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TRANSMITTAL

TO: Mr. Michael Whelan
ARCO Products Company
Post Office Box 5811
San Mateo, California 94402

DATE: January 11, 1993
PROJECT NUMBER: 60026.07
SUBJECT: Final - Subsurface Environmental Investigation & Pumping Test, ARCO Station 276, 10600 MacArthur Blvd., Oakland, California.

FROM: Robert Campbell
TITLE: Staff Geologist

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REMARKS: cc: Mr. H.C. Winsor, ARCO Products Company
Mr. Barney Chan, Alameda County Health Care Services Agency
Mr. Richard Hiett, RWQCB, San Francisco Bay Region
Mr. Joel Coffman, RESNA Industries Inc.

Copies: 1 to RESNA project file no. 60026.07

RW-1) GW extraction test

ORIGINAL

January 11, 1993
0106MWHE
60026.07

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

Subject: Executive Summary of Subsurface Environmental Investigation and Pumping Test at ARCO Station 276, 10600 MacArthur Boulevard, Oakland, California.

Mr. Whelan:

As requested by ARCO Products Company (ARCO), RESNA Industries Inc. (RESNA) performed a subsurface environmental investigation and pumping test at the above referenced ARCO Station and prepared this report of the investigation, as specified in the RESNA/Applied GeoSystems (AGS) Work Plan (AGS, May 22, 1991) and Addendum Two to Work Plan (RESNA, October 15, 1991). This report summarizes the information available to date regarding previous work performed at the site and includes results of the subsurface investigation at the site. This phase of the investigation included drilling one soil boring (B-6), collecting soil samples from the boring, constructing a 6-inch diameter recovery well (RW-1) in the boring, developing and sampling the well, submitting soil and water samples for laboratory analyses, surveying the wellhead elevation, performing an aquifer pumping and recovery test, and preparing this report. In addition, RESNA recommendations for future work at the subject site are included in this Executive Summary.

CONCLUSIONS

RESNA concludes the following, based on the results of this investigation:

- The shallow perched water-bearing zone encountered in monitoring well MW-2 was not encountered in the eastern portion of the site near RW-1. The only onsite floating product encountered to date has been in MW-2 in the shallow perched water-bearing zone.

- Nondetectable concentrations of TPHg and BTEX in previous soil samples, and in the soil samples collected from onsite soil boring B-6/RW-1, suggest that gasoline hydrocarbons have not impacted the soil in the eastern portion of the property, northeast of the former USTs.

- Because PCE was detected at 0.130 ppm in the soil sample collected from soil boring B-6 at the depth of 51 feet below ground surface, and because PCE was also detected in the saturated zone, it is possible that the PCE has been transported to the site via the groundwater. Previously detected VOCs have also been in the saturated zone.

- Potential gasoline impact on the deeper water-bearing zone is still being evaluated.

- Groundwater at the site, and in the eastern portion of the site, has been impacted by VOCs (mainly PCE), as evidenced by PCE concentrations of 400 ppb, 1,000 ppb, 12 ppb, and 980 ppb in the groundwater samples collected from wells MW-3, MW-4, MW-5, and RW-1, respectively, and TCE which was reported at 6.3 ppb in MW-4. The concentrations of PCE exceeded the State MCL of 5 ppb in wells MW-3 through MW-5 and RW-1. TCE exceeded the State MCL of 5 ppb in well MW-4.

- The presence of PCE in well MW-3 located upgradient of the former waste-oil tank pit suggests together with soil and groundwater analytical results that the solvent-contaminated groundwater may be migrating onto the site from an offsite source. This source appears to be located east of the eastern corner of the subject site, at the Foothill Square Shopping Center property, where discolored soil and black free product was encountered in the soil boring EB-1 during an investigation conducted in 1988 by Kaldveer Associates. A Was VOC's Run on this sample? I don't think

- The records research indicated that historical and current use of Foothill Square Shopping Center property, which is adjacent and upgradient to the subject site presented a strong potential for subsurface contamination by TPHg, BTEX, and VOCs. Currently this property is on the California Regional Water Quality Control Board (CRWQCB) fuel leak list.

- Results of the pumping test indicated that the recovery well could easily sustain a pumping rate of 5 gpm and could possibly sustain a rate as high as 15 gpm. The predicted maximum zone of capture is sufficiently large to capture onsite groundwater downgradient in the lower water bearing zone, and a considerable portion of downgradient, offsite groundwater as well.

Copies of the Subsurface Environmental Investigation and Pumping Test report should be forwarded to:

Mr. Barney Chan
Alameda County Health Care Services Agency
Hazardous Materials Division
80 Swan Way, Room 200
Oakland, California 94621

Mr. Richard Hiett
California Regional Water Quality Control Board
San Francisco Bay Region
2101 Webster Street, Suite 500
Oakland, California 94612

If you have any questions or comments regarding this report, please call us at (408) 264-7723.

Sincerely,
RESNA Industries Inc.

Joel Coffman
Project Geologist

Enclosure: Subsurface Environmental Investigation and Pumping Test

cc: H.C. Winsor, ARCO Products Company

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SUBSURFACE ENVIRONMENTAL INVESTIGATION AND PUMPING TEST

at

ARCO Station 276
10600 MacArthur Boulevard
Oakland, California

60026.07

Report prepared for

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

by

RESNA Industries Inc.

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STATE OF CALIFORNIA

January 11, 1993

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SUBSURFACE ENVIRONMENTAL INVESTIGATION AND PUMPING TEST at ARCO Station 276 10600 MacArthur Boulevard Oakland, California

For ARCO Products Company

INTRODUCTION

At the request of ARCO Products Company (ARCO), RESNA Industries Inc. (RESNA) performed a subsurface environmental investigation and aquifer pumping test at ARCO Station 276 located at 10600 MacArthur Boulevard in Oakland, California. This investigation was initiated in response to Alameda County Health Care Services Agency (ACHCSA) request (letters dated June 12 and August 7, 1991) to accelerate investigation and initiate interim remediation (as necessary) at the site. The purpose of this investigation was to evaluate further the lateral and vertical extent of gasoline hydrocarbons and solvents in the soil, and evaluate further the lateral extent of gasoline hydrocarbons and solvents in the groundwater in the eastern portion of the site; and conduct a pumping and recovery test in order to collect hydrologic data necessary for evaluation of the feasibility and design of future remediation systems. Delineation of the lateral and vertical extent of hydrocarbons and solvents in the soil and groundwater in other portions of the site (and offsite) will be reported under separate cover.

The work performed for this investigation included drilling one onsite soil boring (B-6); collecting and describing soil samples from the boring; installing and developing a 6-inch diameter recovery well (RW-1) in the boring; measuring the groundwater level and sampling groundwater from the recovery well in conjunction with quarterly monitoring of groundwater monitoring wells at the site; laboratory analyses of selected soil and groundwater samples; surveying the recovery well (RW-1); performing a pumping test; researching records of the

California Regional Water Quality Control Board (CRWQCB) and Oakland Fire Department to identify potential offsite sources of gasoline hydrocarbons and solvents; and preparing this report presenting field procedures, results and conclusions for this work performed through November, 1991. This work was performed as outlined in the RESNA/Applied GeoSystems (AGS) Work Plan (RESNA/AGS, June 27, 1991), and Addendum Two to Work Plan (RESNA, October 15, 1991).

SITE DESCRIPTION AND BACKGROUND

General

ARCO Station 276 is located at the southeastern corner of the intersection of MacArthur Boulevard and 106th Avenue in Oakland, California, as shown on Plate 1, Site Vicinity Map. Immediately adjacent to and southeast of the station property is the Foothill Square Shopping Center parking lot. Several commercial business are located in the Foothill Square Shopping Center, including a grocery store, coin laundry, dry cleaners, drug store, offices, and another service station at Foothill Boulevard and 108th Avenue. Private residences are north and northeast of the ARCO station. The schematic layout of the ARCO station and the offsite area showing soil boring locations is presented on Plate 2, Site and Vicinity Plan.

Four underground gasoline storage tanks (USTs) (T-1 through T-4) are present in the western portion of the site. These tanks replaced four former gasoline storage tanks (FT-1 through FT-4) which were located in the southern portion of the site. The former waste-oil tank was removed from its location adjacent to the northeastern wall of the station building in 1988. The locations of the former tanks, existing tanks and other pertinent site features are shown on Plate 3, Generalized Site Plan.

Regional Geology and Hydrogeology

The site is located within the East Bay Plain which is situated in the San Francisco Bay depression that is in part an irregular downward block bordered by faulting principally along northwest trending faults (Alameda County Flood Control and Water Conservation District, June 1988). The site is at an elevation of approximately 55 feet above mean sea level (msl) and is

approximately 1/2 mile west of the Hayward Fault Zone. The subsurface soils in the vicinity of the site consist of highly permeable Pleistocene alluvium composed of poorly consolidated to unconsolidated clay, silt, sand, and gravel. The alluvium was derived mainly from the Diablo Range and represents coalescing alluvial fans (Alameda County Flood Control and Water Conservation District, June 1988). Groundwater flow direction in the area is generally inferred to be to the west toward San Francisco Bay, but may have components to the north and east due to recharge areas along the Hayward Fault.

PRELIMINARY RECORDS RESEARCH

RESNA conducted a preliminary records research to identify potential secondary sources of hydrocarbons detected in the soil and groundwater beneath ARCO Station 276.

The search focused on the property located at 10700 MacArthur Boulevard (Foothill Square Shopping Center) which is adjacent to and upgradient of the subject site. According to Kaldveer Associates (Kaldveer Associates, October 3, 1988) the property located at 10700 MacArthur Boulevard was owned by Fageol Motor Company from about 1916 to 1960, and tractors, trucks, and motor buses were manufactured there. During 1960 the current shopping center was constructed. Current business in the center includes several dry cleaners and a USA gasoline station. This type of land-use (historical and current) presents a potential for subsurface contamination. Several subsurface environmental investigations conducted at Foothill Square Shopping Center property (for details see Appendix A, Previous Work) confirmed the presence of elevated concentrations of petroleum hydrocarbons, pesticides, polychlorinated biphenyls (PCBs) and semi-volatile compounds in the soil and groundwater at several locations beneath the shopping center. Free product was encountered in the portion of the property located 60 feet east (upgradient) of the eastern corner of ARCO Station 276. The contaminated soil and groundwater at this location might be a secondary source of hydrocarbons and primary source of solvents detected in the eastern portion of the ARCO Station 276 property.

Currently the Foothill Square Shopping Center property is on the California Regional Water Quality Control Board (CRWQCB) fuel leak site list. The Oakland Fire Department file for the Foothill Square Shopping Center property contains a record of a repair of a vapor recovery line performed in 1979 and removal of a tank of unknown use performed in 1980.

PREVIOUS WORK

Previous subsurface environmental investigations at the site and adjacent Foothill Square Shopping Center performed by RESNA and others are summarized in Appendix A.

FIELD WORK

Drilling

Field work at the site was conducted in accordance with RESNA field protocol and the Site Safety Plan (RESNA, August 15, 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 Alameda County Flood Control and Water Conservation District (ACFCWCD) prior to drilling at the site. A copy of the permit is included in Appendix C. On October 30, 1991, one onsite soil boring (B-6) was drilled in the western portion of the property, and recovery well RW-1 was constructed in the boring to further delineate the lateral and vertical extent of gasoline hydrocarbons in soil and groundwater beneath the site, to collect hydrologic data necessary for evaluation of the feasibility and design of future remediation systems, and to provide an extraction point for future groundwater recovery. The location of onsite boring B-6/RW-1 is shown on Plate 3.

Soil Sampling and Description

A total of 11 soil samples were collected from soil boring B-6. 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 boring is presented on the Log of Boring, Plates 5 and 6. Soil samples from the boring were collected at intervals of 5 feet or less to a total depth of 51-1/2 feet below ground surface. Sampling procedures are described in Appendix B. Field monitoring of organic vapor concentrations in soil samples was performed during drilling using an organic vapor meter (OVM).

Soil cuttings generated from the boring were temporarily stockpiled onsite in the eastern corner of the property and covered with plastic sheeting pending proper disposal. After completion of

drilling on November 30, 1991, four soil samples were collected from the stockpile and submitted for compositing and laboratory analyses. The method used to obtain these samples is described in Appendix B, Field Methods.

Recovery Well Construction and Development

The recovery well RW-1 was constructed in the boring B-6 using 6-inch diameter, Schedule 80, polyvinyl chloride (PVC) casing. Well casing was set in the well to the depth of approximately 51 feet below ground surface. This well was screened in the lower water-bearing zone. Filter pack used within the screened portion of the well was #3 Monterey Sand. The screened casing consisted of 6-inch-diameter, 0.020 inch-wide machine-slotted PVC set from the total depth of the well to approximately 36 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 recovery well was developed on November 1, 1991, to remove fine-grained sediments and allow better communication between the water-bearing zone and the well. Details regarding well construction and development are described in Appendix B.

Groundwater Level Measurement and Sampling

The newly installed recovery well (RW-1) and previously installed groundwater monitoring wells (MW-1 through MW-5) were monitored on November 5, 1991. Depths-to-water were measured in the wells and water samples were collected and visually inspected for floating product.

Recovery well RW-1 and groundwater monitoring wells MW-1 and MW-3 through MW-5 were purged and sampled on November 5 and 6, 1991. Groundwater monitoring well MW-2 was not sampled because of the presence of floating product in the well. MW-2 is screened in the shallow water-bearing zone. The other five onsite wells are screened in the lower water bearing zone. Appendix B contains a description of subjective analyses and groundwater sampling procedures.

Evaluation of Groundwater Elevation

On November 9, 1991, the wellhead for the recovery well was 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. The groundwater elevation for each well was calculated by subtracting the measured depth-to-water from the elevation of the wellhead.

Pumping and Recovery Tests

A step-drawdown test was performed on November 19, 1991, to select the optimum pumping rate at which to perform the constant discharge test. The test indicated that the well could easily sustain a pumping rate of 5 gallons per minute (gpm) with less than a foot of drawdown. Five gpm was the maximum that the pump could produce with 38 foot lift. Even though the well could have produced at a higher rate, because of the costs involved with disposing of large volumes of water, and the possible effect of drawing offsite upgradient hydrocarbons onsite, it was decided to run the long-term test at the rate capable from the pump instead of using a more powerful pump.

An 18-hour pumping test and 6-hour recovery test were conducted on November 21 and 22, 1991. Groundwater recovery well RW-1 was used as the pumping well, and wells MW-1 through MW-5 were used as observation wells. Well RW-1 was chosen as the well to be pumped because it is the proposed remediation well for impacted groundwater at the site. A submersible pump was utilized for the test. Because the discharge rate was small enough so that flow gauge accuracy might not be adequate, the discharge rate was measured using a calibrated 5-gallon bucket and a stopwatch. The discharge water was contained in Baker tanks, and properly disposed within one day of the termination of the test. The hazardous waste manifest form for the discharge water is presented in Appendix E. Pumping continued approximately 18 hours, with a total discharge of approximately 4,000 gallons. Water level measurements were obtained using an electric depth sounder. Water levels were measured prior to start of the test and at 30-minute intervals during the entire test. As a check on the manual readings, water levels were also recorded at five-minute intervals with an In-Situ Hermit Datalogger attached to pressure transducers in monitoring wells RW-1, and MW-1 through MW-5. The pumping test

was followed by a recovery test approximately six hours in length, with similar measurement intervals during recovery.

LABORATORY METHODS

Soil and water samples 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 (Hazardous Waste Testing Laboratory Certification # 1210), for soil and water analyses.

Soil Samples

Soil samples collected from boring B-6 were analyzed in accordance with Alameda County Health 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, and volatile organic compounds (VOCs) using EPA Method 8240. The soil samples were selected for laboratory analysis based on:

- Location above first-encountered groundwater;
- Location with respect to potential confining or perching layer(s) below first-encountered groundwater;
- Areas where the presence of gasoline hydrocarbons or VOCs were suspected based on OVM readings; and
- At changes in soil stratigraphic units.

Soil samples collected from the soil stockpile were composited in the laboratory and analyzed for TPHg and BTEX by EPA Method 5030/8015/8020.

Water Samples

Water samples obtained from recovery well RW-1 and groundwater monitoring wells MW-1, and MW-3 through MW-5 were analyzed in accordance with Alameda County Health requirements for BTEX and TPHg by modified EPA Methods 5030/8015/8020, and for VOCs by EPA Method 601.

FIELD WORK RESULTS

Drilling Observations

The earth materials encountered at the site during drilling of the boring B-6 consisted primarily of silty to sandy clay, sandy silt to silty sand, medium-grained sand, and sandy gravel. Silty to sandy clay was encountered immediately below the baserock material to the depth of approximately 12 feet below ground surface. Below this silty to sandy clay the layer of damp silty sand was present to the depth of 16 feet. This damp silty sand was underlain by silty clay, which extended to the depth of approximately 19 feet. Interbedded layers of sandy silt to silty sand were present below this silty clay to the depth of approximately 37 feet. Groundwater was first encountered in boring B-6 at a depth of approximately 38 feet below the ground surface within medium-grained sand. The saturated zone consisted of medium-grained sand (to 39 feet), sandy silt (to 40-1/2 feet), sandy gravel (to 46 feet) and silty sand (to 50-1/2 feet). A stratum of damp sandy clay with small gravel, which may be a perching or confining layer, was encountered at a depth of 50-1/2 feet below the ground surface, and extended to the total depth of the boring (51-1/2 feet). Data collected during drilling of soil boring B-6 are summarized in the log of boring, Plates 5 and 6.

Field OVM measurements of soil samples from the boring B-6 showed nondetectable levels of hydrocarbons. OVM readings are shown on the boring log (Plates 5 and 6) in the column labeled PID (photoionization detector).

Subjective Groundwater Analyses

Monitoring well MW-2 contained 0.01 feet of floating product on November 5, 1991. The recovery well and groundwater monitoring wells MW-1 and MW-3 through MW-5 contained no floating product or hydrocarbon sheen. Subjective analyses results for floating product in groundwater are included in Table 1.

Groundwater Gradient

The groundwater gradient evaluated for the first-encountered groundwater at this site, based on groundwater elevations obtained from wells RW-1 and MW-1 through MW-5 on November 5, 1991, is approximately 0.002 to 0.003 to the northwest. Groundwater monitoring well MW-2 was not used for gradient interpretations because it is constructed in a shallower, locally perched groundwater zone. Depths to groundwater and groundwater elevations are reported in Table 1, Cumulative Groundwater Monitoring Data. Plate 7, Groundwater Gradient Map, is a graphic interpretation of the groundwater elevations measured on November 5, 1991. Although the groundwater elevation contours appear somewhat skewed by a lower than expected water level in MW-4, this pattern, and interpreted gradient and flow direction, are consistent with previously reported gradients and flow directions in the deeper groundwater zone for this site.

Pumping and Recovery Test Results

Prior to the pumping test on November 21, 1991, groundwater elevations were measured and are reported in Table 2, Groundwater Level Measurements during Pumping Test, for time zero. A product sheen was present in the monitoring well MW-2 during the aquifer pumping and recovery tests. No floating product was found in RW-1, MW-1, and MW-3 through MW-5 prior to starting the test. No floating product was encountered in the discharge during the course of the test.

The recovery well RW-1 was pumped at a time-averaged rate of 3.67 gpm (707 cubic feet per day [ft^3/d]). The initial rate was somewhat higher at 5 gpm, but that rate declined steadily for the first 12 hours of the test. A minimum pumping rate of 3.16 gpm was followed by an increase to 3.53 gpm. While a constant pumping rate would have been ideal for use in

approximations of aquifer characteristics, the data gained was still useful using the time-averaged rate. The time-averaged rate was used in the calculations.

The drawdown in the pumping well reached approximately 0.65 feet in the course of the test indicating that this well could easily sustain a greater pumping rate. After only five minutes of pumping, the drawdown in RW-1 had essentially stabilized at this level, as shown by the semilogarithmic plot of datalogger drawdown data as a function of time for the pumping well, Plate 8. The water level in well MW-2, which appears to be hydraulically separated from the water bearing zone in which RW-1 and the other wells are completed, decreased 0.03 feet in the course of the pumping test (Plate 9) and continued to decrease during the recovery period. This drop in the shallow zone water level may be due to natural seepage from the perched zone, or possibly to response to barometric changes in the shallow, semiconfined, low permeability unit.

Water level responses to pumping for the four observation wells, MW-1, MW-3, MW-4, and MW-5, which were completed in the deeper water bearing zone, are presented on Plates 10 through 17, Drawdown/Time Semilogarithmic and Logarithmic Plots. The manual water level data is plotted for all wells except for MW-3, because the manually obtained data were more consistent than that gathered from the datalogger and pressure transducers. The datalogger data varied by as much as 25 per cent from the manual measurements. This may be due to mechanical reasons such as transducer connections or equipment calibration. Manual measurements could not be obtained in MW-3 because it is only a two-inch diameter well; with the pressure transducer installed, there was no space for the manual electric probe to reach the water. Plate 11, Drawdown/Time Well MW-3 Semilogarithmic Plot, presents the datalogger recorded water level data for MW-3.

Recovery data for the pumping and observation wells are presented on Plates 18 through 21, Residual Drawdown/Normalized Time Semilogarithmic Plots. Data from manual measurements (RW-1, MW-1, MW-2, MW-4 and MW-5) and data logger readings (MW-3) for the pumping test are presented in Table 2, Groundwater Level Measurements during Pumping Test, and for the recovery test in Table 3, Groundwater Level Measurements during Recovery Test. Table 4 summarizes groundwater elevations in the wells prior to the pumping test, at the end of the pumping test and at the end of the recovery test.

Data Analyses

The drawdown data for the observation wells were analyzed using two methods. The first was the method of the Jacob (1950) approximation for the Theis (1935) equation; the second was Neuman's (1975) solution for an unconfined aquifer with a fully penetrating well where delayed yield produces an intermediate flattening of the drawdown curve. This flattening was observed in all four monitoring wells and created less than ideal straight-line plots for the Jacob analyses. The flattening could have been attributed to delayed yield or to the variable pumping rate.

For the Jacob approximation (Plates 10 through 13), the transmissivity (T) was calculated as

$$T = 2.3\ Q / [4\ \pi\ s]$$

for consistent units, where the discharge (Q) was 3.67 gpm and "s" was the drawdown per log cycle, for both the pumping and the recovery data. The value of "s" for each well is given in Table 5, Values Used in Transmissivity and Storativity Calculations. The values of s used to calculate the transmissivity for the pumping and recovery data contained more significant figures than those indicated in Table 5. The values were based on the equation for the best fit line shown on the plots, as determined by linear regression and shown on the individual plots. The storativity (S) was calculated as

$$S = 2.25\ T\ t_o / r^2$$

for consistent units, where "t_o" was the x-intercept for the pumping data and "r" was the radial distance from the pumping well to the observation well (Table 5).

For the Neuman solution (Plates 14 through 17), the transmissivity was calculated based on the match points obtained in curve matching (Table 5) for $W(u_A) = 1$ and $1/u_A = 1$, using

$$T = Q\ W(u_A) / [4\ \pi\ h]$$

for consistent units, where "h" was the match point drawdown. The storativity was calculated using

$$S = u_A \, 4 \, T \, t / r^2$$

for consistent units, where "t" was the match point time. The Neuman type curve and match point are presented on Plate 22, Type Curves for Drawdown Data.

There was difficulty with the curve matching in the Neuman analyses because the field data curves were less than ideal. A number of the wells did exhibit a flattening of the curve, beginning around 60 minutes of pumping, so it appears that delayed yield may play a significant role in this unconfined aquifer, at least for the first few hours of extraction. The intermediate curves that could be matched ranged over less than an order of magnitude (lambda values of 0.1 to 0.6) which supports the reliability of the results.

Recovery data for the pumping and observation wells (Plates 18 through 21) are presented with the x-axis plotted as normalized time (time since the start of pumping divided by the time since the cessation of pumping). The data were analyzed using the Theis (1935) recovery method, where the transmissivity is calculated as for the Jacob solution above, only that the log cycle change is now for normalized time rather than time since the start of pumping. Results for transmissivity and storativity for these three methods are presented in Table 6, Pumping Test Results.

The distance/drawdown data for the end of the pumping test are presented on Plate 23, Drawdown/Distance Semilogarithmic Plot, including the pumping well datum, while Plate 24 is a similar plot but without that datum. These plots were analyzed with the straight-line method where

$$T = 2.3\ Q / [2\ \pi\ s]$$

for consistent units where "s" was 0.17 feet for Plate 23 and 0.30 feet for Plate 24. The storativity was evaluated by

$$S = 2.25\ T\ t / r_0^2$$

for consistent units where "t" was 1040 minutes and "r_0" (the x-intercept at the point of zero drawdown on the drawdown scale, or the radius of influence) was 1422 feet for Plate 23 and 340 feet for Plate 24. For Plates 23 and 24, the transmissivities estimated were 1522 and 862 ft^2/d, respectively, and storativities were 0.0012 and 0.012, respectively.

Plates 25 through 27, Groundwater Gradient Maps, are graphic interpretations of groundwater elevations prior to the pumping test, at the end of the pumping test, and at the end of the recovery test. At the end of 18 hours of pumping (Plate 26) flow is radially toward the pumping well. Within the area defined by the monitoring wells, the water is captured by RW-1, even for this relatively short pumping period. Plate 27 shows the water level contours after 6 hours of recovery, indicating that, at least for short pumping periods, the aquifer is restored to its initial flow direction to the northeast in a relatively short time.

The steady-state zone of capture (Bear, 1979) for this well can be evaluated for an estimated maximum pumping rate (Q) of 15 gpm (= 2,888 ft^3/d), a transmissivity (T) of 1,035 ft^2/d (the average transmissivity value using each method discussed above), and the observed hydraulic gradient (dh/dl) of 2.1 x 10^{-3}. The width (w) of the zone of capture up-gradient of RW-1 is 1328 ft and the distance to the down-gradient stagnation point (r) is 211 ft.

$$w = Q/T(dh/dl)$$
$$= 2,888\ ft^3/d\ /\ [1,035\ ft^2/d\ (2.1 \times 10^{-3})]$$
$$= 1,328\ ft$$

$$r = Q/2\pi T(dh/dl)$$
$$= 2,888\ ft^3/d\ /\ [2\ (3.1416)\ 1,035\ ft^2/d\ (2.1 \times 10^{-3})]$$
$$= 211\ ft$$

This maximum predicted zone of capture for the lower water-bearing zone that was tested is depicted on Plate 28, and assumes a maximum pumping rate of 15 gpm from well RW-1. The maximum zone of capture was predicted to evaluate the largest feasible zone of capture with respect to that likely to be needed at the site. In actuality, the zone of capture will need to be downsized by reducing the pumping rate in order to affect only the area desired.

RESULTS OF LABORATORY ANALYSES

Soil Samples

Laboratory analyses of soil samples collected from boring B-6 indicated nondetectable concentrations of BTEX (less than 0.005 parts per million [ppm]), TPHg (less than 1 ppm) and VOCs for all samples except 0.130 ppm of tetrachloroethene (PCE) detected in the sample collected at the depth of 51 feet below ground surface. Thirty-seven VOCs were analyzed for in the soil samples. The results of these analyses are summarized in Table 7, Laboratory Analyses of Soil Samples, October, 1991. The Chain of Custody form and copies of laboratory reports for soil samples are included in Appendix F of this report.

Laboratory analyses of the composite soil sample collected from the stockpile indicated nondetectable concentrations of TPHg and BTEX. The results of laboratory analyses of the stockpile sample are shown in Table 7. The soil stockpile was removed from the site and transported to BFI Landfill in Livermore by ARCO's contractor, Dillard Trucking Inc. of Byron, California, on November 14, 1991.

Water Samples

Laboratory analytical results for water samples indicated nondetectable TPHg concentrations in the sample collected from monitoring well MW-1; and 290 parts per billion (ppb), 900 ppb, 77 ppb and 750 ppb in the samples collected from wells MW-3, MW-4, MW-5 and RW-1, respectively. Benzene, toluene, ethylbenzene and total xylenes were not detected in the samples collected from monitoring wells MW-1, MW-3, and MW-4; but were detected at concentrations of 4.8 ppb, 3.7 ppb, 3.0 ppb and 3.0 ppb, respectively, in the sample collected from recovery well RW-1, and at lower levels in the sample collected from monitoring well MW-5. However, the TPHg and BTEX data are being further studied to evaluate the effects of the originally unknown presence of tetrachloroethene (PCE) in the groundwater. VOCs (thirty compounds tested in water) were nondetectable with the exception of PCE in samples collected from wells MW-3 (400 ppb), MW-4 (1,000 ppb), MW-5 (12 ppb) and RW-1 (980 ppb), and 6.3 ppb of trichloroethene (TCE) detected in the sample collected from monitoring well MW-4. PCE exceeded the MCL of 5 ppb in wells MW-3 through MW-5 and RW-1, and TCE exceeded the State MCL of 5 ppb in well MW-4 (6.3 ppb). The results of laboratory analyses are summarized in Table 8, Cumulative Results of Laboratory Analyses of Water Samples. Chain of Custody records and laboratory analyses reports are included in Appendix F.

DISCUSSION OF RESULTS

Hydrocarbon Impacted Soil

The soil in the eastern portion of the site appears to be impacted by PCE, as evidenced by 0.130 ppm of this compound detected in the soil sample collected from boring B-6 at a depth of 51 feet below ground surface.

Hydrocarbon Impacted Groundwater

Groundwater beneath the site appears to be impacted by gasoline-related hydrocarbons as floating product was present in the groundwater monitoring well MW-2 installed in a shallow, perched water bearing zone. Elevated concentrations of TPHg (up to 900 ppb) were detected in wells RW-1 and MW-3 through MW-5 installed in the deeper water bearing zone, and concentrations of BTEX (up to 4.8 ppb) were detected in wells RW-1 and MW-5. However, the TPHg and BTEX data are being further studied to evaluate the effects of the originally unknown presence of tetrachloroethene (PCE) in the groundwater. Groundwater beneath the site appears to be impacted by solvents as elevated concentrations of PCE (up to 1,000 ppb) were detected in wells RW-1 and MW-3 through MW-5, and 6.3 ppb of TCE was detected in the groundwater sample collected from monitoring well MW-4.

Pumping and Recovery Test

Data obtained from the pumping test including: estimation of the sustainable pumping rate from recovery well RW-1, storativity of the aquifer, and transmissivity of the aquifer was used to estimate the zone of capture of the recovery well. The test indicated that the recovery well RW-1 could easily sustain a pumping rate of 5 gpm and could possibly sustain a rate as high as 15 gpm.

The transmissivities estimated from the observation well data by the different methods (Jacob and Neuman) are in good agreement, varying by a factor of four between the different methods and wells. The recovery data are probably most reliable due to the fluctuation in pumping rate. For the Jacob plots, if only the later data (after the end of the flattened portion of the curve) had been utilized, values closer to the Neuman values would have been obtained. Within a given method there is even better agreement with variations being at the most within a factor of two, indicating relative homogeneity of hydraulic response at this site. The average transmissivity using each method discussed is 1,035 ft^2/d. The thickness of the shallow water-bearing zone is difficult to evaluate because of the variability and gradational transitions in geologic materials. If one assumes that most of the water is transmitted through the sand and gravel layers which contain significant amounts of fine-grained material, the average aquifer thickness would be on the order of 12 feet. The average transmissivity, 1,035 ft^2/d when divided by the aquifer

thickness of 12 ft gives a hydraulic conductivity of 86 ft/d. This is typical of a sand aquifer and is reasonable for material found at the site.

