Applied GeoSystems, Inc.
A RESNA Company

RESNA
Working To Restore Nature

3315 Almaden Expressway, Suite 34
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Phone: (408) 264-7723
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WORK PLAN
for
ADDITIONAL SUBSURFACE INVESTIGATION
at
ARCO Station 6148
5131 Shattuck Avenue
Oakland, California
09/29/92
61035.04

Prepared for
ARCO Products Company
P.O. Box 5811
San Mateo, California 94402
by
RESNA Industries Inc.

Joel Coffman
Project Geologist

Lou Leet
Environmental Scientist

REGISTERED GEOLOGIST
JAMES LEWIS NELSON
No. 1463
CERTIFIED ENGINEERING GEOLOGIST
STATE OF CALIFORNIA

James L. Nelson
Certified Engineering Geologist 1463

September 29, 1992

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TRANSMITTAL

TO: Ms. Susan Hugo
ACHCSA
Department of Environmental Health
80 Swan Way, Room 200
Oakland, California 94621

DATE: September 29, 1992
PROJECT NUMBER: 61035.04
SUBJECT: ARCO Station 6148 at
5131 Shattuck Avenue, Oakland, CA

FROM: Joel Coffman
TITLE: Project Geologist

WE ARE SENDING YOU:

COPIES	DATED	NO.	DESCRIPTION
1	09/25/92		FINAL-Work Plan for Additional Subsurface Investigation at the above subject site.

THESE ARE TRANSMITTED as checked below:

[ ] For review and comment [ ] Approved as submitted [ ] Resubmit ___ copies for approval

[ ] As requested [ ] Approved as noted [ ] Submit___ copies for distribution

[ ] For approval [ ] Return for corrections [ ] Return ___ corrected prints

[X] For your files

REMARKS: This Work Plan has been forwarded to you at the request of Mr. Mike Whelan at ARCO Products Company.

Copies: 1 to RESNA project file no. 61035.04

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September 29, 1992
0805MWHE
61035.04

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

Subject: Transmittal of Work Plan for Additional Subsurface Investigation at ARCO Station 6148, 5131 Shattuck Avenue, Oakland, California.

Mr. Whelan:

As requested by ARCO Products Company (ARCO), RESNA Industries Inc. (RESNA) has prepared the attached Work Plan for review and approval by ARCO, the Regional Water Quality Control Board (RWQCB), and the Alameda County Health Care Services Agency (ACHCSA). This Work Plan summarizes previous work performed at the site and RESNA's approach, field methods, and project tasks recommended to perform an additional environmental subsurface investigation at this site. The proposed work includes drilling four soil borings (B-5 through B-8), installing groundwater monitoring wells MW-4 through MW-7 in the borings, developing and sampling the monitoring wells, surveying the new wells, submitting soil and groundwater samples for laboratory analyses, performing a well search of public files to evaluate groundwater usage in the vicinity of the site, performing an environmental record search to identify potential offsite sources of hydrocarbons detected in soil and groundwater at the subject site, and preparing a report documenting our findings, interpretations, and conclusions. Recommendations will be included under separate cover as requested by ARCO.

RESNA recommends performing these project tasks to further evaluate the presence and extent of hydrocarbons in the groundwater at the site, and to further evaluate the groundwater gradient at the site. The work involved to perform the proposed project tasks is described in detail in the attached Work Plan.

We recommend that copies of this Work Plan should be sent to the following:

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

Ms. Susan Hugo
Alameda County Health Care Services Agency
Department of Environmental Health
80 Swan Way, Room 200
Oakland, California 94621

Please call us at (408) 264-7723 if you have any questions or comments regarding the contents of this Work Plan.

Sincerely,
RESNA Industries Inc.

Joel Coffman
Project Geologist

Enclosure: Work Plan

cc: Mr. Chris Winsor, ARCO Products Company

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Applied GeoSystems, Inc.
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WORK PLAN
for
ADDITIONAL SUBSURFACE INVESTIGATION
at
ARCO Station 6148
5131 Shattuck Avenue
Oakland, California

INTRODUCTION

This Work Plan summarizes previous work performed by Crosby & Overton (C&O) and RESNA Industries Inc. (RESNA), and describes the work proposed to investigate the lateral extent of hydrocarbon impacted groundwater at the ARCO Station 6148 located at 5131 Shattuck Avenue, Oakland, California. ARCO Products Company (ARCO) requested that RESNA prepare this Work Plan for submittal to the Regional Water Quality Control Board (RWQCB), and the Alameda County Health Care Services Agency (ACHCSA).

SITE DESCRIPTION AND BACKGROUND

General

The site is an operating gasoline station located on the southwestern corner of the intersection of 52nd Street and Shattuck Avenue in Oakland, California. The site location is shown on the Site Vicinity Map (Plate 1). The site is on a relatively flat lot at an elevation of approximately 110 feet above mean sea level.

Presently, according to information provided by ARCO, there are three 12,000 gallon underground gasoline storage tanks (USTs) located in the western portion of the site. The locations of the USTs and pertinent site features are shown on the Generalized Site Plan (Plate 2).

