continuously. Water-level fluctuations in San Francisco Bay will also be monitored to establish a relationship between time and water-level changes observed at the site.

References Cited

Gettler-Ryan Inc., 1988, Groundwater Sampling Report: Report No. 83134-1, dated December 6, 1988.

GeoStrategies Inc., 1989, Quarterly Groundwater Sampling Report: Report No. 7605, dated April 14, 1989.

GeoStrategies Inc., 1989, Quarterly Groundwater Sampling Report: Report No. 7605-2, dated July 13, 1989.

GeoStrategies Inc., 1989, Interim Groundwater Sampling Report: Report No. 7605-3, dated October 10, 1989.

GeoStrategies Inc., 1989, Work Plan: Report No. 7605-4, October 27, 1989.

GeoStrategies Inc., 1990, Quarterly Report: Report No. 7605-5, dated February 2, 1990.

TABLE 1

GROUND-WATER ANALYSES DATA

WELL NO	SAMPLE DATE	ANALYSIS DATE	TPH (PPM)	BENZENE (PPM)	TOLUENE (PPM)	ETHYLBENZENE (PPM)	XYLENES (PPM)	WELL ELEV (FT)	STATIC WATER ELEV (FT)	PRODUCT THICKNESS (FT)	DEPTH TO WATER (FT)
S-5	04-Jan-90	12-Jan-90	1.3	0.52	0.009	0.008	0.01	11.72	3.24	----	8.48
S-8	04-Jan-90	15-Jan-90	1.9	1.3	0.02	<0.01	0.07	12.76	2.99	sheen	9.77
S-9	04-Jan-90	----	----	----	----	----	----	12.75	----	---- *	---- *
S-10	04-Jan-90	12-Jan-90	1.7	0.36	0.010	0.0078	0.17	12.58	3.88	----	8.70
S-12	04-Jan-90	12-Jan-90	<0.25	0.024	0.002	<0.002	<0.005	12.84	3.28	----	9.56
S-13	04-Jan-90	12-Jan-90	2.8	1.4	0.13	0.10	0.50	12.59	2.84	----	9.75
S-14	04-Jan-90	15-Jan-90	<0.25	0.003	0.002	<0.002	<0.005	12.69	2.89	----	9.80
SF-8	04-Jan-90	12-Jan-90	<0.050	<0.0005	<0.0005	<0.0005	<0.001	----	----	----	----
SD-14	04-Jan-90	15-Jan-90	<0.25	0.003	0.003	<0.002	<0.005	----	----	----	----
TB	04-Jan-90	12-Jan-90	<0.050	<0.0005	<0.0005	<0.0005	<0.001	----	----	----	----

CURRENT REGIONAL WATER QUALITY CONTROL BOARD MAXIMUM CONTAMINANT LEVELS
Benzene 0.001 ppm Xylenes 1.750 ppm Ethylbenzene .680 ppm

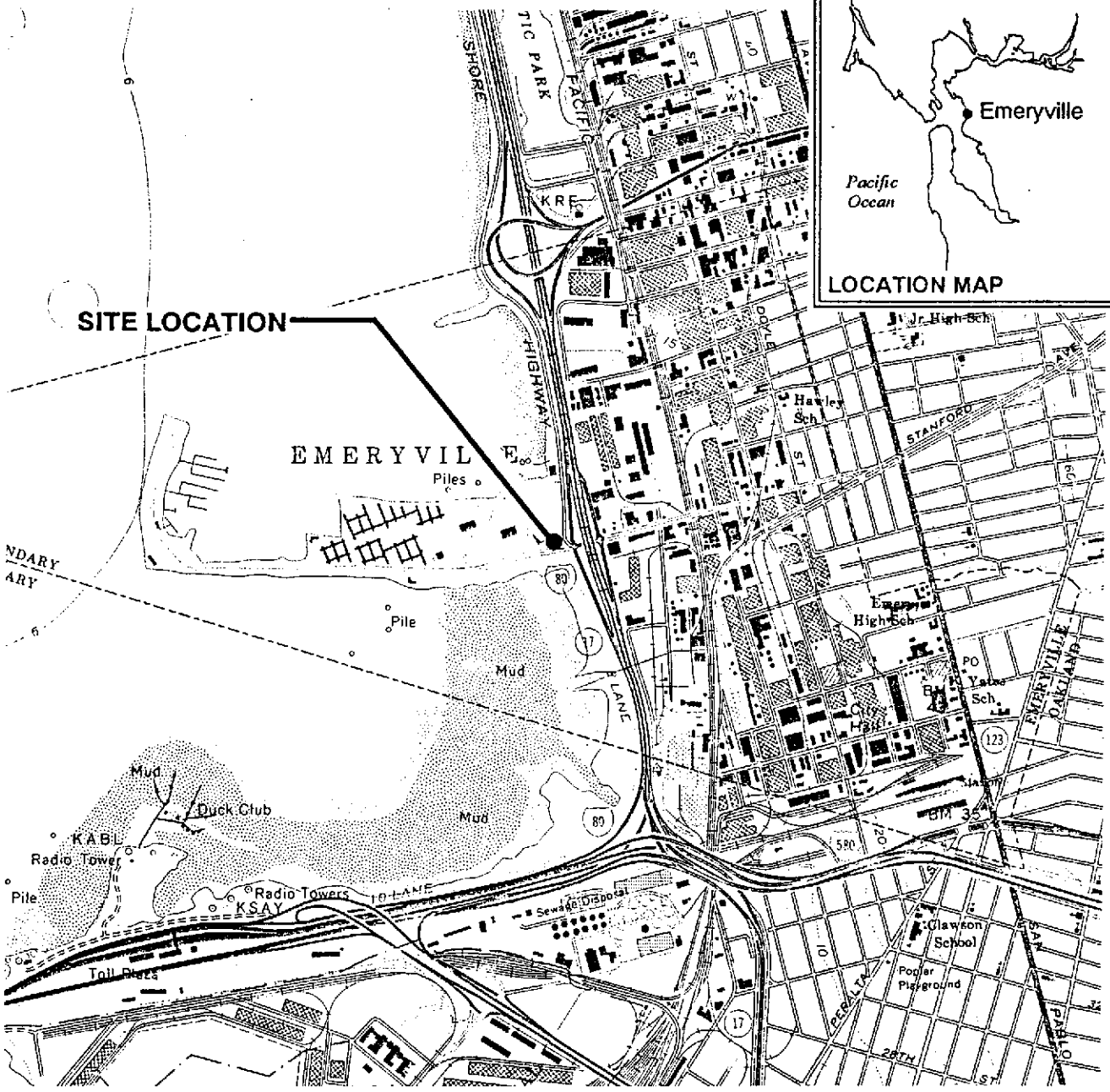
CURRENT DHS ACTION LEVELS
Toluene 0.100 ppm

