PACIFIC
ENVIRONMENTAL
GROUP INC.

February 4, 1993
Project 330-06.16

Mr. Michael Whelan
ARCO Products Company
P.O. Box 5811
San Mateo, California 94402

Re: ARCO Service Station 0608
17601 Hesperian Boulevard
San Lorenzo, California

Dear Mr. Whelan:

This letter presents a work plan prepared by Pacific Environmental Group, Inc. (PACIFIC) for ARCO Products Company (ARCO), to perform additional investigative activities at the above referenced site (Figures 1 and 2). The purpose of the additional activities is to provide detailed site wide characterization of soil and groundwater conditions to assist in defining the most appropriate and feasible method(s) of remediation for petroleum hydrocarbon-impacted soils and groundwater underlying the site. The results of the proposed activities will be documented in separate investigation reports for individual proposed activities, and in a remedial investigation/feasibility study (RI/FS), scheduled to be issued by PACIFIC during the fourth quarter of 1993. In addition, the planned site activities also address concerns of the Alameda County Health Care Services (ACHCS) as presented in letters to ARCO. The following is an outline of this work plan:

- o Background
  - Site Description
  - Previous Investigations
  - Regulatory Response
  - Summary of Site Conditions
- o Proposed Scope Of Work
  - Risk Assessment
  - Exploratory Soil Boring Program
  - Groundwater Monitoring Well Installation
  - Well Development
  - Air Sparging and Soil Vapor Extraction Well Installation

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- Laboratory Analysis
- Biofeasibility Study
- Air Sparging and Soil Vapor Extraction Testing
- Aquifer Testing
- Modeling
- Reporting

o Schedule

BACKGROUND

Site Description

The site is an operating service station located at 17601 Hesperian Boulevard in San Lorenzo, California. **The fueling facility formerly included three 6,000-gallon (two unleaded gasoline and one regular gasoline) tanks located in a common excavation, and one adjacent 6,000-gallon tank (super unleaded gasoline). A 550-gallon tank located southwest of the station building was used to store used oil. All underground storage tanks (USTs) were removed in June 1988, and were replaced with three 12,000-gallon gasoline tanks in the location of the former UST complex, and one used oil tank in the same location as the former used oil tank.** Land use in the vicinity of the site is primarily commercial and residential.

Previous Investigations

Investigations have been conducted at the site by Emcon Associates (Emcon) in June 1985, Applied GeoSystems (AGS) in January 1988, Gettler-Ryan/EA in August 1992, and PACIFIC from April 1988 to the present. Table 1 presents a list of the site reports prepared and issued. All borings, wells, and sample locations described in the following paragraphs are shown on Figures 2, 3, and 4.

Emcon drilled four on-site exploratory soil borings (A-A through A-D), installed one groundwater monitoring well (A-1), and collected selected soil samples for laboratory analysis in January 1985.

o **Soil samples collected from borings drilled by Emcon, located adjacent to the UST complex, at depths ranging from 5-1/2 to 14 feet bgs, contained total volatile hydrocarbons (TVH-g) at concentrations ranging from 880 to 2,800 parts per million (ppm).** Two soil samples collected from a boring located adjacent the used oil tank, at depths of 8-1/2 and 12 feet bgs, contained oil and grease at concentrations of 10,000 and 9,500 ppm, respectively.

- o A groundwater sample collected from Well A-1 contained gasoline and benzene concentrations of 32,000 and 1,000 parts per billion (ppb), respectively.

Groundwater monitoring has been performed on site wells since March 1989.

AGS drilled four on-site exploratory soil borings (B-1 through B-4), converted two of the borings (B-1 and B-2) to groundwater monitoring wells (MW-1 and MW-5, respectively), and collected selected soil samples for laboratory analysis during January 1988. **During field activities, AGS also discovered two additional on-site groundwater wells, and designated them Wells MW-3 and MW-4.**

- o Soil samples collected from borings drilled by AGS, near the UST complex, at depths ranging from 5 to 11 feet bgs, contained TVH at concentrations ranging from non-detectable levels to 10 ppm. A soil sample collected from the boring for Well MW-1, located adjacent the used oil tank, at a depth of 11 feet bgs, contained non-detectable levels of TVH and total oil and grease.

However, traces of BTEX + TVH detected in B-4. Trace benzene in B-2 + B-3 also.

During UST removal activities in June 1988, PACIFIC collected soil samples from beneath four gasoline USTs and one used oil tank, and from each side wall of both UST excavations. In addition, three groundwater samples were collected from beneath the gasoline fuel tanks. **During tank removal activities, Wells MW-1 and MW-2 were destroyed and another unknown on-site groundwater well was found, and designated as Well MW-6 and later as Well E-1. Three vadose monitoring wells (V-1 through V-3) were installed during tank replacement activities at the site.**

- o During tank removal activities, soil samples collected by PACIFIC from beneath the USTs, at depths ranging from 12 to 15 feet bgs, contained total petroleum hydrocarbons calculated as gasoline (TPH-g) at concentrations ranging from 7 to 2,800 ppm. Side wall soil samples collected from each side of the UST excavation, at a depth of 8 feet bgs, contained TPH-g concentrations ranging from non-detectable levels to 350 ppm.

  Concentrations of TPH-g and benzene in groundwater samples collected from beneath the USTs ranged from 8,200 to 22,000 ppb, and 440 to 1,900 ppb, respectively. Separate-phase hydrocarbons (SPH) were noted on groundwater in both the UST and used oil tank excavations.

  Two soil samples collected from beneath the used oil tank, at a depth of 9 feet bgs, contained total oil and grease at concentrations of 6,100 and 13,000 ppm. In addition, five soil samples col-

lected from the excavation sidewalls and bottom were analyzed for volatile organic compounds (VOCs). Acetone was detected in the northeast and southwest sidewall samples at concentrations of 220 and 54 ppm, respectively. No other volatile organic compounds were detected in any sample analyzed. A soil sample collected from the bottom of the excavation, at a depth of 13 feet, contained total oil and grease at a concentration of 20 ppm. Side wall soil samples, collected at depths from 8 to 9 feet bgs, contained oil and grease concentrations ranging from 10 to 200 ppm. High boiling hydrocarbons were noted to range from non-detectable levels to 30 ppm.

PACIFIC performed a soil gas survey at the site during February 1989. Nineteen soil gas probes were installed on and off site at depth intervals ranging from 7 to 8 feet and 10 to 11 feet bgs.

- Soil vapors collected from probes during the soil gas survey indicated total hydrocarbons ranging from non-detectable levels to 130 ppm. Concentrations of benzene were noted to range from non-detectable levels to 390 ppm. The highest concentrations were noted in the northwest portion of the site, extending off-site towards the west. These results were used to select locations for monitoring wells installed in 1990.

In November 1989, PACIFIC performed aquifer testing at the site. A step discharge test was performed in a previously installed, 8-inch diameter, corrugated steel cased well (MW-6).

- **Based on the results of the step-discharge test, it was estimated that the aquifer underlying the site has a specific capacity of approximately 2.45 gallons per minute per foot (gpm/ft), and could sustain a yield of 17 gallons per minute (gpm) with seven feet of drawdown. These values were approximate since well construction details were not known.**

In July 1990, PACIFIC abandoned Wells MW-6 (E-1), MW-3, and MW-4. Between March 1990 and November 1991, PACIFIC installed the following wells: on-site groundwater extraction Well E-1A, on-site groundwater monitoring Wells MW-7 and MW-13, and off-site groundwater monitoring Wells MW-8 through MW-11, and MW-14 though MW-23. **Soil samples for laboratory analysis were submitted from the borings for Wells MW-8 and MW-9.**

- Soil samples collected from the borings for off-site Wells MW-8 and MW-9, at depths of 11-1/2 and 10-1/2 feet bgs, respectively, contained non-detectable levels of TPH-g.

- Concentrations of TPH-g in groundwater has ranged from non-detectable levels to 1,100,000 ppb. The maximum concentration was found in Well MW-3. Benzene concentrations have ranged from non-detectable levels to 13,000 ppb. The highest concentrations of TPH-g and benzene have been noted in on-site wells in the northwestern portion of the site. SPH have been measured in Wells MW-3 and MW-4 at a maximum thickness of 0.01 foot.

- Additional analysis performed on groundwater samples collected from Well MW-8 indicated non-detectable levels of halogenated volatile organics. However, semi-volatile organic compounds were detected including: acenaphthene, dibenzofuran, fluorene, 2-methylnaphthalene, naphthalene, and phenanthrene. In addition, arsenic, barium, and zinc metals were also detected.

PACIFIC documented the location and use of 14 domestic irrigation wells downgradient of the site. Preliminary sampling of the domestic irrigation wells was performed by PACIFIC between September and November 1991. Additional sampling events were performed by PACIFIC in October and December 1992. During the 1991 and 1992 sampling events, 2 to 8 of the 14 wells contained inoperable pumps or were inaccessible; therefore, no groundwater samples were collected from these wells. Based on the analytical results of the initial sampling event, PACIFIC performed a risk assessment to determine if a risk to human health existed as a result of benzene noted in groundwater. The results of PACIFIC's risk assessment were documented in a letter to ACHCS dated March 13, 1992 and are summarized below.

- Concentrations of TPH-g in groundwater collected from the domestic irrigation wells during the 1991 sampling event ranged from non-detectable levels to 780 ppb. Benzene was detected in groundwater at concentrations ranging from non-detectable levels to 13 ppb.

- During the October 1992 sampling event, TPH-g was detected at concentrations ranging from non-detectable levels to 2,200 ppb. Benzene ranged between non-detectable levels and less than 5 ppb.

- During the December 1992 sampling event, TPH-g was detected at concentrations ranging from non-detectable levels to 1,500 ppb. Benzene ranged from non-detectable levels to 14 ppb.

- Results of the risk assessment indicate estimated human health risks due to ingestion and dermal absorption of groundwater were

from 4.46×10^{-6} to 1.08×10^{-5}, and 2.01×10^{-6} to 3.47×10^{-6}, respectively.

In 1991, PACIFIC installed a groundwater extraction and treatment system at the site. The groundwater remediation system began continuous operation on October 15, 1991. The treatment system uses three granular activated carbon vessels to treat the influent groundwater stream before it is discharged into the sanitary sewer. The carbon vessels are arranged in series with valving to permit bed order rotation. This allows for the primary vessel to become the secondary vessel after the carbon has been renewed. Sample ports are located at the treatment system influent, effluent, the mid-point between the carbon vessels, and at each individual well head. A sanitary sewer discharge permit was obtained from the Oro Loma Sanitary District on April 4, 1991. The updated permit is effective through April 4, 1993.

In order to evaluate treatment system performance, PACIFIC monitors water levels, instantaneous and average flow rates, and samples the influent and effluent of the treatment system for TPH-g and BTEX compounds, on a monthly basis. The effluent sample is also analyzed for arsenic, as requested by the Oro Loma Sanitary District.

- Based on the most recent remedial performance evaluation documented in PACIFIC's November 30, 1992 groundwater monitoring results and remedial performance evaluation, the groundwater treatment system has extracted approximately 1,535,640 gallons of groundwater at an average pumping rate of 3.2 gpm. A total of 0.23 gallons of dissolved TPH-g has been recovered since the beginning of operation.

To address the comments in ACHCS June 5, 1992 letter regarding PACIFIC's risk assessment, PACIFIC performed additional data collection on July 22, 1992. Additional data collected included groundwater sampling for drinking water quality standards from domestic irrigation Wells 17349VM and 17203VM, and air monitoring for volatile benzene concentrations from four selected locations and domestic irrigation Well 17349VM. Drinking water quality analyses were performed to determine if local shallow groundwater met California drinking water standards, and air monitoring was performed to gain site-specific data on benzene occurrence in the atmosphere.

- Analysis of groundwater samples collected from domestic irrigation wells indicated odor at 50 units, color ranging between 5 and 20 units and turbidity ranging between 9 and 8.6 Nephelometric Turbidity Units (NTU).

- **During air monitoring at selected locations across the site, volatile benzene concentrations were found to range between 2.1 and 9.6 micrograms per cubic meter (ug/m^3).** The highest concentrations above 5 ug/m^3 were noted at the corner of Hacienda Avenue and Hesperian Boulevard (6.8 ug/m^3) and the corner of Hacienda Avenue and Via Magdalena (9.6 ug/m^3).

On March 26, 1992, Gettler-Ryan Inc. (GR) and EA Engineering, Science and Technology Inc. (EA) performed site activities during closure of a oil-water separator/clarifier located at the site. The separator/clarifier was formerly located within the service bay of the station building.

- Four soil samples were collected during the closure of the oil-water separator/clarifier, and consisted of a concrete sample, concrete/soil interface sample, and soil samples from 2 and 5 feet bgs. **Total recoverable petroleum hydrocarbons were detected in the concrete, concrete/soil interface and 2-foot samples at 3,000, 1,000 and 3,300 ppm, respectively.** VOCs, semi-volatile organic compounds (SVOCs), Toxicity Characteristic Leaching Procedures (TCLP - volatiles, metals, and semi-volatiles), and California Assessment Metals (CAM 17 Metals) were not detected in any soil sample analyzed.

Table 2, and Figures 3 and 4 present a summary of soil analytical results collected during the drilling of Borings B-1 through B-4, and A-A through D-D, excavation of the USTs, and the drilling of the borings for Wells MW-8 and MW-9. Table 3 presents a summary of groundwater elevation data for all wells located at the site. A summary of groundwater analytical results is presented in Table 4. Table 5 presents the results of domestic irrigation well analytical results for drinking water analysis and off-site air monitoring.

Regulatory Response

In a letter to ARCO dated June 5, 1992, the Alameda County Health Care Services (ACHCS) responded to PACIFIC's March 13, 1992 letter documenting the preliminary results of groundwater sampling of off-site domestic irrigation wells and risk assessment performed by PACIFIC. The ACHCS identified the following issues of concern which are paraphrased below:

- **"Increased health risk levels identified in the risk assessment":** ACHCS indicated that risks greater than one in one million exist, which indicate that mitigation actions are appropriate.
- **"Completeness of the risk assessment":** Risk assessment was not complete. In order for the risk assessment to be complete, adult

inhalation pathways, total risk, and separate oral, dermal, and inhalation pathways for children must be calculated.

- o **"Offsite well use":** Domestic well operation may affect plume migration and ARCO's remedial efforts. ACHCS encouraged ARCO to take the lead in requesting domestic irrigation well owners to stop well pumping.
- o **"Effectiveness of the groundwater remediation system":** ACHCS indicated that ARCO's remedial efforts appear inadequate for the extent of the petroleum hydrocarbon plume.

ARCO responded to the ACHCS June 5, 1992 letter on November 30, 1992. In addition to the prepared responses to the ACHCS June 1992 letter, draft letters to well owners regarding discontinuing domestic irrigation well use and the sampling of inoperable wells were also included. **As discussed in the November 30, 1992 letter, a RI/FS will be prepared by PACIFIC on behalf of ARCO, to address ACHCS issues regarding health risks. The RI/FS is described in greater detail in this work plan.**

To address the ACHCS concerns regarding PACIFIC's preliminary baseline risk assessment, PACIFIC performed the additional data collection mentioned above. Site-specific data have been collected to assess exposure frequency, duration, and concentration. In addition, PACIFIC issued a letter dated December 8, 1992 to the ACHCS requesting assistance in determining the appropriate values for the carcinogenic risk parameters (i.e., exposure frequency, concentration, etc.) based on available site-specific data.

On October 2, 1992, the ACHCS issued a letter to ARCO regarding the closure of the oil-water separator/clarifier, and additional groundwater sampling requirements. The ACHCS stated that no groundwater samples have been analyzed for oil and grease, and soil and groundwater samples from the former used oil tank have never been analyzed for chlorinated hydrocarbons, SVOCs or metals.

ACHCS requested a work plan addressing the remediation of impacted soils in the vicinity of the oil-water separator/clarifier. In addition, the ACHCS also requested that groundwater samples from Wells MW-5, MW-8 and the nearest existing downgradient well to the former used oil tank be analyzed for chlorinated hydrocarbons, SVOCs, and metals.

As requested by ACHCS, additional analysis for groundwater samples collected from Well MW-8, including chlorinated hydrocarbons, SVOCs, and metals, were addressed during the fourth quarter 1992 groundwater monitoring event. Well MW-8 is located approximately downgradient from the former used oil tank.

Well MW-5 is crossgradient from the former used oil tank; therefore, groundwater samples collected during the December 1992 groundwater monitoring event were not analyzed for chlorinated hydrocarbons, SVOCs, or metals.