The storage coefficients evaluated with the observation well data vary over several orders of magnitude, with the Neuman method giving the greatest values. The values evaluated vary from on the low end of what might be expected for an unconfined aquifer to on the high end of what might be expected for a confined aquifer. If the test had been carried out for several days more, it is likely that the delayed yield portion of the curve would have transformed into a clearly unconfined response. The validity of the transmissivity values evaluated is not affected by this.

The predicted maximum zone of capture is sufficiently large to capture onsite groundwater in the lower water bearing zone, and a considerable portion of down-gradient, offsite groundwater as well. In all likelihood, the zone of capture will need to be downsized from the maximum to affect only the area desired.

CONCLUSIONS

RESNA concludes the following, based on the results of this investigation:

- The shallow perched water-bearing zone encountered in monitoring well MW-2 was not encountered in the eastern portion of the site near RW-1. The only onsite floating product encountered to date has been in MW-2 in the shallow perched water-bearing zone.

- Nondetectable concentrations of TPHg and BTEX in previous soil samples, and in the soil samples collected from onsite soil boring B-6/RW-1, suggest that gasoline hydrocarbons have not impacted the soil in the eastern portion of the property, northeast of the former USTs.

- Because PCE was detected at 0.130 ppm in the soil sample collected from soil boring B-6 at the depth of 51 feet below ground surface, and because PCE was also detected in the saturated zone, it is possible that the PCE has been transported to the site via the groundwater. Previously detected VOCs have also been in the saturated zone.

- Potential gasoline impact on the deeper water-bearing zone is still being evaluated.

- Groundwater at the site, and in the eastern portion of the site, has been impacted by VOCs (mainly PCE), as evidenced by PCE concentrations of 400 ppb, 1,000 ppb, 12 ppb, and 980 ppb in the groundwater samples collected from wells MW-3, MW-4, MW-5, and RW-1, respectively, and TCE which was reported at 6.3 ppb in MW-4. The concentrations of PCE exceeded the State MCL of 5 ppb in wells MW-3 through MW-5 and RW-1. TCE exceeded the State MCL of 5 ppb in well MW-4.

- The presence of PCE in well MW-3 located upgradient of the former waste-oil tank pit suggests together with soil and groundwater analytical results that the solvent-contaminated groundwater may be migrating onto the site from an offsite source. This source appears to be located east of the eastern corner of the subject site, at the Foothill Square Shopping Center property, where discolored soil and black free product was encountered in the soil boring EB-1 during an investigation conducted in 1988 by Kaldveer Associates.

- The records research indicated that historical and current use of Foothill Square Shopping Center property, which is adjacent and upgradient to the subject site presented a strong potential for subsurface contamination by TPHg, BTEX, and VOCs. Currently this property is on the California Regional Water Quality Control Board (CRWQCB) fuel leak list.

- Results of the pumping test indicated that the recovery well could easily sustain a pumping rate of 5 gpm and could possibly sustain a rate as high as 15 gpm. The predicted maximum zone of capture is sufficiently large to capture onsite groundwater downgradient in the lower water bearing zone, and a considerable portion of downgradient, offsite groundwater as well.

DISTRIBUTION

We recommend that copies of this report be forwarded to the following agencies:

Mr. Barney Chan
Alameda County Health Care Services Agency
Hazardous Materials Division
80 Swan Way, Room 200
Oakland, California 94621

Mr. Richard Hiett
California Regional Water Quality Control Board
San Francisco Bay Region
2101 Webster Street, Suite 500
Oakland, California 94612

LIMITATIONS

This report was prepared in accordance with generally accepted standards of environmental geological and engineering practice in California at the time this investigation was performed. This investigation was conducted solely for the purpose of evaluating environmental conditions of the soil and groundwater with respect to gasoline and solvent-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 investigation 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. This report was prepared for the use of ARCO Products Company; any reliance on this report by a third party shall be at each party's sole risk.

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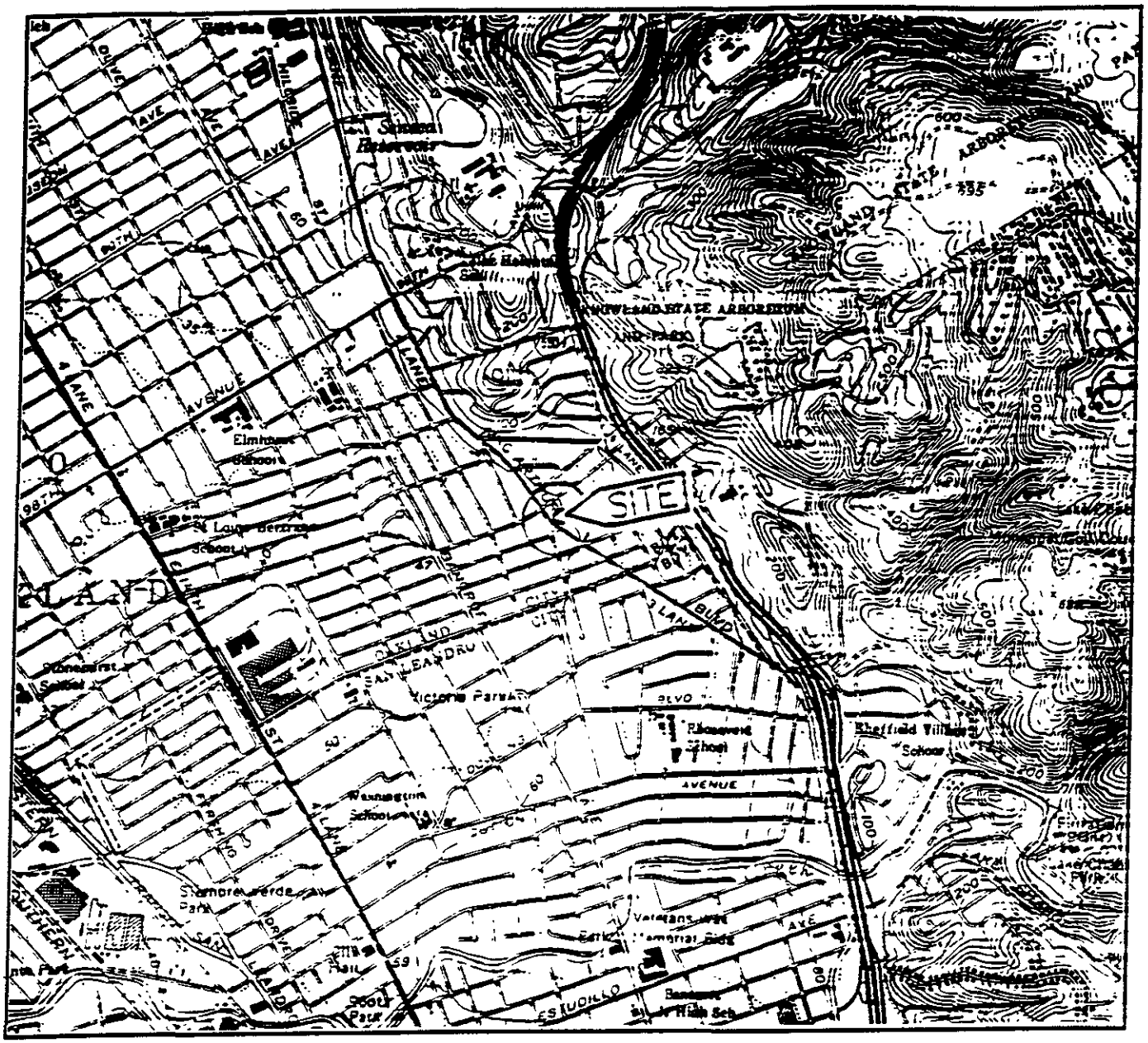

Base: U.S. Geological Survey
7.5–Minute Quadrangles
Oakland East/San Leandro, California.
Photorevised 1980

LEGEND

= Site Location

Approximate Scale

2000 1000 0 2000 4000

feet

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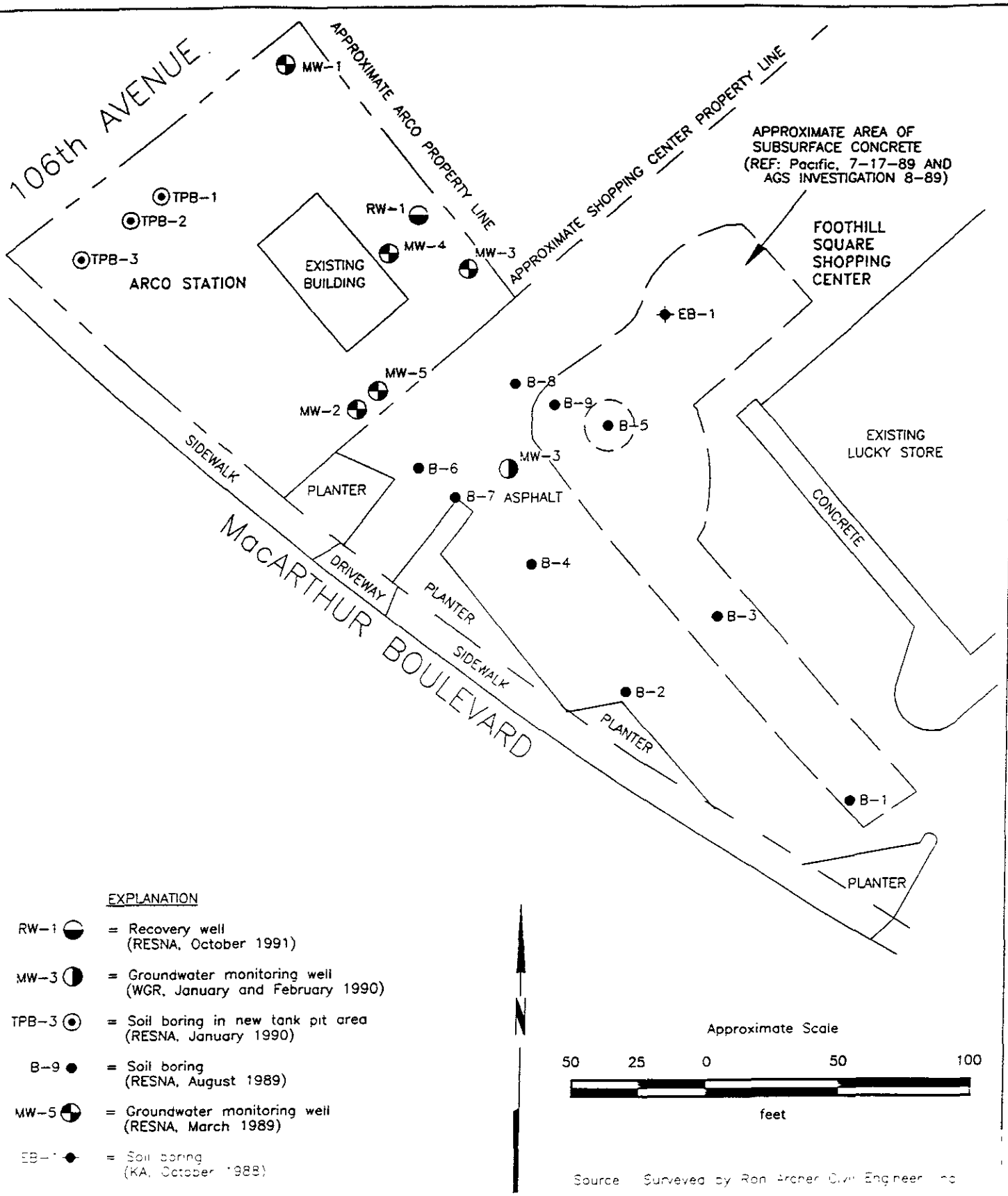
SITE VICINITY MAP
ARCO Station 276
10600 MacArthur Boulevard
Oakland, California

PLATE
1



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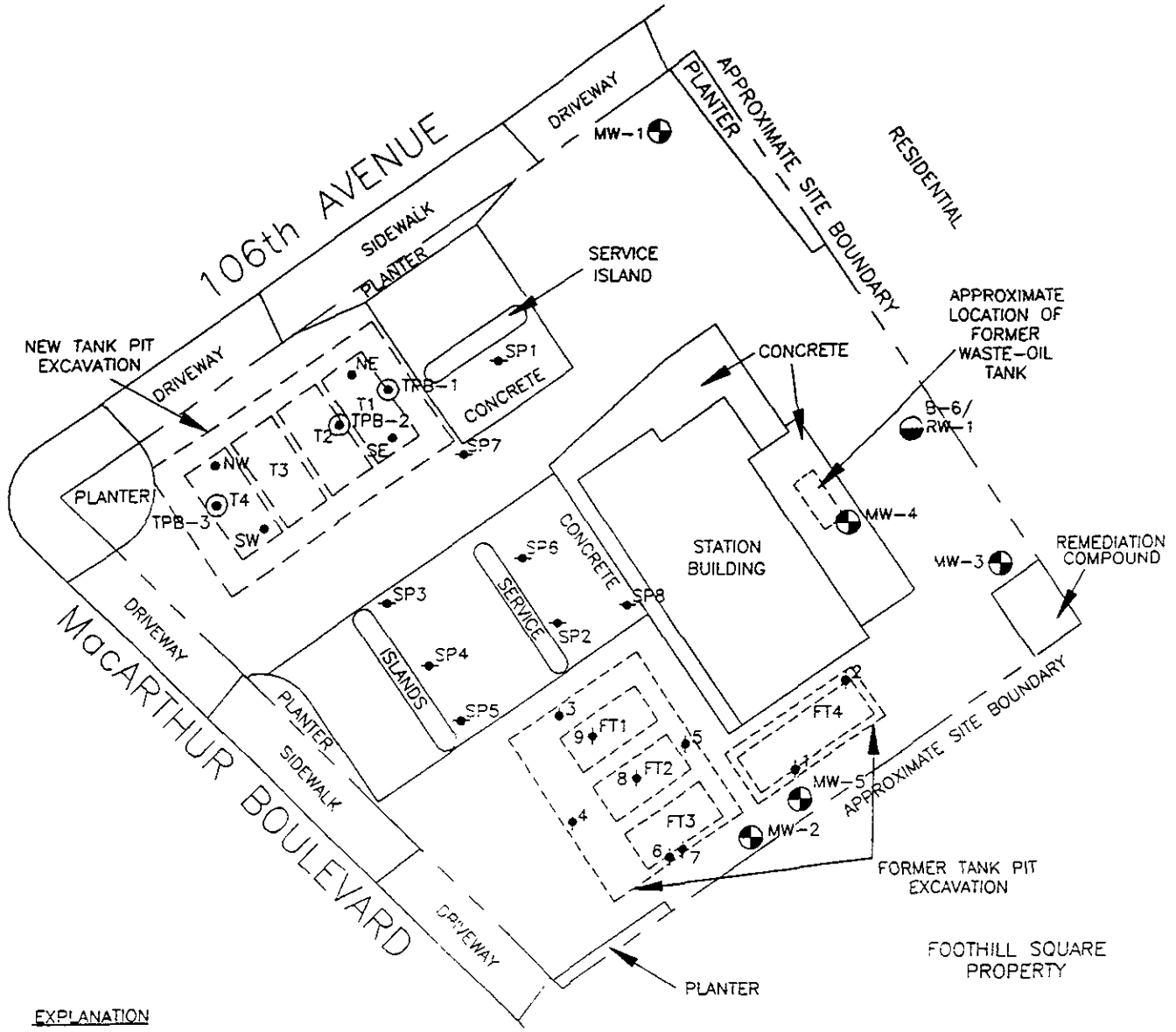
SITE AND VICINITY PLAN
ARCO Station 276
10600 MacArthur Boulevard
Oakland, California

PLATE
2



EXPLANATION

B-6/RW-1 = Recovery well (RESNA, October 1991)

TPB-3 = Soil boring in proposed tank pit (RESNA, January 1990)

MW-5 = Groundwater monitoring well (RESNA, March 1989)

NW = New tank pit excavation bottom soil sample (RESNA, April 1990)

9 = Former tank pit soil sample (S7-TP1SW-1 through S-13-TP2BN-9) (RESNA, Jan.-Feb. 1990)

SP8 = Product line trench soil sample (S-0529-SP1 through S-0613-SP8) (RESNA, May 1990)

T4 = Existing underground storage tanks

FT4 = Former underground storage tanks

Approximate Scale

30 15 0 30 60

feet

Source: Modified from plan supplied by ARCO and surveyed by Ron Archer, Civil Engineer, Inc.

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GENERALIZED SITE PLAN
ARCO Station 276
10600 MacArthur Boulevard
Oakland, California

PLATE 3

UNIFIED SOIL CLASSIFICATION SYSTEM

MAJOR DIVISION		LTR	DESCRIPTION	MAJOR DIVISION		LTR	DESCRIPTION
COARSE-GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	GW	Well-graded gravels or gravel-sand mixtures, little or no fines.	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.
		GP	Poorly-graded gravels or gravel-sand mixtures, little or no fines.			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.
		GM	Silty gravels, grave-sand-silt mixtures.			OL	Organic silts and organic silt-clays of low plasticity.
		GC	Clayey gravel, gravel-sand -clay mixtures.				
	SAND AND SANDY SOILS	SW	Well-graded sand or gravelly sands, little or no fines.		SILTS AND CLAYS LL>50	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts.
		SP	Poorly-graded sands or gravelly sands, little or no fines.			CH	Inorganic clays of high plasticity, fat clays.
		SM	Silty sands, sand-silt mixtures.			OH	Organic clays of medium to high plasticity, organic silts.
		SC	Clayey sands, sand-clay mixtures.	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

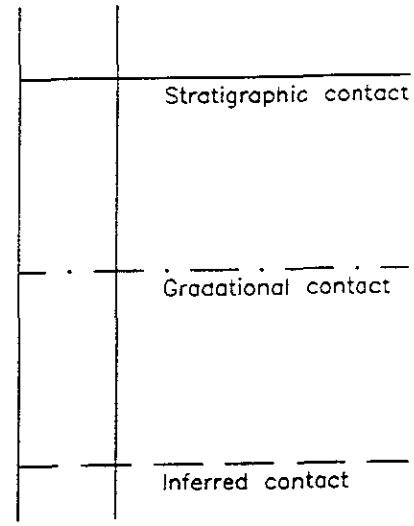

Neat cement


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.

GRADATIONAL AND INFERRED CONTACT 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.

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PROJECT 60026.07

UNIFIED SOIL CLASSIFICATION SYSTEM AND SYMBOL KEY
ARCO Station 276
10600 MacArthur Boulevard
Oakland, California

PLATE 4

Depth of boring: 51-1/2 feet Diameter of boring: 12 inches Date drilled: 10/30/91

Well depth: 51 feet Material type: Sch 80PVC Casing diameter: 4 inches

Screen interval: 36 to 51 feet Filter pack: #3 Monterey Sand Slot size: 0.020-inch

Drilling Company: H.E.W. Drilling Inc Driller: Jeff and Stacey

Method Used: Hollow-Stem Auger Field Geologist: Barbara Sieminski

Signature of Registered Professional: Diane Barclay

Registration No.: CEG 1366 State: CA

Depth	Sample No.	Blows	P.I.D.	USCS Code	Description	Well Const.
0					Asphalt (4 inches).	
				GP	Sandy gravel, brown, dry, medium dense: Baserock.	
2				CH	Silty clay, green-gray, damp, high plasticity, very stiff.	
4				CL	Sandy clay with small gravel, brown, damp, low plasticity, very stiff.	
6	S-5.5	5 10 15	0			
8						
10	S-10.5	6 13 19	0		Slightly moist.	
12				SM	Silty sand, with fine gravel, brown, slightly moist, medium dense.	
14						
16	S-15.5	9 14 18	0	CL	Silty clay, brown, damp, low plasticity, very stiff.	
18						
				ML	Sandy silt, brown, damp, low plasticity, very stiff.	
20	S-20.5	4 6 9	0	SM	Silty sand, fine-grained, brown, damp, medium dense (Section continues downward)	

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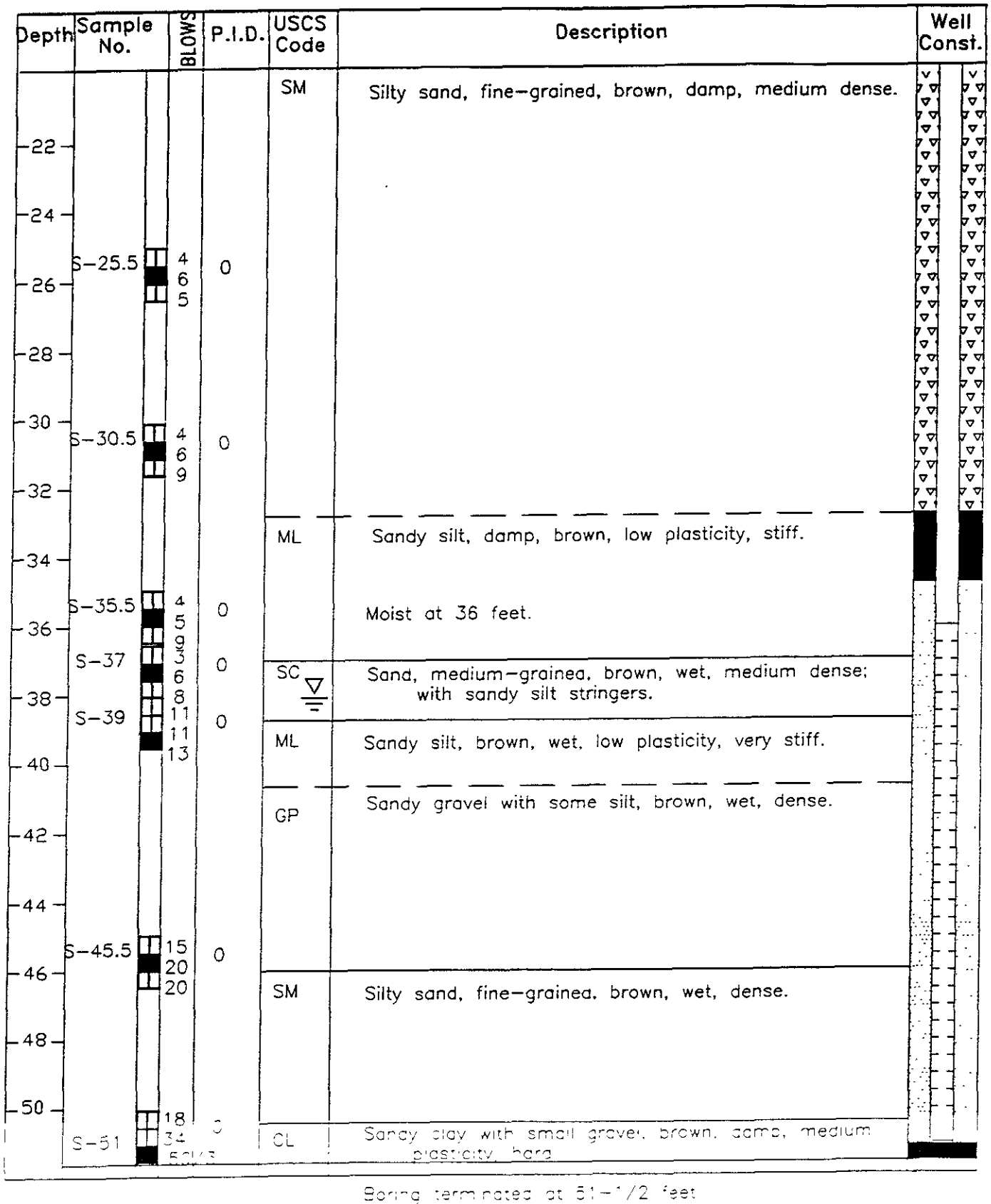
LOG OF BORING B-6/RW-1

ARCO Station 276
10600 MacArthur Boulevard
Oakland, California

PLATE 5

PROJECT: 60026.07



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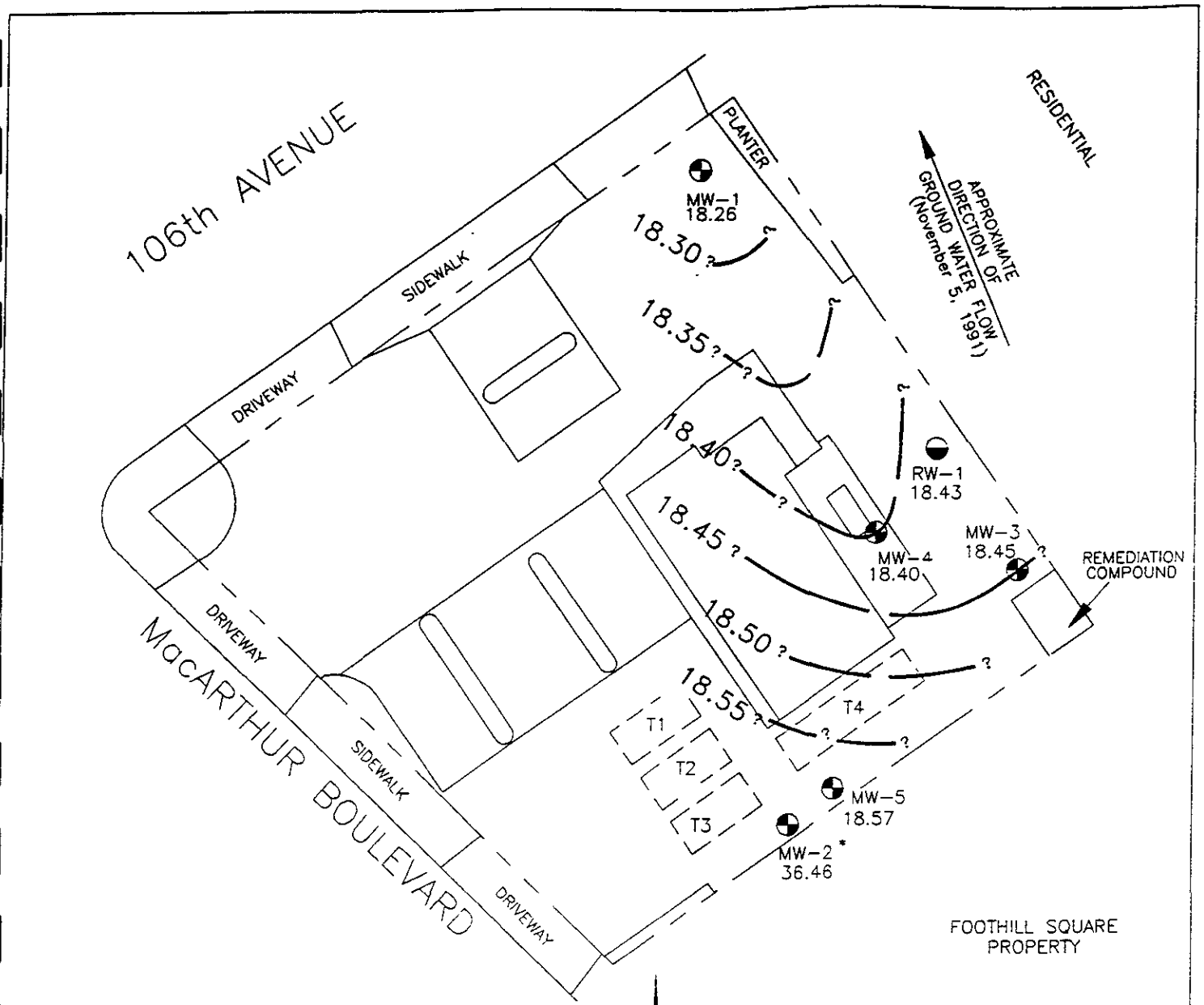
LOG OF BORING B-6/RW-1

ARCO Station 276
10600 MacArthur Boulevard
Oakland, California

PLATE 6

PROJECT 60026.07



EXPLANATION

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

18.57 = Elevation of groundwater in feet MSL November 5, 1991

MW-2 * = Well constructed in a shallow perched zone and not used for groundwater gradient interpretation

RW-1 = Recovery well (RESNA, October 1991

MW-5 = Monitoring well Applied GeoSystems, 1989

N

Approximate Scale

30 15 0 30 60

feet

Source: Modified from plan supplied by ARCO and surveyed by Ron Archer, Civil Engineer, Inc.

