Appendix A

Supplemental Groundwater Information

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List of Acronyms

AMSL	above mean sea level
AWWT	advanced wastewater treatment facility
BRSR	Baseline Remedial Strategy Report
CAWWT	converted advanced wastewater treatment facility
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CMT	Continuous Multi-channel Tubing
DOE	U.S. Department of Energy
EPA	U.S. Environmental Protection Agency
ESD	Explanation of Significant Differences
EW	Extraction Well
FRL	final remediation level
GMA-D	Great Miami Aquifer downgradient
GMA-U	Great Miami Aquifer upgradient
GWLMP	Groundwater/Leak Detection and Leachate Monitoring Plan
HTW	horizontal till well
IAWWT	Interim Advanced Waste Water Treatment
IEMP	Integrated Environmental Monitoring Plan
IW	Re-injection Well
LCS	leachate collection system
LDS	leak detection system
OAC	Ohio Administrative Code
OEPA	Ohio Environmental Protection Agency
OSDF	on-site disposal facility
PCB	polychlorinated biphenyls
PRRS	Paddys Run Road Site
RCRA	Resource Conservation and Recovery Act
RW	Recovery Well
SCL	Shewhart control limit
UCL	upper confidence level
WRS	Wilcoxon Rank Sum

List of Measurement Abbreviations

ft	feet
gpad	gallons per acre per day
gpm	gallons per minute
lb	pound
m	meter
m^3	cubic meter
M gal	million gallons
mg/L	milligrams per liter
µg/L	micrograms per liter
NTU	nephelometric turbidity unit
pCi/L	picoCuries per liter
yd^3	cubic yards

Appendix A presents additional groundwater data and analysis in support of Chapter 3 of this 2007 Site Environmental Report. This appendix consists of five attachments as follows:

- Attachment A.1 provides operational data for the South Field Module, the South Plume Module, and the Waste Storage Area Module for 2007.
- Attachment A.2 provides total uranium data (including summary statistics) and plume maps for the first and second halves of 2007.
- Attachment A.3 evaluates the capture zone by reviewing groundwater flow directions based on groundwater elevation data. It includes groundwater elevation maps from all four quarters of 2007 and hydrographs for specific wells.
- Attachment A.4 provides an analysis of the 2007 non-uranium final remediation level (FRL) exceedances both inside and outside the Waste Storage Area (Phase II) design remediation footprint.
- Attachment A.5 presents 2007 leak detection and leachate monitoring results associated with the On-site Disposal Facility Monitoring program.

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Attachment A.1

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A.1.0 Operational Assessment

At the start of 2007 all extraction systems modules were operational. Figures A.1−1A and A.1−1B depict the locations of extraction and former re-injection wells and identify surrounding monitoring wells. Table A.1−1 provides summaries of gallons pumped, total uranium removed, and uranium removal indices for 2007 and for August 1993 through December 2007.

The operation assessment information in this attachment is organized into the following subsections:

- South Field Module (Section A.1.1)
- South Plume Module (Section A.1.2)
- Waste Storage Area Module (Section A.1.3)
- Total Uranium Data (Section A.1.4)
- Pumping Rates (Section A.1.5).

A.1.1 South Field Module

The South Field Module was built in two phases. Phase I began operating in July 1998 and Phase II began operating in July 2003. At the end of 2007, the South Field Module included 13 active extraction wells, six inactive extraction wells, two inactive re-injection wells, and an inactive injection pond.

- The 13 active extraction wells are 31550 (EW-18), 31560 (EW-19), 31561 (EW-20), 33326 (EW-17a), 32276 (EW-22), 32446 (EW-24), 32447 (EW-23), 33061 (EW-25), 33262 (EW-15a), 33264 (EW-30), 33265 (EW-31), 33266 (EW-32), and 33298 (EW-21a).
- The six inactive extraction wells are 31564 (EW-14), inactive since December 19, 2001; 31565 (EW-13), inactive since May 22, 2001; 31566 (EW-15), inactive since August 7, 1998; 31562 (EW-21), inactive since March 13, 2003 to facilitate installation of a replacement well; 31563 (EW-16), inactive since December 9, 2002 to facilitate conversion to a re-injection well as part of the South Field (Phase II) Project, and 31567 (EW-17) inactive since September 6, 2005 to facilitate installation of a replacement well.
- The two inactive re-injection wells are 31563 (IW 16), which was converted from extraction well 31563 (EW-16); and 33263 (IW 29). South Field Module wells are located near the Southern Waste Unit excavations and the storm sewer outfall ditch in the South Field area of the Fernald Preserve, from Paddys Run to just west of the site’s South Access Road.
- The inactive injection pond was located in the western portion of the southern waste unit excavations area.

The target combined pumping rate for the online South Field Module wells in 2007 was 2,575 gallons per minute (gpm). This target is consistent with pumping rates defined for the Waste Storage Area Phase II Model Design. Tables A.1−2 through A.1−14 provide individual extraction well performance data for the South Field Module extraction wells that were operational in 2007. The footnotes explain individual extraction well outages of greater than 24 hours. The combined performance data for the South Field Module are presented in Table A.1−1.

During 2007, 1,174.09 million gallons of groundwater were pumped by the active extraction wells in the South Field Module resulting in the removal of 409.933 pounds (lbs) of uranium from the Great Miami Aquifer. Since startup of the South Field Module in July 1998, the module has removed 9.766 billion gallons of water and 5,008.3 lbs of uranium from the Great Miami Aquifer.

A.1.2 South Plume Module

At the end of 2007, the South Plume Module included six active recovery wells and one inactive recovery well. The six active Recovery Wells are 3924 (RW-1), 3925 (RW-2), 3926 (RW-3), 3927 (RW-4), 32308 (RW-6), and 32309 (RW-7). Recovery Wells 32308 (RW-6) and 32309 (RW-7) were installed as the South Plume Optimization Module. The one inactive recovery well is 3928 (RW-5), which has been inactive since September 11, 1994. These wells are located south of Willey Road and north of New Haven Road.

The target combined pumping rate for the South Plume Module in 2007 was 1,400 gpm (Jan – April) and 1,200 gpm (May – Dec.). The change in pumping rates involved RW-4. The pumping rate was lowered in May to conform to the Waste Storage Area Phase II Model Design. It was being operated at the higher rate as added protection to make sure that a lobe of the uranium plume just south of Willey Road along the eastern side of the plume was being captured. Model predictions though indicate that the lobe will be captured at the 200 gpm pumping rate and that the extra pumping is not necessary. Tables A.1−15 through A.1−20 provide individual extraction well performance data for the South Plume Module extraction wells that were operational in 2007. The footnotes explain individual extraction well outages of greater than 24 hours. The combined performance data for the South Plume Module are presented in Table A.1−1.

During 2007, 574.58 million gallons of groundwater were pumped by the six wells in the South Plume Module resulting in the removal of 112.306 lbs of uranium from the Great Miami Aquifer. Since startup of the South Plume Module in August 1993, the module has removed 10.566 billion gallons of groundwater and 2,235.21 lbs of uranium from the Great Miami Aquifer.

During 2007, the South Plume Module continued to meet the primary objectives of:

- Preventing further southward movement of the total uranium plume while capturing the main lobe of the South Plume without adversely affecting the Paddys Run Road Site (PRRS) plume (3924 [RW-1], 3925 [RW-2], 3926 [RW-3], and 3927 [RW-4]).
- Actively remediating the higher concentration region of the off property plume (32308 [RW-6] and 32309 [RW-7]).

Attachment A.3 presents additional details concerning capture, along with supporting data. In 2007, as in previous years, Paddys Run Road Site (PRRS) constituents of concern (arsenic, phosphorus, potassium, sodium, and volatile organic compounds) were monitored at 11 monitoring well locations immediately south of the South Plume Module to ensure that the operation of the system does not adversely impact the PRRS plume. The 11 wells monitored were 2128, 2625, 2636, 2898, 2899, 2900, 3128, 3636, 3898, 3899, and 3900 (refer to Figures A.1−1A).

The Mann Kendall test for trend was run on PRRS data collected from these wells. As indicated in Table A.1−21, two wells monitored for PRRS constituents of concern had an “up, significant” trend for potassium based on the Mann Kendall test for trend:

Each year since 2001, Monitoring Wells 2898 and 2899 have had “up, significant” trends for potassium. Potassium concentration versus time plots for these wells are shown in Figures A.1−2 and A.1−3. As reported in Attachment A.3, the groundwater flow direction was from the northeast to southwest at Monitoring Wells 2898 and 2899. This indicates that the increasing potassium concentrations at these two locations were moving toward the PRRS plume, not away from it.

The monitoring activity for PRRS constituents of concern also included sampling for volatile organic compounds. These compounds are monitored because they were present in the PRRS plume, which is not of Fernald origin (ERM Midwest, Inc. 1994). No volatile organic compounds were detected in 2007.

A.1.3 Waste Storage Area Module

Phase I of the Waste Storage Area Module became operational on May 8, 2002. The module consisted of three extraction wells: 32761 (EW-26), 33062 (EW-27), and 33063 (EW-28). Extraction Well 33063 (EW-28) was turned off in July 2004 and was plugged and abandoned to make way for surface remediation activities. Four groundwater monitoring wells surrounding EW-28 (63121, 63122, 83120, and 83123) were also plugged and abandoned. The two remaining extraction wells resumed operation in March 2005, after pumping was suspended for the duration of CAWWT Stage I construction. The target combined pumping rate was 700 gpm. The pumping rate of EW-27 was set higher than what was defined in the Waste Storage Area Phase II Model Design in order to compensate for the temporary loss of EW-28. On June 29, 2006 a replacement well for extraction well EW-28 (EW-28a, 33334) became operational. On October 5, 2006 a new extraction well became operational (EW-33a, 33347) as part of the Waste Storage Area Phase II Design. The target pumping rate for the Waste Storage Area Module following the start up of extraction well EW-33a was 1000 gpm. This target pumping rate is consistent with the Waste Storage Area Phase II Model Design. Tables A.1−22 through A.1−25 provide individual extraction well performance data for the Waste Storage Area Module wells. The combined performance data for the Waste Storage Area Module are presented in Table A.1−1.

During 2007, 479.30 million gallons of groundwater were pumped from extraction wells in the Waste Storage Area Module resulting in the removal of 130.46 lbs of uranium from the Great Miami Aquifer. Since startup of the Waste Storage Area Module in May 2002, 2.28 billion gallons of water and 1,281.73 lbs of uranium have been removed from the Great Miami Aquifer.

A.1.4 Total Uranium Data

Process control water samples were collected weekly through September and monthly from October through December in 2007 from the extraction wells and analyzed for total uranium. The total uranium concentrations are used to calculate the mass of uranium removed by the well, support the statistical trend analysis presented in Attachment A.2, and to determine if a well is routed to treatment or to bypass treatment. Figure A.1−4 provides a graph of the monthly gallons of groundwater extracted versus the monthly gallons of groundwater treated for 2007.

Uranium concentration data collected from the extraction wells are also being tracked graphically in order to predict when the extraction well-specific uranium concentrations will reach the groundwater remediation goal of 30 micrograms per liter (µg/L), and to help determine how long groundwater treatment will be necessary. This is done by plotting uranium concentrations over time and then fitting a regression line to the data set.

Figures A.1−5 through A.1−27 are uranium concentration versus time plots for each extraction well. Each graph displays three different data sets (operational data, 95 percent upper confidence level [UCL] of the operational data, and model predictions). Trend lines for the operational data set and the 95 percent UCL of the operational data set were fitted using the regression function found in Microsoft Excel software.

As pumping continues the uranium concentration of the pumped groundwater will decrease. The slope of a fitted regression curve through the uranium concentration data set collected at each extraction well provides a prediction of when pumping concentrations will decrease below 30 µg/L at each well. However, the slope of a fitted regression curve through the pumped uranium concentration data set is an insufficient statistical measure by itself because future measured concentrations could vary about the trend curve. EPA guidelines in General Methods for Remedial Operation Performance Evaluations (EPA 1992a) suggest that a 95 percent UCL of the measured uranium concentration data set can be used to help evaluate the uncertainty of the predicted data trend. From this perspective, the concentration trend of the measured data set presents a less conservative prediction of when pumping concentrations will decrease below 30 µg/L and the 95 percent UCL data trend presents a more conservative trend prediction (i.e., longer predicted cleanup times).

The graphs in Figures A.1−5 through A.1−27 indicate when the actual measured concentrations and the 95 percent UCL calculated concentrations will reach the 30 µg/L final remediation level (FRL) for total uranium. For example, the concentration trend of pumped water from Extraction Well 31550 (refer to Figure A.1−13) reaches 30 µg/L in approximately 2008 (trend for the measured data set) or approximately 2024 (trend for the 95 percent UCL data).

Figures A.1−5 through A.1−27 also show how modeled uranium concentration predictions relate to the measured and 95 percent UCL data trends. The VAM 3D groundwater model uranium concentration predictions are taken from modeling results for the Waste Storage Area (Phase II) Design.

The Fernald groundwater model predicts the future average pounds of uranium that will be removed from the aquifer for each year of the modeled remedy. The average annual pounds of uranium actually removed from the aquifer are compared to the model predictions to assess remedy progress. Concentration regression equations based on measured concentration data collected at the extraction wells are also used to provide a prediction of the number of pounds of uranium that will be removed from the aquifer in future years. Regression equations based on uranium concentration data collected at extraction wells through December 31, 2007 are summarized in Table A.1−26.

At the end of December 2007, approximately 8,449 net lbs of uranium had been removed from the Great Miami Aquifer by the pump-and-treat remedy. Model predictions indicate that an additional 5,461 lbs of uranium will be removed from the Great Miami Aquifer by operating the system according to the Waste Storage Area (Phase II) Design through 2024. The concentration data set indicates that an additional 4,308 lbs of uranium will be removed from the Great Miami Aquifer based on regression analyses of the individual well data. The 95 percent UCL measured concentration data set indicates that an additional 14,243 lbs of uranium will be removed from the Great Miami Aquifer based on regression analyses of the individual well data. A summary of the predictions are provided below.

	Data	**Model**	**95% UCL**
Net pounds of uranium extracted through December 2007	8449	8449	8449
Predicted pounds of U to be extracted between 2008 and the end of the remedy	4308	5461	14243
Total predicted pounds of uranium to be removed	**12757**	**13910**	**22692**
Estimated Percent Complete (based on lbs of uranium to be removed)	**66**	**61**	**37**

Table A.1−27 provides a yearly breakdown for the three predictions. Figure A.1−28 illustrates the relationship between the three estimates.

Results indicate that as of January 1, 2008, the estimated percent complete for the aquifer remedy is approximately 66 percent (based on the uranium concentration data set) or 61 percent (based on the model predictions) equaling a difference of approximately 5 percent. The remedy is approximately 37 percent complete based on the 95 percent UCL data set. The regression trend predictions based on the measured concentration data are very close to the modeled predictions.

A.1.5 Pumping Rates

Daily pumping rate data for each extraction well are presented on the DOE Office of Legacy Management’s website under the Fernald site (http://www.lm.doe.gov/land/sites/sites_map.htm); therefore, those data have not been repeated here. The footnotes in the well specific operational tables explain individual well outages of greater than 24 hours.

Target extraction well pumping rates for 2007 are provided in Table A.1−28. The total target pumping rate of 4775 gpm is consistent with the rate defined by the Waste Storage Area Phase II Model Design. Up until May, Extraction Well RW-4 had a target pumping rate of 400 gpm, 200 gpm over the design target rate. It was being operated at the higher rate as added protection to make sure that a lobe of the uranium plume just south of Willey Road along the eastern side of the plume was being captured. Model predictions though indicate that the lobe will be captured at the 200 gpm design target rate and that the extra pumping is not needed. As additional operational experience is gained, pumping rate changes may occur as efforts to maximize the effectiveness of each module are made.

Table A.1-1. Aquifer Restoration System Operational Summary Sheet

	Reporting Period					
	January 2007 through December 2007			August 1993 through December 2007		
	Gallons Pumped/ Re-injected [a] (M gal)	Total Uranium Removed/ Re-injected (lbs)	Uranium Removal Index [b] (lbs/M gal)	Gallons Pumped/ Re-injected (M gal)	Total Uranium Removed/ Re-injected (lbs)	Uranium Removal Index [b] (lbs/M gal)
South Field Module	1,174.085	409.933	0.35	9,765.703	5,008.263	0.51
Waste Storage Area Module	479.298	130.464	0.27	2,275.107	1,281.734	0.56
South Plume Module	574.579	112.306	0.20	10,566.223	2,235.214	0.21
Re-injection Module [c]	0	0	NA	1,936.478	76.27	NA
Aquifer Restoration Systems Totals						
Extraction Wells	2,227.961	652.703	0.29	22,598.031	8,525.212	0.38
(Re-injection Wells)	0	0	NA	(1,936.478)	(76.27)	NA
Net	2,227.961	652.703	NA	20,661.553	8,448.942	NA

[a] million gallons
[b] NA = not applicable
[c] Re-Injection module was shut down in September of 2004.

Table A.1-2. Extraction Well 31550 (EW-18) Operational Summary Sheet For 2007

Reference Elevation (feet AMSL) – 572.11 (top of well)
Northing Coordinate ('83) – 477,018.5
Easting Coordinate ('83) – 1,348,979.8

Hours in reporting period – 8760
Hours not pumped – 1068

Hours pumped – 7692
Operational percent – 87.81
Adjusted Operational Percent [a] – 97.71

Target pumping rate – 100 gpm

Monthly Measurements at Well Field				
Month	Monthly Average Pumping Rate [b] (gpm)	Million Gallons Pumped	Monthly Average Total Uranium Concentration (µg/L)	Uranium Removal Index (Pounds of Total Uranium Removed/Million Gallons Pumped)
1/07	106.8	4.768	40.9	0.34
2/07	95.5	3.851	45.7	0.38
3/07	95.1	4.245	46.4	0.39
4/07	92.1	3.978	45.3	0.38
5/07	96.2	4.296	41.3	0.34
6/07	54.7	2.364	46.4	0.39
7/07	29.0	1.296	39.4	0.33
8/07	100.0	4.464	44.3	0.37
9/07	102.7	4.439	43.0	0.36
10/07	106.9	4.771	39.6	0.33
11/07	103.9	4.490	39.1	0.33
12/07	113.2	5.055	37.9	0.32
	Average 91.4	Total 48.017	Average 42.4	Average 0.35

[a] Adjusted for planned annual well field shut down.
[b] Well was shut down from February 21 to February 23 for repairs to CAWWT equipment.
Well was shut down from May 19 to May 20 due to lack of communication with remote computers.
Well was shut down from June 17 to July 23 for the annual well field shut down to allow aquifer water level rebound.

Table A.1-3. Extraction Well 31560 (EW-19) Operational Summary Sheet For 2007

Reference Elevation (feet AMSL) – 574.93 (top of well)
Northing Coordinate ('83) – 477,403.1
Easting Coordinate ('83) – 1,349,028.9

Hours in reporting period – 8760
Hours not pumped – 1291.5

Hours pumped – 7469
Operational percent – 85.26
Adjusted Operational Percent [a] – 95.15

Target pumping rate –100 gpm

Monthly Measurements at Well Field				
Month	Monthly Average Pumping Rate [b] (gpm)	Million Gallons Pumped	Monthly Average Total Uranium Concentration (µg/L)	Uranium Removal Index (Pounds of Total Uranium Removed/Million Gallons Pumped)
1/07	107.2	4.787	33.2	0.28
2/07	90.4	3.646	35.2	0.29
3/07	96.2	4.296	32.8	0.27
4/07	95.3	4.118	38.7	0.32
5/07	92.4	4.126	33.2	0.28
6/07	29.7	1.282	40.1	0.33
7/07	29.2	1.303	30.2	0.25
8/07	106.5	4.755	32.6	0.27
9/07	99.8	4.309	31.2	0.26
10/07	109.0	4.865	28.9	0.24
11/07	104.8	4.526	27.8	0.23
12/07	106.6	4.760	28.0	0.23
	Average 88.9	Total 46.773	Average 32.7	Average 0.27

[a] Adjusted for planned annual well field shut down.
[b] Well was shut down from February 21 to February 23 for repairs to CAWWT equipment.
Well was shut down from May 19 to May 20 due to lack of communication with remote computers.
Well was shut down from June 9 to July 23 for the annual well field shut down to allow aquifer water level rebound.

Table A.1-4. Extraction Well 31561 (EW-20) Operational Summary Sheet For 2007

Reference Elevation (feet AMSL) – 578.77 (top of well)
Northing Coordinate ('83) – 477,660.8
Easting Coordinate ('83) – 1,349,254.5

Hours in reporting period – 8760
Hours not pumped – 1289.5

Hours pumped – 7471
Operational percent – 85.28
Adjusted Operational Percent [a] – 95.18

Target pumping rate – 100 gpm

Monthly Measurements at Well Field				
Month	Monthly Average Pumping Rate [b] (gpm)	Million Gallons Pumped	Monthly Average Total Uranium Concentration (µg/L)	Uranium Removal Index [c] (Pounds of Total Uranium Removed/ Million Gallons Pumped)
1/07	107.7	4.810	29.6	0.25
2/07	96.6	3.893	31.0	0.26
3/07	101.9	4.549	30.0	0.25
4/07	97.8	4.225	31.0	0.26
5/07	102.0	4.552	27.8	0.23
6/07	61.2	2.642	33.3	0.28
7/07	0.0	0.000	33.0	NA
8/07	109.5	4.888	30.1	0.25
9/07	109.5	4.729	31.4	0.26
10/07	109.2	4.876	32.3	0.27
11/07	104.7	4.525	35.3	0.29
12/07	106.8	4.766	34.5	0.29
	Average 92.2	Total 48.456	Average 31.6	Average 0.26

[a] Adjusted for planned annual well field shut down.
[b] Well was shut down from February 21 to February 23 for repairs to CAWWT equipment.
Well was shut down from May 19 to May 20 due to lack of communication with remote computers.
Well was shut down from June 17 to August 2 due to annual well field shut down to allow aquifer water level rebound and start up problems.
[c] NA = not applicable

Table A.1-5. Extraction Well 31567 (EW-17) and 33326 (EW-17a) Operational Summary Sheet For 2007

Reference Elevation (feet AMSL) – 574.84 (top of well)
Northing Coordinate ('83) – 477,905.5
Easting Coordinate ('83) – 1,348,854.1

Hours in reporting period – 8760
Hours not pumped – 1415

Hours pumped – 7345
Operational percent – 83.85
Adjusted Operational Percent [a] – 93.74

Target pumping rate – 175 gpm

Monthly Measurements at Well Field				
Month	Monthly Average Pumping Rate [b] (gpm)	Million Gallons Pumped	Monthly Average Total Uranium Concentration [c] (μg/L)	Uranium Removal Index [c] (Pounds of Total Uranium Removed/ Million Gallons Pumped)
1/07	98.5	4.398	27.0	0.23
2/07	153.0	6.167	28.5	0.24
3/07	187.9	8.389	27.0	0.23
4/07	186.2	8.042	27.5	0.23
5/07	187.6	8.375	25.7	0.21
6/07	95.4	4.120	28.8	0.24
7/07	0.0	0.000	NA	NA
8/07	159.6	7.125	29.1	0.24
9/07	165.4	7.145	26.0	0.22
10/07	171.5	7.657	23.1	0.19
11/07	163.6	7.069	24.8	0.21
12/07	163.7	7.306	25.5	0.21
	Average 144.4	Total 75.792	Average 26.6	Average 0.22

[a] Adjusted for planned annual well field shut down.
[b] Well shut down from January 31 to February 5 for pump replacement.
Well shut down from February 21 to February 23 for repairs to CAWWT equipment.
Well shut down from May 19 to May 20 due to lack of communication with remote computers.
Well shut down from June 17 to August 2 due to the annual well field shut down to allow aquifer water level rebound and start up problems.
[c] NA = not applicable

Table A.1-6. Extraction Well 32276 (EW-22) Operational Summary Sheet For 2007

Reference Elevation (feet AMSL) – 567.14 (top of well)
Northing Coordinate ('83) – 476,447.3
Easting Coordinate ('83) – 1,348,857.3

Hours in reporting period – 8760
Hours not pumped – 1101.5

Hours pumped – 7659
Operational percent – 87.43
Adjusted Operational Percent [a] – 97.32

Target pumping rate – 300 gpm

Monthly Measurements at Well Field				
Month	Monthly Average Pumping Rate [b] (gpm)	Million Gallons Pumped	Monthly Average Total Uranium Concentration (μg/L)	Uranium Removal Index (Pounds of Total Uranium Removed/ Million Gallons Pumped)
1/07	328.8	14.676	43.8	0.37
2/07	277.0	11.171	48.3	0.40
3/07	288.3	12.872	46.4	0.39
4/07	278.1	12.012	53.1	0.44
5/07	280.7	12.529	44.8	0.37
6/07	163.2	7.052	49.7	0.41
7/07	86.7	3.869	42.0	0.35
8/07	317.7	14.183	44.0	0.37
9/07	295.9	12.784	42.5	0.35
10/07	302.8	13.518	42.0	0.35
11/07	298.0	12.873	43.9	0.37
12/07	309.8	13.829	44.2	0.37
	Average 268.9	Total 141.367	Average 45.4	Average 0.38

[a] Adjusted for planned annual well field shut down.
[b] Well shut down from February 21 to February 23 for repairs to CAWWT equipment.
Well shut down from May 19 to May 20 due to lack of communication with remote computers.
Well shut down from June 17 to July 23 for the annual well field shut down to allow aquifer water level rebound.

Table A.1-7. Extraction Well 32446 (EW-24) Operational Summary Sheet For 2007

Reference Elevation (feet AMSL) – 578.367 (top of well)
Northing Coordinate ('83) – 476,634.53
Easting Coordinate ('83) – 1,349,312.38

Hours in reporting period – 8760
Hours not pumped – 1856

Hours pumped – 6904
Operational percent – 78.81
Adjusted Operational Percent [a] – 88.71

Target pumping rate – 300 gpm

Monthly Measurements at Well Field				
Month	Monthly Average Pumping Rate [b] (gpm)	Million Gallons Pumped	Monthly Average Total Uranium Concentration (µg/L)	Uranium Removal Index (Pounds of Total Uranium Removed/ Million Gallons Pumped)
1/07	219.7	9.807	44.5	0.37
2/07	274.2	11.056	48.3	0.41
3/07	285.3	12.735	43.9	0.37
4/07	280.7	12.125	49.2	0.41
5/07	313.7	14.004	42.6	0.36
6/07	177.6	7.672	48.4	0.40
7/07	8.0	0.356	48.0	0.40
8/07	330.0	14.731	48.0	0.40
9/07	242.5	10.478	46.8	0.39
10/07	202.0	9.016	44.7	0.37
11/07	169.6	7.327	48.5	0.40
12/07	115.4	5.153	51.9	0.43
	Average 218.2	Total 114.459	Average 47.1	Average 0.39

[a] Adjusted for planned annual well field shut down.
[b] Well was shut down January 30 to January 31 for pump replacement.
Well was shut down from February 21 to February 23 for repairs to CAWWT equipment.
Well was shut down from June 17 to July 31 due to the annual well field shut down to allow aquifer water level rebound and re-start problems.
Well was shut down from November 28 to December 21 for rehab and pump replacement.

Table A.1-8. Extraction Well 32447 (EW-23) Operational Summary Sheet For 2007

Reference Elevation (feet AMSL) – 574.528 (top of well)
Northing Coordinate ('83) – 477,150.24
Easting Coordinate ('83) – 1,349,421.19

Hours in reporting period – 8760
Hours not pumped – 1075.5

Hours pumped – 7685
Operational percent – 87.72
Adjusted Operational Percent [a] – 97.62

Target pumping rate – 300 gpm

Monthly Measurements at Well Field				
Month	Monthly Average Pumping Rate [b] (gpm)	Million Gallons Pumped	Monthly Average Total Uranium Concentration (µg/L)	Uranium Removal Index (Pounds of Total Uranium Removed/ Million Gallons Pumped)
1/07	318.7	14.227	68.925	0.58
2/07	244.9	9.874	74.25	0.62
3/07	236.3	10.549	68	0.57
4/07	206.5	8.921	73.62	0.61
5/07	183.2	8.177	66.6	0.56
6/07	93.1	4.024	75.5	0.63
7/07	80.2	3.578	65.04	0.54
8/07	325.1	14.514	69.2	0.58
9/07	310.8	13.427	72.5	0.61
10/07	281.8	12.579	68	0.57
11/07	270.8	11.697	68.75	0.57
12/07	244.2	10.902	65.5	0.55
	Average 233.0	Total 122.469	Average 69.7	Average 0.58

[a] Adjusted for planned annual well field shut down.
[b] Well was shut down from February 21 to February 23 for repairs to CAWWT equipment.
Well was shut down from May 19 to May 20 due to lack of communication with remote computers.
Well was shut down from June 17 to July 23 for the annual well field shut down to allow aquifer water level rebound.

Table A.1-9. Extraction Well 33061 (EW-25) Operational Summary Sheet For 2007

Reference Elevation (feet AMSL) – 575.56 (top of well)
Northing Coordinate ('83) – 478318.82
Easting Coordinate ('83) – 1349531.03

Hours in reporting period – 8760
Hours not pumped – 1058

Hours pumped – 7702
Operational percent – 87.92
Adjusted Operational Percent [a] – 97.82

Target pumping rate – 100 gpm

Monthly Measurements at Well Field				
Month	Monthly Average Pumping Rate [b] (gpm)	Million Gallons Pumped	Monthly Average Total Uranium Concentration (µg/L)	Uranium Removal Index (Pounds of Total Uranium Removed/ Million Gallons Pumped)
1/07	146.6	6.542	38.2	0.32
2/07	237.8	9.587	41.0	0.34
3/07	140.1	6.255	43.6	0.36
4/07	136.0	5.876	51.2	0.43
5/07	138.7	6.191	44.9	0.37
6/07	80.5	3.479	42.3	0.35
7/07	37.9	1.693	43.5	0.36
8/07	154.9	6.915	35.4	0.30
9/07	150.3	6.491	32.6	0.27
10/07	140.4	6.269	31.4	0.26
11/07	138.7	5.990	32.9	0.27
12/07	137.9	6.155	29.4	0.25
	Average 136.6	Total 71.444	Average 38.8	Average 0.32

[a] Adjusted for planned annual well field shut down.
[b] Well was shut down from February 21 to February 23 for repairs to CAWWT equipment.
Well was shut down from May 19 to May 20 due to lack of communication with remote computers.
Well was shut down from June 17 to July 23 for the annual well field shut down to allow aquifer water level rebound.

Table A.1-10. Extraction Well 33262 (EW-15a) Operational Summary Sheet For 2007

Reference Elevation (feet AMSL) – 568.368 (top of well)
Northing Coordinate ('83) – 477,799.912
Easting Coordinate ('83) – 1,348,149.97

Hours in reporting period – 8760
Hours not pumped – 1051

Hours pumped – 7709
Operational percent – 88
Adjusted Operational Percent [a] – 97.90

Target pumping rate – 200 gpm

Monthly Measurements at Well Field				
Month	Monthly Average Pumping Rate [b] (gpm)	Million Gallons Pumped	Monthly Average Total Uranium Concentration (µg/L)	Uranium Removal Index (Pounds of Total Uranium Removed/ Million Gallons Pumped)
1/07	218.2	9.739	41.0	0.34
2/07	187.9	7.575	46.7	0.39
3/07	182.4	8.140	42.2	0.35
4/07	193.1	8.342	47.9	0.40
5/07	187.8	8.384	43.5	0.36
6/07	118.2	5.108	46.4	0.39
7/07	62.3	2.782	44.0	0.37
8/07	215.5	9.622	41.3	0.34
9/07	214.1	9.251	36.9	0.31
10/07	220.2	9.831	33.0	0.28
11/07	215.6	9.313	32.2	0.27
12/07	217.3	9.700	32.0	0.27
	Average 186.1	Total 97.788	Average 40.6	Average 0.34

[a] Adjusted for planned annual well field shut down.
[b] Well was shut down from February 21 to February 23 for repairs to CAWWT equipment.
Well was shut down from May 19 to May 20 due to a lack of communication with remote computers.
Well was shut down from June 17 to July 23 for the annual well field shut down to allow aquifer water level rebound.

Table A.1-11. Extraction Well 33264 (EW-30) Operational Summary Sheet For 2007

Reference Elevation (feet AMSL) – 573.818 (top of well)
Northing Coordinate ('83) – 477,200.945
Easting Coordinate ('83) – 1,349,751.49

Hours in reporting period – 8760
Hours not pumped – 1095.5

Hours pumped – 7664.5
Operational percent – 87.49
Adjusted Operational Percent [a] – 97.39

Target pumping rate–200 gpm

Monthly Measurements at Well Field				
Month	Monthly Average Pumping Rate [b] (gpm)	Million Gallons Pumped	Monthly Average Total Uranium Concentration (µg/L)	Uranium Removal Index (Pounds of Total Uranium Removed/ Million Gallons Pumped)
1/07	110.5	4.932	78.4	0.65
2/07	184.3	7.430	75.9	0.63
3/07	195.2	8.712	69.1	0.58
4/07	192.8	8.330	74.8	0.62
5/07	238.5	10.645	68.1	0.57
6/07	175.4	7.579	73.4	0.61
7/07	61.7	2.753	63.9	0.53
8/07	224.6	10.025	68.5	0.57
9/07	234.5	10.129	66.9	0.56
10/07	225.9	10.085	70.8	0.59
11/07	275.6	11.906	67.8	0.57
12/07	227.0	10.133	69.9	0.58
	Average 195.5	Total 102.659	Average 70.6	Average 0.59

[a] Adjusted for planned annual well field shut down.
[b] Well was shut down from January 30 to January 31 for pump replacement.
Well was shut down from February 21 to February 23 for repairs to CAWWT equipment.
Well was shut down from May 19 to May 20 due to lack of communication with remote computers.
Well was shut down from June 17 to July 23 for the annual well field shut down to allow aquifer level rebound.

Table A.1-12. Extraction Well 33265 (EW-31) Operational Summary Sheet For 2007

Reference Elevation (feet AMSL) – 577.474 (top of well)
Northing Coordinate ('83) – 477,598.909
Easting Coordinate ('83) – 1,349,849.01

Hours in reporting period – 8760
Hours not pumped – 1058.5

Hours pumped – 7701.5
Operational percent – 87.92
Adjusted Operational Percent [a] – 97.81

Target pumping rate – 300 gpm

Monthly Measurements at Well Field				
Month	Monthly Average Pumping Rate [b] (gpm)	Million Gallons Pumped	Monthly Average Total Uranium Concentration (μg/L)	Uranium Removal Index (Pounds of Total Uranium Removed/ Million Gallons Pumped)
1/07	296.2	13.224	16.2	0.13
2/07	253.8	10.232	20.9	0.17
3/07	258.8	11.551	18.0	0.15
4/07	230.1	9.942	18.6	0.16
5/07	239.8	10.706	18.2	0.15
6/07	136.1	5.878	19.3	0.16
7/07	66.8	2.980	18.3	0.15
8/07	242.6	10.831	17.8	0.15
9/07	227.7	9.835	17.1	0.14
10/07	233.2	10.408	16.0	0.13
11/07	231.2	9.990	17.0	0.14
12/07	232.2	10.364	15.5	0.13
	Average 220.7	Total 115.942	Average 17.7	Average 0.15

[a] Adjusted for planned annual well field shut down.
[b] Well was shut down from February 21 to February 23 for repairs to CAWWT equipment.
Well was shut down from May 19 to May 20 due to lack of communications with remote computers.
Well was shut down from June 17 to July 23 for the annual well field shut down to allow aquifer water level rebound.

Table A.1-13. Extraction Well 33266 (EW-32) Operational Summary Sheet For 2007

Reference Elevation (feet AMSL) – 579.625 (top of well)
Northing Coordinate ('83) – 476,997.576
Easting Coordinate ('83) – 1,350,046.97

Hours in reporting period – 8760
Hours not pumped – 1236

Hours pumped – 7524
Operational percent – 85.89
Adjusted Operational Percent [a] – 95.79

Target pumping rate – 200 gpm

Monthly Measurements at Well Field				
Month	Monthly Average Pumping Rate [b] (gpm)	Million Gallons Pumped	Monthly Average Total Uranium Concentration (µg/L)	Uranium Removal Index (Pounds of Total Uranium Removed/ Million Gallons Pumped)
1/07	109.8	4.904	12.4	0.10
2/07	137.1	5.526	10.5	0.09
3/07	202.4	9.037	9.3	0.08
4/07	198.2	8.560	10.8	0.09
5/07	203.1	9.066	10.5	0.09
6/07	119.3	5.153	10.4	0.09
7/07	62.4	2.786	12.8	0.11
8/07	217.7	9.720	11.1	0.09
9/07	214.2	9.252	11.0	0.09
10/07	220.7	9.850	11.0	0.09
11/07	220.6	9.529	11.2	0.09
12/07	216.4	9.661	10.4	0.09
	Average 176.8	Total 93.046	Average 10.9	Average 0.09

[a] Adjusted for planned annual well field shut down.
[b] Well was shut down from January 31 to February 8 for pump replacement.
Well was shut down from February 21 to February 23 for repairs to CAWWT equipment.
Well was shut down from May 19 to May 20 due to lack of communication with remote computers.
Well was shut down from June 17 to July 23 for the annual well field shut down to allow aquifer water level rebound.

Table A.1-14. Extraction Well 33298 (EW-21a) Operational Summary Sheet For 2007

Reference Elevation (feet AMSL) – 576.21 (top of well)
Northing Coordinate ('83) – 477,953.1
Easting Coordinate ('83) – 1,349,499.9

Hours in reporting period – 8760
Hours not pumped – 1164.5

Hours pumped – 7596
Operational percent – 86.71
Adjusted Operational Percent [a] – 96.60

Target pumping rate –200 gpm

Monthly Measurements at Well Field				
Month	Monthly Average Pumping Rate [b] (gpm)	Million Gallons Pumped	Monthly Average Total Uranium Concentration (µg/L)	Uranium Removal Index (Pounds of Total Uranium Removed/ Million Gallons Pumped)
1/07	172.1	7.682	47.3	0.39
2/07	152.0	6.130	53.5	0.45
3/07	193.9	8.655	53.3	0.44
4/07	191.2	8.260	52.8	0.44
5/07	185.9	8.297	52.5	0.44
6/07	115.0	4.969	58.0	0.48
7/07	61.0	2.724	58.4	0.49
8/07	223.6	9.981	53.6	0.45
9/07	217.9	9.414	51.7	0.43
10/07	223.8	9.991	47.6	0.40
11/07	221.8	9.582	50.1	0.42
12/07	228.2	10.187	47.3	0.39
	Average 182.2	Total 95.872	Average 52.2	Average 0.44

[a] Adjusted for planned annual well field shut down.
[b] Well was shut down from February 5 to February 8 for pump replacement.
Well was shut down from February 21 to February 23 for repairs to CAWWT equipment.
Well was shut down from May 19 to May 20 due to lack of communication with remote computers.
Well was shut down from June 17 to July 23 for the annual well field shut down to allow aquifer water level rebound.

Table A.1-15. Extraction Well 3924 (RW-1) Operational Summary Sheet For 2007

Reference Elevation (feet AMSL) – 533.51 (top of well)
Northing Coordinate ('83) – 474,219.7
Easting Coordinate ('83) – 1,348,314.3

Hours in reporting period – 8760
Hours not pumped – 1631.5
Hours pumped – 7128.5
Operational percent – 81.38
Target pumping rate – 200 gpm

Monthly Measurements at Well Field							
Month		Monthly Average Pumping Rate[a] (gpm)		Million Gallons Pumped		Monthly Average Total Uranium Concentration (µg/L)	Uranium Removal Index (Pounds of Total Uranium Removed/ Million Gallons Pumped)
1/07		220.7		9.852		23.8	0.20
2/07		95.6		3.857		22.3	0.19
3/07		110.8		4.947		17.7	0.15
4/07		210.3		9.087		18.6	0.16
5/07		201.4		8.989		17.0	0.14
6/07		149.4		6.454		18.9	0.16
7/07		192.1		8.574		18.2	0.15
8/07		122.8		5.483		16.8	0.14
9/07		189.9		8.206		17.1	0.14
10/07		211.0		9.420		17.6	0.15
11/07		220.0		9.502		19.3	0.16
12/07		220.6		9.848		20.4	0.17
	Average	178.7	Total	94.219	Average	19.0	Average 0.16

[a]Well was shut down from February 13 to March 15 due to ice storm damage.
Well was shut down February 21 to February 23 for repairs to CAWWT equipment.
Well was shut down from May 19 to May 20 due to lack of communication with remote computers.
Well was shut down from June 22 to July 4 due to storm damage.
Well was shut down from August 7 to August 20 due to rehab.
Well was shut down from September 27 to October 2 due to electrical problems.

Table A.1-16. Extraction Well 3925 (RW-2) Operational Summary Sheet For 2007

Reference Elevation (feet AMSL) – 542.01 (top of well)
Northing Coordinate ('83) – 474,319.7
Easting Coordinate ('83) – 1,348,565.4

Hours in reporting period – 8760 | Hours pumped – 6716 | Target pumping rate – 200 gpm
Hours not pumped – 2044 | Operational percent – 76.67

Monthly Measurements at Well Field				
Month	Monthly Average Pumping Rate[a] (gpm)	Million Gallons Pumped	Monthly Average Total Uranium Concentration[b] (µg/L)	Uranium Removal Index[b] (Pounds of Total Uranium Removed/ Million Gallons Pumped)
1/07	156.3	6.977	16.8	0.14
2/07	21.0	0.848	20.8	0.17
3/07	104.2	4.653	20.8	0.17
4/07	202.0	8.726	21.5	0.18
5/07	156.7	6.997	19.5	0.16
6/07	0.0	0.000	NA	NA
7/07	195.1	8.710	21.5	0.18
8/07	212.2	9.475	20.2	0.17
9/07	212.5	9.181	18.3	0.15
10/07	216.7	9.674	20.1	0.17
11/07	199.4	8.615	20.0	0.17
12/07	167.0	7.454	20.1	0.17
	Average 153.6	Total 81.309	Average 19.9	Average 0.17

[a]Well was shut down from February 5 to March 15 for pump replacement and ice storm damage.
Well was shut down from February 21 to February 23 for repairs to CAWWT equipment.
Well was shut down from May 19 to May 20 due to lack of communication with remote computers.
Well was shut down from May 24 to May 31 due to a power outage and bad transformer.
Well was shut down from June 22 to July 4 due to storm damage.
[b]NA = not applicable

Table A.1-17. Extraction Well 3926 (RW-3) Operational Summary Sheet For 2007

Reference Elevation (feet AMSL) – 586.73 (top of well)
Northing Coordinate ('83) – 474,428.6
Easting Coordinate ('83) – 1,348,837.5

Hours in reporting period – 8760 | Hours pumped – 7084.5 | Target pumping rate –200 gpm
Hours not pumped – 1675.5 | Operational percent – 80.87

Monthly Measurements at Well Field							
Month	Monthly Average Pumping Rate[a] (gpm)		Million Gallons Pumped		Monthly Average Total Uranium Concentration (µg/L)		Uranium Removal Index (Pounds of Total Uranium Removed/ Million Gallons Pumped)
1/07	174.7		7.800		26.7		0.22
2/07	100.7		4.061		26.1		0.22
3/07	120.5		5.378		27.1		0.23
4/07	226.8		9.796		27.8		0.23
5/07	156.8		6.999		25.5		0.21
6/07	104.8		4.527		27.6		0.23
7/07	198.1		8.843		27.5		0.23
8/07	212.2		9.471		26.1		0.22
9/07	213.8		9.235		27.3		0.23
10/07	207.5		9.261		26.9		0.22
11/07	184.3		7.960		27.7		0.23
12/07	169.7		7.578		28.6		0.24
Average	172.5	Total	90.908	Average	27.1	Average	0.23

[a]Well was shut down from January 4 to January 8 to replace the pump.
Well was shut down from February 13 to March 15 due to ice storm damage.
Well was shut down from February 21 to February 23 for repairs to CAWWT equipment.
Well was shut down from May 19 to May 20 due to lack of communication with remote computers.
Well was shut down from May 24 to June 7 due to a power outage and bad controller.
Well was shut down from June 22 to July 4 due to storm damage.

Table A.1-18. Extraction Well 3927 (RW-4) Operational Summary Sheet For 2007

Reference Elevation (feet AMSL) – 591.84 (top of well)
Northing Coordinate ('83) – 474,541.8
Easting Coordinate ('83) – 1,349,127.3

Hours in reporting period – 8760
Hours not pumped – 1111.5

Hours pumped – 7648.5
Operational percent – 87.31

Target pumping rate–400 / 200 gpm

Monthly Measurements at Well Field				
Month	Monthly Average Pumping Rate[a] (gpm)	Million Gallons Pumped	Monthly Average Total Uranium Concentration (µg/L)	Uranium Removal Index (Pounds of Total Uranium Removed/ Million Gallons Pumped)
1/07	361.2	16.126	2.9	0.02
2/07	297.6	12.000	3.1	0.03
3/07	380.4	16.980	3.1	0.03
4/07	347.8	15.025	3.3	0.03
5/07	222.1	9.914	3.2	0.03
6/07	144.3	6.233	3.3	0.03
7/07	182.5	8.146	3.1	0.03
8/07	85.7	3.825	2.7	0.02
9/07	150.7	6.512	2.5	0.02
10/07	212.1	9.466	2.6	0.02
11/07	216.0	9.331	2.3	0.02
12/07	219.9	9.818	2.4	0.02
Average	235.0	Total 123.377	Average 2.9	Average 0.02

[a]Well was shut down from February 13 to February 14 due to a tree falling on the power line.
Well was shut down from February 21 to February 23 for repairs to CAWWT equipment.
Well was shut down from May 19 to May 20 due to lack of communication with remote computers.
Well was shut down from June 22 to July 4 due to storm damage.
Well was shut down from August 21 to September 10 due to rehab.

Table A.1-19. Extraction Well 32308 (RW-6) Operational Summary Sheet For 2007

Reference Elevation (feet AMSL) – 582.05 (top of casing)
Northing Coordinate ('83) – 475,078.83
Easting Coordinate ('83) – 1,348,693.9

Hours in reporting period – 8760
Hours not pumped – 2228.0

Hours pumped – 6532
Operational percent – 74.57
Adjusted Operational Percent [a] – 84.46

Target pumping rate –200 gpm

Monthly Measurements at Well Field				
Month	Monthly Average Pumping Rate [b] (gpm)	Million Gallons Pumped	Monthly Average Total Uranium Concentration [c] (µg/L)	Uranium Removal Index [c] (Pounds of Total Uranium Removed/ Million Gallons Pumped)
1/07	222.5	9.933	38.4	0.32
2/07	112.8	4.547	42.0	0.35
3/07	124.8	5.573	38.3	0.32
4/07	181.4	7.836	41.5	0.35
5/07	158.5	7.075	34.2	0.29
6/07	0.0	0.000	NA	NA
7/07	63.7	2.844	36.7	0.31
8/07	223.3	9.969	37.7	0.31
9/07	214.4	9.262	40.4	0.34
10/07	216.2	9.651	40.7	0.34
11/07	203.4	8.787	43.5	0.36
12/07	184.2	8.225	43.2	0.36
	Average 158.8	Total 83.701	Average 39.7	Average 0.33

[a] Adjusted for planned annual well field shut down.
[b] Well was shut down from February 13 to February 16 due to ice storm damage.
Well was shut down from February 18 to March 13 due to electrical problems.
Well was shut down from March 23 to March 24 due to electrical problems.
Well was shut down from May 19 to May 20 due to lack of communication with remote computers.
Well was shut down from May 24 to May 31 due to a power outage and blown fuses.
Well was shut down from June 17 to July 23 for the annual well field shut down to allow aquifer water level rebound.
[c] NA = not applicable

Table A.1-20. Extraction Well 32309 (RW-7) Operational Summary Sheet For 2007

Reference Elevation (feet AMSL) – 582.05 (top of casing)
Northing Coordinate ('83) – 475,109.60
Easting Coordinate ('83) – 1,348,366.34

Hours in reporting period – 8760
Hours not pumped – 1131.5

Hours re-injected – 7628.5
Operational percent – 87.08
Adjusted Operational Percent [a] – 96.98

Target pumping rate –200 gpm

Monthly Measurements at Well Field							
Month	Monthly Average Pumping Rate [b] (gpm)		Million Gallons Pumped		Monthly Average Total Uranium Concentration (µg/L)		Uranium Removal Index (Pounds of Total Uranium Removed/ Million Gallons Pumped)
1/07	219.4		9.793		34.5		0.29
2/07	174.9		7.052		36.1		0.30
3/07	222.5		9.933		34.3		0.29
4/07	197.5		8.533		39.9		0.33
5/07	206.9		9.237		36.0		0.30
6/07	120.3		5.199		40.5		0.34
7/07	69.5		3.101		36.4		0.30
8/07	219.7		9.808		38.8		0.32
9/07	216.7		9.361		42.0		0.35
10/07	219.0		9.776		40.6		0.34
11/07	219.2		9.470		42.3		0.35
12/07	219.6		9.802		40.6		0.34
Average	192.1	Total	101.064	Average	38.5	Average	0.32

[a] Adjusted for planned annual well field shut down.
[b] Well was shut down from February 13 to February 16 due to a tree falling on the power line (ice storm damage).
Well was shut down from February 21 to February 23 for repairs to CAWWT equipment.
Well was shut down from May 19 to May 20 due to lack of communication with remote computers.
Well was shut down from June 17 to July 23 for the annual well field shut down to allow aquifer water level rebound.

Table A.1-21. Paddys Run Road Site Groundwater Summary Statistics and Trend Analysis

Constituent	Monitoring Well	Number of Samples[a,b,c]	Min.[a,b,c,d] (mg/L)	Max.[a,b,c,d] (mg/L)	Avg.[a,b,c,d] (mg/L)	SD[a,b,c,d] (mg/L)	Trend[a,b,c,d,e]
Arsenic	2128	230	0.000195	0.1876	0.0115	0.0209	Down, Significant
	2625	206	0.001095	0.0706	0.0119	0.0096	Down, Significant
	2636	176	0.010	0.0939	0.044	0.019	Down, Significant
	2898	47	0.000147	0.082	0.0039	0.0122	No Significant Trend
	2899	40	0.00032	0.0114	0.0015	0.0018	No Significant Trend
	2900	229	0.00032	0.0609	0.0050	0.0054	Down, Significant
	3128	50	0.0004	0.234	0.008	0.03	No Significant Trend
	3636	49	0.0005	0.0152	0.0023	0.0029	No Significant Trend
	3898	47	0.0005	0.0434	0.0034	0.0062	Up, Marginal
	3899	48	0.000147	0.011	0.0017	0.0020	No Significant Trend
	3900	48	0.000375	0.016	0.0025	0.0025	Down, Significant
Phosphorus	2128	56	0.025	16.2	1.58	2.58	Down, Significant
	2625	30	0.307	12.3	3.09	2.96	No Significant Trend
	2636	28	9.6	170	92	46	No Significant Trend
	2898	48	0.005	9.95	0.315	1.45	No Significant Trend
	2899	39	0.005	0.831	0.064	0.13	No Significant Trend
	2900	46	0.05	4.74	0.538	0.729	Down, Significant
	3128	57	0.005	13	0.28	1.7	No Significant Trend
	3636	48	0.00955	1.1	0.079	0.16	No Significant Trend
	3898	46	0.00955	1.24	0.113	0.190	Up, Marginal
	3899	47	0.005	0.83	0.10	0.16	Down, Significant
	3900	48	0.005	1.38	0.103	0.262	Down, Marginal
Potassium	2128	48	0.83	18	3.6	3.7	No Significant Trend
	2625	31	0.64	9.49	3.3	2.0	No Significant Trend
	2636	28	8.51	218	75.5	52.8	Down, Significant
	2898	48	1.11	9.64	4.29	1.35	Up, Significant
	2899	40	1.36	8.85	3.97	1.09	Up, Significant
	2900	47	0.0095	6.0	2.0	1.2	No Significant Trend
	3128	50	1.085	3.7	2.1	0.7	Down, Significant
	3636	48	1.09	4.24	2.31	0.54	Down, Significant
	3898	47	0.61	3.93	2.4	0.5	No Significant Trend
	3899	48	0.875	3.22	2.43	0.36	No Significant Trend
	3900	48	0.975	3.19	1.76	0.43	Down, Significant
Sodium	2128	48	12.3	75.2	35.2	11.8	Down, Significant
	2625	31	16.5	50.7	32.9	7.4	Down, Significant
	2636	28	23	148	53	25	No Significant Trend
	2898	48	4.945	29.2	17.8	3.7	Down, Significant
	2899	40	11.2	22.9	16.6	2.7	Down, Significant
	2900	47	0.01355	43.3	27.6	7.8	No Significant Trend
	3128	50	3.56	13.4	5.89	2.75	Down, Significant
	3636	48	3.14	13.0	6.27	2.93	Down, Significant
	3898	47	7.29	14.6	9.68	1.60	Up, Marginal
	3899	48	6.24	12.1	8.74	1.24	No Significant Trend
	3900	48	3.13	10.8	5.11	1.91	Down, Significant

[a] The data are based on unfiltered samples from the Operable Unit 5 remedial investigation/feasibility study data set (1988 through 1993) and 1994 through 2007 groundwater data (unfiltered and filtered for 2001 through 2007).

[b] If more than one sample is collected per well per day (e.g., duplicate), then only one sample is counted for the total number of samples and the sample with the maximum concentration is used to determine the summary statistics (minimum, maximum, average, standard deviation, and Mann-Kendall test for trend).

[c] Rejected data qualified with either an R or Z were not included in this count or the summary statistics.

[d] Where concentrations are below the detection limit each result used in the summary statistics is set at half the detection limit.

[e] Trend starts on August 27, 1993, and is based on the start-up of the South Plume Extraction Wells (DMEPP).

Table A.1-22. Extraction Well 32761 (EW-26) Operational Summary Sheet For 2007

Reference Elevation (feet AMSL) – 570.88 (top of casing)
Northing Coordinate ('83) – 479892.36
Easting Coordinate ('83) – 1347364.02

Hours in reporting period – 8760
Hours not pumped – 1157

Hours pumped – 7603
Operational percent – 86.79
Adjusted Operational Percent [a] – 96.69

Target pumping rate – 300 gpm

Monthly Measurements at Well Field				
Month	Monthly Average Pumping Rate [b] (gpm)	Million Gallons Pumped	Monthly Average Total Uranium Concentration (µg/L)	Uranium Removal Index (Pounds of Total Uranium Removed/ Million Gallons Pumped)
1/07	331.1	14.780	41.4	0.35
2/07	275.1	11.093	44.8	0.37
3/07	292.7	13.068	42.5	0.35
4/07	288.4	12.461	47.8	0.40
5/07	289.1	12.905	40.5	0.34
6/07	176.7	7.633	44.7	0.37
7/07	88.3	3.941	43.7	0.36
8/07	324.8	14.499	38.6	0.32
9/07	324.7	14.026	37.5	0.31
10/07	286.4	12.783	36.6	0.31
11/07	297.1	12.835	39.7	0.33
12/07	324.5	14.487	36.4	0.30
	Average 274.9	Total 144.511	Average 41.2	Average 0.34

[a] Adjusted for planned annual well field shut down.
[b] Well was shut down from February 21 to February 23 for repairs to CAWWT equipment.
Well was shut down from May 19 to May 20 due to lack of communication with remote computers.
Well was shut down from June 17 to July 23 for the annual well field shut down to allow aquifer water level rebound.
Well was shut down from October 18 to October 22 due to a broken flow meter.

Table A.1-23. Extraction Well 33062 (EW-27) Operational Summary Sheet For 2007

Reference Elevation (feet AMSL) – 575.1 (top of casing)
Northing Coordinate ('83) – 480013.01
Easting Coordinate ('83) – 1348037.2

Hours in reporting period – 8760
Hours not pumped – 1080.5

Hours pumped – 7680
Operational percent – 87.67
Adjusted Operational Percent [a] – 97.56

Target pumping rate–200 gpm

Monthly Measurements at Well Field				
Month	Monthly Average Pumping Rate [b] (gpm)	Million Gallons Pumped	Monthly Average Total Uranium Concentration (µg/L)	Uranium Removal Index (Pounds of Total Uranium Removed/ Million Gallons Pumped)
1/07	223.8	9.991	45.8	0.38
2/07	186.6	7.523	49.1	0.41
3/07	195.4	8.721	44.9	0.37
4/07	186.4	8.052	49.4	0.41
5/07	188.3	8.404	43.9	0.37
6/07	108.7	4.695	50.6	0.42
7/07	58.6	2.617	50.0	0.42
8/07	211.0	9.421	47.5	0.40
9/07	187.4	8.094	46.8	0.39
10/07	176.5	7.877	45.0	0.38
11/07	174.3	7.529	48.2	0.40
12/07	161.3	7.199	46.6	0.39
	Average 171.5	Total 90.123	Average 47.32	Average 0.39

[a] Adjusted for planned annual well field shut down.
[b] Well was shut down from February 21 to February 23 for repairs to CAWWT equipment.
Well was shut down from May 19 to May 20 due to lack of communication with remote computers.
Well was shut down from June 17 to July 23 for the annual well field shut down to allow aquifer water level rebound.

