



99 MAR 11 PM 2:40
March 8, 1999

Project 20805-213.001

PO76

Mr. Paul Supple
ARCO Products Company
P.O. Box 6549
Moraga, California 94570

Re: Quarterly Groundwater Monitoring Report, Fourth Quarter 1998, for ARCO Service Station No. 4931, located at 731 West MacArthur Boulevard, Oakland, California

Dear Mr. Supple:

Pinnacle Environmental Solutions, a division of EMCON (Pinnacle), is submitting the attached report which presents the results of the fourth quarter 1998 groundwater monitoring program at ARCO Products Company (ARCO) Service Station No. 4931, located at 731 West MacArthur Boulevard, Oakland, California. The monitoring program complies with the Alameda County Health Care Services Agency (ACHCSA) requirements regarding underground tank investigations.

LIMITATIONS


No monitoring event is thorough enough to describe all geologic and hydrogeologic conditions of interest at a given site. If conditions have not been identified during the monitoring event, results should not be construed as a guarantee of the absence of such conditions at the site, but rather as the product of the scope and limitations of work performed during the monitoring event.

Please call if you have questions.

Sincerely,

Pinnacle


Glen VanderVeen
Project Manager


Jay R. Johnson, R.G.
Senior Project Supervisor

Attachment: Quarterly Groundwater Monitoring Report, Fourth Quarter 1998

cc: Mr. John Kaiser, Regional Water Quality Control Board - San Francisco Bay Region
Ms. Susan Hugo, Alameda County Health Care Services Agency



Date: March 8, 1999

ARCO QUARTERLY GROUNDWATER MONITORING REPORT

Facility No.: 4931 Address: 731 West MacArthur Boulevard, Oakland, California
ARCO Environmental Engineer: Paul Supple
Consulting Co./Contact Person: Pinnacle Environmental Solutions/ Glen VanderVeen
Consultant Project No.: 20805-213.001
Primary Agency/Regulatory ID No.: Alameda County Health Care Services Agency

WORK PERFORMED THIS QUARTER (FOURTH - 1998):

1. Prepared and submitted quarterly groundwater monitoring report for third quarter 1998.
2. Performed quarterly groundwater monitoring and sampling for fourth quarter 1998.

WORK PROPOSED FOR NEXT QUARTER (FIRST - 1999):

1. Prepare and submit quarterly groundwater monitoring report for fourth quarter 1998.
2. Perform quarterly groundwater monitoring and sampling for first quarter 1999.

QUARTERLY MONITORING:

Current Phase of Project: Monitoring/Remediation
Frequency of Groundwater Sampling: Annual (2nd Quarter): A-7, A-13
Semi-Annual (2nd/4th Quarter): A-3, A-5, A-11, A-12
Quarterly: A-2, A-4, A-6, A-8, A-9
Frequency of Groundwater Monitoring: Quarterly
Is Free Product (FP) Present On-Site: No
FP Recovered this Quarter: None
Cumulative FP Recovered to Date: Unknown
Bulk Soil Removed This Quarter: None
Bulk Soil Removed to Date: Unknown
Current Remediation Techniques: Intrinsic Bioremediation Enhancement using ORC
Approximate Depth to Groundwater: 10.5 feet
Groundwater Flow Direction and Gradient
(Average): 0.007 ft/ft toward Southwest
Period TPPH- g/Benzene Removed: 0.0/0.0
Cumulative TPPH-g/Benzene Removed: 0.45/0.06 gallons

DISCUSSION:

- Bioremediation enhancement is ongoing using oxygen release compound socks (ORC) in wells A-4 and A-8.

ATTACHMENTS:

- Table 1 - Groundwater Elevation and Analytical Data
- Figure 1 - Groundwater Analytical Summary Map
- Figure 2 - Groundwater Elevation Contour Map
- Appendix A - Sampling and Analysis Procedures
- Appendix B - Certified Analytical Reports and Chain-of-Custody Documentation
- Appendix C - Field Data Sheets
- Appendix D - Remedial System Performance Summary

Table 1
Groundwater Elevation and Analytical Data
Total Purgeable Petroleum Hydrocarbons
(TPPH as Gasoline, BTEX Compounds, and MtBE)

ARCO Service Station 4931
731 West MacArthur Boulevard, Oakland, California

Well	Date Gauged/ Numbe Sampled	Well Elevation (feet, MSL)	Depth to Water (feet, TOB)	Groundwater Elevation (feet, MSL)	TPPH as Gasoline (ppb)	Benzen (ppb)	Toluene (ppb)	Ethyl- benzene (ppb)	Xylenes (ppb)	MtBE (ppb)	Dissolved Oxygen (ppm)	Purged/ Not Purged	
A-2	03/26/96	55.48	5.37	50.11	<50	<0.5	<0.5	<0.5	<0.5	NA	NM		
	05/22/96		5.25	50.23	<50	<0.5	<0.5	<0.5	<0.5	NA	NM		
	08/22/96		10.45	45.03	<50	1.1	1.8	<0.5	1.3	<2.5	NM		
	12/19/96		5.53	49.95	<50	<0.5	<0.5	<0.5	<0.5	2.7	NM		
	04/01/97		8.77	46.71	<50	<0.5	<0.5	<0.5	<0.5	<2.5	NM		
	05/27/97		9.87	45.61	<50	<0.5	<0.5	<0.5	<0.5	4.6	NM		
	08/12/97		11.11	44.37	<50	<0.5	<0.5	<0.5	<0.5	5.6	NM		
	11/14/97		10.63	44.85	<50	0.9	2.8	<0.5	2.4	27	2.6		
	03/18/98		3.58	51.90	<50	<0.5	<0.5	<0.5	<0.5	<3	NM		
	05/19/98		4.82	50.66	<50	<0.5	<0.5	<0.5	<0.5	<3	1.30	P	
	07/29/98		8.94	46.54	<50	<0.5	<0.5	<0.5	<0.5	<3	1.2	NP	
10/09/98	10.82	44.66	<50	<0.5	<0.5	<0.5	<0.5	<3	0.5	NP			
A-3	03/26/96	54.66	7.20	47.46	Well Sampled Semiannually								
	05/22/96		7.70	46.96	<50	1.2	1.9	0.7	1.3	NA	NM		
	08/22/96		10.88	43.78	Well Sampled Semiannually								
	12/19/96		7.70	46.96	5,900	<25	<25	<25	<25	5300*	NM		
	04/01/97		9.78	44.88	Well Sampled Semiannually								
	05/27/97		10.55	44.11	2,300	<20	<20	<20	<20	3,800	NM		
	08/12/97		11.12	43.54	Well Sampled Semiannually								
	11/14/97		8.24	46.42	<1,000	<10	<10	<10	<10	1,500	3.8		
	03/18/98		5.05	49.61	Well Sampled Semiannually								
	05/19/98		9.00	45.66	<250	<2.5	<2.5	<2.5	<2.5	220	4.60	P	
	07/29/98		9.86	44.80	Well Sampled Semiannually								
10/09/98	11.36	43.30	<250	<2.5	<2.5	<2.5	<2.5	260	1.0	NP			

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Well Numbe	Date Gauged/ Sampled	Well Elevation (feet, MSL)	Depth to Water (feet, TOB)	Groundwater Elevation (feet, MSL)	TPPH as Gasoline (ppb)	Benzen (ppb)	Toluene (ppb)	Ethyl- benzene (ppb)	Xylenes (ppb)	MtBE (ppb)	Dissolved Oxygen (ppm)	Purged/ Not Purged	
A-4	03/26/96	54.73	7.95	46.78	8,900	1,200	21	200	220	NA	NM		
	05/22/96		8.35	46.38	5,300	700	<10	170	130	NA	NM		
	08/22/96		11.03	43.70	3,000	480	<5.0	75	26	150	NM		
	12/19/96		8.67	46.06	<2,000	<20	<20	<20	<20	15000*	NM		
	04/01/97		11.95	42.78	8,900	1,700	22	310	260	6,900	NM		
	05/27/97		10.80	43.93	7,100	960	<20	150	74	7,900	NM		
	08/12/97		11.38	43.35	4,300	670	12	51	27	2,800	NM		
	11/14/97		7.74	46.99	<20,000	300	500	<200	<200	27,000	2.2		
	03/18/98		6.80	47.93	4,700	600	<20	99	94	1,200	1.0		
	05/19/98		9.06	45.67	<2000	<20	<20	<20	<20	720	2,000	1.28	P
07/29/98	10.05	44.68	8,400	1,300	<20	290	130	1,800	0.7	NP			
10/09/98	11.20	43.53	3,500	400	<20	54	<20	1,700	1.0	NP			
A-5	03/26/96	54.17	7.93	46.24	Well Sampled Semiannually								
	05/22/96		8.20	45.97	<50	<0.5	<0.5	<0.5	<0.5	NA	NM		
	08/22/96		10.70	43.47	Well Sampled Semiannually								
	12/19/96		8.39	45.78	9,900	1,100	330	230	700	24	NM		
	04/01/97		10.83	43.34	Well Sampled Semiannually								
	05/27/97		10.65	43.52	100	<0.5	<0.5	<0.5	<0.5	120	NM		
	08/12/97		11.05	43.12	Well Sampled Semiannually								
	11/14/97		10.51	43.66	<50	<0.5	<0.5	<0.5	<0.5	41	4.8		
	03/18/98		8.10	46.07	Well Sampled Semiannually								
	05/19/98		9.31	44.86	590	<5	<5	<5	<5	710	2.48	P	
07/29/98	9.89	44.28	Well Sampled Semiannually										
10/09/98	11.02	43.15	690	<5	<5	<5	<5	710	1.0	NP			

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Groundwater Elevation and Analytical Data
Total Purgeable Petroleum Hydrocarbons
(TPPH as Gasoline, BTEX Compounds, and MtBE)**

**ARCO Service Station 4931
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Well	Date Gauged/ Sampled	Well Elevation (feet, MSL)	Depth to Water (feet, TOB)	Groundwater Elevation (feet, MSL)	TPPH as Gasoline (ppb)	Benzen (ppb)	Toluene (ppb)	Ethyl-benzene (ppb)	Xylenes (ppb)	MtBE (ppb)	Dissolved Oxygen (ppm)	Purged/ Not Purged	
A-6	03/26/96	55.17	7.15	48.02	52	2.7	<0.5	1.1	2.0	NA	NM		
	05/22/96		7.35	47.82	<50	2.4	<0.5	0.88	1.7	NA	NM		
	08/22/96		10.12	45.05	<50	<0.5	<0.5	<0.5	<0.5	<2.5	NM		
	12/19/96		7.43	47.74	<50	1.7	<0.5	0.78	1.5	<2.5	NM		
	04/01/97		9.97	45.20	<50	4.7	<0.5	1.9	3.2	<2.5	NM		
	05/27/97		9.66	45.51	<50	0.69	<0.5	<0.5	<0.5	<2.5	NM		
	08/12/97		10.43	44.74	<50	<0.5	<0.5	<0.5	<0.5	<2.5	NM		
	11/14/97		9.76	45.41	<50	<0.5	<0.5	<0.5	<0.5	<3	<1.0		
	03/18/98		7.00	48.17	<50	6.2	0.5	2.3	2.6	<3	3.0		
	05/19/98		8.27	46.90	<50	<0.5	<0.5	1.3	4.7	<3	2.16	P	
	07/29/98		8.96	46.21	<50	<0.5	<0.5	<0.5	<0.5	<3	0.8	NP	
10/09/98	10.23	44.94	<50	<0.5	<0.5	<0.5	<0.5	<3	1.0	NP			
A-7	03/26/96	54.71	6.90	47.81	Well Sampled Semiannually								
	05/22/96		8.27	46.44	<50	<0.5	<0.5	<0.5	<0.5	NA	NM		
	08/22/96		9.80	44.91	Well Sampled Semiannually								
	12/19/96		7.19	47.52	Well Sampled Annually								
	04/01/97		9.63	45.08	Well Sampled Annually								
	05/27/97		9.34	45.37	<50	<0.5	<0.5	<0.5	<0.5	<2.5	NM		
	08/12/97		10.10	44.61	Well Sampled Annually								
	11/14/97		9.35	45.36	Well Sampled Annually								
	03/18/98		6.75	47.96	Well Sampled Annually								
	05/19/98		8.85	45.86	<50	<0.5	<0.5	<0.5	<0.5	<3	1.82	P	
	07/29/98		8.84	45.87	Well Sampled Annually								
10/09/98	10.05	44.66	Well Sampled Annually										

