HAGEMAN-AGUIAR, INC.

Underground Contamination Investigations
Groundwater Consultants, Environmental Engineering

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Lafayette, California 94549
(510) 284-1661
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reviewed / approved
w/ minor changes
10/29/92

QUARTERLY
GROUNDWATER SAMPLING REPORT
(sampled August 10, 1992)

AND

PROPOSAL FOR ADDITIONAL SUBSURFACE INVESTIGATION

FORMER CHEVRON STATION
11727 Main Street
Sunol, CA

August 27, 1992

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I. INTRODUCTION

The site location is 11727 Main Street, Sunol, CA. In conjunction with the former Chevron station, the site has historically operated four underground storage tanks:

one 550 gallon diesel
one 550 gallon regular gasoline
one 1000 gallon unleaded gasoline
one 1000 gallon premium gasoline

On February 7, 1990, all four underground storage tanks were removed by Hageman Schank, Inc., under permit from the Alameda County Environmental Health Department. The results of initial laboratory analyses performed upon samples of native soil collected from beneath the smallest diesel tank and the northern-most gasoline tank indicated concentrations of total petroleum hydrocarbons (TPH) of 200 and 1100 parts per million (ppm), respectively. Further excavation at both of these locations resulted in soil samples with non-detectable concentrations of petroleum hydrocarbons.

The location of the site is shown in Figure 1. A map of the site is shown in Figure 2. This map shows the layout of the facility, along with the locations of the previous tank excavations. The only structures remaining at the site are a pump island and a concrete pad (floor of previous lube room).

Subsequent to the underground tank removals, one on-site shallow groundwater monitoring well (well MW-1) was installed by Hageman-Aguiar, Inc., on October 30, 1990. The report of that soil and groundwater investigation was issued on December 10, 1990. The location of the monitoring well is shown in Figure 2.