Table A.1-24. Extraction Well 33334 (EW-28a) Operational Summary Sheet For 2007

Reference Elevation (feet AMSL) – 570.441 (top of casing)
Northing Coordinate ('83) – 479918.959
Easting Coordinate ('83) – 1348686.378

Hours in reporting period – 8760
Hours not pumped – 1045

Hours pumped – 7715
Operational percent – 88.07
Adjusted Operational Percent [a] – 97.97

Target pumping rate–200 gpm

Monthly Measurements at Well Field							
Month		Monthly Average Pumping Rate [b] (gpm)		Million Gallons Pumped		Monthly Average Total Uranium Concentration (µg/L)	Uranium Removal Index (Pounds of Total Uranium Removed/ Million Gallons Pumped)
1/07		218.8		9.768		21.5	0.18
2/07		190.5		7.680		21.4	0.18
3/07		195.1		8.711		20.1	0.17
4/07		189.0		8.166		19.7	0.16
5/07		192.0		8.572		19.0	0.16
6/07		116.7		5.040		20.6	0.17
7/07		63.2		2.822		18.7	0.16
8/07		214.6		9.581		19.6	0.16
9/07		213.2		9.209		19.8	0.17
10/07		220.2		9.830		19.4	0.16
11/07		216.4		9.350		20.5	0.17
12/07		214.0		9.551		19.4	0.16
	Average	187.0	Total	98.280	Average	20.0	Average 0.17

[a] Adjusted for planned annual well field shut down.
[b] Well was shut down from February 21 to February 23 for repairs to CAWWT equipment.
Well was shut down April 3 for flow meter preventive maintenance.
Well was shut down from May 19 to May 20 due to a lack of communication with remote computers.
Well was shut down from June 17 to July 23 for the annual well field shut down to allow aquifer water level rebound.

Table A.1-25. Extraction Well 33347 (EW-33a) Operational Summary Sheet For 2007

Reference Elevation (feet AMSL) – 574.86 (top of casing)
Northing Coordinate ('83) – 481031.762
Easting Coordinate ('83) – 1346715.817

Hours in reporting period – 8760
Hours not pumped – 1309

Hours pumped – 7451
Operational percent – 85.06
Adjusted Operational Percent [a] – 94.95

Target pumping rate–300 gpm

Monthly Measurements at Well Field				
Month	Monthly Average Pumping Rate [b] (gpm)	Million Gallons Pumped	Monthly Average Total Uranium Concentration (µg/L)	Uranium Removal Index (Pounds of Total Uranium Removed/ Million Gallons Pumped)
1/07	329.3	14.702	35.25	0.29
2/07	303.1	12.220	30.53	0.25
3/07	248.5	11.093	28.33	0.24
4/07	299.7	12.947	29.6	0.25
5/07	313.4	13.988	24.6	0.21
6/07	179.4	7.748	29.2	0.24
7/07	95.0	4.239	24.7	0.21
8/07	328.5	14.666	23.0	0.19
9/07	328.7	14.199	19.9	0.17
10/07	328.9	14.683	18.4	0.15
11/07	263.5	11.383	16.7	0.14
12/07	325.2	14.516	14.6	0.12
	Average 278.6	Total 146.383	Average 24.56	Average 0.20

[a] Adjusted for planned annual well field shut down.
[b] Well was shut down from February 21 to February 23 for repairs to CAWWT equipment.
Well was shut down from May 19 to May 20 due to lack of communication with remote computers.
Well was shut down from March 19 to March 26 due to a leak in the line.
Well was shut down from June 17 to July 23 for the annual well field shut down to allow aquifer water level rebound

Table A.1−26. Regression Equations for Uranium Concentration Data Collected at Extraction Wells Data Collected Through December 31, 2007

Well-ID	SED-ID	Data Trend	95% UCL	Function Type
RW-1	3924	y=3.09E+05e-2.47E-04x	y=9.14E+03e-1.34E-04x	Exponential Function
RW-2	3925	y=-5.78E-03x+2.43E+02	y=-5.78E-03x+2.58E+02	Linear
RW-3	3926	y=-2.43E-06x^2+1.85E-01x-3.49E+03	y=-2.43E-06x^2+1.85E-01x-3.47E+03	Polynomial
RW-4	3927	y=2.12E-33x^7.23	y=1.15E-14x3.20	Power Function
RW-6	32308	y=2.31E+05e-2.22E-04x	y=2.21E+04e-1.49E-04x	Exponential Function
RW-7	32309	y=8.72E+05e-2.57E-04x	y=3.87E+04e-1.61E-04x	Exponential Function
EW-15a	33262	y=2.25E+79x-1.69E+01	y=4.48E+55x-1.17E+01	Power Function
EW-17a	33326	y=4.24E+03e-1.30E-04x	y=1.42E+03e-9.03E-05x	Exponential Function
EW-18	31550	y=2.31E+05e-2.25E-04x	y=1.47E+04e-1.36E-04x	Exponential Function
EW-19	31560	y=2.05E+09e-4.63E-04x	y=5.14E+05e-2.20E-04x	Exponential Function
EW-20	31561	y=1.11E+04e-1.49E-04x	y=2.68E+03e-1.01E-04x	Exponential Function
EW-21a	32398	y=2.14E+07e-3.34E-04x	y=1.57E+05e-1.87E-04x	Exponential Function
EW-22	32276	y=3.08E+10e-5.21E-04x	y=1.89E+06e-2.41E-04x	Exponential Function
EW-23	32447	y=1.06E+10e-4.84E-04x	y=4.96E+06e-2.65E-04x	Exponential Function
EW-24	32446	y=2.31E+06e-2.78E-04x	y=8.15E+04e-1.76E-04x	Exponential Function
EW-25	33061	y=1.77E+04e-1.55E-04x	y=3.34E+03e-1.03E-04x	Exponential Function
EW-30	33264	y=7.20E+10e-5.30E-04x	y=7.90E+07e-3.40E-04x	Exponential Function
EW-31	33265	y=2.36E+08e-4.17E-04x	y=6.98E+05e-2.53E-04x	Exponential Function
EW-32	33266	y=1.02E+13e-7.00E-04x	y=2.29E+08e-4.07E-04x	Exponential Function
EW-26	32761	y=9.65E+11e-6.11E-04x	y=4.23E+07e-3.31E-04x	Exponential Function
EW-27	33062	y=1.58E+14e-7.41E-04x	y=1.56E+08e-3.58E-04x	Exponential Function
EW-28a	33334	y=4.36E+17e-9.62E-04x	y=8.77E+07e-3.47E-04	Exponential Function
EW-33a	33347	Y=7.55E+73e-4.25E-03x	y=2.69E+30e-1.67E-03x	Exponential Function

Table- A.1−27. Estimated Percent Complete based on Pounds of Uranium Removed from the Aquifer

	Annual Uranium To Be Extracted From GMA (pounds) Based on Conc. Data	Annual Uranium To Be Extracted From GMA (pounds) Based on Model	Annual Uranium To Be Extracted From GMA (pounds) Based on 95% UCL
2008	**638**	**697**	**1632**
2009	**510**	**586**	**1393**
2010	**436**	**509**	**1240**
2011	**377**	**450**	**1116**
2012	**328**	**404**	**1012**
2013	**286**	**366**	**922**
2014	**250**	**335**	**843**
2015	**219**	**307**	**759**
2016	**217**	**276**	**817**
2017	**191**	**247**	**748**
2018	**168**	**225**	**685**
2019	**149**	**208**	**628**
2020	**133**	**193**	**577**
2021	**118**	**180**	**530**
2022	**106**	**169**	**488**
2023	**95**	**159**	**449**
2024	**85**	**150**	**404**
Total - To Be Extracted	**4308**	**5461**	**14243**
Pounds AlreaadyExtracted Thru 12-31-2007	**8449**	**8449**	**8449**
Total	**12757**	**13910**	**22692**
% Complete Based on Pounds (2007)	**66**	**61**	**37**
% Complete Based on Pounds (2006)	**59**	**55**	**33**

Table A.1-28. 2007 Extraction Well Target Pumping Rates

Module	Extraction Well	January 1 to December 31[a] (gpm)
South Plume	3924 (RW-1)	200
	3925 (RW-2)	200
	3926 (RW-3)	200
	3927 (RW-4)	200 - 400
	32308 (RW-6)	200
	32309 (RW-7)	200
Sub-Total		1200 - 1400
Waste Storage Area	32761 (EW-26)	300
	33062 (EW-27)	200
	33334 (EW-28a)	200
	33347 (EW-33a)	300
Sub-Total		1000
South Field Extraction	31550 (EW-18)	100
	31560 (EW-19)	100
	31561 (EW-20)	100
	33298 (EW-21a)	200
	33326 (EW-17a)	175
	32276 (EW-22)	300
	32446 (EW-24)	300
	32447 (EW-23)	300
	33061 (EW-25)	100
	33264 (EW-30)	200
	33265 (EW-31)	300
	33266 (EW-32)	200
	33262 (EW-15a)	200
Sub-Total		2575
Total Pumping		4775 - 4975

[a] The target pumping rates are from the Waste Storage Area Phase II Design with the following exception: The pumping rate of RW-4 in the South Plume was increased from 200 gpm to 400 gpm to assure capture of a lobe of uranium contamination extending south of Willey Road along the eastern side of the plume.

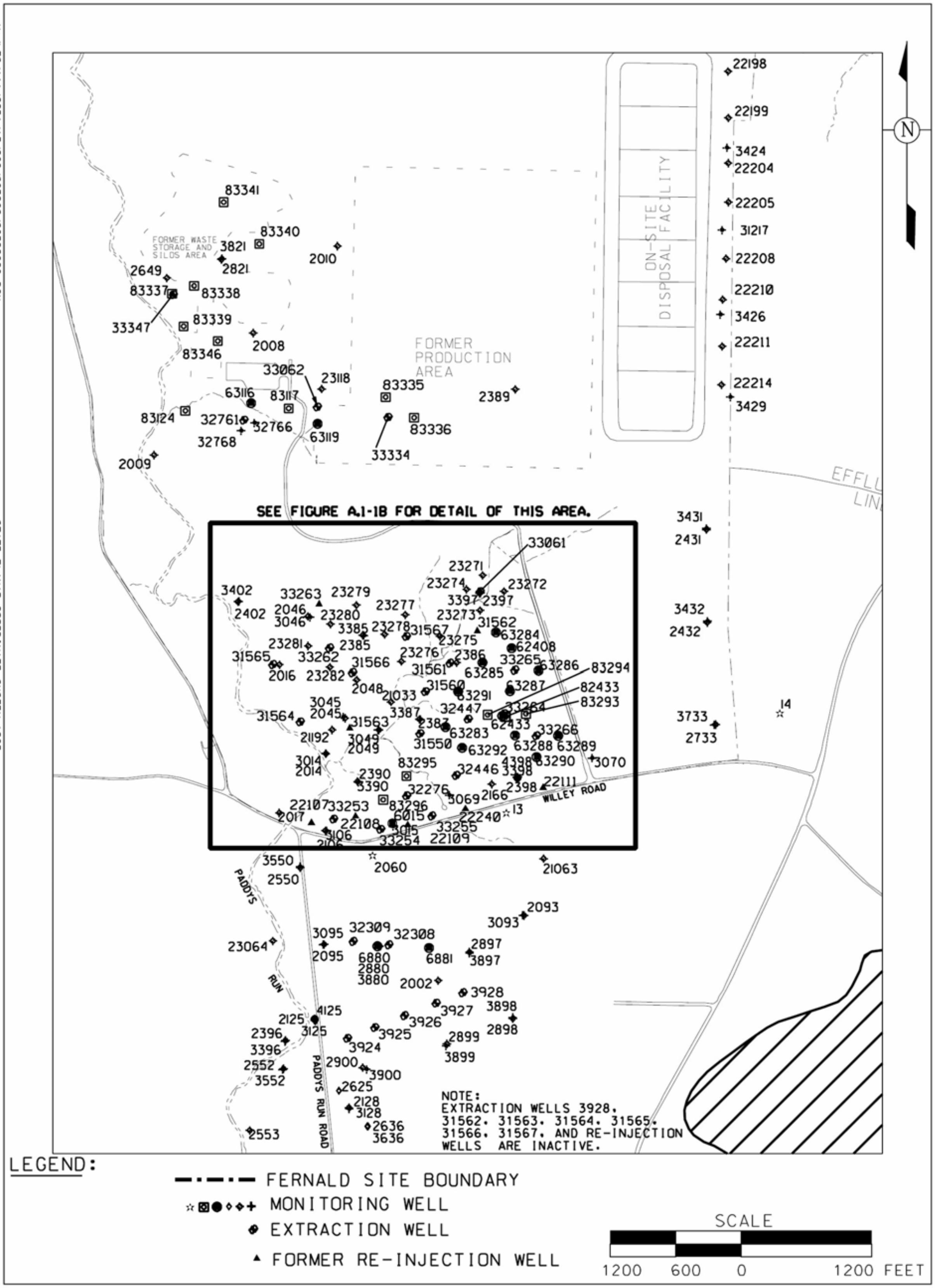

Figure A.1−1A. Well Locations for South Plume, South Field, Waste Storage Area, and Paddy Run Road Site Monitoring Activities

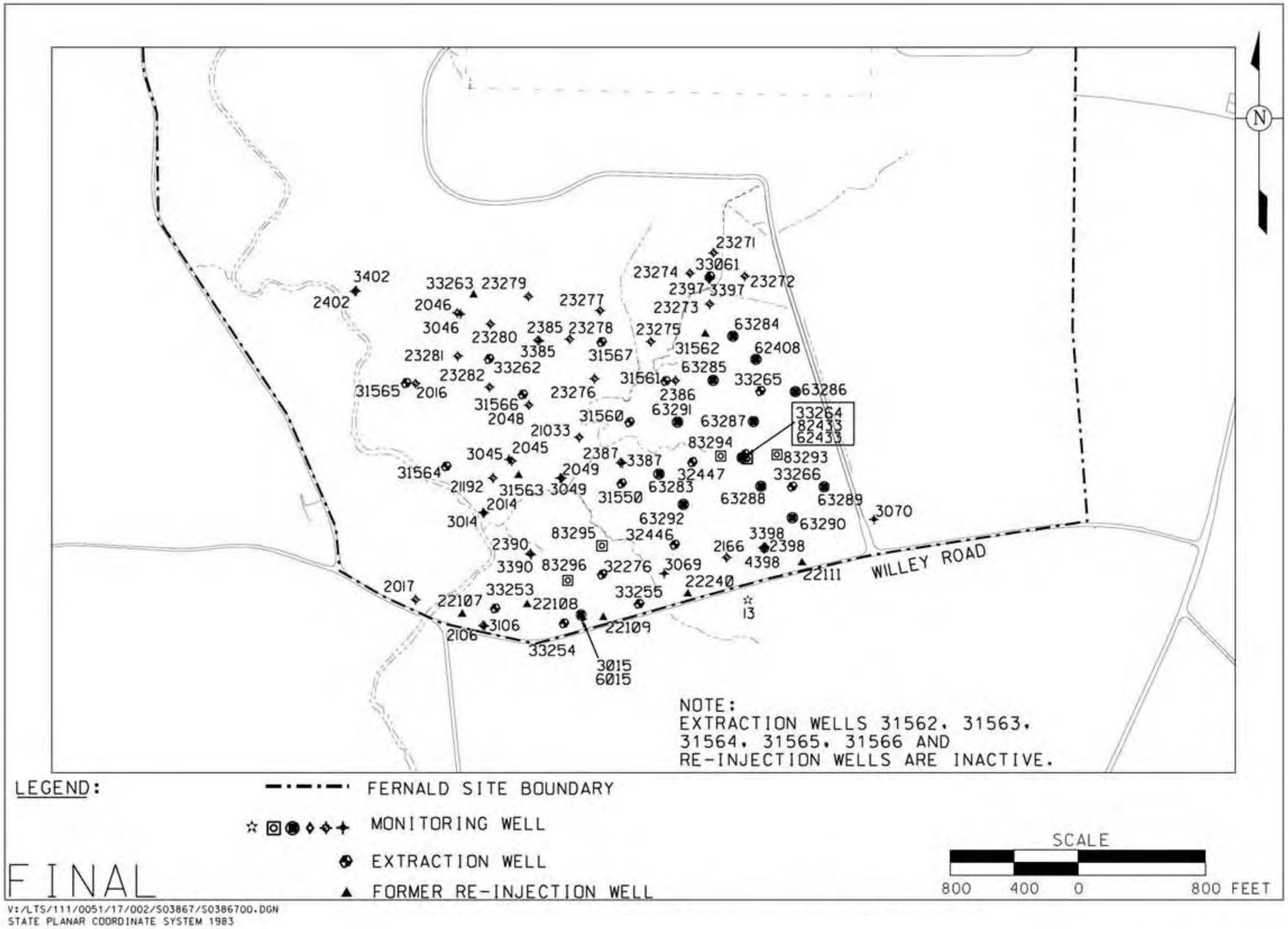

Figure A.1−1B. Well Locations for South Field

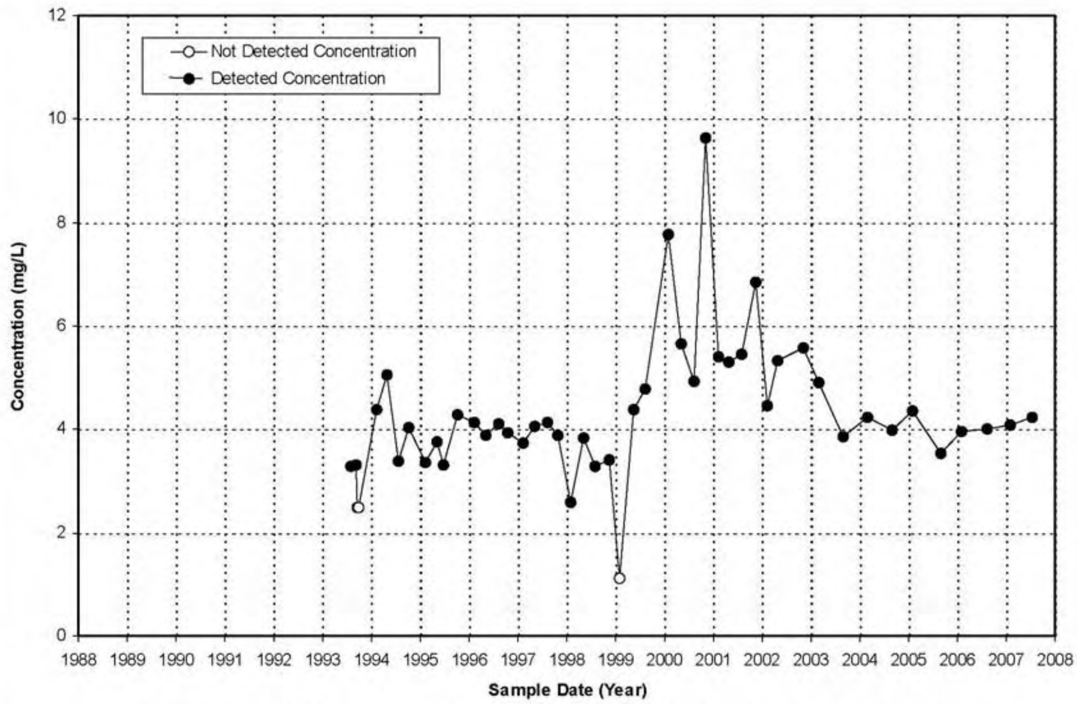

FIGURE A.1-2. POTASSIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 2898

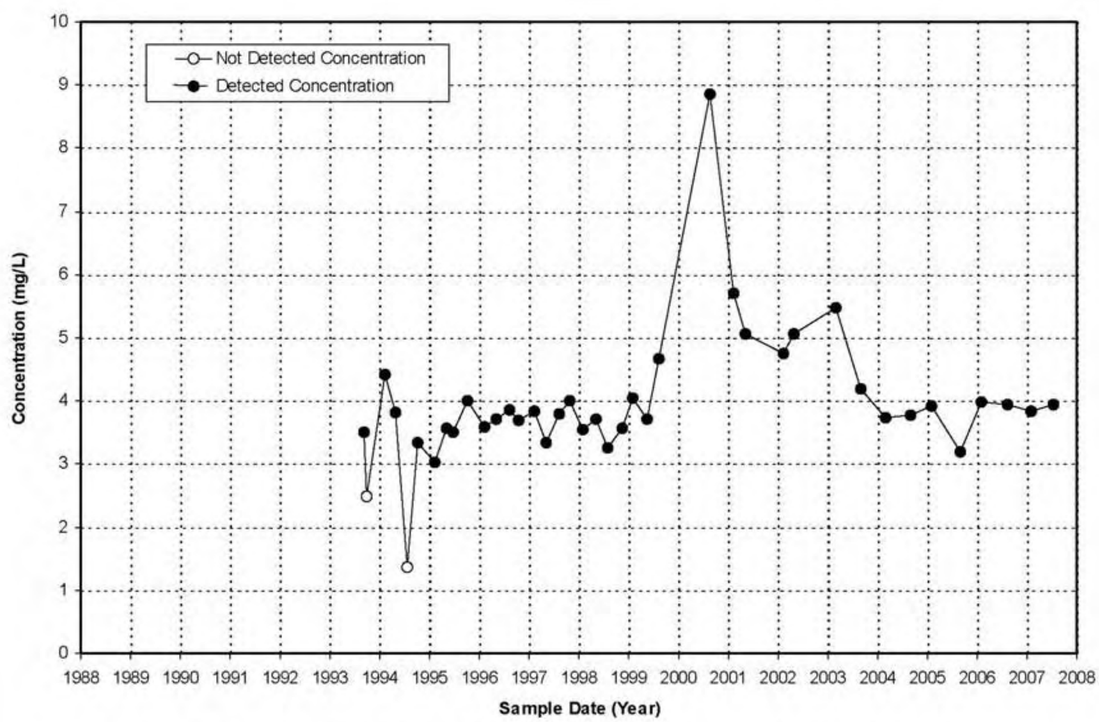

FIGURE A.1-3. POTASSIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 2899

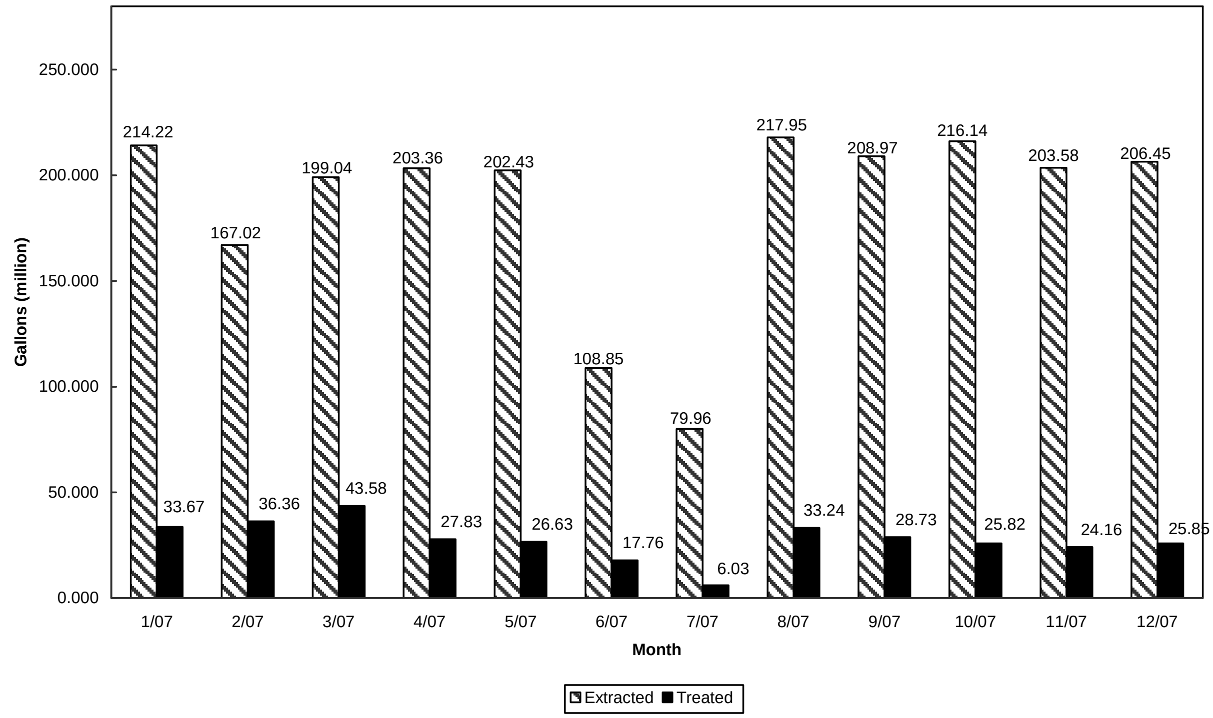

FIGURE A.1-4. TOTAL GROUNDWATER EXTRACTED VS. GROUNDWATER TREATED FOR 2007

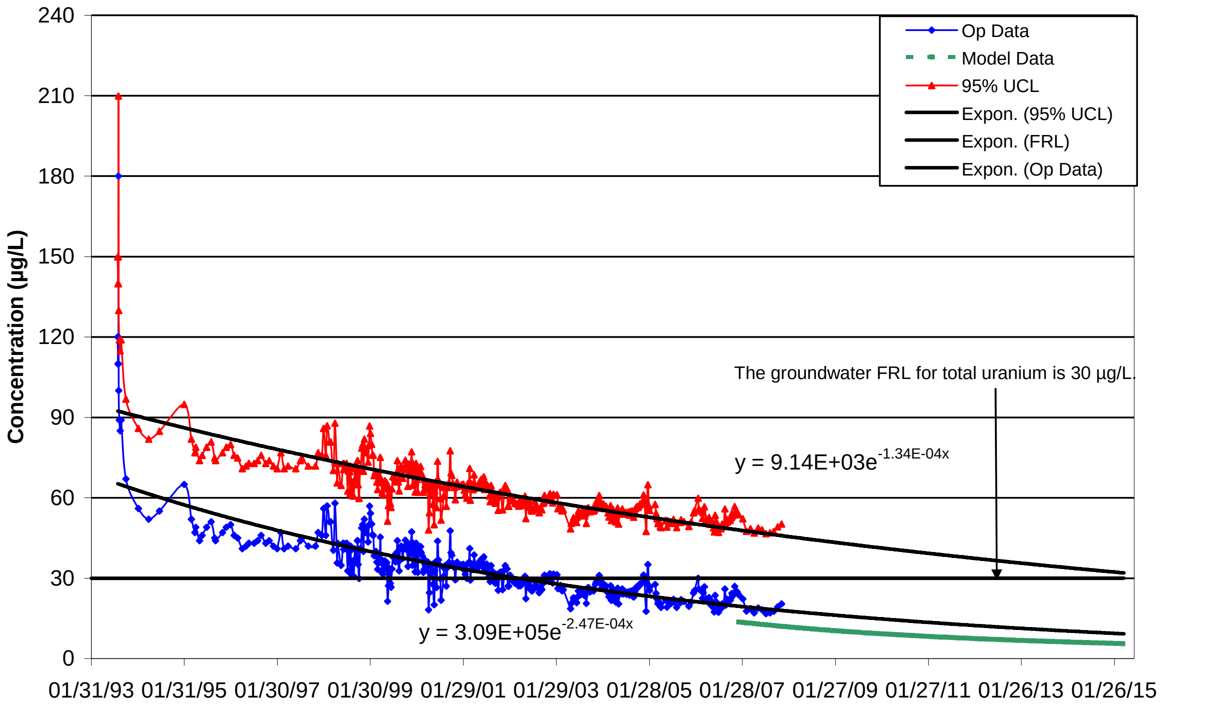

FIGURE A.1-5. TOTAL URANIUM CONCENTRATION VS. TIME PLOT
FOR EXTRACTION WELL 3924 (RW-1) WITH REGRESSION ANALYSIS

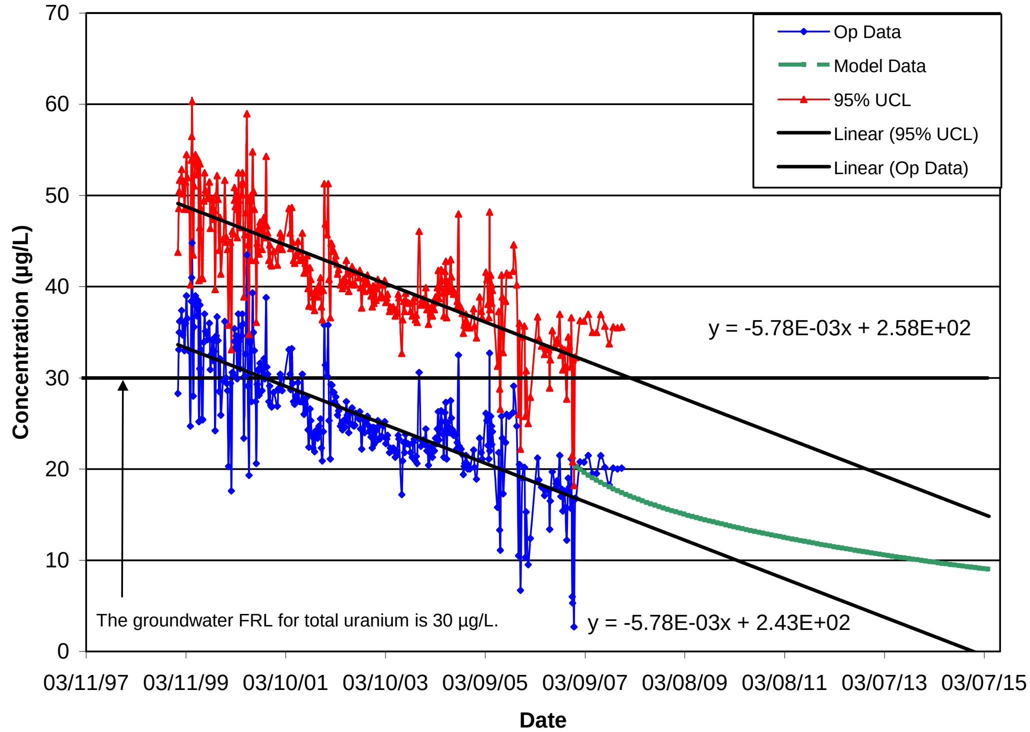

FIGURE A.1-6. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR EXTRACTION WELL 3925 (RW-2) WITH REGRESSION ANALYSIS

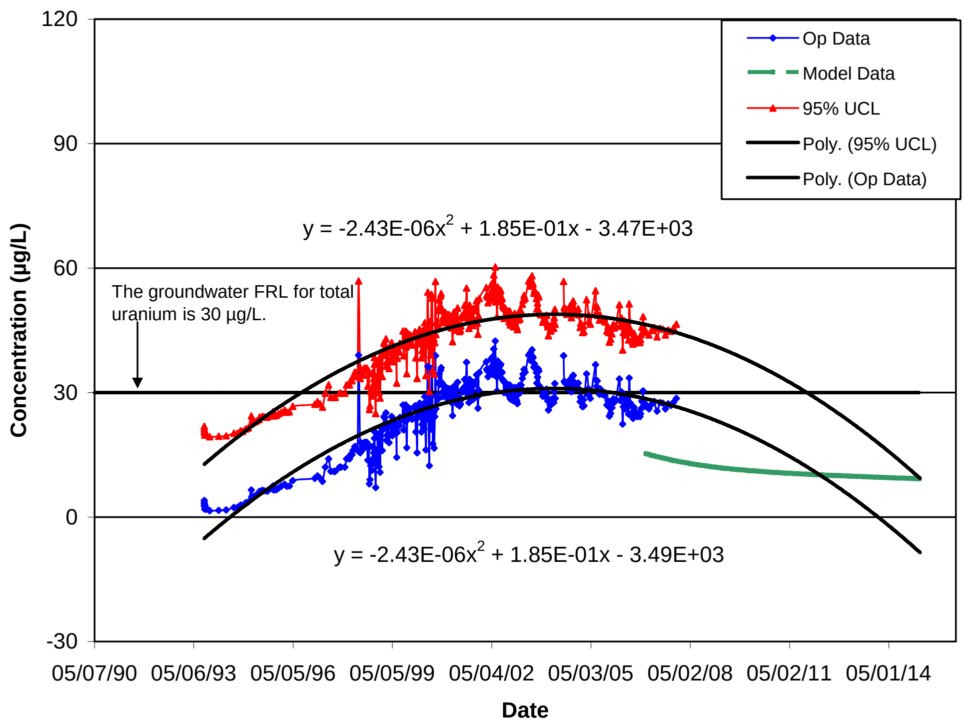

FIGURE A.1-7. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR EXTRACTION WELL 3926 (RW-3) WITH REGRESSION ANALYSIS

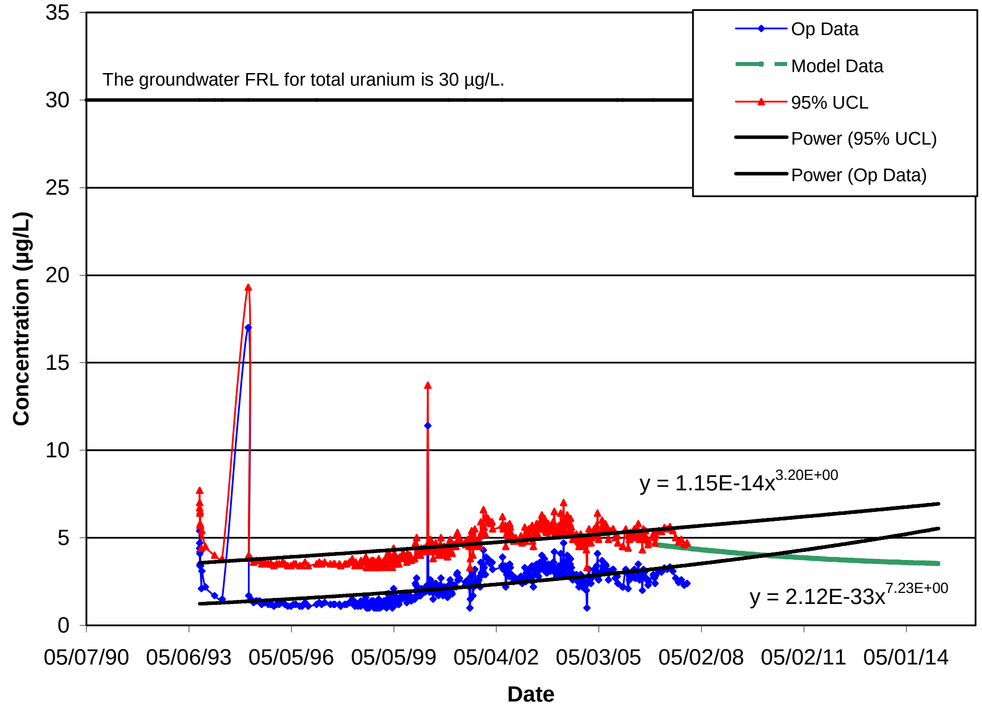

FIGURE A.1-8. TOTAL URANIUM CONCENTRATION VS. TIME PLOT
FOR EXTRACTION WELL 3927 (RW-4) WITH REGRESSION ANALYSIS

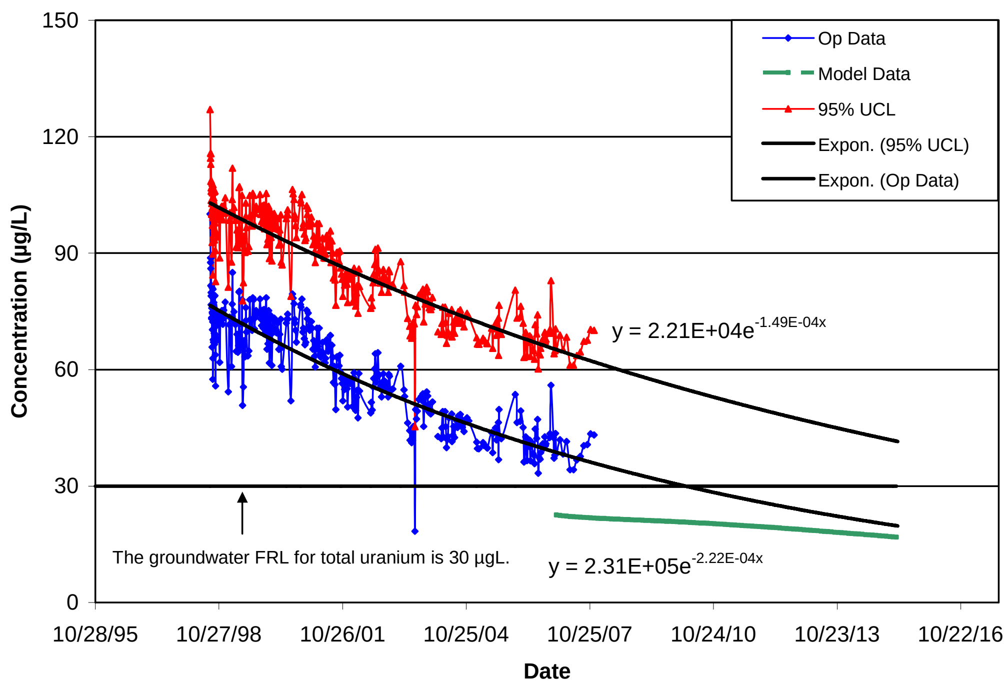

FIGURE A.1-9. TOTAL URANIUM CONCENTRATION VS. TIME PLOT
FOR EXTRACTION WELL 32308 (RW-6) WITH REGRESSION ANALYSIS

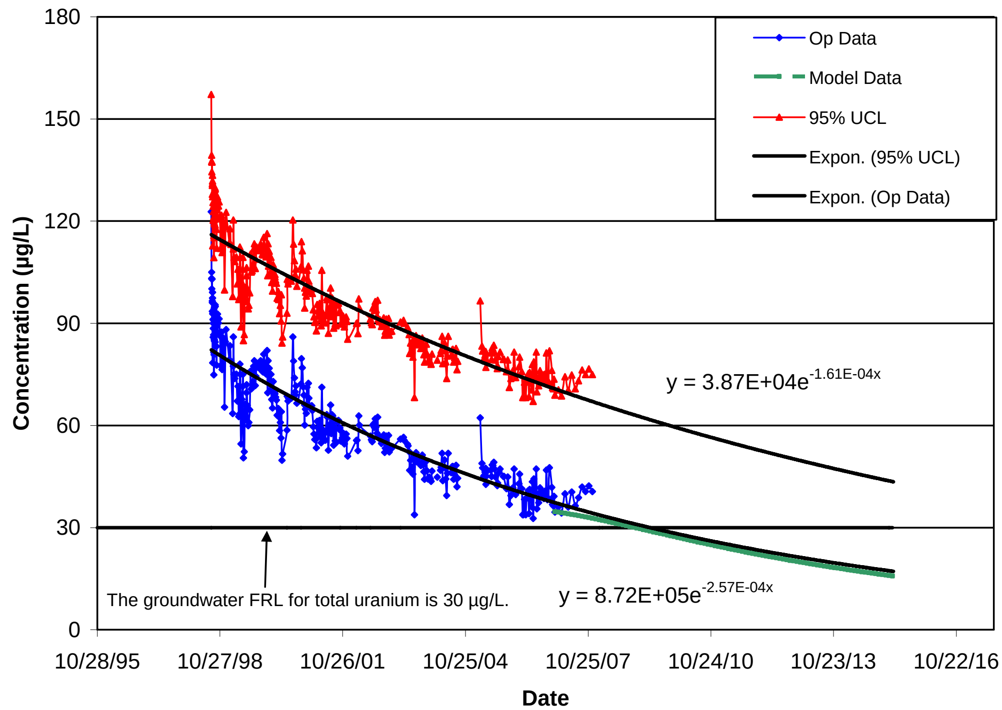

FIGURE A.1-10. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR EXTRACTION WELL 32309 (RW-7) WITH REGRESSION ANALYSIS

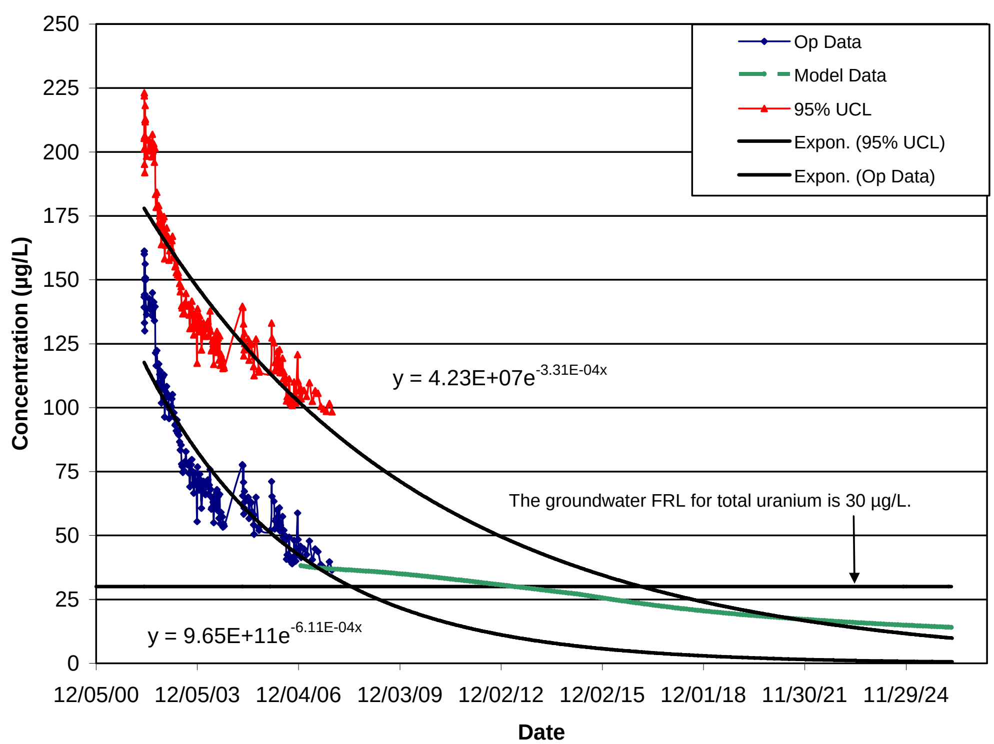

FIGURE A.1-11. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR EXTRACTION WELL 32761 (EW-26) WITH REGRESSION ANALYSIS

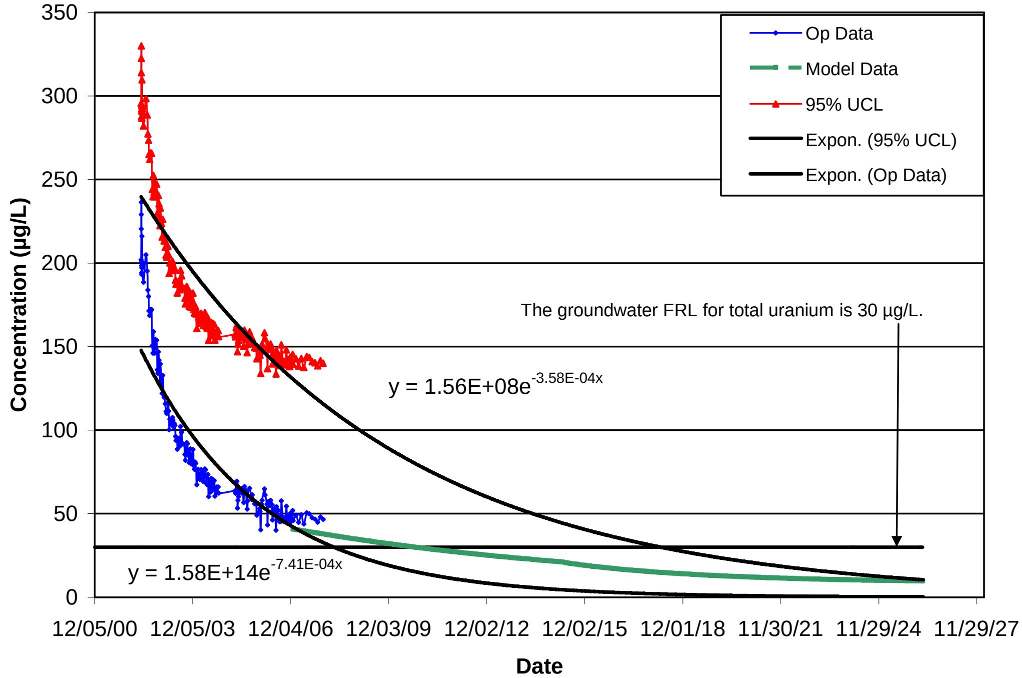

FIGURE A.1-12. TOTAL URANIUM CONCENTRATION VS. TIME PLOT
FOR EXTRACTION WELL 33062 (EW-27) WITH REGRESSION ANALYSIS

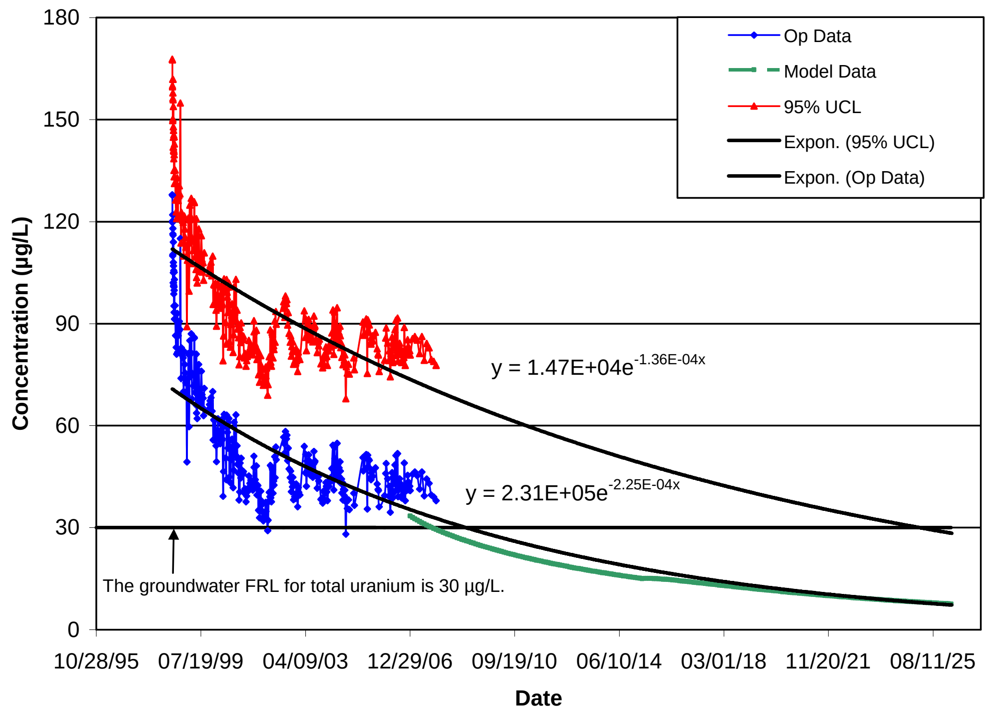

FIGURE A.1-13. TOTAL URANIUM CONCENTRATION VS. TIME PLOT
FOR EXTRACTION WELL 31550 (EW-18) WITH REGRESSION ANALYSIS

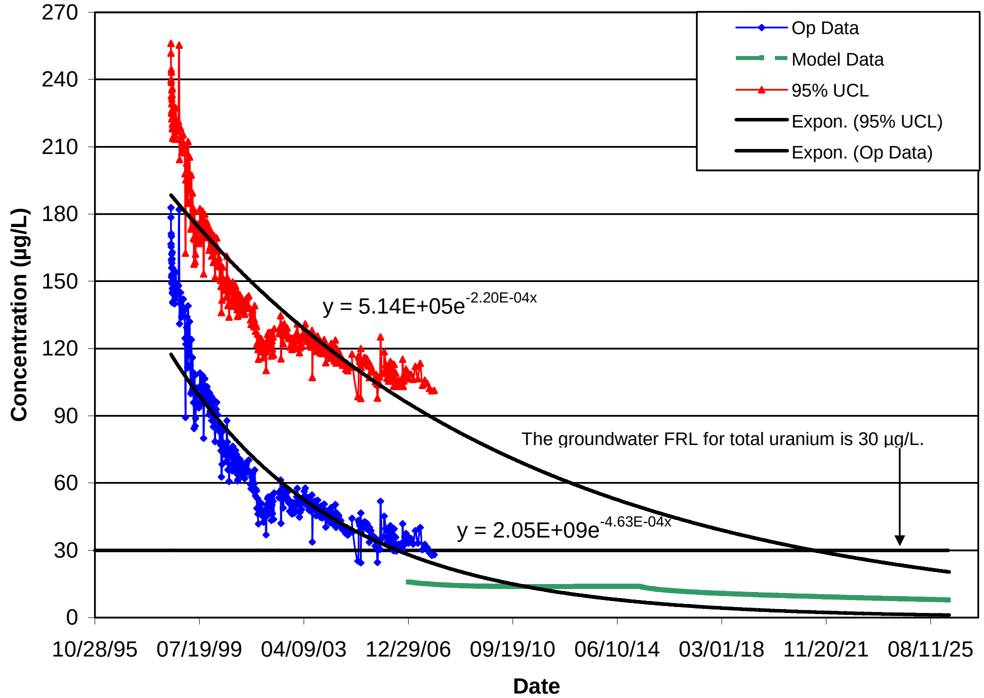

FIGURE A.1-14. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR EXTRACTION WELL 31560 (EW-19) WITH REGRESSION ANALYSIS

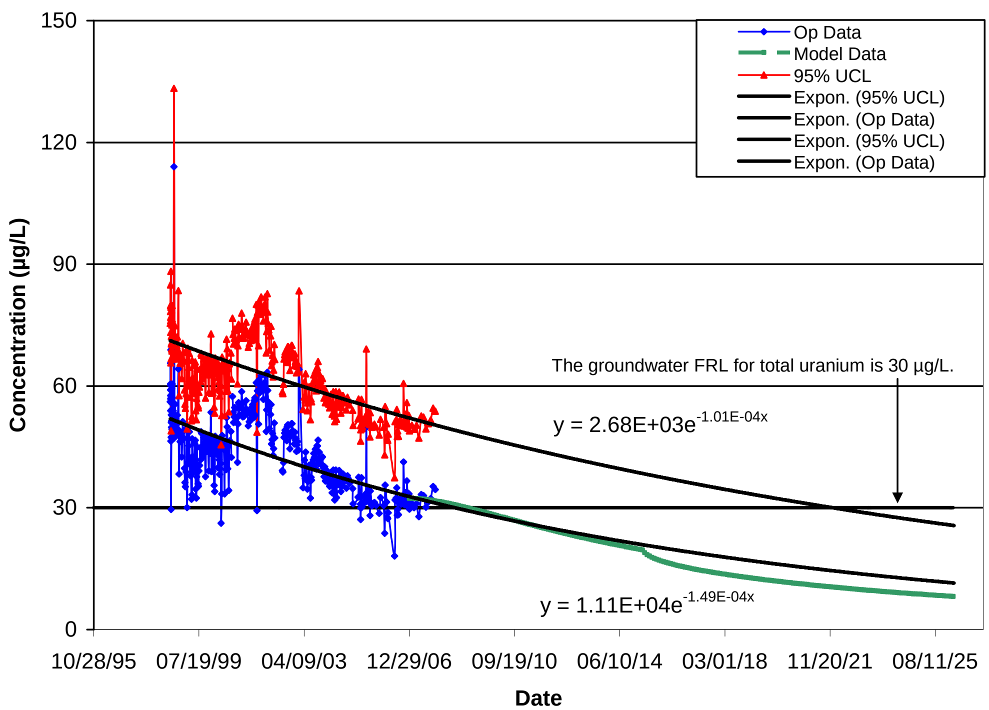

FIGURE A.1-15. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR EXTRATION WELL 31561 (EW-20) WITH REGRESSION ANALYSIS

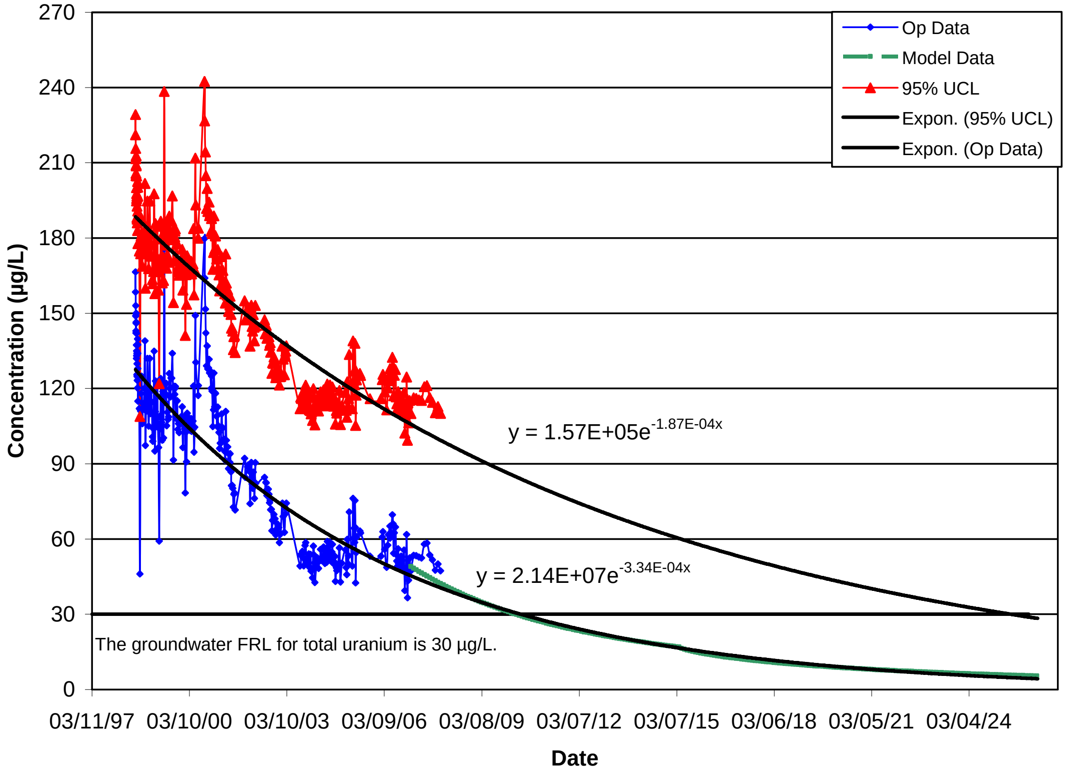

FIGURE A.1-16. TOTAL URANIUM CONCENTRATION VS. TIME PLOT
FOR EXTRACTION WELL 31562 (EW-21) / 33298 (EW-21a) WITH REGRESSION ANALYSIS

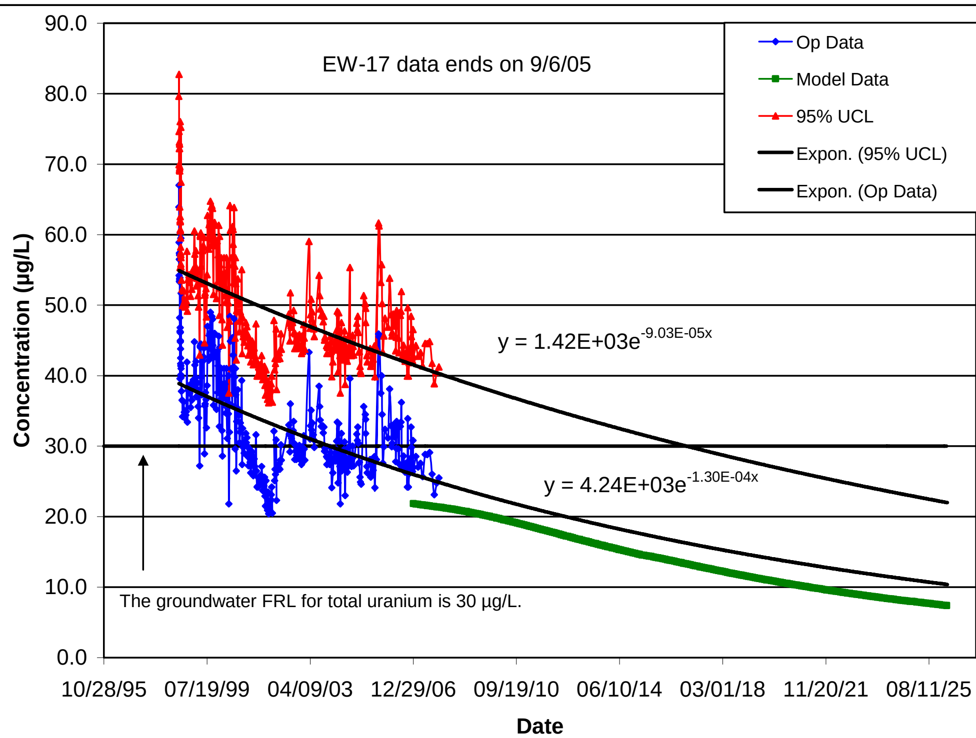

FIGURE A.1-17. TOTAL URANIUM CONCENTRATION VS. TIME PLOT
FOR EXTRACTION WELL 31567 (EW-17)/ 33326 (EW-17a) WITH REGRESSION ANALYSIS

