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DATE: 10/21/91
PROJECT NUMBER: 69034.04
SUBJECT: ARCO STATION 601, 712 LEWELLING BOULEVARD, SAN LEANDRO, CALIFORNIA

FROM: JOEL COFFMAN
TITLE: PROJECT GEOLOGIST

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SUBSURFACE ENVIRONMENTAL ASSESSMENT AND VAPOR EXTRACTION TEST

at

ARCO Station 601
712 Lewelling Boulevard
San Leandro, California

69034.04 10/17/91

Report prepared for

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SUBSURFACE ENVIRONMENTAL INVESTIGATION AND VAPOR EXTRACTION TEST
at
ARCO Station 601
712 Lewelling Boulevard
San Leandro, California

For ARCO Products Company

INTRODUCTION

At the request of ARCO Products Company (ARCO), RESNA/Applied GeoSystems (RESNA) performed a subsurface environmental investigation at ARCO Station 601 located at 712 Lewelling Boulevard in San Leandro, California. This investigation was initiated in the response to the results of the RESNA Subsurface Environmental Assessment Report (RESNA 69034-2, December 14, 1990). The purpose of this investigation was to further evaluate the lateral and vertical extent of hydrocarbons related to the former gasoline- and waste-oil-storage tanks in the soil and groundwater, and to conduct a vapor extraction test to evaluate soil-vapor extraction as a remediation alternative at the site.

The work performed for this investigation included drilling six soil borings, collecting and describing soil samples from the borings, installing and developing 4-inch-diameter groundwater monitoring wells (MW-4 through MW-8) in five of the borings, developing and sampling groundwater from the monitoring wells, laboratory analysis of selected soil and groundwater samples, measuring groundwater levels, performing a soil-vapor extraction test, surveying wellhead elevations, performing research for water supply and monitoring wells within a ½-mile radius of the site, performing a records research to identify potential secondary sources for hydrocarbons detected in soil and water at the subject site,and preparing this report presenting field procedure, results and conclusions. This work was performed as outlined in the Work Plan (RESNA, March 21, 1991), and Addendum One to Work Plan (RESNA, March 21, 1991).

SITE DESCRIPTION AND BACKGROUND

The subject site is on the southwestern corner of the intersection of Lewelling Boulevard and Washington Avenue in San Leandro, California, as shown on the Site Vicinity Map (Plate 1). The site is an operating ARCO service station. The site is bounded by residential and professional buildings to the west-southwest and south, commercial buildings across Washington Avenue to the east and northeast, and an operating Shell service station across Lewelling Boulevard to the north-northwest. The elevation of the site is approximately 22 feet above mean sea level (msl).

There are four 10,000-gallon underground gasoline-storage tanks present at the site. These tanks replaced four former gasoline-storage tanks (one 6,000-gallon tank containing regular gasoline, two 4,000-gallon tanks containing unleaded gasoline, and one 6,000-gallon tank containing super unleaded gasoline, designated T1, T2, T3 and T4 respectively), which were installed in 1974 (GeoStrategies, June 29, 1990). The former gasoline-storage tanks, associated piping and one underground 280-gallon waste-oil storage tank were excavated and removed from the site by Gettler-Ryan Inc. of Hayward, California during January 1990. The approximate locations of existing underground storage tanks, former tanks and other pertinent site features are shown on the Generalized Site Plan (Plate 2).

REGIONAL AND LOCAL HYDROGEOLOGY

The ARCO station is within the East Bay Plain, located in the west-central portion of the San Leandro Cone (Hickenbottom and Muir, 1988). Helley et. al. (1979) mapped the earth materials underlying the site area as Quaternary bay mud deposits composed primarily of dark plastic clay and silty clay rich in organic material. The site is located approximately 700 feet north of the San Lorenzo Creek (which has been channelized in a concrete aqueduct in this area), approximately 1,400 feet east of the Estudillo Canal, and approximately 1¾ miles northeast of Roberts Landing on the eastern shoreline of the San Francisco Bay. The active Hayward Fault is approximately 2½ miles east of the site.

The inferred direction of groundwater flow in the vicinity of the site is to the southwest based on regional and local topography and drainage patterns, and based on previous results

of groundwater monitoring. Groundwater was encountered during previous drilling activities in June 1990 at depths of approximately 9 to 11½ feet below ground surface (RESNA December 14, 1990).

WELL RESEARCH

Information regarding water wells in the vicinity of the site has been researched and was provided to RESNA by the Alameda County Flood Control and Water Conservation District (ACFC&WCD).

The research was performed for the area within ½-mile radius of the site in order to evaluate groundwater usage in the vicinity of the site. **Records exist with ACFC&WCD for 69 wells within ½-mile of the site; two domestic wells, one cathodic protection well, twenty-seven monitoring wells, thirty-two irrigation wells, four test wells, two abandoned wells and one well of unidentified use.** In addition two destroyed wells are on record within ½-mile of the site. Locations of wells within ½-mile radius of the site are shown on Plate 3, Well Location Map.

Both domestic wells are located upgradient of the site. One is located 700 feet northwest of the site and is 42 feet deep and the other is located ⅛-mile north of the site and is 120 feet deep. A cathodic protection well, owned by Exxon Oil USA, is located ½-mile east of the site and is 50 feet deep. Most of the irrigation wells are located west and northwest of the site and their depths range from 18 to 545 feet (depth to water ranges from 5 to 38 feet). Monitoring wells range in depth from 15 to 29 feet (depth to water ranges from 7 to 14 feet) and most of them are located north (upgradient) of the site. Three test wells located north of the site range in depths from 20 to 29 feet, and a fourth test well located approximately ⅛-mile south of the site is 600 feet deep. One abandoned well, located approximately 1000 feet north of the site is 720 feet deep, and the other located 1500 feet south of the site is 370 feet deep. The well of unidentified use is 60 feet deep and is located approximately ⅛-mile northeast of the site.

PRELIMINARY RECORD RESEARCH

Data containing a compilation of Federal and California State Agency environmental data which identifies environmental problem sites and activities in the vicinity of ARCO Station 601 was obtained from Environmental Audit Incorporated to identify potential secondary sources for hydrocarbons detected in the soil and groundwater at the site. The data listed several facilities located upgradient and crossgradient of the ARCO Station with detected tank leaks. The closest secondary sources to the subject site are: (1) Shell Station 204 located at 15275 Washington Avenue, and (2) Greenhouse Plaza at 699 Lewelling Boulevard. Other facilities within approximately 1/6-mile radius of the site with identified tank leaks include: a closed GASCO Station 798 (15201 Washington Ave.), Mobil Service Station (15199 Washington Ave.), and the California Department of Transportation (600 Levelling Boulevard).

PREVIOUS WORK

Previous subsurface environmental investigations related to the former underground gasoline-storage tank and former waste-oil storage tank performed by RESNA/Applied GeoSystems, and an environmental investigation related to tank removal by GeoStrategies, Inc., are summarized in Appendix A.

FIELD WORK

Drilling

Field work at the site was conducted in accordance with RESNA field protocol and Site Safety Plan (RESNA, May 1991). A description of the field methods and Site Safety Plan is included in Appendix B, Field Methods. A well construction permit was acquired from the ACFC&WCD prior to drilling at the site. A copy of the permit is included in Appendix C. On May 29 and 30, 1991, six soil borings (B-9 through B-13, and B-11A) were drilled and groundwater monitoring wells (MW-4 through MW-8) were constructed in borings B-9 through B-13, respectively. These wells were installed to evaluate the extent of floating gasoline product previously encountered in wells MW-1 and MW-3, to evaluate the extent

of gasoline hydrocarbons and waste-oil related hydrocarbons in the soil and first-encountered groundwater at the site, to confirm the gradient and flow direction of the first-encountered groundwater, and to provide vapor-extraction points to perform a soil-vapor extraction test.

Borings B-9 and B-10 were drilled southwest and west of the former gasoline tanks and vapor extraction/groundwater monitoring wells MW-4 and MW-5 were installed in them, respectively. The previously planned location for the boring B-11, was changed due to the presence of underground utilities. During drilling of the boring B-11A fine gravel, identified as backfill of the excavation associated with the former gasoline-storage tanks, was encountered to a depth of 14 feet. Two soil samples from boring B-11A were obtained from the native soil beneath the backfill, and boring B-11A was then grouted from the total depth of 16½ feet to the surface. Another boring (designated B-11) was drilled south of the former gasoline-storage tanks, and vapor extraction/monitoring well MW-6 was installed in the boring. Borings B-12 and B-13 were drilled in the southern part of the property, and vapor extraction/monitoring wells MW-12 and MW-13, respectively, were installed in the borings.

Soil Sampling and Description

A total of 37 soil samples were collected from the soil borings B-9 through B-13, and B-11A. A summary of the Unified Soil Classification System used to identify the soil encountered during drilling is presented on Plate 4, and the description of the soil encountered in the borings is presented on the Logs of Borings, Plates 5 through 10. Soil samples from boring B-9 were collected continuously from a depth of 4½ feet below the ground surface to the total depth of 18 feet. Soil samples from boring B-10 were collected continuously from 5 to 11 feet and from 15 feet to the total depth of 19½ feet. Soil samples from boring B-11A were collected below the artificial fill at depths of 13½ and 15 feet. Soil samples from boring B-11 and B-12 were collected continuously from the depth of 5 feet below the ground surface to the total depth of 15½ feet. Soil samples from boring B-13 were collected at intervals of less than 5 feet from the ground surface to the total depth of 15 feet. Sampling procedures are described in Appendix B.

The earth materials encountered at the site during this and previous investigations consisted primarily of silty to sandy clay, clayey silt, and clayey to silty sand. In the northern and western part of the site, silty clay was encountered immediately below the baserock and gravelly clay to clayey gravel fill to depths of approximately 5 to 7½ feet, while in the southern part of the site a 2½- to 5-foot thick layer of silty sand was encountered overlying the silty clay which extended to a depth of approximately 8 to 8½ feet. A layer of interbedded clayey sand to silty clay was encountered at the site between depths of approximately 8 to 11 feet depth. Groundwater was first encountered in this layer of interbedded clayey sand to silty clay in borings B-9 through B-13, at depths of approximately 7 to 8 feet below the ground surface. A stratum of at least 5 feet of silty clay, which may be a perching or confining layer, was encountered at approximately 9 to 10½ feet below the ground surface in the borings B-9 through B-13. A graphic interpretation of the earth materials encountered during this investigation and previous investigations beneath the site is shown on the geological Cross Sections A-A', B-B', C-C', and D-D', (Plates 11 through 14, respectively). The locations of the cross sections are shown on Plate 2.

Monitoring Well Construction and Development

Five groundwater monitoring wells (MW-4 through MW-8) were constructed in borings B-9 through B-13, respectively. The wells were completed with 4-inch-diameter, Schedule 40, polyvinyl chloride (PVC) casing. Well casings were set in the wells to depths of approximately 9 to 10½ feet below ground surface. The screened casings for the monitoring wells consist of 4-inch-diameter, 0.020 inch machine-slotted PVC set from the total depth of the well to approximately 5½ to 7 feet below the ground surface. Blank PVC casing was set from the top of the screened casing to within a few inches below the ground surface. The monitoring wells were developed on June 4, 1991, to remove fine-grained sediments and to allow better communication between the water-bearing zone and the groundwater monitoring well. Details regarding well construction and development are described in Appendix B.

Groundwater Level Measurement and Sampling

Depths-to-water (DTW) were measured in groundwater monitoring wells MW-1, MW-2, MW-3, MW-5, and MW-8 and water samples were collected and visually inspected for floating product on June 10 and July 18, 1991. Monitoring wells MW-4, MW-6 and MW-7 were dry on June 10, 1991. Monitoring wells MW-6 and MW-7 were dry on July 18, 1991. Wellhead elevations were surveyed on June 20, 1991 to mean sea level (MSL) elevation, based on a city benchmark located at the intersection of Lewelling Boulevard and Washington Avenue. Groundwater elevations were calculated for each well by subtracting the measured DTW from the surveyed wellhead elevation. Appendix B contains a description of subjective analysis and groundwater sampling procedures. Groundwater monitoring wells MW-2, MW-5, and MW-8 were purged and sampled on June 10, 1991. Well Purge Data Sheets are attached in Appendix B.

SOIL-VAPOR EXTRACTION TEST METHODS

RESNA performed a soil-vapor extraction test (VET) at the site on June 19, 1991. The VET had two objectives: (1) to collect operational data to evaluate the efficiency and practicality of vapor-extraction as a soil remediation alternative; and (2) to select the most appropriate off-gas treatment alternative, if the operational data suggest that vapor-extraction is recommended.

The vapor-extraction equipment consisted primarily of: (1) an internal combustion (I.C.) six-cylinder engine for off-gas treatment; (2) instrumentation for measuring air flow, air velocity, air pressure, temperature, electrical current, and petroleum hydrocarbon concentrations; and (3) PVC piping, fittings, and wellhead connections. Five groundwater monitoring wells (MW-1, MW-2, MW-4, MW-5, and MW-6) onsite were used for the VET. The locations of these wells are shown on the Generalized Site Plan, Plate 2.

RESNA operated the vapor-extraction equipment on extraction well MW-6 for approximately two hours while monitoring the change in vacuum at observation wells MW-1, MW-2, MW-4, and MW-5. The distances between the vapor extraction well MW-6 and observation wells MW-1, MW-2, MW-4, and MW-5 are approximately 42, 57, 88, and 57 feet

respectively. The air flow rate measured at the extraction well MW-6 ranged from 35 to 55 cubic feet per minute (cfm) at a vacuum of approximately 50 inches of water. The vapor-extraction equipment was then relocated and used to collect influent samples from MW-1, MW-4, MW-5, and MW-8. The vapor-extraction equipment was operated for a minimum of 30 minutes on each well before vapor samples were collected. A portable organic vapor monitor and, vacuum, flow, and temperature gages were also used to monitor each vapor-extraction well.

Collection of Air Samples

Air samples were collected through a ¼-inch Teflon sample line connected to a stainless steel well head fitting and collected in Tedlar air sample bags. Teflon tubing was used to minimize sample loss through adsorption and the possibility of distorted results from sample lines contaminated by a previous test run. The samples were sealed in the bags and labeled with the sample number, date, time, and sampler's name and placed on ice for transport. RESNA initiated a Chain of Custody Record which accompanied the soil-vapor samples, which were submitted to Sequoia Analytical Laboratories in Concord, California, a State-certified laboratory.

LABORATORY METHODS

All soil and water samples, except soil samples for sieve analyses, were preserved as required by the applicable analytical method, and delivered with Chain of Custody Records to Sequoia Analytical Laboratories of Redwood City, California, a state certified laboratory, for soil and water sample analyses and GTEL Analytical Laboratories of Concord, California, a state certified laboratory, for soil vapor sample analyses.

Soil Samples

Soil samples collected from borings B-9 through B-13 were analyzed in accordance with Alameda County Health Care Services Agency requirements for the gasoline constituents benzene, toluene, ethylbenzene, total xylenes (BTEX) and total petroleum hydrocarbons as gasoline (TPHg) using modified Environmental Protection Agency (EPA) Methods

5030/8015/8020. In addition, soil samples collected from boring B-12 and B-13 were analyzed for high boiling hydrocarbons (HBHC, calculated as diesel [TPHd]) using EPA Methods 3550/8015 and total oil and grease (TOG) using Standard Method 5520 E&F. The soil samples were selected for laboratory analysis based on the following:

- Location above first-encountered groundwater;
- Location in a potential confining or perching layer below first-encountered groundwater;
- Areas where the presence of gasoline or waste oil hydrocarbons was suspected; and
- At 5-foot intervals and/or changes in stratigraphic units, as recommended by state DHS guidelines.

Five soil samples were selected from different stratigraphic units in each boring and submitted to Johnson Filtration Systems Inc. laboratory in St. Paul, Minnesota for particle analysis to aid in future monitoring well design.

Water Samples

Water samples obtained from monitoring wells MW-2, MW-5 and MW-8 were analyzed in accordance with Alameda County Health Care Services Agency requirements for BTEX and TPHg by modified EPA Methods 5030/8015/8020. In addition a water sample obtained from groundwater monitoring well MW-8 was analyzed for TOG according to EPA Method 413.1 (gravimetric). Groundwater monitoring wells MW-1 and MW-3 were not sampled because of the presence of floating or suspended product in these two wells. Groundwater monitoring wells MW-4, MW-6 and MW-7 were not sampled because they were dry at that time.

Vapor Samples

The influent soil-vapor samples collected during the VET from wells MW-1, MW-4, MW-5, MW-6, and MW-8 were analyzed for TPHg and BTEX by EPA Method 8015/8020.

FIELD RESULTS

Drilling Observations

Field organic vapor meter (OVM) measurements of soil samples from borings B-9 through B-13 ranged from nondetectable up to 838 parts per million (ppm). OVM readings are shown on the boring logs (Plates 5 through 10) in the column labeled PID (photoionization detector). A hydrocarbon sheen was present in the saturated soil sample collected from boring B-12 at a depth of 8½ feet below ground surface. A product odor was noted for the soil samples collected from the depths close to the groundwater level during drilling of all borings.

Subjective Water Analysis and Evaluation of Groundwater Gradient

Water samples collected from monitoring well MW-1 exhibited a product odor and bead-like product emulsion on June 10, 1991, and 0.01 feet of free product on July 18, 1991. Initial water samples obtained from groundwater monitoring well MW-3 on June 10, 1991, exhibited a product odor but showed no evidence of floating or suspended product, but after purging 2.5 gallons of water from the well, a water sample from the well exhibited a product sheen. Groundwater monitoring well MW-8 exhibited a product odor. Results of subjective analysis are summarized in Table 1.

On June 20, 1991 the wellheads for the new and existing groundwater monitoring wells were surveyed to a local National Geodetic Vertical Datum benchmark by John E. Koch, a licensed surveyor. The results of this wellhead survey are included in Appendix D, Wellhead Survey. Groundwater elevations for each well were calculated by subtracting the measured depth-to-water from the elevation of the wellhead. The measured depth-to-water,

wellhead elevations, and groundwater elevations are presented in Table 1, Cumulative Groundwater Monitoring Data.

The groundwater gradient evaluated for the first encountered water bearing zone at this site from the groundwater elevations obtained from wells MW-1, MW-2, MW-3, MW-4, MW-5 and MW-8 on July 18, 1991, is approximately 0.003 (0.3-foot vertical drop in 100 feet horizontal distance) to the southwest. Plate 15, Groundwater Gradient Map, is a graphic interpretation of the groundwater elevations measured on that date. This interpreted gradient may be slightly affected by the presence of free product in the well MW-1. This gradient and flow direction are generally consistent with previous monitoring data from this site.

Vapor Extraction Test Field Results

With the vapor-extraction equipment operating on extraction well MW-6, the highest change in vacuum was observed in observation well MW-2 at 0.10 inches of water column at a distance of approximately 57 feet from well MW-6. No measurable vacuum was detected during the VET in observation Well MW-1, at a distance of approximately 42 feet from well MW-6. No measurable vacuum was detected in observation wells MW-4 and MW-5 at extraction air flow rates from 35 to 44 cubic feet per minute (cfm), but vacuums of 0.015 and 0.02 inches of water, respectively, were measured at an extraction flow rate of 55 cfm. Observation wells MW-4 and MW-5 are located about 88 and 57 feet, respectively, from extraction well MW-6. Field data results are shown in Table 2, Vapor-Extraction Test Field Monitoring Data. All wells (MW-1, MW-2, MW-4, MW-5, and MW-6) were screened at approximately the same depths ranging from 5 to 12 feet below ground surface and in silty sand and silty clay layers. The reason that MW-1 showed no vacuum impact is unknown, but may be due in part to the presence of water in this well. At a greater flow rate and vacuum, it is expected that MW-1 will show some vacuum impact.

RESULTS OF LABORATORY ANALYSES

Soil Samples

Laboratory analysis of soil samples collected from borings B-9 through B-13 and B-11A reported TPHg from nondetectable up to 2,700 parts per million (ppm) in a sample from boring B-10 at a depth of 7½ feet. TPHg was below laboratory detection limits (1 ppm) in soil samples collected from below 12 feet in all borings. The results of these analyses are summarized in Table 3, Laboratory Analysis of Soil Samples. TPHg ranged from nondetectable to 15 ppm in boring B-13 at a depth of 5½ feet. TOG was nondetectable in all samples submitted for analysis. BTEX ranged from nondetectable to 370 ppm total xylenes in B-10 at a depth of 7½ feet. Copies of the laboratory reports and Chain-of-Custody records for the soil samples are included in Appendix E. Sieve analysis of selected soil samples reported all samples submitted to be clay. Soil sample sieve analysis and design recommendations are included in Appendix F.