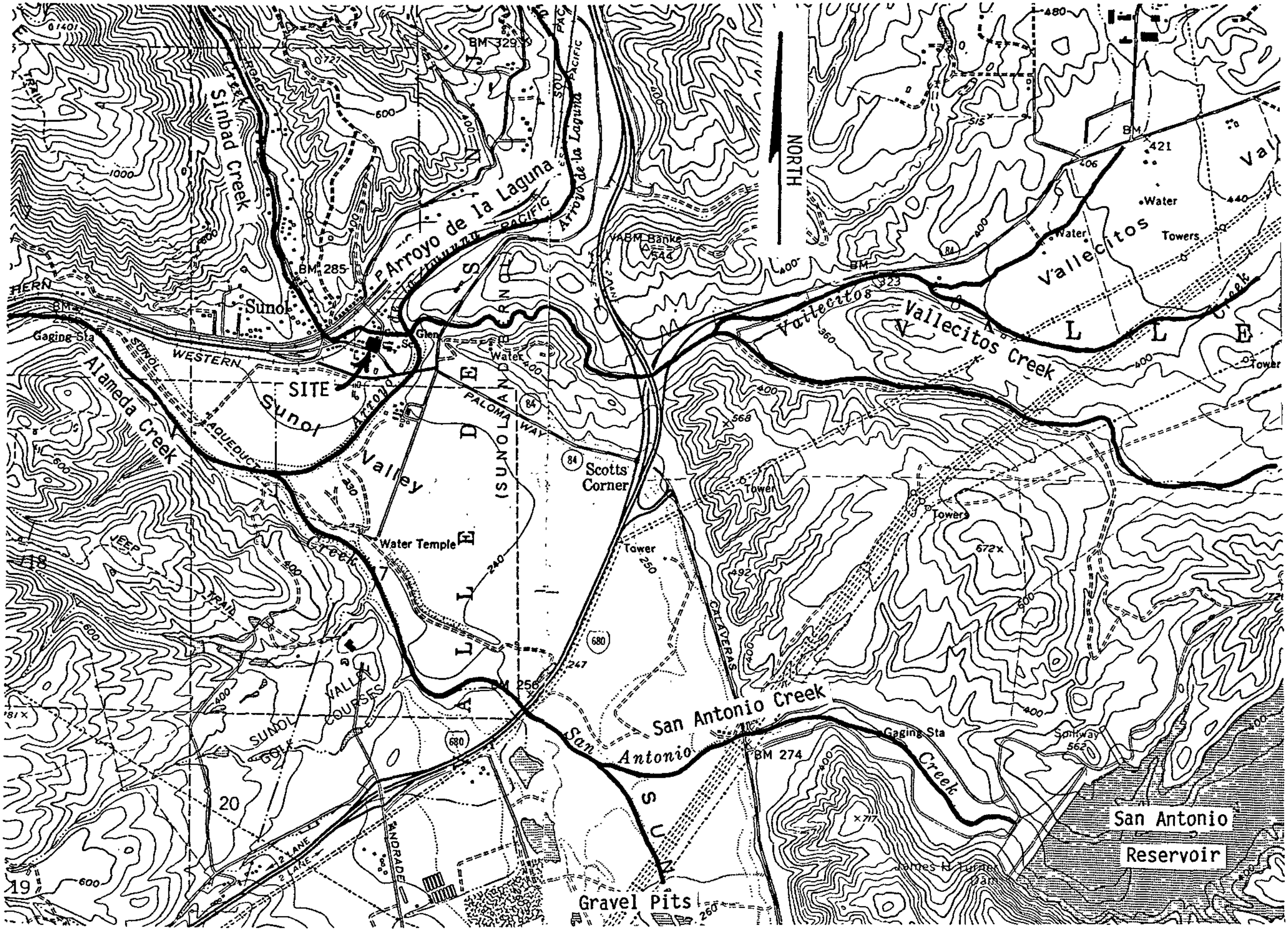


FIGURE 1. Site Vicinity Map

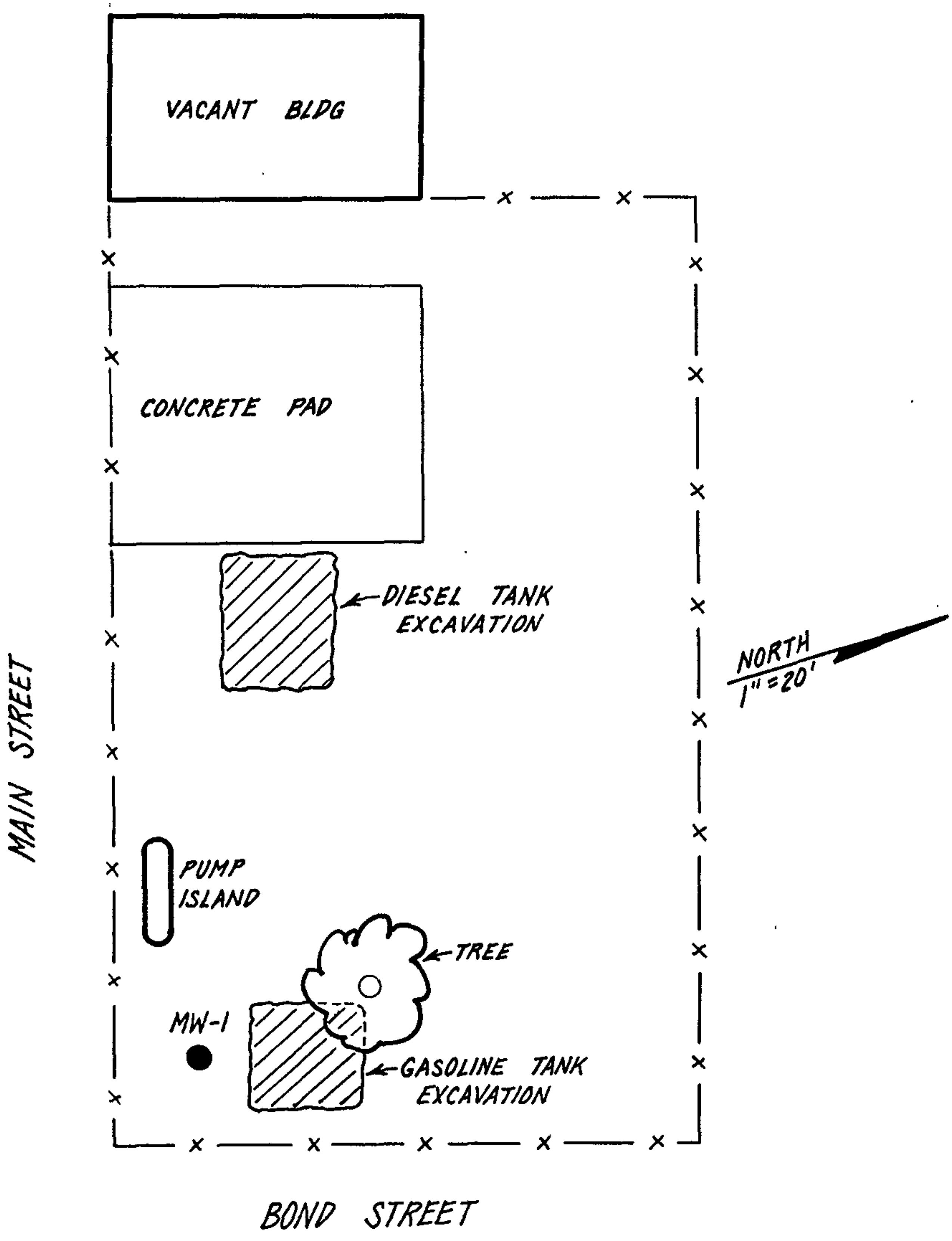


FIGURE 2.
Site Map.

On August 10, 1992, the one on-site monitoring well was sampled for the laboratory analysis for dissolved petroleum constituents. This sampling represents the eighth "round" of groundwater sampling, and is part of the quarterly groundwater monitoring program at the site, as required by the Alameda County Department of Environmental Health and the California Regional Water Quality Control Board (RWQCB), San Francisco Bay Region.

II. FIELD WORK

Monitoring Well Sampling

On August 10, 1992, groundwater samples were collected from the on-site monitoring well MW-1. Prior to groundwater sampling, the well was purged by removing approximately 4 casing volumes of water. Field conductivity, temperature, and pH meters were present on-site during the monitoring well sampling. As the purging process proceeded, the three parameters were monitored. Purging continued until readings appeared to have reasonably stabilized. After the water level in the well had attained 80% or more of the original static water level, a groundwater sample was collected using a clean teflon bailer. The water sample was placed inside appropriate 40 mL VOA vials and 1-liter amber bottles free of any headspace. The samples were immediately placed on crushed ice, then transported under chain-of-custody to the laboratory at the end of the work day.

At the time the monitoring well was sampled, the following information was recorded in the field: 1) depth-to-water prior to purging, using an electrical well sounding tape, 2) identification of any floating product, sheen, or odor prior to purging, using a clear teflon bailer, 3) sample pH, 4) sample temperature, and 5) specific conductance of the sample.

A copy of the well sampling log is included as Attachment A.

Water Level Measurement.

The shallow groundwater elevation in MW-1 was measured as 32.98 feet below ground surface on August 10, 1992.

Wastewater Generation

All water removed from the well during purging was drummed and stored on-site until the results of laboratory analyses were obtained. Based upon these results, the water should be sewered (if possible) as a non-hazardous liquid waste in accordance with local sewering agency permit requirements, or else it should be transported as a hazardous liquid waste under proper manifest to an appropriate TSD facility for treatment and disposal. The disposal of wastewater is the responsibility of the property owner (waste generator), and is beyond the scope of work as described in this report.

III. SHALLOW GROUNDWATER SAMPLING RESULTS

Laboratory Analysis

All analyses were conducted by a California State DOHS certified laboratory in accordance with EPA recommended procedures (Priority Environmental Labs, Milpitas, CA).

All shallow groundwater samples were analyzed for 1) total extractable petroleum hydrocarbons (EPA method 8015), 2) total petroleum hydrocarbons as Gasoline (EPA method 8015) and 3) Benzene, Toluene, Ethylbenzene, and Total Xylenes (EPA method 602).

Results of Laboratory Analysis.

Table 1 presents the results of the laboratory analysis of the groundwater sample collected from monitoring well MW-1.

As shown in Table 1, the sample collected from well MW-1 indicated the presence of Diesel at a concentration of 650 μg/L (ppb). In addition, the sample collected from well MW-1 indicated the presence of Kerosene at a concentration of 520 μg/L (ppb).

For this round of shallow groundwater sampling, no detectable concentrations of either Gasoline or Benzene were found.

A copy of the laboratory certificates for the water sample analysis is included as Attachment B.

TABLE 1.

Shallow Groundwater Sampling Results

Well	Date	TPH as Gasoline (ug/L)	TPH as Kerosene (ug/L)	TPH as Diesel (ug/L)	Benzene (ug/L)	Toluene (ug/L)	Ethyl-benzene (ug/L)	Total Xylenes (ug/L)	Motor Oil (mg/L)
MW-1	11-13-91	ND	---	840	ND	ND	ND	ND	---
	02-26-91	ND	---	ND	ND	ND	ND	ND	---
	05-16-91	ND	---	ND	ND	ND	ND	ND	---
	08-19-91	260	---	220	0.6	ND	0.7	3.1	---
	12-20-91	500	---	480	ND	ND	ND	1.7	---
	02-12-92	440	2,200	ND	0.6	0.6	0.6	2.9	---
	05-13-92	ND	280	ND	ND	ND	0.6	3.6	ND
	08-10-92	ND	520	650	ND	ND	ND	ND	---
Detection Limit		50	50	50	0.5	0.5	0.5	0.5	0.5

ND = Not Detected

IV. PROPOSAL FOR ADDITIONAL SUBSURFACE INVESTIGATION

Placement of Monitoring Wells

The purpose of the proposed additional subsurface investigation is to install two additional on-site monitoring wells in order to 1) determine the direction of shallow groundwater flow beneath the site, and 2) define the extent of any petroleum constituents that may be present in both the soil and the shallow groundwater beneath the site.

The proposed locations of the wells are shown in Figure 3. The locations have been selected based upon 1) known locations of soil contamination during the previous tank removals, 2) the expected shallow groundwater flow direction, and 3) what is believed to be good spacing between data points in order to achieve reasonable plume definitions of any contaminants that may be present in the shallow groundwater beneath the site.

