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IRA

July 26, 2004

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Mr. Don Hwang
Alameda County Health Care Services Agency
1131 Harbor Bay Parkway, Suite 250
Alameda, CA 94502

9/14/04

**Subject:** 3635 13th Avenue
Oakland, California
STID 1121

Dear Mr. Hwang:

Enclosed are the Remedial Investigation / Interim Corrective Action Plan and Groundwater Monitoring report for the above referenced site.

I look forward to discussing this site with you. Thank you and please contact me at (925) 283-6000, extension 104, with any questions or comments.

Sincerely,

Peter McIntyre, RG
Project Manager

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July 19, 2004

# REMEDIAL INVESTIGATION AND INTERIM CORRECTIVE ACTION PLAN

3635 13th Avenue
Oakland, California

AEI Project No. 8499

Prepared For:

Alameda County Health Care Services Agency
1131 Harbor Bay Parkway, Suite 250
Alameda, CA 94521

Prepared By

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AEI

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## APPENDICES

## 1.0 INTRODUCTION

AEI Consultants (AEI) has prepared this Remedial Investigation and Interim Corrective Action Plan on behalf of Mr. John Williamson, owner of the property located at 3635 13th Avenue in the City of Oakland, Alameda County, California (Figure 1). AEI has been retained by Mr. Williamson to provide environmental engineering and consulting services related to the release of fuel hydrocarbons from the former underground storage tank (UST) and dispensing system on the property.

In accordance with the requirements of the Alameda County Health Care Services Agency (ACHCSA), AEI has prepared this plan to present a scope of work for additional site investigation and interim corrective action to mitigate the release. As outlined below, this plan contains two primary components: 1) additional onsite source area characterization and remedial investigation to assess the target area for treatment; and 2) the implementation of long-term pilot study for source area treatment employing in-situ oxidation and enhanced bioremediation via ozone injection.

## 2.0 SITE DESCRIPTION

The subject property (hereinafter referred to as the "site" or "property") is located in a residential area of the City of Oakland, on the west corner of 13th Avenue and Excelsior Street. The site is approximately 4,000 square feet in size and is currently vacant and un-improved. The site is surrounded by fencing. The site was previously developed with a gasoline service station. The adjacent property to the southwest is an apartment building; to the northwest and to the northeast across Excelsior Street are residential dwellings; and to the south across 13th Avenue is a Fire Station.

## 3.0 SITE BACKGROUND

In December 1992, three underground storage tanks (USTs), one 250-gallon waste oil UST, one 500-gallon gasoline UST, and one 1,000-gallon gasoline UST were removed Aqua Science Engineers, Inc. of San Ramon. Refer to Figure 2 for the former locations of the USTs. Soil samples collected beneath the former waste oil UST revealed concentrations of 8,200 mg/kg Total Oil and Grease (TOG), 290 mg/kg Total Petroleum Hydrocarbons (TPH) as gasoline (TPH-g), and 225 mg/kg total lead. Soil samples collected from beneath the 1,000-gallon gasoline UST indicated maximum concentrations of 27 mg/kg TPH-g and 5.5 mg/kg benzene. Only minor concentrations of TPH as gasoline and benzene, toluene, ethylbenzene, and total xylenes (BTEX) were found in samples collected beneath the 500-gallon gasoline UST (1).

In September 1993, AEI removed and disposed of approximately 360 cubic yards of contaminated soil from near the former waste oil UST. Sidewall samples collected from this excavation indicated that only minor contaminant concentrations remained in the soil. The former 250-gallon waste oil UST was concluded to not pose a significant threat to the groundwater (2).

Three monitoring wells (MW-1 through MW-3) were installed in March 1994 [3]. Soil samples analyzed during the well installations contained only minor concentration of petroleum hydrocarbons. The wells were monitored on a quarterly basis from November 1994 to August 1995, when the ACHCSA approved a change in monitoring frequency to a biannual schedule.

On November 16, 1995, AEI advanced a soil boring at each end of the former dispenser island to depths of 4.5 feet below ground surface (bgs) on the west end, and 10 feet bgs on the east. Soil samples were collected beneath the former dispensers at the request of the ACHCSA. Analysis of soil samples collected from the two borings indicated that concentrations of TPH-g and BTEX were below laboratory detection limits [4].

At the request of the ACHCSA, AEI prepared a workplan outlining a scope of work to further define the extent of impacted soil and groundwater beneath the site [5]. This investigation was performed between August 1997 and January 1998. Nine soil borings (SB1 through SB9) were advanced on the property and down-gradient of the former gasoline USTs [6]. Refer to Figure 2 for the locations of the borings. The investigation revealed significant concentrations of contaminants in soil and groundwater and that the release had spread off-site in a southerly direction.

An additional workplan was prepared, outlining the installation of two additional groundwater monitoring wells [7]. However, due to the City of Oakland's requirement for liability insurance provided by the property owner for the wells, off-site monitoring wells could not be installed. A letter addendum to the workplan was prepared and approved to investigate the offsite extent of the release with temporary soil borings [8]. Soil and groundwater samples were collected from six additional soil borings (SB-10 to SB-15) between August and October 2003, the results of which were presented in the *Soil and Groundwater Investigation Report*, dated October 30, 2003.

Refer to Figure 2 for locations of the former USTs, monitoring wells, and soil borings. Groundwater sample analytical data is summarized in Tables 1 through 3 and soil sample analytical data in Table 4.

## 4.0 GEOLOGY AND HYDROLOGY

The site is located at approximately 195 feet above mean seal level (msl). The site is located on a slight topographic rise, which slopes moderately to the southwest, toward Highway 580, approximately 200 feet southwest of the site.

Soil borings revealed that the native soils beneath the site generally consist of clayey sand and clay from near ground surface to between 14 and 18 feet bgs. Clayey and silty sand was present below this depth to between 20 and 23 feet bgs. The sandy layer was underlain by stiff clay. A 0.75 foot thick gravel lens was present in SB-10 at 17 feet bgs, above the sandy zone. Saturated conditions were observed in the sandy zone. Water levels were measured in the summer 2003 borings at 15 to 25 feet bgs.

During recent monitoring activities, water levels were measured at approximately 10 feet bgs. Since monitoring began, groundwater levels have fluctuated over a range of approximately upwards of 9 feet, from approximately 6 feet to 15 feet bgs. Water level measurements have revealed a southeasterly flow direction in 1996 and 1997 but consistently a southerly flow direction in since 2004. The hydraulic gradient calculated from monitoring data since January 2002 has been on the order of 0.05 ft/ft. Historical groundwater elevation data is presented in Table 1 and a summary of flow directions is presented in Table 5.

## 4.1 Sensitive Receptor Survey

AEI conducted a reconnaisance of the site vicinity and review of maps for surface water bodies and other potential groundwater receptors. The nearest surface water bodies are Central Reservoir and Lake Merritt. Central Reservoir is located approximately ½ mile southeast of the site, at approximately equal elevation as the site, across Interstate 580. Although based on the onsite groundwater flow direction, the reservoir is located down gradient, it is 0.5 miles away and on the other side of the Interstate which is expected to act as effective hydrologic divide between the release and the reservoir. Lake Merritt is located 1.2 miles west of the site. Based on the distance of the site from Lake Merritt, the release is not expected to cause a threat to water quality of the lake.

AEI has requested a survey from the Department of Water Resources (DWR) for wells within ¼ mile of the site. As of the issue date of this report, the survey is not yet complete. The well survey results along with review of the RWQCB Basin Plan will be incorporated into final corrective action planning and into selection of final site cleanup goals with respect to groundwater.

## 4.2 Preferential Pathway Study

AEI performed preferential pathway study of the streets surrounding the property to ascertain the nature and location of underground utilities that may cause preferential contaminant migration. City records were reviewed, which provided information on sanitary sewer and storm drain locations. A site inspection and underground service alert markings identified locations of water, natural gas, electricity, and telecommunications lines near the site. Logs of borings were reviewed, as unmarked utilities were encountered during the 2003 offsite investigation.

The utilities identified near the site are shown on Figure 5. The depths of the natural gas, water, electric, and telecommunications lines are assumed to be 3 to 5 feet bgs, as is standard. According to the maps, the sanitary sewer line is approximately 6 feet bgs along 13$^{th}$ Avenue and the trench is likely an additional 1 to 2 feet deep, for a total depth of a preferential migration pathway of approximately 8 feet bgs. The depth of the unidentified pipes on the southern side of 13$^{th}$ Avenue was 5 feet bgs. Based on these depths, these utilities are not expected to represent a significant, continuous, preferential migration pathway for groundwater flow, except when anomalously high groundwater is present, as was observed in 1996. However, groundwater depths have generally been 11 feet bgs or deeper (Table 5).

## 5.0 ENVIRONMENTAL CONCERN

The site contaminants of concern (COCs) consist of gasoline and diesel range fuel hydrocarbons and BTEX. MTBE has been detected at low concentrations in the source area well MW-2 at 87 µg/l, and it's breakdown product tertiary butyl alcohol (TBA) at 110 µg/l in the recent sampling event. Benzene has been detected in groundwater up to 5,300 µg/l (MW-2, 6/17/97), but more recently at 1,100 µg/l in this well. TPH-g and TPH-d were detected in groundwater up to 63,000 µg/l and 200,000 µg/l, respectively, during the 1997/98 source area investigation. Recently (April 2004 monitoring event) TPH-g and TPH-d have been detect up to 6,900 µg/l and 1,200 µg/l, respectively, in MW-2. Reporting of the July 2004 monitoring event has not been completed.

TPH-g and TPH-d have been detected in soil up to 1,000 mg/kg and 160 mg/kg, respective in boring SB3. BTEX were detected in soil in this boring up to 8.6 mg/kg, 15 mg/kg, 15 mg/kg, and 52 mg/kg, respectively. COCs in soil appear to be confined primarily to depths ranging from 10 to 15 feet bgs, likely controlled by the rise and fall of the water table.

The release at the site has significantly impacted both soil and groundwater beneath the site and has resulted in a plume of dissolved contaminants migrating offsite. Based on past sampling performed on site (1997 – 1998), a significant mass of hydrocarbon contaminants exist in both soil and groundwater on the northern portion of the property. Although recent offsite groundwater sampling (SB-10) and groundwater monitoring suggests that contaminant concentrations are decreasing, the plume has spread across 13th Avenue.

