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December 30, 1998
Project 20805-213.001

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

Re: Quarterly Groundwater Monitoring Report, Third 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 third 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 requirements regarding underground tank investigations.

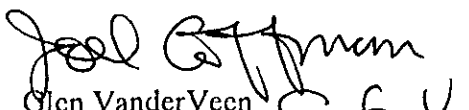
LIMITATIONS

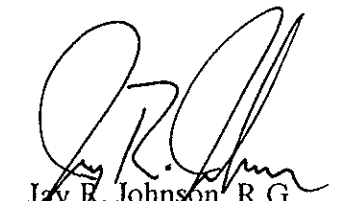
No monitoring event is thorough enough to describe all geologic and hydrogeologic conditions of interest at a given site. If conditions have not been identified during the monitoring event, results should not be construed as a guarantee of the absence of such conditions at the site, but rather as the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

Please call if you have questions.

Sincerely,

Pinnacle


Glen Vander Veen
Project Manager


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

Attachment: Quarterly Groundwater Monitoring Report, Third 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: December 30, 1998

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 (THIRD - 1998):

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

WORK PROPOSED FOR NEXT QUARTER (FOURTH - 1998):

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

QUARTERLY MONITORING:

Current Phase of Project:	<u>Monitoring/Remediation</u>
Frequency of Groundwater Sampling:	<u>Annual (2nd Quarter): A-7, A-13</u> <u>Semi-Annual (2nd/4th Quarter): A-3, A-5, A-11, A-12</u> <u>Quarterly: A-2, A-4, A-6, A-8, A-9</u>
Frequency of Groundwater Monitoring:	<u>Quarterly</u>
Is Free Product (FP) Present On-Site:	<u>No</u>
FP Recovered this Quarter:	<u>None</u>
Cumulative FP Recovered to Date:	<u>Unknown</u>
Bulk Soil Removed This Quarter:	<u>None</u>
Bulk Soil Removed to Date:	<u>Unknown</u>
Current Remediation Techniques:	<u>Intrinsic Bioremediation Enhancement using ORC</u>
Approximate Depth to Groundwater:	<u>9.2 feet</u>
Groundwater Flow Direction and Gradient	
(Average):	<u>0.02 ft/ft toward West-Southwest</u>
Period TPPH- g/Benzene Removed:	<u>0.0/0.0</u>
Cumulative TPPH-g/Benzene Removed:	<u>0.45/0.06 gallons</u>

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 Report 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 at West Street
Oakland, California

Well Number	Date Gauged/ Sampled	Well Elevation (feet, MSL)	Depth to Water (feet, TOB)	Groundwater Elevation (feet, MSL)	TPPH as					Dissolved Oxygen (ppm)	Purged/ Not Purged	
					Gasoline (ppb)	Benzene (ppb)	Toluene (ppb)	Ethyl- benzene (ppb)	Xylenes (ppb)			MtBE (ppb)
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	
07/29/98	8.94	46.54	<50	<0.5	<0.5	<0.5	<0.5	<3	1.2	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	
07/29/98	9.86	44.80	----- Well Sampled Semiannually -----									
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	720	2,000	1.28	
07/29/98	10.05	44.68	8,400	1,300	<20	290	130	1,800	0.7	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	
07/29/98	9.89	44.28	----- Well Sampled Semiannually -----									

**Table 1
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Total Purgeable Petroleum Hydrocarbons
(TPPH as Gasoline, BTEX Compounds, and MtBE)**

**ARCO Service Station 4931
731 West MacArthur Boulevard at West Street
Oakland, California**

Well Number	Date Gauged/ Sampled	Well Elevation (feet, MSL)	Depth to Water (feet, TOB)	Groundwater Elevation (feet, MSL)	TPPH as					Dissolved Oxygen (ppm)	Purged/ Not Purged	
					Gasoline (ppb)	Benzene (ppb)	Toluene (ppb)	Ethyl- benzene (ppb)	Xylenes (ppb)			MtBE (ppb)
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		
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 -----									
A-8 a	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		
A-9 b	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		

