

River Corridor Closure Contract



Annual Report for Gravity Collection Lysimeter Monitoring in ERDF Cells 5, 6, 7, and 8, CY 2009

June 2010

For Public Release

Washington Closure Hanford

Prepared for the U.S. Department of Energy, Richland Operations Office
Office of Assistant Manager for River Corridor



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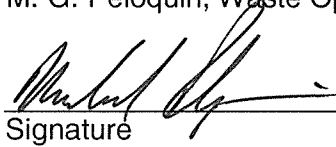
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ACRONYMS

CERCLA	<i>Comprehensive Environmental Response, Compensation, and Liability Act of 1980</i>
COC	Contaminant of Concern
CY	calendar year
ERDF	Environmental Restoration Disposal Facility
ERDF GPP	<i>Groundwater Protection Plan for the Environmental Restoration Disposal Facility</i>
RCRA	<i>Resource Conservation and Recovery Act of 1976</i>
ROD	record of decision

METRIC CONVERSION CHART

Into Metric Units			Out of Metric Units		
<i>If You Know</i>	<i>Multiply By</i>	<i>To Get</i>	<i>If You Know</i>	<i>Multiply By</i>	<i>To Get</i>
Length			Length		
inches	25.4	millimeters	millimeters	0.039	inches
inches	2.54	centimeters	centimeters	0.394	inches
feet	0.305	meters	meters	3.281	feet
yards	0.914	meters	meters	1.094	yards
miles	1.609	kilometers	kilometers	0.621	miles
Area			Area		
sq. inches	6.452	sq. centimeters	sq. centimeters	0.155	sq. inches
sq. feet	0.093	sq. meters	sq. meters	10.76	sq. feet
sq. yards	0.836	sq. meters	sq. meters	1.196	sq. yards
sq. miles	2.6	sq. kilometers	sq. kilometers	0.4	sq. miles
acres	0.405	hectares	hectares	2.47	acres
Mass (weight)			Mass (weight)		
ounces	28.35	grams	grams	0.035	ounces
pounds	0.454	kilograms	kilograms	2.205	pounds
ton	0.907	metric ton	metric ton	1.102	ton
Volume			Volume		
teaspoons	5	milliliters	milliliters	0.033	fluid ounces
tablespoons	15	milliliters	liters	2.1	pints
fluid ounces	30	milliliters	liters	1.057	quarts
cups	0.24	liters	liters	0.264	gallons
pints	0.47	liters	cubic meters	35.315	cubic feet
quarts	0.95	liters	cubic meters	1.308	cubic yards
gallons	3.8	liters			
cubic feet	0.028	cubic meters			
cubic yards	0.765	cubic meters			
Temperature			Temperature		
Fahrenheit	subtract 32, then multiply by 5/9	Celsius	Celsius	multiply by 9/5, then add 32	Fahrenheit
Radioactivity			Radioactivity		
picocuries	37	millibecquerel	millibecquerels	0.027	picocuries

1.0 INTRODUCTION

The Environmental Restoration Disposal Facility (ERDF) is a Hanford Site low-level mixed waste disposal facility that was brought into service in July 1996. The ERDF landfill is authorized under the *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA) and was designed to meet the *Resource Conservation and Recovery Act of 1976* (RCRA) requirements. Wastes disposed at ERDF contain elevated levels of radionuclides and/or hazardous constituents originating from the 100, 200, and 300 Area waste sites and facilities.

Baseline sampling and analytical data obtained from monitoring wells and the ERDF leachate collection system were used to determine contaminants of concern (COCs) and background conditions for long-term monitoring, as described in the *Groundwater Protection Plan for the Environmental Restoration Disposal Facility* (ERDF GPP) (WCH 2008a), and to meet the requirements of the ERDF record of decision (ROD) (EPA 1995) and ERDF amended ROD (EPA 1999). Based on approximately 10 years of ERDF monitoring activities and statistical evaluations of the data, the ERDF GPP (WCH 2008b) was revised and the new *Environmental Restoration Disposal Facility Lysimeter Monitoring and Sampling Plan* (WCH 2009) was implemented. ERDF lysimeter sampling and analytical baseline data is based upon the same COCs as the ERDF leachate system (WCH 2008a).

1.1 PURPOSE AND OBJECTIVES

The purpose of this annual monitoring report is to evaluate the conditions and identify trends to develop Hanford Site-specific data on the performance of the lysimeter systems related to the vadose zone monitoring and potential future use of lysimeter systems. The objectives of this report are as follows:

- Assess data from routine ERDF lysimeter sampling to determine if COC concentrations over time may be attributed to ERDF operations
- Describe and evaluate the sample data, identify changes or trends in the data, and incorporate a summary of the results
- Evaluate the data to determine if the routine analyte list of indicator parameters is adequate
- Document and describe the changes in the volume of liquid in the lysimeter.

Appendix A shows analytical results for lysimeter samples collected from cells 5, 6, 7, and 8.

2.0 BACKGROUND

2.1 GENERAL DESCRIPTION

The ERDF site is located between the 200 East and 200 West Areas of the Hanford Site (Figure 2-1). This location was selected over other possible locations in part because of the depth to groundwater in this area, its location above pre-existing groundwater plumes, the relatively flat topography in this area, and the compatibility of this location with stakeholder recommendations.

2.2 ENVIRONMENTAL RESTORATION DISPOSAL FACILITY

The ERDF was designed as a series of side-by-side cells that measure 21.3 m (70 ft) in depth, 152.4 m by 152.4 m (500 ft) wide at the base, with a wall slope of 3:1 to measure over 304 m (1,000 ft) wide at the surface. There are currently eight waste cells associated with the ERDF site. Initially, cells 1 and 2 were constructed and the placement of waste in these cells has since been completed. An interim cover has been constructed over these cells consisting of a plastic membrane and 0.3 m (1 ft) of soil. Cells 3 and 4 were constructed in 2000 and the placement of waste in these cells has since been completed. Construction of cells 5 and 6 was completed during 2004, and two additional cells, 7 and 8, have recently been constructed and approved for waste disposal in the first half of calendar year (CY) 2009. Super cells 9 and 10 are currently under construction. Figure 2-2 shows a lysimeter construction of a section of ERDF (see Section 2.2.1). Throughout CY 2009, approximately 844,140 metric tons (930,694 tons) of remediation wastes were disposed at ERDF.