Monitoring Well Installations

Well installation will begin as soon as possible, following approval by the appropriate regulatory agencies. Each well will be installed with a truck-mounted drill rig using 8-inch hollow-stem augers.

During the drilling, soil samples for chemical analyses will be collected at 5-foot intervals until the shallow water table is encountered at an expected depth of approximately 30 feet below the ground surface. Soil samples will also be collected at any significant changes in lithology and obvious contamination. Each soil sample will be collected by driving directly into the native soil below the augers with a 2-inch split-barrel sampler fitted with clean brass liners. All

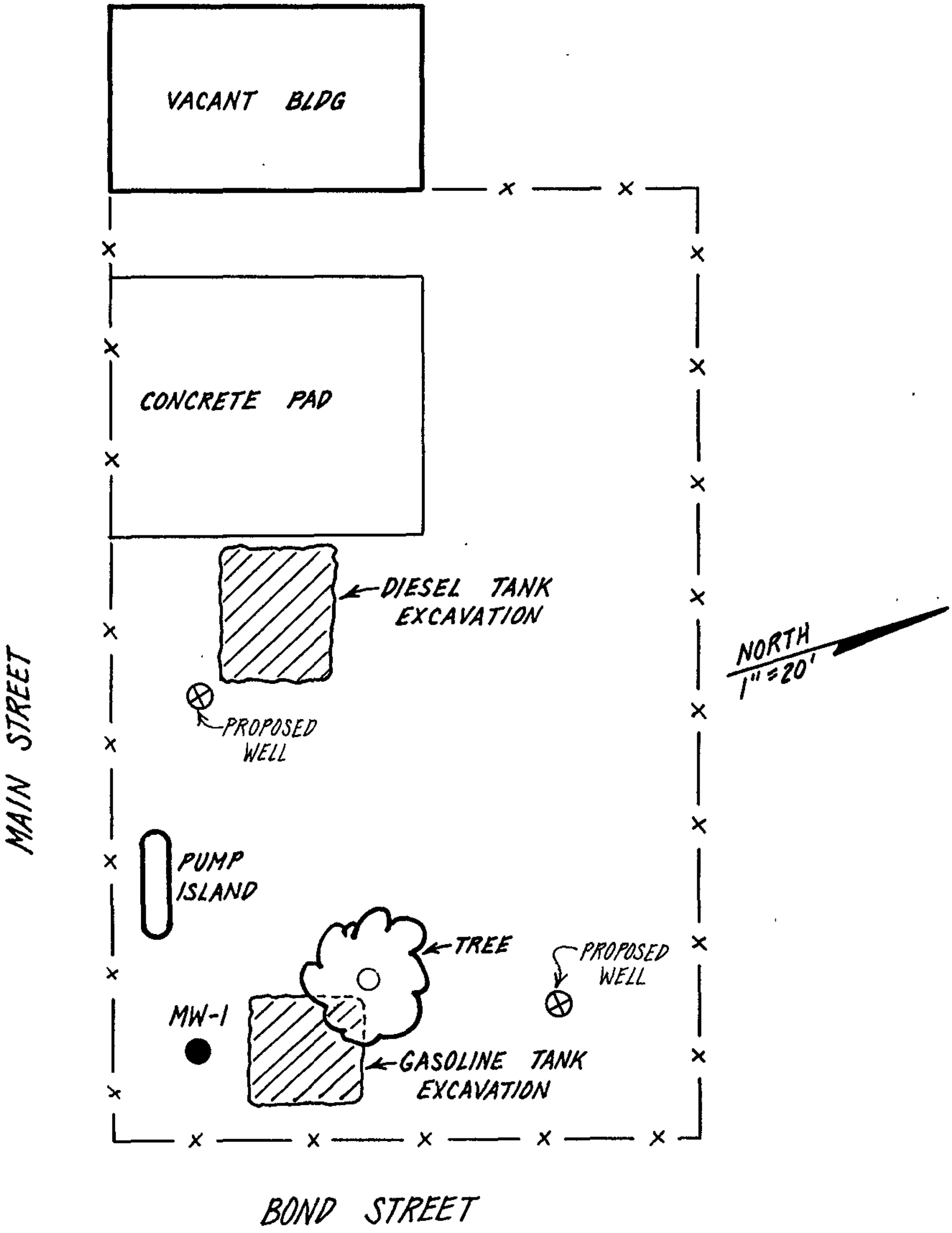


FIGURE 3. Proposed Monitoring Well Locations.

samples will be immediately placed on ice, then transported under chain-of-custody to the laboratory by the end of the work day.

The well borings will extend to approximately 10 feet below the shallow water table. Each well will be cased to approximately three to five feet above the shallow water table with 2-inch PVC slotted screen pipe (0.02" slots). The annular space of each well will be packed to one foot above the slotted section with #3 Monterey Sand. At least one foot of wetted bentonite pellets will be placed upon the sand pack, followed by a neat cement/bentonite seal up to the ground surface. Each well will be fitted with a locking steel traffic lid. The borings will be logged in the field by Gary Aguiar, Registered Civil Engineer #34262 (a statement of qualifications is included as Attachment B). A typical well construction diagram is shown in Figure 4.

Sand Pack Grain Size Selection

The selection of the screen slot size and sand pack grain size was based upon aquifer material encountered during the previous well installation (coarse-grained alluvium). A well pack design based upon the d_{30} and the uniformity coefficient of a well-graded alluvial soil with sizes ranging from coarse sand to silt generally yields a design consisting of 0.02" slots and #3 Monterey sand. This design is therefore considered as a "general purpose" design, appropriate for many monitoring well conditions where well efficiency is not an important issue, but where silting should be kept to a minimum.

In the event that some unexpected and very different aquifer material is encountered, an attempt will be made to obtain and transport to the site alternate well material consisting of well screen with different slot size and sand pack of alternate grain size.