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Well	Date Gauged/ Sampled	Well Elevation (feet, MSL)	Depth to Water (feet, TOB)	Groundwater Elevation (feet, MSL)	TPPH as Gasoline (ppb)	Benzen (ppb)	Toluene (ppb)	Ethyl- benzene (ppb)	Xylenes (ppb)	MtBE (ppb)	Dissolved Oxygen (ppm)	Purged/ Not Purged		
A-8	03/26/96	53.77	7.10	46.67	48,000	2,600	<100	650	1,100	NA	NM			
	05/22/96		7.20	46.57	14,000	2,800	160	320	190	NA	NM			
	08/22/96		11.57	42.20	8,000	1,000	76	150	96	4,300	NM			
	12/19/96		8.04	45.73	12,000	450	110	210	230	<500	NM			
	04/01/97		9.98	43.79	Well Sampled Semiannually									
	05/27/97		11.45	42.32	11,000	1,600	100	220	210	2,300	NM			
	08/12/97		11.59	42.18	Well Sampled Semiannually									
	11/14/97		9.85	43.92	26,000	2,300	<200	400	400	4,100	2.2			
	03/18/98		7.80	45.97	Well Sampled Semiannually									
	05/19/98		8.78	44.99	88,000	4,200	150	640	600	6,700	1.36	P		
	07/29/98		9.59	44.18	46,000	4,900	160	620	580	13,000	0.5	NP		
	10/09/98		11.23	42.54	130,000	3,700	110	500	770	7,300	1.0	NP		
	A-9		03/26/96	53.04	7.05	45.99	<50	<0.5	<0.5	<0.5	<0.5	NA	NM	
05/22/96		7.20	45.84		<50	<0.5	<0.5	<0.5	<0.5	NA	NM			
08/22/96		9.68	43.36		<50	<0.5	<0.5	<0.5	<0.5	8.5	NM			
12/19/96		7.43	45.61		<50	<0.5	<0.5	<0.5	<0.5	2.6	NM			
04/01/97		9.95	43.09		Well Sampled Semiannually									
05/27/97		9.56	43.48		<50	2.3	<0.5	<0.5	<0.5	45	NM			
08/12/97		10.15	42.89		Well Sampled Semiannually									
11/14/97		8.64	44.40		<200	<2.0	<2.0	<2.0	<2.0	190	9.6			
03/18/98		6.45	46.59		Well Sampled Semiannually									
05/19/98		8.35	44.69		<50	<0.5	<0.5	<0.5	<0.5	7	1.27	P		
07/29/98		8.74	44.30		<50	<0.5	<0.5	<0.5	<0.5	<3	0.99	NP		
10/09/98		10.05	42.99		<50	<0.5	<0.5	<0.5	<0.5	<3	1.0	NP		

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Well	Date Gauged/ Sampled	Well Elevation (feet, MSL)	Depth to Water (feet, TOB)	Groundwater Elevation (feet, MSL)	TPPH as Gasoline (ppb)	Benzen (ppb)	Toluene (ppb)	Ethyl-benzene (ppb)	Xylenes (ppb)	MtBE (ppb)	Dissolved Oxygen (ppm)	Purged/ Not Purged
A-10	03/26/96	54.26	8.28	45.98	Well Removed from Sampling Program							
	05/22/96		8.60	45.66	Well Removed from Sampling Program							
	08/22/96		10.98	43.28	Well Removed from Sampling Program							
	12/19/96		8.80	45.46	Well Removed from Sampling Program							
	04/01/97		11.15	43.11	Well Removed from Sampling Program							
	05/27/97		10.90	43.36	Well Removed from Sampling Program							
	08/12/97		11.30	42.96	Well Removed from Sampling Program							
	11/14/97		10.80	43.46	Well Removed from Sampling Program							
	03/18/98					Well Removed from Survey Program						
A-11	03/26/96	53.74	8.10	45.64	Well Sampled Semiannually							
	05/22/96		8.25	45.49	<50	<0.5	<0.5	<0.5	<0.5	NA	NM	
	08/22/96		10.58	43.16	Well Sampled Semiannually							
	12/19/96		8.37	45.37	<50	<0.5	<0.5	<0.5	<0.5	<2.5	NM	
	04/01/97		10.95	42.79	Well Sampled Semiannually							
	05/27/97		10.60	43.14	<50	<0.5	<0.5	<0.5	<0.5	3.1	NM	
	08/12/97		11.07	42.67	Well Sampled Semiannually							
	11/14/97		10.58	43.16	<50	<0.5	<0.5	<0.5	<0.5	<3	1.6	
	03/18/98		8.14	45.60	Well Sampled Semiannually							
	05/19/98		9.40	44.34	<50	<0.5	<0.5	<0.5	<0.5	<3	1.13	P
07/29/98	10.32	43.42	Well Sampled Semiannually									
10/09/98	10.91	42.83	<50	<0.5	<0.5	<0.5	<0.5	<3	2.0	NP		

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Well	Date Gauged/ Sampled	Well Elevation (feet, MSL)	Depth to Water (feet, TOB)	Groundwater Elevation (feet, MSL)	TPPH as Gasoline (ppb)	Benzen (ppb)	Toluene (ppb)	Ethyl- benzene (ppb)	Xylenes (ppb)	MtBE (ppb)	Dissolved Oxygen (ppm)	Purged/ Not Purged	
A-12	03/26/96	52.05	7.83	44.22	Well Sampled Semiannually								
	05/22/96		7.80	44.25	<50	<0.5	<0.5	<0.5	<0.5	NA	NM		
	08/22/96		9.97	42.08	Well Sampled Semiannually								
	12/19/96		8.18	43.87	85	<0.5	<0.5	<0.5	<0.5	170	NM		
	04/01/97		10.30	41.75	Well Sampled Semiannually								
	05/27/97		10.05	42.00	50	12	<0.5	<0.5	<0.5	96	NM		
	08/12/97		10.46	41.59	Well Sampled Semiannually								
	11/14/97		9.70	42.35	<50	<0.5	<0.5	<0.5	<0.5	75	7.0		
	03/18/98		8.15	43.90	Well Sampled Semiannually								
	05/19/98		9.15	42.90	<50	<0.5	<0.5	<0.5	<0.5	29	1.47	P	
	07/29/98		9.38	42.67	Well Sampled Semiannually								
	10/09/98		10.21	41.84	<50	<0.5	<0.5	<0.5	<0.5	7	2.0	NP	
A-13	03/26/96	55.11	Well Inaccessible										
	05/22/96		Well Inaccessible										
	08/22/96		Well Inaccessible										
	12/19/96		Well Inaccessible										
	04/01/97		Well Inaccessible										
	05/27/97		Well Inaccessible										
	08/12/97		Well Inaccessible										
	11/14/97		Well Inaccessible										
	03/18/98		Well Inaccessible										
	05/19/98		Well Inaccessible										
07/29/98	Well Inaccessible												
10/09/98	Well Inaccessible												

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AR-1	03/26/96	54.72	8.13	46.59	6,200	110	64	38	520	NA	NM	
	05/22/96		8.57	46.15	NS	NS	NS	NS	NS	NS	NM	
	08/22/96		10.97	43.75	5,600	100	28	29	310	960	NM	
	12/19/96		8.93	45.79	Well Removed from Sampling Program							
	04/01/97		11.78	42.94	Well Removed from Sampling Program							
	05/27/97		10.76	43.96	Well Removed from Sampling Program							
	08/12/97		11.40	43.32	Well Removed from Sampling Program							
	11/14/97		10.80	43.92	Well Removed from Sampling Program							
	05/19/98		--	--	Well Removed from Sampling Program							
	07/29/98		10.17	44.55	Well Removed from Sampling Program							
10/09/98		11.25	43.47	Well Removed from Sampling Program								
AR-2	03/26/96	54.77	4.93	49.84	<50	<0.5	<0.5	<0.5	<0.5	NA	NM	
	05/22/96		5.65	49.12	NS	NS	NS	NS	NS	NS	NM	
	08/22/96		7.27	47.50	<50	<0.5	<0.5	<0.5	<0.5	200	NM	
	12/19/96		7.78	46.99	Well Removed from Sampling Program							
	04/01/97		6.80	47.97	Well Removed from Sampling Program							
	05/27/97		6.32	48.45	Well Removed from Sampling Program							
	08/12/97		7.43	47.34	Well Removed from Sampling Program							
	11/14/97		8.95	45.82	Well Removed from Sampling Program							
	05/19/98		--	--	Well Removed from Sampling Program							
	07/29/98		4.47	50.30	Well Removed from Sampling Program							
10/09/98		6.90	47.87	Well Removed from Sampling Program								

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Well Numbe	Date Gauged/ Sampled	Well Elevation (feet, MSL)	Depth to Water (feet, TOB)	Groundwater Elevation (feet, MSL)	TPPH as Gasoline (ppb)	Benzen (ppb)	Toluene (ppb)	Ethyl- benzene (ppb)	Xylenes (ppb)	MtBE (ppb)	Dissolved Oxygen (ppm)	Purged/ Not Purged
AR-3	03/26/96	54.19	7.95	46.24	<50	<0.5	<0.5	<0.5	<0.5	NA	NM	
	05/22/96		8.30	45.89	NS	NS	NS	NS	NS	NS	NM	
	08/22/96		10.84	43.35	----- Well Removed from Sampling Program -----							
	12/19/96		8.56	45.63	----- Well Removed from Sampling Program -----							
	04/01/97		11.24	42.95	----- Well Removed from Sampling Program -----							
	05/27/97		10.67	43.52	----- Well Removed from Sampling Program -----							
	08/12/97		11.10	43.09	----- Well Removed from Sampling Program -----							
	11/14/97		10.60	43.59	----- Well Removed from Sampling Program -----							
	05/19/98		--	--	----- Well Removed from Sampling Program -----							
	07/29/98		9.95	44.24	----- Well Removed from Sampling Program -----							
	10/09/98		11.20	42.99	----- Well Removed from Sampling Program -----							

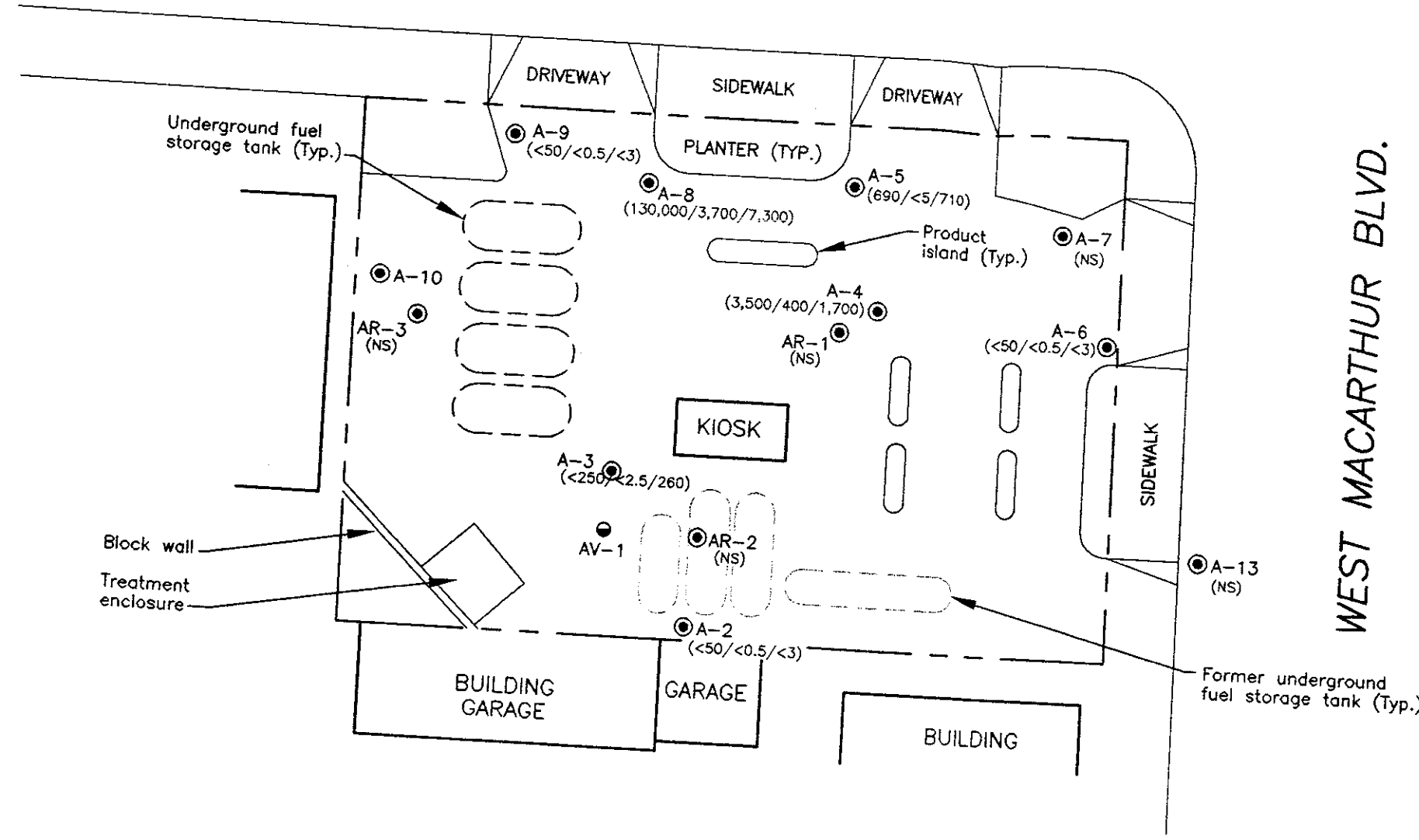
MSL	= Mean sea level
TOB	= Top of box
ppb	= Parts per billion
ppm	= Parts per million
<	= Denotes laboratory detection limit
NA	= Not analyzed
NM	= Not measured
NS	= Not sampled
*	= MtBE results confirmed by EPA Method 8260.