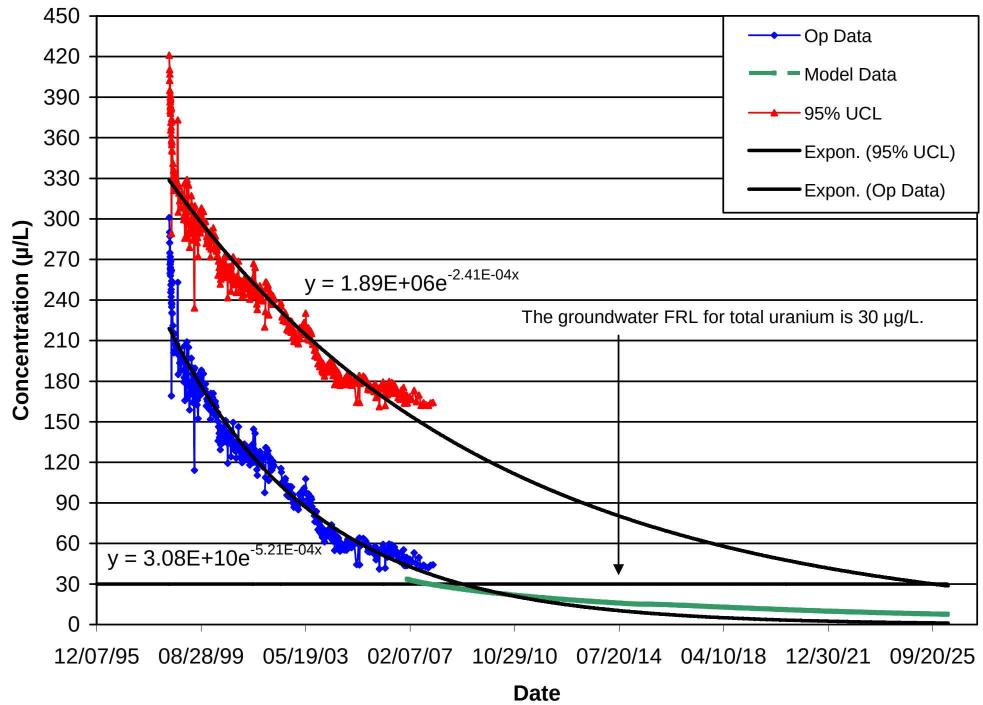

FIGURE A.1-18. TOTAL URANIUM CONCENTRATION VS. TIME PLOT
FOR EXTRACTION WELL 32276 (EW-22) WITH REGRESSION ANALYSIS

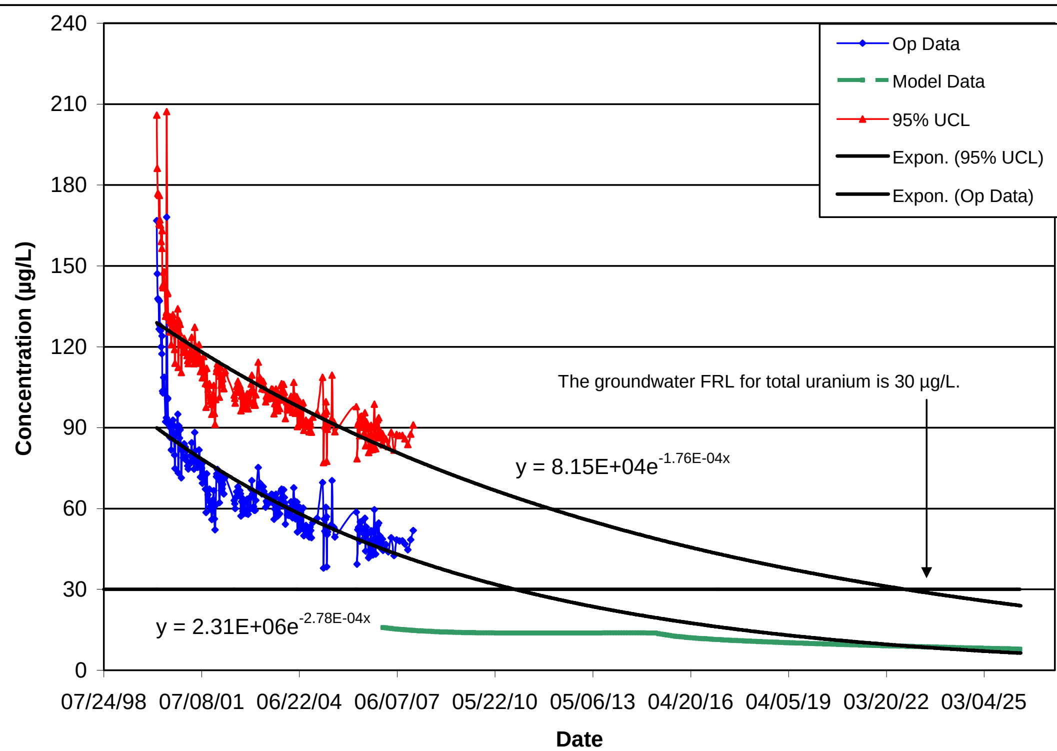

FIGURE A.1-19. TOTAL URANIUM CONCENTRATION VS. TIME PLOT
FOR EXTRACTION WELL 32446 (EW-24) WITH REGRESSION ANALYSIS

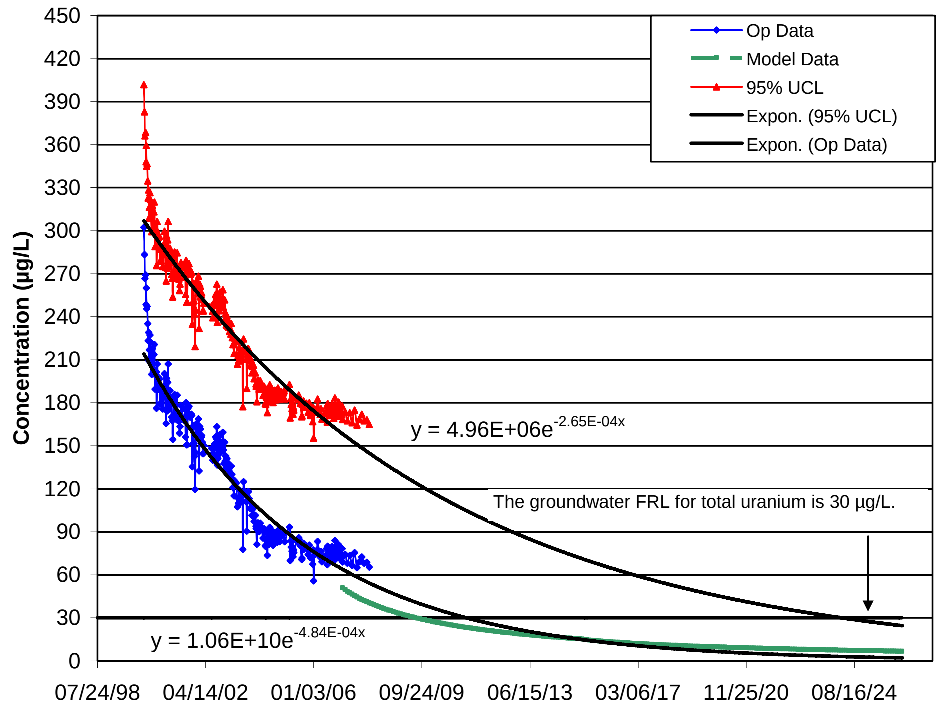

FIGURE A.1-20. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR EXTRACTION WELL 32447 (EW-23) WITH REGRESSION ANALYSIS

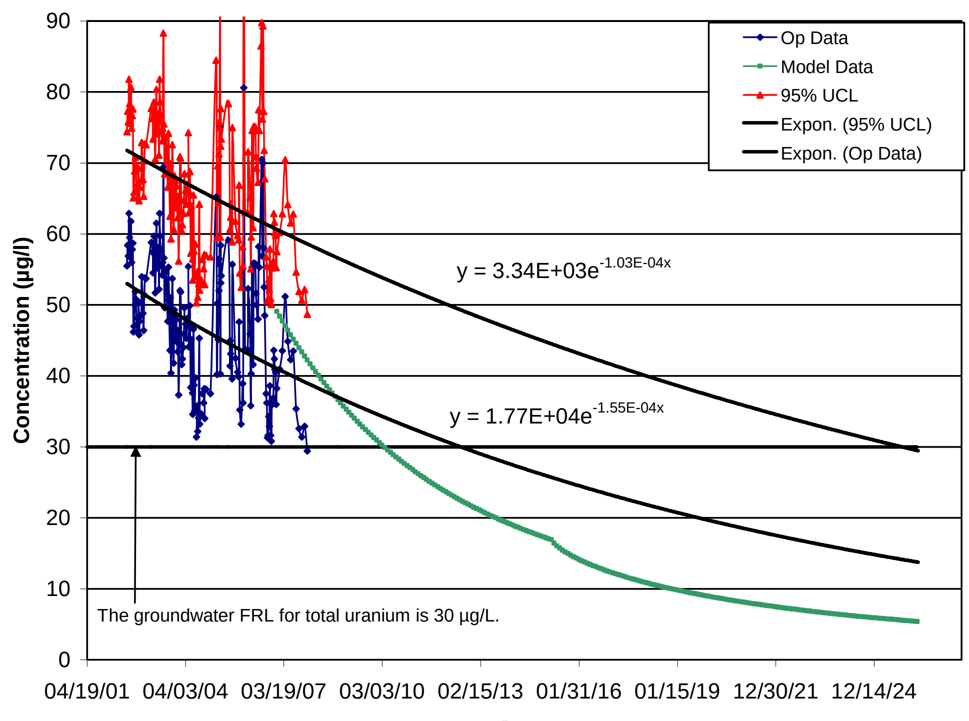

FIGURE A.1-21. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR EXTRACTION WELL 33061 (EW-25) WITH REGRESSION ANALYSIS

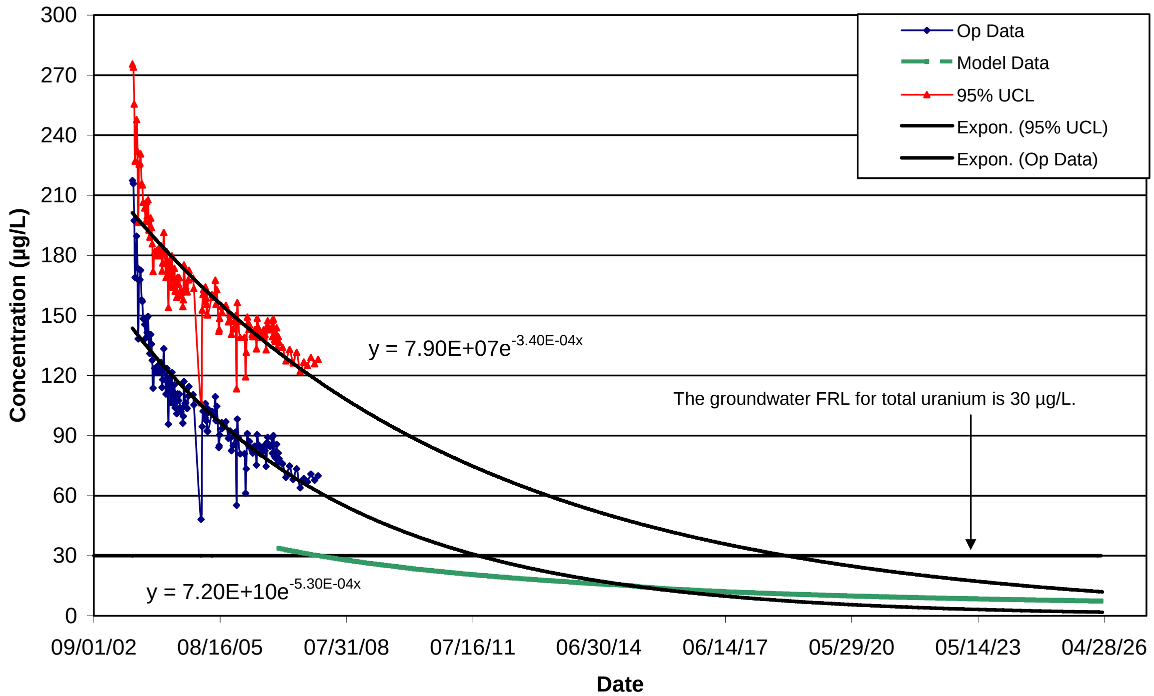

FIGURE A.1-22. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR EXTRACTION WELL 33264 (EW-30) WITH REGRESSION ANALYSIS

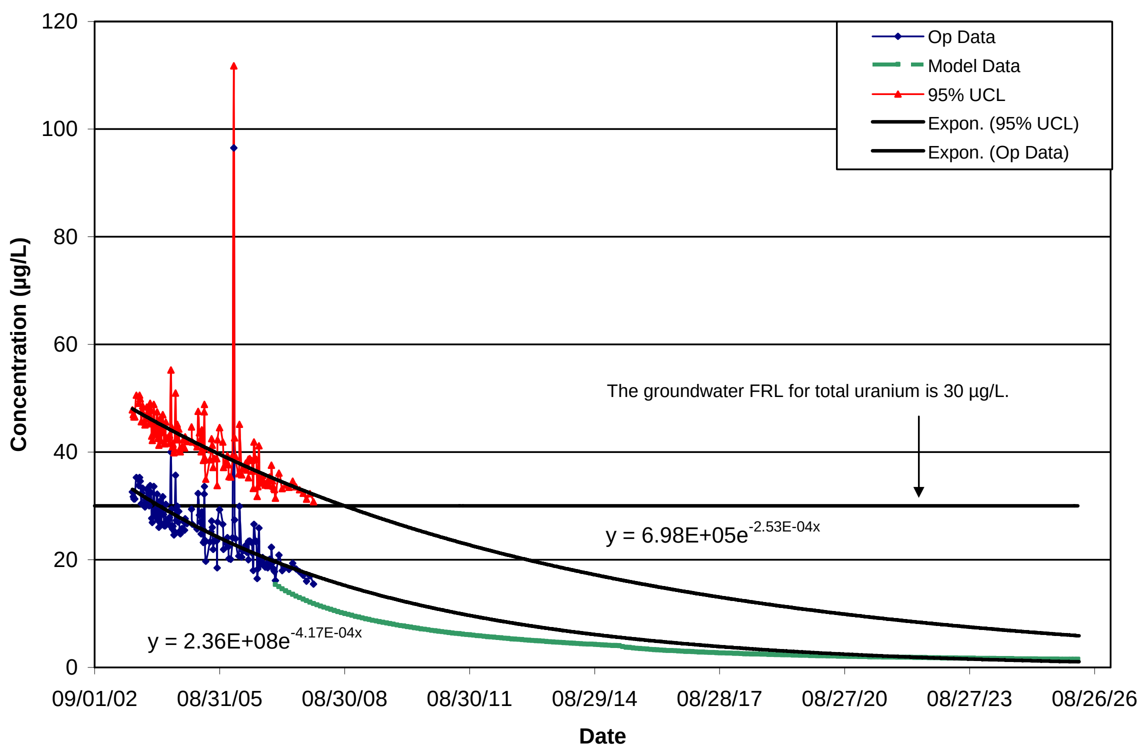

FIGURE A.1-23. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR EXTRACTION WELL 33265 (EW-31) WITH REGRESSION ANALYSIS

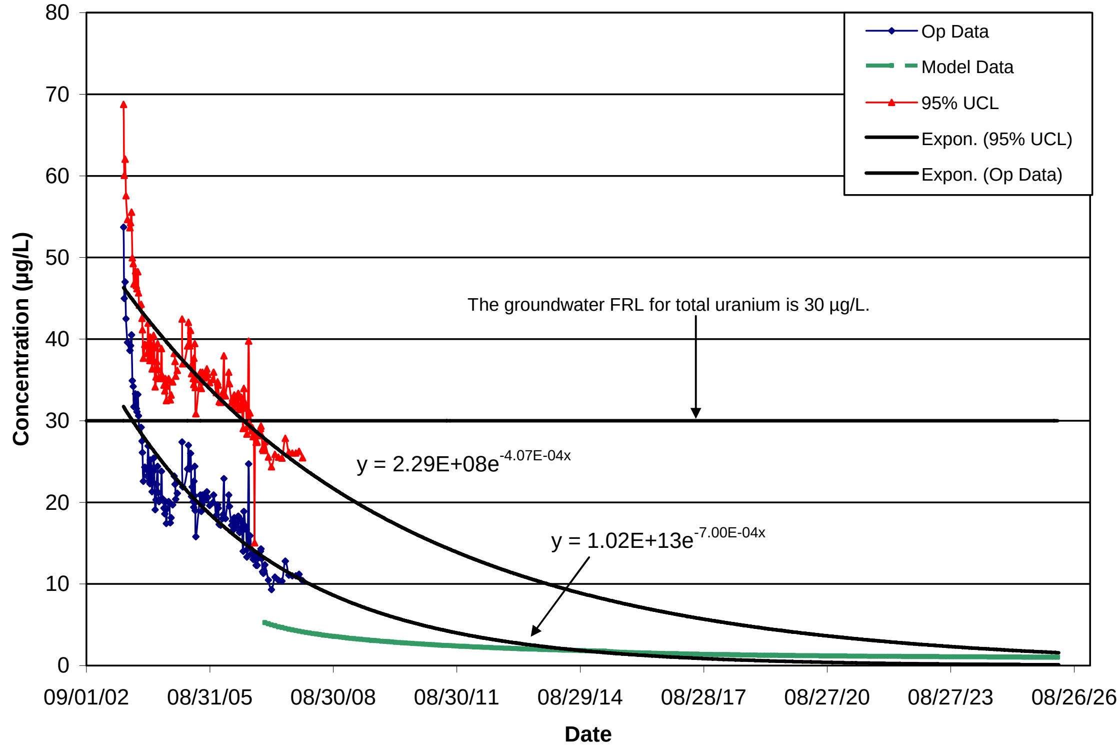

FIGURE A.1-24. TOTAL URANIUM CONCENTRATION VS. TIME PLOT
FOR EXTRACTION WELL 33266 (EW-32) WITH REGRESSION ANALYSIS

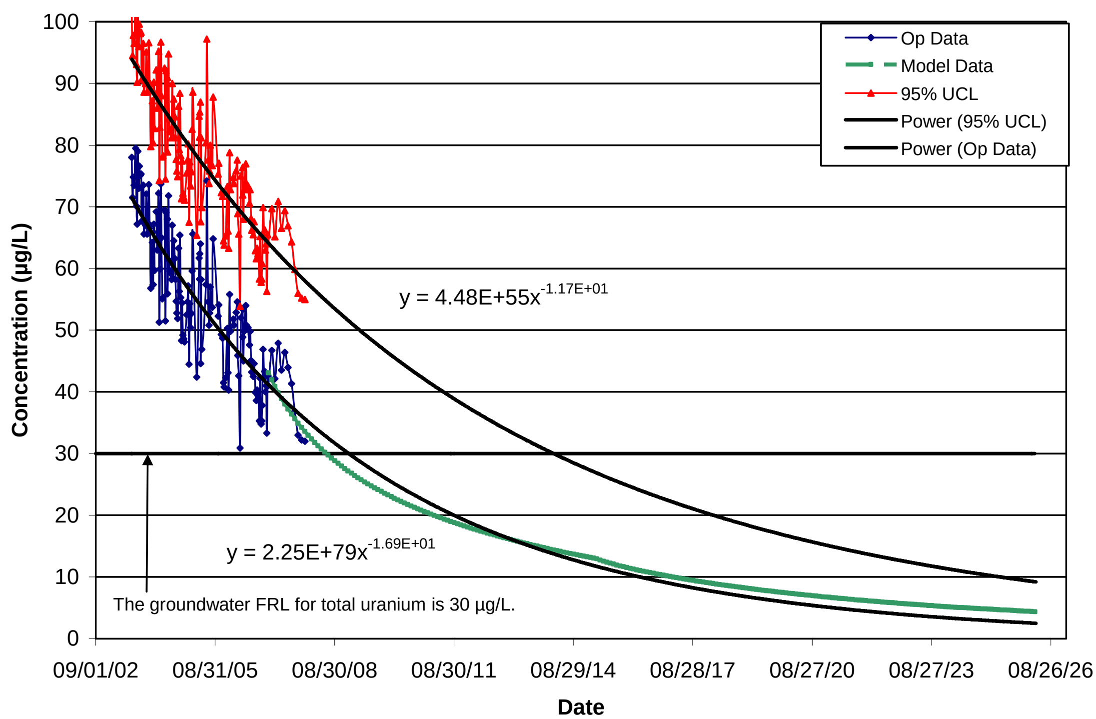

FIGURE A.1-25. TOTAL URANIUM CONCENTRATION VS. TIME PLOT
FOR EXTRACTION WELL 33262 (EW-15a) WITH REGRESSION ANALYSIS

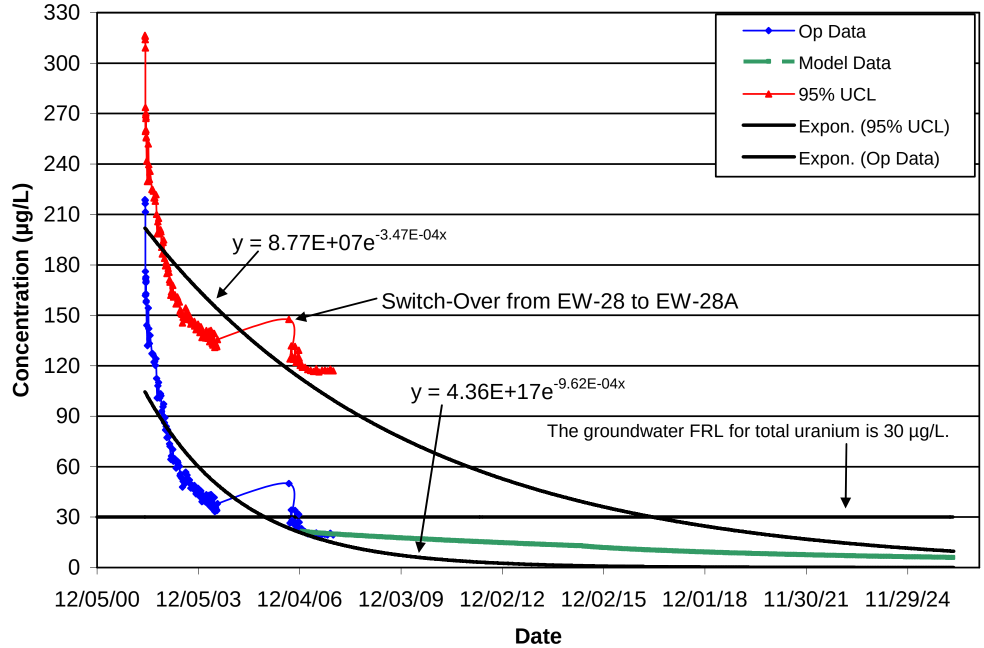

FIGURE A.1-26. TOTAL URANIUM CONCENTRATION VS. TIME PLOT
FOR EXTRACTION WELL 33063 (EW-28) / 33334 (EW-28a) WITH REGRESSION ANALYSIS

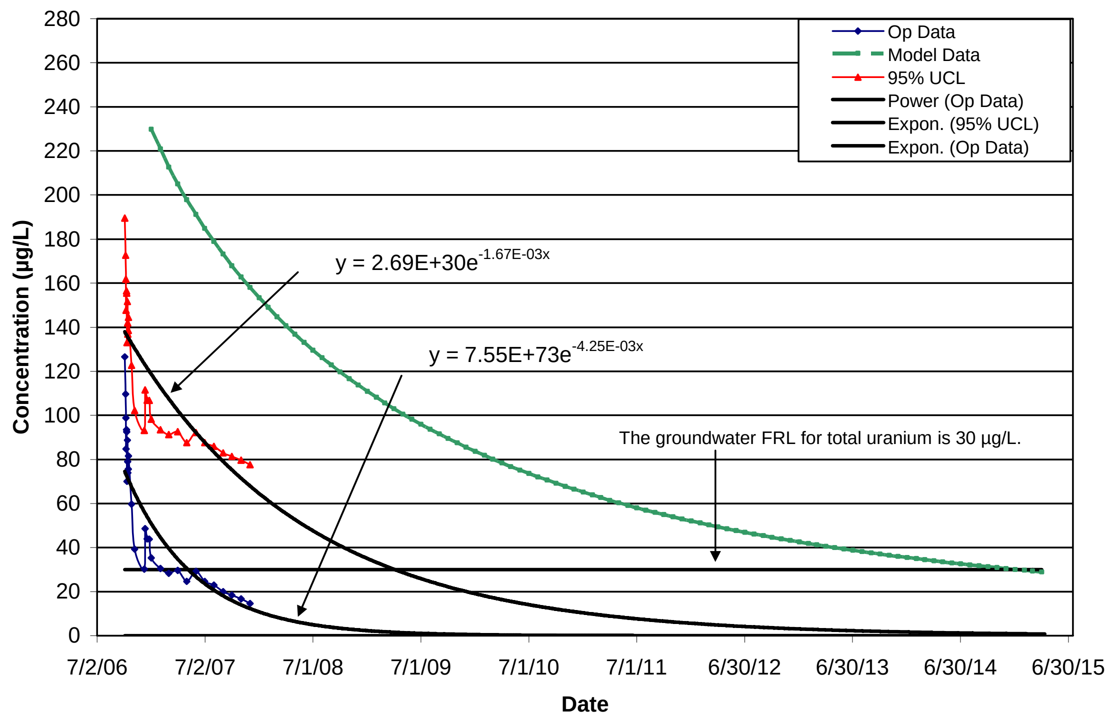

FIGURE A.1-27. TOTAL URANIUM CONCENTRATION VS. TIME PLOT
FOR EXTRACTION WELL 33347 (EW-33a) WITH REGRESSION ANALYSIS

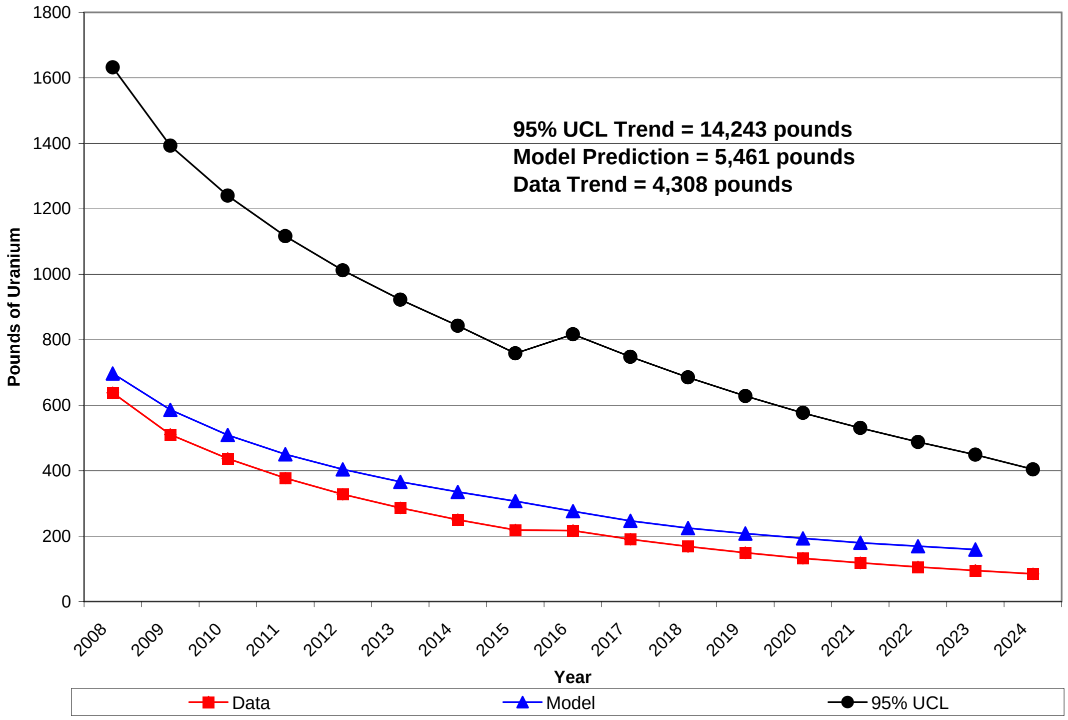

Figure A.1−28. Estimate of Yearly Pounds of Uranium to be Pumped from Aquifer (Model Predictions versus Measured Concentration Trends Data Collected Through 2007)

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Attachment A.2

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A.2.0 Assessment of Total Uranium Results

This attachment discusses groundwater total uranium results for 2007 in context with results collected prior to 2007. Monitoring well locations associated with the IEMP are listed in Table A.2−1. Monitoring and extraction well locations associated with the IEMP are shown in Figure A.2−1. For integration purposes, the on-site disposal facility (OSDF) monitoring well locations are also shown on Figure A.2−1 and Table A.2−1. In addition to the routine monitoring specified in the IEMP, 27 locations were sampled using a direct push sampling tool in 2007, which is discussed in Section A.2.1.1.

Figures A.2−2A, A.2−2B and A.2−3A, A.2−3B show maximum total uranium plume maps for the first and second halves of 2007, respectively. Figures A.2-2A and A.2-3A show direct push (i.e., Geoprobe®) data, Figures A.2-2A and A.2-3A show monitoring well and extraction well data. Data collected from the aquifer are used to progressively update the maximum total uranium plume maps in the following manner:

- Total uranium concentration data are posted on a map with the contours from the previous map. The highest representative total uranium value at a monitoring well location is posted. The highest concentration associated with each direct push location is also posted.
- If a recently measured concentration from a well is greater than the previous concentration contour value at that location, then the plume is re-contoured to honor the higher value.
- If the most recent concentration measurement from a well is less than the previous contour for that location, then the new data are posted but the plume contours are not adjusted to honor the new data until confirmatory direct push sampling can be conducted.
- If direct push data are available and a complete vertical profile of an area indicates that concentrations have changed, then the map is re-contoured to honor the new direct push data.

Table A.2−2 lists the monitoring wells where total uranium concentrations exceeded the 30 µg/L FRL during 2007. Included in the table are total uranium statistical summaries for each well, which include Mann Kendall trend analyses. Table A.2−3 provides total uranium statistical summaries for the extraction wells including Mann Kendall trend analyses. Figure A.2−4 illustrates the statistics presented in Table A.2−2 (e.g., where total uranium concentrations have, if any, an “up, significant,” “down, significant," or a “no significant” trend). Figures A.2−5 through A.2−154 present total uranium concentration versus time plots for those wells listed in Table A.2−1. These plots also show the screen interval for Type 2 wells (if available) and water levels.

Attachment A.2 is subdivided into the following Sections:

- A.2.1 Waste Storage Area
- A.2.2 Plant 6 Area
- A.2.3 South Field and Off-Property South Plume Area
- A.2.4 Flow Monitoring in the Storm Sewer Outfall Ditch (SSOD)

A.2.1 Waste Storage Area

The following highlights for the Waste Storage Area are discussed below:

Direct Push Sampling in the Waste Storage Area (Section A.2.1.1)

- Conducted at eight locations in the Waste Storage Area in 2007.

Groundwater FRL Exceedances for Uranium at/near monitoring well 83341 (Section A.2.1.2)

- Uranium groundwater FRL exceedance in Channel 1 of well 83341 in 2007.
- Direct push sampling south of well 83341, to find additional shallow uranium FRL exceedances, was inconclusive.

Waste Storage Area Maximum Uranium Plume (Section A.2.1.3)

- 1.52 acres larger than in 2006 (19.8 acres in 2006 versus 21.32 acres in 2007). The increase is located in the area of Direct Push Sampling Location 13369.
- New infiltration in the area is helping to flush contamination from the vadose zone and offset the lowering of water levels due to nearby pumping in extraction well EW-33a.

Pilot Plant Drainage Ditch Maximum Uranium Plume (Section A.2.1.4)

- Plume acreage is 3.46 acres smaller than in 2006. (29.7 acres in 2006 versus 26.24 acres in 2007).
- Plume changes occurred near monitoring well 83335, Direct Push Locations 12711A, 13352, and 12710A.

A.2.1.1 Direct Push Sampling in the Waste Storage Area

In 2007 eight locations were sampled in the Waste Storage Area using a direct push sampling tool (12710A, 12711A, 12721A, 13349, 13350, 13352, 13369, and 13370). Direct push sampling results are provided in Tables A.2−4 to A.2−30. All of the locations were sampled for total uranium, but four of the locations were also sampled for Waste Storage Area Parameters (technetium-99, nitrate/nitrite, manganese, molybdenum, and nickel). Non-uranium results are discussed in Attachment A.4

A.2.1.2 Groundwater FRL Exceedances for Uranium at/near monitoring well 83341

Monitoring well 83341, with three sampling channels, was installed in the waste storage area in 2006 to monitor the aquifer off the northeast corner of former waste pit 3. The northeast corner of waste pit 3 was a low point in the pit so if the pit had leaked prior to or during source removal, this would have been a logical location for the leak to have occurred.

Monitoring well 83341 was sampled for the first time in July of 2006. The upper-most sampling channel (Channel 1) had an FRL exceedance for uranium (unfiltered uranium result of 33.4 µg/L and a filtered result of 37 µg/L). A small uranium plume was mapped at monitoring well 83341 on the second half of 2006 maximum total uranium plume map, and carried forward to the 2007 maximum total uranium plume maps.

Monitoring well 83341 was sampled twice in 2007 (June 12 and December 17). A uranium groundwater FRL exceedance was detected in Channel 1 (37.7 µg/L) in the June sample. Channel 1 was dry on December 17. When the water table is below an elevation of 518.25 feet above mean sea level (AMSL) Channel 1 is dry. Sampling results in 2007 support the observation made in the 2006 SER that a uranium groundwater FRL exceedance exists in a thin zone of water near the water table, when the water table is at an elevation above 518.25 feet AMSL.

Direct push sampling was conducted in the second half of 2007 at location 13370 to determine if additional shallow uranium groundwater FRL exceedances are present between monitoring well 83341 and the uranium plume mapped to the south. Location 13370 is south of well 83341 and just north of the mapped 30 µg/L maximum total uranium plume contour (Figure A.2−3A). Groundwater samples were collected from five different depths below the water table (5, 15, 25, and 35 feet). Sampling results are presented in Table A.2−30. No uranium groundwater FRL exceedances were detected. The shallowest depth sampled was at an elevation of approximately 514.3 feet AMSL. This water level elevation is lower than the elevation of the uranium FRL exceedance measured in Channel 1 at monitoring well 83341. The FRL exceedance measured in Channel 1 was at an elevation above 518.25 feet AMSL.

Additional direct push sampling will need to be conducted south of monitoring well 83341 when water levels in the area are above 518.25 feet AMSL to determine if additional shallow FRL exceedances are present. Lack of additional shallow exceedances would indicate that the exceedance measured in Channel 1 at monitoring well 83341 is isolated and most likely was sourced from the northeast corner of former waste pit 3.

It is expected that the groundwater FRL exceedance for uranium at well 83341 will dissipate rather quickly on its own now that the source excavation activities in the Waste Storage Area are complete. Particle path modeling indicates that monitoring well 83341 is located within the model predicted capture based on the Waste Storage Area (Phase II) Design. A map displaying particle paths for the Waste Storage Area (Phase II) Model Design is provided in Attachment A.3 (Figure A.3−5).

A.2.1.3 Waste Storage Area Maximum Uranium Plume

There are two significant observations concerning the maximum total uranium plume in the Waste Storage Area for 2007:

1) The mapped plume expanded to the northwest based on uranium concentrations measured at direct push location 13369.

2) New infiltration in the area is helping to flush contamination from the vadose zone and offset the lowering of water levels due to nearby pumping in EW-33a.

Expansion of the 30 µg/L maximum uranium plume to the northwest

At the end of 2006 it was recognized that additional direct push sampling was required northwest of EW-33a (33347) to better define the western edge of the 30 µg/L maximum total uranium plume. Direct push sampling was conducted in June of 2007 at location 13369. Results are presented in Table A.2−29, and the location is shown in Figures A.2−2A and A.2−3A.

Groundwater samples were collected from four different depths below the water table (5, 15, 25, and 35 feet). Only the shallowest sample (five feet below the water table) had a groundwater FRL exceedance for uranium. The uranium concentration measured five feet below the water table was 166 µg/L. This shallow sample was collected at an elevation of approximately 513.9 feet AMSL. Additional direct push sampling will be conducted in 2008 to further delineate how far to the northwest, the 30 µg/L maximum plume extends.

The area northwest of location 13369 is bounded by Paddys Run to the west, and the former waste pits to the east. Intermittent puddles of surface water collects in this drainage area west of the former Waste Pit 3. As discussed in Section 4, surface water samples have been collected and analyzed from these small intermittent puddles beginning in late 2006 and continuing in 2007. The uranium concentration of some of the collected samples exceeds groundwater FRL limits. Direct push location 13369 was situated down gradient of the area where the surface water could collect before infiltrating into the ground surface. This infiltrating water has likely contributed to the shallow uranium groundwater FRL exceedances measured at location 13369, but it is possible the aquifer exceedances are sourced by flushing contamination from past releases that is sorbed to the aquifer sediments in the vadose zone of the aquifer. When water levels rise high enough to saturate portions of the vadose zone, the sorbed contamination that is present can dissolve into the groundwater.

In addition to rising water levels, increased infiltration of surface water could also help to flush sorbed contamination from the aquifer sediment. Surface grading completed in 2006 in the former waste storage area directs surface water runoff to where the clear well and pit 3 were once located. The surface water is allowed to infiltrate into the ground and serve as a source of recharge to the aquifer. Increased infiltration will help flush sorbed contamination from the aquifer sediments. As discussed below, sampling results observed in 2007 indicate that the flushing process is working.

Monitoring Observations

EW-33a (33347) began pumping on October 5, 2006 at a target pumping rate of 300 gpm. As presented in the 2006 SER, it was anticipated that the combined impact of this new pumping, completed source removal, and new surface water infiltration would have a positive impact on the aquifer remedy in this area. Sampling results for 2007 continue to indicate that sorbed uranium contamination is present in the vadose zone and it appears that this sorbed contamination is being flushed down into the aquifer by the new infiltration, resulting in higher uranium concentrations being measured in 2007.

Sampling results from well 2649 indicate that the uranium concentration at this well increased dramatically between 2006 and 2007. A total uranium concentration vs. time plot for monitoring well 2649 is presented in Figure A.2−41. In 2006, the uranium concentration was approximately

12 µg/L. In 2007 the uranium concentration was approximately 237 µg/L, yet the water table at the time that both samples were collected was approximately the same (519 feet AMSL). This well is very close to EW-33a. It was anticipated that pumping EW-33a would lower water levels in the area of Well 2649. It appears that the new infiltration being directed to this area is helping to maintain water levels.

Sampling results from monitoring wells 83337 and 83338 indicate that the greatest uranium concentrations are found in the shallowest channels. These Type-8 wells contain three sampling channels each (Channel 1 being the shallowest, and Channel 3 being the deepest). Total uranium concentration vs. time plots for monitoring wells 83337 and 83338 are provided in Figures A.2−149 and A.2−150 respectively. Uranium concentrations in Channels 2 and 3 at both wells either fluctuated or decreased in 2007, most likely as a result of nearby pumping. But concentrations in Channel 1 of both wells increased to new highs; 618 µg/L in well 83338 and 1,587 µg/L in well 83337. These sampling results indicate that uranium contamination is sorbed to aquifer sediments in the vadose zone because the largest uranium concentrations are being measured in the shallowest sampling channels of these wells. When water levels are high enough to support the collection of a samples from Channel 1 the groundwater can allow some of this sorbed contamination to dissolve into the aquifer resulting in higher measured concentrations than what is being measured deeper in the aquifer

A.2.1.4 Pilot Plant Drainage Ditch Maximum Uranium Plume

There are four significant observations concerning the Pilot Plant Drainage Ditch Maximum Uranium Plume.

- An acreage increase at monitoring well 83335,
- An acreage decrease at Direct Push Location 12711A,
- An acreage decrease at Direct Push Location 13352, and
- A plume adjustment at Direct Push Location 12710A.

Acreage Increase near monitoring well 83335

In 2006 monitoring well 83335 was posted just outside of the 30 µg/L total uranium plume contour. Based on the uranium concentration measured at Monitoring Well 8335 in April 2007, the mapped total uranium plume was adjusted so that Monitoring Well 83335 well now plots just outside of the of the 50 µg/L total uranium plume contour.

Per the IEMP, all channels in monitoring well 83335 were sampled during the first half of 2007 (April 16) with the exception of Channel 1, which was dry. The uranium concentration measured in the groundwater sample collected from Channel 2 was 49.5 µg/L. In September an attempt was made to sample Channel 2 again, because this is the channel that had the highest uranium concentration in the first half of the year. Channel 2 was dry, so the sample was collected from Channel 3. The sample collected from Channel 3 in September (September 20) had a uranium concentration of 8.6 µg/L.

It should be noted that direct push sampling was conducted just west of monitoring well 83335 in 2007, at location 12721A. Sampling results are provided in Table A.2−15. As shown in Table A.2−15, no uranium FRL exceedances were measured between an elevation of 517.6 feet

AMSL and 477.6 feet AMSL. These results contradict with the first half 2007 sampling results obtained at monitoring well 83335. To err on the conservative side, the mapped plume was expanded to the east as described above, to honor monitoring results at well 83335. The maximum uranium concentration measured at direct push location 12721A was just posted to the map, without adjusting any contours to honor the result. The area will continue to be monitored, and future direct push sampling will be conducted to check on remediation progress.

Acreage decrease at Direct Push Location 12711A

In 2007 direct push location 12711 was re-sampled as 12711A. Results for 2007 are presented in Table A.2−14. Location 12711 was first sampled in 2000. In 2000, groundwater samples were collected between an elevation of approximately 515.04 feet AMSL and 457.04 feet AMSL, with the maximum uranium concentration (121 µg/L) measured at an elevation of approximately 507 feet AMSL (midpoint of a 2 foot long screen). In 2007, groundwater samples were collected between an elevation of approximately 520 feet AMSL and 480 feet AMSL, with the maximum uranium concentration (13.2 µg/L) measured at an elevation of approximately 500 feet AMSL (midpoint of a 10-foot long screen). In 2007, the uranium concentration measured at 510.1 feet AMSL is 11.7 µg/L (midpoint of a 10-foot long screen). Sampling results for 2007 were used to revise the maximum uranium plume map.

Acreage Change near Direct Push Sampling Location 13352

Direct push location 13352 was located in the southwest portion of the Pilot Plant Drainage Ditch Plume. Uranium concentrations measured at direct push location 13352 in 2007 resulted in a slight decrease to the mapped plume acreage.

Direct push location 13352 is close to Monitoring Well 2009. As illustrated in Figure A.2−9, the uranium concentration at Monitoring Well 2009 has been below 30 µg/L since 2002. Direct push sampling location, 13352, was positioned northeast of monitoring well 2009 and sampled in 2007 in order to obtain a new vertical profile of the plume in this area. Results of the sampling are provide in Table A.2−24. As show in Table A.2−24, no uranium FRL exceedance was measured at water samples collected from this location.

Sampling at monitoring well 2009 in the second half of 2007 indicated that the uranium concentration increased to 28.3 µg/L. Continued monitoring at well 2009 will indicate whether or not the reduction to the mapped maximum uranium plume acreage in this area will hold. If uranium concentrations in monitoring well 2009 increase back above 30 µg/L the map will be adjusted accordingly.

Plume adjustment at Direct Push Location 12710A

In 2007, direct push location 12710 was re-sampled as 12710A. Results for 2007 are presented in Table A.2−13. Location 12710 was first sampled in 2000. In 2000, groundwater samples were collected between an elevation of approximately 520 feet AMSL and 481 feet AMSL, with the maximum uranium concentration (116 µg/L) measured at an elevation of approximately 511 feet AMSL (midpoint of a 2-foot long screen). In 2007, groundwater samples were collected between an elevation of approximately 511.9 feet AMSL and 471.9 feet AMSL, with the maximum uranium concentration (82.6 µg/L) measured at an elevation of approximately 511 feet AMSL (midpoint of a 10-foot long screen). Sampling results for 2007 were used to revise the maximum uranium plume map so that this location now plots just outside the 100 µg/L uranium contour.

A.2.2 Plant 6 Area

Background

Plans for a restoration module in the Plant 6 area were abandoned in 2001 based on the outcome of the Design for Remediation of the Great Miami Aquifer in the Waste Storage and Plant 6 area. This design provided data that indicated that the total uranium plume in the Plant 6 area was no longer present. The EPA and OEPA concurred with this decision.

Monitoring well 2389 is the only groundwater monitoring well remaining in the area where Plant 6 was located. All other monitoring wells in the area were plugged and abandoned as part of source removal activities. As indicated in Figure A.2−28, sporadic uranium FRL exceedances have been detected since 2002 at monitoring well 2389.

Direct push sampling is conducted in the area to supplement monitoring well results. Previous direct push sampling in the area indicates that the FRL exceedances are limited to a depth right at the water table. A small uranium plume is shown circling monitoring well 2389 on the maximum total uranium plume map (Figures A.2-2B and A.2-3B). Monitoring in 2007 provided an update on the uranium FRL exceedance at this well.

2007 Results

Two additional uranium groundwater FRL exceedances were measured in 2007 at monitoring well 2389. Sampling results are provided below.

Date	Uranium Concentration	Water Level
April 18, 2007	57.4 µg/L	519 feet AMSL
September 5, 2007	41.6 µg/L	516 feet AMSL

In July of 2007, direct push samples were collected approximately 74 feet southwest of monitoring well 2389 at location 13360. This location was selected to investigate the possibility that an abandoned steel lined shaft that used to be located 87 feet southwest of monitoring well 2389 may have provided a pathway for contamination to reach the aquifer. As reported in the 2005 SER, a steel manhole, covering a steel lined shaft (that had previously been abandoned) was identified in late 2005. The manhole and steel lined shaft are believed to have been associated with the elevator piston mechanism of Plant 5. The abandoned steel lined shaft was deep enough to breach the aquifer and could have provided a potential contamination pathway to the aquifer providing an explanation for the thin layer of uranium contamination that has been detected in the upper foot or so of the aquifer in the location of monitoring well 2389.

When location 13360 was sampled, the water level was at an elevation of 517.3 feet AMSL. The shallowest sample was collected at a depth of approximately 5 feet below the water table, at an elevation of approximately 512 feet AMSL (midpoint of a 10-foot long screen) and had a uranium concentration that was < 1.0 µg/L. The elevation of the shallowest sample was lower than the elevation of the uranium FRL exceedances detected at monitoring well 2389, making the result inconclusive. This direct push location will need to be re-sampled when water levels are at a higher elevation to determine if the elevated uranium concentrations at Monitor Well 2389 might be associated with the abandoned steel lined shaft.

A.2.3 South Field and Off-Property South Plume Uranium Plumes

The following highlights for the South Field and Off-Property South Plume are discussed below:

Direct Push Sampling (Section A.2.3.1)

- Conducted at 18 locations in the South Field/South Plume Area in 2007.

Plume Changes (Section A.2.3.2)

- Mapped plume acreage is 1.25 acres smaller than in 2006 (138.8 acres in 2006 versus 137.55 acres in 2007). Changes were made as follows:
- Plume Acreage Decrease in the Former Inactive Fly Ash Pile Area
- Plume Acreage Decrease along the North Edge of the South Field Plume
- Plume Acreage Increases along Willey Road
- Direct Push Sampling in the Stagnation Zone

Monitoring well 2387 (Section A.2.3.3)

A.2.3.1 Direct Push Sampling

During 2007, direct push sampling was conducted at 18 locations in the South field and Off-Property South Plume Uranium Plumes.

- Three of the 18 locations were in the Former Inactive Fly Ash Pile Area (locations 13353, 12814A, and 12839A).
- One of the 18 locations was located along the north edge of the 30 µg/L total uranium plume in the south field (location 13354).
- Seven of the 18 locations were located along Willey Road (locations 12370H, 12369L, 12372M, 12368I, 12373M, 12369M, and 12370I).
- Seven of the eighteen locations were located in the area of a stagnation zone that exists between the South Field extraction wells and the South Plume extraction wells (13236A, 13237A, 13268A, 13357, 13228C, 12196B, and 12194B).

All of the locations were sampled for total uranium, starting approximately five feet beneath the water table, and then at successive 10 foot deep intervals. Direct push sampling results are presented in Tables A.2−4 through A.2−30.

Plume Acreage Decrease in the Former Inactive Fly Ash Pile Area

As discussed in last year's SER, groundwater monitoring results at several monitoring wells in the former Inactive Fly Ash Pile area (i.e., 2046, 3046, 23281) indicated that the area was mapped as having higher uranium concentrations than are actually present.

In 2007 direct push sampling was conducted at three locations (13353, 12814A, and 12839A) to update the map. Direct push sampling results for locations 13353, 12814A, and 12839A) are provided in Tables A.2−25, A.2−16, and A.2−17 respectively.

Uranium concentrations measured at locations 13353 and 12839A, resulted in changes to the maximum uranium plume map, uranium concentrations measured at location 12814 did not result in a change to the maximum uranium plume map. Specifically:

- Direct push location 13353 had a maximum uranium concentration of 28.9 µg/L at an elevation of 512 feet AMSL (midpoint of a 10-foot long screen). Because this location was mapped in 2006 at a concentration over 100 µg/L, the maximum uranium map was revised for 2007 to honor the lower new maximum uranium concentration. This location was very close to direct push location 12815 which was sampled in 2001. In 2001 location 12815 had a maximum uranium concentration of 64 µg/L at an elevation of 512 feet AMSL (midpoint of a 2-foot long screen). Results from location 13353 have replaced results from location 12815, and old results from location 12815 will no longer be honored on the total uranium plume map.
- Direct push location 12839 was last sampled in 2001. In 2001 this location had a uranium groundwater FRL exceedance (33 µg/L at an elevation of 503.8 feet AMSL, midpoint of a 2-foot long screen). In 2007, a uranium FRL exceedance was not measured between an elevation of 509.1 feet AMSL and 489.1 feet AMSL. In 2007, direct push location 12839A had a maximum uranium concentration of 16.7 µg/L at an elevation of 509.1 feet AMSL (midpoint of a 10-foot long screen). Because this location was mapped in 2006 at a concentration over 30 µg/L, and the new maximum is below 30 µg/L, the maximum uranium plume map was revised for 2007 to honor the lower new maximum uranium concentration.
- Direct push location 12814 was last sampled in 2001. In 2001 this location had a maximum uranium concentration of 31.5 µg/L at an elevation of 512.9 feet AMSL (midpoint of a 2-foot long screen). In 2007, direct push location 12814A had a maximum uranium concentration of 51.9 µg/L at an elevation of 510 feet AMSL (midpoint of a 10-foot long screen). This location was mapped in 2006 at a concentration of approximately 50 µg/L; therefore no changes were made to the maximum uranium plume map in 2007 based on sampling result obtained in 2007.

Plume Acreage Decrease along the north edge of the South Field Plume

In 2007 direct push sampling was conducted at location 13354 to update the uranium plume map. This location is south of the former Storm Water Retention Basin, and is located along the north edge of the maximum total uranium plume in the South Field. Results are provided in Table A.2−26. The location is shown in Figure A.2−3A.

The maximum uranium concentration measured at this location in 2007 was 10.5 µg/L (midpoint of a 10-foot long screen). In 2006 this area was mapped at a concentration of over 50 µg/L total uranium. Based on the new uranium profile data, the maximum total uranium plume map was revised to honor the lower new maximum uranium concentration data.

Plume Acreage Increases along Willey Road

Since 1998 several locations along Willey Road have been sampled using a direct push sampling tool: 12367, 12368, 12369, 12370, 12371, 12372, and 12373. These locations were originally sampled to track re-injection progress along Willey Road. Re-injection was discontinued in September of 2004, however yearly sampling at these locations has continued. Five of the seven locations (12368, 12369, 12370, 12371, and 12372) continue to be sampled yearly. The results are used to prepare two cross sections: Figures A.2−155 and A.2−156.

Re-sampling these locations each year provides insight into how the remedy is progressing in this area now that re-injection is no longer taking place. This area is subject to pumping stresses from both the South Field extraction wells to the north and the South Plume extraction wells to the south, placing the area in a stagnation zone. Re-injection (when it was occurring) helped to break up this stagnation zone. As the remedy progressed two of the locations (12367 and 12371) were dropped from the routine annual sampling because they are now located outside the 30 µg/L total uranium plume.

Because location 12369 was not sampled in 2006, it was sampled twice in 2007 (March and November). Concentrations from the March 2007 sampling were used to prepare Figures A.2−148 and A.2−149 in the 2006 SER. Between March and November 2007, the maximum uranium concentration measured at location 12369 increased dramatically. In March of 2007, the maximum total uranium concentration was 20.4 µg/L (491.66 feet AMSL). Results are provided in Table A.2−7. In November of 2007, the maximum total uranium concentration was 135.6 µg/L (505.96 feet AMSL). Results are provided in Table A.2−8. A comparison of the profiles obtained in both March and November is provided below.

Elevation (midpoint of a 10-foot long screen)	**12369l (March 2007)**	**12369M (November 2007)**
(feet AMSL)	**(ug/L)**	**(ug/L)**
511.66	10.3	
505.96		135.6
501.66	9.4	
496.96		43
491.66	20.4	
485.96		19
481.66	17.3	
475.96		15.4
471.66	15.5	

The water level in March 2007 (516.66 feet AMSL) was higher than the water level in November 2007, (510.96 feet AMSL). As shown above, the elevation range of the sampling in March and November coincided enough so that if the uranium FRL exceedances detected in November had been there in March, they should have been detected.

The acreage of the maximum uranium plume was increased to honor the new high maximum uranium concentration measured at location 12369 in November of 2007. This location will be re-sampled in 2008 to determine if conditions continue to change.

Based on 2007 sampling results at location 12372M, it appears that uranium concentrations have rebounded in this area since 2006. In the 2006 SER, it was reported that the thin maximum uranium plume that was present at the water table at location 12372 was no longer present based on direct push sampling results obtained in 2006. The maximum uranium plume map for 2006 was revised accordingly. In 2007 though, the maximum uranium concentration measured at this location is back up above 30 µg/L (34.3 µg/L). The uranium FRL exceedance is present in the shallowest most sample. In 2006 the water level at this location at the time of sampling was 512.5 feet AMSL, in 2007 the water level at the time of sampling was 514.2 feet AMSL. The acreage of the maximum uranium plume map was increased to honor the 2007 sampling result.

Direct Push Sampling in the Stagnation Zone

Due to pumping in the South Plume and the South Field, a stagnation zone is present in the area along Willey Road. In addition to the routine direct push sampling conducted along Willey Road each year (presented above) direct push sampling was conducted at seven locations in the area of the stagnation zone in 2007 to provide an update on remediation progress. The seven locations (13236A, 13237A, 13268A, 13357, 13228C, 12196B, and 12194B) are shown in Figure A.2−3A. All but one of the seven locations (13357) has been sampled before. A comparison of the previous maximum uranium results and the recent maximum uranium result are provided below. Prior to 2006, direct-push sampling was conducted using 2-foot long screens. Since January 2006, direct push sampling has been conducted using 10-foot long screens. Elevations noted below are mid-screen elevations.

Location	Date	Max. Total U (µg/L)	Elevation (feet AMSL)
13236	5/8/2002	51.4	508.8
13236A	1/10/2007	34.7	510.5
13237	5/3/2002	92.2	498.6
13237A	1/17/2007	85.6	500.4
13268	6/6/2002	7.9	509.5
13268A	1/29/2007	5.7	501.6
13228A	5/30/2002	111.0	505.0
13228B	8/18/2005	24.2	506.3
13228C	2/7/2007	22.9	512.1
12196	12/20/1996	1.6	439.3
12196A	8/27/2005	100.7	495.2
12196B	3/5/2007	103.7	491.7
12194	11/20/1996	497	500.0
12194A	10/7/2003	9.0	504.8
12194B	11/19/2007	8.8	495.8
13357	2/1/2007	27.9	503.2

With the exception of locations 12196 and 13357, all of the locations sampled indicate that uranium concentrations continue to decrease. This indicates that the remediation is generating a positive impact in this area.

Data collected at location 12196 though indicates that uranium concentrations are increasing. This location has been sampled three times: 1996, 2005, and 2007. When first sampled in 1996, the location had a maximum uranium concentration of only 1.6 µg/L. When sampled in 2005, the maximum uranium concentration was 100.7 µg/L (495.2 feet AMSL). In 2007 the maximum uranium concentration was 103.7 µg/L (491.7 feet AMSL). A comparison of the sampling events is provided below. Prior to 2006, direct-push sampling was conducted using 2-foot long screens. Since January 2006, direct push sampling has been conducted using 10-foot long screens. Elevations noted below are mid-screen elevations.

Elevation	12196 (1996)	12196A (2005)	12196B (2007)
518.3	0.5		
514.197		4.4	
511.67			6.7
509.3	0.3		
505.197		**87.5**	
501.67			**59.6**
499.3	0.7		
495.197		**100.7**	
491.67			**103.7**
489.3	0.5		
485.197		14.4	
481.67			3.2
479.3	0.3		
475.197		**37.4**	
471.67			9.0
469.3	0.5		
465.197		18.7	
461.67			3.0
459.3	0.7		
449.3	0.4		
439.3	1.6		

Direct push location 12196 is situated at the leading edge of a lobe of the uranium plume that extends south of Willey Road. This lobe of the plume is well within capture of the South Plume extraction wells. The southern extent of the lobe is bounded by direct push sampling location 13357. Location 13357 was also sampled in 2007. Results are provided in Table A.2−27. No uranium FRL exceedances were detected at location 13357. The maximum uranium concentration measured was 27.9 µg/L (503.22 feet AMSL, midpoint of a 10-foot long screen). These two locations will continue to be re-sampled periodically to track remediation progress at the leading edge of this lobe of the uranium plume.

A.2.3.2 Monitoring Well 2387

A minor revision to the maximum total uranium plume map resulted from sampling results in 2007 at monitoring well 2387. Monitoring well 2387 is located in the south field, due south of EW-19 (31560). This well was sampled twice in 2007 (March 13 and September 10). Results were 228 µg/L and 190 µg/L respectively. The 200 µg/L contour on the maximum total uranium plume maps (Figures A.2-2A, A.2-2B, A.2-3A, and A.2-3B) was revised so that well 2387 is now situated within the 200 µg/L contour.

