93 NOV -8 PM 2:44

TRANSMITTAL

TO: Ms. Eva Chu
Alameda County Health Agency
Hazardous Materials Division
80 Swan Way, Room 200
Oakland, California 94621

DATE: October 28, 1993
PROJECT #: 6130.01
SUBJECT: Work Plan for Shamrock Ford Site

FROM:
Barbara Sieminski
Project Geologist
GeoStrategies, Inc.
2140 West Winton Avenue
Hayward, California 94545

WE ARE SENDING YOU:

COPIES	DATED	DESCRIPTION
1	10/27/93	Work Plan for Initial Subsurface Investigation for Shamrock Ford, 7499 Dublin Boulevard, Dublin, California

THESE ARE TRANSMITTED as checked below:

☐ For review and comment
☒ As requested
☐ For approval
☐ For your files

☐ Approved as submitted
☐ Approved as noted
☐ Return for corrections

☐ Resubmit __ copies for approval
☐ Submit __ copies for distribution
☐ Return __ corrected prints

cc: **Mr. Craig Caldwell**, Shamrock Ford
Job File

GeoStrategies Inc.

93 NOV -8 PM 2:44

WORK PLAN FOR INITIAL SUBSURFACE INVESTIGATION

Shamrock Ford 556-8777
7499 Dublin Boulevard
Dublin, California

7613001-02

October 27, 1993

CONTENTS

TABLES

PLATES

GSI
GeoStrategies Inc.

October 27, 1993

Mr. Craig Caldwell
Shamrock Ford
7499 Dublin Boulevard
Dublin, California 94568

Subject: WORK PLAN FOR INITIAL SUBSURFACE INVESTIGATION at Shamrock Ford, 7499 Dublin Boulevard, Dublin, California.

INTRODUCTION

At the request of Shamrock Ford, GeoStrategies Inc. (GSI) has prepared this Work Plan for initial subsurface investigation at the subject site. This work plan was requested by Ms. Eva Chu of Alameda County Health Care Services Agency (ACHCSA) after groundwater samples collected from the tank pits during removal of one gasoline underground storage tank (UST) and one waste-oil UST indicated the presence of gasoline and waste-oil related hydrocarbons in groundwater beneath the subject site. The purpose of this proposed work is to evaluate the presence and extent of hydrocarbon impacted soil and groundwater beneath the site.

The work to be performed includes: (1) obtaining a drilling permit from the Alameda County Flood Control and Water Conservation District, Zone 7,(ACFCWCD) and preparing a site safety plan and scheduling drilling; (2) drilling three onsite soil borings, collecting soil samples for description and possible laboratory analyses from the borings, and installing three 2-inch diameter groundwater monitoring wells (A-1 through A-3) in the borings; (3) submitting selected soil samples for laboratory analyses; (4) developing wells A-1 through A-3; (5) surveying wells A-1 through A-3; (6) monitoring and sampling groundwater from wells A-1 through A-3 and submitting groundwater samples for laboratory analyses; and (7) preparing a report including field methods, results, and conclusions of the investigation.

The work will be performed according to GSI Field Methods and Procedures attached in Appendix A.

551-8777

2140 WEST WINTON AVENUE • HAYWARD, CALIFORNIA 94545 • (510) 352-4800
601 UNIVERSITY AVENUE • SUITE 150 • SACRAMENTO, CALIFORNIA 95825 • (916) 568-7500

SITE DESCRIPTION AND BACKGROUND

General

Shamrock Ford is an operating dealership facility located at the northern corner of the intersection of Dublin Boulevard and Amador Plaza Road in Dublin, California. The site location is shown on Plate 1, Vicinity map. The site is a relatively flat, asphalt- and concrete-covered lot at an elevation of approximately 335 feet above mean sea level.

One 1,000-gallon waste-oil UST (T1) and one 2,000-gallon gasoline UST (T2) were located in the southwestern portion of the site adjacent to the auto repair center. The approximate locations of the former tanks and other pertinent site features are shown on Plate 2, Generalized Site Plan.

Local and Regional Geology and Hydrogeology

Shamrock Ford site is located in the northwestern end of the Livermore Valley, within the Coast Ranges Geomorphic Province of Northern California. The Livermore Valley is approximately 13 miles long oriented in an east-west direction, approximately 4 miles wide, and is surrounded by hills of the Diablo Range. In the vicinity of the subject site, the valley floor slopes gently to the south-southeast. Soil in the vicinity of the subject site is mapped as Holocene alluvium that consists of unconsolidated, moderately to poorly sorted silt and clay rich in organic material, interfingered with and graded into coarser grained stream deposits toward higher elevations (Helley and others, 1979). Holocene alluvium (estimated to be 10 to 50 feet thick) overlies Pleistocene alluvium, which consists of weakly consolidated, poorly sorted, irregularly interbedded clay, silt, sand and gravel, and older sedimentary deposits. The Calaveras Fault is situated approximately ½-mile west of the site.