Summary of Site Conditions

The following provides a brief summary of site conditions:

- Predominant soil types encountered during on- and off-site drilling consisted primarily of clay, silt, and clayey to silty sand to a depth of approximately 27 feet below ground surface (bgs), the maximum depth explored. **Channel deposits consisting of clayey to silty sand, ranging in thickness between 2 and 5 feet, are noted locally between the depths of approximately 7 and 20 feet bgs. These channel deposits may be the preferential pathway for petroleum hydrocarbon migration across the site.** Deeper sand units also occur locally. Cross-section A-A', showing generalized site geology, is presented in Figure 5. **The approximate extent of the channel deposits across the site is presented in Figure 6.**

- Groundwater was first encountered and stabilized at depths ranging from 12 to 14 feet bgs. **Historically, groundwater flow has been towards the west**, with an average gradient of approximately 0.003.

- **On-site soils in the vicinity of the UST complex have been generally defined to less than 730 ppm TPH-g in all directions. Soils in the vicinity of the former used oil tank location have been defined to less than 200 ppm oil and grease in all directions.** Further on- and off-site soils characterization will be addressed in this work plan.

- The groundwater hydrocarbon plume underlying the site has generally been defined to non-detectable levels in the northern (crossgradient), southern (crossgradient), and western (downgradient) directions. **The eastern (upgradient) direction has not been defined to non-detectable levels.**

- The on-site groundwater extraction and treatment system is currently in continuous operation and is extracting groundwater at an average rate of approximately 3.2 gpm. System performance is currently monitored on a monthly basis.

PROPOSED SCOPE OF WORK

The purpose of the site activities is to complete the site wide characterization of soil and groundwater conditions. The data collected will be applied toward a comprehensive risk assessment to evaluate whether risks to public health exists. In addition, the data will enable PACIFIC to perform a comprehensive remedial investigation. The remedial investigation will define the most appropriate and feasible method(s), if necessary, for remediation of petroleum hydrocarbon-impacted soils and groundwater underlying the site. Remediation, if necessary, will help minimize health risks to acceptable levels and comply with regulatory requirements.

PACIFIC proposes the following scope of work to be performed at the site:

- Complete the human health risk assessment.
- Drill additional exploratory soil borings on and off site to further define geologic conditions, particularly the vertical and lateral extent of a subsurface channel deposit which may be the preferential pathway for hydrocarbon migration, and petroleum hydrocarbon concentrations in on- and off-site capillary fringe soils.

  Drill two soil borings in the vicinity of the former oil-water separator/clarifier to define the vertical and lateral extent of petroleum hydrocarbon concentrations detected during closure.
- Installation of two groundwater monitoring wells to further define the extent of petroleum hydrocarbon-impacted groundwater upgradient (east) and crossgradient (northwest) of the site.
- Installation of two dual completion air sparging and soil vapor extraction wells.
- The development of newly installed groundwater monitoring Wells MW-24 and MW-25, and **redevelopment of Wells MW-10 and E-1A.**
- Laboratory chemical analysis of selected soil samples.
- Perform a baseline analysis on selected soil samples from on- and off-site soil borings, for feasibility of bioremediation.
- Perform air sparging and soil vapor extraction influence tests.
- Perform step- and constant-discharge aquifer tests in Wells MW-10 and E-1A. In addition to these tests, slug tests will be performed in Wells MW-14 and MW-23.

- o Perform fate/transport modeling of solutes in site soils and groundwater.
- o Technical report preparation and submittal.

All field procedures and laboratory analytical procedures are presented in Attachment A.

Risk Assessment

The risk assessment is designed to address comments from ACHCS, and will be based on site-specific data where available. Once the input parameter values are established by ARCO and ACHCS, the risk assessment will be completed. **The risk assessment results will be used in the RI/FS process to target remedial goals.**

Exploratory Soil Boring Program

Up to 12 on-site soil borings are proposed to be drilled through the capillary fringe. The **on-site boring locations** were selected in order to characterize capillary fringe soils in the area around the former UST complex, former used oil tank, product and vent lines and pump islands, and to determine the lateral and vertical extent of the channel deposit underlying the site. **Additional borings will be drilled if the lateral extent of petroleum hydrocarbons is not defined with the drilling of the first 12 borings. In addition, 19 soil borings are proposed to be drilled off site to further define the lateral and vertical extent of the subsurface channel deposit and petroleum hydrocarbons in the capillary fringe downgradient of the site.**

Two soil borings are proposed to be drilled adjacent to the former oil-water separator/clarifier to define the vertical and lateral extent of petroleum hydrocarbons in soils.

The proposed soil borings will be drilled to an approximate depth of 11 to 14 feet bgs by using hand-operated, power-driven drilling equipment. **Soil samples for laboratory analysis from selected on-site soil borings and soil samples for biofeasibility analysis from selected on- and off-site soil borings will be collected at a minimum of 2-foot depth intervals, to below the capillary fringe to an approximate depth of 11 to 14 feet bgs.** The proposed on- and off-site soil boring locations are presented on Figures 7 and 8, respectively.

will they all be analyzed?

Groundwater Monitoring Well Installation

To further define the extent of dissolved hydrocarbons in groundwater upgradient (east) and crossgradient (northwest) of the site, **PACIFIC proposes the installation of two groundwater monitoring wells (MW-24 and MW-25).** Well MW-24 will be installed approximately 100 feet northwest of the site in a restaurant parking lot.

Well MW-25 will be installed approximately 25 feet east of the UST complex, between the eastern most product island and sidewalk. The proposed groundwater monitoring well locations are presented on Figure 8. A proposed groundwater monitoring well construction detail is presented as Figure 9.

Well Development

Following the installation of Wells MW-24 and MW-25, each well will be developed and sampled in conjunction with the current quarterly groundwater monitoring program at the site. In addition, Wells MW-10 and E-1A will also be redeveloped prior to performing aquifer tests in each well.

Air Sparging and Soil Vapor Extraction Well Installation

PACIFIC proposes the drilling and installation of two dual completion air sparging and soil vapor extraction wells (SP-1/V-4 and SP-2/V-5) for the purpose of performing air sparging and soil vapor extraction influence tests. **The tests will help determine whether air sparging and/or soil vapor extraction are effective remedial alternatives for on- and off-site hydrocarbon-impacted soil and groundwater.** Dual completion Well SP-1/V-4 will be installed on-site, approximately 16 feet west of Well MW-5, 23 feet northeast of Well MW-8, and 9 feet southeast of Well E-1A. Dual completion Well SP-2/V-5 will be installed approximately 37 feet northwest of Well MW-11 and approximately 40 feet southeast of Well MW-10, at the intersection of Via Arriba and Hacienda Avenue. These locations were selected to optimize monitoring points for the air sparging and soil vapor influence tests and the aquifer tests. Proposed well locations are presented on Figure 8. A proposed dual completion air sparging and soil vapor extraction well construction detail is presented as Figure 10.

Soil samples for laboratory analysis will be collected from the borings at 5-foot intervals and at the soil/water interface at the approximate depth of 13 to 15 feet bgs. Soil analytical data collected from the borings for the wells will be used to determine petroleum hydrocarbon impact within the capillary fringe at these areas.

Laboratory Analysis

Selected soil samples collected from on- and off-site soil borings, and borings for the groundwater monitoring well and two dual completion wells will be submitted to the laboratory and analyzed for the presence of **TPH-g and benzene, toluene, ethylbenzene, and xylenes (BTEX compounds) by modified EPA Methods 8015, 8020, and 5030. Soil samples collected from borings located adjacent to the former used oil tank will additionally be analyzed for waste oil, and oil and grease by EPA Method 5520 E and F, halogenated VOCs, SVOCs, and total metals by EPA Methods 8010, 8270, and CCR T.22 Metals, respectively.** Soil samples collected

from the oil-water separator/clarifier will be analyzed for waste oil, and oil and grease by EPA Method 5520 E and F. Additionally, the soil samples will be analyzed in the field using a photo-ionization detector (PID) as described in Attachment A.

Biofeasibility Study

Selected soil samples collected from on- and off-site exploratory soil borings will be evaluated for feasibility of biological remediation of hydrocarbons. A baseline analysis consisting of nutrient analysis, moisture content, pH, and microbiological testing will be performed on up to six selected soil samples representing a variety of hydrocarbon concentrations.

Based on the baseline analytical results, column testing may be performed on soil samples with characteristics favorable to bioremediation. Soil samples for column testing would be obtained with the drilling of two large diameter soil borings at the site. Column testing would consist of nutrient analysis, measurement of microbiological growth and respiration (oxygen use), and hydrocarbon degradation.

PACIFIC will contract BioScreen Testing Services, Inc. (BTS) for the baseline analysis and column testing. BTS will perform all analytical and microbiological testing using approved quality assurance guidelines as established under the Environmental Laboratory Accreditation Program (ELAP) administered by the State of California. The laboratory portion of this study should last 90 days.

Air Sparging and Soil Vapor Extraction Well Testing

PACIFIC proposes to perform air sparging and soil vapor extraction influence tests in the proposed dual completion air sparging and soil vapor extraction wells (SP-1/V-4 and SP-2/V-5). The purpose of these tests is determine if air sparging and/or soil vapor extraction are feasible as remedial alternatives for the remediation of petroleum hydrocarbon affected soil and groundwater. The proposed locations of Wells SP-1/V-4 and SP-2/V-5 are presented on Figures 7 and 8.

During the influence tests in Well SP-1/V-4, Wells MW-5, MW-8 and E-1A will be used as observation wells. During the influence tests in Well SP-2/V-5, Wells MW-10 and MW-11 will be used as observation wells. These tests will determine the effective soil vapor extraction/air sparging radii of influence, soil permeability, affects on groundwater, and initial hydrocarbon mass removal rates. In addition, dissolved oxygen concentrations in groundwater will be monitored during the air sparging tests.

Aquifer Testing

To determine aquifer characteristics on and off site, PACIFIC proposes to perform aquifer tests in on-site Well E-1A and off-site Wells MW-10, MW-14, and MW-23. A step-discharge test and 8-hour constant discharge test will be performed in Wells E-1A and MW-10, each of which is completed within the sand channel. The observation well network for each test is described in Attachment A. Falling- and rising-head slug tests will be performed in Wells MW-14 and MW-23, each of which is completed in fine-grained materials. The aquifer tests will supply data to derive transmissivity and storage coefficient of the aquifer, hydraulic conductivity, and radius of influence.

Modeling

To provide a site-wide characterization of petroleum hydrocarbon migration and attenuation, and to evaluate the feasibility of potential remedial alternatives, PACIFIC proposes the technology of computer modeling. PACIFIC will utilize all data collected to model current site conditions with respect to hydrocarbon presence in soils and groundwater, as well as groundwater flow paths. Once the model is calibrated to reflect current conditions, various remedial options will be evaluated to their feasibility and long-term effectiveness. PACIFIC will utilize the MT3D computer model developed by S.S. Papadopulos and Associates, Inc. and/or the BIOPLUME II computer model developed by Hanadi Rifai. The choice of model will be made after a preliminary evaluation of biofeasibility data. Remedial options currently under evaluation include: (1) groundwater extraction, (2) soil vapor extraction, (3) air sparging, (4) bioremediation, and (5) any combination of above.

Reporting

A total of four technical reports will be prepared during the course of this investigation. The first report will address impact delineation, and will include results of the soil boring program and well installation. The second report will address remedial alternatives and will contain results of the biofeasibility testing, the air sparging and soil vapor extraction testing, and the aquifer testing. The third technical report will be the completed risk assessment. The fourth technical report will be the RI/FS, and will include modeling results as part of the RI.

SCHEDULE

Pre-field activities will occur immediately after receipt of a written notification of approval of this work plan by the ACHCS. Field activities will occur within 1 month of the receipt of the ACHCS notification of approval. The attached schedule, presented on Figure 11, shows an estimate of the time required for this

investigation to address remedial investigative activities, testing activities, and computer modeling, through the completion of the comprehensive RI/FS.

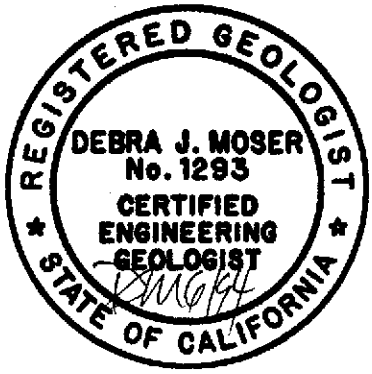
If you have any questions regarding this letter, please call.

Sincerely,

Pacific Environmental Group, Inc.

Kelly C. Brown
Project Geologist

Debra J. Moser
Senior Geologist
CEG 1293



Attachments:
Table 1 - Site Reports
Table 2 - Summary of Soil Analytical Results
Table 3 - Summary of Groundwater Elevation Data
Table 4 - Summary of Groundwater Analytical Results
Table 5 - Drinking Water and Off-Site Air Monitoring Analytical Results
Figure 1 - Site Location Map
Figure 2 - Extended Site Map
Figure 3 - Soil Analytical Results Map - Soil Borings and Wells
Figure 4 - Soil Analytical Results Map - Tank Excavations
Figure 5 - Cross Section A-A'
Figure 6 - Approximate Boundary of Channel Deposit
Figure 7 - Proposed On-Site Soil Boring Location Map
Figure 8 - Proposed Off-Site Soil Boring and Groundwater Monitoring Well Location Map
Figure 9 - Proposed Groundwater Monitoring Well Detail
Figure 10 - Air Sparging/Soil Vapor Extraction Well Detail
Figure 11 - Remedial Investigation and Feasibility Study Schedule
Attachment A - Field Procedures

cc: Ms. Juliett Shin, Alameda County Health Care Services
Ms. Susan Hugo, Alameda County Health Care Services
Mr. Rich Hiett, RWQCB-S.F. Bay Region

Table 1
Site Reports

ARCO Service Station 0608
17601 Hesperian Boulevard
San Lorenzo, California

Report	Date	Consultant
Site Assessment	11/85	Emcon Associates
Site Assessment	03/88	Applied GeoSystems
Work Plan (Includes 1988 tank removal and 1989 soil gas survey results)	10/04/89	Pacific Environmental Group, Inc.
Aquifer Test	04/13/90	Pacific Environmental Group, Inc.
Soil and Groundwater Assessment	01/02/91	Pacific Environmental Group, Inc.
Work Plan	02/13/91	Pacific Environmental Group, Inc.
Site Status Letter	06/12/91	Pacific Environmental Group, Inc.
Progress Letter	08/15/91	Pacific Environmental Group, Inc.
Site Assessment Report	12/16/91	Pacific Environmental Group, Inc.
Risk Assessment Letter	02/04/92	Pacific Environmental Group, Inc.
Off-Site Domestic Well Sampling Letter including February 1992 Risk Assessment Letter	03/13/92	Pacific Environmental Group, Inc.
Oil-Water Separator/Clarifier Assessment	08/92	EA Engineering, Science and Technology, Inc.
ACHCS Response Letter Including Letters to Homeowners	11/30/92	Pacific Environmental Group, Inc.
Domestic Well Sampling Results Letter to Homeowners	01/14/93	Pacific Environmental Group, Inc.
Inoperable Well Letter to Homeowners	01/14/93	Pacific Environmental Group, Inc.
Domestic Well Use Letter to Homeowners	01/25/93	Pacific Environmental Group, Inc.
Quarterly groundwater monitoring has been conducted since March 1989.		

Table 2
Summary of Soil Analytical Results
Soil Samples from Borings
(Total Volatile Hydrocarbons and BTEX Compounds)

ARCO Service Station 0608
17601 Hesperian Boulevard
San Lorenzo, California

Boring Number	Sample Depth (feet)	TVH (ppm)	Benzene (ppm)	Toluene (ppm)	Ethylbenzene (ppm)	Xylenes (ppm)
A-A	7-8.5	NA	NA	NA	NA	NA
	10.5-12	NA	NA	NA	NA	NA
A-B	12.5-14	1,500	NA	NA	NA	NA
A-C	4-5.5	880	NA	NA	NA	NA
	7-8.5	1,900	NA	NA	NA	NA
	12.5-14	2,800	NA	NA	NA	NA
A-D	12.5-14	590	NA	NA	NA	NA
B-1	11	<5	<0.2	<0.2	<0.2	<0.2
B-2	10	<5	0.6	<0.2	<0.2	<0.2
B-3	10	<5	0.4	<0.2	<0.2	<0.2
B-4	5	10	0.8	0.5	4.1	1.2
	10	5	0.4	0.2	1.0	1.0

ppm = Parts per million
TVH = Total volatile hydrocarbons
NA = Not analyzed
< denotes laboratory detection limits.