TPH-G = Total Petroleum Hydrocarbons as Gasoline
PPM = Parts Per Million
SF = Field Blank
SD = Duplicate Sample
TB = Trip Blank

* Unable to measure depth and product thickness accurately

Note: 1. All data shown as <x are reported as ND (none detected).
2. Well S-9 contained floating product and was not sampled.
3. Static Water Elevations referenced to mean sea level (MSL). Elevations are corrected for free product using a correction factor of 0.8.

Project No. 7605-6



Base Map: USGS Topographic Map

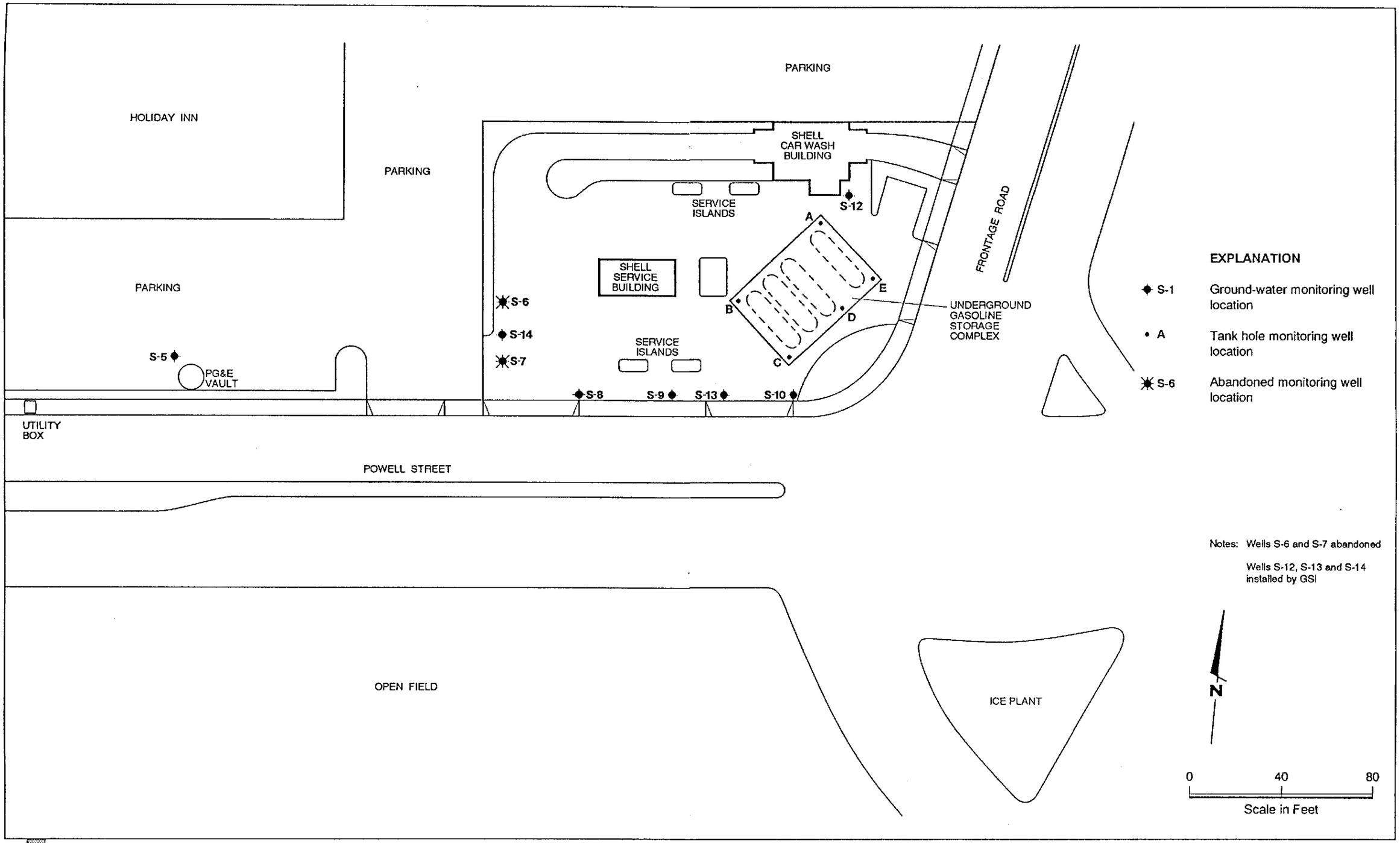
Approx. Scale: 1"=2000'