The Livermore Valley groundwater basin is divided into subbasins on the basis of fault traces or other hydrogeologic discontinuities (California Department of Water Resources, 1974). The groundwater system in Livermore Valley is a multi-layered system with an unconfined aquifer overlying a sequence of leaky or semi-confined aquifers. The subject site is located within the Dublin groundwater subbasin. The groundwater in this subbasin has been reported to be at depths ranging from 10 to 60 feet below ground (fbg) (Alameda County Flood Control and Water Conservation District [ACFCWCD], January 16, 1991).

The site is approximately ¼-mile north of Dublin Creek. The direction of groundwater flow in the vicinity of the site is inferred to be to the southeast, based on regional and local topography, and drainage patterns.

PREVIOUS ENVIRONMENTAL WORK

Underground Tank Removal

In June 1993, Gettler-Ryan Inc. (G-R) removed one 1000-gallon single-walled steel waste-oil UST (T1), and one 2000-gallon single-walled steel gasoline UST (T2) (GSI, 1993). Tank removal was observed by GSI personnel. Examination of the waste-oil UST (T1) indicated that this tank was pitted and rusted, and had holes up to 1-inch in diameter throughout the lower half of the tank. Examination of the gasoline UST (T2) indicated that this tank was in good condition with no visible through-going holes. The backfill material excavated from the tank pit above and around the tanks was predominantly coarse sand. The native soil consisted of dark gray clay (0 to 3 fbg), brown silty clay (3 to 6 fbg), and gray clayey to sandy silt (6 to 8 fbg). Groundwater was encountered in the tank pits at the depth of approximately 7 fbg. Approximately 100 cubic yards of backfill soil removed from the tank pit excavations and after aeration were disposed at BFI Landfill in Livermore, California, under manifest on July 14, 1993.

Two soil samples were collected from native soil from the side walls of each tank pit at depths of approximately 7 feet, just above the groundwater surface. The native soil at the sample depths was clayey to sandy silt.

Laboratory analyses of both soil samples collected from the former waste-oil tank pit indicated nondetectable concentrations of total petroleum hydrocarbons calculated as gasoline (TPH-G), gasoline constituents benzene, ethylbenzene, toluene and total xylenes (BTEX), total petroleum hydrocarbons calculated as diesel (TPH-D), total petroleum hydrocarbons calculated as motor oil (TPH-Motor Oil), oil and grease (O&G), and volatile organic compounds (VOCs). Concentrations of metals cadmium (Cd), chromium (Cr), lead (Pb), nickel (Ni) and zink (Zn) were up to 1.5 parts per million (ppm), 51 ppm, 14 ppm, 37 ppm, and 86 ppm, respectively. Metals appear to be present in the soil in normal background concentrations (Lindsay, 1979; and Scott, 1991).

Laboratory analyses of soil samples collected from the former gasoline tank pit indicated nondetectable TPH-G and BTEX for the sample collected from the southern wall of the tank pit (S-7-T2-1), and 2.4 ppm TPH-G and up to 0.094 ppm BTEX for the sample collected from the northern wall (S-7-T2-2). Lead was detected at a concentration of 12 ppm in sample S-7-T2-1, which is within normal background concentrations (Lindsay, 1979; and Scott, 1991); and was nondetectable in sample S-7-T2-2. Laboratory analyses results for tank pit and stockpile soil samples are presented in Tables 1 and 2, respectively.

Groundwater samples were collected from the tank pits after the tank pits were purged. Laboratory analytical results for the groundwater sample collected from the former waste-oil tank pit indicated 150 parts per billion (ppb) TPH-G; up to 11 ppb BTEX; 8,600 ppb TPH-Motor Oil; and 2,200 ppb O&G. Metals including Cd, Cr, Pb, Ni and Zn were detected at concentrations of 17 ppb, 460 ppb, 850 ppb, 1200 ppb, and 530 ppb, respectively. TPH-D concentration was reported as nondetectable, however, the reporting limit was increased to 100 ppb due to oil interference. VOC concentrations (35 compounds tested) were nondetectable (less than 2 ppb) except benzene (2.6 ppb), toluene (6.1 ppb), P,M-xylene (5.6 ppb), O-xylene (3.2 ppb), methylene chloride (4.4 ppb), and acetone (34 ppb).