As observed in Table 1, high groundwater levels were recorded in February 1996, which was followed by high hydrocarbons concentrations in MW-2. This suggests that during high water levels, groundwater encountered source hydrocarbons in the soil, mobilizing contaminants into the shallow aquifer. Although supported by the existing data, monitoring has been too sporadic to confirm year-to-year annual trends.

Water quality monitoring has indicated low dissolved oxygen concentrations during well purging (generally less than 1.0 mg/l) along with reducing conditions (less than -100 mev). As commonly occurs in a petroleum hydrocarbon plume, oxygen is rapidly depleted as aerobic bio-degradation proceeds. This lack of oxygen is likely a primary limiting factor in further bio-degradation.

### 5.1 Site Cleanup Goals

Target cleanup goals will be based on residential property development and appropriate groundwater quality standards. Specifically, the final site cleanup goals will be based on both the San Francisco Bay RWQCB's document *Screening for Environmental Concerns at*

*Site with Contaminated Soil and Groundwater* (Interim Final, July 2003) and the Oakland Urban Land Use Redevelopment Program: Guidance Document (January, 2000)[10, 11].

As noted in Section 4.1, the well survey component of the sensitive receptor survey has not been completed. However, preliminary cleanup goals for TPH-g, TPH-d, and BTEX are presented below, based on residential land use and non-drinking water standards.

| Contaminant | Soil Cleanup Target (mg/kg) | Groundwater Cleanup Target (μg/l) |
|---|---|---|
| TPH-g | 100 | 500 |
| TPH-d | 100 | 640 |
| Benzene | 0.044 | 46 |
| Toluene | 0.88 | 130 |
| Ethylbenzene | 3.3 | 290 |
| Xylenes | 1.5 | 13 |

If based on results of the well survey, drinking water groundwater cleanup goals are necessary to adequately protect groundwater resources; these targets may be revised downward. In addition, due to the relatively conservative assumptions utilized in the derivation of the cleanup goals referenced above, a more detailed site specific risk evaluation may be performed upon completion of interim corrective activities to account for the non-infinite nature of the source and site-specific attenuation factors for contaminant migration.

## 6.0 REMEDIAL OPTION EVALUATION

As discussed above, significant source area was identified onsite during 1997 – 1998 investigation. Recent data suggests that attenuation may be occurring; however, the current distribution and magnitude of on-site contaminants is not known. Prior to implementation of interim corrective action, limited additional soil and groundwater sampling will be conducted on-site to define the target area for corrective action and provide baseline data for gauging the success of source treatment pilot testing (see Section 7.1).

In this section, treatment alternatives are discussed in general terms for both soil and groundwater medium effected by this release. For ease of discussion, treatment options are separated by medium (soil and groundwater). Selection of a method for pilot testing is based on technical feasibility, likelihood of achieving cleanup goals, and cost effectiveness.

### 6.1 Soil Treatment Options

Soils can be excavated and either treated and reused onsite or transported offsite for disposal. Feasibility and cost considerations include structural concerns of nearby facilities (sidewalks, buildings, etc.), depth of impacted soil and groundwater, and amount of clean overburden. Due to the limited size of the property, proximity of nearby structures, and apparent thickness of clean overburden (up to 10 feet), excavation will not likely be feasible or cost effective.

Volatile contaminants can be removed utilizing soil vapor extraction. Contaminant vapors are then destroyed (IC engine, thermal or catalytic oxidizer) or removed from the vapor stream (GAC). Due to the presence of diesel (low volatility) and proximity of residences and a school and the high energy requirements, this method is expected to be costly and difficult to implement.

In-situ soil treatment involves the destruction of contaminant in the ground and may include oxidant injection (ORC, Fenton's reagent / hydrogen peroxide, ozone), and enhanced in-situ bioremediation. Oxidant injection requires a delivery mechanism (wells or temporary borings), sufficient subsurface permeability for the oxidant to contact the target contaminants, and in most cases special handing procedures. Enhanced bio-remediation involves aerobic bacteria which utilize petroleum hydrocarbons as an energy source, via optimizing subsurface conditions (bacteria batch cultures, oxygen / air injection, nutrient addition). These methods can be employed to treat groundwater as well.

## 6.2 Groundwater Treatment Options

Groundwater can be removed from extraction wells and treated onsite for re-injection or disposal in either sanitary sewer or storm drain system. Treatment options are varied, and include carbon filtration, air-stripping towers, and reactor beds, among others. Pumping well(s) are required and an aquifer test conducted to determine drawdown and yield. Due to the steep hydraulic gradient, recovery of offsite, dissolved contaminants is not expected to be feasible. Due to the high design requirements, operation and maintenance costs, and availability of other options, this method is not considered further.

Air sparging involved removal of volatile contaminants from groundwater via injection of air beneath the contaminated groundwater. Vapor phase contaminants are then removed by soil vapor extraction, as described above.

Chemical oxidation can also be utilized to treat groundwater. As with treatment of soils with these methods, sufficient permeability of the aquifer to the injected material (slurry, vapor bubbles, or liquid) is required. Injection can be performed slowly, over longer timeframes (ozone), or on a one-time or periodic basis (ORC, Fenton's reagent).

## 6.3 Discussion

ozone

Although the above discussion was not intended to be inclusive of all options or combinations thereof, ozone sparging has been selected as suitable for further evaluation and pilot testing. In situ treatment via ozone sparging has been selected as it has a high probability of success in treating the source area as well as effecting the offsite



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contaminants. Compared to other oxidation methods, this approach is scalable; with the ability to increase treatment times, without remobilization of injection equipment, materials, and personnel if longer treatment times become necessary. Ozone has ability to oxidize gasoline and diesel range hydrocarbons, BTEX, and MTBE, and significantly increase oxygen content of groundwater and vadose zone soils in the source area. When compared to traditional air sparging, ozone is nearly 10 times more soluble in water than atmospheric oxygen. In addition to reducing the concentrations of source area contaminants, this highly oxygenated groundwater will migrate down-gradient of the site, enhancing aerobic biodegradation of contaminants beneath 13th Avenue.

AEI will utilize KVA C-sparge™ micro-porous sparge points for delivery. The C-sparge points produces much smaller (3 to 200 micron) bubbles as compared to conventionally screened air sparge wells. The smaller bubbles provide a much larger ratio of bubble surface area to bubble volume, therefore allowing a greater transfer of ozone into groundwater. The much higher surface area to volume ratio allows for more favorable mass transfer between aqueous and gaseous phases.

As opposed to traditional air sparging, the primary contaminant removal mechanism is the destruction by oxidation. The oxidation takes place both within the bubble as it moves upward through the soil column and within the groundwater as ozone is exchanged from within the bubble to the groundwater.

While traditional air sparging relies on high flow rates [>5-10 standard cubic feet per minute (SCFM)] per well, the proposed system produces much lower flow rates (<2-3 SCFM) at any given time, and much lower (less than 1 SCFM) per well averaged over a 24-hour period. The wells are pulsed individually for a short time (5 to 10 minutes each). The pulsing reduces the water table "mounding" that occurs during constant higher flow rate air sparging. Given the much lower flow rate and that the COCs are oxidized primarily in the groundwater, vapor recover and treatment is not generally necessary.

## 7.0 REMEDIAL INVESTIGATION

The remedial investigation will consist of further defining the current vertical and lateral extent of the source area, obtaining necessary soil and groundwater chemistry data necessary to confirm the applicability of ozone sparging, and provide a baseline for gauging short-term and long-term success of corrective action.

AEI proposes to collect additional soil and groundwater samples from seven (7) soil borings (labeled SB-16 to SB-22) advanced in the source area. Upon completion of the borings and review of logs, two to three of the borings will be converted to monitoring wells. The purpose of the additional monitoring wells is to provide a baseline for groundwater conditions within the source area and monitor progress of corrective action. Proposed soil borings are shown on Figure 6.

## 7.2 Drilling and Well Installation

The borings will be advanced with a Geoprobe™ direct-push drilling rig by a California C57 licensed drilling contractor. A soil boring / monitoring well permit will be obtained from Alameda County Public Works Agency (ACPWA). The borings will be advanced to depths of approximately 20 to 30 feet bgs in each boring, as needed to collect appropriate soil and groundwater samples and to adequately log the water table aquifer.

Soil will be continuously collected from each boring in 2" diameter acrylic liners. Soil samples will be cut from the liners at selected depths based on field observations and organic vapor measurements collected in the field. Groundwater samples will be collected from each boring using a drop tube inserted through the direct push rods. If groundwater cannot be collected by this method, temporary slotted PVC casing will be installed to allow for groundwater recharge.

Following collection of samples, two of the borings, tentatively SB-17 and SB-22 will be converted to monitoring wells MW-4 and MW-5, respectively. If evidence of significant contamination is observed in SB-20 or SB-21, one of these borings may also be converted to a monitoring well (MW-6).

The borings to be converted to monitoring wells will be overdrilled with 8¼" outside diameter hollow stem augers. The wells will be constructed with 2" inside diameter Schedule 40 PVC well casing installed through the augers. Each will be constructed with 10 to 15 feet of factory slotted screen to a total depth estimated at 20 to 25 feet bgs; the final construction details will be determined by the onsite AEI geologist upon completion of the initial direct push drilling. A sand pack will be installed through the augers in the annulus of each well from total depth to approximately 2 foot above the screen interval. A bentonite seal will be placed above the sand and the remainder of the boring will be sealed with cement grout. Any borings not converted to monitoring wells will be backfilled with neat cement grout per ACPWA and state guidelines.

The wells will be developed no sooner than 3 days after setting the well seals by surging, bailing, and purging to remove accumulated fines from the casing and sand pack.

Each well will be surveyed relative to each other, mean sea level, and a known datum by a California licensed land surveyor. As required, survey data will be obtained utilizing global positioning system (GPS) equipment, and will be in a format acceptable for submission to the California GeoTracker database, and hydrologic evaluation.

