PARSONS ENGINEERING SCIENCE, INC.

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4 April 1997
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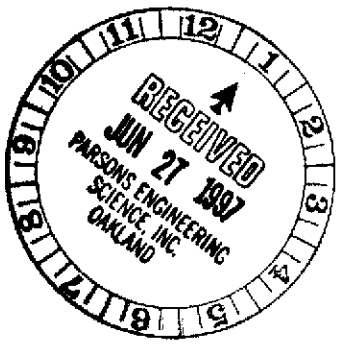


Ms. Juliet Shin
Alameda County Health Care Services Agency
Department of Environmental Health
Hazardous Materials Division
1131 Harbor Bay Parkway, Suite 250
Alameda, CA 94502

Subject: Quarterly Progress Report 8 and Annual Summary Assessment:
Redwood Regional Park Service Yard, Oakland, California

Dear Ms. Shin:

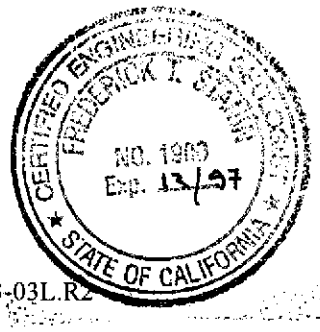
Attached is Quarterly Progress Report 8 and Annual Summary Assessment for the site investigation at Redwood Regional Park Service Yard, Oakland, California. This report describes September 1995 through February 1997 site characterization and groundwater monitoring activities related to two former leaking underground fuel storage tanks. This report also summarizes previous site characterization and remedial activities associated with the former tanks.

We trust that this submittal meets your needs. Please call if you have questions or require additional information.

Very truly yours,

PARSONS ENGINEERING SCIENCE, INC.

Bruce M. Rucker
Project Manager



Frederick T. Stanin, C.E.G.
Principal Geologist

BMR/FTS/slk/73-03L.R2
Enclosure

cc: W. Gee, East Bay Regional Parks District

Quarterly Progress Report 8 and
Annual Summary Assessment
(September 1995 to February 1997)

REDWOOD REGIONAL PARK SERVICE YARD, OAKLAND, CALIFORNIA

Prepared for

EAST BAY REGIONAL PARKS DISTRICT
Oakland, California

April 1997

Prepared by

PARSONS ENGINEERING SCIENCE, INC.
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EXECUTIVE SUMMARY

QUARTERLY PROGRESS REPORT 8
and
ANNUAL SUMMARY ASSESSMENT REPORT

This report presents the results of the February 1997 groundwater monitoring event conducted by Parsons Engineering Science, Inc. (Parsons ES) at the Redwood Regional Park Service Yard, Oakland, California. This report also summarizes the second year of quarterly groundwater monitoring and sampling, conducted between May 1996 and February 1997. (Site monitoring was not conducted between August 1995 and May 1996). Current quarter activities described in this report include:

- Collection of static water levels from all six wells to evaluate the local direction of groundwater flow and calculate the hydraulic gradient.
- Laboratory analysis of groundwater samples from three of the site wells for total petroleum hydrocarbons - gasoline and - diesel ranges (TPH-G,-D) and aromatic hydrocarbons (benzene, toluene, ethylbenzene and total xylenes [BTEX]). Hydrochemical monitoring of wells MW-1, MW-3, and MW-6 was discontinued following the August 1995 event due to lack of detectable groundwater contamination in these wells over four consecutive quarters of monitoring.
- Collection and laboratory analysis of creek surface water samples.

Static water level elevations measured during the current event confirm the northeast to southwest local groundwater flow direction at the site. This direction of groundwater flow is consistent with data collected during previous events.

Groundwater contamination detected in February 1997 was consistent with concentrations detected over the previous year of monitoring, and has decreased significantly since February 1995. Maximum groundwater contaminant concentrations in February 1997 were detected in well MW-4, approximately 100 feet downgradient of the former UFSTs, and included TPH-G (3,300 µg/L) and BTEX (372.5 µg/L). Only benzene was detected at concentrations in excess of regulatory agency standards for drinking water. The limits of groundwater contamination are well defined by the site wells.

Surface water samples have been collected from Redwood Creek in eight events from February 1994 through February 1997. Following initial detection of fuel compounds in February/March 1994, TPH-G and TPH-D/K have each been detected only once, and not in the downstream sampling location. BTEX constituents have never been detected in the downstream sampling location. The presence of algal blooms on the creek surface has been observed in the immediate vicinity of fuel-discolored soil in the east creek bank, suggesting that the fuel serves as a carbon source for the organisms.

Groundwater at the project site is not a current drinking water source, but may constitute a potential drinking water source based on the measured electrical conductivity and sustained

yield inferred. Groundwater contamination may therefore be evaluated with respect to Maximum Contaminant Levels (MCLs) for drinking water. Additionally, groundwater quality data may be considered with respect to numerical water quality objectives for surface water in Redwood Creek which has historically been impacted by groundwater flowing from the project site. Creek surface water samples collected during the February 1997 monitoring event contained no detectable TPH-G, TPH-D or BTEX.

Based on the data presented in this and previous reports, Parsons ES recommends continuation of the established quarterly groundwater and creek surface water monitoring program.

SECTION 1

INTRODUCTION

This report presents the results of the February 1997 groundwater sampling event, and summarizes the results of the second year of the quarterly groundwater and surface water monitoring program at the Redwood Regional Park Service Yard in Oakland, Alameda County, California. The ongoing investigation being conducted by Parsons Engineering Science, Inc. (Parsons ES) (formerly Engineering-Science, Inc. [ES]) is designed to characterize and evaluate the extent and magnitude of surface water and groundwater contamination associated with two former underground fuel storage tanks (UFSTs) which contained gasoline and diesel fuel.

1.1 SITE DESCRIPTION AND HISTORY

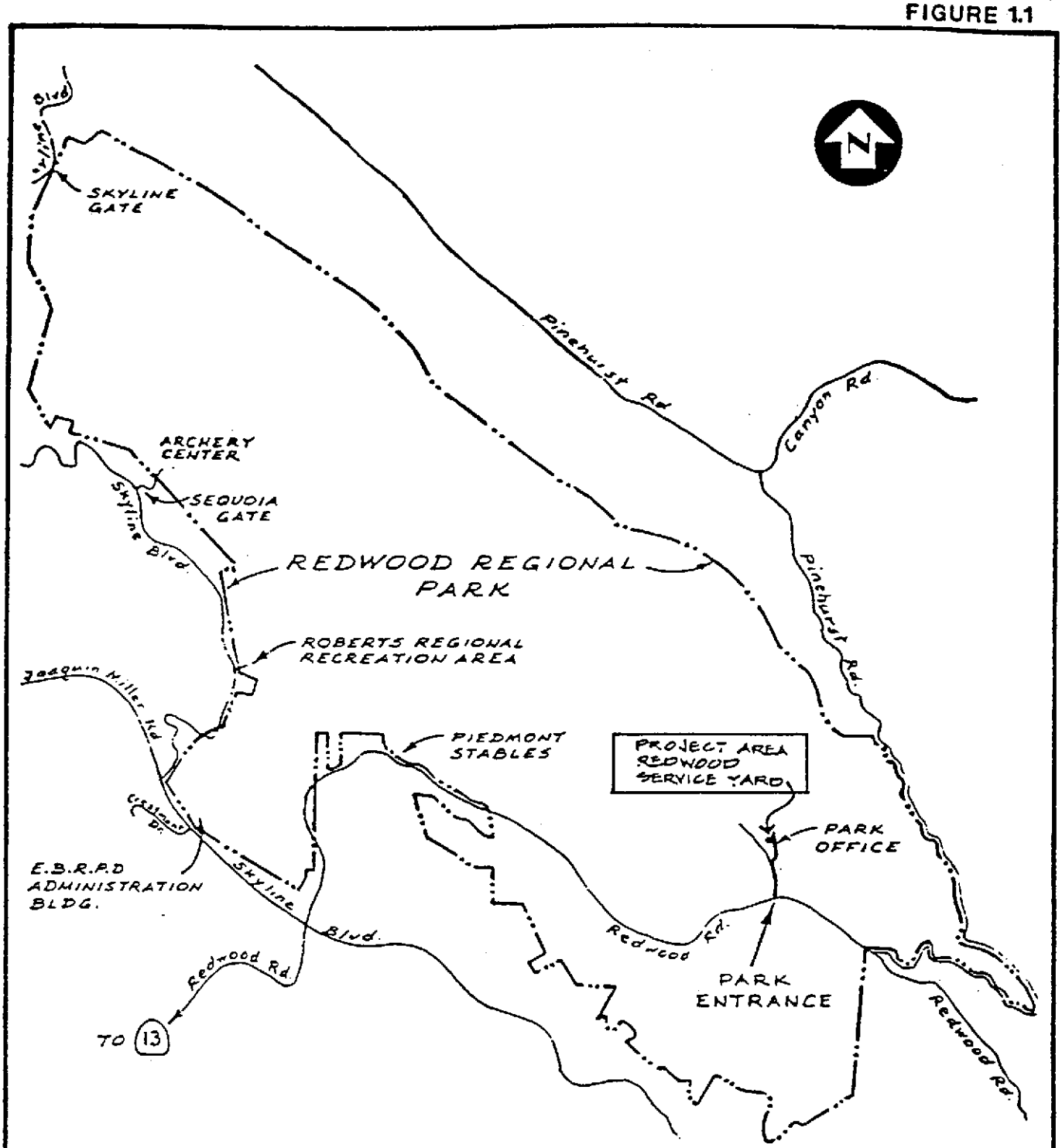
The project site is located at 7867 Redwood Road in Oakland, Alameda County, California. Figure 1.1 shows the location of the project site. The site slopes to the west, from an elevation of approximately 564 feet above mean sea level (MSL) at the eastern edge of the service yard to approximately 545 feet above MSL at Redwood Creek, which approximately defines the western edge of the project site. Figure 1.2 is a site plan of the project site.

The project site is a service yard for Redwood Regional Park, and utilized two UFSTs (one 2,000-gallon diesel fuel and one 5,000-gallon unleaded gasoline) from the mid-1960's to 1993. Figure 1.2 shows the location of the UFSTs. Both UFSTs were reportedly installed between 1965 and 1968 (Parsons ES 1993a). The 5,000-gallon steel UFST contained unleaded gasoline and was reportedly a converted channel buoy purchased from the Navy (Parsons ES 1993a). The tanks and piping underwent integrity testing in 1984, 1986, 1988 and 1989. The unleaded gasoline UFST system failed the 1988 and 1989 tests (Parsons ES 1993a).

1.2 PREVIOUS SITE INVESTIGATIONS

Documented soil, groundwater and surface water contamination at the project site is the result of leaks from the former UFSTs. Soil and groundwater characterization and remediation activities related to the former UFSTs has been conducted by Parsons ES since April 1993. Detailed discussions and evaluations are given in previous reports and workplans (Parsons ES 1993a, 1993b, 1993c, 1994a, 1994b, 1994c, 1994d, 1995a, 1995b, 1995c, 1996a, 1996b, and 1997).