A.2.4 Flow Monitoring in the Storm Sewer Outfall Ditch

Background

A test was conducted in 2005 to gauge seasonal flow of water in the SSOD and to determine if recharge to the Great Miami Aquifer through the SSOD at a rate of 500 gallons per minute was feasible (DOE 2005). As reported in the Groundwater Remedy Evaluation and field Verification Plan (DOE 2004), a modeled infiltration rate of 500 gpm in the SSOD decreased the predicted cleanup time by one year. The study concluded that the operation would not be cost effective. Subsequent discussions in 2006 with EPA and OEPA led to an agreement to continue the infiltration operation.

The agreement is to pump clean groundwater into the SSOD to supplement natural storm water runoff in an attempt to accelerate remediation of the plume in the south field area. Three existing construction water supply wells on the east side of the site are utilized to deliver as much clean groundwater as is needed to maintain a flow of approximately 500 gpm into the SSOD.

As shown in Figure A.2−157, six Parshall flumes are installed in the SSOD. These flumes are used to measure flow into and out-of the SSOD. Water is supplied from a group of three water wells located on the east side of the site (42202, 42471, and 43309). Water pumped from the wells is discharged into a ditch that empties into the former OSDF Borrow Area Sediment Basin. Water from this basin is allowed to overflow into the mouth of the SSOD. Flume 6 is the first flume located down stream of the former OSDF Borrow Area Sediment Basin. Flumes 2, 3, 4, 5, and 6 all measure flows into the SSOD. Flume 1 is the most southern flume. It measures flow emptying out of the SSOD and into Paddys Run.

The six Parshall flumes in the SSOD were originally designed to be temporary installations to support the test conducted in 2005. The design allowed movement of the flumes during the testing period, if circumstances required. Engineering controls (i.e., anchoring the frames with metal stakes and sandbags, and incorporating bonding trenches into the wing-walled construction) were implemented to limit the potential of the flumes to develop leaks or dislodge during the test. Since these engineering controls worked well during the testing period, it was initially decided to continue using the flumes as designed for the longer term operation. As discussed below, the temporary designs are not holding up well.

During 2006, natural flow through the 6 flumes was monitored. Pumping of clean groundwater into the SSOD began in December of 2006, when water from the supply wells was no longer needed for dust suppression to support site closure activities. A few challenges that were not faced during the initial short term test were encountered and noted in the 2006 SER (i.e. freezing temperatures in the winter months, storm events, and dams). Heavy rains are a problem because the flumes are not designed to provide accurate flow rates during large storm events.

In 2006 a large rain event damaged the wing-walls of Flume 1. Temporary repairs to the flume were made, but as stated in the 2006 SER a more permanent solution was needed. Another concern noted in the 2006 SER was that the measured outflow rate in 2006 exceeded the measured inflow rate for the later part of the year resulting in a negative infiltration calculation (i.e., subtracting outflow from inflow). This indicated that unmeasured flow was entering the SSOD. The most likely area for this to occur is in the ditch where Flume 4 is installed. The post closure configuration of the ditch, in which Flume 4 is installed, is too large for the size of the flume. Flow appears to be going under and around the flume.

Results for 2007

In 2007, operations were successful in achieving the target flow rate of 500 gpm in the SSOD. The average annual flow rate in Flume 6 (the upper-most flume) in 2007 was 506 gpm. This flow rate consisted of natural flow and supplemented pumping from the clean production wells located on the east side of the site.

Figure A.2−158 shows a monthly comparison of the flow amount entering into the SSOD in 2006 and 2007. With the exception of December 2006, the only flow entering Flume 6 in 2006 was natural and not supplemented by pumping. As shown in figure A.2−158 supplemental pumping helped to keep flow rates higher in 2007. As discussed above, flow measurements into the SSOD are not accurate (more flow is being measured leaving the SSOD than is being measured entering the SSOD), so the amount of water entering the SSOD in 2007 is probably higher than what was recorded at the flumes. As discussed in Attachment A.3 a drought was in effect in the summer of 2007. Monthly flow rates in May, June, July, and August failed to achieve an average rate of 500 gpm. Efforts will be made in 2008 to increase pumping in these months to maintain an average flow rate of 500 gpm.

During 2007, approximately 138,900,400 gallons of water were pumped from the aquifer and discharged into the SSOD. This total volume for the year works out to an annual average pumping rate of approximately 264 gpm.

Flume Design

A new flume design was used to replace Flume 1 (the southern-most flume) in the summer of 2007. The new design has a rigid wing-wall construction rather than a wing-wall composed of sand bags. A picture of the original Flume 1 and the new, re-designed Flume 1 are provided in Figures A.2−159 and A.2−160 respectively. The rigid wing-walls in the new design are constructed of treated plywood, and are covered with a vinyl polyester fabric that is UV resistant and flexible to 50 degrees below zero. This new design is working well so far. Plans are to use this new design to replace Flume 4 and Flume 2.

Plans for 2008

Monitoring of flow at Flume 6 will continue to record how much water is entering the SSOD during 2008, but until repairs are made to Flume 4 and Flume 2 measured flow rates into the SSOD will be lower than actual flow rates and an accurate infiltration assessment will not be possible. Replacement of Flume 4 and Flume 2 is planned for 2008.

Table A.2–1. List of IEMP Monitoring Wells

Well ID	Monitoring Activity
13	Total Uranium
14	Total Uranium
2002	Total Uranium
2008	Total Uranium
2009	Total Uranium
2010	Waste Storage Area
2014	Total Uranium
2016	Total Uranium
2017	Total Uranium
2045	South Field
2046	Total Uranium
2048	Total Uranium
2049	South Field
2060 (12)	Total Uranium
2093	Property/Plume Boundary for FRL Exceedances
2095	Total Uranium
2106	Total Uranium
2125	Total Uranium
2128	Property/Plume Boundary for Paddys Run Road Site
2166	Total Uranium
2385	Total Uranium
2386	Total Uranium
2387	Total Uranium
2389	Total Uranium
2390	Total Uranium
2396	Total Uranium
2397	Total Uranium
2398	Property/Plume Boundary for FRL Exceedances
2402	Total Uranium
2431	Property/Plume Boundary for FRL Exceedances
2432	Property/Plume Boundary for FRL Exceedances
2550	Total Uranium
2552	Total Uranium
2553	Total Uranium
2625	Property/Plume Boundary for Paddys Run Road Site
2636	Property/Plume Boundary for Paddys Run Road Site
2649	Waste Storage Area
2733	Property/Plume Boundary for FRL Exceedances
2821	Waste Storage Area
2880	Total Uranium
2897	Total Uranium
2898	Property/Plume Boundary for Paddys Run Road Site
2899	Property/Plume Boundary for Paddys Run Road Site
2900	Property/Plume Boundary for Paddys Run Road Site
3014	Total Uranium
3015	Total Uranium
3045	Total Uranium

Table A.2–1 (continued). List of IEMP Monitoring Wells

Well ID	Monitoring Activity
3046	Total Uranium
3049	Total Uranium
3069	Total Uranium
3070	Property/Plume Boundary for FRL Exceedances
3093	Property/Plume Boundary for FRL Exceedances
3095	Total Uranium
3106	Total Uranium
3125	Total Uranium
3128	Property/Plume Boundary for Paddys Run Road Site
3385	Total Uranium
3387	Total Uranium
3390	Total Uranium
3396	Total Uranium
3397	Total Uranium
3398	Property/Plume Boundary for FRL Exceedances
3402	Total Uranium
3424	Property/Plume Boundary for FRL Exceedances
3426	Property/Plume Boundary for FRL Exceedances
3429	Property/Plume Boundary for FRL Exceedances
3431	Property/Plume Boundary for FRL Exceedances
3432	Property/Plume Boundary for FRL Exceedances
3550	Total Uranium
3552	Total Uranium
3636	Property/Plume Boundary for Paddys Run Road Site
3733	Property/Plume Boundary for FRL Exceedances
3821	Waste Storage Area
3880	Total Uranium
3897	Total Uranium
3898	Property/Plume Boundary for Paddys Run Road Site
3899	Property/Plume Boundary for Paddys Run Road Site
3900	Property/Plume Boundary for Paddys Run Road Site
4125	Total Uranium
4398	Property/Plume Boundary for FRL Exceedances
6015	Total Uranium
6880	Total Uranium
6881	Total Uranium
21033	Total Uranium
21063	Property/Plume Boundary for FRL Exceedances
21192	Total Uranium
22198	Property/Plume Boundary for FRL Exceedances and OSDF[a]
22199	Property/Plume Boundary for FRL Exceedances and OSDF[a]
22200	OSDF[a]
22201	OSDF[a]
22203	OSDF[a]
22204	Property/Plume Boundary for FRL Exceedances and OSDF[a]
22205	Property/Plume Boundary for FRL Exceedances and OSDF[a]
22206	OSDF[a]

Table A.2–1 (continued). List of IEMP Monitoring Wells

Well ID	Monitoring Activity
22207	OSDF[a]
22208	Property/Plume Boundary for FRL Exceedances and OSDF[a]
22209	OSDF[a]
22210	Property/Plume Boundary for FRL Exceedances and OSDF[a]
22211	Property/Plume Boundary for FRL Exceedances and OSDF[a]
22212	OSDF[a]
22213	OSDF[a]
22214	Property/Plume Boundary for FRL Exceedances and OSDF[a]
22215	OSDF[a]
22217	OSDF[a]
23064	Total Uranium
23118	Total Uranium
23271	Total Uranium
23272	Total Uranium
23273	Total Uranium
23274	Total Uranium
23275	Total Uranium
23276	Total Uranium
23277	Total Uranium
23278	Total Uranium
23279	Total Uranium
23280	Total Uranium
23281	Total Uranium
23282	Total Uranium
31217	Property/Plume Boundary for FRL Exceedances
32766	Total Uranium
32768	Total Uranium
62408	Total Uranium
62433	Total Uranium
63116	Total Uranium
63119	Total Uranium
63283	Total Uranium
63284	Total Uranium
63285	Total Uranium
63286	Total Uranium
63287	Total Uranium
63288	Total Uranium
63289	Total Uranium
63290	Total Uranium
63291	Total Uranium
63292	Total Uranium
82433	Total Uranium
83117	Total Uranium
83124	Total Uranium
83293	Total Uranium
83294	Total Uranium
83295	Total Uranium

Table A.2–1 (continued). List of IEMP Monitoring Wells

Well ID	Monitoring Activity
83296	Total Uranium
83335	Total Uranium
83336	Total Uranium
83337	Waste Storage Area
83338	Waste Storage Area
83339	Waste Storage Area
83340	Waste Storage Area
83341	Waste Storage Area
83346	Waste Storage Area

[a]OSDF total uranium graphs are included in this attachment and all of the OSDF data are discussed in Attachment A.5

Table A.2–2. Summary Statistics and Trend Analysis of Monitoring Wells for Total Uranium With 2007 Results Above Final Remediation Levels

Well	No. of Samples Since 1988[a,b,c]	Minimum[a,b,c,d] (µg/L)	Maximum[a,b,c,d] (µg/L)	Average[a,b,c,d,e,f] (µg/L)	Standard Deviation[a,b,c,d,e,f] (µg/L)	Trend[a,b,c,d,e,f,g]
2045	49	12.034	462	140	120	**Up, Significant**
2046	48	20	907	190	230	Down, Significant
2049	41	3.0	177.893	86	45	Down, Significant
2060	69	8.4	332	83	64	No Significant Trend
2095	54	27	208	110	40	Down, Significant
2166	43	28.3	95.1	59.5	15.5	Down, Significant
23271	12	49.1	144.3	92.5	29.4	No Significant Trend
23273	12	172	421	288	72	**Up, Significant**
23274	18	128.5	348.3	198.2	62.2	Down, Significant
23275	11	119	164	139	14	No Significant Trend
23276	12	60.4	94	78	9	No Significant Trend
23278	12	78.9	201.4	125	42	Down, Significant
23280	12	67.3	700	240	170	Down, Marginal
23281	12	53.3	366.6	184	82	Down, Significant
2385	35	76.648	592.164	254.59	115.43	No Significant Trend
2386	35	6.67	43.431	21.3	8.5	No Significant Trend
2387	35	18.1	492	138	91	No Significant Trend
2389	24	0.899	120	27	27	**Up, Significant**
2390	34	39.5	163	84.9	26.5	Down, Significant
2397	26	212	737	399	127	No Significant Trend
2550	45	3.3	120	65	19	Down, Significant
2649	30	6.01	237	25.4	47.4	**Up, Significant**
2880	36	0.4	61.7	8.0	13	**Up, Significant**
3069	61	0.5	398.33	130	100	Down, Significant
3095	55	2	94	23	16	No Significant Trend
32766	13	31.8	79.9	51.9	14.0	Down, Significant
62408	23	49.1	157	98.0	40.3	Down, Significant
62433	24	190	844.991	440	150	Down, Significant
63285	12	74.9	256	193	54	**Up, Significant**
63287	12	174	315.7	210	40	Down, Marginal
63288	12	41.3	267	121	72	No Significant Trend
63291	12	37.3	96.7	53.9	17.1	Down, Significant
6880	22	62.8	145	94.3	24.3	Down, Significant
82433_C2	8	55.8	214	129	65	Down, Significant
82433_C3	15	154	506	287	127	Down, Significant
82433_C4	8	48	311	170	120	Down, Significant
83117_C1	14	655	1620	935	259	**Up, Significant**
83117_C2	7	71	330	210	110	Down, Significant
83117_C3	7	71.5	128	101	26	Down, Significant

Table A.2–2 (continued). Summary Statistics and Trend Analysis of Monitoring Wells for Total Uranium With 2007 Results Above Final Remediation Levels

Well	No. of Samples Since 1988[a,b,c]	Minimum[a,b,c,d] (µg/L)	Maximum[a,b,c,d] (µg/L)	Average[a,b,c,d,e,f] (µg/L)	Standard Deviation[a,b,c,d,e,f] (µg/L)	Trend[a,b,c,d,e,f,g]
83117_C4	7	71.3	99	83	10	**Up, Significant**
83124_C1	20	185	1070	489	214	No Significant Trend
83124_C2	7	59	103	73	16	Down, Significant
83124_C4	7	25.4	41.2	33.8	7.3	No Significant Trend
83124_C5	7	24.4	61.4	50.3	12.4	Up, Marginal
83124_C6	7	20	38.6	31	7	No Significant Trend
83293_C4	12	21.8	115	54.4	25.9	Down, Significant
83294_C1	10	98.5	193	160	34	Up, Marginal
83294_C2	11	256	575	422	103	**Up, Significant**
83294_C3	9	272	538.8	418	93	Down, Significant
83294_C4	7	67.7	298.6	187	97	Down, Significant
83295_C2	9	92.3	178	142	29	**Up, Significant**
83295_C3	9	125	175	152	17	Down, Marginal
83295_C4	8	77.2	199.1	137	54	Down, Significant
83295_C5	7	70.8	155	99.8	30.0	Down, Significant
83296_C2	10	41.1	117	71.2	23.6	Down, Significant
83296_C3	9	16.5	75	52	21	Down, Marginal
83296_C4	7	23.6	62.7	42.2	14.1	No Significant Trend
83335_C2	3	4.54	49.5	20.0	NA	NA
83337_C1	4	877.2	1586.5	1228	290	**Up, Significant**
83337_C2	8	6.5	835.1	250	300	Down, Significant
83338_C1	3	454.5	618	552	NA	NA
83338_C2	4	213	648	372	190	No Significant Trend
83341_C1	2	37	37.7	NA	NA	NA
83346_C1	2	45.6	48.6	NA	NA	NA

[a]Summary statistics and Mann-Kendall test for trend are primarily based on unfiltered samples with some filtered samples from the Operable Unit 5 remedial investigation/feasibility study data set (1988 through 1993) and 1994 through 2007 groundwater data.
[b]If more than one sample is collected per well per day (e.g., duplicate), then only one sample is counted for the number of samples, and the sample with the maximum representative concentration is used for determining the summary statistics (minimum, maximum, average, and standard deviation) and Mann-Kendall test for trend.
[c]Rejected data qualified with either an R or Z were not included in this count, the summary statistics, or Mann-Kendall test for trend.
[d]If the number of samples is greater than or equal to four, then all of the summary statistics and the Mann-Kendall test for trend are reported. If the total number of samples is equal to three, then the minimum, maximum, and average are reported. If the total number of samples is equal to two, then the minimum and maximum are reported. If the total number of samples is equal to one, then the data point is reported as the minimum.
[e]NA = not applicable
[f]For results where the concentrations are below the detection limit, the results used in the summary statistics and Mann-Kendall test for trend are each set at half the detection limit.
[g]Mann-Kendall test for trend is performed using data from third quarter 1998 through 2007.

Table A.2–3. Summary Statistics and Trend Analysis of Extraction Wells for Total Uranium

Well	No. of Samples Since 1988[a,b]	Minimum[a,b,c] (µg/L)	Maximum[a,b,c] (µg/L)	Average[a,b,c] (µg/L)	Standard Deviation[a,b,c] (µg/L)	Trend[a,b,c]
South Plume Module (August 27, 1993 through December 31, 2007)						
3924	495	1.8	180	33	15	Down, Significant
3925	489	0.5	84	26	8	Down, Significant
3926	483	1.5	42.4	25	9	**Up, Significant**
3927	488	1.0	17	2.5	1.2	**Up, Significant**
South Plume Optimization Module (August 9, 1998 through December 31, 2007)						
32308	419	18.4	100.1	58.0	14.1	Down, Significant
32309	423	32	122.8	60	18	Down, Significant
South Field Module (July 13, 1998 through December 31, 2007)						
31550	439	18.3	127.9	54.0	19.4	Down, Significant
31560	462	22.9	182.8	67.2	37.2	Down, Significant
31561	436	18.1	114[d]	42.8	10.0	Down, Significant
32276	481	38.2	290.2	114	61	Down, Significant
32446	336	37.9	168.1	65.4	19.5	Down, Significant
32447	355	49.8	302.3	123	50	Down, Significant
33061	241	29.4	98.5	49.3	12.7	Down, Significant
33262	192	30.9	109.7	53.0	12.4	Down, Significant
33264	190	47.4	364.1	101	37	Down, Significant
33265	191	10.6	96.5	24.4	7.5	Down, Significant
33266	187	6.5	105.1	20	11	Down, Significant
33298	150	36.6	76.2	54.2	6.9	No Significant Trend
33326	93	23.1	62.2	29.9	5.4	Down, Significant
Waste Storage Area Module (May 8, 2002 through December 31, 2007)						
32761	233	34.6	161.2	73.1	31.5	Down, Significant
33062	241	37.9	236.4	83.3	46.4	Down, Significant
33334	60	10.9	50	23	7	Down, significant
33347	58	14.6	126.5	41.1	27.1	Down, significant

[a]If more than one sample is collected per well per day (e.g., duplicate), then only one sample is counted for the number of samples, and the sample with the maximum representative concentration is used for determining the summary statistics (minimum, maximum, average, and standard deviation) and Mann-Kendall test for trend.
[b]Rejected data qualified with either an R or Z were not included in this count, the summary statistics, or Mann-Kendall test for trend.
[c]For results where the concentrations are below the detection limit, the results used in the summary statistics and Mann-Kendall test for trend are each set at half the detection limit.
[d]This result (sampled August 31, 1998) appears to be an outlier. It is suspected that the sample for this well was switched with the sample for Extraction Well 31562.

Table A.2−4. Geoprobe Location 12194B

Easting '83:	**1348957**	Feet
Northing '83:	**476293.5**	Feet
Ground Elevation:	**564.8**	Feet AMSL
Depth to Water Table:	**54**	Feet bgs
Water Table Elevation:	**510.8**	Feet AMSL
Work Completed:	**11/19/2007**	

Sample Point	Elevation (ft amsl)	Depth Feet bgs	Sample Interval	Uranium Conc. (5 micron filtered) (μg/L)	Temp 5-micron Celcius	pH 5-micron SU	Cond 5-micron us/cm	Turb NTU	Turb 5-micron NTU	DO 5-micron mg/L
1	506	59	0 feet - 10 feet	8.7	14.0	7.85	0.797	381	>999	7.17
2	495.8	69	10 feet - 20 feet	8.7	14.3	8.12	0.807	>999	>999	6.81
3	495.8	69	10 feet - 20 feet	8.8	14.3	8.12	0.807	>999	>999	6.81
4	485.8	79	20-feet - 30 feet	4.5	14.9	8.26	0.749	>999	>999	7.26
5	475.8	89	30 feet - 40 feet	4.4	14.1	8.07	0.801	>999	>999	6.75
6	465.8	99	40 feet - 50 feet							
7	455.8	109	50 feet - 60 feet							
8	445.8	119	60 feet - 70 feet							
9	435.8	129	70 feet - 80 feet							
Rinsate				< 1.0						

	Temp	pH	Cond	Turb	Turb 5-micron	DO
Max	14.9	8.26	0.807	>999	>999	7.26
Min	14.0	7.85	0.749	381	>999	6.75
Range	0.9	0.41	0.058	>618	ND	0.51
Average	14.3	8.08	0.792	>875.4	>999	6.96

ND = not determinable

Table A.2−5. Geoprobe Location 12196B

Easting '83:	**1349174**	Feet
Northing '83:	**475891**	Feet
Ground Elevation:	**582.67**	Feet AMSL
Depth to Water Table:	**66**	Feet bgs
Water Table Elevation:	**516.67**	Feet AMSL
Work Completed:	**3/5/2007**	

Sample Point	Elevation (ft amsl)	Depth Feet bgs	Sample Interval	Uranium Conc. (5 micron filtered) (μg/L)	Temp 5-micron Celcius	pH 5-micron SU	Cond 5-micron us/cm	Turb NTU	Turb 5-micron NTU	DO 5-micron mg/L
1	511.67	71	0 feet - 10 feet	6.7	13.2	7.35	0.690	>999	>999	7.86
2	501.67	81	10 feet - 20 feet	55.9	14.1	7.41	0.682	>999	16	4.52
3	501.67	81	10 feet - 20 feet	59.6	14.1	7.41	0.682	>999	16	4.52
4	491.67	91	20-feet - 30 feet	103.7	13.1	7.44	0.696	>999	>999	6.51
5	481.67	101	30 feet - 40 feet	3.2	12.6	7.46	0.712	>999	>999	6.59
6	471.67	111	40 feet - 50 feet	9.0	12.3	7.43	0.685	>999	>999	6.56
7	461.67	121	50 feet - 60 feet	3.0	12.1	7.42	0.708	>999	>999	6.41
8	451.67	131	60 feet - 70 feet							
9	441.67	141	70 feet - 80 feet							
Rinsate				< 1.0						

	Temp	pH	Cond	Turb	Turb 5-micron	DO
Max	14.1	7.46	0.712	>999	>999	7.86
Min	12.1	7.35	0.682	>999	16	4.52
Range	2.0	0.11	0.030	ND	>983	3.34
Average	13.1	7.42	0.694	>999	>718	6.14

ND = not determinable

Table A.2−6. Geoprobe Location 12368I

Easting '83:	**1348470.225**	Feet
Northing '83:	**476172.653**	Feet
Ground Elevation:	**576.34**	Feet AMSL
Depth to Water Table:	**63.5**	Feet bgs
Water Table Elevation:	**512.84**	Feet AMSL
Work Completed:	**9/26/2007**	

Sample Point	Elevation (ft amsl)	Depth Feet bgs	Sample Interval	Uranium Conc. (5 micron filtered) (μg/L)	Temp 5-micron Celcius	pH 5-micron SU	Cond 5-micron us/cm	Turb NTU	Turb 5-micron NTU	DO 5-micron mg/L
1	507.84	68.5	0 feet - 10 feet	27.1	17.1	7.94	0.635	>999	606	6.51
2	497.84	78.5	10 feet - 20 feet	5.9	21.1	8.54	0.520	>999	>999	5.63
3	497.84	78.5	10 feet - 20 feet	7.9	21.1	8.54	0.520	>999	>999	5.63
4	487.84	88.5	20-feet - 30 feet	12.7	19.3	8.58	0.503	>999	>999	5.01
5	477.84	98.5	30 feet - 40 feet							
6	467.84	108.5	40 feet - 50 feet							
7	457.84	118.5	50 feet - 60 feet							
8	447.84	128.5	60 feet - 70 feet							
9	437.84	138.5	70 feet - 80 feet							
Rinsate				< 1.0						

	Temp	pH	Cond	Turb	Turb 5-micron	DO
Max	21.1	8.58	0.635	>999	>999	6.51
Min	17.1	7.94	0.503	>999	606	5.01
Range	4.0	0.64	0.132	ND	>393	1.50
Average	19.7	8.40	0.545	>999	>901	5.70

ND = not determinable

Table A.2−7. Geoprobe Location 12369L

Easting '83:	**1348859**	Feet
Northing '83:	**476087**	Feet
Ground Elevation:	**571.66**	Feet AMSL
Depth to Water Table:	**55**	Feet bgs
Water Table Elevation:	**516.66**	Feet AMSL
Work Completed:	**3/7/2007**	

Sample Point	Elevation (ft amsl)	Depth Feet bgs	Sample Interval	Uranium Conc. (5 micron filtered) (μg/L)	Temp 5-micron Celcius	pH 5-micron SU	Cond 5-micron us/cm	Turb NTU	Turb 5-micron NTU	DO 5-micron mg/L
1	511.66	60	0 feet - 10 feet	10.3	11.6	7.07	0.802	538	>999	6.63
2	501.66	70	10 feet - 20 feet	9.4	12.1	7.50	0.755	>999	>999	6.77
3	501.66	70	10 feet - 20 feet	17.9	12.1	7.50	0.755	>999	>999	6.77
4	491.66	80	20-feet - 30 feet	20.4	11.5	7.58	0.754	>999	133	4.92
5	481.66	90	30 feet - 40 feet	17.3	11.7	7.56	0.750	>999	>999	6.48
6	471.66	100	40 feet - 50 feet	15.5	NS	NS	NS	NS	NS	NS
7	461.66	110	50 feet - 60 feet							
8	451.66	120	60 feet - 70 feet							
9	441.66	130	70 feet - 80 feet							
Rinsate				< 1.0						

	Temp	pH	Cond	Turb	Turb 5-micron	DO
Max	12.1	7.58	0.802	>999	>999	6.77
Min	11.5	7.07	0.750	538	133	4.92
Range	0.6	0.51	0.052	>461	>866	1.85
Average	11.8	7.44	0.763	>907	>826	6.31

NS = not sampled - Horiba meter malfunctioned, no readings taken for 40-50 foot sample

Table A.2−8. Geoprobe Location 12369M

Easting '83:	**1348876**	Feet
Northing '83:	**476043.2**	Feet
Ground Elevation:	**570.96**	Feet AMSL
Depth to Water Table:	**60**	Feet bgs
Water Table Elevation:	**510.96**	Feet AMSL
Work Completed:	**11/14/2007**	

Sample Point	Elevation (ft amsl)	Depth Feet bgs	Sample Interval	Uranium Conc. (5 micron filtered) (μg/L)	Temp 5-micron Celcius	pH 5-micron SU	Cond 5-micron us/cm	Turb NTU	Turb 5-micron NTU	DO 5-micron mg/L
1	505.96	65	0 feet - 10 feet	135.6	14.7	7.72	0.834	>999	532	6.70
2	495.96	75	10 feet - 20 feet	43.0	15.2	7.99	0.814	>999	421	5.40
3	495.96	75	10 feet - 20 feet	41.9	15.2	7.99	0.814	>999	421	5.40
4	485.96	85	20-feet - 30 feet	19.0	15.2	8.03	0.799	>999	91	3.89
5	475.96	95	30 feet - 40 feet	15.4	16.4	8.01	0.834	>999	>999	5.34
6	465.96	105	40 feet - 50 feet							
7	455.96	115	50 feet - 60 feet							
8	445.96	125	60 feet - 70 feet							
9	435.96	135	70 feet - 80 feet							
Rinsate				< 1.0						

	Temp	pH	Cond	Turb	Turb	DO
Max	16.4	8.03	0.834	>999	>999	6.70
Min	14.7	7.72	0.799	>999	91	3.89
Range	1.7	0.31	0.035	ND	>908	2.81
Average	15.3	7.95	0.819	>999	>493	5.35

ND = not determinable

Table A.2−9. Geoprobe Location 12370I

Easting '83:	**1349413**	Feet
Northing '83:	**476202**	Feet
Ground Elevation:	**574.3**	Feet AMSL
Depth to Water Table:	**64.5**	Feet bgs
Water Table Elevation:	**509.8**	Feet AMSL
Work Completed:	**11/28/2007**	

Sample Point	Elevation (ft amsl)	Depth Feet bgs	Sample Interval	Uranium Conc. (5 micron filtered) (μg/L)	Temp 5-micron Celcius	pH 5-micron SU	Cond 5-micron us/cm	Turb NTU	Turb 5-micron NTU	DO 5-micron mg/L
1	505	69.5	0 feet - 10 feet	6.1	11.9	7.77	0.881	>999	>999	7.70
2	494.8	79.5	10 feet - 20 feet	5.3	12.2	7.89	0.744	>999	>999	6.84
3	494.8	79.5	10 feet - 20 feet	5.1	12.2	7.89	0.744	>999	>999	6.84
4	484.8	89.5	20-feet - 30 feet	6.0	12.3	7.89	0.741	>999	>999	5.79
5	474.8	99.5	30 feet - 40 feet	5.9	13.1	7.90	0.741	>999	914	6.13
6	464.8	109.5	40 feet - 50 feet							
7	454.8	119.5	50 feet - 60 feet							
8	444.8	129.5	60 feet - 70 feet							
9	434.8	139.5	70 feet - 80 feet							
Rinsate				< 1.0						

	Temp	pH	Cond	Turb	Turb	DO
Max	13.1	7.90	0.881	>999	>999	7.70
Min	11.9	7.77	0.741	>999	914	5.79
Range	1.2	0.13	0.140	ND	>85	1.91
Average	12.3	7.87	0.770	>999	>982	6.66

ND = not determinable

Table A.2−10. Geoprobe Location 12370H

Easting '83:	**1349414.71**	Feet
Northing '83:	**476204.62**	Feet
Ground Elevation:	**575.06**	Feet AMSL
Depth to Water Table:	**59**	Feet bgs
Water Table Elevation:	**516.06**	Feet AMSL
Work Completed:	**1/31/2007**	

Sample Point	Elevation (ft amsl)	Depth Feet bgs	Sample Interval	Uranium Conc. (5 micron filtered) (µg/L)	Temp 5-micron Celcius	pH 5-micron SU	Cond 5-micron us/cm	Turb NTU	Turb 5-micron NTU	DO 5-micron mg/L
1	511.06	64	0 feet - 10 feet	3.8	7.8	7.16	0.920	>999	>999	7.46
2	501.06	74	10 feet - 20 feet	2.9	8.8	7.37	0.754	>999	>999	7.40
3	501.06	74	10 feet - 20 feet	2.8	8.8	7.37	0.754	>999	>999	7.40
4	491.06	84	20-feet - 30 feet	2.6	8.5	7.54	0.731	>999	>999	6.81
5	481.06	94	30 feet - 40 feet	7.3	9.1	7.44	0.738	>999	>999	6.91
6	471.06	104	40 feet - 50 feet							
7	461.06	114	50 feet - 60 feet							
8	451.06	124	60 feet - 70 feet							
9	441.06	134	70 feet - 80 feet							
Rinsate				< 1.0						

	Temp	pH	Cond	Turb	Turb	DO
Max	9.1	7.54	0.920	>999	>999	7.46
Min	7.8	7.16	0.731	>999	>999	6.81
Range	1.3	0.38	0.189	ND	ND	0.65
Average	8.6	7.38	0.779	>999	>999	7.20

ND = not determinable

Table A.2−11. Geoprobe Location 12372M

Easting '83:	**1348558.704**	Feet
Northing '83:	**476215.416**	Feet
Ground Elevation:	**576.2**	Feet AMSL
Depth to Water Table:	**62**	Feet bgs
Water Table Elevation:	**514.2**	Feet AMSL
Work Completed:	**10/24/2007**	

Sample Point	Elevation (ft amsl)	Depth Feet bgs	Sample Interval	Uranium Conc. (5 micron filtered) (μg/L)	Temp 5-micron Celcius	pH 5-micron SU	Cond 5-micron us/cm	Turb NTU	Turb 5-micron NTU	DO 5-micron mg/L
1	509.2	67	0 feet - 10 feet	34.3	13.2	7.76	0.770	>999	>999	7.18
2	499.2	77	10 feet - 20 feet	18.5	12.9	7.91	0.618	>999	824	5.99
3	489.2	87	20 feet - 30 feet	11.4	NS	NS	NS	NS	NS	NS
4	489.2	87	20-feet - 30 feet	11.4	NS	NS	NS	NS	NS	NS
5	479.2	97	30 feet - 40 feet	12.1	13.1	8.15	0.639	>999	>999	7.10
6	469.2	107	40 feet - 50 feet							
7	459.2	117	50 feet - 60 feet							
8	449.2	127	60 feet - 70 feet							
9	439.2	137	70 feet - 80 feet							
Rinsate				< 1.0						
				Max	13.2	8.15	0.770	>999	>999	7.18
				Min	12.9	7.76	0.618	>999	824	5.99
				Range	0.3	0.39	0.152	ND	>175	1.19
				Average	13.1	7.94	0.676	>999	>941	6.76

NS = not sampled
ND = not determinable

Table A.2−12. Geoprobe Location 12373M

Easting '83:	**1349025**	Feet
Northing '83:	**476240**	Feet
Ground Elevation:	**564.08**	Feet AMSL
Depth to Water Table:	**53**	Feet bgs
Water Table Elevation:	**511.08**	Feet AMSL
Work Completed:	**10/29/2007**	

Sample Point	Elevation (ft amsl)	Depth Feet bgs	Sample Interval	Uranium Conc. (5 micron filtered) (μg/L)	Temp 5-micron Celcius	pH 5-micron SU	Cond 5-micron us/cm	Turb NTU	Turb 5-micron NTU	DO 5-micron mg/L
1	506.08	58	0 feet - 10 feet	11.3	13.7	7.94	0.762	>999	>999	3.40
2	496.08	68	10 feet - 20 feet	5.2	15.7	8.26	0.746	>999	939	4.81
3	496.08	68	10 feet - 20 feet	5.1	15.7	8.26	0.746	>999	939	4.81
4	486.08	78	20-feet - 30 feet	6.5	17.3	8.06	0.713	>999	616	7.07
5	476.08	88	30 feet - 40 feet	6.0	16.4	8.12	0.749	>999	>999	7.01
6	466.08	98	40 feet - 50 feet	7.3	15.8	7.92	0.799	>999	>999	6.96
7	456.08	108	50 feet - 60 feet	3.0	11.9	7.49	0.749	>999	596	6.60
8	446.08	118	60 feet - 70 feet							
9	436.08	128	70 feet - 80 feet							
Rinsate				< 1.0						

	Temp 5-micron Celcius	pH 5-micron SU	Cond 5-micron us/cm	Turb NTU	Turb 5-micron NTU	DO 5-micron mg/L
Max	17.3	8.26	0.799	>999	>999	7.07
Min	11.9	7.49	0.713	>999	596	3.40
Range	5.4	0.77	0.086	ND	>403	3.67
Average	15.2	8.01	0.752	>999	>870	5.81

ND = not determinable

Table A.2−13. Geoprobe Location 12710A

Easting '83:	**1347697**	Feet
Northing '83:	**479904**	Feet
Ground Elevation:	**573.9**	Feet AMSL
Depth to Water Table:	**57**	Feet bgs
Water Table Elevation:	**516.9**	Feet AMSL
Work Completed:	**8/7/2007**	

Sample Point	Elevation (ft amsl)	Depth Feet bgs	Sample Interval	Uranium Conc. (5 micron filtered) (µg/L)	Temp 5-micron Celcius	pH 5-micron SU	Cond 5-micron us/cm	Turb NTU	Turb 5-micron NTU	DO 5-micron mg/L
1	511.9	62	0 feet - 10 feet	82.6	17.0	7.52	0.872	756	480	5.62
2	501.9	72	10 feet - 20 feet	56.1	18.4	7.70	0.777	>999	890	3.74
3	501.9	72	10 feet - 20 feet	55.6	18.4	7.70	0.777	>999	890	3.74
4	491.9	82	20-feet - 30 feet	51.5	19.4	7.94	0.695	>999	>999	6.12
5	481.9	92	30 feet - 40 feet	29.5	18.7	7.94	0.663	>999	>999	5.89
6	471.9	102	40 feet - 50 feet	4.2	19.8	7.94	0.659	>999	>999	5.87
7	461.9	112	50 feet - 60 feet							
8	451.9	122	60 feet - 70 feet							
9	441.9	132	70 feet - 80 feet							
Rinsate				< 1.0						
				Max	19.8	7.94	0.872	>999	>999	6.12
				Min	17.0	7.52	0.659	756	480	3.74
				Range	2.8	0.42	0.213	>243	>519	2.38
				Average	18.6	7.79	0.741	>959	>876	5.16

Table A.2−14. Geoprobe Location 12711A

Easting '83:	**1348046**	Feet
Northing '83:	**479851.1**	Feet
Ground Elevation:	**575.1**	Feet AMSL
Depth to Water Table:	**50**	Feet bgs
Water Table Elevation:	**525.1**	Feet AMSL
Work Completed:	**10/16/2007**	

Sample Point	Elevation (ft amsl)	Depth Feet bgs	Sample Interval	Uranium Conc. (5 micron filtered) (μg/L)	Temp 5-micron Celcius	pH 5-micron SU	Cond 5-micron us/cm	Turb NTU	Turb 5-micron NTU	DO 5-micron mg/L
1	520	55	0 feet - 10 feet	3.6	24.1	7.30	0.826	>999	>999	4.90
2	510.1	65	10 feet - 20 feet	11.5	19.3	7.65	0.705	>999	>999	5.80
3	510.1	65	10 feet - 20 feet	11.7	19.3	7.65	0.705	>999	>999	5.80
4	500.1	75	20-feet - 30 feet	13.2	19.8	7.70	0.719	>999	>999	5.57
5	490.1	85	30 feet - 40 feet	2.7	22.0	7.59	0.713	>999	>999	5.02
6	480.1	95	40 feet - 50 feet	< 1.0	20.9	7.52	0.653	>999	>999	5.21
7	470.1	105	50 feet - 60 feet							
8	460.1	115	60 feet - 70 feet							
9	450.1	125	70 feet - 80 feet							
Rinsate				< 1.0						

	Temp 5-micron Celcius	pH 5-micron SU	Cond 5-micron us/cm	Turb NTU	Turb 5-micron NTU	DO 5-micron mg/L
Max	24.1	7.70	0.826	>999	>999	5.80
Min	19.3	7.30	0.653	>999	>999	4.90
Range	4.8	0.40	0.173	ND	ND	0.90
Average	20.9	7.57	0.720	>999	>999	5.38

ND = not determinable

Table A.2−15. Geoprobe Location 12721A

Easting '83:	**1348735**	Feet
Northing '83:	**479988.4**	Feet
Ground Elevation:	**575.1**	Feet AMSL
Depth to Water Table:	**52.5**	Feet bgs
Water Table Elevation:	**522.6**	Feet AMSL
Work Completed:	**10/16/2007**	

Sample Point	Elevation (ft amsl)	Depth Feet bgs	Sample Interval	Uranium Conc. (5 micron filtered) (µg/L)	Temp 5-micron Celcius	pH 5-micron SU	Cond 5-micron us/cm	Turb NTU	Turb 5-micron NTU	DO 5-micron mg/L
1	517.6	57.5	0 feet - 10 feet	15.9	20.1	7.73	0.879	>999	>999	5.41
2	507.6	67.5	10 feet - 20 feet	15.7	21.7	7.87	0.797	>999	>999	5.32
3	507.6	67.5	10 feet - 20 feet	15.4	21.7	7.87	0.797	>999	>999	5.32
4	497.6	77.5	20-feet - 30 feet	3.8	21.7	7.76	0.712	>999	671	4.94
5	487.6	87.5	30 feet - 40 feet	6.5	19.6	7.87	0.687	>999	>999	4.19
6	477.6	97.5	40 feet - 50 feet	6.0	19.5	7.97	0.664	>999	>999	4.78
7	467.6	107.5	50 feet - 60 feet							
8	457.6	117.5	60 feet - 70 feet							
9	447.6	127.5	70 feet - 80 feet							
Rinsate				< 1.0						

	Temp 5-micron Celcius	pH 5-micron SU	Cond 5-micron us/cm	Turb NTU	Turb 5-micron NTU	DO 5-micron mg/L
Max	21.7	7.97	0.879	>999	>999	5.41
Min	19.5	7.73	0.664	>999	671	4.19
Range	2.2	0.24	0.215	ND	>328	1.22
Average	20.7	7.85	0.756	>999	>944	4.99

ND = not determinable

Table A.2–16. Geoprobe Location 12814A

Easting '83:	**1347676**	Feet
Northing '83:	**477889.4**	Feet
Ground Elevation:	**538.2**	Feet AMSL
Depth to Water Table:	**23**	Feet bgs
Water Table Elevation:	**515.2**	Feet AMSL
Work Completed:	**9/12/2007**	

Sample Point	Elevation (ft amsl)	Depth Feet bgs	Sample Interval	Uranium Conc. (5 micron filtered) (μg/L)	Temp 5-micron Celcius	pH 5-micron SU	Cond 5-micron us/cm	Turb NTU	Turb 5-micron NTU	DO 5-micron mg/L
1	510	28	0 feet - 10 feet	51.9	17.7	7.79	0.586	>999	256	5.99
2	500.2	38	10 feet - 20 feet	6.4	16.7	7.98	0.626	>999	504	5.67
3	500.2	38	10 feet - 20 feet	6.3	16.7	7.98	0.626	>999	504	5.67
4	490.2	48	20-feet - 30 feet	3.2	15.3	7.99	0.594	>999	159	4.89
5	480.2	58	30 feet - 40 feet	1.2	18.1	8.29	0.609	>999	>999	7.22
6	470.2	68	40 feet - 50 feet	9.1	16.3	8.03	0.575	>999	889	6.32
7	460.2	78	50 feet - 60 feet							
8	450.2	88	60 feet - 70 feet							
9	440.2	98	70 feet - 80 feet							
Rinsate				< 1.0						

	Temp	pH	Cond	Turb	Turb 5-micron	DO
Max	18.1	8.29	0.626	>999	>999	7.22
Min	15.3	7.79	0.575	>999	159	4.89
Range	2.8	0.50	0.051	ND	>840	2.33
Average	16.8	8.01	0.603	>999	>552	5.96

ND = not determinable

Table A.2−17. Geoprobe Location 12839A

Easting '83:	**1348137**	Feet
Northing '83:	**477646.1**	Feet
Ground Elevation:	**569.6**	Feet AMSL
Depth to Water Table:	**55.5**	Feet bgs
Water Table Elevation:	**514.1**	Feet AMSL
Work Completed:	**9/18/2007**	

Sample Point	Elevation (ft amsl)	Depth Feet bgs	Sample Interval	Uranium Conc. (5 micron filtered) (μg/L)	Temp 5-micron Celcius	pH 5-micron SU	Cond 5-micron us/cm	Turb NTU	Turb 5-micron NTU	DO 5-micron mg/L
1	509.1	60.5	0 feet - 10 feet	16.7	16.7	8.04	0.547	>999	>999	6.94
2	499.1	70.5	10 feet - 20 feet	11.2	23.7	8.35	0.536	>999	696	6.16
3	499.1	70.5	10 feet - 20 feet	10.3	23.7	8.35	0.536	>999	696	6.16
4	489.1	80.5	20-feet - 30 feet	10.4	17.0	8.32	0.511	>999	>999	6.50
5	479.1	90.5	30 feet - 40 feet							
6	469.1	100.5	40 feet - 50 feet							
7	459.1	110.5	50 feet - 60 feet							
8	449.1	120.5	60 feet - 70 feet							
9	439.1	130.5	70 feet - 80 feet							
Rinsate				< 1.0						

	Temp	pH	Cond	Turb	Turb	DO
Max	23.7	8.35	0.547	>999	>999	6.94
Min	16.7	8.04	0.511	>999	696	6.16
Range	7.0	0.31	0.036	ND	>303	0.78
Average	20.3	8.27	0.533	>999	>848	6.44

ND = not determinable

Table A.2−18. Geoprobe Location 13228C

Easting '83:	**1349053.967**	Feet
Northing '83:	**476082.255**	Feet
Ground Elevation:	**577.07**	Feet AMSL
Depth to Water Table:	**60**	Feet bgs
Water Table Elevation:	**517.07**	Feet AMSL
Work Completed:	**2/7/2007**	

Sample Point	Elevation (ft amsl)	Depth Feet bgs	Sample Interval	Uranium Conc. (5 micron filtered) (μg/L)	Temp 5-micron Celcius	pH 5-micron SU	Cond 5-micron us/cm	Turb NTU	Turb 5-micron NTU	DO 5-micron mg/L
1	512.07	65	0 feet - 10 feet	22.9	7.2	7.28	0.722	>999	>999	7.31
2	502.07	75	10 feet - 20 feet	7.6	8.8	7.58	0.730	>999	>999	6.92
3	502.07	75	10 feet - 20 feet	6.8	8.8	7.58	0.730	>999	>999	6.92
4	492.07	85	20-feet - 30 feet	5.6	8.3	7.67	0.687	>999	>999	7.35
5	482.07	95	30 feet - 40 feet	4.0	8.2	7.23	0.716	>999	>999	6.62
6	472.07	105	40 feet - 50 feet	2.5	9.4	7.46	18.70 [a]	>999	>999	7.21
7	462.07	115	50 feet - 60 feet	5.4	8.5	7.37	18.20 [a]	>999	>999	8.40
8	452.07	125	60 feet - 70 feet							
9	442.07	135	70 feet - 80 feet							
Rinsate				< 1.0						

	Temp	pH	Cond	Turb	Turb	DO
Max	9.4	7.67	0.730	>999	>999	8.40
Min	7.2	7.23	0.687	>999	>999	6.62
Range	2.2	0.44	0.043	ND	ND	1.78
Average	8.5	7.45	0.717	>999	>999	7.25

[a] reported reading is suspect
ND = not determinable

Table A.2−19. Geoprobe Location 13236A

Easting '83:	**1348447**	Feet
Northing '83:	**475799**	Feet
Ground Elevation:	**576.5**	Feet AMSL
Depth to Water Table:	**61**	Feet bgs
Water Table Elevation:	**515.5**	Feet AMSL
Work Completed:	**1/10/2007**	

Sample Point	Elevation (ft amsl)	Depth Feet bgs	Sample Interval	Uranium Conc. (5 micron filtered) (μg/L)	Temp 5-micron Celcius	pH 5-micron SU	Cond 5-micron us/cm	Turb NTU	Turb 5-micron NTU	DO 5-micron mg/L
1	510.5	66	0 feet - 10 feet	34.7	12.0	7.13	0.996	>999	835	7.52
2	500.5	76	10 feet - 20 feet	30.1	12.1	7.43	0.907	>999	>999	6.64
3	500.5	76	10 feet - 20 feet	26.8	12.1	7.43	0.907	>999	>999	6.64
4	490.5	86	20-feet - 30 feet	14.6	11.5	7.46	0.725	>999	>999	6.90
5	480.5	96	30 feet - 40 feet	19.5	11.4	7.53	0.675	>999	>999	7.49
6	470.5	106	40 feet - 50 feet	4.6	11.1	7.39	0.686	>999	884	5.00
7	460.5	116	50 feet - 60 feet							
8	450.5	126	60 feet - 70 feet							
9	440.5	136	70 feet - 80 feet							
Rinsate				< 1.0						

	Temp	pH	Cond	Turb	Turb 5-micron	DO
Max	12.1	7.53	0.996	>999	>999	7.52
Min	11.1	7.13	0.675	>999	835	5.00
Range	1.0	0.40	0.321	ND	>164	2.52
Average	11.7	7.40	0.816	>999	>953	6.70

ND = not determinable

Table A.2−20. Geoprobe Location 13237A

Easting '83:	**1348862.8**	Feet
Northing '83:	**475801.7**	Feet
Ground Elevation:	**576.39**	Feet AMSL
Depth to Water Table:	**61**	Feet bgs
Water Table Elevation:	**515.39**	Feet AMSL
Work Completed:	**1/17/2007**	

Sample Point	Elevation (ft amsl)	Depth Feet bgs	Sample Interval	Uranium Conc. (5 micron filtered) (μg/L)	Temp 5-micron Celcius	pH 5-micron SU	Cond 5-micron us/cm	Turb NTU	Turb 5-micron NTU	DO 5-micron mg/L
1	510.39	66	0 feet - 10 feet	22.7	11.0	7.09	0.854	>999	>999	6.68
2	500.39	76	10 feet - 20 feet	82.8	11.5	7.09	0.782	>999	>999	7.10
3	500.39	76	10 feet - 20 feet	85.6	11.5	7.09	0.782	>999	>999	7.10
4	490.39	86	20-feet - 30 feet	22.6	11.5	7.39	0.694	>999	>999	6.60
5	480.39	96	30 feet - 40 feet	5.2	9.7	7.11	0.666	>999	>999	6.52
6	470.39	106	40 feet - 50 feet	2.3	10.3	7.07	0.676	>999	>999	6.10
7	460.39	116	50 feet - 60 feet							
8	450.39	126	60 feet - 70 feet							
9	440.39	136	70 feet - 80 feet							
Rinsate				< 1.0						

	Temp	pH	Cond	Turb	Turb	DO
Max	11.5	7.39	0.854	>999	>999	7.10
Min	9.7	7.07	0.666	>999	>999	6.10
Range	1.8	0.32	0.188	ND	ND	1.00
Average	10.9	7.14	0.742	>999	>999	6.68

ND = not determinable

Table A.2−21. Geoprobe Location 13268A

Easting '83:	**1348975**	Feet
Northing '83:	**475951**	Feet
Ground Elevation:	**578.6**	Feet AMSL
Depth to Water Table:	**62**	Feet bgs
Water Table Elevation:	**516.6**	Feet AMSL
Work Completed:	**1/29/2007**	

Sample Point	Elevation (ft amsl)	Depth Feet bgs	Sample Interval	Uranium Conc. (5 micron filtered) (µg/L)	Temp 5-micron Celcius	pH 5-micron SU	Cond 5-micron us/cm	Turb NTU	Turb 5-micron NTU	DO 5-micron mg/L
1	511.6	67	0 feet - 10 feet	1.8	7.6	7.70	0.681	>999	>999	7.76
2	501.6	77	10 feet - 20 feet	5.7	8.0	7.76	0.734	>999	>999	7.21
3	501.6	77	10 feet - 20 feet	2.3	8.0	7.76	0.734	>999	>999	7.21
4	491.6	87	20-feet - 30 feet	5.7	8.2	7.76	0.688	>999	>999	7.07
5	481.6	97	30 feet - 40 feet	1.0	8.5	7.72	0.739	>999	>999	5.88
6	471.6	107	40 feet - 50 feet	3.0	8.5	7.59	0.680	>999	>999	7.20
7	461.6	117	50 feet - 60 feet							
8	451.6	127	60 feet - 70 feet							
9	441.6	137	70 feet - 80 feet							
Rinsate				< 1.0						

	Temp	pH	Cond	Turb	Turb	DO
Max	8.5	7.76	0.739	>999	>999	7.76
Min	7.6	7.59	0.680	>999	>999	5.88
Range	0.9	0.17	0.059	ND	ND	1.88
Average	8.1	7.72	0.709	>999	>999	7.06

ND = not determinable

Table A.2−22. Geoprobe Location 13349

Easting '83:	**1346542**	Feet
Northing '83:	**481989.8**	Feet
Ground Elevation:	**556.32**	Feet AMSL
Depth to Water Table:	**36.5**	Feet bgs
Water Table Elevation:	**519.82**	Feet AMSL
Work Completed:	**7/3/2007**	

Sample Point	Elevation (ft amsl)	Depth Feet bgs	Sample Interval Feet	Uranium (ug/L) (FRL=30)	Tech-99 (pCi/L) (FRL=94)	Nitrate/Nitrite (mg/L) (FRL=11)	Manganese (mgL) (FRL=0.9)	Molybdenum (mgL) (FRL=0.1)	Nickel (mgL) (FRL=0.1)	Temp Celcius	pH SU	Cond us/cm	Turb NTU U	Turb NTU	DO mg/L
1	515	42	0 to 10	5.6	U	U	0.869	0.0199	0.0239	14.5	7.65	0.973	>999	>999	4.80
2	504.82	52	10 to 20	2.5	U	0.01	0.358	0.0082	0.0051	15.6	7.84	0.870	>999	37	3.97
3	504.82	52	10 to 20	2.7	U	U	0.41	0.0109	0.0092	15.6	7.84	0.870	>999	37	3.97
4	494.82	62	20 to 30	3.3	U	U	0.308	0.012	0.0098	18.1	8.12	0.804	>999	>999	4.68
5	484.82	72	30 to 40	4.0	U	U	0.303	0.0054	0.0048	17.0	8.01	0.897	>999	>999	3.59
Rinsate				< 1.0											

	Temp Celcius	pH SU	Cond us/cm	Turb NTU U	Turb NTU	DO mg/L
Max	18.1	8.12	0.973	>999	>999	4.80
Min	14.5	7.65	0.804	>999	37	3.59
Range	3.6	0.47	0.169	ND	>962	1.21
Average	16.2	7.89	0.883	>999	>614	4.20

ND = not determinable

Table A.2−23. Geoprobe Location 13350

Easting '83:	**1347746**	Feet
Northing '83:	**481662.5**	Feet
Ground Elevation:	**580.2**	Feet AMSL
Depth to Water Table:	**62**	Feet bgs
Water Table Elevation:	**518.2**	Feet AMSL
Work Completed:	**7/6/2007**	

Sample Point	Elevation (ft amsl)	Depth Feet bgs	Sample Interval Feet	Uranium (ug/L) (FRL=30)	Tech-99 (pCi/L) (FRL=94)	Nitrate/Nitrite (mg/L) (FRL=11)	Manganese (mgL) (FRL=0.9)	Molybdenum (mgL) (FRL=0.1)	Nickel (mgL) (FRL=0.1)	Temp Celcius	pH SU	Cond us/cm	Turb NTU U	Turb NTU	DO mg/L
1	513.2	67	0 to 10	6.80	7.19	45.3	0.622	0.0139	0.0155	18.9	7.17	1.520	>999	>999	3.73
2	503.2	77	10 to 20	0.91	11.7	60.3	0.513	U	0.0118	19.5	7.53	1.490	>999	>999	2.61
3	503.2	77	10 to 20	0.59	12.9	51.0	0.94	0.0188	0.0265	19.5	7.53	1.490	>999	>999	2.61
4	493.2	87	20 to 30	2.10	2.4	42.5	1.48	0.0208	0.0234	16.6	7.01	1.270	>999	30	ns
5	483.2	97	30 to 40	8.40	2.0	U	1.32	0.0132	0.0183	17.3	6.98	1.070	>999	309	ns
Rinsate				< 1.0											

	Temp Celcius	pH SU	Cond us/cm	Turb NTU U	Turb NTU	DO mg/L
Max	19.5	7.53	1.520	>999	>999	3.73
Min	16.6	6.98	1.070	>999	30	2.61
Range	2.9	0.55	0.450	ND	>969	1.12
Average	18.4	7.24	1.368	>999	>667	2.98

ND = not determinable

Table A.2−24. Geoprobe Location 13352

Easting '83:	**1346602**	Feet
Northing '83:	**479593.7**	Feet
Ground Elevation:	**554**	Feet AMSL
Depth to Water Table:	**35**	Feet bgs
Water Table Elevation:	**519**	Feet AMSL
Work Completed:	**7/31/2007**	

Sample Point	Elevation (ft amsl)	Depth Feet bgs	Sample Interval	Uranium Conc. (5 micron filtered) (μg/L)	Temp 5-micron Celcius	pH 5-micron SU	Cond 5-micron us/cm	Turb NTU	Turb 5-micron NTU	DO 5-micron mg/L
1	514	40	0 feet - 10 feet	26.2	14.1	7.41	0.717	>999	536	7.10
2	504	50	10 feet - 20 feet	5.5	14.8	7.82	0.619	>999	710	6.60
3	504	50	10 feet - 20 feet	6.9	14.8	7.82	0.619	>999	710	6.60
4	494	60	20-feet - 30 feet	3.8	12.8	7.82	0.618	>999	856	5.77
5	484	70	30 feet - 40 feet	12.0	12.8	7.76	0.639	>999	>999	7.32
6	474	80	40 feet - 50 feet	16.7	14.1	7.71	0.700	>999	479	4.92
7	464	90	50 feet - 60 feet							
8	454	100	60 feet - 70 feet							
9	444	110	70 feet - 80 feet							
Rinsate				< 1.0						
				Max	14.8	7.82	0.717	>999	>999	7.32
				Min	12.8	7.41	0.618	>999	479	4.92
				Range	2.0	0.41	0.099	ND	>520	2.40
				Average	13.9	7.72	0.652	>999	>715	6.39

ND = not determinable

Table A.2−25. Geoprobe Location 13353

Easting '83:	**1347770**	Feet
Northing '83:	**478105.9**	Feet
Ground Elevation:	**565**	Feet AMSL
Depth to Water Table:	**48**	Feet bgs
Water Table Elevation:	**517**	Feet AMSL
Work Completed:	**10/16/2007**	