### 7.3 Sample Analyses

It is anticipated that 4 to 5 soil samples and 1 groundwater sample will be collected from each borings. The following is a summary of soil and groundwater sample analyses planned during this phase of the project.

| Analysis | Method | Number | Purpose |
|---|---|---|---|
| TPH-g | 8015 | 3-4 soil & 1 groundwater / boring | COC distribution |
| TPH-d | 8015 | 3-4 soil & 1 groundwater / boring | COC distribution |
| BTEX & MTBE | 8021 | 3-4 soil & 1 groundwater / boring | COC distribution |
| Grain Size Distribution | Sieve | 2 –3 soil total | General / Permeability Estimate |
| Biological Oxygen Demand | 405.1 | 1-2 soil & 1-2 groundwater total | Evaluate ozone demand |
| Chemical Oxygen Demand | 415.1 | 1-2 soil & 1-2 groundwater total | Evaluate ozone demand |
| Fe (II) | SM3500/200.7 | 2 groundwater | Potential iron precipitation |

### 7.4 Data Interpretation

Upon receipt of analytical data, AEI will evaluate the vertical and lateral extent of impacted soil and groundwater that exceeds the preliminary site target cleanup values. Source area contaminant mass will be estimated and inorganic soil and groundwater chemistry will be interpreted as it relates to subsurface oxygen demand. Upon review of data, the exact location and depth of wells and operating parameters will be established and refinements made to the general plan outlined below. If data suggests that ozone sparging will not be effective or appropriate for the site, data will be presented to the ACHCSA and an alternative corrective action method proposed. Additionally, if floating free phase hydrocarbons are identified, methods for removal will be implemented prior to initiating pilot test activities.

## 8.0 Pilot Test and Interim Corrective Action

Assuming the results of the investigative activities outlined in Section 7.0 supports use of chemical oxidation and enhanced aerobic biodegradation by ozone sparging, the following scope of work has been designed. The goal of the pilot test is to document feasibility of source area treatment using this method. The goal of longer-term interim corrective action is to sufficiently reduce source area contaminants thereby removing limiting the spread of the offsite plume and promoting natural aerobic bioremediation in the remaining contaminants offsite.

The primary purpose of a 2 month pilot test will be to verify the effectiveness of this technology at the site. This length is proposed as sufficient time to evaluate the effectiveness of this method at reducing hydrocarbon contaminants. If the method shows promise, the system will be scaled up to target the onsite extent of the source area soil and groundwater.

## 8.1 Site Preparation

Based on existing data, two sparge well locations are initially proposed. In each location, a sparge point will be installed at the bottom of the water bearing deposits, at approximately 20 to 25 feet bgs. In either or both of these locations, a shallower sparge point may also be installed to target smear zone contamination, at a depth of approximately 15 feet bgs. The locations will be selected such that the deeper sparge points will be beneath areas of highest groundwater contamination and adjacent to monitoring wells, for short-term and long-term monitoring of [radius of influence (ROI)] of sparging. A conservative estimate for a bubble radius (ROI) for the sparge wells of 1 to 1.5 foot per foot of depth below the water table has been utilized for initial well placement. Based on this, a ROI of 10 to 15 feet may be expected. Tentative locations of the two sparge wells (S-1 and S-2) are shown on Figure 6. S-1 would be located up gradient of proposed monitoring well MW-5 and cross gradient of MW-3. S-2 would be up gradient of MW-2 and cross gradient of proposed MW-4 and MW-6 (if MW-6 is installed).

The sparge wells will be constructed in borings advanced with standard 8 ¼" hollow stem augers. The wells will be constructed with a micro-porous sparge point, approximately 18" in length, with the remainder of the casing ¾" flush threaded PVC. A sand pack will be installed from the bottom of the sparge point to approximately 1 foot above. Above the sand pack, a bentonite seal will be installed. If only one point is installed per well, a grout seal will be installed above at least 2 feet of bentonite. If a second sparge point is installed, the bentonite seal will extent to the bottom of the second sparge point. A second sand pack would then be installed, and an additional bentonite seal, followed by the grout seal. A simplified schematic of the sparge wells is presented in Appendix A.

Temporary electrical service will be installed on the property. The proposed ozone generator, compressor, and panel controls requires standard 110 volt / 30 amperage service. A licensed electrical contractor will be contracted to obtain the necessary City permits and coordinate the installation of electrical service with PG&E.

A small temporary enclose will be placed on the property, likely along the eastern fence to house the system components. Although the system is relatively quiet (compared to other treatment equipment, sound abatement insulation may need to be installed in noise levels exceed those caused by the adjacent freeway. The treatment system will consist of a KVA C-Sparger ™ panel. The compound will include the air compressor, ozone generator, sequencer (8 to 12 well control programmable timer), solenoids, cooling fans, outflow one-way check valves, temperature and ozone sensors and shut-downs, and isolator feet. A diagram of the panel components is presented in Appendix A.

During the pilot test, air tubing from the wellheads to the unit will be contained in 2" PVC or ABS conduit to avoid damage during site visits. Initially the conduit will be run over the ground surface, as the property is vacant and surrounded by approximately 12-foot high fence.

## 8.2 Baseline Sampling

Prior to system startup, a groundwater monitoring event will be performed on all wells. Water quality parameters [pH, temperature, specific conductivity, dissolved oxygen (DO), and oxidation-reduction potential (ORP)] will be measured and samples collected for analysis for site COCs. This data, particularly DO, ORP, and COC concentrations, will be used as a baseline for short-term interpretation of ROI and effectiveness of COC destruction.

## 8.3 Startup and Pilot Test Monitoring

Timing of injection pulses will be established based on location and number of sparge points (2 to 4). Tentatively, the system will be set to run each well point for 5 to 10 minutes per cycle for 20 to 30 cycles per day, for a total of 100 to 300 minutes per point per day, in accordance with the manufactures guidelines.

Site visits will be performed on a daily basis for the first week of operation, and weekly for the first month. After the first month, bi-weekly site visits and monthly sampling will be performed.

During each site visit, the unit will be inspected and pressure measurements recorded for each injection well. On a weekly basis for the first month, and at the end of the second month, three selected monitoring wells will be purged, water quality parameters recorded, and samples collected for analyses for site COCs.

During the first month, ozone monitoring will be performed on several monitoring wells with unsaturated screen sections to ensure that ozone is not accumulating in subsurface soils prior to degradation to oxygen.

## 8.4 Pilot Test Reporting

Upon completion of 2 months operation, monitoring and laboratory data, and verification soil samples, a progress report will be prepared for the ACHCSA. The report will include site plans, logs of boring and wells, operation times, data obtained, and contaminant concentrations trends. Any alterations made to this plan will be documented.

Assuming adequate contaminant concentration reductions and effective ROI, scale-up of the system will be recommended. Based on the size of the property and extent of impacted soil and groundwater, tentatively no more than a total of 6 to 10 sparge well locations are thought to be sufficient to treat the source and promote offsite biodegradation. Remediation times will be estimated and, if possible, an estimate of the offsite movement of petroleum hydrocarbon-free, oxygen rich groundwater will be made. In addition, soil and groundwater cleanup target concentrations will be refined.

## 9.0 TENTATIVE SCHEDULE

Once the ACHCSA has reviewed this plan and comments addressed by AEI and Mr. Williamson, if any, AEI anticipates beginning the additional remedial investigation phase (Section 7.0). This is expected to take 4 to 6 weeks to complete, from permitting through data review and interpretation. Assuming positive results, site preparation work (electrical service, well construction, etc.) will begin. Electrical service, site preparation, and panel and equipment procurement is expected to take 5 to 10 weeks. The pilot test is schedule to run for 2 following startup. The pilot test report will be prepared upon completion of the second month, and depending on the results, operation may continue after 2 months, prior to scale-up.

## 10.0 CLOSING STATEMENT AND SIGNATURES

This plan has been prepared by AEI on behalf of Mr. John Williamson and outlines a scope of work to remedial investigation and interim corrective action activities to address the release of petroleum hydrocarbons from the former UST system on the property located at 3635 13$^{th}$ Avenue in the City of Oakland. The recommendations rendered in this report were based on previous field investigations and laboratory testing of soil and groundwater samples. This document does not reflect subsurface variations that may exist between sampling points. These variations cannot be anticipated, nor could they be entirely accounted for, in spite of exhaustive additional testing. This plan should not be regarded as a guarantee that no further contamination, beyond that which could have been detected within the scope of past investigations is present beneath the said property or that all contamination present at the site will be treated or removed. Undocumented, unauthorized releases of hazardous material, the remains of which are not readily identifiable by visual inspection and are of different chemical constituents, are difficult and often impossible to detect within the scope of a chemical specific investigation that may or may not become apparent at a later time. All specified work would be performed in accordance with generally accepted practices in geotechnical and environmental engineering, engineering geology, and hydrogeology and will be performed under the direction of appropriate registered professional(s).

We look forward to comment and concurrence with the scope of work outlined herein. Should you need additional information, please contact Mr. McIntyre.

Sincerely,
**AEI Consultants**

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PETER J. MCINTYRE
Exp. 5/31/06
No. 7702
STATE OF CALIFORNIA

