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GEOMATRIX

March 11, 1993
Project 1736.11

Ms. Juliet Shin
Alameda County Health Care Services Agency
Division of Hazardous Materials
Department of Environmental Health
80 Swan Way, Room 200
Oakland, CA 94621

Subject: Quarterly Monitoring Report
Calendar Quarter January - March 1993
1150 Marina Village Parkway
Marina Village Development
Alameda, California

Dear Ms. Shin:

On behalf of Alameda Real Estate Investments, Inc. (AREI), Geomatrix Consultants, Inc. (Geomatrix), is submitting the subject report. The next quarterly groundwater sampling event is scheduled for April 1993. If you have any questions regarding this report, please call either of the undersigned.

Sincerely,

GEOMATRIX CONSULTANTS, INC.

Jeff Nelson
Project Manager

Elizabeth Nixon
Senior Project Engineer

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Enclosure

cc: Ms. Kathy Luck, AREI
Mr. Richard Hiett, Regional Water Quality Control Board

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QUARTERLY MONITORING REPORT
CALENDAR QUARTER JANUARY - MARCH 1993

1150 Marina Village Parkway
Marina Village Development
Alameda, California

Prepared for

Alameda Real Estate Investments
1150 Marina Village Parkway
Alameda, California

March 1993
Project No. 1736.11

Geomatrix Consultants

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QUARTERLY MONITORING REPORT
CALENDAR QUARTER JANUARY-MARCH 1993

1150 Marina Village Parkway
Marina Village Development
Alameda, California

1.0 INTRODUCTION

This report presents a summary of groundwater monitoring activities conducted by Geomatrix Consultants, Inc. (Geomatrix), on behalf of Alameda Real Estate Investments, Inc. (AREI), at 1150 Marina Village Parkway, Alameda, California (Figure 1). These activities initiated a quarterly groundwater monitoring program and were conducted during the period of January through February 1993. The purpose of this program is to comply with Alameda County Department of Environmental Health (ACDEH) requirements for closure of underground storage tank (UST) sites. Work at the site was completed in accordance with the scope of work submitted to ACDEH by Geomatrix on 29 December 1992.

1.1 Background

One UST apparently was installed at the site in the 1940s by former property owners and was used to store diesel fuel. AREI removed the tank and associated petroleum-containing soil in 1989; the location of the former UST and soil excavation boundary are shown on Figure 2.

2.0 QUARTERLY PROGRESS SUMMARY

The work performed during this quarter is summarized below:

- A groundwater monitoring well was installed and developed downgradient of the former UST and soil excavation. Well installation and development activities were conducted on 1 and 8 February 1993 and are described in Section 3.0.

- Water levels were measured in the new monitoring well and in three existing monitoring wells in the site vicinity on 8 February 1993. Water-level measurements and procedures are described in Section 4.0.

- Geomatrix performed the first of four quarterly groundwater sampling events on 11 February 1993. Section 5.0 describes the groundwater sampling activities and analytical procedures and results.

3.0 INSTALLATION AND DEVELOPMENT OF GROUNDWATER MONITORING WELL

A groundwater monitoring well was installed downgradient of the former UST and soil excavation (Figure 2). The well location was based on groundwater gradient direction data, obtained from investigations at the site and vicinity performed by Levine-Fricke in 1988 and Geomatrix in 1993, indicating that the groundwater gradient direction was toward the northwest. Before well installation, a monitoring well installation permit was obtained from the Alameda County Flood Control and Water Conservation District, Zone 7. Utility clearance at the proposed well location was performed through Underground Service Alert and by Cruz Brothers, Inc., of San Jose, California.

The monitoring well was installed according to Geomatrix Protocol No. 1 (Appendix A) on 2 February 1993 by Gregg Drilling, Inc., of Concord, California. The boring for the monitoring well was drilled to a depth of 18 feet below ground surface using an 8-inch-outside-diameter hollow-stem auger. Continuous core samples were collected and logged for the entire depth of the boring. The core samples were described according to the Unified

Soil Classification System, noting lithology and other characteristics. The boring log is presented in Appendix B.

The well was constructed using 2-inch-diameter, flush-threaded, Schedule-40 polyvinyl chloride (PVC) casing. A 14-foot-long screened section of factory slotted PVC well screen with 0.010-inch slot size, was positioned to intersect the groundwater surface. The well annulus was backfilled with a filter pack of Lonestar #0/30 sand from the bottom of the borehole to one-half foot above the slotted section; a 6-inch-thick bentonite seal was placed above the filter pack. The remaining annulus was backfilled to surface with a 10% bentonite-cement grout seal to protect against surface water infiltration through the sandpack. A locking water-tight cap was placed on the PVC casing and a flush-mounted, traffic-rated Christy box cover was placed over the monitoring well at the ground surface. The well construction diagram is included in Appendix B. Well construction data are summarized in Table 1.

The monitoring well was developed according to Geomatrix Protocol No. 1 (Appendix A) approximately 72 hours after completion to loosen debris that may have accumulated in the well screen, stabilize the sandpack, and establish hydraulic communication with the surrounding water-bearing sediments. Following well completion, the top of the well casing was surveyed for horizontal and vertical control by Luk, Milani and Associates, of Walnut Creek, California, a licensed land surveyor.

4.0 QUARTERLY WATER-LEVEL MEASUREMENTS

Geomatrix measured water levels in four groundwater monitoring wells at or near the site on 8 February 1993. Well construction data for these wells are summarized in Table 1. Monitoring well locations and water-level elevations are shown on Figure 2. Water levels were measured to the nearest 0.01 foot using a Sinco electric well sounder following Geomatrix Protocol No. 2 (Appendix A). Equipment used by Geomatrix personnel was washed with a detergent-water solution and rinsed with deionized water, before each measurement was taken. Water-level measurements from this quarterly monitoring event are summarized in Table 2.

Water-level elevations at or near the site ranged from -4.91 feet at well WC-3 to 0.76 feet at well GMW-1 (City of Alameda Datum). Water-level elevation data proximal to the former excavation suggest that the local hydraulic gradient direction is generally to the west. Based on this gradient, well GMW-6 is down gradient of the former UST and soil excavations. The horizontal hydraulic gradient in the site and vicinity ranges from about 0.001 to 0.02 feet per foot.

5.0 QUARTERLY GROUNDWATER SAMPLING AND ANALYSIS

Groundwater samples were collected from monitoring well GMW-6 on 11 February 1993. Sample collection followed Geomatrix Protocol No. 3 (Appendix A). Immediately after collection, groundwater samples were placed in an ice-chilled cooler and transported under Geomatrix chain-of-custody procedures to Quanteq Laboratories (Quanteq), of Pleasant Hill, California, a state-certified analytical laboratory.

Samples were analyzed by Quanteq for total petroleum hydrocarbons as diesel (TPHd), according to Environmental Protection Agency (EPA) Modified Method 8015 and benzene, toluene, ethylbenzene, and xylenes (BTEX) according to EPA Method 8020. Copies of chain-of-custody records are included in Appendix C.

The results of chemical analyses performed on groundwater samples collected in this quarter are presented in Table 3. No TPHd or BTEX were detected in the groundwater sample. Laboratory reports are included in Appendix C.