TYPICAL MONITORING WELL CONSTRUCTION

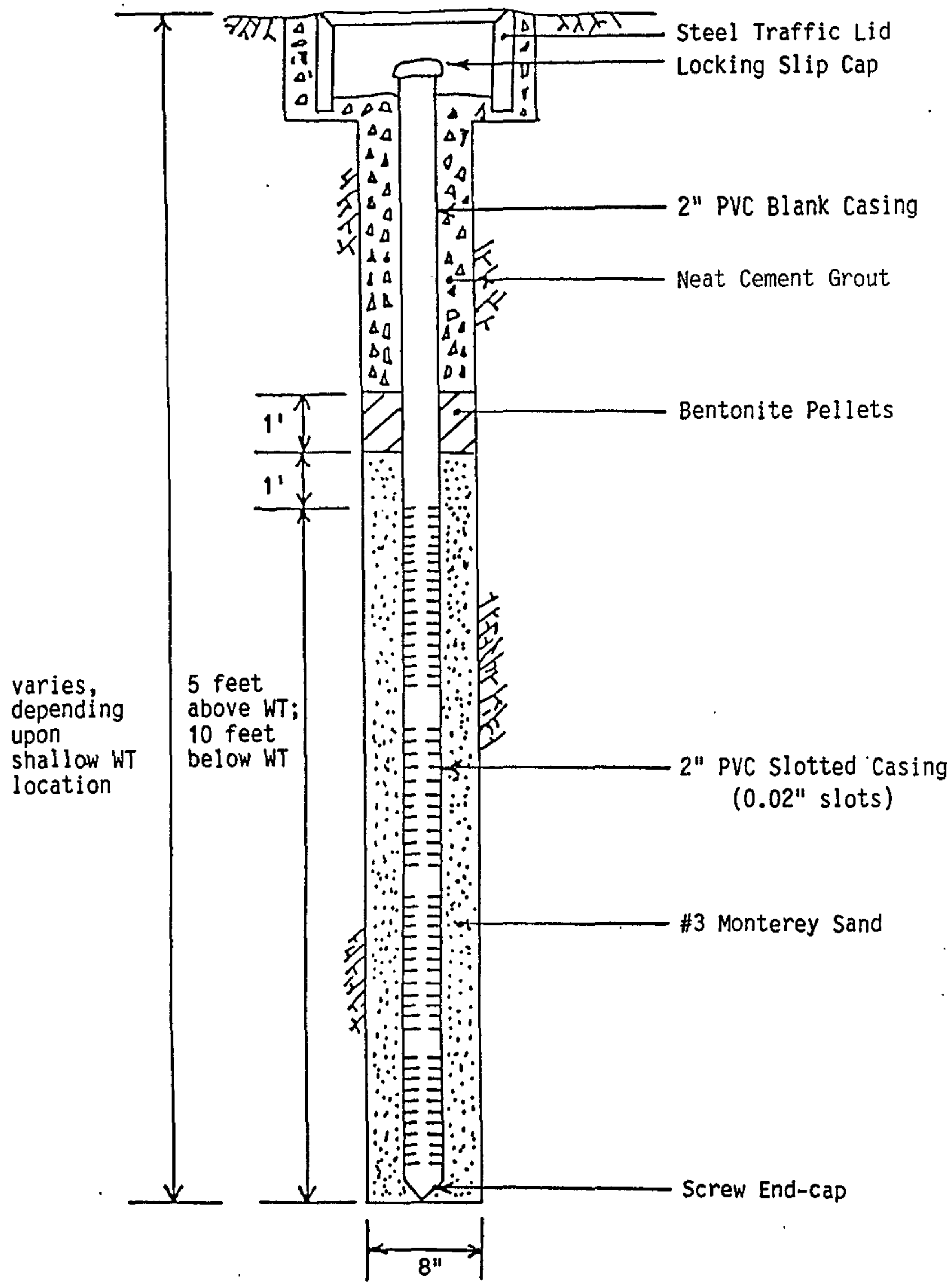


FIGURE 4.

Typical Monitoring Well Construction.

Decontamination

Prior to the installation of each well, all drilling equipment, including augers, drill stem, and split barrel samplers, will be steam-cleaned on-site. Prior to the installation of each well, all drilling equipment, including augers, drill stem, and split barrel samplers, will be steam-cleaned. All on-site steam-cleaning will be conducted within a temporary bermed area, covered by a plastic liner. Wash water collected in this area will subsequently be transferred into appropriate 55-gallon drums, and stored on-site until the results of laboratory analyses of water samples are obtained. Depending upon these results, the water will be sewered as a non-hazardous liquid waste in accordance with local sewering agency permit requirements, or else it will be transported as a hazardous liquid waste under proper manifest to an appropriate TSD facility for treatment and disposal.

Groundwater Sampling Plan

The development of the newly installed monitoring wells will not occur for at least 72 hours after construction. It is proposed that each well will be developed by removing water with a mechanical air-lift pump until the water is relatively clear, or until the apparent turbidity of the water being removed has stabilized. In the event that pumping does not appear to be providing adequate well development, a well development service truck can be brought to the site in order to attempt further development with mechanical surge block and bailer.

A minimum of 24 hours shall pass between well development and groundwater sampling. Prior to groundwater sampling, all three on-site monitoring wells will be purged by bailing 4 to 10 casing volumes of water. Field conductivity, temperature, and pH meters will be present on-site during the monitoring well sampling. As the purging process proceeds, these three parameters will be monitored. Purging must continue until readings appear to have reasonably stabilized. After the water level has attained 80% or more of the original static water level in a particular monitoring well, a groundwater sample will be collected using a clean teflon bailer. The water sample will be placed inside appropriate 40 mL VOA vials and 1-liter amber bottles free of any headspace. The sample will immediately be placed on crushed ice, then transported under chain-of-custody to the laboratory at the end of the work day.

At the time each monitoring well is sampled, the following information will be recorded in the field: 1) depth-to-water prior to purging, using an electrical well sounding tape, 2) identification of any floating product, sheen, or odor prior to purging, using a clear teflon bailer, 3) sample pH, 4) sample temperature, and 5) specific conductance of the sample.

Waste Generation

All drill cuttings will be stockpiled and stored on-site until the results of laboratory analyses are obtained. Depending upon these results, the cuttings will be disposed of as either a non-hazardous waste, or else transported as a hazardous waste under proper manifest to an appropriate TSD facility. In the case of contaminated soil, it may be possible to remove residual Gasoline concentrations by aeration under permit from the Bay Area Air Quality Management District (BAAQMD), and thereby facilitate disposal as a non-hazardous waste.

All water removed from the well during development and purging will be drummed and stored on-site until the results of laboratory analyses are obtained. Depending upon these results, the water will be sewered as a non-hazardous liquid waste in accordance with local sewering agency permit requirements, or else it will be transported as a hazardous liquid waste under proper manifest to an appropriate TSD facility for treatment and disposal.

Laboratory Analysis

All analyses will be conducted by a California State DOHS certified laboratory (Priority Environmental Laboratory, Milpitas, CA) in accordance with EPA recommended procedures.

Soil samples will be analyzed for 1) total extractable petroleum hydrocarbons, 2) total petroleum hydrocarbons as Gasoline and 3) Benzene, Toluene, Ethylbenzene, and Total Xylenes (BTEX).

Groundwater samples will be analyzed for 1) total extractable petroleum hydrocarbons, 2) total petroleum hydrocarbons as Gasoline and 3) Benzene, Toluene, Ethylbenzene, and Total Xylenes (BTEX).

Top-of-Casing Survey

In order to determine groundwater flow direction, the top-of-casing elevation at each monitoring well will be surveyed to within 0.01 feet Mean Sea Level (MSL) of an established County of Alameda bench mark.

Report

A report will be written that will provide a description of all field work, present the geologic log, and present all laboratory results. The report will include, but not be limited to, the following:

1) a map showing well locations and elevations.
2) soil and formation conditions.
3) geologic logs.
4) geologic cross-sections.
5) depths to groundwater.
6) shallow groundwater contour map.
7 report of presence of free product.
8) results of laboratory analyses.
9) contaminant plume definitions.
10) contaminant source identification.
11) recommendations for further investigation and/or remediation, if deemed necessary.