Each of the ERDF cells was constructed with a double-liner system for the purpose of collecting liquids, or leachate, that may travel through the waste materials disposed at the disposal site. These liquids are typically generated from natural precipitation, moisture within the waste matrix, and the application of dust control water that percolates downward through the disposed waste materials and collects on the surface of the lining material. The primary or upper liners and the secondary or lower liners are each designed to deliver leachate to sump areas. Sumps for the upper liners are independent from the sumps associated with the lower liners. The upper and lower sumps at each of the cells are routinely pumped down, and the leachate is stored in holding tanks prior to transfer to the Effluent Treatment Facility.

The lysimeters were constructed below the admixture layer and are located beneath the leachate collection sumps in cells 5, 6, 7, and 8.

Figure 2-1. Location of the Environmental Restoration Disposal Facility.

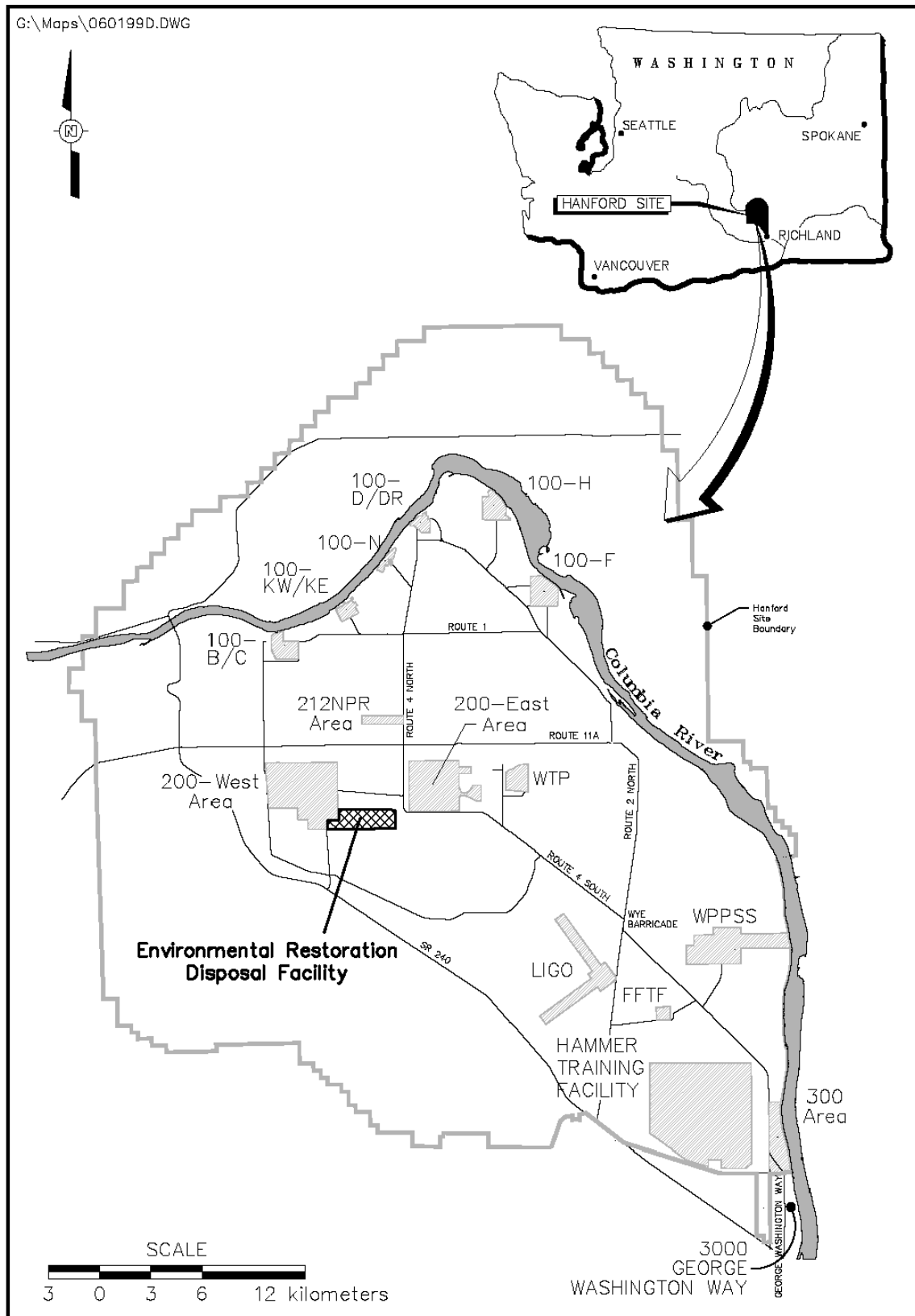
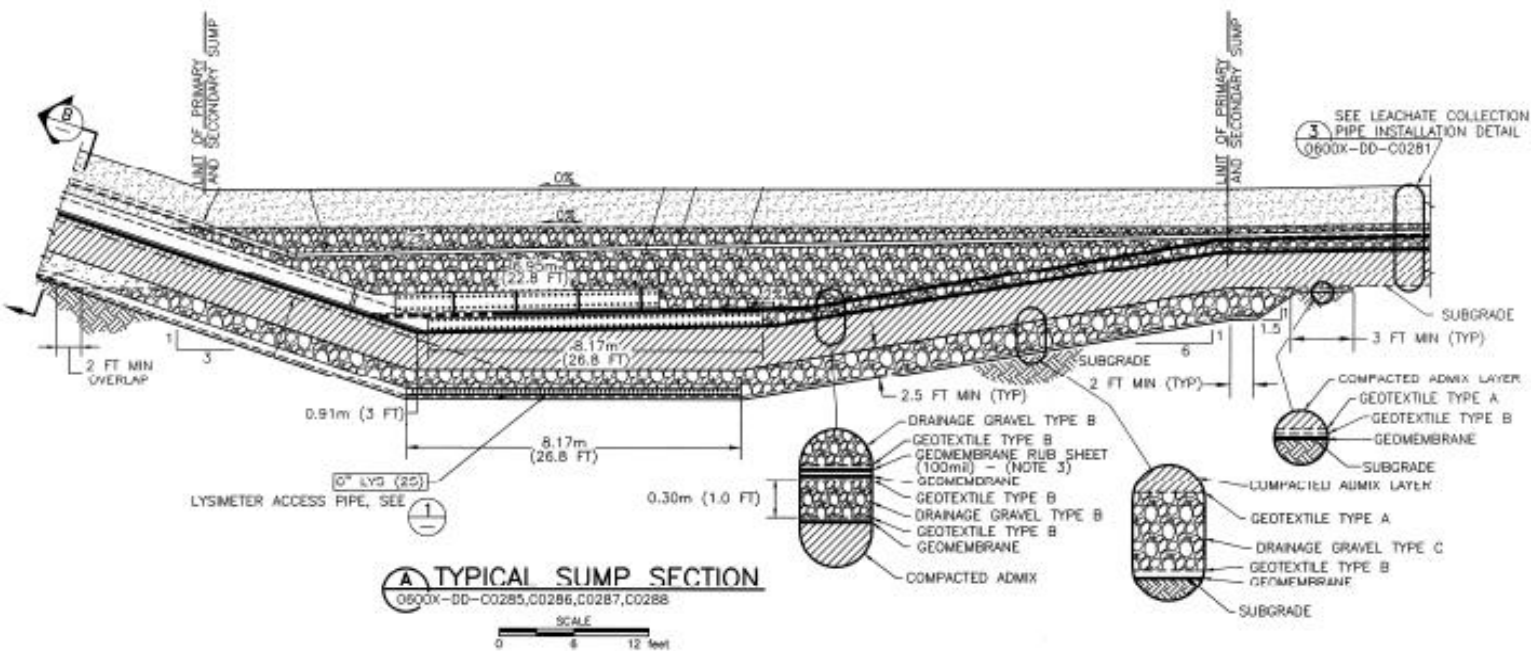