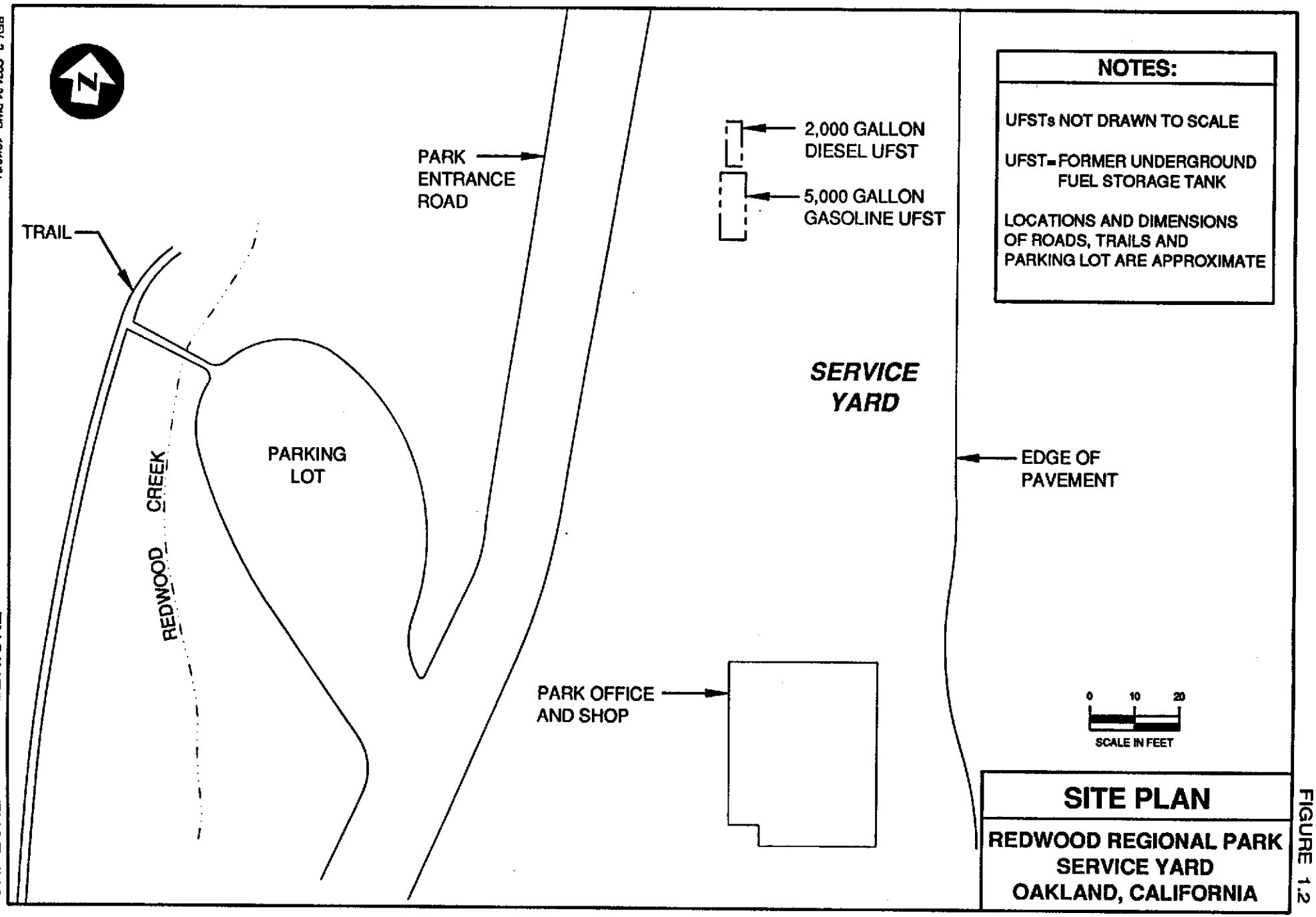
FIGURE 1.1



SITE LOCATION MAP

REDWOOD REGIONAL PARK
SERVICE YARD

OAKLAND, CALIFORNIA


N
PARK ENTRANCE ROAD
TRAIL
2,000 GALLON DIESEL UFST
5,000 GALLON GASOLINE UFST
NOTES:
UFSTs NOT DRAWN TO SCALE
UFST= FORMER UNDERGROUND FUEL STORAGE TANK
LOCATIONS AND DIMENSIONS OF ROADS, TRAILS AND PARKING LOT ARE APPROXIMATE
SERVICE YARD
REDWOOD CREEK
PARKING LOT
EDGE OF PAVEMENT
PARK OFFICE AND SHOP
0 10 20
SCALE IN FEET
SITE PLAN
REDWOOD REGIONAL PARK
SERVICE YARD
OAKLAND, CALIFORNIA
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ENGINEERING-SCIENCE, INC.

FIGURE 1-2

1.2.1 UFST Closure and Soil Remedial Activities

The two project site UFSTs were excavated and transported off-site for disposal in April 1993, at which time discolored soil was observed in the excavation pit below the gasoline UFST location. Initial confirmation soil samples collected from beneath each UFST indicated soil contamination by total petroleum hydrocarbons - gasoline (TPH-G) range and aromatic hydrocarbons (benzene, toluene, ethylbenzene and total xylenes [BTEX]) (Parsons ES 1993a). No elevated levels of lead were detected in those soil samples.

Approximately 600 cubic yards of contaminated soil in the vicinity of the UFSTs were excavated and stockpiled for on site aeration in June 1993. The excavation covered a surface area of approximately 5,000 square feet, and had a maximum depth of approximately 25 feet (below grade relative to the eastern edge of the excavation). Soil excavation activities were halted due to the potential for slope instability, the presence of significant facility constraints (roads and buildings) and the infiltration of spring water into the excavation.

Five confirmation excavation soil samples were collected by Parsons ES in June 1993. Discolored soil was noted only in the eastern wall of the excavation. However, confirmation soil samples from other areas contained up to 1,700 parts per million by volume (ppmv) total ionizable vapors as measured with a photoionization detector (PID) and a total hydrocarbon vapor analyzer (THVA). Maximum concentrations detected in excavation confirmation soil samples include 12,000 milligrams per kilogram (mg/Kg) TPH-G, 1,300 TPH-D/K, 80 mg/Kg benzene, 390 mg/Kg toluene, 230 mg/Kg ethylbenzene and 1,100 mg/Kg total xylenes (Parsons ES 1993c).

The excavation was backfilled between June and August 1993 with previously excavated clean overburden (estimated 270 cubic yards) and imported fill (estimated 330 cubic yards) and the surface was repaved with asphalt.

The approximately 600 cubic yards of contaminated soil were stockpiled on plastic sheeting at an open area behind the Redwood Park Fire Station #2 located on Redwood Road approximately 500 feet east of the project site. Confirmation soil samples were collected from the stockpiled soil in July 1993, and aeration of the stockpiled, contaminated soil began in August 1993 (Parsons ES 1993a). Following Alameda County Health Care Services Agency, Environmental Health Department, Hazardous Materials Division (ACHCSA) approval, the soil was relocated to Sibley Regional Preserve in Contra Costa County, California for further aeration (EBRPD 1995).

1.2.2 Initial Site Characterization

Following submittal of a technical workplan (Parsons ES 1993b), an initial site characterization was conducted in September and October 1993 in the vicinity of the former UFST excavation. Tasks conducted included: advancing 17 exploratory borings and converting five to temporary well points; collecting 27 soil and five "grab" groundwater samples for laboratory analysis; and measurement of static water levels (Parsons ES 1993c). No significant soil contamination was detected in soil borings immediately north, south or east of the former UFST remedial excavation. Soil contamination was detected in soil borings up to 90 feet southwest of the former UFST excavation; maximum soil

contamination detected included 1,900 mg/Kg TPH-G, 1,300 mg/Kg TPH-K and 198 mg/Kg BTEX constituents. Maximum groundwater contamination detected in temporary well points included 810,000 micrograms per liter (µg/L) TPH-G, 2,300,000 µg/L TPH-K, 570 µg/L TPH-D and 125,000 µg/L BTEX (including 12,000 µg/L benzene) (Parsons ES 1993c).

1.2.3 Creek Soil and Surface Water Sampling

Following observation of an area of discolored soil in the bed of Redwood Creek southwest of the former UFSTs, soil and surface water samples were collected for laboratory analysis in February and March 1994 (Parsons ES 1994a and 1994b). One soil sample was collected in February 1994 for laboratory analysis from the discolored soil. That sample contained 3 mg/Kg of TPH-D; neither TPH-G nor BTEX were detected. Field observations have indicated the presence of both a petroleum sheen and an orange algae in the area of the discolored soil suggesting that the fuel is acting as a carbon source for the groundwater contamination seeping from the creek bank.

Surface water samples have been collected from Redwood Creek at locations upstream, downstream, and in the immediate vicinity of the area of discolored soil, when surface water is available, since February 1995. Downstream creek surface water samples have contained detectable TPH-G and BTEX in two of the six sampling events at that location. BTEX constituents have never been detected at the downstream location. One upstream sample (March 1994) contained detectable TPH-G, presumably resulting from runoff of vehicle-sourced fuel from parking lots and/or roadways.

1.2.4 Revisions to Sampling Program

Approval was granted for discontinuing hydrochemical monitoring of wells MW-1, MW-3 and MW-6 following the August 1995 monitoring event due to lack of detectable groundwater contamination in those wells (ACHCSA 1996a).

The following conclusions regarding the extent of soil, groundwater, and surface water contamination are based on the data collected by Parsons ES prior to February 1997:

- Soil excavation activities were effective in reducing the majority of soil contamination in the immediate vicinity of the former UFSTs to concentrations less than regulatory agency action levels.
- Capillary fringe soils and groundwater contaminated with petroleum fuel products and BTEX above regulatory agency action levels were detected up to 130 feet southwest (downgradient) of the UFST source area.
- Surface water in Redwood Creek has been impacted by TPH-G and BTEX.

SECTION 2

SITE HYDROGEOLOGY

The following evaluation of the hydrogeologic conditions at the project site is based on geologic logging and water level measurements collected at the site by Parsons ES beginning in September 1993. This section summarizes site geology and groundwater and surface water hydrology.

2.1 GEOLOGY

The site is located approximately seven miles east of the southeastern shoreline of San Francisco Bay, within the Coast Ranges physiographic province of California. The San Francisco Bay Area is an elongate structural depression bounded by the Santa Cruz Mountains on the west and the Diablo Range on the east. The Berkeley Hills are encompassed by the Diablo Range.

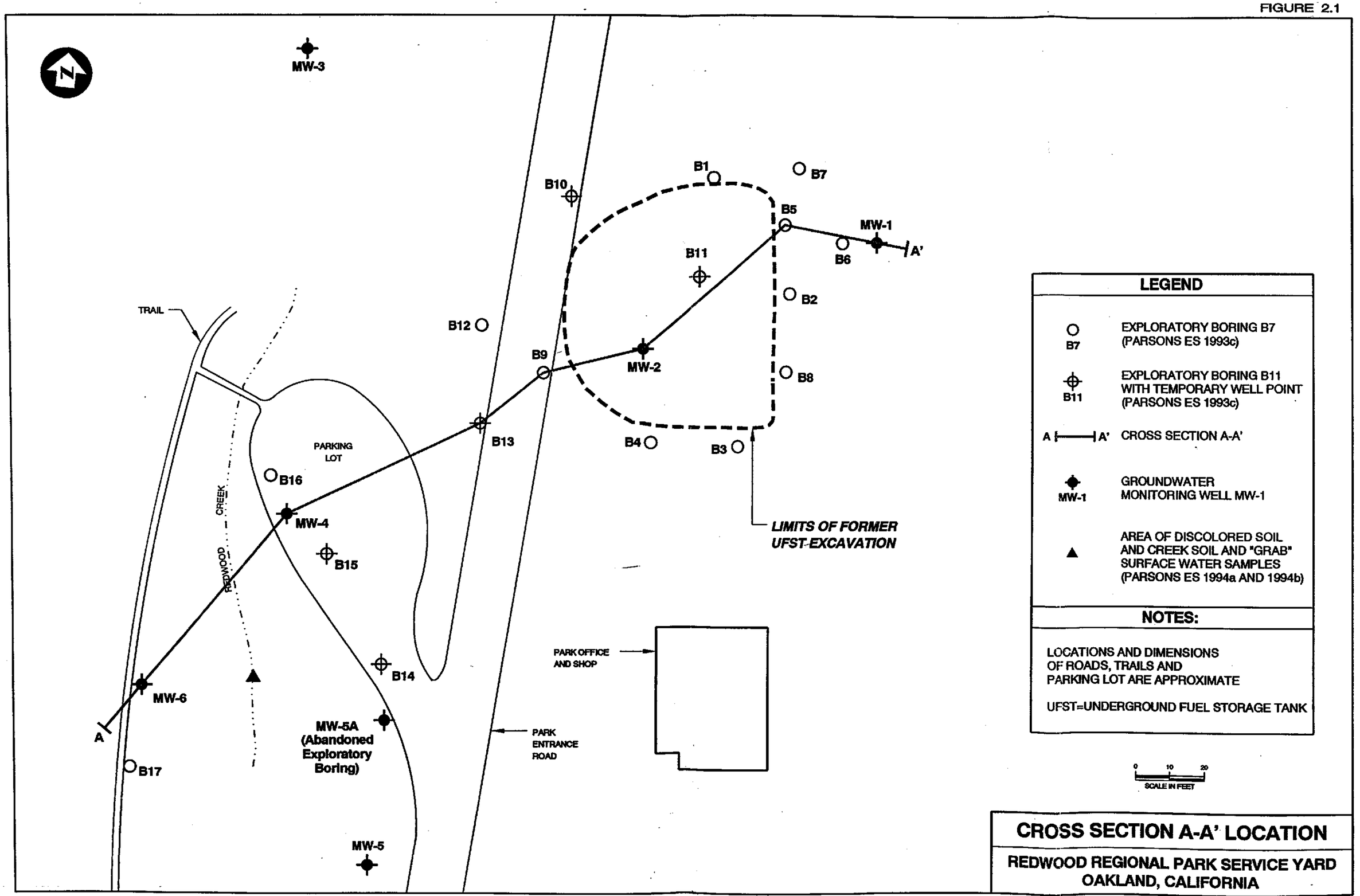
The San Francisco Bay Area is a seismically active region. The area's main geologic structures are associated with two major faults: the San Andreas Fault in the Santa Cruz Mountains and the Hayward Fault which forms the western boundary of the Diablo Range. The Diablo Range has been uplifted and the bay has gradually subsided over the last three million years. The site is located approximately 2.5 miles east of the Hayward Fault (Norris and Webb 1990, Nilsen et. al. 1979).

The bedrock in these mountain ranges is composed of sedimentary, metamorphic and volcanic rocks of Jurassic through Tertiary age (Borcherdt et. al. 1975). Overlying the bedrock in Redwood Creek canyon is Quaternary alluvium consisting of silt, sand and gravel. Subsurface stratigraphy at the site is illustrated in cross section A-A' (Figures 2.1 and 2.2) based on soil boring data acquired during the 1993 initial site characterization and the November 1994 well installation program. Shallow soil stratigraphy consists of a surficial three to ten foot-thick clayey silt unit underlain by a five- to fifteen- foot thick silty clay unit. In all monitoring well borings, a five- to ten-foot thick clayey coarse-grained sand and clayey gravel unit was encountered that laterally grades to a clay or silty clay. This unit overlies a weathered siltstone at the base of the observed soil profile. Soils in the vicinity of MW-1 are inferred to be landslide debris.

2.2 HYDROLOGY

Redwood Creek borders the site to the west and is a seasonal creek known for the occurrence of Rainbow Trout. The site lies approximately one mile upstream (northwest) of Upper San Leandro Reservoir.