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Total Purgeable Petroleum Hydrocarbons
(TPPH as Gasoline, BTEX Compounds, and MtBE)**

**ARCO Service Station 4931
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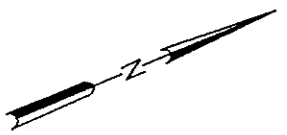
Well Number	Date Gauged/ Sampled	Well Elevation (feet, MSL)	Depth to Water (feet, TOB)	Groundwater Elevation (feet, MSL)	TPPH as Gasoline (ppb)	Benzene (ppb)	Toluene (ppb)	Ethyl- benzene (ppb)	Xylenes (ppb)	MtBE (ppb)	Dissolved Oxygen (ppm)	Purged/ Not Purged	
A-10	03/26/96	54.26	8.28	45.98	----- Well 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 Sampling Program -----								
	05/19/98		--	--	----- Well Removed from Sampling Program -----								
07/29/98	--	--	----- Well Removed from Sampling 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 -----										
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 -----										
A-13	03/26/96	55.11			----- Well Inaccessible -----								
	05/22/96				----- Well Inaccessible -----								
	08/22/96				----- 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 -----								

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 at West Street
Oakland, California

Well Number	Date Gauged/ Sampled	Well Elevation (feet, MSL)	Depth to Water (feet, TOB)	Groundwater Elevation (feet, MSL)	TPPH as					Dissolved Oxygen (ppm)	Purged/ Not Purged	
					Gasoline (ppb)	Benzene (ppb)	Toluene (ppb)	Ethyl- benzene (ppb)	Xylenes (ppb)			MtBE (ppb)
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 -----									
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 -----									
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 -----									

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
a. = Bioremediation enhancement at this well has been in progress since 05/22/96.
b. = Bioremediation enhancement at this well has been in progress since 11/17/95.
* = MtBE results confirmed by EPA Method 8260.