Regional and Local Hydrogeology

ARCO Station 6148 is located west of the East Bay Hills. This area lies within the Berkeley Alluvial Plain, which is a subarea of the East Bay Alluvial Plain. Soils in this area are mapped as older alluvium which consist of a heterogeneous mixture of poorly consolidated to unconsolidated clay, silt, sand, and gravel units (Helley and others, 1979). The sediments

were derived mainly from bedrock underlying the hills and represent successive coalescing alluvial fans deposited during the Pleistocene epoch.

The sediments found beneath the East Bay Alluvial Plain are believed to be about 200 feet thick in the Berkeley area and are the major groundwater source in the region. The water yields from these sediments are highly variable, with generally high yields from wells that are screened through several water-bearing sand and gravel beds. Groundwater in the East Bay Plain occurs predominantly under confined conditions and tends to flow toward the San Francisco Bay to the west and southwest (Hickenbottom and Muir, 1988).

PREVIOUS WORK

Waste-Oil Tank Removal

In June 1987 C&O and Erico Construction performed excavation and removal of a waste-oil tank located in the southwestern portion of the site. Soil excavated from the waste-oil tank pit was transported to the Class I landfill in Casmalia, California.

Initial Subsurface Investigation

RESNA performed an initial subsurface investigation related to the former waste-oil tank on December 19 and 20, 1991 (RESNA, March 20, 1992). This phase of investigation included drilling four soil borings (B-1 through B-4) and constructing three 4-inch diameter groundwater monitoring wells (MW-1 through MW-3) in borings B-1 through B-3, respectively; submitting soil samples for laboratory analyses; developing and sampling the monitoring wells; and preparing a report. Boring B-1 was drilled in the former waste-oil tank pit, borings B-2 and B-3 were drilled west and south, respectively, of the waste-oil tank pit near the borders of the property, and B-4 was drilled east of the former waste-oil tank pit. The soil boring/monitoring well locations are shown on Plate 2.

The results of this investigation indicated that the majority of hydrocarbons at concentrations greater than 100 parts per million (ppm) in the soil in the vicinity of the former waste-oil tank pit were present at depths between approximately 15 and 20 feet, within the sandy gravel and silty sand layers and directly above the local water table. Because the greatest concentrations of hydrocarbons appeared to be limited to a zone directly above the water table it was concluded that hydrocarbons migrated laterally within the capillary fringe along the top of the water table. Because diesel had not been stored at this site, and according to analytical results the diesel detected in the soil contained hydrocarbons intermediate of gasoline and diesel (between C-10 and C-12), the reported total petroleum hydrocarbons as diesel (TPHd) was concluded to be weathered gasoline. The vertical extent of petroleum hydrocarbons in the soil beneath the vicinity of the former waste-oil tank pit had been

delineated to less than about 10 ppm total petroleum hydrocarbons as gasoline (TPHg), and less than about 1 ppm benzene, toluene, ethylbenzene, and total xylenes (BTEX) to depths between about 20 and 26 feet. The vertical extent of total oil and grease (TOG) and apparent weathered gasoline (TPHd) in the vicinity of the waste-oil tank pit had been delineated between depths of 20 and 26 feet. Volatile organic compounds (VOCs) were nondetectable (with the exception of BTEX) in the soil samples collected from borings B-1 through B-4; and concentrations of metals (cadmium, chromium, lead, zinc and nickel) were within the range typical of natural background levels for soil. The results of the soil analyses are presented in Table 1, Results of Laboratory Analyses of Soil Samples. The interpreted extent of hydrocarbon impacted soil beneath the site in the vicinity of the former waste-oil tank pit is presented on the Geologic Cross Sections, Plate 3.

First groundwater at the site was encountered at a depth of approximately 18 feet. The groundwater gradient and flow direction evaluated for the first encountered water-bearing zone was 0.01 to the southwest. Due to the proximity of three onsite wells in the immediate vicinity of the waste-oil tank pit the interpreted gradient may not represent conditions across the entire site. Groundwater beneath the southwestern portion of the site had been impacted by hydrocarbons and VOCs as indicated by the occasional presence of floating product sheen on groundwater samples from monitoring wells MW-1 through MW-3, and laboratory analytical results. The lateral and vertical extent of hydrocarbons in groundwater beneath the site had not been delineated.

Quarterly Groundwater Monitoring

Quarterly groundwater monitoring and sampling began at the site in the first quarter of 1992. This was the first sampling because product sheen was observed in all of the onsite wells following their development in December 1992. Field work during quarterly monitoring, which included purging, sampling, and directing laboratory analyses, was performed under the direction of EMCON Associates. The results of groundwater monitoring are presented in Table 2, Cumulative Groundwater Monitoring Data. Groundwater analyses results are summarized in Table 3, Cumulative Results of Laboratory Analyses of Water Samples - TPHg, TPHd, BTEX, TOG, and Metals and Table 4, Cumulative Results of Laboratory Analyses of Water Samples VOCs. Generally the lowest concentrations of TPHg, TPHd, BTEX, TOG, VOCs and metals were reported in well MW-1, which is located closest to the former waste-oil tank. The results and conclusions of the quarterly monitoring are summarized in RESNA's letter reports listed in the References section.

PROPOSED WORK

RESNA proposes four groundwater monitoring wells to be placed at the perimeter of the site to evaluate the extent of petroleum hydrocarbons and to further evaluate the gradient of the first encountered groundwater at the site. Project Steps 1 through 10 listed below are proposed to be implemented upon regulatory approval of this Work Plan and upon ARCO's authorization to proceed.