Borings A-A through A-D from Emcon Associates, January 1985, as reported by AGS, 1988. Detection limit not known.
Borings B-1 through B-4 from AGS, January 1988. Detection limit 5 ppm for TVH, 0.2 ppm for BTEX compounds.

Table 2 (continued)
Summary of Soil Analytical Results
Soil Samples from Borings
(Oil and Grease)

ARCO Service Station 0608
17601 Hesperian Boulevard
San Lorenzo, California

Boring Number	Depth (feet)	Oil and Grease (ppm)
A-A	7-8.5	10,000
	10.5-12	9,500
B-1	11	<30

ppm = Parts per million
< denotes laboratory detection limits.

Boring A-A from Emcon Associates, January 1985, reported by AGS, 1988. Detection limit not known.
Boring B-1 from AGS, January 1988. Detection limit 30 ppm for total oil and grease.

Table 2 (continued)
Summary of Soil Analytical Results
Soil Samples from Beneath Fuel Tanks
(Gasoline and BTEX Compounds)

ARCO Service Station 0608
17601 Hesperian Boulevard
San Lorenzo, California

Soil Sample	Sample Depth (feet)	Gasoline (ppm)	Benzene (ppm)	Toluene (ppm)	Ethylbenzene and Xylenes (ppm)
E1-N	12.5	60	0.2	<0.3	2
E1-S	NR	2,300	3	5	20
E2-N	12	330	1.6	6	48
E2-S	12	370	1.3	11	45
E3-N	NR	7	1.0	0.1	0.6
E3-S	12	2,800	6	23	120
W4-NE	NR	260	1.2	2	13
W4-SW	15	500	3.5	6	87

ppm = Parts per million
NR = Not recorded
< denotes laboratory detection limits.
Soils sampled by PACIFIC, June 1988

Table 2 (continued)
Summary of Soil Analytical Results
Soil Samples from Fuel Tank Excavation Side Walls
(Gasoline and BTEX Compounds)

ARCO Service Station 0608
17601 Hesperian Boulevard
San Lorenzo, California

Soil Sample	Sample Depth (feet)	Gasoline (ppm)	Benzene (ppm)	Toluene (ppm)	Ethylbenzene and Xylenes (ppm)
ESW-W	8	9	0.12	<1.0	0.4
ESW-N	8	60	0.10	<0.6	1.3
CESW-N	NR	<5	0.06	<0.1	<0.4
ESW-E	8	<5	<0.50	<0.1	<0.4
ESW-S	8	350	1.2	5	50
W4SW-NW	8	<5	<0.05	<0.1	<0.4
W4SW-NW2	12.5	730	<3	<6	100
W4SW-NW3	16.5	<5	<0.5	<0.1	<0.4

ppm = Parts per million
NR = Not recorded
< denotes laboratory detection limits.
Soils sampled by PACIFIC, June 1988.

Table 2 (continued)
Summary of Soil Analytical Results
Soil Samples from Beneath Used Oil Tank
(Polychlorinated Biphenyls and Total Oil and Grease)

ARCO Service Station 0608
17601 Hesperian Boulevard
San Lorenzo, California

Soil Sample	Sample Depth (feet)	Polychlorinated Biphenyls		Total Oil and Grease (ppm)
		Aroclor Mixtures (ppm)	Total (ppm)	
OS-SW	9	None	<0.1	6,100
WOS-SW	9	None	<0.1	13,000

ppm = Parts per million
Soils sampled by PACIFIC, June 1988.

Table 2 (continued)
Summary of Soil Analytical Results
Soil Sample from Used Oil Tank Side Walls
(High-Boiling Hydrocarbons, Oil and Grease, and Volatile Organic Compounds)

ARCO Service Station 0608
17601 Hesperian Boulevard
San Lorenzo, California

Soil Sample	Sample Depth (feet)	High-Boiling Hydrocarbons (ppm)	Oil and Grease (ppm)	VOCs (ppm)
WOSW-NE	8	<10	10	Acetone 220
WOSW-NW	9	<10	10	ND
WOSW-SE	8	10	60	ND
WOSW-SW	9	30	200	Acetone 54
WOSW-SW2	NR	10	20	NA
WO-BOH	13	10	20	ND

VOCs = Volatile organic compounds
ppm = Parts per million
NR = Not recorded
NA = Not analyzed
< denotes laboratory detection limits.
Soil sampled by PACIFIC, June 1988.

Table 2 (continued)
Summary of Soil Analytical Results
Soil Samples from Wells
(Gasoline and BTEX Compounds)

ARCO Service Station 0608
17601 Hesperian Boulevard
San Lorenzo, California

Well Number	Sample Depth (feet)	Gasoline (ppm)	Benzene (ppm)	Toluene (ppm)	Ethylbenzene (ppm)	Xylenes (ppm)
MW-8	10-11.5	<2	<0.003	<0.003	<0.003	<0.003
MW-9	9-10.5	<1	<0.003	<0.003	<0.003	0.006

ppm = Parts per million
< denotes laboratory detection limits.
Soils samples by PACIFIC on 03/29/90 (MW-8) and 04/05/90 (MW-9).

Table 2 (continued)
Summary of Soil Analytical Results
Soil Samples from Oil-Water Separator/Clarifier

ARCO Service Station 0608
1760 Hesperian Boulevard
San Lorenzo, California

Analyte	Concrete Sample	Soil Sample SB1-0	Soil Sample SB1-2
Total Recoverable Petroleum Hydrocarbons	3,000 ppm	1,000 ppm	3,300 ppm
VOCs	ND ppm	ND (ppm)	ND (ppm)
TCLP Metals	ND (Non-toxic) ppm	ND (Non-toxic) ppm	NA
TCLP Volatiles	ND (Non-toxic) ppm	ND (Non-toxic) ppm	NA
TCLP Semi-Volatiles	ND (Non-toxic) ppm	ND (Non-toxic) ppm	NA
PCBs	ND (ppb)	ND (ppb)	NA
CAM17 (Metals)	ND (Non-hazardous) ppm	ND (Non-hazardous) ppm	NA
96-Hour Waste Bioassay	Non-hazardous	Non-hazardous	NA
Ignitability	>100°C	>100°C	NA

ppm = Parts per million
ppb = Parts per billion
ND = None detected
NA = Not analyzed
VOCs = Volatile organic compounds
TCLP = Toxicity characteristic leaching procedures
PCBs = Polychlorinated biphenyls
CAM17 = California Assessment Metals
Samples by EA, August 1992

Table 3
Summary of Groundwater Elevation Data

ARCO Service Station 0608
17601 Hesperian Boulevard at Hacienda Avenue
San Lorenzo, California

Well Number	Sample Date	TOB Elevation (feet, MSL)	Depth to Liquid (feet)	Separate-Phase Hydrocarbon Thickness (feet)	Liquid Surface Elevation (feet, MSL)
MW-1	01/11/88	NA	NA	--	NA
	06/14/88	---------- Well Destroyed ----------			
MW-2	07/05/85	NA	NA	--	NA
	01/11/88				
	06/14/88	---------- Well Destroyed ----------			
MW-3	01/11/88	33.27	NA	--	NA
	03/07/89		11.96	--	21.31
	06/21/89		12.85	--	20.42
	12/12/89		13.46	--	19.81
	03/29/90		13.21	--	20.06
	05/08/90		13.23	--	20.04
	06/22/90		NA	--	NA
	07/18/90	---------- Well Destroyed ----------			
MW-4	01/11/88	32.43	NA	--	NA
	09/12/88		NA	--	NA
	03/07/89		10.76	--	21.67
	06/21/89		11.96	--	20.47
	12/12/89		NA	--	NA
	03/29/90		11.72	0.01	20.71
	05/08/90		12.19	--	20.24
	06/22/90		NA	--	NA
	07/18/90	---------- Well Destroyed ----------			
MW-5	01/11/88	33.99	NA	--	NA
	03/07/89		12.74	--	21.25
	06/21/89		13.26	--	20.73
	12/12/89		NA	--	NA
	03/29/90		13.30	--	20.69
	05/08/90		NA	--	NA
	06/22/90		13.52	--	20.47
	09/19/90		13.99	--	20.00
	12/27/90		NA	--	NA
	03/21/91		13.00	--	20.99
	06/26/91		13.25	--	20.74
	07/03/91		13.33	--	20.66
	09/24/91		Dry	--	NA
	10/04/91		Dry	--	NA
	12/19/91		Dry	--	NA
	01/16/92		Dry	--	NA
	02/19/92		13.5	--	20.49
	03/17/92		11.90	--	22.09
	04/15/92		12.18	--	21.81
	05/14/92		12.78	--	21.21

Table 3 (continued)
Summary of Groundwater Elevation Data

ARCO Service Station 0608
17601 Hesperian Boulevard at Hacienda Avenue
San Lorenzo, California

Well Number	Sample Date	TOB Elevation (feet, MSL)	Depth to Liquid (feet)	Separate-Phase Hydrocarbon Thickness (feet)	Liquid Surface Elevation (feet, MSL)
MW-5 (cont.)	06/15/92		Well Dry		
	07/14/92		Well Dry		
	08/18/92		Well Dry		
	09/15/92		Well Dry		
	12/17/92		12.74	--	21.25
MW-6 (E-1)	06/21/89	32.95	12.48	--	20.47
	12/12/89		13.16	--	13.16
	03/29/90		12.39	--	12.39
	05/08/90		12.93	--	12.93
	06/22/90		12.94	--	12.94
	07/18/90		Well Destroyed		
MW-7	04/13/90	34.40	NA	--	NA
	05/08/90		13.98	--	20.42
	06/22/90		13.91	--	20.49
	09/19/90		15.09	--	19.31
	12/27/90		14.67	--	19.73
	03/21/91		12.88	--	21.52
	06/26/91		13.85	--	20.55
	07/03/91		13.95	--	20.45
	09/24/91		15.54	--	18.86
	10/04/91		15.60	--	18.80
	12/19/91		15.70	--	18.70
	01/16/92		13.33	--	21.83
	02/19/92		12.16	--	NA
	03/17/92		11.86	--	22.54
	04/15/92		12.30	--	21.69
	05/14/92		13.04	--	20.95
	06/15/92		13.78	--	20.21
	07/14/92		14.20	--	19.79
	08/18/92		14.79	--	19.20
	09/15/92		15.12	--	18.87
	12/17/92		13.69	--	20.71
MW-8	04/13/90	32.79	NA	--	NA
	05/08/90		12.77	--	20.02
	06/22/90		12.73	--	20.06
	09/19/90		13.95	--	18.84
	12/27/90		13.56	--	19.23
	03/21/91		11.78	--	21.01
	06/26/91		12.66	--	20.13
	07/03/91		12.75	--	20.04
	09/24/91		13.97	--	18.82
	10/04/91		14.01	--	18.78
	12/19/91		13.35	--	19.44

Table 3 (continued)
Summary of Groundwater Elevation Data

ARCO Service Station 0608
17601 Hesperian Boulevard at Hacienda Avenue
San Lorenzo, California

Well Number	Sample Date	TOB Elevation (feet, MSL)	Depth to Liquid (feet)	Separate-Phase Hydrocarbon Thickness (feet)	Liquid Surface Elevation (feet, MSL)
MW-8 (cont.)	01/16/92		13.40	--	19.39
	02/19/92		11.26	--	21.53
	03/17/92		10.90	--	21.89
	04/15/92		11.35	--	21.44
	05/14/92		12.06	--	20.73
	06/15/92		12.83	--	19.96
	07/14/92		12.75	--	20.04
	08/18/92		13.83	--	18.96
	09/15/92		14.17	--	18.62
	12/17/92		12.68	--	20.11
MW-9	04/13/90	32.11	NA	--	NA
	05/08/90		12.02	--	20.09
	06/22/90		11.93	--	20.18
	09/19/90		13.18	--	18.93
	12/27/90		12.77	--	19.34
	03/21/91		10.94	--	21.17
	06/26/91		11.92	--	20.19
	07/03/91		12.02	--	20.09
	09/24/91		13.27	--	18.84
	10/04/91		13.29	--	18.82
	12/19/91		13.42	--	18.69
	01/16/92		12.45	--	19.66
	02/19/92		10.25	--	21.86
	03/17/92		10.01	--	22.10
	04/15/92		10.49	--	21.62
	05/14/92		11.19	--	20.92
	06/15/92		11.86	--	20.25
	07/14/92		12.28	--	19.83
	08/18/92		12.89	--	19.22
	09/15/92		13.28	--	18.83
	12/17/92		11.76	--	20.35
MW-10	04/13/90	31.67	NA	--	NA
	05/08/90		12.16	--	19.51
	06/22/90		12.10	--	19.57
	09/19/90		13.41	--	18.26
	12/27/90		13.67	--	18.00
	03/21/91		11.11	--	20.56
	06/26/91		12.00	--	19.67
	07/03/91		12.16	--	19.51
	09/24/91		13.40	--	18.27
	10/04/91		13.50	--	18.17
	12/19/91		13.57	--	18.10
	01/16/92		12.55	--	19.12
	02/19/92		10.50	--	21.17
	03/18/92		10.12	--	21.55

Table 3 (continued)
Summary of Groundwater Elevation Data

ARCO Service Station 0608
17601 Hesperian Boulevard at Hacienda Avenue
San Lorenzo, California

Well Number	Sample Date	TOB Elevation (feet, MSL)	Depth to Liquid (feet)	Separate-Phase Hydrocarbon Thickness (feet)	Liquid Surface Elevation (feet, MSL)
MW-10 (cont.)	04/15/92		10.59	--	21.08
	05/14/92		11.30	--	20.37
	06/15/92		11.93	--	19.74
	07/14/92		12.42	--	19.25
	08/18/92		13.03	--	18.64
	09/15/92		13.42	--	18.25
	12/17/92		11.94	--	19.73
MW-11	04/13/90	32.54	NA	--	NA
	05/08/90		12.84	--	19.70
	06/22/90		12.82	--	19.72
	09/19/90		14.09	--	18.45
	12/27/90		13.66	--	18.88
	03/21/91		11.85	--	20.69
	06/26/91		12.69	--	19.85
	07/03/91		12.81	--	19.73
	09/24/91		14.03	--	18.51
	10/04/91		14.18	--	18.36
	12/19/91		14.29	--	18.25
	01/16/92		13.28	--	19.26
	02/19/92		11.29	--	21.25
	03/17/92		10.81	--	21.73
	04/15/92		11.23	--	21.31
	05/14/92		11.96	--	20.58
	06/15/92		12.64	--	19.90
	07/14/92		13.08	--	19.46
	08/18/92		13.72	--	18.82
	09/15/92		14.13	--	18.41
	12/17/92		12.69	--	19.85
E-1A (MW-12)	09/19/90	33.06	14.31	--	18.75
	12/27/90		13.97	--	19.09
	03/21/91		12.11	--	20.95
	06/26/91		12.90	--	20.16
	07/03/91		13.00	--	20.06
	09/24/91		22.47	--	10.59
	01/16/92		23.68	--	9.38
	02/19/92		18.71	--	14.35
	03/17/92		23.10	--	9.96
	04/15/92		20.54	--	12.52
	05/14/92		23.09	--	9.97
	06/15/92		23.72	--	9.34
	07/14/92		13.25	--	19.81
	08/18/92		23.73	--	9.33
	09/15/92		23.62	--	9.44
	12/17/92		22.65	--	10.41

Table 3 (continued)
Summary of Groundwater Elevation Data

ARCO Service Station 0608
17601 Hesperian Boulevard at Hacienda Avenue
San Lorenzo, California

Well Number	Sample Date	TOB Elevation (feet, MSL)	Depth to Liquid (feet)	Separate-Phase Hydrocarbon Thickness (feet)	Liquid Surface Elevation (feet, MSL)
MW-13	07/03/91	35.42	15.19	--	20.23
	09/24/91		16.45	--	18.97
	12/19/91		16.66	--	18.76
	01/16/92		15.70	--	19.72
	02/19/92		13.60	--	21.82
	03/17/92		13.20	--	22.22
	04/15/92		13.64	--	21.78
	05/14/92		14.34	--	21.08
	06/15/92		15.13	--	20.29
	07/14/92		15.45	--	19.97
	08/18/92		16.15	--	19.27
	09/15/92		16.51	--	18.91
	12/17/92		15.07	--	20.35
MW-14	07/03/91	30.46	11.05	--	19.41
	09/24/91		12.30	--	18.16
	10/04/91		12.38	--	18.08
	12/19/91		12.39	--	18.07
	01/16/92		11.34	--	19.12
	02/19/92		9.32	--	21.14
	03/17/92		9.04	--	21.42
	06/15/92		10.83	--	19.63
	09/15/92		12.27	--	18.19
	12/17/92		10.69	--	19.77
MW-15	07/03/91	31.41	12.43	--	18.89
	09/24/91		13.69	--	17.72
	10/04/91		13.80	--	17.61
	12/19/91		13.78	--	17.63
	01/16/92		12.80	--	18.61
	02/19/92		10.85	--	20.56
	03/18/92		10.41	--	21.00
	06/15/92		12.19	--	19.22
	09/15/92		13.69	--	17.72
	12/17/92		12.26	--	19.15
MW-16	07/03/91	31.39	12.92	--	18.47
	09/24/91		14.10	--	17.29
	10/04/91		14.20	--	17.19
	12/19/91		14.14	--	17.25
	01/16/92		13.09	--	18.30
	02/19/92		10.99	--	20.40
	03/18/92		10.85	--	20.54
	06/15/92		12.64	--	18.75
	09/15/92		14.07	--	17.32
	12/17/92		12.56	--	18.83