Peter J. McIntyre, RG
Project Manager

Robert F. Flory
Senior Project Geologist

## 11.0 REFERENCED DOCUMENTS


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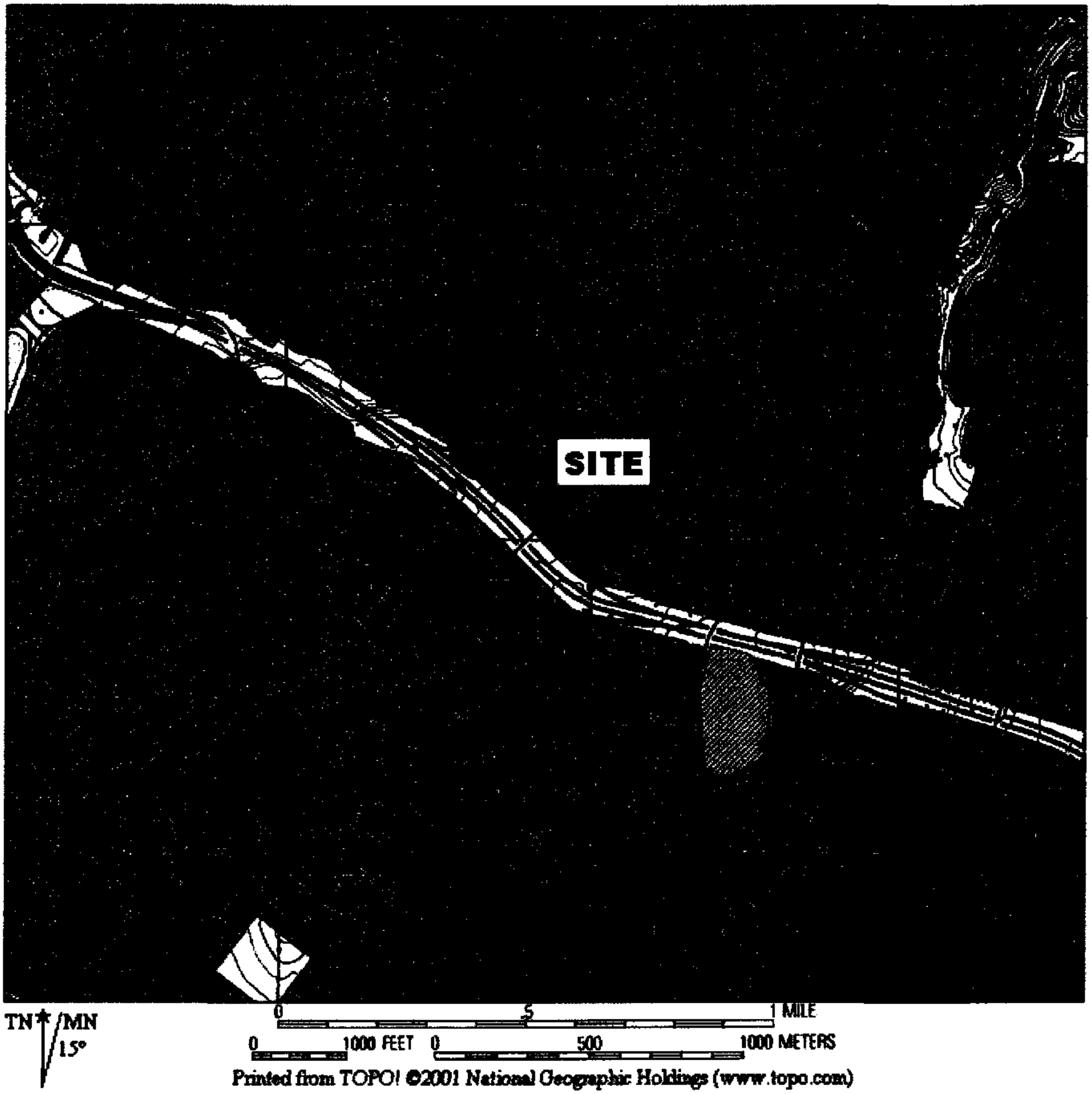
Mr. Sunil Ramdass, UST Cleanup Fund
1001 I Street, Sacramento, CA 94224

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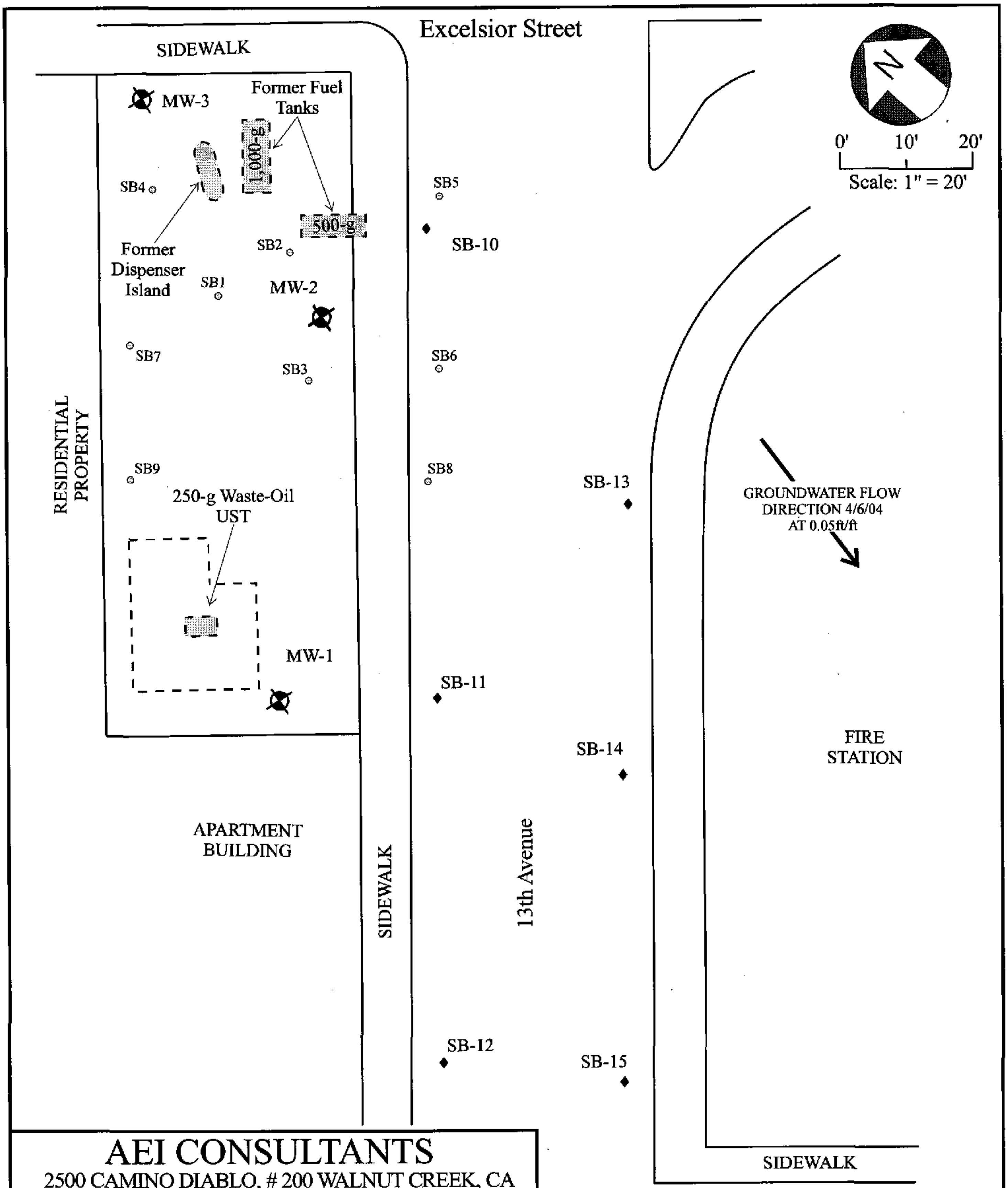
| AEI CONSULTANTS | |
|---|---|
| **SITE LOCATION MAP** | |
| 3635 13th AVENUE<br>OAKLAND, CALIFORNIA | **FIGURE 1**<br>PROJECT NO. 6906 |



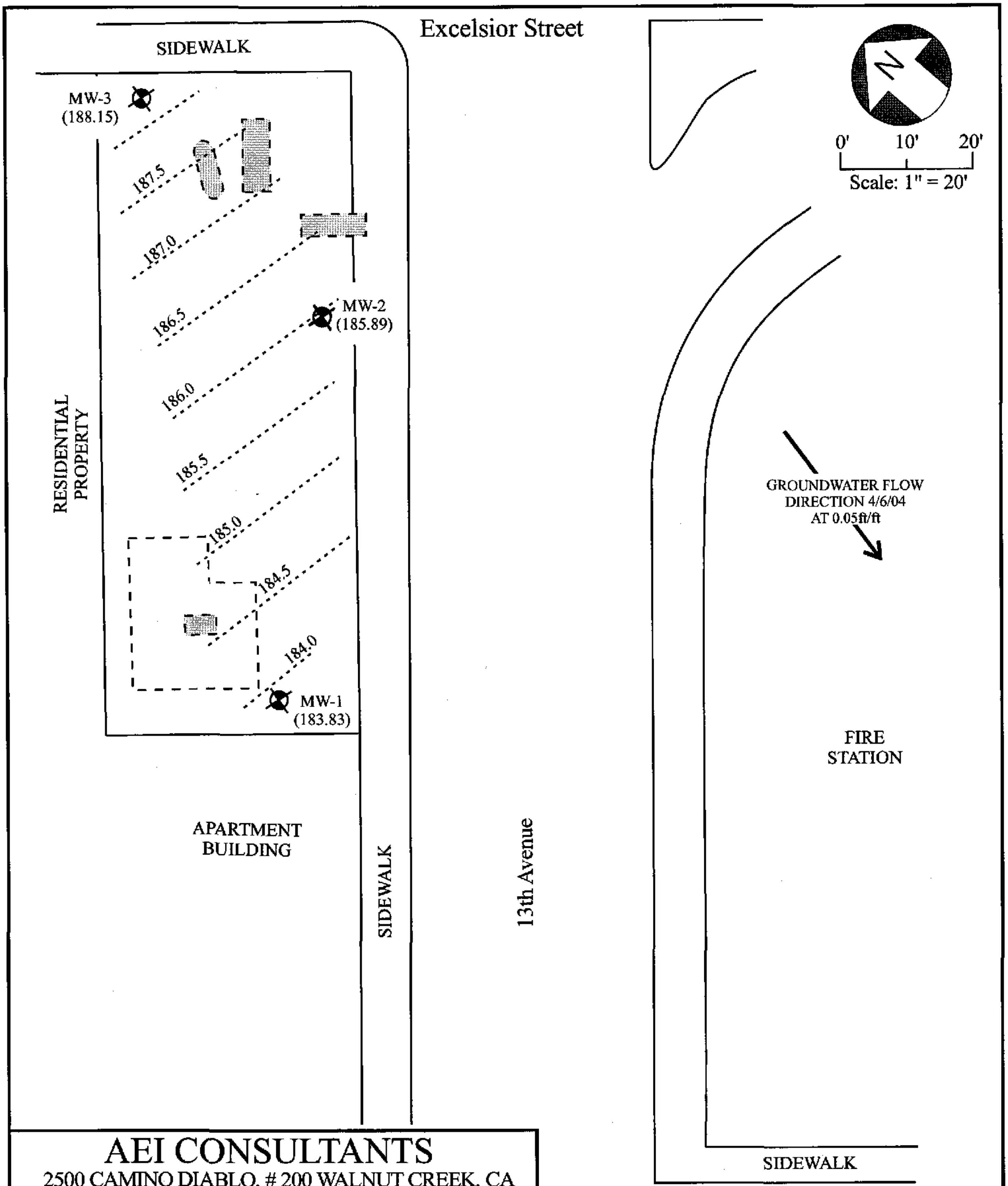

# AEI CONSULTANTS

2500 CAMINO DIABLO, # 200 WALNUT CREEK, CA

## SITE PLAN

| | |
|---|---|
| 3635 13th Avenue<br>Oakland, California | FIGURE 2<br>AEI Project # 8499 |

| LEGEND | (REV. 6/04) |
|---|---|
| ⌖ | Monitoring Well |
| ○ | Soil Boring 11/97 & 1/98 |
| ◆ | Soil Boring 8/21 & 10/9-10 2003 |