Sample Point	Elevation (ft amsl)	Depth Feet bgs	Sample Interval	Uranium Conc. (5 micron filtered) (μg/L)	Temp 5-micron Celcius	pH 5-micron SU	Cond 5-micron us/cm	Turb NTU	Turb 5-micron NTU	DO 5-micron mg/L
1	512	53	0 feet - 10 feet	28.9	18.7	7.21	0.763	>999	>999	6.60
2	502	63	10 feet - 20 feet	12.7	17.9	7.36	0.653	>999	596	4.86
3	502	63	10 feet - 20 feet	12.9	17.9	7.36	0.653	>999	595	4.86
4	492	73	20-feet - 30 feet	14.0	17.3	7.36	0.615	>999	907	5.39
5	482	83	30 feet - 40 feet	11.6	14.6	6.95	0.609	>999	854	5.47
6	472	93	40 feet - 50 feet	1.8	14.9	6.88	0.685	>999	>999	4.97
7	462	103	50 feet - 60 feet							
8	452	113	60 feet - 70 feet							
9	442	123	70 feet - 80 feet							
Rinsate				< 1.0						

	Temp	pH	Cond	Turb	Turb 5-micron	DO
Max	18.7	7.36	0.763	>999	>999	6.60
Min	14.6	6.88	0.609	>999	595	4.86
Range	4.1	0.48	0.154	ND	>404	1.74
Average	16.9	7.19	0.663	>999	>825	5.36

ND = not determinable

Table A.2−26. Geoprobe Location 13354

Easting '83:	**1349097**	Feet
Northing '83:	**478276.4**	Feet
Ground Elevation:	**572.2**	Feet AMSL
Depth to Water Table:	**58**	Feet bgs
Water Table Elevation:	**514.2**	Feet AMSL
Work Completed:	**10/16/2007**	

Sample Point	Elevation (ft amsl)	Depth Feet bgs	Sample Interval	Uranium Conc. (5 micron filtered) (µg/L)	Temp 5-micron Celcius	pH 5-micron SU	Cond 5-micron us/cm	Turb NTU	Turb 5-micron NTU	DO 5-micron mg/L
1	509	63	0 feet - 10 feet	10.5	15.1	7.52	1.080	>999	>999	5.90
2	499.2	73	10 feet - 20 feet	4.5	15.4	7.67	1.050	>999	>999	5.05
3	499.2	73	10 feet - 20 feet	3.9	15.4	7.67	1.050	>999	>999	5.05
4	489.2	83	20-feet - 30 feet	4.9	15.9	7.82	0.762	>999	539	4.68
5	479.2	93	30 feet - 40 feet	2.8	15.2	7.92	0.670	>999	455	4.20
6	469.2	103	40 feet - 50 feet	2.6	15.5	7.83	0.645	>999	809	5.29
7	459.2	113	50 feet - 60 feet							
8	449.2	123	60 feet - 70 feet							
9	439.2	133	70 feet - 80 feet							
Rinsate				< 1.0						

	Temp	pH	Cond	Turb	Turb 5-micron	DO
Max	15.9	7.92	1.080	>999	>999	5.90
Min	15.1	7.52	0.645	>999	455	4.20
Range	0.8	0.40	0.435	ND	>544	1.70
Average	15.4	7.74	0.876	>999	>800	5.03

ND = not determinable

Table A.2−27. Geoprobe Location 13357

Easting '83:	**1349121**	Feet
Northing '83:	**475740**	Feet
Ground Elevation:	**581.22**	Feet AMSL
Depth to Water Table:	**63**	Feet bgs
Water Table Elevation:	**518.22**	Feet AMSL
Work Completed:	**2/1/2007**	

Sample Point	Elevation (ft amsl)	Depth Feet bgs	Sample Interval	Uranium Conc. (5 micron filtered) (μg/L)	Temp 5-micron Celcius	pH 5-micron SU	Cond 5-micron us/cm	Turb NTU	Turb 5-micron NTU	DO 5-micron mg/L
1	513.22	68	0 feet - 10 feet	< 1.0	9.3	7.17	0.714	>999	>999	7.32
2	503.22	78	10 feet - 20 feet	26.6	9.2	7.52	0.722	>999	>999	7.20
3	503.22	78	10 feet - 20 feet	27.9	9.2	7.52	0.722	>999	>999	7.20
4	493.22	88	20-feet - 30 feet	17.8	8.5	7.59	0.722	>999	>999	7.25
5	483.22	98	30 feet - 40 feet	< 1.0	9.3	7.42	18.6 *	>999	950	4.41
6	473.22	108	40 feet - 50 feet	1.1	8.5	7.55	18.8 *	>999	>999	6.79
7	463.22	118	50 feet - 60 feet	1.1	7.7	7.52	18 *	>999	>999	7.10
8	453.22	128	60 feet - 70 feet							
9	443.22	138	70 feet - 80 feet							
Rinsate				< 1.0						

	Temp	pH	Cond	Turb	Turb	DO
Max	9.3	7.59	0.722	>999	>999	7.32
Min	7.7	7.17	0.714	>999	950	4.41
Range	1.6	0.42	0.008	ND	>49	2.91
Average	8.8	7.47	0.720	>999	>992	6.75

* Reported reading does not make sense
ND = not determinable

Table A.2−28. Geoprobe Location 13360

Easting '83:	**1349810**	Feet
Northing '83:	**480113.4**	Feet
Ground Elevation:	**573.8**	Feet AMSL
Depth to Water Table:	**56.5**	Feet bgs
Water Table Elevation:	**517.3**	Feet AMSL
Work Completed:	**7/25/2007**	

Sample Point	Elevation (ft amsl)	Depth Feet bgs	Sample Interval	Uranium Conc. (5 micron filtered) (μg/L)	Temp 5-micron Celcius	pH 5-micron SU	Cond 5-micron us/cm	Turb NTU	Turb 5-micron NTU	DO 5-micron mg/L
1	512.3	62	0 feet - 10 feet	< 1.0	16.2	7.19	1.200	>999	>999	5.49
2	502.3	72	10 feet - 20 feet	1.0	16.9	7.27	1.050	>999	>999	4.89
3	502.3	72	10 feet - 20 feet	1.2	16.9	7.27	1.050	>999	>999	4.89
4	492.3	82	20-feet - 30 feet	< 1.0	17.1	7.52	0.844	>999	273	2.13
5	482.3	92	30 feet - 40 feet							
6	472.3	102	40 feet - 50 feet							
7	462.3	112	50 feet - 60 feet							
8	452.3	122	60 feet - 70 feet							
9	442.3	132	70 feet - 80 feet							
Rinsate				< 1.0						

	Temp	pH	Cond	Turb	Turb 5-micron	DO
Max	17.1	7.52	1.200	>999	>999	5.49
Min	16.2	7.19	0.844	>999	273	2.13
Range	0.9	0.33	0.356	ND	>726	3.36
Average	16.8	7.31	1.036	>999	>818	4.35

ND = not determinable

Table A.2−29. Geoprobe Location 13369

Easting '83:	**1346418**	Feet
Northing '83:	**481315.7**	Feet
Ground Elevation:	**558.4**	Feet AMSL
Depth to Water Table:	**39.5**	Feet bgs
Water Table Elevation:	**518.9**	Feet AMSL
Work Completed:	**6/7/2007**	

Sample Point	Elevation (ft amsl)	Depth Feet bgs	Sample Interval Feet	Uranium (ug/L) (FRL=30)	Tech-99 (pCi/L) (FRL=94)	Nitrate/Nitrite (mg/L) (FRL=11)	Manganese (mgL) (FRL=0.9)	Molybdenum (mgL) (FRL=0.1)	Nickel (mgL) (FRL=0.1)	Temp Celcius	pH SU	Cond us/cm	Turb NTU U	Turb NTU	DO mg/L
1	513.9	44.5	0 to 10	166	1.91	1.09	1.3	0.0231	0.0081	19.7	7.86	0.672	>999	51	5.79
2	503.9	54.5	10 to 20	16.4	U	2.58	0.018	0.0077	0.0039	15.3	7.80	0.598	>999	197	1.28
3	503.9	54.5	10 to 20	15.8	U	2.72	0.222	0.0084	0.0056	15.3	7.80	0.598	>999	197	1.28
4	493.9	64.5	20 to 30	4.1	U	0.143	0.671	0.0098	0.0178	19.2	7.90	0.626	>999	>999	1.77
5	483.9	74.5	30 to 40	10.4	U	U	0.833	0.0069	0.0094	17.1	7.50	1.060	>999	>999	4.01
Rinsate				U											

	Temp	pH	Cond	Turb NTU U	Turb NTU	DO
Max	19.7	7.90	1.060	>999	>999	5.79
Min	15.3	7.50	0.598	>999	51	1.28
Range	4.4	0.40	0.462	ND	>948	4.51
Average	17.3	7.77	0.711	>999	>489	2.83

ND = not determinable

Table A.2−30. Geoprobe Location 13370

Easting '83:	**1347192**	Feet
Northing '83:	**481599.7**	Feet
Ground Elevation:	**574.3**	Feet AMSL
Depth to Water Table:	**55**	Feet bgs
Water Table Elevation:	**519.3**	Feet AMSL
Work Completed:	**7/5/2007**	

Sample Point	Elevation (ft amsl)	Depth Feet bgs	Sample Interval Feet	Uranium (ug/L) (FRL=30)	Tech-99 (pCi/L) (FRL=94)	Nitrate/Nitrite (mg/L) (FRL=11)	Manganese (mgL) (FRL=0.9)	Molybdenum (mgL) (FRL=0.1)	Nickel (mgL) (FRL=0.1)	Temp Celcius	pH SU	Cond us/cm	Turb NTU U	Turb NTU	DO mg/L
1	514.3	60	0 to 10	1.3	163	129	0.91	0.0753	0.0203	17.5	7.28	2.030	>999	657	3.98
2	504.3	70	10 to 20	4.3	56.2	60.8	1.23	0.0605	0.0246	17.1	7.40	2.090	>999	60	2.94
3	504.3	70	10 to 20	3.6	47.0	77.8	1.16	0.0611	0.0178	17.1	7.40	2.090	>999	60	2.94
4	494.3	80	20 to 30	6.4	253.0	160.0	0.334	0.0620	0.0125	19.2	7.22	3.000	>999	>999	3.66
5	484.3	90	30 to 40	3.0	43.6	42.5	0.646	0.0521	0.0285	20.8	7.24	3.730	>999	>999	3.08
6	474.3	100	40 to 50												
7	464.3	110	50 to 60												
8	454.3	120	60 to 70												
9	444.3	130	70 to 80												
Rinsate				< 1.0											

	Temp Celcius	pH SU	Cond us/cm	Turb NTU U	Turb NTU	DO mg/L
Max	20.8	7.40	3.730	>999	>999	3.98
Min	17.1	7.22	2.030	>999	60	2.94
Range	3.7	0.18	1.700	ND	>939	1.04
Average	18.3	7.31	2.588	>999	>555	3.32

ND = not determinable

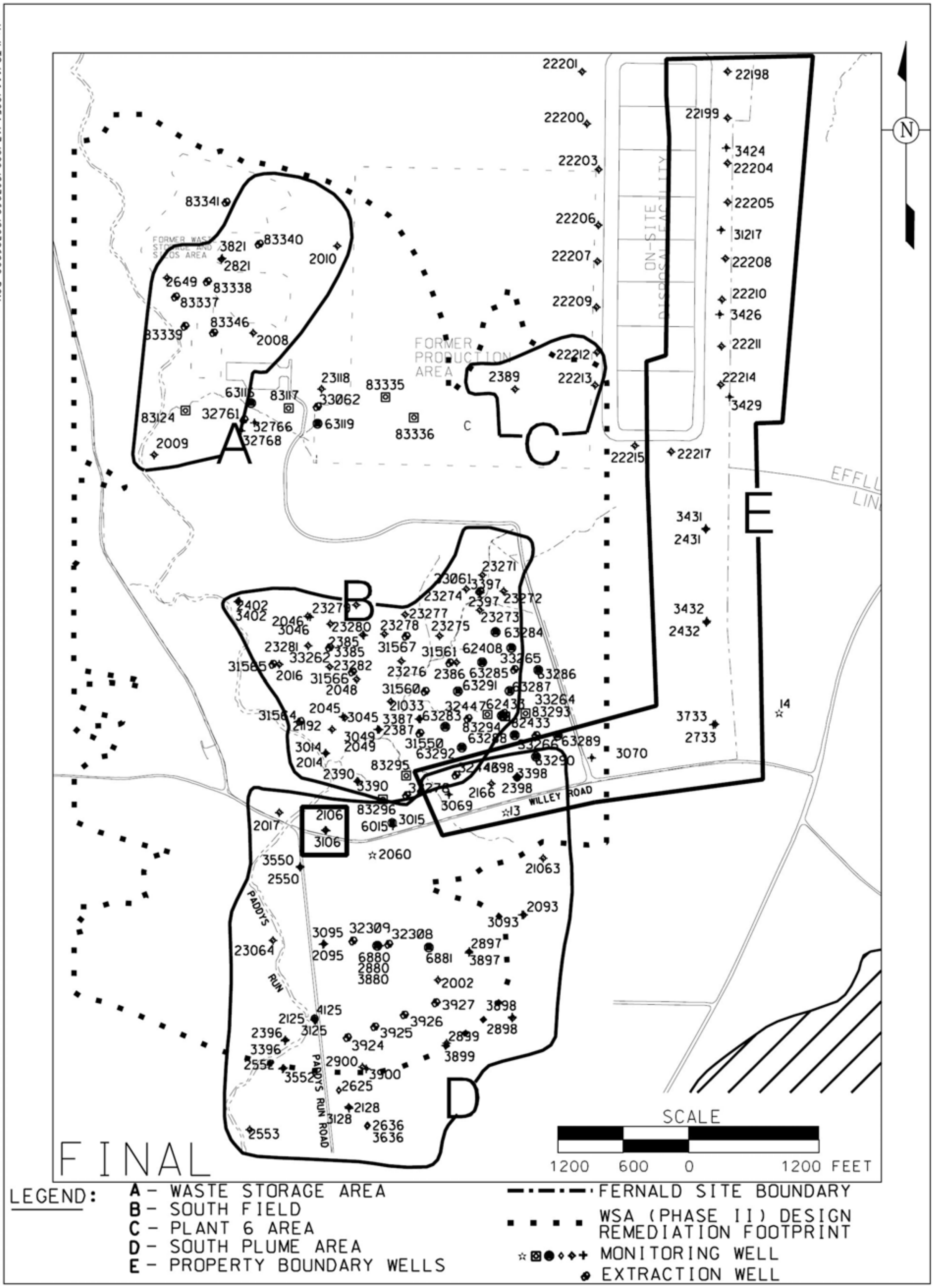

Figure A.2−1. IEMP Water Quality Monitoring Wells and Extraction Wells

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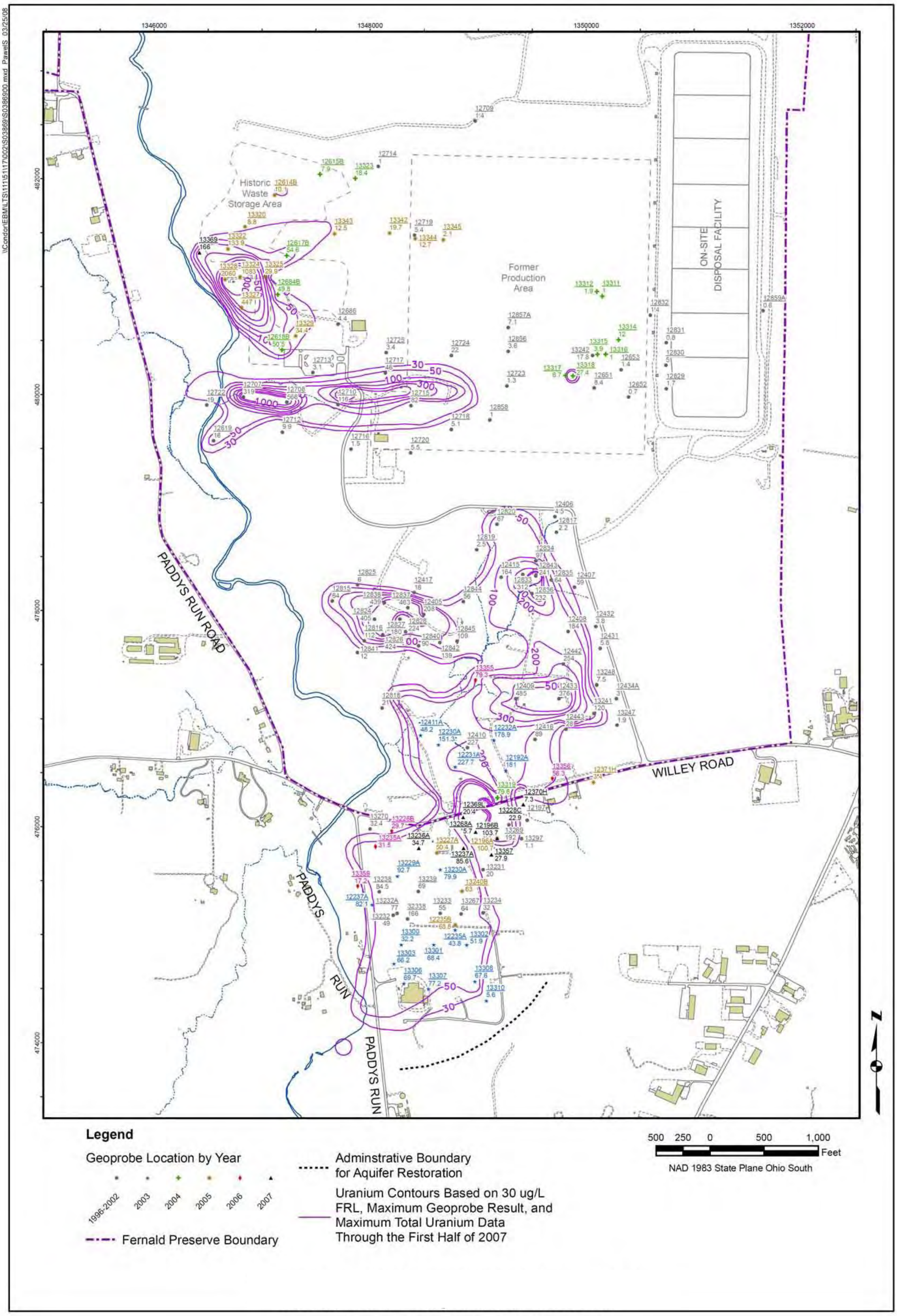


Figure A.2−2A. Direct-Push Data and Maximum Total Uranium Plume Through the First Half of 2007

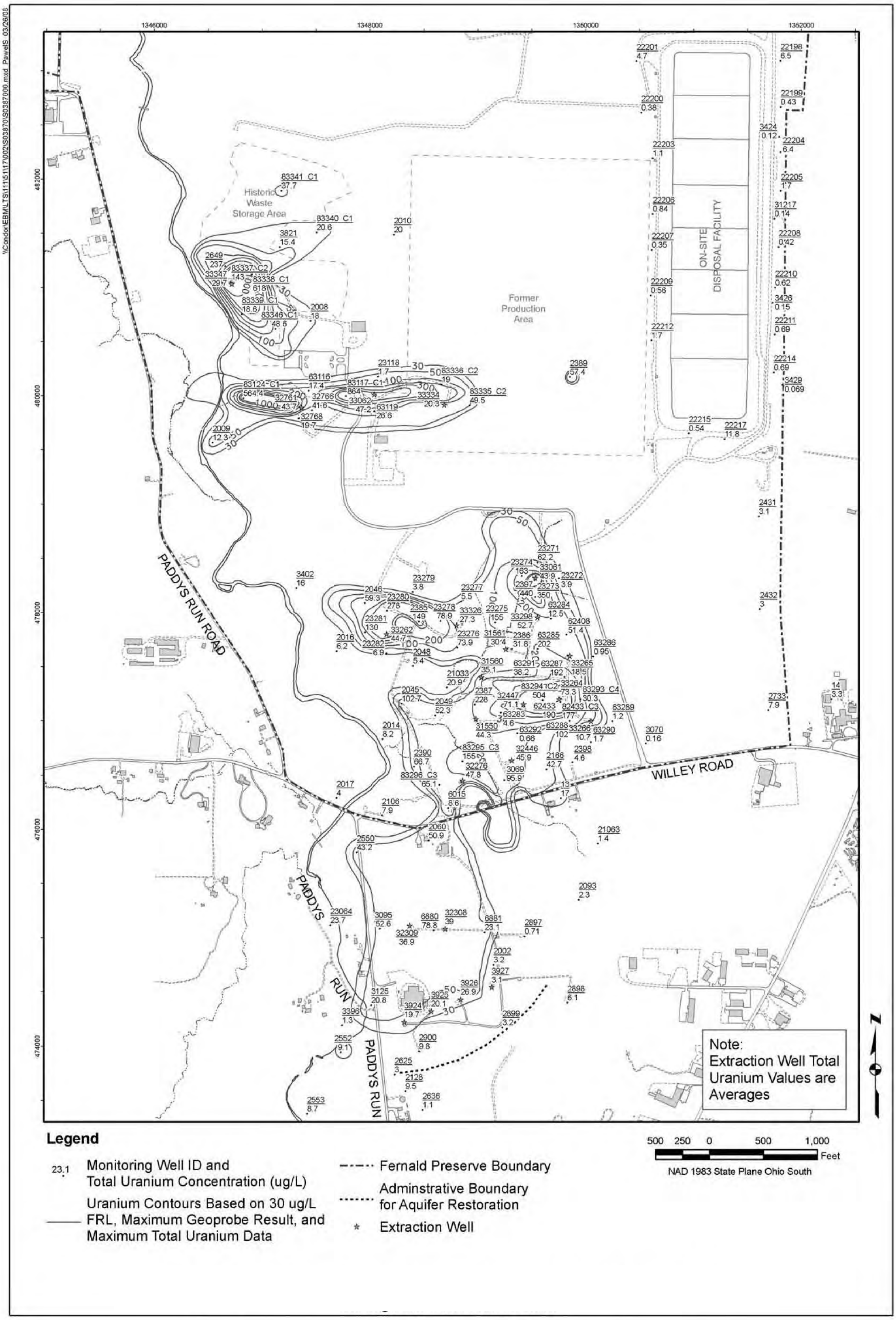


Figure A.2−2B. Monitoring Well Data and Maximum Total Uranium Plume Through the First Half of 2007

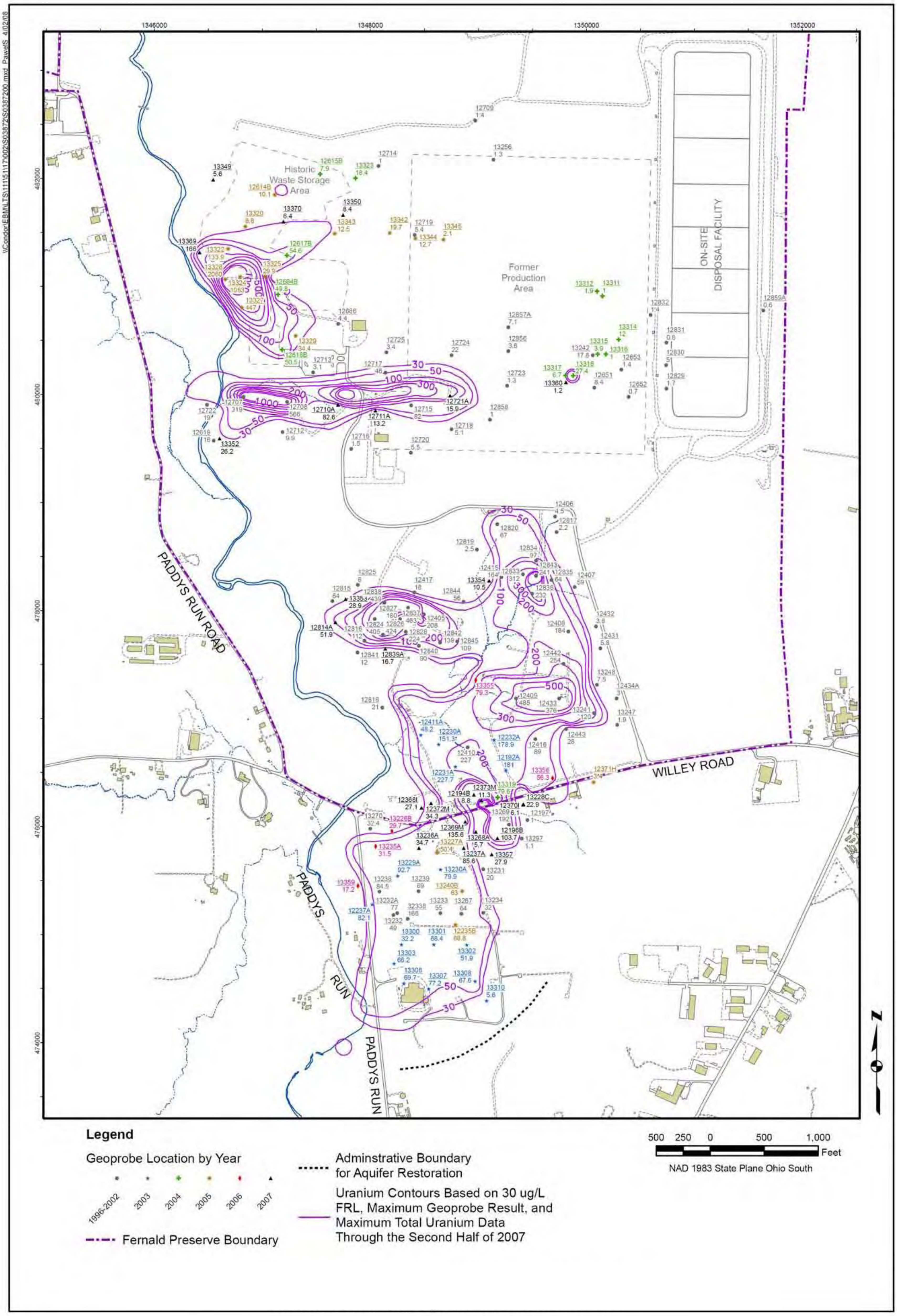


Figure A.2−3A. Direct-Push Data and Maximum Total Uranium Plume Through the Second Half of 2007

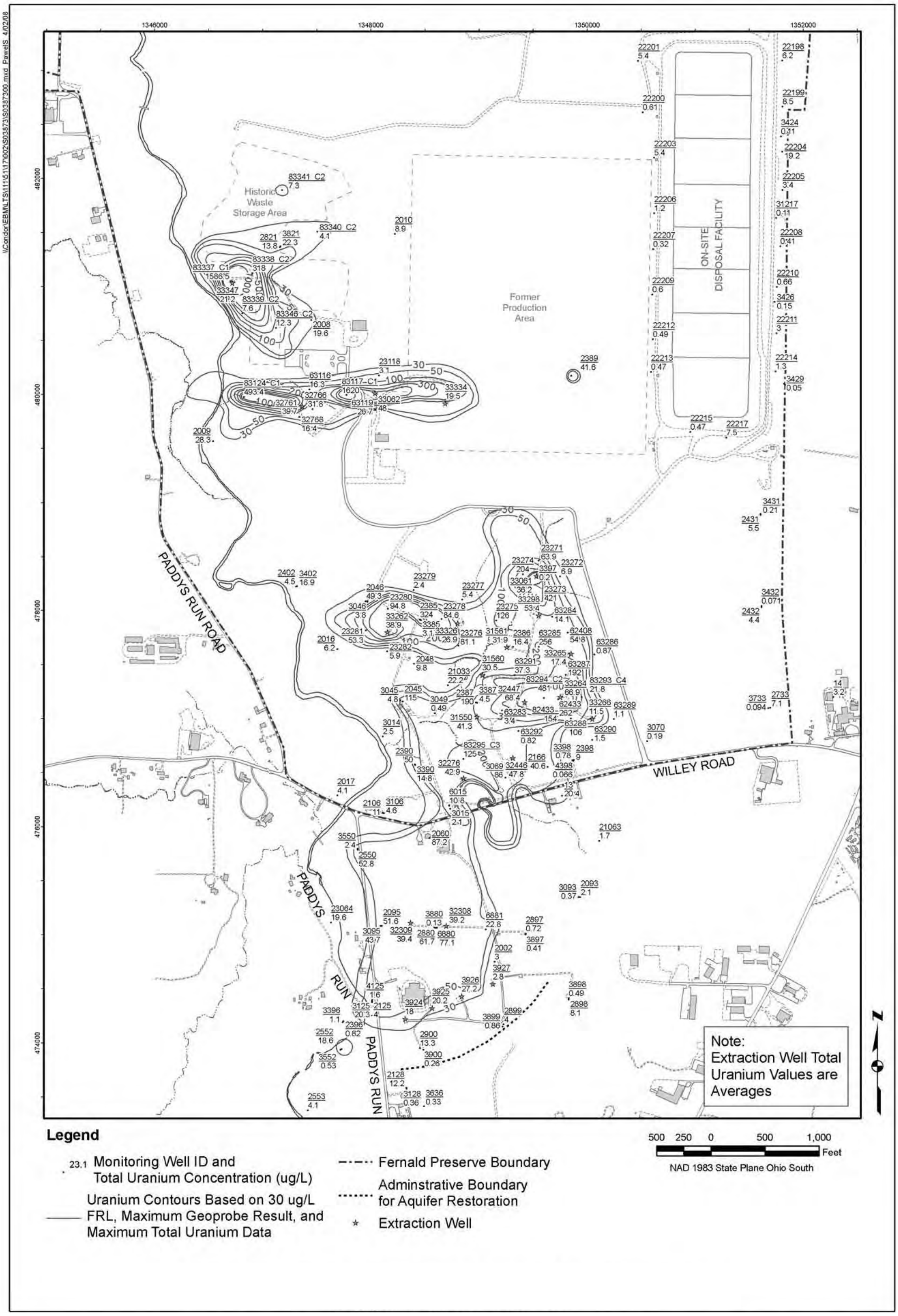


Figure A.2−3B. Monitoring Well Data and Maximum Total Uranium Plume Through the Second Half of 2007

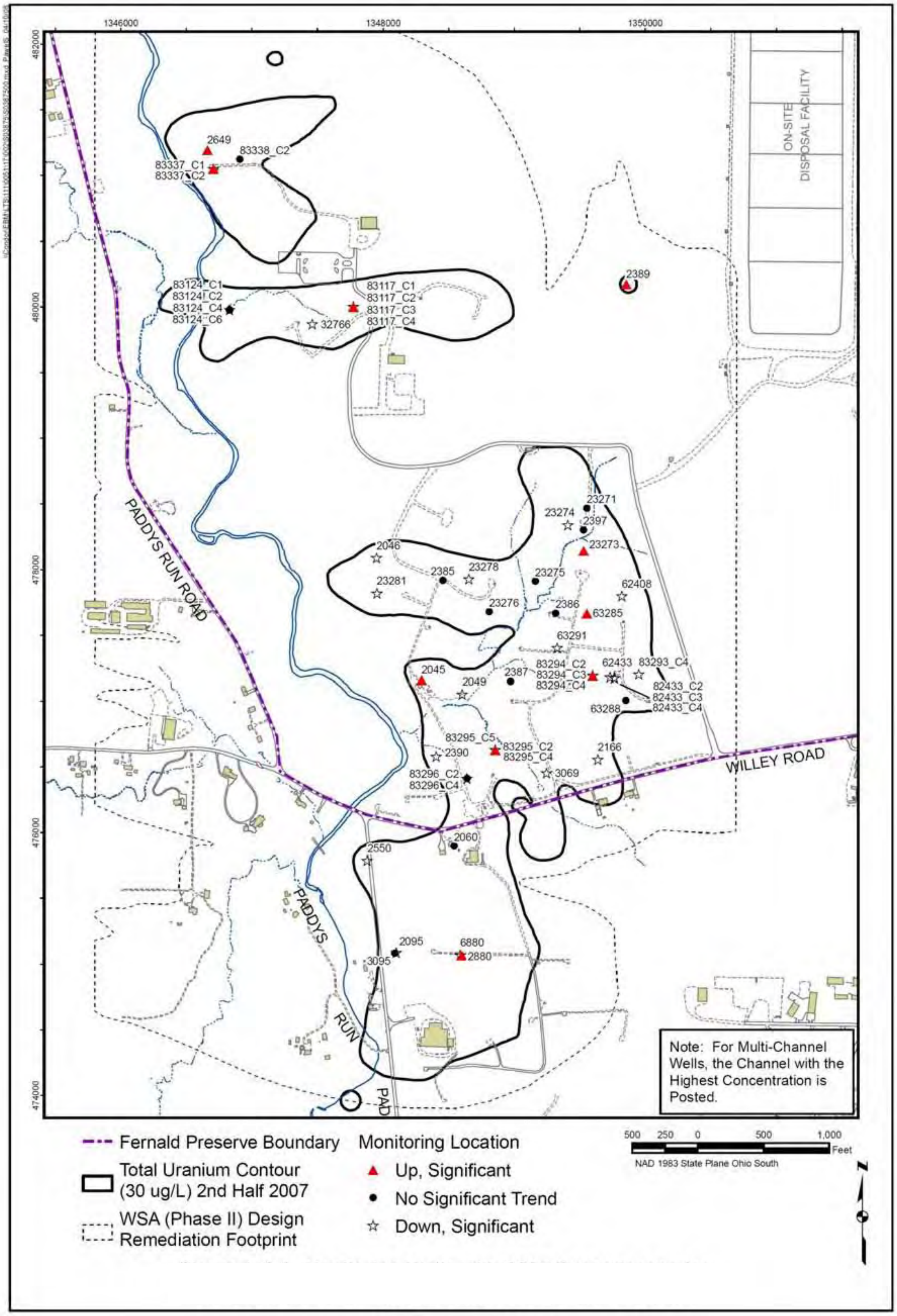


Figure A.2−4. Monitoring Wells with 2007 Exceedances for Total Uranium with Up, Down, or No Significant Trends

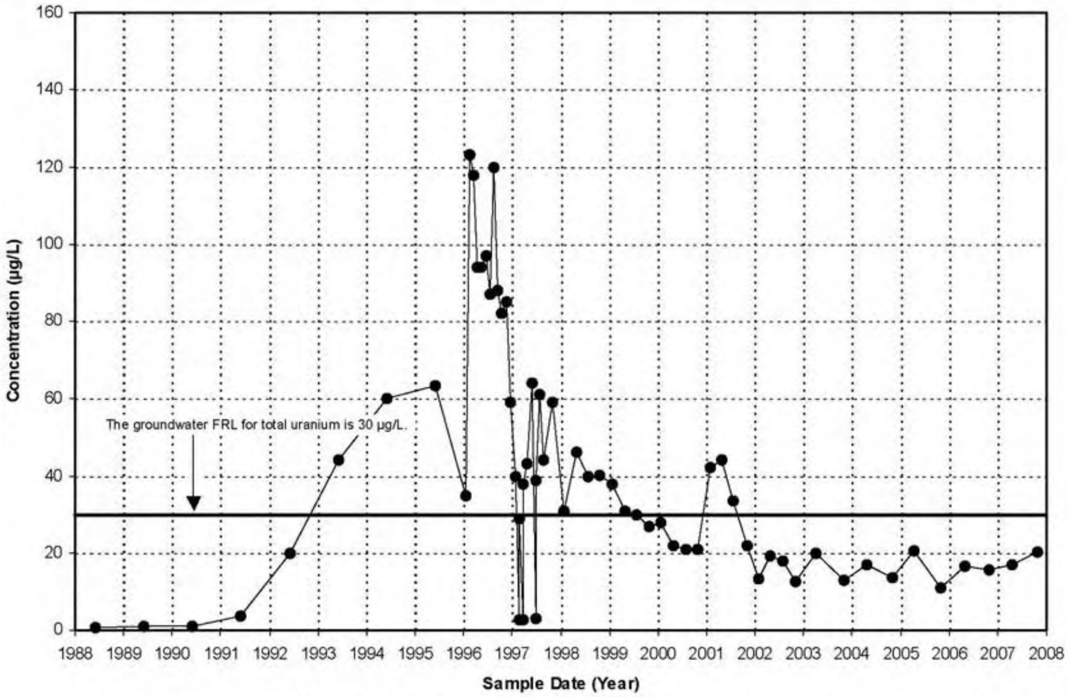


FIGURE A.2-5. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 13

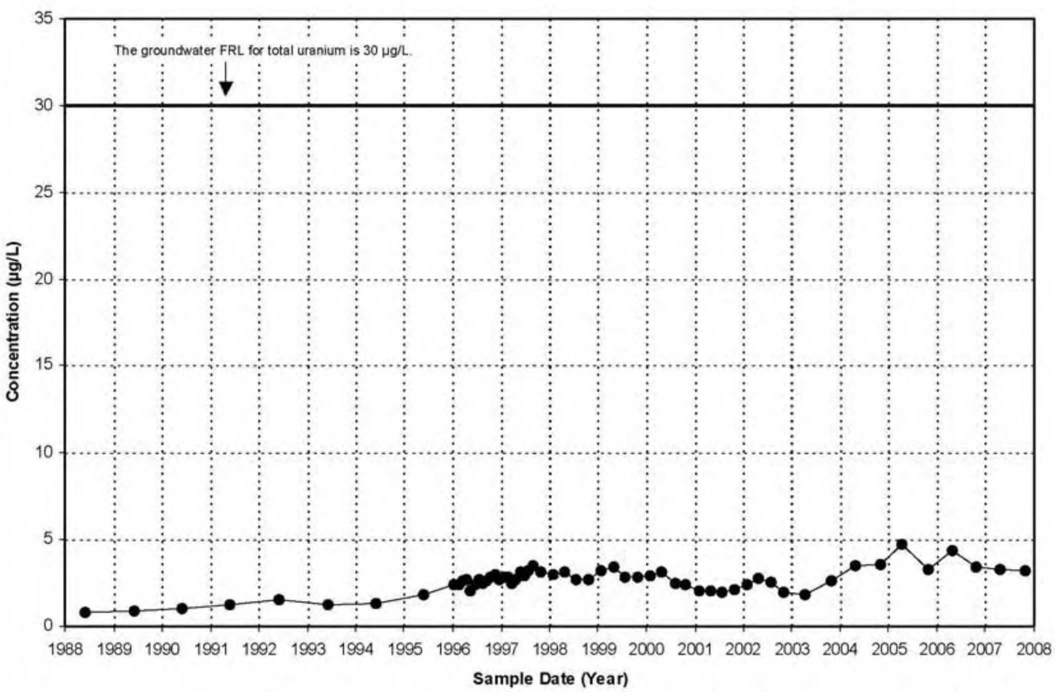


FIGURE A.2-6. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 14

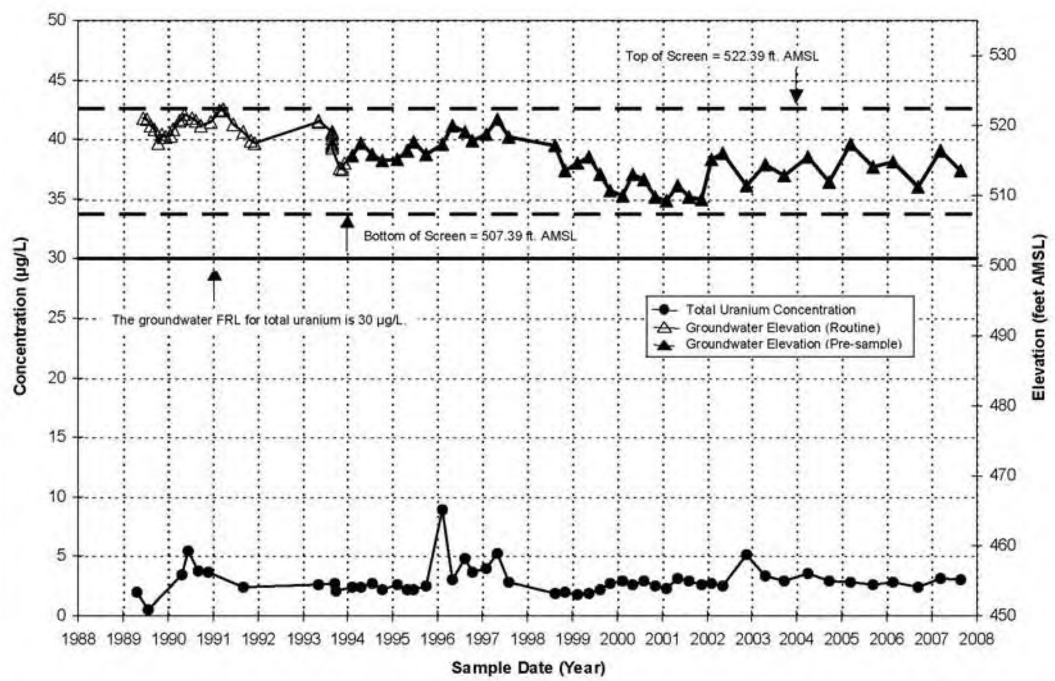


FIGURE A.2-7. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 2002

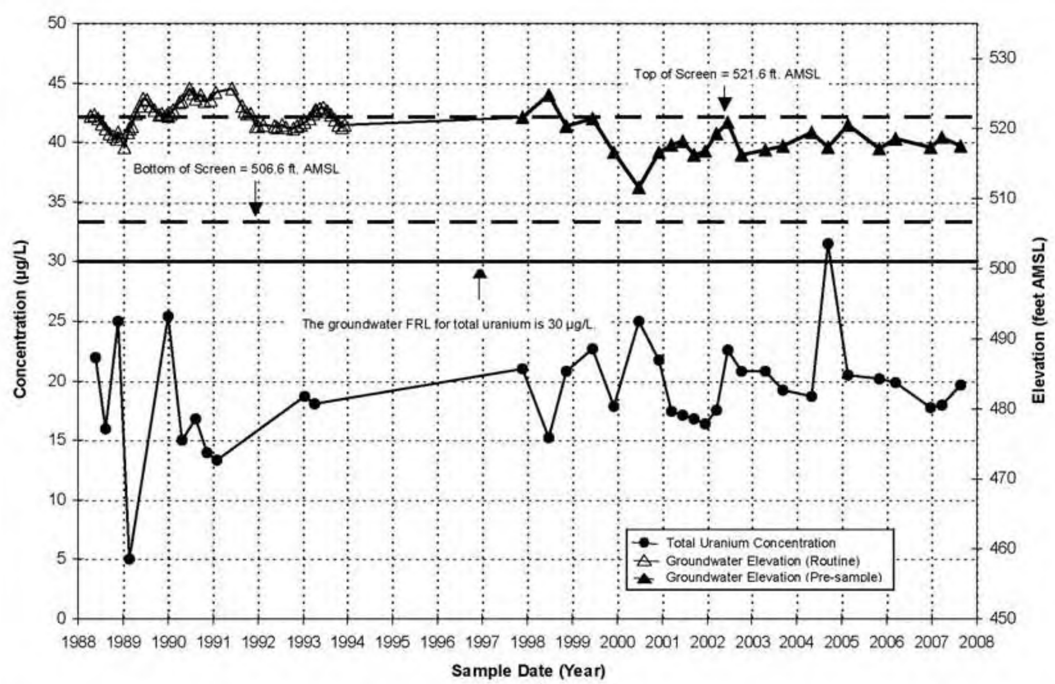


FIGURE A.2-8. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 2008

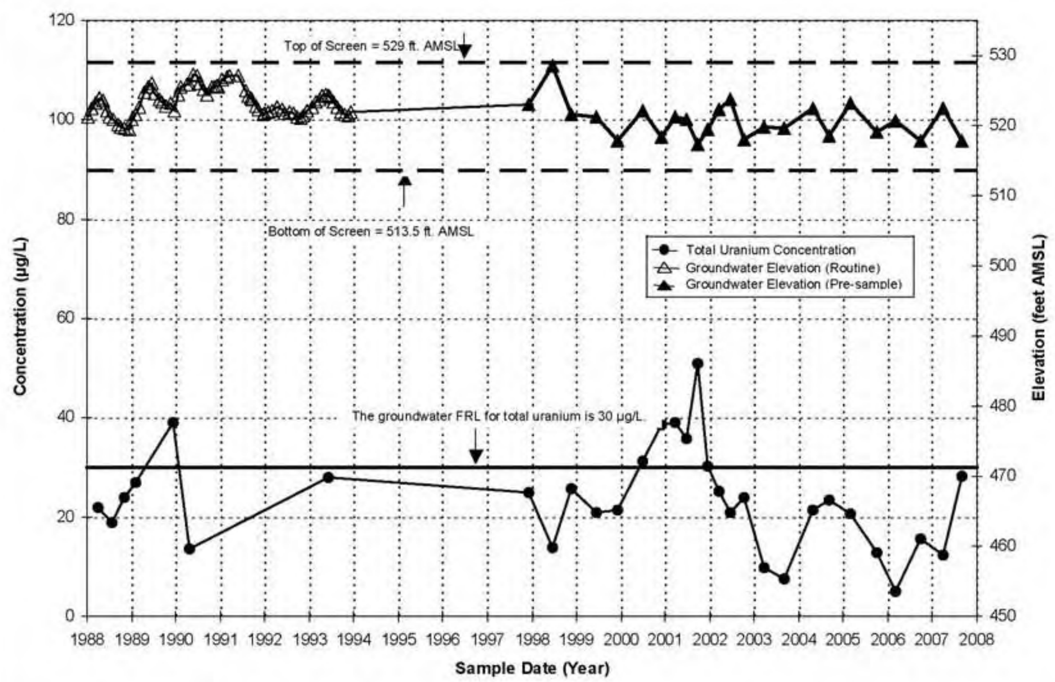


FIGURE A.2-9. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 2009

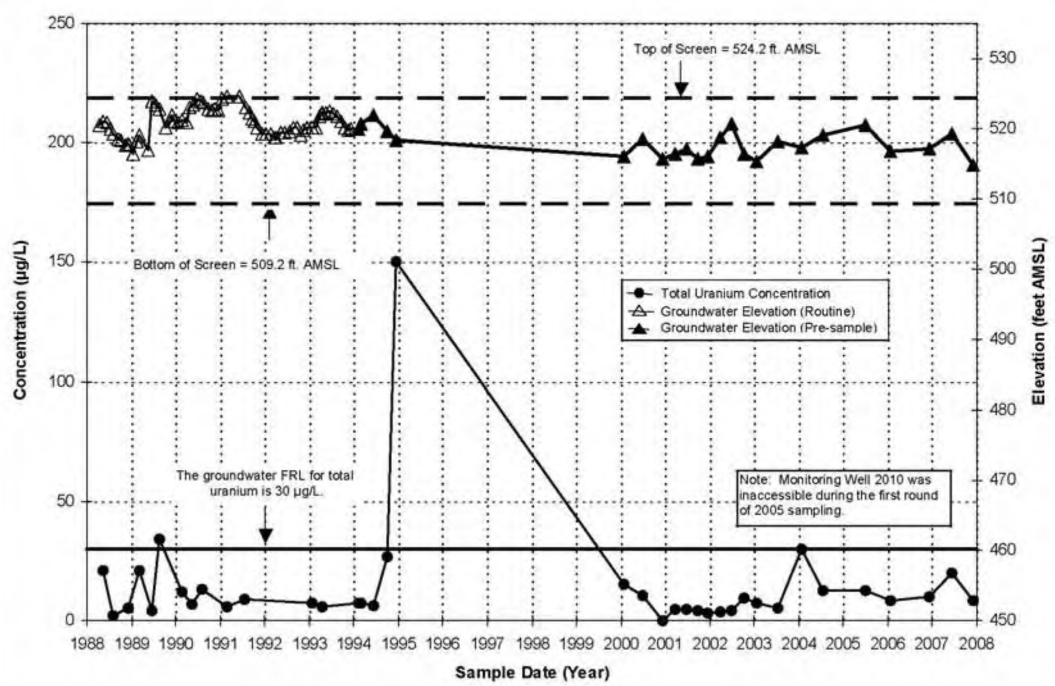


FIGURE A.2-10. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 2010

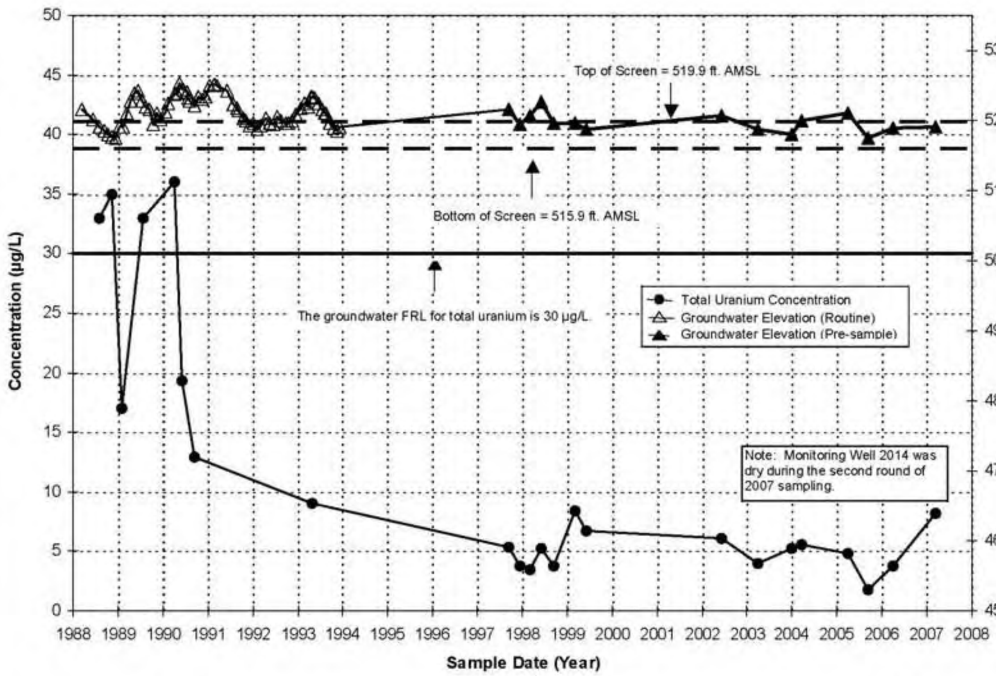


FIGURE A.2-11. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 2014

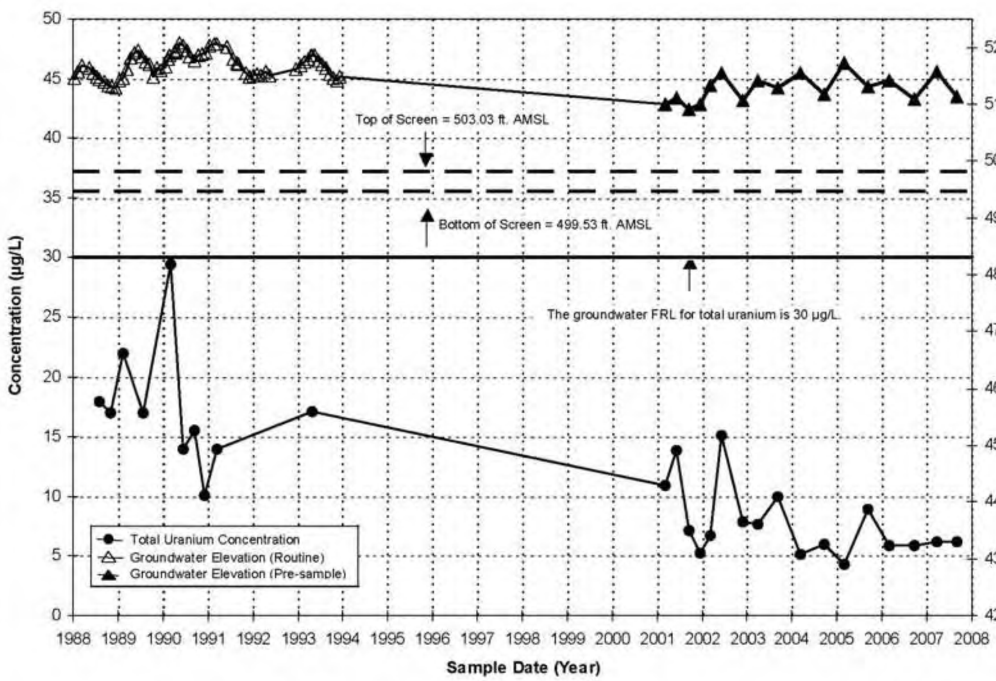


FIGURE A.2-12. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 2016

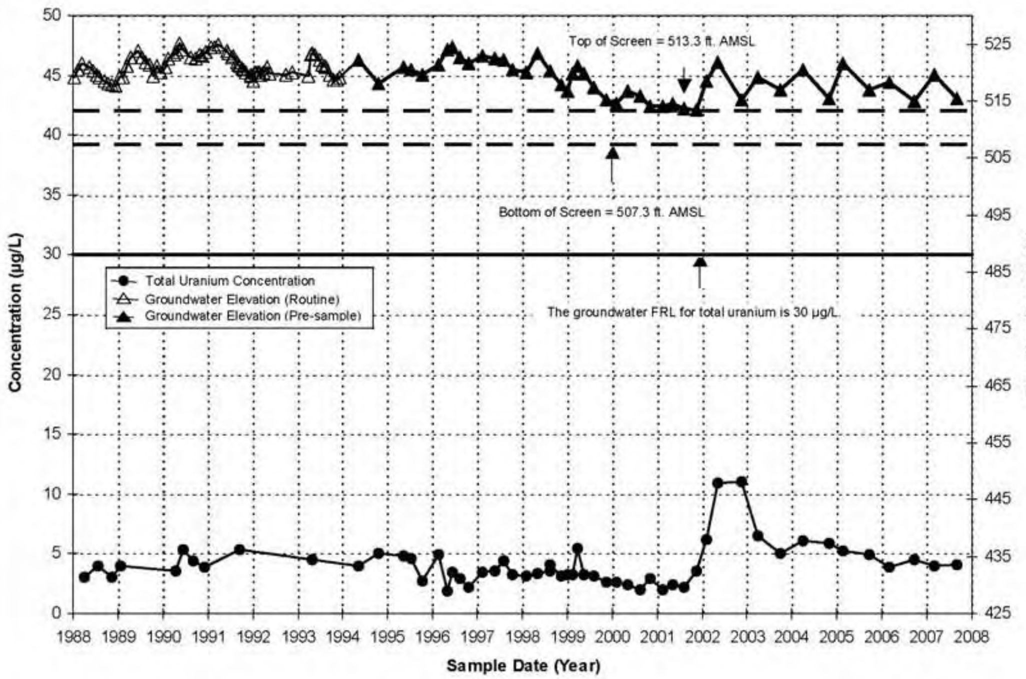


FIGURE A.2-13. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 2017

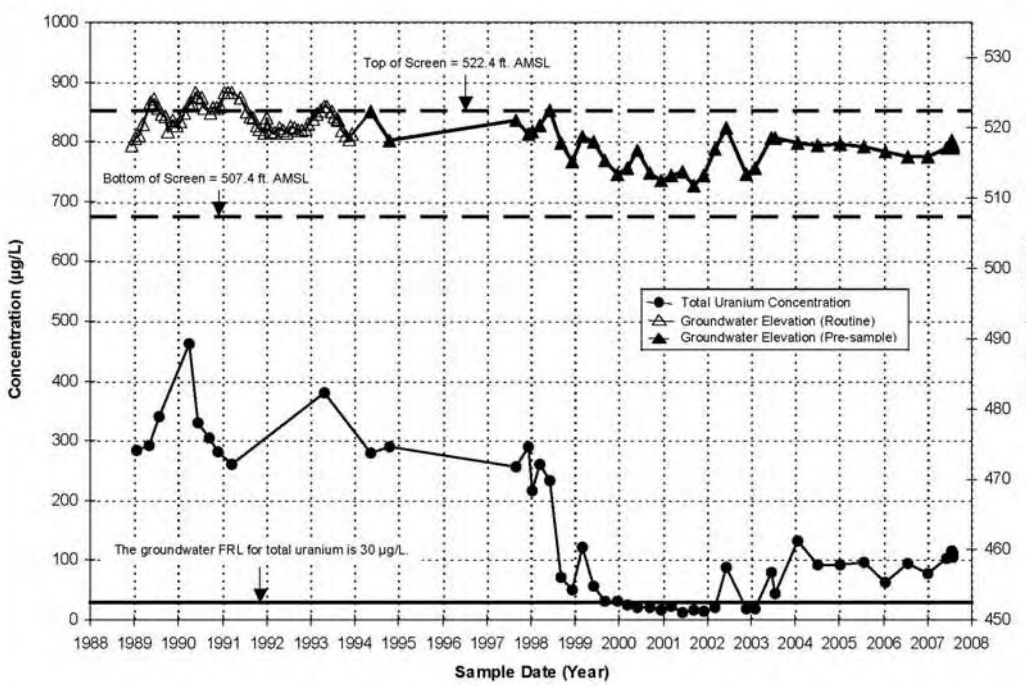


FIGURE A.2-14. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 2045

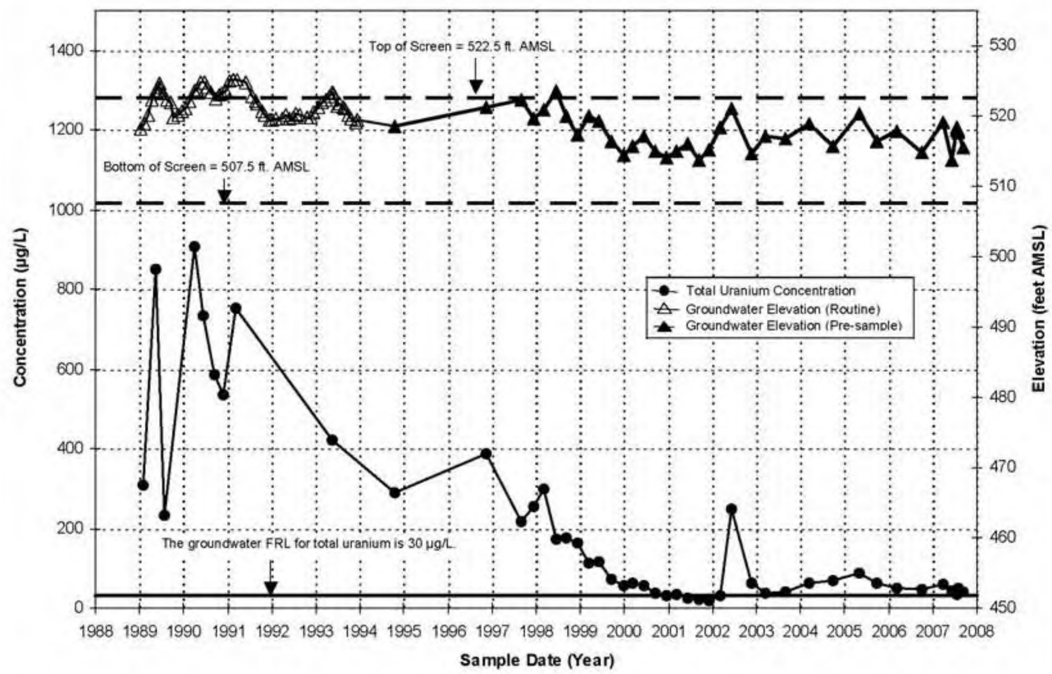


FIGURE A.2-15. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 2046

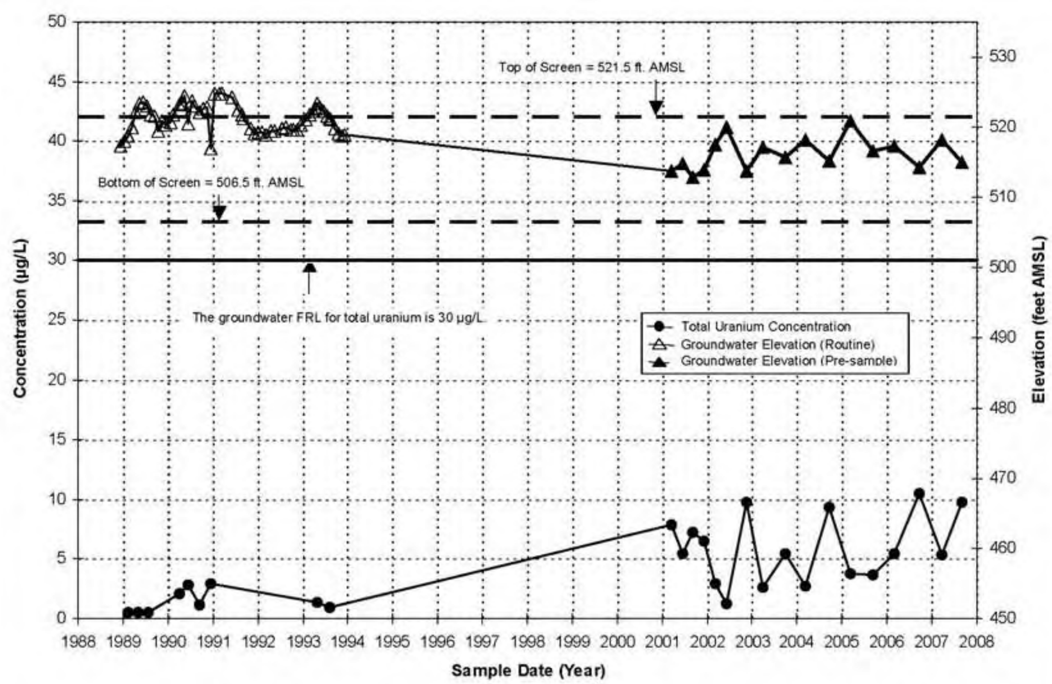


FIGURE A.2-16. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 2048

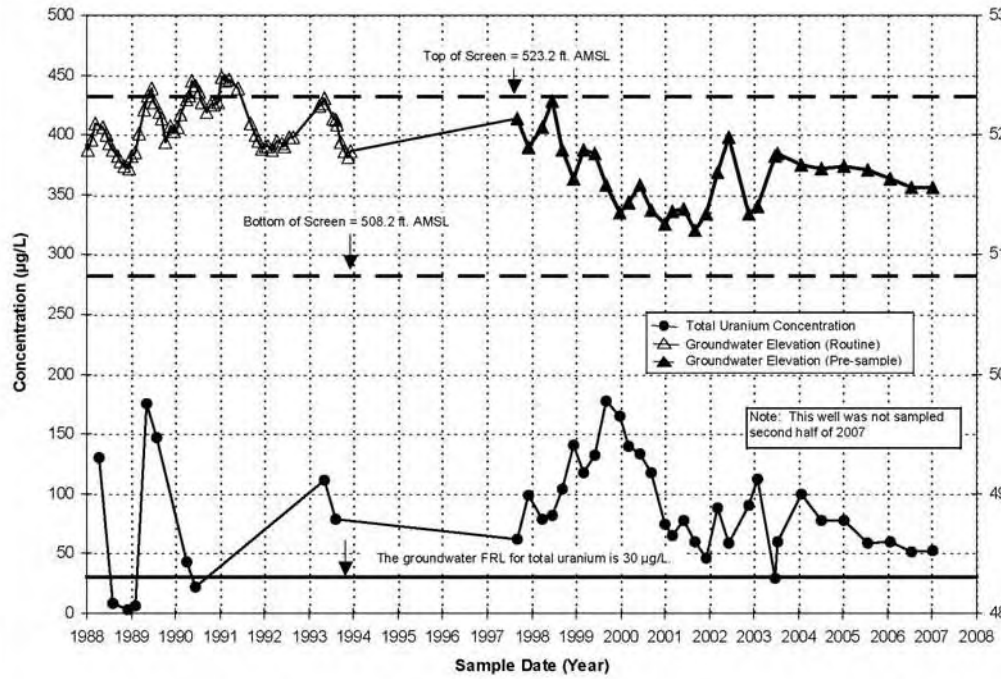


FIGURE A.2-17. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 2049

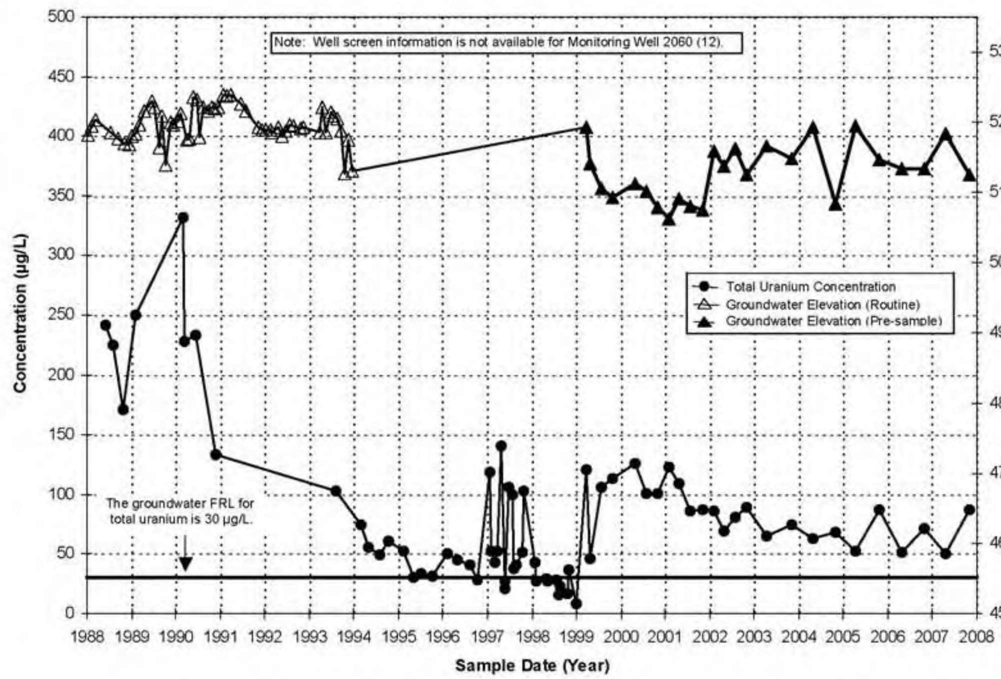


FIGURE A.2-18. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 2060 (12)