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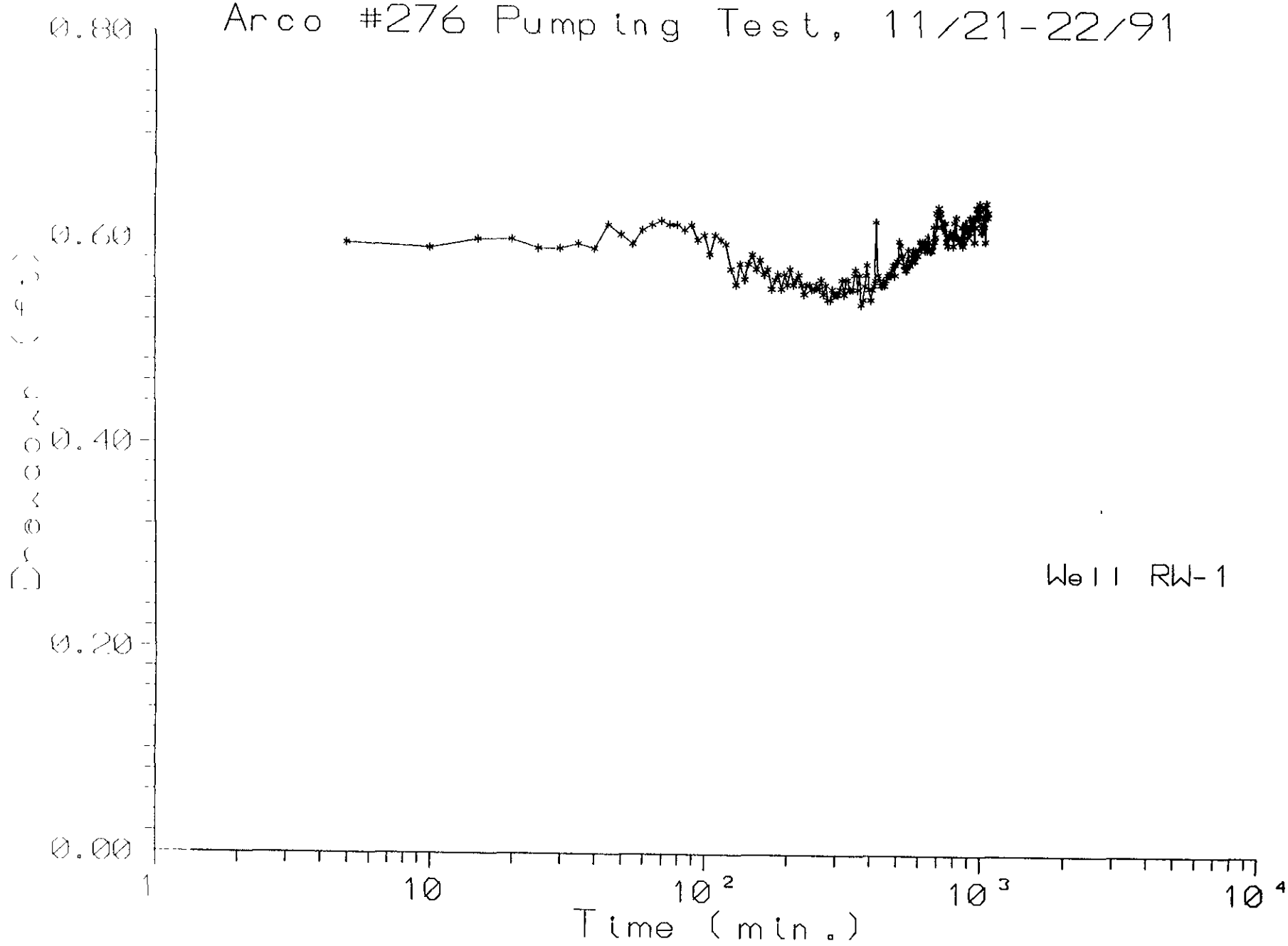
PROJECT 60026.07

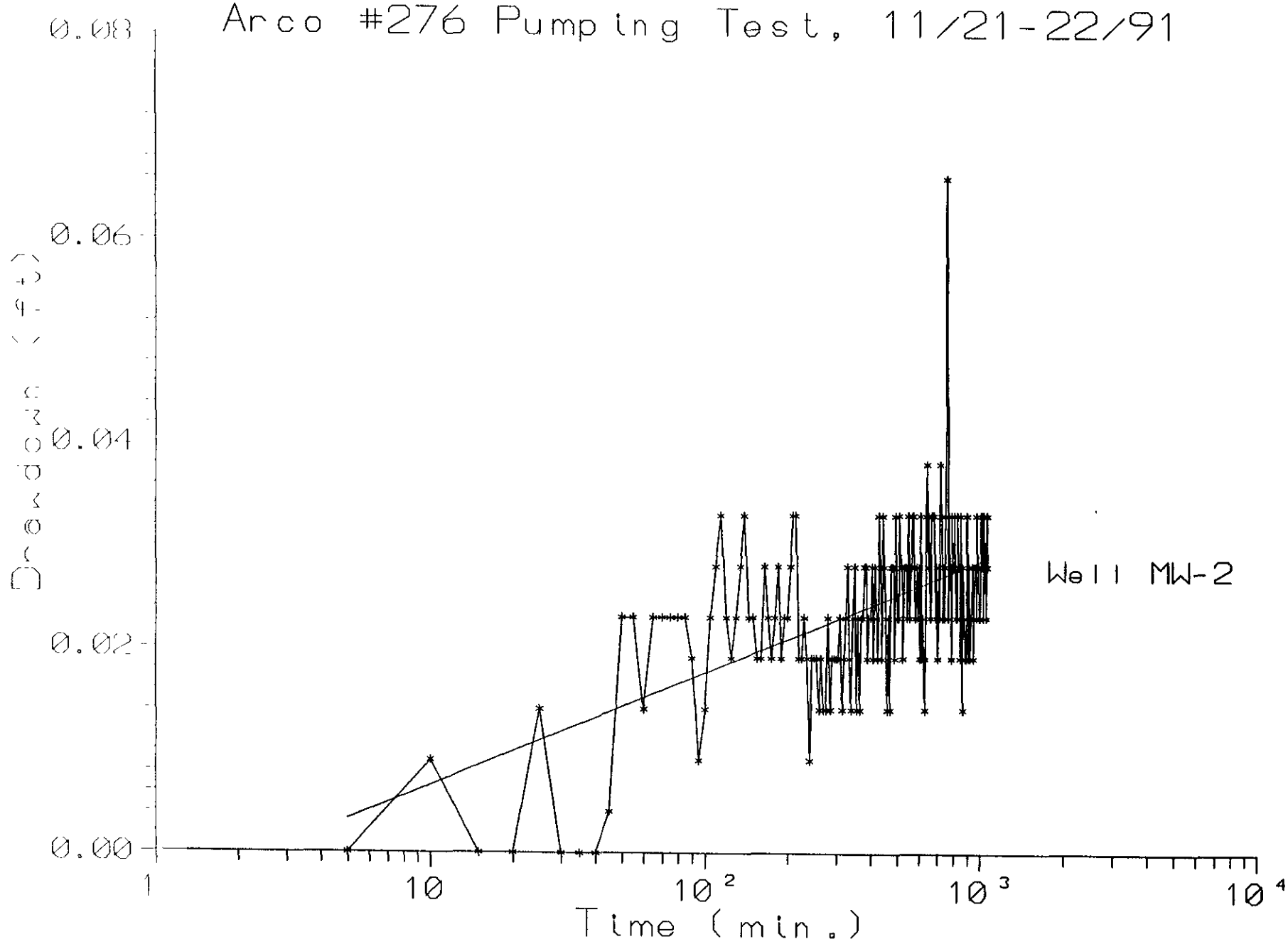
GROUNDWATER GRADIENT MAP
ARCO Station 276
10600 MacArthur Boulevard
Oakland, California

PLATE

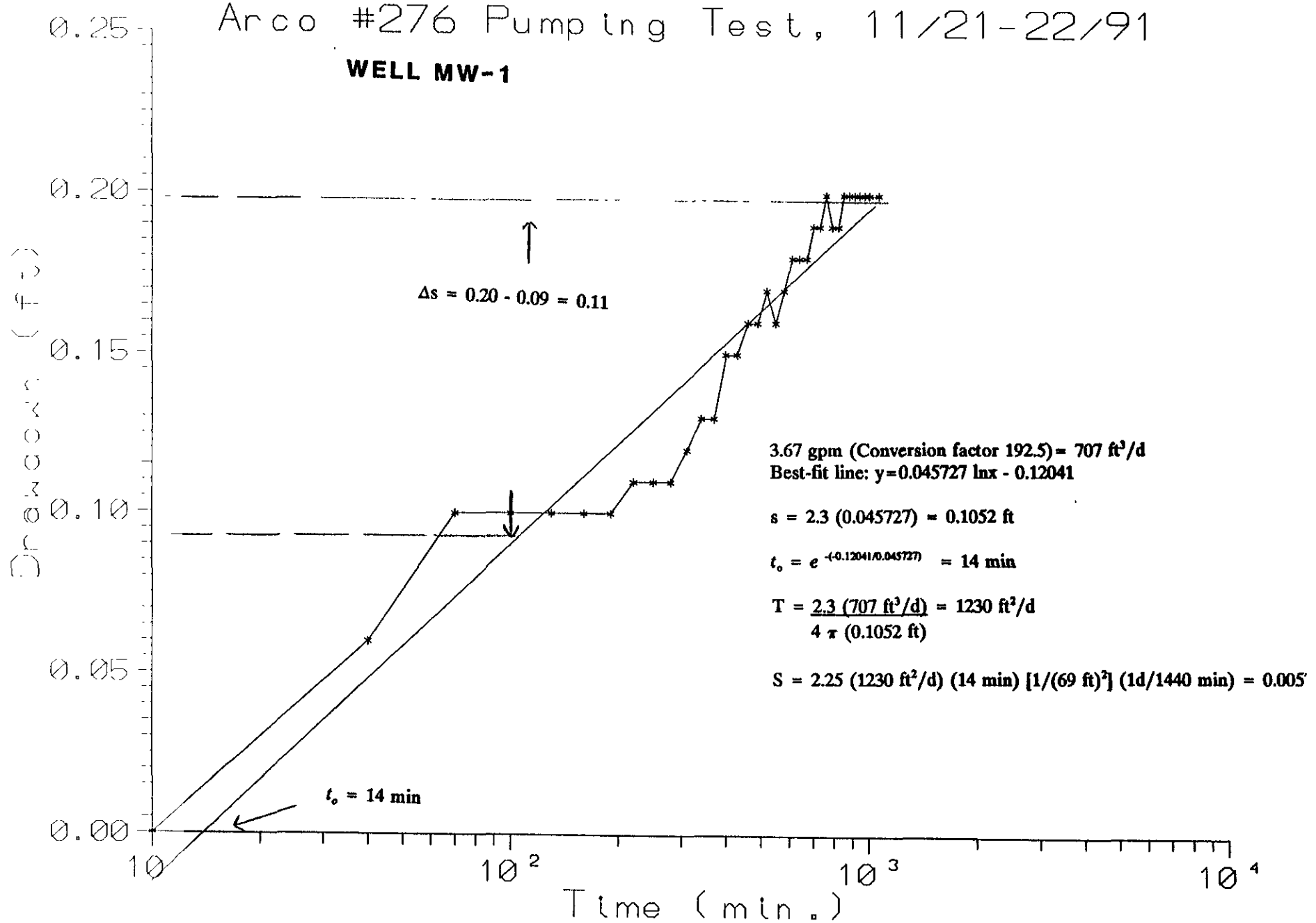
7



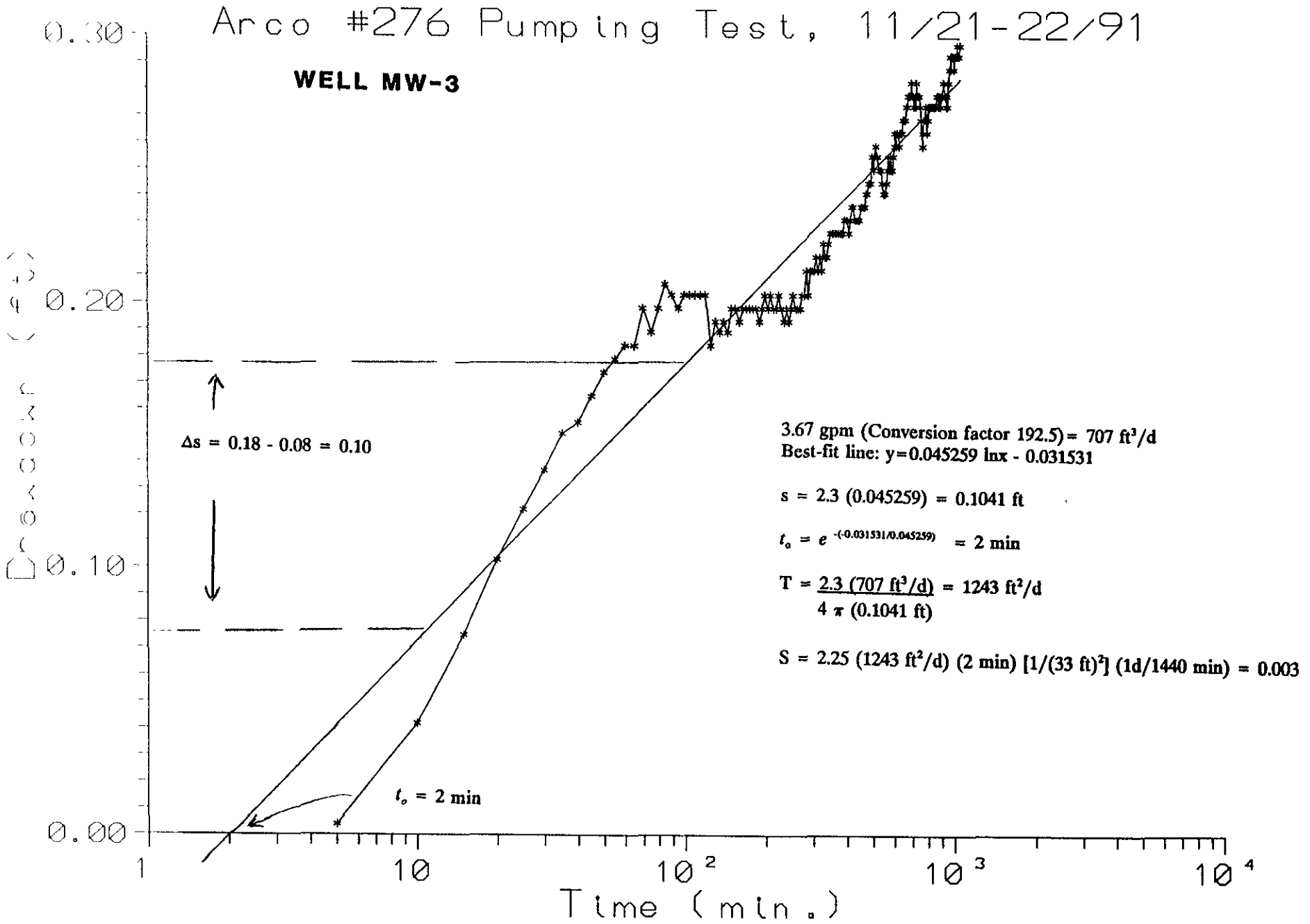
PROJECT 60026.07 DRAWDOWN/TIME WELL RW-1 (SEMI-LOGARITHMIC) PLOT PLATE 6



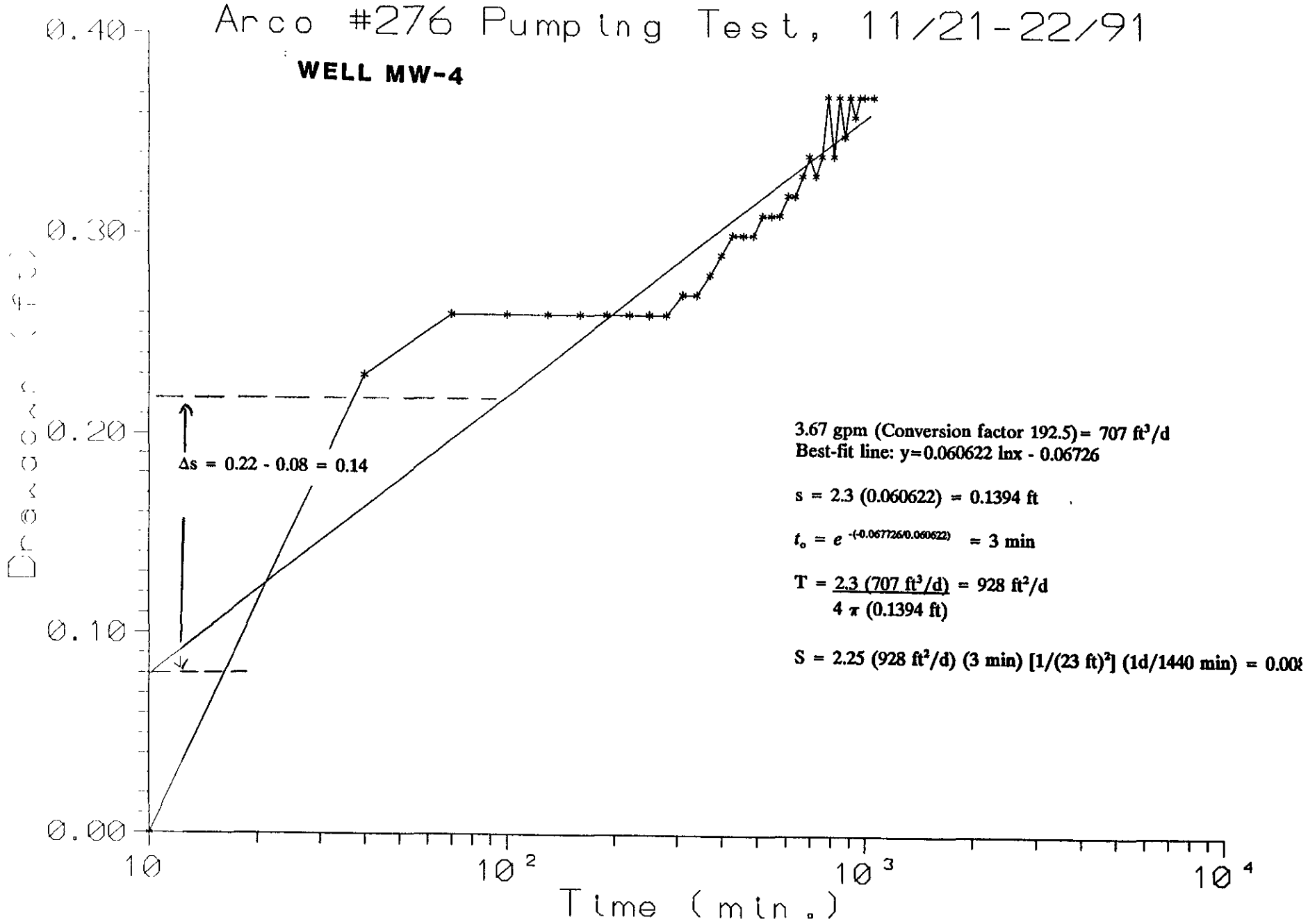
PROJECT 60026.07 DRAWDOWN/TIME WELL MW-2 (SEMI-LOGARITHMIC) PLOT PLATE 9



PROJECT 60026.07 DRAWDOWN/TIME WELL MW-1 (SEMI-LOGARITHMIC) PLOT PLATE 12

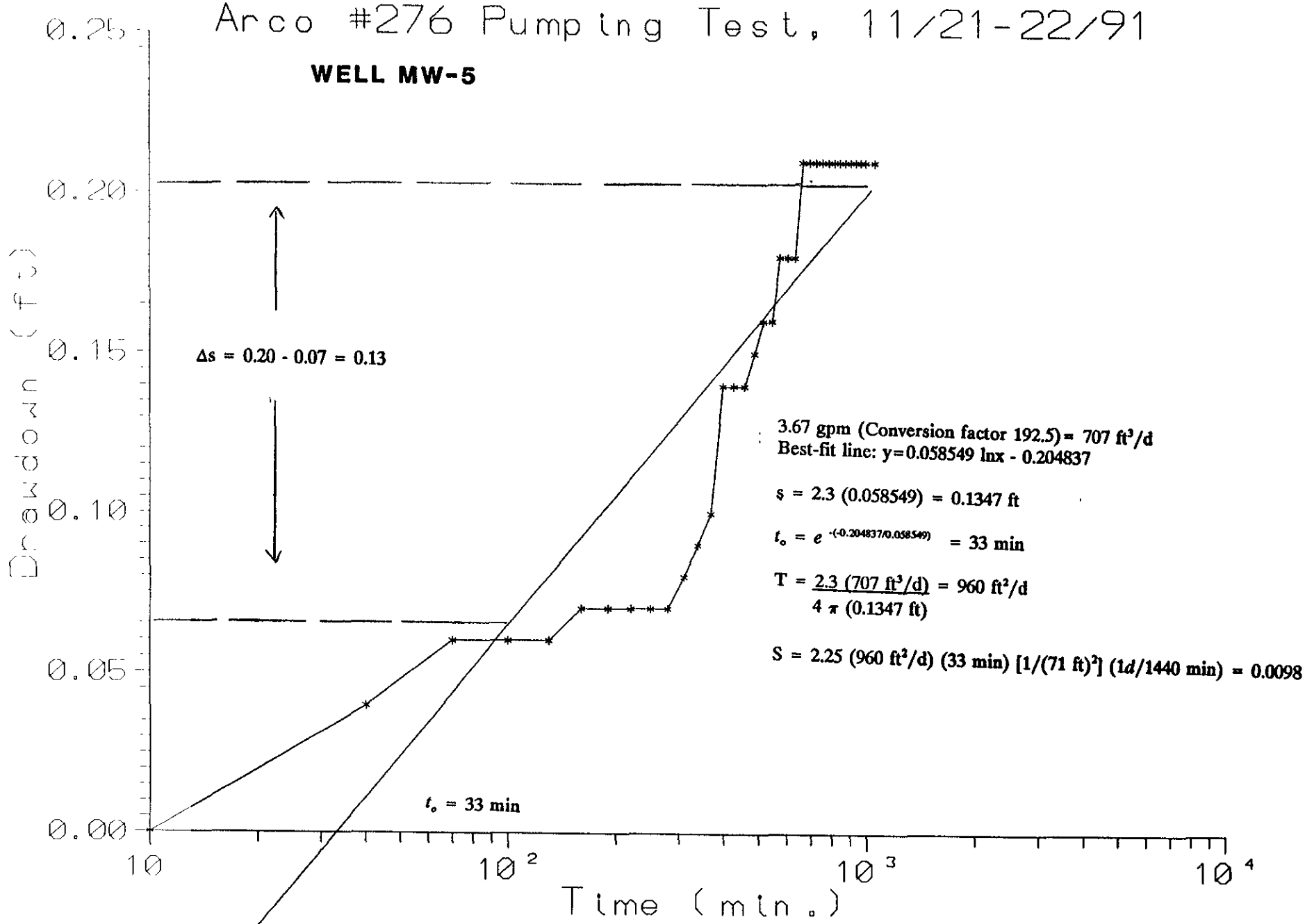


PROJECT 60026.07 DRAWDOWN/TIME WELL MW-3 (SEMI-LOGARITHMIC) PLOT PLATE 11



PROJECT 60026.07

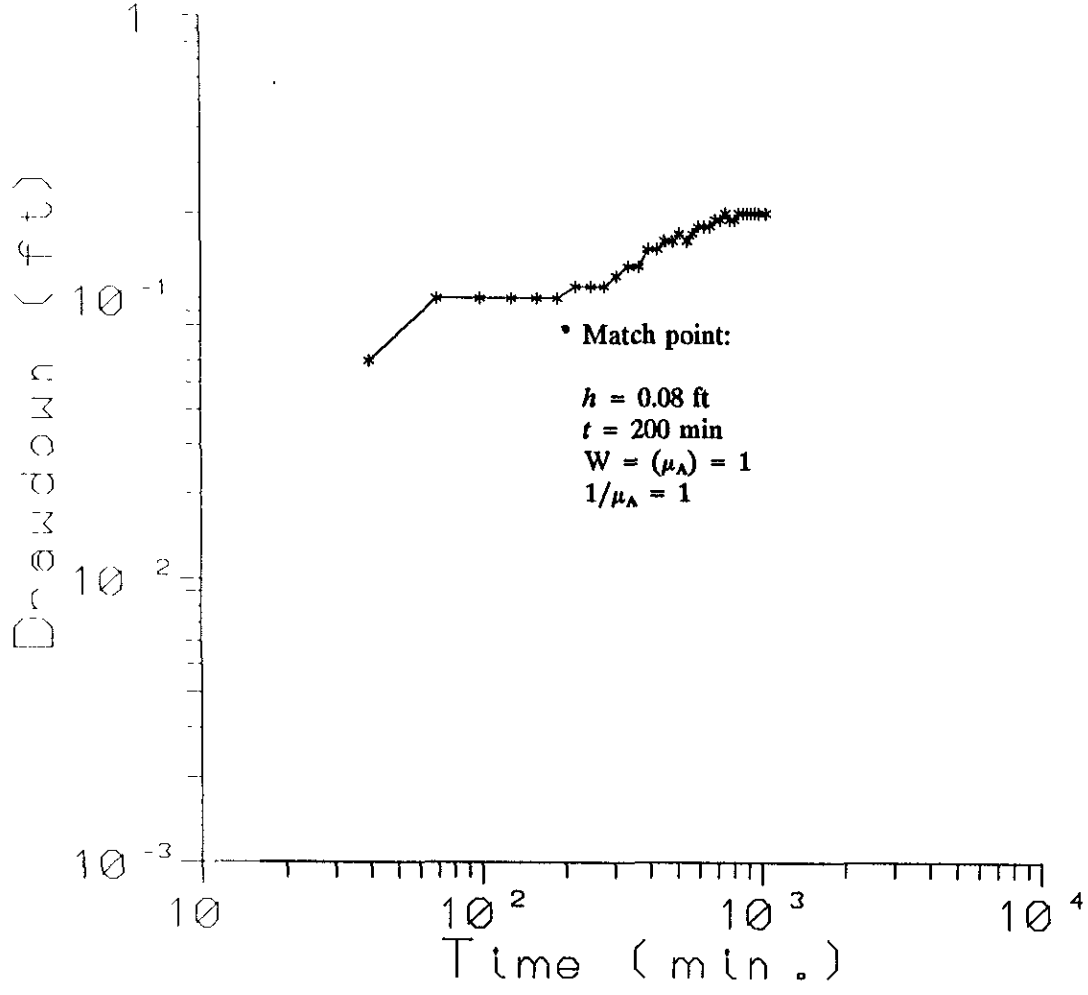
DRAWDOWN/TIME WELL MW-4 (SEMI-LOGARITHMIC) PLOT PLATE 12



PROJECT 60026.07 DRAWDOWN/TIME WELL MW-5 (SEMI-LOGARITHMIC) PLOT PLATE 12

Arco #276 Pumping Test, 11/21-22/91

WELL MW-1



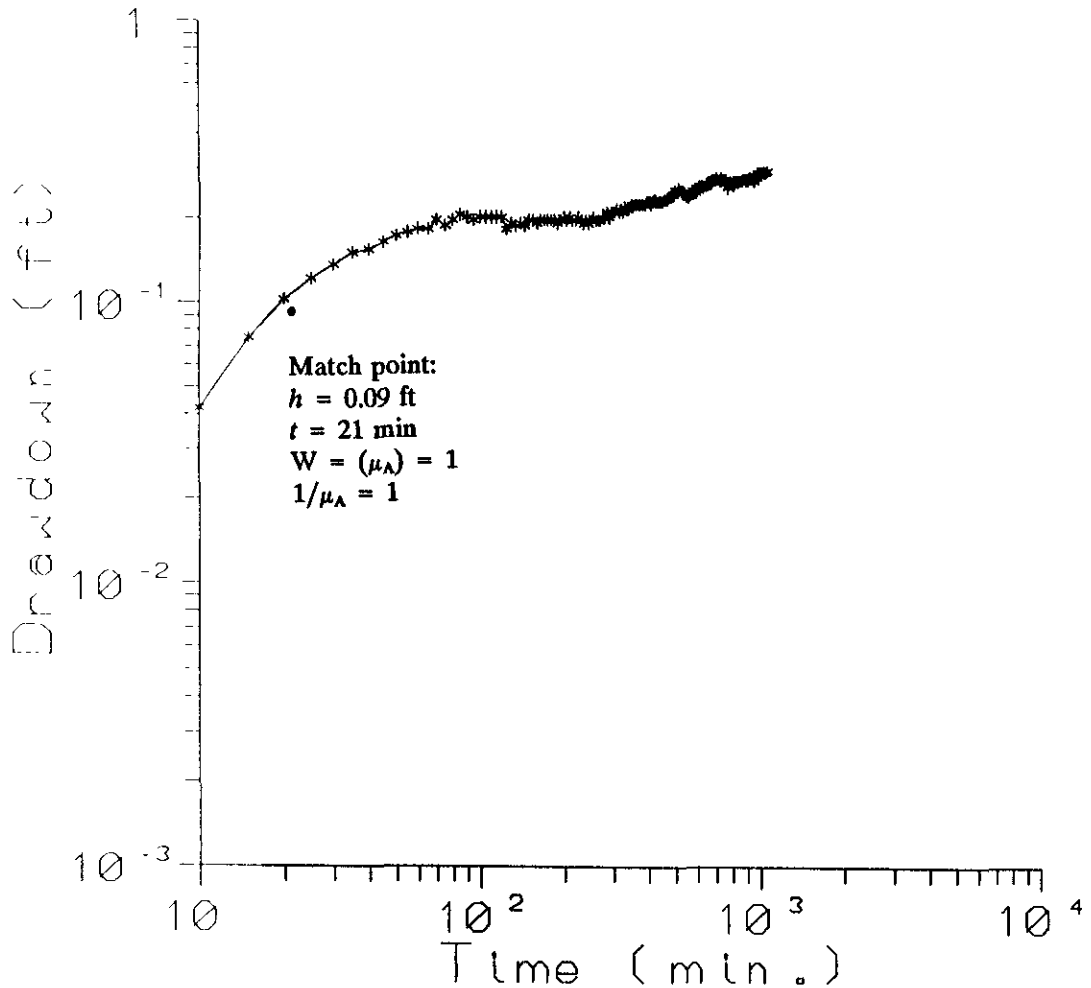
$$T = \frac{QW(\mu_A)}{4\pi h} = \frac{3.67\ gpm(1)}{4\pi(0.08\ ft)} \frac{1440\ min}{d} \frac{1\ ft^3}{7.48g} = 703\ ft^2/d$$

$$S = \frac{\mu_A 4Tt}{r^2} = \frac{(1)(4)(703\ ft^2/d\ (200\ min)\ (1\ d/1440\ min)}{(69\ ft)^2} = 0.08$$

PROJECT 60026.07 **DRAWDOWN/ TIME WELL MW-1 LOGARITHMIC PLOT** **PLATE 14**

Arco #276 Pumping Test, 11/21-22/91

WELL MW-3



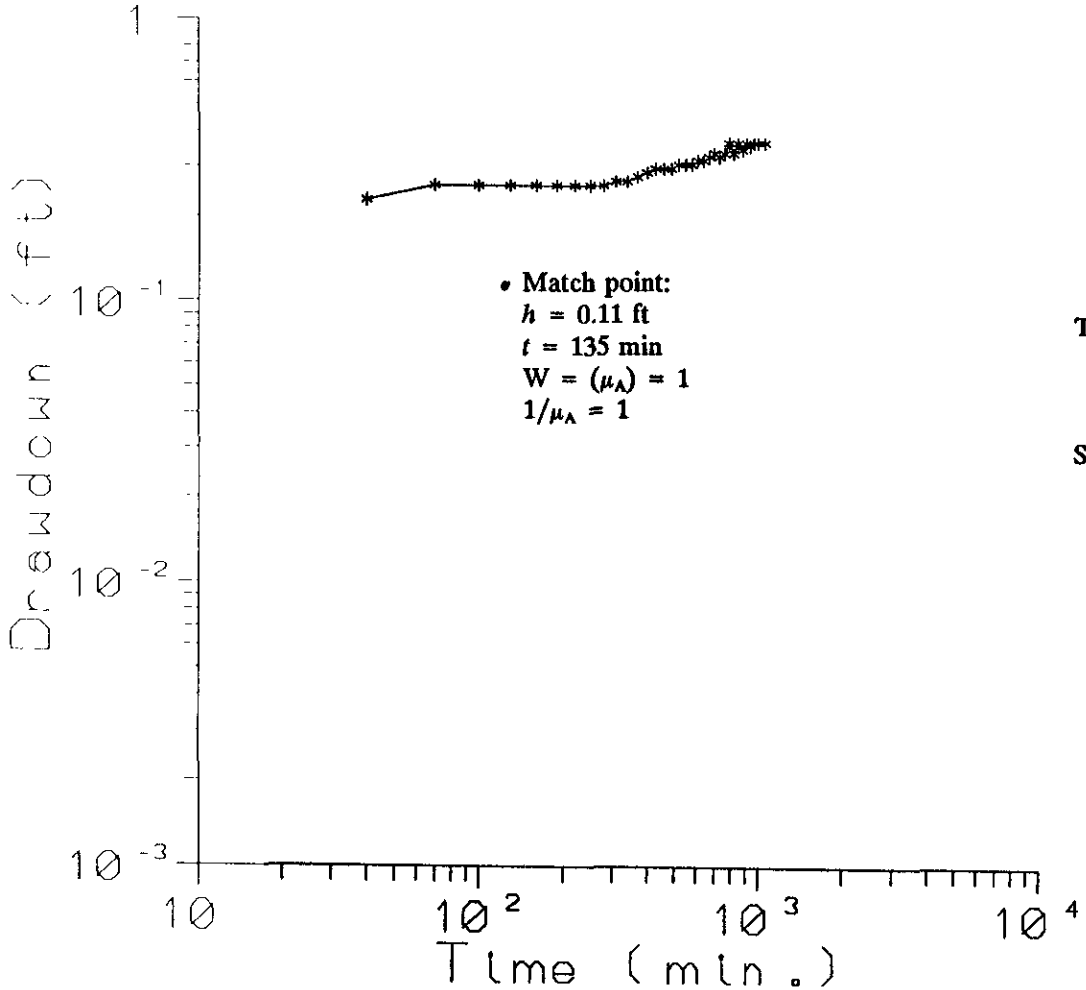
$$T = \frac{QW(\mu_A)}{4\pi h} = \frac{3.67\ \text{gpm}}{4\pi(0.09\ \text{ft})} \frac{1440\ \text{min}}{1\text{d}} \frac{1\ \text{ft}^3}{7.48\text{g}} = 625\ \text{ft}^2/\text{d}$$

$$S = \frac{\mu_A 4Tt}{r^2} = \frac{(1)(4)(625\ \text{ft}^2/\text{d})(21\ \text{min})(1\ d/1440\ \text{min})}{(33\ \text{ft})^2} = 0.03$$

