

September 2008 Monitoring Results for Centralia, Kansas

Environmental Science Division



United States Department of Agriculture

Work sponsored by Commodity Credit Corporation,
United States Department of Agriculture

About Argonne National Laboratory

Argonne is a U.S. Department of Energy laboratory managed by UChicago Argonne, LLC under contract DE-AC02-06CH11357. The Laboratory's main facility is outside Chicago, at 9700 South Cass Avenue, Argonne, Illinois 60439. For information about Argonne and its pioneering science and technology programs, see www.anl.gov.

Availability of This Report

This report is available, at no cost, at <http://www.osti.gov/bridge>. It is also available on paper to the U.S. Department of Energy and its contractors, for a processing fee, from:

U.S. Department of Energy

Office of Scientific and Technical Information

P.O. Box 62

Oak Ridge, TN 37831-0062

phone (865) 576-8401

fax (865) 576-5728

reports@adonis.osti.gov

Disclaimer

This report was prepared as an account of work sponsored by an agency of the United States Government. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of document authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof, Argonne National Laboratory, or UChicago Argonne, LLC.

September 2008 Monitoring Results for Centralia, Kansas

by
Applied Geosciences and Environmental Management Section
Environmental Science Division, Argonne National Laboratory

February 2009



United States Department of Agriculture

Work sponsored by Commodity Credit Corporation,
United States Department of Agriculture

Contents

Notation.....	iv
1 Introduction and Background	1-1
2 Sampling and Analysis Activities.....	2-1
2.1 Measurement of Groundwater Levels.....	2-1
2.2 Monitoring Well and Piezometer Sampling and Analyses	2-1
2.3 Handling and Disposal of Investigation-Derived Waste	2-2
2.4 Quality Control for Sample Collection, Handling, and Analysis	2-2
3 Results and Discussion	3-1
3.1 Groundwater Level Data.....	3-1
3.2 Groundwater Analysis Results.....	3-1
3.2.1 Results of the Groundwater Analyses for VOCs	3-1
3.2.2 Results of Other Groundwater Analyses.....	3-2
4 Conclusions and Recommendations	4-1
4.1 Conclusions.....	4-1
4.2 Recommendations.....	4-2
5 References.....	5-1
Appendix A: Sequence of Sampling Activities at Centralia, Kansas, in September 2008.....	A-1
Appendix B: Data Summary for Verification VOCs Analyses by TestAmerica Laboratories, Inc.	B-1

Figures

1.1 Approved monitoring network at Centralia	1-3
1.2 Locations of pilot test injection points and post-injection groundwater monitoring points PMP1-PMP9	1-4
3.1 Potentiometric surface at Centralia, based on water levels measured manually on June 25, 2008	3-12
3.2 Carbon tetrachloride levels in groundwater at Centralia in September 2008, with the interpreted lateral extent of the contaminant at intervals during the period August 2004 to September 2008.....	3-13
4.1 Previously established monitoring points proposed for ongoing annual monitoring ...	4-4
4.2 Pilot test monitoring points proposed for ongoing annual monitoring or twice yearly monitoring.....	4-5

Tables

3.1	Hand-measured water levels at Centralia in November 2007, March 2008, June 2008, and September 2008.....	3-3
3.2	Analytical results from the AGEM Laboratory for volatile organic compounds in groundwater samples collected at Centralia, August 2004 to September 2008.....	3-4
3.3	Field measurements for groundwater samples collected at Centralia, August 2004 to September 2008	3-8

Notation

AGEM	Applied Geosciences and Environmental Management
AMSL	above mean sea level
BGL	below ground level
°C	degree(s) Celsius
CCC	Commodity Credit Corporation
COC	chain of custody
EPA	U.S. Environmental Protection Agency
ft	foot (feet)
in.	inch(es)
ISCR	<i>in situ</i> chemical reduction
KDHE	Kansas Department of Health and Environment
L	liter(s)
µg/L	microgram(s) per liter
µS/cm	microsiemen(s) per centimeter
mg/L	milligram(s) per liter
mV	millivolt(s)
NAD	North American Datum
NGVD	National Geodetic Vertical Datum
ORP	oxidation-reduction potential
TOC	top of casing
USDA	U.S. Department of Agriculture
VOC	volatile organic compound

September 2008 Monitoring Results for Centralia, Kansas

1 Introduction and Background

In September 2005, periodic sampling of groundwater was initiated by the Commodity Credit Corporation of the U.S. Department of Agriculture (CCC/USDA) in the vicinity of a grain storage facility formerly operated by the CCC/USDA at Centralia, Kansas. The sampling at Centralia is being performed on behalf of the CCC/USDA by Argonne National Laboratory, in accord with a monitoring program approved by the Kansas Department of Health and Environment (KDHE). The objective is to monitor levels of carbon tetrachloride contamination identified in the groundwater at Centralia (Argonne 2003, 2004, 2005a). Under a KDHE-approved monitoring plan (Argonne 2005b), the groundwater was sampled twice yearly (for a recommended period of two years) for analyses for volatile organic compounds (VOCs), as well as measurement of selected geochemical parameters to aid in the evaluation of possible natural contaminant degradation (reductive dechlorination) processes in the subsurface environment.

The sampling in September 2007 represented the fifth and final monitoring event performed under the two-year twice yearly monitoring program (Argonne 2006a,b, 2007a, 2008a). The results from the two-year monitoring program demonstrated the presence of carbon tetrachloride contamination at levels exceeding the KDHE Tier 2 Risk-Based Screening Level of 5 µg/L for this compound in a broad groundwater plume that has shown little movement. The relative concentrations of chloroform, the primary degradation product of carbon tetrachloride, suggested that some degree of reductive dechlorination or natural biodegradation was taking place *in situ* at the former CCC/USDA facility on a localized scale.

The CCC/USDA subsequently developed an *Interim Measure Conceptual Design* (Argonne 2007b), proposing a pilot test of the Adventus EHC *in situ* chemical reduction technology, that was approved by the KDHE in November 2007 (KDHE 2007). Implementation of the proposed interim measure occurred in December 2007. The objective was to create highly reducing conditions that would enhance both chemical and biological reductive dechlorination in the injection test area (Argonne 2009).

The KDHE has requested that sitewide monitoring continue at Centralia until a final remedy has been implemented and a comprehensive program of performance and compliance monitoring has been established for this site (KDHE 2008a). The groundwater sampling events

at Centralia in March 2008 (Argonne 2008b) and September 2008 were performed in response to this request. The present report documents the results of groundwater sampling conducted in September 2008, in the network of 10 monitoring wells and 6 piezometers (Figure 1.1) previously approved by the KDHE for extended monitoring of the groundwater contamination at Centralia (KDHE 2005a,b). Sampling of additional piezometers specifically installed to monitor the progress of the interim measure pilot test (PMP1-PMP9; Figure 1.2) was also performed in September 2008; the results of these analyses are reported and discussed separately (Argonne 2009).

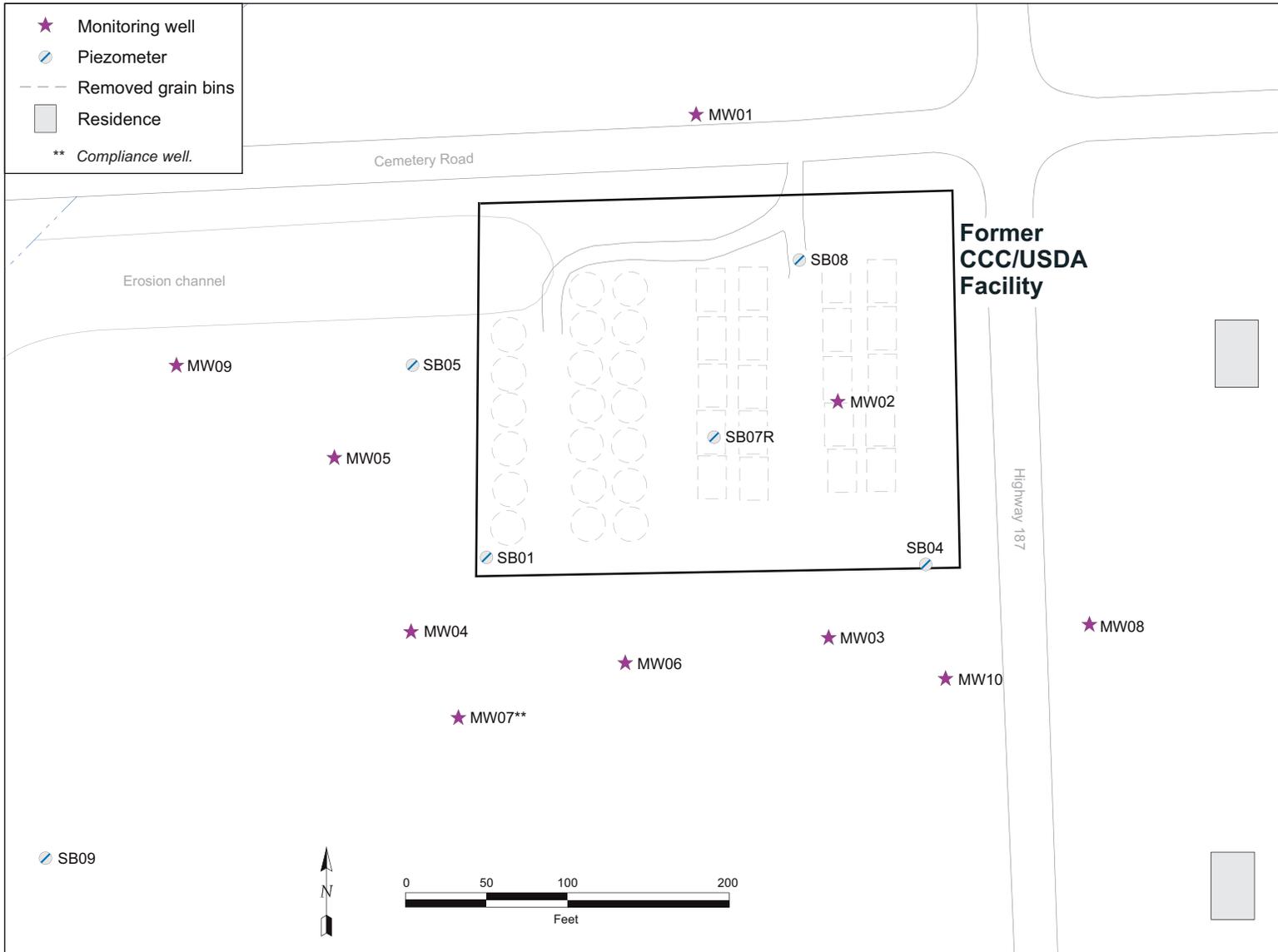


FIGURE 1.1 Approved monitoring network at Centralia.

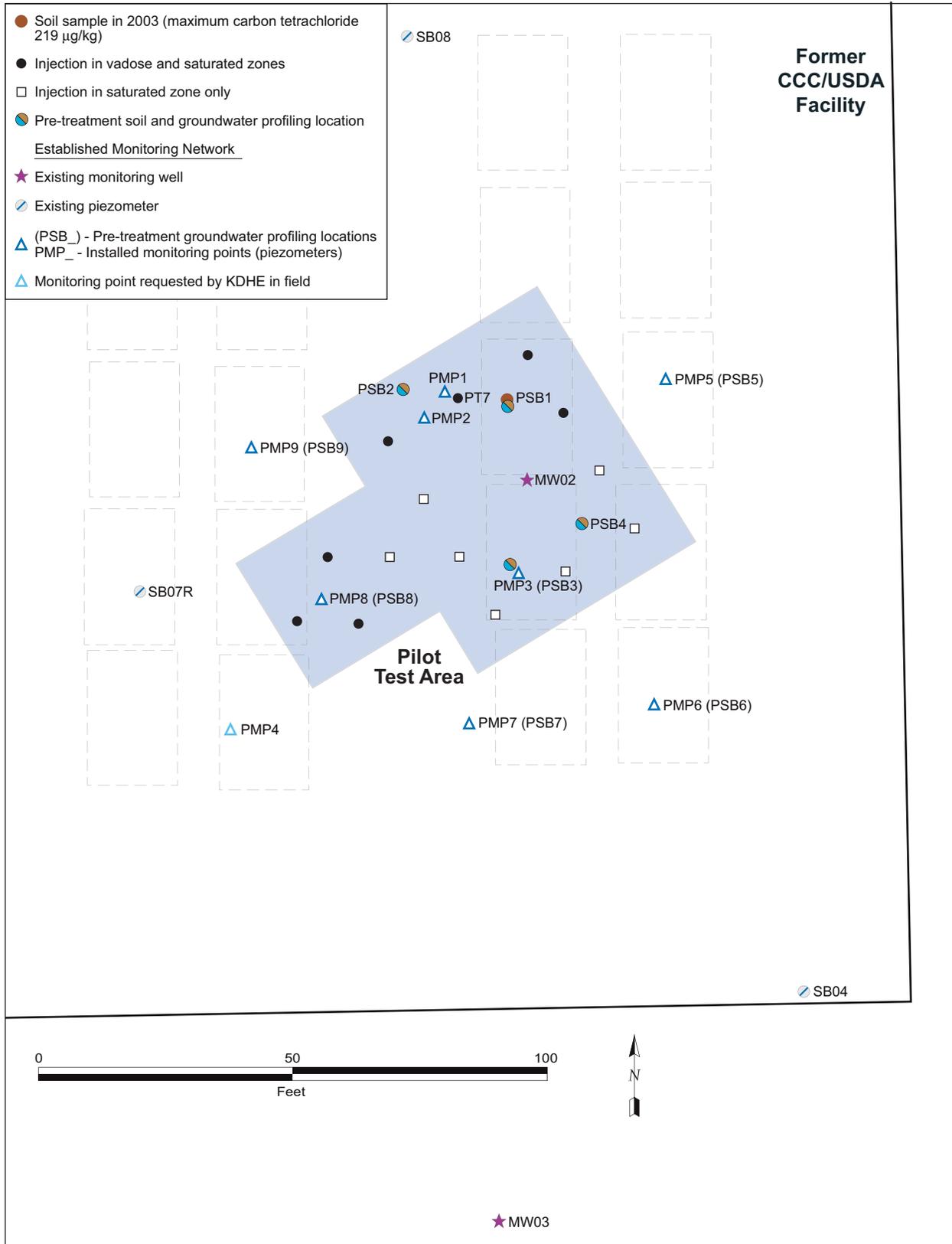


FIGURE 1.2 Locations of pilot test injection points and post-injection groundwater monitoring points PMP1-PMP9.