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TABLES

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TABLE 1

WELL CONSTRUCTION DATA

1150 Marina Village Parkway
Marina Village
Alameda, California

Well Number	Date Constructed	Well Depth (ft. below grade)	Screened Interval (ft. below grade)	Filter Pack Interval (ft. below grade)	Measuring Point Elevation[1] (feet)	Ground Surface Elevation (feet)
LF-2[2]	1988	15	5-15	3-15	4.92	4.52
WC-3[3]	1987	14	7-14	unknown	3.66	4.21
GMW-1	4/15/92	13.5	3.5-13.5	3-13.5	3.86	4.24
GMW-6	2/1/92	18	4-18	3.5-18	3.98	4.2[4]

1 Top of PVC casing elevations were surveyed by Luk, Milani & Associates (formerly Stedman & Associates, Inc.) of Walnut Creek, California. Elevations are relative to City of Alameda Datum (6.4 feet above Mean Sea Level).

2 LF-2 was installed by Levine-Fricke, Inc. in 1988.

3 WC-3 was installed by Woodward-Clyde Consultants, Inc. in 1987.

4 Ground surface elevation is approximate.

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TABLE 2

WATER-LEVEL MEASUREMENTS
1150 Marina Village Parkway
Marina Village
Alameda, California

Well Number	Date Water Level Measured	Measuring Point (MP) Elevation[1] (feet)	Depth to Water Below MP (feet)	Water-Level Elevation[1] (feet)
LF-2	2/8/93	4.92	8.83	-3.91
WC-3	2/8/93	3.66	8.57	-4.91
GMW-1	2/8/93	3.86	3.10	.76
GMW-6	2/8/93	3.98	3.33	.65

1 Top of PVC casing elevations were surveyed by Luk, Milani & Associates (formerly Stedman & Associates, Inc.) of Walnut Creek, California. Elevations are relative to City of Alameda Datum (6.4 feet above Mean Sea Level).

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TABLE 3

ANALYTICAL RESULTS FOR GROUNDWATER SAMPLES[1]
1150 Marina Village Parkway
Marina Village
Alameda, California

Results in micrograms per liter ($\mu g/l$)

Well Number	Sample Date	Extractable Petroleum Hydrocarbons as Motor Oil[2]	Benzene[3]	Toluene[3]	Ethylbenzene[3]	Xylenes[3] (Total)
GMW-6	2/11/93[1]	<50	<0.5	<0.5	<0.5	<2.0

1 Samples collected on 2/11/93 analyzed by Quanteq Laboratories of Pleasant Hill, California.

2 Analyzed according to EPA Modified Method 8015.

3 Analyzed according to EPA Method 8020.

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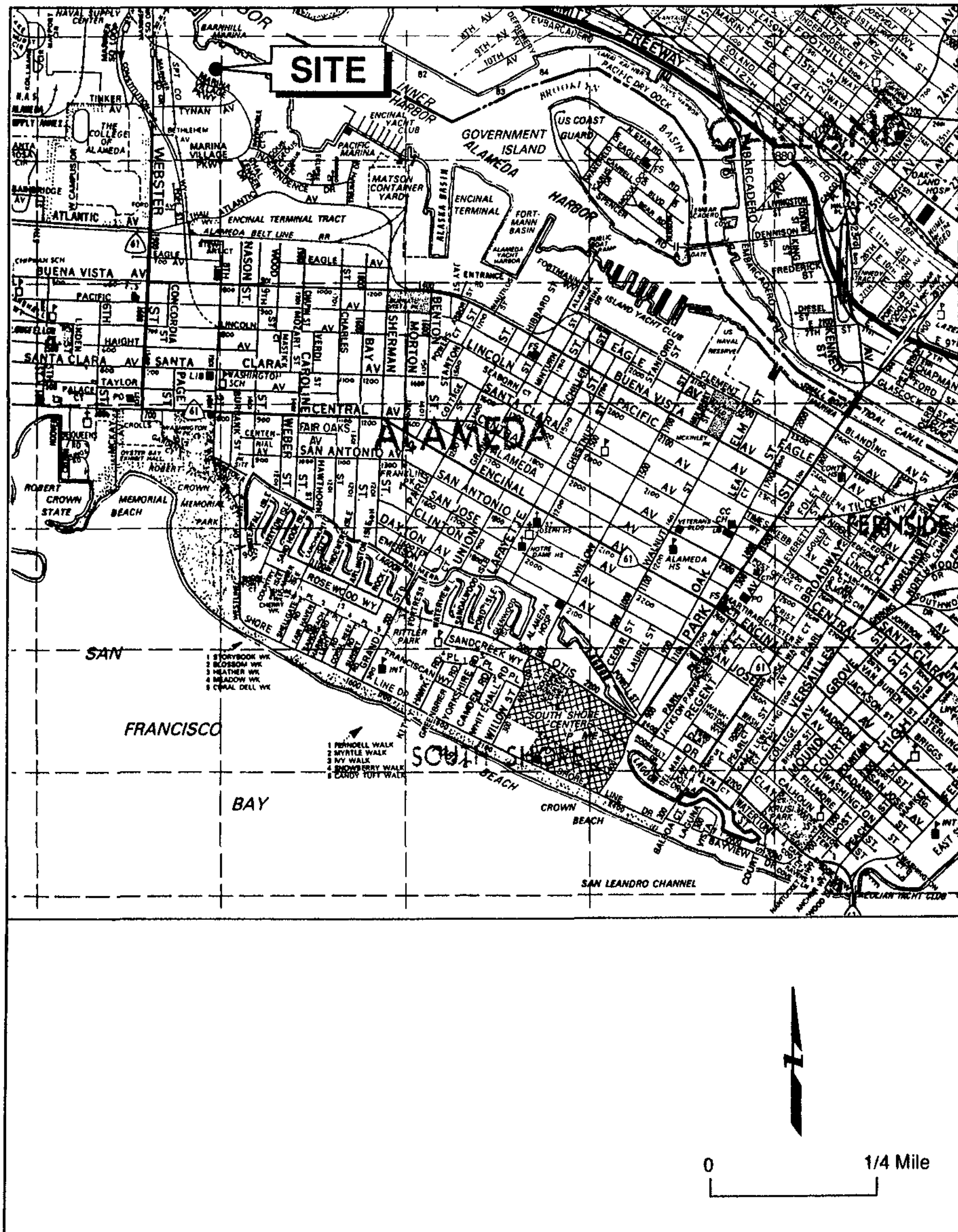
FIGURES