● A-12
($<50/<0.5/<7$)

WEST STREET

● A-11
($<50/<0.5/<3$)



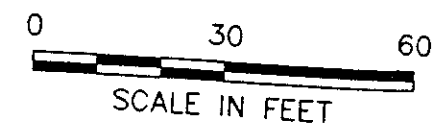
- EXPLANATION**
- Groundwater monitoring well
 - Soil vapor well
 - (690/ $<5/<710$) Concentration of total petroleum hydrocarbons as gasoline (TPHG), benzene, and MTBE in groundwater (ug/L); samples collected 10/9/98
 - < Not detected at or above the indicated laboratory detection limit
 - NS Not sampled

1" 1/2" 0" 1"

IMAGE Files: <No Images>
XREF Files: <No Xrefs>
Dirscale: 30 Ltscale: 30 Peltacale: 1
SANJOSE/CADD: N:\DWG\PINACL\4931\4931CHEM.DWG Tue, 26/Jan/99 03:09pm kblack

Base map from Pacific Environmental Group, Inc.

Pinnacle
ENVIRONMENTAL SOLUTIONS
A DIVISION OF EMCON



DATE JAN. 1999
DWN KAB
APP
REV 0
PROJECT NO.
20805-213.001

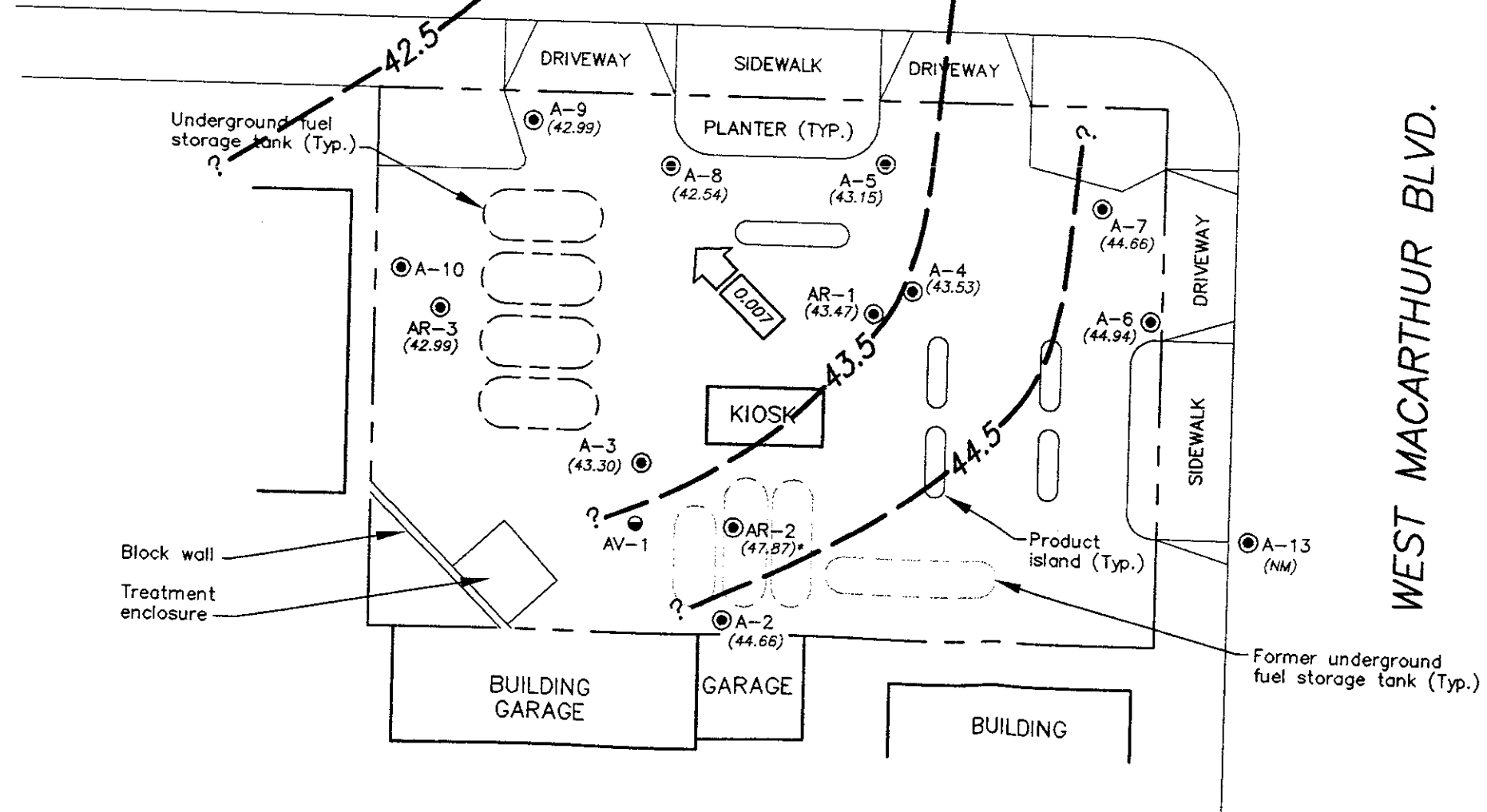
FIGURE 1
ARCO PRODUCTS COMPANY
SERVICE STATION 4931, 731 W. MACARTHUR BLVD.
OAKLAND, CALIFORNIA
GROUNDWATER ANALYTICAL SUMMARY
FOURTH QUARTER 1998



WEST STREET

A-12
(41.84)

A-11
(42.83)



WEST MACARTHUR BLVD.

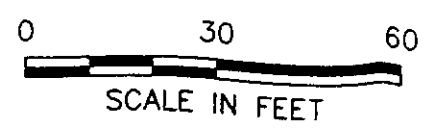
EXPLANATION

- Groundwater monitoring well
- Soil vapor well
- (44.66) Groundwater elevation (Ft.-MSL); measured 10/9/98
- ? - - - Groundwater elevation contour (Ft.-MSL)
- ← Approximate direction of groundwater flow showing gradient
- NM Not measured; well inaccessible
- * Not used to construct contours

IMAGE Files: <No Images>
 XREF Files: <No Xrefs>
 Dimscale: 30 Ltscale: 30 Pellscale: 1
 SANJOSE/CADD: N:\DWG\PINACL\4931\4931CWC.DWG Wed, 03/Feb/99 11:29am kblock

Base map from Pacific Environmental Group, Inc.

Pinnacle
 ENVIRONMENTAL SOLUTIONS
 A DIVISION OF EMCON



DATE JAN. 1999
 DWN KAB
 APP _____
 REV 0
 PROJECT NO.
 20805-213.001

FIGURE 2
 ARCO PRODUCTS COMPANY
 SERVICE STATION 4931, 731 W. MACARTHUR BLVD.
 OAKLAND, CALIFORNIA
GROUNDWATER ELEVATION CONTOURS
FOURTH QUARTER 1998

APPENDIX A
SAMPLING AND ANALYSIS PROCEDURES

APPENDIX A

SAMPLING AND ANALYSIS PROCEDURES

The sampling and analysis procedures for water quality monitoring programs are contained in this appendix. The procedures provided for consistent and reproducible sampling methods, proper application of analytical methods, and accurate and precise analytical results. Finally, these procedures provided guidelines so that the overall objectives of the monitoring program were achieved.

The following documents have been used as guidelines for developing these procedures:

- Procedures Manual for Groundwater Monitoring at Solid Waste Disposal Facilities, Environmental Protection Agency (EPA)-530/SW-611, August 1977
- Resource Conservation and Recovery Act (RCRA) Groundwater Monitoring Technical Enforcement Guidance Document, Office of Solid Waste and Emergency Response (OSWER) 9950.1, September 1986
- Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, EPA SW-846, 3rd edition, November 1986
- Methods for Organic Chemical Analysis of Municipal and Industrial Waste Water, EPA-600/4-82-057, July 1982
- Methods for Organic Chemical Analysis of Water and Wastes, EPA-600/4-79-020, revised March 1983
- Leaking Underground Fuel Tank (LUFT) Field Manual, California State Water Resources Control Board, revised October 1989

Sample Collection

Sample collection procedures include equipment cleaning, water level and total well depth measurements, and well purging and sampling.

Equipment Cleaning

Before the sampling event was started, equipment that was used to sample groundwater was disassembled and cleaned with detergent water and then rinsed with deionized water. During field sampling, equipment surfaces that were placed in the well or came into contact with groundwater during field sampling were steam cleaned with deionized water before the next well was purged or sampled.

Water Level, Floating Hydrocarbon, and Total Well Depth Measurements

Before purging and sampling occurred, the depth to water, floating hydrocarbon thickness, and total well depth were measured using an oil/water interface measuring system. The oil/water interface measuring system consists of a probe that emits a continuous audible tone when immersed in a nonconductive fluid, such as oil or gasoline, and an intermittent tone when immersed in a conductive fluid, such as water. The floating hydrocarbon thickness and water level were measured by lowering the probe into the well. Liquid levels were recorded relative to the tone emitted at the groundwater surface. The sonic probe was decontaminated by being rinsed with deionized water or steam cleaned after each use. A bottom-filling, clear Teflon[®] bailer was used to verify floating hydrocarbon thickness measurements of less than 0.02 foot. Alternatively, an electric sounder and a bottom-filling Teflon bailer may have been used to record floating hydrocarbon thickness and depth to water.

The electric sounder is a transistorized instrument that uses a reel-mounted, two-conductor, coaxial cable that connects the control panel to the sensor. Cable markings are stamped at 1-foot intervals. The water level was measured by lowering the sensor into the monitoring well. A low-current circuit was completed when the sensor contacted the water, which served as an electrolyte. The current was amplified and fed into an indicator light and audible buzzer, signaling when water had been contacted. A sensitivity control compensated for highly saline or conductive water. The electric sounder was decontaminated by being rinsed with deionized water after each use. The bailer was lowered to a point just below the liquid level, retrieved, and observed for floating hydrocarbon.

Liquid measurements were recorded to the nearest 0.01 foot on the depth to water/floating product survey form. The groundwater elevation at each monitoring well was calculated by subtracting the measured depth to water from the surveyed elevation of the top of the well casing. (Every attempt was made to measure depth to water for all wells on the same day.) Total well depth was then measured by lowering the sensor to the bottom of the well. Total well depth, used to calculate purge volumes and to determine whether the well screen was partially obstructed by silt, was recorded to the nearest 0.1 foot on the depth to water/floating product survey form.

Well Purging

If the depth to groundwater was above the top of screens of the monitoring wells, then the wells were purged. Before sampling occurred, a polyvinyl chloride (PVC) bailer, centrifugal pump, low-flow submersible pump, or Teflon bailer was used to purge standing water in the casing and gravel pack from the monitoring well. Monitoring wells were purged according to the protocol presented in Figure A-1. In most monitoring wells, the amount of water purged before sampling was greater than or equal to three casing volumes. Some monitoring wells were expected to be evacuated to dryness after removing fewer than three casing volumes. These low-yield monitoring wells were allowed to recharge for up to 24 hours. Samples were obtained as soon as the monitoring wells recharged to a level sufficient for sample collection. If insufficient water recharged after 24 hours, the monitoring well was recorded as dry for the sampling event.

Groundwater purged from the monitoring wells was transported in a 500-gallon water trailer, 55-gallon drum, or a 325-gallon truck-mounted tank to EMCON's San Jose or Sacramento office location for temporary storage. EMCON arranged for transport and disposal of the purged groundwater through Integrated Waste Stream Management, Inc.

Field measurements of pH, specific conductance, and temperature were recorded in a waterproof field logbook. Figure A-2 shows an example of the water sample field data sheet on which field data are recorded. Field data sheets were reviewed for completeness by the sampling coordinator after the sampling event was completed.