Water Samples

Laboratory analytical results for water samples reported TPHg concentrations of 100,000 parts per billion (ppb) in the sample collected from monitoring well MW-5, 26,000 ppb in the sample collected from MW-2 and 5,800 ppb in the sample collected from MW-8. BTEX were detected in concentrations up to 25,000 ppb, 20,000 ppb, 2,600 ppb, and 12,000 ppb, respectively in the sample collected from monitoring well MW-5 and at lower levels in samples collected from monitoring wells MW-2 and MW-8. The sample collected from monitoring well MW-8 and analyzed for total oil and grease (TOG) reported below laboratory detection limits (less than 5,000 ppb) for TOG. The results of laboratory analyses for water samples are summarized in Table 4, Cumulative Results of Laboratory Analyses of Groundwater. Chain of Custody records and laboratory analysis reports are included in Appendix E. Benzene exceeded the state maximum contaminant level (MCL) in all three wells. Toluene exceeded the state recommended action level in wells MW-2 and MW-5. Ethylbenzene and total xylene concentrations in MW-2 and MW-5 exceeded the state MCLs.

Vapor Samples

TPHg was detected in all the vapor samples in concentrations which ranged from a high of 76,000 milligrams per cubic meter ($mg/m^{3)}$ in the sample collected from monitoring well MW-6 after 20 minutes elapsed time from start of test to a low of 930 mg/m^3 in the sample collected from MW-4 after 75 minutes elapsed time. The results of laboratory analyses of soil vapor samples are summarized in Table 5, Laboratory Analysis of Air Samples. Chain of Custody records and laboratory analysis reports are included in Appendix E. BTEX ranged from nondetectable to 5,500 mg/m^3in extraction well MW-6.

DISCUSSION OF RESULTS

Hydrocarbon Impacted Soil

The presently interpreted extent of gasoline hydrocarbon impacted soil beneath the site is presented on the Geologic Cross Sections, Plates 11 through 14. Highest concentrations of gasoline hydrocarbons appear to be concentrated in the area near and downgradient (southwest) of the former underground gasoline-storage tanks near borings B-9 and B-10, as shown in Table 3.

Hydrocarbon Impacted Groundwater

At the present time, groundwater beneath the site appears to be impacted across the site in the unconfined shallow aquifer. This aquifer may be a perched zone as evidenced by very slow recharge of wells after purging and the tendency for some wells to go dry. This may also be attributed to the low permeability clayey materials present within the aquifer.

Soil-Vapor Extraction Test

The shallow groundwater and narrow zone of interbedded clayey sand to sandy silt in which the wells used for the VET required a short screen interval. The screened interval above the existing groundwater surface was less than approximately three feet, which corresponds to the approximate thickness of relatively permeable interbedded clayey sand to silty clay

between the groundwater and the overlying silty clay. The minimum desired screened interval for a VET is typically five to ten feet. The short screened interval and the low permeability of the interbedded clayey sand to silty clay layer resulted in low air flow rates, even with the application of a high extraction vacuum. [redacted] this initial VET.

CONCLUSIONS

Based on the results of this subsurface investigation and vapor extraction test, RESNA concludes the following:

- The majority of gasoline and waste-oil hydrocarbons at concentrations above 100 parts per million (ppm) in the soil at the site, outside the immediate areas of the former gasoline-storage and waste-oil-storage tanks, appear to be within or just above the layer of interbedded clayey sand to silty clay at depths between approximately 5 and 11 feet below the ground surface. The presence of water in this relatively permeable zone appears to have facilitated the movement of gasoline and waste-oil hydrocarbons laterally.

- The lateral extent of hydrocarbons in the soil associated with the former gasoline-storage tanks at the site has been delineated below 100 ppm TPHg only in the southern part of the site (to 8.4 ppm in B-13/MW-8 and to 23 ppm in B-12/MW-7) and northwest of the former gasoline tank excavation (to 15 ppm in B-7/MW-2). The lateral extent of TPHg hydrocarbons in the soil was delineated to 100 ppm in the eastern portion of the site (B-11/MW-6) and the lateral extent of TPHg hydrocarbons in the soil have not been delineated below 100 ppm in the western (B-8/MW-3 and B-9/MW-4) and northeastern (B-10/MW-5) areas of the site. The lateral extent of hydrocarbons in the soil associated with the former waste-oil-storage tank has been delineated to nondetectable levels of total oil and grease (TOG; less than 30 ppm) south (B-12/MW-7) and downgradient to the southwest (B-13/MW-8) of the former waste-oil tank excavation.

- The vertical extent of TPHg in the soil beneath the site has been delineated to nondetectable (less than 1.0 ppm or less than 10 ppm) at the depths of 11½ to 16½ feet below ground surface with the exception of the eastern vicinity of

the former gasoline tanks (B-3) and near the former waste-oil tank (B-5). The vertical extent of hydrocarbons associated with the former waste-oil tank has not been delineated in the vicinity of this former tank.

- The lateral and vertical extents of hydrocarbons in the groundwater have not been delineated at the site with the exception of waste-oil related hydrocarbons which have been delineated to nondetectable (TOG less than 5 ppm) southwest of the former waste-oil tank pit excavation.

- A source of gasoline hydrocarbons reported in the groundwater may be the gasoline hydrocarbons reported in the soil of the former gasoline tank excavation.

- Tank leaks were reported at the Shell station and Greenhouse Plaza sites located across Lewelling Boulevard, relatively upgradient to ARCO Station 601. Several other facilities with identified tank leaks are located within approximately 1/6-mile radius of the site.

- Installation of horizontal trenching and utilization of horizontal inlet and vapor-extraction lines may be more practical and efficient than vertical vapor-extraction wells. Pumping to depress groundwater levels at the site may be desirable to increase the thickness of vadose zone soils available to soil-vapor extraction, and to enhance the efficiency of soil-vapor extraction as a viable remediation alternative.

- Laboratory results of air samples and field organic vapor measurements taken at MW-1, MW-4, MW-5, MW-6, and MW-8 indicate that significant levels of petroleum hydrocarbons exist throughout a major portion of the site.

LIMITATIONS

This report was prepared in accordance with generally accepted standards of environmental engineering and geological practice in California at the time this investigation was performed. This assessment was conducted solely for the purpose of evaluating environmental conditions of the soil and groundwater with respect to gasoline and waste-oil related hydrocarbons at the site. No soil engineering or geotechnical references are implied or should be inferred. Evaluation of the geologic conditions at the site for the purpose of

this assessment is made from a limited number of observation points. Subsurface conditions may vary away from the data points available. Additional work, including further subsurface investigation, can reduce the inherent uncertainties associated with this type of assessment.

REFERENCES

Applied GeoSystems, November 9, 1989, Limited Environmental Site Assessment at ARCO Service Station No. 601, San Leandro, California, AGS Report 69034-1.

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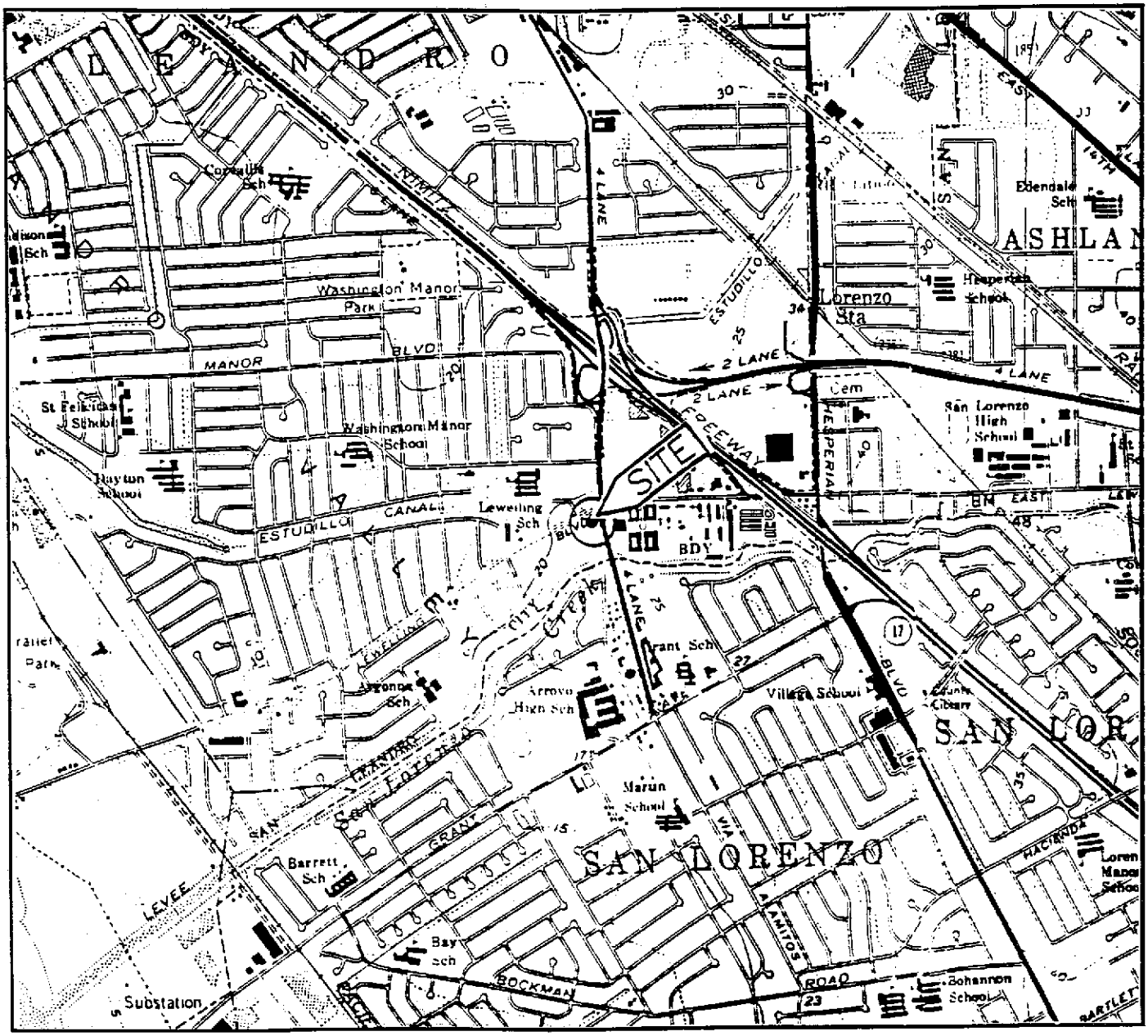
Hickenbottom, Kelvin and Muir, Kenneth, June 1988, Geohydrology and Groundwater - Quality Overview of the East Bay Plain Area, Alameda County, California, Alameda County Flood Control and Water Conservation District, Report 205 (j).

RESNA/Applied GeoSystems, December 14, 1990, Subsurface Environmental Assessment at ARCO Station 601, RESNA/AGS Report 69034-2.

RESNA/Applied GeoSystems, March 21, 1991, Work Plan for Subsurface Investigation and Remediation at ARCO Station 601, RESNA/AGS Report 69034-4W.

RESNA/Applied GeoSystems, March 21, 1991, Addendum One to Work Plan at ARCO Station 601, RESNA Report 69034.04.

RESNA/Applied GeoSystems, May 21, 1991, Site Safety Plan, Subsurface Environmental Investigation at ARCO Service Station 601, RESNA/AGS Report 69034.04S.



Base: U.S. Geological Survey
7.5-Minute Quadrangles
Hayward/San Leandro,
California
Photorevised 1980

N

LEGEND

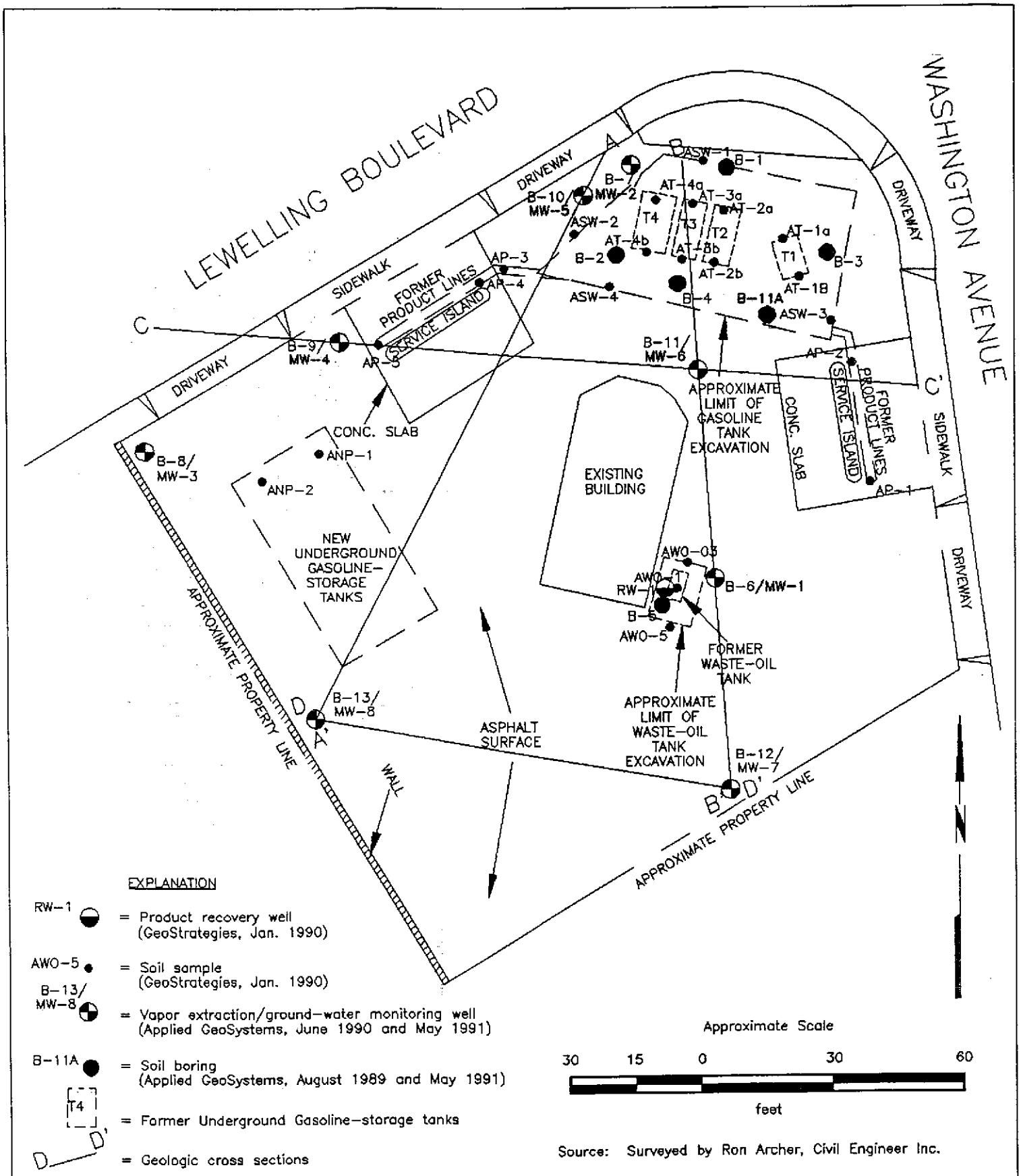
◉ = Site Location

Approximate Scale

2000 1000 0 2000 4000

feet

RESNA	**SITE VICINITY MAP** **ARCO Station 601** **712 Lewelling Boulevard** **San Leandro, California**	**PLATE** **1**
PROJECT 69034.04		



EXPLANATION

RW-1 = Product recovery well (GeoStrategies, Jan. 1990)

AWO-5 = Soil sample (GeoStrategies, Jan. 1990)

B-13/MW-8 = Vapor extraction/ground-water monitoring well (Applied GeoSystems, June 1990 and May 1991)

B-11A = Soil boring (Applied GeoSystems, August 1989 and May 1991)

T4 = Former Underground Gasoline-storage tanks

D D' = Geologic cross sections

Approximate Scale

30 15 0 30 60

feet

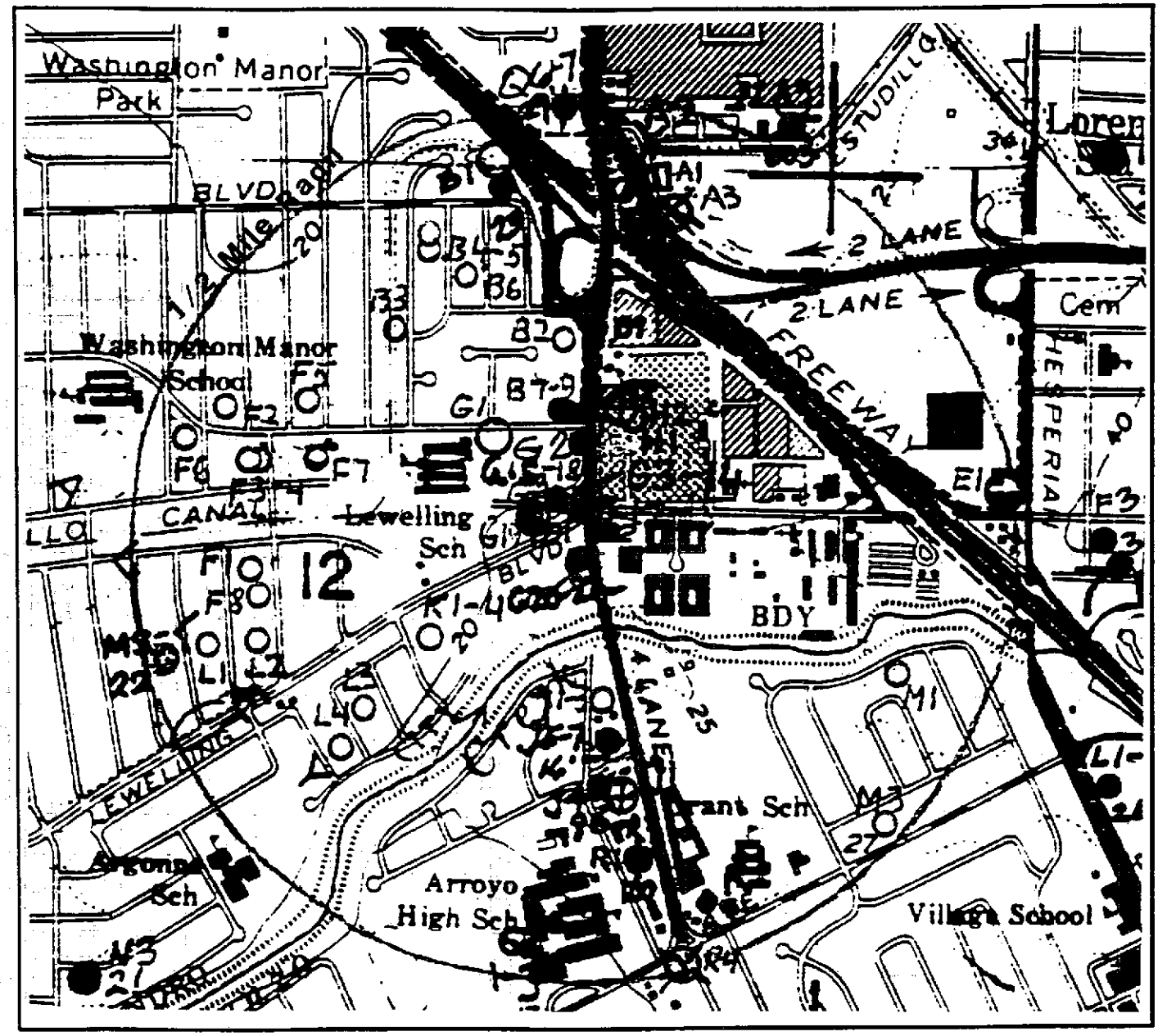
Source: Surveyed by Ron Archer, Civil Engineer Inc.