FIGURE 2.1



CROSS SECTION A-A' LOCATION

REDWOOD REGIONAL PARK SERVICE YARD OAKLAND, CALIFORNIA

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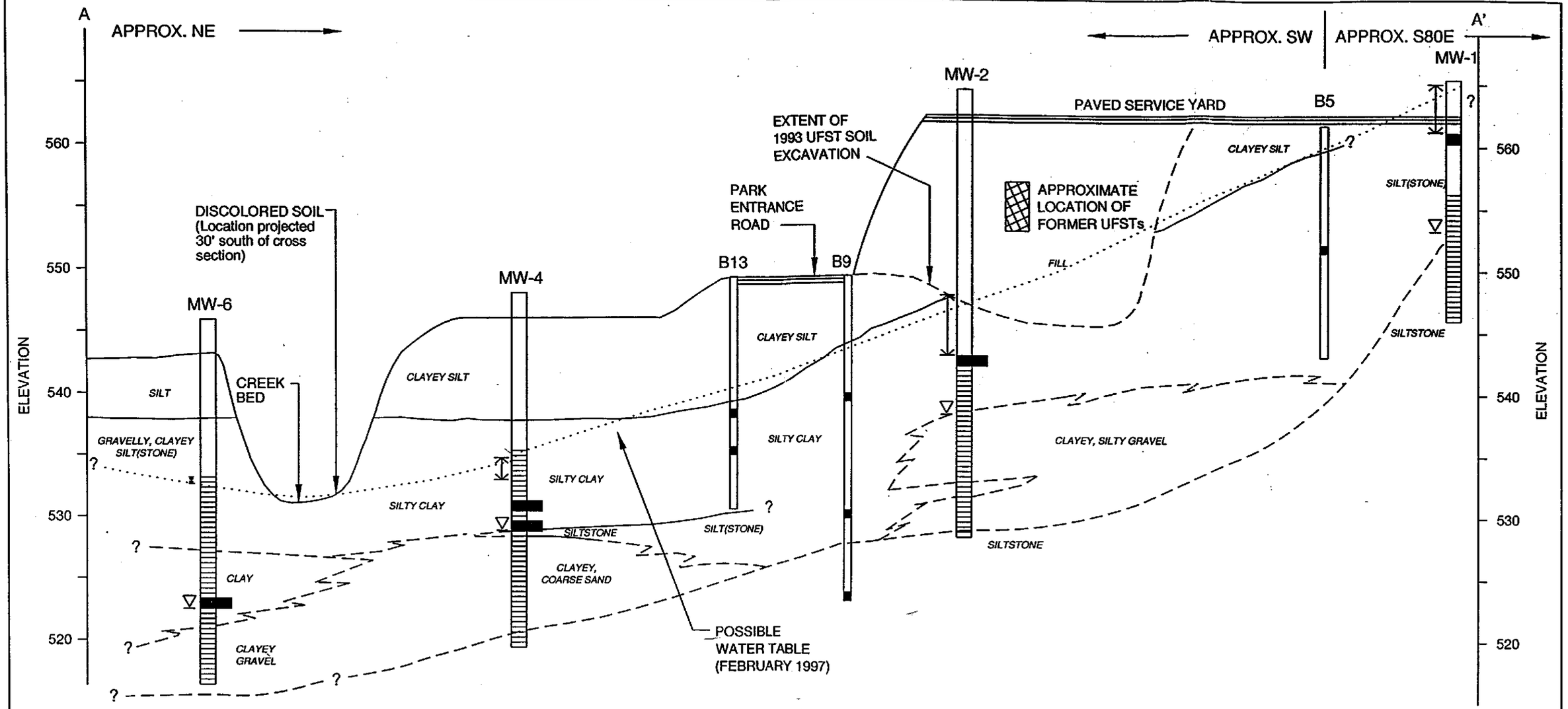
PARSONS ENGINEERING SCIENCE, INC.

FIGURE 2.2



LEGEND		NOTES:
B1 — EXPLORATORY BORING B1 LOCATION OF SOIL SAMPLE COLLECTED FOR LABORATORY ANALYSIS	MW-1 — MONITORING WELL MW-1 SHOWING LOCATION OF SOIL SAMPLE COLLECTED FOR LABORATORY ANALYSIS	LOCATIONS AND DIMENSIONS OF ROADS, TRAILS AND PARKING LOT ARE APPROXIMATE UFST=UNDERGROUND FUEL STORAGE TANK UFSTs NOT DRAWN TO SCALE ALL ELEVATIONS SURVEYED BY EBRPD RELATIVE TO UNITED STATES GEOLOGICAL SURVEY (USGS) SURVEY BENCHMARK NO. JHF-49 AND ARE EXPRESSED AS FEET ABOVE MEAN SEA LEVEL (MSL) WELL CASING AND BORING WIDTHS NOT TO SCALE
FIRST ENCOUNTERED GROUNDWATER DURING DRILLING (10/94)	RANGE OF STATIC WATER LEVELS MEASURED MEASURED BETWEEN NOVEMBER 1994 AND FEBRUARY 1997	

10
SCALE IN FEET
VERTICAL
EXAGGERATION
IS 2.5X
0
0
20

CROSS SECTION A-A'

REDWOOD REGIONAL PARK SERVICE YARD
OAKLAND, CALIFORNIA

REV. 3 C274-42.DWG 09/26/95

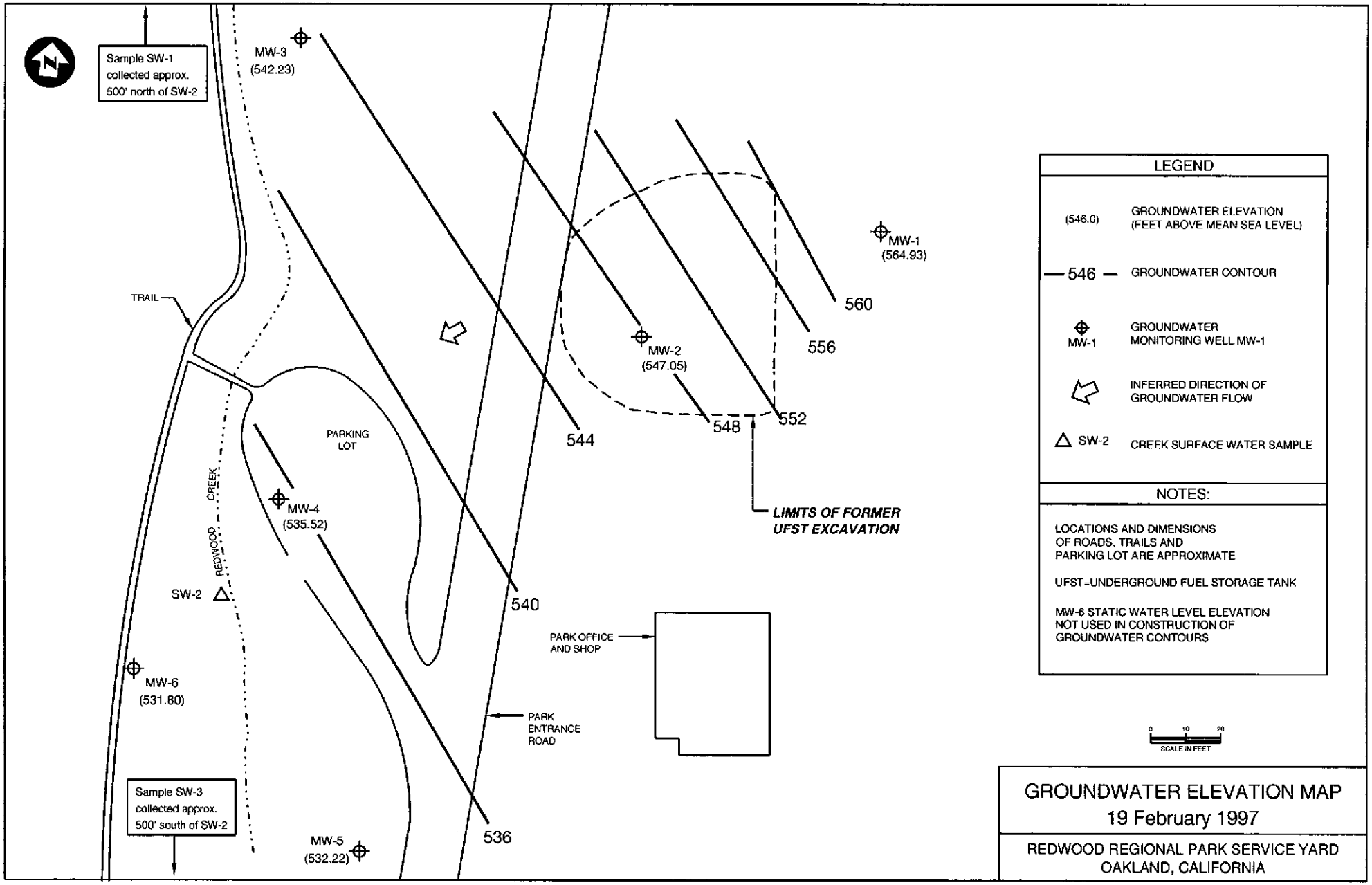
PARSONS ENGINEERING SCIENCE, INC.

Groundwater at the site occurs under predominantly unconfined conditions, as evidenced by the equilibrated static water levels relative to the water level in Redwood Creek and the level of water seepage out of the north face of the former excavation. Groundwater seepage into Redwood Creek is indicated by historical observations of fuel-contaminated capillary fringe soils in the eastern bank of Redwood Creek (Parsons ES 1994d). Groundwater was first observed at the top of the clayey, silty sand-gravel zone in all monitoring well borings except MW-1. First occurrence of groundwater during drilling was encountered from approximately 3 to 25 feet bgs, and equilibrated water levels ranged from 2 to 18 feet bgs (Parsons ES 1993c and Appendices B and C). The difference between first occurrence of groundwater and equilibrated water level ranged from 0 to 13 feet. These differences were the greatest in areas east of the road and were much less west of the road.

Figure 2.3 is a groundwater elevation map constructed from the 19 February 1997 monitoring well static water levels. The direction of local groundwater flow in the portion of the study area east of Redwood Creek is from northeast to southwest. This groundwater flow direction is consistent with previously recorded measurements made in site wells and boreholes since September 1993. For comparison, historical groundwater elevation maps are presented in Appendix A. It is inferred that local groundwater flow direction west of Redwood Creek is toward the east (toward the creek). The groundwater gradient is approximately 0.1 feet per feet between wells MW-2 and Redwood Creek, and is approximately 2 feet per feet between well MW-1 and the former UFST source area. The increased groundwater gradient in that area is inferred to result from the topography and the highly disturbed nature of sediments in the landslide debris.

As discussed above, the materials encountered at the water table in borings in the vicinity of the former UFSTs are predominantly clayey silt and silty clay. A hydraulic conductivity value of approximately 0.003 ft/day and an effective porosity value of 30 percent are representative values of these parameters for this soil type (Fetter 1988). Given a groundwater gradient of 0.1 feet per feet as estimated from static water level measurements west of the UFST source area, the average linear groundwater velocity would be approximately 0.4 feet per year. Materials encountered a few feet below the water table in five of the six monitoring wells include a five- to ten-foot thick clayey coarse-grained sand/clayey gravel unit. This is probably the major water-transmitting unit in the observed soil profile. A hydraulic conductivity value of approximately 0.05 ft/day and an effective porosity of 35 percent are representative of these parameters for this soil type (Fetter 1988), yielding an average linear groundwater velocity of approximately five feet per year (approximately ten times the value for the upper silty clay, clayey silt unit). These values are approximations only, and actual groundwater velocities could vary substantially. There is no comprehensive data on groundwater hydrology in the area of the project site (ACFCWCD 1988).

FIGURE 2.3



GROUNDWATER ELEVATION MAP
19 February 1997

REDWOOD REGIONAL PARK SERVICE YARD
OAKLAND, CALIFORNIA

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PARSONS ENGINEERING SCIENCE, INC.

SECTION 3

CURRENT QUARTER ACTIVITIES

This section summarizes recent (19 February 1997) field activities conducted at the project site related to the current groundwater characterization investigation. These activities were conducted in accordance with specifications contained in a technical workplan (Parsons ES 1994c), and included:

- Measurement of static water levels data and collection of groundwater analytical samples from site wells
- Collection and laboratory analysis of creek surface water samples

The locations of all site monitoring wells are shown on Figures 1.2 and 2.1. Well construction information is summarized in Table 3.1.

TABLE 3.1

GROUNDWATER MONITORING WELL CONSTRUCTION DATA

Well	Well Depth	Screened Interval	Depth to TOC	Ground Surface Elevation	TOC Elevation
MW-1	18	7-17	-2.3	563.6	565.9
MW-2	36	20-35	-2.4	564.1	566.5
MW-3	42	7-41	-2.8	558.1	560.9
MW-4	26	10-25	-2.1	546.0	548.1
MW-5	26	10-25	-2.3	545.2	547.5
MW-6	26	10-25	-2.3	543.3	545.6

Remarks:
1) TOC = Top of Casing
2) All depths are feet below ground surface unless otherwise specified. Negative values for "Depth to TOC" indicate that the TOC is above ground surface.
3) All elevations are feet above USGS mean sea level (MSL). Elevations were surveyed by EBRPD relative to USGS Benchmark No. JHF-49.

3.1 GROUNDWATER MONITORING

Parsons ES personnel measured static water levels (Appendix B) in all six site wells on 19 February 1997. All water level measurements were made using an electric water level indicator.

