HAGEMAN-AGUIAR, INC.
Environmental & Water Resources Engineering
Groundwater Consultants

January 7, 2000

Barney Chan
Alameda County Environmental Health
1131 Harbor Bay Parkway
2nd Floor
Alameda, CA 94502

Re: Golden Gate Petroleum
421-23rd Ave, Oakland, CA

Dear Mr. Chan:

On behalf of Golden Gate Petroleum, please find enclosed a copy of the "*Proposed Workplan for Subsurface Investigation, Golden Gate Petroleum, 421-23rd Avenue, Oakland, California*" by Hageman-Aguiar, Inc., dated January 7, 2000.

If you have any questions, please contact me at (510)620-0891.

Gary Aguiar
Principal Engineer

HAGEMAN-AGUIAR, INC.
Environmental & Water Resources Engineering
Groundwater Consultants

PROPOSED WORKPLAN
FOR
SUBSURFACE INVESTIGATION

GOLDEN GATE PETROLEUM

421 - 23rd Avenue
Oakland, California

January 7, 2000

11100 SAN PABLO AVE., SUITE 200-A, EL CERRITO, CALIFORNIA 94530 • TEL 510-620-0891 • FAX 510-620-0894

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I. INTRODUCTION

The subject site is the Golden Gate Petroleum Oakland Cardlock located at 421-23rd Avenue in Oakland, California. The location of the site is shown in Figure 1.

Background Information

The site has been a service station since 1976. In August 1998, five single walled underground storage tanks, associated piping and dispenser islands were removed from the property. The underground storage tanks were used for the storage of premium unleaded gasoline, regular unleaded gasoline and diesel fuel. The underground storage tanks were replaced with two 20,000 gallon double walled fiberglass underground storage tanks.

During the tank removal activities, approximately 1,300 cubic yards of hydrocarbon impacted soil was excavated and removed from the site. In addition, approximately 28,000 gallons of groundwater and separate phase hydrocarbons were removed.