The pH, specific conductance, and temperature meter were calibrated each day before field activities were begun. The calibration was checked once each day to verify meter performance. Field meter calibrations were recorded on the water sample field data sheet.

Well Sampling

A Teflon bailer was the only equipment acceptable for well sampling. When samples for volatile organic analysis were being collected, the flow of groundwater from the bailer was regulated to minimize turbulence and aeration. Glass bottles of at least 40-milliliters volume and fitted with Teflon-lined septa were used in sampling for volatile organics. These bottles were filled completely to prevent air from remaining in the bottle. A positive meniscus formed when the bottle was completely full. A convex Teflon septum was placed over the positive meniscus to eliminate air. After the bottle was capped, it was inverted and tapped to verify that it contained no air bubbles. The sample containers for other parameters were filled, filtered as required, and capped.

When required, dissolved concentrations of metals were determined using appropriate field filtration techniques. The sample was filtered by emptying the contents of the Teflon bailer into a pressure transfer vessel. A disposable 0.45-micron acrylic copolymer filter was threaded onto the transfer vessel at the discharge point, and the vessel was sealed. Pressure was applied to the vessel with a hand pump and the filtrate directed into the appropriate containers. Each filter was used once and discarded.

Sample Preservation and Handling

The following section specifies sample containers, preservation methods, and sample handling procedures.

Sample Containers and Preservation

Sample containers vary with each type of analytical parameter. Container types and materials were selected to be nonreactive with the particular analytical parameter tested.

Sample Handling

Sample containers were labeled immediately prior to sample collection. Samples were kept cool with cold packs until received by the laboratory. At the time of sampling, each sample was logged on an ARCO chain-of-custody record that accompanied the sample to the laboratory.

Samples that required overnight storage prior to shipping to the laboratory were kept cool (4° C) in a refrigerator. The refrigerator was kept in a warehouse, which was locked when not occupied by an EMCON employee. A sample/refrigerator log was kept to record the date and time that samples were placed into and removed from the refrigerator.

Samples were transferred from EMCON to an ARCO-approved laboratory by courier or taken directly to the laboratory by the environmental sampler. Sample shipments from EMCON to laboratories performing the selected analyses routinely occurred within 24 hours of sample collection.

Sample Documentation

The following procedures were used during sampling and analysis to provide chain-of-custody control during sample handling from collection through storage. Sample documentation included the use of the following:

- Water sample field data sheets to document sampling activities in the field
- Labels to identify individual samples
- Chain-of-custody record sheets for documenting possession and transfer of samples
- Laboratory analysis request sheets for documenting analyses to be performed

Field Logbook

In the field, the sampler recorded the following information on the water sample field data sheet (see Figure A-2) for each sample collected:

- Project number
- Client's name
- Location
- Name of sampler
- Date and time
- Well accessibility and integrity
- Pertinent well data (e.g., casing diameter, depth to water, well depth)
- Calculated and actual purge volumes
- Purging equipment used
- Sampling equipment used
- Appearance of each sample (e.g., color, turbidity, sediment)
- Results of field analyses (temperature, pH, specific conductance)
- General comments

The water sample field data sheet was signed by the sampler and reviewed by the sampling coordinator.

Labels

Sample labels contained the following information:

- Project number
- Sample number (i.e., well designation)
- Sample depth
- Sampler's initials
- Date and time of collection
- Type of preservation used (if any)

Sampling and Analysis Chain-of-Custody Record

The ARCO chain-of-custody record initiated at the time of sampling contained, at a minimum, the sample designation (including the depth at which the sample was collected), sample type, analytical request, date of sampling, and the name of the sampler. The record sheet was signed, timed, and dated by the sampler when transferring the samples. The number of custodians in the chain of possession was minimized. A copy of the ARCO chain-of-custody record was returned to EMCON with the analytical results.

Groundwater Sampling and Analysis Request Form

A groundwater sampling and analysis request form (see Figure A-3) was used to communicate to the environmental sampler the requirements of the monitoring event. At a minimum, the groundwater sampling and analysis request form included the following information:

- Date scheduled
- Site-specific instructions
- Specific analytical parameters
- Well number
- Well specifications (expected total depth, depth of water, and product thickness)



OWT

MONITORING WELL PURGING PROTOCOL

MEASURE AND RECORD DEPTH TO WATER AND WELL TOTAL DEPTH

CHECK FOR FLOATING PRODUCT

YES

MEASURE AND DOCUMENT FLOATING PRODUCT THICKNESS. DO NOT SAMPLE WELL FOR DISSOLVED CONSTITUENTS.

NO

CALCULATE PURGE VOLUME BY USING THE FOLLOWING EQUATION:

$$P = \pi r^2 h \times 7.48 \times 3$$

where:

P = calculated purge volume (gallons)

π = 3.14

r = radius of well casing in feet

h = height of water column in feet

EVACUATE WATER FROM WELL EQUAL TO THE CALCULATED PURGE VOLUME WHILE MONITORING GROUNDWATER STABILIZATION INDICATOR PARAMETERS (pH, CONDUCTIVITY, TEMPERATURE) AT INTERVALS OF ONE CASING VOLUME.

WELL EVACUATED TO PRACTICAL LIMITS OF DRYNESS BEFORE REMOVING CALCULATED PURGE VOLUME

NO

FINAL TWO SETS OF GROUNDWATER STABILIZATION INDICATOR PARAMETER MEASUREMENTS MEET THE FOLLOWING CRITERIA:

- pH = ± 0.1 pH units
- COND. = ± 10 %
- TEMP. = ± 1.0 °F

YES

WELL PURGING CRITERIA MET; PROCEED TO WELL SAMPLING.

NO

CONTINUE PURGING; EVACUATE ADDITIONAL CASING VOLUME OF WATER, MONITORING INDICATOR PARAMETERS FOR STABILITY.

YES

WELL RECHARGES TO A LEVEL SUFFICIENT FOR SAMPLE COLLECTION WITHIN 24 HOURS OF EVACUATION TO DRYNESS.

YES

FIELD TEST FIRST RECHARGE WATER FOR INDICATOR PARAMETERS, THEN PROCEED TO WELL SAMPLING.

NO

RECORD WELL AS DRY FOR PURPOSES OF SAMPLING.



EMCON

MONITORING WELL PURGING PROTOCOL

FIGURE

A-1

WATER SAMPLE FIELD DATA SHEET

Rev. 5/96



OWT

PROJECT NO : _____
 PURGED BY : _____
 SAMPLED BY : _____

SAMPLE ID : _____
 CLIENT NAME : _____
 LOCATION : _____

TYPE: Groundwater _____ Surface Water _____ Leachate _____ Other _____
 CASING DIAMETER (inches): 2 _____ 3 _____ 4 _____ 4.5 _____ 6 _____ Other _____

CASING ELEVATION (feet/MSL) : _____ VOLUME IN CASING (gal.) : _____
 DEPTH OF WELL (feet) : _____ CALCULATED PURGE (gal.) : _____
 DEPTH OF WATER (feet) : _____ ACTUAL PURGE VOL. (gal.) : _____

DATE PURGED : _____ END PURGE : _____
 DATE SAMPLED : _____ SAMPLING TIME : _____

TIME (2400 HR)	VOLUME (gal.)	pH (units)	E.C. (µmhos/cm@25°C)	TEMPERATURE (°F)	TURBIDITY (visual/NTU)	TIME (2400 HR)
_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____

OTHER: _____ ODOR: _____
(COBALT 0-100) (NTU 0-200)

FIELD QC SAMPLES COLLECTED AT THIS WELL (i.e. FB-1, XDUP-1) : _____

PURGING EQUIPMENT

SAMPLING EQUIPMENT

_____ 2" Bladder Pump _____ Bailer (Teflon)
 _____ Centrifugal Pump _____ Bailer (PVC)
 _____ Submersible Pump _____ Bailer (Stainless Steel)
 _____ Well Wizard™ _____ Dedicated
 Other _____

_____ 2" Bladder Pump _____ Bailer (Teflon)
 _____ Bomb Sampler _____ Bailer (Stainless Steel)
 _____ Dipper _____ Submersible Pump
 _____ Well Wizard™ _____ Dedicated
 Other: _____

WELL INTEGRITY: _____ LOCK: _____

REMARKS: _____

pH, E.C., Temp. Meter Calibration: Date: _____ Time: _____ Meter Serial No.: _____

E.C. 1000 _____ / _____ pH 7 _____ / _____ pH 10 _____ / _____ pH 4 _____ / _____

Temperature °F _____

SIGNATURE: _____ REVIEWED BY: _____ PAGE _____ OF _____



EMCON

WATER SAMPLE FIELD DATA SHEET

FIGURE

A-2



OWT

**EMCON - SACRAMENTO
GROUNDWATER SAMPLING AND ANALYSIS REQUEST FORM**

PROJECT NAME :

SCHEDULED DATE :

SPECIAL INSTRUCTIONS / CONSIDERATIONS :

[Empty box for special instructions]

Project Authorization: _____
EMCON Project No.: _____
OWT Project No.: _____
Task Code: _____
Originals To: _____
cc: _____

Well Lock Number (s)

CHECK BOX TO AUTHORIZE DATA ENTRY

Site Contact: _____
Name Phone #

Well Number or Source	Casing Diameter (inches)	Casing Length (feet)	Depth to Water (feet)	ANAYSES REQUESTED

Laboratory and Lab QC Istructions:



EMCON

SAMPLING AND ANALYSIS REQUEST FORM

**FIGURE
A-3**

APPENDIX B

**CERTIFIED ANALYTICAL REPORTS,
AND CHAIN-OF-CUSTODY DOCUMENTATION**



October 23, 1998

Service Request No.: S9802691

Glen Vanderveen
PINNACLE
144 A Mayhew Wy.
Walnut Creek, CA 94596

RE: #20805-302.003/TO#22312.00/RAT#8/4931 OAKLAND

Dear Mr. Vanderveen:

The following pages contain analytical results for sample(s) received by the laboratory on October 9, 1998. Results of sample analyses are followed by Appendix A which contains sample custody documentation and quality assurance deliverables requested for this project. The work requested has been assigned the Service Request No. listed above. To help expedite our service, please refer to this number when contacting the laboratory.

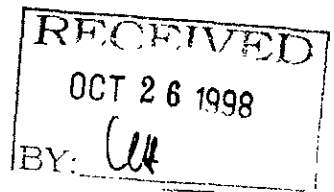
Analytical results were produced by procedures consistent with Columbia Analytical Services' (CAS) Quality Assurance Manual (with any deviations noted). Signature of this CAS Analytical Report below confirms that pages 2 through 18, following, have been thoroughly reviewed and approved for release in accord with CAS Standard Operating Procedure ADM-DatRev3.

Please feel welcome to contact me should you have questions or further needs.

Sincerely,

Steven L. Green
Project Chemist

Greg Anderson
Regional QA Coordinator



COLUMBIA ANALYTICAL SERVICES, Inc.