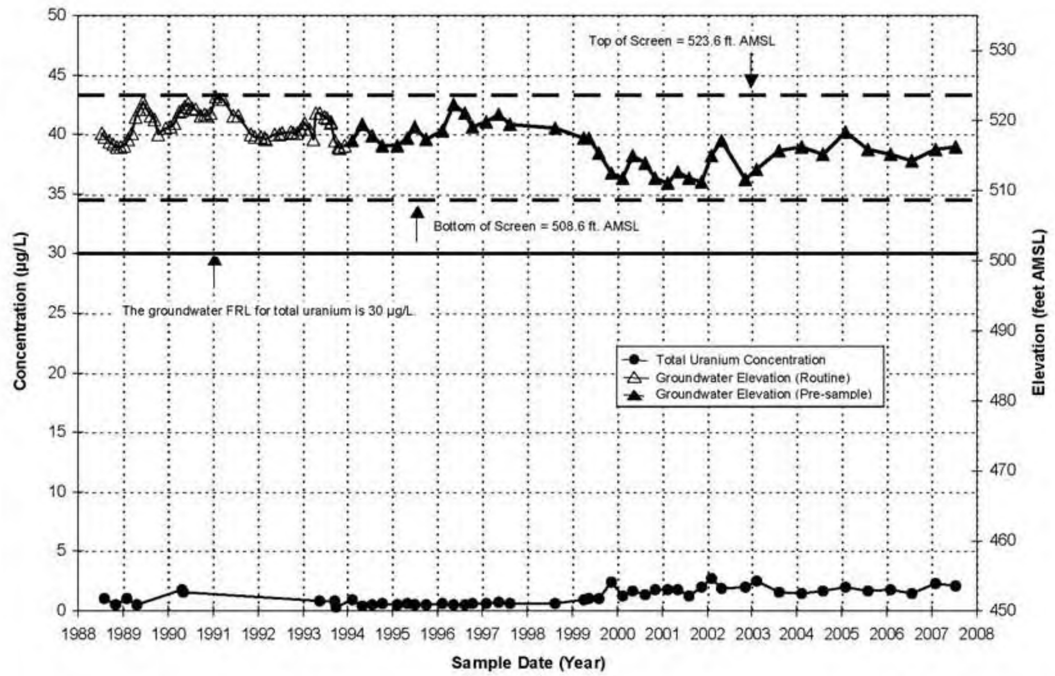


FIGURE A.2-19. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 2093

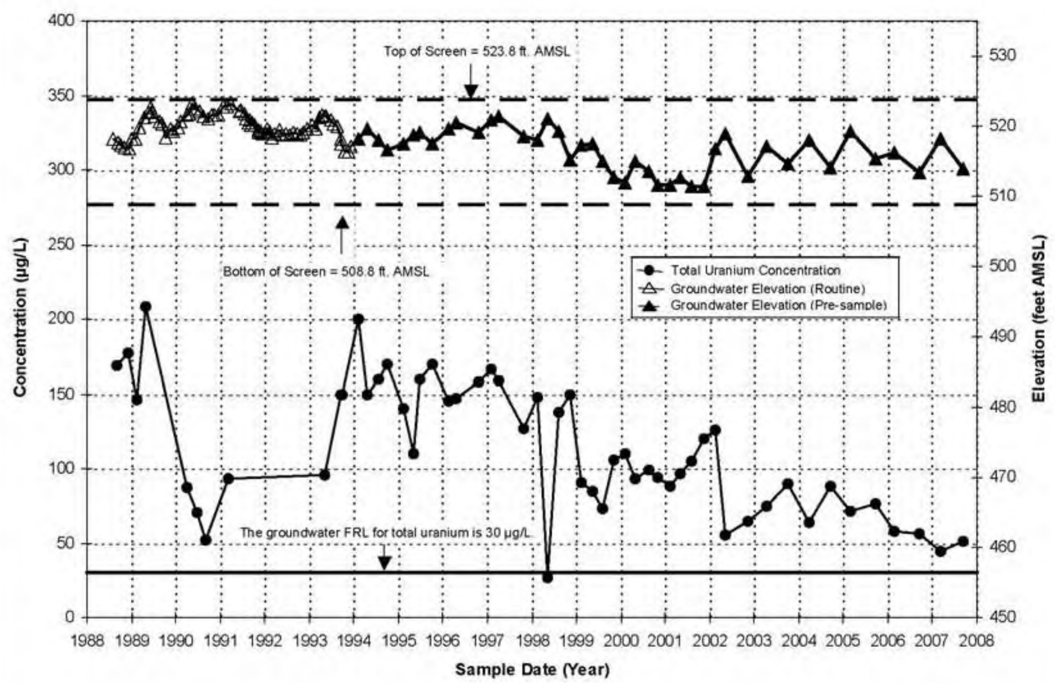


FIGURE A.2-20. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 2095

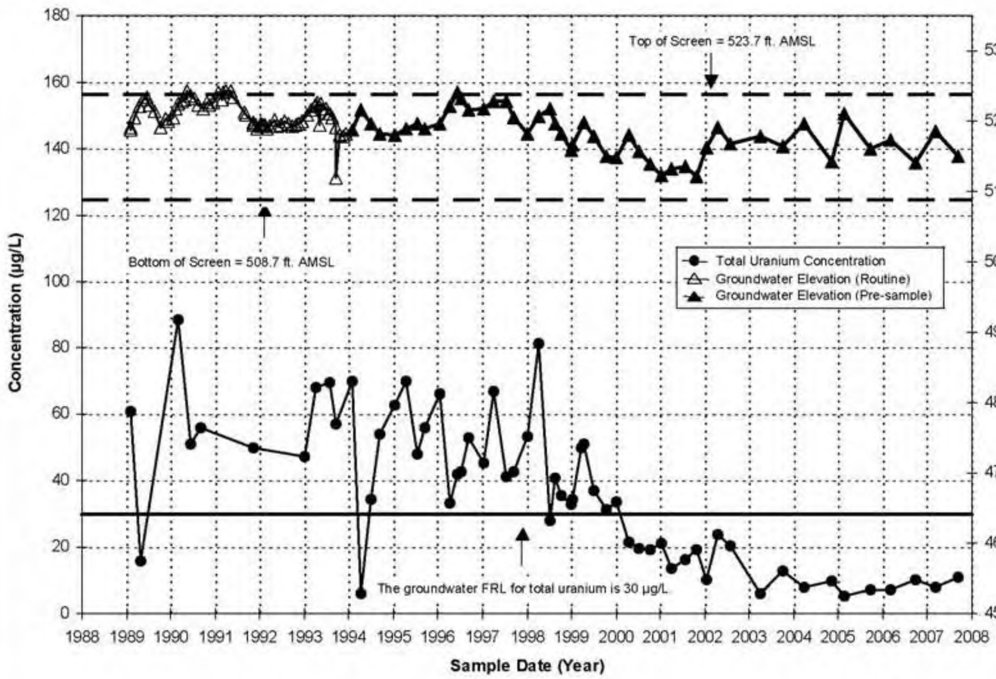


FIGURE A.2-21. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 2106

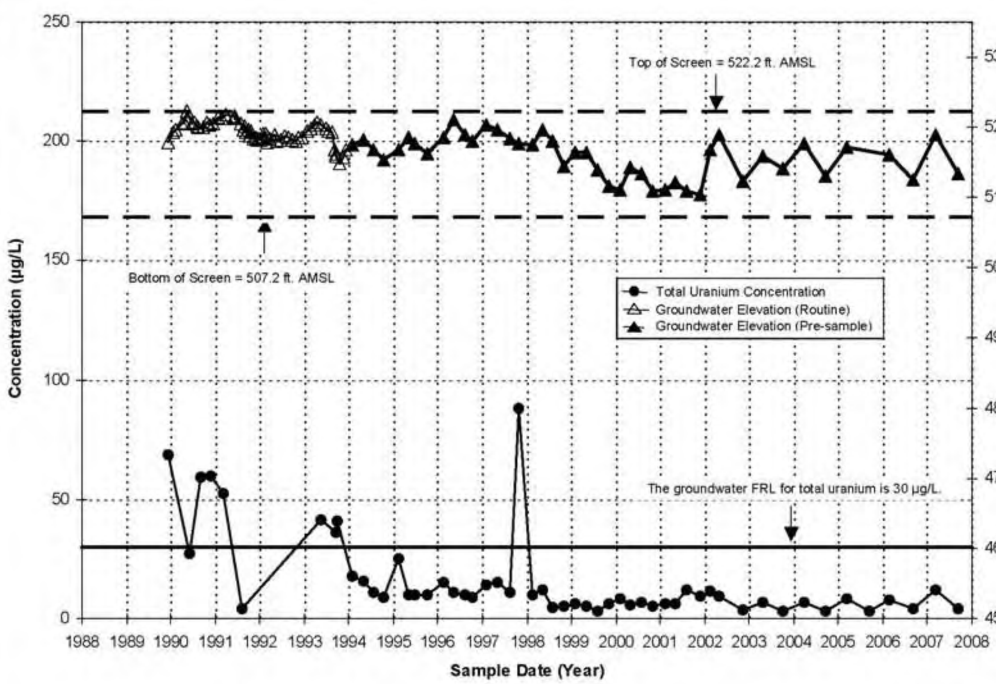


FIGURE A.2-22. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 2125

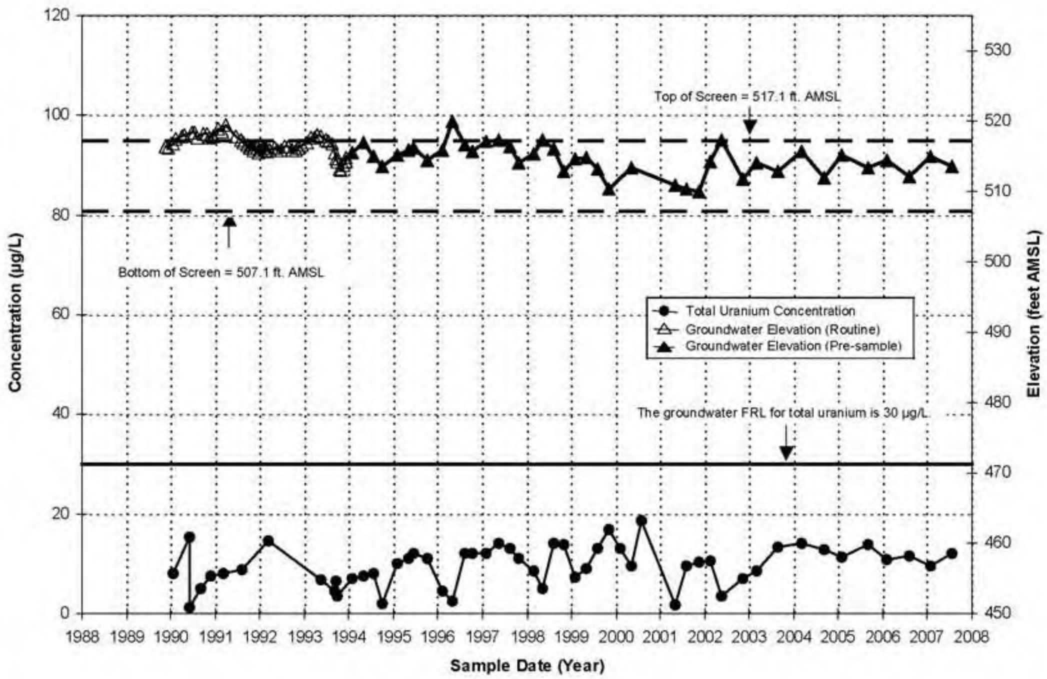


FIGURE A.2-23. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 2128

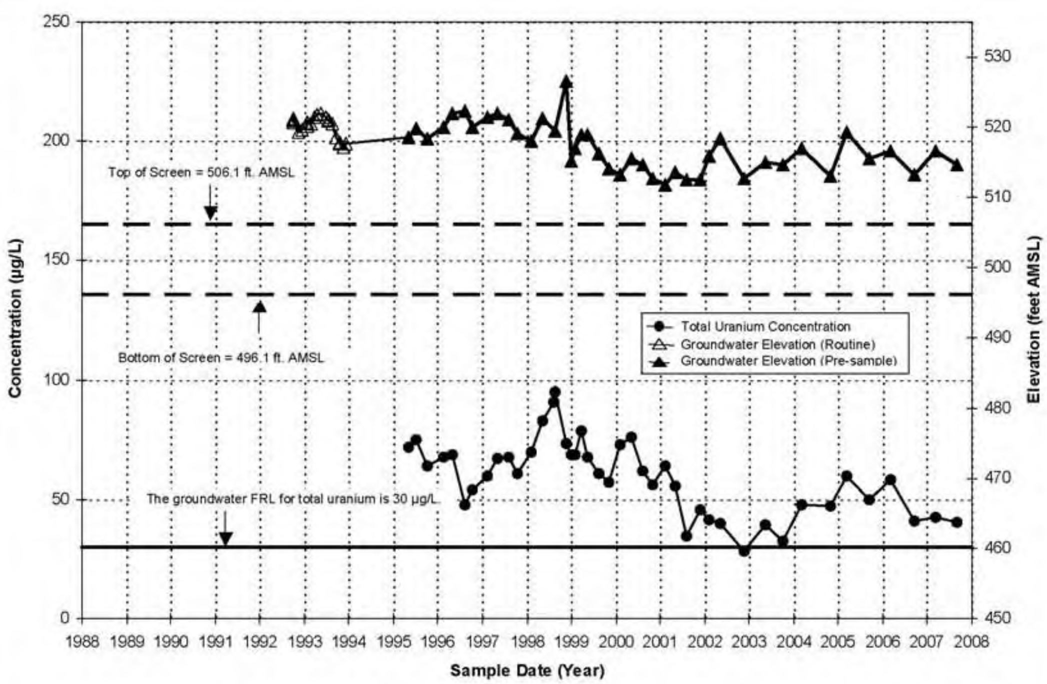


FIGURE A.2-24. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 2166

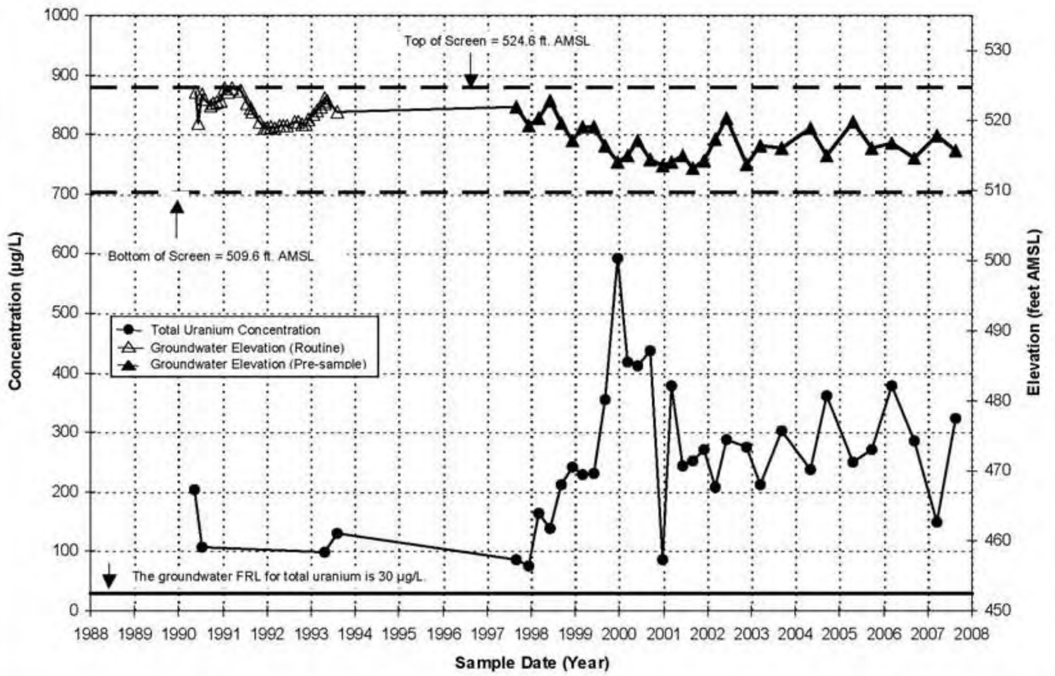


FIGURE A.2-25. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 2385

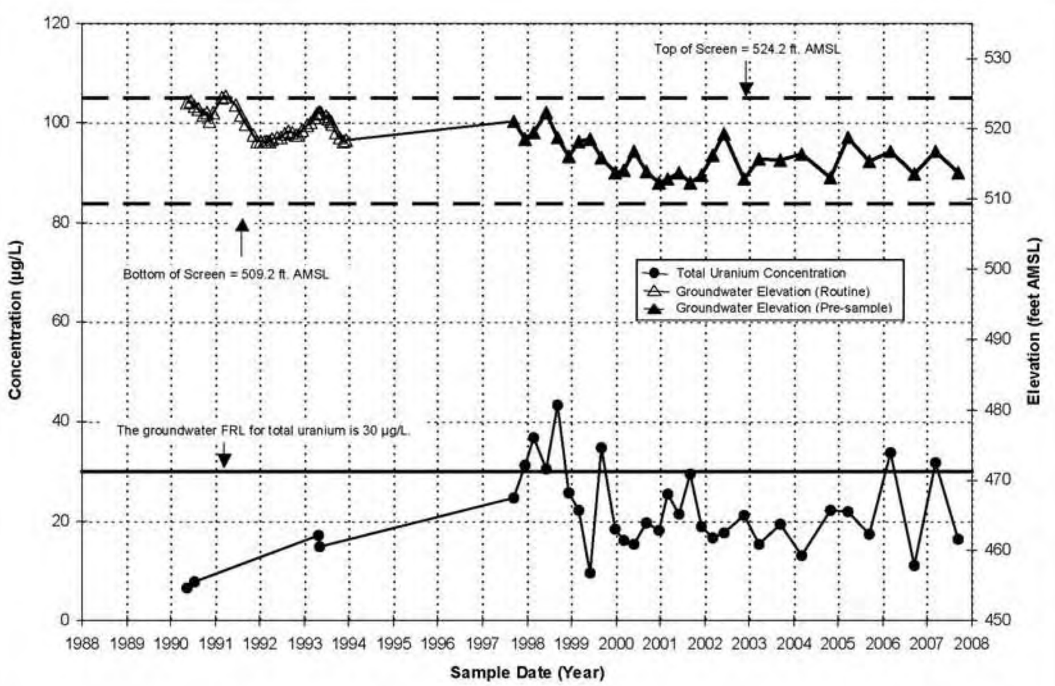


FIGURE A.2-26. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 2386

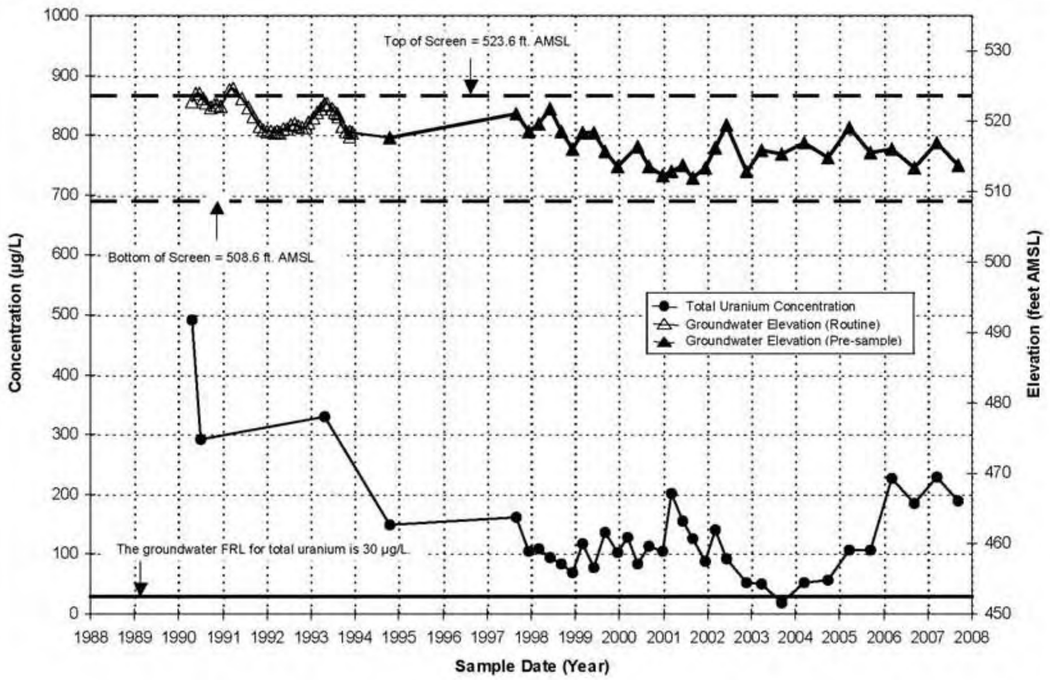


FIGURE A.2-27. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 2387

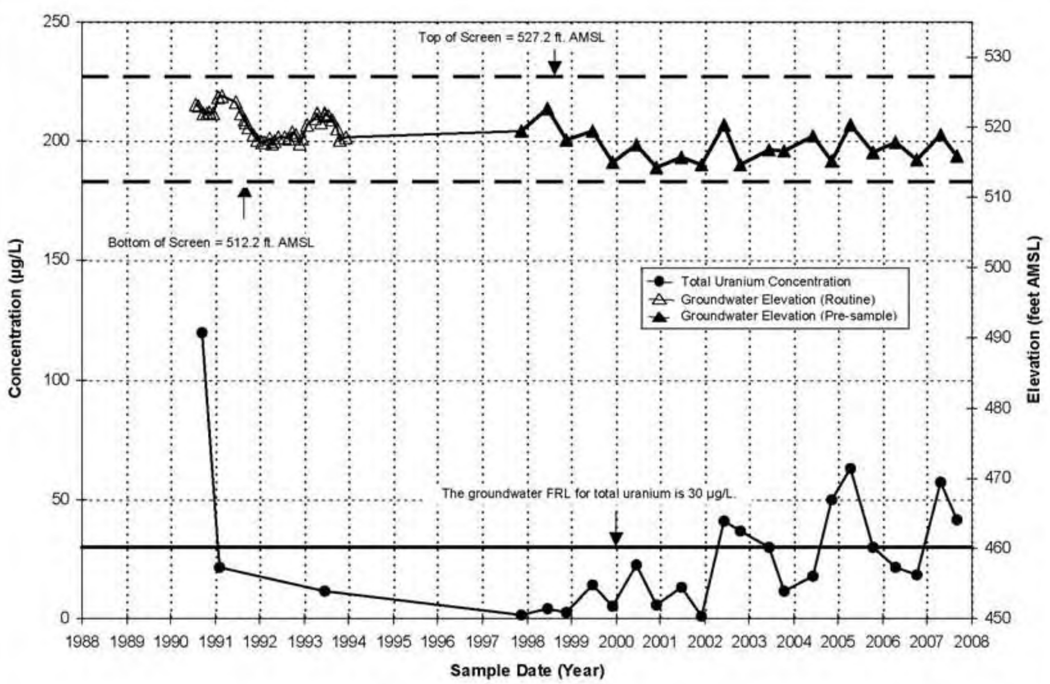


FIGURE A.2-28. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 2389

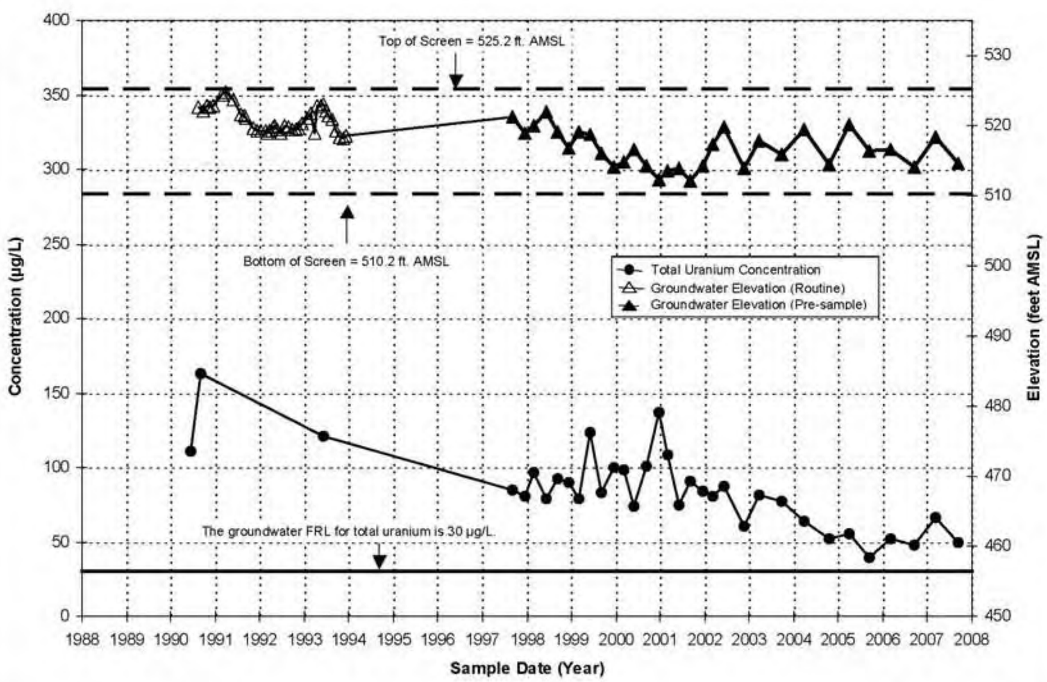


FIGURE A.2-29. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 2390

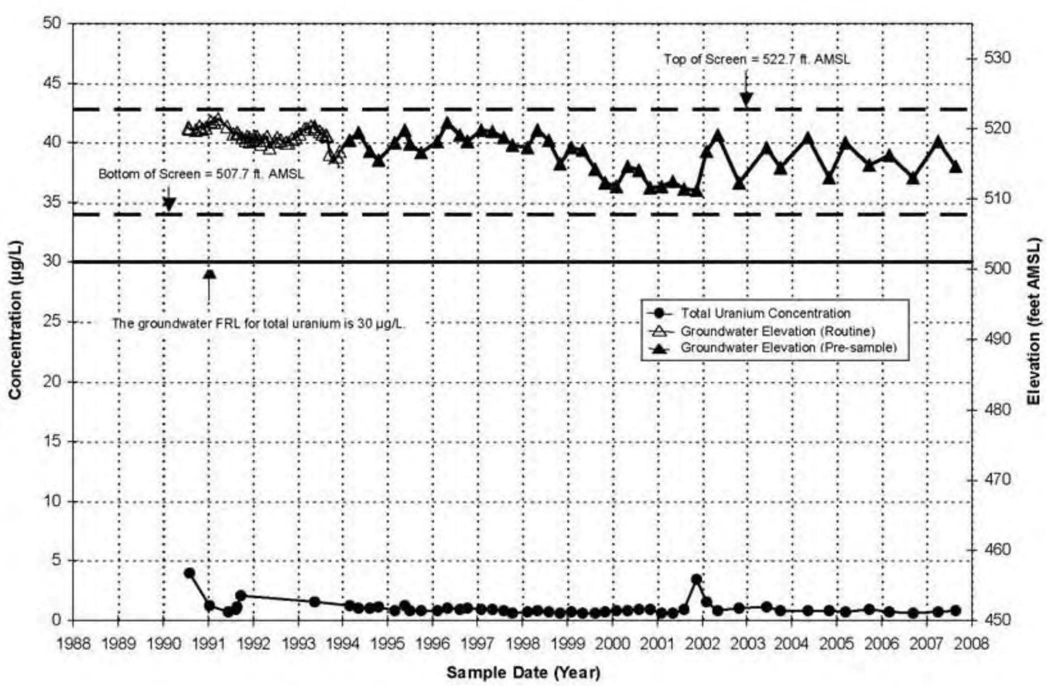


FIGURE A.2-30. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 2396

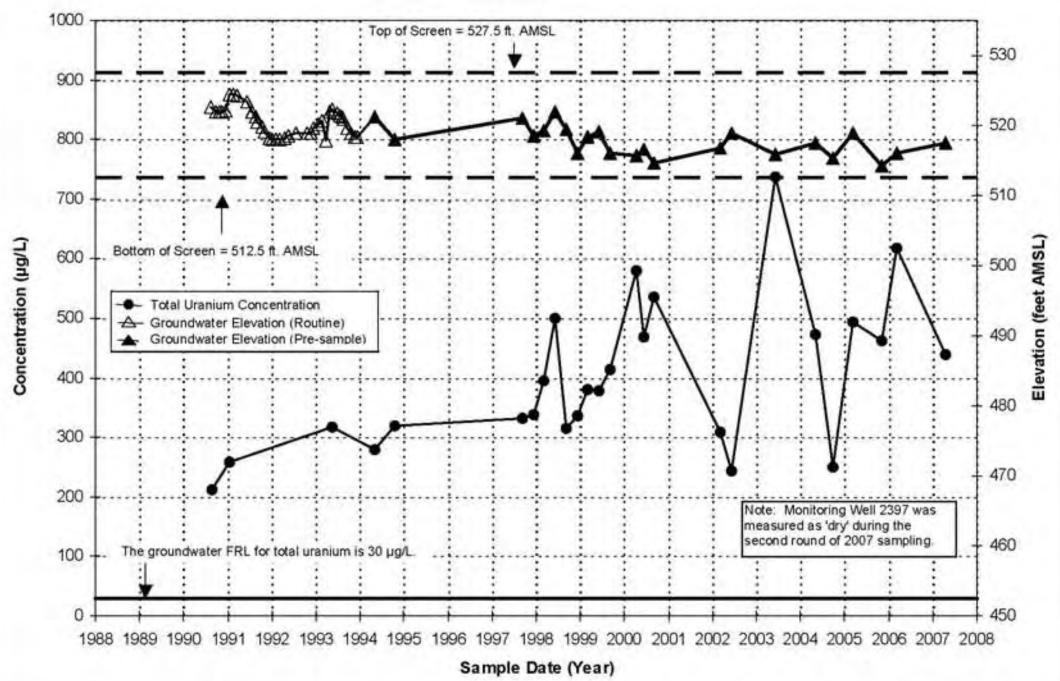


FIGURE A.2-31. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 2397

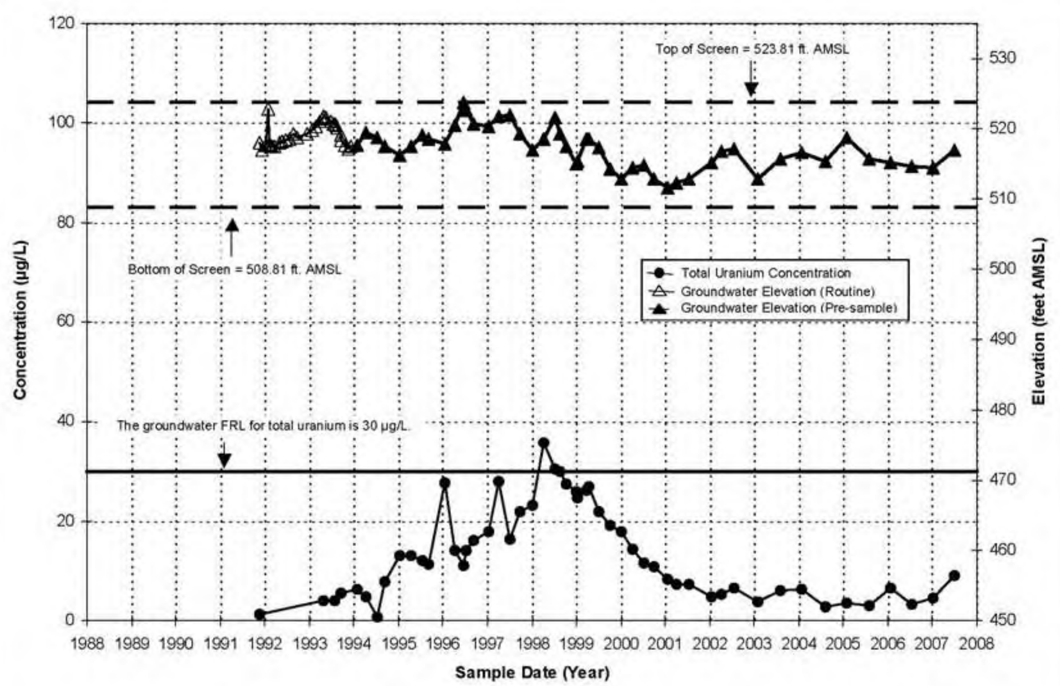


FIGURE A.2-32. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 2398

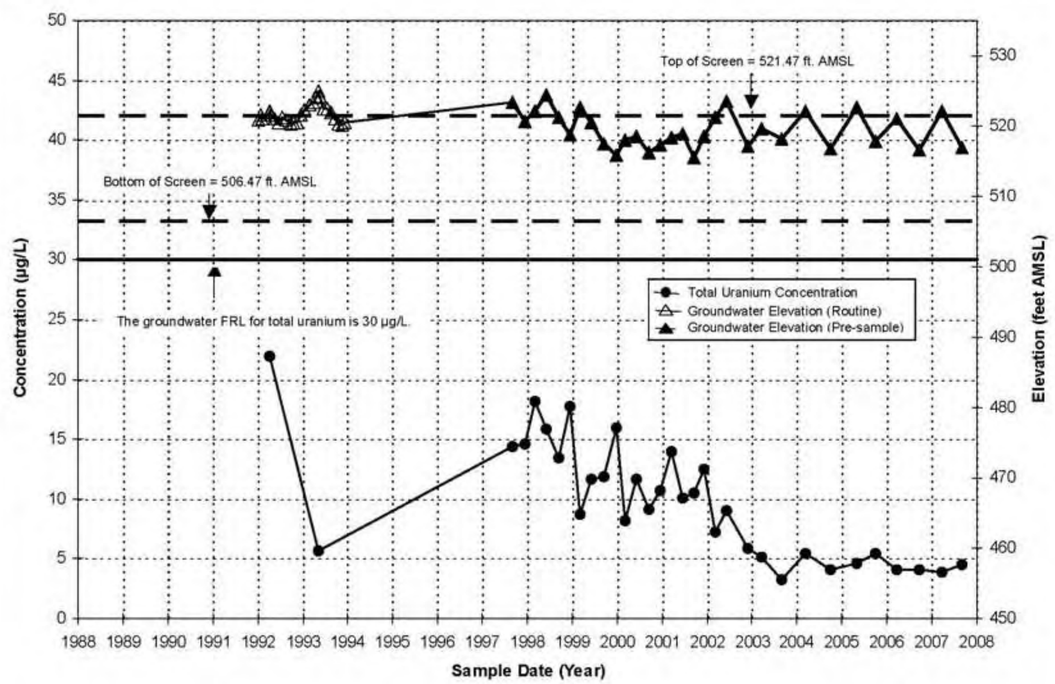


FIGURE A.2-33. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 2402

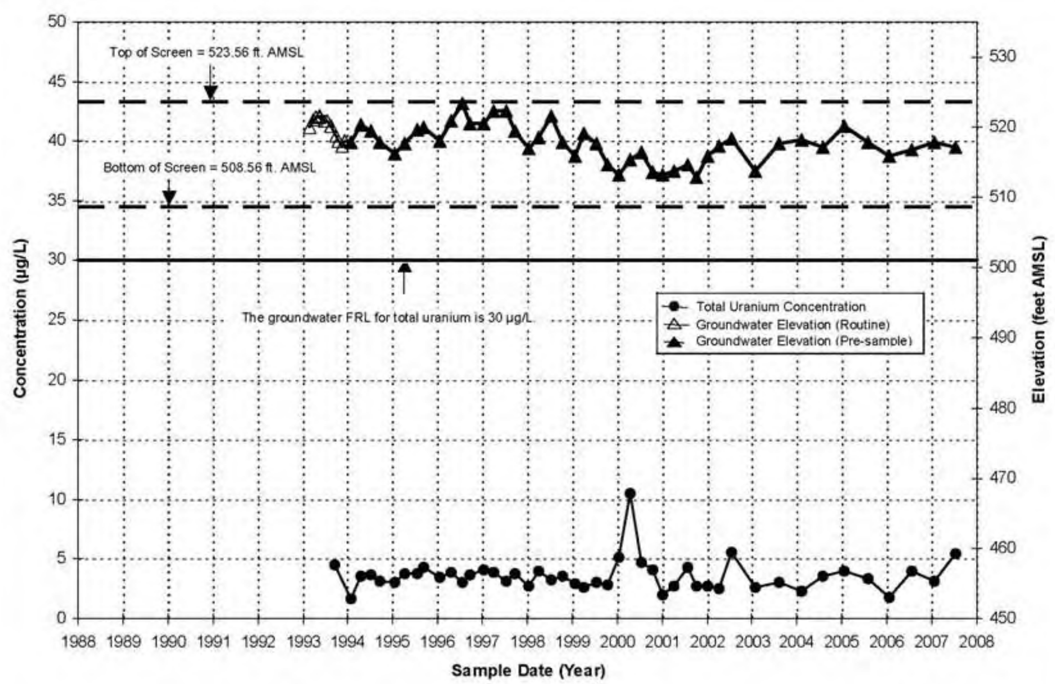


FIGURE A.2-34. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 2431

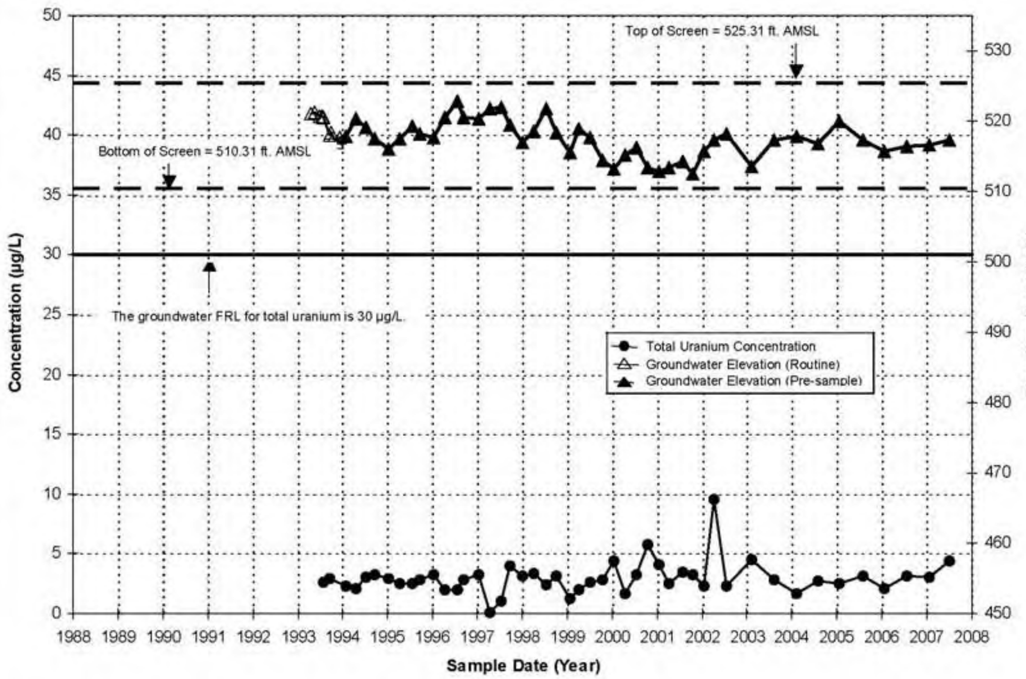


FIGURE A.2-35. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 2432

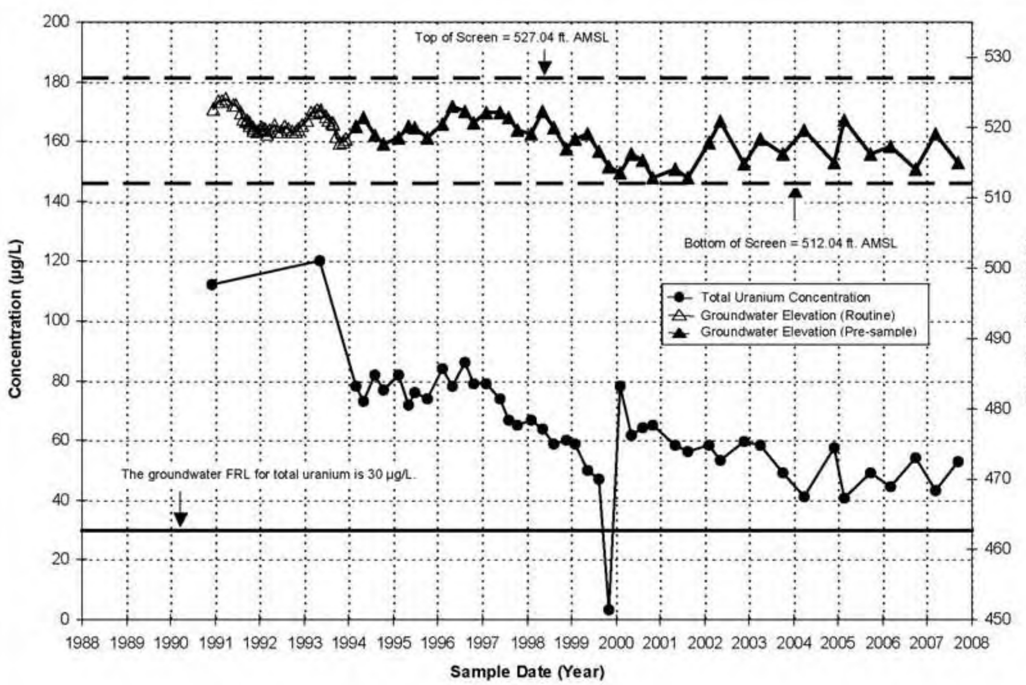


FIGURE A.2-36. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 2550

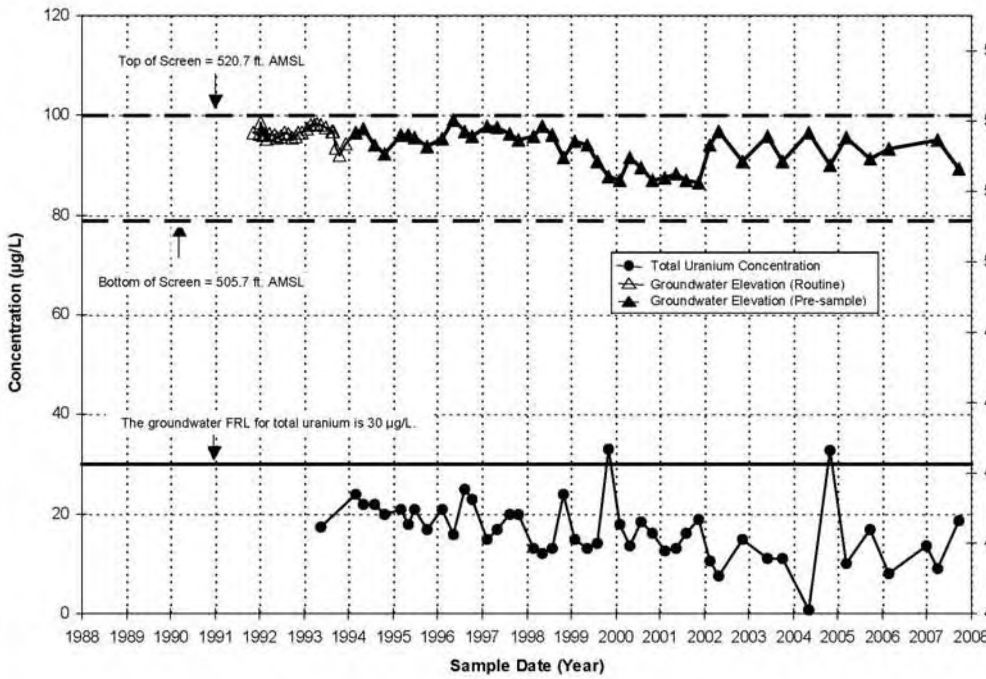


FIGURE A.2-37. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 2552

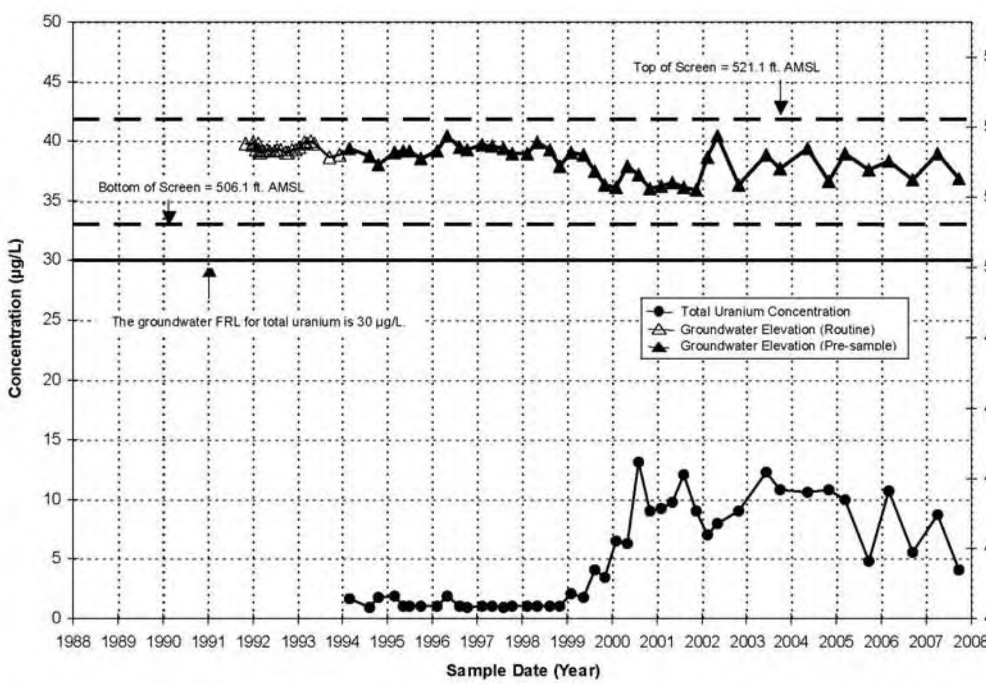


FIGURE A.2-38. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 2553

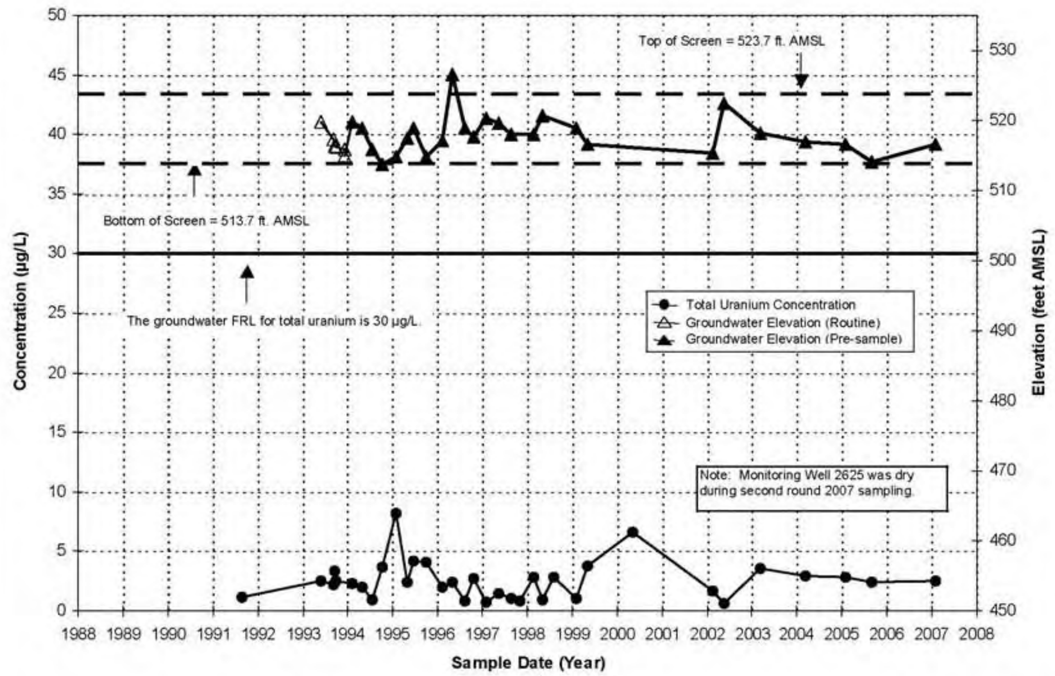


FIGURE A.2-39. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 2625

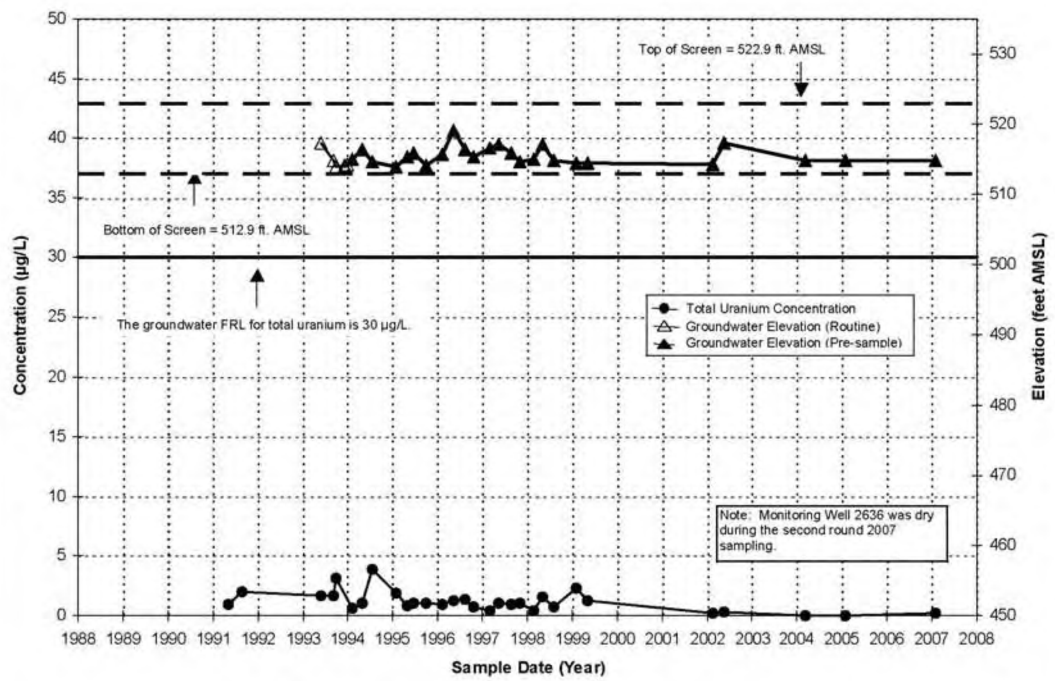


FIGURE A.2-40. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 2636

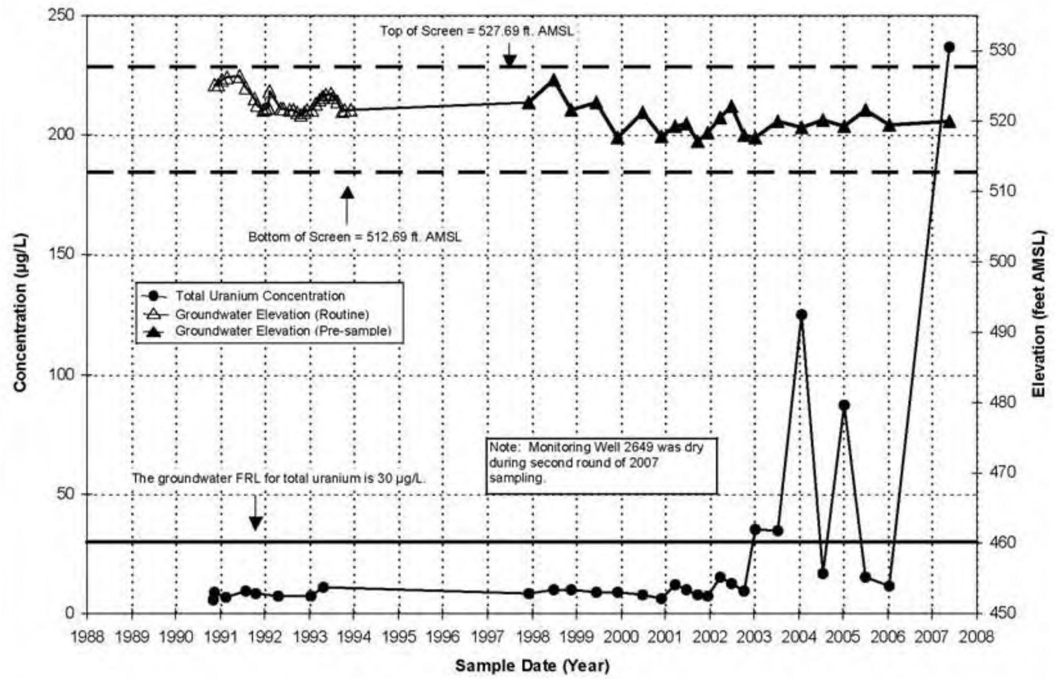


FIGURE A.2-41. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 2649

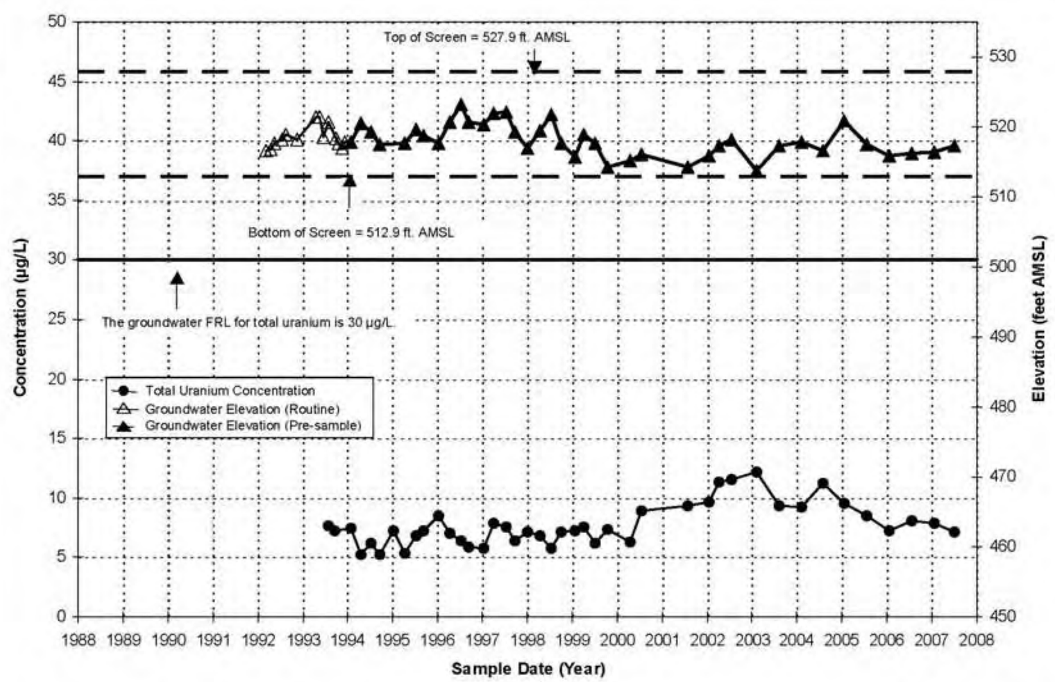