Laboratory analytical results for the groundwater sample collected from the former gasoline tank pit indicated 3600 ppb TPH-G; up to 540 ppb BTEX; and 16 ppb of lead. Laboratory analyses results for groundwater samples are presented in Table 3.

PROPOSED WORK

GSI proposes project steps 1 through 7 listed below to evaluate the presence and extent of hydrocarbon impacted soil and groundwater at the subject site.

Step 1 Upon approval of the Work Plan obtain a well drilling permit from the ACFCWCD; prepare a site specific health and safety plan; and schedule underground locating services, drillers, equipment, and personnel.

Step 2 Drill three soil borings to the depth of approximately 30 feet below ground (fbg) and install groundwater monitoring wells (A-1 through A-3) in these borings in the locations shown on Plate 2. The wells are located to evaluate gradient direction and extent of dissolved hydrocarbons. Soil samples in borings will be collected for analyses every 5 feet and at the changes in soil stratigraphy. The soil samples will be classified by GSI geologist using the United Soil Classification System (USCS), placed in the cooler with ice and retained for possible laboratory analyses.

The groundwater monitoring wells will be constructed using 2-inch inner-diameter schedule 40, polyvinyl chloride (PVC) blank casing and 0.020-inch wide, machine slotted, schedule 40 PVC screen. The well annulus will be filled with Lonestar #2/12 sand to approximately one foot above the well screen, and overlain with approximately 1-foot of bentonite. The bentonite will then be hydrated and the annulus will be grouted up to a depth of approximately 1 fbg. A aluminum utility well box will be placed over each wellhead and set in concrete placed flush with the surrounding ground surface. The well will be secured with a locking water tight well cap.

Soil cuttings generated during drilling will be stockpiled onsite, placed on and covered with plastic sheeting and sampled for disposal purposes. After receipt of laboratory analytical results, the soil cuttings will be properly disposed under manifest by a licensed waste hauler.

Step 3 Submit selected soil samples from borings A-1 through A-3 under Chain-of-Custody Records to a State-certified laboratory for analyses for: TPH-G using Modified Environmental Protection Agency (EPA) Method 8015; BTEX using EPA Method 8020; TPH-D and TPH-Motor Oil using Modified EPA Method 8015/Extraction; O&G using EPA Method 5520 E,F; VOCs using EPA Method 8240; and metals Cd, Cr, Pb, Ni and zinc Zn using EPA Method 6010.

Step 4 Within 48 hours, develop groundwater monitoring wells A-1 through A-3 by bailing or over-pumping and surge-block techniques to remove fine-grained sediments and allow better communication between the well and the water bearing zone (see Appendix A).

Step 5 Survey wells A-1 through A-3 to a U.S. Coast and Geodetic Survey Datum relative to mean sea level. This work will be performed by a licensed land surveyor.

Step 6 At least 24 hours after development, purge and sample wells A-1 through A-3. Groundwater samples collected from the wells will be submitted with Chain-of-Custody Records to a State-certified laboratory and analyzed for TPH-G using Modified EPA Method 8015; BTEX using EPA Method 602; TPH-D and TPH-Motor Oil using Modified EPA Method 8015/Extraction; O&G using EPA Method 5520B,F,; VOCs using EPA Method 624; and metals (Cd, Cr, Pb, Ni and Zn) using EPA Method 7000/6010/200.7 (see Appendix A).

Purge water generated during well development and sampling will be properly disposed under manifest by a licensed waste hauler.

Step 7 Prepare a report including results of the investigation, field methods, interpretations and conclusions.

SCHEDULE OF OPERATIONS

A preliminary time schedule to perform the steps described above is shown on Plate 3, Preliminary Time Schedule. This time schedule is an estimate and is subject to change should circumstances dictate. Time is estimated in weeks after gaining regulatory approval of the Work Plan and any changes which must be incorporated into this Work Plan due to regulatory request. GSI can initiate work at the site within 1 week after receiving authorization to proceed, provided that site access can be received and baring unexpected subsurface conditions.

DISTRIBUTION

On behalf of Shamrock Ford, GSI has forwarded copies of this report to:

Ms. Eva Chu
Alameda County Health Care Services Agency
80 Swan Way, Room 200
Oakland, California 94621

If you have any questions or comments, please call us at (510) ~~352-4800.~~ 551-8777

Sincerely,
GeoStrategies, Inc.