Table 3 (continued)
Summary of Groundwater Elevation Data

ARCO Service Station 0608
17601 Hesperian Boulevard at Hacienda Avenue
San Lorenzo, California

Well Number	Sample Date	TOB Elevation (feet, MSL)	Depth to Liquid (feet)	Separate-Phase Hydrocarbon Thickness (feet)	Liquid Surface Elevation (feet, MSL)
MW-17	07/03/91	32.43	13.75	--	18.68
	09/24/91		14.98	--	17.45
	10/04/91		15.20	--	17.23
	12/19/91		15.02	--	17.41
	01/16/92		13.92	--	18.51
	02/19/92		11.65	--	20.78
	03/18/92		11.71	--	20.72
	06/15/92		13.50	--	18.93
	09/15/92		14.95	--	17.48
	12/17/92		13.34	--	19.09
MW-18	10/04/91	29.70	13.00	--	16.59
	12/19/91		12.91	--	16.71
	03/18/92		9.73	--	19.97
	06/15/92		11.50	--	18.20
	09/15/92		12.90	--	16.80
	12/17/92		11.21	--	18.49
MW-19	10/04/91	29.02	12.43	--	16.59
	12/19/91		12.31	--	16.71
	03/18/92		9.22	--	19.80
	06/15/92		10.94	--	18.08
	09/15/92		12.38	--	16.64
	12/17/92		10.51	--	18.51
MW-20	10/04/91	29.54	12.56	--	16.98
	12/19/91		12.48	--	17.06
	03/18/92		9.49	--	20.05
	06/15/92		11.11	--	18.43
	09/15/92		12.50	--	17.04
	12/17/92		10.74	--	18.80
MW-21	10/04/91	28.72	12.88	--	15.84
	12/19/91		12.68	--	16.04
	03/18/92		9.55	--	19.17
	06/15/92		11.30	--	17.42
	09/15/92		12.78	--	15.94
	12/17/92		10.80	--	17.92
MW-22	10/04/91	29.29	13.37	--	15.92
	12/19/91		13.19	--	16.10
	03/17/92		10.05	--	19.24
	06/15/92		11.84	--	17.45
	09/15/92		13.27	--	16.02
	12/17/92		11.58	--	17.71

Table 3 (continued)
Summary of Groundwater Elevation Data

ARCO Service Station 0608
17601 Hesperian Boulevard at Hacienda Avenue
San Lorenzo, California

Well Number	Sample Date	TOB Elevation (feet, MSL)	Depth to Liquid (feet)	Separate-Phase Hydrocarbon Thickness (feet)	Liquid Surface Elevation (feet, MSL)
MW-23	10/04/91	30.99	14.50	--	16.49
	12/19/91		14.38	--	16.61
	03/17/92		11.20	--	19.79
	06/15/92		12.94	--	18.05
	09/15/92		14.40	--	16.59
	12/17/92		13.01	--	17.98

TOB = Top of box
MSL = Mean sea level
Well elevations are measured from set mark at top of vault box.

Table 4
Summary of Groundwater Analytical Results
Total Petroleum Hydrocarbons
(Collected from Beneath Fuel Tanks)

ARCO Service Station 0608
17601 Hesperian Boulevard at Hacienda Avenue
San Lorenzo, California

Groundwater Sample Number	Sample Date	Gasoline (ppb)	Benzene (ppb)	Toluene (ppb)	Ethylbenzene and Xylenes (ppb)
E1-S	06/14/88	15,000	1,400	2,300	4,700
E2-S	06/14/88	22,000	1,900	3,900	4,900
E3-N	06/14/88	8,200	440	1,100	2,300

ppb = Parts per billion

Table 4 (continued)
Summary of Groundwater Analytical Results
Total Petroleum Hydrocarbons
(Collected from Domestic Irrigation Wells)

ARCO Service Station 0608
17601 Hesperian Boulevard at Hacienda Avenue
San Lorenzo, California

Well Address	Sample Date	Gasoline (ppb)	Benzene (ppb)	Toluene (ppb)	Ethylbenzene (ppb)	Xylenes (ppb)
17349 VM	09/27/91	780	13	<3.0	<3.0	<3.0
	10/14/92	2,200	<5	<5	<5	110
	12/18/92	1,500	14	1.8	7.1	56
17372 VM	09/27/91	300	5.5	<0.60	1.3	0.72
	10/14/92	220	<1.0	<1.0	<1.0	<1.0
	12/18/92	290	3.8	0.88	0.99	1.2
17302 VM	10/21/91	72	0.64	<0.30	0.44	<0.30
	10/14/92	NS	NS	NS	NS	NS
	12/21/92	<50	<0.50	<0.50	<0.50	<0.50
590 H	11/13/91	<30	<0.30	<0.30	<0.30	<0.30
	10/14/92	<50	<0.50	<0.50	<0.50	<0.50
	12/21/92	<50	<0.50	<0.50	<0.50	<0.50
633 H	09/27/91	NS	NS	NS	NS	NS
	10/14/92	NS	NS	NS	NS	NS
	12/21/92	<50	<0.50	<0.50	<0.50	<0.50
634 H	09/27/91	NS	NS	NS	NS	NS
	10/14/92	NS	NS	NS	NS	NS
	12/18/92	NS	NS	NS	NS	NS
642 H	11/13/91	<30	<0.30	<0.30	<0.30	<0.30
	10/16/92	<50	<0.50	<0.50	<0.50	<0.50
	12/21/92	<50	<0.50	<0.50	<0.50	<0.50
675 H	09/27/91	NS	NS	NS	NS	NS
	11/13/92	NS	NS	NS	NS	NS
	12/21/92	NS	NS	NS	NS	NS
17197 VM	11/13/91	<30	<0.30	<0.30	<0.30	<0.30
	10/14/92	<50	<0.50	<0.50	<0.50	<0.50
	12/21/92	<50	<0.50	<0.50	<0.50	<0.50
17200 VM	11/13/91	440	2.7	<0.30	<0.30	12
	10/16/92	NS	NS	NS	NS	NS
	12/18/92	160	1.4	<0.50	<0.50	3.4

Table 4 (continued)
Summary of Groundwater Analytical Results
Total Petroleum Hydrocarbons
(Collected from Domestic Irrigation Wells)

ARCO Service Station 0608
17601 Hesperian Boulevard at Hacienda Avenue
San Lorenzo, California

Well Address	Sample Date	Gasoline (ppb)	Benzene (ppb)	Toluene (ppb)	Ethylbenzene (ppb)	Xylenes (ppb)
17203 VM	11/13/91	<30	<0.30	<0.30	<0.30	<0.30
	10/16/92	NS	NS	NS	NS	NS
	12/21/92	<50	<0.50	<0.50	<0.50	<0.50
17348 VE	11/13/91	NS	NS	NS	NS	NS
	10/16/92	NS	NS	NS	NS	NS
	12/21/92	<50	<0.50	<0.50	<0.50	<0.50
17371 VM	11/13/91	**870**	**9.0**	**1.0**	**2.1**	**4.5**
	10/14/92	<50	<0.50	<0.50	<0.50	<0.50
	12/18/92	<50	<0.50	<0.50	<0.50	<0.50
17393 VM	11/13/91	**31**	<0.30	<0.30	<0.30	<0.30
	10/16/92	NS	NS	NS	NS	NS
	12/18/92	<50	<0.50	<0.50	<0.50	<0.50

ppb = Parts per billion
< = Denotes laboratory detection limit
NS = Currently not accessible for sampling

Table 4 (continued)
Summary of Groundwater Analytical Results
Total Petroleum Hydrocarbons
(Collected from Groundwater Wells)

ARCO Service Station 0608
17601 Hesperian Boulevard at Hacienda Avenue
San Lorenzo, California

Well Number	Sample Date	Gasoline (ppb)	Benzene (ppb)	Toluene (ppb)	Ethylbenzene (ppb)	Xylenes (ppb)
MW-1	01/11/88	300	20	10	50	80
	06/14/88	Well Destroyed				
MW-2	07/05/85	32,000	1,000	690	NA*	1,500*
	01/11/88	3,300	804	115	168	166
	06/14/88	Well Destroyed				
MW-3	01/11/88	1,800	20	20	80	60
	03/07/89	150,000	4,600	5,200	5,600	13,000
	06/21/89	63,000	2,700	5,800	3,300	12,000
	12/12/89	Not Sampled--Insufficient Water Volume				
	03/29/90	1,100,000**	13,000	60,000	17,000	91,000
	06/22/90	Not Sampled--Insufficient Water Volume				
	07/18/90	Well Destroyed				
MW-4	01/11/88	62,000	2,700	7,900	850	5,200
	09/12/88	Not Sampled--Separate-Phase Hydrocarbon				
	03/07/89	84,000	2,400	3,400	2,500	7,600
	06/21/89	31,000	400	800	200	1,500
	12/12/89	Not Sampled--Well Dry				
	03/29/90	Not Sampled-0.01 foot Separate-Phase Hydrocarbon				
	06/22/90	Not Sampled--Well Dry				
	07/18/90	Well Destroyed				
MW-5	01/11/88	31,000	4,000	2,700	3,800	5,500
	03/07/89	1,300	340	ND	140	50
	06/21/89	1,100	200	ND	130	40
	12/12/89	Not Sampled--Well Dry				
	03/29/90	Not Sampled--Insufficient Water Volume				
	06/22/90	Not Sampled--Insufficient Water Volume				
	09/19/90	Not Sampled--Well Dry				
	12/27/90	Not Sampled--Well Dry				
	03/21/91	Not Sampled--Well Dry				
	06/26/91	Not Sampled--Well Dry				
	09/24/91	Not Sampled--Well Dry				
	12/19/91	Not Sampled--Well Dry				
	03/18/92	11,000	110	2.0	410	150
	06/15/92	Not Sampled--Well Dry				
	09/16/92	Not Sampled--Well Dry				
	12/22/92	960	220	6.5	4	2
MW-6 (E-1)	06/21/89	1,700	170	170	85	290
	12/12/89	500	26	7	8	18
	03/29/90	130	14	9	4	11
	06/22/90	150	15	5	4	13
	07/18/90	Well Destroyed				

Table 4 (continued)
Summary of Groundwater Analytical Results
Total Petroleum Hydrocarbons
(Collected from Groundwater Wells)

ARCO Service Station 0608
17601 Hesperian Boulevard at Hacienda Avenue
San Lorenzo, California

Well Number	Sample Date	Gasoline (ppb)	Benzene (ppb)	Toluene (ppb)	Ethylbenzene (ppb)	Xylenes (ppb)
MW-7	04/13/90	<50	<0.3	<0.3	<0.3	<0.3
	06/22/90	<50	0.5	1	0.6	3
	09/19/90	<50	<0.3	<0.3	<0.3	<0.3
	12/27/90	69	<0.3	0.3	0.4	2
	03/21/91	<30	<0.30	<0.30	<0.30	<0.30
	06/26/91	<30	<0.30	<0.30	<0.30	<0.30
	09/24/91	<30	<0.30	<0.30	<0.30	<0.30
	12/19/91	<30	<0.30	<0.30	<0.30	<0.30
	03/17/92	<30	<0.30	<0.30	<0.30	<0.30
	06/17/92	<30	<0.30	<0.30	<0.30	<0.30
	09/16/92	<50	<0.5	<0.5	<0.5	<0.5
	12/21/92	<50	<0.5	<0.5	<0.5	<0.5
MW-8	04/13/90	4,900	350	16	450	33
	06/22/90	3,700	370	12	330	28
	09/19/90	140	4	3	3	3
	12/27/90	1,200	7	0.3	53	<0.3
	03/21/91	540	8.8	<6.0	21	9.6
	06/26/91	2,100	290	<6.0	56	<6.0
	09/24/91	260	51	0.34	7.9	<0.30
	12/19/91	5,300	300	<3.0	21	4.8
	03/17/92	9,200	370	3.0	48	4.9
	06/17/92	3,300	460	2.7	63	6.9
	09/16/92	1,500	58	<0.5	6.1	4.5
	12/22/92	3,600	410	56	62	4.4
MW-9	04/13/90	<50	<0.3	<0.3	<0.3	2
	06/22/90	12,000	200	3	250	180
	09/19/90	<50	<0.3	<0.3	<0.3	0.6
	12/27/90	<50	<0.3	<0.3	<0.3	<0.3
	03/21/91	<30	<0.30	<0.30	<0.30	<0.30
	06/26/91	<30	<0.30	<0.30	<0.30	<0.30
	09/24/91	<30	<0.30	<0.30	<0.30	<0.30
	12/19/91	<30	<0.30	<0.30	<0.30	<0.30
	03/17/92	<30	<0.30	<0.30	<0.30	<0.30
	06/16/92	<30	<0.30	<0.30	<0.30	<0.30
	09/16/92	<50	<0.5	<0.5	<0.5	<0.5
	12/21/92	75	<0.5	<0.5	<0.5	<0.5
MW-10	04/13/90	10,000	150	4	280	200
	06/22/90	9,700	28	<0.3	131	210
	09/19/90	1,800	<0.3	4	0.8	10
	12/27/90	5,700	7	3	95	61
	03/21/91	6,900	22	<15	92	33
	06/26/91	9,300	51	<0.30	59	34
	09/24/91	360	8.6	5.2	14	6.2
	12/19/91	3,300	9.2	8.4	11	17
	03/18/92	4,700	14	<6.0	29	10

Table 4 (continued)
Summary of Groundwater Analytical Results
Total Petroleum Hydrocarbons
(Collected from Groundwater Wells)

ARCO Service Station 0608
17601 Hesperian Boulevard at Hacienda Avenue
San Lorenzo, California

Well Number	Sample Date	Gasoline (ppb)	Benzene (ppb)	Toluene (ppb)	Ethylbenzene (ppb)	Xylenes (ppb)
MW-10 (cont.)	06/16/92	4,800	0.46	0.34	7.4	3.8
	09/16/92	2,000	8.3	3.0	3.3	5.5
	12/22/92	2,700	6.2	0.5	7.5	2.8
MW-11	04/13/90	<50	<0.3	<0.3	<0.3	<0.3
	06/22/90	63	0.4	0.9	0.7	3
	09/19/90	<50	<0.3	<0.3	<0.3	<0.3
	12/27/90	<50	<0.3	<0.3	<0.3	<0.3
	03/21/91	<30	<0.30	<0.30	<0.30	<0.30
	06/26/91	<30	<0.30	<0.30	<0.30	<0.30
	09/24/91	<30	<0.30	<0.30	<0.30	<0.30
	12/19/91	<30	<0.30	<0.30	<0.30	<0.30
	03/17/92	<30	<0.30	<0.30	<0.30	<0.30
	06/16/92	<30	<0.30	<0.30	<0.30	<0.30
	09/16/92	<50	<0.5	<0.5	<0.5	<0.5
	12/22/92	<50	<0.5	<0.5	<0.5	<0.5
E-1A (MW-12)	09/19/90	<50	7	0.9	1	2
	12/27/90	<50	3	0.5	1	1
	03/21/91	<30	4.2	<0.30	1.1	0.89
	06/26/91	41	6.3	<0.30	1.2	0.59
		---------- Converted to Extraction Well 8/91 ----------				
MW-13	07/03/91	<30	<0.30	<0.30	<0.30	<0.30
	09/24/91	<30	<0.30	<0.30	<0.30	<0.30
	12/19/91	<30	<0.30	<0.30	<0.30	<0.30
	03/17/92	<30	<0.30	<0.30	<0.30	<0.30
	06/17/92	<30	<0.30	<0.30	<0.30	<0.30
	09/16/92	<50	<0.5	<0.5	<0.5	<0.5
	12/21/92	<50	<0.5	<0.5	<0.5	<0.5
MW-14	07/03/91	<30	<0.30	<0.30	<0.30	<0.30
	09/24/91	<30	<0.30	<0.30	<0.30	<0.30
	12/19/91	<30	<0.30	<0.30	<0.30	<0.30
	03/17/92	<30	<0.30	<0.30	<0.30	<0.30
	06/16/92	<30	<0.30	<0.30	<0.30	<0.30
	09/16/92	<50	<0.5	<0.5	<0.5	<0.5
	12/22/92	<50	<0.5	<0.5	<0.5	<0.5
MW-15	07/03/91	570	1.8	1.0	1.0	2.2
	09/24/91	<30	<0.30	<0.30	<0.30	<0.30
	12/19/91	360	<0.60	<0.60	0.64	<0.60
	03/18/92	730	0.74	0.98	1.8	0.68
	06/16/92	310	0.54	0.34	0.96	2.5
	09/16/92	100	1.0	<0.5	<0.5	<0.5
	12/22/92	130	<0.5	<0.5	<0.5	<0.5