Site Safety Plan

A site-specific set of health and safety operating procedures for field investigations of underground spills of motor oil and petroleum distillate fuel is provided in Attachment C. In order to maintain a safe working environment for field personnel, a copy of these operating procedures will be kept on-site during the field operations, and will be followed in accordance with the magnitude of petroleum contamination encountered.

QUARTERLY GROUNDWATER SAMPLING REPORT
PROPOSAL FOR ADDITIONAL SUBSURFACE INVESTIGATION

FORMER CHEVRON STATION
11727 Main Street, Sunol, CA

August 27, 1992

REGISTERED PROFESSIONAL ENGINEER
GARY H. AGUIAR
No. C-34262
CIVIL
STATE OF CALIFORNIA

EXP. 9-30-95

Gary Aguiar **RCE 34262**

Bruce Hageman

ATTACHMENT A

WELL SAMPLING LOGS

WELL SAMPLING LOG

Project/No. O'LAUGHLIN

Page 1 of 1

Site Location SUNOL

Date 8-10-92

Well No. MW 1

Time Began 1035

Weather CLEAR/90°F

Completed 1130

EVACUATION DATA

Description of Measuring Point (MP) WELL BOX AT GRADE

Total Sounded Depth of Well Below MP 64.30

− Depth to Water Below MP 32.98

Diameter of Casing 2"

= Water Column in Well 31.32

Gallons in Casing 5.0 + Annular Space (30% porosity) X 4 = Total Gallons 20

Gallons Pumped Prior to Sampling 20

Evacuation Method ACRYLIC HAND BAILER

SAMPLING DATA / FIELD PARAMETERS

Inspection for Free Product: (thickness to 0.1 inch, if any) NO APPARENT PRODUCT

Time	1035	1048	1101	1110
Gals Removed	0	10	15	20
Temperature	22.9	21.5	19.7	18.8
Conductivity	1000	950	950	900
pH	7.1	7.2	7.3	7.3
Color / Odor	CLR/NO	GRY/NO	GRY/NO	GRY/NO
Turbidity	LOW	LOW	MED	MED

Comments: NONE

ATTACHMENT B

ANALYTICAL RESULTS: GROUNDWATER

PEL

PRIORITY ENVIRONMENTAL LABS

Precision Environmental Analytical Laboratory

August 11, 1992

PEL # 9208017

HAGEMAN - AGUIAR, INC.

Attn: Jeffrey Roth
Re: One water sample for Gasoline/BTEX and TEPH analyses.

Project name: O'Laughlin
Project location: Sunol, CA.

Date sampled: Aug 10, 1992
Date extracted: Aug 10-11,1992

Date submitted: Aug 10, 1992
Date analyzed: Aug 10-11,1992

RESULTS:

SAMPLE I.D.	Gasoline (ug/L)	Diesel (ug/L)	Benzene (ug/L)	Toluene (ug/L)	Ethyl Benzene (ug/L)	Total Xylenes (ug/L)	Kerosene (ug/L)
MW 1	N.D.	650	N.D.	N.D.	N.D.	N.D.	520
Blank	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Spiked Recovery	87.4%	93.6%	83.1%	86.8%	82.4%	95.8%	90.2%
Detection limit	50	50	0.5	0.5	0.5	0.5	50
Method of Analysis	5030 / 8015	3510 / 8015	602	602	602	602	3510 / 8015

David Duong
Laboratory Director

PEL # 9208017

INV # 22988

CHAIN OF CUSTODY RECORD

PROJECT NAME AND ADDRESS:
O'LAUGHLIN
SUNOL, CA

SAMPLER: (Signature)

HAGEMAN - AGUIAR, INC.
3732 Mt. Diablo Blvd., Suite 372
Lafayette, CA 94549
(415)284-1661 (415)284-1664 (FAX)

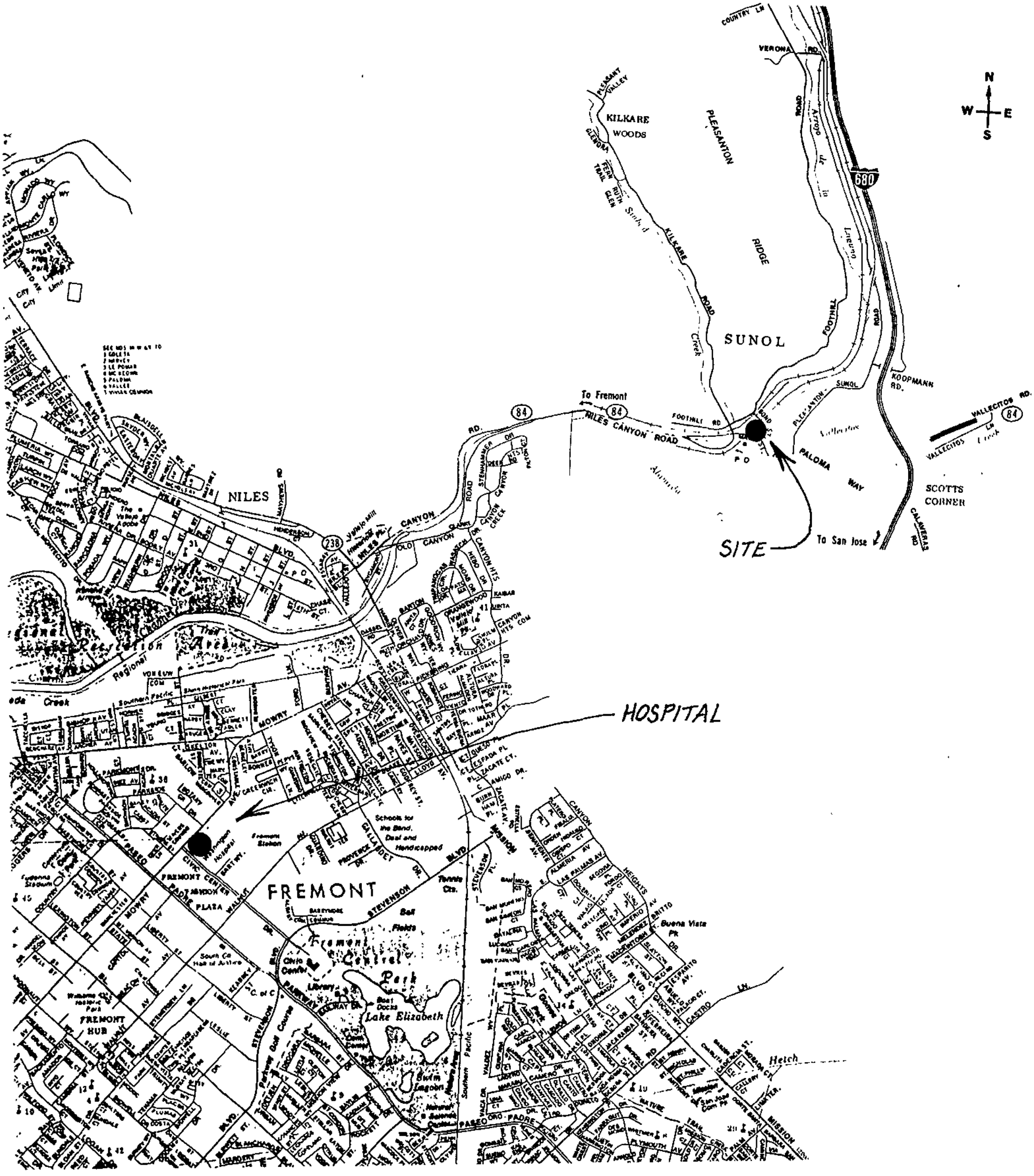
ANALYSIS REQUESTED

CROSS REFERENCE NUMBER	DATE	TIME	SOIL	WATER	STATION LOCATION		TPH GAS	BTXE	TPH DIESEL				REMARKS
MW 1	8-10-92	1105		X	MONITORING WELL # 1		X	X	X				NORM TAT