Barbara Sieminski

Barbara Sieminski
Project Geologist

Gary Pischke
Senior Geologist
C.E.G. 1501

REGISTERED GEOLOGIST
GARY PISCHKE
No. 1501
CERTIFIED ENGINEERING GEOLOGIST
STATE OF CALIFORNIA

REFERENCES CITED

Alameda County Flood Control and Water Conservation District, Zone 7: January 16, 1991. Fall 1990 Groundwater Level Report.

California Department of Water Resources, 1974. Evaluation of Groundwater Resources Engineering Livermore and Sunol Valleys; Bulletin No. 118-2, Appendix A.

GSI. August 16, 1993. Underground Tank Removal Report. GSI #610001-01.

Helley E.J., K.R. Lajoie, W.E. Spangle, and M.L. Blair, 1979. Flatland Deposits of the San Francisco Bay Region, California. U.S. Geological Survey Professional Paper 943.

Lindsay, W.L., 1979. Chemical Equilibria in Soil. John Wiley and Sons.

Scott, C.M., December 1991. Background Metal Concentrations in Soils in Northern Santa Clara County, California. M.S. Thesis at the University of San Francisco Environmental Management Program.

TABLES

TABLE 1
LABORATORY ANALYSES OF TANK PIT SOIL SAMPLES
Shamrock Ford
Dublin, California

TANK PIT/ SAMPLE NO.	SAMPLE DATE	TPH-G (PPM)	BENZENE (PPM)	TOLUENE (PPM)	ETHYLBENZENE (PPM)	XYLENES (PPM)	TPH-D (PPM)	TPH-MO (PPM)	O&G (PPM)	VOCs (PPM)	METALS (PPM)
Waste-oil Tank Pit											
S-7-T1-1	23-Jun-93	<0.50	<0.0050	<0 0050	<0.0050	<0.0050	<10	<10	<50	ND*	Cadmium - 1 5 Chromium - 49 Lead - 13 Nickel - 34 Zinc - 86
S-7-T1-2	23-Jun-93	<0.50	<0.0050	<0.0050	<0.0050	<0.0050	<10	<10	<50	ND*	Cadmium - 1.3 Chromium - 51 Lead - 14 Nickel - 37 Zinc - 56
Gasoline Tank Pit											
S-7-T2-1	23-Jun-93	<0.50	<0.0050	<0.0050	<0.0050	<0.0050	NA	NA	NA	NA	Lead - 12
S-7-T2-2	23-Jun-93	2.4	0.015	0.0060	0.030	0.094	NA	NA	NA	NA	Lead - <10

TPH G = Total Petroleum Hydrocarbons calculated as Gasoline
TPH-D = Total Petroleum Hydrocarbons calculated as Diesel.
TPH-MO = Total Petroleum Hydrocarbons calculated as Motor Oil.
O&G = Oil and Grease
VOCs = Volatile Organic Compounds
PPM = Parts per Million
ND = Not detected
* = 35 compounds tested
NA = Not analyzed

Notes: 1. All data shown as <x are reported as ND (none detected).

TABLE 2
LABORATORY ANALYSES OF STOCKPILE SOIL SAMPLES
Shamrock Ford
Dublin, California

SAMPLE NO.	SAMPLE DATE	TPH-G (PPM)	BENZENE (PPM)	TOLUENE (PPM)	ETHYLBENZENE (PPM)	XYLENES (PPM)	TRPH (PPM)	VOCs (PPM)	SVOCs (PPM)	RCI	METALS (PPM)
SP-1A,B,C,D	23-Jun-93	1.1	<0.0050	<0.0050	0.012	0.076	460	ND*	ND**	Reactive Cyanide - <1.0 ppm; Reactive Sulfide - <10 ppm; pH - 8.8; Flashpoint - >140F	Antimony - <0.030 Arsenic - 0.28 Barium - 6.2 Beryllium - 0.0045 Cadmium - 0.016 Chromium - 0.066 Cobalt - 0.21 Copper - 0.16 Lead -0.17(0.19***) Mercury - <0.0050 Molybdenum-<0.010 Nickel - 0.44 Selenium - 0.025 Silver - <0.0050 Thallium - <0.010 Vanadium - 0.36 Zinc - 1.0
SP-2A,B,C,D	23-Jun-93	460	0.64	<0.50	2.4	22	NA	NA	NA	Reactive Cyanide - <1.0 ppm; Reactive Sulfide - <10 ppm; pH - 8.7; Flashpoint - >140F	Lead - 0.064***
SP-2A,B,C,D	09-Jul-93	0.78	<0.0003	<0.0003	<0.0003	0.0014	NA	NA	NA	NA	NA