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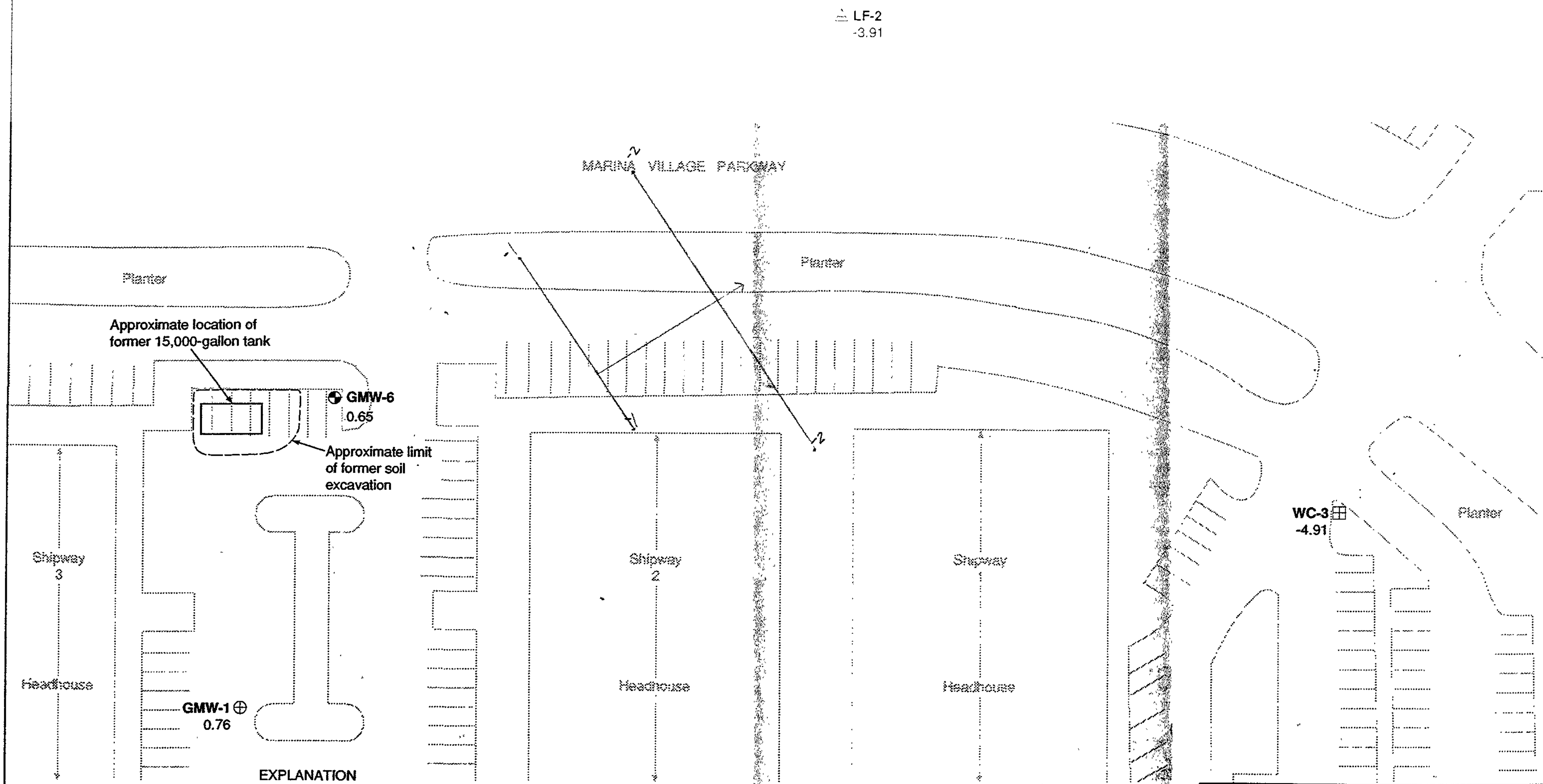
SITE VICINITY MAP
1150 Marina Village Parkway
Marina Village Development
Alameda, California

Figure	1
Project No	1736.11



EXPLANATION

GMW-6 Groundwater monitoring well, Geomatrix, February 1993

GMW-1 Groundwater monitoring well, Geomatrix, April 1992

LF-2 Groundwater monitoring well, Levine•Fricke, 1988

WC-3 Groundwater monitoring well, Woodward-Clyde, 1987

-4.91 Water-level elevation, in feet (City of Alameda Datum)

SITE PLAN SHOWING MONITORING WELLS AND WATER-LEVEL ELEVATIONS (FEBRUARY 1993)
1150 Marina Village Parkway
Marina Village Development
Alameda, California

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APPENDIX A

Geomatrix Protocols

PROTOCOL NO. 1

INSTALLATION AND DESTRUCTION OF WELLS

1.0 INTRODUCTION

This protocol describes procedures to be followed during the installation or destruction of monitoring, groundwater extraction, and vapor extraction wells. The procedures presented herein are intended to be of general use. As the work progresses, and if warranted, appropriate revisions will be made and approved by the project manager. Detailed procedures in this protocol may be superceded by applicable regulatory requirements.

2.0 WELL INSTALLATION

If required, permits for the installation of wells will be acquired from the appropriate regulatory agency before drilling is initiated. After well installation, well completion report(s) will be completed and filed with the California State Department of Water Resources or the appropriate agency.

Each groundwater monitoring well will be designed to enable measurement of the potentiometric surface and to permit water sampling of a specific water-bearing zone. Each vapor monitoring well will be designed to enable measurement of pressure conditions and permit sampling of a specific zone. The field geologist/engineer, in consultation with the project Geologist or Engineer who will be registered with the State of California if required, will specify the screened interval using the lithologic log and geophysical log (if performed) and will select the well materials and techniques for well completion to be compatible with the formations and the intended use of the well. Drilling and logging of the borings for the wells will be in conformance with the protocol DRILLING OF SOIL BORINGS. Construction of all wells will be in conformance with the following provisions. A TYPICAL MONITORING WELL CONSTRUCTION DIAGRAM is attached.

2.1 WELL SCREEN AND CASING

The well casing will generally consist of threaded stainless steel or polyvinyl chloride (PVC) schedule 40 (minimum) casing. The inside diameter of the casing will be large enough to permit easy passage of an appropriate water level probe and equipment for purging wells and water sample collection.

The well screen will generally consist of machine-slotted or wire-wrapped PVC or stainless steel screen. The slot sizes will be compatible in size with the selected filter material. The screened sections will provide flow between the target zone and the well, allowing efficiency in well development and collection of representative samples.

2.2 FILTER MATERIAL

Filter material will be well graded, clean sand with less than 2 percent by weight passing a No. 200 sieve and less than 5 percent by weight of calcareous material. The filter material will be either a standard sand gradation designed for a range of anticipated soil types or a sand gradation specifically designed to fit the soils collected from anticipated well completion zones.

2.3 SETTING SCREENS AND RISER CASING

Upon completion of drilling and/or geophysical logging, the boring will be sounded to verify the total depth, and the well casing will be assembled and lowered into the boring. Well casing materials will be measured to the nearest 0.01 foot and steam cleaned before being lowered into the borehole. The casing and screen will be suspended a few inches above the bottom of the boring. The well assembly will be designed so that the well screen is opposite the target zone. The bottom of the screen will typically be flush with the bottom of the well and will be fitted with a secure bottom cap. The PVC casing and well screen joints will be flush coupled. No PVC cement or other solvents will be used to fasten the joints of casing or well screen. When installing wells in an open borehole, stainless steel centralizers will be used immediately above and below the well screen and approximately every thirty (30) to fifty (50) feet along the length of the casing. Centralizers need not be placed on well assemblies installed within augers or drill casings because the auger or drill casing will adequately center the well casing and screen in the borehole.

For borings drilled by the mud rotary method, potable water may be added to the drill mud fluid and circulated in the borehole after completion of the boring. Circulation will continue until the suspended sediment in the return fluid has been thinned. If borehole conditions are relatively stable, the mud will be thinned before the casing assembly is lowered to the specified depth. This is preferred because it minimizes clogging of the well screen with thick mud. Conversely, if borehole conditions are relatively unstable, the mud will be thinned after the casing is placed at the specified depth but prior to installation of annular fill materials. After installation of the well assembly, a slurry of filter sand and potable water will then be tremied into the annular space. For borings drilled using the hollow stem auger method, the filter sand will be placed after the well assembly has been lowered to the specific depth through the augers. The augers will be incrementally raised as the filter sand is placed by free fall through the augers. The depth to the top of the filter pack will be measured after each increment to detect possible bridging. If bridging occurs, it will be broken by washing the filter materials into proper place with potable water, or by repeatedly raising and lowering the augers slightly. The filter sand will be placed in a calculated quantity sufficient to fill the annular space to a level of about 1 to 2 feet above the top of the well screen for monitoring wells. For extraction wells the level of filter sand above the well screen will be based on site-specific conditions. The depth to the top of the filter pack will be verified by measuring, using a tremie pipe or a weighted tape. Groundwater extraction wells or monitoring wells may be surged before placement of the transition seal to promote filter pack settlement, as specified by the project manager.