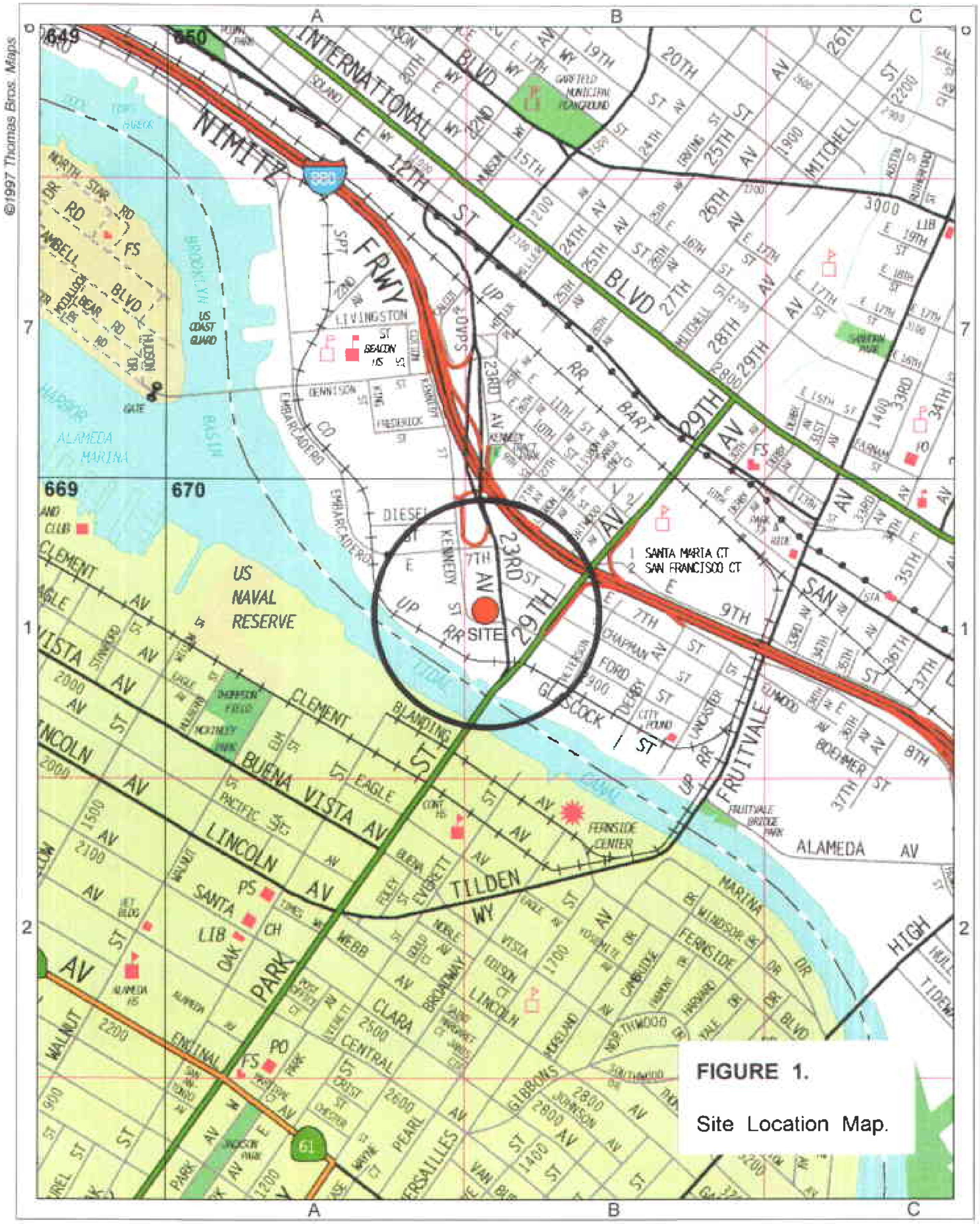

FIGURE 1.

Site Location Map.

SITE: 421-23rd Ave, Oakland, CA, Page & Grid 670 B1

Results of Previous Subsurface Investigation

In October & November 1999, a subsurface investigation was conducted by Hageman-Aguiar, Inc. The results of this investigation were presented in the "*Report Of Subsurface Investigation, Golden Gate Petroleum, 421-23rd Avenue, Oakland, California*" by Hageman-Aguiar, Inc., dated November 23, 1999. The investigation included the collection of soil and "grab" groundwater samples from eight "Geoprobe" borings and the installation and sampling of four shallow groundwater monitoring wells.

The results of the investigation indicated that relatively effective contaminant source removal was achieved at the time of the previous underground tank removals and over-excavation activities. The data did indicate, however, that elevated concentrations of Diesel, Gasoline and MTBE are presence in the shallow groundwater beneath the site. Each respective concentration plume configuration was found to be consistent with the measured shallow groundwater flow direction beneath the site. Off-site migration of dissolved petroleum constituents in the shallow groundwater is clearly indicated.

Hydrogeology

Based upon the data obtained from the various soil borings and monitoring well installations that have been conducted, the subject property is underlain by the site is largely underlain by Clay (CL-CH), with the shallow groundwater found to occur in thin layers of Clayey Sand (SC) and Clayey Sand & Gravel (GC). Saturated soils ~~were~~ are typically first encountered at depths ranging between 11 and 15 feet below ground surface, followed by a rise in the borehole water level.

Static shallow groundwater table elevations were found to range between 8.25 and 9.65 below ground surface. The shallow groundwater flow was determined to be in a southwesterly direction, toward the Oakland Inner Harbor. This flow direction is indicated in Figure 2 (site vicinity map), and is consistent with the predicted regional groundwater movement.

Purpose of Proposed Workplan

The purpose of this proposed workplan is to further delineate the extent of dissolved petroleum constituents in the shallow groundwater down-gradient of the site. This proposed workplan is provided in response to a request by Barney Chan, Alameda County Environmental Health, in a letter to Golden Gate Petroleum, dated November 30, 1999. A copy of that letter is included in Attachment A.

Following the completion of this proposed investigation, the following future tasks are anticipated for the site:

1) Conduct a sensitive receptors survey (wells and surface water bodies).

2) Conduct a conduit study to determine if any preferential pathways exist for groundwater migration.

3) Prepare a risk assessment in accordance with ASTM Standard E-1739, including an ecological risk assessment due to the proximity of the Oakland-Alameda estuary.