Figure 2-2. Typical Basin Lysimeter Construction Design.



2.2.1 Lysimeter System

The gravity collection lysimeters (basin lysimeters) were constructed in response to the *Study of Vadose Zone Monitoring at the Hanford Site, Task 1, Use in New Cells at the Environmental Restoration Disposal Facility* (DOE-RL 2003). This study was performed by Fluor Hanford for the U.S. Department of Energy, Richland Operations Office. The purpose of the study was to report on the status of vadose zone monitoring and to recommend measures that could be taken at the Hanford Site to further develop the technology of vadose zone monitoring.

The lysimeter design selected from the study for installation under the ERDF cells was a basin lysimeter (Figure 2-2). These are constructed by excavating a sloping recession within the cell sub-grade beneath the composite liner system and installing an approximate 380.9-m² (4,100-ft²) liner into the area. A 15-cm (6-in.)-diameter perforated pipe section is laid atop the lysimeter liner and connected to a 15-cm (6-in.)-diameter high-density polyethylene piping that is installed to the upper edge of the cell area.

This type of lysimeter is not configured to detect small increases in liquid accumulation. A thick-walled, 15-cm (6-in.)-diameter pipe is laid flat on the bottom of a collection area of approximately 50.7 m² (546 ft²) and increasing to 380.9m² (4,100 ft²) at the top of the lysimeter. The lysimeter has an approximate capacity to contain 181,699 L (48,000 gal) within the available pore space of the gravel.

The vadose zone monitoring activities described herein are expected to continue until after the final landfill cap is installed and the annual quantity of leachate collected in the secondary leachate collection and removal system is shown to be insignificant (i.e., less than the amount needed to activate the removal pumps).

3.0 LYSIMETER MONITORING AND SAMPLING

The lysimeter monitoring program is described in the *Environmental Restoration Disposal Facility Lysimeter Monitoring and Sampling Plan* (WCH 2009). This section provides an overview of these monitoring requirements.

3.1 LYSIMETER MONITORING

The lysimeters will be visually inspected and dewatered semi-annually until it can be demonstrated that the lysimeters have been successfully dewatered. Once dewatering has been completed, the lysimeters should be visually inspected annually in accordance with the *Environmental Restoration Disposal Facility Lysimeter Monitoring and Sampling Plan* (WCH 2009). The visual inspection will look at the structural integrity of pipe interior, depth to obstructions, depth to water, evaluation of pump use, and general observations.

3.1.1 Camera Inspection and Dewatering

Visual inspection of the lysimeters associated with cells 5, 6, 7, and 8 occurred in April 2009, and the December 2009 inspection and sampling was delayed until February 2010 due to weather conditions. The lysimeters were visually structurally sound without any obstructions

within the visual portion of the pipe. The lysimeters had some silt settlement within the water layer that clouded out the camera when disturbed. Prior to the visual disturbance associated with the silt the liquid associated with the lysimeters appeared transparent with minimal suspended particles. The liquid surfaces had no apparent sheen and only had a very minor amount of unidentifiable floating particles.

Depth-to-water measurements were achieved by using a distance counter associated with the inspection camera. The water depth is determined from the top of the lysimeter opening to the water level.

Cell 5. The water level of the cell 5 lysimeter was reached at 97.5 m (320 ft) in April 2009. This was a 7 m (23 ft) increase of water in the lysimeter pipe from the December 2008 sampling, where the water level was reached at 104.5 m (343 ft). The dewatering activities in 2009 resulted in a total dewatering of 7,007 L (1,851 gal). During the February 2010 inspection and sampling, water level was reached at 95.4 m (313 ft). This is an increase in water level by 9.1 m (30 ft) from December 2008. The depth to the bottom of the lysimeter is 102 m (336 ft).

Cell 6. The water level of the cell 6 lysimeter was reached at 97.5 m (320 ft) in April 2009. This was a 7.6 m (25 ft) increase of water in the lysimeter pipe from the December 2008 sampling, where the water level was reached at 105.2 m (345 ft). The dewatering activities in 2009 resulted in a total dewatering of 1,356 L (3,000 gal). During the February 2010 inspection and sampling, water level was reached at 102.7 m (337 ft). This is an increase in water level by 2.4 m (8 ft) from December 2008. The depth to the bottom of the lysimeter is 107 m (352 ft).

Cell 7. A baseline water level of the cell 7 lysimeter was established in April 2009 with an initial water depth of 94.5 m (310 ft). The dewatering of cell 7 in 2009 resulted in a total dewatering of 3,028 L (800 gal). During the inspection and sampling activities in February 2010, water level in cell 7 was reached at 93 m (305 ft). This is an increase in water level by 1.5 m (5 ft) from April 2009. The depth to the bottom of the lysimeter is 96 m (315 ft).

Cell 8. A baseline water level of the cell 8 lysimeter was established in April 2009 with an initial water depth of 99 m (325 ft). The dewatering of cell 8 in 2009 resulted in a total dewatering of 2,461 L (650 gal). During the inspection and sampling activities in February 2010, water level in cell 8 was reached at 100 m (328 ft). This is a decrease in water level by .9 m (3 feet) from April 2009. The depth to the bottom of the lysimeter is 121 m (346 ft).