Table 4 (continued)
Summary of Groundwater Analytical Results
Total Petroleum Hydrocarbons
(Collected from Groundwater Wells)

ARCO Service Station 0608
17601 Hesperian Boulevard at Hacienda Avenue
San Lorenzo, California

Well Number	Sample Date	Gasoline (ppb)	Benzene (ppb)	Toluene (ppb)	Ethylbenzene (ppb)	Xylenes (ppb)
MW-16	07/03/91	2,700	31	6.9	4.6	3.1
	09/24/91	430	1.8	1.3	1.9	1.5
	12/19/91	75	<0.30	<0.30	<0.30	<0.30
	03/18/92	1,500	4.0	0.73	2.2	1.3
	06/16/92	80	<0.30	<0.30	<0.30	<0.30
	09/16/92	<50	<0.5	<0.5	<0.5	<0.5
	12/22/92	<50	<0.5	<0.5	<0.5	<0.5
MW-17	07/03/91	1,200	12	1.9	28	40
	09/24/91	150	2.7	0.50	3.9	0.59
	12/19/91	370	2.6	<0.30	7.2	6.5
	03/18/92	470	3.1	<0.30	9.1	8.6
	06/16/92	310	1.7	0.56	12	9.6
	09/16/92	77	1.5	<0.5	1.2	1.0
	12/21/92	220	1.2	<0.5	9.8	9.4
MW-18	10/04/91	<30	<0.30	<0.30	<0.30	<0.30
	12/19/91	<30	<0.30	<0.30	<0.30	<0.30
	03/18/92	<30	<0.30	<0.30	<0.30	<0.30
	06/15/92	<30	<0.30	<0.30	<0.30	<0.30
	09/15/92	<50	<0.5	<0.5	<0.5	<0.5
	12/21/92	<50	<0.5	<0.5	<0.5	<0.5
MW-19	10/04/91	<30	<0.30	<0.30	<0.30	<0.30
	12/19/91	<30	<0.30	<0.30	<0.30	<0.30
	03/18/92	<30	<0.30	<0.30	<0.30	<0.30
	06/15/92	<30	<0.30	<0.30	<0.30	<0.30
	09/15/92	<50	<0.5	<0.5	<0.5	<0.5
	12/21/92	<50	<0.5	<0.5	<0.5	<0.5
MW-20	10/04/91	<30	<0.30	<0.30	<0.30	<0.30
	12/19/91	<30	<0.30	<0.30	<0.30	<0.30
	03/18/92	<30	<0.30	<0.30	<0.30	<0.30
	06/15/92	<30	<0.30	<0.30	<0.30	<0.30
	09/15/92	<50	<0.5	<0.5	<0.5	<0.5
	12/21/92	<50	<0.5	<0.5	<0.5	<0.5
MW-21	10/04/91	<30	<0.30	<0.30	<0.30	<0.30
	12/19/91	<30	<0.30	<0.30	<0.30	<0.30
	03/18/92	<30	<0.30	<0.30	<0.30	<0.30
	06/15/92	<30	<0.30	<0.30	<0.30	<0.30
	09/15/92	<50	<0.5	<0.5	<0.5	<0.5
	12/22/92	<50	<0.5	<0.5	<0.5	<0.5

Table 4 (continued)
Summary of Groundwater Analytical Results
Total Petroleum Hydrocarbons
(Collected from Groundwater Wells)

ARCO Service Station 0608
17601 Hesperian Boulevard at Hacienda Avenue
San Lorenzo, California

Well Number	Sample Date	Gasoline (ppb)	Benzene (ppb)	Toluene (ppb)	Ethylbenzene (ppb)	Xylenes (ppb)
MW-22	10/04/91	<30	<0.30	<0.30	<0.30	<0.30
	12/19/91	<30	<0.30	<0.30	<0.30	<0.30
	03/17/92	<30	<0.30	<0.30	<0.30	<0.30
	06/15/92	<30	<0.30	<0.30	<0.30	<0.30
	09/15/92	<50	<0.5	<0.5	<0.5	<0.5
	12/22/92	<50	<0.5	<0.5	<0.5	<0.5
MW-23	10/04/91	<30	<0.30	<0.30	<0.30	<0.30
	12/19/91	<30	<0.30	<0.30	<0.30	<0.30
	03/17/92	<30	<0.30	<0.30	<0.30	<0.30
	06/15/92	<30	<0.30	<0.30	<0.30	<0.30
	09/15/92	<50	<0.5	<0.5	<0.5	<0.5
	12/22/92	<50	<0.5	<0.5	<0.5	<0.5

ppb = Parts per billion
NA = Not available
< = Denotes laboratory detection limits. See attached analytical reports.
* Ethylbenzene and xylenes given as a combined value.
** Well contained slight product sheen.

MW-1 and MW-2 destroyed prior to March 7, 1989 sampling event.
MW-3, MW-4, and MW-6 (E-1) destroyed June 18, 1990.

Table 4 (continued)
Summary of Groundwater Analytical Results
Halogenated Volatile Organics, Semi-Volatile Organics, and Metals
(collected from Well MW-8, December 22, 1992)

ARCO Service Station 0608
17601 Hesperian Boulevard
San Lorenzo, California

Analyses		Sample Results (ppb)
Halogenated Volatile Organics		ND
Semi-Volatile Organics		
Acenaphthene		2.7
Dibenzofuran		1.2
Fluorene		1.6
2-Methylnaphthalene		14
Naphthalene		34
Phenanthrene		1.8
Metals	**STLC (ppm)**	**TTLC (ppm)**
Arsenic	ND	0.025
Barium	ND	0.21
Zinc	ND	0.015

ppb = Parts per billion
ppm = Parts per million
ND = Not detected
STLC = Soluble Threshold Limit Concentration
TTLC = Total Threshold Limit Concentration

Table 5
Drinking Water and Off-Site Air Monitoring Analytical Results
(Collected from Domestic Irrigation Wells)
Drinking Water Analyses

ARCO Service Station 0608
17601 Hesperian Boulevard
San Lorenzo, California

Well Identification	Odor (units)	Color (units)	Turbidity (NTU)
17349 VM	NA	20	9
17203 VM	50	5	8.6
Regulatory Limit*	3	15	5

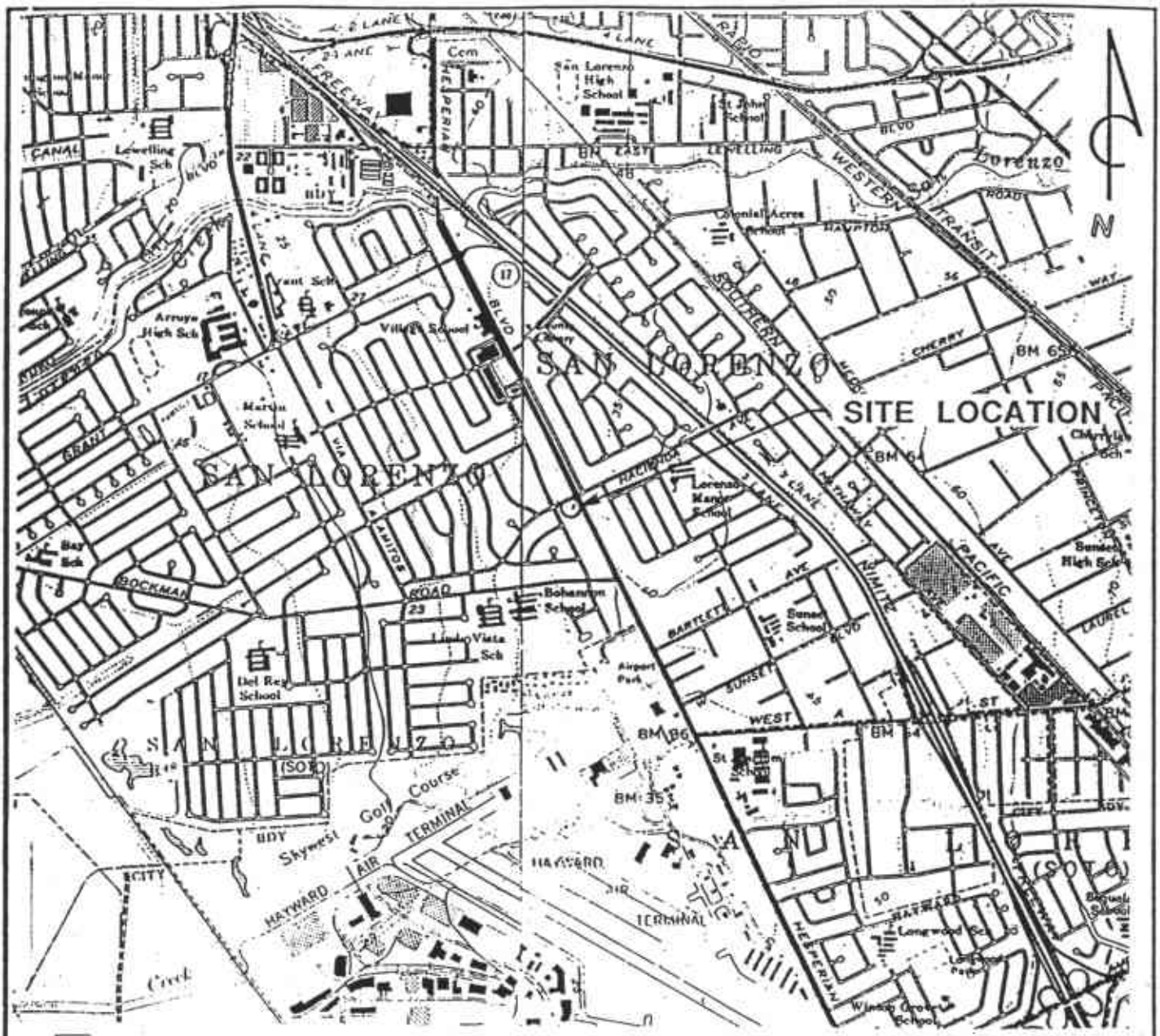
NTU = Nephelometric Turbidity Units
NA = Not available
* California Secondary Standards for Drinking Water
Samples collected July 22, 1992

Table 5 (continued)
Drinking Water and Off-Site Air Monitoring Analytical Results
(Collected from Off-Site Air Monitoring Locations)
Benzene Analyses

ARCO Service Station 0608
17601 Hesperian Boulevard
San Lorenzo, California

Sample Identification	Sample Date	**Benzene (ug/m^3)**	Sample Location Description
AVM100	07/22/92	**3.4**	Across Via Magdalena 100' Downwind
AH&VM	07/22/92	**9.6**	Corner of Hacienda Avenue and Via Magdalena
AH&H	07/22/92	**6.8**	Corner of Hacienda Avenue and Hesperian Boulevard
AVM+P	07/22/92	*	Corner of Via Magdalena and Potrero Court
BO17349	07/22/92	**2.5**	17349VM (Well Before Operation)
DO17349	07/22/92	**2.8**	17349VM (Well During Operation)
AO17349	07/22/92	**3.8**	17349VM (Well After Operation)
IV17349	07/22/92	**2.5**	Irrigation Vapor (During Well 17349VM Operation)
P17349	07/22/92	**2.1**	Plant Vapor (During Well 17349VM Operation)

ug/m^3 = Micrograms per cubic meter
ppbv = Parts per billion, by volume
* = **Sample container failed (no analysis was conducted on sample)**



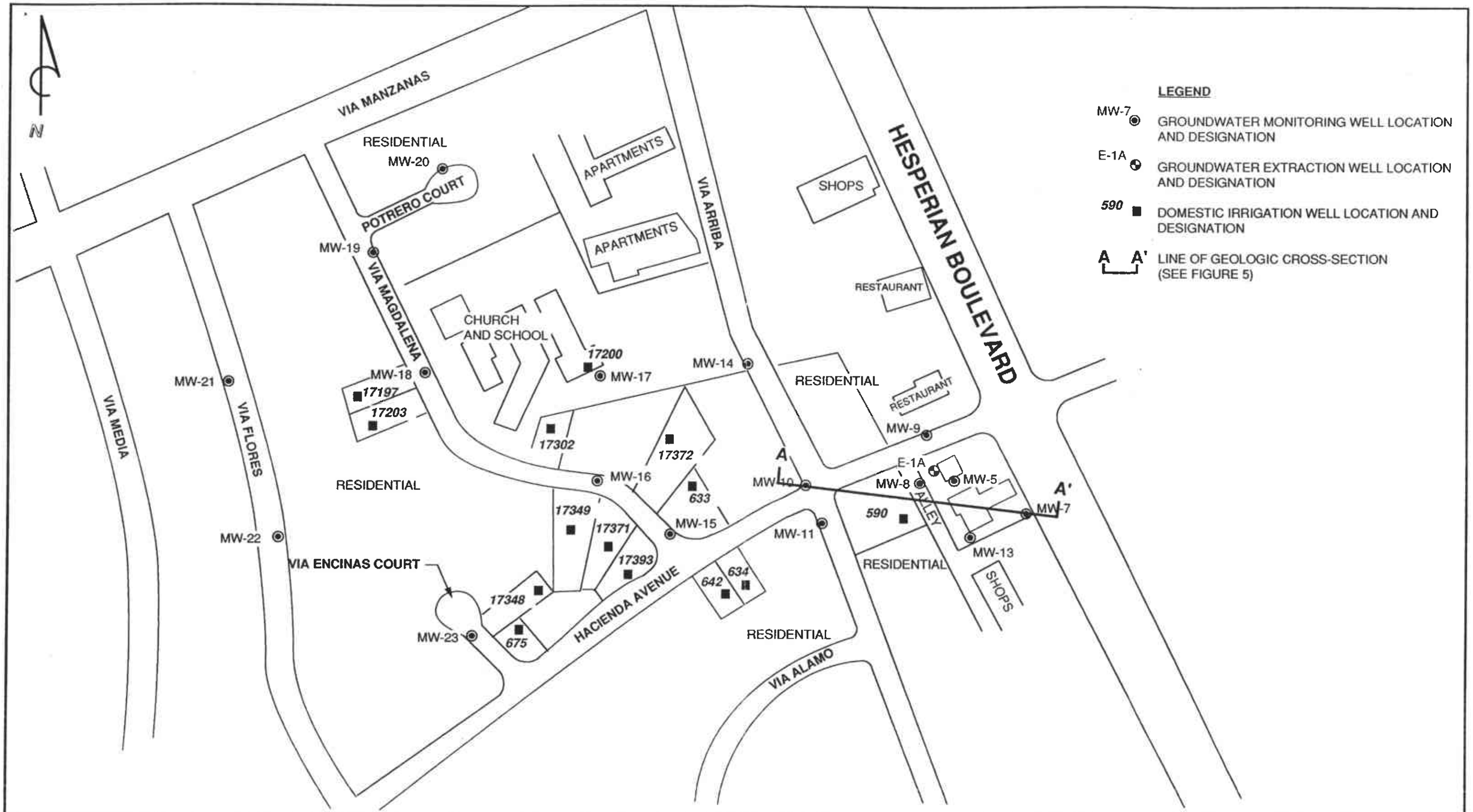
REFERENCES:

USGS 7.5 MIN. TOPOGRAPHIC MAP
TITLED: HAYWARD, CALIFORNIA
DATED: 1959 REVISED: 1980
TITLED: SAN LEANDRO, CALIFORNIA
DATED: 1959 REVISED: 1980

SCALE

2000 0 2000 FEET

PACIFIC ENVIRONMENTAL GROUP, INC.	ARCO SERVICE STATION 0608 17601 Hesperian Boulevard San Lorenzo, California SITE LOCATION MAP	FIGURE: 1 PROJECT: 330-06.16



PACIFIC ENVIRONMENTAL GROUP, INC.