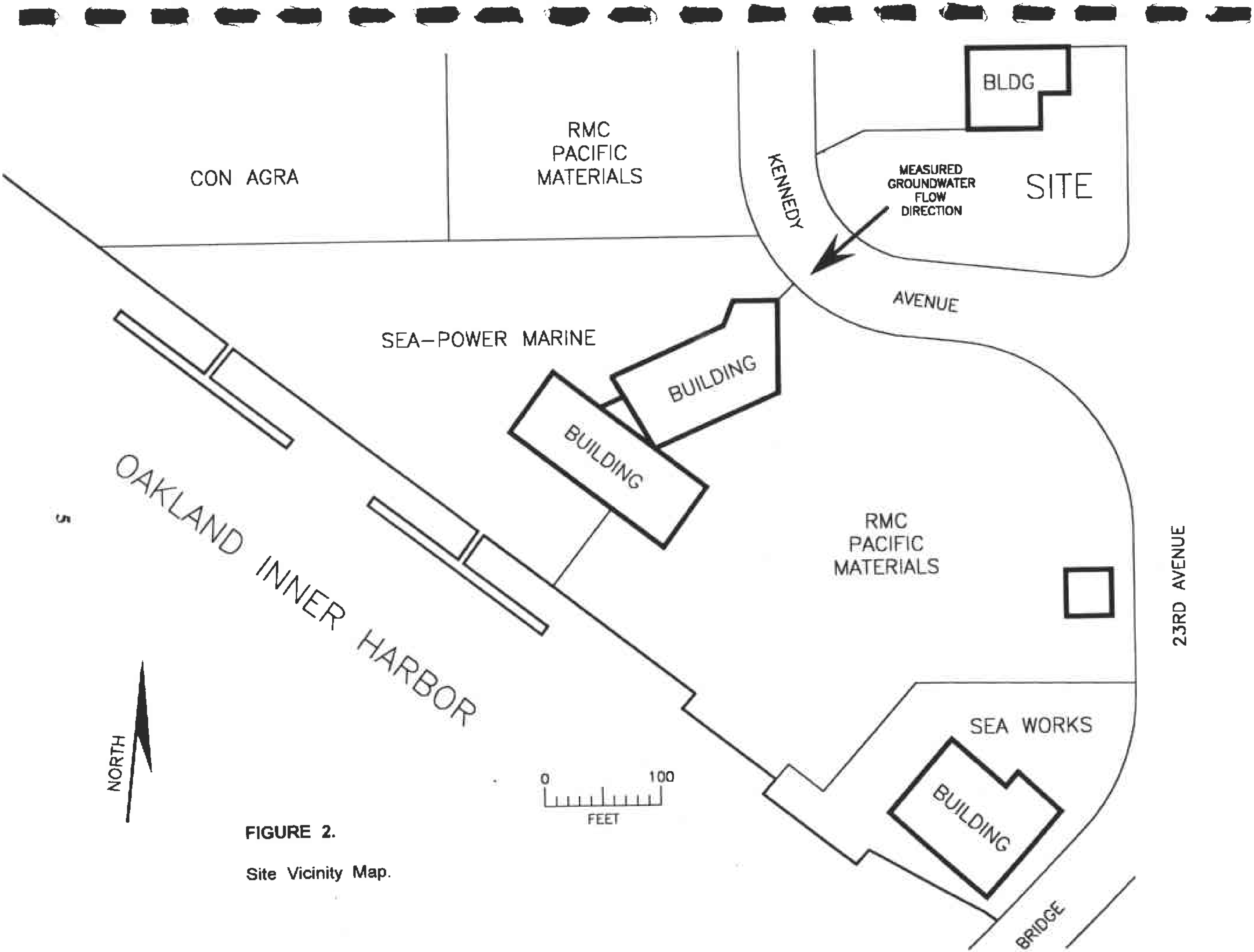

FIGURE 2.

Site Vicinity Map.

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II. PROPOSED SCOPE OF WORK

Monitoring Well Locations

The proposed groundwater monitoring wells are shown in Figure 3. The locations have been selected based upon 1) the measured shallow groundwater flow direction, 2) the known configurations of the dissolved petroleum hydrocarbon plumes in the shallow groundwater, 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.

Permits

Prior to conducting the field work at the site, a drilling permit will be obtained from the Alameda County Public Works Agency.

Since the monitoring wells will be located in the City right-of-way, additional City of Oakland encroachment and excavation permits will have to be obtained prior to the commencement of the field work.