Step 1: Submit well construction permit application to the Alameda County Flood Control and Water Conservation District (ACFCWCD) for approval.

Step 2: Drill and obtain soil samples for soil classification and laboratory analyses from four proposed onsite soil borings (B-5 through B-8) as shown on Plate 4, Proposed Boring/Well Locations. Drill borings B-5 through B-8 no more than 5 feet into a possible perching or confining soil layer beneath the first water-bearing zone or no more than 20 feet into the water-bearing zone (total depths of approximately 30 feet below the ground surface). Collect and describe relatively undisturbed soil samples at 5-foot intervals or less from the ground surface to the total depths of the borings. Install four 4-inch diameter groundwater monitoring wells (MW-4 through MW-7) in the borings, respectively. The chemical analyses data obtained from these proposed borings/groundwater monitoring wells will be used to further delineate the vertical and horizontal extent of waste-oil hydrocarbons in the soil and groundwater beneath the site and further evaluate the gradient of the first groundwater-bearing zone beneath the site.

Step 3 Submit selected soil samples from borings B-5 through B-8 to a State-certified laboratory for analyses for TPHg and BTEX using modified Environmental Protection Agency (EPA) Methods 5030/8015/8020.

Step 4 Develop groundwater monitoring wells MW-4 through MW-7 until relatively clear water can be removed from the wells as described in Appendix A.

Step 5 Measure depth to water (DTW), purge, and sample groundwater monitoring wells MW-1 through MW-7.

Step 6 Submit representative groundwater samples to an ARCO contracted, State-certified laboratory for analyses for TPHg and BTEX analyses using modified EPA Methods 5030/602, TPHd using modified EPA Method 3510/602. In addition, wells MW-1 through MW-3 will be analyzed for VOCs using EPA Method 601.

Step 7 Direct a survey of the newly installed groundwater monitoring wells to a U.S. Coast and Geodetic Survey Datum relative to mean sea level elevation.

Step 8 Conduct a well search of public files to identify all known domestic supply, irrigation, commercial, cathodic, groundwater monitoring, and abandoned wells within 1/2-mile radius of the site.

Step 9 Obtain and study available aerial photographs of the site vicinity and consultant's reports containing environmental data to identify historical site usage and potential environmental concerns in the vicinity of the site. Data obtained will be used to identify potential off-site sources of hydrocarbons detected in soil and groundwater at the subject site.

Step 10 Prepare a report summarizing the results and conclusions of the environmental investigation.

Field work proposed in this Work Plan will be performed according to the Field Methods included in Appendix A of this Work Plan for Additional Subsurface Investigation for the subject site. Subsequent Work Plans will be prepared and submitted to ARCO and appropriate regulatory agencies as necessary to describe future work proposed at the site.

SCHEDULE OF OPERATIONS

Preliminary time schedules to perform additional phases of work will be included with the additional work plans presented for regulatory review, as necessary. RESNA can begin work at the site within one week after receiving authorization to proceed. The preliminary schedule is depicted in Plate 5, Preliminary Time Schedule.

PROJECT STAFF

Mr. James L. Nelson, a Certified Engineering Geologist (C.E.G. 1463) in the State of California, will be in overall charge of hydrogeologic aspects, and Dr. Joan E. Tiernan, Ph.D., a Registered Civil Engineer (C.E. 044600) will be in overall charge of engineering aspects of this project. Mr. Greg Barclay, General Manager, will provide supervision of field and office operations of the project. Mr. Joel Coffman, Project Geologist, will be responsible for the day-to-day field and office operations of the project. RESNA employs a staff of geologists and technicians who will assist with the project.

REFERENCES

Helley, E.S., K.R. Lajoie, W.E. Spangle, and M.L. Blair. 1979. Flatland deposits of the San Francisco Bay Region, California. U.S. Geological Survey Professional Paper 943.

Hickenbottom, K. and Muir, K. 1988. Geohydrology And Groundwater-Quality Overview, East Bay Plain Area, Alameda County, California 205(J) Report. Alameda County Flood Control and Water Conservation District, California.

RESNA. August 30, 1991. Work Plan for Initial Subsurface Investigation Related to Former Waste-oil Tank at ARCO Station 6148, 5131 Shattuck Avenue, Oakland, California. RESNA 61035.01

RESNA. October 10, 1991. Site Safety Plan. RESNA 61035.02S.

RESNA. November 7, 1991. Addendum to Work Plan for Initial Subsurface Investigation Related to Former Waste-Oil Tank at ARCO Station 6148, 5131 Shattuck Avenue, Oakland, California. RESNA 61035.02

RESNA. March 20, 1992. Draft Initial Subsurface Investigation Related to Former Waste-Oil Tank at ARCO Station 6148, 5131 Shattuck Avenue, Oakland, California. 61035.02

RESNA. June 4, 1992. Letter Report Quarterly Groundwater Monitoring, First Quarter 1992 at ARCO Station 6148, 5131 Shattuck Avenue, Oakland, California. 61035.03

RESNA. September 28, 1992. Letter Report Quarterly Groundwater Monitoring, Second Quarter 1992 at ARCO Station 6148, 5131 Shattuck Avenue, Oakland, California. 61035.03

Base: U.S. Geological Survey
7.5-Minute Quadrangles
Oakland East/West, California.
Photorevised 1980