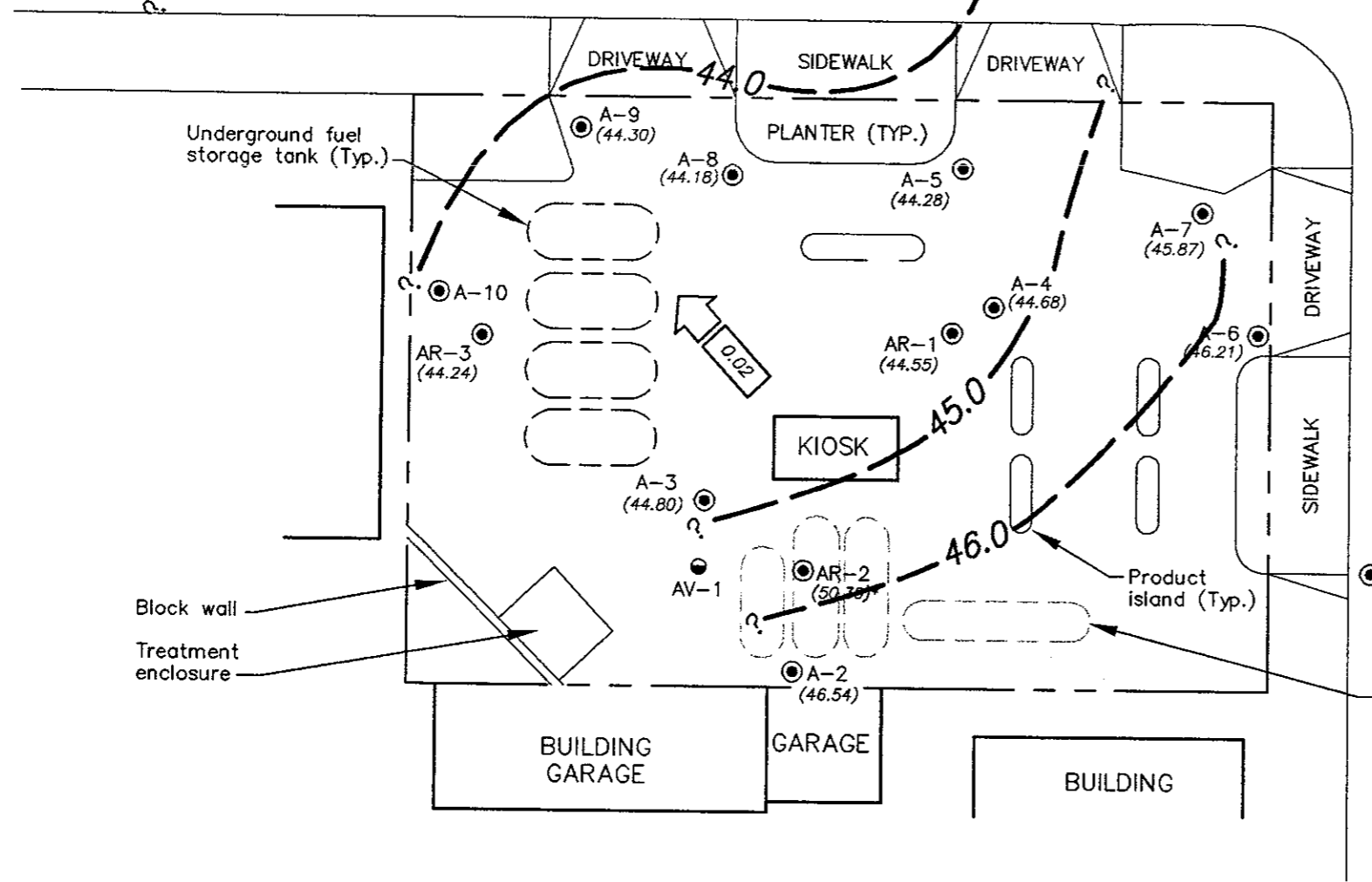


WEST STREET

A-12
(42.67)

A-11
(43.42)

43.0



Underground fuel storage tank (Typ.)

Block wall
Treatment enclosure

BUILDING GARAGE

GARAGE

BUILDING

WEST MACARTHUR BLVD.

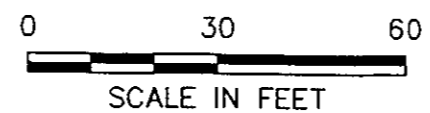
EXPLANATION

- Groundwater monitoring well
- Soil vapor well
- (46.21) Groundwater elevation (Ft.-MSL); measured 7/29/98
- ? - - - 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 Psttscale: 1
SANJOSE/CADD: N:\DWG\PINACL\4931\GWC.DWG Tue, 15/Dec/98 03:21pm ktroyer

Base map from Pacific Environmental Group, Inc.