Table 3-1 shows the total gallons of water associated with the lysimeter dewatering activity.

Based on the limited data, response to dewatering activities cannot be analyzed adequately. Further video inspections and dewatering of lysimeters is planned as a routine activity during CY 2010 to provide further data on the lysimeters and will be available in the CY 2010 annual report.

Table 3-1. Lysimeter Dewatering Activity.

	Cell 5 Lysimeter		Cell 6 Lysimeter		Cell 7 Lysimeter		Cell 8 Lysimeter	
	Date	Gallons	Date	Gallons	Date	Gallons	Date	Gallons
CY 2005			Dec 2005	2302				
CY 2006	Jan 2006	1651						
	Jun 2006	1890	Jul 2006	273 ^a				
CY 2007								
CY 2008	Oct 2008	2770						
CY 2009	Jun 2009	1051	Jul 2009	2600	Jul 2009	800	Jul 2009	450
	Nov 2009	800	Nov 2009	400	Not Enough to Pump		Nov 2009	200
Total		8,162		5,575		800		650

^a Equipment malfunction prevented complete dewatering.
CY = calendar year

3.2 LYSIMETER SAMPLING

The lysimeters are now on a schedule to be sampled semi-annually in conjunction with the leachate system sampling (WCH 2009). Analytical results will be evaluated to document vadose zone conditions, characterized to ensure proper management of liquids, and monitored for any trends in the data.

The vadose zone monitoring activities are expected to continue until after the final landfill cap is installed and the annual quantity of leachate collected in the secondary leachate collection and removal system is shown to be insignificant (i.e., less than the amount needed to activate the removal pumps).

Lysimeters in cells 5 and 6 were initially sampled in August 2005 in accordance with *Gravity Collection Lysimeter Monitoring Plan ERDF Cells 5 and 6* (BHI 2005). Initial lysimeter samples were analyzed for chloride, gross alpha, technetium-99, and gross beta. The cell 7 and 8 lysimeters were initially sampled in April 2009. In CY 2009 the *Environmental Restoration Disposal Facility Lysimeter Monitoring and Sampling Plan* (WCH 2009) was developed. It was determined that the COCs for the sampling of the lysimeters should be consistent with the COCs for the routine leachate sampling at ERDF as described in the *Environmental Restoration Disposal Facility Leachate Sampling and Analysis Plan* (WCH 2008b).

The purpose of the initial characterization was to establish a baseline and determine if the routine analyte list of indicator parameters was adequate.

3.2.1 General Approach to Evaluating Results

Lysimeter samples were analyzed in accordance with the requirements of the U.S. Environmental Protection Agency SW-846 (EPA 1986), industry standard, or laboratory-specific test methods as presented in Table 3-2. The following data selection and evaluation criteria were applied:

- Quality assurance/quality control data were evaluated for the purpose of identifying potential collection or analytical problems. However, unless a problem with the data was identified during this review, the results of or a discussion regarding the quality assurance/quality control data were not included in this report.
- All data qualifiers were recorded.
- If the relative percent difference between values reported for main and duplicate samples was greater than 20%, the samples were flagged in the data spreadsheet and the data evaluated to determine their applicability.
- Data acceptance based on a less than 20% relative percent difference criterion was relaxed for analytical results reported at or near the method detection limit (e.g., typically within five times the detection limit). This allows for an expected increased analytical error when values are close to the detection limit.

Table 3-2. List of Baseline Lysimeter Analytes by Analytical Method. (2 Pages)

Analyte	Method ^a	Practical Quantitation Limit	Accuracy ^b (%)	Precision ^b (%)
Arsenic	6010B	15 µg/L	±25	±25
Barium	6010B	10 µg/L	±25	±25
Calcium	6010B	20 µg/L	±25	±25
Chromium	6010B	10 µg/L	±25	±25
Lead	6010B	9 µg/L	±25	±25
Potassium	6010B	3,000 µg/L	±25	±25
Selenium	6010B	15 µg/L	±25	±25
Silicon	6010B	500 µg/L	±25	±25
Sodium	6010B	500 µg/L	±25	±25
Thallium	6010B	15 µg/L	±25	±25
Tin	6010B	100 µg/L	±25	±25
Vanadium	6010B	10 µg/L	±25	±25
Zinc	6010B	10 µg/L	±25	±25
Carbon tetrachloride	8260B	1 µg/L	±25	±25
Trichloroethylene	8260B	1 µg/L	±25	±25
Bromide	300.0A ^c	200 µg/L	±25	±25
Chloride	300.0A ^c	30,000 µg/L	±20	±25
Fluoride	300.0A ^c	500 µg/L	±20	±25
Nitrogen (in nitrite/nitrate)	353.2	1000 µg/L	±20	±25
Sulfate	300.0A ^c	250,000 µg/L	±20	±25

Table 3-2. List of Baseline Lysimeter Analytes by Analytical Method. (2 Pages)

Analyte	Method ^a	Practical Quantitation Limit	Accuracy ^b (%)	Precision ^b (%)
Phosphate	300.0A ^c	500 µg/L	±20	±25
Total dissolved solids	2540C	10,000 µg/L	±20	NA
Total suspended solids	2540D	8000 µg/L	±20	NA
Total organic halides	9020B	30 µg/L	±20	NA
Carbon-14	^d	200 pCi/L	±20	±25
Iodine-129	^d	5 pCi/L	±20	±25
Technetium-99	^d	10 pCi/L	±20	±25
Radium	903.1 ^e	1 pCi/L	±20	±25
Total uranium	^d	0.1 µg/L	±20	±25
Gross alpha	900.0 ^e	3 pCi/L	±20	±25
Gross beta	900.0 ^e	4 pCi/L	±20	±25
Alkalinity	2320B	5,000 µg/L	±20	±25
pH	^f	NA	NA	NA
Specific conductance	^f	25 µS/cm	±20	NA

^a Method number indicated is from *Test Method for Evaluating Solid Wastes: Physical Chemical Methods* (SW-846) (EPA 1986), unless otherwise specified.

^b Accuracy is expressed as percent recovery; precision is expressed as a percent relative difference.

^c Method specified is from *Determination of Inorganic Anions in Aqueous and Solids Samples by Ion Chromatography* (Lindahl 1984) and is a modification of EPA Method 300.0.

^d Industry standard method, laboratory-specific, based on acceptance by Washington Closure Hanford.