Once the depth to the top of the filter pack has been verified, bentonite or fine sand may be placed in the annular space as a transition seal between the filter sand and the grout. If bentonite is to be placed below standing water, a high solids bentonite grout will be pumped through a tremie pipe, or pellets may be poured through the annulus. If bentonite is to be placed above standing water, a high solids bentonite grout should be used or pellets may be placed in three-inch lifts. Each lift should be hydrated using approximately one gallon of potable water per 3-inch lift of pellets. A sufficient quantity of bentonite will be poured to fill the annular space to a level of about 2 feet above the top of the filter pack. The completed bentonite transition seal will be allowed to hydrate for at least 30 minutes prior to placing the grout. If a layer of fine sand is placed as the transition seal, the fine sand will be mixed with potable water and placed as a slurry through the tremie pipe or poured dry through the annulus. The depth to the top of the transition seal will be verified by measuring, using the tremie pipe or a weighted tape.

A neat cement grout, cement/sand grout, or cement/bentonite grout seal will be placed from the top of the transition seal to the ground surface. The grout seal will be placed by pumping through a tremie pipe lowered to within five feet of the top of the transition seal in mud rotary borings. The grout seal will be placed in hollow stem auger borings by free fall through the augers as they are incrementally raised or by pumping through flexible hose lowered to near the bottom of the zone to be grouted. The grout must be tremied if there is any standing water in the augers above the transition seal. Grout/additive/water mixtures will be determined on a site-specific basis. Typical specifications of grout mixtures include: a) neat cement/bentonite grout, a mixture of one sack (94 pounds) portland cement, approximately 2 to 5 percent by weight (of cement) powdered bentonite, and approximately 6 to 8 gallons of water; b) neat cement grout consisting of one sack of portland cement and approximately 5 to 6 gallons of water; and c) cement/sand grout consisting of no more than two parts sand to 1 part cement and approximately 7 gallons of water. Only potable water will be used to prepare the grout. After grouting, no work will be done on the monitoring well until the grout has set a minimum of 24 hours.

2.4 DEVELOPMENT OF GROUNDWATER MONITORING OR EXTRACTION WELLS

When the well installation is complete, the well will be developed by surging, bailing, and/or pumping or other appropriate method as specified by the project manager. The objectives of well development are to remove sediment that may have accumulated during well installation, to consolidate the filter pack around the well screen, and to enhance the hydraulic connection between the target zone and the well. A minimum of 24 hours must pass between completion of grouting and development, to allow sufficient curing of the grout. In most instances, a bailer will be used to remove sediment and turbid water from the bottom of the well. A surge block then used within the entire screened interval to flush the filter pack of fine sediment. Surging will be conducted slowly to minimize disruption to the filter pack and screen. The well will be bailed again to remove sediment drawn in by the surging process until suspended sediment is minimized. Following the bailing and surging the well will be further developed using air-lift or pumping methods. A bailer may be used for low-yield wells. The well will be developed at a higher pumping rate than the anticipated rate of future purging, if possible. During development, the turbidity of the water will be monitored and the pH, specific conductance, and temperature of the return water will be measured. Drawdown and recovery will be measured during and at the end of the development process, respectively, using an electric sounder. Well development will proceed until the return water is of sufficient clarity, in the judgment of the Geomatrix field personnel. If the screened interval is too long to be developed adequately in one stage, additional stages will be employed, in which the end of the pump intake will be raised or lowered to various depths, as required.

2.5 SURFACE COMPLETION

Upon completion of the well, a suitable slip-on cap, threaded end cap, or waterproof cap will be fitted on the top of the riser casing to prevent the entry of surface runoff or foreign matter. A steel protective well cover (e.g., stovepipe) will be completed either above the ground surface, or a vault with a traffic rated cover will be completed at the ground surface. All wells will be locked for security, and will be designed to limit surface water infiltration.

2.6 DOCUMENTATION

A well construction diagram for each well will be completed in the field on the MONITORING WELL LOG by the field geologist/engineer and submitted to the project geologist or engineer upon completion of each well. Well installation and construction data will be summarized on the FIELD WELL CONSTRUCTION SUMMARY. Well development notes and field measurements of water quality parameters will be summarized on a MONITORING WELL SAMPLING RECORD. A DAILY FIELD RECORD and the well development record will also be submitted to the project geologist or engineer upon completion of each monitoring well.

3.0 CLEANING OF DRILLING EQUIPMENT

Cleaning of the drill rig and associated drilling equipment will follow the procedures discussed in Section 2 of the protocol DRILLING AND DESTRUCTION OF SOIL BORINGS.

All well casing materials will be cleaned thoroughly before they are installed. Well development equipment will be cleaned thoroughly before use. The following cleaning procedure has been found to be effective and will be used or adapted as appropriate for general conditions of materials or equipment to be cleaned.

1. Swab surfaces, inside and out, with a laboratory grade detergent-potable water solution or steam clean with a detergent-potable water solution.

2. Steam rinse with potable water or rinse in deionized or organic-free water.

3. Cover with clean plastic to protect materials and equipment from contact with chemical products, dust, or other contaminants.

Alternatively, well casing materials that have been steam-cleaned and sealed in individual airtight plastic bags by the factory can be used.

Decontamination rinsate will be collected and stored for future disposal by the client in accordance with legal requirements.

4.0 WELL DESTRUCTION

Destruction of wells will be completed in accordance with applicable state and local requirements. If required, permits for destruction will be obtained from the appropriate regulatory agency. As part of destruction design and implementation, care will be taken to seal groundwater pathways between multiple aquifers, and limit surface water infiltration through the destroyed borehole.

If possible, the well casing will be removed from the borehole. For shallow wells, and if the well has been completed in the uppermost aquifer, the casing may be pulled from the borehole before auger entry. Alternatively, and if the well has been completed below the uppermost aquifer, the annular fill may be drilled out with hollow-stem augers and the casing removed from the borehole through the augers. If the well casing is PVC or other similar material and cannot be removed as described above, it may be removed by drilling out the casing and annular fill using a tricone or drag bit and a rotary drilling method. The borehole will be redrilled to the same or slightly larger diameter than the original borehole. The redrilled borehole will be plumb and adequately centered, and all the well casing will be removed. The borehole will be filled with a neat cement, cement/sand or cement/bentonite grout. A high-solids bentonite grout may be used in the saturated zone. The grout will be placed in one continuous pour before its initial set from the bottom of the boring to the ground surface. The grout will be emplaced by pumping through a tremie pipe or flexible hose which is initially lowered to the bottom of the borehole. and raised incrementally as emplacement proceeds. The augers should be raised incrementally as emplacement proceeds, but not to exceed increments of 20 feet or greater than allowed by borehole stability. Boreholes that are terminated above the water table and are not greater than 20 feet deep may be grouted by a continuous pour originating at the ground surface.

If the well casing cannot be removed, grout may be tremied into the casing as described above. If the filter pack interconnects multiple distinct water-yielding zones, the casing must be cut opposite the aquifer to be sealed as well as through the intervening aquitard before grout is emplaced. This will allow the grout to seal the filter pack area, thereby prohibiting vertical movement of groundwater between the zones. Grout should be placed opposite the aquifer and for a vertical distance of at least ten feet above (and below the aquifer, if applicable). If the aquifer is confined and the head pressure is great, the grout may need to be emplaced under pressure.