TPH-G = Total Petroleum Hydrocarbons calculated as Gasoline.
TPH-D = Total Petroleum Hydrocarbons calculated as Diesel.
TRPH = Total Recoverable Petroleum Hydrocarbons.
VOCs = Volatile Organic Compounds.
SVOCs = Semi Volatile Organic Compounds.
Notes: 1. All data shown as <x are reported as ND (none detected)

RCI = Reactivity, Corrosivity, Ignitability.
PPM = Parts per Million.
* = 35 compounds tested were nondetectable except P,M-Xylene (0.011 ppm) and O-Xylene (0.010 ppm).
** = All 56 compounds tested were nondetectable.
*** = Analyzed by "Waste Extraction Test for Lead".

TABLE 3
LABORATORY ANALYSES OF WATER SAMPLES FROM TANK PITS
Shamrock Ford
Dublin, California

TANK PIT/ SAMPLE NO.	SAMPLE DATE	TPH-G (PPB)	BENZENE (PPB)	TOLUENE (PPB)	ETHYLBENZENE (PPB)	XYLENES (PPB)	TPH-D (PPB)	TPH-MO (PPB)	O&G (PPB)	VOCs (PPB)	METALS (PPB)
Waste-oil Tank Pit											
W-7-T1	29-Jun-93	150	3.4	6.5	2.2	11	<100*	8600	2200	ND** except: Methylene Chloride - 4.4; Acetone - 34; Benzene - 2.6; Toluene 6.1; P,M-Xylene - 5.6; O-Xylene - 3.2	Cadmium - 17 Chromium - 460 Lead - 850 Nickel - 1200 Zinc - 530
Gasoline Tank Pit											
W-7-T2	24-Jun-93	3600	67	40	170	540	NA	NA	NA	NA	Lead - 16

Current Regional Water Quality Control Board Maximum Contaminant Levels:
Benzene 1 0 ppb, Xylenes 1750 ppb, Ethylbenzene 680 ppb
Current Cal EPA Action Levels: Toluene 100 ppb

TPH-G = Total Petroleum Hydrocarbons calculated as Gasoline.
TPH-D = Total Petroleum Hydrocarbons calculated as Diesel.
TPH MO = Total Petroleum Hydrocarbons calculated as Motor Oil.
O&G = Oil and Grease
VOCs = Volatile Organic Compounds
PPB = Parts per Billion
ND = Not detected
NA = Not analyzed
* = Reporting limit increased due to oil interference.
** = 35 compounds tested.
Notes: 1. All data shown as <x are reported as ND (none detected).