^e Method specified is from *Prescribed Procedures for Measurement of Radioactivity in Drinking Water* (EPA 1989).

^f Parameter will be measured in the field.

NA = not available or not applicable

4.0 ANALYTICAL RESULTS AND FIELD DATA

Analytical results for lysimeter samples collected during CY 2009 are discussed in the following subsections.

4.1 SUMMARY OF LYSIMETER ANALYSIS

Data associated with leachate sampling conducted from CY 2005 through CY 2010 are presented in Appendix A, Table A-1. Analytical results from CY 2009 sampling events are presented in Table 4-1. Only analytical results that were reported as significant detects (>1 ppb) or that were reported as nondetected values on the routine COCs list are included in this report.

Table 4-1. 2009 Lysimeter Analytical Results for Cells 5 and 6.

Analyte	Lysimeter Cell 5 June 2009	Lysimeter Cell 5 (Duplicate Sample) June 2009	Lysimeter Cell 5 Feb 2010	Lysimeter Cell 6 June 2009	Lysimeter Cell 6 Feb 2010	Lysimeter Cell 6 (Duplicate Sample) Feb 2010	Units
Calcium	391,000	379,000	87,800	264,000	152,000	151,000	µg/L
Magnesium	63,200B	60,800B	16,200	382B	2,400	2,420	µg/L
Potassium	21,600	20,800	5,020	22,300	14,300	14,100	µg/l
Sodium	130,000	126,000	24,400	213,000	104,000	103,000	µg/L
Chloride	55,500D	55,300D	11,200D	82,300D	56,900D	60,300D	µg/L
Nitrogen (in nitrite/nitrate)	32,000D	29,700D	8,640D	22,200D	27,400D	30,300D	µg/L
Nitrate	234,000D	253,000D	41,900D	171,000D	127,000D	133,000D	µg/L
Sulfate	1,030,000D	1,050,000D	200,000D	801,000D	389,000D	402,000D	µg/L
Total dissolved solids	2,580,000	2,650,000	445,000	1,940,000	934,000	926,000	µg/L
Total suspended solids	124,000	41,000	70,000	25,000	55,000	61,000	µg/L
Total organic compounds	8,880	8,580	3,520	12,600	9,000	9,030	µg/L
Technetium-99	0.225U	-0.45U	3.60U	-0.645U	3.29U	3.93U	pCi/L
Uranium (total)	22.9	22.9	4.83	0.042	0.925	0.351	pCi/L
Uranium (filtered)	22.8	22.3	4.83	-0.003U	0.379	0.352	pCi/L
Gross alpha	15.2	13.3U	4.96	-1.25U	0.879U	1.14U	pCi/L
Gross beta	27.4	25.6	6.17	19.5	12.8	12.8	pCi/L
Alkalinity			170000				µg/L
pH	7.53	7.52	7.6	9.65	8.7	8.64	pH
Specific conductance	2,560	2,620	665	2,170	1,250	1,240	µS/cm

B = Organics: Method blanks contamination, Inorganics: Value is an estimate.

D = Result reported from secondary dilution.

U = Result is nondetected.

Because of dewatering activities in November 2009 there was not enough liquid in the cell 8 lysimeter to sample during the February 2010 sampling activities. Waste material was not placed in cells 7 and 8 until July 2009.

The data presented in Tables 4-1 through 4-3 are intended to provide a baseline for future comparison and trending. Lysimeter samples contained detectable concentrations of common metals, anions, and radionuclides. The following is a brief description of those constituents for which concentrations/activities contained inconsistencies when compared with the other lysimeter.

- **Sulfate.** Soluble salts, such as sulfate, were the primary constituents present within the lysimeter liquid and can be directly correlated to the levels of the primary constituents found within the ad-mix material used to construct the cells.
- **Total Dissolved Solids.** Total dissolved solids concentrations indicate a significant decrease in all of the cell lysimeters.
- **Total Suspended Solids.** Total suspended solids concentrations appear to remain stable in all of the cell lysimeters.
- **Uranium.** Uranium levels within cell 5 lysimeter appeared to be elevated and to be decreasing in concentration, while the other cells had very low detectable levels.
- **Gross Alpha.** Gross alpha activity concentrations in cell 5 lysimeter appear elevated when compared to the other cell lysimeters.
- **Gross Beta.** Gross beta activity appears to be within a consistent range within the lysimeters, except cell 7 lysimeter which had an increase.
- **pH.** The cells appear to have stable pH levels.

Table 4-2. 2009 Lysimeter Analytical Results for Cell 7. (2 Pages)

Analyte	Lysimeter Cell 7 April 2009	Lysimeter Cell 7 April 2009	Lysimeter Cell 7 June 2009	Lysimeter Cell 7 Feb 2010	Lysimeter Cell 7 Feb 2010	Units
Arsenic	9.2BM	4.4B				µg/L
Barium	210	190				µg/L
Calcium	140,000	130,000	192,000	150,000	144,000	µg/L
Chromium	7	4.8				µg/L
Lead	2.6U	2.6U				µg/L
Magnesium			405,00B	30,400	29,100	µg/L
Potassium	15,000	14,000	18,400	14,700	14,300	µg/l
Selenium	4.9U	4.9U				µg/L
Silicon	27,000N	24,000				µg/L
Sodium	120,000	110,000	111,000	112,000	110,000	µg/L
Tin	5.8U	5.8U				µg/L
Thallium	4.9UN	4.9U				µg/L

Table 4-2. 2009 Lysimeter Analytical Results for Cell 7. (2 Pages)