Acronyms

A2LA	American Association for Laboratory Accreditation
ASTM	American Society for Testing and Materials
BOD	Biochemical Oxygen Demand
BTEX	Benzene, Toluene, Ethylbenzene, Xylenes
CAM	California Assessment Metals
CARB	California Air Resources Board
CAS Number	Chemical Abstract Service registry Number
CFC	Chlorofluorocarbon
CFU	Colony-Forming Unit
COD	Chemical Oxygen Demand
DEC	Department of Environmental Conservation
DEQ	Department of Environmental Quality
DHS	Department of Health Services
DLCS	Duplicate Laboratory Control Sample
DMS	Duplicate Matrix Spike
DOE	Department of Ecology
DOH	Department of Health
EPA	U. S. Environmental Protection Agency
ELAP	Environmental Laboratory Accreditation Program
GC	Gas Chromatography
GC/MS	Gas Chromatography/Mass Spectrometry
IC	Ion Chromatography
ICB	Initial Calibration Blank sample
ICP	Inductively Coupled Plasma atomic emission spectrometry
ICV	Initial Calibration Verification sample
J	Estimated concentration The value is less than the MRL, but greater than or equal to the MDL. If the value is equal to the MRL, the result is actually <MRL before rounding.
LCS	Laboratory Control Sample
LUFT	Leaking Underground Fuel Tank
M	Modified
MBAS	Methylene Blue Active Substances
MCL	Maximum Contaminant Level. The highest permissible concentration of a substance allowed in drinking water as established by the U. S. EPA.
MDL	Method Detection Limit
MPN	Most Probable Number
MRL	Method Reporting Limit
MS	Matrix Spike
MTBE	Methyl tert-Butyl Ether
NA	Not Applicable
NAN	Not Analyzed
NC	Not Calculated
NCASI	National Council of the paper industry for Air and Stream Improvement
ND	Not Detected at or above the method reporting/detection limit (MRL/MDL)
NIOSH	National Institute for Occupational Safety and Health
NTU	Nephelometric Turbidity Units
ppb	Parts Per Billion
ppm	Parts Per Million
PQL	Practical Quantitation Limit
QA/QC	Quality Assurance/Quality Control
RCRA	Resource Conservation and Recovery Act
RPD	Relative Percent Difference
SIM	Selected Ion Monitoring
SM	Standard Methods for the Examination of Water and Wastewater, 18th Ed., 1992
STLC	Solubility Threshold Limit Concentration
SW	Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846, 3rd Ed., 1986 and as amended by Updates I, II, IIA, and IIB.
TCLP	Toxicity Characteristic Leaching Procedure
TDS	Total Dissolved Solids
TPH	Total Petroleum Hydrocarbons
tr	Trace level. The concentration of an analyte that is less than the PQL but greater than or equal to the MDL. If the value is equal to the PQL, the result is actually <PQL before rounding.
TRPH	Total Recoverable Petroleum Hydrocarbons
TSS	Total Suspended Solids
TTLC	Total Threshold Limit Concentration
VOA	Volatile Organic Analyte(s)

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client: ARCO Products Company
Project: #20805-302 003/TO#22312 00/RAT#8/4931 OAKLAND
Sample Matrix: Water

Service Request: S9802691
Date Collected: 10/9/98
Date Received: 10/9/98

BTEX, MTBE and TPH as Gasoline

Sample Name: A-3(12)
Lab Code: S9802691-001
Test Notes:

Units: ug/L (ppb)
Basis: NA

Analyte	Prep Method	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	Result Notes
TPH as Gasoline	EPA 5030	CA/LUFT	50	5	NA	10/22/98	<250	C1
Benzene	EPA 5030	8020	0.5	5	NA	10/22/98	<2.5	C1
Toluene	EPA 5030	8020	0.5	5	NA	10/22/98	<2.5	C1
Ethylbenzene	EPA 5030	8020	0.5	5	NA	10/22/98	<2.5	C1
Xylenes, Total	EPA 5030	8020	0.5	5	NA	10/22/98	<2.5	C1
Methyl <i>tert</i> -Butyl Ether	EPA 5030	8020	3	5	NA	10/22/98	260	

C1 The MRL was elevated due to high analyte concentration requiring sample dilution.

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client: ARCO Products Company
Project: #20805-302.003/TO#22312 00/RAT#8/4931 OAKLAND
Sample Matrix: Water

Service Request: S9802691
Date Collected: 10/9/98
Date Received: 10/9/98

BTEX, MTBE and TPH as Gasoline

Sample Name: A-5(12)
Lab Code: S9802691-002
Test Notes:

Units: ug/L (ppb)
Basis: NA

Analyte	Prep Method	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	Result Notes
TPH as Gasoline	EPA 5030	CA/LUFT	50	10	NA	10/22/98	690	G2
Benzene	EPA 5030	8020	0.5	10	NA	10/22/98	<5	C1
Toluene	EPA 5030	8020	0.5	10	NA	10/22/98	<5	C1
Ethylbenzene	EPA 5030	8020	0.5	10	NA	10/22/98	<5	C1
Xylenes, Total	EPA 5030	8020	0.5	10	NA	10/22/98	<5	C1
Methyl <i>tert</i> -Butyl Ether	EPA 5030	8020	3	10	NA	10/22/98	710	

C1 The MRL was elevated due to high analyte concentration requiring sample dilution.
G2 The chromatogram does not match the typical gasoline fingerprint.

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client: ARCO Products Company
Project: #20805-302.003/TO#22312.00/RAT#8/4931 OAKLAND
Sample Matrix: Water

Service Request: S9802691
Date Collected: 10/9/98
Date Received: 10/9/98

BTEX, MTBE and TPH as Gasoline

Sample Name: A-11(12)
Lab Code: S9802691-003
Test Notes:

Units: ug/L (ppb)
Basis: NA

Analyte	Prep Method	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	Result Notes
TPH as Gasoline	EPA 5030	CA/LUFT	50	1	NA	10/18/98	ND	
Benzene	EPA 5030	8020	0.5	1	NA	10/18/98	ND	
Toluene	EPA 5030	8020	0.5	1	NA	10/18/98	ND	
Ethylbenzene	EPA 5030	8020	0.5	1	NA	10/18/98	ND	
Xylenes, Total	EPA 5030	8020	0.5	1	NA	10/18/98	ND	
Methyl <i>tert</i> -Butyl Ether	EPA 5030	8020	3	1	NA	10/18/98	ND	

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client: ARCO Products Company
Project: #20805-302.003/TO#22312 00/RAT#8/4931 OAKLAND
Sample Matrix: Water

Service Request: S9802691
Date Collected: 10/9/98
Date Received: 10/9/98

BTEX, MTBE and TPH as Gasoline

Sample Name: A-12(12)
Lab Code: S9802691-004
Test Notes:

Units: ug/L (ppb)
Basis: NA

Analyte	Prep Method	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	Result Notes
TPH as Gasoline	EPA 5030	CA/LUFT	50	1	NA	10/18/98	ND	
Benzene	EPA 5030	8020	0.5	1	NA	10/18/98	ND	
Toluene	EPA 5030	8020	0.5	1	NA	10/18/98	ND	
Ethylbenzene	EPA 5030	8020	0.5	1	NA	10/18/98	ND	
Xylenes, Total	EPA 5030	8020	0.5	1	NA	10/18/98	ND	
Methyl <i>tert</i> -Butyl Ether	EPA 5030	8020	3	1	NA	10/18/98	7	

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client: ARCO Products Company
Project: #20805-302.003/TO#22312.00/RAT#8/4931 OAKLAND
Sample Matrix: Water

Service Request: S9802691
Date Collected: 10/9/98
Date Received: 10/9/98

BTEX, MTBE and TPH as Gasoline

Sample Name: A-6(12)
Lab Code: S9802691-005
Test Notes:

Units: ug/L (ppb)
Basis: NA

Analyte	Prep Method	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	Result Notes
TPH as Gasoline	EPA 5030	CA/LUFT	50	1	NA	10/18/98	ND	
Benzene	EPA 5030	8020	0.5	1	NA	10/18/98	ND	
Toluene	EPA 5030	8020	0.5	1	NA	10/18/98	ND	
Ethylbenzene	EPA 5030	8020	0.5	1	NA	10/18/98	ND	
Xylenes, Total	EPA 5030	8020	0.5	1	NA	10/18/98	ND	
Methyl <i>tert</i> -Butyl Ether	EPA 5030	8020	3	1	NA	10/18/98	ND	

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client: ARCO Products Company
Project: #20805-302.003/TO#22312.00/RAT#8/4931 OAKLAND
Sample Matrix: Water

Service Request: S9802691
Date Collected: 10/9/98
Date Received: 10/9/98

BTEX, MTBE and TPH as Gasoline

Sample Name: A-8(12)
Lab Code: S9802691-006
Test Notes:

Units: ug/L (ppb)
Basis: NA

Analyte	Prep Method	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	Result Notes
TPH as Gasoline	EPA 5030	CA/LUFT	50	200	NA	10/22/98	130000	
Benzene	EPA 5030	8020	0.5	200	NA	10/22/98	3700	
Toluene	EPA 5030	8020	0.5	200	NA	10/22/98	110	
Ethylbenzene	EPA 5030	8020	0.5	200	NA	10/22/98	500	
Xylenes, Total	EPA 5030	8020	0.5	200	NA	10/22/98	770	
Methyl <i>tert</i> -Butyl Ether	EPA 5030	8020	3	200	NA	10/22/98	7300	

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client: ARCO Products Company
Project: #20805-302.003/TO#22312.00/RAT#8/4931 OAKLAND
Sample Matrix: Water

Service Request: S9802691
Date Collected: 10/9/98
Date Received: 10/9/98

BTEX, MTBE and TPH as Gasoline

Sample Name: A-9(12)
Lab Code: S9802691-007
Test Notes:

Units: ug/L (ppb)
Basis: NA

Analyte	Prep Method	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	Result Notes
TPH as Gasoline	EPA 5030	CA/LUFT	50	1	NA	10/18/98	ND	
Benzene	EPA 5030	8020	0.5	1	NA	10/18/98	ND	
Toluene	EPA 5030	8020	0.5	1	NA	10/18/98	ND	
Ethylbenzene	EPA 5030	8020	0.5	1	NA	10/18/98	ND	
Xylenes, Total	EPA 5030	8020	0.5	1	NA	10/18/98	ND	
Methyl <i>tert</i> -Butyl Ether	EPA 5030	8020	3	1	NA	10/18/98	ND	

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client: ARCO Products Company
Project: #20805-302 003/TO#22312.00/RAT#8/4931 OAKLAND
Sample Matrix: Water

Service Request: S9802691
Date Collected: 10/9/98
Date Received: 10/9/98

BTEX, MTBE and TPH as Gasoline

Sample Name: A-2(12)
Lab Code: S9802691-008
Test Notes:

Units: ug/L (ppb)
Basis: NA

Analyte	Prep Method	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	Result Notes
TPH as Gasoline	EPA 5030	CA/LUFT	50	1	NA	10/18/98	ND	
Benzene	EPA 5030	8020	0.5	1	NA	10/18/98	ND	
Toluene	EPA 5030	8020	0.5	1	NA	10/18/98	ND	
Ethylbenzene	EPA 5030	8020	0.5	1	NA	10/18/98	ND	
Xylenes, Total	EPA 5030	8020	0.5	1	NA	10/18/98	ND	
Methyl <i>tert</i> -Butyl Ether	EPA 5030	8020	3	1	NA	10/18/98	ND	

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client: ARCO Products Company
Project: #20805-302.003/TO#22312.00/RAT#8/4931 OAKLAND
Sample Matrix: Water

Service Request: S9802691
Date Collected: 10/9/98
Date Received: 10/9/98

BTEX, MTBE and TPH as Gasoline

Sample Name: A-4(12)
Lab Code: S9802691-009
Test Notes:

Units: ug/L (ppb)
Basis: NA

Analyte	Prep Method	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	Result Notes
TPH as Gasoline	EPA 5030	CA/LUFT	50	40	NA	10/22/98	3500	G2
Benzene	EPA 5030	8020	0.5	40	NA	10/22/98	400	
Toluene	EPA 5030	8020	0.5	40	NA	10/22/98	<20	C1
Ethylbenzene	EPA 5030	8020	0.5	40	NA	10/22/98	54	
Xylenes, Total	EPA 5030	8020	0.5	40	NA	10/22/98	<20	C1
Methyl <i>tert</i> -Butyl Ether	EPA 5030	8020	3	40	NA	10/22/98	1700	

C1 The MRL was elevated due to high analyte concentration requiring sample dilution.
G2 The chromatogram does not match the typical gasoline fingerprint.

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client: ARCO Products Company
Project: #20805-302.003/TO#22312.00/RAT#8/4931 OAKLAND
Sample Matrix: Water

Service Request: S9802691
Date Collected: NA
Date Received: NA

BTEX, MTBE and TPH as Gasoline

Sample Name: Method Blank
Lab Code: S981017-WB1
Test Notes:

Units: ug/L (ppb)
Basis: NA

Analyte	Prep Method	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	Result Notes
TPH as Gasoline	EPA 5030	CA/LUFT	50	1	NA	10/17/98	ND	
Benzene	EPA 5030	8020	0.5	1	NA	10/17/98	ND	
Toluene	EPA 5030	8020	0.5	1	NA	10/17/98	ND	
Ethylbenzene	EPA 5030	8020	0.5	1	NA	10/17/98	ND	
Xylenes, Total	EPA 5030	8020	0.5	1	NA	10/17/98	ND	
Methyl <i>tert</i> -Butyl Ether	EPA 5030	8020	3	1	NA	10/17/98	ND	

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client: ARCO Products Company
Project: #20805-302.003/TO#22312.00/RAT#8/4931 OAKLAND
Sample Matrix: Water

Service Request: S9802691
Date Collected: NA
Date Received: NA

BTEX, MTBE and TPH as Gasoline

Sample Name: Method Blank
Lab Code: S981021-WB2
Test Notes:

Units: ug/L (ppb)
Basis: NA

Analyte	Prep Method	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	Result Notes
TPH as Gasoline	EPA 5030	CA/LUFT	50	1	NA	10/21/98	ND	
Benzene	EPA 5030	8020	0.5	1	NA	10/21/98	ND	
Toluene	EPA 5030	8020	0.5	1	NA	10/21/98	ND	
Ethylbenzene	EPA 5030	8020	0.5	1	NA	10/21/98	ND	
Xylenes, Total	EPA 5030	8020	0.5	1	NA	10/21/98	ND	
Methyl <i>tert</i> -Butyl Ether	EPA 5030	8020	3	1	NA	10/21/98	ND	

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client: ARCO Products Company
Project: #20805-302.003/TO#22312.00/RAT#8/4931 OAKLAND
Sample Matrix: Water

Service Request: S9802691
Date Collected: NA
Date Received: NA

BTEX, MTBE and TPH as Gasoline

Sample Name: Method Blank
Lab Code: S981022-WB2
Test Notes:

Units: ug/L (ppb)
Basis: NA

Analyte	Prep Method	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	Result Notes
TPH as Gasoline	EPA 5030	CA/LUFT	50	1	NA	10/22/98	ND	
Benzene	EPA 5030	8020	0.5	1	NA	10/22/98	ND	
Toluene	EPA 5030	8020	0.5	1	NA	10/22/98	ND	
Ethylbenzene	EPA 5030	8020	0.5	1	NA	10/22/98	ND	
Xylenes, Total	EPA 5030	8020	0.5	1	NA	10/22/98	ND	
Methyl <i>tert</i> -Butyl Ether	EPA 5030	8020	3	1	NA	10/22/98	ND	

APPENDIX A

COLUMBIA ANALYTICAL SERVICES, INC.