GeoStrategies Inc.

Vicinity Map
Shell Service Station
1800 Powell Street
Emeryville, California

PLATE
1

JOBNUMBER	REVIEWEDBYRG/CEG	DATE	REVISEDDATE	REVISEDDATE
7605		10/89		

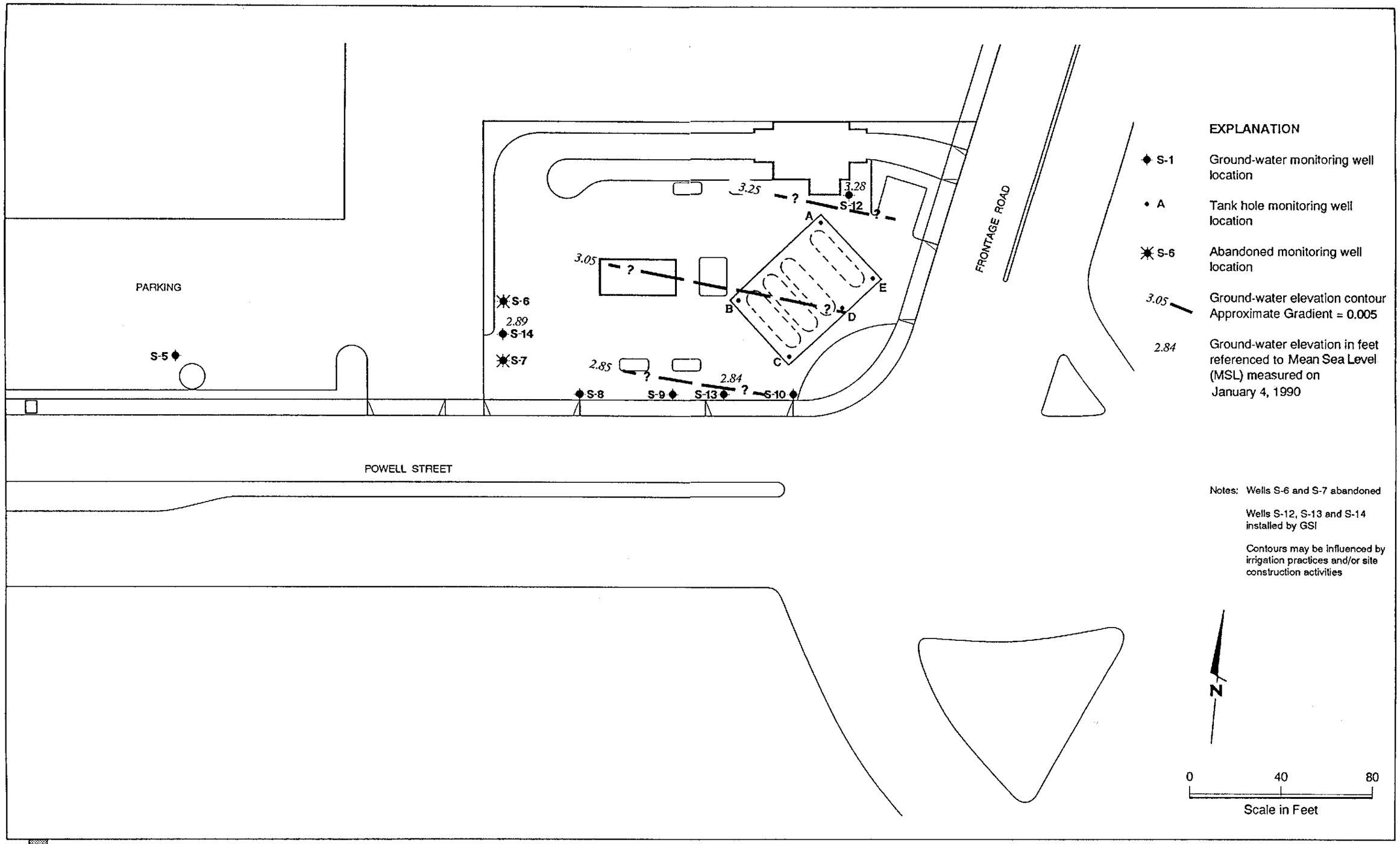


GeoStrategies Inc.