LEGEND

⊙ = Site Location

Approximate Scale

2000 1000 0 2000 4000

feet

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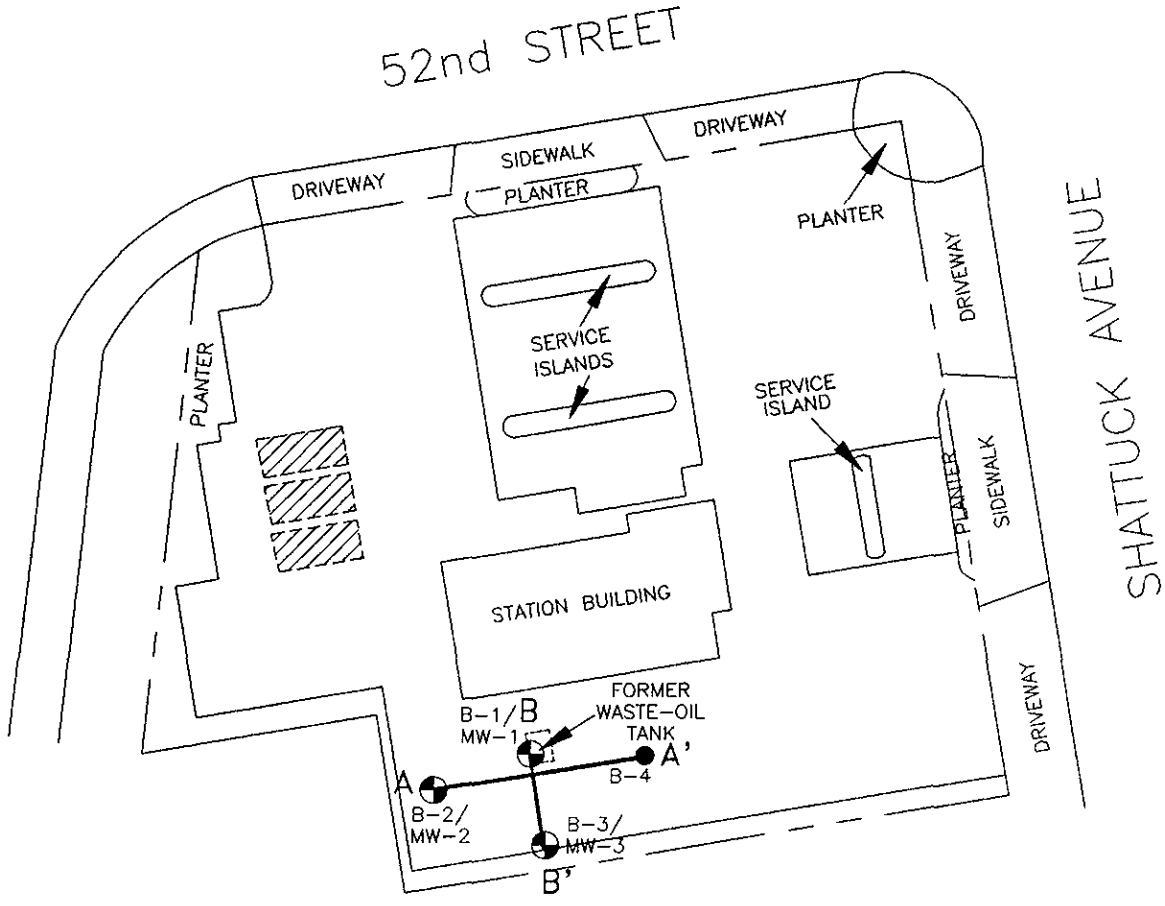
PROJECT 61035.03

SITE VICINITY MAP
ARCO Station 6148
5131 Shattuck Avenue
Oakland, California

PLATE
1



EXPLANATION

B-3/ MW-3 = Monitoring well (RESNA, December 1991)

B-4 = Soil boring (RESNA, December 1991)

= Underground storage tank

B — B' = Geologic cross section

N

Approximate Scale

40 20 0 40 80

feet

Source: Based on ARCO Site Plan dated 1980.