2 Sampling and Analysis Activities

2.1 Measurement of Groundwater Levels

Monitoring wells MW01-MW10 and piezometers SB01, SB04, SB05, SB07R, SB08, and SB09 (Figure 1.1) were sampled on September 8-10, 2008. Before the sampling, a water level indicator was used to measure the depth to groundwater and the total depth of each well, to within 0.01 ft, from the top of the well casing. Samples were collected by using a low-flow bladder pump and a Waterra pump, with the approval of the KDHE (2008b).

Data recorders currently installed in MW01-MW06 are gathering long-term data on the groundwater elevation and gradient at Centralia. The data recorders in these wells were downloaded, and water levels were measured manually at all monitoring points, on June 25, 2008.

The groundwater level data are discussed in Section 3.1.

2.2 Monitoring Well and Piezometer Sampling and Analyses

After measurement of water levels, each monitoring point was purged of a small volume by using low-flow techniques, in accord with U.S. Environmental Protection Agency (EPA) procedure EPA/540/S-95/504 (Puls and Barcelona 1996) and the equipment manufacturers' instructions. Field measurements of temperature, pH, conductivity, dissolved oxygen (DO), and oxidation reduction potential (ORP) were taken during purging until the measurements stabilized. Field measurements of iron(II) were made as outlined in the monitoring plan (Argonne 2005b), in accord with procedures in the *Master Work Plan* (Argonne 2002). The sequence of activities during the September 2008 well sampling event is summarized in Appendix A.

Groundwater samples designated for VOCs analyses and selected geochemical analyses identified in the monitoring plan (Argonne 2005b) were collected in appropriate laboratory containers, labeled, packaged, and chilled to 4°C by placement in ice-filled coolers. The samples were shipped by an overnight delivery service to the Applied Geosciences and Environmental Management (AGEM) Laboratory at Argonne for VOCs analyses with EPA Method 524.2 (EPA

1995). Aliquots of selected samples (chosen in the field) were also shipped to TestAmerica Laboratories, Inc., South Burlington, Vermont, for verification VOCs analyses.

The analytical results for groundwater samples are discussed in Section 3.2.

2.3 Handling and Disposal of Investigation-Derived Waste

The small volume of purge water generated as potentially contaminated investigation-derived waste was containerized on-site. After sampling and analysis by a KDHE-certified laboratory (see Section 2.4), the accumulated purge water was taken to the Sabetha, Kansas, publicly owned treatment works on December 11, 2008, for disposal, per verbal approval of the KDHE.

2.4 Quality Control for Sample Collection, Handling, and Analysis

Quality assurance/quality control procedures followed during the September 2008 monitoring event are described in detail in the *Master Work Plan* (Argonne 2002). The results are summarized as follows:

- Sample collection and handling activities were monitored by the documentation of samples as they were collected and the use of chain-of-custody forms and custody seals to ensure sample integrity during handling and shipment.
- Samples designated for VOCs analyses were received with custody seals intact and at the appropriate preservation temperature. All samples were analyzed within the required holding times.
- Quality control samples collected to monitor sample collection and handling activities included equipment rinsates and trip blanks. In addition, method blanks were analyzed with the samples to monitor analytical methodologies. All quality control samples analyzed at the AGEM Laboratory were free of carbon tetrachloride and chloroform contamination.

- Groundwater samples were analyzed for VOCs at the AGEM Laboratory with the purge-and-trap method on a gas chromatograph-mass spectrometer system. Calibration checks with each sample delivery group were required to be within $\pm 20\%$ of the standard. Surrogate standard determinations performed on samples and blanks were within the specified range of 80-120% for all samples, in either the initial analysis or a successful reanalysis.
- In accordance with the quality control procedures defined in the *Master Work Plan* (Argonne 2002), the analyses of water samples at the AGEM Laboratory were verified by a second laboratory. Three groundwater samples collected during the September 2008 monitoring event (from monitoring wells MW01, MW04, and PMP1) were submitted for verification organic analysis according to EPA Contract Laboratory Program methodology by TestAmerica. Results show good agreement over the range of contaminant concentrations detected, with average relative percent difference values of 7.7% for carbon tetrachloride and 7.4% for chloroform. Summary pages for the verification organic analyses by TestAmerica for samples collected on September 8-10, 2008, are in Appendix B.

3 Results and Discussion

3.1 Groundwater Level Data

Depths to groundwater were measured manually in all available monitoring wells on November 12, 2007, March 12-20, 2008 (during sampling), June 25, 2008, and September 9-10, 2008 (during sampling). The hand-measured water level data are in Table 3.1.

The potentiometric surface at Centralia, interpreted from manual measurements on June 25, 2008, is depicted in Figure 3.1. The recent results are consistent with previous measurements (Argonne 2006a, 2007a, 2008a,b), indicating an apparent groundwater flow direction toward the southwest across much of the former CCC/USDA facility. Like previous depictions of the potentiometric surface, Figure 3.1 indicates that groundwater flow is focused toward a localized low in the potentiometric surface, defined by the water level measurements at SB01, MW04, MW06, and MW07. Argonne's earlier investigations (Argonne 2003, 2004) suggested that the increased hydraulic gradients observed near these wells are a reflection of relatively low-permeability silts and clays that comprise the aquifer unit in this portion of the study area, in comparison to the more coarse-grained deposits identified in the northern and eastern portions of the site. The results of groundwater analyses at Centralia (discussed in Section 3.2) support an interpretation of slow groundwater flow (and carbon tetrachloride migration) to the south-southwest, in keeping with the observed water level patterns.

3.2 Groundwater Analysis Results

3.2.1 Results of the Groundwater Analyses for VOCs

The analytical data for VOCs in the groundwater samples collected in September 2008 are in Table 3.2, together with data for the previous sampling events conducted at Centralia since sampling of the monitoring well network began in 2004. The September 2008 data for carbon tetrachloride are illustrated in Figure 3.2, along with the lateral margins of the plume, as interpreted by Argonne on the basis of each of the groundwater sampling events summarized in Table 3.2.

Carbon tetrachloride was detected in September 2008 at 10 of the 16 approved monitoring locations (KDHE 2005a,b) on and downgradient from the former CCC/USDA facility (Figure 3.2), at concentrations ranging from 2.0 µg/L (at MW04) to a maximum of 378 µg/L (at SB01). Chloroform concentrations ranging from < 1 µg/L to 57 µg/L were detected at 9 of the 16 sampled locations (Table 3.2). The decrease in carbon tetrachloride concentration noted at MW02 (from 1,138 µg/L in September 2007 to no detection in March 2008 to 18 µg/L in September 2008) and the corresponding increase in chloroform and methylene chloride at that location are related to the interim measure pilot test (Argonne 2007b) initiated in December 2007. The results of the pilot test were reported separately (Argonne 2009).

Except for the noted change at MW02, the present carbon tetrachloride concentrations in sitewide monitoring wells are consistent with previous measurements. The data in Table 3.2 and Figure 3.2 continue to suggest longer-term trends of slightly increasing carbon tetrachloride levels at monitoring points SB05, MW03, MW04, and MW07, along the western and southern margins of the groundwater plume and in the apparent direction of groundwater flow.

3.2.2 Results of Other Groundwater Analyses

The results of field measurements on the groundwater samples are summarized in Table 3.3. Additional parameters were formerly reported to estimate whether the *in situ* conditions at Centralia are suitable for possible degradation of carbon tetrachloride by natural anaerobic (reductive dechlorination) processes, as outlined in regulatory guidance for the evaluation of these conditions (KDHE 2001; EPA 1998). Because the results gave only limited evidence for possible anaerobic biodegradation of carbon tetrachloride at Centralia, the analyses for additional parameters have been discontinued. The persistent occurrence of the carbon tetrachloride breakdown product chloroform at relatively elevated concentrations at monitoring points SB01, SB05, and MW02 during the March 2005 sampling event and subsequently (Table 3.2) suggested that carbon tetrachloride degradation was occurring at these locations.

TABLE 3.1 Hand-measured water levels at Centralia in November 2007, March 2008, June 2008, and September 2008.

Well	Top of Casing Elevation (ft AMSL)	November 12, 2007		March 12-20, 2008 ^a		June 25, 2008		September 8-10, 2008 ^a	
		Depth to Groundwater ^b (ft TOC)	Groundwater Elevation (ft AMSL)						
MW01	1329.30	13.95	1315.35	11.89	1317.41	9.88	1319.42	13.6	1315.70
MW02	1334.82	22.68	1312.14	21.85	1312.97	20.25	1314.57	21.9	1312.92
MW03	1334.70	22.54	1312.16	21.22	1313.48	19.65	1315.05	20.8	1313.90
MW04	1322.71	26.06	1296.65	24.23	1298.48	23.10	1299.61	24.0	1298.71
MW05	1318.11	10.49	1307.62	7.32	1310.79	8.36	1309.75	10.0	1308.11
MW06	1329.82	38.47	1291.35	34.70	1295.12	36.50	1293.32	36.6	1293.22
MW07	1324.83	29.59	1295.24	28.32	1296.51	26.60	1298.23	28.2	1296.63
MW08	1332.41	20.40	1312.01	18.85	1313.56	17.80	1314.61	18.6	1313.81
MW09	1310.49	2.89	1307.60	0.00	1310.49	0.61	1309.88	2.5	1307.99
MW10	1334.56	22.36	1312.20	20.90	1313.66	19.52	1315.04	21.1	1313.46
SB01	1325.16	19.72	1305.44	15.87	1309.29	16.23	1308.93	20.1	1305.06
SB04	1335.73	23.68	1312.05	22.34	1313.39	20.69	1315.04	21.9	1313.83
SB05	1321.28	–	–	7.43	1313.85	7.50	1313.78	10.6	1310.68
SB07R	1331.71	19.56	1312.15	18.23	1313.48	16.63	1315.08	18.4	1313.31
SB08	1332.56	20.49	1312.07	19.24	1313.32	17.41	1315.15	18.6	1313.96
SB09	1311.04	6.27	1304.77	2.90	1308.14	6.47	1304.57	6.6	1304.44

^a Measurements made during sampling.

^b Depths measured from the top of the casing (TOC).

TABLE 3.2 Analytical results from the AGEM Laboratory for volatile organic compounds in groundwater samples collected at Centralia, August 2004 to September 2008.

Well	Screen Interval (ft BGL)	Sample	Sampling Date	Concentration (µg/L)		
				Carbon Tetrachloride	Chloroform	Methylene Chloride
<i>Wells in the approved sitewide monitoring network</i>						
MW01	54.5-64.5	CNMW01-W-16158	8/24/04	ND ^a	ND	ND
		CNMW01-W-19276	9/10/05	ND	ND	ND
		CNMW01-W-16308	10/11/05	ND	ND	ND
		CNMW01-W-19890	3/15/06	ND	ND	ND
		CNMW01-W-22501	9/25/06	ND	ND	ND
		CNMW01-W-16326	3/29/07	ND	ND	ND
		CNMW01-W-16228	9/26/07	1 R ^b	ND	ND
		CNMW01-W-26082	1/11/08	ND	ND	ND
		CNMW01-W-26023	3/19/08	ND	ND	ND
CNMW01-W-26673	9/9/08	ND	ND	ND		
MW02	49.5-59.5	CNMW02-W-16159	8/26/04	215	6.2	ND
		CNMW02-W-19282	9/11/05	776	33	ND
		CNMW02-W-16309	10/12/05	528	21	ND
		CNMW02-W-19908	3/16/06	847	21	ND
		CNMW02-W-22508	9/26/06	1233	25	ND
		CNMW02-W-15489	3/26/07	829	14	ND
		CNMW02-W-16227	9/26/07	1138	18	ND
		CNMW02-W-26000	3/12/08	ND	1.2	1.9
CNMW02-W-26674	9/8/08	18	57	11		
MW03	50.5-60.5	CNMW03-W-16178	8/24/04	1.2	ND	ND
		CNMW03-W-19277	9/10/05	1.6	ND	ND
		CNMW03-W-16310	10/11/05	1.8	ND	ND
		CNMW03-W-19909	3/17/06	2.6	0.2 J ^c	ND
		CNMW03-W-22513	9/26/06	2.7	ND	ND
		CNMW03-W-15494	3/27/07	2.5	ND	ND
		CNMW03-W-16223	9/25/07	3.5	ND	ND
		CNMW03-W-26001	3/12/08	2.3	ND	ND
CNMW03-W-26675	9/9/08	3.2	0.3 J	ND		
MW04	37.5-47.5	CNMW04-W-16180	8/24/04	ND	ND	ND
		CNMW04-W-19280	9/11/05	0.9 J	ND	ND
		CNMW04-W-16311	10/11/05	0.8 J	ND	ND
		CNMW04-W-19891	3/15/06	1.3	ND	ND
		CNMW04-W-22506	9/25/06	1.4	0.1 J	ND
		CNMW04-W-16210	3/28/07	2.1	ND	ND
		CNMW04-W-16220	9/24/07	2.0	ND	ND
		CNMW04-W-26024	3/19/08	1.3	ND	ND
CNMW04-W-26676	9/9/08	2.0	ND	ND		
MW05	34.5-44.5	CNMW05-W-16183	8/25/04	ND	ND	ND
		CNMW05-W-19279	9/10/05	1.9	ND	ND
		CNMW05-W-16312	10/11/05	1.5	ND	ND
		CNMW05-W-19976	3/15/06	1.3	ND	ND
		CNMW05-W-22505	9/25/06	1.3	ND	ND
		CNMW05-W-16213	3/28/07	0.5 J	ND	ND
		CNMW05-W-16218	9/24/07	1.2	ND	ND
		CNMW05-W-26025	3/19/08	1.9	ND	ND
CNMW05-W-26677	9/10/08	13	0.7 J	ND		

TABLE 3.2 (Cont.)