The volume of sealing material used will be calculated and compared to the casing or borehole volume to ensure bridging has not taken place during well destruction. If the well

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is in an urban area and if the casing remains in the borehole, a hole will be excavated around the well to a depth of five feet, and the casing will be removed to the bottom of the excavation. The sealing material will be allowed to spill over into the excavation to form a cap. The remainder of the excavation will be backfilled with either native material, grout, or concrete.

PROTOCOL NO. 2

WATER LEVEL, WELL DEPTH, AND FREE PRODUCT MEASUREMENTS

1.0 INTRODUCTION

This protocol describes procedures to be followed during water level, well depth, and free product measurements. The procedures presented herein are intended to be of a general nature and, as the investigation progresses and when warranted, appropriate revisions may be made by the project manager.

2.0 WATER LEVEL AND WELL DEPTH MEASUREMENTS

Water level measurements at a site will be taken as quickly as possible, to best represent the potentiometric surface across the site at a single time. If pressure is suspected or has developed inside the well casing, the well will be allowed to stand without a cap for a few minutes before taking the water-level measurement. Water-level measurements will be recorded to the nearest hundredth foot, and well depth measurements will be noted to the nearest half foot. Equipment placed in the wells for water level and well depth measurements will be cleaned prior to reuse, as discussed in Section 5. Care will be taken to not drop any foreign objects into the wells and to not allow the tape or sounding device to touch the ground around the well during monitoring.

2.1 WATER LEVEL MEASUREMENTS

Water level measurements will be performed by one of the following methods:

A. Wetted-tape Method

A steel surveyor's tape will be prepared by coating several feet of the lower end of the tape with chalk or water-finding paste. A lead weight is attached to the lower end of the steel tape to keep it taut. The tape is lowered into the well until a foot or two of the chalked portion is submerged.

Tape without weight can be used if the well opening or pump casing clearance is too small and restricts the passage of weight. The proper length to lower the tape may have to be determined experimentally. Measurement will be done as follows:

1. Lower and hold the tape at an even foot mark at the Measuring Point (MP) and note this tape reading.

2. Remove the steel tape from the well. Add or subtract the wetted length from the even foot mark noted in Step 1 as appropriate for your tape, and record this as water level below MP on the WATER LEVEL MONITORING RECORD.

B. Electric Sounder Method

An electric sounder consists of a contact electrode that is suspended by an insulated electric cable from a reel that has an ammeter, a buzzer, a light, or other closed circuit indicator attached. The indicator shows a closed circuit and flow of current when the electrode touches the water surface. Electric sounders will be calibrated by measuring each interval and remarking them where necessary.

The procedure for measuring water levels with an electric sounder is as follows:

1. Switch on.

2. Lower the electric sounder cable into the well until the ammeter or buzzer indicates a closed circuit. Raise and lower the electric cable slightly until the shortest length of cable that gives the maximum response on the indicator is found.

3. With the cable in this fixed position, note the length of cable at the MP.

4. Since the electric cable is graduated in intervals, use a pocket steel tape measure (graduated in hundredths of a foot) to interpolate between

consecutive marks. Care must be taken that the tape measurements are subtracted from graduated mark footage value when the water level hold point (determined in Step 3) is below the graduated mark and added when above the mark. Record the resulting value as water level below MP on the WATER LEVEL MONITORING RECORD.

2.2 WELL DEPTH MEASUREMENT

Depth of a well will be measured by sounding with a weighted steel surveying tape or an electric sounding line, weighted when possible. Procedures to be followed are described below.

A. Measure the distance between the zero mark on the end of the measuring line and the bottom of the weight.

B. Lower the weighted measuring line into the well until the line becomes slack or there is noticeable decrease in weight, which indicates the bottom of the well. Raise the line slowly until it becomes taut (this may have to be done several times to determine that taut point) and, with the line in this fixed position, note the reading at the MP. Add the distance described in Step A to this reading, and record the resulting value as well depth. This procedure will be performed before and after initial well development or as necessary to determine well casing depth.

C. Record the well depth value on a MONITORING WELL SAMPLING RECORD.

4.0 FLOATING FREE PRODUCT MEASUREMENT

Floating free product level/thickness measurements will be measured using a Flexidip interface probe (or other similar interface probe) or using an electric sounder and a bailer. The electric sounder and bailer method is limited to measuring product thickness less than the length of the bailer. Alternatively, if the free product is to be measured is hydrocarbon product, the thickness is greater than the length of the bailer, and a Flexidip is not available, a steel surveyor's tape and gasoline or oil finding paste in combination with water finding paste may be used. All floating free product level measurements shall be recorded to the nearest hundredth foot. All equipment placed in the wells for free product level measurement will be cleaned prior to reuse, as discussed in Section 5.0. Care will be taken to not drop any foreign objects into the wells and to not allow the measuring device to touch the ground around the well during monitoring.

4.1 FLEXIDIP INTERFACE PROBE METHOD

The Flexidip free product-water interface probe consists of a contract electrode that is suspended by a graduated tape from a reel that has a light and two-toned audible signals. Audible and visual signals occur when the electrode touches the free product surface and then the water surface.

The procedure for measuring free product levels using the Flexidip is as follows:

1. Turn the probe on. A short chirp every 5 seconds signals that the probe is on.
2. Lower the steel probe cover into the well until the cover sits on well casing near the measuring point. Make sure the WIPER switch is off.
3. Unlock the reel using the lock screw and lower tape and probe down into well using reel.
4. When the probe reaches the free product level, the audible signal will be a continuous tone, and the yellow OIL light will be illuminated.
5. Lock reel using lock screw, lift up, and read the level from the tape-viewing window on the side of the steel probe cover.
6. Unlock the reel and slowly lower probe to find the interface level.
7. When the probe reaches the interface, the audible signal changes from a continuous tone to an interrupted tone, and the red INTERFACE light flashes.
8. Lock reel and read level.

9. Turn on WIPER switch and reel up. Always thoroughly clean off any free product before reeling the tape and probe in.

10. Turn probe off and store in case after cleaning.

11. Replace battery when a continuous chirping sound is heard after turning on power with the probe in air. Always replace battery in a gas-free atmosphere.

4.2 ELECTRIC SOUNDER AND BAILER METHOD

The procedure for measuring free product using an electric sounder and an acrylic bailer are as follows:

A. Measure the water level with the electric sounder as described in Section 2.1

B. Suspend a clean acrylic bailer on a line and slowly lower the bailer into the well until it partially intersects the groundwater surface

C. Slowly pull the bailer to the surface

D. Let the bailer stand for several minutes

E. Measure the thickness of the product in the bailer to the nearest 0.01 foot and record the value on the sampling record. If the product is less than 0.01 foot thick the amount should be recorded as less than 0.01 foot. If only a shean is observed, or no free product is seen, these observations should be recorded.

4.3 STEEL TAPE AND PASTE METHOD

A. Measure the water level with an electric sounder as described in Section 2.1.

B. Spread a thin layer of gasoline or oil finding paste on one side of a steel surveyor's tape beginning at the zero foot mark and extending up the tape about one-foot more than the anticipated thickness of the free product.

C. Spread a thin film of water finding paste on the opposite side of the tape beginning at the zero foot mark and extending up the tape about one-foot.