# AEI CONSULTANTS

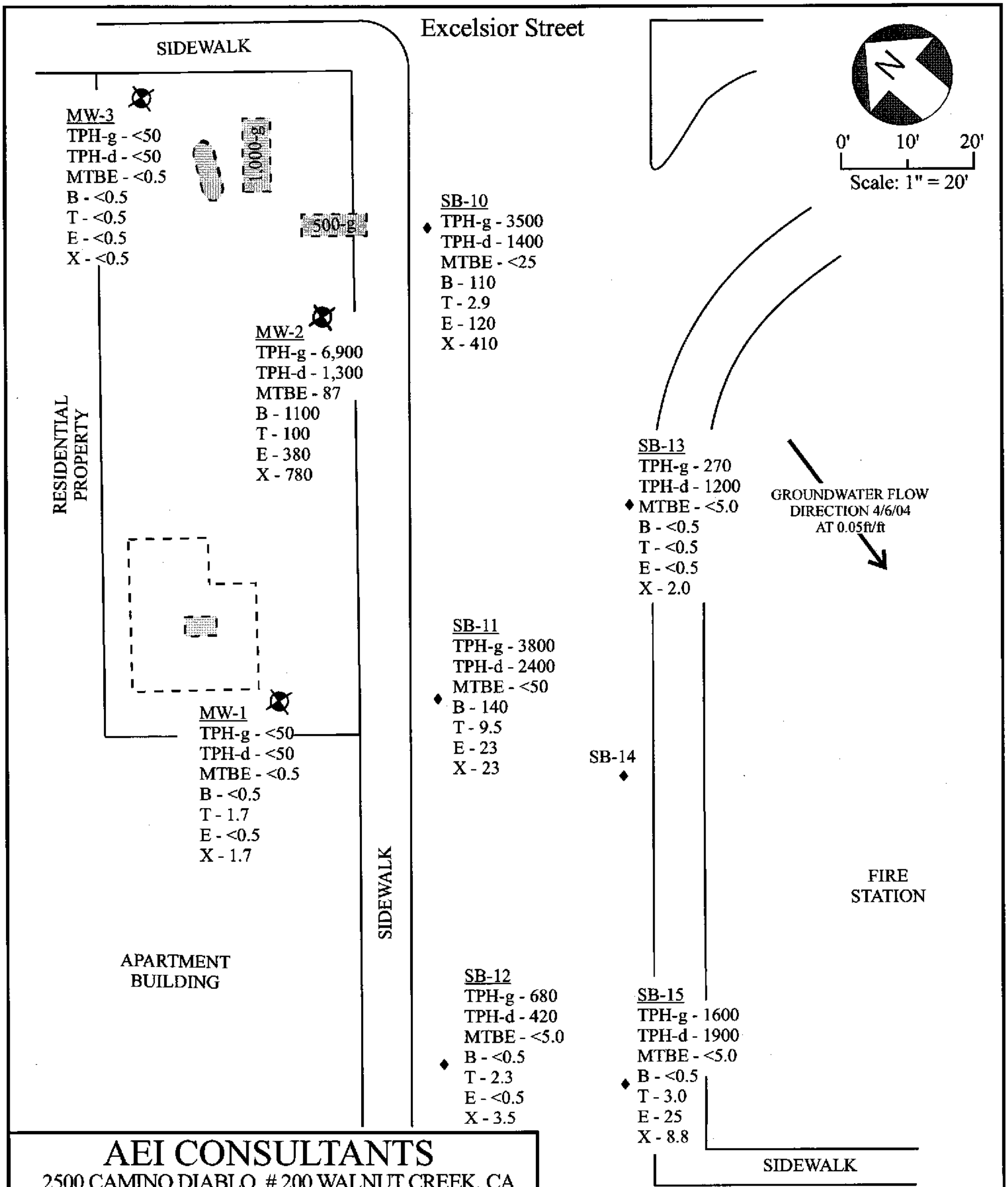
2500 CAMINO DIABLO, # 200 WALNUT CREEK, CA

## WATER TABLE CONTOURS 4/6/04

| | |
|---|---|
| 3635 13th Avenue<br>Oakland, California | FIGURE 3<br>AEI Project # 8499 |

LEGEND (REV. 6/04)

- Monitoring Well, with water table elevation in ft above msl (4/6/04)
- Water table contours in ft above msl Interval = 0.5 ft




# AEI CONSULTANTS

2500 CAMINO DIABLO, # 200 WALNUT CREEK, CA

## RECENT GROUNDWATER SAMPLE ANALYTICAL DATA

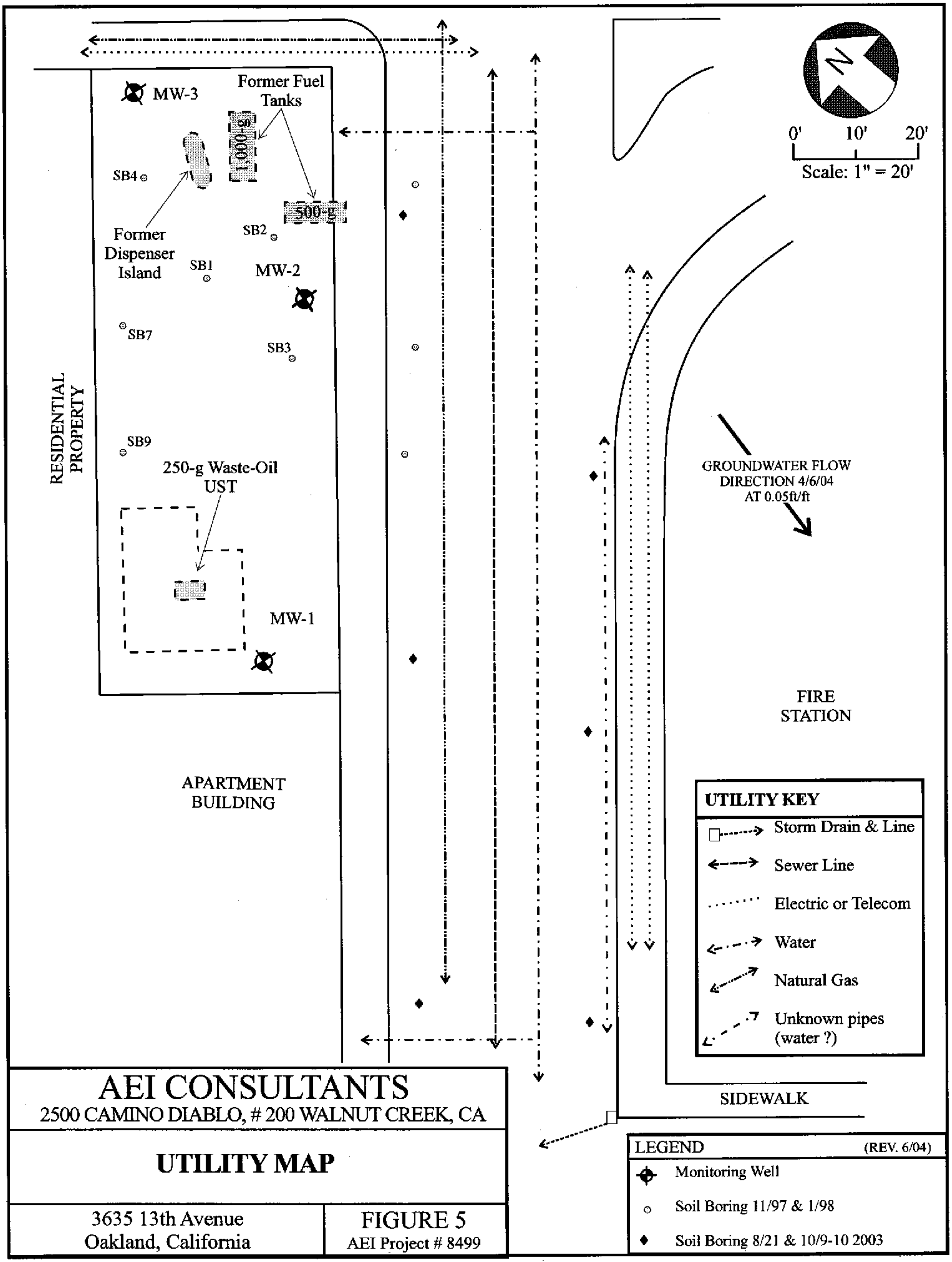
3635 13th Avenue
Oakland, California

FIGURE 4
AEI Project # 8499

LEGEND (REV. 6/04)

- Monitoring Well (data from 4/6/04 event)
- Soil Boring (data from 8/21 & 10/9-10/03)