RESNA

PROJECT 69034.04

GENERALIZED SITE PLAN
ARCO Station 601
712 Lewelling Boulevard
San Leandro, California

PLATE
2



Source: U.S. Geological Survey
7.5-Minute Quadrangles
Hayward/San Leandro
California
Photorevised 1980

Note: Information obtained from SCVWD dated 7-19-91

- = Domestic wells
- = Irrigation wells
- = Cathodic Protection well
- = Monitoring wells
- = Test wells
- = Destroyed wells
- = Abandoned wells
- = Unidentified use wells

N

Approximate Scale

1000 500 0 1000 2000

feet

RESNA

PROJECT 69034.04

WELL LOCATION MAP
ARCO Station 601
712 Lewelling Boulevard
San Leandro, California

PLATE
3

UNIFIED SOIL CLASSIFICATION SYSTEM

MAJOR DIVISION		LTR	DESCRIPTION
COARSE-GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	GW	Well-graded Gravels or Gravel-Sand mixtures, little or no fines.
		GP	Poorly-graded Gravels or Gravel-Sand mixtures, little or no fines.
		GM	Silty Gravels, Gravel-Sand-Silt mixtures.
		GC	Clayey Gravel, Gravel-Sand-Clay mixtures.
	SAND AND SANDY SOILS	SW	Well-graded Sand or Gravelly Sands, little or no fines.
		SP	Poorly-graded Sands or Gravelly Sands, little or no fines.
		SM	Silty Sands, Sand-Silt mixtures.
		SC	Clayey Sands, Sand-Clay mixtures.

MAJOR DIVISION		LTR	DESCRIPTION
FINE-GRAINED SOILS	SILTS AND CLAYS LL<50	ML	Inorganic Silts and very fine sands, rock flour, Silty or Clayey fine Sands, or Clayey Silts with slight plasticity.
		CL	Inorganic Clays of low to medium plasticity, Gravelly Clays, Sandy Clays, Silty Clays, Lean Clays.
		OL	Organic Silts and Organic Silt-Clays of low plasticity.
	SILTS AND CLAYS LL>50	MH	Inorganic Silts, micaceous or diatomaceous fine Sandy or Silty Soils, Elastic Silts.
		CH	Inorganic Clays of high plasticity, fat Clays.
		OH	Organic Clays of medium to high plasticity, organic Silts.
HIGHLY ORGANIC SOILS		PT	Peat and other highly Organic Soils.


Depth through which sampler is driven


Relatively undisturbed sample


No sample recovered


Static water level observed in well/boring


Initial water level observed in boring

S-10 Sample number


Sand pack


Bentonite


Neat cement


Caved native soil


Blank PVC


Machine-slotted PVC

P.I.D. Photoionization detector

BLOWS REPRESENT THE NUMBER OF BLOWS OF A 140-POUND HAMMER FALLING 30 INCHES TO DRIVE THE SAMPLER THROUGH EACH 6 INCHES OF AN 18-INCH PENETRATION.

DASHED LINES SEPARATING UNITS ON THE LOG REPRESENT APPROXIMATE BOUNDARIES ONLY. ACTUAL BOUNDARIES MAY BE GRADUAL LOGS REPRESENT SUBSURFACE CONDITIONS AT THE BORING LOCATION AT THE TIME OF DRILLING ONLY.

RESNA	**UNIFIED SOIL CLASSIFICATION SYSTEM AND SYMBOL KEY ARCO Station 601 712 Lewelling Boulevard San Leandro, California**	**PLATE 4**
PROJECT 69034.04		

Depth of boring: 18 feet Diameter of boring: 8 inches Date drilled: 5-29-91

Well depth: 9 feet Material type: Sch 40 PVC Casing diameter: 4 inches

Screen interval: 6 to 9 feet Slot size: 0.020-inch

Drilling Company: H.E.W. Drilling Co. Driller: Jasper and Mike

Method Used: Hollow-Stem Auger Field Geologist: Phil Mayberry

Signature of Registered Professional: J E Timmons

Registration No. RCE 044600 State: CA

Depth	Sample No.	Blows	P.I.D.	USCS Code	Description	Well Const.
					Paved area.	
0					Asphalt 6 inches.	
2				GC	Clayey gravel, brown, damp, medium dense: fill (baserock).	
					Native soil at 1-1/2 feet.	
4				CL	Silty clay, dark gray, damp, medium plasticity, stiff; noticeable product odor.	
	S-5.5	2 6 7	257			
6	S-7	2 4 7	609	ML	Clayey silt, gray, moist, low plasticity, stiff; noticeable product odor.	
				▽		
8	S-8.5	4 6 10	692	SC	Clayey sand, fine-grained, gray, wet, medium dense; noticeable product odor.	
				CL	Silty clay, dark gray, damp, medium plasticity, stiff.	
10	S-10	3 6 8	179			
	S-11.5	5 9 13	55.7		Color change to brown, very stiff.	
12	S-13	4 9 14	20			
14	S-14.5	5 10 12	219			
		5 10 13	35.1			
16		6 10 13			Color change to light brown.	
	S-17.5		0			
18					Total Depth = 18 feet.	
20						

RESNA

PROJECT: 69034.04

LOG OF BORING B-9/MW-4

ARCO Station 601
712 Lewelling Boulevard
San Leandro, California

PLATE 5

Depth of boring: 19-1/2 feet Diameter of boring: 8 inches Date drilled: 5-30-91

Well depth: 10-1/2 feet Material type: Sch 40 PVC Casing diameter: 4 inches

Screen interval: 6 to 10-1/2 feet Slot size: 0.020-inch

Drilling Company: H.E.W. Drilling Co. Driller: Jasper and Mike

Method Used: Hollow-Stem Auger Field Geologist: Phil Mayberry

Signature of Registered Professional:

Registration No. RCE 044600 State: CA

Depth	Sample No.	Blows	P.I.D.	USCS Code	Description	Well Const.
					Paved area.	
0					Asphalt 6 inches.	
				GC	Clayey gravel, brown, damp, medium dense: fill (baserock).	
2				CL	Silty clay, dark gray, damp, medium plasticity, stiff: native soil.	
4						
6	S-5.5	2 4 5	587	SC	Clayey sand, dark gray, damp, loose; noticeable product odor.	
	S-7.5	6 7 8	747	▽	Medium dense, wet; obvious product odor.	
8	S-9	2 3 8	232	CL	Silty clay, dark gray, damp, medium plasticity, stiff; noticeable product odor.	
10	S-10	3 4 7	664	SC	Clayey sand, fine-grained, moist, loose, noticeable product odor.	
12				CL	Silty clay, dark brown, damp, medium plasticity, stiff; obvious product odor.	
14						
16	S-16	4 8 9	51		Very stiff.	
	S-17	4 7 9	20	SC	Clayey sand, with fine gravel, light brown, damp, dense.	
18	S-18.5	3 5 7	83	▽	5/30/91 Moist, medium dense.	
20					Total Depth = 19-1/2 feet.	

RESNA

PROJECT: 69034.04

LOG OF BORING B-10/MW-5

ARCO Station 601
712 Lewelling Boulevard
San Leandro, California

PLATE 6

Depth of boring: 16-1/2 feet Diameter of boring: 8 inches Date drilled: 5-30-91

Well depth: NA Material type: NA Casing diameter: NA

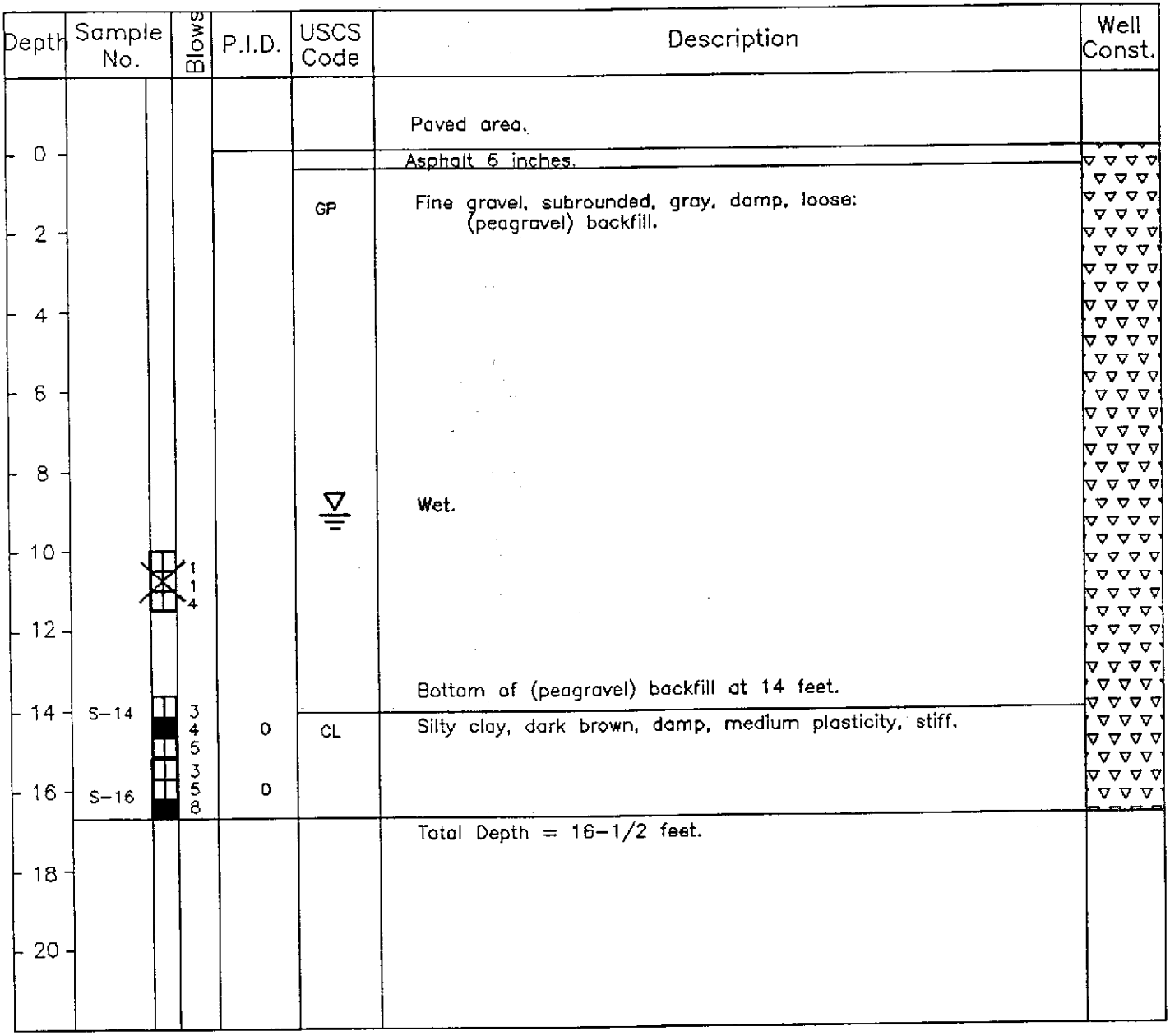
Screen interval: NA Slot size: NA

Drilling Company: H.E.W. Drilling Co. Driller: Jasper and Mike

Method Used: Hollow-Stem Auger Field Geologist: Phil Mayberry

Signature of Registered Professional: _____

Registration No.: _____ State: _____



RESNA	LOG OF BORING B-11A ARCO Station 601 712 Lewelling Boulevard San Leandro, California	PLATE 7
PROJECT: 69034.04		

Depth of boring: 15-1/2 feet Diameter of boring: 8 inches Date drilled: 5-30-91

Well depth: 9 feet Material type: Sch 40 PVC Casing diameter: 4 inches

Screen interval: 5-1/2 to 9 feet Slot size: 0.020-inch

Drilling Company: H.E.W. Drilling Co. Driller: Jasper and Mike

Method Used: Hollow-Stem Auger Field Geologist: Phil Mayberry

Signature of Registered Professional:

Registration No. RCE 044600 State: CA

Depth	Sample No.	Blows	P.I.D.	USCS Code	Description	Well Const.
					Paved area.	
0					Asphalt 6 inches.	
				GC	Clayey gravel, brown, damp, medium dense: fill (baserock).	
2				CL	Silty clay, dark gray, damp, soft; bay mud.	
4						
6	S-5.5	1 2 3	86	SM	Silty sand, dark gray, damp, loose; noticeable product odor.	
	S-7.5	3 4 4	153	▽		
8	S-8.5	2 3 7	838	CL	Silty clay, dark gray, damp, medium plasticity, firm; with lenses of silty sand; obvious product odor.	
10	S-10.5	2 5 7	240	CL	Silty clay, brown-gray, damp, medium plasticity, stiff.	
12	S-12	7 9 13	254		Very stiff.	
	S-13.5	3 6 9	12		Stiff.	
14	S-15	9 11 14	0		Very stiff.	
16					Total Depth = 15-1/2 feet.	
18						
20						

RESNA

PROJECT: 69034.04

LOG OF BORING B-11/MW-6

ARCO Station 601
712 Lewelling Boulevard
San Leandro, California

PLATE 8

Depth of boring: 15-1/2 feet Diameter of boring: 8 inches Date drilled: 5-29-91

Well depth: 10-1/2 feet Material type: Sch 40 PVC Casing diameter: 4 inches

Screen interval: 7 to 10 feet Slot size: 0.020-inch

Drilling Company: H.E.W. Drilling Co. Driller: Jasper and Mike

Method Used: Hollow-Stem Auger Field Geologist: Phil Mayberry

Signature of Registered Professional:

Registration No. RCE 044600 State: CA

Depth	Sample No.	Blows	P.I.D.	USCS Code	Description	Well Const.
					Paved area.	
0					Asphalt 6 inches.	
				GC	Clayey gravel, brown, damp, medium dense: fill (baserock).	
2					Bottom of fill (baserock) at 2-1/2 feet.	
4				SM	**Silty sand**, fine-grained, brown, damp, loose: native soil.	
6	S-6	3 2 3	0			
	S-7.5	2 5 5	0			
8				CL	Silty clay, brown, damp, medium plasticity, stiff. Color change to dark gray.	
	S-8.5	3 3 4	635	▽ SM	**Silty sand**, brown mottled with gray, **wet**, loose; **obvious product odor; sheen on the sample.**	
10	S-10.5	0 4 7	322	CL	**Silty clay**, gray, damp, medium plasticity, stiff; **noticeable product odor.**	
12	S-12	5 8 12	55		Very stiff.	
	S-13.5	5 8 12	0			
14	S-14.5	4 6 9	0			
16					Total Depth = 15-1/2 feet.	
18						
20						

RESNA

PROJECT: 69034.04

LOG OF BORING B-12/MW-7

ARCO Station 601
712 Lewelling Boulevard
San Leandro, California

PLATE 9

Depth of boring: 15-1/2 feet Diameter of boring: 8 inches Date drilled: 5-29-91

Well depth: 10-1/2 feet Material type: Sch 40 PVC Casing diameter: 4 inches

Screen interval: 6-1/2 to 10-1/2 feet Slot size: 0.020-inch

Drilling Company: H.E.W. Drilling Co. Driller: Jasper and Mike

Method Used: Hollow-Stem Auger Field Geologist: Phil Mayberry

Signature of Registered Professional:

Registration No. RCE 044600 State: CA

Depth	Sample No.	Blows	P.I.D.	USCS Code	Description	Well Const.
					Paved area.	
0					Asphalt 6 inches.	
				GC	Clayey gravel, brown, damp, medium dense: fill (baserock).	
2				SM	**Silty sand**, fine-grained, gray, moist, loose.	
4	S-5.5	2 2 3	38.2			
6				CL	**Silty clay**, gray, moist, medium plasticity, firm.	
8	S-8.5	2 4 4	381	SM ▽	**Silty sand**, fine-grained, gray, moist, loose; noticeable product odor.	
10				SC	**Clayey sand**, fine-grained, brown mottled with gray, **wet**, loose.	
	S-11	3 6 7	7.6	CL	**Silty clay**, dark brown, damp, low to medium plasticity, stiff.	
12	S-13	6 7 11	5			
14	S-15	4 7 11	0			
16					Total Depth = 15-1/2 feet.	
18						
20						

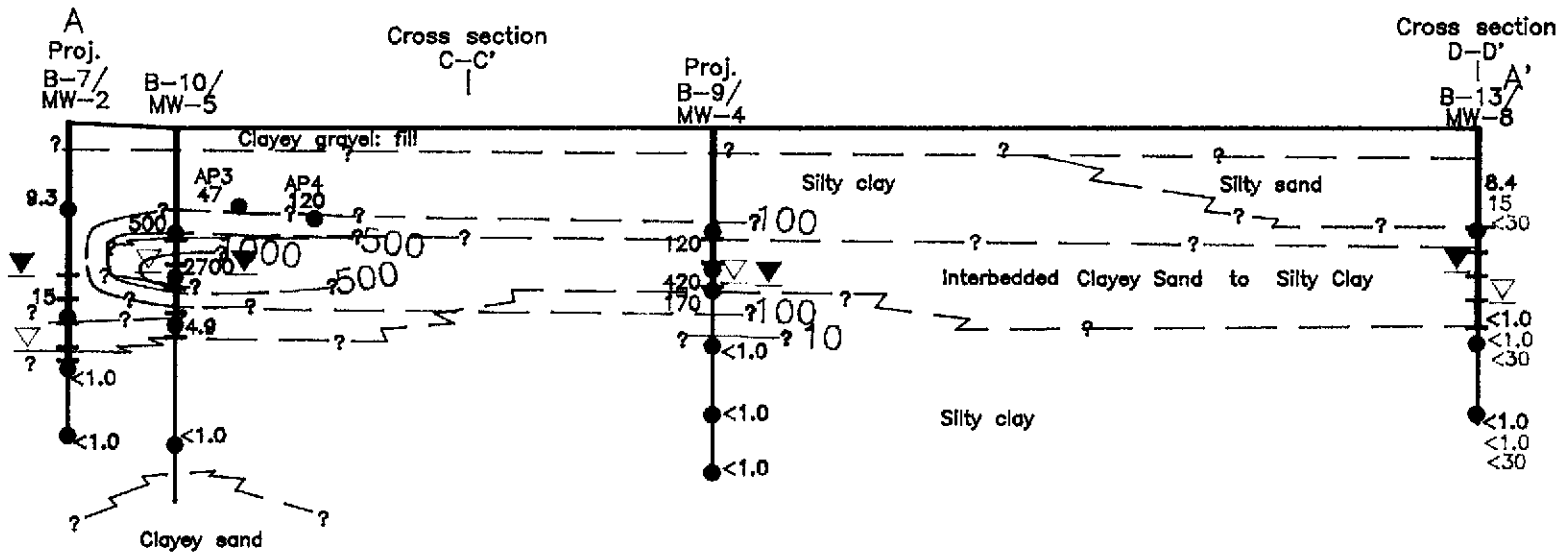
RESNA

PROJECT: 69034.04

LOG OF BORING B-13/MW-8

ARCO Station 601
712 Lewelling Boulevard
San Leandro, California

PLATE 10



EXPLANATION

1000 = Line of equal concentration of TPHg in soil

2700 / 15 / <30 = Laboratory analyzed soil sample showing concentration of TPHg (red), TPHd (green), TOG (orange) in parts per million

= Well casing

= Well screen

= Boring

= Initial water level in boring (6/90 and 5/91)

= Static water level in well (6/91)

AP3 = Former product lines soil sample

AP4 = Former product lines soil sample

Approximate Horizontal Scale

20 10 0 20 40

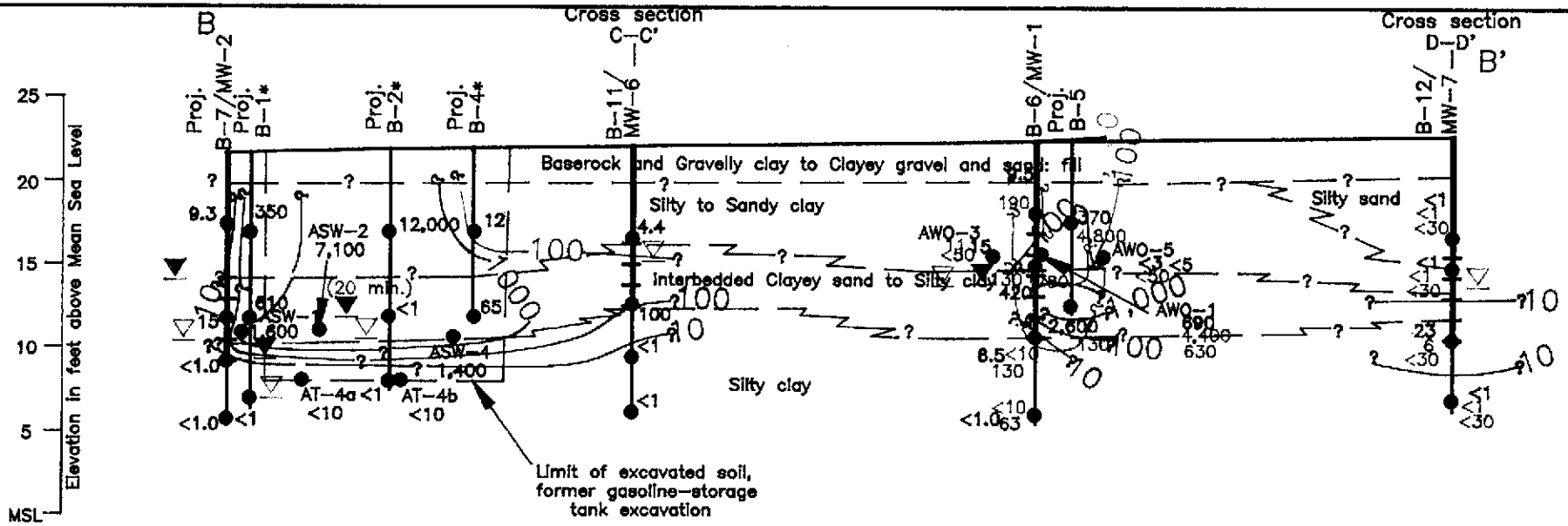
feet

Approximate Vertical Scale

10 5 0 10 20

feet

PLATE 11	GEOLOGIC CROSS SECTION A-A' ARCO Station 601 712 Lewelling Boulevard San Leandro, California	RESNA PROJECT 69034.04