D. Slowly lower the tape into the well until the zero foot mark is located about six inches below the water level (the tape reading at the measuring point should be six inches greater than the actual depth to water). Take care not touch the sides of the well with the tape.

E. Slowly remove the tape from the well. The pastes will have changed color upon contact with the water or the free product. The product thickness is the difference between the tape reading at the point where water finding paste indicates the water level to be and the point where the gasoline or oil finding paste indicates the top of the free product to be.

5.0 EQUIPMENT CLEANING

Steel tapes, electric well sounders, and acrylic bailers will be cleaned after measurements in each well. Cleaning procedures will be as follows:

A. Wipe free product off with disposable towels. Rinse probe or portion of instrument that was immersed in well water with a solution of laboratory-grade detergent and potable water.

B. Rinse with potable water.

C. Dry with a clean paper towel.

D. The Flexidip may also be cleaned with acetone at this stage.

Solutions resulting from cleaning procedures will be collected and stored for future disposal by the client in accordance with legal requirements.

PROTOCOL NO. 3

SAMPLING OF GROUNDWATER MONITORING WELLS AND WATER SUPPLY WELLS

1.0 INTRODUCTION

This protocol describes procedures to be followed during collection of field water quality measurements and groundwater samples for laboratory chemical analysis from monitoring wells and water supply wells. The procedures presented herein are intended to be of general use. As the work progresses, and if warranted, appropriate revisions will be made by the Geomatrix project manager.

2.0 SAMPLING

2.1 SAMPLE COLLECTION

A. Monitoring Wells - For wells completed without dedicated sampling pumps, at least four well casing volumes or one saturated borehole volume, whichever is greater, will be removed to purge the well prior to collection of groundwater samples. The saturated borehole volume is the volume of water in the well casing plus the volume of water in the filterpack. Periodic observations of turbidity and measurements of temperature, pH, and specific conductance will be made with field equipment during purging to evaluate whether the water samples are representative of the target zone. Samples will be collected only when: 1) a minimum of four sets of parameter readings have been taken, and 2) the temperature, pH, and specific conductance reach relatively constant values, and the turbidity has stabilized.

Wells that recharge very slowly may be purged dry once, allowed to recharge, and then sampled as soon as sufficient water is available. In this case, at least two parameter readings of field water quality should be taken; one initially and one after recharge.

A submersible pump, diaphragm pump, positive displacement pump which may contain a bladder, or a bailer will be used for evacuating (purging) the monitoring well casing. Generally, purging will begin with the pump inlet at the midscreen interval and the pump will be raised through the water column as purging progresses, ending just below the water table in order to remove stagnant water from the well casing. The majority of the purge volume will be taken from the mid-screen interval. Purging will progress at a rate intended to minimize differential drawdown between the interior of the wellscreen and the filter sand, to limit cascading water along the inside of the well casing.

Clean latex or solvex gloves will be worn by the sampler before beginning sampling. A Teflon® bailer or a stainless steel positive displacement Teflon® bladder pump with Teflon® tubing will be used to collect the water samples for laboratory chemical analysis. The sample will be taken from the midscreen interval and the depth will be recorded.

Each sampling episode will begin with the well having the least suspected concentrations of target compounds. Successive wells will be sampled in sequence of increasing suspected concentration.

B. Water Supply Wells - Water supply wells, designated by the project manager, will be sampled by purging the wells for a period of time adequate to purge the pump riser pipe. If the well is currently pumping, the sample can be taken without purging the well. Water samples will then be collected from the discharge point nearest the well head. Samples will be collected directly in laboratory-prepared bottles.

C. Extraction Wells - Extraction wells will be sampled while extraction is occurring, from an in-line sampling port after purging the sampling line. Samples will be collected directly in laboratory-prepared bottles.

A MONITORING WELL SAMPLING RECORD will be used to record the following information:

- Sample I.D.
- Duplicate I.D., if applicable
- Date and time sampled.
- Name of sample collector.
- Well designation (State well numbering system for water supply wells, and unique sequential number for other wells).
- Owner's name, or other common designation for water supply wells.
- Well diameter
- Depth to water on day sampled
- Casing volume on day sampled
- Method of purging (bailing, pumping, etc.).
- Amount of water purged.
- Extraordinary circumstances (if any).

- Results of instrument calibration/standardization and field measurements (temperature, pH, specific electrical conductance) and observed relative turbidity.
- Depth from which sample was obtained.
- Number and type of sample container(s).
- Purging pump intake depth.
- Times and volumes corresponding to water quality measurement.
- Purge rate.

2.2 SAMPLE CONTAINERS AND PRESERVATION

Appropriate sample containers and preservatives for the analyses to be performed will be obtained from the subcontracted analytical laboratory. Frequently requested analyses and sample handling requirements are listed in Table 1.

2.3 SAMPLE LABELING

Sample containers will be labeled with self-adhesive tags having the following information written in waterproof ink:

A. Geomatrix

B. Project number.

C. Sample number.

D. Date and time sample was collected.

E. Initials of sample collector.

2.4 QUALITY CONTROL SAMPLES

In order to evaluate the precision and accuracy of analytical data, quality control samples such as duplicates and blanks will be periodically employed. These samples will be collected, or prepared and analyzed by the laboratory, as specified in the project Quality Assurance Project Plan or by the project manager.

2.5 HANDLING, STORAGE, AND TRANSPORTATION

Efforts will be made to handle, store, and transport supplies and samples safely. Exposure to dust, direct sunlight, high temperature, adverse weather conditions, and possible contamination will be avoided. Samples will be placed in a clean chest, which contains ice or blue ice if cooling is required, immediately following collection and will be transported to the subcontracted laboratory as soon as possible.

3.0 FIELD MEASUREMENTS

Field measurements of temperature, pH, and specific conductance will be performed on groundwater samples. Data obtained from field water quality measurements will be recorded on the MONITORING WELL SAMPLING RECORD. Field measurements will be made on aliquots of groundwater that will not be submitted for laboratory analysis.

3.1 TEMPERATURE MEASUREMENT

Temperature measurements will be made with a mercury filled thermometer or an electronic thermistor, and all measurements will be recorded in degrees Celsius.

3.2 PH MEASUREMENT

The pH measurement will be made as soon as possible after collection of the sample, generally within a few minutes.

The pH meter will be calibrated at the beginning and once during each sampling day and whenever appropriate in accordance with the equipment manufacturer's specifications as outlined in the instruction manual for the specific pH meter used. Two buffers (either pH-4 and pH-7, or pH-7 and pH-10, whichever most closely bracket the anticipated range of groundwater conditions) will be used for instrument calibration.

3.3 SPECIFIC CONDUCTANCE MEASUREMENT

Specific conductance will be measured by immersing the conductivity probe directly in the water source or into a sample. The probes used should automatically compensate for the temperature of the sample. Measurements will be reported in units of micromhos per centimeter at 25 degrees Celsius.

The specific conductance meter will be calibrated at the beginning and once during each sampling day in accordance with the equipment manufacturer's specifications as outlined in the instruction manual for the specific conductivity meter used. The conductivity meter will be calibrated with a standardized potassium chloride (KCl) solution.

4.0 DOCUMENTATION

4.1 FIELD DATA SHEETS

A MONITORING WELL SAMPLING RECORD will be used to record the information collected during water quality sampling. Following completion of sampling and review by the project manager or task leader, the original data sheets will be placed in the project file.

4.2 CHAIN-OF-CUSTODY PROCEDURES

After samples have been collected and labeled, they will be maintained under chain-of-custody procedures. These procedures document the transfer of custody of samples from the field to a designated laboratory.