3.2 GROUNDWATER SAMPLING

Groundwater sampling MW-2, MW-4, and MW-5 was conducted in accordance with California Water Resources Control Board (WRCB 1989) guidelines for sampling dissolved product in groundwater associated with leaking UFSTs. Prior to collection of groundwater samples, a pre-cleaned Teflon (tradename) bailer or submersible pump was used to purge a minimum of three casing volumes from each well. To minimize potential loss of volatile constituents in groundwater samples, well purging rates were maintained at 2 gallons per minute (gpm) or less, and water level drawdown was not allowed to exceed 2 feet below the top of the well casing screened interval. Electrical conductivity (EC), hydrogen ion index (pH), and temperature (T) of purge water were measured during well purging, to document the stabilization of formation-water in the wells. Appendix B includes water level data and groundwater monitoring field notes from the groundwater monitoring event.

Glass sample containers were filled with sample water from a pre-cleaned Teflon (tradename) bailer. Only the water sample collected from well MW-4 displayed a petroleum sheen or odor. To prevent cross-contamination, groundwater sampling equipment was decontaminated prior to use and between each monitoring well with an Alconox (tradename) wash followed by three deionized water rinses. Following sample collection, sample containers were labeled, placed in a cooler packed with "blue ice," and transported under chain-of-custody the same day to a laboratory accredited by the California Environmental Protection Agency (Cal EPA) Department of Health Services (DHS) Environmental Laboratory Accreditation Program (ELAP). Chain-of-custody records for the groundwater samples are included in Appendix C. A total of approximately 80 gallons of purge water and decontamination rinsate from the current groundwater sampling event was containerized in the on-site plastic tank. It is anticipated that site purge water will continue to be accumulated in this on-site tank until it is full, at which time it will be transported by a licensed waste hauler to a permitted wastewater facility.

3.3 CREEK SURFACE WATER SAMPLING

Surface water samples were collected on 19 February 1997 from locations SW-1, SW-2, and SW-3 in Redwood Creek (Figure 2). Surface water samples were collected by immersing the sample containers just under the water surface, and immediately capping the containers, which were then labeled, chilled and transported under chain-of-custody the same day to the analytical laboratory. No petroleum sheen or odor was noted in any of the surface water samples. In the vicinity of sampling location SW-2, petroleum sheen in soil was observed at multiple locations along an approximately 25-foot wide section of the east creek bank, just above the surface water level, indicating seepage of capillary fringe groundwater contamination at the creek bank. At each location where petroleum sheen was observed in soil, orange algae was present, suggesting that the petroleum was serving as a carbon source for the algae. At the time of sampling, the creek was flowing briskly and had a water depth of 6 to 12 inches at the sampling locations.

SECTION 4

EVALUATION OF RESULTS

This section describes the results of the eighth (February 1997) quarterly groundwater and surface water sampling event. Also presented is a summary of the groundwater and surface water results from the previous seven quarterly groundwater sampling events (November 1994 through May 1996).

4.1 FEBRUARY 1997 GROUNDWATER AND SURFACE WATER ANALYTICAL RESULTS

The current groundwater and surface water monitoring and sampling program is consistent with the Parsons ES workplan for groundwater characterization at the site (Parsons ES 1994c). Groundwater and surface water samples collected in February 1997 were analyzed for the following constituents:

- TPH-G, D/K by the California Department of Toxic Substances Control (DTSC) Leaking Underground Fuel Tank (LUFT) Manual Method (equivalent to modified EPA Method 8015)
- BTEX by EPA Method 8020

4.1.1 Groundwater Samples

Table 4.1 summarizes groundwater sample analytical results from the February 1997 groundwater sampling event. Maximum groundwater contamination by TPH-G (3,300 µg/L) and total BTEX constituents (approximately 372.5 µg/L) was detected in downgradient well MW-4. Benzene and ethylbenzene were the only groundwater contaminants detected in well MW-2 (total 1.24 µg/L). No groundwater contamination was detected in well MW-5. TPH-D/K were not detected in any of the three site wells sampled.

4.1.2 Creek Surface Water

Surface water samples collected from Redwood Creek (Figure 1.2) were analyzed for TPH-G, TPH-D/K and BTEX. None of these constituents were detected in any of the surface water samples.

TABLE 4.1

GROUNDWATER SAMPLE ANALYTICAL RESULTS
19 February 1997
Redwood Regional Park Service Yard, Oakland, California

	Concentration (µg/L)					
Compound:	TPH-G	TPH-D/K	Benzene	Toluene	Ethylbenzene	Total Xylenes
Reporting Limit:	50	50	0.5	0.5	0.5	0.5
Sample Location						
MW-2	ND	ND	0.69	ND	0.55	ND
MW-4[(b)]	3,300	ND	120	ND[(b)]	150	102.5
MW-4[(a)(b)]	4,100	NA	150	ND[(b)]	190	125.8
MW-5	ND	ND	ND	ND	ND	ND

Notes:
(a) = Quality control field duplicate sample designated MW-0A on the chain-of-custody and analytical laboratory report
TPH-G = Total petroleum hydrocarbons - gasoline range
TPH-D/K = Total petroleum hydrocarbons - diesel/kerosene ranges
NA - Not Analyzed
ND = Not Detected
µg/L = Micrograms per liter, equivalent to parts per billion (ppb)
(b) = Method reporting limit = 1 µg/L for all BTEX constituents

4.1.3 Quality Control Sample Analytical Results

Two types of field quality control (QC) samples were used to assess whether field or laboratory procedures affected analytical results of the current groundwater sampling event. One equipment rinsate blank (MW-0B) was collected following sampling and decontamination activities at well MW-4 to monitor potential cross-contamination in the field due to inadequate decontamination of sampling equipment and/or sample contamination during transport. That sample was analyzed for TPH-G and BTEX; none of these constituents were detected, verifying the integrity of field decontamination procedures and sample containers.

One field duplicate sample (MW-0A) was collected from well MW-4 and analyzed for TPH-G and BTEX to assess whether field procedures produced reproducible results. For detected compounds, relative percent differences (RPDs) (aka, variance from the mean) in concentration between the field and duplicate samples included: 21.6% (TPH-G); 22.2% (benzene); 23.5% (ethylbenzene); and 20.4% (total xylenes).

Laboratory QC samples (e.g. method blanks, matrix spikes, surrogate spikes, etc.) were analyzed by the laboratory in accordance with requirements of each analytical method. All laboratory QC sample results and sample holding times were within the acceptance limits of the methods (Appendix C).

4.2 SUMMARY OF GROUNDWATER AND SURFACE WATER CONTAMINATION

The following summarizes available data regarding detected groundwater and surface water contamination at the project site, collected by Parsons ES since September 1993. Documentation of specific analytical methods and individual analyses may be found in the referenced documents.

4.2.1 Summary of Groundwater Contamination

Maximum groundwater contamination detected in temporary well points installed in September 1993 included 810,000 µg/L TPH-G, 2,300,000 µg/L TPH-K, 570 µg/L TPH-D and 125,000 µg/L BTEX (including 12,000 µg/L benzene) (ES 1993c). Table 4.2 summarizes groundwater analytical results collected during quarterly monitoring of the six site groundwater monitoring wells since November 1994. The lateral extent of former site UFST-sourced groundwater contamination has been well defined by the six site wells, and appears to extend from the former UFST remedial excavation downgradient (west) to Redwood Creek.

Groundwater contamination was not detected in wells MW-1 (upgradient), MW-3 (cross-gradient) and MW-6 (downgradient) over the four quarters of monitoring prior to their removal from the hydrochemical monitoring program, except for a detection of BTEX (0.8 µg/L) attributable to cross-contamination of field equipment.

Neither TPH-G nor TPH-D/K have been detected in source area well MW-2 since November 1994, and BTEX constituents have been detected at concentrations less than or equal to 8 µg/L in five of the eight events.

Site-wide maximum concentrations of groundwater contamination were detected in well MW-4 in February 1995, and have decreased significantly in subsequent monitoring events. Groundwater contaminant concentrations have remained relatively stable in the five monitoring events conducted since August 1995. TPH-G has been sporadically detected just above the method detection limit (maximum of 80 µg/L) in well MW-5, and an unconfirmed detection of BTEX (0.6 µg/L) was reported in February 1995.

The following conclusions are supported by the available data:

- The lateral extent of the groundwater contamination plume is well defined by the six site wells.
- The leading edge of the groundwater contaminant plume has reached the east bank of Redwood Creek.

4.2.2 Summary of Creek Surface Water Contamination

Table 4.3 summarizes analytical results of surface water samples collected from Redwood Creek (downgradient of the former UFSTs) since February 1994. Surface water contamination has been detected in three of the eight sampling events conducted since February 1994. Maximum concentrations include: 200 µg/L TPH-G (August 1996); 74

µg/L TPH-D/K (May 1996); 7.5 µg/L benzene (August 1996); 5.4 µg/L ethylbenzene (August 1996); and 3.2 µg/L total xylenes (March 1994). All of these maximum levels except the TPH-D/K detection were found at location SW-2. Toluene has never been detected in any site surface water samples.

Areas of fuel-discolored soil have been observed in the east creek bed directly downgradient of the former UFSTs sporadically since February 1994, indicating that the leading edge of the UFST-sourced groundwater contaminant plume has reached the creek. Blooms of orange algae on the water surface have been observed coincident with the areas of discolored soil, suggesting that the fuel is serving as a carbon source for the organisms. Groundwater contamination has been detected at downstream location SW-3 in only two events: 69 µg/L TPH-G in August 1996 and 74 µg/L TPH-D/K in March 1996. BTEX constituents have never been detected at the downstream sampling location.

Groundwater contamination was detected once (50 µg/L TPH-G in February 1994) at upstream location SW-1, presumably resulting from runoff of vehicle-sourced fuels from nearby parking lots or roadways.

TABLE 4.2

GROUNDWATER ANALYTICAL SUMMARY

November 1994 - February 1997

Redwood Regional Park Service Yard, Oakland, California

Sample ID	Analyte	MRL (µg/L)	November 1994	February 1995	May 1995	August 1995	May 1996	August 1996	December 1996	February 1997
MW-1	TPH-G	50	ND	ND	ND	ND	*	*	*	*
	TPH-D/K	50	ND	ND	ND	ND	*	*	*	*
	BTEX	0.5	ND	ND	ND	ND	*	*	*	*
MW-2	TPH-G	50	66	89	ND	ND	ND	ND	ND	ND
	TPH-D/K	50	ND	ND	ND	ND	ND	ND	ND	ND
	BTEX	0.5	4.3	29.6	8.0	5.7	ND	ND	7.9	1.2
MW-3	TPH-G	50	ND	ND	ND	ND	*	*	*	*
	TPH-D/K	50	ND	ND	ND	ND	*	*	*	*
	BTEX	0.5	ND	0.8	ND	ND	*	*	*	*
MW-4	TPH-G	50	2,600	11,000	7,200	1,800	1,100	3,700	2,700	3,300
	TPH-D/K	50	230	330	440	240	140	120	240	ND
	BTEX	0.5	362.8	1,337	1,033	227.3	98	409	242	372.5
MW-5	TPH-G	50	50	70	ND	ND	ND	80	ND	ND
	TPH-D/K	50	ND	ND	ND	ND	ND	ND	ND	ND
	BTEX	0.5	ND	0.6	ND	ND	ND	ND	ND	ND
MW-6	TPH-G	50	ND	ND	ND	ND	*	*	*	*
	TPH-D/K	50	ND	ND	ND	ND	*	*	*	*
	BTEX	0.5	ND	ND	ND	ND	*	*	*	*

Notes:

TPH-G = Total petroleum hydrocarbons, gasoline range (California Department of Toxic Substances Control [DTSC] Leaking Underground Fuel Tank [LUFT] Field Manual Method).
TPH-D/K = Total petroleum hydrocarbons, diesel and kerosene range (California Department of Toxic Substances Control [DTSC] Leaking Underground Fuel Tank [LUFT] Field Manual Method).
BTEX = Benzene, toluene, ethylbenzene and total xylenes (EPA Method 8020).
ND = Not detected above MRL.
MRL = Method reporting limit.
* = Well not sampled.

TABLE 4.3

CREEK SURFACE WATER ANALYTICAL SUMMARY
February 1994 - February 1997
Redwood Regional Park Service Yard, Oakland, California

Sample ID	Analyte	MRL (µg/L)	February/March 1994	February 1995	May 1995	August 1995	May 1996	August 1996	December 1996	February 1997
SW-1[a]	TPH-G	50	50	NS	ND	NS	ND	ND	ND	ND
	TPH-D/K	50	ND	NS	ND	NS	ND	ND	ND	ND
	BTEX	0.5	ND	NS	ND	NS	ND	ND	ND	ND
SW-2[b]	TPH-G	50	130/80	NS	ND	ND	ND	200	ND	ND
	TPH-D/K	50	ND/ND	NS	ND	ND	ND	ND	ND	ND
	BTEX	0.5	9.5/4.6	NS	ND	ND	ND	12.9	ND	ND
SW-3	TPH-G	50	NS	NS	ND	ND	ND	69	ND	ND
	TPH-D/K	50	NS	NS	ND	ND	74	ND	ND	ND
	BTEX	0.5	NS	NS	ND	ND	ND	ND	ND	ND

Notes:

[a] Sample ID is CW-2 for February 1994 sampling event.
[b] Sample ID is CW-1 for February 1994 and CW-3 for March 1994 sampling event.