Pinnacle
ENVIRONMENTAL SOLUTIONS
A DIVISION OF EMCON



DATE	NOV. 1998
DWN	KAB
APP	
REV	0
PROJECT NO.	20805-213.001

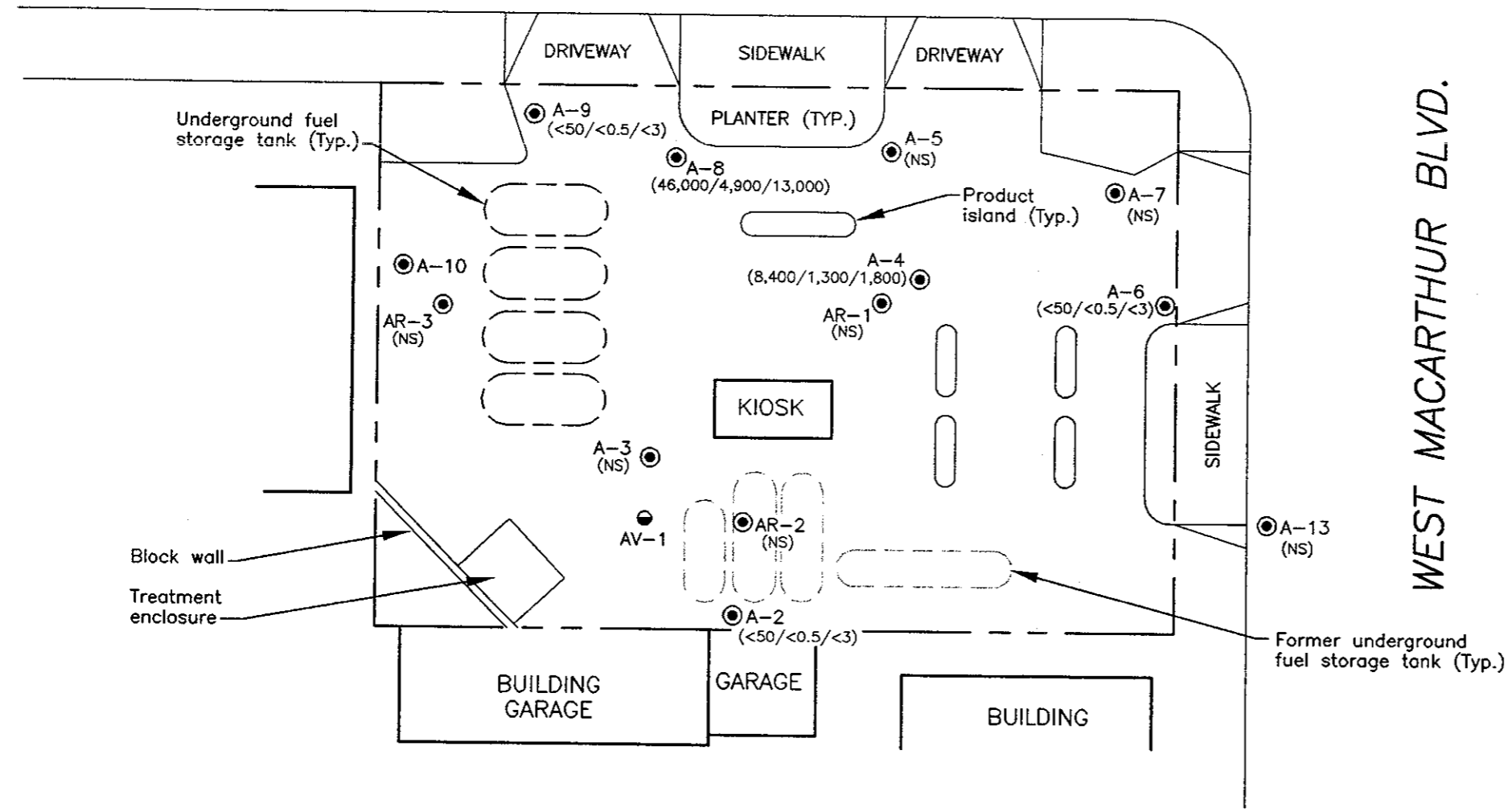
FIGURE 2
ARCO PRODUCTS COMPANY
SERVICE STATION 4931, 731 W. MACARTHUR BLVD.
OAKLAND, CALIFORNIA
GROUNDWATER ELEVATION CONTOURS
THIRD QUARTER 1998



● A-12
(NS)

WEST STREET

● A-11
(NS)

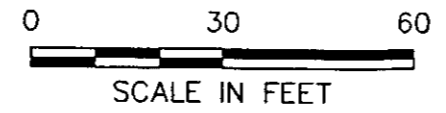


- EXPLANATION
- Groundwater monitoring well
 - Soil vapor well
 - (8,400/1,300/1,800) Concentration of total petroleum hydrocarbons as gasoline (TPHG), benzene, and MTBE in groundwater (ug/L); samples collected 7/29/98
 - < Not detected at or above the indicated laboratory detection limit
 - NS Not sampled

IMAGE Files: <No Images>
 XREF Files: <No Xrefs>
 Dimscale: 30 Ltscale: 30 Psttscale: 1
 SANJOSE/CADD: N:\DWG\PINACL\4931\CHEM.DWG Tue, 24/Nov/98 02:03pm kblack

Base map from Pacific Environmental Group, Inc.