Analyte	Lysimeter Cell 7 April 2009	Lysimeter Cell 7 April 2009	Lysimeter Cell 7 June 2009	Lysimeter Cell 7 Feb 2010	Lysimeter Cell 7 Feb 2010	Units
Vanadium	21	15				µg/L
Zinc	29	22				µg/L
Carbon tetrachloride	0.19U	0.19U				µg/L
Trichloroethylene	0.16U	0.16U				µg/L
Bromide	210	200				µg/L
Chloride	45,000	46,000	36,500D	48,300D		µg/L
Fluoride	600	630				µg/L
Nitrogen (in nitrite/nitrate)	140	160	2,300D	240	80	µg/L
Nitrate	160B	160B	17,300D	250U	250U	µg/L
Nitrite	49U	53B				µg/L
Sulfate	590,000ND	590,000ND	535,000D	564,000D	566,000D	µg/L
Phosphate						µg/L
Total dissolved solids	1,000,000	1,200,000D	1,350,000	1,040,000	1,060,000	µg/L
Total suspended solids	260,000D	190,000D	1,600,000	148,000	143,000	µg/L
Total organic compounds			7,840	7,220	7,280	µg/L
Total organic halides	22B	14B				µg/L
Carbon-14	-1.01U	0.728U				pCi/L
Iodine-129	0.537U	1.27U				pCi/L
Technetium-99	2.62U	3.19U	0.333U	3.71U	2.22U	pCi/L
Radium	0.318	0.412				pCi/L
Uranium (total)	3.07	2.81	4.99	3.40	3.38	pCi/L
Uranium (filtered)				3.37	3.37	pCi/L
Gross alpha	6.23	5.96	31	4.86	6.52	pCi/L
Gross beta	27.7	21.4	59.4	13.8	15.5	pCi/L
Alkalinity	1,100U	89,000				µg/L
pH	7.9	8	7.77	7.62	7.56	pH
Specific conductance	1,300	1,300	1,390	1,340	1,350	µS/cm

B = Organics: Method blanks contamination, Inorganics: Value is an estimate.

D = Result reported from secondary dilution.

M = Sample duplicate precision not met.

N = MS/MSD recovery outside control limits.

U = Result is nondetected.

Table 4-3. 2009 Lysimeter Analytical Results Cell 8. (2 Pages)

Analyte	Lysimeter Cell 8 April 2009	Lysimeter Cell 8 June 2009	Lysimeter Cell 8 June 2009	Units
Arsenic	4.4U			µg/L
Barium	190			µg/L
Calcium	130,000	131,000	129,000	µg/L
Chromium	10			µg/L
Lead	4.2B			µg/L

Table 4-3. 2009 Lysimeter Analytical Results Cell 8. (2 Pages)

Analyte	Lysimeter Cell 8 April 2009	Lysimeter Cell 8 June 2009	Lysimeter Cell 8 June 2009	Units
Magnesium		33,100B	32,100B	µg/L
Potassium	13,000	13,200	12,600	µg/l
Selenium	4.9U			µg/L
Silicon	31,000			µg/L
Sodium	74,000	74,400	75,200	µg/L
Tin	5.8U			µg/L
Thallium	4.9U			µg/L
Vanadium	30			µg/L
Zinc	42			µg/L
Carbon tetrachloride	0.19U			µg/L
Trichloroethylene	0.16U			µg/L
Bromide	180B			µg/L
Chloride	36,000	33,200D	35,700D	µg/L
Fluoride	700			µg/L
Nitrogen (in nitrite/nitrate)	75B	100	90	µg/L
Nitrate	110B	760	620	µg/L
Nitrite	49U			µg/L
Sulfate	330,000D	330,000D	328,000D	µg/L
Total dissolved solids	770,000D	1,010,000	1,100,000	µg/L
Total suspended solids	640,000D	105,000	61,000	µg/L
Total organic compounds		7,720	7,430	µg/L
Total organic halides	21B			µg/L
Carbon-14	-3.7U			pCi/L
Iodine-129	-0.442U			pCi/L
Technetium-99	3.46U	-0.006U	1.24U	pCi/L
Radium	0.825			pCi/L
Uranium (total)	3.98	3.64	4.23	pCi/L
Gross alpha	4.14	17.8	2.16U	pCi/L
Gross beta	24.4	20.3	14.8	pCi/L
Alkalinity	230,000			µg/L
pH	8	7.63	7.56	pH
Specific conductance	1,100	1,180	1,170	µS/cm

B = Organics: Method blanks contamination, Inorganics: Value is an estimate.

D = Result reported from secondary dilution.

U = Result is nondetected.

5.0 CONCLUSIONS

The following conclusions and recommendations are presented based on the CY 2009 analytical results, an evaluation of lysimeter monitoring data, a review of the water-level measurement data, and a comparison of lysimeter data versus leachate and admix analytical results. December 2009 sampling activities were delayed to February 2010 due to the adverse winter conditions.

The source of the liquid within the lysimeters is from the vadose zone located beneath the ERDF cell liner and is made up of compaction moisture from the admix layer located immediately above the lysimeter, construction water, consolidation water, and/or condensation water. The absence of technetium-99 within the lysimeter liquid is a very good indicator that the leachate collection system located above the lysimeters is not leaking liquid into the lysimeters. This is based on technetium-99's high solubility and ease of mobility through soils when soluble, and there are no detectable levels of technetium-99 within the lysimeter liquid. Additional supporting evidence is the high sulfate concentration in the lysimeter liquid in comparison to the leachate, indicating there is no effective dilution of the lysimeter liquid.

Soluble salts were the primary constituents present within the lysimeters and can be directly correlated to the levels of the primary constituents found within the admix material used to construct the cells as shown in Appendix A.

Dewatering activities appear to have reduced significant amounts of total suspended solids, total dissolved solids, and lysimeter water within the cells' lysimeter sumps.

6.0 RECOMMENDATIONS

Semiannual monitoring of the lysimeter systems will continue in CY 2010 and until the leachate system produces an insignificant amount of liquid. Visual inspections of the lysimeters will also occur prior to and following all dewatering events and prior to all scheduled sampling to occur during CY 2010.

7.0 REFERENCES

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APPENDIX A
LYSIMETER SAMPLING SUMMARY, 2005 & 2009

Table A-1. Lysimeter Analytical Results (Cell 5).

Analyte	Lysimeter Cell 5 Aug 2005	Lysimeter Cell 5 Aug 2005	Lysimeter Cell 5 June 2009	Lysimeter Cell 5 June 2009	Lysimeter Cell 5 Feb 2010	Units
Arsenic						µg/L
Barium						µg/L
Calcium			391,000	379,000	87,800	µg/L
Chromium						µg/L
Lead						µg/L
Magnesium			63,200B	60,800B	16,200	µg/L
Potassium			21,600	20,800	5,020	µg/L
Selenium						µg/L
Silicon						µg/L
Sodium			130,000	126,000	24,400	µg/L
Tin						µg/L
Thallium						µg/L
Vanadium						µg/L
Zinc						µg/L
Carbon tetrachloride						µg/L
Trichloroethylene						µg/L
Bromide						µg/L
Chloride	23,800	30,600	55,500D	55,300D	11,200D	µg/L
Fluoride						µg/L
Nitrogen (in nitrite/nitrate)			32,000D	29,700D	8,640D	µg/L
Nitrate			234,000D	253,000D	41,900D	µg/L
Nitrite						
Sulfate			1,030,000D	1,050,000D	200,000D	µg/L
Phosphate						µg/L
Total dissolved solids			2,580,000	2,650,000	445,000	µg/L
Total suspended solids			124,000	41,000	70,000	µg/L
Total organic compounds			8,880	8,580	3,520	µg/L
Total organic halides						µg/L
Carbon-14						pCi/L
Iodine-129						pCi/L
Technetium-99	0.230U	-0.629U	0.225U	-0.45U	3.60U	pCi/L
Radium						pCi/L
Uranium (total)			22.9	22.9	4.83	pCi/L
Uranium (filtered)			22.8	22.3	4.83	pCi/L
Gross alpha	0.262U	-0.345U	15.2	13.3U	4.96	pCi/L
Gross beta	15.4	15.2	27.4	25.6	6.17	pCi/L
Alkalinity					170000	µg/L
pH			7.53	7.52	7.6	pH
Specific conductance			2,560	2,620	665	µS/cm