Well	Screen Interval (ft BGL)	Sample	Sampling Date	Concentration (µg/L)		
				Carbon Tetrachloride	Chloroform	Methylene Chloride
<i>Wells in the approved sitewide monitoring network (cont.)</i>						
MW06	46.5-56.5	CNMW06-W-16184	8/25/04	ND	ND	ND
		CNMW06-W-19278	9/10/05	ND	ND	ND
		CNMW06-W-16313	10/11/05	0.3 J	ND	ND
		CNMW06-W-19889	3/15/06	0.2 J	ND	ND
		CNMW06-W-22511	9/27/06	ND	ND	ND
		CNMW06-W-16208	3/27/07	ND	ND	ND
		CNMW06-W-16222	9/24/07	ND	ND	ND
		CNMW06-W-26026	3/19/08	ND	ND	ND
		CNMW06-W-26678	9/9/08	ND	ND	ND
MW07	45-55	CNMW07-W-19887	3/14/06	0.4 J	0.6 J	ND
		CNMW07-W-22512	9/26/06	1.1	ND	ND
		CNMW07-W-15492	3/26/07	1.8	ND	ND
		CNMW07-W-16221	9/24/07	2.4	ND	ND
		CNMW07-W-26027	3/19/08	3.0	ND	ND
		CNMW07-W-26679	9/9/08	4.0	0.2 J	ND
MW08	38-53	CNMW08-W-19284	3/14/06	ND	ND	ND
		CNMW08-W-22507	9/26/06	ND	ND	ND
		CNMW08-W-15493	3/27/07	ND	ND	ND
		CNMW08-W-16226	9/25/07	ND	ND	ND
		CNMW08-W-26028	3/20/08	ND	ND	ND
		CNMW08-W-26680	9/10/08	ND	ND	ND
MW09	25-35	CNMW09-W-19285	3/15/06	ND	ND	ND
		CNMW09-W-22504	9/25/06	ND	ND	ND
		CNMW09-W-16209	3/27/07	ND	ND	ND
		CNMW09-W-16219	9/24/07	ND	ND	ND
		CNMW09-W-26029	3/20/08	ND	ND	ND
		CNMW09-W-26681	9/10/08	ND	ND	ND
MW10	30-45	CNMW10-W-19886	3/14/06	ND	ND	ND
		CNMW10-W-22510	9/26/06	ND	ND	ND
		CNMW10-W-16215	3/28/07	ND	ND	ND
		CNMW10-W-16224	9/25/07	ND	ND	ND
		CNMW10-W-26030	3/20/08	ND	ND	ND
		CNMW10-W-26682	9/9/08	ND	ND	ND
SB01	40-50	CNSB01-W-16188	8/26/04	186	6.5	ND
		CNSB01-W-19274	9/9/05	269	6.8	ND
		CNSB01-W-16314	10/12/05	288	6.6	ND
		CNSB01-W-19979	3/17/06	320	5.7	ND
		CNSB01-W-22516	9/27/06	267	6.3	ND
		CNSB01-W-15491	3/27/07	222	4.9	ND
		CNSB01-W-16232	9/27/07	283	4.6	ND
		CNSB01-W-26031	3/20/08	325	4.8	ND
		CNSB01-W-26683	9/10/08	378	4.1	ND

TABLE 3.2 (Cont.)

Well	Screen Interval (ft BGL)	Sample	Sampling Date	Concentration (µg/L)		
				Carbon Tetrachloride	Chloroform	Methylene Chloride
<i>Wells in the approved sitewide monitoring network (cont.)</i>						
SB04	51-61	CNSB04-W-16189	8/26/04	30	ND	ND
		CNSB04-W-19273	9/9/05	47	0.6 J	ND
		CNSB04-W-16315	10/12/05	44	0.5 J	ND
		CNSB04-W-19906	3/16/06	51	0.5 J	0.4 J B ^d
		CNSB04-W-22503	9/25/06	54	0.7 J	ND
		CNSB04-W-16216	3/28/07	44	0.5 J	ND
		CNSB04-W-16230	9/26/07	36	0.4 J	ND
		CNSB04-W-26002	3/12/08	30	0.3 J	ND
		CNSB04-W-26684	9/9/08	15	0.3 J	ND
SB05	32-42	CNSB05-W-16190	8/26/04	59	5.5	ND
		CNSB05-W-19275	9/9/05	77	7.2	ND
		CNSB05-W-16323	10/12/05	54	5.5	ND
		CNSB05-W-19904	3/17/06	104	7.2	ND
		CNSB05-W-19940	9/27/06	139	12	ND
		CNSB05-W-16212	3/28/07	138	12	ND
		CNSB05-W-16233	9/26/07	221	16	ND
		CNSB05-W-26032	3/20/08	224	17	ND
		CNSB05-W-26685	9/9/08	256	20	ND
SB07R	45-60	CNSB07R-W-19978	3/15/06	41	2.7	ND
		CNSB07R-W-19924	9/26/06	30	1.7	ND
		CNSB07R-W-15490	3/26/07	30	1.7	ND
		CNSB07R-W-16225	9/25/07	50	2.4	ND
		CNSB07R-W-26003	3/12/08	13	0.9 J	ND
		CNSB07R-W-26686	9/9/08	21	1.4 J	ND
SB08	52-62	CNSB08-W-16192	8/26/04	79	3.1	ND
		CNSB08-W-19272	9/8/05	80	2.6	ND
		CNSB08-W-16317	10/12/05	77	2.8	ND
		CNSB08-W-19903	3/17/06	91	2.7	ND
		CNSB08-W-22500	9/21/06	53	1.6	ND
		CNSB08-W-16214	3/28/07	64	2.0	ND
		CNSB08-W-16229	9/26/07	68	1.8	ND
		CNSB08-W-26004	3/12/08	28	1.1	ND
		CNSB08-W-26687	9/8/08	22	1.2 J	ND
SB09	32-42	CNSB09-W-16193	8/26/04	ND	ND	ND
		CNSB09-W-19281	9/11/05	ND	ND	ND
		CNSB09-W-16318	10/11/05	ND	ND	ND
		CNSB09-W-19902	3/17/06	ND	ND	ND
		CNSB09-W-22502	9/25/06	ND	ND	ND
		CNSB09-W-16211	3/28/07	ND	ND	ND
		CNSB09-W-16231	9/26/07	ND	ND	ND
		CNSB09-W-26033	3/20/08	ND	ND	ND
		CNSB09-W-26688	9/10/08	ND	ND	ND

TABLE 3.2 (Cont.)

Well	Screen Interval (ft BGL)	Sample	Sampling Date	Concentration (µg/L)		
				Carbon Tetrachloride	Chloroform	Methylene Chloride
<i>Pilot test wells installed in September 2008^e</i>						
PMP1	50-60	CNPMP1-W-26689	9/9/08	136	30	ND
PMP2	50-60	CNPMP2-W-26690	9/9/08	1854	318	5.6
PMP3	50-60	CNPMP3-W-26691	9/9/08	21	57	6.2
PMP4	48.75-58.75	CNPMP4-W-26692	9/9/08	49	4.2	ND
PMP5	50-60	CNPMP5-W-26693	9/10/08	418	46	1.6 J
PMP6	50-60	CNPMP6-W-26694	9/8/08	110	7.8	ND
PMP7	50-60	CNPMP7-W-26695	9/9/08	119	13	ND
PMP8	50-60	CNPMP8-W-26696	9/9/08	72	125	3.4
PMP9	50-60	CNPMP9-W-26697	9/9/08	7.6	0.4 J	ND

^a ND, not detected at an instrument detection limit of 0.1 µg/L.

^b Qualifier R indicates that the contaminant was present in the associated equipment rinsate.

^c Qualifier J indicates an estimated concentration below the method quantitation limit of 1.0 µg/L.

^d Qualifier B indicates that the contaminant was present in the associated method blank.

^e Details for the pilot test wells were reported separately (Argonne 2009).

TABLE 3.3 Field measurements for groundwater samples collected at Centralia, August 2004 to September 2008.

Location	Screen Interval (ft BGL)	Sample Date	Temperature (°C)	pH	Conductivity (µS/cm)	Concentration (mg/L)			ORP (mV)
						Dissolved Oxygen	Carbon Dioxide	Iron(II)	
<i>Wells in the approved sitewide monitoring network</i>									
MW01	54.5-64.5	8/24/04	16.3	7.39	652	0.06	25	0.00	230
		9/10/05	16.3	7.26	599	6.31	— ^a	0.00	104
		10/11/05	16.4	6.45	634	—	—	—	—
		3/15/06	14.3	7.56	621	9.33	30	0.04	297
		9/25/06	13.3	7.01	782	6.82	50	0.31	92
		3/29/07	16.5	6.54	629	4.39	—	0.00	174
		9/26/07	17.8	7.06	630	0.89	35	0.09	146
		3/19/08	9.5	7.31	613	3.34	—	—	122
		9/9/08	13.9	7.28	595	5.18	20	0.03	28
MW02	49.5-59.5	8/26/04	14.4	7.31	729	0.16	20	0.12	235
		9/11/05	15.3	7.02	739	1.28	—	—	—
		10/12/05	14.8	6.60	766	—	—	—	—
		3/16/06	14.2	6.78	759	1.24	—	0.00	295
		9/26/06	13.2	6.98	957	3.05	40	0.06	67
		3/26/07	15.7	6.39	739	2.29	50	—	67
		9/26/07	15.4	7.04	763	3.39	25	0.00	156
		3/12/08	11.1	5.58	10174	0.28	—	3.3 ^b	-42
		9/8/08	13.1	6.12	6821	0.40	50	3.3 ^b	-74
MW03	50.5-60.5	8/24/04	13.1	7.28	783	0.10	55	0.21	230
		9/10/05	15.1	7.05	715	10.42	65	0.00	142
		10/11/05	16.3	6.46	765	—	—	—	—
		3/17/06	13.8	6.75	753	9.39	77	0.00	290
		9/26/06	13.2	6.92	960	11.57	45	0.08	251
		3/27/07	15.3	6.40	774	7.73	25	—	268
		9/25/07	14.3	6.97	738	8.44	30	0.00	162
		3/12/08	14.6	7.12	777	7.90	—	3.13	89
		9/9/08	14.9	7.13	763	9.60	110	0.12	66
MW04	37.5-47.5	8/24/04	16.2	7.39	717	0.11	40	0.04	210
		9/11/05	15.4	7.18	665	8.43	60	0.00	226
		10/11/05	14.4	7.14	811	—	—	—	—
		3/15/06	13.5	7.78	675	6.82	55	0.06	283
		9/25/06	—	7.02	613	9.13	40	0.19	46
		3/28/07	15.4	6.47	678	5.46	—	0.00	197
		9/24/07	17.4	7.10	667	6.94	35	0.24	261
		3/19/08	11.2	7.32	636	7.55	—	—	164
		9/9/08	14.2	7.14	648	8.68	100	0.00	72
MW05	34.5-44.5	8/25/04	14.3	7.14	613	0.08	25	0.06	215
		9/10/05	14.2	6.80	620	1.40	110	0.00	160
		10/11/05	14.8	6.35	610	—	—	—	—
		3/15/06	14.3	6.90	701	0.90	30	0.06	156
		9/25/06	13.6	6.95	768	0.09	50	0.02	55
		3/28/07	14.4	6.44	573	4.53	35	0.00	295
		9/24/07	15.8	7.06	368	3.09	45	0.00	182
		3/19/08	12.9	7.42	642	5.42	—	—	177
		9/10/08	13.9	7.11	663	7.14	95	0.00	130

TABLE 3.3 (Cont.)

Location	Screen Interval (ft BGL)	Sample Date	Temperature (°C)	pH	Conductivity (μS/cm)	Concentration (mg/L)			ORP (mV)
						Dissolved Oxygen	Carbon Dioxide	Iron(II)	
<i>Wells in the approved sitewide monitoring network (cont.)</i>									
MW06	46.5-56.5	8/25/04	15.9	7.50	637	0.05	15	0.00	215
		9/10/05	14.6	7.23	659	0.04	60	0.00	41
		10/11/05	15.8	6.99	638	—	—	—	—
		3/15/06	14.1	7.38	630	9.87	35	0.02	263
		9/27/06	13.1	6.16	652	0.05	45	1.12	63
		3/27/07	19.0	6.42	466	0.11	20	0.00	13
		9/24/07	16.8	7.11	463	8.00	25	0.41	191
		3/19/08	14.1	7.01	552	7.00	—	—	172
		9/9/08	14.4	7.20	437	0.36	105	0.07	-96
MW07	45-55	3/14/06	14.7	6.61	709	0.34	—	0.03	143
		9/26/06	13.1	7.23	642	2.91	50	0.00	—
		3/26/07	15.8	6.50	642	1.87	30	0.00	261
		9/24/07	19.0	7.18	609	9.05	60	0.18	190
		3/19/08	12.5	7.29	647	2.70	—	—	215
		9/9/08	15.6	7.10	629	1.41	68	0.00	16
MW08	38-53	3/14/06	13.5	6.35	854	5.32	—	0.00	145
		9/26/06	13.3	6.75	1095	0.16	50	0.18	37
		3/27/07	15.8	6.31	874	1.49	30	0.21	237
		9/25/07	15.8	6.92	627	1.42	45	0.14	219
		3/20/08	13.5	7.19	869	2.11	—	—	185
		9/10/08	16.3	7.03	864	1.17	100	0.03	117
MW09	25-35	3/15/06	17.7	7.33	664	0.95	55	0.09	214
		9/25/06	12.8	6.87	859	1.59	45	0.18	90
		3/27/07	14.9	6.35	689	4.10	30	0.69	152
		9/24/07	16.6	6.94	1999	3.86	55	0.14	186
		3/20/08	13.5	7.17	720	4.70	—	—	173
		9/10/08	14.7	7.02	706	3.68	110	0.07	120
MW10	30-45	3/14/06	14.8	6.60	834	6.42	65	0.00	166
		9/26/06	13.6	6.87	1058	6.94	50	0.50	51
		3/28/07	17.0	6.36	834	5.09	35	0.00	270
		9/25/07	15.8	6.94	827	6.64	35	0.21	199
		3/20/08	10.9	7.18	898	6.12	—	—	187
		9/9/08	14.8	7.05	879	7.18	100	0.06	94
SB01	40-50	8/26/04	26.0	7.46	699	5.21	30	0.00	210
		9/9/05	25.0	7.11	674	6.25	95	0.00	140
		10/12/05	13.8	7.23	686	—	—	—	—
		3/17/06	12.4	7.30	692	5.98	55	0.00	185
		9/27/06	14.4	7.03	832	6.54	40	0.52	198
		3/27/07	18.0	6.37	659	3.81	25	0.23	173
		9/27/07	13.5	7.24	720	6.55	45	1.04	143
		3/20/08	15.6	7.29	783	8.02	—	—	182
		9/10/08	16.5	7.10	676	2.89	100	0.17	100

TABLE 3.3 (Cont.)