EXPLANATION

1,000 = Line of equal concentration of TPHg in soil

1,000 = Line of equal concentration of TOG in soil

12,000 / 630 / 4,800 / 4,400 = Laboratory analyzed soil sample showing concentration of TPHg (red), TPHd (green), TOG (orange), and TPHo (blue) in parts per million

= Well casing

= Well screen

= Boring

= Initial water level in boring (8/89, 6/90, and 5/91)

= Static water level in well (6/91)

* = Boring in subsequently excavated soil

ASW–4 = Excavation sidewall soil sample

AT–4b = Excavation soil sample beneath former tank

AWO–5 = Former waste–oil tank excavation soil sample

Approximate Horizontal Scale

20 10 0 20 40

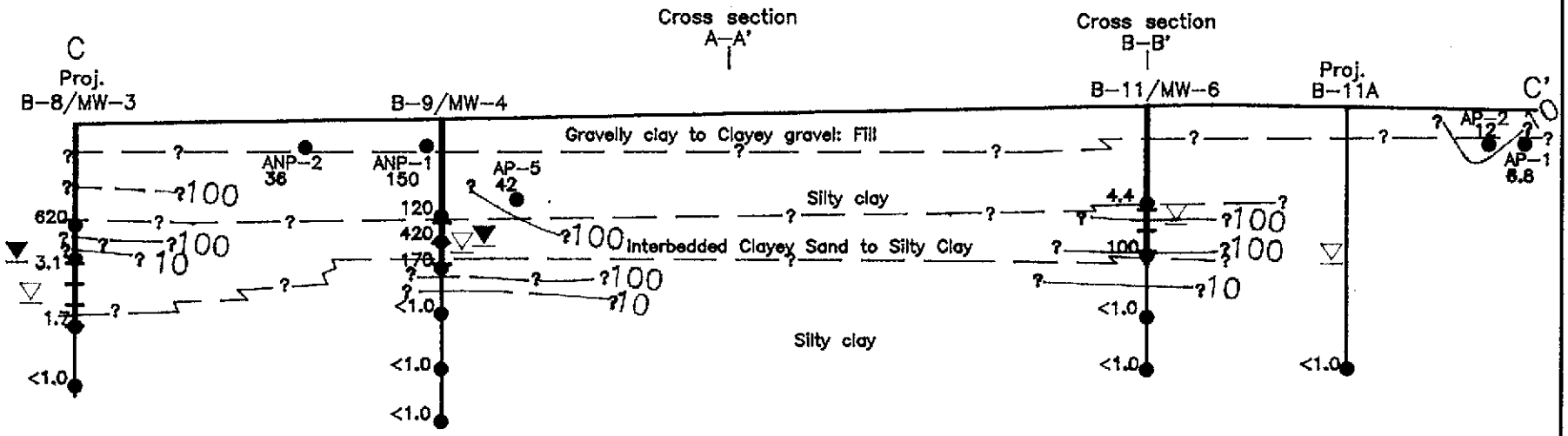
feet

Approximate Vertical Scale

10 5 0 10 20

feet

PLATE 12	GEOLOGIC CROSS SECTION B-B' ARCO Station 601 712 Lewelling Boulevard San Leandro, California	RESNA PROJECT 69034.04



EXPLANATION

100 = Line of equal concentration of TPHg in soil

620 / 15 / <30 = Laboratory analyzed soil sample showing concentration of TPHg (**red**), TPHd (green), TOG (orange) in parts per million

= Well casing

= Well screen

= Boring

= Initial water level in boring (6/90 and 5/91)

= Static water level in well (6/91)

AP5 = Former product lines soil sample

ANP-2 = New tank excavation soil sample

Approximate Horizontal Scale

20 10 0 20 40

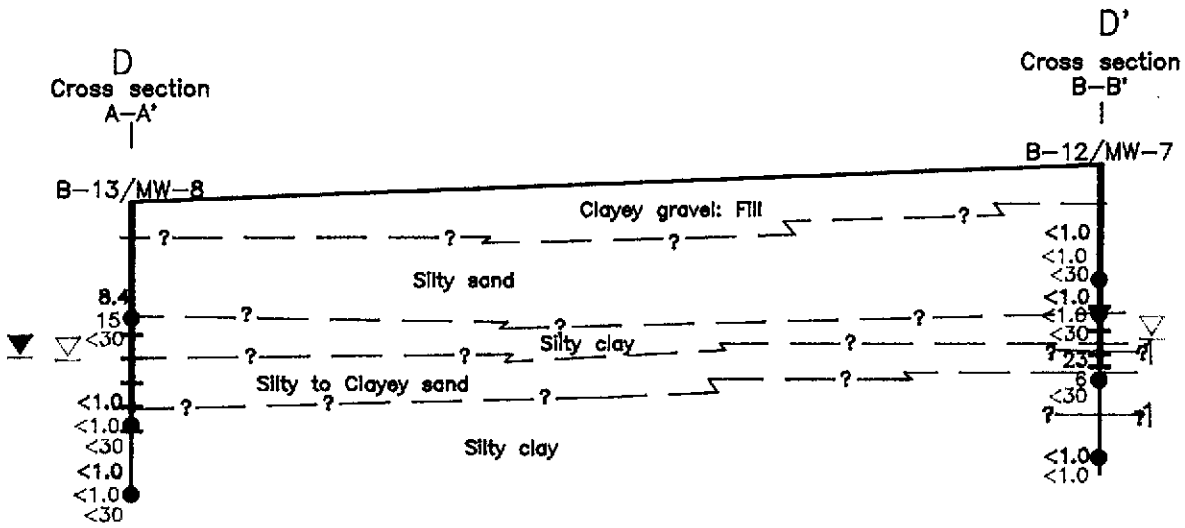
feet

Approximate Vertical Scale

10 5 0 10 20

feet

PLATE 13	**GEOLOGIC CROSS SECTION C-C'** **ARCO Station 601** **712 Lewelling Boulevard** **San Leandro, California**	**RESNA** **PROJECT 69034.04**



EXPLANATION

= Line of equal concentration of TPHg in soil

23
15
<30
= Laboratory analyzed soil sample showing concentration of TPHg (**red**), TPHd (green), TOG range) in parts per million

= Well casing

= Well screen

= Boring

= Initial water level in boring (5/91)

= Static water level in well (6/91)

Approximate Horizontal Scale

20 10 0 20 40

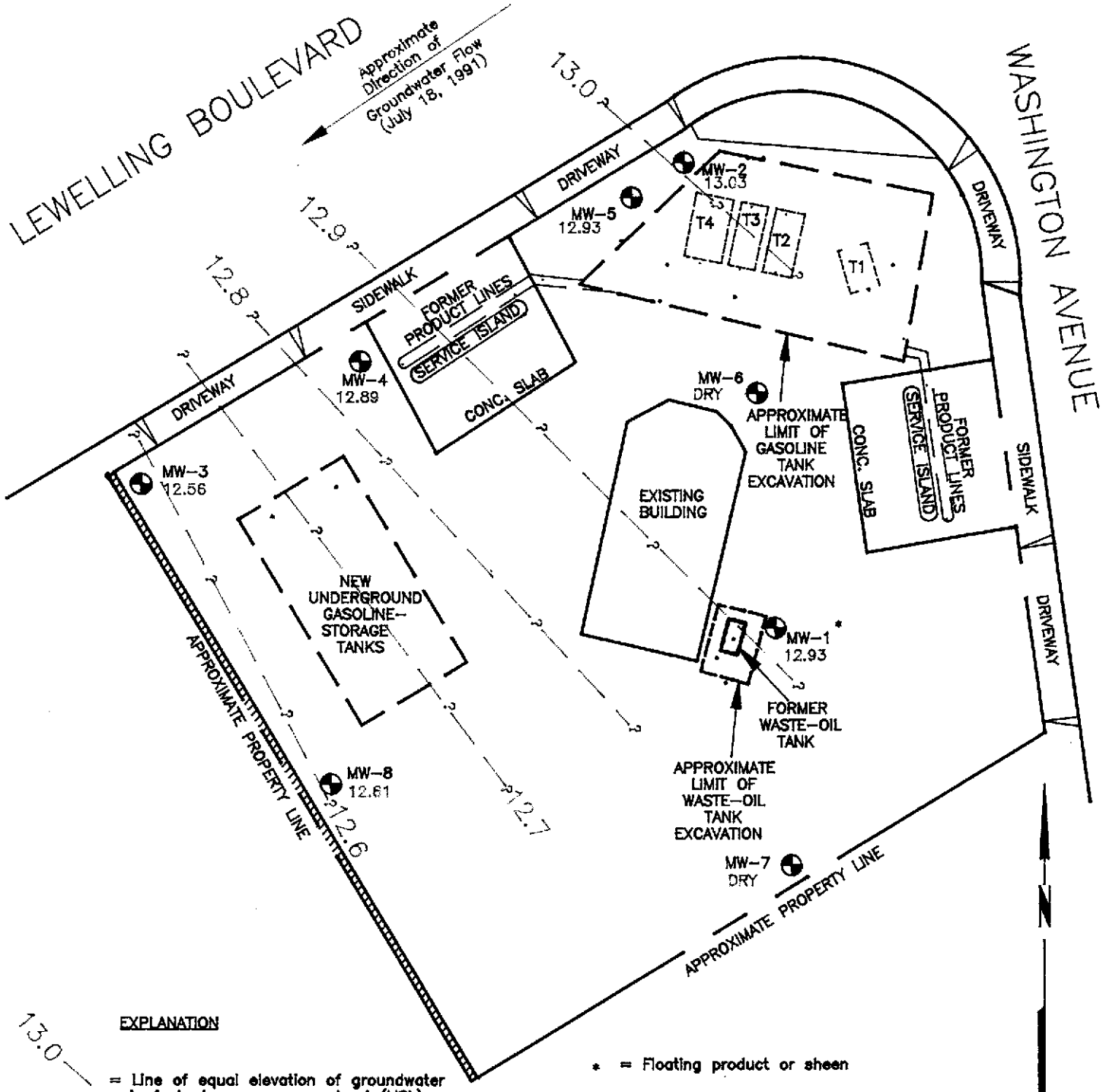
feet

Approximate Vertical Scale

10 5 0 10 20

feet

PLATE 14	**GEOLOGIC CROSS SECTION D-D'** **ARCO Station 601** **712 Lewelling Boulevard** **San Leandro, California**	**RESNA** **PROJECT 69034.04**



EXPLANATION

13.0 = Line of equal elevation of groundwater in feet above mean sea level (MSL)

13.03 = Elevation of groundwater in feet (MSL) July 18, 1991

MW-8 = Ground-water monitoring well (Applied GeoSystems, June 1990 and May 1991)

T4 = Former Underground Gasoline-storage tanks

* = Floating product or sheen

Approximate Scale

30 15 0 30 60

feet

Source: Surveyed by Ron Archer, Civil Engineer Inc.

RESNA	**GROUNDWATER GRADIENT MAP** **ARCO Station 601** **712 Lewelling Boulevard** **San Leandro, California**	**PLATE** **15**
PROJECT 69034.04		

TABLE 1
CUMULATIVE GROUNDWATER MONITORING DATA
ARCO Station 601
San Leandro, California
(Page 1 of 2)

Date Well Measured	Depth of Well	Well Elevation	Depth-to-Water	Water Elevation	Product Evidence
MW-1					
07/17/90	11.20	22.98*	9.03	13.95	emulsion
08/07/90			9.19	13.79	odor
10/15/90			9.85	13.13	0.25
11/20/90			9.79	13.19	0.46
12/21/90			9.18	13.80	sheen
01/09/91			9.47	13.51	0.02
06/10/91		22.26**	9.00	13.26	emulsion
07/18/91			9.34	12.92	0.01
MW-2					
07/17/90	12.33	22.06*	7.86	14.20	odor
08/07/90			8.03	14.03	
10/15/90			8.61	13.45	
11/20/90			8.76	13.30	
12/21/90			8.28	13.78	odor
01/09/91			8.43	13.63	odor
06/10/91		21.33**	7.91	13.42	
07/18/91			8.30	13.03	
MW-3					
07/17/90	11.99	20.84*	7.03	13.81	sheen
08/07/90			7.21	13.63	odor
10/15/90			8.19	12.65	0.75
11/20/90			7.98	12.85	1.08
12/21/90			7.22	13.62	0.01
01/09/91			7.46	13.38	0.30
06/10/91		20.11**	7.14	12.97	sheen
07/18/91			7.55	12.56	odor

See Notes on Page 2 of 2

TABLE 1
CUMULATIVE GROUNDWATER MONITORING DATA
ARCO Station 601
San Leandro, California
(Page 2 of 2)

Date Well Measured	Depth of Well	Well Elevation	Depth-to-Water	Water Elevation	Product Evidence
MW-4					
06/10/91	9.00	20.75**	---	well dry	
07/18/91			7.86	12.89	
MW-5					
06/10/91	10.50	20.90**	7.58	13.32	
07/18/91			7.97	12.93	
MW-6					
06/10/91	9.00	22.08**	---	well dry	
07/18/91			---	well dry	
MW-7					
06/10/91	10.00	22.89**	---	well dry	
07/18/91			---	well dry	
MW-8					
06/10/91	10.50	20.97**	7.80	13.17	odor
07/18/91			8.36	12.61	odor

Measurements in feet.
Elevations expressed as feet mean sea level.
Depth-to-Water measured in feet below top of casing.
Wells were surveyed on 07/17/90 (*) and resurveyed with new wells 06/20/91 (**).

TABLE 2
VAPOR-EXTRACTION TEST FIELD MONITORING DATA
ARCO Station 601
San Leandro, California

Influent Air Stream at Extraction Well				Observation Wells (Vacuum Measured)			
Flow	Conc.	Vacuum	Temp.	MW-1	MW-2	MW-4	MW-5
37	NT	>50	72	0	0	0	0
35	1,000	49	72	0	>0.06	0	0
55	2,500	>50	72	0	>0.10	0.015	0.02
44	3,000	>50	73	0	>0.09	0	0
Distance from extraction well MW-6 (feet):				42	57	88	57

NT = Not Taken
Flow measured in cubic feet per minute (CFM).
Concentration of organic vapors measured in parts per million by volume (ppmv) on Organic Vapor Meter.
Vacuum measured in inches of water column vacuum.
Temperature measured in degrees Fahrenheit.

TABLE 3
LABORATORY ANALYSIS OF SOIL SAMPLES
May 1991
ARCO Station 601
712 Lewelling Boulevard
San Leandro, California
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Sample Number	TPHg	TPHd	TOG	B	T	E	X
S-5 1/2-B9	120	NA	NA	1.6	4.2	1.9	12
S-7-B9	420	NA	NA	5.9	24	8.4	48
S-8 1/2-B9	170	NA	NA	3.7	14	3.5	20
S-11 1/2-B9	<1.0	NA	NA	<0.0050	<0.0050	<0.0050	<0.0050
S-14 1/2-B9	<1.0	NA	NA	<0.0050	<0.0050	<0.0050	<0.0050
S-17 1/2-B9	<1.0	NA	NA	<0.0050	<0.0050	<0.0050	<0.0050
S-5 1/2-B10	500	NA	NA	2.8	8.1	7.4	34
S-7 1/2-B10	2,700	NA	NA	27	150	65	370
S-10-B10	4.9	NA	NA	0.33	0.33	0.10	0.51
S-16-B10	<1.0	NA	NA	<0.0050	<0.0050	<0.0050	<0.0050
S-6-B11A	<1.0	NA	NA	<0.0050	<0.0050	<0.0050	<0.0050
S-5 1/2-B11	4.4	NA	NA	0.72	0.0.19	0.022	0.041
S-8 1/2-B11	100	NA	NA	3.0	9.3	2.7	1.5
S-12-B11	<1.0	NA	NA	0.011	0.019	0.0055	0.025
S-15-B11	<1.0	NA	NA	<0.0050	<0.0050	<0.0050	<0.0050
S-5 1/2-B12	<1.0	<1.0	<30	<0.0050	<0.0050	<0.0050	<0.0050
S-7 1/2-B12	<1.0	<1.0	<30	<0.0050	<0.0050	<0.0050	<0.0050
S-10 1/2-B12	23	6.0	<30	<0.0050	0.24	0.50	2.2
S-14 1/2-B12	<1.0	<1.0	<30	<0.0050	<0.0050	<0.0050	<0.0050

See Notes on Page 2 of 2

TABLE 3
LABORATORY ANALYSIS OF SOIL SAMPLES
May 1991
ARCO Station 601
San Leandro, California
(Page 2 of 2)

Sample Number	TPHg	TPHd	TOG	B	T	E	X
S-5 1/2-B13	8.4	15	<30	0.022	0.017	0.20	0.059
S-11-B13	<1.0	<1.0	<30	<0.0050	<0.0050	<0.0050	<0.0050
S-15-B13	<1.0	<1.0	<30	<0.0050	<0.0050	<0.0050	<0.0050

Results are in parts per million (ppm)
TPHg = total petroleum hydrocarbons as gasoline
TPHd = total petroleum hydrocarbons as diesel
TOG = total oil and grease
B = benzene
T = toluene
E = ethylbenzene
X = total xylenes
< = Below indicated laboratory reporting limit
NA = Not Analyzed

Sample Number explanation:
S-12-B9
| | └── Boring number
| └──── Sample depth in feet below ground surface
└────── Soil sample

TABLE 4
CUMULATIVE RESULTS OF LABORATORY ANALYSES OF GROUNDWATER
ARCO Service Station 601
San Leandro, California
(Page 1 of 3)

Sample Date	TPHg	TPHd	B	T	E	X	TOG
MW-1							
07/17/90	NA	NR	NA	NA	NA	NA	NR
10/15/90	NA	NR	NA	NA	NA	NA	NR
01/09/91	NA	NR	NA	NA	NA	NA	NR
06/10/91	NS	NS	NS	NS	NS	NS	NS
MW-2							
07/17/90	35,000	850*	3,800 (3,200)	2,900 (2,400)	690 (270)	3,600 (2,900)	<5,000
10/15/90	6,400	NR	650	290	110	560	NR
01/09/91	13,000	NR	1500 (1700)	970 (1200)	390 (370)	1500 (2400)	NR
06/10/91	26,000	NR	3,000	2,500	880	4,200	NR
MW-3							
07/17/90	NA	NR	NA	NA	NA	NA	<5,000
10/15/90	NA	NR	NA	NA	NA	NA	NR
01/09/91	NA	NR	NA	NA	NA	NA	NR
06/10/91	NS	NS	NS	NS	NS	NS	NS
MW-4							
06/10/91	NS	NS	NS	NS	NS	NS	NS
MW-5							
06/10/91	100,000	NR	25,000	20,000	2,600	12,000	NR
MW-6							
06/10/91	NS	NS	NS	NS	NS	NS	NS

See Notes on Page 2 of 3

TABLE 4
CUMULATIVE RESULTS OF LABORATORY ANALYSES OF GROUNDWATER
ARCO Service Station 601
San Leandro, California
(Page 2 of 3)

Sample	TPHg	TPHd	B	T	E	X	TOG
MW-7							
06/10/91	NS	NS	NS	NS	NS	NS	NS
MW-8							
06/10/91	5,800	NR	73	7.2	150	21	<5,000
MCLs	NA	NA	1.0	---	680	1750	NA
DWALs	NA	NA	NA	100	NA	NA	NA

Results in micrograms per liter (ug/L) = parts per billion (ppb).
NA: Not analyzed. NR:Not requested. NS:Not Sampled.
TPHg: Total petroleum hydrocarbons as gasoline by EPA method 8015.
TPHd: Total petroleum hydrocarbons as diesel by EPA method 3550/3510.
B: Benzene, T: Toluene, E: Ethylbenzene, X: Total Xylene isomers.
BTEX: Measured by EPA method 8020/602.
TOG: Total oil and grease measured by Standard method 503A/E.
<: Results reported as less than the detection limit.
*: Applied Analytical Laboratories reports that the chromatograph resembled gasoline not diesel.
( ): BTEX results analyzed as VOCs by EPA method 624.
MCLs: Adopted Maximum Contaminant Levels in Drinking Water, DHS (July 1989)
DWAL: Recommended Drinking Water Action Levels, DHS (January 1990)

TABLE 4
CUMULATIVE RESULTS OF LABORATORY ANALYSES OF GROUNDWATER
ARCO Service Station 601
San Leandro, California
(Page 3 of 3)

Sample	BNAs	VOCs	Cadmium	Chromium	Lead	Zinc
MW-2						
07/17/90	340[a],170[b]	39[c]	<20	50	50	120
MCLs	--	40[c]	10	50	50	5000**

BNAs: Base neutral and acid extractables including polynuclear aromatics
Concentrations are below laboratory reporting limits for respective compounds except as indicated ([a] = naphthalene, [b] = 2-methylnaphthalene).