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PROJECT 61035.04

GENERALIZED SITE PLAN
ARCO Station 6148
5131 Shattuck Avenue
Oakland, California

PLATE
2

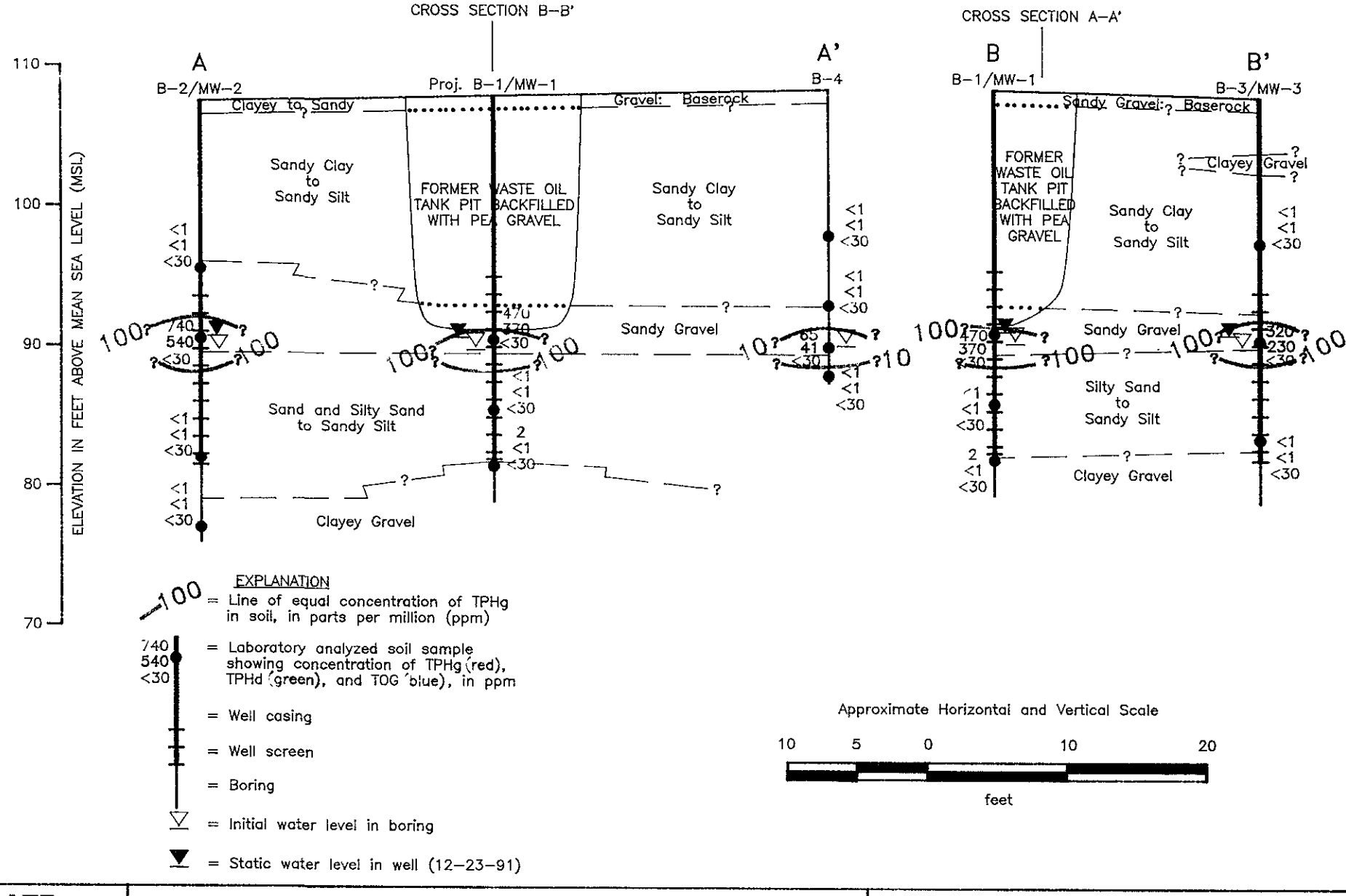
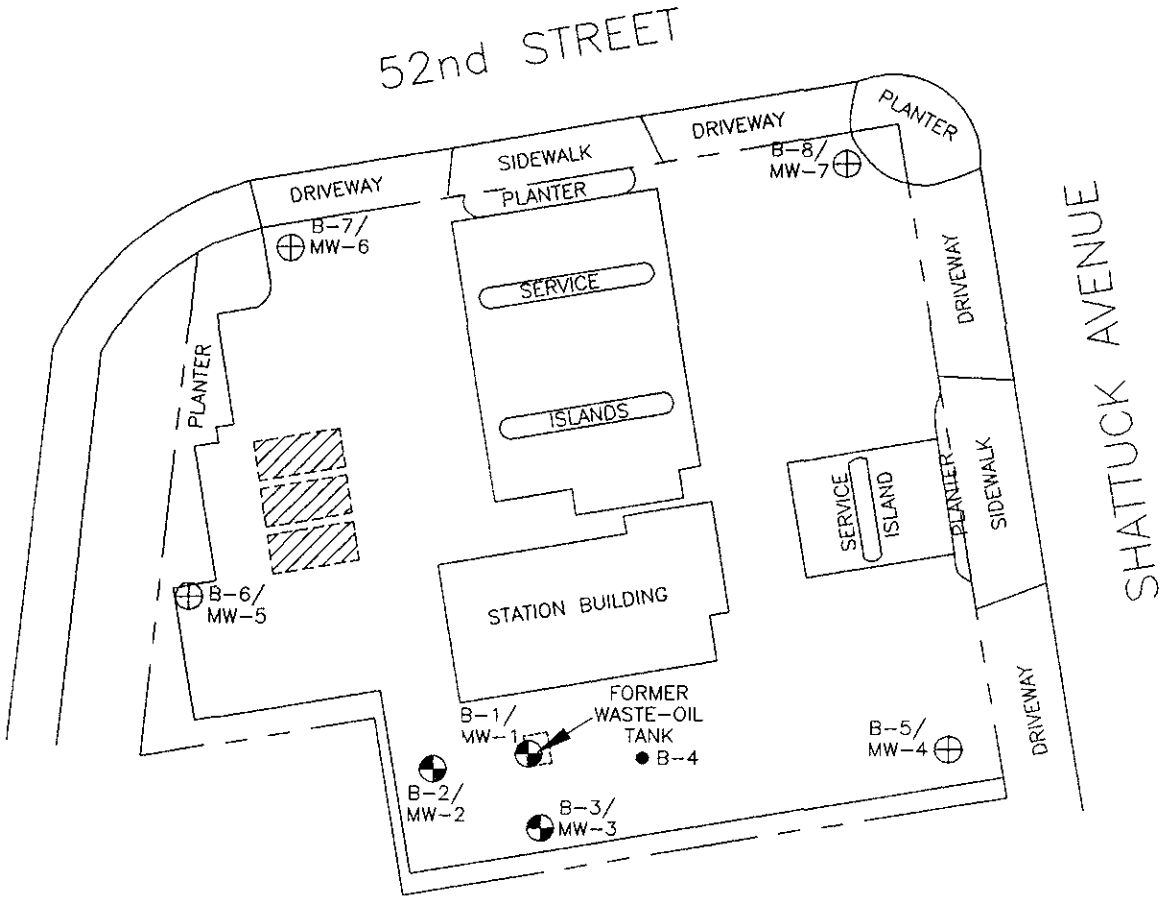