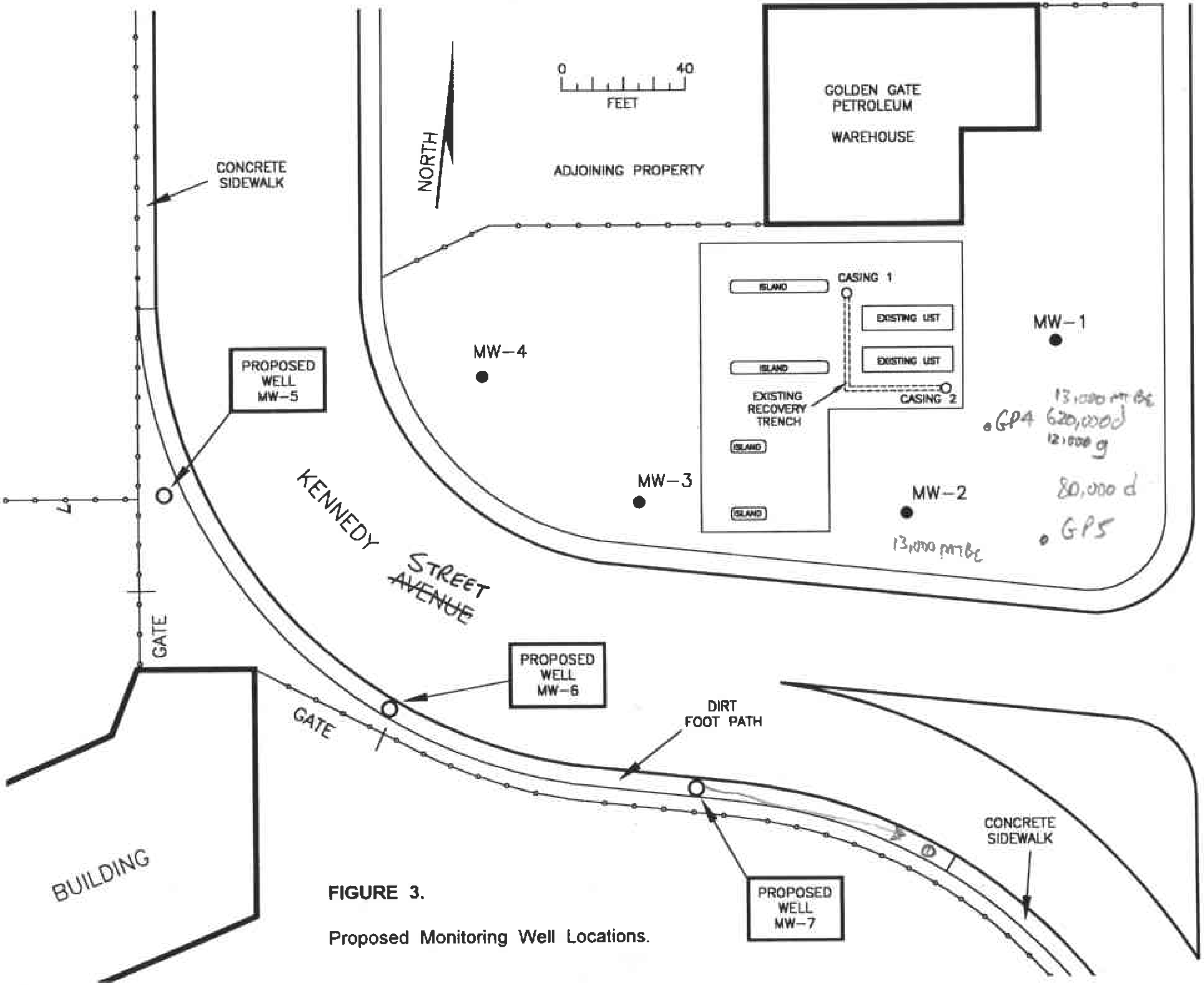


FIGURE 3.

Proposed Monitoring Well Locations.

Monitoring Well Installations

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 10 feet below the ground surface. 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 samples will be immediately placed on ice, then transported under chain-of-custody to the laboratory at the conclusion of the well installation field work.

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 typical Well Construction Diagram is shown in Figure 4.

Equipment Decontamination

Prior to the drilling of each boring, all drilling equipment, including augers and drill rods will be steam-cleaned. All split-barrel samplers, brass tubes, and other sampling equipment will be decontaminated by washing in a water and TSP solution.