TPH-G = Total petroleum hydrocarbons, gasoline range (California Department of Toxic Substances Control [DTSC] Leaking Underground Fuel Tank [LUFT] Field Manual Method).
TPH-D/K = Total petroleum hydrocarbons, diesel and kerosene range (California Department of Toxic Substances Control [DTSC] Leaking Underground Fuel Tank [LUFT] Field Manual Method).
BTEX = Benzene, toluene, ethylbenzene and total xylenes (EPA Method 8020).
ND = Not detected above MRL.
NS = Not sampled
MRL = Method reporting limit.
All concentrations are µg/L (equivalent to parts per billion).

SECTION 5

REGULATORY CONSIDERATIONS

The ACHCSA is the designated lead agency for oversight of environmental investigations at the project site, and is therefore the principal contact regarding interpretation of applicable regulations. The California Regional Water Quality Control Board - San Francisco Bay Region (RWQCB) provides oversight of ACHCSA decisions.

5.1 RELEVANT CRITERIA FOR GROUNDWATER AND SURFACE WATER CONTAMINATION

5.1.1 Drinking Water Standards

Measured electrical conductivity values of groundwater at the site range from approximately 200 to 500 µmhos/cm (Appendix D) and rarely exceed the maximum value of 5,000 µmhos/cm (equivalent to µS/cm) established by WRCB for potential public water supplies. Additionally, sustained yield of site wells is likely to be greater than the 200 gallons per day [gpd] criterion for potentially suitable drinking water (WRCB 1988). Based on these data, groundwater at the site may be considered as a potential drinking water source, and therefore drinking water standards (i.e. Maximum Contaminant Levels [MCLs]) may be applicable to contaminated groundwater at the site.

Numerical drinking water quality standards are published for several contaminants detected in groundwater at the site. Relevant standards include:

Benzene	1 µg/L	(California Primary MCL)
Toluene	1,000 µg/L	(Proposed Federal Primary MCL)
	40 µg/L	(Proposed Federal Secondary MCL)
Xylenes	1,750 µg/L	(California Primary MCL)
	20 µg/L	(Proposed Federal Secondary MCL)
Ethylbenzene	680 µg/L	(California Primary MCL)
	30 µg/L	(Proposed Federal Secondary MCL)

However, it should be noted that specific MCLs for drinking water are not published for total petroleum hydrocarbons in groundwater. This contaminant would therefore be regulated under the RWQCB general "nondegradation of beneficial use" policy (RWQCB 1992).

5.1.2 Beneficial Uses and Water Quality Objectives

Beneficial uses of surface water quality in California are used to establish water quality standards and discharge prohibitions (RWQCB 1992). There are no listed beneficial uses for Redwood Creek. However, there are listed beneficial uses for Upper San Leandro Reservoir (located approximately 4,000 feet south [downstream] of the project site), into which Redwood Creek flows. Existing beneficial uses for Upper San Leandro Reservoir include: water contact recreation; municipal and domestic supply; warm and cold fresh water habitats; wildlife habitat; and fish spawning. Potential beneficial uses include non-contact water recreation.

Groundwater seepage occurs along the eastern boundary of Redwood Creek approximately 130 feet west (downgradient) of the UFST source area. Surface water originating at the seeps flows into Upper San Leandro Reservoir approximately 4,000 feet south (downstream).

The only contaminant detected in surface or groundwater at the site in excess of a published water quality objective (WQO) is benzene (0.34 µg/L in inland surface waters that are existing or potential sources of drinking water) and 21 µg/L for "other waters") (WRCB 1991). These WQOs are based on 30-day average concentrations, however the available site analytical results do not represent an average concentration over a 30-day period.

5.2 GROUNDWATER AND SURFACE WATER CONTAMINATION REGULATORY EVALUATION

Maximum contaminant concentrations detected in site groundwater samples during the previous year of groundwater monitoring (all in well MW-4) in excess of published regulatory agency ARARs include:

- Benzene (150 µg/L; exceeds the 1 µg/l California Primary MCL and the 0.34 µg/L and 21 µg/L WQOs for inland surface waters)
- Ethylbenzene (200 µg/L; exceeds the proposed Federal Secondary MCL)
- Total xylenes (144 µg/L; exceeds the proposed Federal Secondary MCL)

The only contaminant historically detected in the creek surface water samples in excess of published regulatory agency ARARs is benzene at 1.8 µg/L (exceeds the 0.34 µg/L WQO for inland surface waters that are potential drinking water sources), however, this concentration is not an average concentration over a 30-day period, upon which the WQO is based.

Benzene has never been detected at downstream sampling location SW-3; hence, it is very unlikely that any site-sourced benzene would be present above the WQO at the point of discharge into Upper San Leandro Reservoir.

SECTION 6

RECOMMENDATIONS

RECOMMENDATIONS

Parsons Engineering Science recommends a continuation of the current program of groundwater and surface water monitoring. This recommendation is predicated on the assumption that present hydrochemical trends will continue. However, all analytical data collected during ensuing monitoring events will be reviewed to determine whether changes in hydrochemical trends warrant additional characterization and/or remediation measures.

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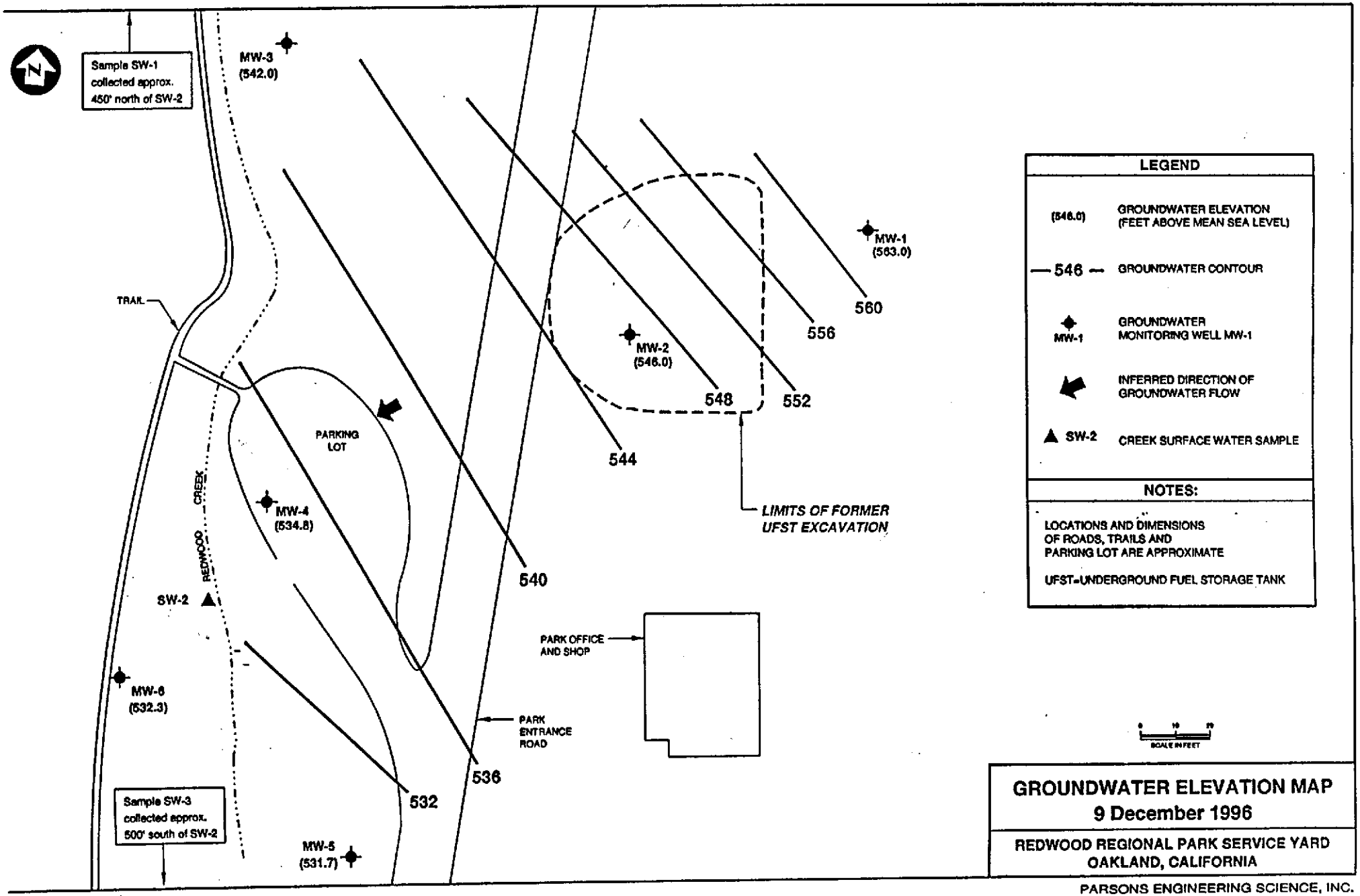
APPENDIX A

HISTORICAL GROUNDWATER ELEVATION MAPS

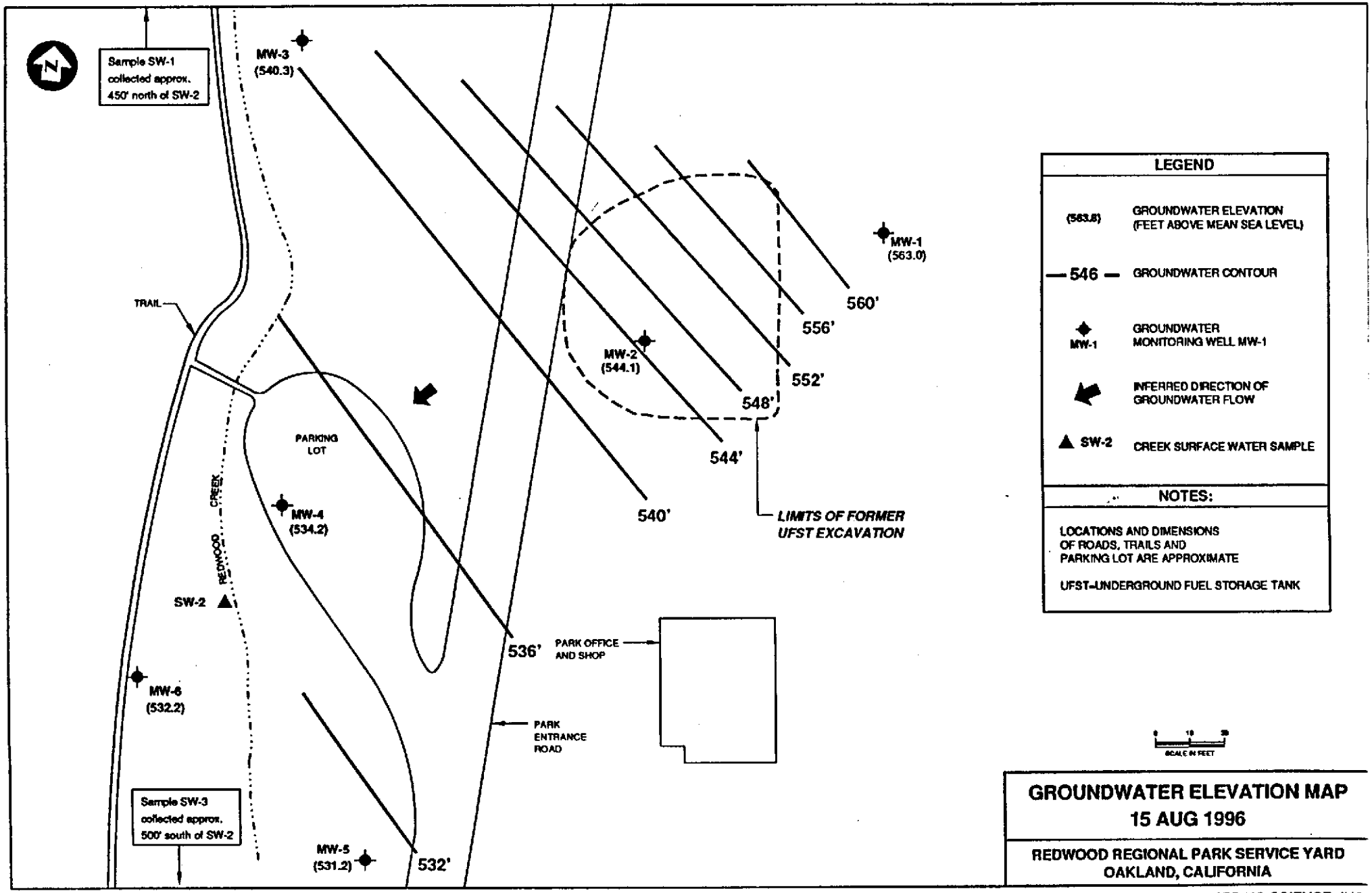


GROUNDWATER ELEVATION MAP
9 December 1996

REDWOOD REGIONAL PARK SERVICE YARD
OAKLAND, CALIFORNIA

PARSONS ENGINEERING SCIENCE, INC.