Pinnacle
 ENVIRONMENTAL SOLUTIONS
 A DIVISION OF EMCON



DATE NOV. 1998
 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
THIRD 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

NO

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

CALCULATE PURGE VOLUME BY USING THE FOLLOWING EQUATION:
 $P = \pi r^2 \times 7.48 \times h$

where:

P = calculated purge volume (gallons)

$\pi = 3.14$

r = radius of well casing in feet

h = height of water column in feet

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

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.

NO

YES

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

pH = ± 0.1 pH units

COND. = ± 10 %

TEMP. = ± 1.0 °F

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

YES

NO

YES

NO

WELL PURGING CRITERIA MET; PROCEED TO WELL SAMPLING.

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

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

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



EMCON - SACRAMENTO
GROUNDWATER SAMPLING AND ANALYSIS REQUEST FORM

OWT

PROJECT NAME :

SCHEDULED DATE :

SPECIAL INSTRUCTIONS / CONSIDERATIONS :

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**



August 14, 1998

Service Request No.: S9802010

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

RE: 20805-213.001/TO#22312.00/RAT8/4931 OAKLAND

Dear Mr. Vanderveen:

The following pages contain analytical results for sample(s) received by the laboratory on July 31, 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.

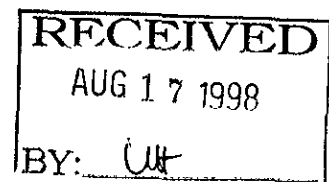
Analytical results were produced by procedures consistent with Columbia Analytical Services' (CAS) Quality Assurance Manual (with any deviations noted). Signature of this CAS Analytical Report below confirms that pages 2 through 12, following, have been thoroughly reviewed and approved for release in 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: 20805-213.001/TO#22312.00/RAT8/4931 OAKLAND
Sample Matrix: Water

Service Request: S9802010
Date Collected: 7/29/98
Date Received: 7/31/98

BTEX, MTBE and TPH as Gasoline

Sample Name: A-6(23)
Lab Code: S9802010-001
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	1	NA	8/5/98	ND	
Benzene	EPA 5030	8020	0.5	1	NA	8/5/98	ND	
Toluene	EPA 5030	8020	0.5	1	NA	8/5/98	ND	
Ethylbenzene	EPA 5030	8020	0.5	1	NA	8/5/98	ND	
Xylenes, Total	EPA 5030	8020	0.5	1	NA	8/5/98	ND	
Methyl <i>tert</i> -Butyl Ether	EPA 5030	8020	3	1	NA	8/5/98	ND	

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client: ARCO Products Company
Project: 20805-213.001/TO#22312.00/RAT8/4931 OAKLAND
Sample Matrix: Water

Service Request: S9802010
Date Collected: 7/29/98
Date Received: 7/31/98

BTEX, MTBE and TPH as Gasoline

Sample Name: A-8(20)
Lab Code: S9802010-002
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	200	NA	8/5/98	46000	
Benzene	EPA 5030	8020	0.5	200	NA	8/5/98	4900	
Toluene	EPA 5030	8020	0.5	200	NA	8/5/98	160	
Ethylbenzene	EPA 5030	8020	0.5	200	NA	8/5/98	620	
Xylenes, Total	EPA 5030	8020	0.5	200	NA	8/5/98	580	
Methyl <i>tert</i> -Butyl Ether	EPA 5030	8020	3	200	NA	8/5/98	13000	

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client: ARCO Products Company
Project: 20805-213.001/TO#22312.00/RAT8/4931 OAKLAND
Sample Matrix: Water