VOCs: Volatile organics except for BTEX
Concentrations are below laboratory reporting limits for respective compounds except as indicated ([c] = methylene chloride).

**: Secondary drinking water standard (July1990)

TABLE 5
LABORATORY ANALYSIS OF AIR SAMPLES
ARCO Station 601
San Leandro, California

Sample ID	Well	E/T (Min.)	TPHg	B	T	E	X
AS1	inf MW-6	20	76,000	5,500	1,200	79	130
AS2	inf MW-1	35	24,000	1,200	170	ND	ND
AS3	inf MW-5	55	30,000	2,100	600	ND	ND
AS4	inf MW-4	75	930	67	74	9.7	50
AS5	inf MW-8	95	9,500	100	82	54	40

Concentrations are in mg/mg3

E/T: Vapor extraction time
inf: Influent
ND: Non-detectable
TPHg: Total Petroleum Hydrocarbons as gasoline (analyzed by EPA SW-846 Methods 5030 and 8015)
B: Benzene
T: Toluene
E: Ethylbenzene
X: Total Xylenes
BTEX: Analyzed by EPA SW-846 Methods 5030 and 8020.
AS5: Air Sample Number five (5).

APPENDIX A

PREVIOUS WORK

PREVIOUS WORK

August 1989

Applied GeoSystems (1989) performed a limited environmental site assessment at the request of ARCO to evaluate possible hydrocarbons in the soil in the vicinity of the underground storage tanks prior to removal of the four underground gasoline-storage tanks and one underground waste-oil-storage tank. Work performed during this limited assessment included: drilling and obtaining soil samples for laboratory analysis from five soil borings (B-1 through B-5) to depths to or just above the first-encountered groundwater; analyzing selected soil samples from each of the borings for total petroleum hydrocarbons as gasoline (TPHg) and the gasoline constituents benzene, toluene, ethylbenzene, and total xylenes (BTEX); analyzing selected soil samples from the boring located near the waste-oil tank for total oil and grease (TOG) and halogenated volatile organics (VOC); and preparation of a report including results, conclusions and recommendations for future work.

The soil borings were drilled to depths from approximately 10-1/2 to 15-1/2 feet below the ground surface. Groundwater was first encountered at depths of 14-1/2 feet and 11-1/2 feet in borings B-1 and B-2, respectively, and stabilized after a period of approximately one hour at a depth of approximately 11 feet below the ground surface. Borings B-3, B-4, and B-5 were drilled to total depths of approximately 10-1/2 feet below the ground surface, and were completed prior to encountering groundwater. Free hydrocarbon product was encountered in each of the five soil borings drilled. The soil encountered during this limited assessment consisted primarily of silty clay with lesser amounts of sandy clay and clayey silt.

Results of laboratory analyses of selected soil samples from borings B-1 through B-4, drilled in the area of the gasoline-storage tanks, indicated concentrations of TPHg up to 12,000 parts per million (ppm) and concentrations of BTEX up to 60 ppm, 450 ppm, 110 ppm, and 660 ppm, respectively. Results of laboratory analyses of selected soil samples from borehole B-5, drilled adjacent to the waste-oil tank, indicated TPHg at concentrations up to 2,600 ppm, total oil and grease up to 4,800 ppm, and BTEX up to 10 ppm, 90 ppm, 21 ppm, and 130 ppm, respectively. No halogenated volatile organic compounds (VOC) were detected in samples analyzed from boring B-5. The laboratory results are summarized in Table A1.

Applied GeoSystems concluded that the shallow soil in the area of the four underground gasoline-storage tanks and the underground waste-oil-storage tank had been impacted by elevated levels of hydrocarbons, and that the first-encountered groundwater beneath the site appeared to have been affected by hydrocarbons.

November 1989

GeoStrategies Inc. (GSI) (1989), of Hayward, California, prepared a work plan for ARCO. This Work Plan included: excavation of contaminated soils during tank and product line removal and replacement; observation of excavation and obtaining soil samples for laboratory analysis from tank excavations, product line trenches, and soil stockpiles as specified by the California Department of Health Services LUFT Manual and San Leandro Fire Department guidelines; drilling three soil borings, obtaining soil samples for laboratory analysis, installing three groundwater monitoring wells, developing the monitoring wells and sampling groundwater for laboratory analysis, surveying wellhead elevations and obtaining groundwater elevations to determine the groundwater flow direction and gradient magnitude, and preparing a report to include results, conclusions and recommendations for future work at the site.

January 1990

GSI (1990) observed removal of four underground gasoline-storage tanks and one underground waste-oil-storage tank, noted contaminant distribution within the subsurface, and assisted in directing soil excavation. GSI also obtained soil samples for laboratory analysis from the tank excavations (including the new tank excavation), the product line trenches, and soil stockpiles, and prepared a report summarizing field procedures and results for ARCO.

Approximately 600 cubic yards of soil were removed from the former underground gasoline-storage tank and product line trench excavations, approximately 950 cubic yards of soil were removed from the new underground gasoline-storage tank excavation, and approximately 15 cubic yards of soil were removed from the former waste-oil tank excavation. According to GSI, the size of the former gasoline-storage tank excavation was limited by the presence of existing structures on the site. Laboratory analysis of composite soil samples obtained from the soil stockpiles reported TPHg concentrations above 1000 ppm for approximately 200 cubic yards, and above 100 ppm for approximately 350 cubic yards of soil removed from the former tank excavation. This approximately 550 cubic yards of soil was removed to disposal facilities operated by GSX (as identified by GSI, presently Laidlaw Environmental Services, Inc., Limited Class I Disposal Facility, Button Willow, California). Laboratory analysis of composite soil samples obtained from the soil stockpiles reported TPHg concentrations of less than 100 ppm for approximately 50 cubic yards of soil removed from the former gasoline tank excavation, and for approximately 950 cubic yards of soil removed from the new gasoline tank excavation. This approximately 1,000 cubic yards of soil was removed to a Class III landfill. Approximately 15 cubic yards of soil removed from the former waste-oil

tank excavation were removed to a disposal facility operated by GSX. Excavations were backfilled with clean pea gravel. In addition, a 6-inch diameter 0.020 slot size PVC casing product recovery well (RW-1) was installed in the backfill of the former waste-oil tank excavation, at the approximate location shown on the Generalized Site Plan (Plate 2) of this report.

The results of laboratory analysis of native soil samples obtained from the former gasoline tank excavation, former product line trenches, former waste-oil tank excavation, and new tank excavation are included in Table A2.

June 1990

In June, 1990 RESNA/AGS performed a Limited Subsurface Investigation (RESNA/AGS, December 1990) at the site including drilling borings B-6 through B-8 and installing groundwater monitoring wells MW-1 through MW-3 in the borings. The monitoring wells were developed and sampled as part of this investigation and selected soil samples collected from the borings and groundwater samples were sent to a state-certified laboratory for analyses. Laboratory analytical results for soil are shown in Tables A-1 through A-3. Table 2 in the main body of this report presents the measured groundwater elevations. Table 3 in the main body of this report presents cumulative results of groundwater analytical results.

RESNA/Applied GeoSystems concluded:

- The majority of gasoline and waste-oil hydrocarbons at concentrations above 100 parts per million (ppm) in the soil at the site outside the immediate areas of the former gasoline-storage and waste-oil-storage tanks appeared to be within or just above the interbedded clayey sand to silty clay at depths between approximately 8 and 12 feet below the ground surface. The presence of water in this relatively permeable zone appeared to have facilitated the movement of gasoline and waste-oil hydrocarbons laterally.

- The lateral extent of hydrocarbons in the soil associated with the former gasoline- and waste-oil-storage tanks at the site had not been delineated below 100 ppm, with the exception of gasoline hydrocarbons which had been delineated to 15 ppm total petroleum hydrocarbons as gasoline (TPHg) northeast of the former gasoline tank excavation.

- The vertical extent of TPHg in the soil had been delineated to nondetectable (< 1.0 ppm) in soil samples obtained from 15-1/2 to 16-1/2 feet in soil borings B-6, B-7,

and B-8, and to nondetectable (<10 ppm) in soil samples obtained by GSI approximately 14 feet deep in the excavation beneath the former gasoline tanks. The vertical extent of gasoline hydrocarbons remained to be delineated in the eastern and southwestern vicinity of the former gasoline tanks, near the former waste-oil tank, and near the new gasoline storage tanks. The vertical extent of hydrocarbons associated with the former waste-oil tank had not been delineated in the vicinity of this tank.

- Laboratory analysis of soil samples obtained from soil boring B-6 near the former waste-oil tank for the total metals cadmium, chromium, lead, and zinc reported levels from 4.5 ppm cadmium to 287.1 ppm lead, and were below the levels of Total Threshold Limit Concentration Values in soil of Title 22 of the California State Administrative Code, recorded January 1988, for these respective metals. Laboratory analysis of the groundwater sample obtained from well MW-2 reported levels of the metals cadmium, chromium, lead, and zinc at or below the respective California State Department of Health Services (DHS) drinking water action levels.

- The lateral and vertical extent of hydrocarbons in the groundwater had not been delineated at the site. A source of gasoline hydrocarbons reported in the groundwater may be the gasoline hydrocarbons reported in the soil north and northwest of the former gasoline tank excavation. An additional offsite source of gasoline hydrocarbons may be indicated by the presence of a product sheen in well MW-3, which is located relatively crossgradient from the former gasoline storage tanks. The source of detectable concentrations of naphthalene, which is a minor constituent of gasoline, may be associated with the former gasoline-storage tanks, but the source of detectable concentrations of 2-methylnaphthalene and methylene chloride was uncertain.

TABLE A1
LABORATORY ANALYSIS OF SOIL SAMPLES
August 1989
ARCO Station 601
712 Lewelling Boulevard
San Leandro, California

Sample	TPHg	TOG	B	T	E	X	VOCs
S-5-B1	350	NA	8.3	19	5.1	26	NA
S-10-B1	610	NA	10	37	6	48	NA
S-15-B1	<10	NA	0.007	0.011	<0.005	0.012	NA
S-5-B2	12,000	NA	60	450	110	660	NA
S-10-B2	<1	NA	0.015	0.016	<0.005	0.018	NA
S-14-B2	<1	NA	0.015	0.030	<0.005	0.035	NA
S-5-B3	23	NA	0.710	<0.05	0.40	0.034	NA
S-10-B3	180	NA	0.700	3.2	1.4	9.6	NA
S-5-B4	12	NA	0.33	0.37	<0.05	0.75	NA
S-10-B4	65	NA	1.9	2.0	0.7	4.6	NA
S-5-B5	370	4,800	2.1	3.8	0.8	2.8	brl
S-10-B5	2,600	130	10	90	21	130	

Results are in parts per million (ppm)
TPHg = total petroleum hydrocarbons as gasoline
B = benzene; T = toluene; E = ethylbenzene; X = total xylenes
VOCs = volatile organic compounds
< = Below indicated laboratory reporting limit
brl = below laboratory reporting limit for respective compounds
NA = Not Analyzed
Sample Number explanation:

S-10-B5
| | └── Boring number
| └──── Sample depth in feet below ground surface
└────── Soil sample

TABLE A2
LABORATORY ANALYSIS OF SOIL SAMPLES BY GEOSTRATEGIES
January 1990
ARCO Station 601
712 Lewelling Boulevard
San Leandro, California
(Page 1 of 2)

Sample Number	TPHg	TPHd	TPHo	TOG	B	T	E	X
AP-1	6.8	NA	NA	NA	0.13	<0.025	<0.025	0.20
AP-2	12	NA	NA	NA	0.71	0.049	0.31	0.60
AP-3	47	NA	NA	NA	1.1	2.1	0.63	5.5
AP-4	120	NA	NA	NA	5.1	10	2.8	18
AP-5	42	NA	NA	NA	1.5	3.9	0.95	14
AT-1a	<10	NA	NA	NA	0.043	0.072	0.013	0.085
AT-1b	<10	NA	NA	NA	0.014	0.035	0.0079	0.046
AT-2a	<10	NA	NA	NA	<0.005	0.0068	<0.005	<0.005
AT-2b	<10	NA	NA	NA	0.0071	<0.005	<0.005	<0.005
AT-3a	<10	NA	NA	NA	0.023	0.041	0.013	0.036
AT-3b	<10	NA	NA	NA	0.016	<0.005	<0.005	0.0077
AT-4a	<10	NA	NA	NA	0.068	0.17	<0.005	0.014
AT-4b	<10	NA	NA	NA	<0.005	0.048	<0.005	0.08
ASW-1	1,600	NA	NA	NA	36	111	50	210
ASW-2	7,100	NA	NA	NA	175	509	220	980
ASW-3	140	NA	NA	NA	3.1	3.1	3.8	15
ASW-4	1,400	NA	NA	NA	12	46	26	129

See Notes on Page 2 of 2

TABLE A2
LABORATORY ANALYSIS OF SOIL SAMPLES BY GEOSTRATEGIES
January 1990
ARCO Station 601
712 Lewelling Boulevard
San Leandro, California
(Page 2 of 2)

Sample Number	TPHg	TPHd	TPHo	TOG	B	T	E	X
ANP-1	150	NA	NA	NA	8.1	3.9	5.8	20
ANP-2	36	NA	NA	NA	2	0.8	1.4	5.1
AWO-1	690	630	4,400	NA	<0.010	0.027	0.019	0.69
AWO-3	15	11	<50	<20	1.5	0.08	0.25	0.88
AWO-5	<3.0	<5	<50	<20	0.11	0.11	<0.03	0.10

Results are in parts per million (ppm)
TPHg = total petroleum hydrocarbons as gasoline
TPHd = Total Petroleum Hydrocarbons as diesel
TPHo = Total Petroleum Hydrocarbons as oil
TOG = Total Oil and Grease
B = benzene T = toluene E = ethylbenzene X = total xylenes
< = Below indicated laboratory reporting limit
NA = Not Analyzed

Sample Number explanation:

AP-5 = Product line soil sample
AT-4b = Former product tank number base soil sample
ASW-4 = Former product tank excavation sidewall soil sample
ANP-2 = New product tank excavation soil sample
AWO-5 = Former waste-oil tank excavation soil sample
Reference: Geostratigies Inc. Tank Replacement Report, June 29, 1990

TABLE A3
LABORATORY ANALYSIS OF SOIL SAMPLES
June 1990
ARCO Station 601
712 Lewelling Boulevard
San Leandro, California
(Page 1 of 2)

Sample Number	TPHg	TPHd	TOG	B	T	E	X	Organic Lead
S-4 1/2-B6	9.5	<10	190	1.4 (0.490)	0.099 (0.038)	0.25 (0.120)	1.3 (0.650)	NA
S-7 1/2-B6	420	280	130	6.0 (5.800)	27 (33.000)	8.8 (19.000)	52 (130.000)	NA
S-12-B6	6.5	<10	130	0.062 (<0.010)	0.29 (0.037)	0.10 (0.011)	0.60 (0.097)	<0.01
S-16 1/2-B6	<1.0	<10	63	<0.0050 (<0.010)	0.040 (0.015)	0.011 (<0.010)	0.069 (0.041)	NA
S-4 1/2-B7	9.3	NA	NA	0.71	0.040	0.18	0.68	NA
S-10-B7	15	NA	NA	0.99	0.71	0.50	1.3	<0.01
S-12 1/2-B7	<1.0	NA	NA	0.056	0.015	<0.0050	0.011	NA
S-16-B7	<1.0	NA	NA	0.0085	0.0071	<0.0050	0.0094	NA
S-6-B8	620	NA	NA	11	30	16	82	NA
S-9-B8	3.1	NA	NA	0.18	0.25	0.094	0.43	<0.01
S-12-B8	1.7	NA	NA	0.034	0.039	0.0098	0.046	NA
S-15 1/2-B8	<1.0	NA	NA	0.082	0.076	<0.0050	0.079	NA

See Notes on Page 2 of 2

TABLE A3
LABORATORY ANALYSIS OF SOIL SAMPLES
June 1990
ARCO Station 601
712 Lewelling Boulevard
San Leandro, California
(Page 2 of 2)

Sample Number	BNAs	VOCs	Cadmium	Chromium	Lead	Zinc
S-4 1/2-B6	brl	brl	9.4	63.0	287.1	63.9
S-7 1/2-B6	2.9[a], 2.6[b]	brl	4.5	49.8	242.0	51.3
S-12-B6	brl	brl	13.2	61.2	105.1	55.0
S-16 1/2-B6	brl	brl	13.5	64.8	100.5	53.0
TTLC			100	2,500	1,000	5,000

Results are in parts per million (ppm)
TPHg = total petroleum hydrocarbons as gasoline
B = benzene
T = toluene
E = ethylbenzene
X = total xylenes
( ) = BTEX results analyzed as VOCs
BNAs = base neutral and acid extractables including polynuclear aromatics ([a] = naphthalene, [b] = 2-methylnaphthalene)
VOCs = volatile organics except for BTEX
< = Below indicated laboratory reporting limit
brl = below laboratory reporting limit for respective compounds
NA = Not Analyzed
TTLC = Total threshold limit concentration values (Title 22 of the California Administrative Code, January 1988)
Sample Number explanation:

S-12-B6
- S-12-B6 — Boring number
- S-12-B6 — Sample depth in feet below ground surface
- S-12-B6 — Soil sample

APPENDIX B

FIELD METHODS
WELL PURGE DATA SHEETS

FIELD METHODS

Site Safety Plan

The Site Safety Plan (Applied GeoSystems, August 1, 1989) describes the safety requirements for the evaluation of gasoline hydrocarbons in soil and groundwater at the site. The site Safety Plan is applicable to personnel of RESNA and its subcontractors. RESNA personnel and subcontractors of RESNA scheduled to perform the work at the site were briefed on the contents of the Site Safety Plan before work began. A copy of the Site Safety Plan was available for reference by appropriate parties during the work. The Staff Geologist of RESNA was Site Safety Officer for the project.

Soil Borings

Prior to the drilling of borings and construction of monitoring wells, permits were acquired from the appropriate regulatory agency. A copy of the permit is included in Appendix C of this report. Prior to drilling, Underground Services Alert was notified of our intent to drill, and known underground utility lines and structures were marked. The borings were drilled by a truck-mounted drill rig equipped with 8- or 10-inch-diameter, hollow-stem augers. The augers were steam-cleaned prior to drilling each boring to minimize the possibility of cross-contamination. After the borings were drilled, monitoring wells were constructed in the borings, or the borings were backfilled to the ground surface with neat-cement grout and bentonite.

Borings for groundwater monitoring wells were drilled to a depth of no more than 20 feet below the depth at which a saturated zone was first encountered, or a short distance into a stratum beneath the saturated zone which was of moisture content and consistency to be judged as a perching layer by the field geologist, whichever was shallower.

Drill Cuttings

Drill cuttings subjectively evaluated for hydrocarbons at levels greater than 100 parts per million (ppm) were separated from those subjectively evaluated for hydrocarbons at levels less than 100 ppm. Evaluation was based either on subjective evidence of soil discoloration, or on measurements made using a field calibrated organic vapor meter (OVM). Readings were taken by placing a soil sample into a ziplock-type plastic bag and allowing volatilization to occur. The intake probe of the OVM was then inserted into the headspace created in the plastic bag immediately after opening it. The drill cuttings from the borings were placed

on plastic at the site, and covered with plastic. The cuttings were removed to a Class II Sanitary Landfill by ARCO.