All data in µg/l
See Tables 1 & 3 for details

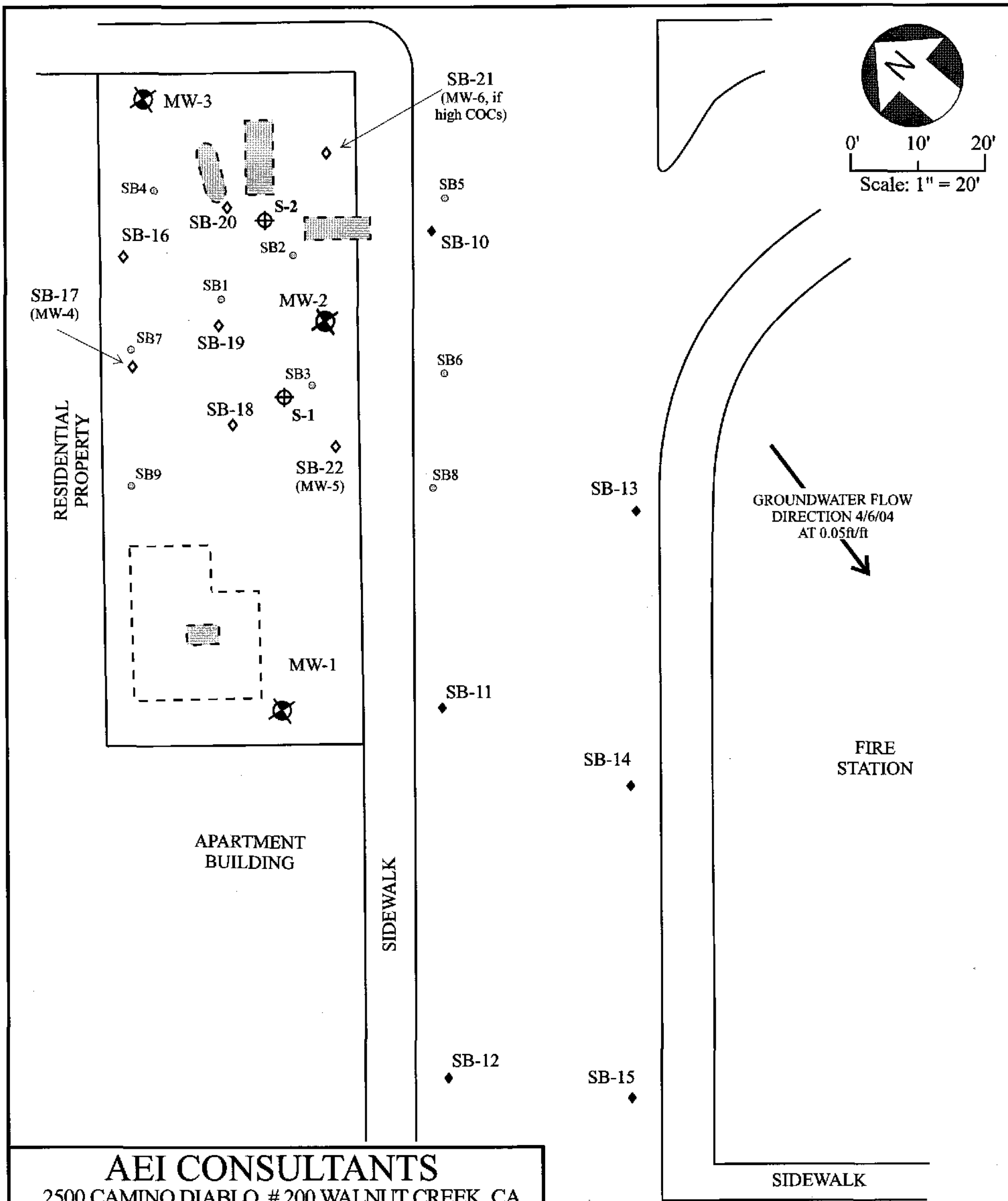



AEI CONSULTANTS
2500 CAMINO DIABLO, # 200 WALNUT CREEK, CA

**UTILITY MAP**

3635 13th Avenue
Oakland, California

FIGURE 5
AEI Project # 8499




# AEI CONSULTANTS

2500 CAMINO DIABLO, # 200 WALNUT CREEK, CA

## PROPOSED BORING AND WELL LOCATIONS

3635 13th Avenue
Oakland, California

FIGURE 6
AEI Project # 8499

LEGEND (REV. 6/04)

- Monitoring Well
- Previous Borings
- Proposed Boring / monitoring well
- Tentaive sparge well

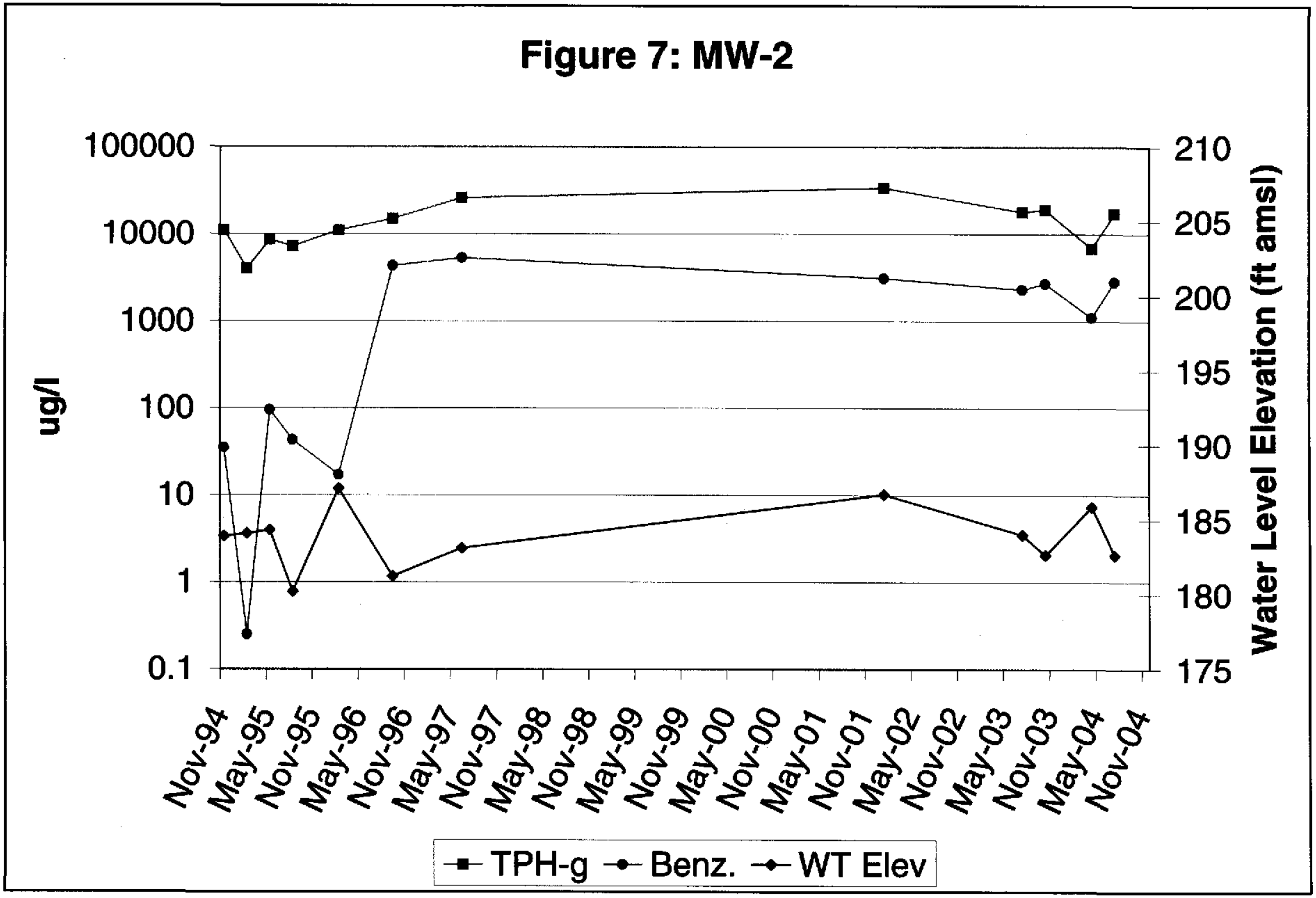


Figure 7: MW-2
100000
10000
1000
100
10
1
0.1
ug/l
210
205
200
195
190
185
180
175
Water Level Elevation (ft amsl)
Nov-94
May-95
Nov-95
May-96
Nov-96
May-97
Nov-97
May-98
Nov-98
May-99
Nov-99
May-00
Nov-00
May-01
Nov-01
May-02
Nov-02
May-03
Nov-03
May-04
Nov-04
TPH-g
Benz.
WT Elev

**Table 1**
**Monitoring Well Sample Analytical Data**

| Well ID (depth / diam.) | Date | Well Elevation | Depth to Water | Water Table Elevation | TPH-g (µg/l) | TPH-d (µg/l) | TOG (mg/l) | MTBE (µg/l) | Benzene (µg/l) | Toluene (µg/l) | E-benzene (µg/l) | Xylenes (µg/l) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | EPA 8015M | | EPA 5520 | EPA 8020 / 8021 | | | | |
| MW - 1 23.5' / 2" | 11/22/1994 | 194.75 | 10.92 | 183.83 | 210 | <50 | <0.5 | - | <0.5 | <0.5 | <0.5 | 2.3 |
| | 2/23/1995 | 194.75 | 10.58 | 184.17 | 140 | <50 | 1.2 | - | <0.5 | <0.5 | 0.6 | 1.5 |
| | 5/24/1995 | 194.75 | 10.94 | 183.81 | <50 | <50 | <0.5 | - | <0.5 | <0.5 | <0.5 | <0.5 |
| | 8/18/1995 | 194.75 | 14.52 | 180.23 | 2800 | <50 | <0.5 | - | 25 | 6.2 | 22 | 30 |
| | 2/7/1996 | 194.75 | 4.43 | 190.32 | <50 | <50 | <0.5 | - | <0.5 | <0.5 | <0.5 | <0.5 |
| | 9/6/1996 | 194.75 | 13.60 | 181.15 | <50 | <50 | <5.0 | <5.0 | <0.5 | <0.5 | <0.5 | <0.5 |
| | 6/19/1997 | 194.75 | 13.07 | 181.68 | 630 | 400 | <5.0 | 15 | 25 | 9.7 | 100 | 14 |
| | 1/24/2002 | 194.75 | 9.53 | 185.22 | 60 | <50 | - | <5.0 | 3.3 | 2.8 | 2.0 | 6.0 |
| | 7/15/2003 | 194.75 | 12.85 | 181.90 | 87 | <50 | - | <5.0 | 15 | 4.9 | 3.3 | 9.2 |
| | 10/10/2003 | 194.75 | 14.58 | 180.17 | 81 | 110 | - | <5.0 | <0.5 | 0.62 | 0.57 | 0.5 |
| | **4/6/2004** | **194.75** | **10.92** | **183.83** | **<50** | **<50** | - | **<5.0** | **<0.5** | **<0.5** | **<0.5** | **<0.5** |
| MW - 2 36' / 2" | 11/22/1994 | 196.44 | 12.54 | 183.90 | 11000 | <50 | <0.5 | - | 35 | 21 | 7.2 | 50 |
| | 2/23/1995 | 196.44 | 12.35 | 184.09 | 4000 | <50 | 1.6 | - | <0.5 | <0.5 | 2.5 | 5.7 |
| | 5/24/1995 | 196.44 | 12.11 | 184.33 | 8600 | <50 | <0.5 | - | 95 | 37 | 37 | 70 |
| | 8/18/1995 | 196.44 | 16.25 | 180.19 | 7200 | <50 | <0.5 | - | 43 | 21 | 21 | 71 |
| | 2/7/1996 | 196.44 | 9.34 | 187.10 | 11000 | <50 | 0.6 | - | 17 | 9.3 | 9.3 | 25 |
| | 9/6/1996 | 196.44 | 15.22 | 181.22 | 15000 | 1900 | <5.0 | ND | 4300 | 920 | 460 | 1600 |
| | 6/19/1997 | 196.44 | 13.33 | 183.11 | 26000 | 2900 | <5.0 | <200 | 5300 | 1500 | 910 | 3200 |
| | 1/24/2002 | 196.44 | 9.72 | 186.72 | 34000 | 5300 | - | <200 | 3100 | 1100 | 1100 | 2900 |
| | 7/15/2003 | 196.44 | 12.42 | 184.02 | 18000 | 6600 | - | <1000 | 2300 | 310 | 690 | 1600 |
| | 10/10/2003 | 196.44 | 13.79 | 182.65 | 19000 | 1800 | - | <500 | 2700 | 460 | 850 | 1800 |
| | **4/6/2004** | **196.44** | **10.55** | **185.89** | **6900** | **1300** | - | **<200** | **1100** | **100** | **380** | **780** |
| MW -3 35.5' / 2" | 11/22/1994 | 198.93 | 11.53 | 187.40 | 200 | <50 | 3 | - | <0.5 | <0.5 | <0.5 | 2 |
| | 2/23/1995 | 198.93 | 11.89 | 187.04 | 1500 | <50 | 0.9 | - | 6.6 | 6.4 | 4.2 | 13 |
| | 5/24/1995 | 198.93 | 12.71 | 186.22 | 710 | <50 | <0.5 | - | 2.5 | 3.2 | 3.1 | 16 |
| | 8/18/1995 | 198.93 | 16.14 | 182.79 | 310 | <50 | <0.5 | - | 3.1 | 2.1 | 2.2 | 11 |
| | 2/7/1996 | 198.93 | 6.22 | 192.71 | 400 | <50 | 2.2 | - | 1.4 | 2.5 | 2.2 | 7 |
| | 9/6/1996 | 198.93 | 13.51 | 185.42 | <50 | <50 | <5.0 | <5.0 | <0.5 | <0.5 | <0.5 | <0.5 |
| | 6/19/1997 | 198.93 | 12.46 | 186.47 | <50 | <50 | <5.0 | <5.0 | <0.5 | <0.5 | <0.5 | <0.5 |
| | 1/24/2002 | 198.93 | 10.08 | 188.85 | 58 | <50 | - | <5.0 | 4 | 2.7 | 2.3 | 6.7 |
| | 7/15/2003 | 198.93 | 12.45 | 186.48 | <50 | <50 | - | <5.0 | <0.5 | <0.5 | <0.5 | <0.5 |
| | 10/10/2003 | 198.93 | 14.00 | 184.93 | 350 | 75 | - | <5.0 | 14 | 16 | 23 | 60 |
| | **4/6/2004** | **198.93** | **10.78** | **188.15** | **<50** | **<50** | - | **<5.0** | **<0.5** | **1.7** | **<0.5** | **1.7** |