Location	Screen Interval (ft BGL)	Sample Date	Temperature (°C)	pH	Conductivity (μS/cm)	Concentration (mg/L)			ORP (mV)
						Dissolved Oxygen	Carbon Dioxide	Iron(II)	
<i>Wells in the approved sitewide monitoring network (cont.)</i>									
SB04	51-61	8/26/04	17.9	7.14	765	3.78	55	0.37	230
		9/9/05	16.0	7.09	708	8.67	100	–	206
		10/12/05	13.9	7.17	813	–	–	–	–
		3/16/06	13.0	7.57	799	5.96	30	–	276
		9/25/06	14.9	7.16	791	9.32	70	1.18	64
		3/28/07	16.2	6.45	850	6.18	–	0.23	266
		9/26/07	19.8	7.03	760	6.61	30	0.00	202
		3/12/08	15.5	7.04	819	6.16	–	0.09	154
		9/9/08	16.5	7.11	802	6.48	100	0.02	70
SB05	32-42	8/26/04	15.7	7.25	761	–	25	0.06	220
		9/9/05	16.9	6.98	687	7.58	100	–	–
		10/12/05	14.0	7.00	728	–	–	–	–
		3/17/06	13.3	7.67	718	4.80	40	0.18	253
		9/27/06	13.7	6.58	763	4.70	50	0.25	78
		3/28/07	16.7	4.03	0.11	2.58	35	0.07	296
		9/26/07	15.1	6.98	810	4.10	30	0.50	221
		3/20/08	14.5	7.11	870	5.56	–	–	206
		9/9/08	13.7	6.79	890	7.60	90	0.09	56
SB07R	45-60	3/15/06	16.8	7.24	685	7.41	60	0.08	83
		9/26/06	13.2	6.89	842	6.17	55	0.26	67
		3/26/07	19.0	6.38	668	5.08	40	0.07	237
		9/25/07	17.4	7.06	642	6.30	35	0.11	170
		3/12/08	17.3	7.18	639	5.33	–	0.00	108
		9/9/08	14.1	7.06	631	5.08	100	0.07	55
SB08	52-62	8/26/04	19.5	7.31	635	0.16	20	0.53	235
		9/8/05	21.2	7.27	598	3.21	75	0.00	111
		10/12/05	13.9	7.15	630	–	–	–	–
		3/17/06	12.9	7.14	645	3.40	40	0.00	246
		9/21/06	14.1	6.96	809	4.53	40	0.00	37
		3/28/07	15.8	6.53	645	3.57	35	0.24	208
		9/26/07	17.4	7.11	617	4.56	40	0.77	156
		3/12/08	17.1	7.17	642	3.63	–	0.14	102
		9/8/08	13.6	7.14	626	2.70	90	0.00	230
SB09	32-42	8/26/04	30.9	7.09	910	0.26	75	0.00	185
		9/11/05	14.6	6.71	877	0.13	225	0.00	–
		10/11/05	13.9	6.85	910	–	–	–	–
		3/17/06	11.7	7.03	969	1.53	99	0.00	206
		9/25/06	14.2	7.00	976	0.29	70	0.38	86
		3/28/07	14.3	6.32	957	0.89	40	0.09	236
		9/26/07	15.2	6.77	969	1.53	45	0.12	199
		3/20/08	10.1	6.94	1000	1.57	–	–	221
		9/10/08	18.4	6.87	977	0.56	160	0.11	109

TABLE 3.3 (Cont.)

Location	Screen Interval (ft BGL)	Sample Date	Temperature (°C)	pH	Conductivity (μS/cm)	Concentration (mg/L)			ORP (mV)
						Dissolved Oxygen	Carbon Dioxide	Iron(II)	
<i>Pilot test wells installed in September 2008^c</i>									
PMP1	50-60	9/9/08	14.4	5.54	700	1.37	115	0.23	40
PMP2	50-60	9/9/08	14.4	7.09	997	0.05	180	1.68	-41
PMP3	50-60	9/9/08	14.5	6.98	1301	0.03	150	3.3 ^b	-150
PMP4	48.75-58.75	9/9/08	14.3	4.97	738	4.87	100	0.49	134
PMP5	50-60	9/10/08	16.9	7.20	875	2.51	105	0.18	117
PMP6	50-60	9/8/08	13.2	6.87	787	3.32	75	0.09	173
PMP7	50-60	9/9/08	14.2	6.30	807	2.18	70	0.18	15
PMP8	50-60	9/9/08	14.4	7.05	1388	0.03	60	2.72	-129
PMP9	50-60	9/9/08	14.0	6.36	606	7.78	120	0.10	45

^a Measurement not recorded.

^b Maximum reading from instrument.

^c Details for the pilot test wells were reported separately (Argonne 2009).

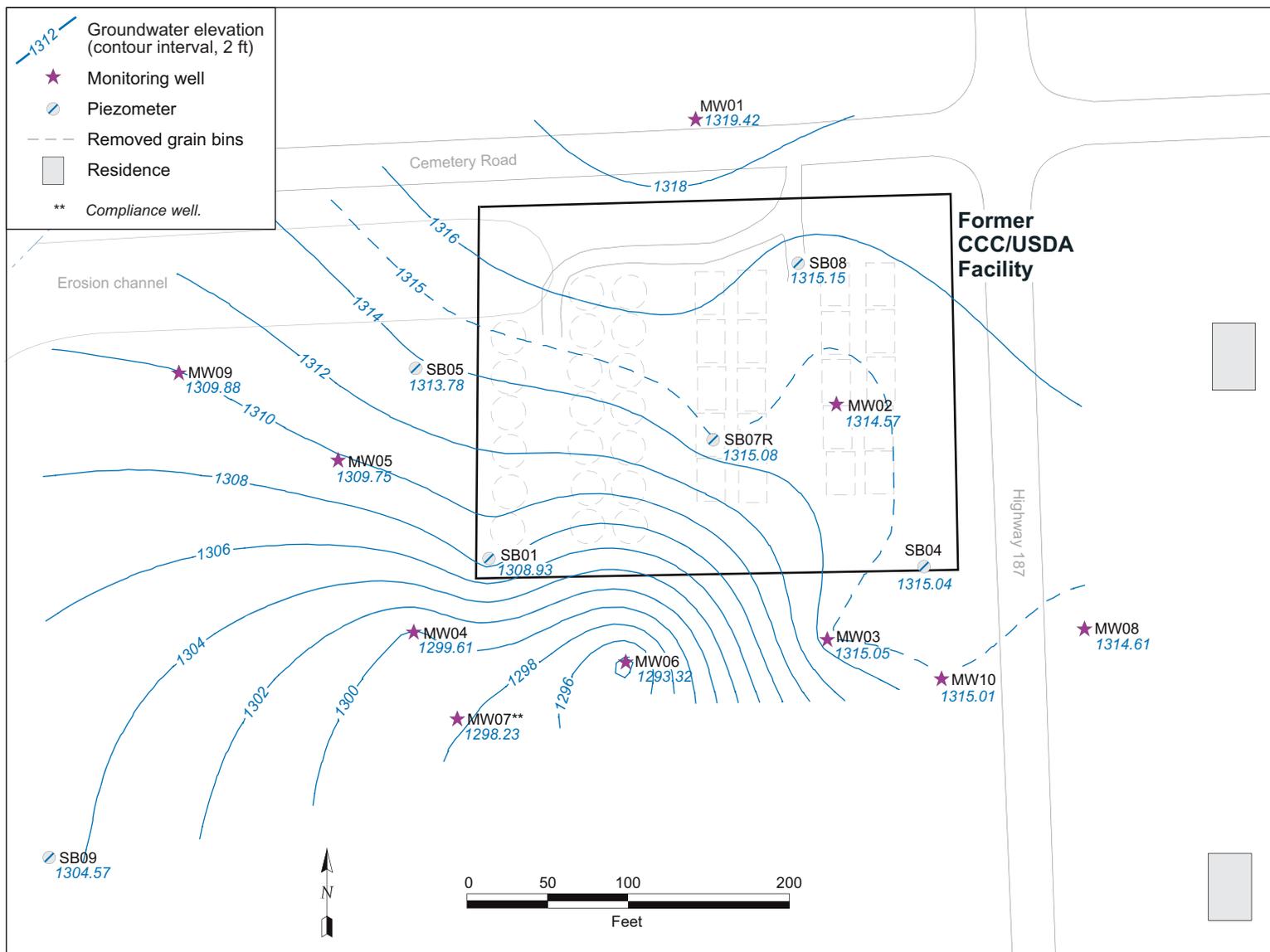


FIGURE 3.1 Potentiometric surface at Centralia, based on water levels measured manually on June 25, 2008.

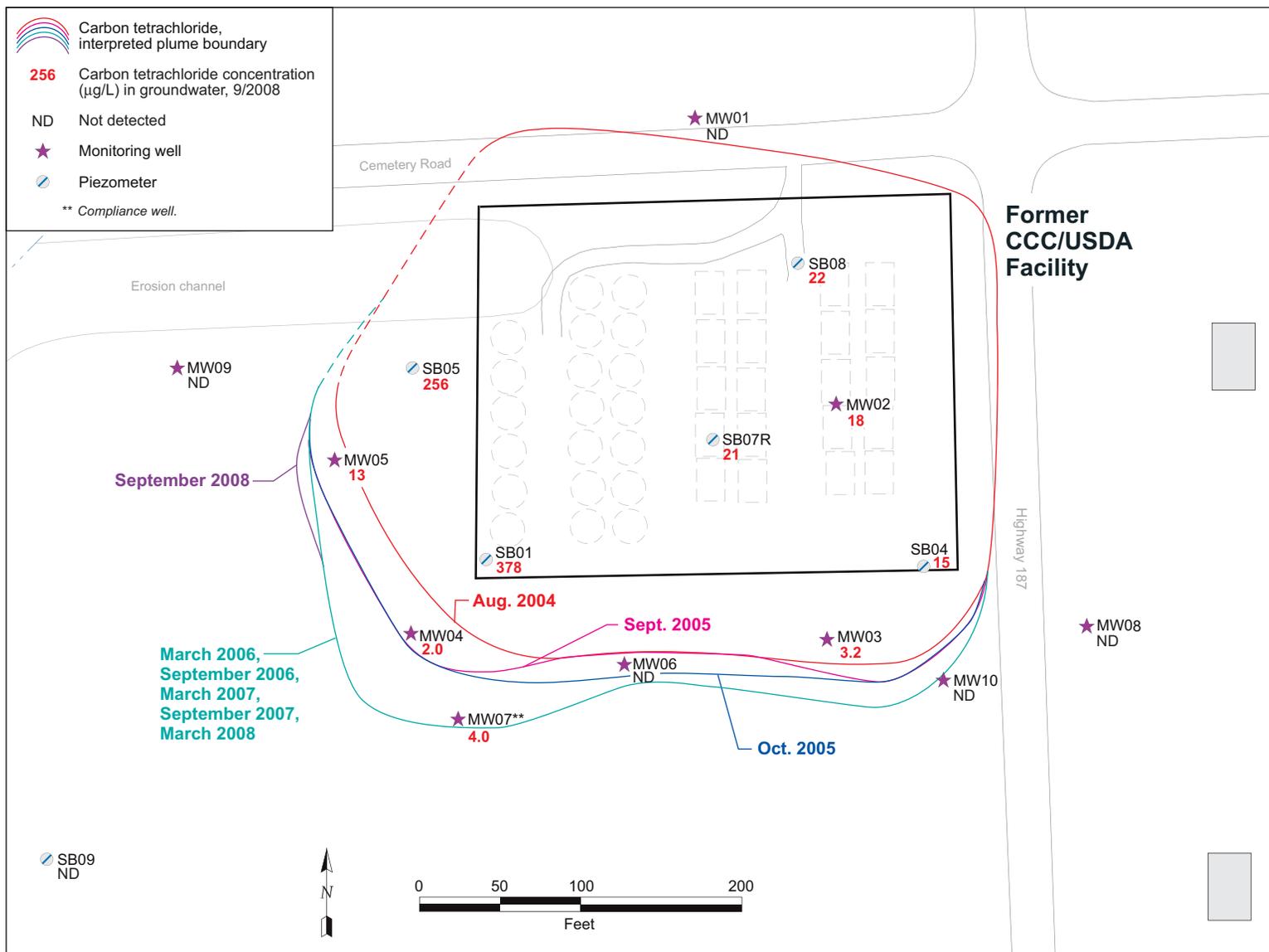


FIGURE 3.2 Carbon tetrachloride levels in groundwater at Centralia in September 2008, with the interpreted lateral extent of the contaminant at intervals during the period August 2004 to September 2008.

4 Conclusions and Recommendations

4.1 Conclusions

The findings of the September 2008 monitoring event at Centralia support the following conclusions:

- Measurements of groundwater levels obtained manually and through the use of automatic recorders have consistently indicated an apparent direction of groundwater flow to the south-southwest across the former CCC/USDA facility.
- The September 2008 carbon tetrachloride data for monitoring wells in the approved sitewide network are generally consistent with previous results. Longer-term trends of slightly increasing carbon tetrachloride concentrations continue to be observed at monitoring points SB05, MW03, MW04, and MW07, along the western and southern margins of the groundwater plume. These trends suggest very slow expansion of the plume at the downgradient locations.
- A dramatic decrease in carbon tetrachloride concentration at MW02, from 1,138 µg/L in September 2007, followed implementation of the interim measure pilot test in December 2007. A reduction of 96-99% in the levels of carbon tetrachloride in groundwater in the injection area near MW02 was observed within the first 5-7 weeks after injection. Monitoring at MW02 in March 2008 showed no carbon tetrachloride present, while monitoring in September 2008 indicated that carbon tetrachloride concentrations had increased slightly (to 18 µg/L), though they remained at or near the dramatically decreased levels observed initially post-injection.
- Sampling in 2004-2007 yielded only limited evidence for the presence of subsurface conditions at Centralia conducive to anaerobic degradation of the carbon tetrachloride contamination in groundwater. Nevertheless, consistent detection of chloroform at relatively elevated concentrations at monitoring

points SB01, SB05, and MW02 suggested that degradation of carbon tetrachloride was occurring at those locations.

4.2 Recommendations

The September 2007 sampling was the final monitoring event performed under the original two-year, twice yearly monitoring program (Argonne 2005b) approved by the KDHE (2005a,b). The CCC/USDA developed an *Interim Measure Conceptual Design* (Argonne 2007b), proposing a pilot test of the Adventus EHC *in situ* chemical reduction (ISCR) technology, that was approved by the KDHE in November 2007 (KDHE 2007). Implementation of the interim measure occurred in December 2007. The results of the September 2007 monitoring (Argonne 2008a) served as pre-injection baseline data for existing monitoring points, per agreement with the KDHE.

The EHC materials, proprietary mixtures of food-grade organic carbon and zero-valent iron, were injected into the subsurface as a slurry (EHC) or in dissolved form (EHC-A) for subsequent slow release into the formation. The materials are designed to create highly reducing geochemical conditions in the vadose and saturated zones that foster both thermodynamic and biological reductive dechlorination of carbon tetrachloride. Adventus has estimated that the EHC materials might have an effect on the subsurface geochemical environment in the pilot test area for 1-5 years (Adventus 2009). The results to date of the EHC pilot injections were discussed with the KDHE in September 2008 and were documented separately (Argonne 2009). On the basis of these data, the CCC/USDA has recommended additional monitoring of the pilot test site to determine the longer-term effects of the EHC injections; however, no further implementation of the ISCR technology is proposed (Argonne 2009).