Soil Sampling in Borings

Soil samples were collected at no greater than 5-foot intervals from the ground surface to the total depth of the borings. The soil samples were collected by advancing the boring to a point immediately above the sampling depth, and then driving a California-modified, split-spoon sampler containing brass sleeves through the hollow center of the auger into the soil. The sampler and brass sleeves were laboratory-cleaned, steam-cleaned, or washed thoroughly with Alconox® and water, prior to each use. The sampler was driven with a standard 140-pound hammer repeatedly dropped 30 inches. The number of blows to drive the sampler each successive six inches was counted and recorded to evaluate the relative consistency of the soil.

The samples selected for laboratory analysis were removed from the sampler and quickly sealed in their brass sleeves with aluminum foil, plastic caps, and aluminized duct tape. The samples were then labeled, promptly placed in iced storage, and delivered to a laboratory certified by the State of California to perform the analyses requested.

One of the samples in brass sleeves not selected for laboratory analysis at each sampling interval was tested in the field using an OVM that was field calibrated at the beginning of each day it was used. This testing was performed by inserting the intake probe of the OVM into the headspace created in the plastic bag containing the soil sample as described in the Drill Cuttings section above. The OVM readings are presented in Logs of Borings included in the report.

Logging of Borings

A geologist was present to log the soil cuttings and samples using the Unified Soil Classification System. Samples not selected for chemical analysis, and the soil in the sampler shoe, were extruded in the field for inspection. Logs include texture, color, moisture, plasticity, consistency, blow counts, and any other characteristics noted. Logs also include subjective evidence for the presence of hydrocarbons, such as soil staining, noticeable or obvious product odor, and OVM readings.

Monitoring Well Construction

Monitoring wells were constructed in selected borings using clean 4-inch-diameter, thread-jointed, Schedule 40 polyvinyl chloride (PVC) casing. No chemical cements, glues, or solvents were used in well construction. Each casing bottom was sealed with a threaded end-plug, and each casing top with a locking plug. The screened portions of the wells were constructed of machine-slotted PVC casing with 0.020-inch-wide slots for initial site wells. Slot size for subsequent wells will be based on sieve analysis and/or well development data. The screened sections in groundwater monitoring wells were placed to allow monitoring during seasonal fluctuations of groundwater levels.

The annular space of each well was backfilled with No. 2 by 12 sand, to approximately two feet above the top of the screened casing for initial site wells. The sand pack grain size for subsequent wells will be based on sieve analysis and/or well development data. A 1- to 2-foot-thick bentonite plug was placed above the sand as a seal against cement entering the filter pack. The remaining annulus was then backfilled with a slurry of water, neat cement, and bentonite to approximately one foot below the ground surface.

An aluminum utility box with a PVC apron was placed over each wellhead and set in concrete placed flush with the surrounding ground surface. Each wellhead cover has a seal to protect the monitoring well against surface-water infiltration and requires a special wrench to open. The design discourages vandalism and reduces the possibility of accidental disturbance of the well.

Groundwater Monitoring Well Development

The monitoring wells were developed by bailing or over-pumping and surge-block techniques. The wells were either bailed or pumped, allowed to recharge, and bailed or pumped again until the water removed from the wells was subjectively evaluated to be clear by the field geologist. The wells were allowed to equilibrate for at least 48 hours after development prior to sampling. Water generated by well development was stored in 17E Department of Transportation (DOT) 55-gallon drums on site and was removed on August 21, 1990 by ARCO's subcontractor H&H Environmental Services of San Francisco, California.

Groundwater Sampling

The static water level in each well was measured to the nearest 0.01-foot using a Solinst® electric water-level sounder cleaned with Alconox® and water before use in each well. The

liquid in the onsite wells was examined for visual evidence of hydrocarbons by gently lowering approximately half the length of a Teflon® bailer (cleaned with Alconox® and water) past the air/water interface. The sample was then retrieved and inspected for floating product, sheen, emulsion, color, and clarity. The thickness of floating product detected was recorded to the nearest 0.1-inch.

Wells which did not contain floating product were purged using a submersible pump. The pump, cables, and hoses were cleaned with Alconox® and water prior to use in each well. The wells were purged until withdrawal was of sufficient volume to result in stabilized pH, temperature, and electrical conductivity of the water, as measured using portable meters calibrated to standard water solutions. If a purged well became de-watered, the water level was allowed to recover to at least 80 percent of the initial water level. Prior to the collection of each groundwater sample, the Teflon® bailer was cleaned with Alconox® and rinsed with tap water and deionized water, and the latex gloves worn by the sampler changed. Hydrochloric acid was added to the sample vials as a preservative (as required for specific laboratory analysis). A sample-method blank was collected by pouring distilled water into the bailer and then into sample vials. A sample of the groundwater was then collected from the surface of the water in each of the wells using the Teflon® bailer. The water samples were then gently poured into laboratory-cleaned, 40-milliliter (ml) glass vials, 500 ml plastic bottles, or 1-liter glass bottles (as required for specific laboratory analysis) and sealed with Teflon®-lined caps, and inspected for air bubbles to check for headspace, which would allow volatilization to occur. The samples were then labeled and promptly placed in iced storage. A field log of well purging procedures and parameter monitoring was maintained. Water generated by the purging of wells was stored in 17E DOT 55-gallon drums onsite, and was removed and disposed of by ARCO's subcontractor H & H Environmental Services of San Francisco on August 21, 1990.

Vadose-Zone Sampling

Vapor readings are made with a field calibrated OVM, which has a lower detection limit of 0.1 ppm. Prior to purging each vadose-zone monitoring well, an initial reading is taken inside the well by connecting the tubing of the OVM to a tight fitting at the top of the well. Each vadose-zone monitoring well is then purged for approximately 60 seconds using an electric vacuum pump connected to the tight fitting. Ambient readings of the air at the site are taken with the OVM after each well is purged. The OVM is then connected to the well fitting, and the reading recorded. The well is then again purged for approximately 30 seconds, and again measured using the OVM. These purging and measuring procedures are repeated until two consecutive OVM readings are within ten percent of each other.

Sample Labeling and Handling

Sample containers were labeled in the field with the job number, sample location and depth, and date, and promptly placed in iced storage for transport to the laboratory. A Chain of Custody Record was initiated by the field geologist and updated throughout handling of the samples, and accompanied the samples to a laboratory certified by the State of California for the analyses requested. Copies of the Chain of Custody records are included in Appendix E. Samples will be properly disposed of after their useful life has expired.

WELL PURGE DATA SHEET

Project Name: ARCO 601 Job No. 69034-4

Date: 6/10/91 Page 1 of 2

Well No. MW-2 Time Started 11:53

Time (hr)	Gallons (cum.)	Temp. (F)	pH	Conduct. (micromoh)	Turbidity (NTU)
11:53	Begin pumping well MW-2				
11:57	1	72.9	7.27	14.52	14.4
12:00	2	70.4	6.96	13.55	9.5
12:04	3	69.9	6.87	13.28	15.1
12:08	4	68.6	6.85	13.15	9.8
12:11	5	68.5	6.88	13.27	15.8
12:14	6	68.0	6.88	13.16	12.9
12:22	7	66.7	6.88	13.00	21.4
12:24	8	67.5	6.83	13.12	14.8
12:27	9	67.7	6.86	13.35	22.6
12:31	10	67.2	6.88	12.78	20.5
12:33	11	67.5	6.84	13.31	30.7
12:37	12	67.6	6.88	13.42	22.8
12:42	13	67.4	6.90	13.61	44.6
12:46	14	68.1	6.83	12.98	31.9
12:54	18	68.2	6.88	13.62	65.5
12:59	20	68.6	6.92	13.76	85.9
13:13	25	69.8	6.96	14.15	53.4
14:47	28	78.1	6.94	15.72	46.5
14:55	31	77.5	6.94	15.13	30.0
15:04	34	76.7	6.87	15.12	42.4

RESNA

WELL PURGE DATA SHEET

Project Name: ARCO 601 Job No. 69034-3

Date: 10/15/90 Page 2 of 2

Well No. MW-2 (continued) Time Started 11:53

Time (hr)	Gallons (cum.)	Temp. (F)	pH	Conduct. (micromoh)	Turbidity (NTU)
15:14	37	76.7	7.00	15.13	38.9
	Stop pumping MW-2				

Notes:

Depth to Bottom (feet)	12.33
Depth to Water - initial (feet)	7.58
Depth to Water - final (feet)	7.92
% recovery	95.7
Time Sampled	17:15
Gallons per Well Casing Volume	3.1
Gallons Purged	37
Well Casing Volumes Purged	11.9
Approximate Pumping Rate (gpm)	0.36

RESNA

WELL PURGE DATA SHEET

Project Name: ARCO 601 Job No. 69034-4

Date: 6/10/91 Page 1 of 1

Well No. MW-5 Time Started 13:19

Time (hr)	Gallons (cum.)	Temp. (F)	pH	Conduct. (micromoh)	Turbidity (NTU)
13:19	Begin pumping well MW-5				
13:22	1	73.4	9.78	8.03	15.5
13:26	2	73.4	9.89	8.04	>200
	Well dewater, stop pumping MW-5				

Notes:

Depth to Bottom (feet) :	9.88
Depth to Water - initial (feet) :	7.58
Depth to Water - final (feet) :	7.58
% recovery :	100
Time Sampled :	17:30
Gallons per Well Casing Volume :	1.5
Gallons Purged :	2.0
Well Casing Volumes Purged :	1.3
Approximate Pumping Rate (gpm) :	0.28

RESNA

WELL PURGE DATA SHEET

Project Name: ARCO 601 Job No. 69034-4

Date: 6/10/91 Page 1 of 1

Well No. MW-8 Time Started 13:35

Time (hr)	Gallons (cum.)	Temp. (F)	pH	Conduct. (micromoh)	Turbidity (NTU)
13:35	Begin pumping well MW-8				
13:39	1	78.7	7.12	14.25	>200
13:41	2	77.1	7.14	14.90	>200
	Well dewater, stop pumping MW-8				

Notes:

Depth to Bottom (feet)	: 10.50
Depth to Water - initial (feet)	: 7.80
Depth to Water - final (feet)	: 7.98
% recovery	: 97.7
Time Sampled	: 17:00
Gallons per Well Casing Volume	: 1.8
Gallons Purged	: 2.0
Well Casing Volumes Purged	: 1.1
Approximate Pumping Rate (gpm)	: 0.33

RESNA

APPENDIX C

WELL CONSTRUCTION PERMIT

ALAMEDA COUNTY FLOOD CONTROL AND WATER CONSERVATION DISTRICT

5997 PARKSIDE DRIVE • PLEASANTON, CALIFORNIA 94588 • (415) 484-2600

GROUNDWATER PROTECTION ORDINANCE PERMIT APPLICATION

FOR APPLICANT TO COMPLETE

LOCATION OF PROJECT ARCO Station 601
712 Lewelling Boulevard
San Leandro, California

CLIENT
Name ARCO Products Company
Address P.O. Box 5811 Phone (415)571-2434
City San Mateo Zip CA 94402

APPLICANT
Name RESNA/Applied GeoSystems
Barbara Sieminski
Address 3315 Almaden Expy. Suite 34 Phone (408)264-7723
City San Jose Zip CA 95118

TYPE OF PROJECT

Well Construction		Geotechnical Investigation	
Cathodic Protection	___	General	___
Water Supply	___	Contamination	___
Monitoring	V	Well Destruction	___

PROPOSED WATER SUPPLY WELL USE
Domestic ___ Industrial ___ Other ___
Municipal ___ Irrigation ___

DRILLING METHOD:
Mud Rotary ___ Air Rotary ___ Auger V Hollowstem
Cable ___ Other ___

DRILLER'S LICENSE NO. C-57 596545

WELL PROJECTS
Drill Hole Diameter 10 in. Maximum
Casing Diameter 4 in. Depth 20 ft.
Surface Seal Depth 5 ft. Number 6

GEOTECHNICAL PROJECTS
Number of Borings ___ Maximum
Hole Diameter ___ in. Depth ___ ft.

ESTIMATED STARTING DATE 5/28/91
ESTIMATED COMPLETION DATE 5/30/91

I hereby agree to comply with all requirements of this permit and Alameda County Ordinance No. 73-68.

APPLICANT'S SIGNATURE Barbara Sieminski Date 5/16/91

FOR OFFICE USE

PERMIT NUMBER 91281
LOCATION NUMBER ___

PERMIT CONDITIONS

Circled Permit Requirements Apply

(A.) GENERAL
1. A permit application should be submitted so as arrive at the Zone 7 office five days prior proposed starting date.
2. Submit to Zone 7 within 60 days after completi of permitted work the original Department Water Resources Water Well Drillers Report equivalent for well projects, or drilling lo and location sketch for geotechnical projects.
3. Permit is void if project not begun within days of approval date.

(B.) WATER WELLS, INCLUDING PIEZOMETERS
1. Minimum surface seal thickness is two inches cement grout placed by tremie.
2. Minimum seal depth is 50 feet for municipal a industrial wells or 20 feet for domestic an irrigation wells unless a lesser depth specially approved. Minimum seal depth f monitoring wells is the maximum depth practicab or 20 feet.

C. GEOTECHNICAL. Backfill bore hole with compacted cu tings or heavy bentonite and upper two feet with co pacted material. In areas of known or suspect contamination, tremied cement grout shall be used place of compacted cuttings.

D. CATHODIC. Fill hole above anode zone with concre placed by tremie.

E. WELL DESTRUCTION. See attached.

Approved Wyman Hong Date 20 May 9
Wyman Hong

12198

ALAMEDA COUNTY FLOOD CONTROL AND WATER CONSERVATION DISTRICT
5997 PARKSIDE DRIVE • PLEASANTON, CALIFORNIA 94588 • (415) 484-2600

21 May 1991

Applied GeoSystems
3315 Almaden Expressway, Ste. 34
San Jose, CA 95118

Gentlemen:

Enclosed is Drilling permit 91281 for a monitoring well construction project at 712 Lewelling Boulevard in San Leandro for Arco Products Company.

Please note that permit condition A-2 requires that a well construction report be submitted after completion of the work. The report should include drilling and completion logs, location sketch, and permit number.

If you have any questions, please contact Wyman Hong or me at 484-2600.

Very truly yours,

Craig A. Mayfield

Craig A. Mayfield
Water Resources Engineer

WH:mm
Enc.

APPENDIX D

WELLHEAD SURVEY

JOHN E. KOCH
Land Surveyor
CA. State Lic. No. LS4811
5427 Telegraph Ave., Suite A
Oakland, CA 94609
(415)655-9956
FAX(415)655-9745

06/26/91

Applied GeoSystems
3315 Almaden Expressway, Suite 34
San Jose, CA 95118
(408)264-7723
FAX(408)264-2435

Tabulation of Elevations as of
01:00 p.m. 06/20/91

Job #91037
AGS Project 69034-4
Assistant Project Geologist:Joel Coffman
Site: Arco Station 601
712 Lewelling Boulevard
@ Washington Ave.
San Leandro, CA

BENCHMARK: Cinch nail on curb at Storm Water Inlet at NW corner of the intersection of Lewelling and Washington (El. 21.107').

MONITOR WELL DATA TABLE

Well Designation	Elevation	Description
MW-1	22.26	Top of PVC casing
	22.65	Top of Box
MW-2	21.33*	Top of PVC casing
	21.57*	Top of Box
MW-3	20.11	Top of PVC casing
	20.39	Top of Box
MW-4	20.75	Top of PVC Casing
	21.08	Top of Box
MW-5	20.90	Top of PVC Casing
	21.32	Top of Box
MW-6	22.08	Top of PVC Casing
	22.36	Top of Box

JOHN E. KOCH, P.L.S. AGS JOB #69034-4 JEK JOB #91037

MW-7	22.89	Top of PVC Casing
	23.16	Top of Box
MW-8	20.97	Top of PVC Casing
	21.26	Top of Box

NOTES:

1. Datum is City of San Leandro= 1973 Adj., NGS

2. TBM JEK #91037 (El. 23.00') is at the top of SE 1- 1/8" bolt on signal standard. Located at westerly side of Washington and southerly side of Lewelling.

3. Top of PVC Casing elevation located on the top of a 4" PVC for all wells.

4. Top of Box elevation located at the rim of "Christie" box for all wells.

5. * denotes that the elevation arrived at was achieved by subtracting the mean differential of 0.73 feet found between the current elevations of MW-1 (0.72') and MW-3 (0.73') and previous data of 07/17/90 provided by client. MW-2 was not surveyed on the above date.

JOHN E. KOCH
Land Surveyor
CA. State Lic. No. LS4811
5427 Telegraph Ave., Suite A
Oakland, CA 94609
(415)655-9956
FAX(415)655-9745

06/28/91

Applied GeoSystems
3315 Almaden Expressway, Suite 34
San Jose, CA 95118
(408)264-7723
FAX(408)264 2435

Tabulation of Elevations as of
01:00 p.m. 06/20/91

Job #91037
AGS Project #69034-4
Assistant Project Geologist:Joel Coffman
Site: Arco Station 601
712 Lewelling Boulevard
@ Washington Ave.
San Leandro, CA

Well #	Gd. El.	Orient	T.O.C. El.	Casing dia.	Casing Orient
MW-1	22.65	N	22.26	4"	N
MW-2	21.57*	*	21.33*	*	*
MW-3	20.39	N	20.11	4"	N
MW-4	21.08	N	20.75	4"	N
MW-5	21.32	N	20.90	4"	N
MW-6	22.36	N	22.08	4"	N
MW-7	23.16	N	22.89	4"	N
MW-8	21.26	N	20.97	4"	N

NOTES:

1. Datum is City of San Leandro= 1973 Adj., NGS

2. Bench Mark (El. = 21.107') is a cinch nail on curb at Storm Water Inlet at NW corner of the intersection of Lewelling Blvd. and Washington Ave.

3. TBM JEK #91037 (El. 23.00') is at the top of SE 1 1/8" bolt on signal standard. Located at westerly side of Washington and southerly side of Lewelling.

4. Ground elevation (Gd. El.) is at the top of "Christie" box for all wells.

5. Top of Casing elevation (T.O.C. El.) is at found mark on top of PVC for MW-1 and MW-3; at set mark on top of PVC for MW's 4-8.

6. * denotes that the elevation arrived at was achieved by subtracting the mean differential of 0.73 feet found between the current elevations of MW-1 (0.72') and MW-3 (o.73') and previous data of 07/17/90 provided by client. MW-2 was not surveyed on the above date.

APPENDIX E

LABORATORY ANALYSIS REPORTS
CHAIN OF CUSTODY RECORDS

SEQUOIA ANALYTICAL

680 Chesapeake Drive • Redwood City, CA 94063
(415) 364-9600 • FAX (415) 364-9233

Applied GeoSystems
3315 Almaden Expressway, Ste 34
San Jose, CA 95118
Attention: Joel Coffman

Project: Arco, SS-601,San Leandro

Enclosed are the results from 22 soil samples received at Sequoia Analytical on May 31,1991. The requested analyses are listed below:

SAMPLE #	SAMPLE DESCRIPTION	DATE OF COLLECTION	TEST METHOD
1054394	Soil, S-5.5-B-9	5/29/91	EPA 5030/8015/8020
1054395	Soil, S-7-B-9	5/29/91	EPA 5030/8015/8020
1054396	Soil, S-8.5-B-9	5/29/91	EPA 5030/8015/8020
1054397	Soil, S-11.5-B-9	5/29/91	EPA 5030/8015/8020
1054398	Soil, S-14.5-B-9	5/29/91	EPA 5030/8015/8020
1054399	Soil, S-17.5-B-9	5/29/91	EPA 5030/8015/8020
1054400	Soil, S-5.5-B10	5/29/91	EPA 5030/8015/8020
1054401	Soil, S-7.5-B10	5/29/91	EPA 5030/8015/8020
1054402	Soil, S-10-B10	5/29/91	EPA 5030/8015/8020
1054403	Soil, S-16-B10	5/29/91	EPA 5030/8015/8020
1054404	Soil, S-16.0-11A	5/30/91	EPA 5030/8015/8020
1054405	Soil, S-5.5-B11B	5/30/91	EPA 5030/8015/8020
1054406	Soil, S-8.5-B11B	5/30/91	EPA 5030/8015/8020
1054407	Soil, S-12.0-B11B	5/30/91	EPA 5030/8015/8020
1054408	Soil, S-15.0-B11B	5/30/91	EPA 5030/8015/8020
1054409	Soil, S-5.5-B12	5/29/91	EPA 3550/8015 EPA 5030/8015/8020 SM 5520 E&F (Gravimetric)
1054410	Soil, S-7.5-B12	5/29/91	EPA 3550/8015 EPA 5030/8015/8020 SM 5520 E&F (Gravimetric)
1054411	Soil, S-10.5-B12	5/29/91	EPA 3550/8015 EPA 5030/8015/8020

SEQUOIA ANALYTICAL

680 Chesapeake Drive • Redwood City, CA 94063
(415) 364-9600 • FAX (415) 364-9233

SAMPLE #	SAMPLE DESCRIPTION	DATE OF COLLECTION	TEST METHOD
			SM 5520 E&F (Gravimetric)
1054412	Soil, S-14.5-B12	5/29/91	EPA 3550/8015 EPA 5030/8015/8020 SM 5520 E&F (Gravimetric)
1054413	Soil, S-5.5-B13	5/29/91	EPA 3550/8015 EPA 5030/8015/8020 SM 5520 E&F (Gravimetric)
1054414	Soil, S-11-B13	5/29/91	EPA 3550/8015 EPA 5030/8015/8020 SM 5520 E&F (Gravimetric)
1054415	Soil, S-15-B13	5/29/91	EPA 3550/8015 EPA 5030/8015/8020 SM 5520 E&F (Gravimetric)

Please contact me if you have any questions. In the meantime, thank you for the opportunity to work with you on this project.