Site Plan
Shell Service Station
1800 Powell Street
Emeryville, California

PLATE
2

JOB NUMBER	REVIEWED BY RG/CEG	DATE	REVISED DATE	REVISED DATE
7605		3/90		

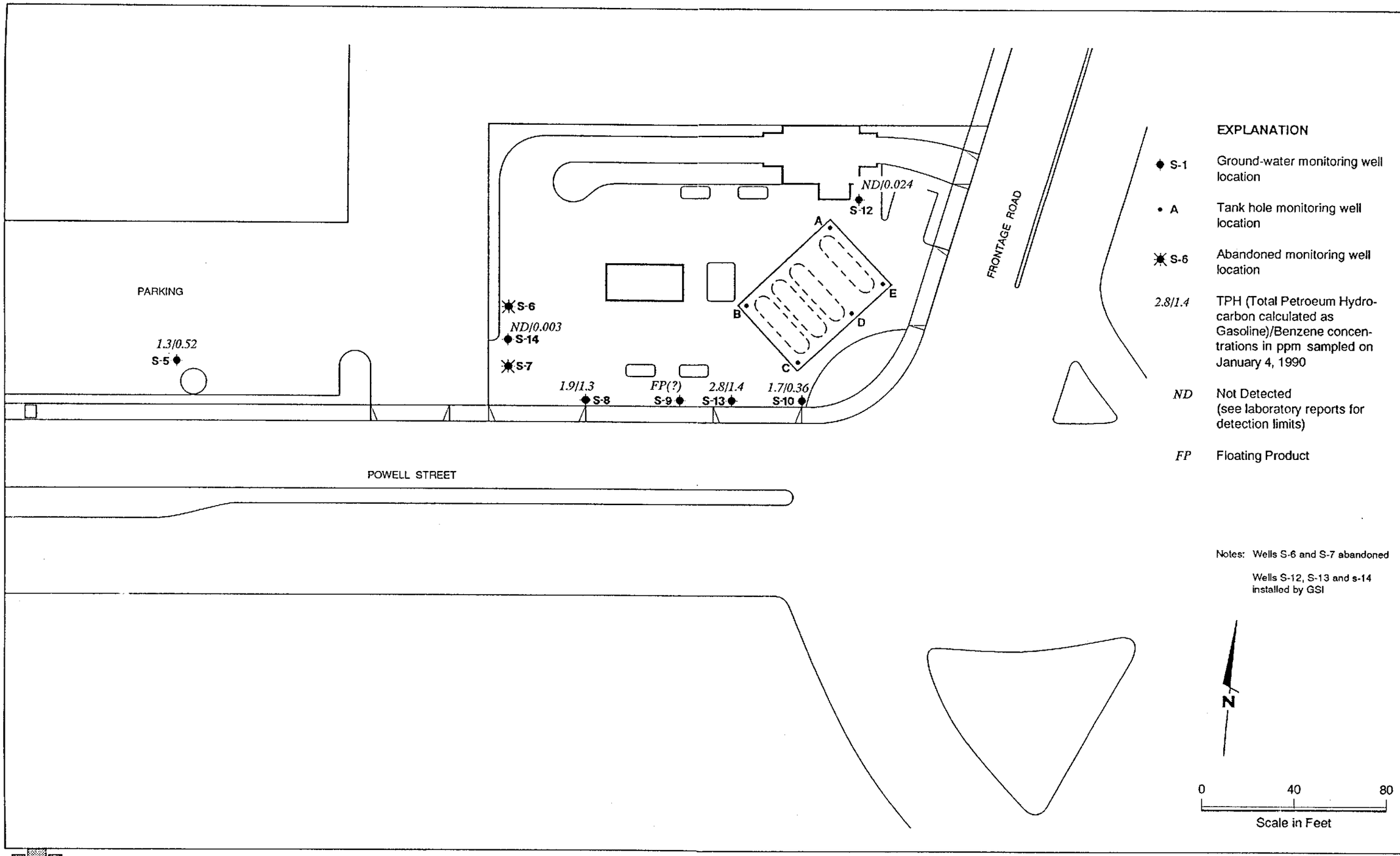


GeoStrategies Inc.

Potentiometric Map
Shell Service Station
1800 Powell Street
Emeryville, California

PLATE
3

JOB NUMBER	REVIEWED BY RG/CEG	DATE	REVISED DATE	REVISED DATE
7605	CMP CEG 1262	3/90		



GeoStrategies Inc.

TPH-G/Benzene Concentration Map
Shell Service Station
1800 Powell Street
Emeryville, California

PLATE
4

JOB NUMBER	REVIEWED BY RG/CEG	DATE	REVISED DATE	REVISED DATE
7605		3/90		

APPENDIX A
FIELD METHODS AND PROCEDURES

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 Gettler-Ryan Inc. 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) samples 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 mg/l	50 ml. vial glass, Teflon lined septum 1 l glass, Teflon	cool, 4 C HCl to pH<2	7 days (w/o preservative) 14 days (w preservative)
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)
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	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			

GeoStrategies Inc.