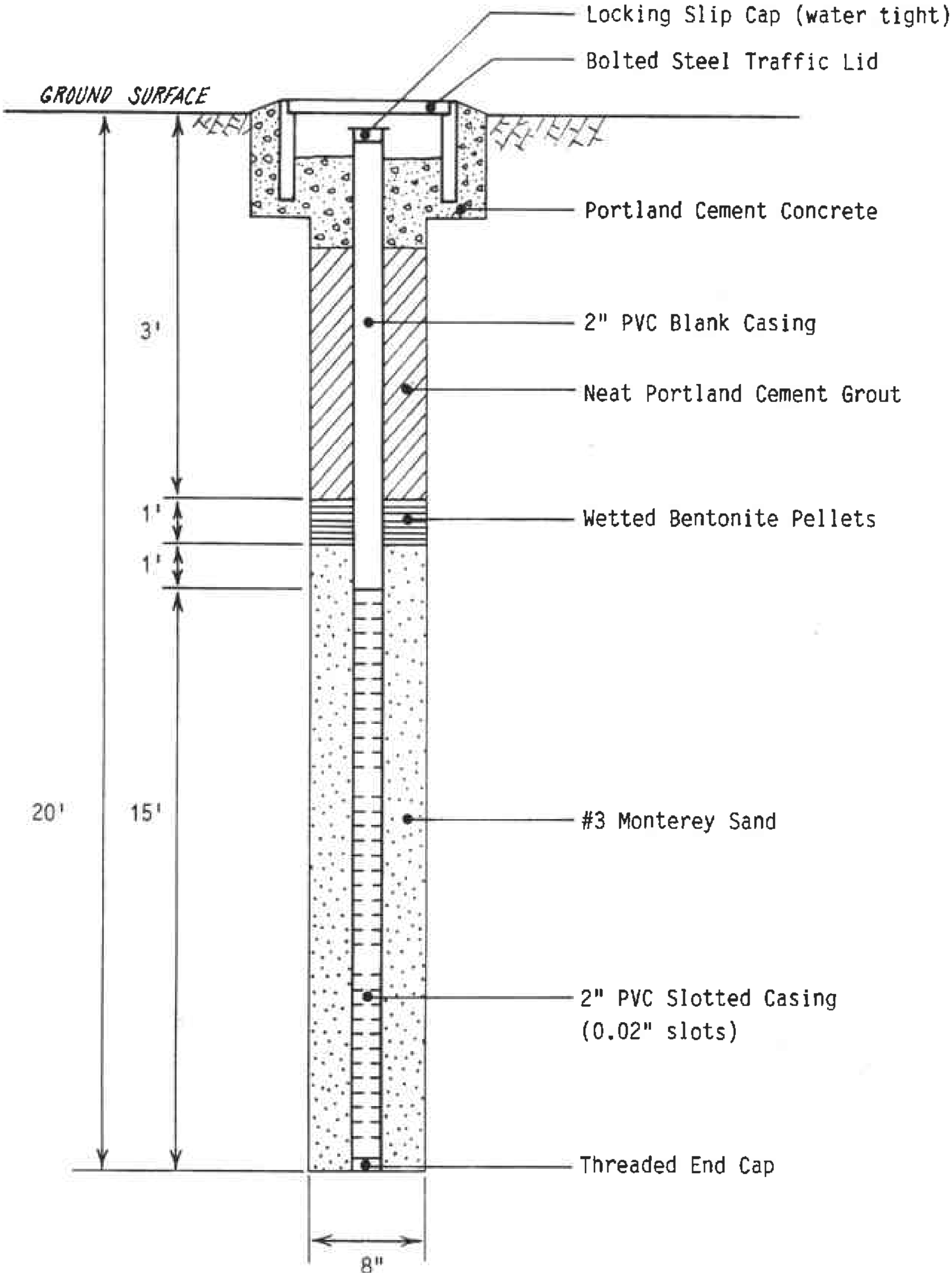


FIGURE 4.

Typical Well Construction.

Any 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.

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 by hand bailing until the water is relatively clear, or until the apparent turbidity of the water being removed has stabilized. In addition to hand bailing, a surge block is typically used during the development process.

Groundwater sampling shall not occur less than 24 hours after well development. Prior to groundwater sampling, all 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. Groundwater samples will subsequently be collected using new disposable sampling bailers. The water samples will be placed inside appropriate 40 mL VOA vials and 1-liter amber bottles free of any headspace. The samples 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.

Top-of-Casing Survey

In order to determine the shallow groundwater flow direction, the top-of-casing elevation at each new monitoring well will be surveyed to within 0.01 feet Mean Sea Level (MSL), using the previously surveyed top-of-casing elevations of the existing on-site monitoring wells as reference points.

Waste Generation

All soil cuttings will be drummed and stored on-site until the results of laboratory analyses are obtained. In addition, all water and other liquid waste collected during the well installation and purging activities will be drummed and stored on-site. The soil cuttings and wastewater will be subsequently transported by a licensed waste hauler to an appropriate TSD facility for treatment and/or disposal.

III. LABORATORY ANALYSIS

All analyses will be conducted by a California State DOHS certified in accordance with EPA recommended procedures.

Selected soil samples were analyzed for:

1) Total Petroleum Hydrocarbons as Gasoline (EPA method 8015M).
2) Total Petroleum Hydrocarbons as Diesel (EPA method 8015M).
3) Benzene, Toluene, Ethylbenzene, Total Xylenes and MTBE (EPA method 8020).

All groundwater samples were analyzed for:

1) Total Petroleum Hydrocarbons as Gasoline (EPA method 8015M).
2) Total Petroleum Hydrocarbons as Diesel (EPA method 8015M).
3) Benzene, Toluene, Ethylbenzene, Total Xylenes and MTBE (EPA method 8020).

IV. REPORT

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

1) a map showing monitoring well locations.
2) soil and formation conditions.
3) geologic logs.
4) depths to groundwater.
5) results of laboratory analyses.
6) groundwater plume definitions.
7) conclusions and recommendations.

V. SITE SAFETY PLAN

A site-specific set of health and safety operating procedures is included in Attachment B. 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 any contamination encountered.