Well Elevation in feet above mean sea level (msl)
Depth to water in feet below the tops of the well casings
Water Table Elevations in feet above msl
TPH-g - Total petroleum hydrocarbons (TPH) as gasoline

TOG - Total oil and grease
MTBE - Methyl tertiary butyl ether
E-benzene: Ethyl-benzene
TPH-d - TPH as diesel

mg/l - milligrams per liter
µg/l - micrograms per liter
- = sample not analyzed by this method
ND = non detect (detection limit not known)

**Table 2**
**Fuel Oxygenate Analyses**

| Well ID | Date | TAME (µg/l) | TBA (µg/l) | EDB (µg/l) | 1,2-DCA (µg/l) | DIPE (µg/l) | Ethanol (µg/l) | ETBE (µg/l) | Methanol (µg/l) | MTBE (µg/l) |
|---|---|---|---|---|---|---|---|---|---|---|
| | | EPA method 8260 | | | | | | | | |
| MW - 1 | 4/6/2004 | <0.5 | <5.0 | <0.5 | <0.5 | <0.5 | <50 | <0.5 | <500 | <0.5 |
| MW - 2 | 4/6/2004 | <5.0 | **110** | <5.0 | <5.0 | <5.0 | <500 | <5.0 | <5000 | **87** |
| MW -3 | 4/6/2004 | <0.5 | <5.0 | <0.5 | <0.5 | <0.5 | <50 | <0.5 | <500 | <0.5 |

TAME: tert amyle methyl ether
TBA: t-butyl alcohol
EDB: 1,2-Dibromoethane
1,2-DCA: 1,2-Dichloroethane
DIPE: Diisopropyl ether

ETBE: Ethyl tert-butyl ether
MTBE: Methyl tert-butyl ether
µg/l - micrograms per liter
- = sample not analyzed by this method
ND = non detect

## Table 3
## Groundwater Sample Analytical Results: Soil Borings

| Sample ID | Date | TPH-g (µg/l) | TPH-d (µg/l) | MTBE (µg/l) | Benzene (µg/l) | Toluene (µg/l) | E-benzene (µg/l) | Xylenes (µg/l) |
|---|---|---|---|---|---|---|---|---|
| | | (EPA 8015) | | (EPA 8020 / 8021) | | | | |
| SB1 | 8/97-1/98 | 63,000 | 27,000 | <200 | 2,600 | 1,100 | 1,700 | 3,600 |
| SB3 | 8/97-1/98 | 11,000 | 790 | <100 | 1,700 | 840 | 330 | 1,100 |
| SB5 | 8/97-1/98 | 12,000 | 28,000 | <330 | 200 | 14 | 280 | 28 |
| SB6 | 8/97-1/98 | 2,200 | - | <28 | 330 | 4.7 | 49 | 14 |
| SB7 | 8/97-1/98 | 36,000 | 200,000 | <1100 | 2,200 | 550 | 850 | 1,700 |
| SB8 | 8/97-1/98 | 6,200 | 1,200 | <92 | 430 | 22 | 150 | 170 |
| SB9 | 8/97-1/98 | 160 | 210 | 22 | 6.2 | 8.1 | 4.2 | 17 |
| SB-10W | 8/21/2003 | 3,500 | 1,400 | <25 | 110 | 2.9 | 120 | 410 |
| SB-11W | 8/21/2003 | 3,800 | 2,400 | <50 | 140 | 9.5 | 23 | 23 |
| SB-12 W | 10/9/2003 | 680 | 420 | <5.0 | <0.5 | 2.3 | <0.5 | 3.5 |
| SB-13 W | 10/10/2003 | 270 | 1,200 | <5.0 | <0.5 | <0.5 | <0.5 | 2.0 |
| SB-15 W | 10/10/2003 | 1,600 | 1,900 | <5.0 | <0.5 | 3.0 | 25.0 | 8.8 |
| MDL | | 50 | 50 | 5 | 0.5 | 0.5 | 0.5 | 0.5 |

MTBE - Methyl tertiary butyl ether
mg/l - milligrams per liter
µg/l - micrograms per liter
- = sample not analyzed by this method

TPH-g - Total petroleum hydrocarbons (TPH) as gasoline
TPH-d - TPH as diesel
MDL - method detection limit with no sample dilution
E-benzene: Ethyl-benzene

**Table 4**
**Soil Sample Analytical Data**

| Sample ID | Date | TPH-g mg/kg | TPH-d mg/kg | MTBE mg/kg | Benzene mg/kg | Toluene mg/kg | E-benzene mg/kg | Xylenes mg/kg |
|---|---|---|---|---|---|---|---|---|
| | | EPA 8015 | | EPA 8020 / 8021 | | | | |
| SB1-10' | 8/97-1/98 | 8.2 | 15 | <2.0 | 0.17 | 0.031 | 0.097 | 0.069 |
| SB2-10' | 8/97-1/98 | 1.3 | <1.0 | <0.05 | 0.061 | 0.016 | 0.03 | 0.014 |
| SB3-5' | 8/97-1/98 | 1.6 | - | <0.05 | 0.048 | 0.044 | 0.016 | 0.046 |
| SB3-10' | 8/97-1/98 | 590 | 160 | <6.0 | 8.6 | 15 | 10 | 48 |
| SB3-15' | 8/97-1/98 | 1,000 | - | <10 | 8.3 | 8.8 | 15 | 52 |
| SB3-20' | 8/97-1/98 | <1.0 | - | <0.05 | 0.006 | 0.009 | <0.005 | 0.017 |
| SB3-25' | 8/97-1/98 | <1.0 | - | <0.05 | <0.005 | <0.005 | <0.005 | <0.005 |
| SB4-10' | 8/97-1/98 | <1.0 | <1.0 | <0.05 | <0.005 | <0.005 | <0.005 | <0.005 |
| SB5-15' | 8/97-1/98 | 2.0 | 4.9 | <0.05 | 0.08 | <0.005 | 0.045 | 0.012 |
| SB6-15' | 8/97-1/98 | 2.2 | <1.0 | <0.05 | 0.058 | 0.008 | 0.007 | 0.073 |
| SB7-15' | 8/97-1/98 | 7.9 | 2.3 | <0.05 | <0.005 | 0.016 | <0.005 | 0.073 |
| SB8-10' | 8/97-1/98 | 33 | 11 | <0.23 | 0.25 | 0.089 | 0.30 | 0.29 |
| SB9-10' | 8/97-1/98 | <1.0 | <1.0 | <0.05 | <0.005 | <0.005 | <0.005 | <0.005 |
| SB-10 12' | 8/21/2003 | 100 | 38 | <1.0 | 0.39 | <0.10 | 0.88 | 1.4 |
| SB-10 19' | 8/21/2003 | 66 | 6.3 | <0.05 | <0.005 | 0.075 | 0.047 | 0.13 |
| SB-11 8' | 8/21/2003 | 1.8 | 1.1 | <0.05 | 0.10 | 0.012 | <0.005 | <0.005 |
| SB-11 12' | 8/21/2003 | 1.3 | 2.1 | <0.05 | 0.05 | <0.005 | <0.005 | <0.005 |
| SB-11 19' | 8/21/2003 | 150 | 27 | <0.50 | 0.13 | 0.11 | 0.25 | 0.18 |
| SB-12 12' | 10/9/2003 | <1.0 | <1.0 | <0.05 | <0.005 | <0.005 | <0.005 | <0.005 |
| SB-12 18' | 10/9/2003 | <1.0 | <1.0 | <0.05 | <0.005 | <0.005 | <0.005 | <0.005 |
| SB-13 20' | 10/10/2003 | <1.0 | <1.0 | <0.05 | <0.005 | <0.005 | <0.005 | <0.005 |
| SB-14 16' | 10/10/2003 | 74 | 98 | <0.50 | <0.050 | <0.050 | <0.050 | 0.12 |
| SB-14 23' | 10/10/2003 | <1.0 | <1.0 | <0.05 | <0.005 | <0.005 | <0.005 | <0.005 |
| SB-15 15' | 10/10/2003 | 660 | 100 | <2.0 | <0.20 | 5.6 | 1.3 | 1.9 |
| SB-15 19' | 10/10/2003 | <1.0 | <1.0 | <0.05 | <0.005 | <0.005 | <0.005 | <0.005 |
| MDL | | 1.0 | 1.0 | 0.05 | 0.005 | 0.005 | 0.005 | 0.005 |