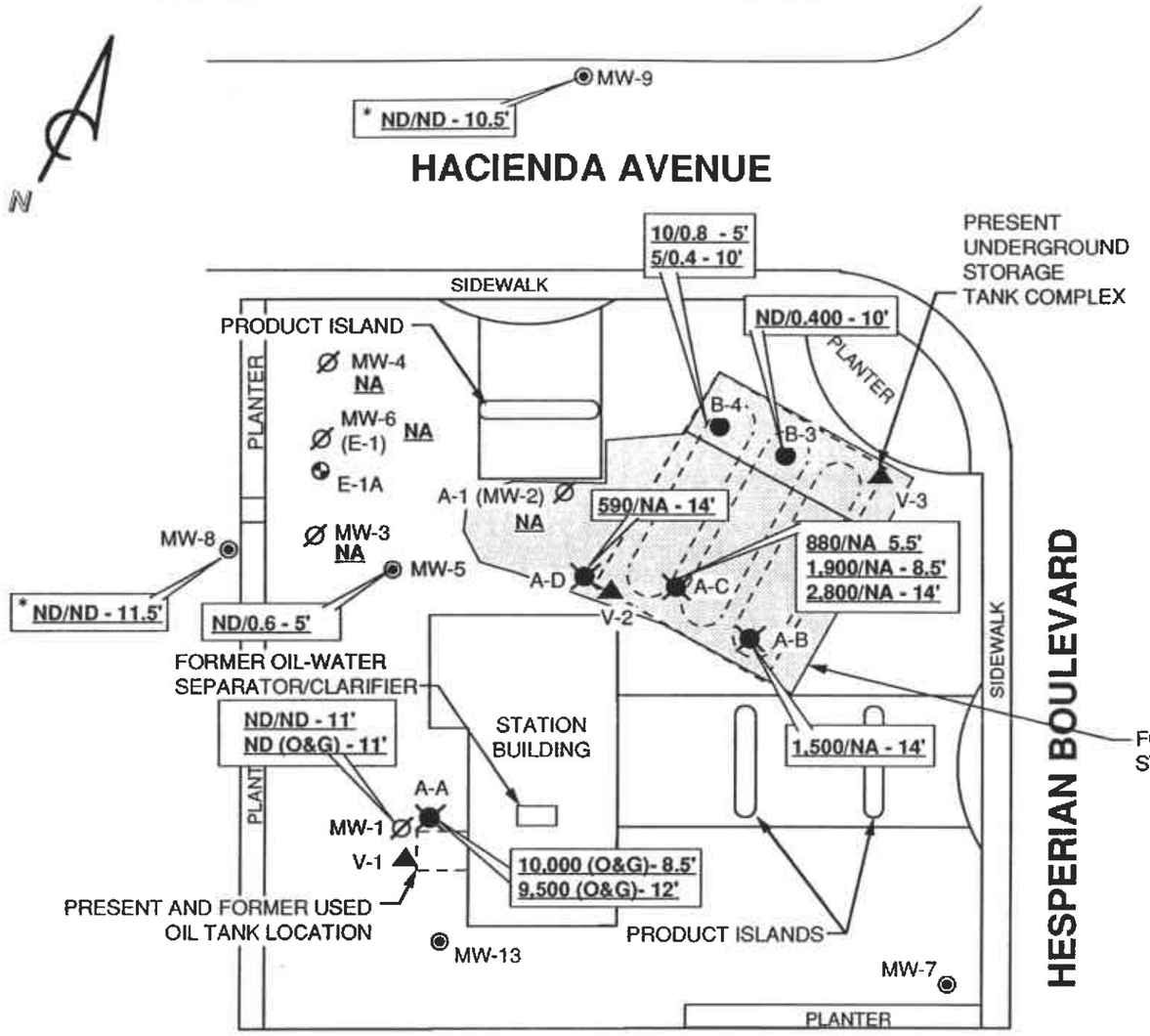
APPROXIMATE SCALE
0 150 300 FEET

ARCO SERVICE STATION 0608
17601 Hesperian Boulevard
San Lorenzo, California

EXTENDED SITE MAP

FIGURE: **2**
PROJECT: 330-06.16

2/03/93



LEGEND

- MW-5 ◉ GROUNDWATER MONITORING WELL LOCATION AND DESIGNATION
- MW-3 Ø DESTROYED WELLS LOCATION AND DESIGNATON
- E-1A ◉ EXTRACTION WELL LOCATION AND DESIGNATION
- B-3 ● SOIL BORING LOCATION AND DESIGNATION (AGS, 1988)
- A-A ✕ SOIL BORING LOCATION AND DESIGNATION (EMCON, 1985)
- V-1 ▲ VADOSE WELL LOCATION AND DESIGNATION
- 10/0.8 - 5' TVH-GASOLINE/BENZENE CONCENTRATION IN PARTS PER MILLION (ppm), AT DEPTH INDICATED IN FEET. (O&G) INDICATES OIL and GREASE CONCENTRATION IN ppm. * INDICATES TPH-GASOLINE/BENZENE CONCENTRATION IN ppm
- ND NOT DETECTED
- NA NOT ANALYZED

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SCALE
0 30 60 FEET

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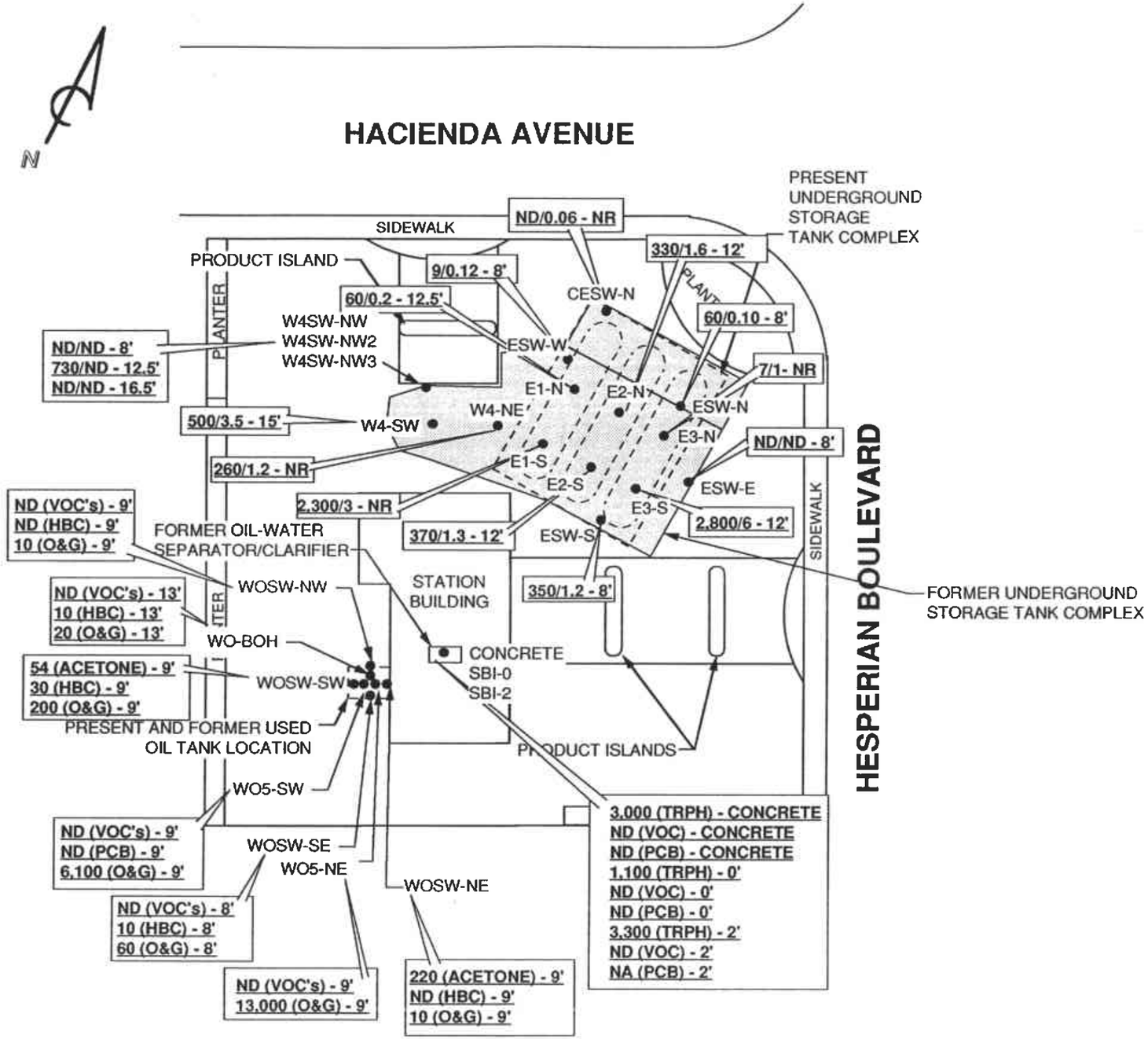
San Lorenzo, California

SOIL ANALYTICAL RESULTS MAP - SOIL BORINGS AND WELLS

FIGURE
3
PROJECT:
330-06.16

2/04/93



LEGEND

E2-N ● SOIL SAMPLE LOCATION AND DESIGNATION

60/0.10 - 8' TPH-GASOLINE/BENZENE CONCENTRATON IN PARTS PER MILLION (ppm), AT DEPTH INDICATED IN FEET

(O&G) - INDICATES OIL and GREASE CONCENTRATION IN ppm
(HBC) - INDICATES HIGH BOILING HYDROCARBONS IN ppm
(PCB) - INDICATES POLYCHLORINATED BIPHENYLS IN ppm
(VOC's) - INDICATES VOLATILE ORGANIC COMPOUNDS IN ppm
(TRPH) - INDICATES TOTAL RECOVERABLE PETROLEUM HYDROCARBONS IN ppm.

ND NOT DETECTED

NR NOT RECORDED

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SCALE
0 30 60 FEET

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SOIL ANALYTICAL RESULTS MAP - TANK EXCAVATION

FIGURE 4
PROJECT: 330-06.16

2/03/93

WEST

A

EAST

A'

MW-10 (31.67)

MW-11 (32.54) Proj. 45'N

MW-8 (32.79) Proj. 20'S

MW-1 (Destroyed) Proj. 10'N

MW-7 (34.40)

30

20

10

0

?

SCREENED INTERVAL

SAND PACKED INTERVAL

ELEVATION IN FEET - MSL

LEGEND

MW-7 MONITORING WELL DESIGNATION

(34.40) ELEVATION IN FEET - MSL

STATIC GROUNDWATER LEVEL, (3-92)

CLAY AND SILT (CH, CL, ML)

CLAYEY AND SILTY SAND (SC, SM)

PROJECT NUMBER

DRAWN BY

DATE/NUMBER

REVISIONS

PACIFIC ENVIRONMENTAL GROUP, INC.

SCALE

HORIZONTAL 1" = 30'
VERTICAL 1" = 5'

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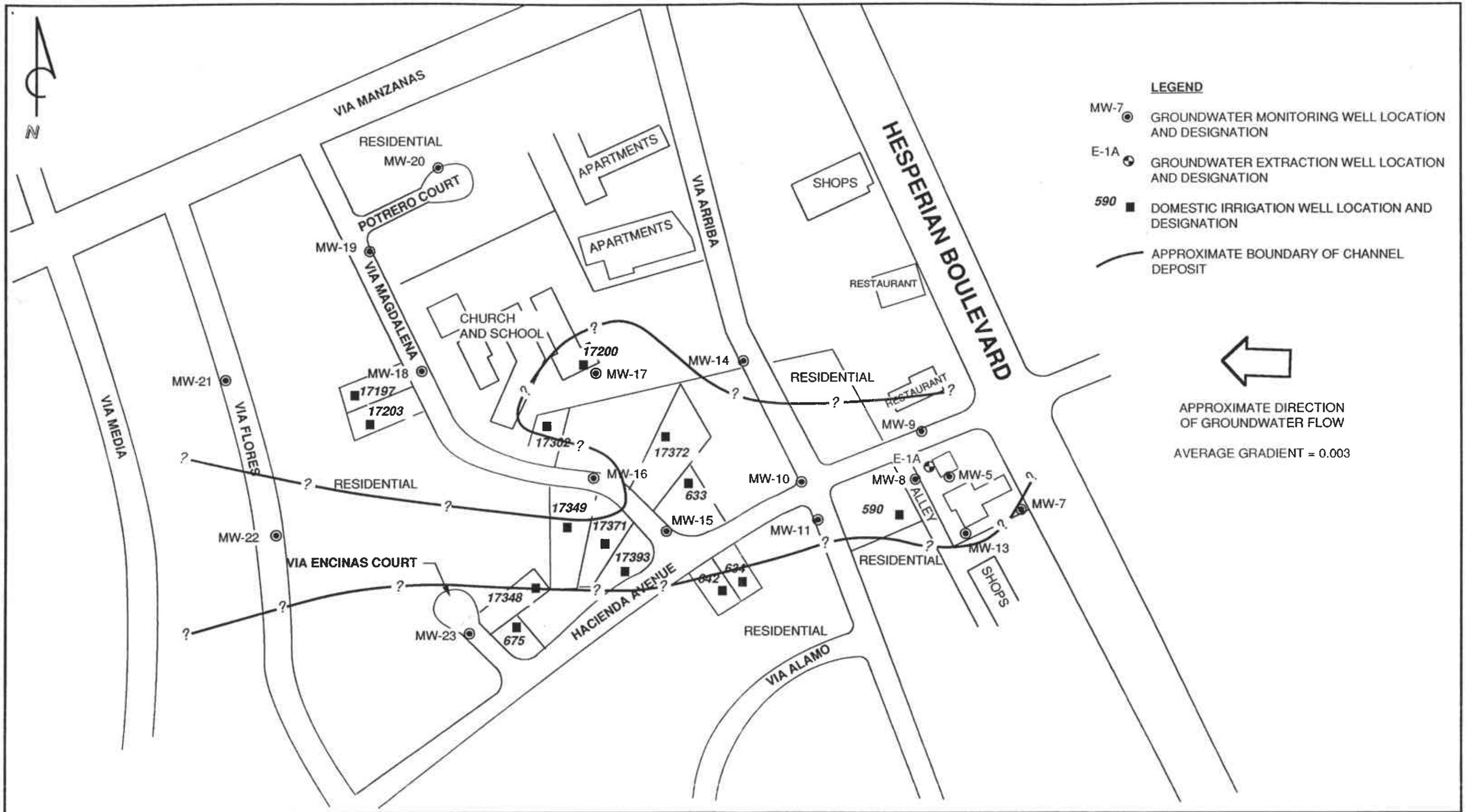
CROSS SECTION A-A'

FIGURE: 5

PROJECT: 330-06.16



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APPROXIMATE SCALE
0 150 300 FEET