QA/QC Report

Client: ARCO Products Company
Project: #20805-302.003/TO#22312.00/RAT#8/4931 OAKLAND
Sample Matrix: Water

Service Request: S9802691
Date Collected: NA
Date Received: NA
Date Extracted: NA
Date Analyzed: NA

Surrogate Recovery Summary
 BTEX, MTBE and TPH as Gasoline

Prep Method: EPA 5030
Analysis Method: 8020 CA/LUFT

Units: PERCENT
Basis: NA

Sample Name	Lab Code	Test Notes	Percent Recovery	
			4-Bromofluorobenzene	a,a,a-Trifluorotoluene
A-3(12)	S9802691-001		102	96
A-5(12)	S9802691-002		103	96
A-11(12)	S9802691-003		88	93
A-12(12)	S9802691-004		90	91
A-6(12)	S9802691-005		91	90
A-8(12)	S9802691-006		116	77
A-9(12)	S9802691-007		91	89
A-2(12)	S9802691-008		89	89
A-4(12)	S9802691-009		107	87
BATCH QC	S9802704-002MS		103	95
BATCH QC	S9802704-002DMS		100	99
Method Blank	S981017-WB1		84	87
Method Blank	S981021-WB2		105	90
Method Blank	S981022-WB2		108	92

CAS Acceptance Limits: 69-116 69-116

COLUMBIA ANALYTICAL SERVICES, INC.

QA/QC Report

Client: ARCO Products Company
Project: #20805-302.003/TO#22312.00/RAT#8/4931 OAKLAND
Sample Matrix: Water

Service Request: S9802691
Date Collected: NA
Date Received: NA
Date Extracted: NA
Date Analyzed: 10/22/98

Matrix Spike/Duplicate Matrix Spike Summary
 TPH as Gasoline

Sample Name: BATCH QC Units: ug/L (ppb)
Lab Code: S9802704-002MS, S9802704-002DMS Basis: NA
Test Notes:

Analyte	Prep Method	Analysis Method	Percent Recovery											Result Notes
			Spike Level		Sample Result	Spike Result		CAS		Relative Percent Difference				
			MRL	MS		DMS	MS	DMS	MS		DMS	Acceptance Limits		
Gasoline	EPA 5030	CA/LUFT	50	250	250	ND	240	270	96	108	75-135	12		

COLUMBIA ANALYTICAL SERVICES, INC.

QA/QC Report

Client: ARCO Products Company
Project: #20805-302.003/TO#22312.00/RAT#8/4931 OAKLAND

Service Request: S9802691
Date Analyzed: 10/21/98

Initial Calibration Verification (ICV) Summary
 BTEX, MTBE and TPH as Gasoline

Sample Name: ICV Units: ug/L (ppb)
 Lab Code: ICVI Basis: NA
 Test Notes:

ICV Source:

Analyte	Prep Method	Analysis Method	True Value	Result	CAS Percent Recovery		Result Notes
					Acceptance Limits	Percent Recovery	
TPH as Gasoline	EPA 5030	CA/LUFT	250	260	90-110	104	
Benzene	EPA 5030	8020	25	26	85-115	104	
Toluene	EPA 5030	8020	25	26	85-115	104	
Ethylbenzene	EPA 5030	8020	25	26	85-115	104	
Xylenes, Total	EPA 5030	8020	75	78	85-115	104	
Methyl tert-Butyl Ether	EPA 5030	8020	25	24	85-115	96	

ARCO Products Company

Division of Atlantic/Richfield Company

59802691

Task Order No. 22312.00

Chain of Custody

ARCO Facility no. 4931	City (Facility) Oakland	Project manager (Consultant) Glen VanderVeen	Laboratory Name CAS
ARCO engineer Paul Supple	Telephone no. (ARCO)	Telephone no. (Consultant) (408) 453-7300	Contract Number
Consultant name EMCON		Address (Consultant) 44-A Mayhew Way Walnut Creek, CA 95496	
			Method of shipment Sampler will deliver

Sample I.D.	Lab no.	Container no.	Matrix			Preservation		Sampling date	Sampling time	BTEX 802EPA 8020	BTEX/TPH EPA 1602/20015	TPH Modified 8015 Gas Diesel	Oil and Grease 413.1 413.2	TPH EPA 418.1SM 503E	EPA 6018010	EPA 6240240	EPA 6250270	TCLP Semi Metals VOAD VOAD	CAM Metals EPA 60107000	TLCJ STLCJ	Lead Org/DHS Lead EPA 7420742	
			Soil	Water	Other	Ice	Acid															
A-3(12)①		2	X			X	HCL	10/9/98	0855	X												
A-5(12)②		2	X			X	HCL		0905	X												
A-11(12)③		2	X			X	HCL		0945	X												
A-12(12)④		2	X			X	HCL		0935	X												
A-6(12)⑤		2	X			X	HCL		1000	X												
A-8(12)⑥		2	X			X	HCL		1015	X												
A-9(12)⑦		2	X			X	HCL		1030	X												
A-7(12)⑧		2	X			X	HCL		1040	X												
A-4(12)⑨		2	X			X	HCL		1055	X												

Special Detection Limit/reporting Lowest Possible
Special QA/QC As Normal
Remarks RAT 8 2-40ml HCL VOAs
Lab Number #70805-302.003

Condition of sample:			Temperature received:		
Relinquished by sampler <i>[Signature]</i>	Date 10/9/98	Time 1220	Received by <i>[Signature]</i>	Date 10/9/98	Time 1220
Relinquished by	Date	Time	Received by	Date	Time
Relinquished by	Date	Time	Received by laboratory	Date	Time

Turnaround Time:	
Priority Rush 1 Business Day	<input type="checkbox"/>
Rush 2 Business Days	<input type="checkbox"/>
Expedited 5 Business Days	<input type="checkbox"/>
Standard 10 Business Days	<input checked="" type="checkbox"/>

APPENDIX C
FIELD DATA SHEETS

**FIELD REPORT
DEPTH TO WATER / FLOATING PRODUCT SURVEY**

PROJECT # : 21775-302.003

STATION ADDRESS : 731 W. MacArthur Blvd. Oakland, CA

DATE : 10/9/98

ARCO STATION # : 4931

FIELD TECHNICIAN : Manuel Gallegos/ Mike Ross

DAY : Friday

DTW Order	WELL ID	Well Box Seal	Well Lid Secure	Gasket Present	Lock Number	Type Of Well Cap	FIRST DEPTH TO WATER (feet)	SECOND DEPTH TO WATER (feet)	DEPTH TO FLOATING PRODUCT (feet)	FLOATING PRODUCT THICKNESS (feet)	WELL TOTAL DEPTH (feet)	COMMENTS
1	A-3	OK	G-5	NO	NONE 2357	LWC	11.36	11.36	ND	ND	19.2	
2	A-5	OK	G-5	NO	NONE 2357	LWC	11.02	11.02	ND	ND	25.6	well box lid split into two pieces
3	A-6	OK	G-5	NO	NONE 2357	LWC	10.23	10.23	ND	ND	25.4	
4	A-7	OK	G-5	NO	NONE 2357	LWC	10.05	10.05	ND	ND	22.7	
5	A-8	OK	VAULT	YES	NONE	SLIP	11.23	11.23	ND	ND	22.2	ORC sock
6	A-9	OK	VAULT	YES	NONE	SLIP	10.05	10.05	ND	ND	38.8	
7	A-2	OK	G-5	NO	NONE 2357	LWC	10.82	10.82	ND	ND	19.8	
8	A-4	OK	G-5	NO	NONE 2357	LWC	11.20	11.20	ND	ND	20.3	ORC sock
9	A-11	OK	G-5	NO	NONE	LWC	10.91	10.91	ND	ND	30.0	
10	A-12	OK	G-5	NO	NONE	LWC	10.21	10.21	ND	ND	30.4	
11	A-13	Iw	Iw	Iw	Iw	Iw	Iw	Iw	Iw	Iw	Iw	well paved over
12	AR-1	OK	VAULT	NO	NONE	SLIP	11.25	11.25	ND	ND	30.0	
13	AR-2	OK	VAULT	NO	NONE	SLIP	6.90	6.90	ND	ND	27.6	
14	AR-3	OK	VAULT	NO	NONE	SLIP	11.20	11.20	ND	ND	29.8	

SURVEY POINTS ARE TOP OF WELL BOXES

WATER SAMPLE FIELD DATA SHEET

Rev 1/9"



OWT

PROJECT NO 21775-302.003
 PURGED BY NR
 SAMPLED BY M. Ross

SAMPLE ID A-2(12)
 CLIENT NAME ARCO 4931
 LOCATION Oakland, Ca.

TYPE Groundwater Surface Water Leachate Other
 CASING DIAMETER (inches) 2 3 4 4.5 6 Other

CASING ELEVATION (feet/MSL) NR VOLUME IN CASING (gal) NR
 DEPTH OF WELL (feet) 19.8 CALCULATED PURGE (gal) NR
 DEPTH OF WATER (feet) 10.80 ACTUAL PURGE VOL (gal) NR

DATE PURGED NR END PURGE NR
 DATE SAMPLED 10/9/98 SAMPLING TIME 1040

TIME (2400 HR)	VOLUME (gal)	pH (units)	E C (µmhos/cm@25°C)	TEMPERATURE (°F)	COLOR (visual)	TURBIDITY (visual)
<u>1040</u>	<u>GRAB</u>	<u>6.93</u>	<u>440</u>	<u>69.9</u>	<u>Clr</u>	<u>Clr</u>

OTHER: D.O. 0.5 mg/L ODOR: None NR NR
(COBALT 0-100) (NTU 0-200)

FIELD QC SAMPLES COLLECTED AT THIS WELL (i.e. FB-1, XDUP-1): NR

PURGING EQUIPMENT

2" Bladder Pump Bailer (Teflon)
 Centrifugal Pump Bailer (PVC)
 Submersible Pump Bailer (Stainless Steel)
 Well Wizard™ Dedicated
 Other NR

SAMPLING EQUIPMENT

2" Bladder Pump Bailer (Teflon)
 Bomb Sampler Bailer (Stainless Steel)
 Dipper Submersible Pump
 Well Wizard™ Dedicated
 Other NR

WELL INTEGRITY: NR LOCK: None

REMARKS: GRAB Sample taken - Water Column Below top of screens.

pH, E C, Temp Meter Calibration Date 10/9/98 Time 0840 Meter Serial No 600232
 E C 1000 1 pH 7 1 pH 10 1 pH 4 1

Temperature °F See A-3
 SIGNATURE: Mike Ross REVIEWED BY: JA PAGE 1 OF 9

WATER SAMPLE FIELD DATA SHEET

Rev 1/97



OWT

PROJECT NO 21775-302.003
 PURGED BY NR
 SAMPLED BY M. ROSS

SAMPLE ID A-3(12)
 CLIENT NAME ARCO 4931
 LOCATION Oakland, Ca

TYPE Groundwater Surface Water Leachate Other
 CASING DIAMETER (inches) 2 3 4 5 6 Other

CASING ELEVATION (feet/MSL) NR VOLUME IN CASING (gal) NR
 DEPTH OF WELL (feet) 19.2 CALCULATED PURGE (gal) NR
 DEPTH OF WATER (feet) 11.36 ACTUAL PURGE VOL (gal) NR