VI. TIME SCHEDULE

TASK	COMPLETION DATE
1) Permitting	February 15, 2000
2) Monitoring Well Installation	February 28, 2000
3) Well Development	March 5, 2000
4) Well Sampling	March 10, 2000
5) Laboratory Results	March 20, 2000
6) Data Analysis, Final Report	March 31, 2000

PROPOSED WORKPLAN FOR SUBSURFACE INVESTIGATION

GOLDEN GATE PETROLEUM

421 - 23rd Avenue, Oakland, CA

January 7, 2000

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

EXP. 9-30-03

Gary Aguiar RCE 34262

ATTACHMENT A

Correspondence

ALAMEDA COUNTY
HEALTH CARE SERVICES
AGENCY
DAVID J. KEARS, Agency Director

ENVIRONMENTAL HEALTH SERVICES
ENVIRONMENTAL PROTECTION (LOP)
1131 Harbor Bay Parkway, Suite 250
Alameda, CA 94502-6577
(510) 567-6700
FAX (510) 337-9335

November 30, 1999
StID # 191

Mr. Harvey Brook
Golden Gate Petroleum
1001 Galaxy Way, Suite 308
Concord, CA 94520

Re: Report of Subsurface Investigation at Golden Gate Petroleum, 421-23rd Ave., Oakland CA 94606

Dear Mr. Brook:

Our office has received and reviewed the November 23, 1999 Hageman-Aguiar (HA) report referenced above. This report gives the results of soil and groundwater samples taken from the recent geoprobe borings and monitoring wells advanced at this site. The work plan followed was that by Bonkowski & Associates, previously provided and approved, with slight changes.

Our office concurs with the following HA observations:

- Soil contamination appears confined to the area southeast of the existing underground tanks and pump islands, with the highest concentrations being found in the boring from MW-2.
- The gasoline, diesel and MTBE plumes appear to be concentrated in the same southeast direction from the existing underground tanks. The limits of these contaminants in groundwater have not been defined and it is assumed that the contamination has migrated off-site.
- The general groundwater gradient from the initial monitoring event indicates a southwest direction ,however, given the groundwater results, a southeasterly direction may also exist.
- There's a relative absence of benzene in both soil and groundwater.
- The groundwater samples from the extraction casings exhibited relative low gasoline, diesel and BTEX with slightly elevated MTBE. Given these results, HA believes that the soil and groundwater removal performed during the tank removals has had a significant impact in removing petroleum contamination. They, therefore, do not recommend using the extraction casings for remediation purposes.

HA, in their November 24, 1999 cover letter has the following recommendations:

- Conduct additional subsurface investigation down-gradient of the site
- Conduct a sensitive receptors survey (wells and surface water bodies)
- Conduct quarterly monitoring and
- Prepare a risk assessment in accordance with ASTM Standard E-1739.

Our office agrees with these recommendations. We also have the following concerns:

- You should also perform a conduit study to determine if any preferential pathways exist for groundwater migration.
- Your risk assessment should also include an ecological risk assessment due to the proximity of the Oakland-Alameda estuary.
- If groundwater monitoring confirms the presence of elevated MTBE concentrations, some type of active remediation must be proposed. Therefore, you cannot rule out the possibility of using the extraction trench and casings installed by Bonkowski & Associates.

Please provide comment to this letter and provide a work plan for your off-site investigation to our office within 30 days or no later than January 3, 2000.

You may contact me at (510) 567-6765 if you have any questions.

Sincerely,

Barney M. Chan

Barney M. Chan
Hazardous Materials Specialist

C: B. Chan, files
Mr. G.Aguiar, Hageman-Aguiar, Inc., 11100 San Pablo Ave., Suite 200-A, El Cerrito, CA 94530
Mr. M. Owens, SWRCB Cleanup Fund, 2014 T St., Suite 130, Sacramento, CA 94244-2120
Add Wp421-23rd

HAGEMAN-AGUIAR, INC.
Environmental & Water Resources Engineering
Groundwater Consultants

December 31, 1999

Barney Chan
Alameda County Environmental Health
1131 Harbor Bay Parkway
2nd Floor
Alameda, CA 94502

Re: Golden Gate Petroleum
421-23rd Ave, Oakland, CA

Dear Mr. Chan:

This letter is to advise you of our progress in the preparation of the workplan for additional subsurface investigation down-gradient of the site (off-site investigation). We are in the process of finalizing the exact locations of the proposed off-site monitoring wells and shortly we will be providing a draft copy of the workplan to Golden Gate Petroleum for their review. We expect to deliver the completed workplan to your office by Friday, January 7, 1999.

If you have any questions, please contact me at (510)620-0891.