B = Organics: Method blanks contamination, Inorganics: Value is an estimate.
D = Result reported from secondary dilution.
U = Result is nondetected.

Table A-2. Lysimeter Analytical Results (Cell 6).

Analyte	Lysimeter Cell 6 Aug 2005	Lysimeter Cell 6 Aug 2005	Lysimeter Cell 6 June 2009	Lysimeter Cell 6 Feb 2010	Lysimeter Cell 6 Feb 2010	Units
Arsenic						µg/L
Barium						µg/L
Calcium			264,000	152,000	151,000	µg/L
Chromium						µg/L
Lead						µg/L
Magnesium			382B	2,400	2,420	µg/L
Potassium			22,300	14,300	14,100	µg/L
Selenium						µg/L
Silicon						µg/L
Sodium			213,000	104,000	103,000	µg/L
Tin						µg/L
Thallium						µg/L
Vanadium						µg/L
Zinc						µg/L
Carbon tetrachloride						µg/L
Trichloroethylene						µg/L
Bromide						µg/L
Chloride	62,800	79,000	82,300D	56,900D	60,300D	µg/L
Fluoride						µg/L
Nitrogen (in nitrite/nitrate)			22,200D	27,400D	30,300D	µg/L
Nitrate			171,000D	127,000D	133,000D	µg/L
Nitrite						
Sulfate			801,000D	389,000D	402,000D	µg/L
Phosphate						µg/L
Total dissolved solids			1,940,000	934,000	926,000	µg/L
Total suspended solids			25,000	55,000	61,000	µg/L
Total organic compounds			12,600	9,000	9,030	µg/L
Total organic halides						µg/L
Carbon-14						pCi/L
Iodine-129						pCi/L
Technetium-99	-0.617U	-3.33U	-0.645U	3.29U	3.93U	pCi/L
Radium						pCi/L
Uranium (total)			0.042	0.925	0.351	pCi/L
Uranium (filtered)			-0.003U	0.379	0.352	pCi/L
Gross alpha	0.361U	-0.908U	-1.25U	0.879U	1.14U	pCi/L
Gross beta	16.9	16.1	19.5	12.8	12.8	pCi/L
Alkalinity						µg/L
pH			9.65	8.7	8.64	pH
Specific conductance			2,170	1,250	1,240	µS/cm

B = Organics: Method blanks contamination, Inorganics: Value is an estimate.
D = Result reported from secondary dilution.
U = Result is nondetected.

Table A-2. Lysimeter Analytical Results (Cell 6).

Analyte	Lysimeter Cell 6 Aug 2005	Lysimeter Cell 6 Aug 2005	Lysimeter Cell 6 June 2009	Lysimeter Cell 6 Feb 2010	Lysimeter Cell 6 Feb 2010	Units
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Table A-3. 2008 AdMix Cell 5 and 6 Analytical Results.

Analyte	AdMix Cells 5 and 6	Units
Arsenic	3,000	µg/kg
Barium	87,000	µg/kg
Calcium	5,800,000	µg/kg
Chromium	6,700	µg/kg
Lead	5,900	µg/kg
Magnesium	N/A	µg/kg
Potassium	1,200,000	µg/kg
Selenium	1,000U	µg/kg
Silicon	250,000	µg/kg
Sodium	1,700,000	µg/kg
Tin	1,100	µg/kg
Thallium	780U	µg/kg
Vanadium	40,000	µg/kg
Zinc	35,000	µg/kg
Carbon tetrachloride	0.76U	µg/kg
Trichloroethylene	0.28U	µg/kg
Bromide	470B	µg/kg
Chloride	18,000M	µg/kg
Fluoride	1,800BM	µg/kg
Nitrogen (in nitrite/nitrate)	N/A	µg/kg
Nitrate	24000	µg/kg
Nitrite	690BM	µg/kg
Sulfate	1300000D	µg/kg
Total dissolved solids	N/A	µg/kg
Total suspended solids	N/A	µg/kg
Total organic compounds	N/A	µg/kg
Carbon-14	-0.477U	pCi/g
Iodine-129	-0.00194U	µg/kg
Technetium-99	-0.0262U	pCi/g
Radium	N/A	pCi/g
Uranium (total)	0.00181	pCi/g
Gross alpha	4.05U	pCi/g
Gross beta	22.9	pCi/L
Alkalinity	N/A	µg/L
pH	N/A	pH
Specific conductance	N/A	µS/cm

B = Organics: Method blanks contamination, Inorganics: Value is an estimate.
D = Result reported from secondary dilution.
M = Sample duplicate precision not met.
N/A = Not Available or Not Applicable
U = Result is nondetected.

Table A-4. 2009 Lysimeter Analytical Results (Cell 7).