The March and September 2008 sampling events were extensions of the original two-year (from 2005 to 2007) program of twice yearly monitoring at Centralia previously approved by the KDHE. The KDHE (2008a) has requested that sitewide monitoring continue at Centralia until a final remedy has been selected (as part of a Corrective Action Study [CAS] evaluation) and implemented. The CCC/USDA has therefore recommended (Argonne 2009) the development of a revised monitoring program, to address both the continued pilot test and sitewide monitoring objectives. With the KDHE's approval, the interim plan presented here will be implemented while a CAS for the Centralia site is being prepared.

The interim monitoring plan being recommended by the CCC/USDA acknowledges the observation that the contaminant plume has shown almost no movement or expansion during several years of monitoring. The elements of the proposed interim monitoring plan are as follows:

- Annual sampling of
 - Twelve previously established (before the pilot test) monitoring points (locations identified in Figure 4.1) and
 - The five outlying pilot test monitoring points (PMP4, PMP5, PMP6, PMP7, PMP9; Figure 4.2).
- Sampling twice yearly at the five pilot test monitoring points inside the injection area (PMP1, PMP2, PMP3, PMP8, MW02; Figure 4.2).
- Elimination of MW01 (upgradient), MW08 (upgradient), and SB09 (far downgradient) from the monitoring network, unless site conditions change to indicate the need for resumed monitoring at those locations.

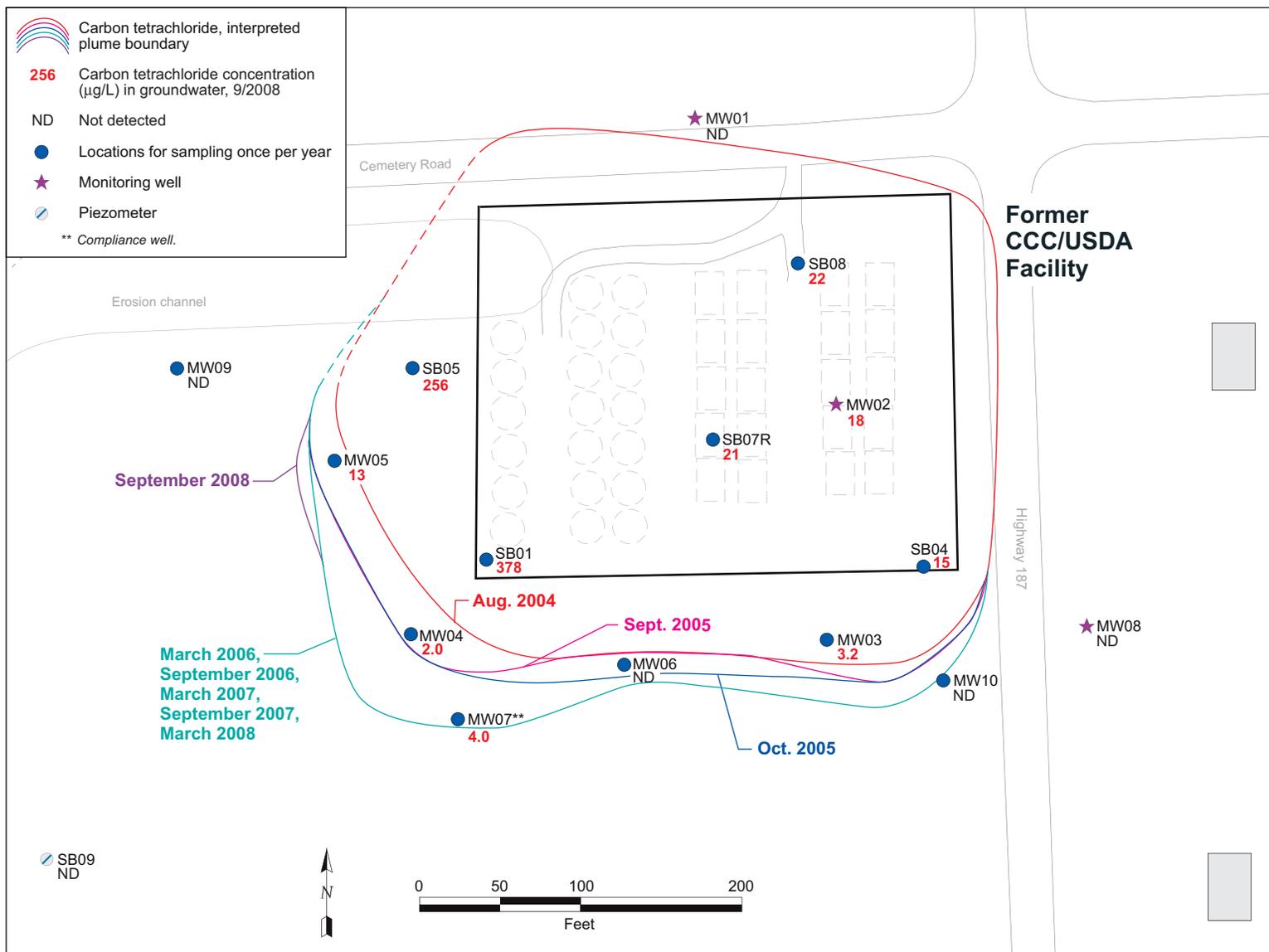


FIGURE 4.1 Previously established (before the pilot test) monitoring points proposed for ongoing annual monitoring.

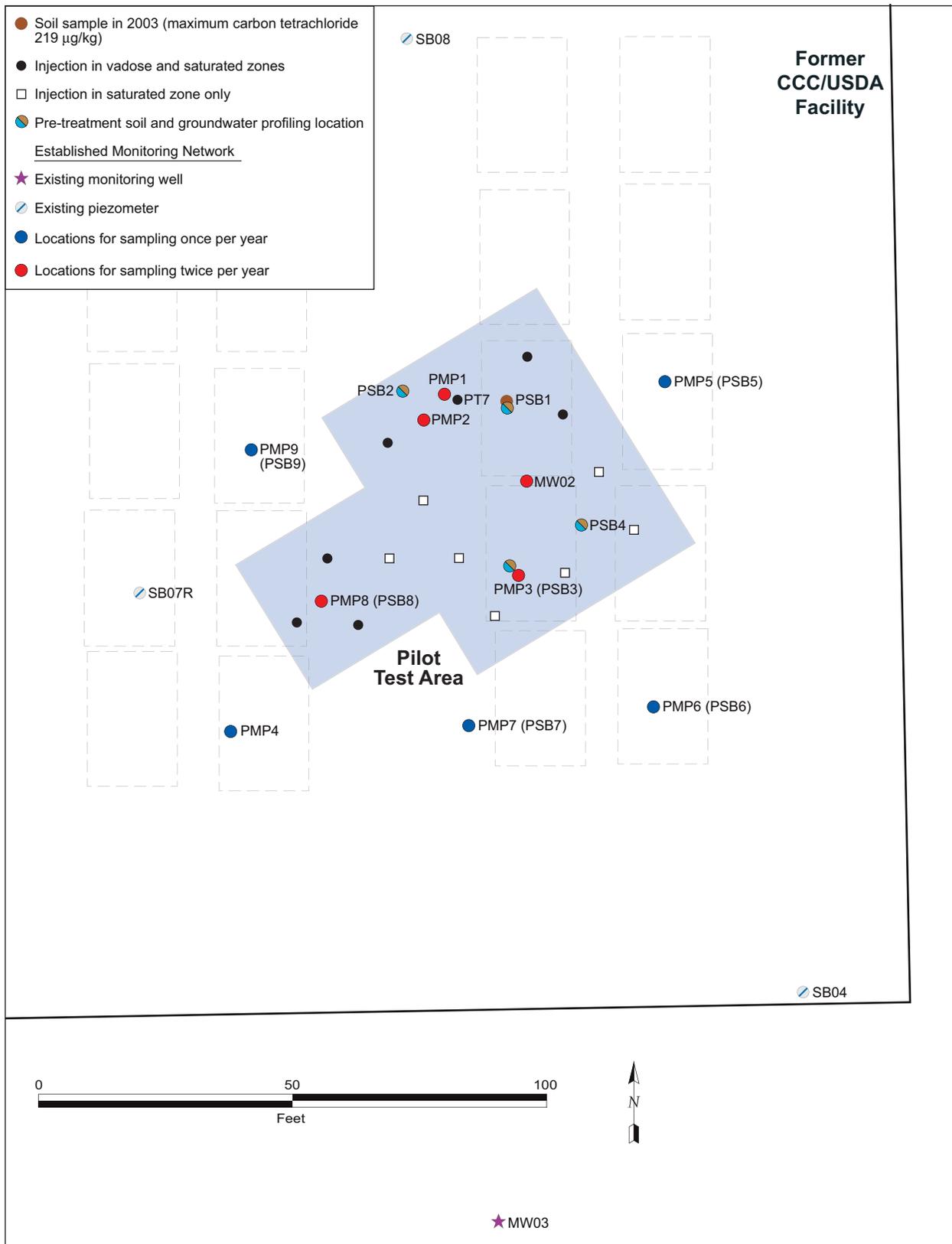


FIGURE 4.2 Pilot test monitoring points proposed for ongoing annual monitoring or twice yearly monitoring.

5 References

Adventus, 2009, *EHC[®] Technology Overview — Field Applications*, Adventus Americas, Inc., Freeport, Illinois, http://www.adventusgroup.com/pdfs/EHC_applications.pdf, accessed January 15.

Argonne, 2002, *Final Master Work Plan: Environmental Investigations at Former CCC/USDA Facilities in Kansas, 2002 Revision*, ANL/ER/TR-02/2004, prepared for the Commodity Credit Corporation, U.S. Department of Agriculture, Washington, D.C., by Argonne National Laboratory, Argonne, Illinois, December.

Argonne, 2003, *Final Phase I Report and Phase II Work Plan: QuickSite[®] Investigation, Centralia, Kansas*, ANL/ER/TR-02/009, prepared for the Commodity Credit Corporation, U.S. Department of Agriculture, Washington, D.C., by Argonne National Laboratory, Argonne, Illinois, March.

Argonne, 2004, *Final Phase II Report: QuickSite[®] Investigation, Centralia, Kansas*, ANL/ER/TR-03/006, prepared for the Commodity Credit Corporation, U.S. Department of Agriculture, Washington, D.C., by Argonne National Laboratory, Argonne, Illinois, March.

Argonne, 2005a, *Final Report: 2004 Monitoring Well Installation and Sampling at Centralia, Kansas*, ANL/ER/TR-04/011, prepared for the Commodity Credit Corporation, U.S. Department of Agriculture, Washington, D.C., by Argonne National Laboratory, Argonne, Illinois, October.

Argonne, 2005b, *Final Work Plan: Groundwater Monitoring at Centralia, Kansas*, ANL/ER/TR-05/004, prepared for the Commodity Credit Corporation, U.S. Department of Agriculture, Washington, D.C., by Argonne National Laboratory, Argonne, Illinois, August.

Argonne, 2006a, *Final Report: Groundwater Monitoring at Centralia, Kansas, in September-October 2005 and March 2006, with Expansion of the Monitoring Network in January 2006*, ANL/EVS/AGEM/TR-06-06, prepared for the Commodity Credit Corporation, U.S. Department of Agriculture, Washington, D.C., by Argonne National Laboratory, Argonne, Illinois, October.

Argonne, 2006b, *September 2006 Monitoring Results for Centralia, Kansas*, ANL/EVS/AGEM/CHRON-1003, prepared for the Commodity Credit Corporation,

U.S. Department of Agriculture, Washington, D.C., by Argonne National Laboratory, Argonne, Illinois, November 10.

Argonne, 2007a, *March 2007 Monitoring Results for Centralia, Kansas*, ANL/EVS/AGEM/TR-07-08, prepared for the Commodity Credit Corporation, U.S. Department of Agriculture, Washington, D.C., by Argonne National Laboratory, Argonne, Illinois, June.

Argonne, 2007b, *Interim Measure Conceptual Design for Remediation at the Former CCC/USDA Grain Storage Facility at Centralia, Kansas: Pilot Test and Remedy Implementation*, ANL/EVS/AGEM/TR-07-11, prepared for the Commodity Credit Corporation, U.S. Department of Agriculture, Washington, D.C., by Argonne National Laboratory, Argonne, Illinois, October.

Argonne, 2008a, *September 2007 Monitoring Results for Centralia, Kansas*, ANL/EVS/AGEM/TR-08-01, prepared for the Commodity Credit Corporation, U.S. Department of Agriculture, Washington, D.C., by Argonne National Laboratory, Argonne, Illinois, January.

Argonne, 2008b, *March 2008 Monitoring Results for Centralia, Kansas*, ANL/EVS/AGEM/TR-08-08, prepared for the Commodity Credit Corporation, U.S. Department of Agriculture, Washington, D.C., by Argonne National Laboratory, Argonne, Illinois, May.

Argonne, 2009, *Progress Report and Technical Evaluation of the ISCR Pilot Test Conducted at the Former CCC/USDA Grain Storage Facility in Centralia, Kansas*, ANL/EVS/AGEM/TR-08-18, prepared for the Commodity Credit Corporation, U.S. Department of Agriculture, Washington, D.C., by Argonne National Laboratory, Argonne, Illinois, January.

EPA, 1995, *Method 524.2: Measurement of Purgeable Organic Compounds in Water by Capillary Column Gas Chromatography/Mass Spectrometry, Revision 4.1*, edited by J.W. Munch, National Exposure Research Laboratory, Office of Research and Development, U.S. Environmental Protection Agency, Cincinnati, Ohio.

EPA, 1998, *Technical Protocol for Evaluating Natural Attenuation of Chlorinated Solvents in Ground Water*, EPA/600/R-98/128, Office of Research and Development, U.S. Environmental Protection Agency, Washington, D.C., September (<http://www.epa.gov/superfund/resources/gwdocs/protocol.htm>).

KDHE, 2001, *Monitored Natural Attenuation*, Policy BER-RS-042, Bureau of Environmental Remediation, Kansas Department of Health and Environment, Topeka, Kansas, March 30 (revised December 18, 2005; http://www.kdheks.gov/ber/policies/BER_RS_042.pdf).

KDHE, 2005a, letter from C. Carey (Bureau of Environmental Remediation, Kansas Department of Health and Environment, Topeka, Kansas) to C. Roe (Commodity Credit Corporation, U.S. Department of Agriculture, Washington, D.C.), regarding *Final Work Plan: Groundwater Monitoring at Centralia, Kansas*, October 13.

KDHE, 2005b, letter from C. Carey (Bureau of Environmental Remediation, Kansas Department of Health and Environment, Topeka, Kansas) to C. Roe (Commodity Credit Corporation, U.S. Department of Agriculture, Washington, D.C.), regarding results of the fall 2005 sampling at Centralia and recommendations for expansion of the monitoring network, November 22.