FIGURE A.2-42. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 2733

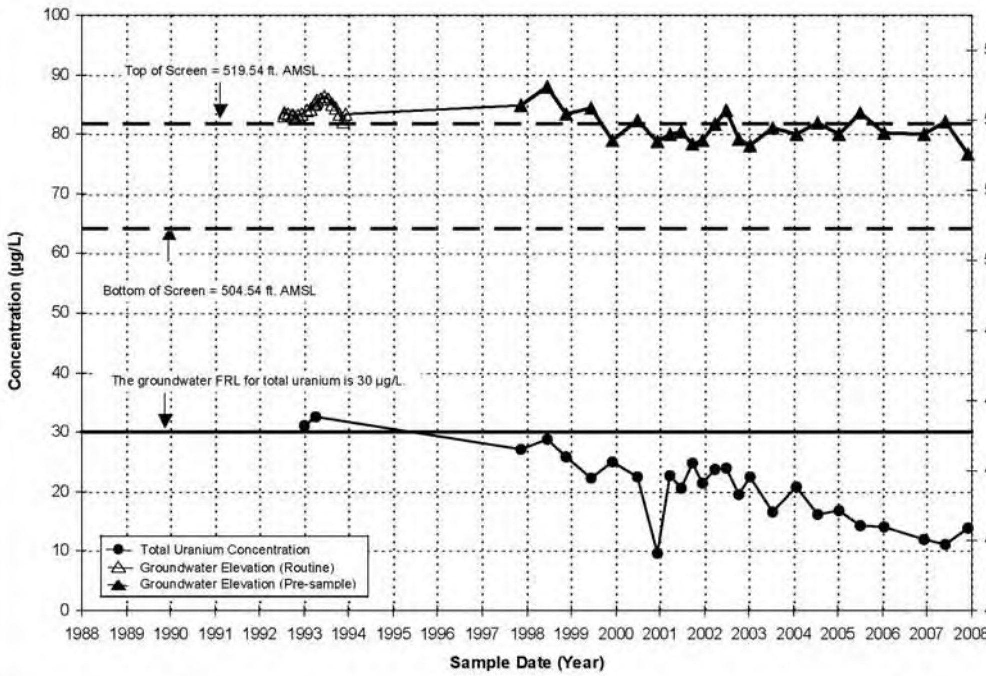


FIGURE A.2-43. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 2821

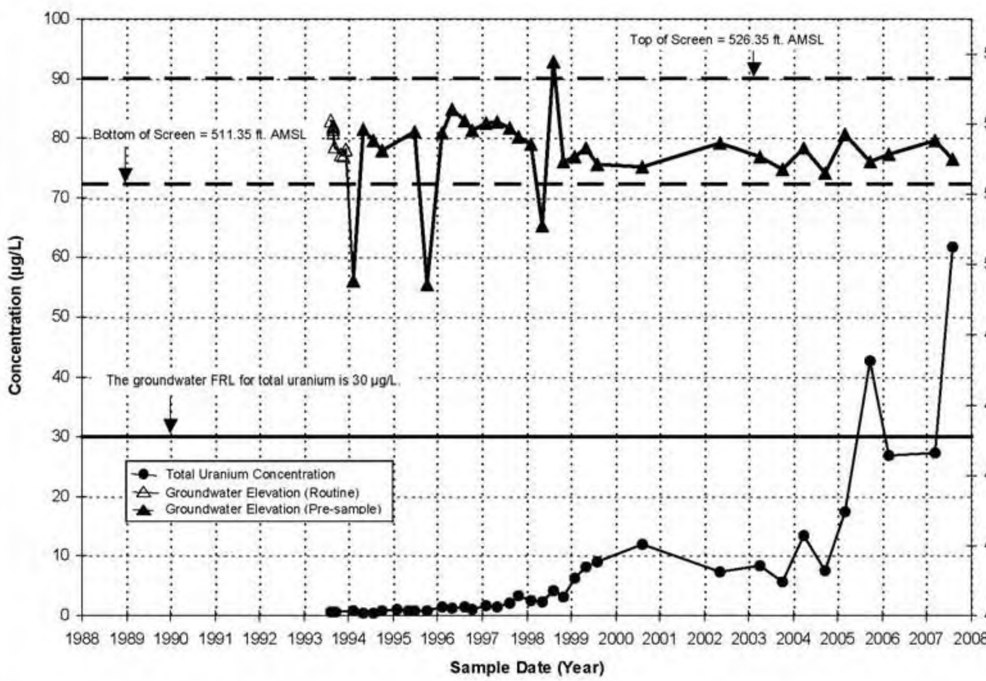


FIGURE A.2-44. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 2880

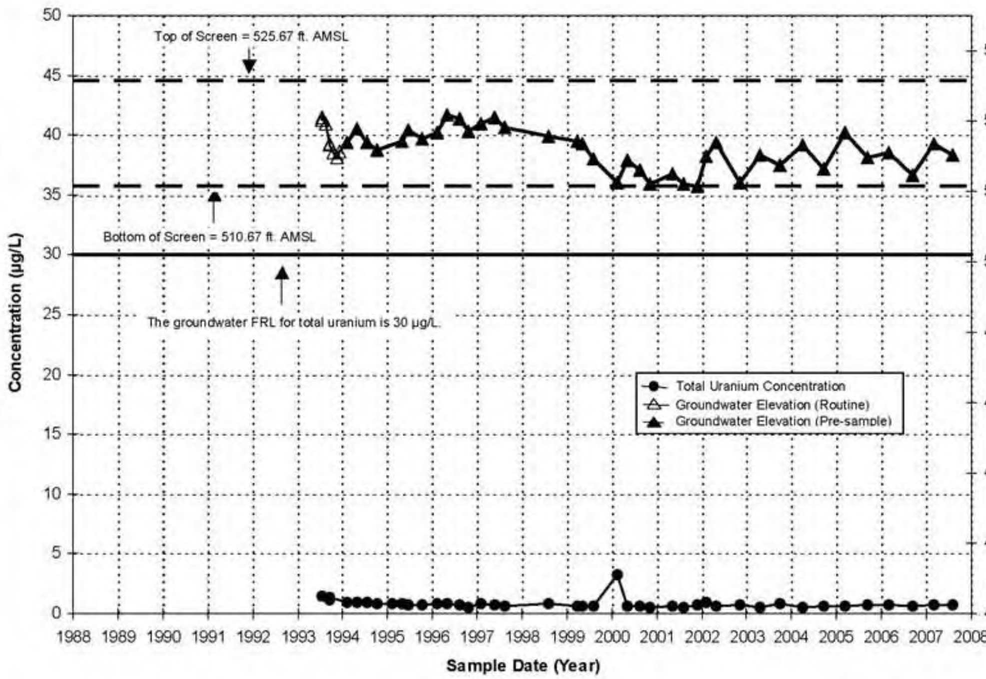


FIGURE A.2-45. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 2897

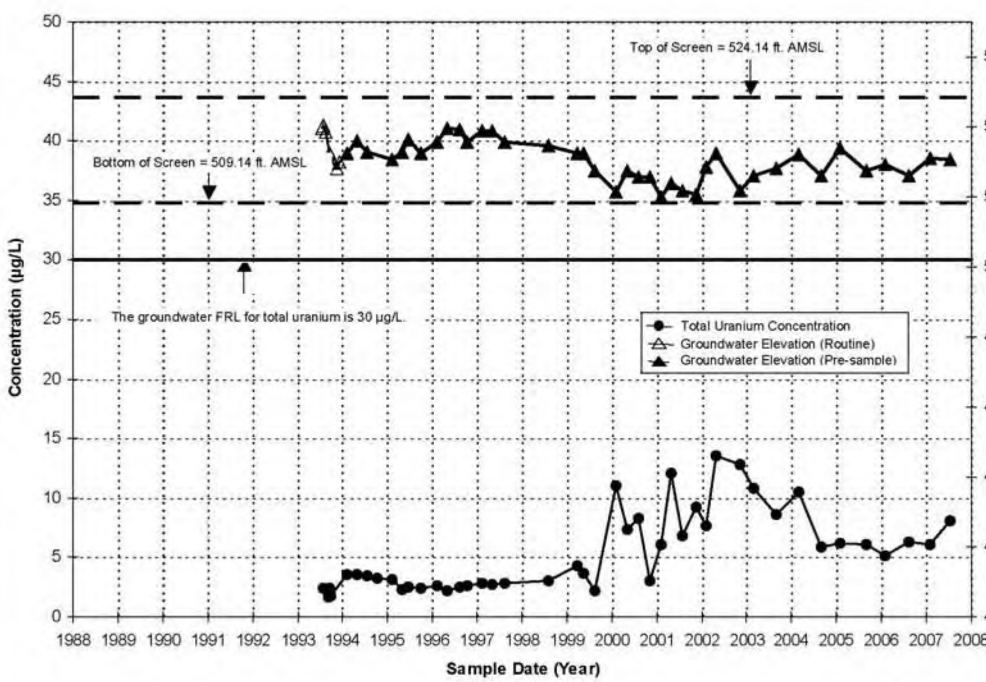


FIGURE A.2-46. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 2898

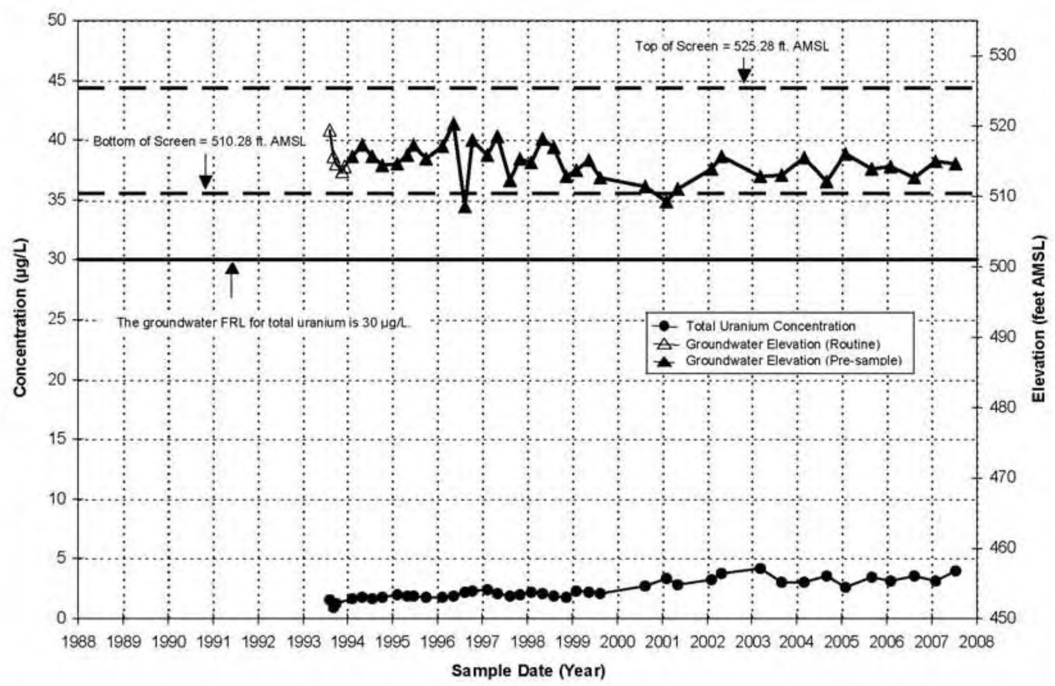


FIGURE A.2-47. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 2899

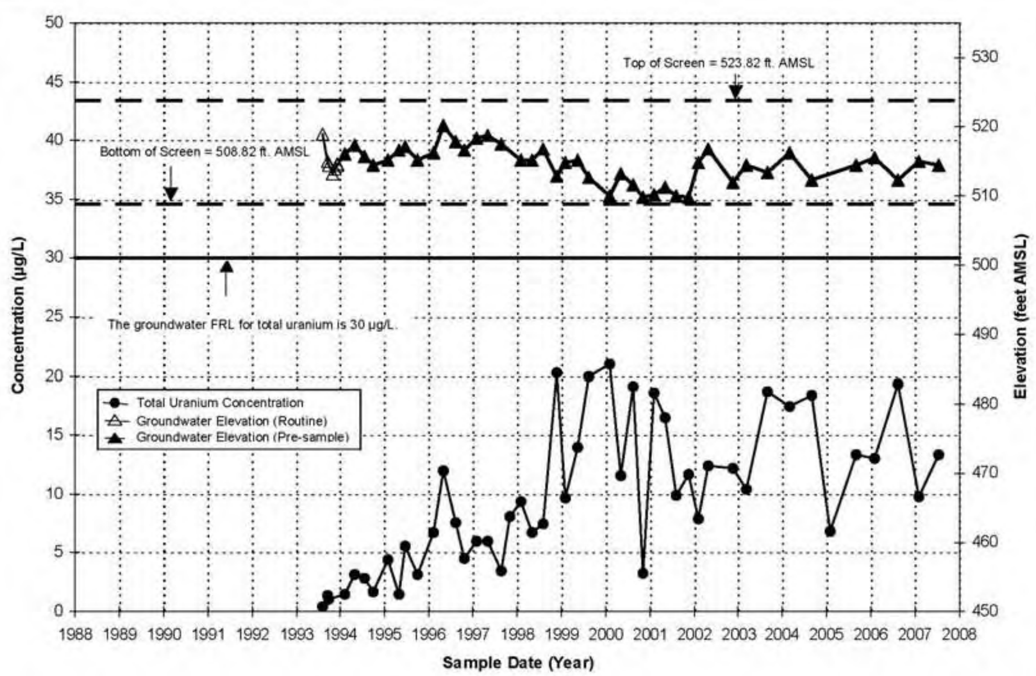


FIGURE A.2-48. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 2900

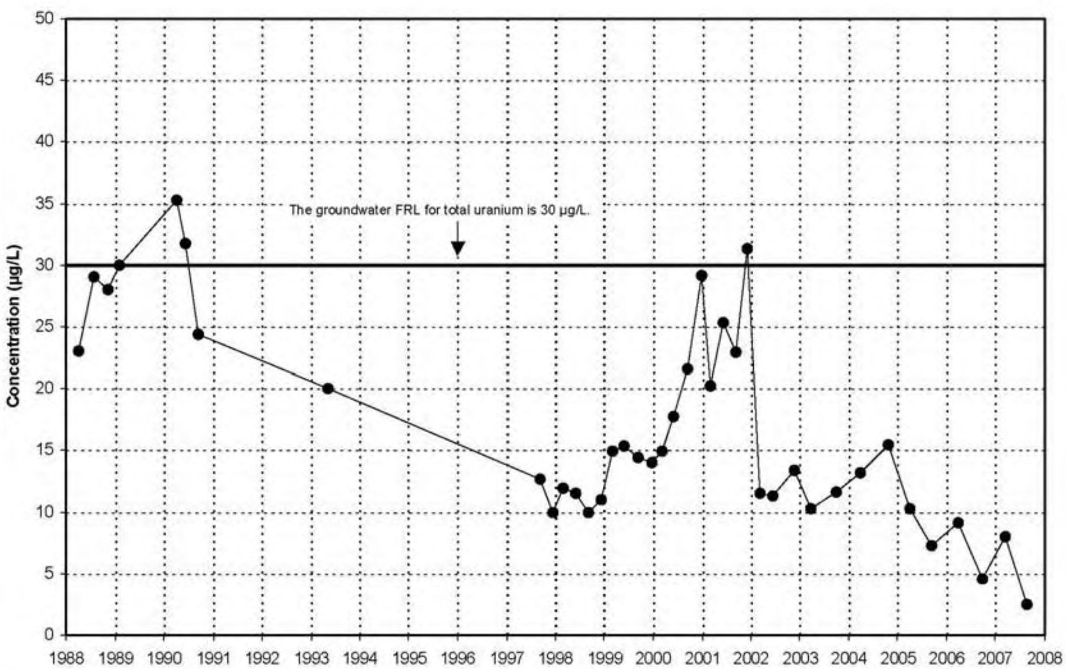


FIGURE A.2-49. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 3014

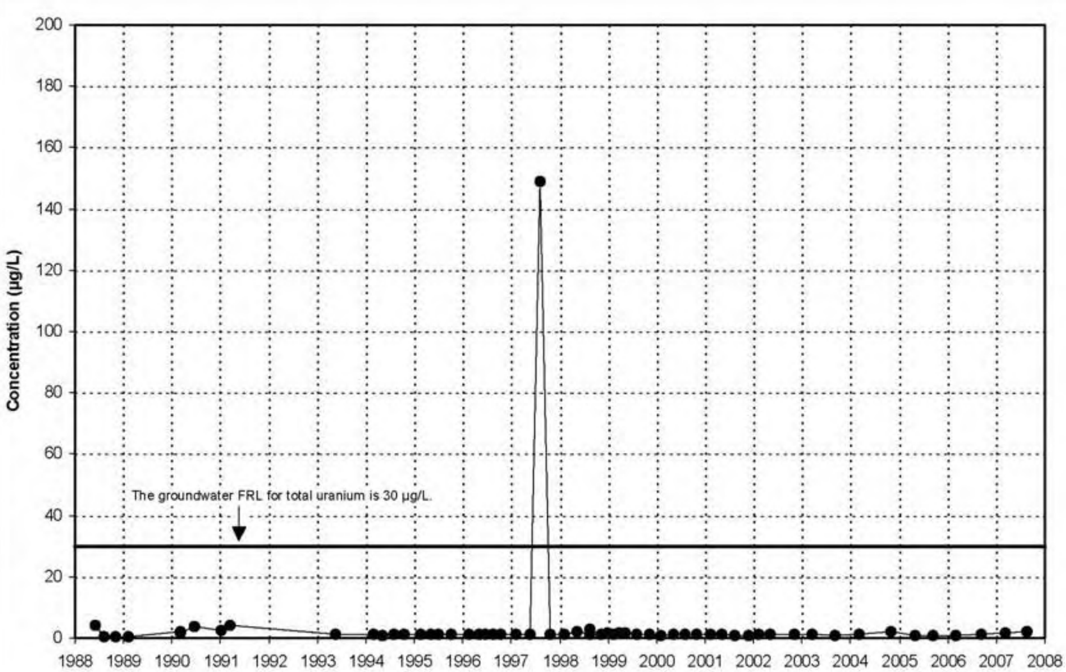


FIGURE A.2-50. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 3015

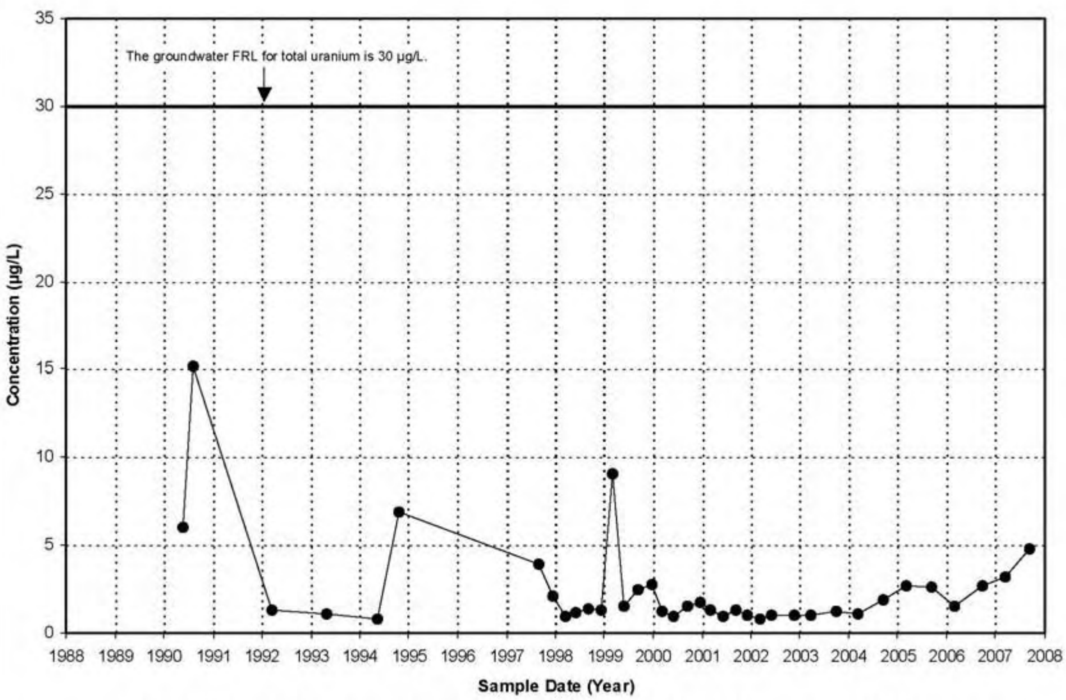


FIGURE A.2-51. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 3045

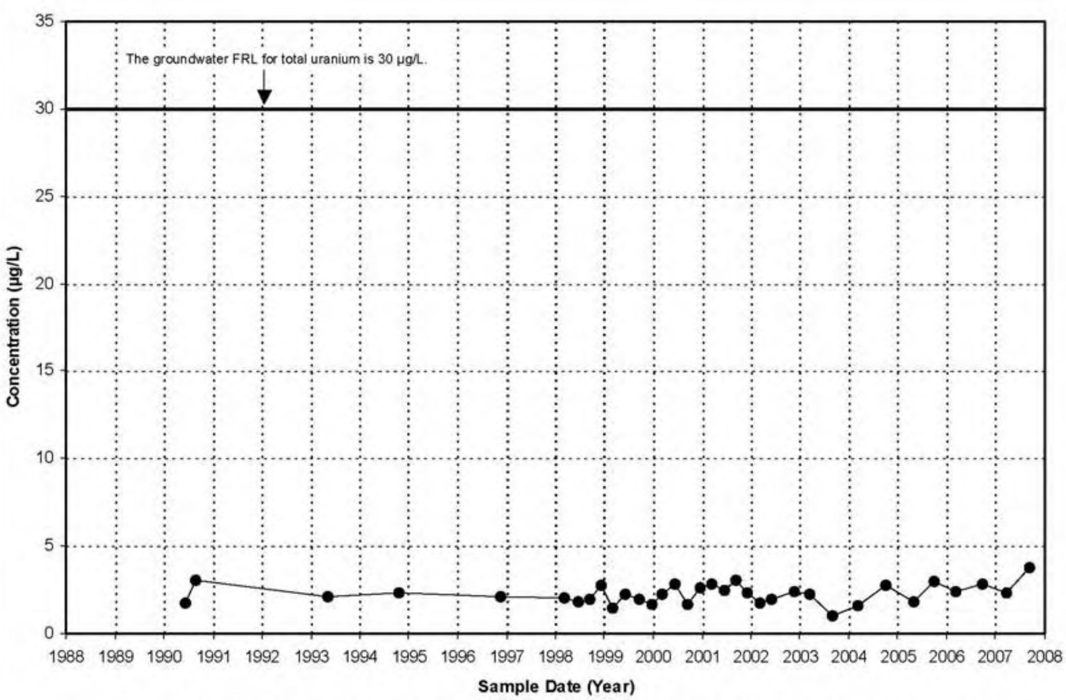


FIGURE A.2-52. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 3046

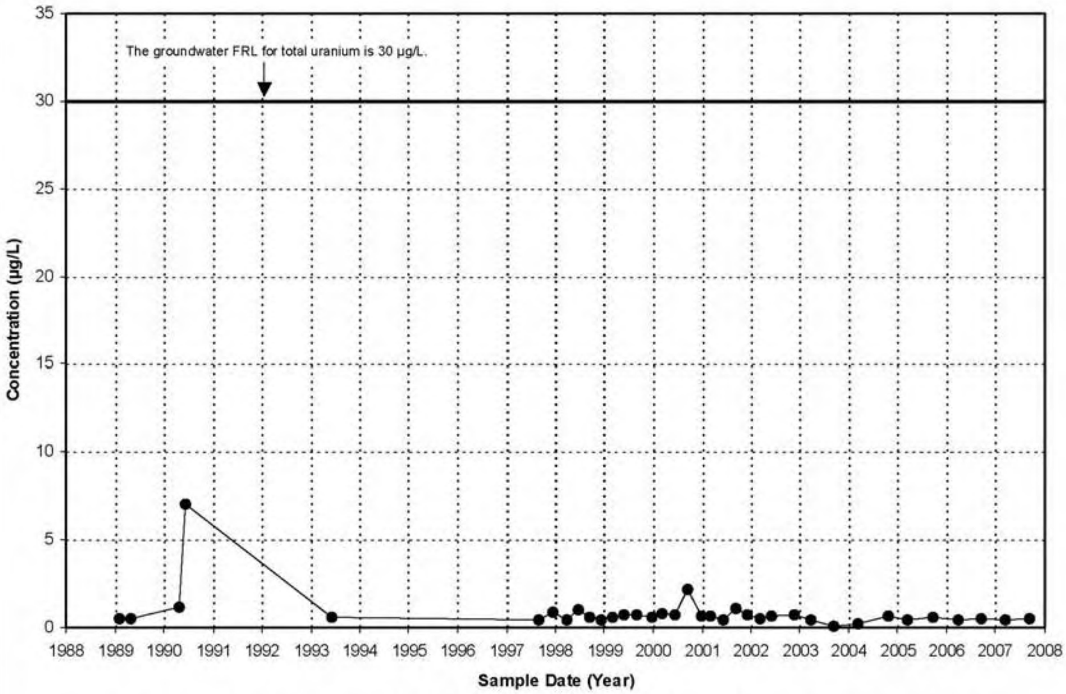


FIGURE A.2-53. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 3049

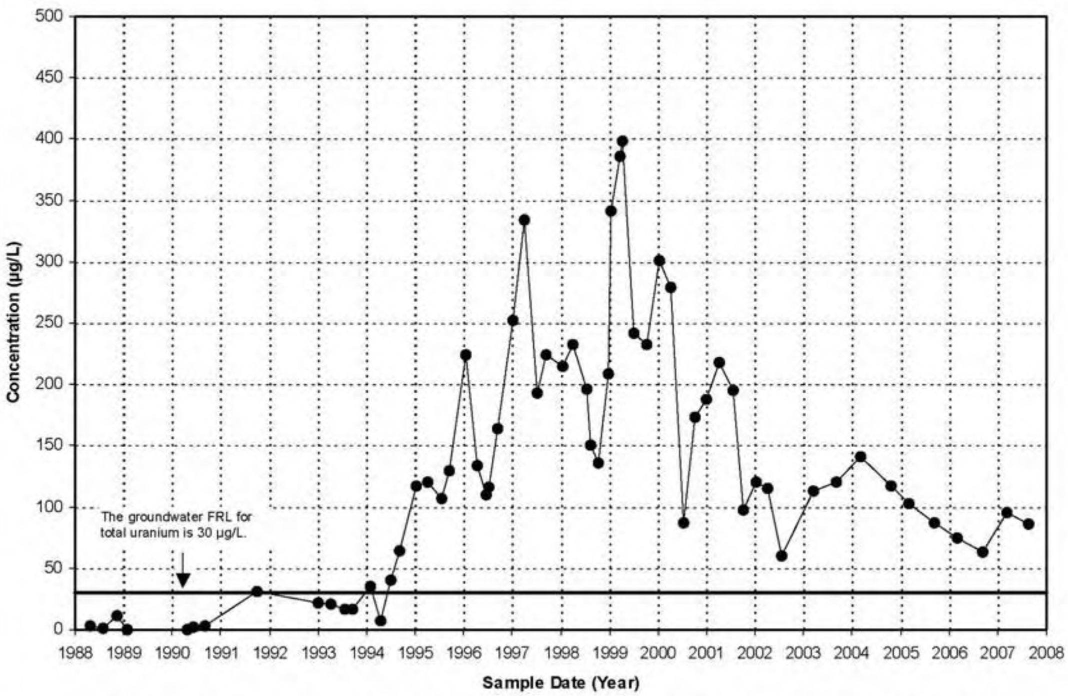


FIGURE A.2-54. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 3069

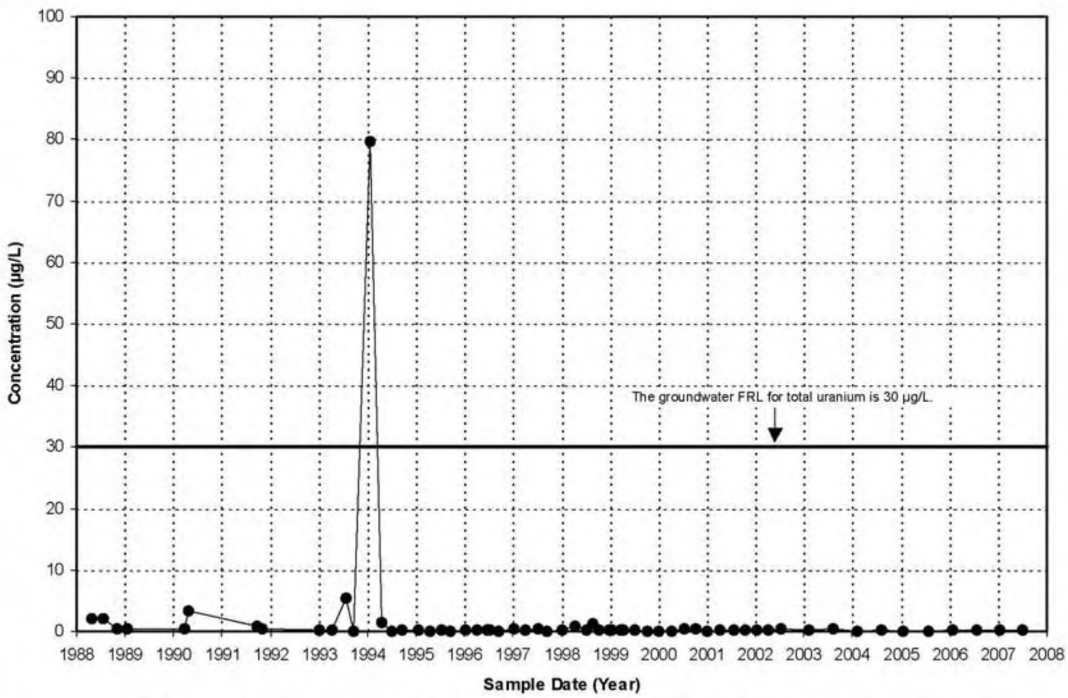


FIGURE A.2-55. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 3070

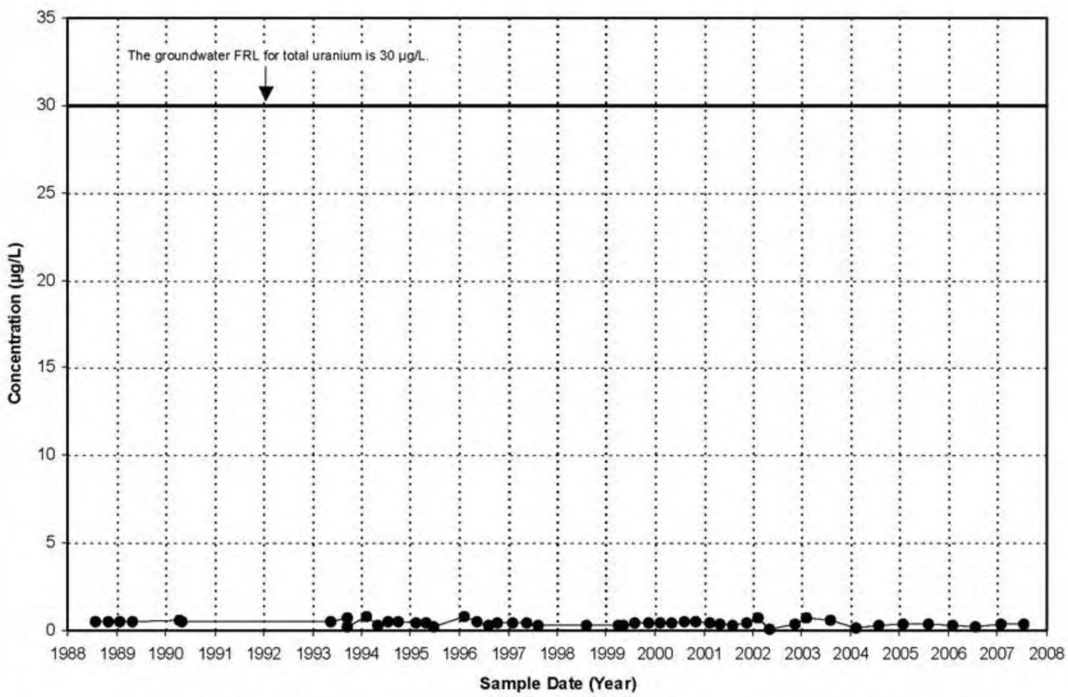


FIGURE A.2-56. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 3093

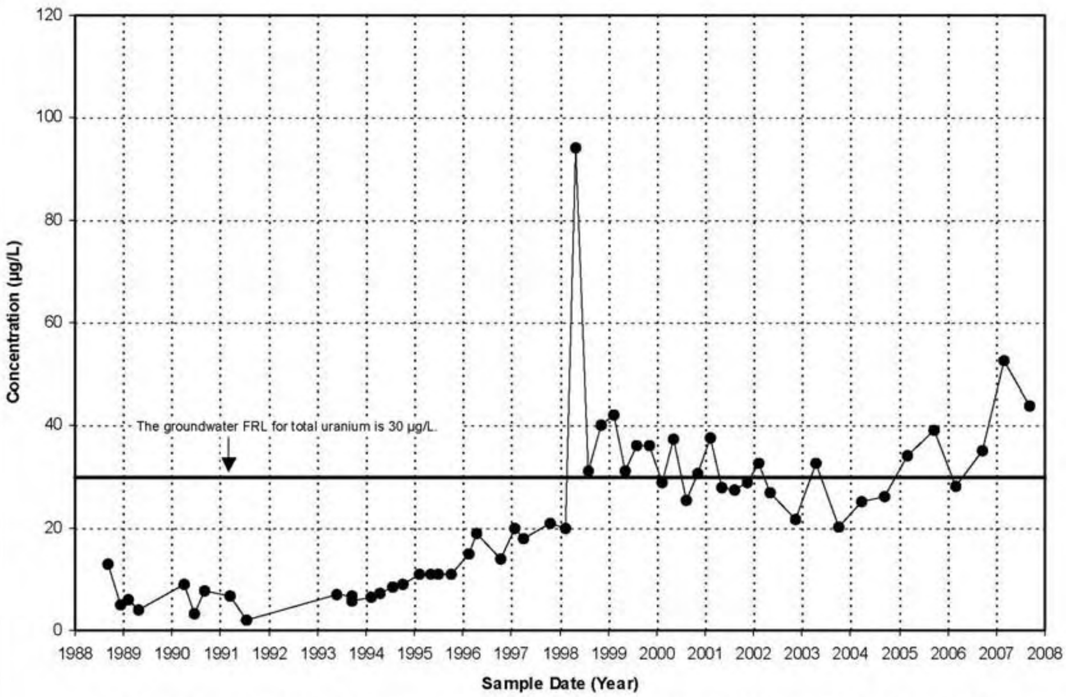


FIGURE A.2-57. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 3095

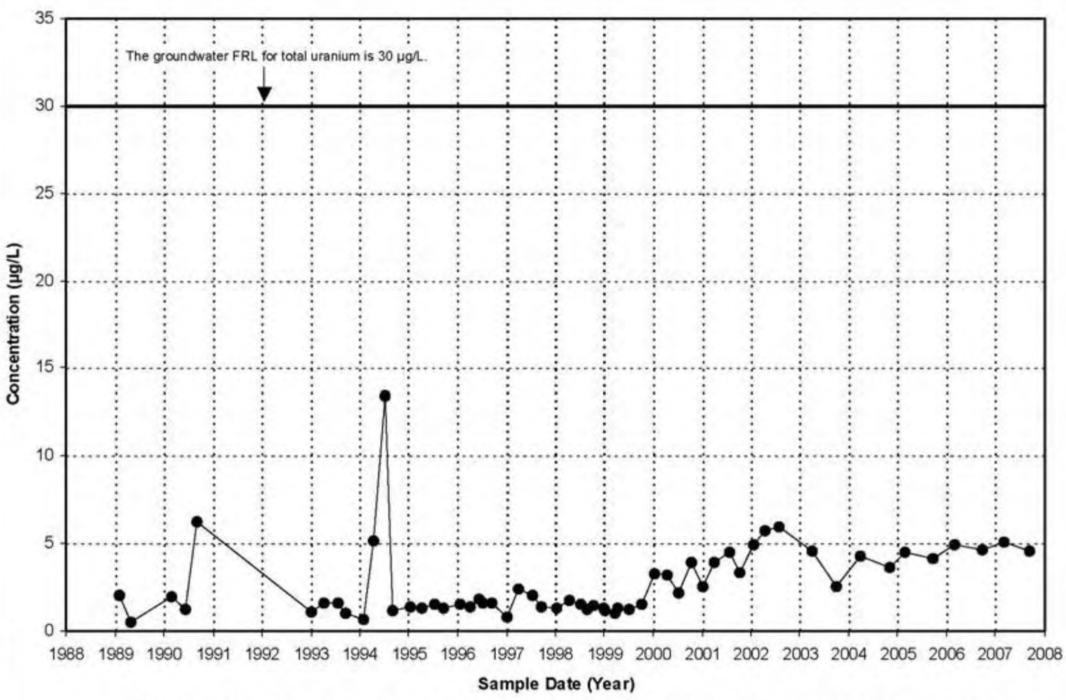


FIGURE A.2-58. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 3106

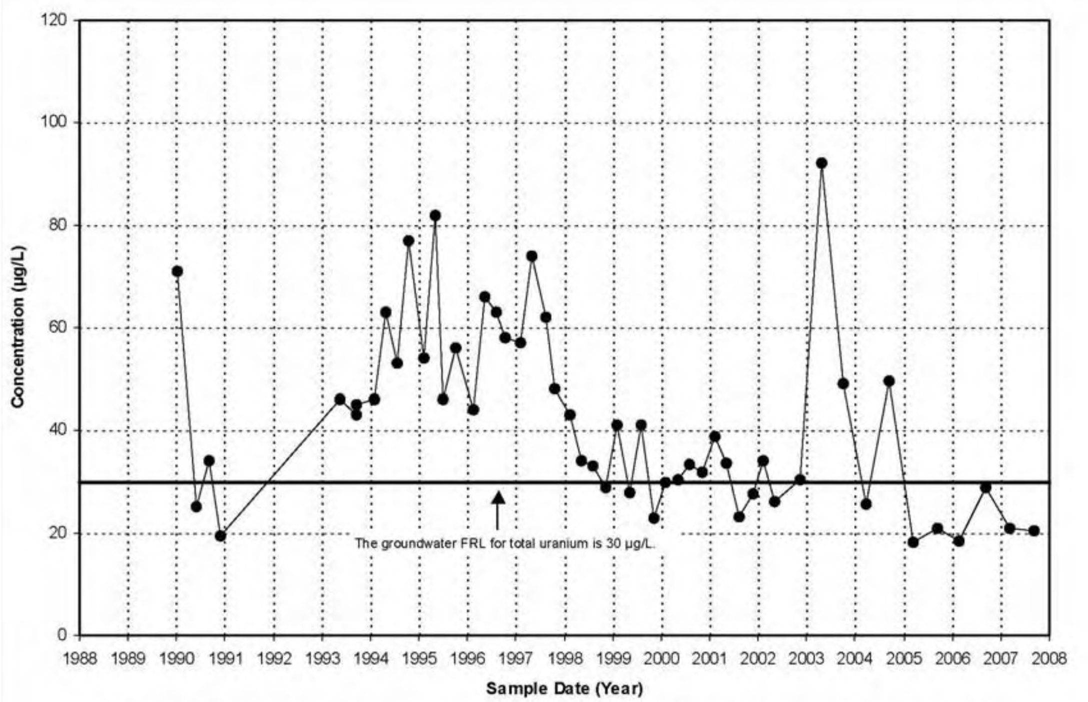


FIGURE A.2-59. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 3125

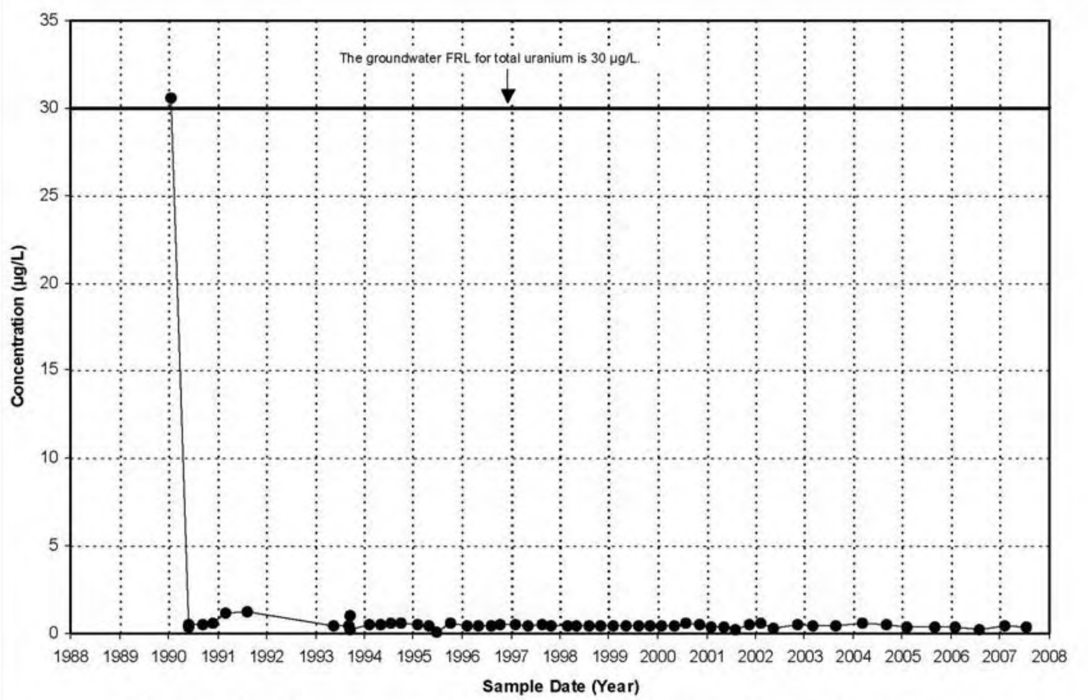


FIGURE A.2-60. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 3128

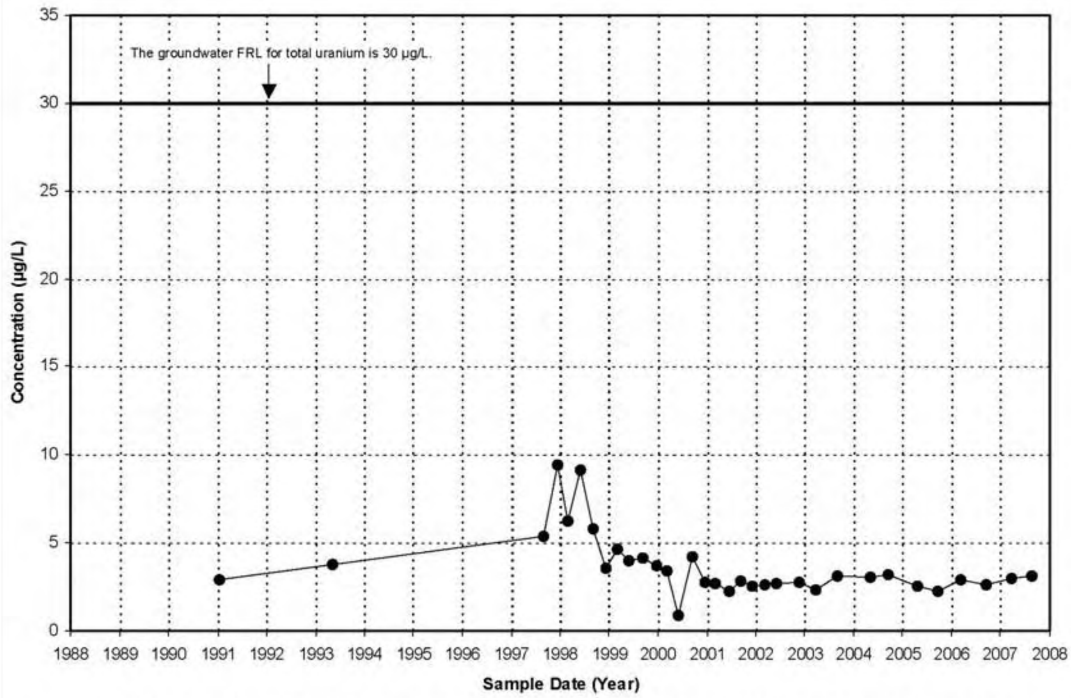


FIGURE A.2-61. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 3385

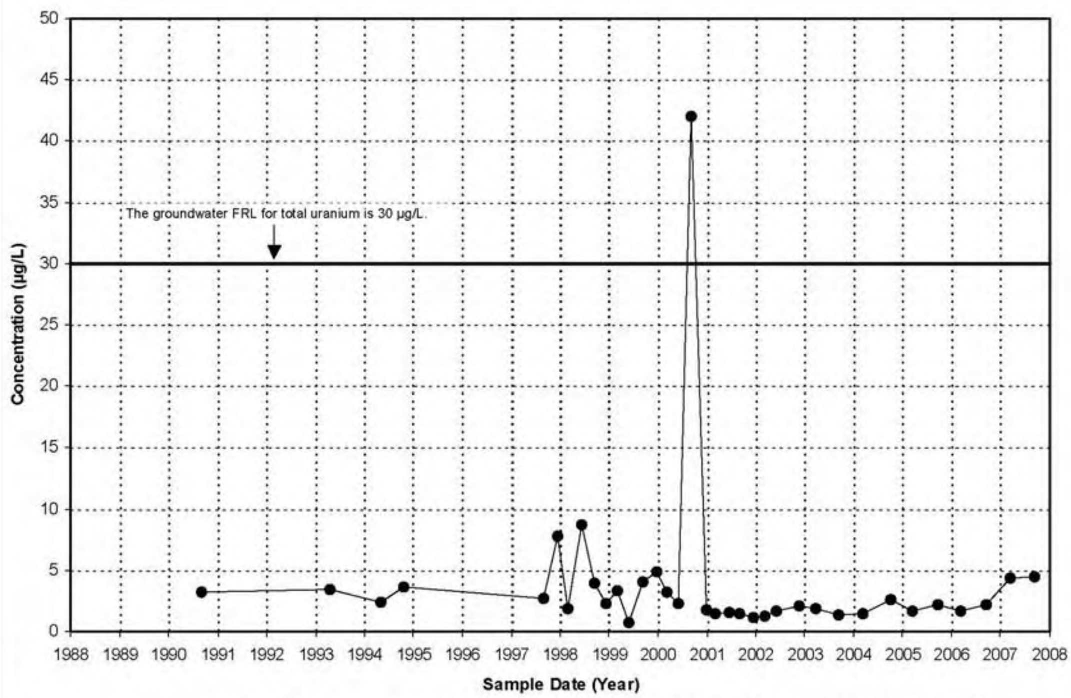


FIGURE A.2-62. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 3387

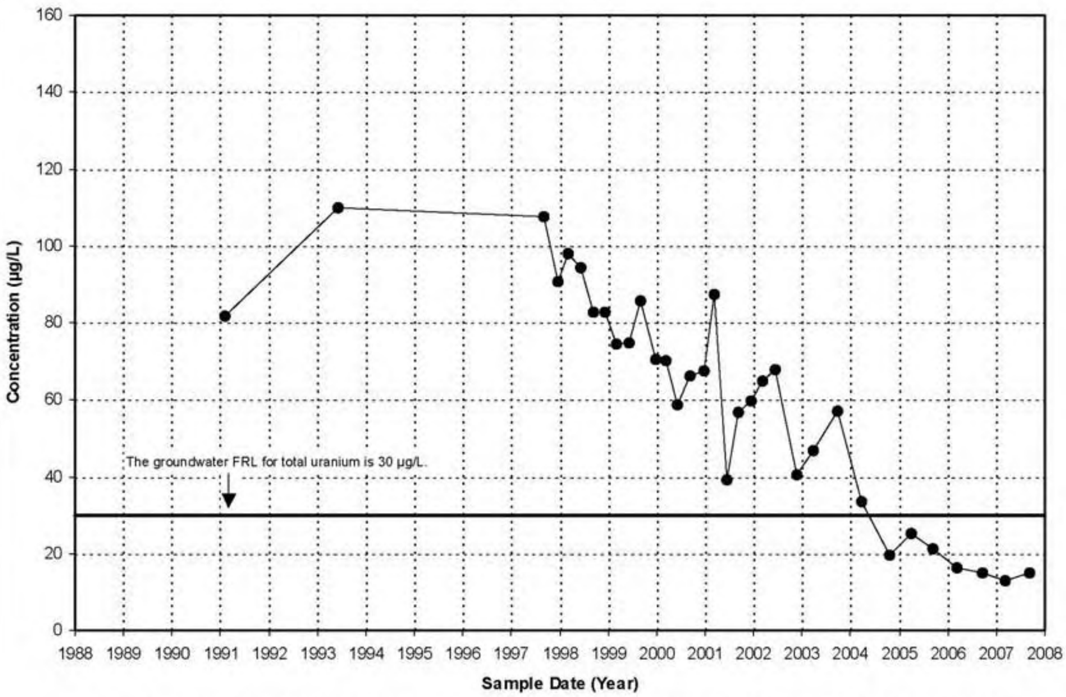


FIGURE A.2-63. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 3390

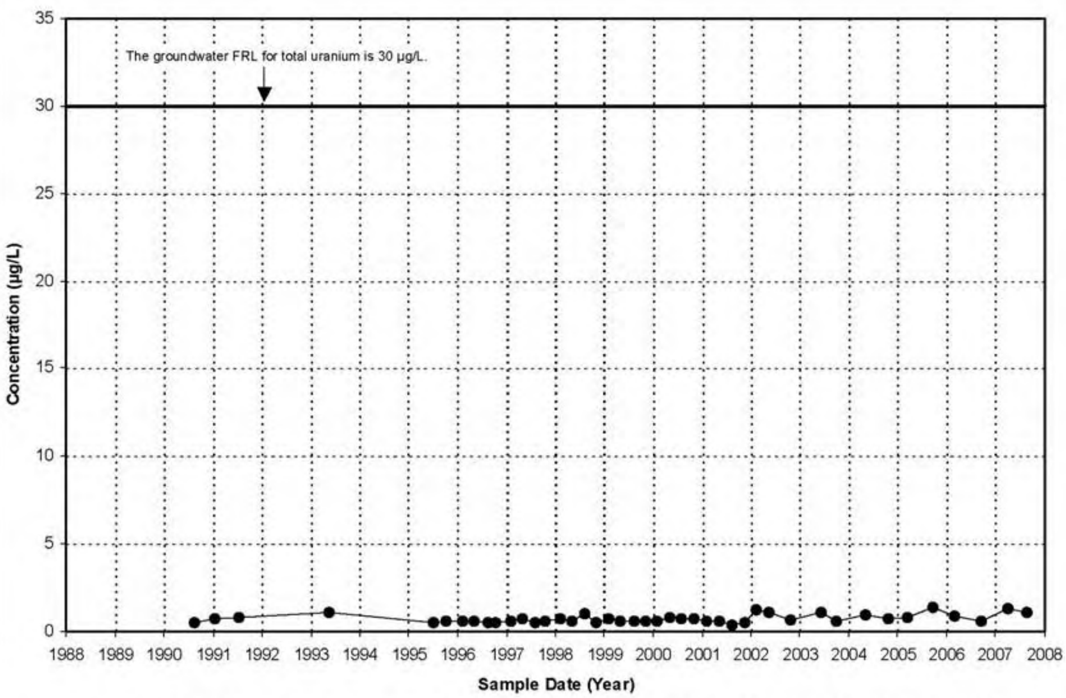


FIGURE A.2-64. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 3396

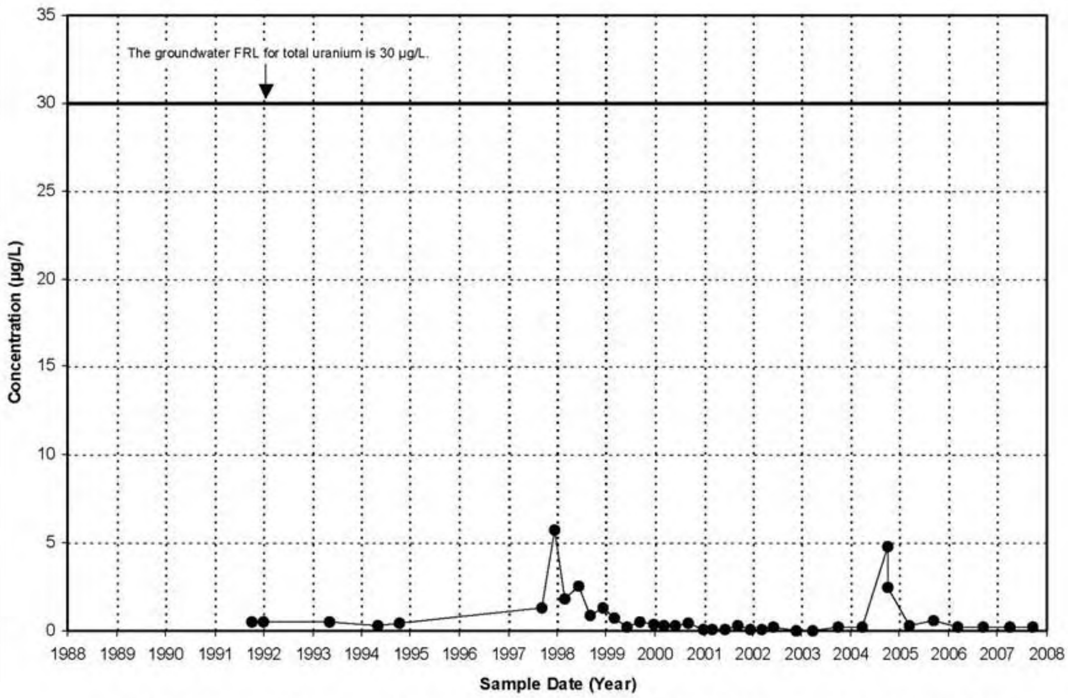