A CHAIN-OF-CUSTODY RECORD will be filled out for each shipment of samples to be sent to the laboratory for analysis. Each sample will be entered on the Chain-of-Custody form after it is collected and labeled. Information contained on the triplicate carbonless form will include the following:

- Name of sampler.
- Date and time sampled.
- Sample I.D.
- Number of sample bottles.
- Sample Matrix (soil, water, or other).
- Analyses required.

- Remarks, including any preservatives, special conditions, or specific quality control measures.
- Turnaround time and person to receive lab report.
- Project number.
- Signatures of all people assuming custody.
- Signatures of field sampler at top of chain-of-custody.
- Condition of samples when received by lab.

Blank spaces on the CHAIN-OF-CUSTODY RECORD will be crossed out between last sample number listed and signatures at the bottom of the sheet.

The field sampler will sign the and record the time and the date at the time of transfer to the laboratory or to an intermediate person. A set of signatures is required for each relinquished/reserved transfer including transfer within Geomatrix. The original imprint of the chain-of-custody record will accompany the sample containers. Following review by the project manager or task leader, a duplicate copy will be placed in the project file.

5.0 EQUIPMENT CLEANING

Bailers, sampling pumps, purge pumps, and any other purging or sampling apparatus will be cleaned before and after sampling of each well. Factory new and sealed disposable bailers may be used for sampling, but may not be reused. Thermometers, pH electrodes, and conductivity probes that will be used repeatedly will be cleaned before and after sampling each well and at any time during sampling if the object comes in contact with foreign matter.

Purged waters and solutions resulting from cleaning of purging or sampling equipment will be collected stored for future disposal by the client in accordance with legal requirements. Disposal of purged water will be arranged following receipt of laboratory analyses for groundwater samples.

Cleaning of reusable equipment which is not dedicated to a particular well will consist of the following:

- Bailers - the inside and outside of bailers will be cleaned in a solution of laboratory grade detergent and potable water, followed by a thorough rinse with deionized (DI) water. They may also be steam cleaned, followed by a DI rinse. If metals samples are to be collected, the bailer should be rinsed with a pH2 nitric acid solution before the final DI rinse.

- Purge Pumps - All downhole, reusable portions of purge pumps will be steam cleaned on the outside. If the pump does not have a backflow check valve, the inside of the pump and tubing should also be steam cleaned. For purge pump with a backflow check valve, the interior of the pump and tubing may be cleaned by pumping a laboratory-grade detergent and potable water solution through the system followed by a potable water rinse, or by steam-cleaning.

- Water Quality Meters - All meters will be cleaned by rinsing the probe portions in DI water and allowing to air-dry.

- Bailer Tripod - The tripod cable will be steam cleaned or rinsed with DI water.

Sample bottles and bottle caps will be cleaned by the subcontracted laboratory using standard EPA-approved protocols. Sample bottles and bottle caps will be protected from contact with solvents, dust, or other contamination between time of receipt by Geomatrix Consultants and time of actual usage at the sampling site. Sample bottles will not be reused.

GEOMATRIX

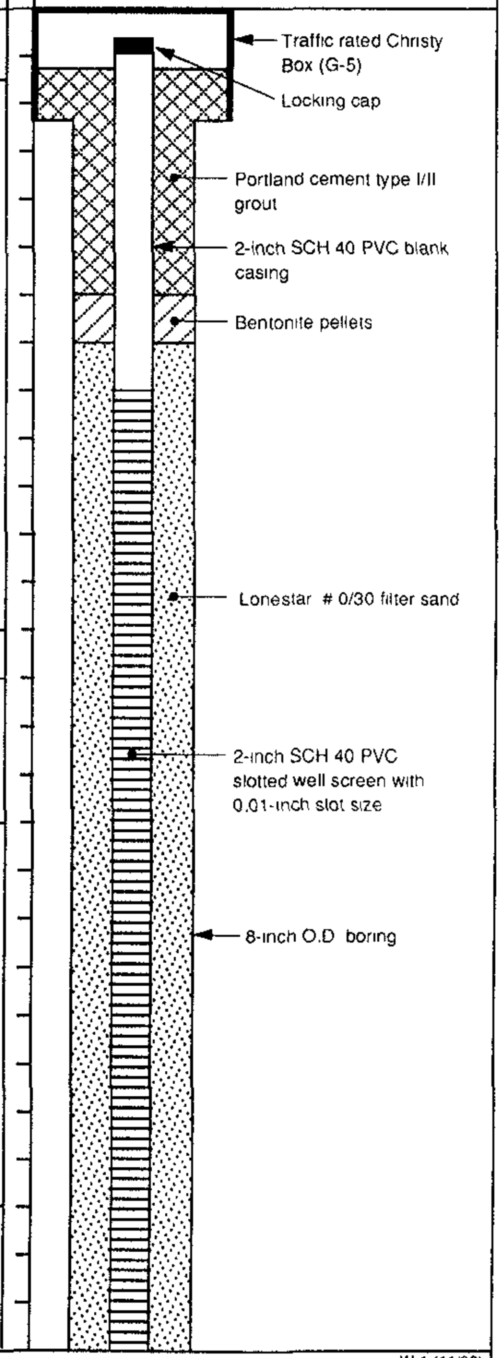
APPENDIX B

Boring Logs

PROJECT: MARINA VILLAGE Alameda, California	**Log of Well No. GMW-6**
BORING LOCATION: 1150 Marina Village Drive	ELEVATION AND DATUM: ---
DRILLING CONTRACTOR: Gregg Drilling	DATE STARTED: 2/1/93 | DATE FINISHED. 2/1/93
DRILLING METHOD: Hollow stem auger (8 1/4" OD)	TOTAL DEPTH 18.0' | SCREEN INTERVAL: 4.0' – 18.0'
DRILLING EQUIPMENT: Mobile Drill B-53	DEPTH TO WATER ATD 7' | CASING. 2" dia SCH 40 PVC
SAMPLING METHOD: 5-foot continous dry core sampler	LOGGED BY: Jeff Nelson
HAMMER WEIGHT: N/A | DROP: N/A	RESPONSIBLE PROFESSIONAL: D.A. Zemo | REG. NO. # RG4824

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	SAMPLES: Blows/ Foot	OVM Reading	DESCRIPTION NAME (USCS Symbol): color, moist, % by wt., plast., density, structure, cementation, react. w/HCl, geo. inter Surface Elevation:
0–0.75		X (0–3)			Asphalt
0.75–6.5		X (5–6)			WELL GRADED GRAVEL with SILT and SAND (GW-GM) Dark grayish brown (2.5Y 4/2), moist,, 50% fine to coarse gravel, 40% medium sand, 10% low plasticity fines
6.5–8.5					CLAYEY SAND (SC) ▽ Very dark gray (5Y 3/1), wet, 60% fine sand, 40% medium plasticity fines
8.5–12.5		X (10–12.5)			POORLY GRADED SAND (SP) Dark gray (5Y 4/1), wet, 95% fine sand, trace to 5% fines, gravel and wood in top 4 inches
12.5–14					POORLY GRADED SAND (SP) Olive gray (5Y 4/2), wet, 100% medium sand

WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS



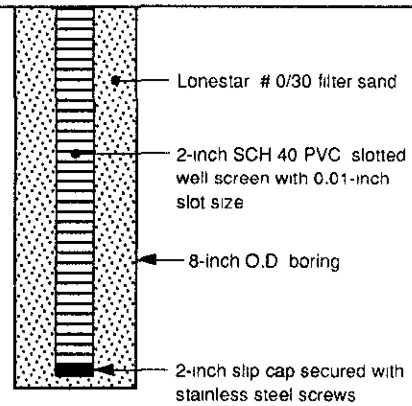
W-1 (11/92)

Geomatrix Consultants	Project No 1736.11	Figure ...