DATE PURGED NR END PURGE NR
 DATE SAMPLED 10/9/98 SAMPLING TIME 0855

TIME (2400 HR)	VOLUME (gal)	pH (units)	E.C. (µmhos/cm@25°C)	TEMPERATURE (°F)	COLOR (visual)	TURBIDITY (visual)
<u>0855</u>	<u>GRAB</u>	<u>6.49</u>	<u>865</u>	<u>66.8</u>	<u>clr</u>	<u>clr</u>

OTHER: D.O. 1.0 mg/L ODOR none NR NR
(COBALT 0-100) (NTU 0-200)

FIELD QC SAMPLES COLLECTED AT THIS WELL (i.e. FB-1, XDUP-1): NR

PURGING EQUIPMENT

2" Bladder Pump Bailer (Teflon)
 Centrifugal Pump Bailer (PVC)
 Submersible Pump Bailer (Stainless Steel)
 Well Wizard™ Dedicated
 Other NR

SAMPLING EQUIPMENT

2" Bladder Pump Bailer (Teflon)
 Bomb Sampler Bailer (Stainless Steel)
 Dipper Submersible Pump
 Well Wizard™ Dedicated
 Other DISPOSABLE

WELL INTEGRITY: OK LOCK: NONE ~~2357~~

REMARKS: Grab sample taken - water column below top of screens.

pH, E.C., Temp Meter Calibration Date 10/9/98 Time 0840 Meter Serial No 600232
 E.C. 1000/1000, 1000 pH 7.70, 7.00 pH 10/002, 1000 pH 4 397, 400
 Temperature °F 59.7
 SIGNATURE: M. Ross REVIEWED BY MA PAGE 2 OF 9

WATER SAMPLE FIELD DATA SHEET

Rev 1/97



OWT

PROJECT NO 21775-302.003
 PURGED BY NR
 SAMPLED BY M. Ross

SAMPLE ID A-4(2)
 CLIENT NAME ALD 4931
 LOCATION Oakland, Ca

TYPE Groundwater Surface Water Leachate Other
 CASING DIAMETER (inches) 2 3 4 4.5 6 Other

CASING ELEVATION (feet/MSL) NR VOLUME IN CASING (gal) NR
 DEPTH OF WELL (feet) 20.3 CALCULATED PURGE (gal) NR
 DEPTH OF WATER (feet) 11.20 ACTUAL PURGE VOL (gal) NR

DATE PURGED 10/9/98 END PURGE NR
 DATE SAMPLED 10/9/98 SAMPLING TIME 1055

TIME (2400 HR)	VOLUME (gal)	pH (units)	E C (µmhos/cm@25°C)	TEMPERATURE (°F)	COLOR (visual)	TURBIDITY (visual)
<u>1055</u>	<u>GRAB</u>	<u>6.63</u>	<u>1710</u>	<u>70.5</u>	<u>clr</u>	<u>clr</u>

OTHER: 0.0, 1.0 mg/L ODOR Strong NR
(COBALT 0-100) NR
(NTU 0-200)

FIELD QC SAMPLES COLLECTED AT THIS WELL (i.e. FB-1, XDUP-1): _____

PURGING EQUIPMENT	SAMPLING EQUIPMENT
<input type="checkbox"/> 2" Bladder Pump <input type="checkbox"/> Bailer (Teflon) <input checked="" type="checkbox"/> Centrifugal Pump <input type="checkbox"/> Bailer (PVC) <input type="checkbox"/> Submersible Pump <input type="checkbox"/> Bailer (Stainless Steel) <input type="checkbox"/> Well Wizard™ <input type="checkbox"/> Dedicated Other <u>NR</u>	<input type="checkbox"/> 2" Bladder Pump <input checked="" type="checkbox"/> Bailer (Teflon) <input type="checkbox"/> Bomb Sampler <input type="checkbox"/> Bailer (Stainless Steel) <input type="checkbox"/> Dipper <input type="checkbox"/> Submersible Pump <input type="checkbox"/> Well Wizard™ <input type="checkbox"/> Dedicated Other <u>Disposable</u>

WELL INTEGRITY: OK LOCK: None

REMARKS: GRAB Sample taken - water column below top of screens

pH, E C, Temp Meter Calibration Date 10/9/98 Time 0840 Meter Serial No 600232
 EC 1000 1 pH 7 1 pH 10 1 pH 4 1
 Temperature °F See A-3
 SIGNATURE: M. Ross REVIEWED BY: SA PAGE 3 OF 9

WATER SAMPLE FIELD DATA SHEET

Rev 1/97



PROJECT NO 21775-302.003
 PURGED BY NR
 SAMPLED BY M. Ross

SAMPLE ID A-5(12)
 CLIENT NAME ARCO 4931
 LOCATION Oakland, Ca

TYPE Groundwater Surface Water Leachate Other
 CASING DIAMETER (inches) 2 3 4 4.5 6 Other

CASING ELEVATION (feet/MSL) NR VOLUME IN CASING (gal) NR
 DEPTH OF WELL (feet) 25.6 CALCULATED PURGE (gal) NR
 DEPTH OF WATER (feet) 11.02 ACTUAL PURGE VOL (gal) NR

DATE PURGED NR END PURGE NR
 DATE SAMPLED 10-9-98 SAMPLING TIME 0905

TIME (2400 HR)	VOLUME (gal)	pH (units)	E.C (µmhos/cm@25°C)	TEMPERATURE (°F)	COLOR (visual)	TURBIDITY (visual)
<u>0905</u>	<u>GRAB</u>	<u>6.54</u>	<u>971</u>	<u>66.7</u>	<u>clr</u>	<u>clr</u>

OTHER: D.O. 1.0 Mg/L ODOR slight NR NR
(COBALT 0-100) (NTU 0-200)

FIELD QC SAMPLES COLLECTED AT THIS WELL (i.e. FB-1, XDUP-1): NR

PURGING EQUIPMENT

2" Bladder Pump Bailer (Teflon)
 Centrifugal Pump Bailer (PVC)
 Submersible Pump Bailer (Stainless Steel)
 Well Wizard™ Dedicated
 Other NR

SAMPLING EQUIPMENT

2" Bladder Pump Bailer (Teflon)
 Bomb Sampler Bailer (Stainless Steel)
 Dipper Submersible Pump
 Well Wizard™ Dedicated
 Other Disposable

WELL INTEGRITY: ok LOCK: None

REMARKS: GRAB Sample taken - water column below top of screens.

pH, E.C., Temp Meter Calibration Date 10/9/98 Time 0840 Meter Serial No 600232
 E.C. 1000 1 pH 7 1 pH 10 1 pH 4 1
 Temperature °F 59 A-3
 SIGNATURE M. Ross REVIEWED BY MA PAGE 4 OF 9

WATER SAMPLE FIELD DATA SHEET

Rev 1/97



OWT

PROJECT NO 21775-302.003
PURGED BY NR
SAMPLED BY M. Ross

SAMPLE ID A-6 (12)
CLIENT NAME ARCO
LOCATION Oakland, Ca

TYPE Groundwater Surface Water Leachate Other
CASING DIAMETER (inches) 2 3 4 4.5 6 Other

CASING ELEVATION (feet/MSL) NR VOLUME IN CASING (gal) NR
DEPTH OF WELL (feet) 25.4 CALCULATED PURGE (gal) NR
DEPTH OF WATER (feet) 10.23 ACTUAL PURGE VOL (gal) NR

DATE PURGED NR END PURGE NR
DATE SAMPLED 10/9/98 SAMPLING TIME 1000

TIME (2400 HR)	VOLUME (gal)	pH (units)	EC (µmhos/cm@25°C)	TEMPERATURE (°F)	COLOR (visual)	TURBIDITY (visual)
<u>1000</u>	<u>GRAB</u>	<u>6.61</u>	<u>623</u>	<u>68.7</u>	<u>clr</u>	<u>clr</u>

OTHER: D.O. 1.0 mg/L ODOR: None NR NR
(COBALT 0-100) (NTU 0-200)

FIELD QC SAMPLES COLLECTED AT THIS WELL (i.e. FB-1, XDUP-1): NR

PURGING EQUIPMENT

2" Bladder Pump Bailer (Teflon)
 Centrifugal Pump Bailer (PVC)
 Submersible Pump Bailer (Stainless Steel)
 Well Wizard™ Dedicated
Other NR

SAMPLING EQUIPMENT

2" Bladder Pump Bailer (Teflon)
 Bomb Sampler Bailer (Stainless Steel)
 Dipper Submersible Pump
 Well Wizard™ Dedicated
Other D. Sposarolo

WELL INTEGRITY OK LOCK None

REMARKS: GRAB Sample taken - water column below top of screens

pH, E.C., Temp Meter Calibration Date 10/9/98 Time 0840 Meter Serial No 600232
E.C. 1000 1 pH 7 1 pH 10 1 pH 4 1

Temperature °F See A-3
SIGNATURE: M. Ross REVIEWED BY NA PAGE 5 OF 9

WATER SAMPLE FIELD DATA SHEET

Rev 1/97



OWT

PROJECT NO 21275-302.003
 PURGED BY NR
 SAMPLED BY M. ROSS

SAMPLE ID A-8(12)
 CLIENT NAME ARLO 4931
 LOCATION Oakland, Ca

TYPE Groundwater Surface Water Leachate Other
 CASING DIAMETER (inches) 2 3 4 4.5 6 Other

CASING ELEVATION (feet/MSL) NR VOLUME IN CASING (gal) NR
 DEPTH OF WELL (feet) 22.2 CALCULATED PURGE (gal) NR
 DEPTH OF WATER (feet) 110.3 ACTUAL PURGE VOL (gal) NR

DATE PURGED NR END PURGE NR
 DATE SAMPLED 10/9/98 SAMPLING TIME 10:15

TIME (2400 HR)	VOLUME (gal)	pH (units)	E C (µmhos/cm@25°C)	TEMPERATURE (°F)	COLOR (visual)	TURBIDITY (visual)
<u>10:15</u>	<u>6.0</u>	<u>6.65</u>	<u>1670</u>	<u>70.7</u>	<u>clr</u>	<u>clr</u>

OTHER: D.O. 1.0 mg/L ODOR: STRONG NR NR
(COBALT 0-100) (NTU 0-200)

FIELD QC SAMPLES COLLECTED AT THIS WELL (i.e. FB-1, XDUP-1): NR

PURGING EQUIPMENT	SAMPLING EQUIPMENT
2" Bladder Pump <input type="checkbox"/> Bailer (Teflon) <input type="checkbox"/> Centrifugal Pump <input type="checkbox"/> Bailer (PVC) <input type="checkbox"/> Submersible Pump <input type="checkbox"/> Bailer (Stainless Steel) <input type="checkbox"/> Well Wizard™ <input type="checkbox"/> Dedicated <input type="checkbox"/> Other <u>NR</u>	2" Bladder Pump <input checked="" type="checkbox"/> Bailer (Teflon) <input type="checkbox"/> Bomb Sampler <input type="checkbox"/> Bailer (Stainless Steel) <input type="checkbox"/> Dipper <input type="checkbox"/> Submersible Pump <input type="checkbox"/> Well Wizard™ <input type="checkbox"/> Dedicated <input type="checkbox"/> Other <u>DISPOSABLE</u>

WELL INTEGRITY: OK LOCK: none

REMARKS: 6.0 sample taken - water column below top of screen
OK sock in well heavy sheen

pH, E.C., Temp Meter Calibration Date 10/9/98 Time 0840 Meter Serial No 600232
 E.C. 1000 1 pH 7 1 pH 10 1 pH 4 1

Temperature °F See A-3
 SIGNATURE: M. Ross REVIEWED BY MA PAGE 6 OF 9

WATER SAMPLE FIELD DATA SHEET

Rev 1/97



OWT

PROJECT NO 21775-302.003
 PURGED BY NR
 SAMPLED BY M. Ross

SAMPLE ID A-9(L12)
 CLIENT NAME ARCO 4931
 LOCATION Oaklands, Ca

TYPE Groundwater Surface Water Leachate Other
 CASING DIAMETER (inches) 2 3 4 5 6 Other

CASING ELEVATION (feet/VMSL) NR VOLUME IN CASING (gal) NR
 DEPTH OF WELL (feet) 30.4 CALCULATED PURGE (gal) NR
 DEPTH OF WATER (feet) 10.21 ACTUAL PURGE VOL (gal) NR

DATE PURGED NR END PURGE NR
 DATE SAMPLED 10/9/98 SAMPLING TIME 1030

TIME (2400 HR)	VOLUME (gal)	pH (units)	EC (µmhos/cm@25°C)	TEMPERATURE (°F)	COLOR (visual)	TURBIDITY (visual)
<u>1030</u>	<u>GRAB</u>	<u>6.99</u>	<u>697</u> 1745	<u>73.5</u>	<u>clr</u>	<u>clr</u>