PROJECT 60026.07 DRAWDOWN/TIME WELL MW-3 LOGARITHMIC PLOT PLATE 15

Arco #276 Pumping Test, 11/21-22/91

WELL MW-4



- **Match point:**
  h = 0.11 ft
  t = 135 min
  W = (μ_A) = 1
  $1/\mu_A$ = 1

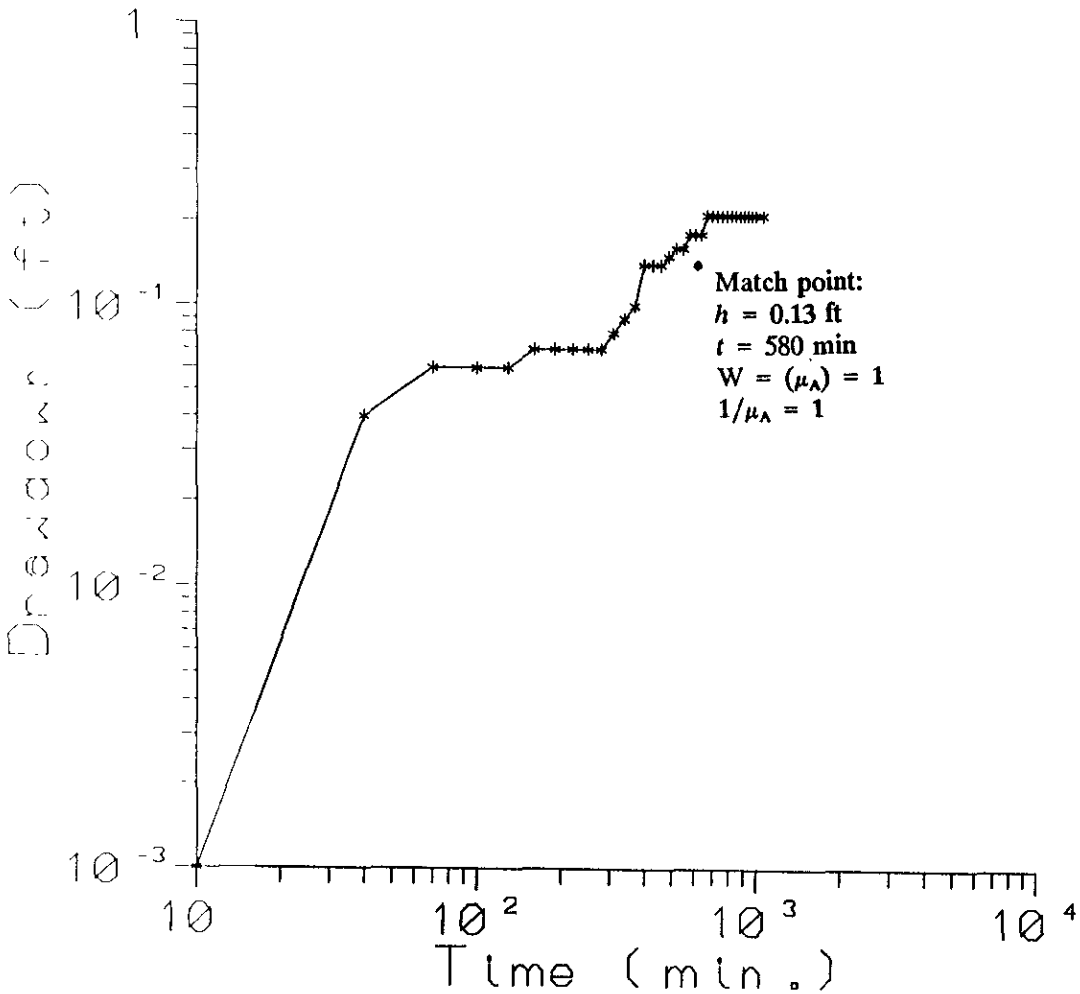
$$T = \frac{QW(\mu_A)}{4\pi h} = \frac{3.67\ \text{gpm}}{4\pi(0.11\ \text{ft})} \frac{1440\ \text{min}}{1\text{d}} \frac{1\ \text{ft}^3}{7.48\text{g}} = 511\ \text{ft}^2/\text{d}$$

$$S = \frac{\mu_A 4Tt}{r^2} = \frac{(1)(4)(511\ \text{ft}^2/\text{d})(135\ \text{min})(1\ \text{d}/1440\ \text{min})}{(23\ \text{ft})^2} = 0.36$$

ROJECT 60026.07 **DRAWDOWN/TIME WELL MW-4 LOGARITHMIC PLOT** PLATE 16

Arco #276 Pumping Test, 11/21-22/91

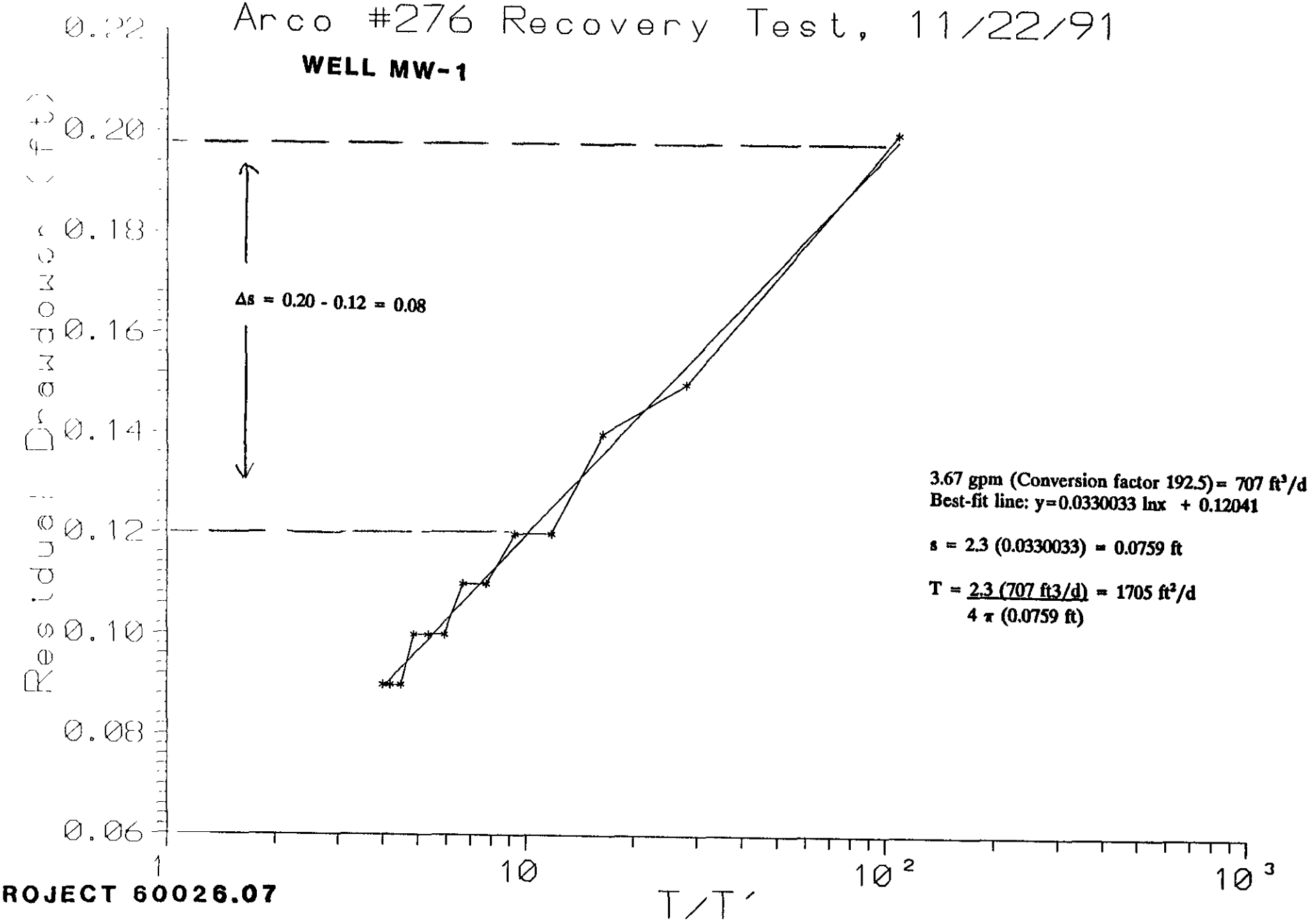
WELL MW-5



$$T = \frac{QW(\mu_A)}{4\pi h} = \frac{3.67\ \text{gpm}(1)}{4\pi(0.13\ \text{ft})}\ \frac{1440\ \text{min}}{1\text{d}}\ \frac{1\ \text{ft}^3}{7.48\text{g}} = 433\ \text{ft}^2/\text{d}$$

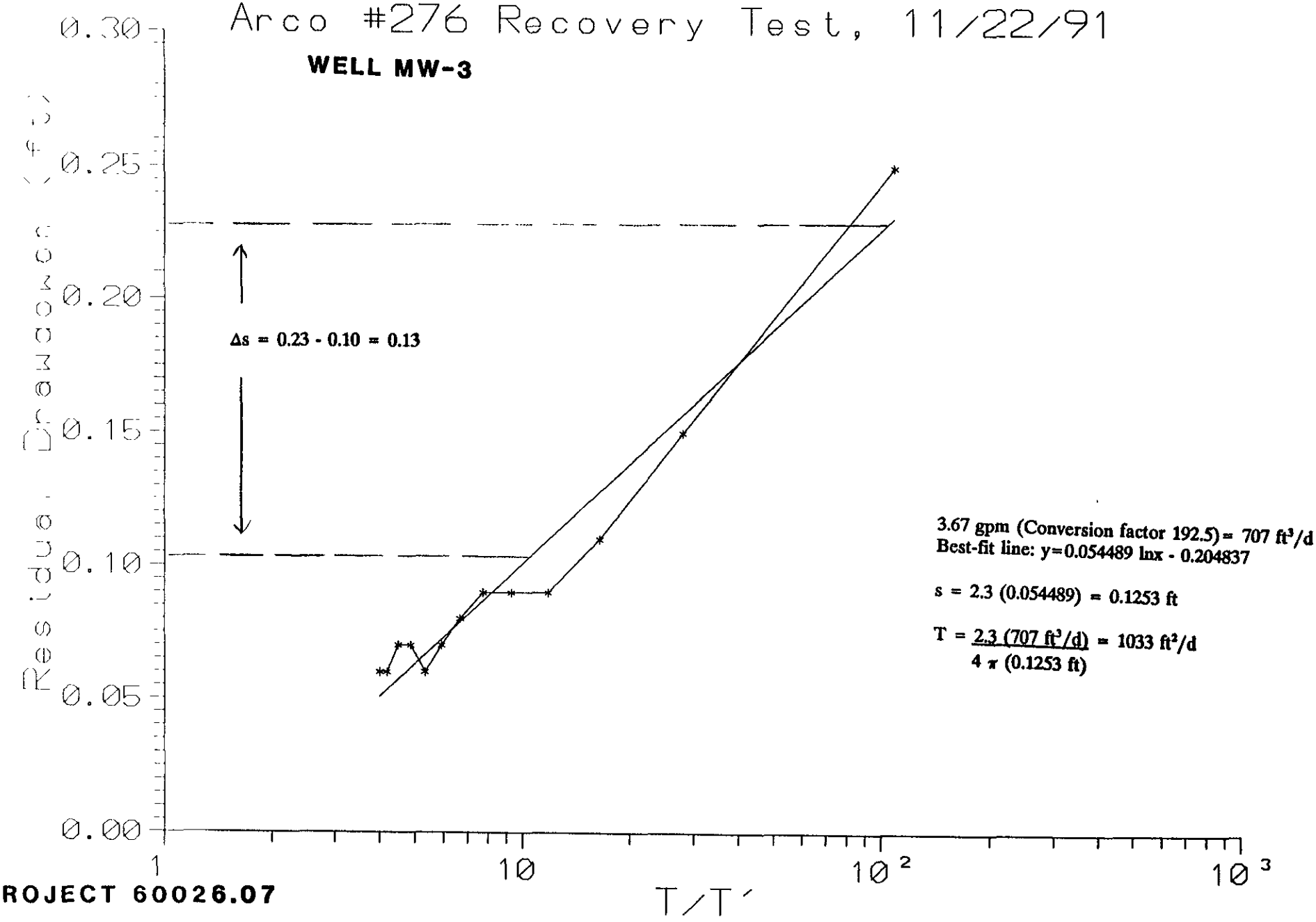
$$S = \frac{\mu_A 4Tt}{r^2} = \frac{(1)(4)(433\text{ft}^2/\text{d})(580\ \text{min})(1\ \text{d}/1440\ \text{min})}{(71\ \text{ft})^2} = 0.14$$