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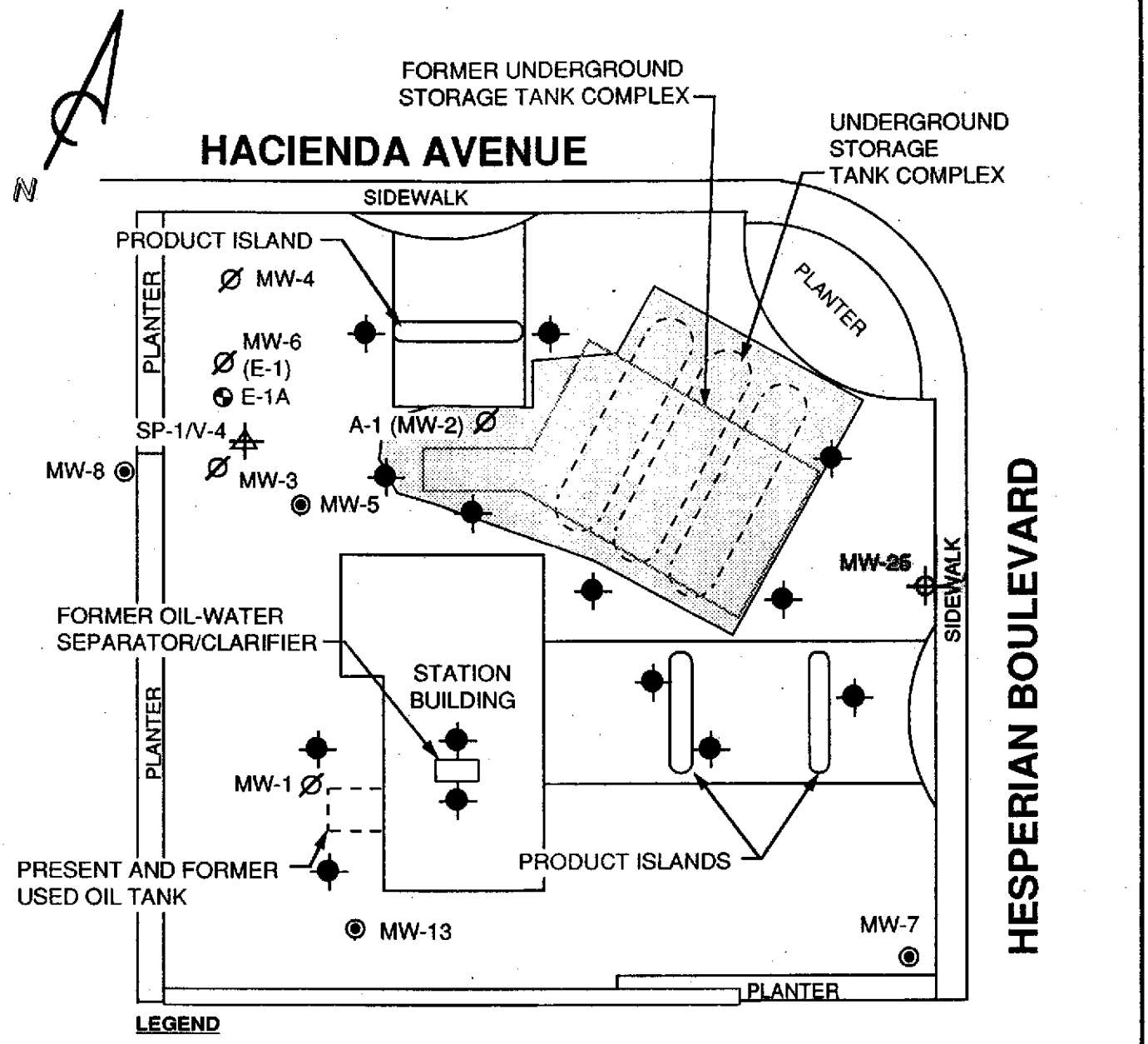
APPROXIMATE BOUNDARY OF CHANNEL DEPOSIT

FIGURE: 6
PROJECT: 330-06.16

2/03/93



LEGEND

MW-5 ◉ GROUNDWATER MONITORING WELL LOCATION AND DESIGNATION

E-1A ◔ GROUNDWATER EXTRACTION WELL LOCATION AND DESIGNATION

MW-3 Ø DESTROYED WELL LOCATION AND DESIGNATON

✦ PROPOSED SOIL BORING LOCATION

SP-1/V-4 ✦ PROPOSED AIR SPARGING/SOIL VAPOR EXTRACTION WELL LOCATION AND DESIGNATION

MW-25 ⊕ PROPOSED GROUNDWATER MONITORNG WELL LOCATION AND DESIGNATION

SCALE

0 30 60 FEET

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PROPOSED ON-SITE SOIL BORING LOCATION MAP

FIGURE: 7

PROJECT: 330-06.16

2/03/93

N

VIA MANZANAS

RESIDENTIAL

MW-20

POTRERO COURT

APARTMENTS

APARTMENTS

VIA ARRIBA

SHOPS

HESPERIAN BOULEVARD

MW-19

VIA MAGDALENA

RESTAURANT

CHURCH AND SCHOOL

MW-18

MW-17

MW-14

MW-21

VIA MEDIA

VIA FLORES

RESIDENTIAL

MW-24

RESTAURANT

MW-9

MW-25

SITE LOCATION

E-1A

MW-16

MW-10

MW-8

MW-5

SP-1/V-4

MW-7

RESIDENTIAL

SP-2/V-5

MW-15

MW-11

ALLEY

MW-22

MW-13

VIA ENCINAS COURT

RESIDENTIAL

SHOPS

MW-23

RESIDENTIAL

VIA ALAMO

HACIENDA AVENUE

LEGEND

MW-7 — GROUNDWATER MONITORING WELL LOCATION AND DESIGNATION

E-1A — GROUNDWATER EXTRACTION WELL LOCATION AND DESIGNATION

MW-24 — PROPOSED GROUNDWATER MONITORING WELL LOCATION AND DESIGNATION

SP-1/V-4 — PROPOSED AIR SPARGING/SOIL VAPOR EXTRACTION WELL LOCATION AND DESIGNATION

PROPOSED SOIL BORING LOCATION

PACIFIC ENVIRONMENTAL GROUP, INC.

APPROXIMATE SCALE

0 150 300 FEET

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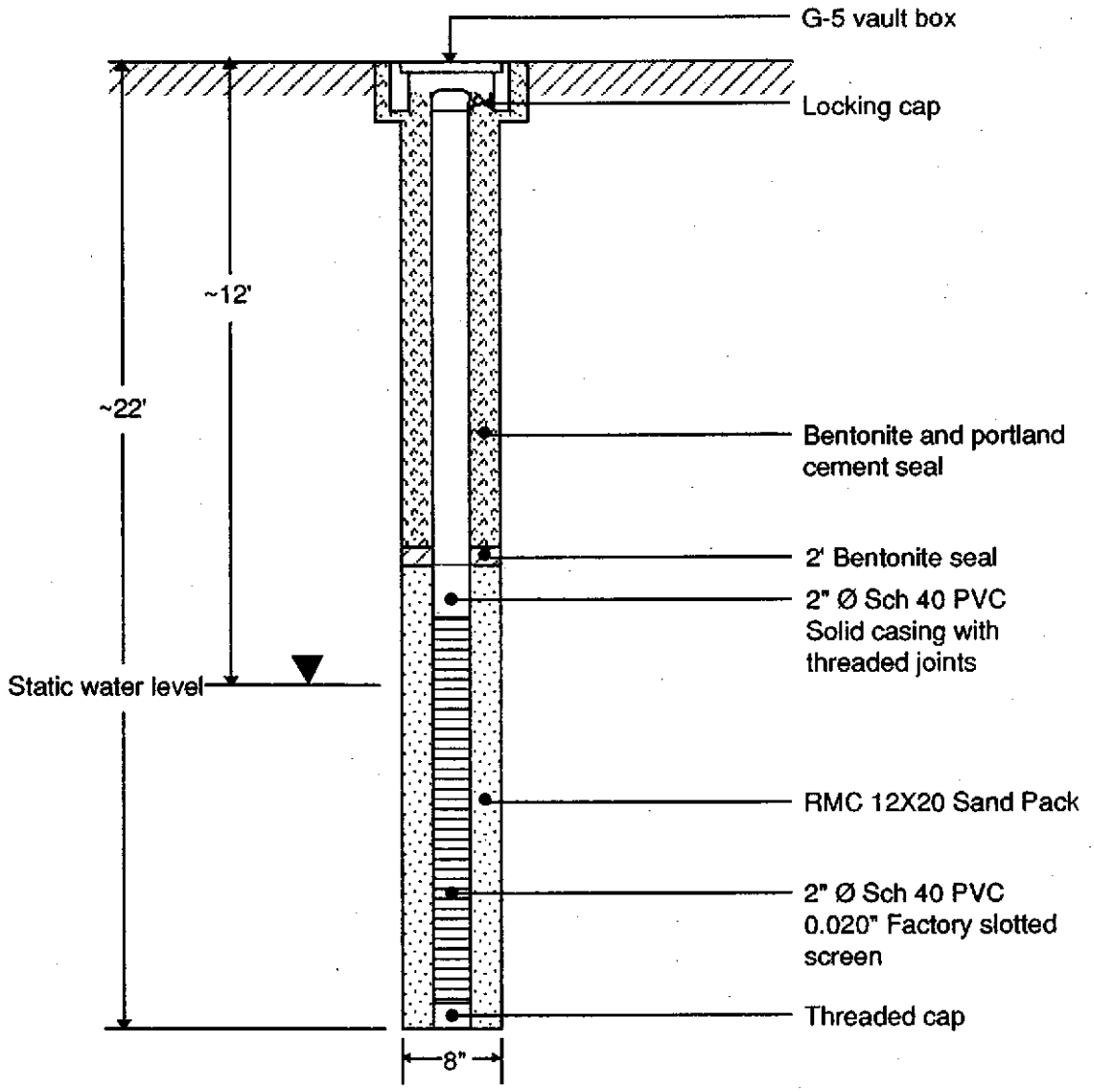
San Lorenzo, California

PROPOSED OFF-SITE SOIL BORING AND GROUNDWATER MONITORING WELL LOCATION MAP

FIGURE: 8

PROJECT: 330-06.16

2/03/93



NOT TO SCALE

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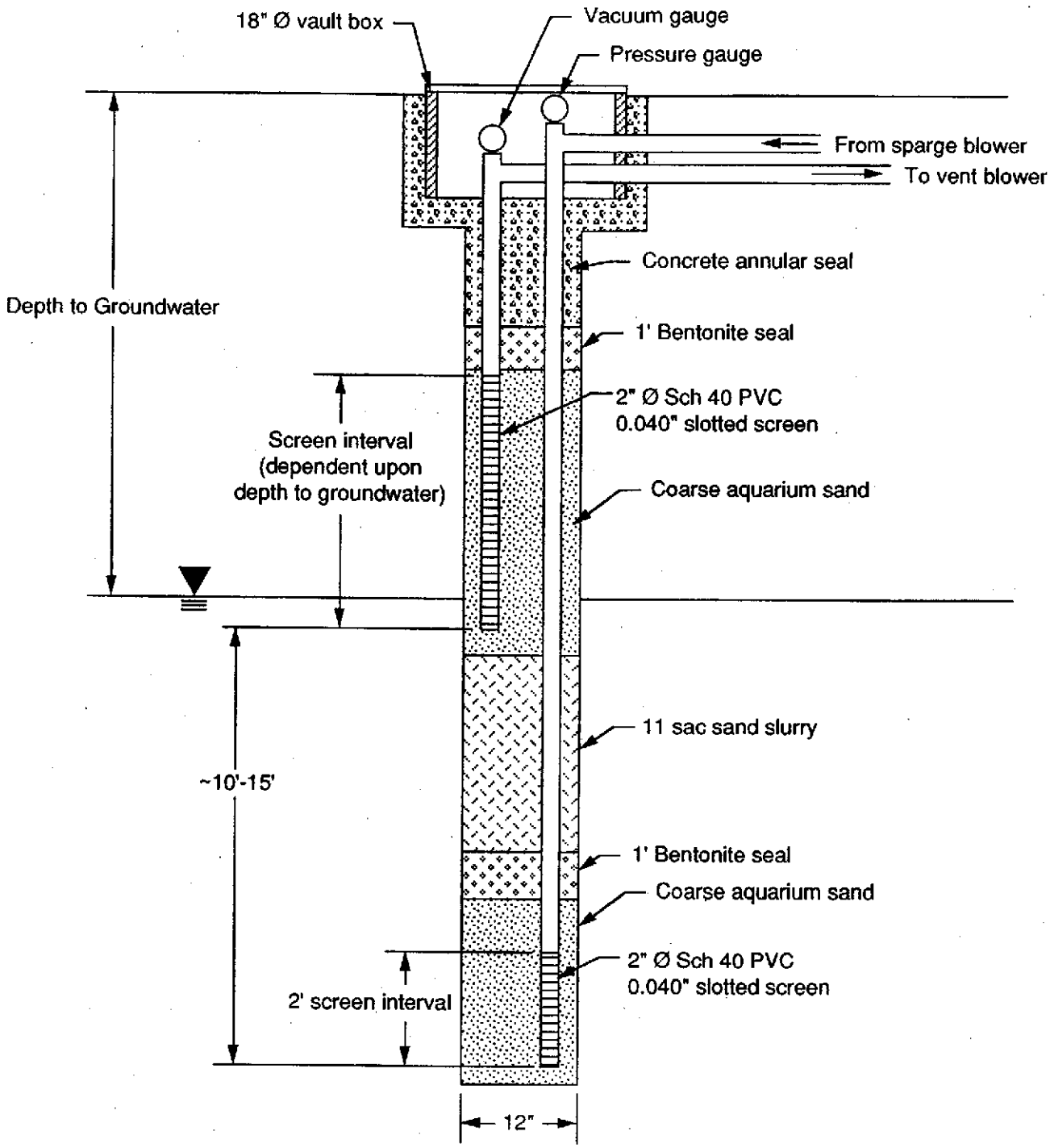
PROPOSED GROUNDWATER MONITORING WELL DETAIL

FIGURE: 9

PROJECT: 330-06.16

2/02/93



NOT TO SCALE

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San Lorenzo, Califorina

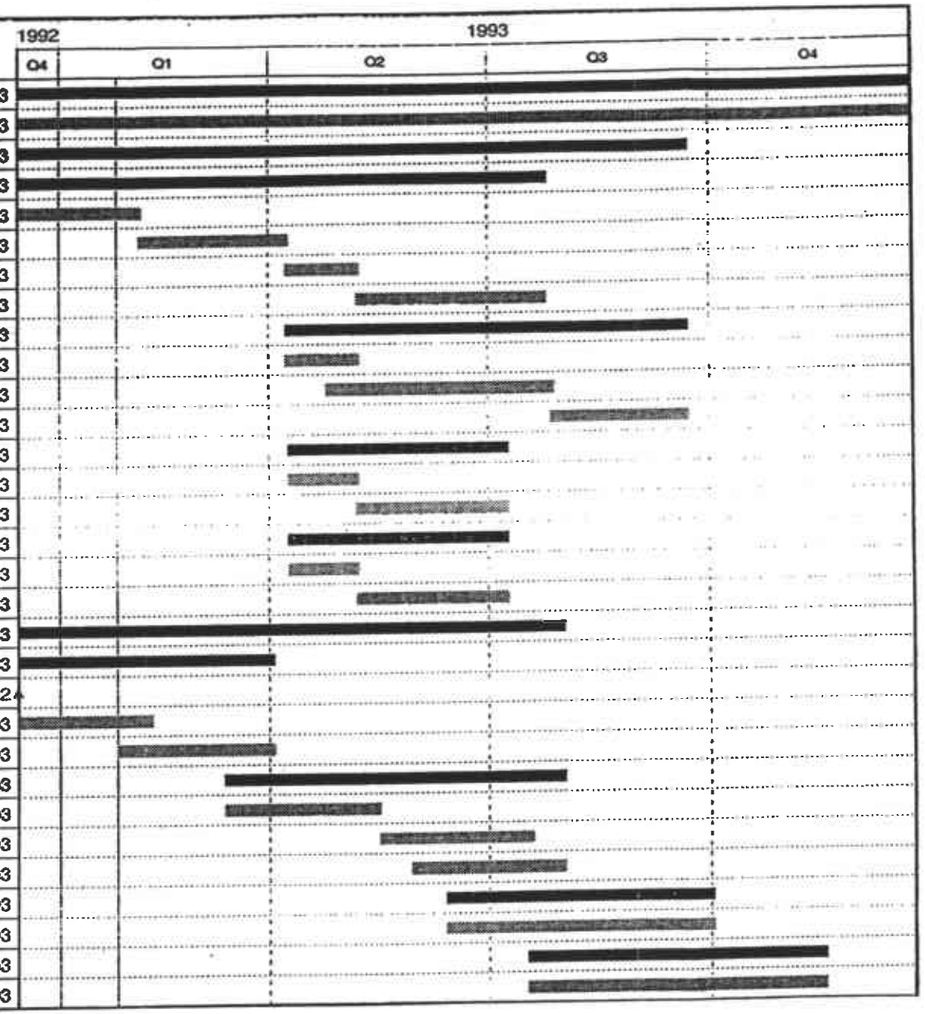
AIR SPARGING/SOIL VAPOR EXTRACTION WELL DETAIL

FIGURE: **10**

PROJECT: 330-06.16

2/02/93

Task Name	Start Date	End Date
QUARTERLY MONITORING PROGRAM	15-Dec-92	31-Dec-93
Quarterly Monitoring Program	15-Dec-92	31-Dec-93
REMEDIAL INVESTIGATION	15-Dec-92	22-Sep-93
Impact Delineation	15-Dec-92	26-Jul-93
Work Plan Preparation	15-Dec-92	5-Feb-93
ACHCS Review/Approval	5-Feb-93	8-Apr-93
Field Work	8-Apr-93	7-May-93
Report Preparation	7-May-93	26-Jul-93
Biofeasibility Testing	8-Apr-93	22-Sep-93
Field Work	8-Apr-93	7-May-93
Laboratory Testing	26-Apr-93	28-Jul-93
Report Preparation	28-Jul-93	22-Sep-93
SVE and Air Sparging Testing	8-Apr-93	9-Jul-93
Field Work	8-Apr-93	7-May-93
Report Preparation	7-May-93	9-Jul-93
Aquifer Testing	8-Apr-93	9-Jul-93
Field Work	8-Apr-93	7-May-93
Report Preparation	7-May-93	9-Jul-93
RISK ASSESSMENT	27-Oct-92	2-Aug-93
Parameter Values Letter	27-Oct-92	2-Apr-93
Letter Preparation	27-Oct-92	8-Dec-92
ACHCS Response	8-Dec-92	10-Feb-93
ACHCS Liaison	27-Jan-93	2-Apr-93
Risk Assessment Summary Letter	12-Mar-93	2-Aug-93
Report Preparation	12-Mar-93	17-May-93
ACHCS Response	17-May-93	20-Jul-93
ACHCS Liaison	1-Jun-93	2-Aug-93
MODELING	15-Jun-93	1-Oct-93
Modeling	15-Jun-93	1-Oct-93
R.I.F.S.	19-Jul-93	22-Nov-93
Report Preparation	19-Jul-93	22-Nov-93



Assumes maximum review periods of: ARCO (30 days); ACHCS (60 days).
Schedule assumes ACHCS-approval of work plan and letters.
Weather, encroachment, and equipment availablity may affect schedule.
3300614\RIFS0193

Task Duration
Sub-Task Duration
Completed Prior to Schedule Development

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San Lorenzo, California

REMEDIAL INVESTIGATION AND FEASIBILITY STUDY SCHEDULE

FIGURE: **11**
PROJECT: 330-06.16

ATTACHMENT A
FIELD PROCEDURES

ATTACHMENT A
FIELD PROCEDURES

Exploratory Drilling

The on- and off-site exploratory soil borings, and soil borings for the oil-water separator/clarifier will be drilled using 1-inch diameter, pneumatically driven, hand-sampling drilling equipment. The borings will be logged by a Pacific Environmental Group, Inc. (PACIFIC) geologist using the Unified Soil Classification System and standard geologic techniques. The borings will be drilled to depths of approximately 11 to 14 feet below ground surface (bgs).