Service Request: S9802010
Date Collected: 7/29/98
Date Received: 7/31/98

BTEX, MTBE and TPH as Gasoline

Sample Name: A-9(36)
Lab Code: S9802010-003
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	8/5/98	ND	
Benzene	EPA 5030	8020	0.5	1	NA	8/5/98	ND	
Toluene	EPA 5030	8020	0.5	1	NA	8/5/98	ND	
Ethylbenzene	EPA 5030	8020	0.5	1	NA	8/5/98	ND	
Xylenes, Total	EPA 5030	8020	0.5	1	NA	8/5/98	ND	
Methyl <i>tert</i> -Butyl Ether	EPA 5030	8020	3	1	NA	8/5/98	ND	

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client: ARCO Products Company
Project: 20805-213.001/TO#22312.00/RAT8/4931 OAKLAND
Sample Matrix: Water

Service Request: S9802010
Date Collected: 7/29/98
Date Received: 7/31/98

BTEX, MTBE and TPH as Gasoline

Sample Name: A-2(18)
Lab Code: S9802010-004
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	8/5/98	ND	
Benzene	EPA 5030	8020	0.5	1	NA	8/5/98	ND	
Toluene	EPA 5030	8020	0.5	1	NA	8/5/98	ND	
Ethylbenzene	EPA 5030	8020	0.5	1	NA	8/5/98	ND	
Xylenes, Total	EPA 5030	8020	0.5	1	NA	8/5/98	ND	
Methyl <i>tert</i> -Butyl Ether	EPA 5030	8020	3	1	NA	8/5/98	ND	

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client: ARCO Products Company
Project: 20805-213.001/TO#22312.00/RAT8/4931 OAKLAND
Sample Matrix: Water

Service Request: S9802010
Date Collected: 7/29/98
Date Received: 7/31/98

BTEX, MTBE and TPH as Gasoline

Sample Name: A-4(18) **Units:** ug/L (ppb)
Lab Code: S9802010-005 **Basis:** NA
Test Notes:

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	8/6/98	8400	
Benzene	EPA 5030	8020	0.5	40	NA	8/6/98	1300	
Toluene	EPA 5030	8020	0.5	40	NA	8/6/98	<20	C1
Ethylbenzene	EPA 5030	8020	0.5	40	NA	8/6/98	290	
Xylenes, Total	EPA 5030	8020	0.5	40	NA	8/6/98	130	
Methyl <i>tert</i> -Butyl Ether	EPA 5030	8020	3	40	NA	8/6/98	1800	

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

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client: ARCO Products Company
Project: 20805-213.001/TO#22312.00/RAT8/4931 OAKLAND
Sample Matrix: Water

Service Request: S9802010
Date Collected: NA
Date Received: NA

BTEX, MTBE and TPH as Gasoline

Sample Name: Method Blank
Lab Code: S980805-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	8/5/98	ND	
Benzene	EPA 5030	8020	0.5	1	NA	8/5/98	ND	
Toluene	EPA 5030	8020	0.5	1	NA	8/5/98	ND	
Ethylbenzene	EPA 5030	8020	0.5	1	NA	8/5/98	ND	
Xylenes, Total	EPA 5030	8020	0.5	1	NA	8/5/98	ND	
Methyl <i>tert</i> -Butyl Ether	EPA 5030	8020	3	1	NA	8/5/98	ND	

APPENDIX A

COLUMBIA ANALYTICAL SERVICES, INC.

QA/QC Report

Client: ARCO Products Company
Project: 20805-213.001/TO#22312.00/RAT8/4931 OAKLAND
Sample Matrix: Water

Service Request: S9802010
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 CALUFT

Units: PERCENT
Basis: NA

Sample Name	Lab Code	Test Notes	Percent Recovery	
			4-Bromofluorobenzene	a,a,a-Trifluorotoluene
A-6(23)	S9802010-001		100	93
A-8(20)	S9802010-002		101	94
A-9(36)	S9802010-003		97	91
A-2(18)	S9802010-004		102	92
A-4(18)	S9802010-005		104	87
A-6(23)	S9802010-001MS		94	100
A-6(23)	S9802010-001DMS		94	98
Method Blank	S980805-WB1		98	90

CAS Acceptance Limits: 69-116 69-116

COLUMBIA ANALYTICAL SERVICES, INC.