Gary Aguiar
Principal Engineer

11100 SAN PABLO AVE., SUITE 200-A, EL CERRITO, CALIFORNIA 94530 • TEL 510-620-0891 • FAX 510-620-0894

ATTACHMENT B

Health & Safety Plan

SITE HAZARD INFORMATION

FC 1006 (05-11-90)

PLEASE PROVIDE THE FOLLOWING INFORMATION FOR THE SITE

Owners Name: Golden Gate Petroleum

Site Address: 421 - 23rd Avenue
Oakland, California

Directions to Site: From 880 South: take 23rd Avenue exit. Stay on Kennedy Street. Site is at intersection Kennedy and 23rd Avenue. From 880 North: take Park ST/Alameda exit. Go west toward Alameda. Right on Ford STreet (before the bridge to Alameda). Site is at Ford and 23rd Avenue

Consultant On Site: Hageman-Aguiar, Inc. Phone Number: (510) 620-0891

Site Safety Officer: Gary Aguiar Phone Number: (510) 620-0891

Type of Facility: fuel cardlock pager: 310-2173

Site Activities: [X] 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 [X] Water [ ] Air	Health Affects
Gasoline	less than 1,000 ug/L (ppb)	dizziness, irritation of eyes, nose & throat

Physical Hazards

[X] Noise
[X] Traffic
[X] Underground Hazards
[X] Overhead Hazards
[ ] Excavations/Trenches
[ ] Other

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

Level Of Protection Equipment

[ ] A [ ] B [ ] C [X] D [ ] See Personal Protective Equipment

Personal Protective Equipment

R = Required A = As Needed

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

R Safety Eyewear (Type) safety glasses
__ Respirator (Type)
Filter (Type)
R Gloves (Type) nitrile
__ Other

SITE HAZARD INFORMATION

FC 1006 (05-11-90)

Monitoring Equipment on Site

- [X] Organic Vapor Analyzer
- [ ] Oxygen Meter
- [ ] Combustible Gas Meter
- [ ] H_2S Meter
- [ ] W.B.G.T.
- [X] PID with lamp of 10.6 eV
- [ ] Draeger Tube
- [ ] Passive Dosimeter
- [ ] Air Sampling Pump
- [ ] Filter Media

Site Control Measures: Work area delineated by cones & yello caution tape. Road shoulder closu closure by orange cones may be required. Work area to be continuously supervised.

Decontamination Procedures: Sampling equipment washed with TSP on-site. Gloves & tyvek suits to be disposed of in facility solid waste disposal bin. Personnel to wash with soap and water prior to leaving and/or eating.

Hospital/Clinic: Alameda Hospital Phone: (510) 522-3700

Hospital Address: 2070 Clinton Avenue, Alameda emergency room: 523-4357

Paramedic: 911 Fire Dept. 911 Police Dept. 911

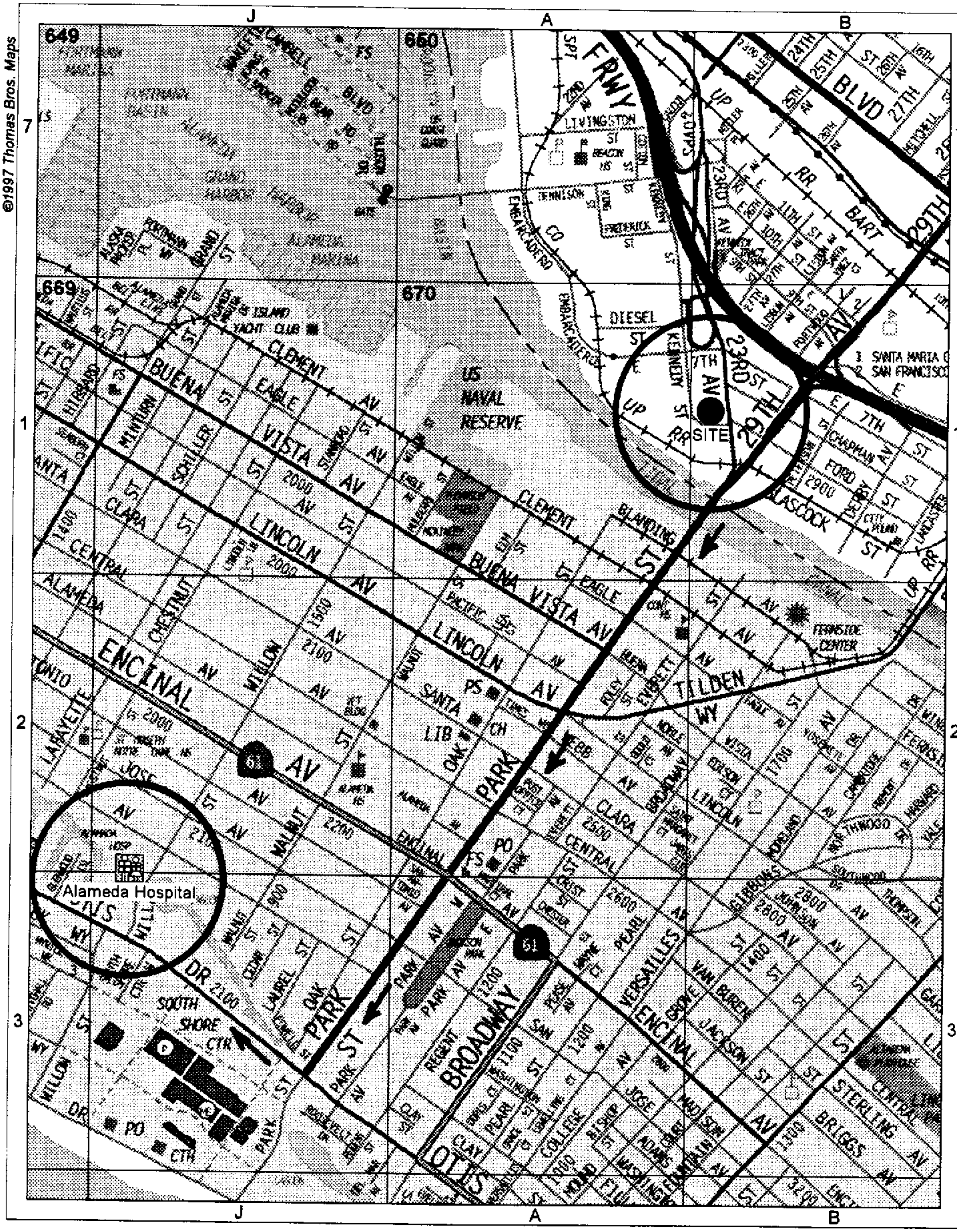
Emergency/Contingency Plans & Procedures: Use emergency shut-off switch on drill rig. Clear the area. Meet at a pre-designated staging area. Call 911.