RELINQUISHED BY: (Signature)	DATE 8-10-92 TIME 1225	RECEIVED BY: (Signature)	DATE TIME
RELINQUISHED BY: (Signature)	DATE TIME	RECEIVED BY: (Signature)	DATE TIME
RELINQUISHED BY: (Signature)	DATE TIME	RECEIVED BY: (Signature)	DATE TIME
RELINQUISHED BY: (Signature)	DATE TIME	RECEIVED FOR LABORATORY BY: (Signature)	DATE 08/10/92 TIME 12.25

ATTACHMENT C

SITE SAFETY PLAN


N
W
E
S
680
COUNTRY LN
VERONA RD
PLEASANT VALLEY
KILKARE WOODS
PLEASANTON RIDGE
KILKARE ROAD
Sinbad Creek
FOOTHILL ROAD
Arroyo de la Laguna
SUNOL
KOOPMANN RD.
VALLECITOS RD.
84
To Fremont
NILES CANYON ROAD
FOOTHILL RD
P O
PALOMA WAY
SCOTTS CORNER
CALAVERAS RD
To San Jose
SITE
NILES
238
NILES CANYON RD.
HOSPITAL
Washington Hospital
Fremont Station
Schools for the Blind, Deaf and Handicapped
FREMONT
MOWRY AV
PASEO PADRE PKWY
FREMONT CENTER
MISSION BLVD
STEVENSON BLVD
Fremont Central Park
Lake Elizabeth
FREMONT HUB
Southern Pacific
Regional

SITE HAZARD INFORMATION

FC 1006 (05-11-90)

***PLEASE PROVIDE THE FOLLOWING INFORMATION FOR THE SITE**

Owners Name: Jim O'Laughlin

Site Address: 11727 Main Street
Sunol, CA

Directions to Site:

Consultant On Site: Hageman-Aguiar, Inc. Phone Number: (510) 284-1661

Site Safety Officer: Gary Aguiar Phone Number: (510) 284-1661

Type of Facility: vacant lot, previous service station Mobile Phone: 415-710-2844

Site Activities: ☒ Drilling ☐ Construction ☐ Tank Excavation ☐ Soil Excavation ☐ Work in Traffic Area
☐ Groundwater Extraction ☐ Vapor Extraction ☐ In Situ Remediation ☐ Above Ground Remediation
☐ Other:

Hazardous Substance

Name (CAS#)	Expected Concentration ☒ Soil ☐ Water ☐ Air	Health Affects
Gasoline	< 1,000 mg/kg (ppm)	dizziness, eye irritation,
Diesel	< 1,000 mg/kg (ppm)	headache, nose & throat irrit.

Physical Hazards

☒ Noise
☐ Traffic
☐ Underground Hazards
☐ Overhead Hazards
☐ Excavations/Trenches
☐ Other

Potential Explosion and Fire Hazards (Flammable Range = 1% to 10% Gas Vapor):

Level Of Protection Equipment

☐ A ☐ B ☒ C ☒ D ☐ See Personal Protective Equipment

Personal Protective Equipment

R = Required A = As Needed

R Hard Hat
R Safety Boots
Orange Vest
A Hearing Protection
A Tyvek Coveralls
5 Minute Escape Respirator

R Safety Eyewear (Type)
A Respirator (Type) half-face
Filter (Type) carbon (organic vapor)
R Gloves (Type) Rubber
Other

SITE HAZARD INFORMATION

FC 1006 (05-11-90)

Monitoring Equipment on Site

☐ Organic Vapor Analyzer
☒ Oxygen Meter
☒ Combustible Gas Meter
☐ H_2S Meter
☐ W.B.G.T.

☐ PID with lamp of ______ eV
☐ Draeger Tube ______
☐ Passive Dosimeter
☐ Air Sampling Pump
☐ Filter Media ______

Site Control Measures FID meter on-site. Public access restricted by existing perimeter fencing

Decontamination Procedures Equipment steam-cleaned on-site. Rinseate stored in DOT 17H drums. Gloves, tyvek suits to be disposed of with drill cuttings. Personnel to wash with soap and water prior to eating and/or leaving site.

Hospital/Clinic Washington Hospital
Phone (510) 791-3430 (24-hr emergency #)
Hospital Address 2000 Mowry Avenue, Fremont

Paramedic 911
Fire Dept. 911
CDF Fire Stn 862-2197
Police Dept. 911
Sheriff 833-6670

Emergency/Contingency Plans & Procedures ______

Site Hazard Information Provided By: Gary Aguiar
Print
Gary Aguiar
Signature

Phone Number: (510)284-1661
Date: 8/28/92

HEALTH AND SAFETY PROCEDURES
FOR
FIELD INVESTIGATION OF UNDERGROUND SPILLS OF MOTOR OIL AND PETROLEUM DISTILLATE FUEL

1.0 PURPOSE

This operating procedure established minimum procedures for protecting personnel against the hazardous properties of motor oil and petroleum distillate fuels during the performance of field investigations of known and suspected underground releases of such materials. The procedure was developed to enable health and safety personnel and project managers to quickly prepare and issue site safety plans for investigations of such releases.

2.0 APPLICABILITY

This procedure is applicable to field investigations of underground releases of the substances listed below and involving one or more of the activities listed below.

Substances

Motor oil (used and unused)
Leaded and unleaded gasoline
No. 1 Fuel oil (kerosene, JP-1)
No. 1-D Fuel oil (light diesel)
No. 2 Fuel oil (home heating oil)
No. 2-D Fuel oil (medium diesel)
No. 4 Fuel oil (residual fuel oil)
No. 5 Fuel oil (residual fuel oil)
No. 6 Fuel oil (Bunker C fuel oil)
JP-3, 4 & 5 (jet fuels)
Gasahol

Activities

Collection of samples of subsurface soil with aid of truck-mounted drill rig, hand-held power auger or hand auger.

Construction, completion and testing of groundwater monitoring wells.

Collection of groundwater samples from new and existing wells.

Observing removal of underground fuel pipes and storage tanks.

This procedure must not be used for confined space entry (including trench entry) or for installing or operating pilot and full-scale fuel recovery systems.

No safety plans needed for non-intrusive geophysical surveys, reconnaissance surveys and collection of surface soil, surface water and biota.

3.0 RESPONSIBILITY AND AUTHORITY

Personnel responsible for project safety are the Business Unit Health and Safety Officer (HSO), the Project Manager (PM) and the Site Safety Officer (SSO).