PROJECT: MARINA VILLAGE
Alameda, California

Log of Well No. GMW-6 (cont'd.)

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	SAMPLES: Blows/Foot	OVM Reading	DESCRIPTION NAME (USCS Symbol): color, moist, % by wt., plast., density, structure, cementation, react. w/HCl, geo inter.	WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS
					POORLY GRADED SAND (SP) (continued)	
15						
16						
17						
18					Bottom of boring at 18.0 feet	
19						
20						
21						
22						
23						
24						
25						
26						
27						
28						
29						
30						
31						



W-2 (11/92)

Geomatrix Consultants	Project No. 1736.11	Figure ---

GEOMATRIX

APPENDIX C

Laboratory Analytical Results and Chain-of-Custody Records

QuanteQ Laboratories

An Ecologics Company

Certificate of Analysis

DOHS CERTIFICATION NO E772 AIHA ACCREDITATION NO 332

GEOMATRIX CONSULTANTS
100 PINE STREET
10TH FLOOR
SAN FRANCISCO, CA 94111
ATTN: ELIZABETH NIXON

CLIENT PROJ. ID: 1736.11
C.O.C. NO: 3490

REPORT DATE: 02/24/93

DATE SAMPLED: 02/11/93

DATE RECEIVED: 02/11/93

QUANTEQ JOB NO: 9302122

PROJECT SUMMARY:

On February 11, 1993, this laboratory received one (1) water sample.

Client requested sample be analyzed for Total Petroleum Hydrocarbons as Diesel by EPA Method 3520 GCFID, Benzene, Toluene, Ethylbenzene and Total Xylenes by EPA Method 8020. Sample identification, results and dates analyzed are summarized on the following pages.

Sample fraction for extractable hydrocarbons was centrifuged prior to extraction and the sample bottle was not rinsed in order to analyze the water phase only. The sample extract was treated with silica gel prior to analysis.

All laboratory quality control parameters were found to be within established limits. Batch QC data is included at the end of this report.

If you have any questions, please contact Client Services at (510) 930-9090.

Larry Klein
Laboratory Manager

Results FAXed 02/22/93

GEOMATRIX CONSULTANTS

DATE SAMPLED: 02/11/93
DATE RECEIVED: 02/11/93
CLIENT PROJ. ID: 1736.11

REPORT DATE: 02/24/93

QUANTEQ JOB NO: 9302122

Client Sample Id.	Quanteq Lab Id.	Extractable Hydrocarbons as Diesel (mg/L)
GMW-6	01A	ND
Reporting Limit		0.05

Method: 3520 GCFID

Instrument: C

Date Extracted: 02/17/93
Date Analyzed: 02/19/93

ND = Not Detected

Quanteq Laboratories
An Ecologics Company

GEOMATRIX CONSULTANTS

SAMPLE ID: GMW-6
CLIENT PROJ. ID: 1736.11
DATE SAMPLED: 02/11/93
DATE RECEIVED: 02/11/93
REPORT DATE: 02/24/93

QUANTEQ LAB NO: 9302122-01C
QUANTEQ JOB NO: 9302122
DATE ANALYZED: 02/18/93
INSTRUMENT: F

BTEX (WATER MATRIX)
METHOD: EPA 8020 (5030)

COMPOUND	CAS #	CONCENTRATION (ug/L)	REPORTING LIMIT (ug/L)
Benzene	71-43-2	ND	0.5
Toluene	108-88-3	ND	0.5
Ethylbenzene	100-41-4	ND	0.5
Xylenes, Total	1330-20-7	ND	2

ND = Not Detected

QUALITY CONTROL DATA

DATE EXTRACTED: 02/17/93
DATE ANALYZED: 02/19/93
CLIENT PROJ. ID: 1736.11

QUANTEQ JOB NO: 9302122
SAMPLE SPIKED: D.I. WATER
INSTRUMENT: C

MATRIX SPIKE RECOVERY SUMMARY
TPH EXTRACTABLE WATER
METHOD 3520 GCFID
(WATER MATRIX; EXTRACTION METHOD)

ANALYTE	Spike Conc. (mg/L)	Sample Result (mg/L)	MS Result (mg/L)	MSD Result (mg/L)	Average Percent Recovery	RPD
Diesel	2.00	ND	1.17	1.17	58.5	0.0

CURRENT QC LIMITS (Revised 05/14/92)

Analyte	Percent Recovery	RPD
Diesel	(49.3-101.4)	29

MS = Matrix Spike
MSD = Matrix Spike Duplicate
RPD = Relative Percent Difference
ND = Not Detected

QUALITY CONTROL DATA

DATE ANALYZED: 02/18/93
SAMPLE SPIKED: 9302164-03C
CLIENT PROJ. ID: 1736.11

QUANTEQ JOB NO: 9302122

INSTRUMENT: F

MATRIX SPIKE RECOVERY SUMMARY
METHOD: EPA 8020
(WATER MATRIX)

ANALYTE	Spike Conc. (ug/L)	Sample Result (ug/L)	MS Result (ug/L)	MSD Result (ug/L)	Average Percent Recovery	RPD
Benzene	13.9	ND	13.6	13.8	98.6	1.5
Toluene	49.6	ND	46.0	46.9	93.6	1.9

CURRENT QC LIMITS (Revised 05/14/92)

Analyte	Percent Recovery	RPD
Benzene	(81.4-115.3)	10.2
Toluene	(85.3-112.4)	9.4

MS = Matrix Spike
MSD = Matrix Spike Duplicate
RPD = Relative Percent Difference
ND = Not Detected

K-3, S-1
R-1, S-E

9302122

Chain-of-Custody Record

№ 3490

Date: 02/11/93

Page 1 of 1

Project No.: 1736.11

Samplers (Signatures): James M Carolan

Date	Time	Sample Number	EPA Method 8010	EPA Method 8020	EPA Method 8240	EPA Method 8270	TPH as gasoline	TPH as diesel	TPH as BTEX 8020	Cooled	Soil (S) or water (W)	Acidified	Number of containers	Additional comments
02/11	13:40	GMW-6						X	X	X	W	X	5	01A-E

Per client: analyze liquid only / centrifuge / silica gel cleanup prior to analysis; BTEX only on 8020

Turnaround time: Standard

Results to: Elizabeth Nixon

Total No. of containers: 5

Relinquished by:	Date:	Relinquished by:	Date:	Relinquished by:	Date:	Method of shipment: Lab Pickup
Signature: James M Carolan	02/11/93	Signature: Thomas R Jones	2-11-93	Signature: [signature]	2-11-93	Laboratory comments and Log No.: 9302122
Printed name: Jim Carolan		Printed name: THOMAS R JONES		Printed name: NEIL HERRICK		
Company: Geomatrix		Company: GEOMATRIX		Company: QUANTEQ		
Received by:	**Time:**	**Received by:**	**Time:**	**Received by:** Denise Harrington	**Time:**	
Signature: Thomas R Jones	15:40	Signature: [signature]	16:50	Signature: DENISE HARRINGTON	17:50	
Printed name: THOMAS R JONES		Printed name: NEIL HERRICK		Printed name: QUANTEQ LABS		
Company: GEOMATRIX		Company: QUANTEQ		Company:		

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