PLATE	GEOLOGIC CROSS SECTIONS A-A' AND B-B'	RESNA
3	ARCO Station 6148 5131 Shattuck Avenue Oakland, California	Working to Restore Nature
		PROJECT 61035.04



EXPLANATION

B-8/ MW-7 ⊕ = Proposed boring/monitoring well

B-4 ● = Soil boring (RESNA, December 1991)

B-3/ MW-3 ◓ = Monitoring well (RESNA, December 1991)

▨ = Underground storage tanks

N

Approximate Scale

40 20 0 40 80

feet

Source: Based on ARCO Site Plan dated 1980.

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PROPOSED BORING/WELL LOCATIONS
ARCO Station 6148
5131 Shattuck Avenue
Oakland, California

PLATE
4

STEP 1:
Submit application and receive approved well permit

STEP 2:
Drill soil borings (B5–B8) and install groundwater monitoring wells (MW4–MW7)

STEP 3:
Submit soil samples for laboratory analyses and receive results

STEP 4:
Develop groundwater monitoring wells MW4–MW7

STEP 5:
Measure depth of water, purge and sample wells (MW1–MW7)

STEP 6:
Submit groundwater samples for laboratory analyses and receive results

STEP 7:
Survey newly installed ground-water monitoring wells

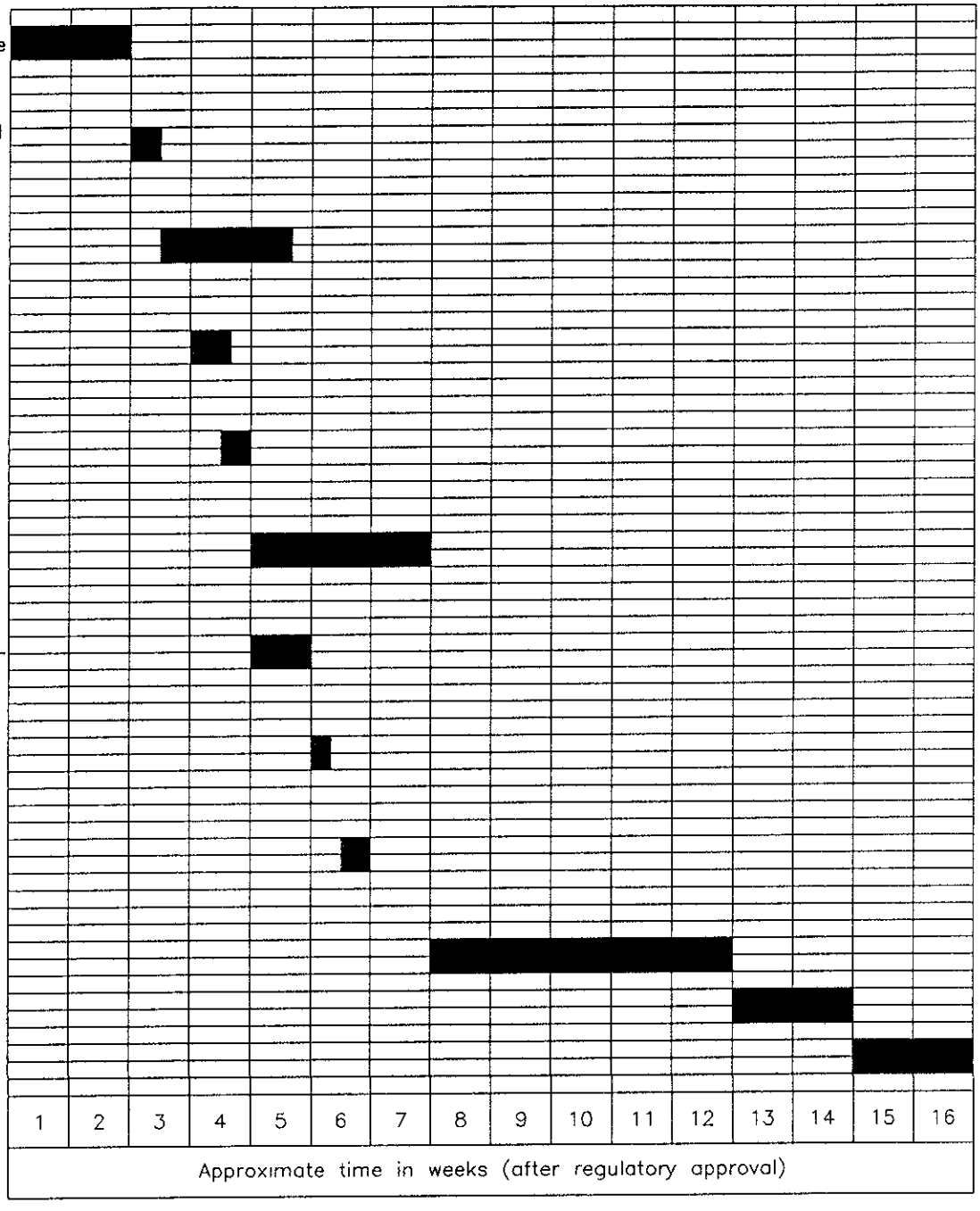
STEP 8:
Well search

STEP 9:
Environmental record search

STEP 10:
a) Prepare a draft report

b) Submit draft report to ARCO for review

c) Revise and finalize report



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PROJECT **61035.04**

PRELIMINARY TIME SCHEDULE
ARCO Station 6148
5131 Shattuck Avenue
Oakland, California

PLATE
5

TABLE 1
RESULTS OF LABORATORY ANALYSES OF SOIL SAMPLES
ARCO Station 6148
Oakland, California
December 19-20, 1991
(Page 1 of 2)

Sample Identification	TPHg	TPHd	B	T	E	X	TOG
S-17-1/2-B1	470	370	2.3 [1.3]	5.1 [1.8]	5.1 [1.8]	24 [8.8]	<30
S-22-1/2-B1	<1.0	<1.0	0.010	<0.0050	<0.0050	<0.0050	<30
S-26-1/2-B1	2.0	<1.0	0.026	0.014	0.011	0.049	<30
S-12-B2	<1.0	<1.0	<0.0050	<0.0050	<0.0050	<0.0050	<30