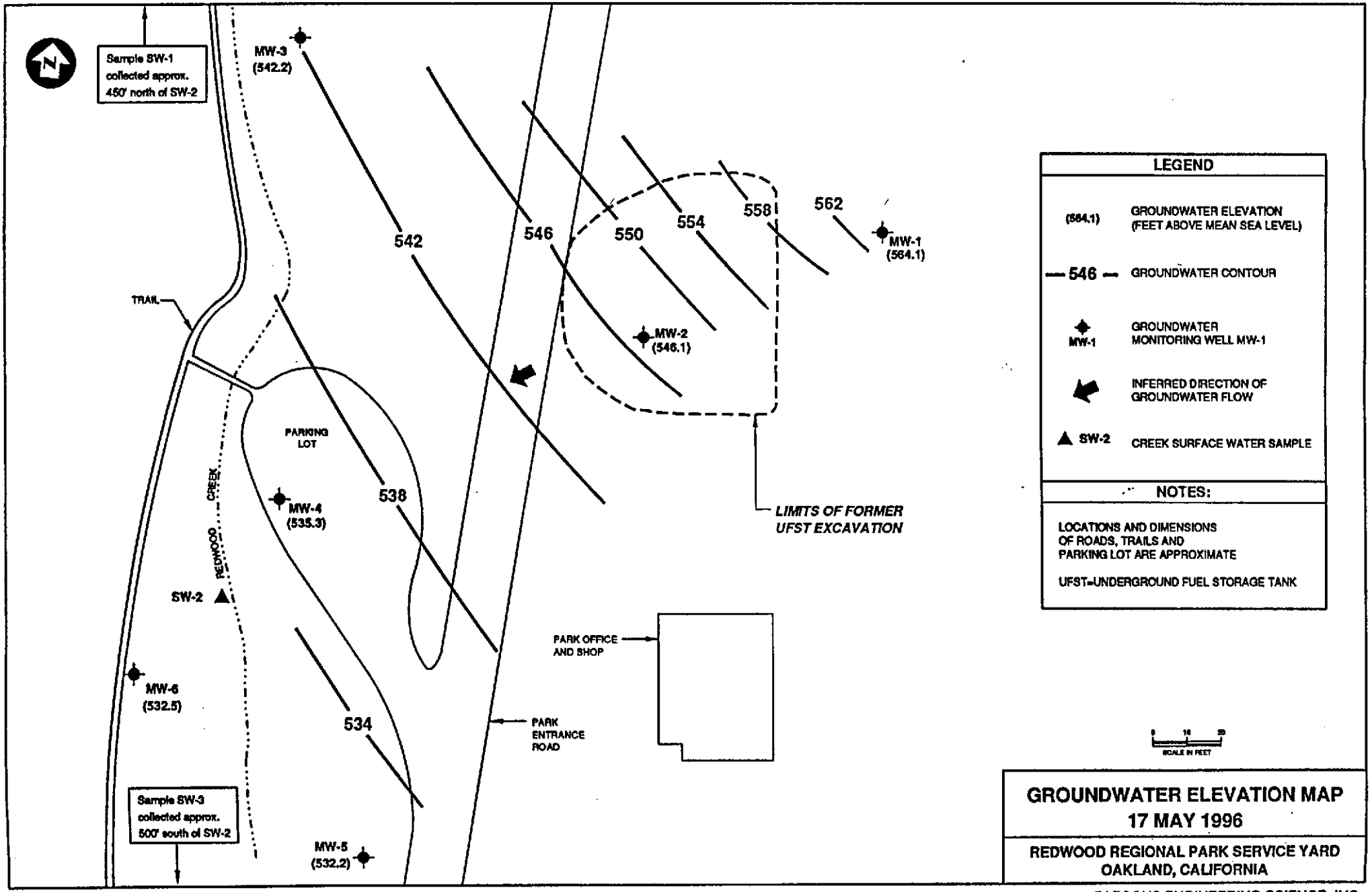
REV. 3 R400-04.DWG 09/21/96



GROUNDWATER ELEVATION MAP
15 AUG 1996

REDWOOD REGIONAL PARK SERVICE YARD
OAKLAND, CALIFORNIA

PARSONS ENGINEERING SCIENCE, INC.

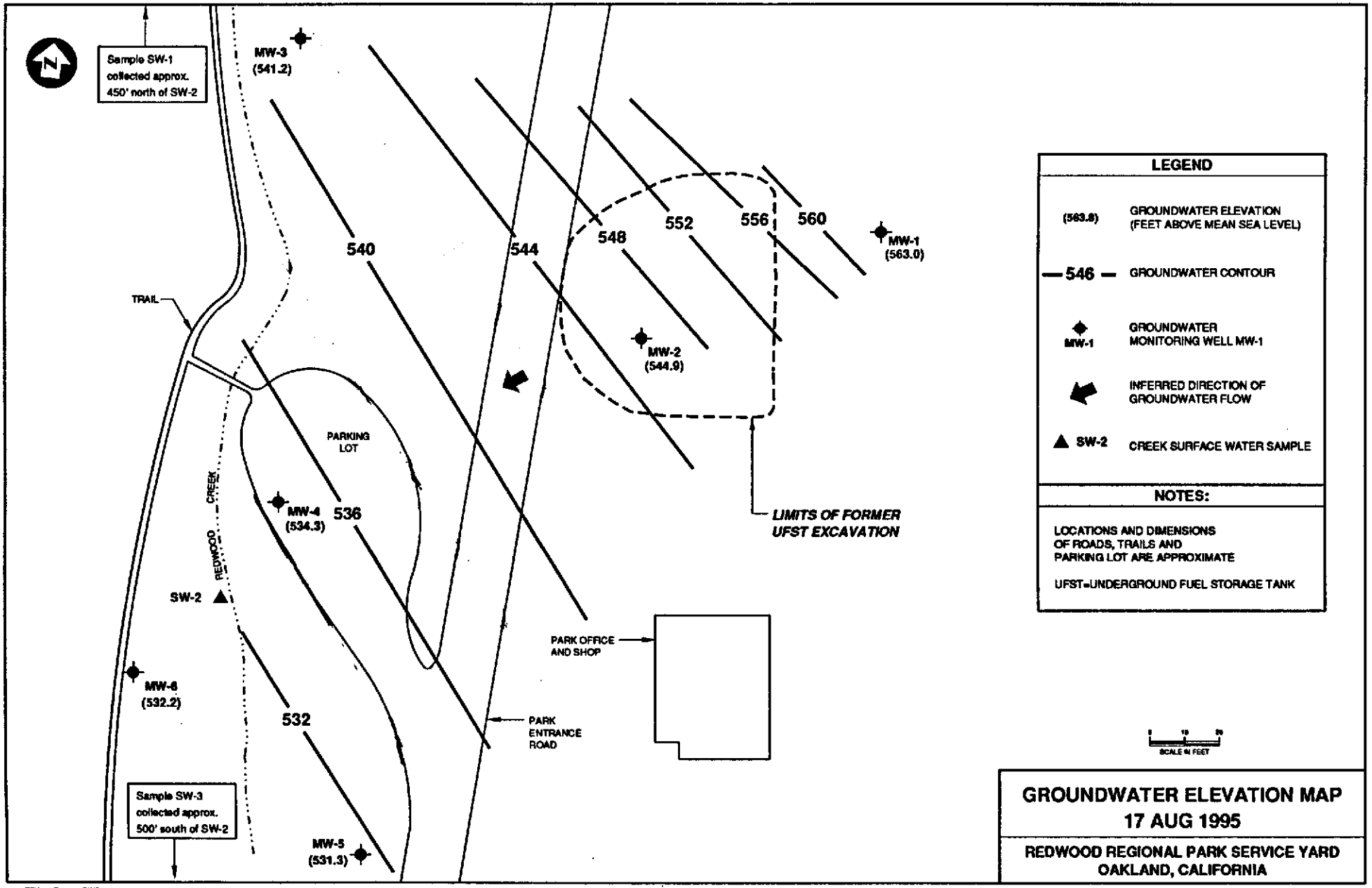


GROUNDWATER ELEVATION MAP
17 MAY 1996

REDWOOD REGIONAL PARK SERVICE YARD
OAKLAND, CALIFORNIA

PARSONS ENGINEERING SCIENCE, INC.

FIGURE

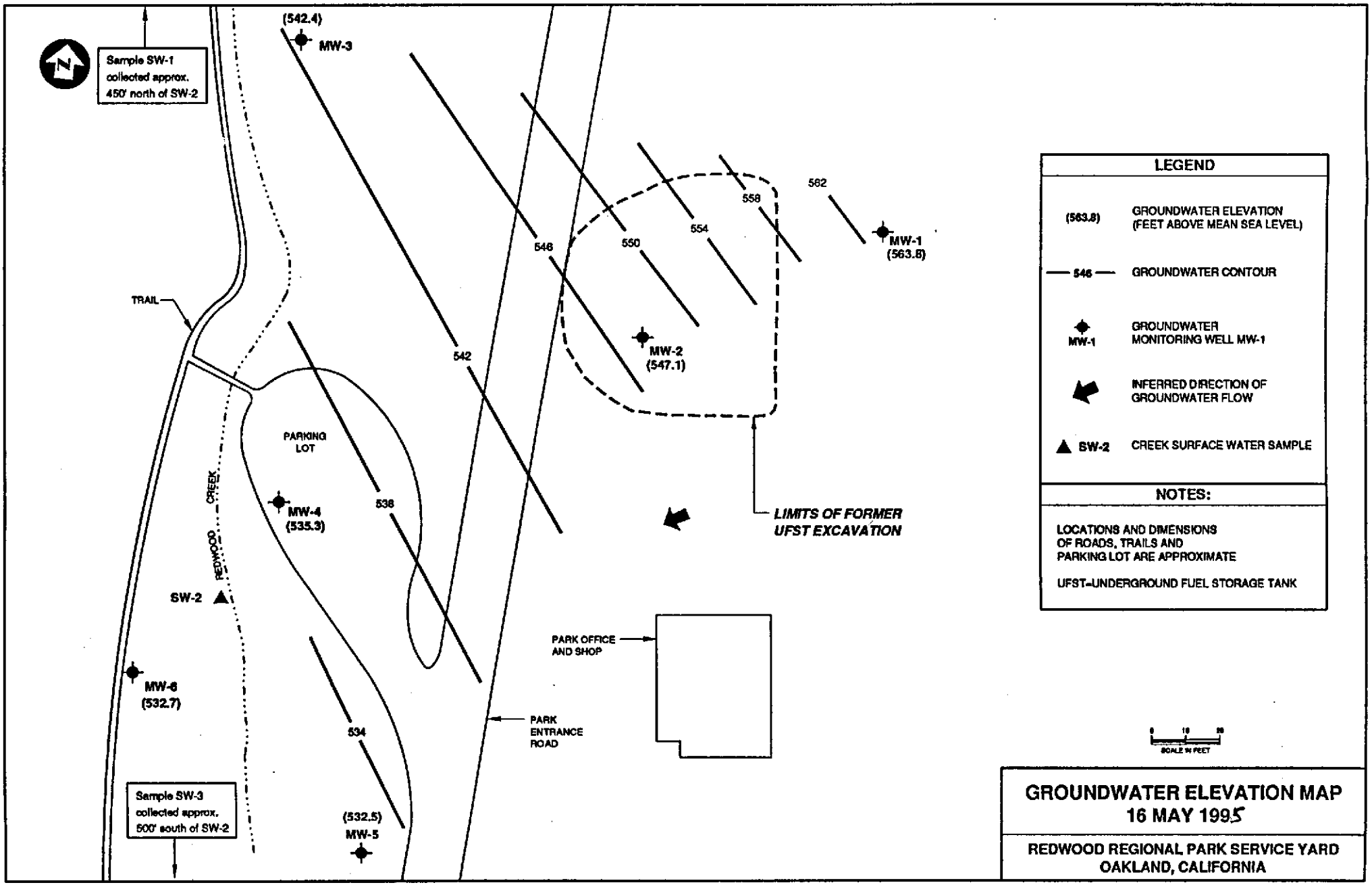


GROUNDWATER ELEVATION MAP
17 AUG 1995

REDWOOD REGIONAL PARK SERVICE YARD
OAKLAND, CALIFORNIA

REV. 1 R468-94.DWG 8/31/95

PARSONS ENGINEERING SCIENCE, INC.