Analyte	Lysimeter Cell 7 April 2009	Lysimeter Cell 7 April 2009	Lysimeter Cell 7 June 2009	Lysimeter Cell 7 Feb 2010	Lysimeter Cell 7 Feb 2010	Units
Arsenic	9.2BM	4.4B				µg/L
Barium	210	190				µg/L
Calcium	140,000	130,000	192,000	150,000	144,000	µg/L
Chromium	7	4.8				µg/L
Lead	2.6U	2.6U				µg/L
Magnesium			40,500B	30,400	29,100	µg/L
Potassium	15,000	14,000	18,400	14,700	14,300	µg/L
Selenium	4.9U	4.9U				µg/L
Silicon	27,000N	24,000				µg/L
Sodium	120,000	110,000	111,000	112,000	110,000	µg/L
Tin	5.8U	5.8U				µg/L
Thallium	4.9UN	4.9U				µg/L
Vanadium	21	15				µg/L
Zinc	29	22				µg/L
Carbon tetrachloride	0.19U	0.19U				µg/L
Trichloroethylene	0.16U	0.16U				µg/L
Bromide	210	200				µg/L
Chloride	45,000	46,000	36,500D	47,400D	48,300D	µg/L
Fluoride	600	630				µg/L
Nitrogen (in nitrite/nitrate)	140	160	2,300D	240	80	µg/L
Nitrate	160B	160B	17,300D	250U	250U	µg/L
Nitrite	49U	53B				µg/L
Sulfate	590,000ND	590,000ND	535,000D	564,000D	566,000D	µg/L
Phosphate						µg/L
Total dissolved solids	1,000,000	1,200,000D	1,350,000	1,040,000	1,060,000	µg/L
Total suspended solids	260,000D	190,000D	1,600,000	148,000	143,000	µg/L
Total organic compounds			7,840	7,220	7,280	µg/L
Total organic halides	22B	14B				µg/L
Carbon-14	-1.01U	0.728U				pCi/L
Iodine-129	0.537U	1.27U				pCi/L
Technetium-99	2.62U	3.19U	0.333U	3.71U	2.22U	pCi/L
Radium	0.318	0.412				pCi/L
Uranium (Total)	3.07	2.81	4.99	3.40	3.38	pCi/L
Uranium (Filtered)				3.37	3.37	pCi/L
Gross alpha	6.23	5.96	31	4.86	6.52	pCi/L
Gross beta	27.7	21.4	59.4	13.8	15.5	pCi/L
Alkalinity	1100U	89000				µg/L
pH	7.9	8	7.77	7.62	7.56	pH
Specific conductance	1,300	1,300	1,390	1,340	1,350	µS/cm

B = Organics: Method blanks contamination, Inorganics: Value is an estimate.
D = Result reported from secondary dilution.
M = Sample duplicate precision not met.
N = MS/MSD recovery outside control limits.
U = Result is nondetected.

Table A-5. 2009 Lysimeter Analytical Results (Cell 8).

Analyte	Lysimeter Cell 8 April 2009	Lysimeter Cell 8 June 2009	Lysimeter Cell 8 June 2009	Units
Arsenic	4.4U			µg/L
Barium	190			µg/L
Calcium	130,000	131,000	129,000	µg/L
Chromium	10			µg/L
Lead	4.2B			µg/L
Magnesium		33,100B	32,100B	µg/L
Potassium	13,000	13200	12,600	µg/L
Selenium	4.9U			µg/L
Silicon	31,000			µg/L
Sodium	74,000	74,400	75,200	µg/L
Tin	5.8U			µg/L
Thallium	4.9U			µg/L
Vanadium	30			µg/L
Zinc	42			µg/L
Carbon tetrachloride	0.19U			µg/L
Trichloroethylene	0.16U			µg/L
Bromide	180B			µg/L
Chloride	36,000	33,200D	35,700D	µg/L
Fluoride	700			µg/L
Nitrogen (in nitrite/nitrate)	75B	100	90	µg/L
Nitrate	110B	760	620	µg/L
Nitrite	49U			µg/L
Sulfate	330,000D	330,000D	328,000D	µg/L
Phosphate				µg/L
Total dissolved solids	770,000D	1,010,000	1,100,000	µg/L
Total suspended solids	640,000D	105,000	61,000	µg/L
Total organic compounds		7,720	7,430	µg/L
Total organic halides	21B			µg/L
Carbon-14	-3.7U			pCi/L
Iodine-129	-0.442U			pCi/L
Technetium-99	3.46U	-0.006U	1.24U	pCi/L
Radium	0.825			pCi/L
Uranium (Total)	3.98	3.64	4.23	pCi/L
Uranium (Filtered)				pCi/L
Gross alpha	4.14	17.8	2.16U	pCi/L
Gross beta	24.4	20.3	14.8	pCi/L
Alkalinity	230,000			µg/L
pH	8	7.63	7.56	pH
Specific conductance	1,100	1,180	1,170	µS/cm

B = Organics: Method blanks contamination, Inorganics: Value is an estimate.
D = Result reported from secondary dilution.
U = Result is nondetected.

Table A-5. 2009 Lysimeter Analytical Results (Cell 8).

Analyte	Lysimeter Cell 8 April 2009	Lysimeter Cell 8 June 2009	Lysimeter Cell 8 June 2009	Units
Arsenic	4.4U			µg/L
Barium	190			µg/L
Calcium	130,000	131,000	129,000	µg/L
Chromium	10			µg/L
Lead	4.2B			µg/L
Magnesium		33,100B	32,100B	µg/L
Potassium	13,000	13200	12,600	µg/L
Selenium	4.9U			µg/L
Silicon	31,000			µg/L
Sodium	74,000	74,400	75,200	µg/L
Tin	5.8U			µg/L
Thallium	4.9U			µg/L
Vanadium	30			µg/L
Zinc	42			µg/L
Carbon tetrachloride	0.19U			µg/L
Trichloroethylene	0.16U			µg/L
Bromide	180B			µg/L
Chloride	36,000	33,200D	35,700D	µg/L
Fluoride	700			µg/L
Nitrogen (in nitrite/nitrate)	75B	100	90	µg/L
Nitrate	110B	760	620	µg/L
Nitrite	49U			µg/L
Sulfate	330,000D	330,000D	328,000D	µg/L
Phosphate				µg/L
Total dissolved solids	770,000D	1,010,000	1,100,000	µg/L
Total suspended solids	640,000D	105,000	61,000	µg/L
Total organic compounds		7,720	7,430	µg/L
Total organic halides	21B			µg/L
Carbon-14	-3.7U			pCi/L
Iodine-129	-0.442U			pCi/L
Technetium-99	3.46U	-0.006U	1.24U	pCi/L
Radium	0.825			pCi/L
Uranium (Total)	3.98	3.64	4.23	pCi/L
Uranium (Filtered)				pCi/L
Gross alpha	4.14	17.8	2.16U	pCi/L
Gross beta	24.4	20.3	14.8	pCi/L
Alkalinity	230,000			µg/L
pH	8	7.63	7.56	pH
Specific conductance	1,100	1,180	1,170	µS/cm

B = Organics: Method blanks contamination, Inorganics: Value is an estimate.
D = Result reported from secondary dilution.
U = Result is nondetected.

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