The HSO is responsible for reviewing and approving site safety plans and any addenda and for advising both PM and SSO on health and safety matters. The HSO has the authority to audit compliance with the provisions of site safety plans. suspend work or modify work practices for safety reasons, and to dismiss from the site any individual whose conduct on site endangers the health and safety of others.

The PM is responsible for having site safety plans prepared and distributing them to all field personnel and to an authorized representative of each firm contracted to assist with on-site work. The PM is also responsible for ensuring that the provisions of safety plans and their addenda are carried out.

The SSO is responsible for assisting the PM with on site implementation of site safety plans. Responsibilities include:

1. Maintaining safety equipment supplies.
2. Performing or supervising air quality measurements.
3. Directing decontamination operations and emergency response operations.
4. Setting up work zone markers and signs if such zones are specified in the site safety plan.
5. Reporting all accidents, incidents and infractions of safety rules and requirements.
6. Directing other personnel to wear protective equipment when use conditions described in Section 5.0 are met.

The SSO may suspend work anytime he/she determines that the provisions of the site safety plan are inadequate to ensure worker safety and inform the PM and HSO of individuals who on-site behavior jeopardizes their health and safety or the health and safety of others.

4.0 HAZARD EVALUATION

Motor oil and petroleum distillate fuels are mixtures of aliphatic and aromatic hydrocarbons. The predominant classes of compounds in motor oil, gasoline, kerosene and jet fuels are the paraffins (e.g., benzene, toluene). Gasoline contains about 80 percent paraffins, 6 percent naphthenes, and 14 percent aromatic. Kerosene and jet fuels contain 42-48 percent paraffins, 36-38 percent naphthenes, and 16-20 percent aromatic. Diesel fuels and heating oils contain less than 10 percent paraffins, 14-23 percent naphthenes, and 68-78 percent non-volatile aromatic. These heavier fuels contain almost no volatile aromatic compounds. Chemicals are usually added to automotive and aviation fuels to improve their burning properties. Examples are tetraethyl-lead and ethylene dibromide. Most additives are proprietary materials.

Flammability

Crude oil and petroleum distillate fuels possess two intrinsic hazardous properties, namely, flammability and toxicity. The flammable property of the oil and fuels presents a far greater hazard to field personnel than toxicity because it is difficult to protect against and can result in catastrophic consequences. Being flammable, the vapors of volatile components of crude oil and the fuels can be explosive when confined.

The lower flammable or explosive limits (LFL or LEL) of the fuels listed in SEction 508.2 range from 0.6 percent for JP-5 to 1.4 percent for gasolines. LFL and LEL are synonyms. Flash points range from -36°F for gasoline to greater than 150°F for No. 6 fuel oil. JP-5 has a flash point of 140°F. Although it has a lower LEL than gasoline, it can be considered less hazardous because its vapors must be heated to a higher temperature to ignite.

Crude oil and petroleum distillate fuels will not burn in the liquid form; only the vapors will burn and only if the vapor concentration is between the upper and lower flammable limits, sufficient oxygen is present, and an ignition source is present. If these conditions occur in a confined area an explosion may result.

The probability of fire and explosion can be minimized by eliminating any one of the three factors needed to produce combustion. Two of the factors -- ignition source and vapor concentration -- can be controlled in many cases. Ignition can be controlled by prohibiting open fires and smoking on site, installing spark arrestors on drill rig engines, and turning the engines off when LELs are approached. Vapor concentrations can be reduced by using fans. In fuel tanks, vapor concentrations in the head space can be reduced by introducing dry ice (solid carbon dioxide) into the tank; the carbon dioxide gas will displace the combustible vapors.

Toxicity

Crude oil and petroleum distillate fuels exhibit relatively low acute inhalation and dermal toxicity. Concentrations of 160 to 270 ppm gasoline vapor have been reported to cause eye, nose and throat irritation after several hours of exposure. Levels of 500 to 900 ppm can cause irritation and dizziness in one hour, and 2000 ppm produces mile anesthesia in 30 minutes. Headaches have been reported with exposure to 25 ppm or more of gasoline vapors measured with a photoionization meter. Most fuels, particularly gasoline, kerosene and jet fuels are capable of causing skin irritation after several hours contact with the skin.

Petroleum fuels exhibit moderate oral toxicity. The lethal dose of gasoline in children has been reported to be as low as 10-15 grams (2-3 teaspoons). In adults, ingestion of 20-50 grams of gasoline may produce severe symptoms of poisoning. If liquid fuel aspirated (passed in to the lungs) gasoline and other petroleum distillate fuels may cause secondary pneumonia.

Some of the additives to gasoline, such as ethylene dichloride, ethylene dibromide, and tetraethyl and tetramethyl lead,are highly toxic; however, they are present in such low concentrations that their contribution to the overall toxicity of gasoline and other fuels is negligible in most instances.

OSHA has not developed permissible workplace exposure limits for crude oil and petroleum distillate fuels. It recommends using permissible exposure limits for individual components, such as benzene. ACGIH has established a permissible exposure limit of 300 ppm for gasoline. The limit took into consideration the average concentration of benzene in gasoline (one percent) as well as its common additives. Exposure limits established by other countries range from 250 to 500 ppm. Chemical data sheets, prepared for the U.S. Coast Guard's Chemical Hazard Information System (CHRIS), list 200 ppm as the permissible exposure limit for kerosene and jet fuels. This limit was not developed by NIOSH/OSHA or ACGIH.

5.0 HEALTH AND SAFETY DIRECTIVES

5.1 Site-Specific Safety Briefing

Before field work beings, all field personnel, including subcontractor employees, must be briefed on their work assignments and safety procedures contained in this document.

5.2 Personal Protective Equipment

The following equipment should be available on-site to each member of the field team:

- NIOSH-approved full or half-face respirator with organic vapor cartridges (color coded black)
- Saranex or polyethylene-coated Tyvek coveralls
- Splash-proof safety goggles
- Nitrile or neoprene gloves
- Neoprene or butyl boots, calf-length with steel toe and shank
- Hardhat

Equipment Usage

Chemical-resistant safety boots must be worn during the performance of work where surface soil is obviously contaminated with oil or fuel, when product quantities of oil or fuel are likely to be encountered, and within 10 feet of operating heavy equipment.

Respirators must be worn whenever total airborne hydrocarbons levels in the breathing zone of field personnel reach or exceed a 15-minute average of 25 ppm. If total airborne hydrocarbons in the breathing zone exceeds 100 ppm, work must be suspended, personnel directed to move a safe distance from the source, and the HSO or designee consulted.

Chemical resistant gloves must be worn whenever soil or water known or suspected of containing petroleum hydrocarbons is collected or otherwise handled.

Chemical resistant coveralls must be worn whenever product quantities of fuel are actually encountered and when oil or fuel-saturated soil is handled.

Safety goggles must be worn when working within 10 feet of any operating heavy equipment (e.g., drill rig, backhoe). Splash-proof goggles or face shields must be worn whenever product quantities of oil or fuel are encountered.

Hardhats must be worn when working within 10 feet of an operating drill rig, backhoe or other heavy equipment.