PROJECT 60026.07 **DRAWDOWN/TIME WELL MW-5 LOGARITHMIC PLOT** **PLATE 17**



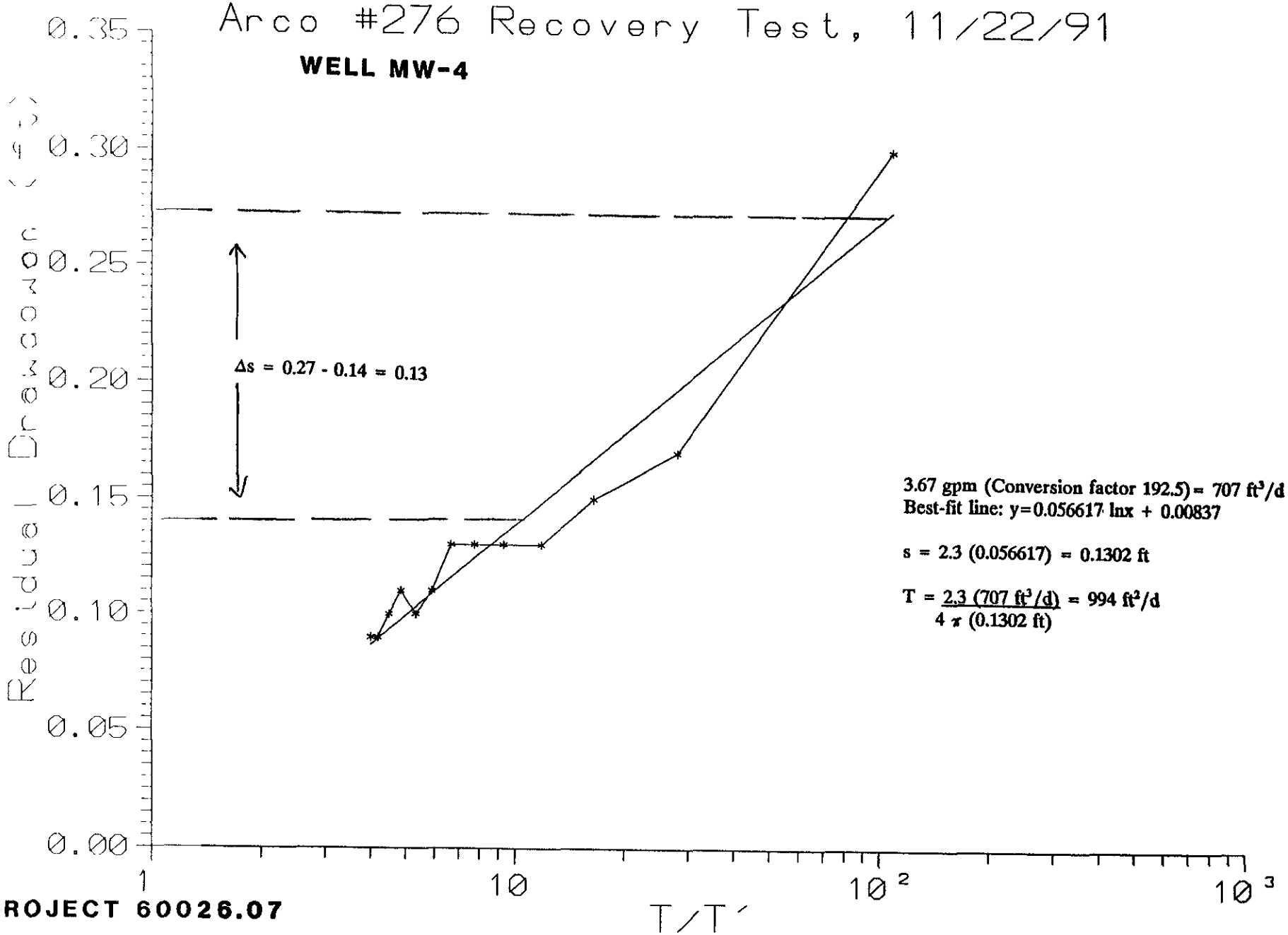
PROJECT 60026.07

RESIDUAL DRAWDOWN/NORMALIZED TIME WELL MW-1 (SEMI-LOGARITHMIC) PLOT PLATE 18

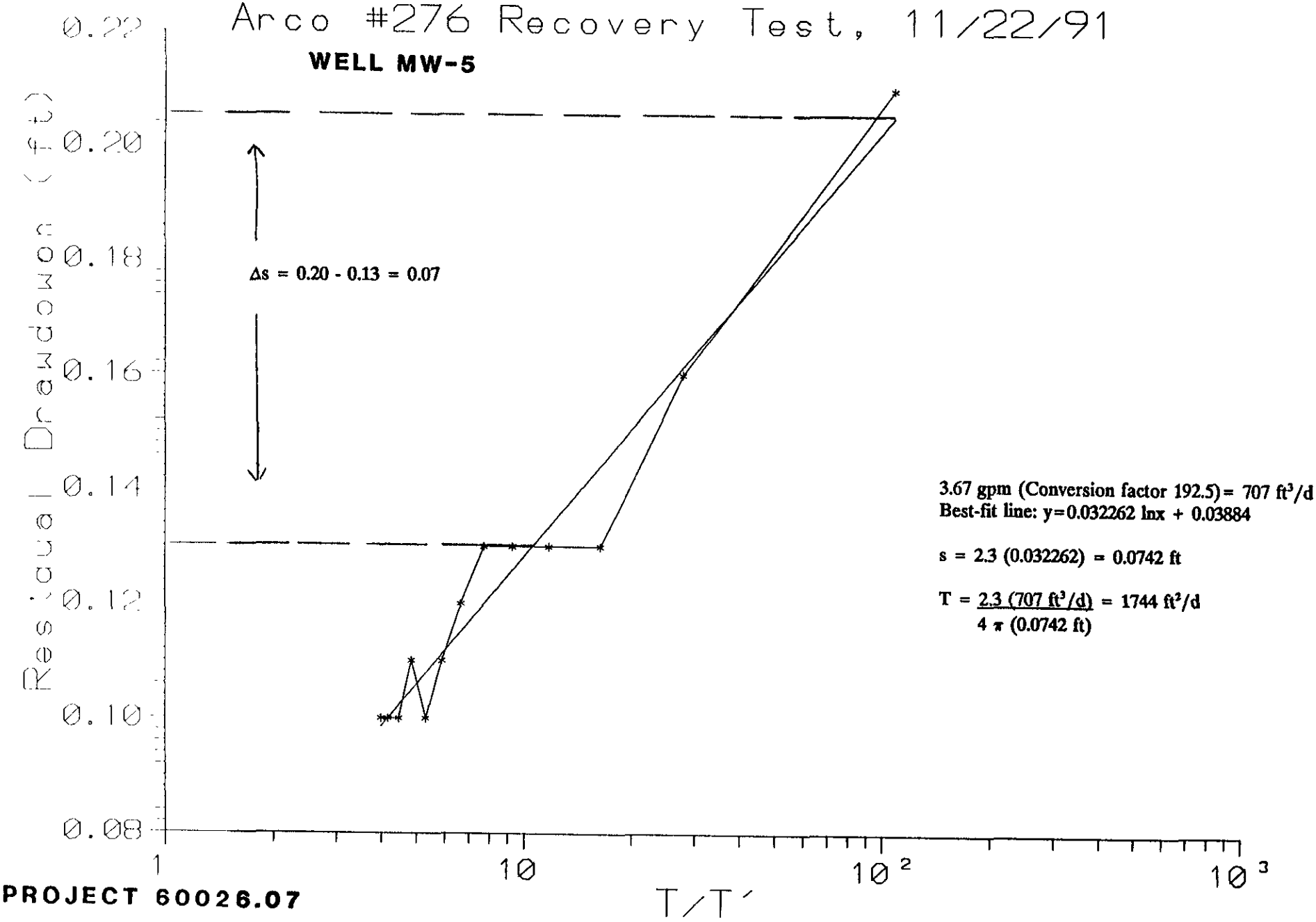


PROJECT 60026.07

RESIDUAL DRAWDOWN/NORMALIZED TIME WELL MW-3 (SEMI-LOGARITHMIC) PLOT PLATE 19

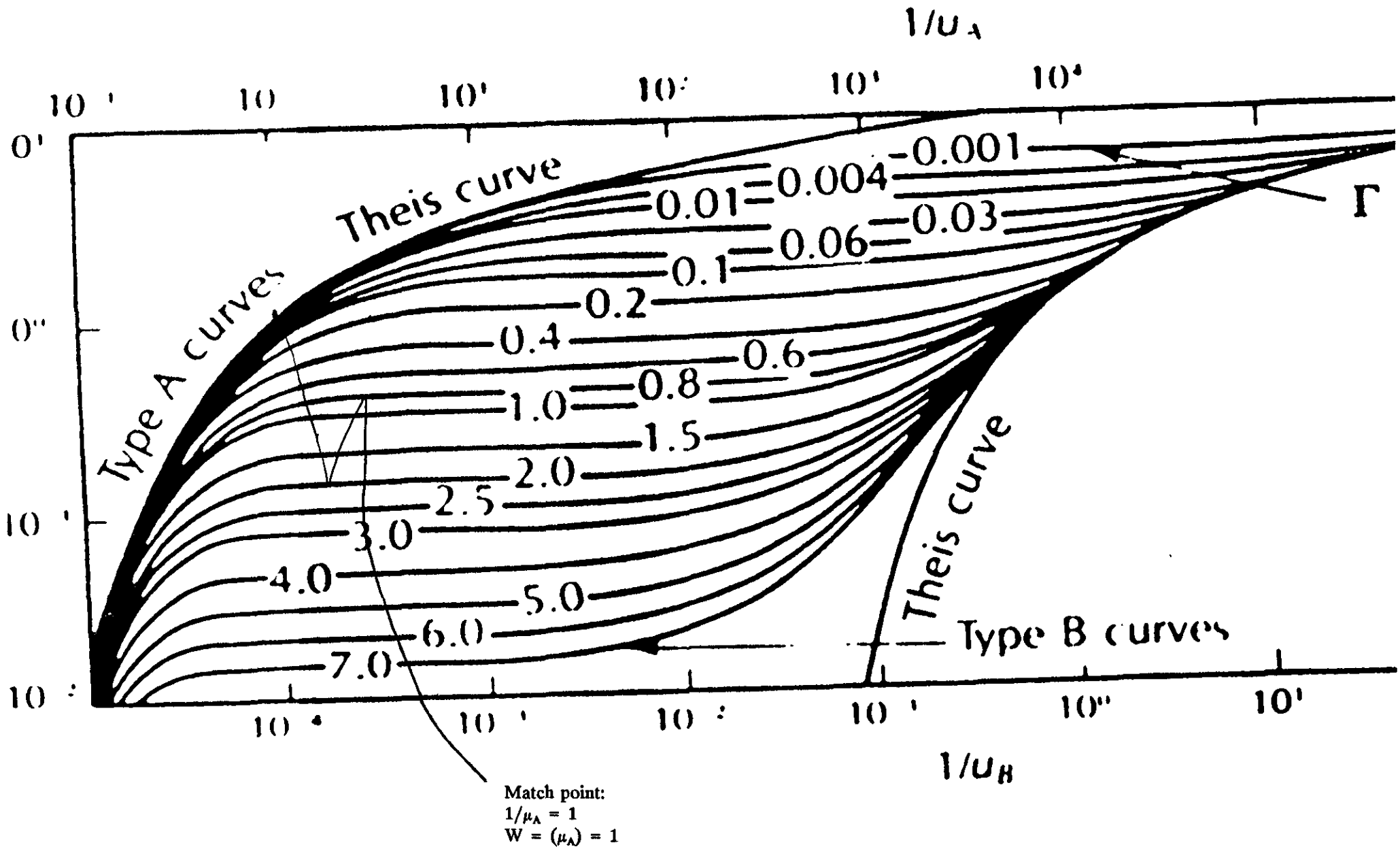


RESIDUAL DRAWDOWN/NORMALIZED TIME WELL MW-4 (SEMI-LOGARITHMIC) PLOT PLATE 20



PROJECT 60026.07

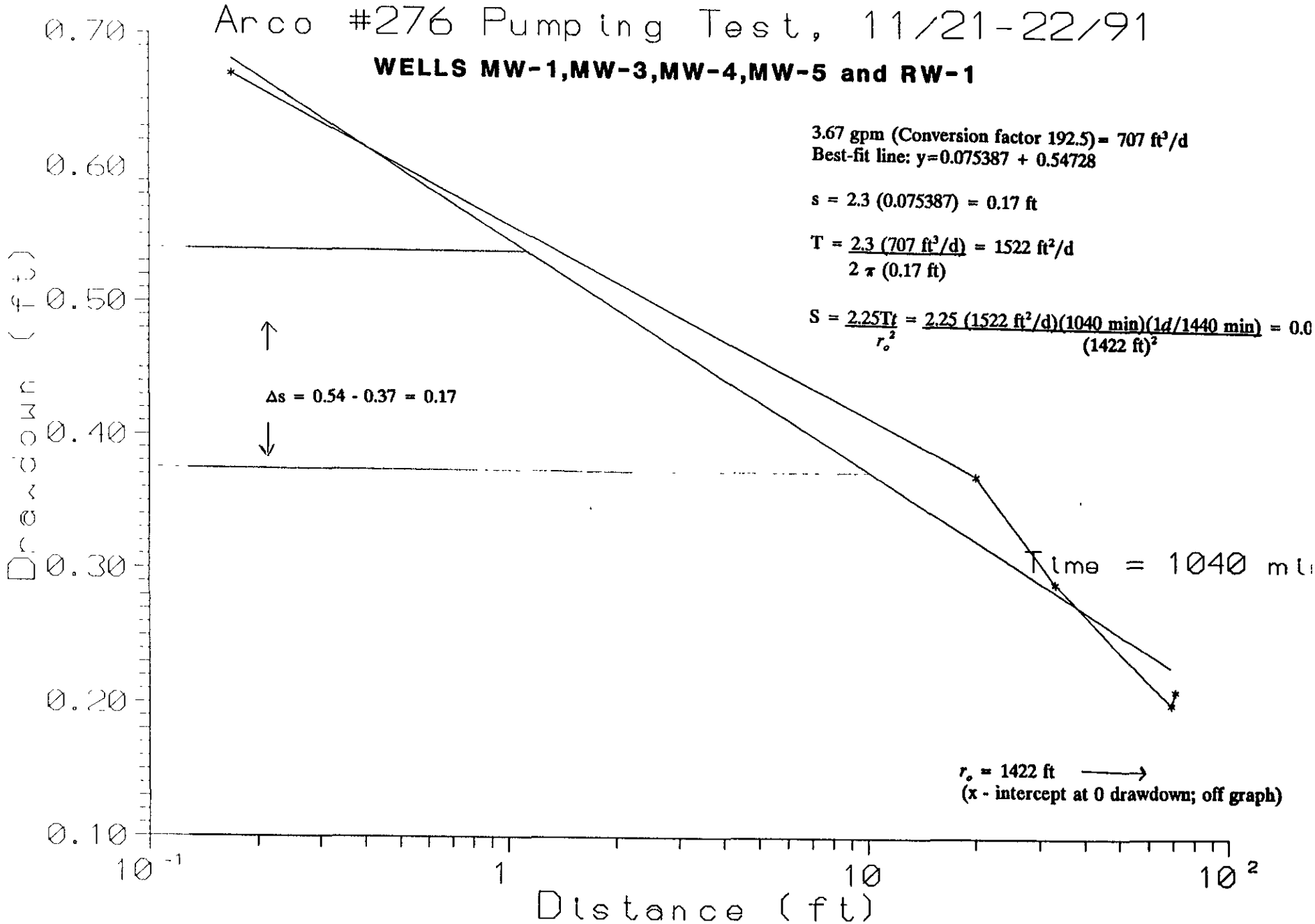
RESIDUAL DRAWDOWN/NORMALIZED TIME WELL MW-5 (SEMI-LOGARITHMIC) PLOT PLATE 9.1



PROJECT 60026.07

NEUMAN TYPE CURVES FOR DRAWDOWN DATA

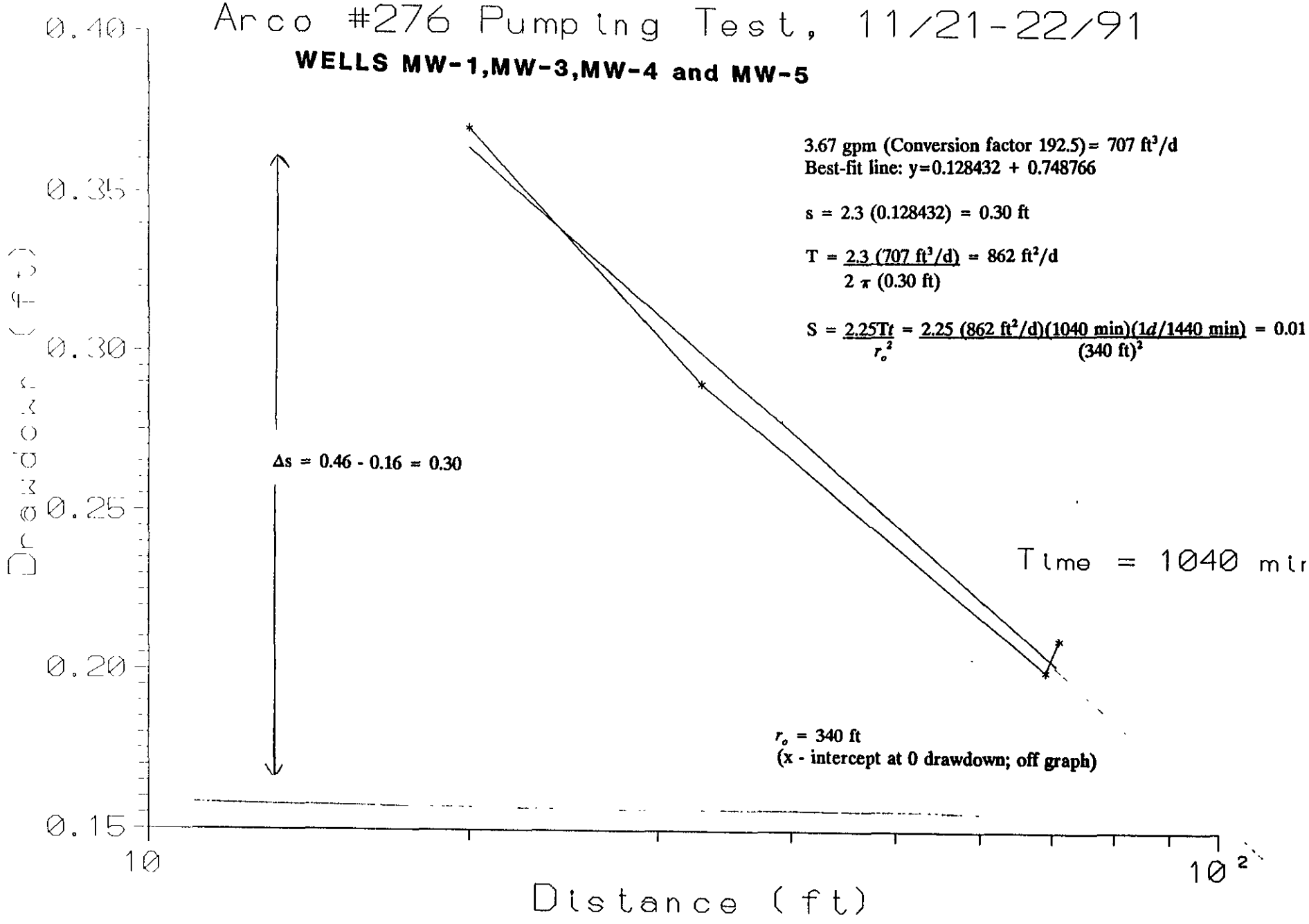
PLATE 22



PROJECT 60026.07

DRAWDOWN/DISTANCE (SEMI-LOGARITHMIC) PLOT

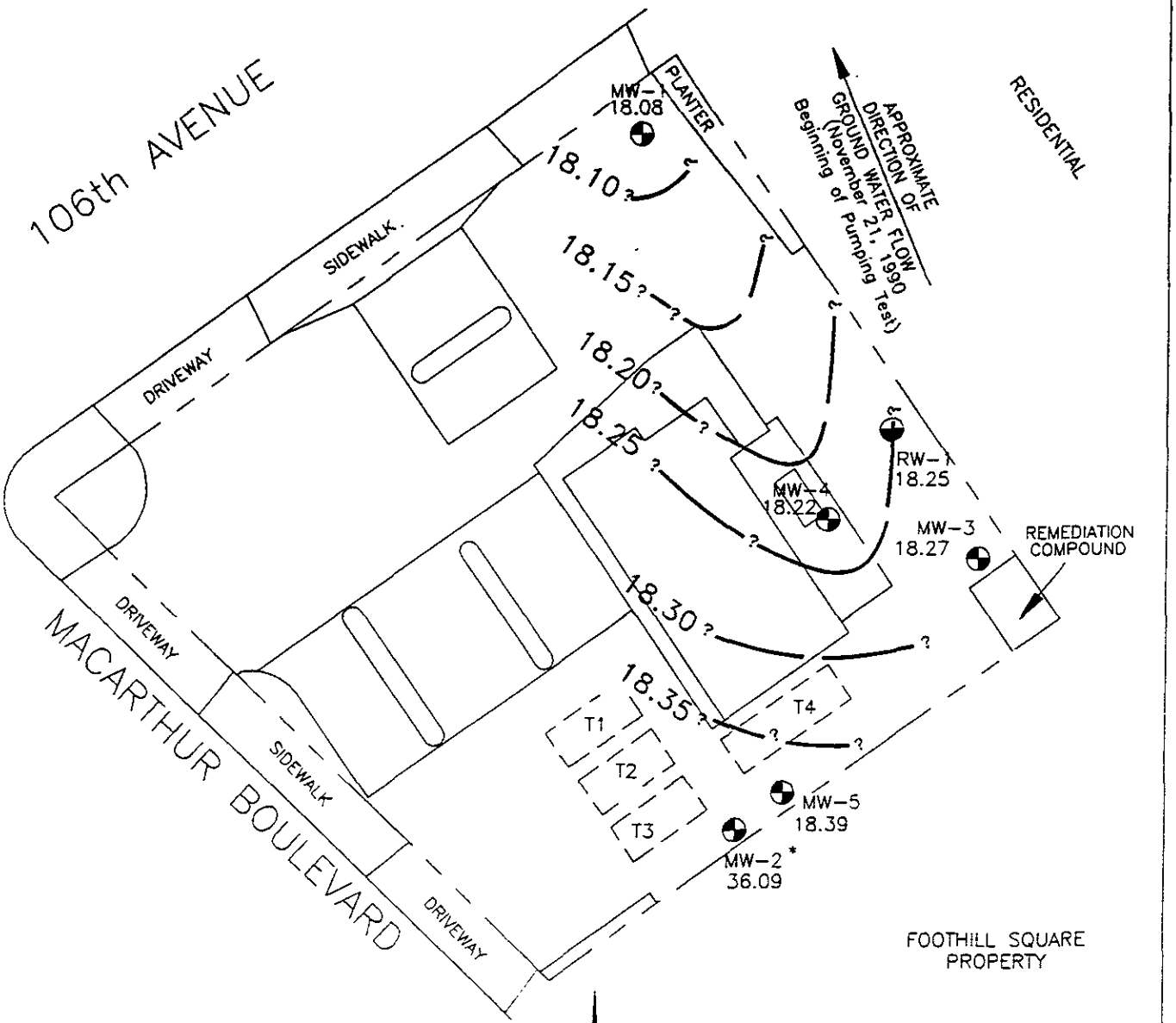
PLATE 23



PROJECT 60026.07

DRAWDOWN/DISTANCE (SEMI-LOGARITHMIC) PLOT

PLATE 24



EXPLANATION

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

18.39 = Elevation of groundwater in feet above MSL November 21, 1991, beginning of pumping test

MW-2 * = Well constructed in a shallow perched zone and not used for groundwater gradient interpretation

RW-1 = Recovery well (RESNA, October 1991)

MW-5 = Monitoring well (Applied GeoSystems, 1989)

Source: Modified from plan supplied by ARCO and surveyed by Ron Archer, Civil Engineer, Inc.

RESNA
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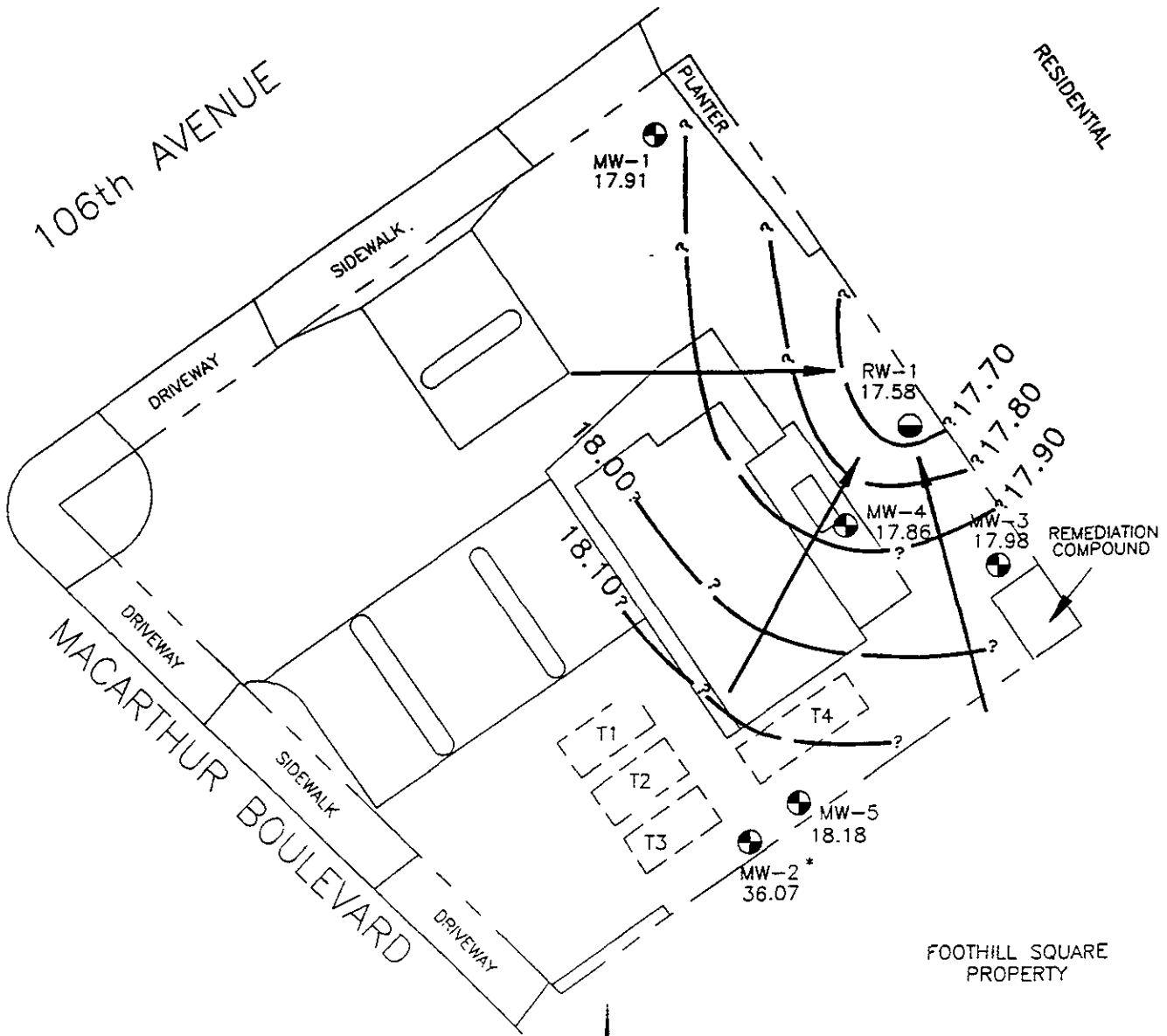
GROUNDWATER GRADIENT MAP BEGINNING OF PUMPING TEST ARCO Station 276 10600 MacArthur Boulevard Oakland, California

PLATE 25



EXPLANATION

= Approximate direction of groundwater flow (November 22, 1991, end of pumping test)

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

18.18 = Elevation of groundwater in feet above MSL November 22, 1991, end of pumping test

MW-2 * = Well constructed in a shallow perched zone and not used for groundwater gradient interpretation

RW-1 = Recovery well (RESNA, October 1991)

MW-5 = Monitoring well Applied GeoSystems 1989

N

Approximate Scale

30 15 0 30 60

feet

Source Modified from plan supplied by ARCO and surveyed by Ron Archer, Civil Engineer, nc

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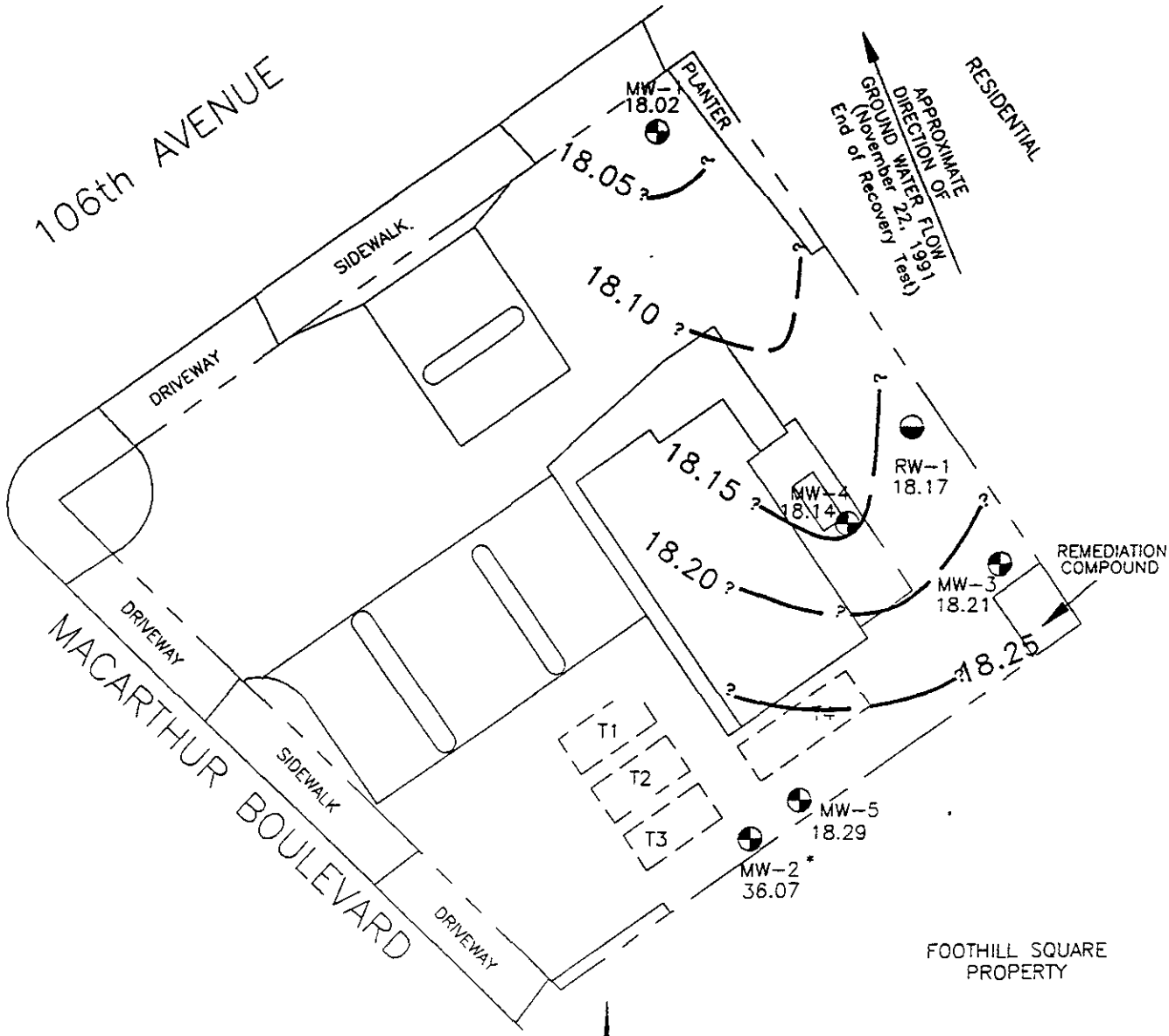
GROUNDWATER GRADIENT MAP
END OF PUMPING TEST
ARCO Station 276
10600 MacArthur Boulevard
Oakland, California

PLATE
26



EXPLANATION

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

18.29 = Elevation of groundwater in feet above MSL November 22, 1991, end of recovery test

MW-2 * = Well constructed in a shallow perched zone and not used for groundwater gradient interpretation

RW-1 = Recovery well (RESNA, October 1991)

MW-5 = Monitoring well (Applied GeoSystems, 1989)

N

Approximate Scale

30 15 0 30 60

feet

Source: Modified from plan supplied by ARCO and surveyed by Ron Archer, Civil Engineer, Inc.

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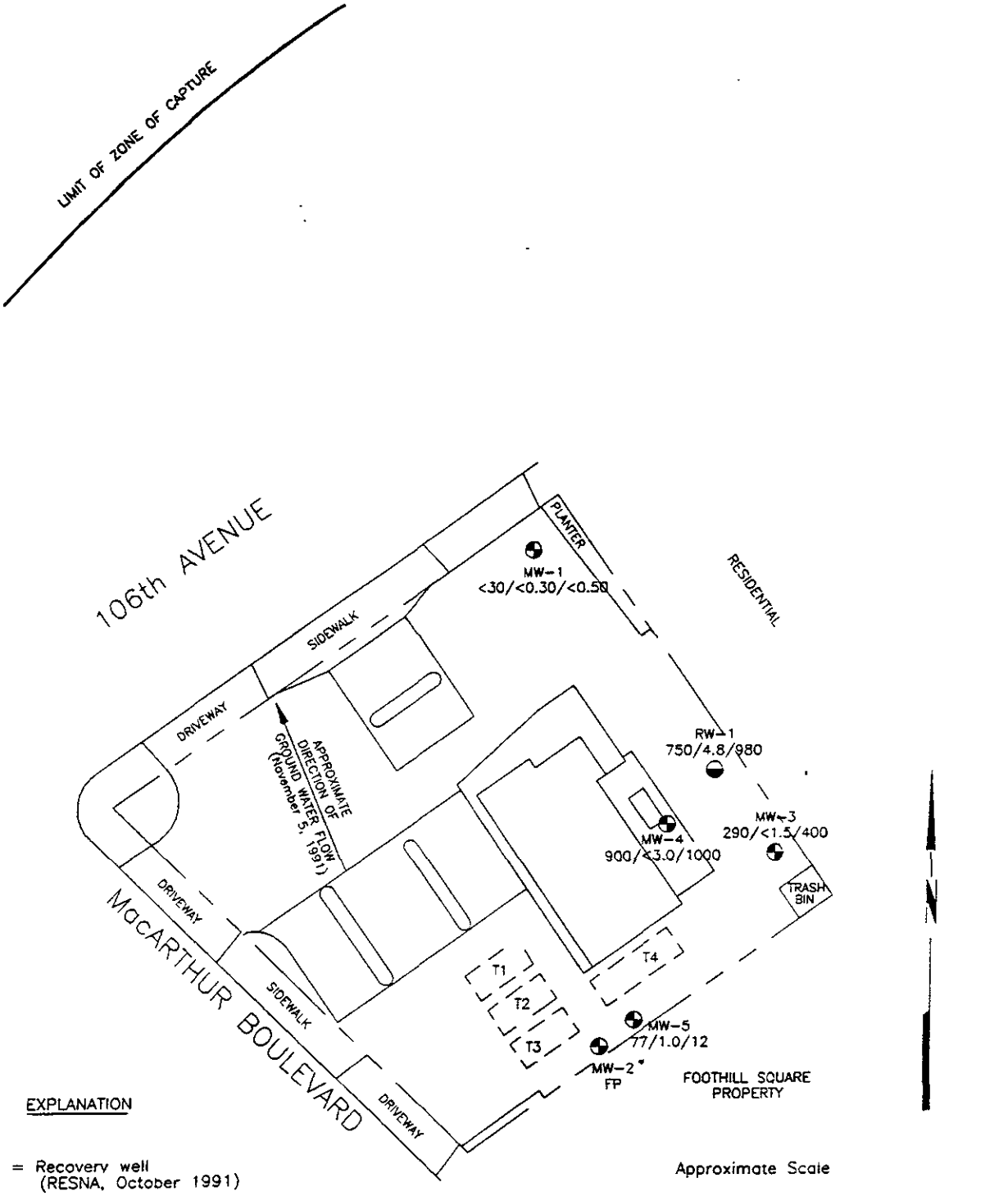
PROJECT 60026.07

GROUNDWATER GRADIENT MAP
END OF RECOVERY TEST
ARCO Station 276
10600 MacArthur Boulevard
Oakland, California

PLATE 27



EXPLANATION

RW-1 = Recovery well (RESNA, October 1991)

MW-5 = Monitoring well (Applied GeoSystems, 1989)

MW-2 * = Well constructed in a shallow perched zone and not used for groundwater gradient interpretation

FP = Floating Product

300/<3.0/1000 = Concentration of TPHg/benzene/VOC in groundwater in parts per billion (11/5, 91)

Approximate Scale

40 20 0 40 80

feet

Source: Modified from plan supplied by ARCO and surveyed by Ron Archer, Civil Engineer, Inc

RESNA
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PROJECT 60026.07

PREDICTED ZONE OF CAPTURE
ARCO Station 276
10600 MacArthur Boulevard
Oakland, California

PLATE
28

TABLE 1
CUMULATIVE GROUNDWATER MONITORING DATA
ARCO Station 276
Oakland, California
(Page 1 of 3)

Date Well Measured	Well Elevation	Depth to Water	Water Elevation	Floating Product
MW-1				
04/17/89		33.04	22.87	None
04/24/89		33.84	22.07	None
10/13/89	55.91	37.19	18.72	None
02/01/90		36.73	19.18	None
07/31/90		36.42	19.49	None
08/01/90		36.41	19.50	None
08/28/90		36.88	19.03	None
10/30/90		37.73	18.18	None
11/20/90		37.92	18.37	None
12/19/90		37.90	18.01	None
01/30/91		38.06	17.85	None
02/27/91		37.66	18.25	None
03/20/91		36.77	19.14	None
04/30/91		34.63	21.28	None
05/31/91		34.83	21.08	None
07/24/91		35.96	19.95	None
08/06/91		36.21	19.70	None
09/04/91		36.74	19.17	None
10/17/91		37.57	18.34	None
11/05/91		37.65	18.26	None
MW-2				
04/17/89		17.20	38.15	None
04/24/89		17.83	37.52	None
10/13/89	55.35	20.15*	35.20*	0.03
02/01/90		NM	NM	Sheen
07/31/90		18.90	36.45	None
08/01/90		18.23*	37.03*	1.04
08/28/90		21.25*	34.10*	0.83
10/30/90		24.21*	31.14*	1.04
11/20/90		25.08*	30.27*	0.60
12/19/90		18.23	37.12	Odor
01/30/91		19.47*	35.88*	0.03
02/27/91		18.84*	36.51*	0.02
03/20/91		16.02*	39.33*	0 01
04/30/91		16.55*	38.80	Sheen
05/31/91		18 41*	36.94*	0.01
07/24/91		19 81	35.54	Sheen
08/06/91		20 59*	34.76*	0 14
09/04/91		23 23*	32.12*	0 54
10/17/91		24 83*	30 52*	0 20
11/05/91		18 89*	36 46*	0 01

See notes on Page 3 of 3

TABLE 1
CUMULATIVE GROUNDWATER MONITORING DATA
ARCO Station 276
Oakland, California
(Page 2 of 3)

Date Well Measured	Well Elevation	Depth to Water	Water Elevation	Floating Product
MW-3				
04/24/89		34.47	22.08	None
10/13/89	56.55	37.60	18.95	None
02/01/90		37.20	19.35	None
07/31/90		36.90	19.65	None
08/01/90		36.87	19.68	None
08/28/90		37.33	19.22	None
10/30/90		38.15	18.40	None
11/20/90		38.33	18.58	None
12/19/90		38.30	18.25	None
01/30/91			Well Dry	
02/27/91		38.11	18.44	None
03/20/91		37.26	19.29	None
04/30/91		35.02	21.53	None
05/31/91		35.26	21.29	None
07/24/91		36.40	20.15	None
08/06/91		36.66	19.89	None
09/04/91		37.20	19.35	None
10/17/91		38.04	18.51	None
11/05/91		38.10	18.45	None
MW-4				
04/17/89		33.87	22.07	None
04/24/89		33.76	22.18	None
10/13/89	55.94	37.03	18.91	None
02/01/90		36.57	19.37	None
07/31/90		36.39	19.55	None
08/01/90		6.32	19.62	None
08/28/90		36.79	19.15	None
10/30/90		37.62	18.32	None
11/20/90		37.82	18.52	None
12/19/90		37.74	18.20	None
01/30/91		37.97	17.97	None
02/27/91		37.52	18.42	None
03/20/91		36.69	19.25	None
04/30/91		34 48	21 46	None
05/31/91		34.73	21.21	None
07/24/91		35.86	20 08	None
08/06/91		36.15	19.79	None
09/04/91		36.66	19.28	None
10/17/91		37.49	18.45	None
11/05/91		37.54	18 40	None

See notes on Page 3 of 3

TABLE 1
CUMULATIVE GROUNDWATER MONITORING DATA
ARCO Station 276
Oakland, California
(Page 3 of 3)

Date Well Measured	Well Elevation	Depth to Water	Water Elevation	Floating Product
MW-5				
04/17/89		33.17	22.26	None
04/24/89		33.06	22.37	None
10/13/89	55.43	36.33	19.10	None
02/01/90		35.96	19.47	None
07/31/90		35.70	19.73	None
08/01/90		35.69	19.74	None
08/28/90		36.14	19.29	None
10/30/90		36.94	18.49	None
11/20/90		37.09	18.64	None
12/19/90		37.05	18.38	None
01/30/91		37.26	18.17	None
02/27/91		36.81	18.62	None
03/20/91		36.04	19.39	None
04/30/91		33.75	21.68	None
05/31/91		34.01	21.42	None
07/24/91		35.20	20.23	None
08/06/91		35.48	19.95	None
09/04/91		36.00	19.43	None
10/17/91		36.84	18.59	None
11/05/91		36.86	18.57	None
RW-1				
11/05/91	56.32	37.89	18.43	None

Depths are in feet below top of each well casing.
Elevations are referenced in feet above mean sea level.
Floating product reported in feet.
* = depth to water and water elevation adjusted for floating product.

TABLE 2
GROUNDWATER LEVEL MEASUREMENTS DURING PUMPING TEST
ARCO Station 276
Oakland, California
November 21-22, 1991

Elapsed Time	Depths to Water					
	Well RW-1	Well MW-1	Well MW-2	Well MW-3	Well MW-4	Well MW-5
0	38.07	37.80	19.25	38.28	37.71	37.04
30	38.70	37.80	19.25	38.14	37.71	37.04
60	38.70	37.86	19.25	38.10	37.94	37.08
90	38.70	37.90	19.25	38.08	37.97	37.10
120	38.70	37.90	19.25	38.08	37.97	37.10
150	38.70	37.90	19.25	38.08	37.97	37.10
180	38.69	37.90	19.25	38.08	37.97	37.11
210	38.67	37.90	19.25	38.08	37.97	37.11
240	38.67	37.91	19.25	38.08	37.97	37.11
270	38.67	37.90	19.25	38.08	37.97	37.11
300	38.66	37.91	19.25	38.07	37.97	37.11
330	38.66	37.92	19.25	38.06	37.98	37.12
360	38.66	37.93	19.25	38.05	37.98	37.13
390	38.65	37.93	19.25	38.05	37.99	37.14
420	38.65	37.95	19.26	38.04	38.00	37.18
450	38.70	37.95	19.26	38.05	38.01	37.18
480	38.88	37.96	19.27	38.04	38.01	37.18
510	38.74	37.96	19.26	38.03	38.01	37.19
540	38.62	37.97	19.28	38.03	38.02	37.20
570	38.71	37.96	19.28	38.03	38.02	37.20
600	38.68	37.97	19.26	38.03	38.02	37.22
630	38.70	37.98	19.24	38.02	38.03	37.22
660	38.54	37.98	19.28	38.01	38.03	37.22
690	38.70	37.98	19.28	38.00	38.04	37.25
720	38.68	37.99	19.28	38.00	38.05	37.25
750	38.72	37.99	19.28	38.00	38.04	37.25
780	38.58	38.00	19.28	38.01	38.05	37.25
810	38.78	37.99	19.30	38.01	38.08	37.25
840	38.76	37.99	19.28	38.01	38.05	37.25
870	38.72	38.00	19.28	38.01	38.08	37.25
900	38.72	38.00	19.28	38.00	38.06	37.25
930	38.74	38.00	19.28	38.00	38.08	37.25
960	38.74	38.00	19.28	38.01	38.07	37.25
990	38.74	38.00	19.28	37.99	38.08	37.25
1020	38.74	38.00	19 28	37.99	38.08	37.25
1050	38.74	38.00	19 28	37.99	38.08	37.25
1080	END PUMPING TEST					

Elapsed Time in minutes from start of pumping test. Depths to Water measured in feet from top of casing.

Approximate Total Gallons Pumped	4,000
Began pumping:	9:50 a.m. 11-21-91
Ended pumping:	3:50 a.m. 11-22-91
Total Pumping Time	1080 Minutes
Average Pumping Rate.	3 67 gallons/minute

TABLE 3
GROUNDWATER LEVEL MEASUREMENTS DURING RECOVERY TEST
ARCO Station 276
Oakland, California
November 21-22, 1991

Elapsed Time	Depths to Water					
	Well RW-1	Well MW-1	Well MW-2	Well MW-3	Well MW-4	Well MW-5
0	38.74	38.00	19.28	37.99	38.08	37.25
10	38.32	38.00	19.27	38.03	38.01	37.25
30	38.22	37.95	19.27	38.11	37.88	37.20
60	38.19	37.94	19.27	38.16	37.86	37.17
90	38.18	37.92	19.27	38.19	37.84	37.17
120	38.18	37.92	19.22	38.20	37.84	37.17
150	38.18	37.91	19.27	38.20	37.84	37.17
180	38.16	37.91	19.27	38.21	37.84	37.16
210	38.16	37.90	19.27	38.21	37.82	37.15
240	38.16	37.90	19.28	38.21	37.81	37.14
270	38.16	37.90	19.30	38.21	37.82	37.15
300	38.15	37.89	19.28	38.21	37.81	37.14
330	38.15	37.89	19.28	38.22	37.80	37.14
360	38.15	37.89	19.28	38.22	37.80	37.14
360	END RECOVERY TEST					

NOTES:
Elapsed Time measured in minutes after pump was turned off.
Depths to Water measured in feet from top of casing.
Began Recovery Test: 3:50 a.m. 11-22-91
Ended Recovery Test: 9:50 p.m. 11-22-91

TABLE 4
GROUNDWATER ELEVATIONS PRIOR TO THE PUMPING TEST,
AT THE END OF THE PUMPING TEST,
AND AT THE END OF THE RECOVERY TEST
ARCO Station 276
Oakland, California
November 21-22, 1991

Time / Date	Groundwater Elevations (in feet)					
	Well RW-1	Well MW-1	Well MW-2	Well MW-3	Well MW-4	Well MW-5
9:50am (11/21/91)	18.25	18.08	36.09	18.27	18.22	18.39
3:50am (11/22/91)	17.58	17.91	36.07	17.98	17.86	18.18
9:50am (11/22/91)	18.17	18.02	36.07	18.21	18.14	18.29

NOTES:
Groundwater elevation measured in feet.