QA/QC Report

Client: ARCO Products Company
Project: 20805-213.001/TO#22312.00/RAT8/4931 OAKLAND
Sample Matrix Water

Service Request: S9802010
Date Collected: NA
Date Received: NA
Date Extracted: NA
Date Analyzed: 8/5/98

Matrix Spike/Duplicate Matrix Spike Summary
TPH as Gasoline

Sample Name: A-6(23) Units: ug/L (ppb)
Lab Code: S9802010-001MS, S9802010-001DMS Basis: NA
Test Notes:

Analyte	Prep Method	Analysis Method	Percent Recovery								Result Notes	
			Spike Level		Sample Result	Spike Result		CAS Acceptance Limits	Relative Percent Difference			
			MRL	MS	DMS	MS	DMS	MS	DMS			
Gasoline	EPA 5030	CA/LUFT	50	250	250	ND	260	260	104	104	75-135	<1

COLUMBIA ANALYTICAL SERVICES, INC.

QA/QC Report

Client: ARCO Products Company
Project: 20805-213.001/TO#22312.00/RAT8/4931 OAKLAND

Service Request: S9802010
Date Analyzed: 8/5/98

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

Sample Name: ICV **Units:** ug/L (ppb)
Lab Code: ICV1 **Basis:** NA
Test Notes:

ICV Source:

Analyte	Prep Method	Analysis Method	True Value	Result	CAS		Result Notes
					Acceptance Limits	Percent Recovery	
TPH as Gasoline	EPA 5030	CA/LUFT	250	250	90-110	100	
Benzene	EPA 5030	8020	25	26	85-115	104	
Toluene	EPA 5030	8020	25	25	85-115	100	
Ethylbenzene	EPA 5030	8020	25	25	85-115	100	
Xylenes, Total	EPA 5030	8020	75	80	85-115	107	
Methyl <i>tert</i> -Butyl Ether	EPA 5030	8020	25	25	85-115	100	

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 : 7/29/98

ARCO STATION # : 4931 FIELD TECHNICIAN : Patrick Jimison/ Brice Hendricks DAY : Wednesday

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	/	G-5	NO	2357	LWC	9.86	9.86	N.D.	ND	16.3	
2	A-5		G-5	NO	2357	LWC	9.89	9.89	N.D.	—	24.9	Broken Vault Lid
3	A-6	/	G-5	NO	2357	LWC	8.46	8.46	N.O.	—	24.8	DD = 0.8 Temp = 20.0 °C G
4	A-7		G-5	NO	2357	LWC	8.84	8.84	N.O.	—	22.3	
5	A-8	✓	VAULT	YES	NONE	LWC	9.59	9.59	N.D.	—	21.6	DD = 0.5 Temp = 19.0 °C G
6	A-9	/	VAULT	YES	NONE	SLIP	8.74	8.74	N.D.	—	37.9	DD = 0.99 Temp = 19.7 °C G
7	A-2	/	G-5	NO	2357	LWC	8.44	8.44	N.O.	—	19.6	DD = 1.2 Temp = 19.1 °C
8	A-4	/	G-5	NO	2357	LWC	10.05	10.05	N.O.	—	19.7	DD = 0.7 Temp = 20.0 °C
9	A-11		G-5	NO	NONE	LWC	10.32	10.32	N.O.	—	29.9	
10	A-12		G-5	NO	NONE	LWC	9.38	9.38	N.O.	—	29.9	
11	A-13						Paved Over — could not locate.					
12	AR-1	/	/	/	/	/	10.17	10.17	N.O.	/	29.5	
13	AR-2	/	/	/	/	/	4.47	4.47	N.O.	—	26.3	
14	AR-3	/	/	/	/	/	9.95	9.95	N.O.	—	29.1	