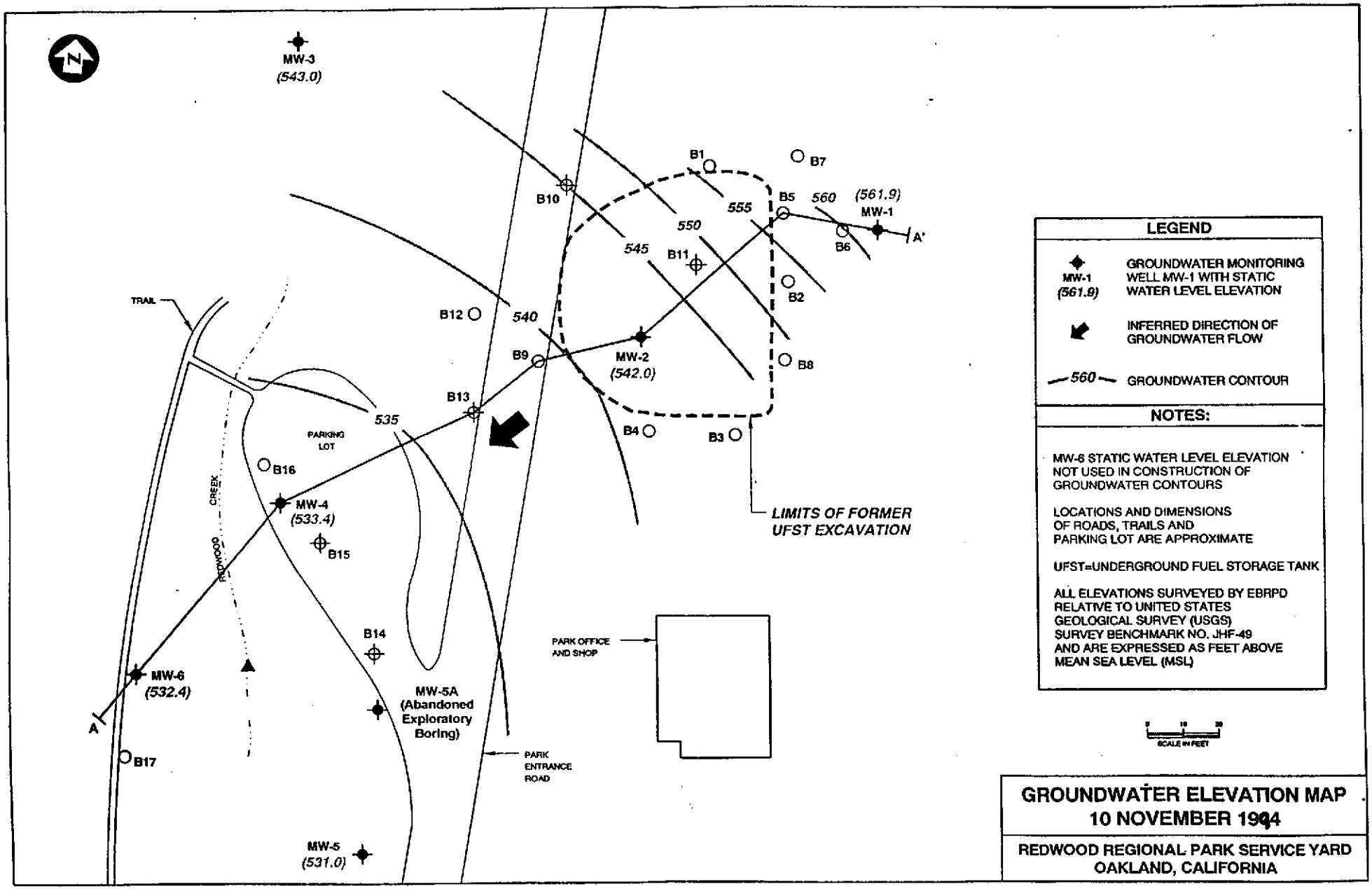


GROUNDWATER ELEVATION MAP
16 MAY 1995

REDWOOD REGIONAL PARK SERVICE YARD
OAKLAND, CALIFORNIA

REV. 2 R400-04.DWG 06/02/95

PARSONS ENGINEERING SCIENCE, INC.

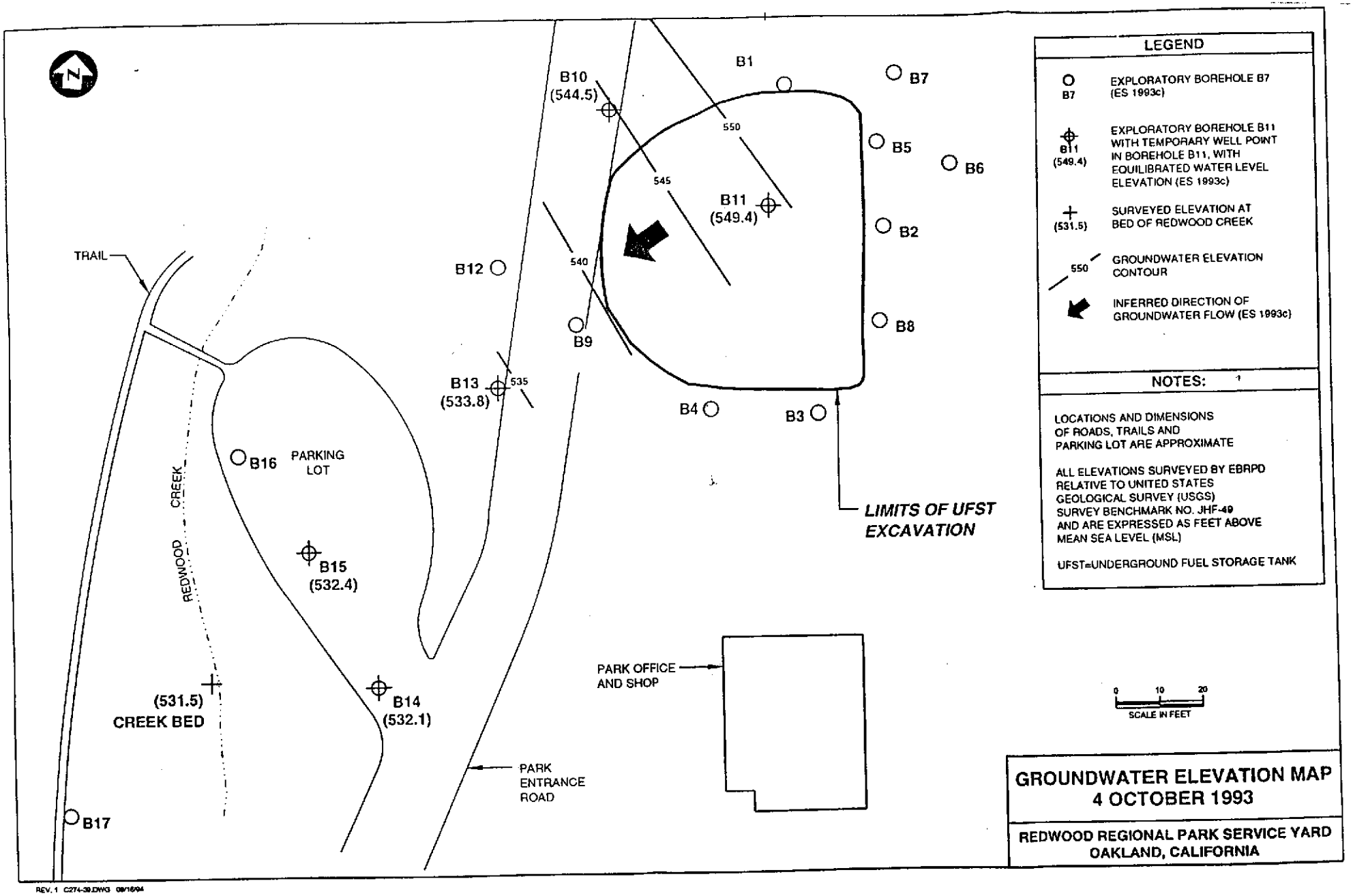


GROUNDWATER ELEVATION MAP
10 NOVEMBER 1994

REDWOOD REGIONAL PARK SERVICE YARD
OAKLAND, CALIFORNIA

REV. 1 C274-41.DWG 12/19/94

PARSONS ENGINEERING SCIENCE, INC.


B1
B7
B10
(544.5)
550
B5
B6
545
B11
(549.4)
B2
B12
540
B9
B8
B13
(533.8)
535
B4
B3
TRAIL
B16
PARKING
LOT
CREEK
REDWOOD
B15
(532.4)
LIMITS OF UFST
EXCAVATION
PARK OFFICE
AND SHOP
(531.5)
CREEK BED
B14
(532.1)
PARK
ENTRANCE
ROAD
B17
LEGEND
B7
EXPLORATORY BOREHOLE B7
(ES 1993c)
B11
(549.4)
EXPLORATORY BOREHOLE B11
WITH TEMPORARY WELL POINT
IN BOREHOLE B11, WITH
EQUILIBRATED WATER LEVEL
ELEVATION (ES 1993c)
(531.5)
SURVEYED ELEVATION AT
BED OF REDWOOD CREEK
550
GROUNDWATER ELEVATION
CONTOUR
INFERRED DIRECTION OF
GROUNDWATER FLOW (ES 1993c)
NOTES:
LOCATIONS AND DIMENSIONS
OF ROADS, TRAILS AND
PARKING LOT ARE APPROXIMATE
ALL ELEVATIONS SURVEYED BY EBRPD
RELATIVE TO UNITED STATES
GEOLOGICAL SURVEY (USGS)
SURVEY BENCHMARK NO. JHF-49
AND ARE EXPRESSED AS FEET ABOVE
MEAN SEA LEVEL (MSL)
UFST=UNDERGROUND FUEL STORAGE TANK
0
10
20
SCALE IN FEET
GROUNDWATER ELEVATION MAP
4 OCTOBER 1993
REDWOOD REGIONAL PARK SERVICE YARD
OAKLAND, CALIFORNIA
REV. 1 C274-39.DWG 08/16/94

APPENDIX B

FEBRUARY 1997 WATER LEVEL DATA AND GROUNDWATER MONITORING NOTES

WATER LEVEL DATA

PARSONS ENGINEERING SCIENCE

DATE: 19 February 1997

PROJECT/LOCATION: Redwood Regional Park Service Yard, Oakland, California

PROJECT No.: 729457

PERSONNEL: Bruce Rucker

Well No	Water Level from T.O.C.	Well Depth From T.O.C	Depth to T.O.C	Water Level from G.S.	Well Casing Dia.	Gallons/ Casing Vol.	T.O.C. Elev. USGS	Water Level USGS
MW-1	0.97	18.0	-2.3	-1.3	4	NS	565.9	564.93
MW-2	19.45	36.5	-2.4	17.1	4	11.1	566.5	547.05
MW-3	18.67	45.0	-2.8	15.9	4	NS	560.9	542.23
MW-4	12.58	26.0	-2.1	10.5	4	8.7	548.1	535.52
MW-5	15.28	26.0	-2.3	13.0	4	7.0	547.5	532.22
MW-6	13.80	27.0	-2.3	11.5	4	NS	545.6	531.80

NOTES:

T.O.C.: Top of Casing

Gallons/casing volume for 4" inner diameter casing = 0.65 gallons per linear foot

Negative value for "Depth to T.O.C." indicates that T.O.C. is above ground surface

G.S.: Ground Surface

USGS: U.S. Geological Survey mean sea level (MSL)

NS: Not Sampled

All elevations surveyed by East Bay Regional Parks District relative to USGS Survey Benchmark No. JHF-49

GROUNDWATER SAMPLING FIELD NOTES

PARSONS ENGINEERING SCIENCE

PROJECT/LOCATION REDWOOD REGIONAL PARK SERVICE YARD, OAKLAND, CA **PERSONNEL:** Bruce Rucker

PROJECT NUMBER: 729457 **DATE:** 19 February 1997

Well ID	*Sampler Date Time*	*Water Level Before, Well Diameter and Depth**	*Water Level After**	*Gallons per Casing Volume*	*Well Purging Method **	*Pump On*	*Pump Off*	*Temp. (o C)*	*Specific Cond (umhos/cm)*	*pH*	*Total Water Purged (gals)*	*Sample Coll. Method*	*Analysis & Number/type of Containers*	*Comments*
MW-1	NS	0.97 4" 18.0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NS	NS	
MW-2	BMR 2/19/97 1310	19.45 4" 36.5	20.80	11.1	B	NA	NA	13.0 13.3 13.1 13.1	600 600 600 600	7.68 7.34 7.22 7.21	1 11 22 33	B	(a) (b) & (c)	Sample semi-turbid; no sheen
MW-3	NS	18.67 4" 45.0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NS	NS	
MW-4	BMR 2/19/97 1355	12.58 4" 26.0	14.20	8.7	B	NA	NA	12.4 12.6 12.6 12.9	450 460 460 450	6.98 6.88 6.81 6.83	1 9 18 27	B	(a) (b) & (c)	Sample slightly turbid; petroleum odor and sheen

NOTES

* Measured from top of casing in feet

** WW -- Well Wizard; G – Grundfos Pump; B - Bailer

NA Not Applicable

NR Not Recorded

(a) Total Petroleum Hydrocarbons as diesel (TPH-D), unpreserved {1: 1L amber bottles}.

(b) BTEX, EPA Method 8020, HCl preserved {2: 40ml VOAs}.

(c) Total Petroleum Hydrocarbons as gasoline (TPH-G), HCl preserved {2: 40ml VOAs}.

GROUNDWATER SAMPLING FIELD NOTES

PARSONS ENGINEERING SCIENCE

PROJECT/LOCATION REDWOOD REGIONAL PARK SERVICE YARD, OAKLAND, CA

PERSONNEL: Bruce Rucker

PROJECT NUMBER: 729457

DATE: 19 February 1997

Well ID	*Sampler Date Time*	*Water Level Before, Well Diameter and Depth**	*Water Level After**	*Gallons per Casing Volume*	*Well Purging Method* **	*Pump On*	*Pump Off*	*Temp. (o C)*	*Specific Cond (umhos/ cm)*	*pH*	*Total Water Purged (gals)*	*Sample Coll. Method*	*Analysis & Number/type of Containers*	*Comments*
MW-5	BMR 2/19/97 1055	15.28 4" 26.0	16.9	7.0	B	—	—	12.4 12.8 12.7 12.6	390 390 400 410	8.33 7.36 7.26 7.18	1 7 14 21	B	(a) (b) & (c)	Sample slightly turbid, no petroleum sheen
MW-6	NS	13.8 4" 27.0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NS	NS	
MW-0A	BMR 2/19/97 1405	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		(b) & (c)	Field duplicate collected at well MW-4
MW-0B	BMR 2/19/97 1410	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	(b) & (c)	Equipment rinsate blank, collected after decon. at well MW-4

NOTES

* Measured from top of casing in feet

** WW -- Well Wizard; G -- Grundfos Pump; B - Bailer

NA Not Applicable

NR Not Recorded

(a) Total Petroleum Hydrocarbons as diesel (TPH-D), unpreserved {1: 1L amber bottles}.

(b) BTEX, EPA Method 8020, HCl preserved {2: 40ml VOAs}.