S-17-B2	740	540	2.3 [4.3]	13 [92]	7.7 [57]	41 [360]	<30
S-25-1/2-B2	<1.0	<1.0	0.015	0.016	<0.0050	0.019	<30
S-30-1/2-B2	<1.0	<1.0	0.015	0.0080	<0.0050	<0.0050	<30
S-10-1/2-B3	<1.0	<1.0	0.0070	<0.0050	<0.0050	<0.0050	<30
S-17-1/2-B3	320	230	0.65	0.65	2.3	5.9	<30
S-26-1/2-B3	<1.0	<1.0	<0.0050	<0.0050	<0.0050	<0.0050	<30
S-10-1/2-B4	<1.0	<1.0	<0.0050	<0.0050	<0.0050	<0.0050	<30
S-15-1/2-B4	<1.0	<1.0	0.010	<0.0050	<0.0050	<0.0050	<30
S-18-1/2-B4	65	41	0.42 [0.46]	0.22 [0.24]	0.54 [1.7]	0.77 [3.2]	<30
S-20-B4	<1.0	<1.0	0.0070	<0.0050	<0.0050	<0.0050	<30
S-1220-SP-(A-D)	25	11	0.11	0.14	0.11	0.38	<30

See notes on Page 2 of 2.

TABLE 1
RESULTS OF LABORATORY ANALYSES OF SOIL SAMPLES
ARCO Station 6148
Oakland, California
December 19-20, 1991
(Page 2 of 2)

Sample Identification	VOCs	Cd	Cr	Pb	Zn	Ni
S-17-1/2-B1	ND*	0.87	31	8.3	62	41
S-22-1/2-B1	ND	0.82	30	4.1	62	34
S-17-B2	ND*	0.87	24	6.7	68	46
S-25-1/2-B2	ND	<0.50	28	2.8	45	26
S-17-1/2-B3	NA	0.95	31	3.9	66	38
S-26-1/2-B3	ND	0.77	48	6.9	70	66
S-18-1/2-B4	ND*	<0.50	27	3.6	57	35
S-20-B4	ND	NA	NA	NA	NA	NA

All results shown in parts per million (ppm)
TPHg: Total petroleum hydrocarbons as gasoline by EPA method 5030/8015/8020.
TPHd: Total petroleum hydrocarbons as diesel by EPA method 3550/8015.
B: Benzene, T: Toluene, E: Ethylbenzene, X: Total Xylene isomers;
BTEX: Measured by EPA method 8030/8015/8020.
TOG: Total oil and grease by Standard Method 5520 E&F.
VOCs: Volatile Organic Compounds by EPA Method 8240.
Cd: Cadmium by EPA Method 6010.
Cr: Chromium by EPA Method 6010.
Pb: Lead by EPA Method 7421.
Zn: Zinc by EPA Method 6010.
Ni: Nickel by EPA Method 6010.
[ ]: BTEX detected using EPA Method 8240.
<: Results reported as less than the detection limit.
ND: All 37 compounds tested were not detected.
ND*: All compounds tested were not detected with the exception of BTEX.
NA: Not analyzed.