Very truly yours,

SEQUOIA ANALYTICAL

MTague /for

Elizabeth W. Hackl
Project Manager

SEQUOIA ANALYTICAL

680 Chesapeake Drive • Redwood City, CA 94063
(415) 364-9600 • FAX (415) 364-9233

Applied GeoSystems	Client Project ID:	Arco, SS-601,San Leandro	Sampled:	May 29, 1991
3315 Almaden Expressway, Ste 34	Matrix Descript:	Soil	Received:	May 31, 1991
San Jose, CA 95118	Analysis Method:	EPA 5030/8015/8020	Analyzed:	6/5-6/91
Attention: Joel Coffman	First Sample #:	105-4394	Reported:	Jun 12, 1991

TOTAL PETROLEUM FUEL HYDROCARBONS with BTEX DISTINCTION (EPA 8015/8020)

Sample Number	Sample Description	Low/Medium B.P. Hydrocarbons mg/kg (ppm)	Benzene mg/kg (ppm)	Toluene mg/kg (ppm)	Ethyl Benzene mg/kg (ppm)	Xylenes mg/kg (ppm)
105-4394	S-5.5-B-9	120	1.6	4.2	1.9	12
105-4395	S-7-B-9	420	5.9	24	8.4	48
105-4396	S-8.5-B-9	170	3.7	14	3.5	20
105-4397	S-11.5-B-9	N.D.	N.D.	N.D.	N.D.	N.D.
105-4398	S-14.5-B-9	N.D.	N.D.	N.D.	N.D.	N.D.
105-4399	S-17.5-B-9	N.D.	N.D.	N.D.	N.D.	N.D.
105-4400	S-5.5-B10	500	2.8	8.1	7.4	34
105-4401	S-7.5-B10	2,700	27	150	65	370
105-4402	S-10-B10	4.9	0.33	0.33	0.10	0.51
105-4403	S-16-B10	N.D.	N.D.	N.D.	N.D.	N.D.
Detection Limits:		**1.0**	**0.0050**	**0.0050**	**0.0050**	**0.0050**

Low to Medium Boiling Point Hydrocarbons are quantitated against a gasoline standard.
Analytes reported as N.D. were not present above the stated limit of detection.

SEQUOIA ANALYTICAL

Bjorn A. Bjorkman
Project Manager

SEQUOIA ANALYTICAL

680 Chesapeake Drive • Redwood City, CA 94063
(415) 364-9600 • FAX (415) 364-9233

Applied GeoSystems	Client Project ID:	Arco, SS-601,San Leandro	Sampled:	May 30, 1991
3315 Almaden Expressway, Ste 34	Matrix Descript:	Soil	Received:	May 31, 1991
San Jose, CA 95118	Analysis Method:	EPA 5030/8015/8020	Analyzed:	Jun 5, 1991
Attention: Joel Coffman	First Sample #:	105-4404	Reported:	Jun 12, 1991

TOTAL PETROLEUM FUEL HYDROCARBONS with BTEX DISTINCTION (EPA 8015/8020)

Sample Number	Sample Description	Low/Medium B.P. Hydrocarbons mg/kg (ppm)	Benzene mg/kg (ppm)	Toluene mg/kg (ppm)	Ethyl Benzene mg/kg (ppm)	Xylenes mg/kg (ppm)
105-4404	S-16.0-B11A	N.D.	N.D.	N.D.	N.D.	N.D.
105-4405	S-5.5-B11B	4.4	0.72	0.019	0.022	0.041
105-4406	S-8.5-B11B	100	3.0	9.3	2.7	1.5
105-4407	S-12.0-B11B	N.D.	0.011	0.019	0.0055	0.025
105-4408	S-15.0-B11B	N.D.	N.D.	N.D.	N.D.	N.D.
105-4409	S-5.5-B12	N.D.	N.D.	N.D.	N.D.	N.D.
105-4410	S-7.5-B12	N.D.	N.D.	N.D.	N.D.	N.D.
105-4412	S-14.5-B12	N.D.	N.D.	N.D.	N.D.	N.D.
105-4413	S-5.5-B13	8.4	0.022	0.017	0.20	0.059
105-4414	S-11-B13	N.D.	N.D.	N.D.	N.D.	N.D.
Detection Limits:		**1.0**	**0.0050**	**0.0050**	**0.0050**	**0.0050**

Low to Medium Boiling Point Hydrocarbons are quantitated against a gasoline standard.
Analytes reported as N.D. were not present above the stated limit of detection.

SEQUOIA ANALYTICAL

Elizabeth W. Hackl
Project Manager

SEQUOIA ANALYTICAL

680 Chesapeake Drive • Redwood City, CA 94063
(415) 364-9600 • FAX (415) 364-9233

Applied GeoSystems	Client Project ID:	Arco, SS-601,San Leandro	Sampled:	May 29, 1991
3315 Almaden Expressway, Ste 34	Matrix Descript:	Soil	Received:	May 31, 1991
San Jose, CA 95118	Analysis Method:	EPA 5030/8015/8020	Analyzed:	Jun 5, 1991
Attention: Joel Coffman	First Sample #:	105-4415	Reported:	Jun 12, 1991

TOTAL PETROLEUM FUEL HYDROCARBONS with BTEX DISTINCTION (EPA 8015/8020)

Sample Number	Sample Description	Low/Medium B.P. Hydrocarbons mg/kg (ppm)	Benzene mg/kg (ppm)	Toluene mg/kg (ppm)	Ethyl Benzene mg/kg (ppm)	Xylenes mg/kg (ppm)
105-4415	S-15-B-13	N.D.	N.D.	N.D.	N.D.	N.D.
Detection Limits:		**1.0**	**0.0050**	**0.0050**	**0.0050**	**0.0050**

Low to Medium Boiling Point Hydrocarbons are quantitated against a gasoline standard.
Analytes reported as N.D. were not present above the stated limit of detection.

SEQUOIA ANALYTICAL

Bjorn A. Bjorkman
Project Manager

SEQUOIA ANALYTICAL

680 Chesapeake Drive • Redwood City, CA 94063
(415) 364-9600 • FAX (415) 364-9233

Applied GeoSystems	Client Project ID:	Arco, SS-601,San Leandro	Sampled:	May 29, 1991
3315 Almaden Expressway, Ste 34	Matrix Descript:	Soil	Received:	May 31, 1991
San Jose, CA 95118	Analysis Method:	EPA 5030/8015/8020	Analyzed:	Jun 5, 1991
Attention: Joel Coffman	First Sample #:	105-4411	Reported:	Jun 12, 1991

TOTAL PETROLEUM FUEL HYDROCARBONS with BTEX DISTINCTION (EPA 8015/8020)

Sample Number	Sample Description	Low/Medium B.P. Hydrocarbons mg/kg (ppm)	Benzene mg/kg (ppm)	Toluene mg/kg (ppm)	Ethyl Benzene mg/kg (ppm)	Xylenes mg/kg (ppm)
105-4411	S-10.5-B12	23	N.D.	0.24	0.50	2.2
Detection Limits:		**10**	**0.050**	**0.050**	**0.050**	**0.050**

Low to Medium Boiling Point Hydrocarbons are quantitated against a gasoline standard.
Analytes reported as N.D. were not present above the stated limit of detection. Because matrix effects and/or other factors required additional sample dilution, detection limits for this sample have been raised.

SEQUOIA ANALYTICAL

Bjorn A. Bjorkman
Project Manager

SEQUOIA ANALYTICAL

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Applied GeoSystems	Client Project ID:	Arco, SS-601,San Leandro	Sampled:	May 29, 1991
3315 Almaden Expressway, Ste 34	Matrix Descript:	Soil	Received:	May 31, 1991
San Jose, CA 95118	Analysis Method:	EPA 3550/8015	Extracted:	Jun 4, 1991
Attention: Joel Coffman	First Sample #:	105-4409	Analyzed:	Jun 5, 1991
			Reported:	Jun 12, 1991

TOTAL PETROLEUM FUEL HYDROCARBONS (EPA 8015)

Sample Number	Sample Description	High B.P. Hydrocarbons mg/kg (ppm)
105-4409	S-5.5-B12	N.D.
105-4410	S-7.5-B12	N.D.
105-4411	S-10.5-B12	6.0
105-4412	S-14.5-B12	N.D.
105-4413	S-5.5-B13	15
105-4414	S-11-B13	N.D.
105-4415	S-15-B13	N.D.

Detection Limits:	**1.0**

High Boiling Point Hydrocarbons are quantitated against a diesel fuel standard.
Analytes reported as N.D. were not present above the stated limit of detection.

SEQUOIA ANALYTICAL

Bjorn A. Bjorkman
Project Manager

SEQUOIA ANALYTICAL

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(415) 364-9600 • FAX (415) 364-9233

Applied GeoSystems	Client Project ID:	Arco, SS-601,San Leandro	Sampled:	May 29, 1991
3315 Almaden Expressway, Ste 34	Matrix Descript:	Soil	Received:	May 31, 1991
San Jose, CA 95118	Analysis Method:	SM 5520 E&F (Gravimetric)	Extracted:	Jun 4, 1991
Attention: Joel Coffman	First Sample #:	105-4409	Analyzed:	Jun 4, 1991
			Reported:	Jun 12, 1991

TOTAL RECOVERABLE PETROLEUM OIL

Sample Number	Sample Description	Oil & Grease mg/kg (ppm)
105-4409	S-5.5-B12	N.D.
105-4410	S-7.5-B12	N.D.
105-4411	S-10.5-B12	N.D.
105-4412	S-14.5-B12	N.D.
105-4413	S-5.5-B13	N.D.
105-4414	S-11-B13	N.D.
105-4415	S-15-B13	N.D.

Detection Limits:	**30**

Analytes reported as N.D. were not present above the stated limit of detection.

SEQUOIA ANALYTICAL

Bjorn A. Bjorkman
Project Manager

SEQUOIA ANALYTICAL

680 Chesapeake Drive • Redwood City, CA 94063
(415) 364-9600 • FAX (415) 364-9233

Applied GeoSystems
3315 Almaden Expressway, Ste 34
San Jose, CA 95118
Attention: Joel Coffman

Client Project ID: Arco, SS-601,San Leandro
QC Sample Group: 1054394 - 15
Reported: Jun 12, 1991

QUALITY CONTROL DATA REPORT

ANALYTE	Benzene	Toluene	Ethyl Benzene	Xylenes	Diesel	Ttl. Oil & Grease
Method:	EPA 8015/8020	EPA 8015/8020	EPA 8015/8020	EPA 8015/8020	EPA 8015	SM5520E&F
Analyst:	R.Eastman	R.Eastman	R.Eastman	R.Eastman	R.Lee	L.Laikhtman
Reporting Units:	ng	ng	ng	ng	ng/L	mg/L
Date Analyzed:	Jun 1, 1991	Jun 1, 1991	Jun 1, 1991	Jun 1, 1991	Jun 5, 1991	Jun 4, 1991
QC Sample #:	GBLK060191	GBLK060191	GBLK060191	GBLK060191	DBLK060491	BLK6/4/91
Sample Conc.:	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Spike Conc. Added:	100	100	100	300	900	100
Conc. Matrix Spike:	100	110	100	310	880	83
Matrix Spike % Recovery:	100	110	100	100	98	83
Conc. Matrix Spike Dup.:	99	100	100	300	750	77
Matrix Spike Duplicate % Recovery:	99	100	100	100	83	77
Relative % Difference:	1.0	9.5	0.0	3.3	16	6.3

Quality Assurance Statement: All standard operating procedures and quality control requirements have been met.

SEQUOIA ANALYTICAL

Bjorn A. Bjorkman
Project Manager

% Recovery:	Conc. of M.S. - Conc. of Sample / Spike Conc. Added	x 100
Relative % Difference:	Conc. of M.S. - Conc. of M.S.D. / (Conc. of M.S. + Conc. of M.S.D.) / 2	x 100

SEQUOIA ANALYTICAL

680 Chesapeake Drive • Redwood City, CA 94063
(415) 364-9600 • FAX (415) 364-9233

Applied GeoSystems
3315 Almaden Expressway, Ste 34
San Jose, CA 95118
Attention: Joel Coffman

Client Project ID: Arco, SS-601,San Leandro

QC Sample Group: 1054394 - 15

Reported: Jun 12, 1991

QUALITY CONTROL DATA REPORT

ANALYTE	Benzene	Toluene	Ethyl Benzene	Xylenes
Method:	EPA 8015/8020	EPA 8015/8020	EPA 8015/8020	EPA 8015/8020
Analyst:	L.Gonzales	L.Gonzales	L.Gonzales	L.Gonzales
Reporting Units:	ng	ng	ng	ng
Date Analyzed:	Jun 5, 1991	Jun 5, 1991	Jun 5, 1991	Jun 5, 1991
QC Sample #:	GBLK060591	GBLK060591	GBLK060591	GBLK060591
Sample Conc.:	N.D.	N.D.	N.D.	N.D.
Spike Conc. Added:	100	100	100	300
Conc. Matrix Spike:	100	100	100	300
Matrix Spike % Recovery:	100	100	100	100
Conc. Matrix Spike Dup.:	95	94	93	270
Matrix Spike Duplicate % Recovery:	95	94	93	90
Relative % Difference:	5.1	6.2	7.3	11

Quality Assurance Statement: All standard operating procedures and quality control requirements have been met.

SEQUOIA ANALYTICAL

Bjorn A. Bjorkman
Project Manager

% Recovery:	Conc. of M.S. - Conc. of Sample / Spike Conc. Added	x 100
Relative % Difference:	Conc. of M.S. - Conc. of M.S.D. / (Conc. of M.S. + Conc. of M.S.D.) / 2	x 100

ARCO Products Company
Division of AtlanticRichfieldCompany

Chain of Custody

Task Order No. 362-91-2

ARCO Facility no. 88-601	City (Facility) San Leandro	Project manager (Consultant) JOEL GOFFMAN	Laboratory name SEQUOIA
ARCO engineer CHUCK CARMEL	Telephone no. (ARCO) 415 571 2469	Telephone no. (Consultant) 408 264 7723	Fax no. (Consultant) 408 264 2435	Contract number 07-073
Consultant name Applied GeoSystems	Address (Consultant) 3315 Almaden Expy #34 San Jose, CA		Method of shipment Prime courier #396

Sample I.D.	Lab no.	Container no.	Matrix: Soil	Matrix: Water	Matrix: Other	Preservation: Ice	Preservation: Acid	Sampling date	Sampling time	BTEX 602/EPA 8020	BTEX/TPH EPA M602/8020/8015	TPH Modified 8015 Gas ☐ Diesel ☒	Oil and Grease 413.1 ☐ 413.2 ☐	TPH EPA 418.1/SM503E	EPA 601/8010	EPA 624/8240	EPA 625/8270	TCLP Semi Metals ☐ VOA ☐ VOA ☐	CAM Metals EPA 6010/7000 TTLC ☐ STLC ☐	Lead Org./DHS ☐ Lead EPA 7420/7421 ☐
S5.5, B11b			X			X		5-30-91			X						10544405			
S8.5, B11b											X						4406			
S12.0, B11b											X						4407			
S15.0, B11b								5-30-91			X						4408			
S5.5, B12								5-29-91			X	X	X				4409			
S7.5, B12											X	X	X				4410			
S10.5, B12											X	X	X				4411			
S14.5, B12											X	X	X				4412			
S5.5, B13											X	X	X				4413			
S11.0, B13											X	X	X				4414			
S15.0, B-13			X			X		5-29-91			X	X	X				4515			

Special detection Limit/reporting

Special QA/QC

Remarks
Oil & Grease by Compareable Method to 5520 E F

Lab number

Turnaround time
- Priority Rush 1 Business Day ☐
- Rush 2 Business Days ☐
- Expedited 5 Business Days ☐
- Standard 10 Business Days ☒

Condition of sample: GOOD
Temperature received: cold

	Date	Time	Received by
Relinquished by sampler: Joel Goffman	5-31-91	3:00 PM ~~5-31-91~~	Received by: Royce C. Winkel
Relinquished by: Royce C. Winkel	5-31-91	4:10 PM	Received by: K. Neill
Relinquished by:	Date	Time	Received by laboratory: K. Wallace — Date: 5/31 — Time: 4:10pm

Distribution: White copy — Laboratory; Canary copy — ARCO Environmental Engineering; Pink copy — Consultant
APPC-3292 (2-91)

ARCO engineer: Chuck Carmel | Telephone no. (ARCO): (415) 571-2469 | Telephone no. (Consultant): (408) 264-7723 | Fax no. (Consultant): (408) 264-2435

Consultant name: Applied Geosystems | Address (Consultant): 3315 Almaden Expy. #34 San Jose, CA

Sequoia

Contract number: 07-073

Method of shipment: Prime Courier #386

Sample I.D.	Lab no.	Container no.	Matrix: Soil	Matrix: Water	Matrix: Other	Preservation: Ice	Preservation: Acid	Sampling date	Sampling time	BTEX 602/EPA 8020	BTEX/TPH 9a.5 EPA M602/8020/8015	TPH Modified 8015 Gas ☐ Diesel ☐	Oil and Grease 413.1 ☐ 413.2 ☐	TPH EPA 418.1/SM503E	EPA 601/8010	EPA 624/8240	EPA 625/8270	Semi TCLP Metals ☐ VOA ☐ VOA ☐	CAM Metals EPA 6010/7000 TTLC ☐ STLC ☐	Lead Org./DHS ☐ Lead EPA 7420/7421 ☐
S5.5, B9			X			X		5-29-91			X						10	54394		
S7.0, B9											X							4395		
S8.5, B9											X							4396		
S10.0, B9																				
S11.5, B9											X						10	54397		
S13.0, B9																				
S14.5, B9											X						10	54398		
S17.5, B9											X							4399		
S5.5, B10											X							4400		
S7.5, B10											X							4401		
S9.0, B10																				
S10.0, B10											X						10	54402		
S16.0, B10											X							4403		
S17.0, B10																				
S18.5, B10			X			X		X												
S16.0, B11a			X			X		5-30-91			X						10	54404		

Special detection Limit/reporting

Special QA/QC

Remarks: If no X marked - no analysis - Hold

Lab number

Turnaround time

- Priority Rush 1 Business Day ☐
- Rush 2 Business Days ☐
- Expedited 5 Business Days ☐
- Standard 10 Business Days X

Condition of sample: GOOD | Temperature received: COLD

Relinquished by sampler	Date	Time	Received by
Joel Hoffman	5-31-91	3:00 pm	Roya C. Minikel
Roya C. Minikel	5-31-91	4:10 PM	

Relinquished by	Date	Time	Received by laboratory	Date	Time
			K. Walters	5/31	4:10pm

Distribution: White copy — Laboratory; Canary copy — ARCO Environmental Engineering; Pink copy — Consultant

APPC-3292 (2-91)

SEQUOIA ANALYTICAL

680 Chesapeake Drive • Redwood City, CA 94063
(415) 364-9600 • FAX (415) 364-9233

Applied GeoSystems
3315 Almaden Expressway, Ste 34
San Jose, CA 95118
Attention: Joel Coffman

Project: #69034.03, Arco #601, San Leandro

Enclosed are the results from 4 water samples received at Sequoia Analytical on June 11,1991. The requested analyses are listed below:

1061561 A-D	Water Composite, W-7.9-MW2	6/10/91	EPA 5030/8015/8020
1061562 A-D	Water Composite, W-7.5-MW5	6/10/91	EPA 5030/8015/8020
1061563 A-D	Water Composite, W-8-MW8	6/10/91	EPA 5030/8015/8020
1061563 E-G	Water Composite, W-8-MW8	6/10/91	EPA 413.1 (Gravimetric)

Please contact me if you have any questions. In the meantime, thank you for the opportunity to work with you on this project.