KDHE, 2007, letter from C. Carey (Bureau of Environmental Remediation, Kansas Department of Health and Environment, Topeka, Kansas) to C. Roe (Commodity Credit Corporation, U.S. Department of Agriculture, Washington, D.C.), regarding review of *Interim Measure Conceptual Design* for Centralia, Kansas, November 9.

KDHE, 2008a, letter from C. Carey (Bureau of Environmental Remediation, Kansas Department of Health and Environment, Topeka, Kansas) to C. Roe (Commodity Credit Corporation, U.S. Department of Agriculture, Washington, D.C.), regarding *September 2007 Monitoring Results for Centralia, Kansas*, March 12.

KDHE, 2008b, electronic mail message from C. Carey (Bureau of Environmental Remediation, Kansas Department of Health and Environment, Topeka, Kansas) to L. LaFreniere (Argonne National Laboratory, Argonne, Illinois), regarding use of the low-flow sampling technique at Centralia, February 11.

Puls, R.W., and Barcelona, M.J., 1996, "Low-Flow (Minimal Drawdown) Ground-Water Sampling Procedures," EPA/540/S-95/504, in *Ground Water Issue*, Superfund Technology Support Center for Ground Water, National Risk Management Research Laboratory, Ada, Oklahoma, April (www.epa.gov/tio/tsp/download/lwflw2a.pdf).

Appendix A:

Sequence of Sampling Activities at Centralia, Kansas, in September 2008

TABLE A.1 Sequence of water sampling activities at Centralia in September 2008.

Date	Time	Sample	Type ^a	Location ^b	Depth ^c (ft TOC)	Chain of Custody	Sample Description
9/8/08	12:04	CNSB08-W-26687	CPT/P	SB08	52-62	6122	Depth to water = 18.6 ft. Depth of 1-in. well = 62 ft. Sample collected by using low-flow bladder pump after purging of 3 L. Water clear.
9/8/08	13:16	CNMW02-W-26674	MW	MW02	49.5-59.5	6122	Depth to water = 21.9 ft. Depth of 4-in. well = 59.5 ft. Sample collected by using low-flow bladder pump after purging of 6.7 L. Water tannish in color with strong manure-like odor. Carbon dioxide difficult to read.
9/8/08	13:19	CNPMP6-W-26694	MW	PMP6	50-60	6124	Depth to water = 20.9 ft. Depth of 0.5-in. well = 60 ft. Sample collected by using Waterra pump after purging of 5.2 L. Water brown to tannish in color.
9/9/08	9:30	CNMW01-W-26673	MW	MW01	54.5-64.5	6123	Depth to water = 13.6 ft. Depth of 4-in. well = 64.5 ft. Sample collected by using low-flow bladder pump after purging of 10 L. Water clear.
9/9/08	10:52	CNSB07R-W-26686	CPT/P	SB07R	45-60	6123	Depth to water = 18.4 ft. Depth of 2-in. well = 60 ft. Sample collected by using low-flow bladder pump after purging of 6 L. Water clear.
9/9/08	11:27	CNPMP7-W-26695	MW	PMP7	50-60	6123	Depth to water = 20 ft. Depth of 0.5-in. well = 60 ft. Sample collected by using Waterra pump. Water has light brown tint.
9/9/08	12:04	CNSB04-W-26684	CPT/P	SB04	51-61	6123	Depth to water = 21.9 ft. Depth of 1-in. well = 61 ft. Sample collected by using low-flow bladder pump after purging of 3.2 L. Water clear.
9/9/08	12:33	CNPMP4-W-26692	MW	PMP4	48.75-58.75	6123	Depth to water = 19.15 ft. Depth of 0.5-in. well = 58.75 ft. Sample collected by using Waterra pump after purging of 5.5 L. Water tannish brown in color.
9/9/08	12:54	CNMW03-W-26675	MW	MW03	50.5-60.5	6123	Depth to water = 20.8 ft. Depth of 4-in. well = 60.5 ft. Sample collected by using low-flow bladder pump after purging of 6.3 L. Water clear.
9/9/08	13:10	CNPMP8-W-26696	MW	PMP8	50-60	6123	Depth to water = 20.3 ft. Depth of 0.5-in. well = 60 ft. Sample collected by using Waterra pump after purging of 5.5 L. Water tannish in color with odor.
9/9/08	13:40	CNPMP3-W-26691	MW	PMP3	50-60	6123	Depth to water = 21.6 ft. Depth of 0.5-in. well = 60 ft. Sample collected by using Waterra pump after purging of 5.2 L. Water cloudy to grayish tint in color, with odor.
9/9/08	13:48	CNMW10-W-26682	MW	MW10	30-45	6123	Depth to water = 21.1 ft. Depth of 2-in. well = 45 ft. Sample collected by using low-flow bladder pump after purging of 7 L. Water clear.

TABLE A.1 (Cont.)

Date	Time	Sample	Type ^a	Location ^b	Depth ^c (ft TOC)	Chain of Custody	Sample Description
9/9/08	14:12	CNPMP9-W-26697	MW	PMP9	50-60	6122	Depth to water = 16.2 ft. Depth of 0.5-in. well = 60 ft. Sample collected by using Waterra pump after purging of 5.4 L. Water clear to cloudy.
9/9/08	14:42	CNPMP2-W-26690	MW	PMP2	50-60	6123	Depth to water = 20.9 ft. Depth of 0.5-in. well = 60 ft. Sample collected by using Waterra pump after purging of 5.1 L. Water clear to cloudy, with strong odor.
9/9/08	15:10	CNMW06-W-26678	MW	MW06	46.5-56.5	6123	Depth to water = 36.6 ft. Depth of 4-in. well = 56.5 ft. Sample collected by using low-flow bladder pump after purging of 6.4 L. Water tannish in color.
9/9/08	15:12	CNPMP1-W-26689	MW	PMP1	50-60	6123	Depth to water = 20.9 ft. Depth of 0.5-in. well = 60 ft. Sample collected by using Waterra pump after purging of 5 L. Water brown-tan in color, with odor.
9/9/08	16:18	CNMW07-W-26679	MW	MW07	45-55	6123	Depth to water = 28.2 ft. Depth of 2-in. well = 55 ft. Sample collected by using low-flow bladder pump after purging of 7 L. Water clear.
9/9/08	16:59	CNSB05-W-26685	CPT/P	SB05	32-42	6123	Depth to water = 10.6 ft. Depth of 1-in. well = 42 ft. Sample collected by using Waterra pump after purging of 15 L. Water clear to cloudy.
9/9/08	17:10	CNMW04-W-26676	MW	MW04	37.5-47.5	6123	Depth to water = 24 ft. Depth of 4-in. well = 47.5 ft. Sample collected by using low-flow bladder pump after purging of 6.2 L. Water clear.
9/10/08	9:22	CNMW05-W-26677	MW	MW05	34.5-44.5	6124	Depth to water = 10 ft. Depth of 4-in. well = 44.5 ft. Sample collected by using low-flow bladder pump after purging of 5 L. Water clear.
9/10/08	9:23	CNMW05DUP-W-26698	MW	MW05	34.5-44.5	6124	Replicate of sample CNMW05-W-26677.
9/10/08	10:22	CNPMP5-W-26693	MW	PMP5	50-60	6124	Depth to water = 21.4 ft. Depth of 1-in. well = 60 ft. Sample collected by using low-flow bladder pump after purging of 3 L. Water brownish color.
9/10/08	11:38	CNSB01-W-26683	CPT/P	SB01	40-50	6124	Depth to water = 20.1 ft. Depth of 1-in. well = 50 ft. Sample collected by using low-flow bladder pump after purging of 3 L. Water clear.
9/10/08	11:45	CNQCIR-W-26700	RI	QC	–	6124	Rinsate of decontaminated pump purge line after collection of sample CNSB01-W-26683.
9/10/08	12:22	CNMW09-W-26681	MW	MW09	25-35	6124	Depth to water = 2.5 ft. Depth of 2-in. well = 35 ft. Sample collected by using low-flow bladder pump after purging of 6 L.
9/10/08	13:34	CNSB09-W-26688	CPT/P	SB09	32-42	6124	Depth to water = 6.6 ft. Depth of 1-in. well = 42 ft. Sample collected by using low-flow bladder pump after purging of 3 L.

TABLE A.1 (Cont.)

Date	Time	Sample	Type ^a	Location ^b	Depth ^c (ft TOC)	Chain of Custody	Sample Description
9/10/08	13:45	CNQCIR-W-26701	RI	QC	–	6124	Rinsate of decontaminated pump purge line after collection of sample CNMW09-W-26681.
9/10/08	14:28	CNMW08-W-26680	MW	MW08	38-53	6124	Depth to water = 18.6 ft. Depth of 2-in. well = 53 ft. Sample collected by using low-flow bladder pump after purging of 6.5 L. Water clear.
9/10/08	14:29	CNMW08DUP-W-26699	MW	MW08	38-53	6124	Replicate of sample CNMW08-W-26680.
9/10/08	15:00	CNQCTB-W-26702	TB	QC	–	6122, 6123, 6124, 6134	Trip blank sent to the AGEM Laboratory for organic analyses with water samples listed on chain-of-custody forms (COCs) 6122, 6123, and 6124, as well as to TestAmerica for verification organic analysis with samples listed on COC 6134.

^a Sample types: CPT/P, cone penetrometer piezometer; RI, rinsate; MW, monitoring well; TB, trip blank.

^b PMP wells were installed in September 2008 in the pilot test treatment zone. Details for these wells were reported separately (Argonne 2009).

^c Depths were measured from the top of the casing (TOC).

Appendix B:

**Data Summary for Verification VOCs Analyses
by TestAmerica Laboratories, Inc.**

CHAIN-OF-CUSTODY / Analytical Request Document

The Chain-of-Custody is a LEGAL DOCUMENT. All relevant fields must be completed accurately.



Section A Required Client Information: Company: Larsen & Associates, Inc. Address: 1311 E. 25th St. Suite B Lawrence, KS 66048 Email To: Larsen, Evans, Henderson, Burke Phone: 785-841-8707 Fax: 785-865-4282 Requested Due Date/TAT: STANDARD		Section B Required Project Information: Report To: Lisa Larsen Copy To: Brooke Evans, Holly Burke Purchase Order No.: Project Name: Centralia Project Number:		Section C Invoice Information: Attention: Lisa Larsen Company Name: Address: Pace Quote Reference: Pace Project Manager: Trudy Gipson Pace Profile #:		Page: _____ of _____		
Section D Required Client Information Valid Matrix Codes MATRIX CODE DRINKING WATER WW WASTE WATER WW WASTE WATER PRODUCT P SOLID WASTE SW WIFE WP AIR AR OTHER OT TISSUE TS SAMPLE ID (A-Z, 0-9 / -) Sample IDs MUST BE UNIQUE		MATRIX CODE (see valid codes to left) SAMPLE TYPE (=GRAV C=COMP) COLLECTED COMPOSITE START DATE TIME COMPOSITE END/GRAB DATE TIME SAMPLE TEMP AT COLLECTION # OF CONTAINERS PRESERVATIVES Unpreserved H ₂ SO ₄ HNO ₃ HCl NaOH Na ₂ S ₂ O ₃ Methanol Other Analysis Test Full Vol EDB (41) Nitrate		REGULATORY AGENCY NPDES <input type="checkbox"/> GROUND WATER <input type="checkbox"/> DRINKING WATER <input type="checkbox"/> UST <input type="checkbox"/> CERCLA <input type="checkbox"/> OTHER <input type="checkbox"/> Site Location STATE: KS		Requested Analysis Filtered (Y/N) Residual Chlorine (Y/N) Pace Project No. / Lab I.D. CSS		
ITEM #	ADDITIONAL COMMENTS	RELINQUISHED BY / AFFILIATION	DATE	TIME	ACCEPTED BY / AFFILIATION	DATE	TIME	SAMPLE CONDITIONS
1	Centralia ww Grab 2008	Paul Gallagher / Larsen	11/26/08	1300	Brooke Evans	11/26/08	1300	
2		Brooke Evans	11/26/08	1500	Paul Gallagher	11/26/08	1615	
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
SAMPLER NAME AND SIGNATURE PRINT Name of SAMPLER: Paul Gallagher SIGNATURE of SAMPLER: Paul Gallagher		DATE Signed (MM/DD/YYYY): 11/26/08		Temp in °C Received on Ice (Y/N) Custody Sealed Cooler (Y/N) Samples Intact (Y/N)				

*Important Note: By signing this form you are accepting Pace's NET 30 day payment terms and agreeing to late charges of 1.5% per month for any invoices not paid within 30 days.



Sample Condition Upon Receipt

Client Name: Leban

Project # 06550659

Courier: Fed Ex UPS USPS Client Commercial Pace Other _____

Tracking #: _____

Custody Seal on Cooler/Box Present: yes no Seals intact: yes no

Packing Material: Bubble Wrap Bubble Bags None Other foam

Thermometer Used T-142 T-184

Type of Ice: W6 Blue None Samples on ice, cooling process has begun

Cooler Temperature 3.4

Biological Tissue is Frozen: Yes No

Optional
Proj. Due Date: <u>12/10</u>
Proj. Name: _____
<u>Cooler</u>

Date and Initials of person examining contents: SR/11/2/08

Temp should be above freezing to 6°C

Comments:

Chain of Custody Present:	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A	1.
Chain of Custody Filled Out:	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A	2.
Chain of Custody Relinquished:	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A	3.
Sampler Name & Signature on COC:	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A	4.
Samples Arrived within Hold Time:	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A	5.
Short Hold Time Analysis (<72hr):	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No <input type="checkbox"/> N/A	6.
Rush Turn Around Time Requested:	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No <input type="checkbox"/> N/A	7.
Sufficient Volume:	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A	8.
Correct Containers Used:	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A	9.
-Pace Containers Used:	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A	
Containers Intact:	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A	10.
Filtered volume received for Dissolved tests	<input type="checkbox"/> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> N/A	11.
Sample Labels match COC:	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A	12.
-Includes date/time/ID/Analysis Matrix: <u>LS</u>		
All containers needing preservation have been checked.	<input type="checkbox"/> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> N/A	13.
All containers needing preservation are found to be in compliance with EPA recommendation.	<input type="checkbox"/> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> N/A	
exceptions: <u>VOA</u> , coliform, TOC, O&G, WI-DRO (water)	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	Initial when completed <u>SR</u> Lot # of added preservative
Samples checked for dechlorination:	<input type="checkbox"/> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> N/A	14.
Headspace in VOA Vials (>6mm):	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No <input type="checkbox"/> N/A	15.
Trip Blank Present:	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No <input type="checkbox"/> N/A	16.
Trip Blank Custody Seals Present	<input type="checkbox"/> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> N/A	
Pace Trip Blank Lot # (if purchased):		

Client Notification/ Resolution:

Field Data Required? Y / N

Person Contacted: _____ Date/Time: _____

Comments/ Resolution: _____

Project Manager Review: SR 11.28.08

Date: _____

Note: Whenever there is a discrepancy affecting North Carolina compliance samples, a copy of this form will be sent to the North Carolina DEHNR Certification Office (i.e. out of hold, incorrect preservative, out of temp, incorrect containers)



Pace Analytical Services, Inc.
9608 Loiret Blvd.
Lenexa, KS 66219
(913)599-5665

December 10, 2008

Lisa Larsen
Larsen & Associates, Inc.
1311 E. 25th St.
Suite B
Lawrence, KS 66046

RE: Project: Centralia
Pace Project No.: 6050659

Dear Lisa Larsen:

Enclosed are the analytical results for sample(s) received by the laboratory on November 26, 2008. The results relate only to the samples included in this report. Results reported herein conform to the most current NELAC standards, where applicable, unless otherwise narrated in the body of the report.