Sample Identification:

S-20-B4
- Boring number
- Depth in feet
- Soil sample

S-1220-SP-(A-D)
- Composite sample
- Soil pile
- Date sampled
- Soil sample

TABLE 2
CUMULATIVE GROUNDWATER MONITORING DATA
ARCO Station 6148
Oakland, California

Date Well Measured	Well Elevation	Depth to Water	Water Elevation	Floating Product
MW-1				
12-23-91		18.26	89.77	Sheen
01-07-92	108.03	17.44	90.59	Sheen
01-19-92		17.17	90.86	None
02-19-92		16.52	91.51	None
03-18-92		16.81	91.22	None
04-20-92		17.56	90.47	None
05-15-92		17.96	90.07	None
06-12-92		18.16	89.87	None
MW-2				
12-23-91		17.98	89.45	Sheen
01-07-92	107.43	17.15	90.28	Sheen
01-19-92		17.47	89.96	None
02-19-92		16.28	91.15	None
03-18-92		16.52	90.91	None
04-20-92		17.27	90.16	None
05-15-92		17.62	89.81	None
06-12-92		17.67	89.76	0.05
MW-3				
12-23-91		18.14	89.63	Sheen
01-07-92	107.77	17.26	90.51	Sheen
01-19-92		17.63	90.14	None
02-19-92		16.34	91.43	None
03-18-92		16.62	91.15	None
04-20-92		17.38	90.39	None
05-15-92		17.80	89.97	None
06-12-92		18.01	89.76	None

Measurements in feet.
Wells surveyed on December 27, 1991. Datum is City of Oakland = (USGS) + 3.00

TABLE 3
CUMULATIVE RESULTS OF LABORATORY ANALYSES OF WATER SAMPLES-
TPHg, TPHd, BTEX, TOG, and Metals
ARCO Station 6148
Oakland, California

WELL DATE	TPHg	TPHd	B	T	E	X	Cd	Cr	Pb	Ni	Zn	TOG
MW-1												
03/18/92	790	<50	310	26	12	44	<3	5	3	<20	31	<0.5 (1.4)
06-12-92	1000	<50**	290	15	10	30	NA	NA	NA	NA	NA	<0.5
MW-2												
03/18/92	8,400	230*	1,400	1,000	220	870	<3	21	9	38	54	1.2 (3.0)
06/12/92	Not sampled--floating product											
MW-3												
03/18/92	20,000	2,800*	3,200	560	380	1,000	<3	67	27	113	156	7.8 (8.1)
06/12/92	46,000	1,600**	3,400	4,200	1,300	5,400	NA	NA	NA	NA	NA	16
MCL:	—	—	1	—	680	1,750	10	50	50	—	—	—
DWAL:	—	—	—	100	—	—	—	—	—	—	—	—

Results in parts per billion (ppb), except TOG which is in parts per million (ppm).
TPHg: Total petroleum hydrocarbons as gasoline by EPA method 5030/8015/8020.
TPHd: Total petroleum hydrocarbons as diesel by EPA method 3510.
B: benzene, T: toluene, E: ethylbenzene, X: total xylenes isomers
BTEX: Analyzed by EPA method 5030/8015/8020.
TOG: Total oil and grease by Standard method 5520F-IR.
( ): Concentrations in parentheses were results of Method 5520C.
*: Laboratory reported sample matrix contained high boiling point fuel mixture calculated as diesel, possibly weathered gasoline.
Metals: By EPA method 6010 and 7421.
<: Results reported below the laboratory detection limit.
**: Samples taken on July 2, 1992. Laboratory reported sample contains a lower boiling point hydrocarbon mixture quantified as diesel. The chromatogram does not match the typical diesel fingerprint, appears to be weathered gasoline.

TABLE 4
CUMULATIVE RESULTS OF LABORATORY ANALYSES OF WATER SAMPLES-VOCs
ARCO Station 6148
Oakland, California

Date/Well	Compound	VOCs (ppb)
MW-1		
03/18/21	Tetrachloroethene	13
	Trichloroethene	1.2
06/12/92	Tetrachloroethene	18
	Trichloroethene	1.4
MW-2		
03/18/92	Tetrachloroethene	19
	Trichloroethene	2.22
	cis-1,2-Dichloroethene	0.5
06/12/92	Not sampled--floating product	
MW-3		
03/18/92	Tetrachloroethene	2.7
06/12/92	Tetrachloroethene	1.9

MCL:	PCE	TCE	cis-1,2-DCE
	5	5	6*

Results in parts per billion (ppb).
VOCs: Volatile Organic Compounds by EPA method 5030/8010. Compounds not shown were not detected.
Cd: Cadmium by EPA method 6010.
Cr: Chromium by EPA method 6010.
Pb: Lead by EPA method 7421.
Zn: Zinc by EPA method 6010.
Ni: Nickel by EPA method 6010.
MCLs: Maximum Contaminant Levels as reported by the California Department of Health Services 10/24/90.
*: Proposed MCL.

APPENDIX A

FIELD PROTOCOL

FIELD PROTOCOL

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

Site Safety Plan

The Site Safety Plan describes the safety requirements for the evaluation of gasoline and waste-oil 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 to 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 be 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 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. 3 sand, or similar sorted sand, to approximately two feet above the top of the screened casing for 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 determined to be relatively clear. Turbidity measurements (in NTUs) are recorded during well development and are used in evaluating well development. The development method used, 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.

Vadose-Zone Sampling

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

Sample Labeling and Handling

Sample containers 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.