Very truly yours,

SEQUOIA ANALYTICAL

Bjorn A. Bjorkman
Project Manager

SEQUOIA ANALYTICAL

680 Chesapeake Drive • Redwood City, CA 94063
(415) 364-9600 • FAX (415) 364-9233

Applied GeoSystems	Client Project ID:	#69034.03, Arco #601, San Leandro	Sampled:	Jun 10, 1991
3315 Almaden Expressway, Ste 34	Matrix Descript:	Water Composite	Received:	Jun 11, 1991
San Jose, CA 95118	Analysis Method:	EPA 5030/8015/8020	Analyzed:	6/12-13/91
Attention: Joel Coffman	First Sample #:	106-1561 A - D	Reported:	Jun 17, 1991

TOTAL PETROLEUM FUEL HYDROCARBONS with BTEX DISTINCTION (EPA 8015/8020)

Sample Number	Sample Description	Low/Medium B.P. Hydrocarbons µg/L (ppb)	Benzene µg/L (ppb)	Toluene µg/L (ppb)	Ethyl Benzene µg/L (ppb)	Xylenes µg/L (ppb)
1061561 A-D	W-7.9-MW2	26,000	3,000	2,500	880	4,200
1061562 A-D	W-7.5-MW5	100,000	25,000	20,000	2,600	12,000
1061563 A-D	W-8-MW8	5,800	73	7.2	150	21
Detection Limits:		**30**	**0.30**	**0.30**	**0.30**	**0.30**

Low to Medium Boiling Point Hydrocarbons are quantitated against a gasoline standard.
Analytes reported as N.D. were not present above the stated limit of detection.

SEQUOIA ANALYTICAL

Bjorn A. Bjorkman
Project Manager

SEQUOIA ANALYTICAL

680 Chesapeake Drive • Redwood City, CA 94063
(415) 364-9600 • FAX (415) 364-9233

Applied GeoSystems	Client Project ID:	#69034.03, Arco #601, San Leandro	Sampled:	Jun 10, 1991
3315 Almaden Expressway, Ste 34	Matrix Descript:	Water Composite	Received:	Jun 11, 1991
San Jose, CA 95118	Analysis Method:	EPA 413.1 (Gravimetric)	Extracted:	Jun 14, 1991
Attention: Joel Coffman	First Sample #:	106-1563 E - G	Analyzed:	Jun 14, 1991
			Reported:	Jun 17, 1991

TOTAL RECOVERABLE OIL & GREASE

Sample Number	Sample Description	Oil & Grease mg/L (ppm)
1061563 E-G	W-8-MW8	N.D.

Detection Limits:	**5.0**

Analytes reported as N.D. were not present above the stated limit of detection.

SEQUOIA ANALYTICAL

Bjorn A. Bjorkman
Project Manager

SEQUOIA ANALYTICAL

680 Chesapeake Drive • Redwood City, CA 94063
(415) 364-9600 • FAX (415) 364-9233

Applied GeoSystems
3315 Almaden Expressway, Ste 34
San Jose, CA 95118
Attention: Joel Coffman

Client Project ID: #69034.03, Arco #601, San Leandro

QC Sample Group: 1061561 - 63

Reported: Jun 17, 1991

QUALITY CONTROL DATA REPORT

ANALYTE	Benzene	Toluene	Ethyl Benzene	Xylenes
Method:	EPA 8020	EPA 8020	EPA 8020	EPA 8020
Analyst:	S.Chieffo	S.Chieffo	S.Chieffo	S.Chieffo
Reporting Units:	ng	ng	ng	ng
Date Analyzed:	Jun 12, 1991	Jun 12, 1991	Jun 12, 1991	Jun 12, 1991
QC Sample #:	GBLK061291	GBLK061291	GBLK061291	GBLK061291
Sample Conc.:	N.D.	N.D.	N.D.	N.D.
Spike Conc. Added:	100	100	100	300
Conc. Matrix Spike:	96	97	99	300
Matrix Spike % Recovery:	96	97	99	100
Conc. Matrix Spike Dup.:	100	100	100	310
Matrix Spike Duplicate % Recovery:	100	100	100	100
Relative % Difference:	4.1	3.0	1.0	3.3

Quality Assurance Statement: All standard operating procedures and quality control requirements have been met.

SEQUOIA ANALYTICAL

Bjorn A. Bjorkman
Project Manager

% Recovery:	Conc. of M.S. - Conc. of Sample / Spike Conc. Added	x 100
Relative % Difference:	Conc. of M.S. - Conc. of M.S.D. / (Conc. of M.S. + Conc. of M.S.D.) / 2	x 100

SEQUOIA ANALYTICAL

680 Chesapeake Drive • Redwood City, CA 94063
(415) 364-9600 • FAX (415) 364-9233

Applied GeoSystems
3315 Almaden Expressway, Ste 34
San Jose, CA 95118
Attention: Joel Coffman

Client Project ID: #69034.03, Arco #601, San Leandro

QC Sample Group: 1061561 - 63

Reported: Jun 17, 1991

QUALITY CONTROL DATA REPORT

ANALYTE	Benzene	Toluene	Ethyl Benzene	Xylenes	Ttl. Oil & Grease
Method:	EPA 8020	EPA 8020	EPA 8020	EPA 8020	EPA 413.1
Analyst:	J.Dinsay	J.Dinsay	J.Dinsay	J.Dinsay	V.Nunzir
Reporting Units:	ng	ng	ng	ng	mg/L
Date Analyzed:	Jun 13, 1991	Jun 13, 1991	Jun 13, 1991	Jun 13, 1991	Jun 14, 1991
QC Sample #:	GBLK061391	GBLK061391	GBLK061391	GBLK061391	BLK61491
Sample Conc.:	N.D.	N.D.	N.D.	N.D.	N.D.
Spike Conc. Added:	100	100	100	300	100
Conc. Matrix Spike:	99	99	100	300	83
Matrix Spike % Recovery:	99	99	100	100	83
Conc. Matrix Spike Dup.:	94	95	94	290	85
Matrix Spike Duplicate % Recovery:	94	95	94	97	85
Relative % Difference:	5.2	4.1	6.2	3.4	2.3

Quality Assurance Statement: All standard operating procedures and quality control requirements have been met.

SEQUOIA ANALYTICAL

Bjorn A. Bjorkman
Project Manager

% Recovery:	Conc. of M.S. - Conc. of Sample / Spike Conc. Added	x 100
Relative % Difference:	Conc. of M.S. - Conc. of M.S.D. / (Conc. of M.S. + Conc. of M.S.D.) / 2	x 100

ARCO Products Company — Division of AtlanticRichfieldCompany

Chain of Custody

Task Order No. 601-90-2

ARCO Facility no. ARCO 601	City (Facility) SAN LEANDRO	Project manager (Consultant) JOEL COFFMAN	Laboratory name SEQUOIA
ARCO engineer CHUCK CARMEL	Telephone no. (ARCO)	Telephone no. (Consultant) (408) 264-7723	Fax no. (Consultant) 408-264-2435	Contract number 07-073
Consultant name RESNA/APPLIED GEOSYSTEMS	Address (Consultant) 3315 ALMADEN EXPRESSWAY, SAN JOSE		Method of shipment SEQUOIA FIELD TECH

Sample I.D.	Lab no.	Container no.	Matrix: Soil	Matrix: Water	Matrix: Other	Preservation: Ice	Preservation: Acid	Sampling date	Sampling time	BTEX 602/EPA 8020	BTEX/TPH EPA M602/8020/8015	TPH Modified 8015 Gas ☐ Diesel ☐	Oil and Grease 413.1 ☐ 413.2 ☐	TPH EPA 418.1/SM503E	EPA 601/8010	EPA 624/8240	EPA 625/8270	TCLP Metals ☐ Semi VOA ☐ VOA ☐	CAM Metals EPA 6010/7000 TTLC ☐ STLC ☐	Lead Org./DHS ☐ Lead EPA 7420/7421 ☐	
W-7.9-MW2		1		X		X	X	6-10-91	5:05		X										
W-7.9-MW2		1		X		X	X	6-10-91	5:05		X										
W-7.9-MW2		1		X		X	X	6-10-91	5:05		X			10615	61						
W-7.9-MW2		1		X		X	X	6-10-91	5:05		X										
W-7.5-MW5		1		X		X	X	6-10-91	5:30		X										
W-7.5-MW5		1		X		X	X	6-10-91	5:30		X										
W-7.5-MW5		1		X		X	X	6-10-91	5:30		X			10615	62						
W-7.5-MW5		1		X		X	X	6-10-91	5:30		X										
W-8-MW8		1		X		X	X	6-10-91	5:00		X										
W-8-MW8		1		X		X	X	6-10-91	5:00		X										
W-8-MW8		1		X		X	X	6-10-91	5:00		X										
W-8-MW8		1		X		X	X	6-10-91	5:00		X										
W-8-MW8		1		X		X		6-10-91	5:00				X			10615	63				
W-8-MW8		1		X		X		6-10-91	5:00				X								
W-8-MW8		1		X		X		6-10-91	5:00				X								

Special detection Limit/reporting

Special QA/QC

Remarks: JOB NO 69034.03

Lab number

Turnaround time

- Priority Rush 1 Business Day ☐
- Rush 2 Business Days ☐
- Expedited 5 Business Days ☐
- Standard 10 Business Days ☒

Condition of sample: good		Temperature received: cool	
Relinquished by sampler: L. J. Leet	Date 6-11-91 Time 1:56	Received by: Dawn Sullivan	
Relinquished by: Dawn Sullivan	Date 6/11/91 Time 4:53 PM	Received by:	
Relinquished by:	Date Time	Received by laboratory:	Date 6/11 Time 1655

Distribution: White copy — Laboratory; Canary copy — ARCO Environmental Engineering; Pink copy — Consultant

ARCO Products Company — Division of Atlantic Richfield Company

Chain of Custody

Task Order No. 601-91-2

ARCO Facility no.	601
City (Facility)	SAN LEANDRO
Project manager (Consultant)	M.J. Hodges / Joel Coffman
Laboratory name	Sequoia Analytical
ARCO engineer	CHUCK CARMEL
Telephone no. (ARCO)	
Telephone no. (Consultant)	916 452-2901
Fax no. (Consultant)	916 452 0534
Consultant name	Applied GeoSystems
Address (Consultant)	4191 Power Inn Rd. Sacto.
Contract number	07-013
Method of shipment	LAB ARRANGED

Sample I.D.	Lab no.	Container no.	Matrix: Soil	Matrix: Water	Matrix: Other — Air	Preservation: Ice	Preservation: Acid	Sampling date	Sampling time	BTEX 602/EPA 8020	BTEX/TPH EPA M602/8020/8015	TPH Modified 8015 Gas / Diesel	Oil & Grease 413.2	TPH EPA 418.1/SM503E	EPA 601/8010	EPA 624/8240	EPA 625/8270	TCLP Semi / Metals / VOA / VOA	CAM Metals EPA 6010/7000 TTLC / STLC	Lead Org./DHS / Lead EPA 7420/7421	
67034.05 AS 1		1			✓			6-18-91	1:40		✓				1062781		81				
67034.04 AS 2		1			✓			6-18-91	1:55		✓						82				
67034.03 AS 3		1			✓			6-18-91	2:15		✓						83				
67034.05 AS 4		1			✓			6-18-91	2:35		✓						84				
67034.05 AS 5		1			✓			6-18-91	2:55		✓						85				

Special detection Limit/reporting: PLEASE REPORT ~~RESULTS~~ RESULTS IN mg/m³

Special QA/QC:

Remarks: 72 hr. hold time

Lab number: 1062781

Condition of sample: Room temp.

Temperature received:

	Date	Time
Relinquished by sampler	6-18-91	605
Relinquished by	6-19-91	9:15
Relinquished by	6-19-91	11:17a
Received by		
Received by		
Received by laboratory	6-19	9:12

(MICHAEL HODGES)

Turnaround time

- Priority Rush 1 Business Day [ ]
- Rush 2 Business Days [X]
- Expedited 5 Business Days [ ]
- Standard 10 Business Days [ ]

Distribution: White copy — Laboratory; Canary copy — ARCO Environmental Engineering; Pink copy — Consultant

APPC-3292 (2-91)

SEQUOIA ANALYTICAL

680 Chesapeake Drive • Redwood City, CA 94063
(415) 364-9600 • FAX (415) 364-9233

Applied GeoSystems
4191 E. Power Inn Rd.
Sacramento, CA 95826
Attention: Joel Coffman

Project: Arco, #0601, #69034.05

Enclosed are the results from 5 special matrix samples received at Sequoia Analytical on June 19,1991. The requested analyses are listed below:

1062781	Air, #69034.05-AS, 1	6/18/91	EPA 5030/8015/8020
1062782	Air, #69034.05-AS, 2	6/18/91	EPA 5030/8015/8020
1062783	Air, #69034.05-AS, 3	6/18/91	EPA 5030/8015/8020
1062784	Air, #69034.05-AS, 4	6/18/91	EPA 5030/8015/8020
1062785	Air, #69034.05-AS, 5	6/18/91	EPA 5030/8015/8020

Please contact me if you have any questions. In the meantime, thank you for the opportunity to work with you on this project.

Very truly yours.

SEQUOIA ANALYTICAL

Bjorn A. Bjorkman
Project Manager

SEQUOIA ANALYTICAL

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4191 E. Power Inn Rd.
Sacramento, CA 95826
Attention: Joel Coffman

Client Project ID: Arco, #0601, #69034.05

QC Sample Group: 1062781 - 85

Reported: Jun 21, 1991

QUALITY CONTROL DATA REPORT

ANALYTE	Benzene	Toluene	Ethyl Benzene	Xylenes
Method:	EPA 8020	EPA 8020	EPA 8020	EPA 8020
Analyst:	L.Laikhtman	L.Laikhtman	L.Laikhtman	L.Laikhtman
Reporting Units:	mg/L	mg/L	mg/L	mg/L
Date Analyzed:	Jun 20, 1991	Jun 20, 1991	Jun 20, 1991	Jun 20, 1991
QC Sample #:	BLK062091	BLK062091	BLK062091	BLK062091
Sample Conc.:	N.D.	N.D.	N.D.	N.D.
Spike Conc. Added:	100	100	100	300
Conc. Matrix Spike:	83	83	84	250
Matrix Spike % Recovery:	83	83	84	83
Conc. Matrix Spike Dup.:	90	90	91	270
Matrix Spike Duplicate % Recovery:	90	90	91	90
Relative % Difference:	8.1	8.1	8.0	7.7

Quality Assurance Statement: All standard operating procedures and quality control requirements have been met.

SEQUOIA ANALYTICAL

Bjorn A. Bjorkman
Project Manager

% Recovery:	Conc. of M.S. - Conc. of Sample / Spike Conc. Added	x 100
Relative % Difference:	Conc. of M.S. - Conc. of M.S.D. / (Conc. of M.S. + Conc. of M.S.D.) / 2	x 100

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Applied GeoSystems	Client Project ID:	Arco, #0601, #69034.05	Sampled:	Jun 18, 1991
4191 E. Power Inn Rd.	Matrix Descript:	Air	Received:	Jun 19, 1991
Sacramento, CA 95826	Analysis Method:	EPA 5030/8015/8020	Analyzed:	Jun 21, 1991
Attention: Joel Coffman	First Sample #:	106-2785	Reported:	Jun 21, 1991

TOTAL PETROLEUM FUEL HYDROCARBONS with BTEX DISTINCTION (EPA 8015/8020)

Sample Number	Sample Description	Low/Medium B.P. Hydrocarbons mg/m³	Benzene mg/m³	Toluene mg/m³	Ethyl Benzene mg/m³	Xylenes mg/m³
106-2785	#69034.05-AS. 5	9,500	100	82	54	40
Detection Limits:		**2,400**	**24**	**24**	**24**	**24**

Low to Medium Boiling Point Hydrocarbons are quantitated against a gasoline standard.
Analytes reported as N.D. were not present above the stated limit of detection. Because matrix effects and/or other factors required additional sample dilution, detection limits for this sample have been raised.

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Bjorn A. Bjorkman
Project Manager

SEQUOIA ANALYTICAL

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Applied GeoSystems	Client Project ID:	Arco, #0601, #69034.05	Sampled:	Jun 18, 1991
4191 E. Power Inn Rd.	Matrix Descript:	Air	Received:	Jun 19, 1991
Sacramento, CA 95826	Analysis Method:	EPA 5030/8015/8020	Analyzed:	Jun 21, 1991
Attention: Joel Coffman	First Sample #:	106-2784	Reported:	Jun 21, 1991

TOTAL PETROLEUM FUEL HYDROCARBONS with BTEX DISTINCTION (EPA 8015/8020)

Sample Number	Sample Description	Low/Medium B.P. Hydrocarbons mg/m³	Benzene mg/m³	Toluene mg/m³	Ethyl Benzene mg/m³	Xylenes mg/m³
106-2784	#69034.05-AS, 4	930	67	74	9.7	50
Detection Limits:		**150**	**1.5**	**1.5**	**1.5**	**1.5**

Low to Medium Boiling Point Hydrocarbons are quantitated against a gasoline standard.
Analytes reported as N.D. were not present above the stated limit of detection. Because matrix effects and/or other factors required additional sample dilution, detection limits for this sample have been raised.

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Bjorn A. Bjorkman
Project Manager

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Applied GeoSystems	Client Project ID:	Arco, #0601, #69034.05	Sampled:	Jun 18, 1991
4191 E. Power Inn Rd.	Matrix Descript:	Air	Received:	Jun 19, 1991
Sacramento, CA 95826	Analysis Method:	EPA 5030/8015/8020	Analyzed:	Jun 21, 1991
Attention: Joel Coffman	First Sample #:	106-2783	Reported:	Jun 21, 1991

TOTAL PETROLEUM FUEL HYDROCARBONS with BTEX DISTINCTION (EPA 8015/8020)

Sample Number	Sample Description	Low/Medium B.P. Hydrocarbons mg/m³	Benzene mg/m³	Toluene mg/m³	Ethyl Benzene mg/m³	Xylenes mg/m³
106-2783	#69034.05-AS, 3	30,000	2,100	600	N.D.	N.D.
Detection Limits:		**12,000**	**120**	**120**	**120**	**120**

Low to Medium Boiling Point Hydrocarbons are quantitated against a gasoline standard.
Analytes reported as N.D. were not present above the stated limit of detection. Because matrix effects and/or other factors required additional sample dilution, detection limits for this sample have been raised.

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Bjorn A. Bjorkman
Project Manager

SEQUOIA ANALYTICAL

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Applied GeoSystems	Client Project ID:	Arco, #0601, #69034.05	Sampled:	Jun 18, 1991
4191 E. Power Inn Rd.	Matrix Descript:	Air	Received:	Jun 19, 1991
Sacramento, CA 95826	Analysis Method:	EPA 5030/8015/8020	Analyzed:	Jun 21, 1991
Attention: Joel Coffman	First Sample #:	106-2781	Reported:	Jun 21, 1991

TOTAL PETROLEUM FUEL HYDROCARBONS with BTEX DISTINCTION (EPA 8015/8020)

Sample Number	Sample Description	Low/Medium B.P. Hydrocarbons mg/m³	Benzene mg/m³	Toluene mg/m³	Ethyl Benzene mg/m³	Xylenes mg/m³
106-2781	#69034.05-AS, 1	76,000	5,500	1,200	79	130
106-2782	#69034.05-AS, 2	24,000	1,200	170	N.D.	N.D.
Detection Limits:		**4,800**	**48**	**48**	**48**	**48**

Low to Medium Boiling Point Hydrocarbons are quantitated against a gasoline standard.
Analytes reported as N.D. were not present above the stated limit of detection. Because matrix effects and/or other factors required additional sample dilution, detection limits for this sample have been raised.

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Bjorn A. Bjorkman
Project Manager

APPENDIX F

SIEVE ANALYSIS REPORT

Johnson Filtration Systems Inc.
World leader through talent & technology ™
P.O. Box 64118 • St. Paul, Minnesota 55164-0118
612-636-3900 • 1-800-VEE-WIRE • FAX 612-636-3132

June 21, 1991

Joel Coffman
Applied GeoSystems Inc.
3315 Almaden Expressway Suite 34
San Jose, CA 95118

Mr. Coffman :

All of the samples that you sent us for job ARCO SS# 601,AGS 69034.04 were clay . We recommend you try a 16 slot (0.016in) screen with Monteray 20 sand.

Sincerely,
Bill Schafer
Bill Schafer