FIELD EXPLORATORY BORING LOG

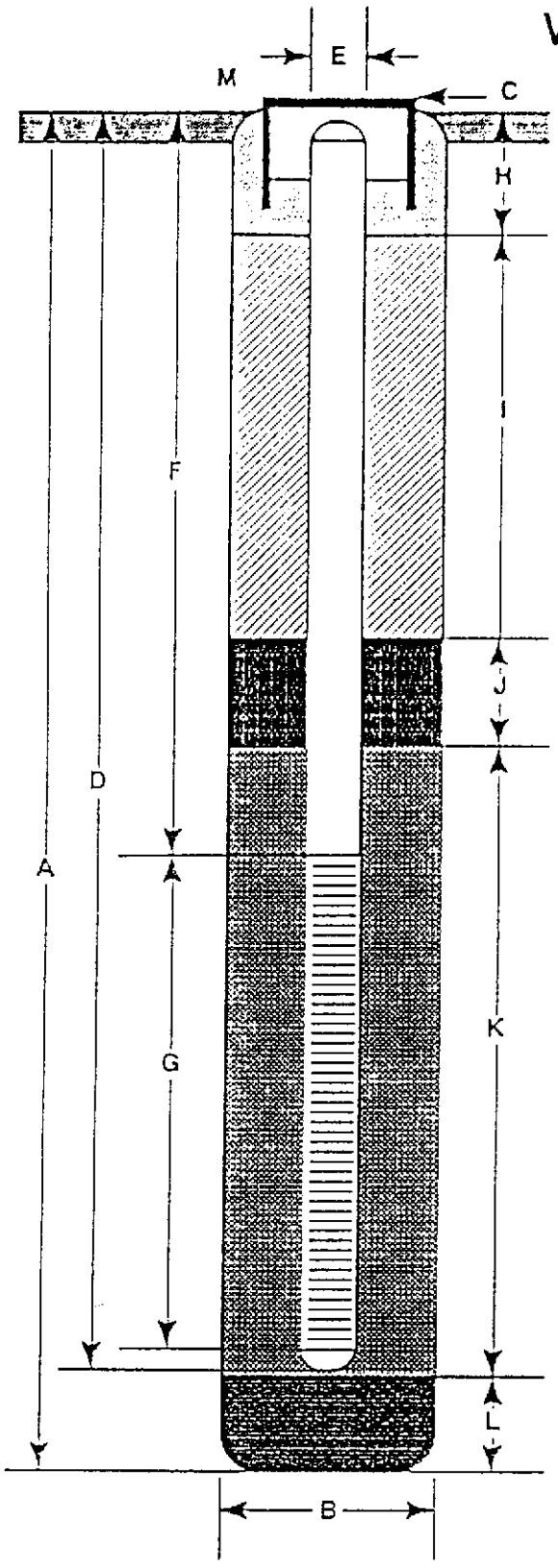
Field location of boring:	Project No.:	Date:	Boring No:
	Client:		
	Location:		
	City:		Sheet
	Logged by:	Driller:	of
Drilling method:	Casing installation data:		
Hole diameter:	Top of Box Elevation:	Datum:	

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

Remarks:

FIGURE 1

WELL CONSTRUCTION DETAIL



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

FIGURE 2

WELL DEVELOPMENT FORM

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_____

_____

_____

FIGURE 3

GETTLER-RYAN INC.

General and Environmental Contractors

WELL SAMPLING FIELD DATA SHEET

COMPANY _____ JOB # _____

LOCATION _____ DATE _____

CITY _____ TIME _____

Well ID. _____ Well Condition _____

Well Diameter _____ in. Hydrocarbon Thickness _____ ft.

Total Depth _____ ft.

Depth to Liquid- _____ 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	

(# 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 _____

FIGURE 4

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

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

V = Purge volume (gallons)

$\pi = 3.14159$

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

FIGURE 5

Gettler - Ryan Inc. ENVIRONMENTAL DIVISION

Chain of Custody

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 _____

FIGURE 6

APPENDIX B
GETTLER-RYAN INC.
GROUNDWATER SAMPLING REPORT

gettler — ryan inc.

January 30, 1990

GROUNDWATER SAMPLING REPORT

Referenced Site: Shell Service Station
1800 Powell Street
Emeryville, California

Sampling Date: January 4, 1990

This report presents the results of the quarterly groundwater sampling and analytical program conducted by Gettler-Ryan Inc. on January 4, 1990 at the referenced location. The site is occupied by an operating service station located on the northwest corner of Powell Street and I-80. The service station has underground storage tanks containing regular leaded, unleaded and super unleaded gasoline products and diesel.

There are currently six groundwater monitoring wells and five tank backfill wells on site, and one well off site at the locations shown on the attached site map. Prior to sampling, the monitoring wells were 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 depths ranged from 8.48 to 9.80 feet below grade. A product sheen was observed in well S-8. Well S-9 was not monitored or sampled due to the presence of a black tarry substance.