If you have any questions concerning this report, please feel free to contact me.

Sincerely,

Trudy Gipson

trudy.gipson@pacelabs.com
Project Manager

Enclosures

cc: Holly Burke, Larsen & Associates, Inc.
Brooke Evans, Larsen & Associates, Inc.

REPORT OF LABORATORY ANALYSIS

Page 1 of 14

This report shall not be reproduced, except in full,
without the written consent of Pace Analytical Services, Inc..





Pace Analytical Services, Inc.
9608 Loiret Blvd.
Lenexa, KS 66219
(913)599-5665

CERTIFICATIONS

Project: Centralia
Pace Project No.: 6050659

Kansas Certification IDs

Utah Certification Number: 9135995665
Texas Certification Number: T104704407-08-TX
Oklahoma Certification Number: 9205/9935
Nevada Certification Number: KS000212008A
Louisiana Certification Number: 03055

Iowa Certification Number: 118
Illinois Certification Number: 001191
Arkansas Certification Number: 05-008-0
A2LA Certification Number: 2456.01
Kansas/NELAP Certification Number: E-10116

REPORT OF LABORATORY ANALYSIS

This report shall not be reproduced, except in full,
without the written consent of Pace Analytical Services, Inc..





Pace Analytical Services, Inc.
9608 Loiret Blvd.
Lenexa, KS 66219
(913)599-5665

SAMPLE SUMMARY

Project: Centralia
Pace Project No.: 6050659

Lab ID	Sample ID	Matrix	Date Collected	Date Received
6050659001	CENTRALIA WW	Water	11/26/08 10:50	11/26/08 16:15

REPORT OF LABORATORY ANALYSIS

This report shall not be reproduced, except in full,
without the written consent of Pace Analytical Services, Inc..





Pace Analytical Services, Inc.
9608 Loiret Blvd.
Lenexa, KS 66219
(913)599-5665

SAMPLE ANALYTE COUNT

Project: Centralia
Pace Project No.: 6050659

Lab ID	Sample ID	Method	Analysts	Analytes Reported
6050659001	CENTRALIA WW	EPA 300.0	AJM	1
		EPA 5030B/8260	AJA	71
		EPA 504.1	SRM	1

REPORT OF LABORATORY ANALYSIS

This report shall not be reproduced, except in full,
without the written consent of Pace Analytical Services, Inc..





Pace Analytical Services, Inc.
9608 Loiret Blvd.
Lenexa, KS 66219
(913)599-5665

ANALYTICAL RESULTS

Project: Centralia
Pace Project No.: 6050659

Sample: CENTRALIA WW **Lab ID: 6050659001** Collected: 11/26/08 10:50 Received: 11/26/08 16:15 Matrix: Water

Parameters	Results	Units	Report Limit	DF	Prepared	Analyzed	CAS No.	Qual
504 GCS EDB and DBCP Analytical Method: EPA 504.1 Preparation Method: EPA 504.1								
1,2-Dibromoethane (EDB)	ND	ug/L	0.029	1	12/08/08 00:00	12/08/08 20:53	106-93-4	
8260 MSV Analytical Method: EPA 5030B/8260								
Acetone	451	ug/L	50.0	5		12/08/08 15:57	67-64-1	
Benzene	ND	ug/L	5.0	5		12/08/08 15:57	71-43-2	
Bromobenzene	ND	ug/L	5.0	5		12/08/08 15:57	108-86-1	
Bromochloromethane	ND	ug/L	5.0	5		12/08/08 15:57	74-97-5	
Bromodichloromethane	ND	ug/L	5.0	5		12/08/08 15:57	75-27-4	
Bromoform	ND	ug/L	5.0	5		12/08/08 15:57	75-25-2	
Bromomethane	ND	ug/L	5.0	5		12/08/08 15:57	74-83-9	
TOTAL BTEX	28.2	ug/L	5.0	5		12/08/08 15:57		
2-Butanone (MEK)	452	ug/L	50.0	5		12/08/08 15:57	78-93-3	
n-Butylbenzene	ND	ug/L	5.0	5		12/08/08 15:57	104-51-8	
sec-Butylbenzene	ND	ug/L	5.0	5		12/08/08 15:57	135-98-8	
tert-Butylbenzene	ND	ug/L	5.0	5		12/08/08 15:57	98-06-6	
Carbon disulfide	ND	ug/L	25.0	5		12/08/08 15:57	75-15-0	
Carbon tetrachloride	ND	ug/L	5.0	5		12/08/08 15:57	56-23-5	
Chlorobenzene	ND	ug/L	5.0	5		12/08/08 15:57	108-90-7	
Chloroethane	ND	ug/L	5.0	5		12/08/08 15:57	75-00-3	
Chloroform	ND	ug/L	5.0	5		12/08/08 15:57	67-66-3	
Chloromethane	ND	ug/L	5.0	5		12/08/08 15:57	74-87-3	
2-Chlorotoluene	ND	ug/L	5.0	5		12/08/08 15:57	95-49-8	
4-Chlorotoluene	ND	ug/L	5.0	5		12/08/08 15:57	106-43-4	
1,2-Dibromo-3-chloropropane	ND	ug/L	12.5	5		12/08/08 15:57	96-12-8	
Dibromochloromethane	ND	ug/L	5.0	5		12/08/08 15:57	124-48-1	
1,2-Dibromoethane (EDB)	ND	ug/L	5.0	5		12/08/08 15:57	106-93-4	
Dibromomethane	ND	ug/L	5.0	5		12/08/08 15:57	74-95-3	
1,2-Dichlorobenzene	ND	ug/L	5.0	5		12/08/08 15:57	95-50-1	
1,3-Dichlorobenzene	ND	ug/L	5.0	5		12/08/08 15:57	541-73-1	
1,4-Dichlorobenzene	ND	ug/L	5.0	5		12/08/08 15:57	106-46-7	
Dichlorodifluoromethane	ND	ug/L	5.0	5		12/08/08 15:57	75-71-8	
1,1-Dichloroethane	ND	ug/L	5.0	5		12/08/08 15:57	75-34-3	
1,2-Dichloroethane	ND	ug/L	5.0	5		12/08/08 15:57	107-06-2	
1,2-Dichloroethene (Total)	ND	ug/L	5.0	5		12/08/08 15:57	540-59-0	
1,1-Dichloroethene	ND	ug/L	5.0	5		12/08/08 15:57	75-35-4	
cis-1,2-Dichloroethene	ND	ug/L	5.0	5		12/08/08 15:57	156-59-2	
trans-1,2-Dichloroethene	ND	ug/L	5.0	5		12/08/08 15:57	156-60-5	
1,2-Dichloropropane	ND	ug/L	5.0	5		12/08/08 15:57	78-87-5	
1,3-Dichloropropane	ND	ug/L	5.0	5		12/08/08 15:57	142-28-9	
2,2-Dichloropropane	ND	ug/L	5.0	5		12/08/08 15:57	594-20-7	
1,1-Dichloropropene	ND	ug/L	5.0	5		12/08/08 15:57	563-58-6	
cis-1,3-Dichloropropene	ND	ug/L	5.0	5		12/08/08 15:57	10061-01-5	
trans-1,3-Dichloropropene	ND	ug/L	5.0	5		12/08/08 15:57	10061-02-6	
Ethylbenzene	ND	ug/L	5.0	5		12/08/08 15:57	100-41-4	
Hexachloro-1,3-butadiene	ND	ug/L	5.0	5		12/08/08 15:57	87-68-3	
2-Hexanone	ND	ug/L	50.0	5		12/08/08 15:57	591-78-6	
Isopropylbenzene (Cumene)	ND	ug/L	5.0	5		12/08/08 15:57	98-82-8	

Date: 12/10/2008 03:08 PM

REPORT OF LABORATORY ANALYSIS

Page 5 of 14

This report shall not be reproduced, except in full,
without the written consent of Pace Analytical Services, Inc..





Pace Analytical Services, Inc.
9608 Loiret Blvd.
Lenexa, KS 66219
(913)599-5665

ANALYTICAL RESULTS

Project: Centralia
Pace Project No.: 6050659

Sample: **CENTRALIA WW** Lab ID: **6050659001** Collected: 11/26/08 10:50 Received: 11/26/08 16:15 Matrix: Water

Parameters	Results	Units	Report Limit	DF	Prepared	Analyzed	CAS No.	Qual
8260 MSV		Analytical Method: EPA 5030B/8260						
p-Isopropyltoluene	ND	ug/L	5.0	5		12/08/08 15:57	99-87-6	
Methylene chloride	ND	ug/L	5.0	5		12/08/08 15:57	75-09-2	
4-Methyl-2-pentanone (MIBK)	ND	ug/L	50.0	5		12/08/08 15:57	108-10-1	
Methyl-tert-butyl ether	ND	ug/L	5.0	5		12/08/08 15:57	1634-04-4	
Naphthalene	ND	ug/L	50.0	5		12/08/08 15:57	91-20-3	
n-Propylbenzene	ND	ug/L	5.0	5		12/08/08 15:57	103-65-1	
Styrene	ND	ug/L	5.0	5		12/08/08 15:57	100-42-5	
1,1,1,2-Tetrachloroethane	ND	ug/L	5.0	5		12/08/08 15:57	630-20-6	
1,1,2,2-Tetrachloroethane	ND	ug/L	5.0	5		12/08/08 15:57	79-34-5	
Tetrachloroethene	ND	ug/L	5.0	5		12/08/08 15:57	127-18-4	
Toluene	16.2	ug/L	5.0	5		12/08/08 15:57	108-88-3	
1,2,3-Trichlorobenzene	ND	ug/L	5.0	5		12/08/08 15:57	87-61-6	
1,2,4-Trichlorobenzene	ND	ug/L	5.0	5		12/08/08 15:57	120-82-1	
1,1,1-Trichloroethane	ND	ug/L	5.0	5		12/08/08 15:57	71-55-6	
1,1,2-Trichloroethane	ND	ug/L	5.0	5		12/08/08 15:57	79-00-5	
Trichloroethene	ND	ug/L	5.0	5		12/08/08 15:57	79-01-6	
Trichlorofluoromethane	ND	ug/L	5.0	5		12/08/08 15:57	75-69-4	
1,2,3-Trichloropropane	ND	ug/L	12.5	5		12/08/08 15:57	96-18-4	
1,2,4-Trimethylbenzene	ND	ug/L	5.0	5		12/08/08 15:57	95-63-6	
1,3,5-Trimethylbenzene	ND	ug/L	5.0	5		12/08/08 15:57	108-67-8	
Vinyl chloride	ND	ug/L	5.0	5		12/08/08 15:57	75-01-4	
Xylene (Total)	16.1	ug/L	15.0	5		12/08/08 15:57	1330-20-7	
4-Bromofluorobenzene (S)	105	%	85-119	5		12/08/08 15:57	460-00-4	
Dibromofluoromethane (S)	104	%	85-114	5		12/08/08 15:57	1868-53-7	
1,2-Dichloroethane-d4 (S)	107	%	81-118	5		12/08/08 15:57	17060-07-0	
Toluene-d8 (S)	99	%	82-114	5		12/08/08 15:57	2037-26-5	
Preservation pH	1.0		0.10	5		12/08/08 15:57		
300.0 IC Anions		Analytical Method: EPA 300.0						
Nitrate as N	ND	mg/L	0.10	1		11/28/08 09:57	14797-55-8	





Pace Analytical Services, Inc.
9608 Loiret Blvd.
Lenexa, KS 66219
(913)599-5665

QUALITY CONTROL DATA

Project: Centralia
Pace Project No.: 6050659

QC Batch: WETA/8508 Analysis Method: EPA 300.0
QC Batch Method: EPA 300.0 Analysis Description: 300.0 IC Anions
Associated Lab Samples: 6050659001

METHOD BLANK: 414626 Matrix: Water
Associated Lab Samples: 6050659001

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
Nitrate as N	mg/L	ND	0.10	11/28/08 08:46	

LABORATORY CONTROL SAMPLE: 414627

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Nitrate as N	mg/L	2.5	2.6	103	90-110	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 414628 414629

Parameter	Units	6050659001 Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limits	Max		
										RPD	RPD	Qual
Nitrate as N	mg/L	ND	5	5	5.3	4.7	105	95	73-114	10	5	R1





Pace Analytical Services, Inc.
9608 Loiret Blvd.
Lenexa, KS 66219
(913)599-5665

QUALITY CONTROL DATA

Project: Centralia
Pace Project No.: 6050659

QC Batch: OEXT/15115 Analysis Method: EPA 504.1
QC Batch Method: EPA 504.1 Analysis Description: GCS 504 EDB DBCP
Associated Lab Samples: 6050659001

METHOD BLANK: 418021 Matrix: Water
Associated Lab Samples: 6050659001

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
1,2-Dibromoethane (EDB)	ug/L	ND	0.030	12/08/08 14:15	

LABORATORY CONTROL SAMPLE & LCSD: 418022 418023

Parameter	Units	Spike Conc.	LCS Result	LCSD Result	LCS % Rec	LCSD % Rec	% Rec Limits	RPD	Max RPD	Qualifiers
1,2-Dibromoethane (EDB)	ug/L	.25	0.23	0.26	94	103	70-130	9	20	





Pace Analytical Services, Inc.
9608 Loiret Blvd.
Lenexa, KS 66219
(913)599-5665

QUALITY CONTROL DATA

Project: Centralia
Pace Project No.: 6050659

QC Batch: MSV/18481 Analysis Method: EPA 5030B/8260
QC Batch Method: EPA 5030B/8260 Analysis Description: 8260 MSV Water 10 mL Purge
Associated Lab Samples: 6050659001