TABLE 5
VALUES USED IN TRANSMISSIVITY AND STORATIVITY CALCULATIONS
ARCO Station 276
Oakland, California

	Jacob		Neuman		
Well	s(ft)	t_o(min)	r(ft)	h(ft)	t(min)
Pumping					
MW-1	0.11	14	69	0.08	200
MW-3	0.10	2.0	33	0.09	21
MW-4	0.14	3	23	0.11	135
MW-5	0.13	33	71	0.13	580
Recovery					
MW-1	0.08				
MW-3	0.13				
MW-4	0.13				
MW-5	0.07				

s(ft) = Drawdown per log cycle measured (feet)
t_o(min) = X-intercept for pumping data (minutes)
r(ft) = Radial distance from the pumping well to the observation well (feet)
h(ft) = Match point drawdown (Plate 22)
t(min) = Match point time (Plate 22)

TABLE 6
PUMPING TEST RESULTS
ARCO Station 276
Oakland, California

	TRANSMISSIVITY (ft^2/d)			STORATIVITY	
Well	Jacob	Recovery	Neuman	Jacob	Neuman
MW-1	1230	1705	703	0.0057	0.08
MW-3	1243	1033	625	0.0036	0.03
MW-4	928	994	511	0.0082	0.36
MW-5	960	1744	433	0.0098	0.14

Jacob = Calculated using Jacob (1950) approximation for Theis (1935) equation
Recovery = Transmissivity calculated using recovery test data as for the Jacob method
Neuman = Calculated using Neuman (1975) solution

TABLE 7
LABORATORY ANALYSES OF SOIL SAMPLES
ARCO Station 276
Oakland, California
October 1991

Sample Number	B	T	E	X	TPHg	VOCs
S-15-1/2-B6	<0.005	<0.005	<0.005	<0.005	<1.0	ND
S-25-1/2-B6	<0.005	<0.005	<0.005	<0.005	<1.0	ND
S-35-1/2-B6	<0.005	<0.005	<0.005	<0.005	<1.0	ND
S-51-B6	<0.005	<0.005	<0.005	<0.005	<1.0	0.130*
S-1030-SP(A-D)	<0.005	<0.005	<0.005	<0.005	<1.0	NA

Results in parts per million (ppm).
B = benzene, T = toluene, E = ethylbenzene, X = total xylenes. BTEX measured by 5030/8015/8020
TPHg: Total petroleum hydrocarbons as gasoline by EPA 5030/8015/8020.
VOCs: Volatile organics by GC/MS (EPA 8240)
<: Less than the laboratory detection limit.
ND: Not detected for 37 compounds tested.
*: 0.130 ppm of tetrachloroethene and not detected for 36 other compounds tested.
NA: Not analyzed
Sample Identification:

S-51-B6
- Boring number
- Approximate sample depth in feet below grade
- Soil sample

S-1030-SP(A-D)
- Composite sample
- Soil stockpile
- Date sampled
- Soil sample

TABLE 8
CUMULATIVE RESULTS OF LABORATORY ANALYSES OF WATER SAMPLES
ARCO Station 276
Oakland, California
(Page 1 of 4)

Date/Well	TPHg (ppb)	TPHd (ppb)	B (ppb)	T (ppb)	E (ppb)	X (ppb)	TOG (ppb)
MW-1							
04/24/89#	<50	NA	<0.50	<0.50	<0.50	<0.50	NA
10/13/89#	<20	NA	<0.50	<0.50	<0.50	<0.50	NA
02/01/90#	91	NA	<0.30	<0.30	<0.30	0.36	NA
07/31/90#	<20	NA	<0.50	<0.50	<0.50	<0.50	NA
10/30/90#	<50	NA	<0.5	<0.5	<0.5	<0.5	NA
01/30/91#	<50	NA	<0.5	<0.5	<0.5	<0.5	NA
04/30/91#	<30	NA	<0.30	<0.30	<0.30	<0.30	NA
08/06/91#	<30	NA	<0.30	<0.30	<0.30	<0.30	NA
11/05/91#	<30	NA	<0.30	<0.30	<0.30	<0.30	NA
MW-2							
04/24/89	165,000	NA	13,000	21,000	2,100	12,700	NA
10/13/89	Not sampled--floating product						
02/01/90	Not sampled--sheen						
07/31/90	240,000	NA	14,000	24,000	3,000	17,000	NA
10/30/90	Not sampled--floating product						
01/30/91	Not sampled--floating product						
04/30/91	Not sampled--sheen						
08/06/91	Not sampled--floating product						
11/05/91	Not sampled--floating product						
MW-3							
04/24/89#	560	NA	0.54	0.75	<0.50	<0.50	NA
10/13/89#	450	NA	<0.50	<0.50	<0.50	<0.50	NA
02/01/90#	360	NA	<0.30	<0.30	<0.30	0.85	NA
08/01/90#	440	NA	<0.50	<0.50	<0.50	<0.50	NA
10/30/90#	340	NA	<0.5	<0.5	<0.5	<0.5	NA
01/30/91	Not sampled--well dry						
04/30/91	Not sampled--well inaccessible due to construction						
08/06/91#	430	NA	<0.30	<0.30	<0.30	<0.30	NA
11/05/91#	290	NA	<1.5	<1.5	<1.5	<1.5	NA
MW-4							
04/24/89#	2,500	NA	270	1.4	<0.50	85	NA
10/13/89#	760	NA	0.86	<0 50	1.2	<0 50	NA
02/01/90#	680	NA	<0.30	<0 30	<0.30	1 6	NA
07/31/90#	470	240	<0 50	<0.50	<0 50	<0.50	<5,000
10/30/90#	430	<100	<0.5	<0.5	<0.5	<0.5	<5,000
01/30/91#	<50	<100	<0.5	<0.5	1.2	<0 5	<5,000
04/30/91#	600	NA	<0.30	0.30	<0.30	0.43	NA
08/06/91#	520	NA	<0 30	<0.30	<0.30	<0 30	NA
11 '05/91#	900	NA	<3 0	<3.0	<3 0	<3 0	NA

See notes on Page 4 of 4

TABLE 8
CUMULATIVE RESULTS OF LABORATORY ANALYSES OF WATER SAMPLES
ARCO Station 276
Oakland, California
(Page 2 of 4)

Date/Well	TPHg (ppb)	TPHd (ppb)	B (ppb)	T (ppb)	E (ppb)	X (ppb)	TOG (ppb)
MW-5							
04/24/89#	130	NA	0.67	<0.50	<0.50	<0.50	NA
10/13/89#	75	NA	<0.50	<0.50	<0.50	<0.50	NA
02/01/90#	81	NA	0.94	0.88	<0.30	1.8	NA
07/31/90#	110	NA	<0.50	<0.50	<0.50	<0.50	NA
10/30/90#	<50	NA	<0.5	<0.5	<0.5	<0.5	NA
01/30/91#	<50	NA	<0.5	<0.5	<0.5	<0.5	NA
04/30/91#	120	NA	<0.30	<0.30	<0.30	<0.30	NA
08/06/91#	<30	NA	<0.30	<0.30	<0.30	<0.30	NA
11/05/91#	77	NA	1.0	3.6	0.60	2.6	NA
RW-1							
11/05/91#	750	NA	4.8	3.7	3.0	3.0	NA
MCL	—	—	1	—	680	1,750	—
DWAL	—	—	—	100	—	—	—

See notes on Page 4 of 4.

TABLE 8
CUMULATIVE RESULTS OF LABORATORY ANALYSES OF WATER SAMPLES
ARCO Station 276
Oakland, California
(Page 4 of 4)

	Results in parts per billion (ppb), except heavy metals which are in parts per million (ppm).
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, T: Total Xylene isomers;	
BTEX:	Measured by EPA method 8020/602.
TOG:	Total oil and grease by Standard Method 503A/E.
VOCs:	Volatile Organic Compounds. Compounds not shown were not detected.
Cd:	Cadmium by EPA method 200.7.
Cr:	Chromium by EPA method 200.7.
Pb:	Lead by EPA method 239.7.
Zn:	Zinc by EPA method 200.7.
Ni:	Nickel by EPA method 200.7.
<:	Results reported as less than the detection limit.
#:	Based on new results, previous data is being studied to evaluate possible effects from single-peak hydrocarbons.
NA:	Not analyzed.
*:	Exceeds the MCL of 5 ppb concentration of tetrachloroethene and Trichloroethene.
Compounds not shown not detected.	
MCLs:	Maximum Contaminant Levels as reported by the California Department of Health Services (DHS, October 1990)
DWAL	Recommended drinking water action level (DHS, October 1990)

TABLE 8
CUMULATIVE RESULTS OF LABORATORY ANALYSES OF WATER SAMPLES
ARCO Station 276
Oakland, California
(Page 3 of 4)

Date/Well	Compound	VOCs (ppb)	Cd (ppm)	Cr (ppm)	Pb (ppm)	Zn (ppm)	Ni (ppm)
MW-1							
09/04/91	Tetrachloroethene	4.5	NA	NA	NA	NA	NA
11/06/91	Tetrachloroethene	<0.50	NA	NA	NA	NA	NA
MW-2							
09/04/91	———	Not sampled–floating product					
11/06/91	———	Not sampled–floating product					
MW-3							
09/04/91	Tetrachloroethene	1,600*	NA	NA	NA	NA	NA
11/06/91	Tetrachloroethene	400*	NA	NA	NA	NA	NA
MW-4							
07/31/90	Trichloroethene	7.5*	NA	NA	NA	NA	NA
	Tetrachloroethene	1600*	NA	NA	NA	NA	NA
	1,2 Dichloroethene	0.7	NA	NA	NA	NA	NA
10/30/90	Trichloroethene	8.1*	NA	NA	NA	NA	NA
	Tetrachloroethene	3600*	NA	NA	NA	NA	NA
	1,2 Dichloroethene	0.7	NA	NA	NA	NA	NA
01/30/91	Trichloroethene	12*	NA	NA	NA	NA	NA
	Tetrachloroethene	4,900*	NA	NA	NA	NA	NA
04/30/91	Tetrachloroethene	2,200*	NA	NA	NA	NA	NA
08/06/91	Tetrachloroethene	1,700*	<0.010	0.065	0.0067	0.14	0.098
09/04/91	Tetrachloroethene	2,000*	NA	NA	NA	NA	NA
11/06/91	Tetrachloroethene	1,000*	NA	NA	NA	NA	NA
	Trichloroethene	6.3*					
MW-5							
08/06/91	Tetrachloroethene	7.3*	NA	NA	NA	NA	NA
09/04/91	Tetrachloroethene	25*	NA	NA	NA	NA	NA
11/06/91	Tetrachloroethene	12*	NA	NA	NA	NA	NA
RW-1							
11/06/91	Tetrachloroethene	980*	NA	NA	NA	NA	NA
MCL		—	0.010	0.05	0.05	5.0	—

See notes on Page 4 of 4

APPENDIX A

PREVIOUS WORK

PREVIOUS WORK

1988 Offsite Investigation

Kaldveer Associates (KA) conducted a preliminary site history survey at the Foothill Square Shopping Center property southeast and adjacent to the ARCO Station 276 (KA, October 3, 1988). The work focused on a survey of present and past site and near-vicinity conditions and concluded that there was potential for soil and groundwater contamination from past uses of the site, and that several facilities within a 1-1/2 mile radius of the site had a history of releases.

KA also conducted a subsurface environmental investigation. The work included drilling 15 soil borings on the shopping center site, collecting soil samples, collecting "grab" water samples from a seasonally saturated perched water bearing zone encountered in the borings, and analyzing soil and groundwater samples. Analyses of soil and groundwater samples indicated the presence of petroleum hydrocarbons, primarily in the northwestern parking lot area of the shopping center, the area which is immediately adjacent to the ARCO Station 276. Free product was present in Boring EB-1, located about 90 feet east of the ARCO station building. Concentrations of total petroleum hydrocarbons as gasoline (TPHg) in the groundwater samples ranged from nondetectable (ND) to 8,360 ppm parts per million (ppm). Concentrations of benzene, toluene, ethylbenzene, and total xylenes (BTEX) in groundwater ranged from ND to 877 ppm. Pesticides, polychlorinated biphenyls (PCBs), and semi-volatile compounds were also detected in a water sample. Concentrations of tetrachloroethene (PCE) were below the method detection limit, however, the detection limit was raised to 125 ppm due to the high levels of hydrocarbons in the sample. TPHg and TPHd concentrations were present in trace amounts in some of the soil samples taken and benzene was detected in one soil sample at 0.11 ppm (KA, October 7, 1988).

Western Geologic Resources, Inc., (WGR) conducted a subsurface environmental investigation at the Foothill Square Shopping Center, which included constructing five groundwater monitoring wells and analyzing nine soil and five groundwater samples for TPHg and BTEX. Concentrations of TPHg were not detected in the soil samples, but benzene was present in one sample at 0.016 ppm. Concentrations of TPHg in groundwater samples ranged from ND to 0.3 ppm. Groundwater samples also contained near trace level concentrations of BTEX and trichloroethane (WGR, January 17, 1989). The groundwater flow direction was interpreted to be toward the south at a gradient of about 0.04 ft/ft.

1988 Onsite Investigation

Pacific Environmental Group, Inc. (PEG) removed an underground waste-oil storage tank and excavated soils from the tank pit, and collected soil samples for analyses from the ARCO station site between September 29 and December 6, 1988. Hydrocarbons in soil in the vicinity of the tank pit were delineated and the soil excavated for disposal (PEG, February 6, 1989).

March 1989 Onsite Investigation

AGS drilled five soil borings (B-1 through B-5) onsite, collected soil samples for description and laboratory analysis for TPHg and BTEX, installed five groundwater monitoring wells in the borings (MW-1 through MW-5, respectively), and collected and analyzed groundwater samples for TPHg and BTEX. Boring/monitoring well locations are shown on Plate 3, Generalized Site Plan, in the main body of this report. Soils encountered during drilling were primarily sandy and silty clay underlain by silty sand with clay and gravel lenses. The depth to first-encountered groundwater in the borings was approximately 35 feet, with the exception of boring B-2 in which ground water was encountered at 17 feet below ground surface in an apparently localized perched water-bearing zone.

Concentrations of TPHg were present in soil samples collected from borings B-2 (MW-2) and B-5 (MW-5), located in the southeastern portion of the station site near the former USTs, at concentrations up to 690 ppm. TPHg was not detected at concentrations above laboratory detection limits in borings B-3 and B-4, located behind the station building in the vicinity of the former waste-oil tank. Groundwater samples from four of the five wells contained TPHg concentrations which ranged from nondetectable in monitoring well MW-1 to 165 ppm in monitoring well MW-2 (the perched zone well). Concentrations of BTEX ranged from nondetectable to 21 ppm of toluene in monitoring well MW-2. No laboratory evidence of hydrocarbon-impacted groundwater was detected in samples collected from monitoring well MW-1, located in the northern corner of the site. Tetrachloroethene (PCE) was detected in the groundwater sample collected from monitoring well MW-4 at 1.5 ppm (AGS, August 8, 1989). Waste-oil hydrocarbons were not detected in samples collected from monitoring well MW-4 located near the former waste-oil tank.

A records check of local wells within a 1/2-mile radius of the area identified three domestic wells, two irrigation wells, and three wells used for cathodic protection (information obtained from Mr. Kelvin Hickenbottom of Alameda County Flood Control and Water Conservation District; AGS, August 8, 1989). The total well depths ranged from 75 feet to 120 feet below ground surface.

Since the first quarter of 1989, RESNA has been conducting quarterly monitoring of the onsite groundwater monitoring wells on ARCO property. Groundwater monitoring data is presented in Table 1, Cumulative Groundwater Monitoring Data, and groundwater laboratory analytical data is presented in Table 8, Cumulative Results of Laboratory Analyses of Water Samples, in the main body of this report. The direction of groundwater flow, disregarding MW-2 which appeared to be in a perched zone, was evaluated to be toward the north/northwest at a gradient of about 0.002 to 0.003 ft/ft (AGS, January 29 and April 16, 1991; RESNA, July 11, 1991).

June 1989 Onsite and Offsite Soil Vapor Survey

PEG conducted a soil-vapor survey at the ARCO Station and the adjacent Foothill Square Shopping Center parking lot. The highest total hydrocarbon gas concentrations (40,000 ppm) were found within approximately 125 feet south of the station building at depths of 21 - 24 feet below ground surface (PEG, July 17, 1989).

August 1989 Offsite Investigation

Based on the PEG soil vapor survey, ARCO requested additional offsite soil borings and AGS drilled nine borings (B-1 through B-9) at the Foothill Shopping Center parking lot to assess the extent of hydrocarbons in the subsurface soil. These boring locations are shown on Plate 2, Site and Vicinity Plan, in the main body of this report. The field and analytical data suggested a zone of hydrocarbon contamination located approximately 20 feet below ground surface and centralized around 2 borings (B-6 and B-7), 50 - 65 feet south/southeast of the ARCO station building, where the maximum TPHg concentrations were up to 1,400 ppm and total petroleum hydrocarbons as diesel (diesel) concentrations up to 320 ppm (AGS, January 17, 1991). The soil samples from other borings were found to contain hydrocarbon levels near or below the detection limits.

Two water bearing zones were confirmed to be present at the ARCO station site and adjacent property: a shallow perched zone which occasionally was dry and had a relatively steep gradient (0.04 ft/ft) toward south/southeast; and a deeper water-bearing zone which had a flatter gradient of about 0.002 ft/ft and a northerly flow direction.

January - February 1990 Onsite Investigation

AGS personnel supervised the drilling of three soil borings (TPB-1 through TPB-3) to depths of approximately 20 feet below ground surface in the proposed new gasoline underground storage tank (UST) pit area, shown on Plate 3. Soil samples collected

contained concentrations of TPHg and BTEX up to 290 ppm and 6.6 ppm, respectively. The groundwater table was encountered at about 18-1/2 feet below the ground surface in the borings (AGS, February 11, 1991).

On February 8, 1990 four USTs (FT-1 through FT-4) were removed from the site under observation of an AGS geologist. The tanks consisted of a 6,000 gallon supreme unleaded (FT-1), a 6,000 gallon regular unleaded (FT-2), a 4,000 gallon regular unleaded (FT-3), and a 10,000 gallon regular leaded (FT-4) tank. Visible inspection of the removed tanks revealed that the tanks appeared to be in good condition with no visible signs of leaks, puncture or corrosion. Locations of the former tanks are shown on Plate 3. Nine soil samples were obtained from the walls and the base of former tank pit excavation (13 feet below ground surface) and submitted for analyses. The samples contained concentrations of TPHg and BTEX up to 360 ppm and 43 ppm, respectively. Five composite samples from stockpiled soil from former tank pits were analyzed for aeration and disposal characterization. Soils were then aerated and removed from the site and properly disposed.

April 1990 Onsite Investigation

The excavation for the installation for four USTs was performed April 26, 1990. The excavated soil was visually inspected for any indication of petroleum hydrocarbons and monitored with an organic vapor monitor (OVM). OVM readings indicated concentrations of hydrocarbons greater than 500 ppm in saturated gravel lenses at depths between 11 and 15 feet below ground surface. Soil samples collected from the bottom corners of the new tank pit (19 feet below ground surface) showed no detectable concentrations of TPHg and low levels of BTEX (maximum 0.035 ppm). Excavated soil containing hydrocarbon concentrations greater than 100 ppm was aerated and then removed from the site and properly disposed (AGS, February 11, 1991).

May 1990 Onsite Investigation

The product supply pipelines associated with the former USTs and surrounding fill material were removed on May 29 and May 30, 1990 under AGS observation. Eight soil samples were collected for analyses along the trench at 20 foot lateral intervals. The maximum TPHg concentration detected in product line trench soil samples was 14 ppm (AGS, February 11, 1991).

Ongoing Quarterly Monitoring

Quarterly water-level measurements and sampling for analyses and reporting by RESNA are continuing at the site. Groundwater monitoring data is presented in Table 1, and groundwater laboratory analytical data is presented in Table 8, in the main body of this report.

APPENDIX B

FIELD PROTOCOL
WELL PURGE DATA SHEETS

FIELD PROTOCOL

The following presents RESNA's protocol for a typical site investigation involving gasoline hydrocarbon-impacted soil and/or groundwater.

Site Safety Plan

The Site Safety Plan describes the safety requirements for the evaluation of gasoline hydrocarbons in soil, groundwater, and the vadose-zone 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 are be briefed on the contents of the Site Safety Plan before work begins. A copy of the Site Safety Plan is available for reference by appropriate parties during the work. A site Safety Officer is assigned to the project.

Sampling of Stockpiled Soil

One composite soil sample is collected for each 50 cubic yards of stockpiled soil, and for each individual stockpile composed of less than 50 cubic yards. Composite soil samples are obtained by first evaluating relatively high, average, and low areas of hydrocarbon concentration by digging approximately one to two feet into the stockpile and placing the intake probe of a field calibrated OVM against the surface of the soil; and then collecting one sample from the "high" reading area, and three samples from the "average" areas. Samples are collected by removing the top one to two feet of soil, then driving laboratory-cleaned brass sleeves into the soil. The samples are sealed in the sleeves using aluminum foil, plastic caps, and aluminized duct tape; labeled; and promptly placed in iced storage for transport to the laboratory, where compositing will be performed.

Soil Borings

Prior to the drilling of borings and construction of monitoring wells, permits are acquired from the appropriate regulatory agency. In addition to the above-mentioned permits, encroachment permits from the City or State are acquired if drilling of borings offsite in the City or State streets is necessary. Copies of the permits are included in the appendix of the project report. Prior to drilling, Underground Services Alert is notified of our intent to drill, and known underground utility lines and structures are approximately marked.

The borings are drilled by a truck-mounted drill rig equipped with 8- or 10-inch-diameter, hollow-stem augers. The augers are steam-cleaned prior to drilling each boring to minimize

the possibility of cross-contamination. After drilling the borings, monitoring wells are constructed in the borings, or neat-cement grout with bentonite is used to backfill the borings to the ground surface.

Borings for groundwater monitoring wells are drilled to a depth of no more than 20 feet below the depth at which a saturated zone is first encountered, or a short distance into a stratum beneath the saturated zone which is of sufficient moisture and consistency to be judged as a perching layer by the field geologist, whichever is shallower. Drilling into a deeper aquifer below the shallowest aquifer can begin only after a conductor casing is properly installed and allowed to set, to seal the shallow aquifer.

Drill Cuttings

Drill cuttings subjectively evaluated as having hydrocarbon contamination at levels greater than 100 parts per million (ppm) are separated from those subjectively evaluated as having hydrocarbon contamination levels less than 100 ppm. Evaluation is based either on subjective evidence of soil discoloration, or on measurements made using a field calibrated OVM. Readings are taken by placing a soil sample into a ziplock type plastic bag and allowing volatilization to occur. The intake probe of the OVM is then inserted into the headspace created in the plastic bag immediately after opening it. The drill cuttings from the borings are placed in labeled 55-gallon drums approved by the Department of Transportation; or on plastic at the site, and covered with plastic. The cuttings remain the responsibility of the client.

Soil Sampling in Borings

Soil samples are collected at no greater than 5-foot intervals from the ground surface to the total depth of the borings. The soil samples are 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 are laboratory-cleaned, steam-cleaned, or washed thoroughly with Alconox® and water, prior to each use. The sampler is driven with a standard 140-pound hammer repeatedly dropped 30 inches. The number of blows to drive the sampler each successive six inches are counted and recorded to evaluate the relative consistency of the soil.

The samples selected for laboratory analysis are removed from the sampler and quickly sealed in their brass sleeves with aluminum foil, plastic caps, and aluminized duct tape. The

samples are 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 is tested in the field using an OVM that is field calibrated at the beginning of each day it is used. This testing is 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 project report.

Logging of Borings

A geologist is 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, are 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 are constructed in selected borings using clean 2- or 4-inch-diameter, thread-jointed, Schedule 40 polyvinyl chloride (PVC) casing. No chemical cements, glues, or solvents are used in well construction. Each casing bottom is sealed with a threaded end-plug, and each casing top with a locking plug. The screened portions of the wells are constructed of machine-slotted PVC casing with 0.020-inch-wide (typical) slots for initial site wells. Slot size for subsequent wells may be based on sieve analysis and/or well development data. The screened sections in groundwater monitoring wells are placed to allow monitoring during seasonal fluctuations of groundwater levels.

The annular space of each well is backfilled with No. 2 by 12 sand, or similar sorted sand, to approximately two feet above the top of the screened casing for initial site wells. The sand pack grain size for subsequent wells may be based on sieve analysis and/or well development data. A 1- to 2-foot-thick bentonite plug is placed above the sand as a seal against cement entering the filter pack. The remaining annulus is 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 is 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 are developed by bailing or over-pumping and surge-block techniques. The wells are either bailed or pumped, allowed to recharge, and bailed or pumped again until the water removed from the wells is evaluated to be clear. Turbidity measurements (in NTUs) are recorded during well development and are used in evaluating well development. The development method used, initial turbidity measurement, volume of water removed, final turbidity measurement, and other pertinent field data and observations are included in reports. The wells are allowed to equilibrate for at least 48 hours after development prior to sampling. Water generated by well development will be stored in 17E Department of Transportation (DOT) 55-gallon drums on site and will remain the responsibility of the client.

Groundwater Sampling

The static water level in each well is measured to the nearest 0.01-foot using a Solinst® electric water-level sounder or oil/water interface probe (if the wells contain floating product) cleaned with Alconox® and water before use in each well. The liquid in the onsite wells is 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 is then retrieved and inspected for floating product, sheen, emulsion, color, and clarity. The thickness of floating product detected is recorded to the nearest 1/8-inch.

Wells which do not contain floating product are purged using a submersible pump. The pump, cables, and hoses are cleaned with Alconox® and water prior to use in each well. The wells are purged until withdrawal is of sufficient duration to result in stabilized pH, temperature, and electrical conductivity of the water, as measured using portable meters calibrated to a standard buffer and conductivity standard. If the well becomes dewatered, the water level is allowed to recover to at least 80 percent of the initial water level. Prior to the collection of each groundwater sample, the Teflon® bailer is cleaned with Alconox® and rinsed with tap water and deionized water, and the latex gloves worn by the sampler changed. Hydrochloric acid is added to the sample vials as a preservative (when applicable).

A sample method blank is collected by pouring distilled water into the bailer and then into sample vials. A sample of the formation water is then collected from the surface of the water in each of the wells using the Teflon® bailer. The water samples are 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 are then labeled and promptly placed in iced storage. A field log of well evacuation procedures and parameter monitoring is maintained. Water generated by the purging of wells is stored in 17E DOT 55-gallon drums onsite and remains the responsibility of the client.

Sample Labeling and Handling

Sample containers are 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 is initiated by the field geologist and updated throughout handling of the samples, and accompanies the samples to a laboratory certified by the State of California for the analyses requested. Samples are transported to the laboratory promptly to help ensure that recommended sample holding times are not exceeded. Samples are properly disposed of after their useful life has expired.

Aquifer Testing

Pumping Test

The initial water levels in wells to be used during the test are measured prior to commencement of pumping. The flow rate of the pump is adjusted to the desired pumping rate, and water levels allowed to recover to initial levels. Pumping then begins, and the starting time of pumping is recorded. Drawdowns in observation wells are recorded at intervals throughout pumping using pressure transducers. Evacuated water is stored in a storage tank at the site and remains the responsibility of the client. After the pump is shut off, recovery measurements are taken in the wells until recovery is at least 80 percent of the initial water level. Barometric pressure and tidal information are collected for the time interval of the pumping test to allow screening of possible effects of atmospheric pressure and tidal fluctuations on the groundwater levels.