Wells that did not contain separate phase product were 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. Each well 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 groundwater 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 field blank (SF-8), and a trip blank, supplied by the laboratory, were included and analyzed to assess quality control. A duplicate sample (SD-14) was submitted without well designation to assess laboratory performance. Analytical results for the blanks are included in the Certified Analytical Report (CAR's). Chain of custody records were established noting sample identification numbers, time, date, and custody signatures.

1992 national avenue • hayward, california 94545-1787 • (415) 783-7500

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

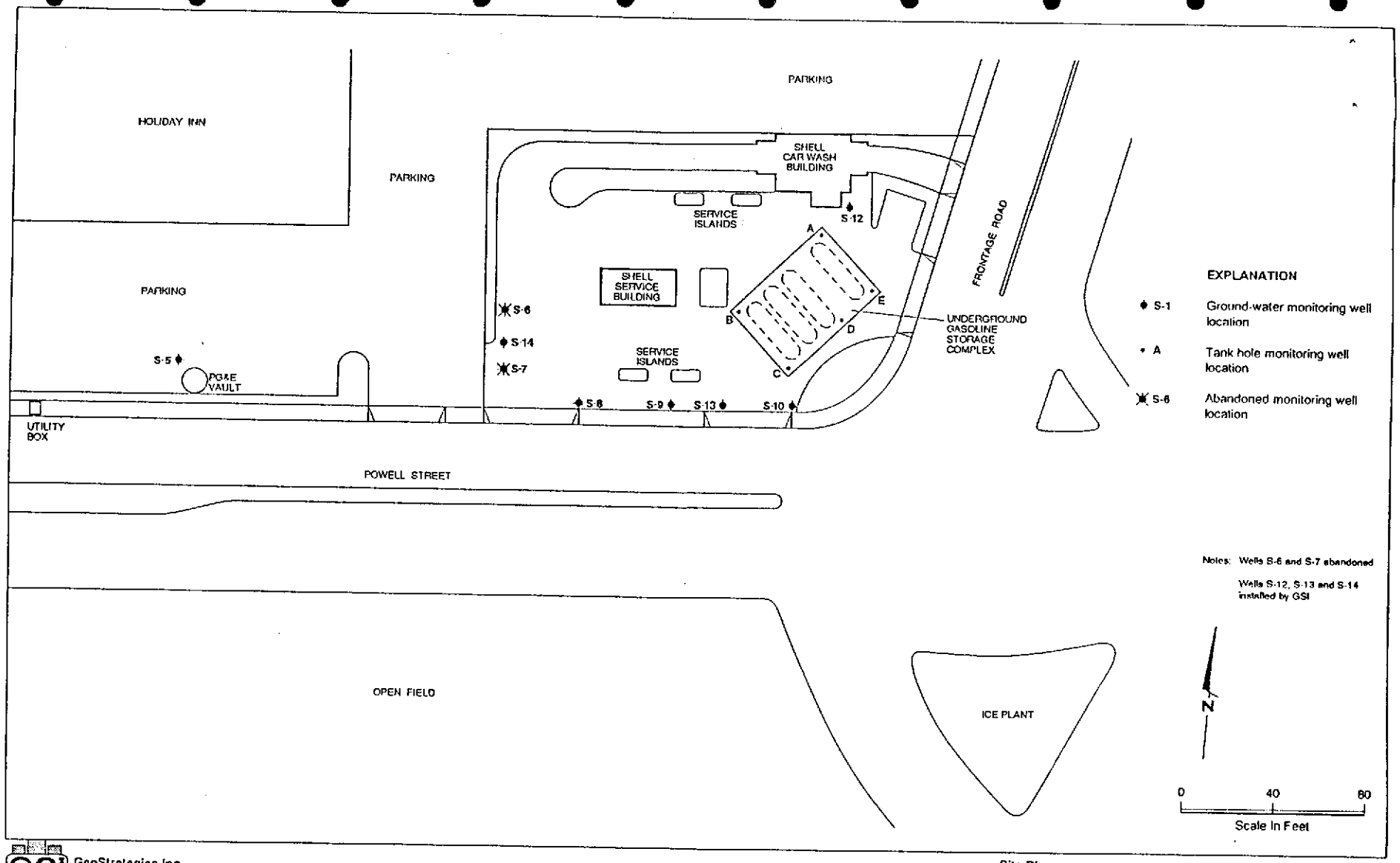
WELL I.D.	S-5	S-8	S-9	S-10	S-12	S-13
Casing Diameter (inches)	6	3	3	6	3	3
Total Well Depth (feet)	12.1	19.2	----	18.7	24.4	19.6
Depth to Water (feet)	8.48	9.77	----	8.70	9.56	9.75
Free Product (feet)	none	sheen	----	none	none	none
Reason Not Sampled	----	----	tarry substance	----	----	----
Calculated 4 Case Vol.(gal.)	21.8	14.3	----	60.0	22.6	14.9
Did Well Dewater?	yes	no	----	yes	no	yes
Volume Evacuated (gal.)	20	19	----	30	28	7
Purging Device	Bailer	Suction	----	Suction	Suction	Suction
Sampling Device	Bailer	Bailer	----	Bailer	Bailer	Bailer
Time	14:54	12:57	----	12:12	09:43	11:08
Temperature (F)*	64.5	69.6	----	66.7	67.6	69.5
pH*	6.23	6.54	----	6.09	6.44	6.23
Conductivity (umhos/cm)*	3280	5340	----	2310	7450	10650