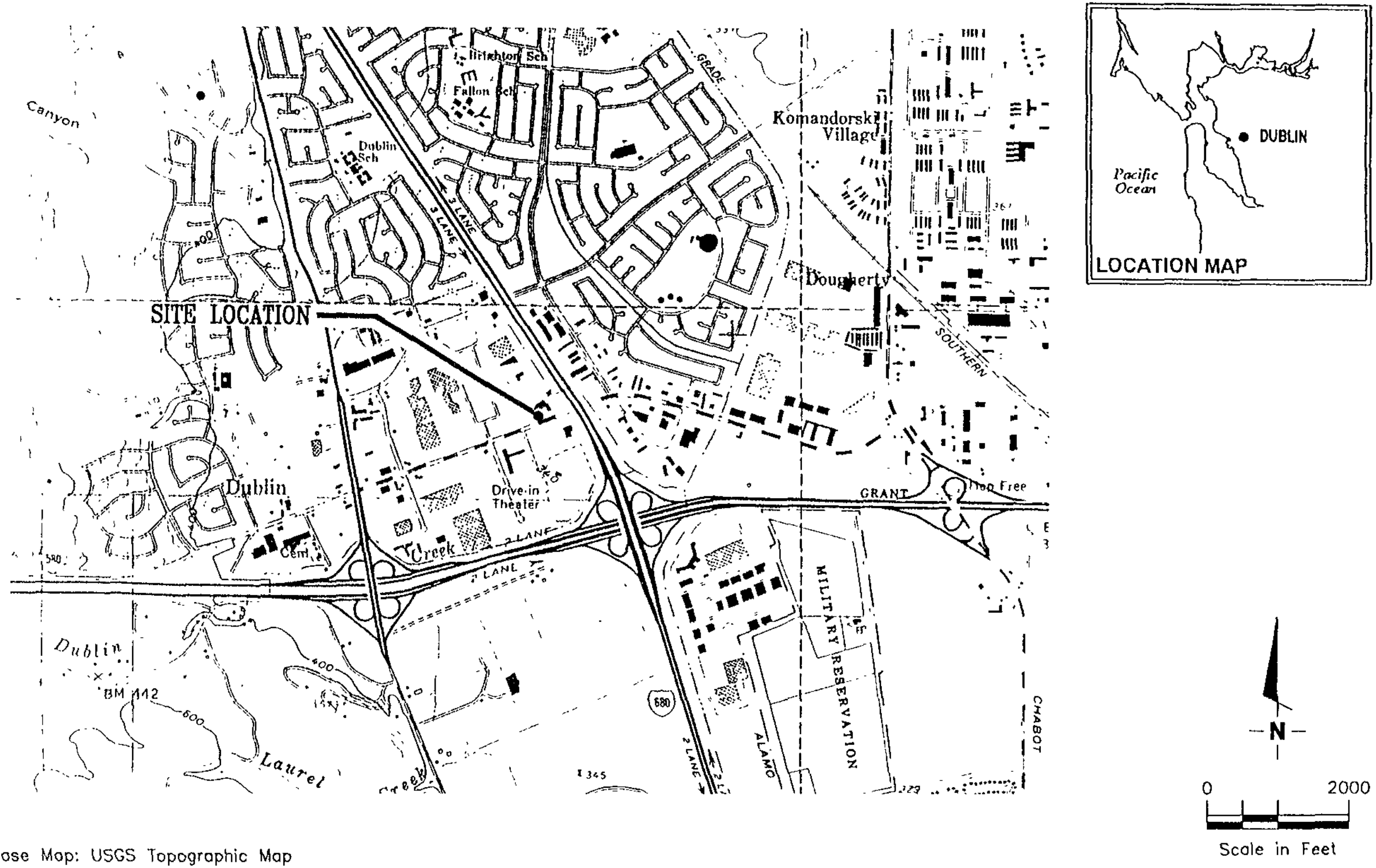
TABLE 3
LABORATORY ANALYSES OF WATER SAMPLES FROM TANK PITS
Shamrock Ford
Dublin, California

TANK PIT/ SAMPLE NO.	SAMPLE DATE	TPH G (PPB)	BENZENE (PPB)	TOLUENE (PPB)	ETHYLBENZENE (PPB)	XYLENES (PPB)	TPH-D (PPB)	TPH-MO (PPB)	O&G (PPB)	VOCs (PPB)	METALS (PPB)
Waste-oil Tank Pit											
W-7-T1	29-Jun-93	150	3 4	6.5	2.2	11	<100*	8600	2200	ND** except: Methylene Chloride - 4.4, Acetone - 34; Benzene - 2.6; Toluene 6.1; P,M-Xylene - 5.6; 0-Xylene - 3.2	Cadmium - 17 Chromium - 460 Lead - 850 Nickel - 1200 Zinc - 530
Gasoline Tank Pit											
W-7-T2	24-Jun-93	3600	67	40	170	540	NA	NA	NA	NA	Lead - 16

Current Regional Water Quality Control Board Maximum Contaminant Levels:
Benzene 1 0 ppb, Xylenes 1750 ppb, Ethylbenzene 680 ppb
Current Cal EPA Action Levels: Toluene 100 ppb

TPH-G = Total Petroleum Hydrocarbons calculated as Gasoline.
TPH D = Total Petroleum Hydrocarbons calculated as Diesel.
TPH-MO = Total Petroleum Hydrocarbons calculated as Motor Oil.
O&G = Oil and Grease
VOCs = Volatile Organic Compounds
PPB = Parts per Billion
ND = Not detected
NA = Not analyzed
* = Reporting limit increased due to oil interference.
** = 35 compounds tested.
Notes. 1. All data shown as <x are reported as ND (none detected).

ILLUSTRATIONS



Base Map: USGS Topographic Map

GeoStrategies Inc.