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WELL PURGE DATA SHEET

Project Name: ARCO 276
Date: 11/05/91
Well No. MW-1

Job No. 60026.07
Page 1 of 1

Time Started 11:28

Time (hr)	Gallons (cum.)	Temp. (F)	pH	Conduct. (micromoh)	Turbidity (NTU)
11:28	Begin purging well MW-1				
11:29	0.1	72.5	6.21	3.41	NM
11:36	0.5	70.1	6.26	3.31	NM
13:32	1.0	70.4	6.21	3.49	NM
13:32	Stop purging MW-1				

Notes:

Depth to Bottom (feet)	: 38.67
Depth to Water - initial (feet)	: 37.65
Depth to Water - final (feet)	: 37.67
% recovery	: 98%
Time Sampled	: 14:30
Gallons per Well Casing Volume	: 0.17
Gallons Purged	: 1.0
Well Casing Volumes Purged	: 5.9
Approximate Pumping Rate (gpm)	: 0.01

NM = Not measured

RESNA
Working To Restore Nature

WELL PURGE DATA SHEET

Project Name: ARCO 276 Job No. 60026.07
Date: 11/05/91 Page 1 of 1
Well No. MW-3

Time Started 11:42

Time (hr)	Gallons (cum.)	Temp. (F)	pH	Conduct. (micromoh)	Turbidity (NTU)
11:42	Begin purging well MW-3				
11:43	0.2	68.2	6.50	11.62	NM
13:42	0.5	67.8	6.56	11.49	NM
13:42	Stop purging MW-3				

Notes:

Depth to Bottom (feet)	: 38.37
Depth to Water - initial (feet)	: 38.10
Depth to Water - final (feet)	: 38.08
% recovery	: 93%
Time Sampled	: 14:56
Gallons per Well Casing Volume	: 0.05
Gallons Purged	: 0.5
Well Casing Volumes Purged	: 10
Approximate Pumping Rate (gpm)	: 0.004

NM = Not measured

RESNA
Working To Restore Nature

WELL PURGE DATA SHEET

Project Name: ARCO 276 Job No. 60026.07
Date: 11/05/91 Page 1 of 1
Well No. MW-4 Time Started 13:37

Time (hr)	Gallons (cum.)	Temp. (F)	pH	Conduct. (micromoh)	Turbidity (NTU)
13:37	Begin pumping well MW-4				
13:38	0.5	69.3	6.89	1.79	NM
13:39	3	68.9	6.89	1.64	NM
13:40	6	69.0	6.89	1.65	NM
13:43	9	68.8	6.86	1.69	NM
13:45	12	69.0	6.83	1.59	NM
13:47	15	70.0	6.85	1.62	NM
13:48	18	68.9	6.84	1.67	NM
13:50	21	68.3	6.85	1.68	NM
13:50	Stop pumping MW-4				

Notes:

Depth to Bottom (feet) : 49.10
Depth to Water - initial (feet) : 37.54
Depth to Water - final (feet) : 37.54
% recovery :100
Time Sampled : 14:56
Gallons per Well Casing Volume : 2.0
Gallons Purged : 21
Well Casing Volumes Purged : 10.5
Approximate Pumping Rate (gpm) : 1.6
NM = Not measured

RESNA
Working To Restore Nature

WELL PURGE DATA SHEET

Project Name: ARCO 276
Date: 11/05/91
Well No.MW-5

Job No. 60026.07
Page 1 of 1
Time Started 14:05

Time (hr)	Gallons (cum.)	Temp. (F)	pH	Conduct. (micromoh)	Turbidity (NTU)
14:05	Begin pumping well MW-5				
14:06	0.5	68.9	6.18	4.64	NM
14:07	3	70.0	6.12	4.50	NM
14:10	6	69.7	6.12	4.60	NM
14:12	9	70.0	6.12	4.59	NM
14:13	12	70.2	6.13	4.52	NM
14:16	15	69.9	6.17	4.72	NM
14:18	18	70.3	6.18	4.67	NM
14:20	21	70.3	6.17	4.80	NM
14:23	24	70.8	6.21	4.92	NM
14:25	27	70.6	6.20	5.01	NM
14:27	30	69.9	6.21	5.05	NM
14:27	Stop pumping MW-5				

Notes:

Depth to Bottom (feet) : 46.83
Depth to Water - initial (feet) : 36.86
Depth to Water - final (feet) : 36.96
% recovery : 99
Time Sampled : 15:05
Gallons per Well Casing Volume : 6.6
Gallons Purged : 30
Well Casing Volumes Purged : 4.5
Approximate Pumping Rate (gpm) : 1.4
NM = Not measured

RESNA
Working To Restore Nature

WELL PURGE DATA SHEET

Project Name: ARCO 276 Job No. 60026.07
Date: 11/05/91 Page 1 of 2
Well No. RW-1 Time Started 12:00

Time (hr)	Gallons (cum.)	Temp. (F)	pH	Conduct. (micromoh)	Turbidity (NTU)
12:00	Begin pumping well RW-1				
12:01	0.5	71.2	7.01	14.06	NM
12:04	5	70.4	6.89	14.14	NM
12:06	10	71.1	6.87	14.21	NM
12:08	15	70.6	6.92	14.00	NM
12:10	20	70.4	6.79	13.94	NM
12:12	25	70.0	6.84	13.95	NM
12:14	30	70.0	6.80	13.92	NM
12:20	35	70.8	6.87	14.13	NM
12:22	40	71.1	6.77	14.23	NM
12:24	45	71.5	6.73	14.18	NM
12:26	50	71.9	6.77	14.16	NM
12:28	55	70.2	6.87	14.30	NM
12:30	60	70.3	6.80	14.11	NM
12:33	70	69.8	6.75	14.00	NM
12:38	80	71.2	6.80	14.30	NM
12:42	83	71.3	6.74	14.25	NM
12:42	Stop pumping RW-1				

RESNA
Working To Restore Nature

WELL PURGE DATA SHEET

Project Name: ARCO 276 Job No. 60026.07
Date: 11/05/91 Page 2 of 2
Well No. RW-1

Time Started 12:00

Notes:

Depth to Bottom (feet)	: 51.00
Depth to Water - initial (feet)	: 37.89
Depth to Water - final (feet)	: 37.88
% recovery	:100
Time Sampled	: 14:39
Gallons per Well Casing Volume	: 19.7
Gallons Purged	: 83
Well Casing Volumes Purged	: 4.2
Approximate Pumping Rate (gpm)	: 2.0

NM = Not measured

APPENDIX C

WELL CONSTRUCTION PERMIT

ALAMEDA COUNTY FLOOD CONTROL AND WATER CONSERVATION DISTRICT

5997 PARKSIDE DRIVE ♦ PLEASANTON, CALIFORNIA 94566 ♦ (415) 484-2600

DRILLING PERMIT APPLICATION

FOR APPLICANT TO COMPLETE

OCATION OF PROJECT ARCO Station 276
10600 MacArthur Blvd
Oakland, CA

LIENT
ame ARCO Products Company
ddress P.O. Box 5811 Phone (415) 571-2434
ity San Mateo Zip CA 94402

PPLICANT
ame Barbara Sieminski
RESNA
ddress 3315 Almaden Expy #34 Phone 408-264-7723
ity San Jose Zip 95118

YPE OF PROJECT
Well Construction — Geotechnical Investigation
Cathodic Protection ___ — General ___
Water Supply ___ — Contamination ___
~~Monitoring~~ Recovery well ✓ — Well Destruction ___

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

RILLING METHOD:
Mud Rotary ___ Air Rotary ___ Auger ✓ Hollow-stem
Cable ___ Other ___

RILLER'S LICENSE NO. C57 596545

WELL PROJECTS
Drill Hole Diameter 12" In. — Maximum
Casing Diameter 6 In. — Depth 45 ft.
Surface Seal Depth 30 ft. — Number 1

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

ESTIMATED STARTING DATE 10/28/91
ESTIMATED COMPLETION DATE 10/28/91

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

APPLICANT'S SIGNATURE [signature] Date 10/25/91

FOR OFFICE USE

PERMIT NUMBER 91612
LOCATION NUMBER ___

PERMIT CONDITIONS

Circled Permit Requirements Apply

(A.) GENERAL
1. A permit application should be submitted so as to arrive at the Zone 7 office five days prior to proposed starting date.
2. Submit to Zone 7 within 60 days after completion of permitted work the original Department of Water Resources Water Well Drillers Report or equivalent for well projects, or drilling logs and location sketch for geotechnical projects.
3. Permit is void if project not begun within 90 days of approval date.

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

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

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

E. WELL DESTRUCTION. See attached.

Approved [signature] Date 17 Oct 91
Wyman Hong

51991

APPENDIX D

WELLHEAD SURVEY

1JOHN E. KOCH
Land Surveyor
CA. State Lic. No. LS4811
5427 Telegraph Ave., Suite A
Oakland, CA 94609
(510)655-9956
FAX(510)655-9745

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

11/09/91

Tabulation of Elevations as of
03:00 p.m. 11/09/91

Job #91076
AGS Project Job # 60026.07
Project Manager: Joel Coffman
Site: Arco Station 276
10600 MacArthur Blvd.
@ 106th Ave.
Oakland, CA

BENCHMARK:#14/B
Top of disc set in a standard City of Oakland monument casing in middle of concrete sidewalk on the most S'LY corner of 106th Ave. and MacArthur Boulevard.
(Elev. 52.811' City of Oakland Datum) *see note 1.

MONITOR WELL DATA TABLE

Well Designation	Elevation	Description
RW-1	56.32	Top of PVC Casing
	56.59	Top of Box

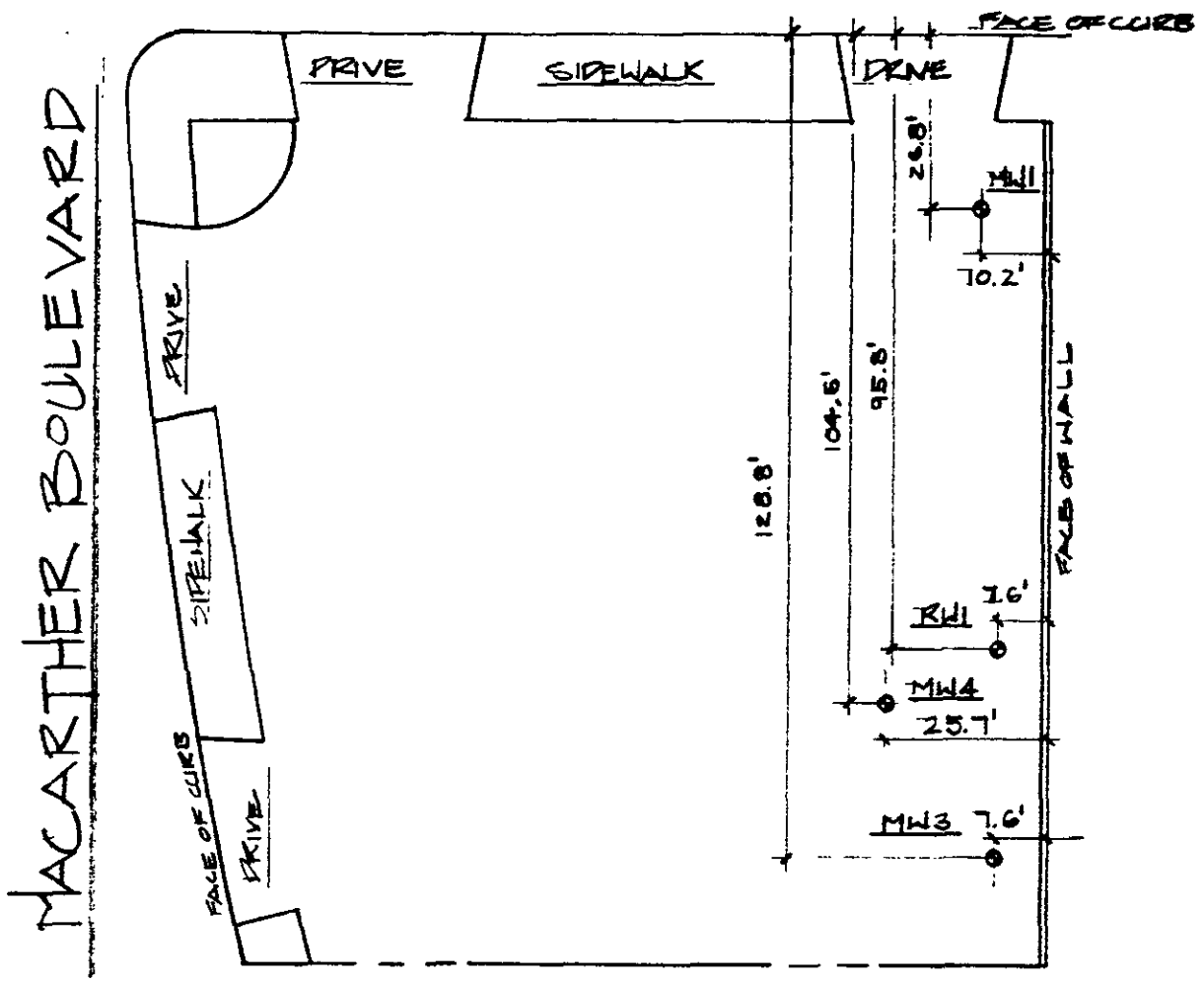
NOTE:

1. Datum is City of Oakland - (USCS) 52.00

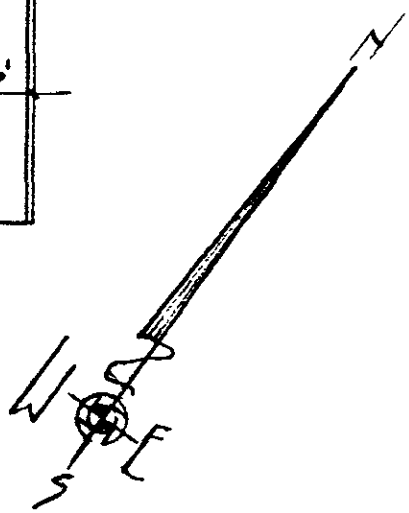
2. Top of Casing Elevation T.O.C.El. is at set mark on rim of [illegible].

3. [illegible] is at set mark on top of box.

4. [illegible] was surveyed [illegible] same El. [illegible] by client.



ELEVATIONS		
WELL #	T.O.C.	T.O.B.
RW1	56.32'	56.59'



1" 0 2" 50

SCALE: 1"=30.0'
JEK JOB# 91076
DATE 11-12 91
DRWN BY: RGRAT

SITE
ARCO STATION 276
10600 MACARTHUR BLVD
@106TH AVENUE
OAKLAND

CLIENT
AGS / RECHA
JOB# 60026.07

JOHN E KOCH
LAND SURVEYOR
CA STATE LIC. NO. LS 4811
5427 TELEGRAPH AVE. SUITE A
OAKLAND, CA. 94609
PHONE (415) 655 9956
FAX (415) 655 9745

APPENDIX E

HAZARDOUS WASTE MANIFEST FORM

State of California—Health and Welfare Agency

Please print or type. *Form designed for use on elite (12-pitch typewriter).*

See Instructions on back of page 6.

Department of Health Services
Toxic Substances Control Program
Sacramento, California

91507424

IN CASE OF EMERGENCY OR SPILL, CALL THE NATIONAL RESPONSE CENTER 1-800-424-8802; WITHIN CALIFORNIA, CALL 1-800-852-7550

UNIFORM HAZARDOUS WASTE MANIFEST

GENERATOR		
1. Generator's US EPA ID No.	Manifest Document No.	2. Page 1 of
Information in the shaded areas is not required by Federal law.		
3. Generator's Name and Mailing Address: ARCO; P. O. Box 5811 San Mateo, CA 94402	A. State Manifest Document Number: 91507424	
4. Generator's Phone (415) 571 434 571 2420	B. State Generator's ID	
5. Transporter 1 Company Name: H & H Ship Service Company	6. US EPA ID Number	C. State Transporter's ID: 200505
		D. Transporter's Phone: (415) 543 4835
7. Transporter 2 Company Name	8. US EPA ID Number	E. State Transporter's ID
		F. Transporter's Phone
9. Designated Facility Name and Site Address: H & H Ship Service Company, 220 China Basin Street, San Francisco CA 94107	10. US EPA ID Number	G. State Facility's ID
		H. Facility's Phone

11. US DOT Description (Including Proper Shipping Name, Hazard Class, and ID Number)	12. Containers No.	12. Containers Type	13. Total Quantity	14. Unit Wt/Vol	I. Waste Number
a. OIL AND WATER NON-RCRA HAZARDOUS WASTE LIQUID	001	TT	04800	G	State: / EPA/Other:
b.					State: / EPA/Other:
c.					State: / EPA/Other:
d.					State: / EPA/Other:

J. Additional Descriptions for Materials Listed Above: FUEL, OIL AND WATER; PROFILE #A094

K. Handling Codes for Wastes Listed Above: a. 01; b.; c.; d.

15. Special Handling Instructions and Additional Information

JOB #0663 — JOB SITE: ARCO STATION, #0276
24 Hr. Emergency Contact: H & H #(415) 543 4835 — 10600 MacArthur Avenue
APPROPRIATE PROTECTIVE CLOTHING AND RESPIRATOR — Oakland California

16. **GENERATOR'S CERTIFICATION:** I hereby declare that the contents of this consignment are fully and accurately described above by proper shipping name and are classified, packed, marked, and labeled, and are in all respects in proper condition for transport by highway according to applicable international and national government regulations.

If I am a large quantity generator, I certify that I have a program in place to reduce the volume and toxicity of waste generated to the degree I have determined to be economically practicable and that I have selected the practicable method of treatment, storage, or disposal currently available to me which minimizes the present and future threat to human health and the environment; OR, if I am a small quantity generator, I have made a good faith effort to minimize my waste generation and select the best waste management method that is available to me and that I can afford.

Printed/Typed Name	Signature	Month Day Year
Robert D. Campbell	[signature]	[illegible]

TRANSPORTER

17. Transporter 1 Acknowledgement of Receipt of Materials

Printed/Typed Name	Signature	Month Day Year
ESTEBAN M. PENALVER	[signature]	[illegible]

18. Transporter 2 Acknowledgement of Receipt of Materials

Printed/Typed Name	Signature	Month Day Year

FACILITY

19. Discrepancy Indication Space

20. Facility Owner or Operator Certification of receipt of hazardous materials covered by this manifest except as noted in Item 19.

Printed/Typed Name	Signature	Month Day Year

DO NOT WRITE BELOW THIS LINE.

HS 8022A (12/90)
EPA 8700—22

APPENDIX F

LABORATORY ANALYSES REPORTS AND CHAIN OF CUSTODY RECORDS

SEQUOIA ANALYTICAL

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

RESNA
3315 Almaden Expwy., Suite 34
San Jose, CA 95112
Attention: Joel Coffman

Project: ARCO 276, Oakland

Enclosed are the results from 10 water samples received at Sequoia Analytical on November 7,1991. The requested analyses are listed below:

SAMPLE #	SAMPLE DESCRIPTION	DATE OF COLLECTION	TEST METHOD
1111692	Water, W-37-MW1	11/6/91	EPA 601
1111693	Water, W-38-MW3	11/6/91	EPA 601
1111694	Water, W-36-MW5	11/6/91	EPA 601
1111695	Water, W-37-MW4	11/6/91	EPA 601
1111696	Water, W-37-RW1	11/6/91	EPA 601
1111697	Water, W-37-RW1	11/5/91	EPA 5030/8015/8020
1111698	Water, W-37-MW1	11/5/91	EPA 5030/8015/8020
1111699	Water, W-36-MW5	11/5/91	EPA 5030/8015/8020
1111700	Water, W-37-MW4	11/5/91	EPA 5030/8015/8020
1111701	Water, W-38-MW3	11/5/91	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

Maria Lee
Project Manager

SEQUOIA ANALYTICAL

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

RESNA
3315 Almaden Expwy., Suite 34
San Jose, CA 95112
Attention: Joel Coffman

Client Project ID: ARCO 276, Oakland
Matrix Descript: Water
Analysis Method: EPA 5030/8015/8020
First Sample #: 111-1697

Sampled: Nov 5, 1991
Received: Nov 7, 1991
Analyzed: Nov 16, 1991
Reported: Nov 22, 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)
111-1697	W-37-RW1	750	4 8	3.7	N.D.	N.D.
111-1700	W-37-MW4	900	N.D.	N.D.	N.D.	N.D.
Detection Limits:		300	3.0	3.0	3.0	3.0

Low to Medium Boiling Point Hydrocarbons are quantitated against a gasoline fuel 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

Maria Lee
Project Manager

111697.RRR

SEQUOIA ANALYTICAL

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

RESNA
3315 Almaden Expwy., Suite 34
San Jose, CA 95112
Attention: Joel Coffman

Client Project ID: ARCO 276, Oakland
Matrix Descript: Water
Analysis Method: EPA 5030/8015/8020
First Sample #: 111-1698

Sampled: Nov 5, 1991
Received: Nov 7, 1991
Analyzed: Nov 15, 1991
Reported: Nov 22, 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)
111-1698	W-37-MW1	N.D.	N.D.	N.D.	N.D.	N.D.
111-1699	W-36-MW5	77	1.0	3.6	0.60	2.6
Detection Limits:		30	0.30	0.30	0.30	0.30

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

SEQUOIA ANALYTICAL

Maria Lee
Project Manager

SEQUOIA ANALYTICAL

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

RESNA
3315 Almaden Expwy., Suite 34
San Jose, CA 95112
Attention: Joel Coffman

Client Project ID: ARCO 276, Oakland
Matrix Descript: Water
Analysis Method: EPA 5030/8015/8020
First Sample #: 111-1701

Sampled: Nov 5, 1991
Received: Nov 7, 1991
Analyzed: Nov 16, 1991
Reported: Nov 22, 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)
111-1701	W-38-MW3	290	N.D.	N.D.	N.D.	N.D.
Detection Limits:		150	1.5	1.5	1.5	1.5

Low to Medium Boiling Point Hydrocarbons are quantitated against a gasoline fuel 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

Please Note:
Chromatogram Pattern: gasoline fuel / non-gasoline fuel / residue

Maria Lee
Project Manager

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

RESNA
3315 Almaden Expwy., Suite 34
San Jose, CA 95112
Attention: Joel Coffman

Client Project ID: ARCO 276, Oakland

QC Sample Group: 1111698-699

Reported: Nov 22, 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:	µg/L	µg/L	µg/L	µg/L
Date Analyzed:	Nov 15, 1991	Nov 15, 1991	Nov 15, 1991	Nov 15, 1991
QC Sample #:	GBLK111591	GBLK111591	GBLK111591	GBLK111591
Sample Conc.:	N.D.	N.D.	N.D.	N.D.
Spike Conc. Added:	10	10	10	30
Conc. Matrix Spike:	10	11	11	31
Matrix Spike % Recovery:	100	110	110	103
Conc. Matrix Spike Dup.:	11	11	11	33
Matrix Spike Duplicate % Recovery:	110	110	110	110
Relative % Difference:	9.5	0.0	0.0	6.3

SEQUOIA ANALYTICAL

Maria Lee
Project Manager

% Recovery = (Conc. of M.S. − Conc. of Sample) / Spike Conc. Added × 100

Relative % Difference = (Conc. of M.S. − Conc. of M.S.D.) / (Conc. of M.S. + Conc. of M.S.D.) × 200

111597.RRR

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

RESNA
3315 Almaden Expwy., Suite 34
San Jose, CA 95112
Attention: Joel Coffman

Client Project ID: ARCO 276, Oakland

QC Sample Group: 1111697, 700-701

Reported: Nov 22, 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:	µg/L	µg/L	µg/L	µg/L
Date Analyzed:	Nov 16, 1991	Nov 16, 1991	Nov 16, 1991	Nov 16, 1991
QC Sample #:	BLK111691	BLK111691	BLK111691	BLK111691
Sample Conc.:	N.D.	N.D.	N.D.	N.D.
Spike Conc. Added:	10	10	10	30
Conc. Matrix Spike:	10	11	10	32
Matrix Spike % Recovery:	100	110	100	107
Conc. Matrix Spike Dup.:	11	11	11	32
Matrix Spike Duplicate % Recovery:	110	110	110	107
Relative % Difference:	9.5	0.0	9.5	0.0

SEQUOIA ANALYTICAL

% Recovery = (Conc. of M.S. - Conc. of Sample) / Spike Conc. Added × 100

Relative % Difference = (Conc. of M.S. - Conc. of M.S.D.) / (Conc. of M.S. + Conc. of M.S.D.) × 200

Maria Lee
Project Manager

1111697.RPR 5/

SEQUOIA ANALYTICAL

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

RESNA	Client Project ID:	ARCO 276, Oakland	Sampled: Nov 6, 1991
3315 Almaden Expwy., Suite 34	Sample Descript:	Water, W-37-MW1	Received: Nov 7, 1991
San Jose, CA 95112	Analysis Method:	EPA 601	Analyzed: Nov 19, 1991
Attention: Joel Coffman	Lab Number:	111-1692	Reported: Nov 22, 1991

PURGEABLE HALOCARBONS (EPA 601)

Analyte	Detection Limit µg/L	Sample Results µg/L
Bromodichloromethane	0.50	N.D.
Bromoform	1.0	N.D.
Bromomethane	1.0	N.D.
Carbon tetrachloride	0.50	N.D.
Chlorobenzene	0.50	N.D.
Chloroethane	1.0	N.D.
2-Chloroethylvinyl ether	1.0	N.D.
Chloroform	0.50	N.D.
Chloromethane	1.0	N.D.
Dibromochloromethane	0.50	N.D.
1,2-Dichlorobenzene	0.50	N.D.
1,3-Dichlorobenzene	0.50	N.D.
1,4-Dichlorobenzene	0.50	N.D.
Dichlorodifluoromethane	2.0	N.D.
1,1-Dichloroethane	0.50	N.D.
1,2-Dichloroethane	0.50	N.D.
1,1-Dichloroethene	0.50	N.D.
cis-1,2-Dichloroethene	0.50	N.D.
trans-1,2-Dichloroethene	0.50	N.D.
1,2-Dichloropropane	0.50	N.D.
cis-1,3-Dichloropropene	1.0	N.D.
trans-1,3-Dichloropropene	1.0	N.D.
Methylene chloride	2.0	N.D.
1,1,2,2-Tetrachloroethane	0.50	N.D.
Tetrachloroethene	0.50	N.D.
1,1,1-Trichloroethane	0.50	N.D.
1,1,2-Trichloroethane	0.50	N.D.
Trichloroethene	0.50	N.D.
Trichlorofluoromethane	1.0	N.D.
Vinyl chloride	1.0	N.D.

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

SEQUOIA ANALYTICAL

Maria Lee
Project Manager

SEQUOIA ANALYTICAL

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

RESNA
3315 Almaden Expwy., Suite 34
San Jose, CA 95112
Attention: Joel Coffman

Client Project ID: ARCO 276, Oakland
Sample Descript: Water, W-38-MW3
Analysis Method: EPA 601
Lab Number: 111-1693

Sampled: Nov 6, 1991
Received: Nov 7, 1991
Analyzed: Nov 20, 1991
Reported: Nov 22, 1991

PURGEABLE HALOCARBONS (EPA 601)

Analyte	Detection Limit µg/L	Sample Results µg/L
Bromodichloromethane	5.0	N.D.
Bromoform	10	N.D.
Bromomethane	10	N.D.
Carbon tetrachloride	5.0	N.D.
Chlorobenzene	5.0	N.D.
Chloroethane	10	N.D.
2-Chloroethylvinyl ether	10	N.D.
Chloroform	5.0	N.D.
Chloromethane	10	N.D.
Dibromochloromethane	5.0	N.D.
1,2-Dichlorobenzene	5.0	N.D.
1,3-Dichlorobenzene	5.0	N.D.
1,4-Dichlorobenzene	5.0	N.D.
Dichlorodifluoromethane	20	N.D.
1,1-Dichloroethane	5.0	N.D.
1,2-Dichloroethane	5.0	N.D.
1,1-Dichloroethene	5.0	N.D.
cis-1,2-Dichloroethene	5.0	N.D.
trans-1,2-Dichloroethene	5.0	N.D.
1,2-Dichloropropane	5.0	N.D.
cis-1,3-Dichloropropene	10	N.D.
trans-1,3-Dichloropropene	10	N.D.
Methylene chloride	20	N.D.
1,1,2,2-Tetrachloroethane	5.0	N.D.
Tetrachloroethene	5.0	400
1,1,1-Trichloroethane	5.0	N.D.
1,1,2-Trichloroethane	5.0	N.D.
Trichloroethene	5.0	N.D.
Trichlorofluoromethane	10	N.D.
Vinyl chloride	10	N.D.

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

Maria Lee
Project Manager

111697 ARR 7

SEQUOIA ANALYTICAL

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

RESNA	Client Project ID:	ARCO 276, Oakland	Sampled:	Nov 6, 1991
3315 Almaden Expwy., Suite 34	Sample Descript:	Water, W-36-MW5	Received:	Nov 7, 1991
San Jose, CA 95112	Analysis Method:	EPA 601	Analyzed:	Nov 20, 1991
Attention: Joel Coffman	Lab Number:	111-1694	Reported:	Nov 22, 1991

PURGEABLE HALOCARBONS (EPA 601)

Analyte	Detection Limit µg/L	Sample Results µg/L
Bromodichloromethane	0.50	N.D.
Bromoform	1.0	N.D.
Bromomethane	1.0	N.D.
Carbon tetrachloride	0.50	N.D.
Chlorobenzene	0.50	N.D.
Chloroethane	1.0	N.D.
2-Chloroethylvinyl ether	1.0	N.D.
Chloroform	0.50	N.D.
Chloromethane	1.0	N.D.
Dibromochloromethane	0.50	N.D.
1,2-Dichlorobenzene	0.50	N.D.
1,3-Dichlorobenzene	0.50	N.D.
1,4-Dichlorobenzene	0.50	N.D.
Dichlorodifluoromethane	2.0	N.D.
1,1-Dichloroethane	0.50	N.D.
1,2-Dichloroethane	0.50	N.D.
1,1-Dichloroethene	0.50	N.D.
cis-1,2-Dichloroethene	0.50	N.D.
trans-1,2-Dichloroethene	0.50	N.D.
1,2-Dichloropropane	0.50	N.D.
cis-1,3-Dichloropropene	1.0	N.D.
trans-1,3-Dichloropropene	1.0	N.D.
Methylene chloride	2.0	N.D.
1,1,2,2-Tetrachloroethane	0.50	N.D.
Tetrachloroethene	**0.50**	**12**
1,1,1-Trichloroethane	0.50	N.D.
1,1,2-Trichloroethane	0.50	N.D.
Trichloroethene	0.50	N.D.
Trichlorofluoromethane	1.0	N.D.
Vinyl chloride	1.0	N.D.

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

SEQUOIA ANALYTICAL

Maria Lee
Project Manager

111697 RRR 8

SEQUOIA ANALYTICAL

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

RESNA	Client Project ID:	ARCO 276, Oakland	Sampled:	Nov 6, 1991
3315 Almaden Expwy., Suite 34	Sample Descript:	Water, W-37-MW4	Received:	Nov 7, 1991
San Jose, CA 95112	Analysis Method:	EPA 601	Analyzed:	Nov 20, 1991
Attention: Joel Coffman	Lab Number:	111-1695	Reported:	Nov 22, 1991

PURGEABLE HALOCARBONS (EPA 601)

Analyte	Detection Limit µg/L	Sample Results µg/L
Bromodichloromethane	5.0	N.D.
Bromoform	10	N.D.
Bromomethane	10	N.D.
Carbon tetrachloride	5.0	N.D.
Chlorobenzene	5.0	N.D.
Chloroethane	10	N.D.
2-Chloroethylvinyl ether	10	N.D.
Chloroform	5.0	N.D.
Chloromethane	10	N.D.
Dibromochloromethane	5.0	N.D.
1,2-Dichlorobenzene	5.0	N.D.
1,3-Dichlorobenzene	5.0	N.D.
1,4-Dichlorobenzene	5.0	N.D.
Dichlorodifluoromethane	20	N.D.
1,1-Dichloroethane	5.0	N.D.
1,2-Dichloroethane	5.0	N.D.
1,1-Dichloroethene	5.0	N.D.
cis-1,2-Dichloroethene	5.0	N.D.
trans-1,2-Dichloroethene	5.0	N.D.
1,2-Dichloropropane	5.0	N.D.
cis-1,3-Dichloropropene	10	N.D.
trans-1,3-Dichloropropene	10	N.D.
Methylene chloride	20	N.D.
1,1,2,2-Tetrachloroethane	5.0	N.D.
Tetrachloroethene	**5.0**	**1,000**
1,1,1-Trichloroethane	5.0	N.D.
1,1,2-Trichloroethane	5.0	N.D.
Trichloroethene	**5.0**	**6.3**
Trichlorofluoromethane	10	N.D.
Vinyl chloride	10	N.D.

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

Maria Lee
Project Manager

111697.RRR 9

SEQUOIA ANALYTICAL

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

RESNA
3315 Almaden Expwy., Suite 34
San Jose, CA 95112
Attention: Joel Coffman

Client Project ID: ARCO 276, Oakland
Sample Descript: Water, W-37-RW1
Analysis Method: EPA 601
Lab Number: 111-1696

Sampled: Nov 6, 1991
Received: Nov 7, 1991
Analyzed: Nov 20, 1991
Reported: Nov 22, 1991

PURGEABLE HALOCARBONS (EPA 601)

Analyte	Detection Limit µg/L	Sample Results µg/L
Bromodichloromethane	5.0	N.D.
Bromoform	10	N.D.
Bromomethane	10	N.D.
Carbon tetrachloride	5.0	N.D.
Chlorobenzene	5.0	N.D.
Chloroethane	10	N.D.
2-Chloroethylvinyl ether	10	N.D.
Chloroform	5.0	N.D.
Chloromethane	10	N.D.
Dibromochloromethane	5.0	N.D.
1,2-Dichlorobenzene	5.0	N.D.
1,3-Dichlorobenzene	5.0	N.D.
1,4-Dichlorobenzene	5.0	N.D.
Dichlorodifluoromethane	20	N.D.
1,1-Dichloroethane	5.0	N.D.
1,2-Dichloroethane	5.0	N.D.
1,1-Dichloroethene	5.0	N.D.
cis-1,2-Dichloroethene	5.0	N.D.
trans-1,2-Dichloroethene	5.0	N.D.
1,2-Dichloropropane	5.0	N.D.
cis-1,3-Dichloropropene	10	N.D.
trans-1,3-Dichloropropene	10	N.D.
Methylene chloride	20	N.D.
1,1,2,2-Tetrachloroethane	5.0	N.D.
Tetrachloroethene	**5.0**	**980**
1,1,1-Trichloroethane	5.0	N.D.
1,1,2-Trichloroethane	5.0	N.D.
Trichloroethene	5.0	N.D.
Trichlorofluoromethane	10	N.D.
Vinyl chloride	10	N.D.