Site Hazard Information Provided By: Gary Aguiar (Print)

Phone Number: (510) 620-0891

[Signature] Gary Aguiar

Date: 1/6/00



Alameda Hospital: 2070 Clinton Av, Alameda, 94501, 669 J2

SITE: 670 B1

HAGEMAN - AGUIAR, INC.

Standard Operating Procedure HS-01

HEALTH AND SAFETY PROCEDURES

FOR

FIELD INVESTIGATION OF UNDERGROUND SPILLS OF
MOTOR OIL AND PETROLEUM DISTILLATE FUEL

July 1999

CONTENTS

1. PURPOSE

This operating procedure establishes 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 Hageman-Aguiar, Inc., health and safety personnel and project managers to quickly prepare and issue site safety plans for investigations of such releases.

2. APPLICABILITY

This procedure is applicable to field investigations conducted by Hageman-Aguiar, Inc., of underground releases of the substances listed below and involving one or more of the activities listed below:

2.1 <u>Substances</u>

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

2.2 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).

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

3. RESPONSIBILITY & AUTHORITY

Personnel responsible for project safety during Hageman-Aguiar, Inc., field activities are the Corporate 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 distributed 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 whose on-site behavior jeopardizes their health and safety of the health and safety of others.

4. 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 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.

4.1 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 grater 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 2.1) range from 0.6 percent for JP-5 to 1.4 percent for gasoline. 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.

4.2 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, node 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 mild anesthesia in 30 minutes. Headaches have been reported with exposure to 25 ppm or more of gasoline vapors measured with a photoionization meter. Must fuels, particularly gasoline, kerosene and jet fuels are capable of causing skin irritation after several hours of 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 (passes into the lungs), gasoline and other petroleum distillate fuels may cause secondary pneumonia.

Some of the additives to gasoline, such as ethylene dichloride, ethylene dibromide, 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. The American Conference of Government Industrial Hygienists (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. HEALTH AND SAFETY DIRECTIVES

5.1 <u>Site-Specific Safety Briefing</u>

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

5.2 <u>Personal Protective Equipment</u>

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
- Hardhats

5.2.1 <u>Equipment Usage</u>

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 hydrocarbon 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 for 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

5.3.1 Required Equipment

--- Organic vapor meter the flame or photoionization detector

--- Combustible gas meter

5.3.2 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 solid.

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, 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 meter 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 spoilage.

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 shot down, and corrective action taken if combustible gas concentrations reach 40 percent of LEL within a 12-inch radius of the borehole of 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 off-scale 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 area and the local fire department and facility management must be alerted.

Organic vapor meter 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 measured 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 than 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 are in progress. Official visitors should be discouraged from entering hazardous areas, but may be allowed to enter only if the 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:

5.5.1 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 efficient 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 water also; however, if weathered to an asphaltic condition, mechanic's waterless hand cleaner is recommended for initial cleaning followed by detergent and water.

5.5.2 Equipment

Gloves, respirators, hardhats, boots and goggles should be cleaned as described under personnel. If boots do not become clean after washing with detergent and water, wash them with a strong solution of trisodium phosphate and hot water.

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)	---
ethylcyclohexane	100	---	---
Aromatic			
Benzene	150	100 (143)	122
Toluene	110	100 (143)	100
Ethylbenzene	100	---	---
p-Xylene	116	114 (60)	---
Cumene	100	---	---
n-Propylbenzene	---	---	---
Naphthalene	---	---	---

[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.