* Indicates Stabilized Value

TABLE OF MONITORING DATA
GROUNDWATER WELL SAMPLING REPORT

WELL I.D.	S-14 SD-14
Casing Diameter (inches)	3
Total Well Depth (feet)	23.6
Depth to Water (feet)	9.80
Free Product (feet)	none
Reason Not Sampled	----
Calculated 4 Case Vol.(gal.)	20.9
Did Well Dewater?	no
Volume Evacuated (gal.)	26.6
Purging Device	Suction
Sampling Device	Bailer
Time	13:50
Temperature (F)*	67.0
pH*	6.28
Conductivity (umhos/cm)*	5170

* Indicates Stabilized Value



GSI GeoStrategies Inc.

Site Plan
Shell Service Station
1800 Powell Street
Emeryville, California

PLATE

JOB NUMBER
605

REVIEWED BY RG/CEG

DATE
11/89

REVISED DATE

REVISED DATE

INTERNATIONAL TECHNOLOGY CORPORATION

ANALYTICAL SERVICES

CERTIFICATE OF ANALYSIS

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

Date: January 24, 1990

Work Order Number: TO-01-042

P.O. Number: MOH 890501A

This is the Certificate of Analysis for the following samples:

Client Project ID:	GR#3605, 1800 Powell St., Emeryville, CA
Date Received by Lab:	1/5/90
Number of Samples:	9
Sample Type:	Water

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, ethyl benzene and xylenes.

Reviewed and Approved

Michael E. Dean
Project Manager

MED/ww
1 Page Following - Table of Results

IT ANALYTICAL SERVICES
SAN JOSE, CA

Date: January 24, 1990
Client Project ID: GR#3605, 1800 Powell St., Emeryville, CA
Work Order Number: TO-01-042

Lab Sample ID	Client Sample ID	Sample Date	Date Analysis Completed	Sample Condition on Receipt
TO-01-042-01	S-5	1/4/90	1/12/90	cool, pH<2
TO-01-042-02	S-8	1/4/90	1/15/90	cool, pH<2
TO-01-042-03	S-10	1/4/90	1/12/90	cool, pH<2
TO-01-042-04	S-12	1/4/90	1/12/90	cool, pH<2
TO-01-042-05	S-13	1/4/90	1/12/90	cool, pH<2
TO-01-042-06	S-14	1/4/90	1/15/90	cool, pH<2
TO-01-042-07	SF-8	1/4/90	1/12/90	cool, pH<2
TO-01-042-08	SD-14	1/4/90	1/15/90	cool, pH<2
TO-01-042-09	Trip Blank	---	1/12/90	cool, pH<2

Total Petroleum Hydrocarbons - Modified E.P.A. Methods 8015, 8020

ND = None Detected

Results - Milligrams per Liter

Lab Sample ID	Client Sample ID	Low Boiling Hydrocarbons (calculated as Gasoline)	Benzene	Toluene	Ethyl Benzene	Xylenes (total)
TO-01-042-01	S-5	1.3	0.52	0.009	0.008	0.01
Detection Limit		0.50	0.005	0.005	0.005	0.01
TO-01-042-02	S-8	1.9	1.3	0.02	ND	0.07
Detection Limit		1.0	0.01	0.01	0.01	0.02
TO-01-042-03	S-10	1.7	0.36	0.010	0.0078	0.17
Detection Limit		0.050	0.0005	0.0005	0.0005	0.001
TO-01-042-04	S-12	ND	0.024	0.002	ND	ND
Detection Limit		0.25	0.002	0.002	0.002	0.005
TO-01-042-05	S-13	2.8	1.4	0.13	0.10	0.50
Detection Limit		1.0	0.01	0.01	0.01	0.02
TO-01-042-06	S-14	ND	0.003	0.002	ND	ND
Detection Limit		0.25	0.002	0.002	0.002	0.005
TO-01-042-07	SF-8	ND	ND	ND	ND	ND
Detection Limit		0.050	0.0005	0.0005	0.0005	0.001
TO-01-042-08	SD-14	ND	0.003	0.003	ND	ND
Detection Limit		0.25	0.002	0.002	0.002	0.005
TO-01-042-09	Trip Blank	ND	ND	ND	ND	ND
Detection Limit		0.050	0.0005	0.0005	0.0005	0.001

Gettler - Ryan Inc ENVIRONMENTAL DIVISION

0867 Chain of Custody

COMPANY Shell Oil Co JOB NO.

JOB LOCATION 1800 Powell St.