(c) Total Petroleum Hydrocarbons as gasoline (TPH-G), HCl preserved {2: 40ml VOAs}.

NS Not sampled

APPENDIX C

FEBRUARY 1997 CHAIN-OF-CUSTODY RECORD AND ANALYTICAL LABORATORY REPORT

Curtis & Tompkins, Ltd., Analytical Laboratories, Since 1878
2323 Fifth Street, Berkeley, CA 94710, Phone (510) 486-0900

A N A L Y T I C A L R E P O R T

Prepared for:

Parsons Engineering Science, Inc.
2101 Webster Street
Suite 700
Oakland, CA 94612

Date: 03-MAR-97
Lab Job Number: 128393
Project ID: 729457
Location: Redwood G.Water & Surface

Reviewed by: _____

Reviewed by: _____

Curtis & Tompkins, Ltd.

LABORATORY NUMBER: 128393
CLIENT: ENGINEERING SCIENCE
PROJECT ID: 729457
LOCATION: REDWOOD G. WATER & SURFACE

DATE SAMPLED: 02/19/97
DATE RECEIVED: 02/19/97
DATE EXTRACTED: 02/25/97
DATE ANALYZED: 03/06/97
DATE REPORTED: 03/06/97
DATE REVISED: 03/21/97
BATCH NO:15176

Extractable Petroleum Hydrocarbons in Aqueous Solutions
California DOHS Method
LUFT Manual October 1989

LAB ID	CLIENT ID	DIESEL RANGE (ug/L)	REPORTING LIMIT (ug/L)
128393-001	MW-5	ND	50
128393-002	SW-3	ND	50
128393-003	SW-2	ND	50
128393-004	SW-1	ND	50
128393-005	MW-2	ND	50
128393-006	MW-4	ND	50
METHOD BLANK	N/A	ND	50

ND = Not detected at or above reporting limit. Reporting limit applies to all analytes.

QA/QC SUMMARY: BS/BSD

RPD, %	4
RECOVERY, %	90

TVH-Total Volatile Hydrocarbons

Client: Parsons Engineering Science, Inc.
Project#: 729457
Location: Redwood G.Water & Surface

Analysis Method: CA LUFT (EPA 8015M)
Prep Method: EPA 5030

Sample #	Client ID	Batch #	Sampled	Extracted	Analyzed	Moisture
128393-001	MW-5	32614	02/19/97	02/27/97	02/27/97	
128393-002	SW-3	32614	02/19/97	02/27/97	02/27/97	
128393-003	SW-2	32614	02/19/97	02/27/97	02/27/97	
128393-004	SW-1	32614	02/19/97	02/27/97	02/27/97	

Matrix: Water

Analyte Diln Fac:	Units	128393-001 1	128393-002 1	128393-003 1	128393-004 1
Gasoline	ug/L	<50	<50	<50	<50
Surrogate					
Trifluorotoluene	%REC	95	96	91	94
Bromobenzene	%REC	111	116	109	112

BTXE

Client: Parsons Engineering Science, Inc.
Project#: 729457
Location: Redwood G.Water & Surface

Analysis Method: EPA 8020
Prep Method: EPA 5030

Sample #	Client ID	Batch #	Sampled	Extracted	Analyzed	Moisture
128393-001	MW-5	32614	02/19/97	02/27/97	02/27/97	
128393-002	SW-3	32614	02/19/97	02/27/97	02/27/97	
128393-003	SW-2	32614	02/19/97	02/27/97	02/27/97	
128393-004	SW-1	32614	02/19/97	02/27/97	02/27/97	

Matrix: Water

Analyte Diln Fac:	Units	128393-001 1	128393-002 1	128393-003 1	128393-004 1
Benzene	ug/L	<0.5	<0.5	<0.5	<0.5
Toluene	ug/L	<0.5	<0.5	<0.5	<0.5
Ethylbenzene	ug/L	<0.5	<0.5	<0.5	<0.5
m,p-Xylenes	ug/L	<0.5	<0.5	<0.5	<0.5
o-Xylene	ug/L	<0.5	<0.5	<0.5	<0.5
Surrogate					
Trifluorotoluene	%REC	90	97	89	91
Bromobenzene	%REC	83	103	83	87

TVH-Total Volatile Hydrocarbons

Client: Parsons Engineering Science, Inc.
Project#: 729457
Location: Redwood G.Water & Surface

Analysis Method: CA LUFT (EPA 8015M)
Prep Method: EPA 5030

Sample #	Client ID	Batch #	Sampled	Extracted	Analyzed	Moisture
128393-005	MW-2	32614	02/19/97	02/27/97	02/27/97	
128393-006	MW-4	32614	02/19/97	02/28/97	02/28/97	
128393-007	MW-0A	32614	02/19/97	02/28/97	02/28/97	
128393-008	MW-0B	32614	02/19/97	02/27/97	02/27/97	

Matrix: Water

Analyte Diln Fac:	Units	128393-005 1	128393-006 2	128393-007 2	128393-008 1
Gasoline	ug/L	<50	3300	4100	<50
Surrogate					
Trifluorotoluene	%REC	91	104	105	93
Bromobenzene	%REC	107	137 *	140 *	112

* Values outside of QC limits

BTXE

Client: Parsons Engineering Science, Inc.
Project#: 729457
Location: Redwood G.Water & Surface

Analysis Method: EPA 8020
Prep Method: EPA 5030

Sample #	Client ID	Batch #	Sampled	Extracted	Analyzed	Moisture
128393-005	MW-2	32614	02/19/97	02/27/97	02/27/97	
128393-006	MW-4	32614	02/19/97	02/28/97	02/28/97	
128393-007	MW-0A	32614	02/19/97	02/28/97	02/28/97	
128393-008	MW-0B	32614	02/19/97	02/27/97	02/27/97	

Matrix: Water

Analyte Diln Fac:	Units	128393-005 1	128393-006 2	128393-007 2	128393-008 1
Benzene	ug/L	0.69	120	150	<0.5
Toluene	ug/L	<0.5	<1	<1	<0.5
Ethylbenzene	ug/L	0.55	150	190	<0.5
m,p-Xylenes	ug/L	<0.5	97	120	<0.5
o-Xylene	ug/L	<0.5	5.5	5.8	<0.5
Surrogate					
Trifluorotoluene	%REC	91	103	105	90
Bromobenzene	%REC	95	109	111	84

Curtis & Tompkins, Ltd.

TVH-Total Volatile Hydrocarbons

Client: Parsons Engineering Science, Inc.
Project#: 729457
Location: Redwood G.Water & Surface

Analysis Method: CA LUFT (EPA 8015M)
Prep Method: EPA 5030

METHOD BLANK

Matrix: Water
Batch#: 32614
Units: ug/L
Diln Fac: 1

Prep Date: 02/27/97
Analysis Date: 02/27/97

MB Lab ID: QC40930

Analyte	Result	
Gasoline	<50	
Surrogate	**%Rec**	**Recovery Limits**
Trifluorotoluene	97	69-120
Bromobenzene	109	70-122

Lab #: 128393

BATCH QC REPORT

BTXE

Client: Parsons Engineering Science, Inc.
Project#: 729457
Location: Redwood G.Water & Surface

Analysis Method: EPA 8020
Prep Method: EPA 5030

METHOD BLANK

Matrix: Water
Batch#: 32614
Units: ug/L
Diln Fac: 1

Prep Date: 02/27/97
Analysis Date: 02/27/97

MB Lab ID: QC40930

Analyte	Result
Benzene	<0.5
Toluene	<0.5
Ethylbenzene	<0.5
m,p-Xylenes	<0.5
o-Xylene	<0.5

Surrogate	%Rec	Recovery Limits
Trifluorotoluene	95	58-130
Bromobenzene	98	62-131

TVH-Total Volatile Hydrocarbons

Client: Parsons Engineering Science, Inc.
Project#: 729457
Location: Redwood G.Water & Surface

Analysis Method: CA LUFT (EPA 8015M)
Prep Method: EPA 5030

LABORATORY CONTROL SAMPLE

Matrix: Water
Batch#: 32614
Units: ug/L
Diln Fac: 1

Prep Date: 02/27/97
Analysis Date: 02/27/97

LCS Lab ID: QC40928

Analyte	Result	Spike Added	%Rec #	Limits
Gasoline	2132	2000	107	80-120

Surrogate	%Rec	Limits
Trifluorotoluene	110	69-120
Bromobenzene	96	70-122

Column to be used to flag recovery and RPD values with an asterisk
* Values outside of QC limits
Spike Recovery: 0 out of 1 outside limits

Curtis & Tompkins, Ltd.

Lab #: 128393 BATCH QC REPORT

BTXE

Client: Parsons Engineering Science, Inc.
Project#: 729457
Location: Redwood G.Water & Surface

Analysis Method: EPA 8020
Prep Method: EPA 5030

LABORATORY CONTROL SAMPLE

Matrix: Water
Batch#: 32614
Units: ug/L
Diln Fac: 1

Prep Date: 02/27/97
Analysis Date: 02/27/97

LCS Lab ID: QC40929

Analyte	Result	Spike Added	%Rec #	Limits
Benzene	21.37	20	107	80-120
Toluene	23.19	20	116	80-120
Ethylbenzene	22.23	20	111	80-120
m,p-Xylenes	43.95	40	110	80-120
o-Xylene	22.23	20	111	80-120

Surrogate	%Rec	Limits
Trifluorotoluene	100	58-130
Bromobenzene	104	62-131

Column to be used to flag recovery and RPD values with an asterisk
* Values outside of QC limits
Spike Recovery: 0 out of 5 outside limits

Curtis & Tompkins, Ltd.

Lab #: 128393 BATCH QC REPORT

BTXE

Client: Parsons Engineering Science, Inc.
Project#: 729457
Location: Redwood G.Water & Surface

Analysis Method: EPA 8020
Prep Method: EPA 5030

MATRIX SPIKE/MATRIX SPIKE DUPLICATE

Field ID: SW-3
Lab ID: 128393-002
Matrix: Water
Batch#: 32614
Units: ug/L
Diln Fac: 1

Sample Date: 02/19/97
Received Date: 02/19/97
Prep Date: 02/27/97
Analysis Date: 02/27/97

MS Lab ID: QC40931

Analyte	Spike Added	Sample	MS	%Rec #	Limits
Benzene	20	<0.5	18.07	90	75-125
Toluene	20	<0.5	19.65	98	75-125
Ethylbenzene	20	<0.5	19.18	96	75-125
m,p-Xylenes	40	<0.5	37.75	94	75-125
o-Xylene	20	<0.5	19.65	98	75-125

Surrogate	%Rec	Limits
Trifluorotoluene	98	58-130
Bromobenzene	107	62-131

MSD Lab ID: QC40932

Analyte	Spike Added	MSD	%Rec #	Limits	RPD #	Limit
Benzene	20	20.64	103	75-125	13	20
Toluene	20	22.18	111	75-125	12	20
Ethylbenzene	20	21.62	108	75-125	12	20
m,p-Xylenes	40	42.37	106	75-125	12	20
o-Xylene	20	22.08	110	75-125	12	20

Surrogate	%Rec	Limits
Trifluorotoluene	99	58-130
Bromobenzene	107	62-131

Column to be used to flag recovery and RPD values with an asterisk
* Values outside of QC limits
RPD: 0 out of 5 outside limits
Spike Recovery: 0 out of 10 outside limits

ES Engineering-Science, Inc.
1301 Marina Village Parkway, Suite 200
Alameda, California 94501
Phone: (510) 769-0100 Fax: (510) 769-9244

12-913

CHAIN OF CUSTODY RECORD

LABORATORY:	PROJECT MANAGER:	PROJ. #:
Curtis & Tompkins	Rucker, Bruce	729457

PROJECT NAME/LOCATION: Redwood Regional Park / Oakland, CA

SAMPLER(S): (SIGNATURE) Bruce M. Rucker / Bruce M. Rucker

	SAMPLE ID	DATE	TIME	MATRIX	SAMPLE LOCATION	NO. OF CONTAINERS	METHOD PRESERVED: TPH-Gasoline DTSC LUFT	TPH-Diesel DTSC LUFT	BTEX EPA Method 8020						TO BE COMPOSITED BY LAB	TURN AROUND TIME	REMARKS
1	MW-5	2/19/97	1055	water	well MW-5	3	X	X	X							5-day	
2	SW-3		1110		Surface water location 3	3	X	X	X								
3	SW-2		1115		" " " 2	3	X	X	X								
4	SW-1		1120		" " " 1	3	X	X	X								
5	MW-2		1310		well MW-2	3	X	X	X								
6	MW-4		1355		well MW-4	3	X	X	X								
7	MW-0A		1405		well MW-0A	2	X		X								
8	MW-0B		1410		well MW-0B	2	X		X								
9	MW-0C		—		Trip Blank	1	Do	not	analyze								

RELINQUISHED BY: (SIGNATURE)	DATE	TIME	RECEIVED BY: (SIGNATURE)	RELINQUISHED BY(SIGNATURE)	DATE	TIME	RECEIVED BY: (SIGNATURE)
Bruce M. Rucker	2/19/97	1615					

RELINQUISHED BY: (SIGNATURE)	DATE	TIME	RECEIVED FOR LABORATORY BY: (SIGNATURE)	DATE	TIME	REMARKS:
				2/19/97	16:20	

DISTRIBUTION: WHITE: ACCOMPANIES SHIPMENT & RET'N WITH LAB REPORT, CANARY: LAB COPY, PINK: FIELD COPY

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