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

Maria Lee
Project Manager

1697 RRR

SEQUOIA ANALYTICAL

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

RESNA
3315 Almaden Expwy., Suite 34
San Jose, CA 95112
Attention: Joel Coffman

Client Project ID: ARCO 276, Oakland

QC Sample Group: 1111692-696

Reported: Nov 22, 1991

QUALITY CONTROL DATA REPORT

ANALYTE	1,1-Dichloro-ethene	Trichloro-ethene	Chloro-benzene
Method:	EPA 601	EPA 601	EPA 601
Analyst:	C. Pollock	C. Pollock	C. Pollock
Reporting Units:	µg/L	µg/L	µg/L
Date Analyzed:	Nov 20, 1991	Nov 20, 1991	Nov 20, 1991
QC Sample #:	BLK112091	BLK112091	BLK112091
Sample Conc.:	N.D.	N.D.	N.D.
Spike Conc. Added:	10	10	10
Conc. Matrix Spike:	10	8.0	10
Matrix Spike % Recovery:	100	80	100
Conc. Matrix Spike Dup.:	10	11	11
Matrix Spike Duplicate % Recovery:	100	110	110
Relative % Difference:	0.0	32	10

SEQUOIA ANALYTICAL

Maria Lee
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

1111697.RRR 11/..

ARCO Products Company ◆ [redacted] of Atlantic Richfield Company [redacted] Task Order No. 276-91-5 [redacted] Chain of Custody

ARCO Facility no 276-6902 | City (Facility) Oakland | Project manager (Consultant) JOEL COFFMAN/LEO LEFT | Laboratory name [redacted]

ARCO engineer CHUCK CARMEL | Telephone no (ARCO) | Telephone no (Consultant) (408) 264-7723 | Fax no (Consultant) (408) 264-2435 | Contract number [redacted]

Consultant name RESNA | Address (Consultant) 3315 ALMADEN EXPRESSWAY, SUITE 34 SAN JOSE, CA | Method of shipment Sequoia Tech

Sample ID	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 / VOA / Semi VOA	CAM Metals EPA 6010/7000 TTLC / STLC	Lead Org./DHS / Lead EPA 7420/7421	Special detection Limit/reporting
U-37	MW1	3		X		X		11/06/91	15:30						X				1111	692	
U-35	MW3	3		X		X		11/06/91	15:52						X					93	
U-36	MW5	3		X		X		11/06/91	16:00						X					94	
U-37	MW4	3		X		X		11/06/91	15:40						X					95	Special QA/QC
U-37	RW1	3		X		X		11/06/91	15:10						X					96	
U-37	MW1	3		X		X	X	11/05/91	14:39		X									97	
U-37	MW1	3		X		X	X	11/05/91	14:30		X									98	
U-36	MW2	3		X		X	X	11/05/91	15:05		X									99	
U-37	MW4	3		X		X	X	11/05/91	14:44		X									1700	Remarks
U-35	MW3	3		X		X	X	11/05/91	14:56		X								C	01	

Condition of sample: Good | Temperature received: Cool

Relinquished by sampler: [redacted] | Date 11/7/91 | Time 324pm | Received by: [redacted]

Relinquished by: [redacted] | Date 11/7/91 | Time 455pm | Received by: [redacted]

Relinquished by: [redacted] | Date | Time | Received by laboratory: [redacted] | Date 11/7 | Time 510p

Lab number [redacted]

Turnaround time

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

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APPC 3292 (7-91)

SEQUOIA ANALYTICAL

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

RESNA
3315 Almaden Expwy., Suite 34
San Jose, CA 95112
Attention: Joel Coffman

Project: ARCO 276, Oakland

Enclosed are the results from 1 water sample received at Sequoia Analytical on November 7,1991. The requested analyses are listed below:

SAMPLE #	SAMPLE DESCRIPTION	DATE OF COLLECTION	TEST METHOD
111-1268	Water, W-37-MW4	11/5/91	Hazardous Waste Bioassay

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

Maria Lee

Maria Lee
Project Manager

SEQUOIA ANALYTICAL

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

RESNA
3315 Almaden Expwy., Suite 34
San Jose, CA 95112
Attention: Joel Coffman

Client Project ID: Arco 276, Oakland
Sample Descript: Water, W-37-MW4
Analysis Method: See below
Lab Number: 1111268

Sampled: 11/5/91
Received: 11/7/91
Reported: 11/19/91

STATIC ACUTE HAZARDOUS WASTE BIOASSAY

Static [X]
Cont. Flow [ ]

Screening [ ]
Definitive [X]

Species: Pimephales promelas
Common Name: Fathead Minnow
Mean length: 43 mm
Mean weight: 0.73 g
Supplier: Sticklebacks Unlimited
Acclimation Temp.: 18 degrees C

Organisms/Tank: 10
Replicates: 2
Organisms/Conc.: 20
Tank Depth: 13 cm
Tank Volume: 10 L

Dilution Water: Synthetic Softwater

	Alkalinity, mg/L		Hardness, mg/L	
	Initial	Final	Initial	Final
Control	50	52	33	33
100 ppm	70	77	50	50
320 ppm	62	66	44	46
1000 ppm	74	75	46	47

	Initial	24 Hr	48 Hr	72 Hr	96 Hr
DATE	11/13	11/14	11/15	11/16	11/17

	DO mg/L	C Temp	pH Units	DO mg/L	C Temp	pH Units	# M Dead	DO mg/L	C Temp	pH Units	# M Dead	DO mg/L	C Temp	pH Units	# M Dead	DO mg/L	C Temp	pH Units	# M Dead	Total Dead
Control	9.4	20	8.0	6.9	18	7.2	0	6.9	16	7.3	0	8.6	17	7.5	0	7.3	17	7.3	0	0
100 ppm	9.9	20	8.1	8.6	18	7.6	0	9.2	16	7.6	0	8.7	18	7.3	0	8.6	17	7.3	0	0
180 ppm	9.9	20	8.1	8.8	18	7.7	0	9.5	16	7.7	0	8.6	18	7.4	0	8.5	17	7.3	0	0
320 ppm	9.9	20	8.1	7.0	18	7.3	0	6.9	16	7.3	0	7.0	18	7.3	0	7.3	17	7.4	0	0
560 ppm	9.9	20	8.2	9.3	18	7.8	0	9.6	16	7.7	0	7.8	18	7.5	0	7.5	17	7.4	0	0
1000 ppm	9.9	20	8.2	7.7	18	7.5	0	9.0	16	7.6	0	8.6	18	7.4	0	8.2	17	7.4	0	0

LC-50: >1000 ppm

LC-50 Calculation Method: Moving average angle

Remarks:

Analyst R Geckler

Method Reference Static Acute Bioassay Procedures for Hazardous Waste Samples. September 1987. California Department of Fish and Game WPCL.

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

RESNA
3315 Almaden Expwy., Suite 34
San Jose, CA 95112
Attention: Joel Coffman

Client Project ID: Arco 276, Oakland
Sample Descript: Water, W-37-MW4
Analysis Method: See below
Lab Number: 1111268 (duplicate)

Sampled: 11/5/91
Received: 11/7/91
Reported: 11/19/91

STATIC ACUTE HAZARDOUS WASTE BIOASSAY

Static [X]
Cont. Flow [ ]

Screening [ ]
Definitive [X]

Species: Pimephales promelas
Common Name: Fathead Minnow
Mean length: 43 mm
Mean weight: 0.73 g
Supplier: Sticklebacks Unlimited
Acclimation Temp.: 18 degrees C

Organisms/Tank: 10
Replicates: 2
Organisms/Conc.: 20
Tank Depth: 13 cm
Tank Volume: 10 L

Dilution Water: Synthetic Softwater

	Alkalinity, mg/L		Hardness, mg/L	
	Initial	Final	Initial	Final
Control	50	52	33	33
100 ppm	64	70	40	44
320 ppm	65	69	42	45
1000 ppm	65	69	45	46

	Initial	24 Hr	48 Hr	72 Hr	96 Hr
DATE	11/13	11/14	11/15	11/16	11/17

	DO mg/L	C Temp	pH Units	DO mg/L	C Temp	pH Units	# M Dead	DO mg/L	C Temp	pH Units	# M Dead	DO mg/L	C Temp	pH Units	# M Dead	DO mg/L	C Temp	pH Units	# M Dead	Total Dead
Control	9.4	20	8.0	6.9	20	7.2	0	6.9	16	7.3	0	8.6	17	7.5	0	7.3	17	7.3	0	0
100 ppm	9.9	20	8.1	8.3	20	7.4	0	8.7	16	7.5	0	8.4	18	7.6	0	8.3	17	7.4	0	0
180 ppm	9.9	20	8.1	8.7	20	7.4	0	9.8	16	7.7	0	9.0	18	7.5	0	8.7	17	7.4	0	0
320 ppm	9.9	20	8.0	8.4	20	7.5	0	9.7	16	7.7	0	8.5	18	7.5	0	8.4	17	7.5	0	0
560 ppm	9.9	20	8.2	8.4	20	7.5	0	8.4	16	7.5	0	8.5	18	7.4	0	8.4	17	7.4	0	0
1000 ppm	9.9	20	8.2	9.0	20	7.6	0	9.7	16	7.8	0	8.6	18	7.6	0	8.5	17	7.5	0	0

LC-50: >1000 ppm

LC-50 Calculation Method: Moving average angle

Remarks:

Analyst: R Geckler

Method Reference: Static Acute Bioassay Procedures for Hazardous Waste Samples. September 1987. California Department of Fish and Game WPCL.

SEQUOIA ANALYTICAL

Maria Lee
Project Manager

ARCO Products Company
Division of AtlanticRichfieldCompany

Task Order No. ~~276-91-5~~ 3107-91-5

Chain of Custody

ARCO Facility no ~~276~~ 6006.03 ~~0107-6006.03~~
City (Facility) Oakland
Project manager (Consultant) JOEL COFFMAN ~~Lou LEET~~
Laboratory name SEQUOIA

ARCO engineer CHUCK CARMEL
Telephone no (ARCO)
Telephone no (Consultant) (408) 264-7723
Fax no. (Consultant) (415) 264-2435
Contract number 07023

Consultant name RESNA
Address (Consultant) 3315 ALMADEN EXPRESSWAY, SUITE 34 SAN JOSE, CA
Method of shipment Sequoia Tech

Sample ID	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 ☐ VOA ☐ Semi VOA ☐	CAM Metals EPA 6010/7000 TTLC ☐ STLC ☐	Lead Org./DHS ☐ Lead EPA 7420/7421 ☐	B104 5544
W-37	MW1	2		X		X		11-05-91	14:44						1	1	1268				X

Special detection Limit/reporting

Special QA/QC

Remarks

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

	Date	Time		Date	Time
Relinquished by sampler	11/7/91	3:24pm	Received by		
Relinquished by	11/7/91	4:50pm	Received by		
Relinquished by			Received by laboratory	11/7/91	4:50pm

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APPC 3292 (2 91)

SEQUOIA ANALYTICAL

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

RESNA
3315 Almaden Expwy., Suite 34
San Jose, CA 95112
Attention: Joel Coffman

Project: ARCO 276, Oakland

Enclosed are the results from 1 soil samples received at Sequoia Analytical on October 31,1991. The requested analyses are listed below:

SAMPLE #	SAMPLE DESCRIPTION	DATE OF COLLECTION	TEST METHOD
1105791	Soil, S-1030, SP (A-D), composite	10/30/91	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

Elizabeth W. Hackl
Project Manager

SEQUOIA ANALYTICAL

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

RESNA	Client Project ID:	ARCO 276, Oakland	Sampled:	Oct 30, 1991
3315 Almaden Expwy., Suite 34	Sample Descript.:	Soil, S-1030, SP (A-D), composite	Received:	Oct 31, 1991
San Jose, CA 95112	Analysis Method:	EPA 5030/8015/8020	Analyzed:	Nov 1, 1991
Attention: Joel Coffman	Lab Number:	110-5791	Reported:	Nov 4, 1991

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

Analyte	Detection Limit mg/kg (ppm)	Sample Results mg/kg (ppm)
Low to Medium Boiling Point Hydrocarbons	1.0	N.D.
Benzene	0.0050	N.D.
Toluene	0.0050	N.D.
Ethyl Benzene	0.0050	N.D.
Xylenes	0.0050	N.D.

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

RESNA
3315 Almaden Expwy., Suite 34
San Jose, CA 95112
Attention: Joel Coffman

Client Project ID: ARCO 276, Oakland
QC Sample Group: 110-5791
Reported: Nov 4, 1991

QUALITY CONTROL DATA REPORT

ANALYTE	Benzene	Toluene	Ethyl-Benzene	Xylenes
Method:	EPA 8020	EPA 8020	EPA 8020	EPA 8020
Analyst:	A. Miraftab	A. Miraftab	A. Miraftab	A. Miraftab
Reporting Units:	mg/kg	mg/kg	mg/kg	mg/kg
Date Analyzed:	Nov 1, 1991	Nov 1, 1991	Nov 1, 1991	Nov 1, 1991
QC Sample #:	GBLK110191	GBLK110191	GBLK110191	GBLK110191
Sample Conc.:	N.D.	N.D.	N.D.	N.D.
Spike Conc. Added:	0.20	0.20	0.20	0.60
Conc. Matrix Spike:	0.17	0.17	0.16	0.47
Matrix Spike % Recovery:	85	85	80	78
Conc. Matrix Spike Dup.:	0.17	0.17	0.16	0.47
Matrix Spike Duplicate % Recovery:	85	85	80	78
Relative % Difference:	0.0	0.0	0.0	0.0

SEQUOIA ANALYTICAL

Elizabeth W Hackl
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. 276-91-3

ARCO Facility no: 276	City (Facility): Oakland	Project manager (Consultant): Joel Coffman	Laboratory name: Sequoia Anal
ARCO engineer: Chuck Carmel	Telephone no. (ARCO): (415) 571-2434	Telephone no. (Consultant): (408) 264-7723	Fax no (Consultant): (408) 264-2435
Consultant name: RESNA	Address (Consultant): 3315 Almaden Exp., Suite 34, San Jose, CA 95118		Contract number: 07-073

Method of shipment: Sequoia Courier

Sample ID	Lab no	Container no	Matrix: Soil	Water	Other	Preservation: Ice	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 ☐		
S-1030-SP-A		1 (composite)	✓			✓		10/30/91	4:30 PM		✓											
S-1030-SP-B		1	✓			✓		10/30/91	4:35 PM		✓											
S-1030-SP-C		1	✓			✓		10/30/91	4:40 PM		✓											
S-1030-SP-D		1	✓			✓		10/30/91	4:45 PM		✓											

TCLP Metals: 1105791

Special detection Limit/reporting

Special QA/QC

Remarks: 48 hr turnaround time composite sample

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: Barbara Kleinitsky	Date: 10-31-91	Time: 4:10	Received by: Don Seaver
Relinquished by: Don Seaver	Date: 10-31-91	Time: 5:10	Received by:
Relinquished by:	Date:	Time:	Received by laboratory: R. Dalton
			Date: 10/31/91
			Time: 510

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

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

RESNA
3315 Almaden Expwy., Suite 34
San Jose, CA 95112
Attention: Joel Coffman

Project: ARCO 276, Oakland

Enclosed are the results from 4 soil samples received at Sequoia Analytical on October 31,1991. The requested analyses are listed below:

SAMPLE #	SAMPLE DESCRIPTION	DATE OF COLLECTION	TEST METHOD
1105931	Soil, S-15.5-B6	10/30/91	EPA 5030/8015/8020 EPA 8240
1105932	Soil, S-25.5-B6	10/30/91	EPA 5030/8015/8020 EPA 8240
1105933	Soil, S-35.5-B6	10/30/91	EPA 5030/8015/8020 EPA 8240
1105934	Soil, S-51-B6	10/30/91	EPA 5030/8015/8020 EPA 8240

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

Maria Lee

Maria Lee
Project Manager

SEQUOIA ANALYTICAL

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

RESNA	Client Project ID:	ARCO 276, Oakland	Sampled: Oct 30, 1991
3315 Almaden Expwy., Suite 34	Matrix Descript:	Soil	Received: Oct 31, 1991
San Jose, CA 95112	Analysis Method:	EPA 5030/8015/8020	Analyzed: Nov 5-6, 1991
Attention: Joel Coffman	First Sample #:	110-5931	Reported: Nov 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)
110-5931	S-15.5-B6	N.D.	N.D.	N.D.	N.D.	N.D.
110-5932	S-25.5-B6	N.D.	N.D.	N.D.	N.D.	N.D.
110-5933	S-35.5-B6	N.D.	N.D.	N.D.	N.D.	N.D.
110-5934	S-51-B6	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

Maria Lee
Project Manager

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

RESNA
3315 Almaden Expwy., Suite 34
San Jose, CA 95112
Attention: Joel Coffman

Client Project ID: ARCO 276, Oakland

QC Sample Group: 1105932-34

Reported: Nov 12, 199

QUALITY CONTROL DATA REPORT

ANALYTE	Benzene	Toluene	Ethyl-Benzene	Xylenes
Method:	EPA 8020	EPA 8020	EPA 8020	EPA 8020
Analyst:	E. Cunanan	E. Cunanan	E. Cunanan	E. Cunanan
Reporting Units:	mg/kg	mg/kg	mg/kg	mg/kg
Date Analyzed:	Nov 5, 1991	Nov 5, 1991	Nov 5, 1991	Nov 5, 1991
QC Sample #:	GBLK110591	GBLK110591	GBLK110591	GBLK110591
Sample Conc.:	N.D.	N.D.	N.D.	N.D.
Spike Conc. Added:	0.20	0.20	0.20	0.60
Conc. Matrix Spike:	0.18	0.17	0.17	0.5
Matrix Spike % Recovery:	90	85	85	83
Conc. Matrix Spike Dup.:	0.19	0.19	0.18	0.55
Matrix Spike Duplicate % Recovery:	95	95	90	92
Relative % Difference:	5.4	11	5.7	9.5

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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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(415) 364-9600 • FAX (415) 364-9233

RESNA
3315 Almaden Expwy., Suite 34
San Jose, CA 95112
Attention: Joel Coffman

Client Project ID: ARCO 276, Oakland

QC Sample Group: 110-5931

Reported: Nov 12, 1991

QUALITY CONTROL DATA REPORT

ANALYTE	Benzene	Toluene	Ethyl-Benzene	Xylenes
Method:	EPA 8020	EPA 8020	EPA 8020	EPA 8020
Analyst:	A. Maralit	A. Maralit	A. Maralit	A. Maralit
Reporting Units:	mg/kg	mg/kg	mg/kg	mg/kg
Date Analyzed:	Nov 6, 1991	Nov 6, 1991	Nov 6, 1991	Nov 6, 1991
QC Sample #:	GBLK110591 MS/MSD	GBLK110591 MS/MSD	GBLK110591 MS/MSD	GBLK110591 MS/MSD
Sample Conc.:	N.D.	N.D.	N.D.	N.D.
Spike Conc. Added:	0.20	0.20	0.20	0.60
Conc. Matrix Spike:	0.18	0.18	0.18	0.53
Matrix Spike % Recovery:	90	90	90	88
Conc. Matrix Spike Dup.:	0.18	0.18	0.18	0.54
Matrix Spike Duplicate % Recovery:	90	90	90	90
Relative % Difference:	0.0	0.0	0.0	1.9

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Maria Lee
Project Manager

% Recovery	$\frac{\text{Conc. of M.S. - Conc. of Sample}}{\text{Spike Conc. Added}}$	x 100
Relative % Difference	$\frac{\text{Conc. of M.S. - Conc. of M.S.D.}}{(\text{Conc. of M.S. + Conc. of M.S.D.}) \div 2}$	x 100

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RESNA	Client Project ID:	ARCO 276, Oakland	Sampled:	Oct 30, 199
3315 Almaden Expwy., Suite 34	Sample Descript:	Soil, S-15.5-B6	Received:	Oct 31, 199
San Jose, CA 95112	Analysis Method:	EPA 8240	Analyzed:	Nov 8, 199
Attention: Joel Coffman	Lab Number:	110-5931	Reported:	Nov 12, 199

VOLATILE ORGANICS by GC/MS (EPA 8240)

Analyte	Detection Limit µg/kg	Sample Results µg/kg
Acetone	500	N.D.
Benzene	100	N.D.
Bromodichloromethane	100	N.D.
Bromoform	100	N.D.
Bromomethane	100	N.D.
2-Butanone	500	N.D.
Carbon disulfide	100	N.D.
Carbon tetrachloride	100	N.D.
Chlorobenzene	100	N.D.
Chloroethane	100	N.D.
2-Chloroethyl vinyl ether	500	N.D.
Chloroform	100	N.D.
Chloromethane	100	N.D.
Dibromochloromethane	100	N.D.
1,1-Dichloroethane	100	N.D.
1,2-Dichloroethane	100	N.D.
1,1-Dichloroethene	100	N.D.
cis-1,2-Dichloroethene	100	N.D.
trans-1,2-Dichloroethene	100	N.D.
1,2-Dichloropropane	100	N.D.
cis-1,3-Dichloropropene	100	N.D.
trans-1,3-Dichloropropene	100	N.D.
Ethylbenzene	100	N.D.
2-Hexanone	500	N.D.
Methylene chloride	100	N.D.
4-Methyl-2-pentanone	500	N.D.
Styrene	100	N.D.
1,1,2,2-Tetrachloroethane	100	N.D.
Tetrachloroethene	100	N.D.
Toluene	100	N.D.
1,1,1-Trichloroethane	100	N.D.
1,1,2-Trichloroethane	100	N.D.
Trichloroethene	100	N.D.
Trichlorofluoromethane	100	N.D.
Vinyl acetate	100	N.D.
Vinyl chloride	100	N.D.
Total Xylenes	100	N.D.

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

SEQUOIA ANALYTICAL

Maria Lee

Maria Lee
Project Manager

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

RESNA	Client Project ID:	ARCO 276, Oakland	Sampled:	Oct 30, 199
3315 Almaden Expwy., Suite 34	Sample Descript:	Soil, S-25.5-B6	Received:	Oct 31, 199
San Jose, CA 95112	Analysis Method:	EPA 8240	Analyzed:	Nov 8, 199
Attention: Joel Coffman	Lab Number:	110-5932	Reported:	Nov 12, 199

VOLATILE ORGANICS by GC/MS (EPA 8240)

Analyte	Detection Limit µg/kg	Sample Results µg/kg
Acetone	500	N.D.
Benzene	100	N.D.
Bromodichloromethane	100	N.D.
Bromoform	100	N.D.
Bromomethane	100	N.D.
2-Butanone	500	N.D.
Carbon disulfide	100	N.D.
Carbon tetrachloride	100	N.D.
Chlorobenzene	100	N.D.
Chloroethane	100	N.D.
2-Chloroethyl vinyl ether	500	N.D.
Chloroform	100	N.D.
Chloromethane	100	N.D.
Dibromochloromethane	100	N.D.
1,1-Dichloroethane	100	N.D.
1,2-Dichloroethane	100	N.D.
1,1-Dichloroethene	100	N.D.
cis-1,2-Dichloroethene	100	N.D.
trans-1,2-Dichloroethene	100	N.D.
1,2-Dichloropropane	100	N.D.
cis-1,3-Dichloropropene	100	N.D.
trans-1,3-Dichloropropene	100	N.D.
Ethylbenzene	100	N.D.
2-Hexanone	500	N.D.
Methylene chloride	200	N.D.
4-Methyl-2-pentanone	500	N.D.
Styrene	100	N.D.
1,1,2,2-Tetrachloroethane	100	N.D.
Tetrachloroethene	100	N.D.
Toluene	100	N.D.
1,1,1-Trichloroethane	100	N.D.
1,1,2-Trichloroethane	100	N.D.
Trichloroethene	100	N.D.
Trichlorofluoromethane	100	N.D.
Vinyl acetate	100	N.D.
Vinyl chloride	100	N.D.
Total Xylenes	100	N.D.

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

SEQUOIA ANALYTICAL

Maria Lee
Project Manager

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RESNA	Client Project ID:	ARCO 276, Oakland	Sampled:	Oct 30, 1991
3315 Almaden Expwy., Suite 34	Sample Descript:	Soil, S-35.5-B6	Received:	Oct 31, 1991
San Jose, CA 95112	Analysis Method:	EPA 8240	Analyzed:	Nov 8, 1991
Attention: Joel Coffman	Lab Number:	110-5933	Reported:	Nov 12, 1991

VOLATILE ORGANICS by GC/MS (EPA 8240)

Analyte	Detection Limit µg/kg	Sample Results µg/kg
Acetone	500	N.D.
Benzene	100	N.D.
Bromodichloromethane	100	N.D.
Bromoform	100	N.D.
Bromomethane	100	N.D.
2-Butanone	500	N.D.
Carbon disulfide	100	N.D.
Carbon tetrachloride	100	N.D.
Chlorobenzene	100	N.D.
Chloroethane	100	N.D.
2-Chloroethyl vinyl ether	500	N.D.
Chloroform	100	N.D.
Chloromethane	100	N.D.
Dibromochloromethane	100	N.D.
1,1-Dichloroethane	100	N.D.
1,2-Dichloroethane	100	N.D.
1,1-Dichloroethene	100	N.D.
cis-1,2-Dichloroethene	100	N.D.
trans-1,2-Dichloroethene	100	N.D.
1,2-Dichloropropane	100	N.D.
cis-1,3-Dichloropropene	100	N.D.
trans-1,3-Dichloropropene	100	N.D.
Ethylbenzene	100	N.D.
2-Hexanone	500	N.D.
Methylene chloride	200	N.D.
4-Methyl-2-pentanone	500	N.D.
Styrene	100	N.D.
1,1,2,2-Tetrachloroethane	100	N.D.
Tetrachloroethene	100	N.D.
Toluene	100	N.D.
1,1,1-Trichloroethane	100	N.D.
1,1,2-Trichloroethane	100	N.D.
Trichloroethene	100	N.D.
Trichlorofluoromethane	100	N.D.
Vinyl acetate	100	N.D.
Vinyl chloride	100	N.D.
Total Xylenes	100	N.D.

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

SEQUOIA ANALYTICAL

Maria Lee

Maria Lee
Project Manager

SEQUOIA ANALYTICAL

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

RESNA	Client Project ID:	ARCO 276, Oakland	Sampled:	Oct 30, 1991
3315 Almaden Expwy., Suite 34	Sample Descript:	Soil, S-51-B6	Received:	Oct 31, 1991
San Jose, CA 95112	Analysis Method:	EPA 8240	Analyzed:	Nov 8, 1991
Attention: Joel Coffman	Lab Number:	110-5934	Reported:	Nov 12, 1991

VOLATILE ORGANICS by GC/MS (EPA 8240)

Analyte	Detection Limit µg/kg	Sample Results µg/kg
Acetone	500	N.D.
Benzene	100	N.D.
Bromodichloromethane	100	N.D.
Bromoform	100	N.D.
Bromomethane	100	N.D.
2-Butanone	500	N.D.
Carbon disulfide	100	N.D.
Carbon tetrachloride	100	N.D.
Chlorobenzene	100	N.D.
Chloroethane	100	N.D.
2-Chloroethyl vinyl ether	500	N.D.
Chloroform	100	N.D.
Chloromethane	100	N.D.
Dibromochloromethane	100	N.D.
1,1-Dichloroethane	100	N.D.
1,2-Dichloroethane	100	N.D.
1,1-Dichloroethene	100	N.D.
cis-1,2-Dichloroethene	100	N.D.
trans-1,2-Dichloroethene	100	N.D.
1,2-Dichloropropane	100	N.D.
cis-1,3-Dichloropropene	100	N.D.
trans-1,3-Dichloropropene	100	N.D.
Ethylbenzene	100	N.D.
2-Hexanone	500	N.D.
Methylene chloride	200	N.D.
4-Methyl-2-pentanone	500	N.D.
Styrene	100	N.D.
1,1,2,2-Tetrachloroethane	100	N.D.
Tetrachloroethene	100	130
Toluene	100	N.D.
1,1,1-Trichloroethane	100	N.D.
1,1,2-Trichloroethane	100	N.D.
Trichloroethene	100	N.D.
Trichlorofluoromethane	100	N.D.
Vinyl acetate	100	N.D.
Vinyl chloride	100	N.D.
Total Xylenes	100	N.D.

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

SEQUOIA ANALYTICAL

Maria Lee
Project Manager

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

RESNA
3315 Almaden Expwy., Suite 34
San Jose, CA 95112
Attention: Joel Coffman

Client Project ID: ARCO 276, Oakland
Method (units): EPA 8240 (µg/L purged)
Analyst(s): T. Fowler
QC Sample #: VBLK110491

Q.C. Sample Dates
Analyzed: Nov 8, 199
Reported: Nov 12, 199

QUALITY CONTROL DATA REPORT

Analyte	Sample Conc.	Spike Conc. Added	Conc. Matrix Spike	Matrix Spike % Recovery	Conc. Matrix Spike Duplicate	Matrix Spike Duplicate % Recovery	Relative % Difference
1,1-Dichloro-ethene	N.D.	50	50	100	51	102	2.0
Trichloroethene	N.D.	50	55	110	56	112	1.8
Benzene	N.D.	50	48	96	50	100	4.1
Toluene	N.D.	50	54	108	53	106	1.9
Chlorobenzene	N.D.	50	54	108	56	112	3.6

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Project Manager

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

RCO Products Company
Division of AtlanticRichfieldCompany

Task Order No. 276-91-3

Chain of Custody

CO Facility no 276	City (Facility) Oakland	Project manager (Consultant) Joel Coffman	Laboratory name Sequoia Anal.
CO engineer Chuck Carmel	Telephone no. (ARCO) (415) 571-2434	Telephone no (Consultant) (408)264-7723	Fax no. (Consultant) (408)264-2435	Contract number 07-073
sultant name RESNA	Address (Consultant) 3315 Almaden Exp., Suite 34, San Jose, CA 95118		Method of shipment Sequoia Courier

Sample ID	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 ☐	
155-B6		1	✓			✓		10/30/91			✓					✓		110593 1			
55-B6		1	✓			✓		10/30/91			✓					✓		110593 0			
355-B6		1	✓			✓		10/30/91			✓					✓		110593 3			
51-B6		1	✓			✓		10/30/91			✓					✓		110593 4			

Special detection Limit/reporting

Special QA/QC

Remarks

Lab number

Turnaround time

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

ondition of sample: good

Temperature received: cool

elinquished by sampler Barbara Sieminski	Date 10-31-91	Time 4:10	Received by Don Deorge
elinquished by Don Deorge	Date 10-31-91	Time 5:10	Received by
elinquished by	Date	Time	Received by laboratory	Date 11/2/91	Time 9:10