CITY Emeryville, CA PHONE NO. 783-7500

AUTHORIZED John Wetzel DATE 1-4-90 P.O. NO. 3605

SAMPLE ID	NO. OF CONTAINERS	SAMPLE MATRIX	DATE/TIME SAMPLED	ANALYSIS REQUIRED	SAMPLE CONDITION LAB ID
S-5	3	liquid	1-4-90 / 14:56	THC (gas) BTXE	OK/cool
S-8	3		/ 12:57		
S-10	3		/ 12:12		
S-12	3		/ 9:43		
S-13	3		/ 11:08		
S-14	3		/ 13:50		
SE-8	3		—		
SD-14	3		—		
Trip	1		12-29-89		

RELINQUISHED BY: John J. Zwierzyski

RECEIVED BY: 1/5/90 07:00

RELINQUISHED BY: 1/5/90 14:40

RECEIVED BY:

RELINQUISHED BY:

RECEIVED BY LAB: 1/5/90 1440

DESIGNATED LABORATORY: IT (SCV) DHS # 137

REMARKS: Normal TAT ~~2 Weeks~~ 2 Weeks

DATE COMPLETED 1-4-90 FOREMAN John J. Zwierzyski

ORIGINAL

APPENDIX C
HISTORICAL ANALYTICAL DATA

ANALYTICAL LOG

SAMPLE DATE	SAMPLE POINT	TPH (PPM)	BENZENE (PPM)	TOLUENE (PPM)	E.B. (PPM)	XYLENES (PPM)	DIESEL (PPM)	OIL (PPM)
27-Oct-88	S-5	3.	0.66	0.02	0.02	0.07	N/A	N/A
10-Feb-89	S-5	2.9	0.55	0.02	0.02	0.03	N/A	N/A
28-Apr-89	S-5	4.3	0.75	0.01	0.02	<0.03	N/A	N/A
07-Jul-89	S-5	1.5	0.30	0.008	0.007	0.009	N/A	N/A
25-Oct-89	S-5	2.1	0.76	0.01	0.04	0.05	N/A	N/A
04-Jan-90	S-5	1.3	0.52	0.009	0.008	0.01	N/A	N/A
27-Oct-88	S-6	6.	1.7	0.05	0.08	0.42	N/A	N/A
10-Feb-89	S-6	2.8	0.74	0.02	0.02	0.14	N/A	N/A
28-Apr-89	S-6	6.5	2.4	0.03	0.05	0.21	N/A	N/A
07-Jul-89	S-6	3.7	1.7	0.034	0.055	0.20	N/A	N/A
25-Oct-89	S-6	<0.05	0.023	<0.005	<0.005	0.01	N/A	N/A
27-Oct-88	S-7	0.05	0.0011	<0.001	<0.001	0.004	N/A	N/A
10-Feb-89	S-7	0.05	0.0009	<0.001	<0.001	<0.003	N/A	N/A
28-Apr-89	S-7	<0.05	0.001	<0.001	<0.001	<0.003	N/A	N/A
07-Jul-89	S-7	0.07	0.0022	<0.001	<0.001	<0.003	N/A	N/A
25-Oct-89	S-7	6.2	2.2	0.13	0.19	0.66	N/A	N/A
27-Oct-88	S-8	1.	0.61	0.009	0.001	0.042	N/A	N/A
10-Feb-89	S-8	0.5	0.16	0.005	<0.002	0.017	N/A	N/A
28-Apr-89	S-8	2.7	1.5	0.02	0.01	0.04	N/A	N/A
07-Jul-89	S-8	0.44	0.18	0.005	0.002	0.012	N/A	N/A
25-Oct-89	S-8	2.	1.1	0.017	0.005	0.07	N/A	N/A
04-Jan-90	S-8	1.9	1.3	0.02	<0.01	0.07	N/A	N/A
27-Oct-88	S-10	700.	37.	100.	20.	110.	N/A	N/A
10-Feb-89	S-10	6.5	0.48	0.7	0.1	1.8	N/A	N/A
28-Apr-89	S-10	13.	1.3	0.5	0.6	3.7	N/A	N/A
07-Jul-89	S-10	14.	1.3	0.31	0.27	2.4	N/A	N/A
25-Oct-89	S-10	4.2	0.58	0.034	0.044	0.44	N/A	N/A
04-Jan-90	S-10	1.7	0.36	0.010	0.0078	0.17	N/A	N/A
17-Nov-89	S-12	<0.25	0.018	<0.002	<0.002	<0.005	1.4	N/A
04-Jan-90	S-12	<0.25	0.024	0.002	<0.002	<0.005	N/A	N/A
17-Nov-89	S-13	1.9	0.70	0.16	0.07	0.34	2.0	5.
04-Jan-90	S-13	2.8	1.4	0.13	0.10	0.50	N/A	N/A
17-Nov-89	S-14	<0.25	0.003	<0.002	<0.002	<0.005	<0.4	3.
04-Jan-90	S-14	<0.25	0.003	0.002	<0.002	<0.005	N/A	N/A

ALL DATA SHOWN AS <X ARE REPORTED AS ND (NONE DETECTED)