SURVEY POINTS ARE TOP OF WELL BOXES



WATER SAMPLE FIELD DATA SHEET

Rev. 1/97

PROJECT NO: 21775-302.003
PURGED BY: _____
SAMPLED BY: B. Hendricks

SAMPLE ID: A-2 (18')
CLIENT NAME: ARCO 4931
LOCATION: Oakland

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

CASING ELEVATION (feet/MSL): _____ VOLUME IN CASING (gal.): 6.9
DEPTH OF WELL (feet): 19.6 CALCULATED PURGE (gal.): 20.9
DEPTH TO WATER (feet): 8.94 ACTUAL PURGE VOL. (gal.): 8

DATE PURGED: No purge END PURGE: _____
DATE SAMPLED: 7/29/98 SAMPLING TIME: 1419

TIME (2400 HR)	VOLUME (gal.)	pH (units)	E.C. (µmhos/cm @ 25°C)	TEMPERATURE (°F)	COLOR (visual)	TURBIDITY (visual)
<u>1417</u>	<u>—</u>	<u>6.54</u>	<u>466</u>	<u>68.6</u>	<u>clear</u>	<u>low</u>
_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____

OTHER: _____ ODOR: None
(COBALT 3-100) (NTU 0-200)

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

PURGING EQUIPMENT

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

SAMPLING EQUIPMENT

2" Bladder Pump Bailer (Teflon)
 Bomb Sampler Bailer (Stainless Steel)
 Dipper Submersible Pump
 Well Wizard® Dedicated
 Other: Dispo bailer

WELL INTEGRITY: Good LOCK:

REMARKS: DTW below top of screen, grab sample

pH, E.C., Temp. Meter Calibration: Date: See MW-8 Arco 2185 Time: _____ Meter Serial No.: _____
E.C. 1000 _____ pH 7 _____ pH 10 _____ pH 4 _____
Temperature °F _____

SIGNATURE: BH REVIEWED BY: [Signature] PAGE 1 OF 5



WATER SAMPLE FIELD DATA SHEET

Rev. 1/97

PROJECT NO: 21775-302.003
PURGED BY: _____
SAMPLED BY: B. Handrick

SAMPLE ID: A-C₆ (28')
CLIENT NAME: Arco 4931
LOCATION: Oakland

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

CASING ELEVATION (feet/MSL): _____ VOLUME IN CASING (gal.): 5.8
DEPTH OF WELL (feet): 29.8 CALCULATED PURGE (gal.): 17.5
DEPTH TO WATER (feet): 9.96 ACTUAL PURGE VOL. (gal.): 0

DATE PURGED: no purge END PURGE: _____
DATE SAMPLED: 7/29/98 SAMPLING TIME: 1340

TIME (2400 HR)	VOLUME (gal.)	pH (units)	E.C. (µmhos/cm @ 25°C)	TEMPERATURE (°F)	COLOR (visual)	TURBIDITY (visual)
<u>1344</u>	—	<u>6.72</u>	<u>564</u>	<u>71.0</u>	<u>Brown</u>	<u>mod</u>

OTHER: _____ ODOR: None
(COBAL T 2-100) (NTU 0-200)

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

PURGING EQUIPMENT

- 2" Bladder Pump
- Centrifugal Pump
- Submersible Pump
- Well Wizard[®]
- Other: _____

SAMPLING EQUIPMENT

- 2" Bladder Pump
- Bomb Sampler
- Dipper
- Well Wizard[®]
- Other: Dispo bailer

WELL INTEGRITY: Good LOCK: _____

REMARKS: DTW below top of screen, grab sample.

pH, E.C., Temp. Meter Calibration: Date: See MW-8 Arco 2185 Time: _____ Meter Serial No.: _____
E.C. 1000 _____ pH 7 _____ pH 10 _____ pH 4 _____
Temperature °F _____

SIGNATURE: BH REVIEWED BY: [Signature] PAGE 3 OF 5

APPENDIX D
REMEDIAL SYSTEM PERFORMANCE SUMMARY