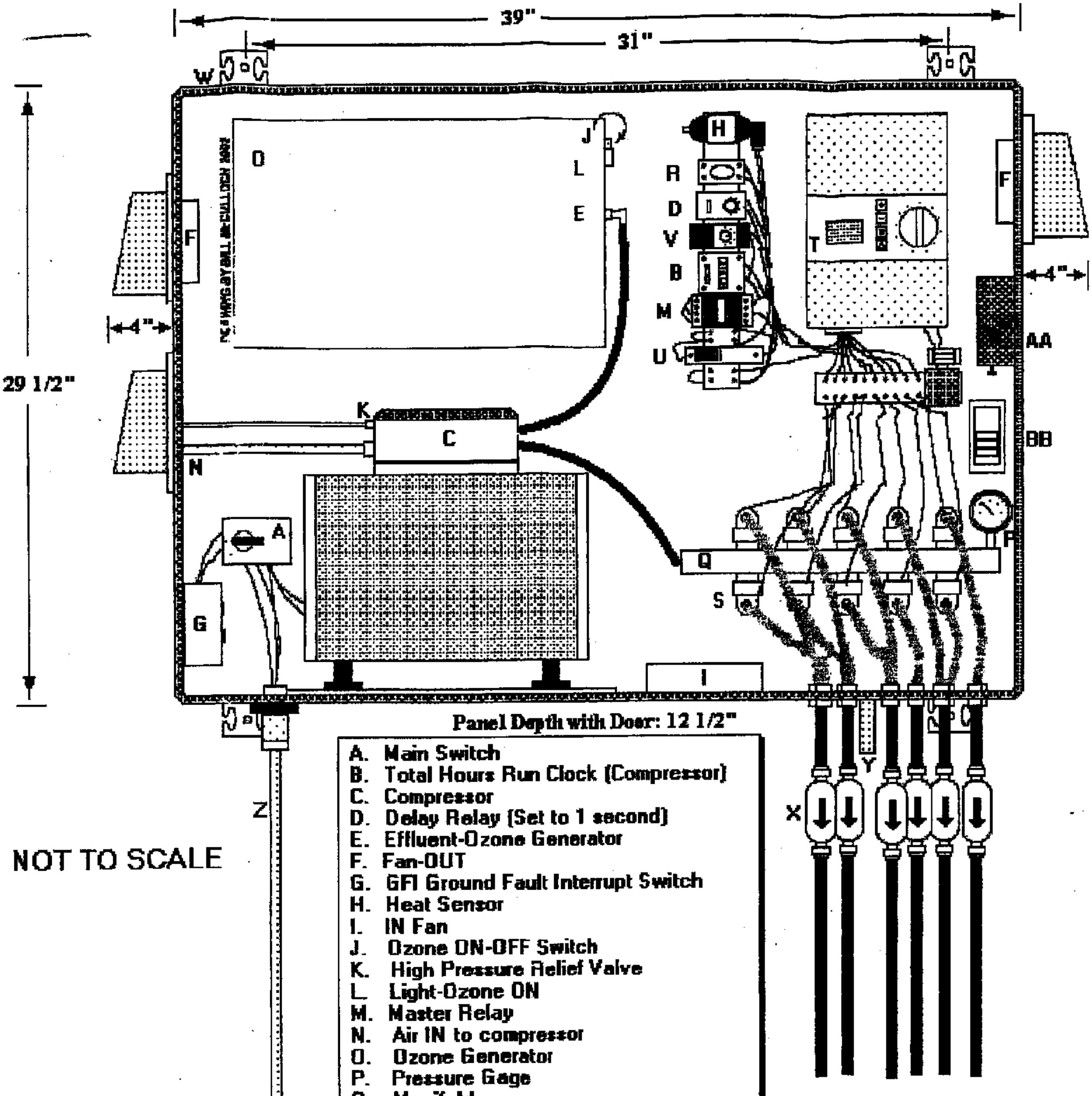
MTBE - Methyl tertiary butyl ether
mg/kg - milligrams per kilogram
MDL - method detection limit with no sample dilution
- = sample not analyzed by this method

TPH-g - Total petroleum hydrocarbons (TPH) as gasoline
TPH-d - TPH as diesel
E-benzene: Ethyl-benzene

**Table 5**
**Groundwater Flow Summary**

| Monitoring Episode Date | Average Depth to Water | Average Water Table Elevation | Elevation Change from previous (ft) | Flow Direction (gradient ft/ft) |
|---|---|---|---|---|
| 11/22/1994 | 11.66 | 185.04 | - | - |
| 2/23/1995 | 11.61 | 185.10 | 0.06 | - |
| 5/24/1995 | 11.92 | 184.79 | -0.31 | - |
| 8/18/1995 | 15.64 | 181.07 | -3.72 | - |
| 2/7/1996 | 6.66 | 190.04 | 8.97 | SE (0.32) |
| 9/6/1996 | 14.11 | 182.60 | -7.45 | SE (0.18) |
| 6/19/1997 | 12.95 | 183.75 | 1.16 | SSE (0.08) |
| 1/24/2002 | 9.78 | 186.93 | 3.18 | S (0.05) |
| 7/15/2003 | 12.57 | 184.13 | -2.80 | S (0.06) |
| 10/10/2003 | 14.12 | 182.58 | -1.55 | S (0.05) |
| 4/6/2004 | 10.75 | 185.96 | 3.37 | S (0.05) |

Elevations in feet above mean sea level
- not available



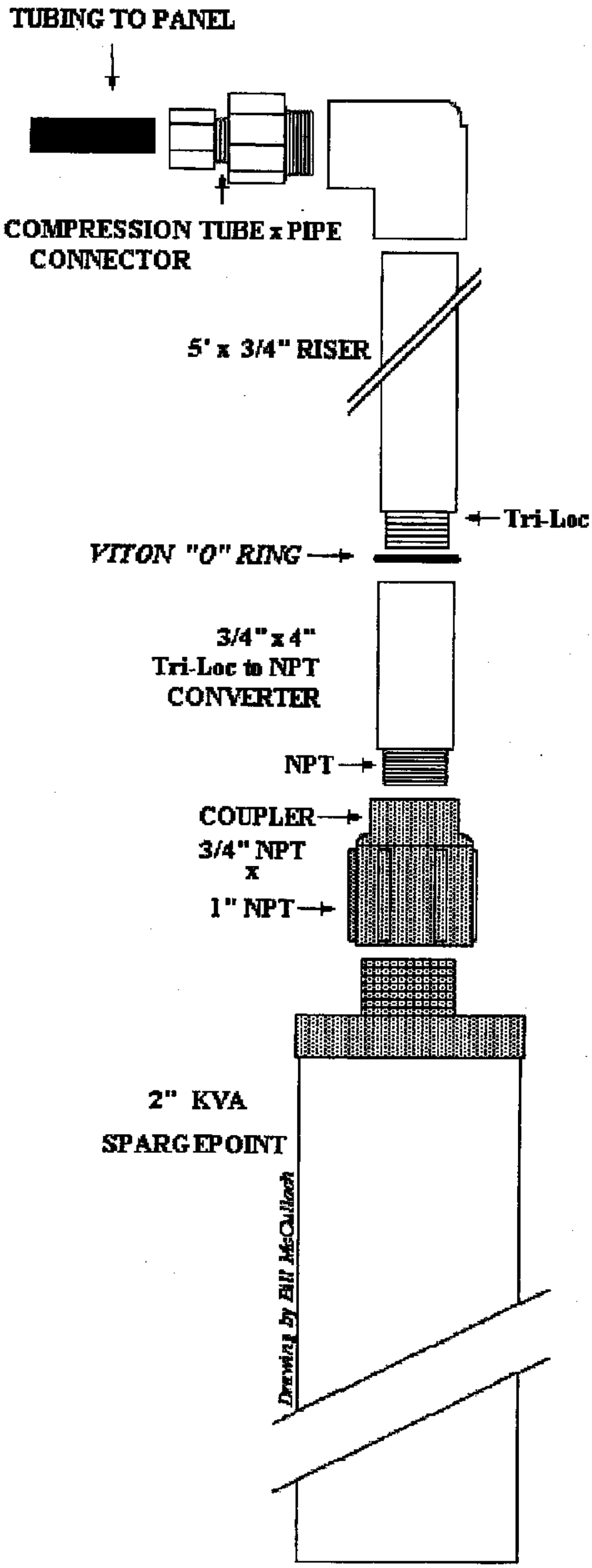

**Panel Depth with Door: 12 1/2"**

NOT TO SCALE

A. Main Switch
B. Total Hours Run Clock (Compressor)
C. Compressor
D. Delay Relay (Set to 1 second)
E. Effluent-Ozone Generator
F. Fan-OUT
G. GFI Ground Fault Interrupt Switch
H. Heat Sensor
I. IN Fan
J. Ozone ON-OFF Switch
K. High Pressure Relief Valve
L. Light-Ozone ON
M. Master Relay
N. Air IN to compressor
O. Ozone Generator
P. Pressure Gage
Q. Manifold
R. Relay
S. Solenoid
T. Timer-Controller
U. 16 Amp Breaker
V. Current Sensing Relay
W. Mounting Bracket
X. One-Way Checkvalve (Arrow Down)
Y. Grounding Wire
Z. Power Cord Plug
AA. Ozone Sensor and Reset
BB. Ozone Sensor Relay

**Note: This drawing is meant for general identification of panel components only. Design and configuration may vary.**

**This is NOT intended to serve as a wiring diagram.**



TUBING TO PANEL
COMPRESSION TUBE x PIPE CONNECTOR
5' x 3/4" RISER
Tri-Loc
VITON "O" RING
3/4" x 4" Tri-Loc to NPT CONVERTER
NPT
COUPLER
3/4" NPT x 1" NPT
2" KVA SPARGEPOINT
Drawing by Bill McCulloch