Operators of some facilities, such as refineries, often require all personnel working within facility boundaries to wear certain specified safety equipment. Such requirements shall be strictly observed

5.3 Vapor Monitoring

Required Equipment

--- Organic vapor meter with flame or photoionization detector
--- Combustible gas meter

Monitoring Requirements and Guidelines

Vapor monitoring shall be performed as often as necessary and whenever necessary to protect field personnel from hazardous vapors. Monitoring must be performed by individuals trained in the use and care of the monitoring equipment.

During drilling operations, vapor emissions from boreholes must be measured whenever the auger is removed from the boring and whenever flights are added or removed from hollow-stem augers. This requirement does not apply to borings less than five feet deep and borings of any depth made to install monitoring wells in uncontaminated soils. Measurements should be made initially with an organic vapor meter, followed with a combustible gas meter if vapor levels exceed the highest concentration measurable with the organic vapor meter.

Initially measurements shall be made about 12 inches from the bore hole, both upwind and downwind positions. If the total hydrocarbon concentrations exceed the respirator use action level (See Section 508.5.2), measurements must be made in the breathing zone of the individual(s) working closest to the borehole. Decisions regarding respiratory protection should be made using vapor concentrations in the breathing zone.

Organic vapor meters capable of being operated continuously without attention may be operated in that fashion if desired. However, the instrument must be equipped with an alarm set to sound when vapor concentrations reach 25 ppm and must be protected against physical damage and soilage.

If total organic vapor concentrations within 12 inches of the borehole exceed the capacity of the organic vapor meter, a combustible gas meter (CGM) must be used to determine if explosive conditions exist. Operations must be suspended, the drill rig motor shut down, and corrective action taken if combustible gas concentrations reach 40 percent of LEL within a 12-inch radius of the borehole or 10 percent of LEL at a distance greater than 24 inches from the borehole. This procedure must also be followed whenever the organic vapor meter goes offscale at its highest range and no CGM is available. If corrective action cannot be taken, field personnel and all other individuals in the vicinity of the borehole must be directed to move to a safe are and the local fire department and facility management must be alerted.

Organic vapor meters with flame ionization detectors (FID) are much more sensitive to paraffins, with the major component of gasoline, kerosene, and jet fuels, then are meters with 10.0 or 10.2 eV photoionization detectors. As the data in Table 1 show, an FID instrument, such as the Century Systems OVA (Foxboro Analytical), will detect 70-90 percent of actual paraffin concentrations, whereas PID instruments, such as the HNU Model PI-101, AID Model 580, and Photovac TIP with 10.0 to 10.2 eV lamp will detect only 17-25 percent of actual paraffin concentrations when calibrated with benzene and only 24-35 percent when calibrated with isobutylene. Both types of meters are equally sensitive to most aromatic, including benzene, toluene, xylene and ethylbenzene. For these compounds, meter readings equal or exceed 100 percent of actual concentrations. PIDs with 11.7 eV lamps are extremely sensitive to paraffins and aromatic. When calibrated to isobutylene, an 11.7 eV PID will register about twice actual paraffin concentrations and 100 percent or more of actual concentrations of benzene, toluene, and xylene.

An FID meter, recently calibrated with methane and in good working condition, can be expected to provide readings close enough to actual petroleum hydrocarbon concentrations to make corrections unnecessary. Value obtained with a PID must be corrected when measuring for paraffins. For 10.0 and 10.2 eV PIDs, the meter reading should be multiplied by 5 if the instrument is calibrated with benzene. If the instrument is calibrated with isobutylene, the meter readings should be multiplied by 3. If the instrument is equipped with an 11.7 eV probe and is calibrated with isobutylene, the meter reading should be divided by 2.

5.4 Area Control

Access to hazardous and potential hazardous areas of spill sites must be controlled to reduce the probability of occurrence of physical injury and chemical exposure of field personnel, visitors and the public. A hazardous or potentially hazardous area includes any area where

1. Field personnel are required to wear respirators.

2. Borings are being drilled with powered augers.

3. Excavating operations with heavy equipment are being performed.

The boundaries of hazardous and potentially hazardous areas must be identified by cordons, barricades, or emergency traffic cones or posts, depending on conditions. If such areas are left unattended, signs warning of the danger and forbidding entry must be placed around the perimeter if the areas are accessible to the public. Trenches and other large holes must be guarded with wooded or metal barricades spaced no further than 20 feet apart and connected with yellow or yellow and black nylon tape not less and 3/4-inches wide. The barricades must be placed no less than two feet from the edge of the excavation or hole.

Entry to hazardous areas shall be limited to individuals who must work in those areas. Unofficial visitors must not be permitted to enter hazardous areas while work in those areas is in progress. Official visitors should be discouraged from entering hazardous areas, but may be allowed to enter only if they agree to abide by the provisions of this document, follow orders issued by the site safety officer and are informed of the potential dangers that could be encountered in the areas.

5.5 Decontamination

Field decontamination of personnel and equipment is not required except when contamination is obvious (visually or by odor). Recommended decontamination procedures follow:

Personnel

Gasoline, kerosene, jet fuel, heating oil, gasahol and diesel oil should be removed from skin using a mild detergent and water. Hot water is more effective than cold. Liquid dishwashing detergent is more effective than hand soap. Motor oil and the heavier fuel oils (No. 4-6) can be removed with dishwashing detergent and hot ware also; however, if weathered to an asphaltic condition, mechanic's waterless hand cleaner is recommended for initial cleaning followed by detergent and water.

Equipment

Gloves, respirators, hardhats, boots and goggles should be cleaned as described under personnel; however, if boots do not become clean after washing with detergent and water, wash them with a strong solution of trisodium phosphate and hot water and, if this fails, clean them with diesel oil followed by detergent and water to remove diesel oil.

Sampling equipment, augers, vehicle undercarriages and tires should be steam cleaned. The steam cleaner is a convenient source of hot water for personnel and protective equipment cleaning.

5.6 Smoking

Smoking and open flames are strictly prohibited at sites under investigation.

TABLE 1
RELATIVE SENSITIVITIES OF FID AND PID INSTRUMENTS TO SELECTED COMPONENTS OF OILS AND PETROLEUM DISTILLATE FUELS

	Sensitivity in Percent of Standard		
	FID	PID	
Component		10.2 eV[a]	11.7 eV[b]
Paraffins			
Pentane	65	--	141
Hexane	70	22 (31)	189
Heptane	75	17 (24)	221
Octane	80	25 (35)	--
Nonane	90		--
Decane	75	--	--
Napthenes			
Cyclopentane	--	--	--
Methylcyclopentane	80	--	--
Cyclohexane	85	34 (40)	--
Methylcyclohexane	100	--	--
Aromatic			
Benzene	150	100 (143)	122
Toluene	110	100 (143)	100
Ethylbenzene	100	--	--
p-Xylene	116	114 (60)	--
Cumene	100	--	--
n-Propylbenzene	--	--	--
Napthaeine	--	--	--

[a] Values are relative to benzene standard. Values in parentheses are relative to isobutylene standard and were calculated.

[b] Values are relative to isobutylene standard.