VICINITY MAP
SHAMROCK FORD
7499 Dublin Boulevard
Dublin, California

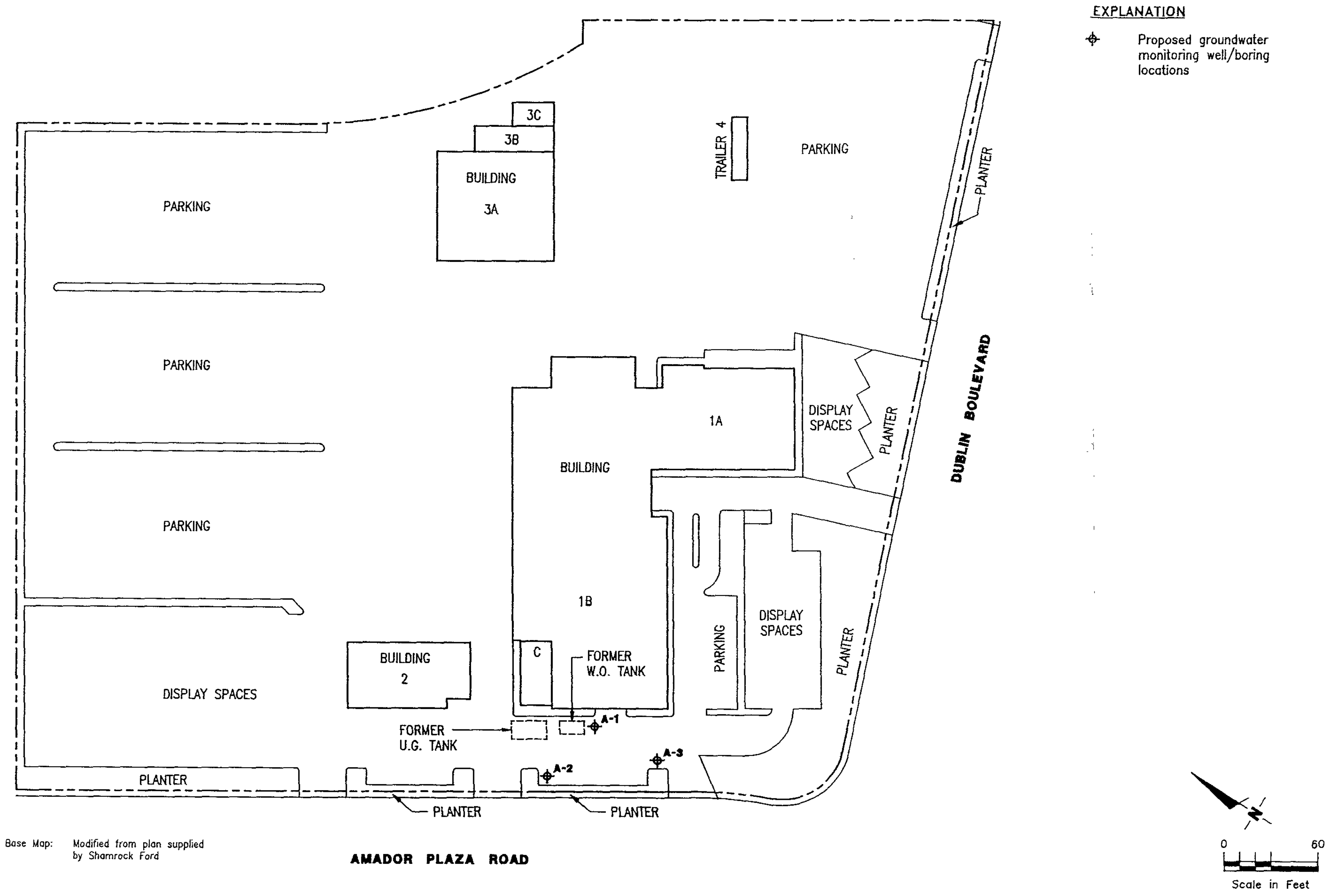
PLATE
1

JOB NUMBER 6100

REVIEWED BY

DATE 8/93

REVISED DATE



EXPLANATION

⌖ Proposed groundwater monitoring well/boring locations

Base Map: Modified from plan supplied by Shamrock Ford

PLATE
2

PROPOSED BORING/WELL LOCATIONS
SHAMROCK FORD
7499 Dublin Boulevard
Dublin, California

GSI
GeoStrategies Inc.

JOB NUMBER
613001-02

REVIEWED BY
BS

DATE
10/93

REVISED DATE

PRELIMINARY TIME SCHEDULE

PROJECT STEPS	ESTIMATED TIME IN WEEKS (AFTER ACQUIRING REGULATORY APPROVAL)																								COMMENTS
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	
(1) OBTAIN PERMITS, SCHEDULE DRILLING	■	■																							
(2) DRILL AND INSTALL WELLS			■																						
(3) SUBMIT SOIL SAMPLES FOR ANALYSIS			■	■	■																				
(4) DEVELOP WELLS				■																					
(5) SURVEY WELLS					■																				
(6) PURGE & SAMPLE WELLS AND SUBMIT SAMPLES FOR LABORATORY ANALYSES					■	■																			
(7) PREPARE REPORT							■	■	■	■	■	■													

NOTES: 1. IF CLIENT HAS NOT RECEIVED REGULARORY APPROVAL OF THIS WORK PLAN WITHIN 60 DAYS, THEY WILL PROCEED AS STATED IN TITLE 23, ARTICLE 11, CHAPTER 16, SECTIONS 2722 (b)(5) AND 2726 (c).