METHOD BLANK: 418050 Matrix: Water
Associated Lab Samples: 6050659001

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
1,1,1,2-Tetrachloroethane	ug/L	ND	1.0	12/08/08 11:13	
1,1,1-Trichloroethane	ug/L	ND	1.0	12/08/08 11:13	
1,1,2,2-Tetrachloroethane	ug/L	ND	1.0	12/08/08 11:13	
1,1,2-Trichloroethane	ug/L	ND	1.0	12/08/08 11:13	
1,1-Dichloroethane	ug/L	ND	1.0	12/08/08 11:13	
1,1-Dichloroethene	ug/L	ND	1.0	12/08/08 11:13	
1,1-Dichloropropene	ug/L	ND	1.0	12/08/08 11:13	
1,2,3-Trichlorobenzene	ug/L	ND	1.0	12/08/08 11:13	
1,2,3-Trichloropropane	ug/L	ND	2.5	12/08/08 11:13	
1,2,4-Trichlorobenzene	ug/L	ND	1.0	12/08/08 11:13	
1,2,4-Trimethylbenzene	ug/L	ND	1.0	12/08/08 11:13	
1,2-Dibromo-3-chloropropane	ug/L	ND	2.5	12/08/08 11:13	
1,2-Dibromoethane (EDB)	ug/L	ND	1.0	12/08/08 11:13	
1,2-Dichlorobenzene	ug/L	ND	1.0	12/08/08 11:13	
1,2-Dichloroethane	ug/L	ND	1.0	12/08/08 11:13	
1,2-Dichloroethene (Total)	ug/L	ND	1.0	12/08/08 11:13	
1,2-Dichloropropane	ug/L	ND	1.0	12/08/08 11:13	
1,3,5-Trimethylbenzene	ug/L	ND	1.0	12/08/08 11:13	
1,3-Dichlorobenzene	ug/L	ND	1.0	12/08/08 11:13	
1,3-Dichloropropane	ug/L	ND	1.0	12/08/08 11:13	
1,4-Dichlorobenzene	ug/L	ND	1.0	12/08/08 11:13	
2,2-Dichloropropane	ug/L	ND	1.0	12/08/08 11:13	
2-Butanone (MEK)	ug/L	ND	10.0	12/08/08 11:13	
2-Chlorotoluene	ug/L	ND	1.0	12/08/08 11:13	
2-Hexanone	ug/L	ND	10.0	12/08/08 11:13	
4-Chlorotoluene	ug/L	ND	1.0	12/08/08 11:13	
4-Methyl-2-pentanone (MIBK)	ug/L	ND	10.0	12/08/08 11:13	
Acetone	ug/L	ND	10.0	12/08/08 11:13	
Benzene	ug/L	ND	1.0	12/08/08 11:13	
Bromobenzene	ug/L	ND	1.0	12/08/08 11:13	
Bromochloromethane	ug/L	ND	1.0	12/08/08 11:13	
Bromodichloromethane	ug/L	ND	1.0	12/08/08 11:13	
Bromoform	ug/L	ND	1.0	12/08/08 11:13	
Bromomethane	ug/L	ND	1.0	12/08/08 11:13	
Carbon disulfide	ug/L	ND	5.0	12/08/08 11:13	
Carbon tetrachloride	ug/L	ND	1.0	12/08/08 11:13	
Chlorobenzene	ug/L	ND	1.0	12/08/08 11:13	
Chloroethane	ug/L	ND	1.0	12/08/08 11:13	
Chloroform	ug/L	ND	1.0	12/08/08 11:13	
Chloromethane	ug/L	ND	1.0	12/08/08 11:13	
cis-1,2-Dichloroethene	ug/L	ND	1.0	12/08/08 11:13	
cis-1,3-Dichloropropene	ug/L	ND	1.0	12/08/08 11:13	
Dibromochloromethane	ug/L	ND	1.0	12/08/08 11:13	

Date: 12/10/2008 03:08 PM

REPORT OF LABORATORY ANALYSIS

Page 9 of 14

This report shall not be reproduced, except in full,
without the written consent of Pace Analytical Services, Inc..





Pace Analytical Services, Inc.
9608 Loiret Blvd.
Lenexa, KS 66219
(913)599-5665

QUALITY CONTROL DATA

Project: Centralia
Pace Project No.: 6050659

METHOD BLANK: 418050 Matrix: Water

Associated Lab Samples: 6050659001

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
Dibromomethane	ug/L	ND	1.0	12/08/08 11:13	
Dichlorodifluoromethane	ug/L	ND	1.0	12/08/08 11:13	
Ethylbenzene	ug/L	ND	1.0	12/08/08 11:13	
Hexachloro-1,3-butadiene	ug/L	ND	1.0	12/08/08 11:13	
Isopropylbenzene (Cumene)	ug/L	ND	1.0	12/08/08 11:13	
Methyl-tert-butyl ether	ug/L	ND	1.0	12/08/08 11:13	
Methylene chloride	ug/L	ND	1.0	12/08/08 11:13	
n-Butylbenzene	ug/L	ND	1.0	12/08/08 11:13	
n-Propylbenzene	ug/L	ND	1.0	12/08/08 11:13	
Naphthalene	ug/L	ND	10.0	12/08/08 11:13	
p-Isopropyltoluene	ug/L	ND	1.0	12/08/08 11:13	
sec-Butylbenzene	ug/L	ND	1.0	12/08/08 11:13	
Styrene	ug/L	ND	1.0	12/08/08 11:13	
tert-Butylbenzene	ug/L	ND	1.0	12/08/08 11:13	
Tetrachloroethene	ug/L	ND	1.0	12/08/08 11:13	
Toluene	ug/L	ND	1.0	12/08/08 11:13	
TOTAL BTEX	ug/L	ND	1.0	12/08/08 11:13	
trans-1,2-Dichloroethene	ug/L	ND	1.0	12/08/08 11:13	
trans-1,3-Dichloropropene	ug/L	ND	1.0	12/08/08 11:13	
Trichloroethene	ug/L	ND	1.0	12/08/08 11:13	
Trichlorofluoromethane	ug/L	ND	1.0	12/08/08 11:13	
Vinyl chloride	ug/L	ND	1.0	12/08/08 11:13	
Xylene (Total)	ug/L	ND	3.0	12/08/08 11:13	
1,2-Dichloroethane-d4 (S)	%	97	81-118	12/08/08 11:13	
4-Bromofluorobenzene (S)	%	104	85-119	12/08/08 11:13	
Dibromofluoromethane (S)	%	97	85-114	12/08/08 11:13	
Toluene-d8 (S)	%	98	82-114	12/08/08 11:13	

LABORATORY CONTROL SAMPLE: 418051

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
1,1,1,2-Tetrachloroethane	ug/L	10	10.9	109	77-127	
1,1,1-Trichloroethane	ug/L	10	10.6	106	78-130	
1,1,2,2-Tetrachloroethane	ug/L	10	10.2	102	73-131	
1,1,2-Trichloroethane	ug/L	10	11.2	112	85-126	
1,1-Dichloroethane	ug/L	10	10.7	107	76-124	
1,1-Dichloroethene	ug/L	10	10.8	108	76-129	
1,1-Dichloropropene	ug/L	10	11.1	111	83-125	
1,2,3-Trichlorobenzene	ug/L	10	11.6	116	78-129	
1,2,3-Trichloropropane	ug/L	10	11.0	110	69-117	
1,2,4-Trichlorobenzene	ug/L	10	11.6	116	79-127	
1,2,4-Trimethylbenzene	ug/L	10	10.3	103	82-124	
1,2-Dibromo-3-chloropropane	ug/L	10	13.0	130	62-141	
1,2-Dibromoethane (EDB)	ug/L	10	10.9	109	85-124	
1,2-Dichlorobenzene	ug/L	10	9.2	92	85-123	

Date: 12/10/2008 03:08 PM

REPORT OF LABORATORY ANALYSIS

Page 10 of 14

This report shall not be reproduced, except in full,
without the written consent of Pace Analytical Services, Inc..





Pace Analytical Services, Inc.
9608 Loiret Blvd.
Lenexa, KS 66219
(913)599-5665

QUALITY CONTROL DATA

Project: Centralia
Pace Project No.: 6050659

LABORATORY CONTROL SAMPLE: 418051

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
1,2-Dichloroethane	ug/L	10	10.3	103	77-129	
1,2-Dichloroethene (Total)	ug/L	20	21.0	105	81-127	
1,2-Dichloropropane	ug/L	10	10.7	107	82-121	
1,3,5-Trimethylbenzene	ug/L	10	9.9	99	85-122	
1,3-Dichlorobenzene	ug/L	10	9.5	95	84-121	
1,3-Dichloropropane	ug/L	10	10.1	101	86-121	
1,4-Dichlorobenzene	ug/L	10	9.5	95	83-121	
2,2-Dichloropropane	ug/L	10	11.6	116	47-154	
2-Butanone (MEK)	ug/L	25	25.1	101	64-126	
2-Chlorotoluene	ug/L	10	9.2	92	83-125	
2-Hexanone	ug/L	25	28.9	116	65-128	
4-Chlorotoluene	ug/L	10	9.6	96	84-121	
4-Methyl-2-pentanone (MIBK)	ug/L	25	26.5	106	64-121	
Acetone	ug/L	25	25.6	102	52-139	
Benzene	ug/L	10	10.6	106	87-117	
Bromobenzene	ug/L	10	9.7	97	83-126	
Bromochloromethane	ug/L	10	9.6	96	82-129	
Bromodichloromethane	ug/L	10	10.6	106	75-127	
Bromoform	ug/L	10	11.0	110	64-133	
Bromomethane	ug/L	10	10	100	21-188	
Carbon disulfide	ug/L	10	11.8	118	53-120	
Carbon tetrachloride	ug/L	10	12.1	121	76-131	
Chlorobenzene	ug/L	10	9.8	98	85-120	
Chloroethane	ug/L	10	8.8	88	69-126	
Chloroform	ug/L	10	10.3	103	79-126	
Chloromethane	ug/L	10	6.7	67	44-118	
cis-1,2-Dichloroethene	ug/L	10	10.4	104	79-128	
cis-1,3-Dichloropropene	ug/L	10	11.1	111	76-122	
Dibromochloromethane	ug/L	10	11.3	113	74-121	
Dibromomethane	ug/L	10	10.6	106	75-130	
Dichlorodifluoromethane	ug/L	10	4.7	47	12-132	
Ethylbenzene	ug/L	10	10.4	104	84-123	
Hexachloro-1,3-butadiene	ug/L	10	11.9	119	71-144	
Isopropylbenzene (Cumene)	ug/L	10	8.8	88	72-107	
Methyl-tert-butyl ether	ug/L	10	9.9	99	69-115	
Methylene chloride	ug/L	10	10.2	102	74-132	
n-Butylbenzene	ug/L	10	9.9	99	80-126	
n-Propylbenzene	ug/L	10	9.8	98	83-123	
Naphthalene	ug/L	10	8.7J	87	61-150	
p-Isopropyltoluene	ug/L	10	9.9	99	82-118	
sec-Butylbenzene	ug/L	10	10.1	101	84-121	
Styrene	ug/L	10	9.9	99	84-128	
tert-Butylbenzene	ug/L	10	9.6	96	83-124	
Tetrachloroethene	ug/L	10	9.8	98	83-126	
Toluene	ug/L	10	10.5	105	81-124	
TOTAL BTEX	ug/L		61.8			
trans-1,2-Dichloroethene	ug/L	10	10.6	106	80-130	
trans-1,3-Dichloropropene	ug/L	10	10.2	102	75-122	

Date: 12/10/2008 03:08 PM

REPORT OF LABORATORY ANALYSIS

Page 11 of 14

This report shall not be reproduced, except in full,
without the written consent of Pace Analytical Services, Inc..





Pace Analytical Services, Inc.
9608 Loiret Blvd.
Lenexa, KS 66219
(913)599-5665

QUALITY CONTROL DATA

Project: Centralia
Pace Project No.: 6050659

LABORATORY CONTROL SAMPLE: 418051

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Trichloroethene	ug/L	10	10.6	106	80-130	
Trichlorofluoromethane	ug/L	10	9.7	97	65-113	
Vinyl chloride	ug/L	10	9.7	97	59-124	
Xylene (Total)	ug/L	30	30.3	101	83-125	
1,2-Dichloroethane-d4 (S)	%			106	81-118	
4-Bromofluorobenzene (S)	%			102	85-119	
Dibromofluoromethane (S)	%			101	85-114	
Toluene-d8 (S)	%			101	82-114	





Pace Analytical Services, Inc.
9608 Loiret Blvd.
Lenexa, KS 66219
(913)599-5665

QUALIFIERS

Project: Centralia
Pace Project No.: 6050659

DEFINITIONS

DF - Dilution Factor, if reported, represents the factor applied to the reported data due to changes in sample preparation, dilution of the sample aliquot, or moisture content.

ND - Not Detected at or above adjusted reporting limit.

J - Estimated concentration above the adjusted method detection limit and below the adjusted reporting limit.

MDL - Adjusted Method Detection Limit.

S - Surrogate

1,2-Diphenylhydrazine (8270 listed analyte) decomposes to Azobenzene.

Consistent with EPA guidelines, unrounded data are displayed and have been used to calculate % recovery and RPD values.

LCS(D) - Laboratory Control Sample (Duplicate)

MS(D) - Matrix Spike (Duplicate)

DUP - Sample Duplicate

RPD - Relative Percent Difference

Pace Analytical is NELAP accredited. Contact your Pace PM for the current list of accredited analytes.

BATCH QUALIFIERS

Batch: MSV/18481

[1] A matrix spike/matrix spike duplicate was not performed for this batch due to insufficient sample volume.

ANALYTE QUALIFIERS

R1 RPD value was outside control limits.



Pace Analytical Services, Inc.
9608 Loiret Blvd.
Lenexa, KS 66219
(913)599-5665

QUALITY CONTROL DATA CROSS REFERENCE TABLE

Project: Centralia
Pace Project No.: 6050659

Lab ID	Sample ID	QC Batch Method	QC Batch	Analytical Method	Analytical Batch
6050659001	CENTRALIA WW	EPA 300.0	WETA/8508		
6050659001	CENTRALIA WW	EPA 504.1	OEXT/15115	EPA 504.1	GCSV/6219
6050659001	CENTRALIA WW	EPA 5030B/8260	MSV/18481		





Environmental Science Division

Argonne National Laboratory
9700 South Cass Avenue, Bldg. 203
Argonne, IL 60439-4843
www.anl.gov



U.S. DEPARTMENT OF
ENERGY

A U.S. Department of Energy laboratory
managed by UChicago Argonne, LLC