Soil core sampling is accomplished by using 5-foot sections of 1-inch diameter galvanized steel pipe. A 1-foot long 3/4-inch diameter, galvanized steel soil core tube is connected to the probe pipe. Stainless steel insert rods are placed through the probe pipe and sampling core. The probe pipe, soil core, and insert rods are together pneumatically driven using a percussion hammer to the depth the soil sample is desired. The insert rods are removed, and the probe pipe and core with 3/4-inch brass liners are driven 1 foot into undisturbed soil beyond the tip of the probe pipe to obtain the soil core sample. Soil samples for logging and laboratory analysis will be collected at 2-foot depth intervals (at the minimum). The brass liner containing the deepest 4 inches of soil from each sample interval will be retained for chemical analysis, and will be capped with Teflon tape squares and plastic end caps, which are adhered to the brass ring using a non-volatile, rubber-based tape, and then placed in a sealable plastic bag. These samples will be placed on ice for transport to the laboratory, accompanied by chain-of-custody documentation.

Following the collection of appropriate samples from the soil borings, each boring will be sealed with a bentonite and Portland cement seal from the bottom of the boring to the ground surface.

The boring for the on- and off-site groundwater monitoring wells will be drilled using 8-inch diameter hollow-stem auger drilling equipment. Soil samples for logging and chemical analysis will be collected at 5-foot depth intervals and at the capillary fringe by advancing a California-modified split-spoon sampler with 4-inch brass liners into undis-

turbed soil beyond the tip of the auger. The sampler will be driven a maximum of 18 inches, using a 140-pound hammer with a 30-inch drop. The brass liner containing the deepest 4 inches of soil from each sample interval will be retained for chemical analysis, and will be capped with Teflon tape squares and plastic end caps, which are adhered to the brass ring using a non-volatile, rubber-based tape, and then placed in a sealable plastic bag. These samples will be placed on ice for transport to the laboratory, accompanied by chain-of-custody documentation.

The borings for the dual completion air sparging and soil vapor extraction wells will be using 10-inch diameter hollow-stem auger drilling equipment. Soil samples for logging and chemical analysis (from selected borings) will be collected at 5-foot depth intervals and at the soil/water interface by advancing a California-modified split-spoon sampler with 4-inch brass liners into undisturbed soil beyond the tip of the auger. The sampler will be driven a maximum of 18 inches, using a 140-pound hammer with a 30-inch drop. The brass liner containing the deepest 4 inches of soil from each sample interval will be retained for chemical analysis, and will be capped with Teflon tape squares and plastic end caps, which are adhered to the brass ring using a non-volatile, rubber-based tape, and then placed in a sealable plastic bag. These samples will be placed on ice for transport to the laboratory, accompanied by chain-of-custody documentation.

Soil samples collected during drilling activities will be analyzed in the field for ionizable organic compounds using the HNU Model PI-101 (or equivalent) photo-ionization detector (PID) with a 10.2 eV lamp. The test procedure will involved measuring approximately 30 grams from an undisturbed soil sample, placing this sub-sample in a clean glass jar, and sealing the jar with aluminum foil secured under a ring-type threaded lid. The jar will be warmed for approximately 20 minutes (in the sun), then the foil will be pierced and the head-space within the jar will be tested for total organic vapor, measured in parts per million (ppm) (volume/volume). The instrument will be calibrated prior to drilling using a 100 ppm isobutylene standard (in air) and a sensitivity factor of 55 which relates the photo-ionization potential of benzene to that of isobutylene at 100 ppm. PID measurements of hydrocarbons levels are useful for indicating relative levels of contamination, but cannot be used to evaluate hydrocarbon levels with the confidence of laboratory analysis. The results of PID field analysis will be noted on the boring logs.

All downhole drilling equipment will be steam-cleaned prior to drilling and between boring locations. All residual soils obtained from drilling operations will be stockpiled on site and covered with plastic sheeting until laboratory analyses were completed and the results evaluated. Arrangements are then made for disposal to an appropriate landfill based on the detected gasoline concentrations.

Groundwater Monitoring Well Installation

The borings for the groundwater monitoring wells will be drilled to a depth of approximately 22 feet bgs. After drilling to the proposed depth and obtaining the appropriate samples, each soil boring will be converted to a groundwater monitoring well with the installation of 2-inch diameter Schedule 40 PVC casing with 0.020-inch factory slotted screen, and Schedule 40 PVC solid casing. Screen will be placed from a depth of approximately 22 feet bgs to approximately 7 feet bgs. A 7-foot section of 2-inch diameter solid casing will extend from the top of the screen interval to the ground surface. The annular space will be filled with RMC 12 x 20 sand across the entire screened interval, extending approximately 2 feet above the top of the screen. Each well will then be sealed with approximately 2 feet of bentonite above the top of the sand pack, and a bentonite and Portland cement seal to the ground surface. A locking water-tight cap and protective vault box will be installed on each wells. The boring logs for the wells will show construction details. A proposed groundwater well construction detail is presented on Figure 7.

Air Sparging and Soil Vapor Extraction Well Installation

After drilling to the proposed depth of approximately 25 feet, and obtaining the appropriate samples, two soil borings will each be converted to a dual completion air sparging and soil vapor extraction wells by the installation of two, 2-inch diameter, flush-threaded, Schedule 40 PVC casings. One casing will comprise the air sparging well, and one casing will comprise the soil vapor extraction well. The air sparging wells will be constructed by placing a 1-foot length of Schedule 40 PVC 0.020-inch factory-slotted screen threaded to a 24-foot length of Schedule 40 PVC solid casing from the bottom of the boring to the ground surface. An RMC 12 x 20 sand will be placed in the annular space and will extend across the entire screened interval, extending approximately 1 foot above the top of the screens. A Portland cement and bentonite seal impregnated with a catalyst will extend from the top of the sand pack to approximately 13 feet bgs. The catalyst is used for quickening the setting time of the Portland cement and bentonite seal. The soil vapor extraction wells will be constructed by placing a 7-foot length of Schedule 40 PVC 0.040-inch factory slotted screen, extending from the top of the seal for the air sparging well, at a depth of approximately 13 feet bgs, to a depth of approximately 6 feet bgs. A 6-foot length of Schedule 40 PVC solid casing will extend from the top of the slotted screen section to the ground surface. Coarse aquarium sand will be placed in the annular space across the entire screened interval, and will extend approximately 1 foot above the top of the screen. Approximately 2 feet of bentonite and a bentonite and Portland cement seal will extend from the sand pack for the soil vapor extraction well to the ground surface. A locking water-tight cap will be installed

on each well and a protective vault box will be installed on each dual completion well. The boring logs for each well will show construction details. A proposed dual completion air sparging and soil vapor extraction well construction detail is presented as Figure 8.

Well Development and Sampling Procedures

Following the installation of the newly installed groundwater monitoring well, the well will be surged by swab and block techniques and bailed of approximately 10 casing volumes of water, or until dryness, or until the majority of suspended fines are removed from the well. Wells MW-10 and E-1A will also be developed using the same technique. The sampling procedure for Wells MW-24 and MW-25 consists first of measuring the water level and checking for the presence of separate-phase hydrocarbons (SPH) using either an electronic indicator and a clear Teflon bailer or an oil-water interface probe. The well will then be purged of approximately four casing volumes (or to dryness) using a gas displacement pump. During purging, temperature, pH, and electrical conductivity will be monitored in order to document that these parameters are stable prior to collecting a groundwater sample. After purging, the water level will be allowed to partially recover. A groundwater sample will be collected using a Teflon bailer, placed into appropriate EPA-approved containers, labeled, logged onto chain-of-custody documents, and transported on ice to a California State-certified laboratory.

Water generated during well installation, development, and sampling, will be stored on site in 55-gallon drums until analytical results are evaluated, at which point appropriate disposal activities will be implemented, including the removal of purge water by a licensed hauler. The water will be delivered to a site permitted to accept such material.

Laboratory Analysis

Soil samples from selected on-site soil borings will be analyzed for the presence of total petroleum hydrocarbons calculated as gasoline (TPH-g) and benzene, toluene, ethylbenzene, and xylenes (BTEX compounds) by modified EPA Methods 8015, 8020, and 5030. Soil samples collected from borings located adjacent the former used oil tank will be analyzed for waste oil, and oil and grease by EPA Method 5520. In addition, the soil samples collected from adjacent to the former used oil tank will also be analyzed for halogenated volatile organic compounds, semi-volatile organic compounds, and total metals by EPA Methods 8010 and 8270, and CCR T.22 Metals, respectively. The samples analyzed for TPH-g and BTEX compounds will be examined using the purge and trap technique, with final detection by gas chromatography using a flame-ionization detector (FID) as well as a PID, and motor oil and oil and grease by Methods E and F. All analyses will be performed by a California State-certified laboratory.

Air Sparging and Soil Vapor Extraction Well Testing

Air sparging and soil vapor extraction tests will be performed on newly installed dual completion air sparging and soil vapor extraction Wells SP-1/V-4 and SP-2/V-5. The purpose of the test is to determine if air sparging and soil vapor extraction are feasible remedial methods for the site. Additionally, field data will be collected during the tests, which, if feasible, will be used to design an air sparging and/or soil vapor extraction system.

Air sparging tests (AST) will be performed on Wells SP-1/V-4 and SP-2/V-5. The ASTs test will monitor groundwater elevations and dissolved oxygen during the test. The air supply for the test will be provided by an oil-free, 10 cubic feet per minute (cfm) compressor. The AST performed on Well SP-1/V-4, will monitor groundwater elevations and dissolved oxygen levels in Wells SP-1/V-4, MW-5, MW-8, and E-1A. The AST performed on Well SP-2/V-5 will monitor groundwater elevations and dissolved oxygen levels in Wells SP-2/V-5, MW-10, and MW-11.

Before initiating and terminating each AST, a FID will be used to measure vapor concentrations being emitted at each well. In addition, groundwater elevations and dissolved oxygen levels will be measured at the termination of each AST. A second reading with the FID will be collected at each well to monitor any change in vapor concentrations. Vapor samples collected will be analyzed for total volatile hydrocarbons calculated as gasoline (TVH-g) and BTEX compounds by EPA Method 8015/8020.

The soil vapor extraction tests (SVET) conducted on Wells SP-1/V-4 and SP-2/V-5 will be performed by connecting a minimum of a 2.5-horsepower regenerative blower to the wells and applying a vacuum. During the SVET at Well SP-1/V-4, manometers will be placed on surrounding Wells MW-5, MW-7, MW-8, and MW-13. During the SVET at Well SP-2/V-5, manometers will be placed on Wells MW-8, MW-10, MW-11, and MW-15. The applied vacuum, extracted soil vapor flow rate, and vacuum influence on surrounding wells will be monitored during each test. One vapor sample will be collected from each well during the test and analyzed for TVH-g and BTEX compounds by EPA Method 8015/8020. An FID will also be used to provide continuous data during each test. Additionally, a step-vapor extraction test will be performed on each extraction well to determine the expected extraction rate versus applied vacuum.

Step-Discharge Test

Step- and constant-discharge aquifer tests will be performed on Wells E-1A and MW-10. The step-discharge tests will be performed to determine the appropriate discharge rate for the constant-discharge tests. The step-discharge test on Well MW-10

will be performed by temporarily installing an American Standard 2-1/2-inch diameter electric submersible pump in the extraction well. The test on Well E-1A will use the existing groundwater extraction pump installed in Well E-1A. The discharge from the pump will be routed through a flow metering device. All fluids pumped during the step-discharge test and the subsequent constant-discharge test will be discharged to the existing groundwater treatment system located at the site. During the test on Well E-1A, groundwater elevations in Wells MW-8, MW-5, and MW-13 will be monitored, and during the test on Well MW-10 groundwater elevations in Wells MW-9, MW-11, MW-15, and SP-2/V-5 will be monitored. Groundwater elevations will be monitored at close time intervals using pressure transducers and data logger arrangement. It is anticipated that each step-discharge test will require between 3 and 6 hours of pumping to determine the appropriate flow rate for the constant-discharge test. Several successively higher discharge rates will be tested, beginning with a discharge rate of 0.5 gallons per minute. Pumping at each discharge rate will continue until a discernable drawdown trend over time is established. Once the trend has been established at a particular discharge rate, it is possible to project the drawdown trend forward in time to the anticipated duration of the constant-discharge test (24 hours). Projecting the drawdown trend in this manner yields the predicted drawdown in the pumping well using the current discharge rate at the end of 24 hours.

Successively higher discharge rates are tested in this manner until a discharge rate is found which will consume all of the available drawdown in the pumping well in 24 hours. This is the discharge rate which will then be used during the constant-discharge test.

Following the determination of the ideal discharge rate, the pump will be stopped and the recovering water levels in the pumping well and the observation wells will be monitored and recorded. Data collection will continue until the pumping well has recovered approximately 90 percent of the maximum drawdown. The recovery data will be used to augment the determination of aquifer parameters from the constant-discharge test data.

Constant-Discharge Test

It is anticipated that the constant-discharge tests will begin on the day following the step-discharge test, and will be performed in Wells E-1A and MW-10. Prior to starting each test, static water levels will be measured, recorded, and compared to the static levels measured during the previous days activities to ensure that the pumping and observation wells have recovered sufficiently from the step-discharge test. Pumping will be initiated at the discharge rate determined during the step-discharge test, and data collection will be facilitated as before, using transducers and datalogger. Personnel will

monitor the progress of the test in 8 to 12 hour shifts throughout the entire pumping period (until steady-state conditions are achieved, up to a maximum of 24-hours), and the recovery period. Recovery water levels will be monitored until the water level in the pumping well have recovered approximately 90 percent of the maximum drawdown.

Following the end of data-collection activities during the constant-discharge test recovery, the submersible electrical pump, and associated equipment will be removed from the pumping well and observation wells, and the testing activities will be concluded. The data contained in the datalogger memory will then be transferred to office computers for plotting and analysis.

Slug Tests

Falling- and rising-head slug tests will be performed in Wells MW-14 and MW-23. The falling-head tests will be conducted by rapidly introducing a slug, constructed of a 7 foot length of 2-inch diameter galvanized steel pipe, plugged at both ends, into the well and then measuring the water level repeatedly, at short time intervals, as it returns to static conditions. Rising-head tests will be conducted by removing the slug from the well and obtaining several water-level measurements as the water returns to its original static level. Water-level measurements will be obtained for both types of tests with an electronic pressure transducer which has an accuracy to within 0.02 feet.