LEGEND

■ ESTIMATED SCHEDULE

GSI GeoStrategies Inc.

PRELIMINARY TIME SCHEDULE
SHAMROCK FORD
7499 Dublin Boulevard
Dublin, California

PLATE
3

JOB NUMBER
613001-02

REVIEWED BY

DATE
10/93

REVISED DATE

APPENDIX A

GSI FIELD METHODS AND PROCEDURES

FIELD METHODS AND PROCEDURES

EXPLORATION DRILLING

Mobilization

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

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

Drilling

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

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

Soil Sampling

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

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

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

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

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

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

Soil Sampling - cont.

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

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

Monitoring Well Installation

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

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

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

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

Well Development

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

Bailing

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

Pumping

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

Surging

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

Air Lifting

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

Well Development - cont.

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

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

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

Well Surveying

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

GROUND-WATER SAMPLING AND 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 analytical laboratory for analysis, and what types of analyses shall be performed.

GSI GeoStrategies Inc

FIELD EXPLORATORY BORING LOG

Field location of boring

Project No. Date

Boring No.

Client

Location

City

Sheet

Logged by

Driller

of

Casing installation date

Drilling method

Hole diameter

Top of Box Elevation

Datum

Water Level

Time

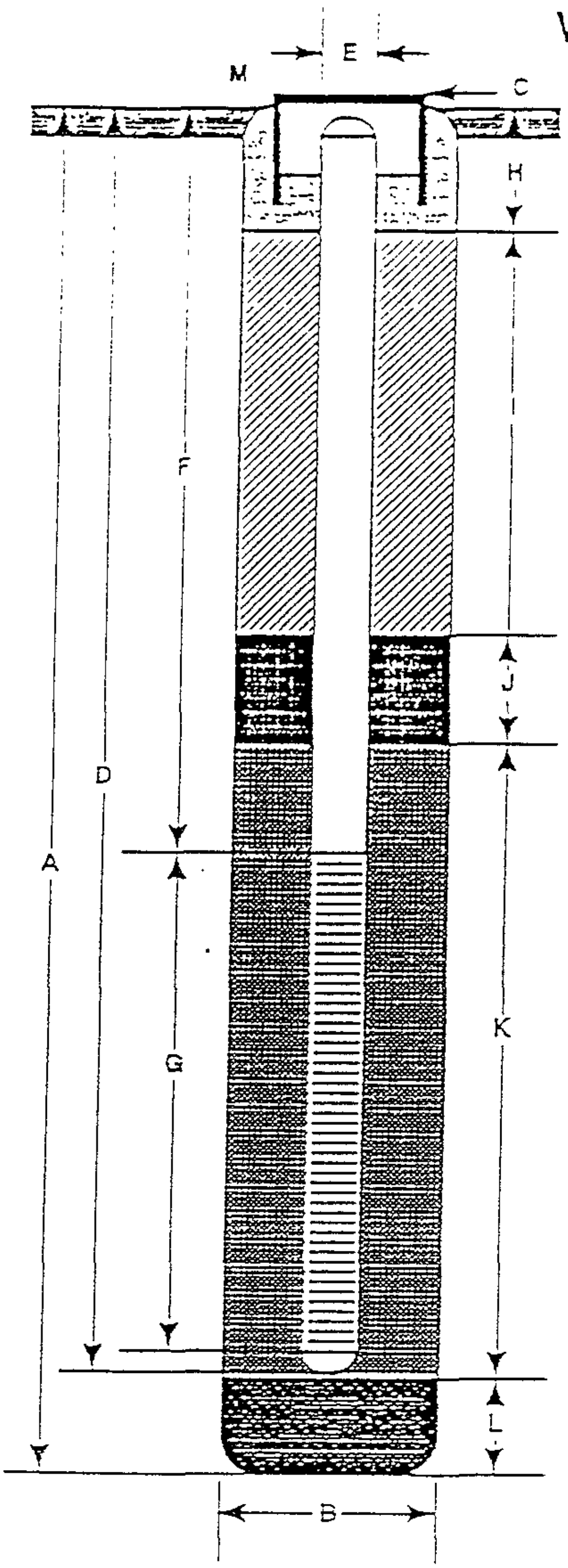
Date

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

GS 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____