OTHER: D.O. 1.0 mg/L ODOR Slight NR NR
 (COBALT 0-100) (NTU 0-200)

FIELD QC SAMPLES COLLECTED AT THIS WELL (i.e. FB-1, XDUP-1): NR

PURGING EQUIPMENT		SAMPLING EQUIPMENT	
<input type="checkbox"/> 2" Bladder Pump	<input type="checkbox"/> Bailer (Teflon)	<input type="checkbox"/> 2" Bladder Pump	<input checked="" type="checkbox"/> Bailer (Teflon)
<input checked="" type="checkbox"/> Centrifugal Pump	<input type="checkbox"/> Bailer (PVC)	<input type="checkbox"/> Bomb Sampler	<input type="checkbox"/> Bailer (Stainless Steel)
<input type="checkbox"/> Submersible Pump	<input type="checkbox"/> Bailer (Stainless Steel)	<input type="checkbox"/> Dipper	<input type="checkbox"/> Submersible Pump
<input type="checkbox"/> Well Wizard™	<input type="checkbox"/> Dedicated	<input type="checkbox"/> Well Wizard™	<input type="checkbox"/> Dedicated
Other <u>NR</u>		Other <u>Dispersing</u>	

WELL INTEGRITY OK LOCK None

REMARKS: GRAB Sample taken water column below top of screens

pH, E.C., Temp Meter Calibration Date 10/9/98 Time 0840 Meter Serial No 600232
 EC 1000 1 pH 7 1 pH 10 1 pH 4 1
 Temperature °F See A-3
 SIGNATURE M. Ross REVIEWED BY NR PAGE 7 OF 9

WATER SAMPLE FIELD DATA SHEET

Rev 1/97



OWT

PROJECT NO 21775-302.003

SAMPLE ID A-118 (42)

PURGED BY NR

CLIENT NAME ARCO 4931

SAMPLED BY M. ROSS

LOCATION Oakland, Ca

TYPE Groundwater Surface Water Leachate Other
 CASING DIAMETER (inches) 2 3 4 4.5 6 Other

CASING ELEVATION (feet/MSL) NR VOLUME IN CASING (gal) NR
 DEPTH OF WELL (feet) 30.0 CALCULATED PURGE (gal) NR
 DEPTH OF WATER (feet) 10.91 ACTUAL PURGE VOL (gal) NR

DATE PURGED NR END PURGE NR
 DATE SAMPLED 10/9/98 SAMPLING TIME 0945

TIME (2400 HR)	VOLUME (gal)	pH (units)	E.C. (µmhos/cm@25°C)	TEMPERATURE (°F)	COLOR (visual)	TURBIDITY (visual)
<u>0945</u>	<u>GRAB</u>	<u>6.63</u>	<u>651</u>	<u>68.3</u>	<u>Clr</u>	<u>Clr</u>

OTHER: D.O. 2.0 mg/l ODOR NONE NR NR
(COBALT 0-100) (NTU 0-200)

FIELD QC SAMPLES COLLECTED AT THIS WELL (i.e. FB-1, XDUP-1): NR

PURGING EQUIPMENT

2" Bladder Pump Bailer (Teflon)
 Centrifugal Pump Bailer (PVC)
 Submersible Pump Bailer (Stainless Steel)
 Well Wizard™ Dedicated
 Other NR

SAMPLING EQUIPMENT

2" Bladder Pump Bailer (Teflon)
 Bomb Sampler Bailer (Stainless Steel)
 Dipper Submersible Pump
 Well Wizard™ Dedicated
 Other Disposable

WELL INTEGRITY OK LOCK

REMARKS: GRAB Sample taken - water drawn below top of screens.

pH, E.C., Temp Meter Calibration Date 10/9/98 Time 0940 Meter Serial No 600232
 E.C. 1000 1 pH 7 1 pH 10 1 pH 4 1

Temperature °F See A-3
 SIGNATURE M. Ross REVIEWED BY MA PAGE 8 OF 9

WATER SAMPLE FIELD DATA SHEET

Rev 1/97



PROJECT NO 21775-302.003 SAMPLE ID A-12(12)
 PURGED BY NR CLIENT NAME ARCO 4931
 SAMPLED BY M. Ross LOCATION Oakland, Ca

TYPE Groundwater Surface Water Leachate Other
 CASING DIAMETER (inches) 2 3 4 4.5 6 Other

CASING ELEVATION (feet/MSL) NR VOLUME IN CASING (gal) NR
 DEPTH OF WELL (feet) 30.4 CALCULATED PURGE (gal) NR
 DEPTH OF WATER (feet) 10.21 ACTUAL PURGE VOL (gal) NR

DATE PURGED NR END PURGE NR
 DATE SAMPLED 10/9/98 SAMPLING TIME 0935

TIME (2400 HR)	VOLUME (gal)	pH (units)	E.C (µmhos/cm@25°C)	TEMPERATURE (°F)	COLOR (visual)	TURBIDITY (visual)
<u>0935</u>	<u>GRAB</u>	<u>6.85</u>	<u>410</u>	<u>67.8</u>	<u>CLR</u>	<u>CLR</u>

OTHER: D.O. 2.0 mg/L ODOR None NR NR
(COBALT 0-100) (NTU 0-200)

FIELD QC SAMPLES COLLECTED AT THIS WELL (i.e. FB-1, XDUP-1). NR

PURGING EQUIPMENT

2" Bladder Pump Bailer (Teflon)
 Centrifugal Pump Bailer (PVC)
 Submersible Pump Bailer (Stainless Steel)
 Well Wizard™ Dedicated
 Other NR

SAMPLING EQUIPMENT

2" Bladder Pump Bailer (Teflon)
 Bomb Sampler Bailer (Stainless Steel)
 Dipper Submersible Pump
 Well Wizard™ Dedicated
 Other Disposable

WELL INTEGRITY OK LOCK None

REMARKS: GRAB Sample taken - water column below top of screens.

pH, E.C., Temp Meter Calibration Date 10/9/98 Time 0840 Meter Serial No 600232
 E.C. 1000 1 pH 7 1 pH 10 1 pH 4 1

Temperature °F See A-3
 SIGNATURE M. Ross REVIEWED BY NA PAGE 9 OF 9

1921 Ringwood Avenue

1998

ARCO 4931

San Jose, California

21775-302.003

Well ID	Quarter	Date	Purge Volume (gallons)	Did well dry	Well Contained Product	Gallons			
						First	Second	Third	Fourth
						65.00	224.50	0.00	0.00
A-2	First	03/18/98	32.00	NO	NO				
	Second	05/19/98	15.00	YES	NO				
	Third	07/29/98	0.00	GRAB	NO				
	Fourth	10/09/98	0.00	GRAB	NO				
A-3	First	03/18/98	0.00	NA	NO				
	Second	05/19/98	5.50	YES	NO				
	Third	07/29/98	0.00	GRAB	NO				
	Fourth	10/09/98	0.00	GRAB	NO				
A-4	First	03/18/98	13.00	NO	NO				
	Second	05/19/98	11.00	YES	NO				
	Third	07/29/98	0.00	GRAB	NO				
	Fourth	10/09/98	0.00	GRAB	NO				
A-5	First	03/18/98	0.00	NA	NO				
	Second	05/19/98	17.50	NO	NO				
	Third	07/29/98	0.00	NA	NO				
	Fourth	10/09/98	0.00	GRAB	NO				
A-6	First	03/18/98	20.00	NO	NO				
	Second	05/19/98	19.00	NO	NO				
	Third	07/29/98	0.00	GRAB	NO				
	Fourth	10/09/98	0.00	GRAB	NO				
A-7	First	03/18/98	0.00	NA	NO				
	Second	05/19/98	15.50	NO	NO				
	Third	07/29/98	0.00	NA	NO				
	Fourth	10/09/98	0.00	NA	NO				
A-8	First	03/18/98	0.00	NA	NO				
	Second	05/19/98	8.00	YES	NO				
	Third	07/29/98	0.00	GRAB	NO				
	Fourth	10/09/98	0.00	GRAB	NO				
A-9	First	03/18/98	0.00	NA	NO				
	Second	05/19/98	133.00	NO	NO				
	Third	07/29/98	0.00	GRAB	NO				
	Fourth	10/09/98	0.00	GRAB	NO				
A-11	First	03/18/98	0.00	NA	NO				
	Second	05/19/98	23.00	NO	NO				
	Third	07/29/98	0.00	NA	NO				
	Fourth	10/09/98	0.00	GRAB	NO				
A-12	First	03/18/98	0.00	NA	NO				
	Second	05/19/98	23.50	NO	NO				
	Third	07/29/98	0.00	NA	NO				
	Fourth	10/09/98	0.00	GRAB	NO				

1921 Ringwood Avenue
San Jose, California

1998

ARCO 4931
21775-302.003

Well ID	Quarter	Date	Purge Volume (gallons)	Did well dry	Well Contained Product	Gallons			
						First	Second	Third	Fourth
						65.00	224.50	0.00	0.00
A-13	First	03/18/98	0.00	NA	NO				
	Second	05/19/98	0.00	NA	NO				
	Third	07/29/98	0.00	NA	NO				
	Fourth	10/09/98	0.00	NA	NO				
	First					Steam water (gal) _____			
	Second								
	Third								
	Fourth								

ARCO Products Company

Division of Atlantic/Richfield Company

Task Order No.

Chain of Custody

ARCO Facility no. 4931 City (Facility) Oakland Telephone no. (ARCO) 415-730-1530 Fax no. (Consultant) (408) 453-9526

ARCO engineer Paul Supple Consultant name ELKON Address (Consultant) 14000 Way Walnut Creek, CA 95146

Laboratory Name CAS
Contract Number

Sample I.D.	Lab no.	Container no.	Matrix			Preservation		Sampling date	Sampling time	EPA 411.1/SM 503E	EPA 601/6010	EPA 602/6040	EPA 605/6070	TOP	SAMPLING	CALIBRATION	EQUIPMENT	LEAD OPERATOR
			Soil	Water	Other	Ice	Acid											
A-3(1)		2	X			X	HCL	10/15/98	08:30									
A-5(1)		2	X			X	HCL	10/15/98	09:45									
A-11(1)		2	X			X	HCL	10/15/98	09:35									
A-12(1)		2	X			X	HCL	10/15/98	10:00									
A-6(1)		2	X			X	HCL	10/15/98	10:15									
A-8(1)		2	X			X	HCL	10/15/98	10:30									
A-9(1)		2	X			X	HCL	10/15/98	10:40									
A-2(1)		2	X			X	HCL	10/15/98	10:50									
A-4(1)		2	X			X	HCL	10/15/98	10:55									

Method of analysis Sampler with deuter

Special Data Limit/reporting Lowest Possible

Special QA/QC As Normal

Remarks RAT's
2 - 40ml HCL
VOAs

Lab Number 470500-300-043

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

Condition of sample:

Relinquished by sampler [Signature] Date 10/9/98 Time 12:00

Relinquished by [Signature] Date 10/9/98 Time 12:20

Relinquished by [Signature] Date 10/9/98 Time 12:20

APPENDIX D

REMEDIAL SYSTEM PERFORMANCE SUMMARY

GWE System

Groundwater extraction (GWE) was conducted intermittently between November 10, 1992, and July 5, 1995. The GWE system was comprised of electric GWE pumps in Wells A-9, AR-1, AR-2, and AR-3, and three 1,500-pound granular activated carbon vessels arranged in series. The GWE system was permitted by East Bay Municipal Utility District Permit Account Number 502-62131. Based on Alameda County Health Care Services Agency authorization that GWE at the site was no longer required, the permit was relinquished during the second quarter 1996. Overall, 4.6 million gallons of groundwater were extracted and less than 0.06 gallon of benzene removed. Please refer to the Second Quarter 1997 Groundwater Monitoring Report for historical GWE system performance and analytical data.

Intrinsic Bioremediation Evaluation

At the request of ARCO, intrinsic bioremediation indicator parameters (bioparameters) were monitored during the fourth quarter 1996 groundwater monitoring event. Groundwater samples from Wells A-4, A-8, and A-12 were analyzed for biological oxygen demand (BOD), carbon dioxide (CO₂), chemical oxygen demand (COD), methane, nitrate, sulfate, dissolved oxygen (DO), and ferrous iron. Wells A-4 and A-8 are located within the plume; Well A-12 is located outside the plume. Based on analysis of the collected data, intrinsic bioremediation was occurring at the site. Please refer to the First Quarter 1997 Groundwater Monitoring Report for details.

Currently using ORC in wells A-4 and A-8 to enhance biodegradation of dissolved oxygen.