FIGURE A.2-65. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 3397

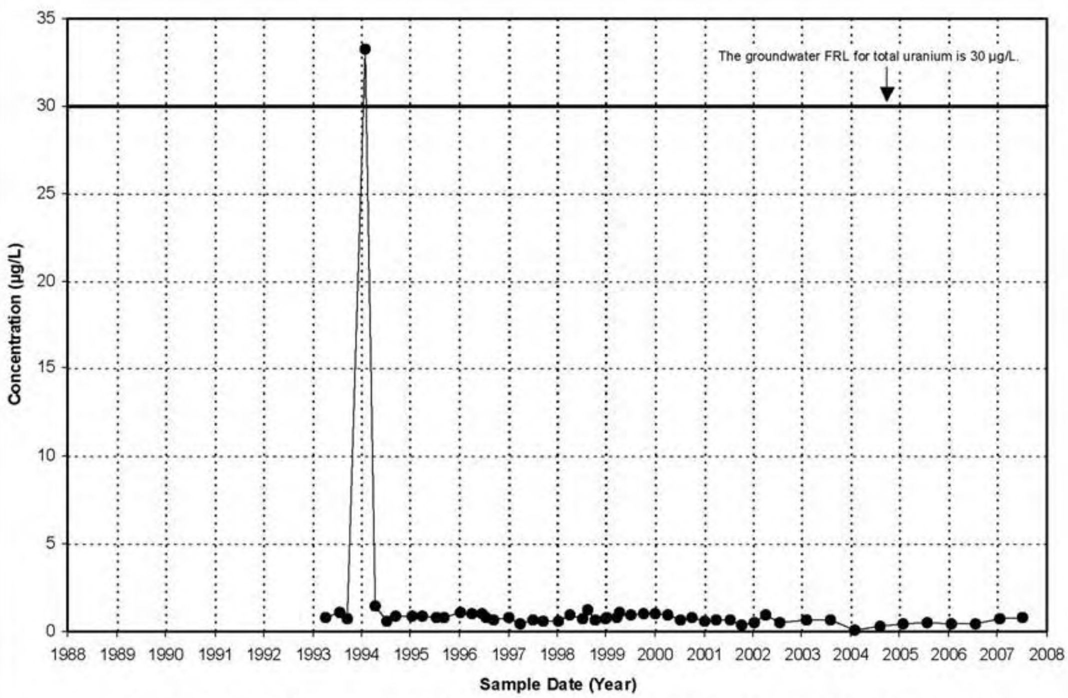


FIGURE A.2-66. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 3398

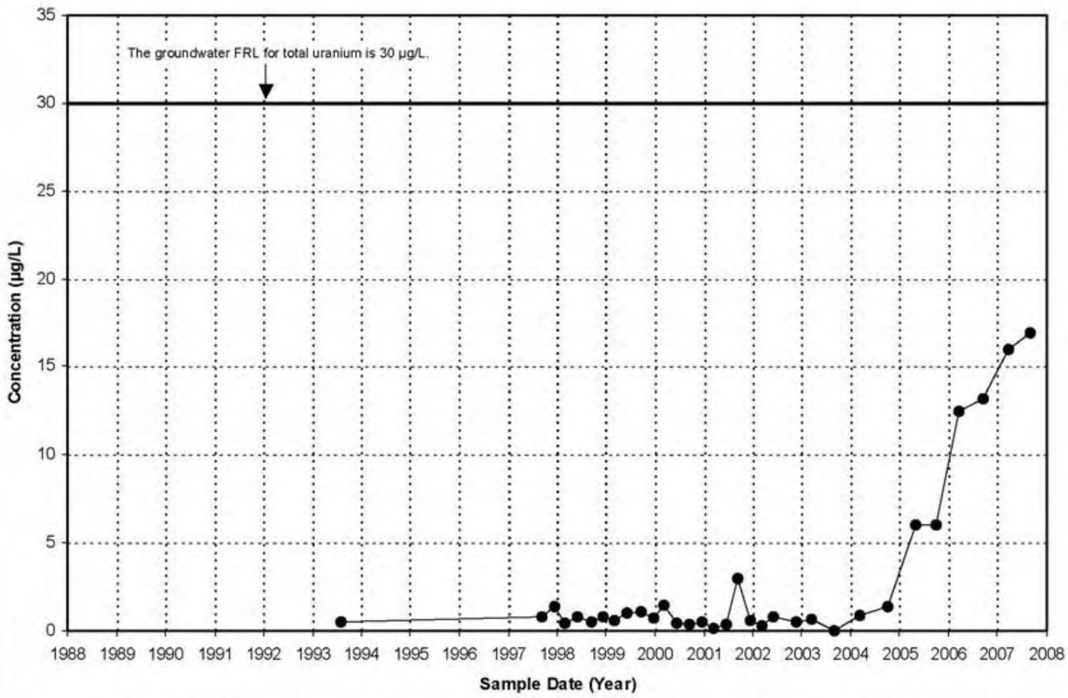


FIGURE A.2-67. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 3402

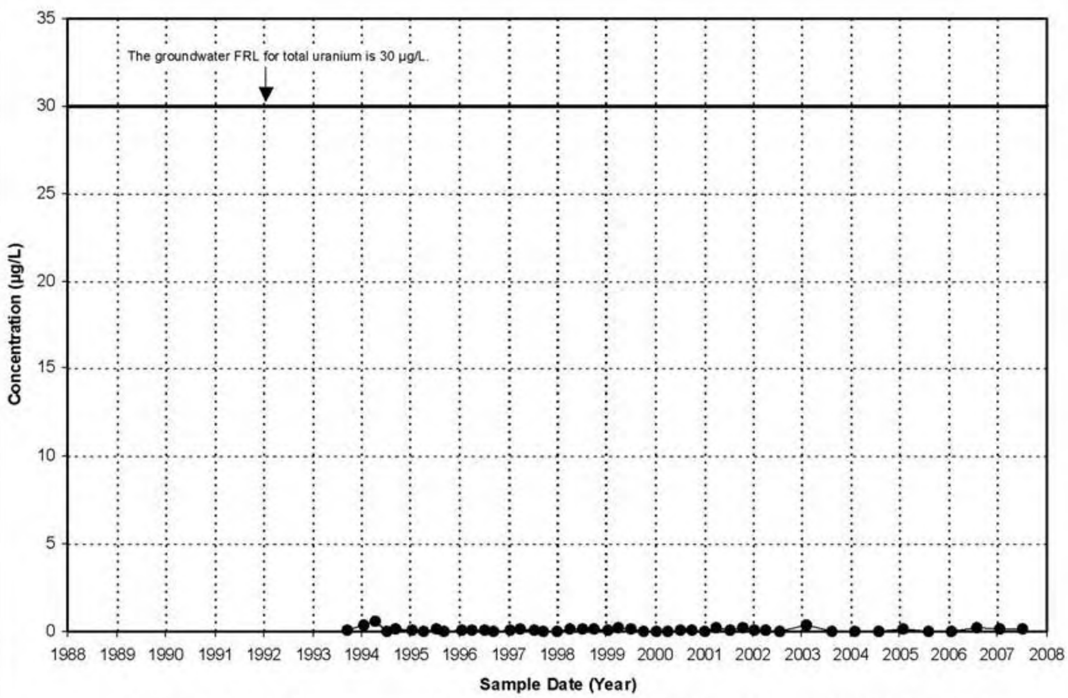


FIGURE A.2-68. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 3424

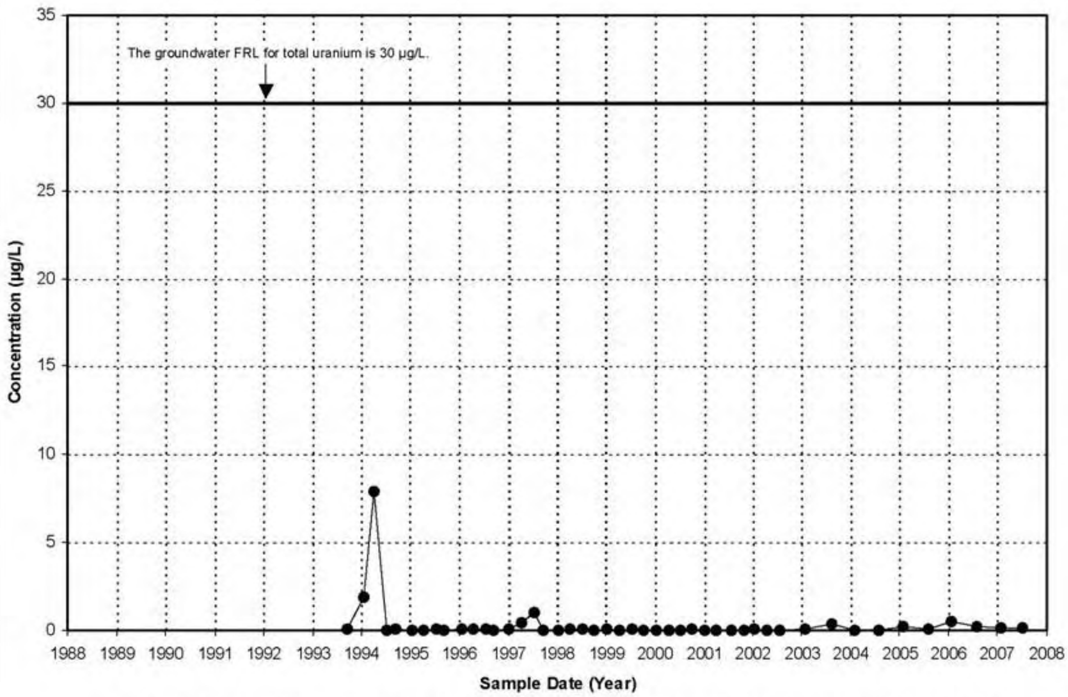


FIGURE A.2-69. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 3426

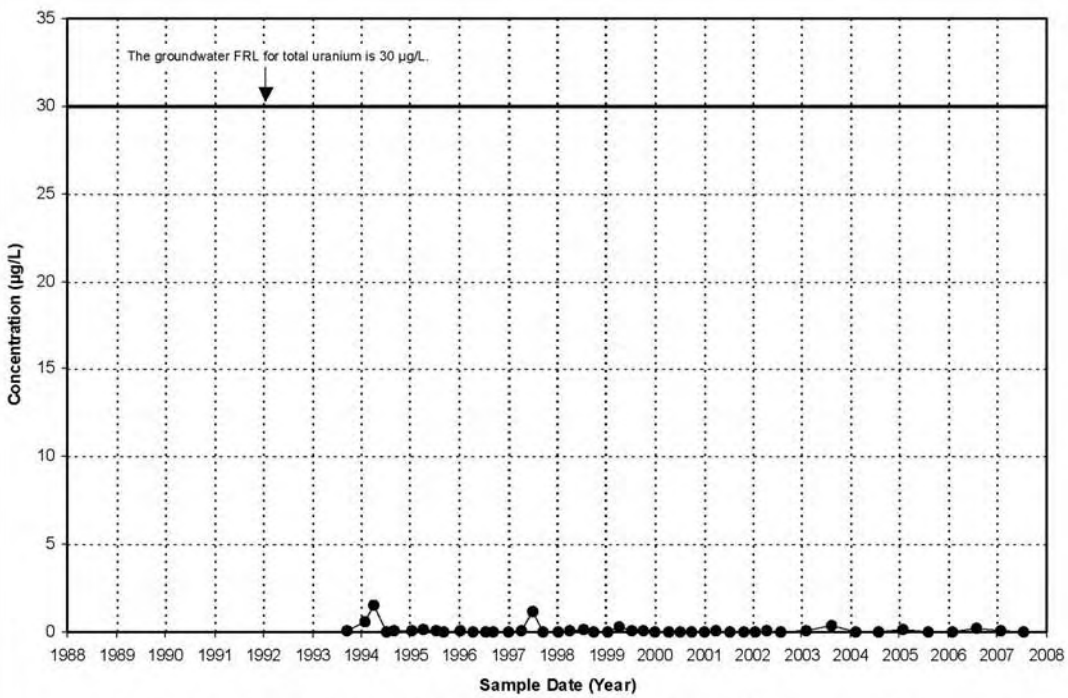


FIGURE A.2-70. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 3429

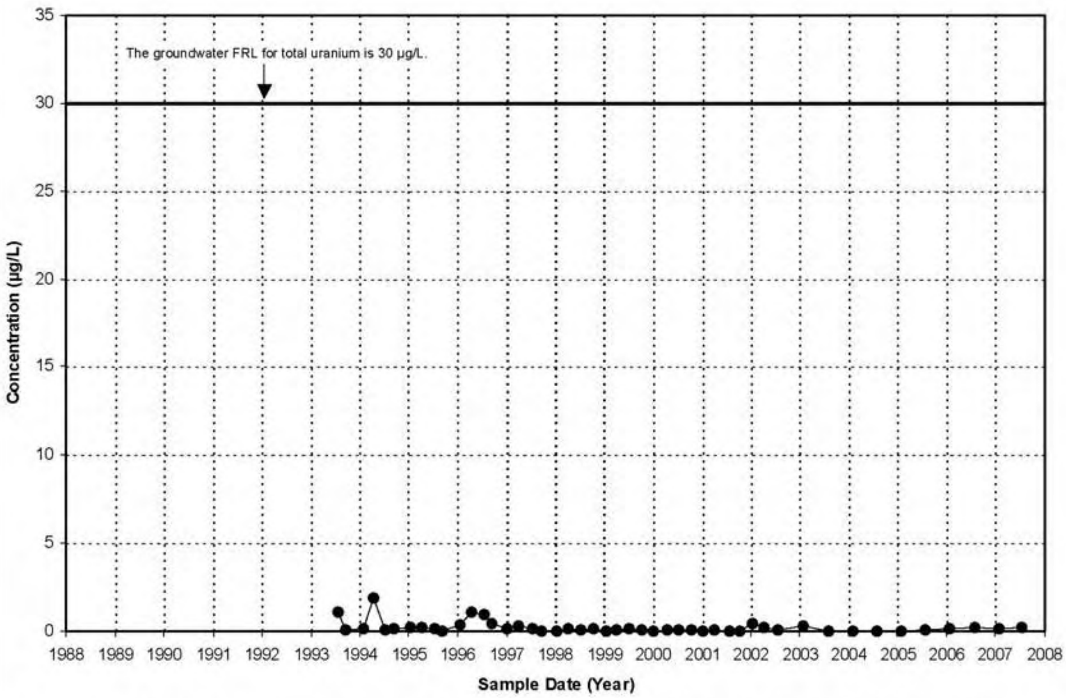


FIGURE A.2-71. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 3431

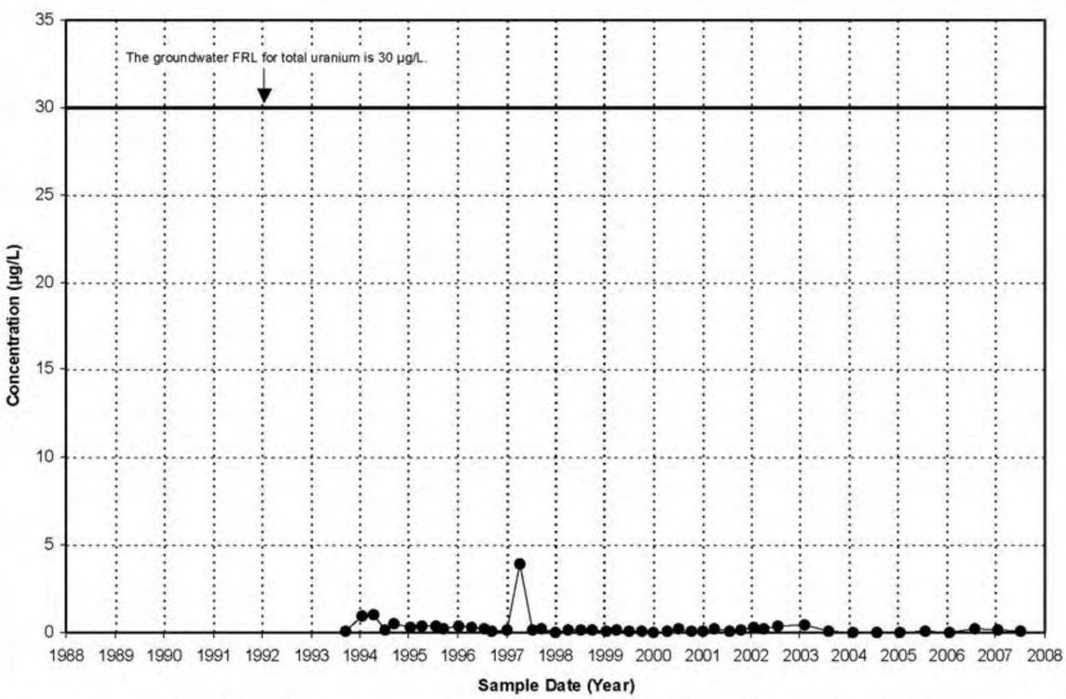


FIGURE A.2-72. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 3432

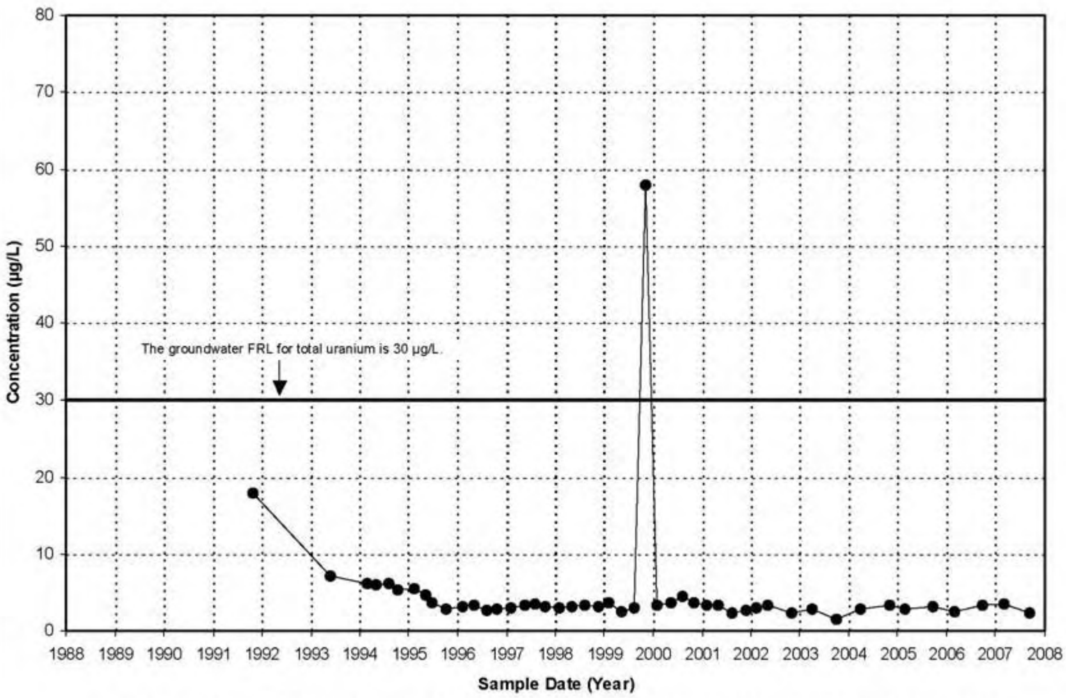


FIGURE A.2-73. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 3550

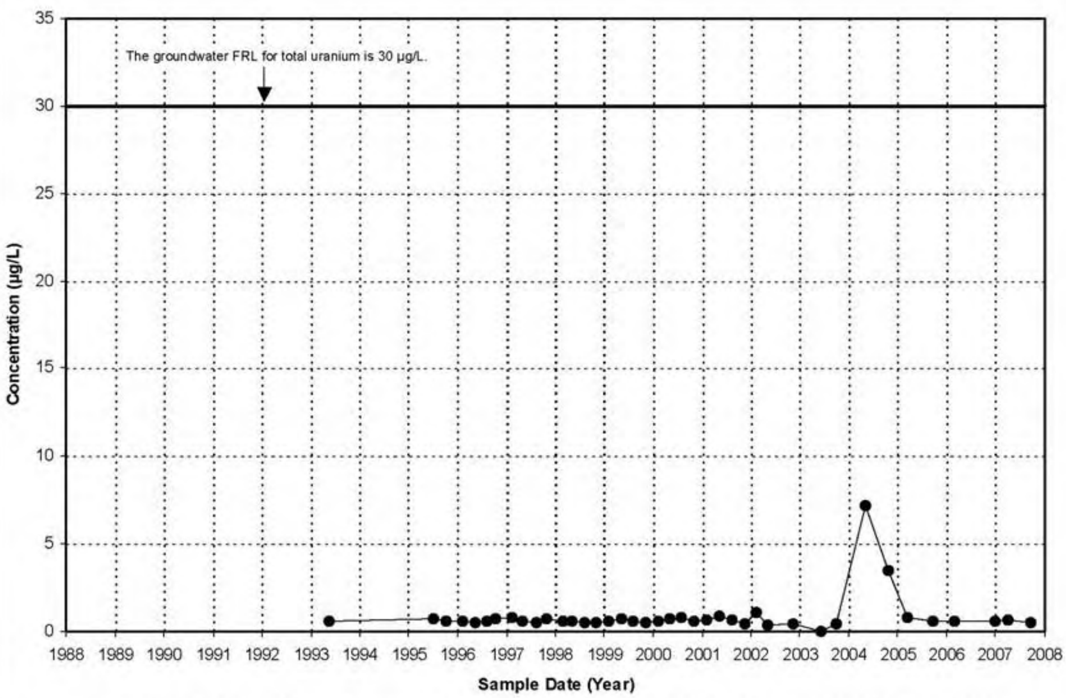


FIGURE A.2-74. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 3552

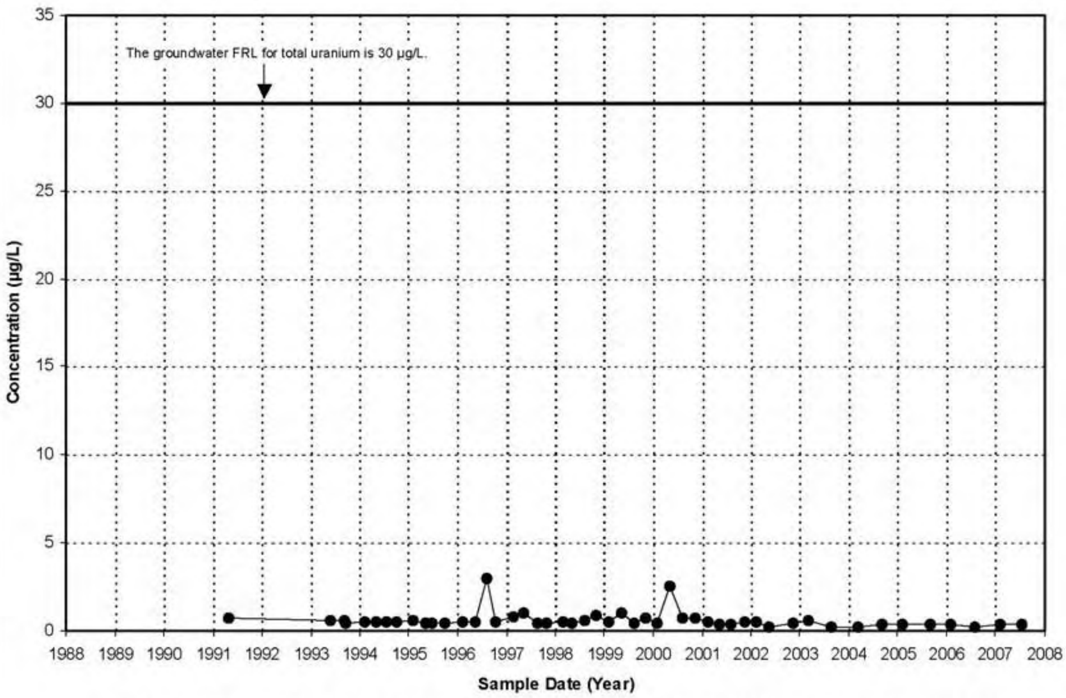


FIGURE A.2-75. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 3636

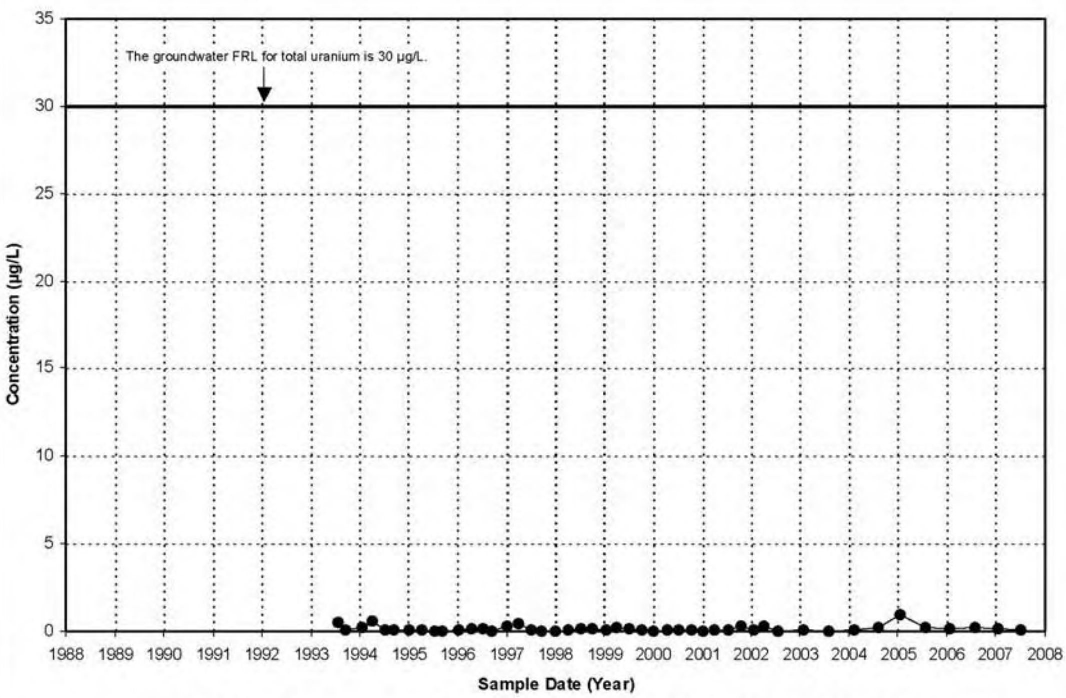


FIGURE A.2-76. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 3733

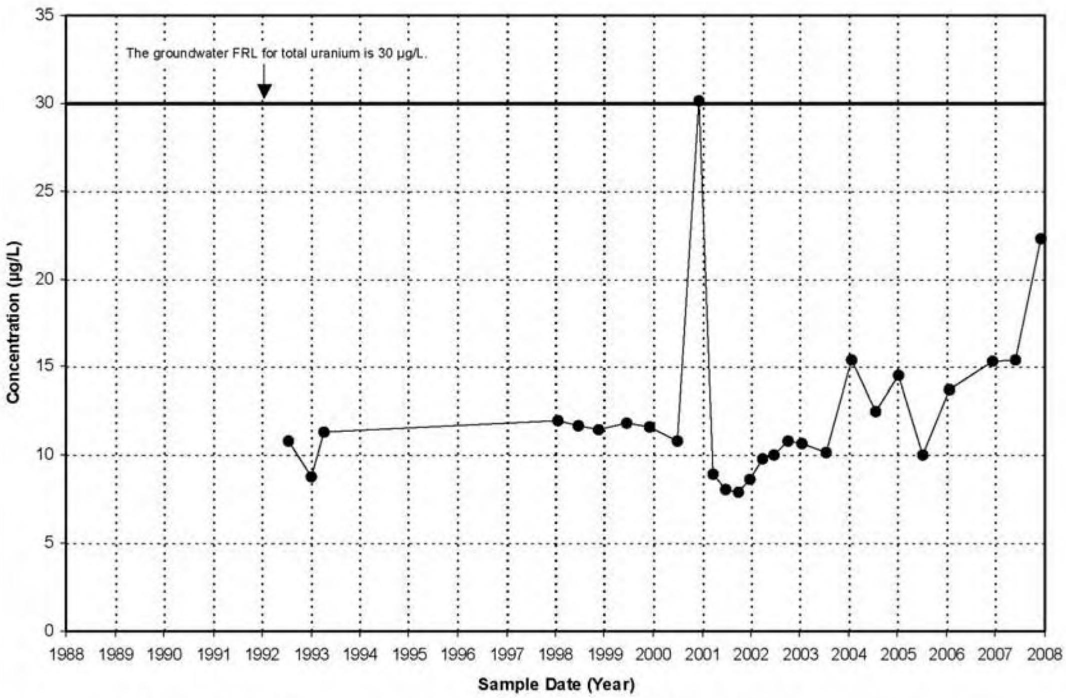


FIGURE A.2-77. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 3821

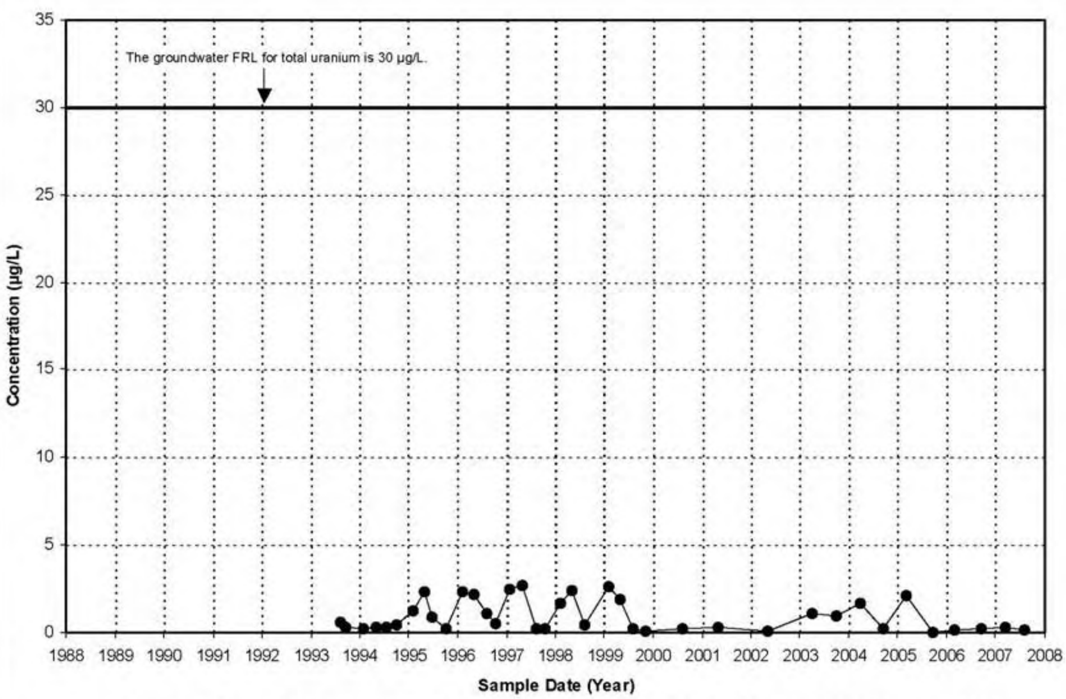


FIGURE A.2-78. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 3880

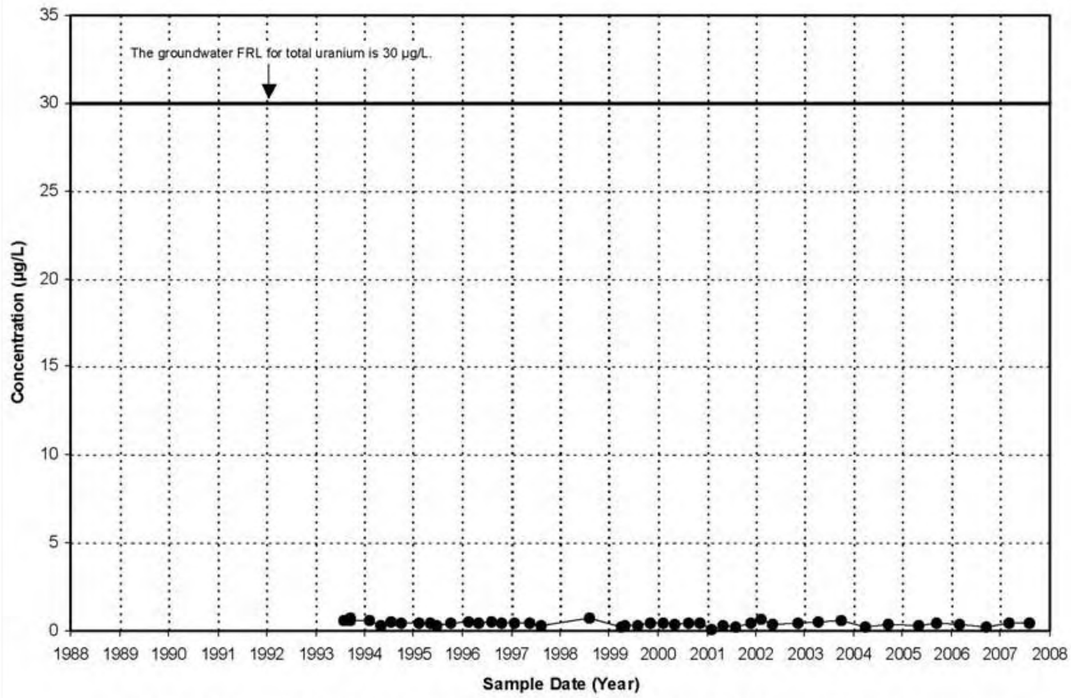


FIGURE A.2-79. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 3897

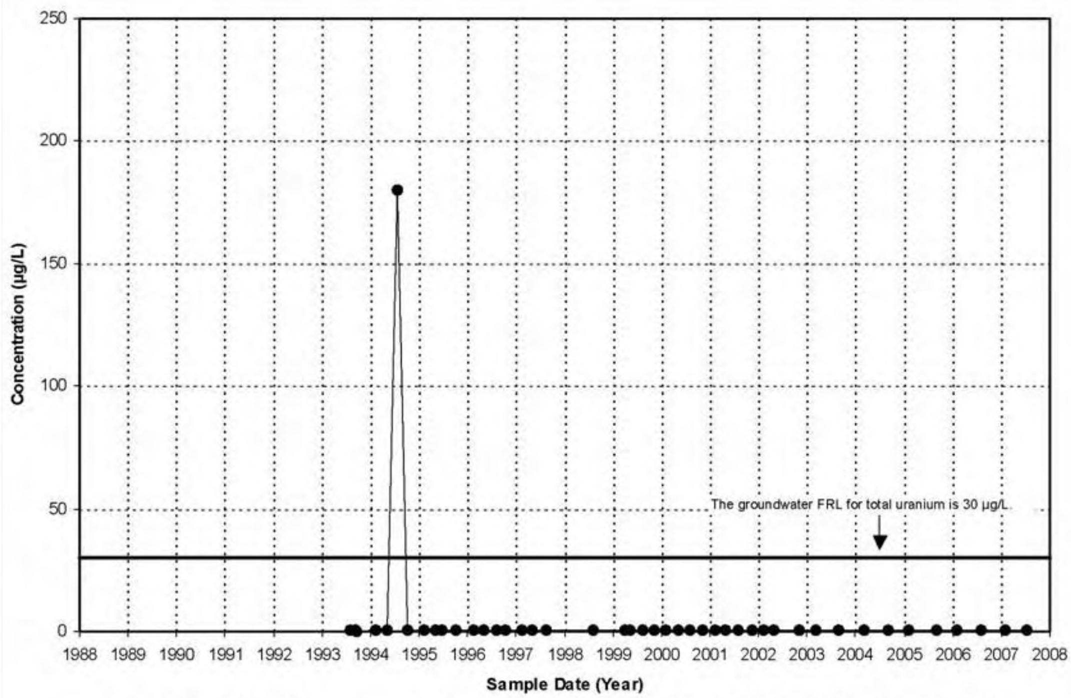


FIGURE A.2-80. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 3898

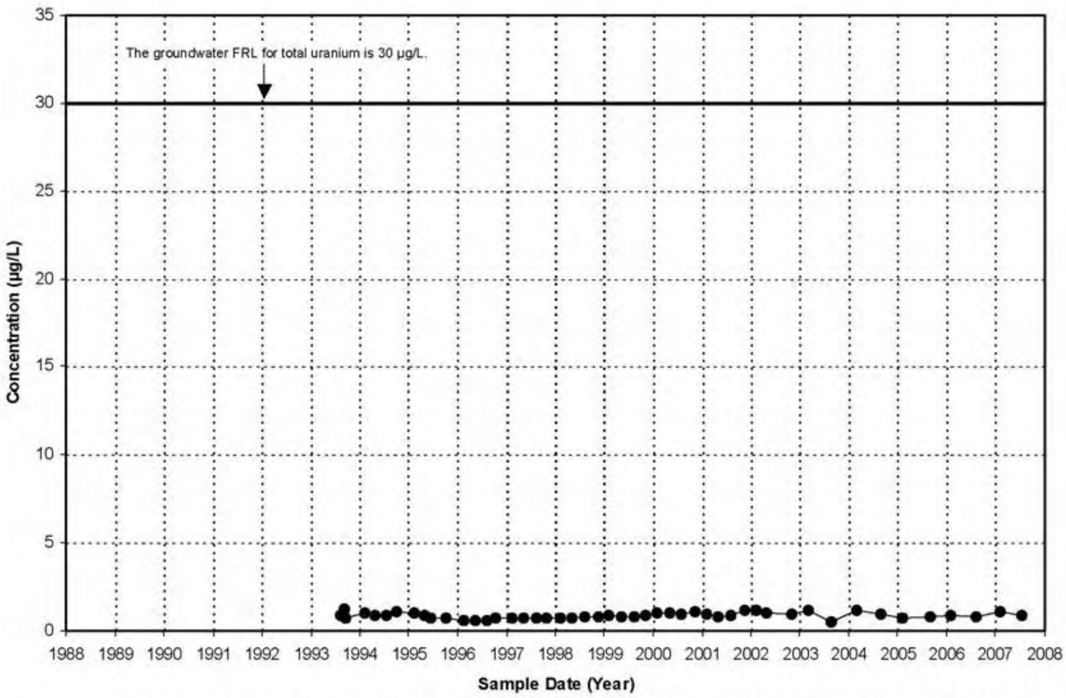


FIGURE A.2-81. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 3899

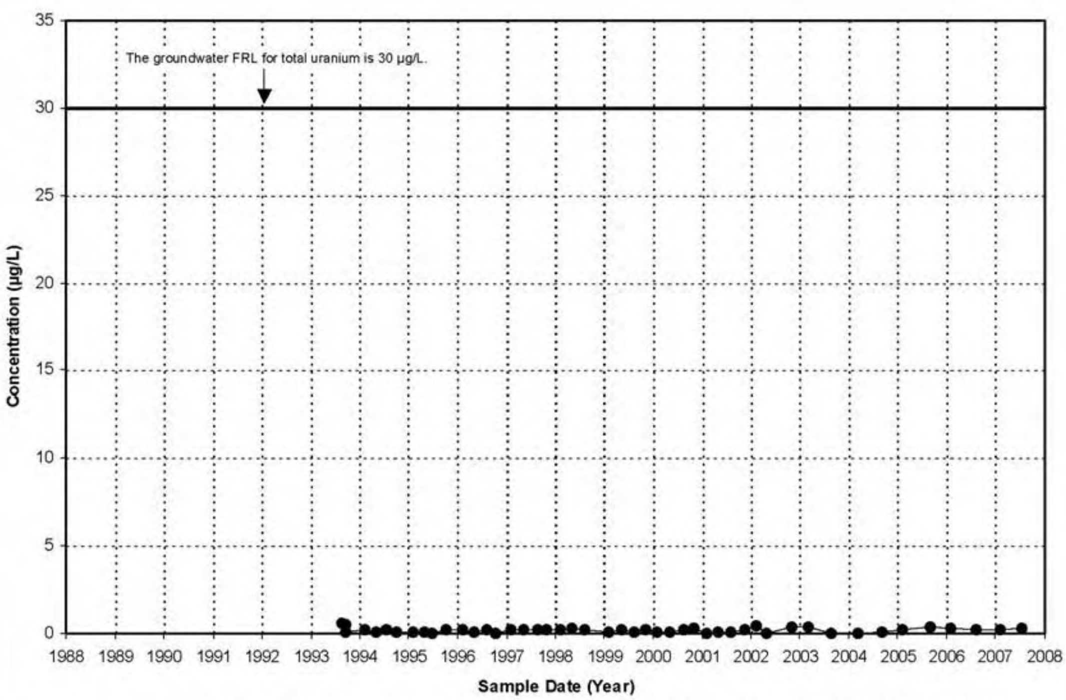


FIGURE A.2-82. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 3900

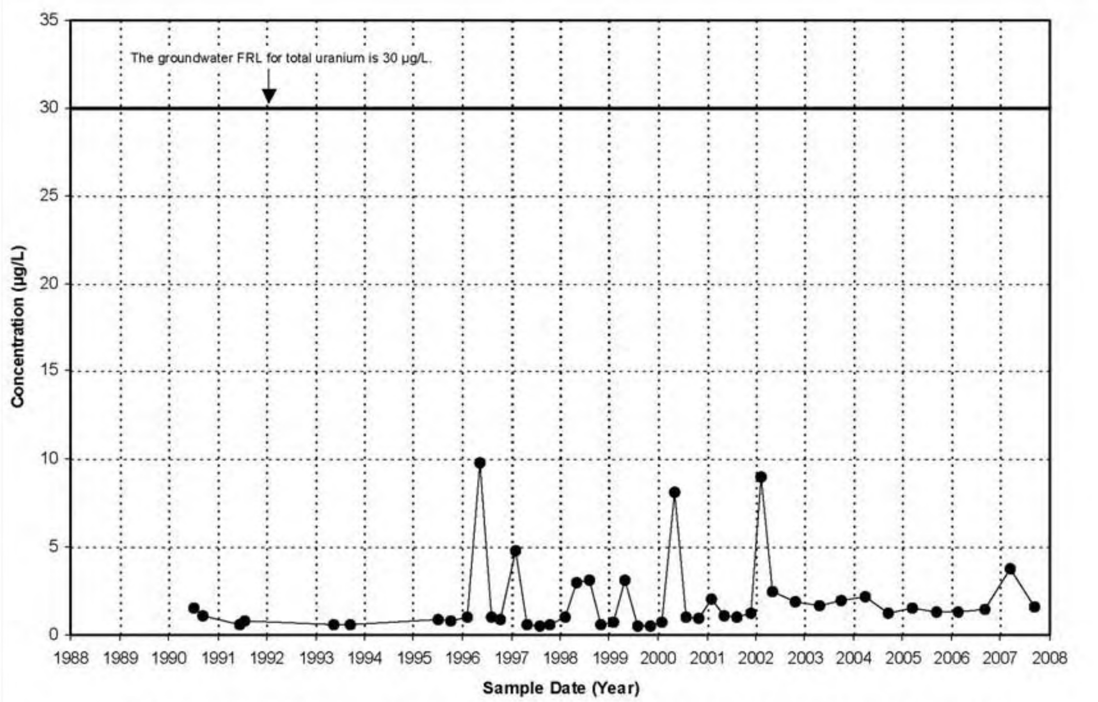


FIGURE A.2-83. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 4125

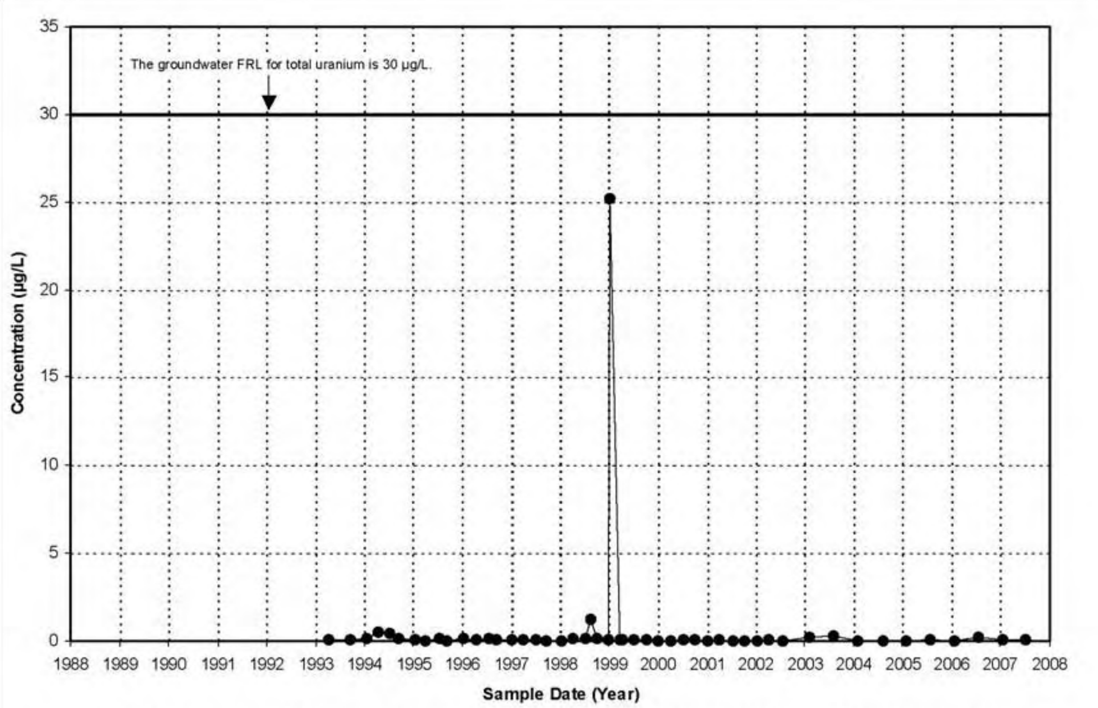


FIGURE A.2-84. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 4398

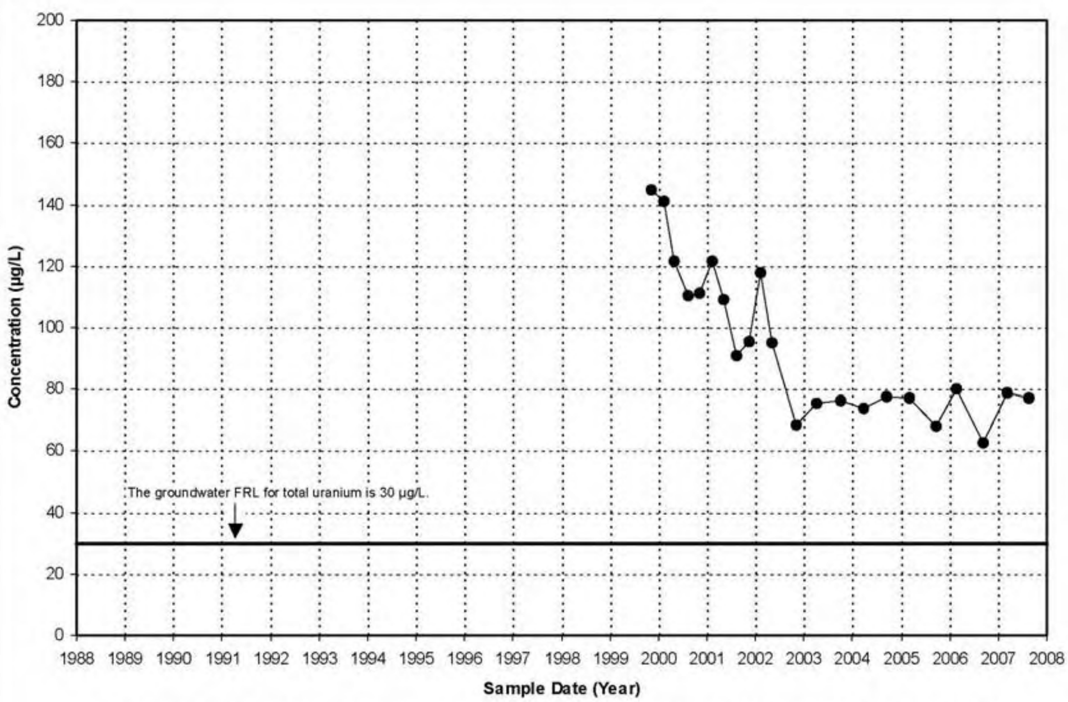


FIGURE A.2-85. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 6880

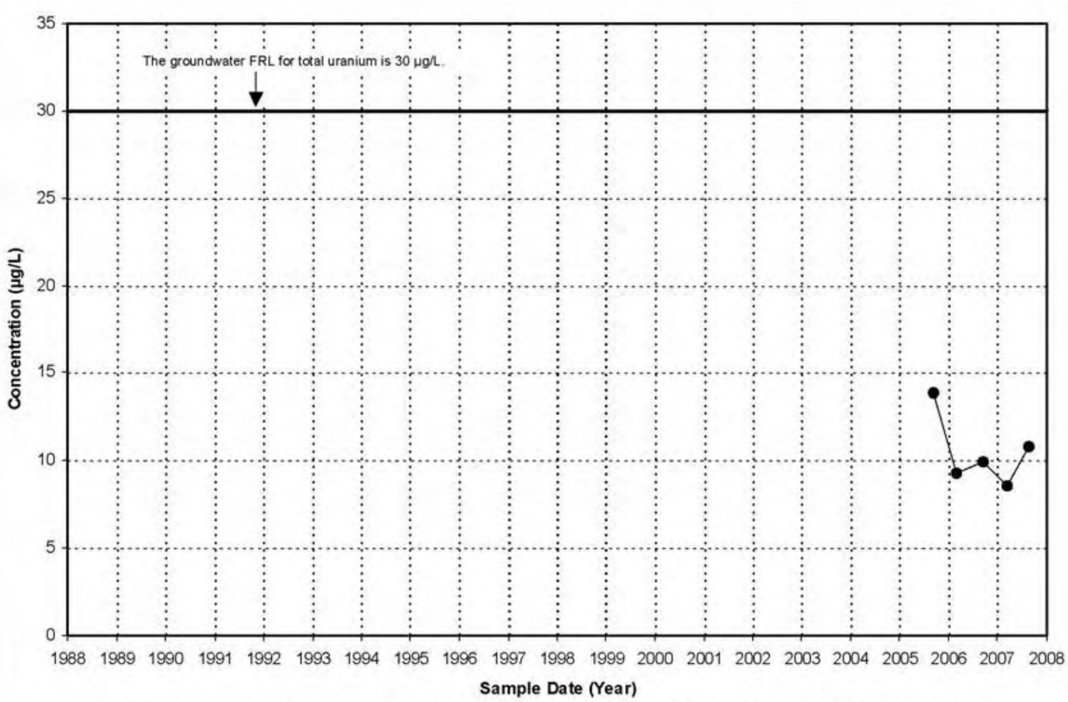


FIGURE A.2-86. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 6015

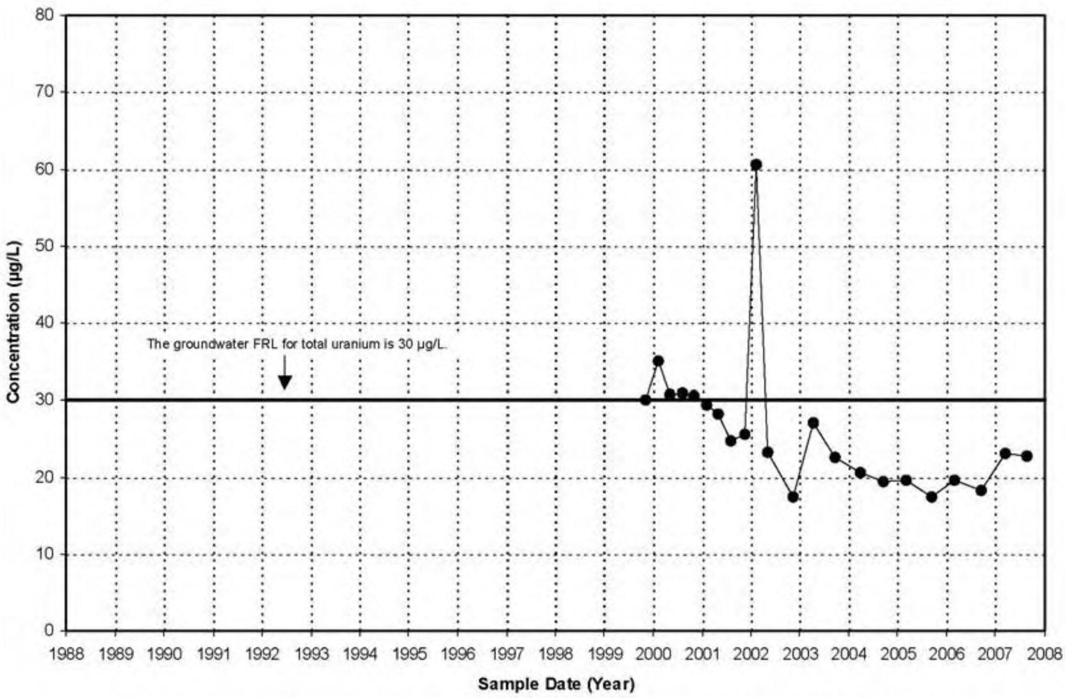


FIGURE A.2-87. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 6881

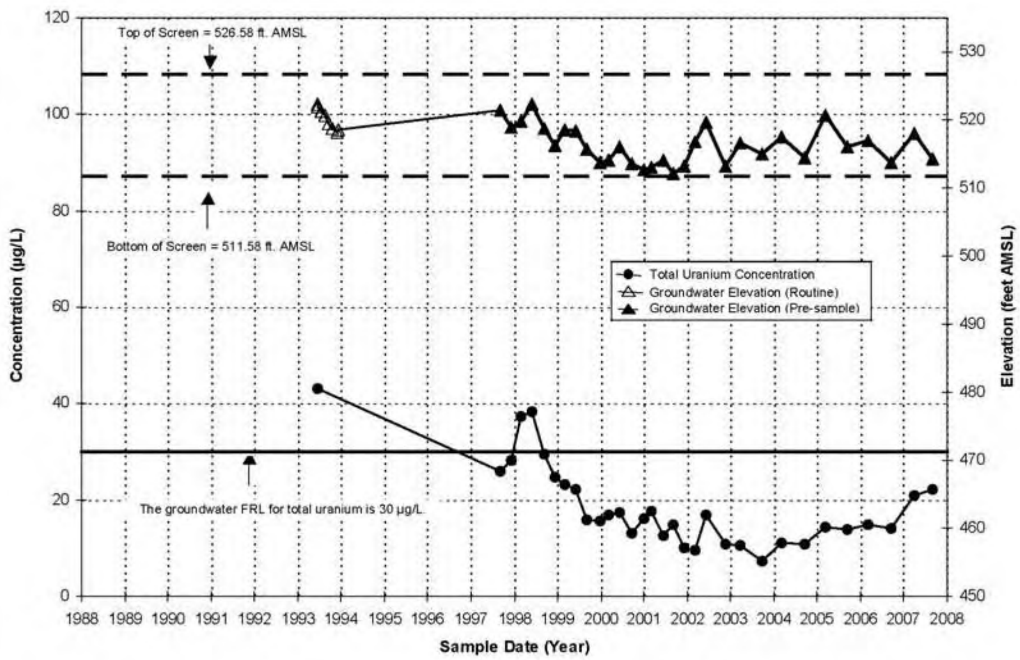


FIGURE A.2-88. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 21033

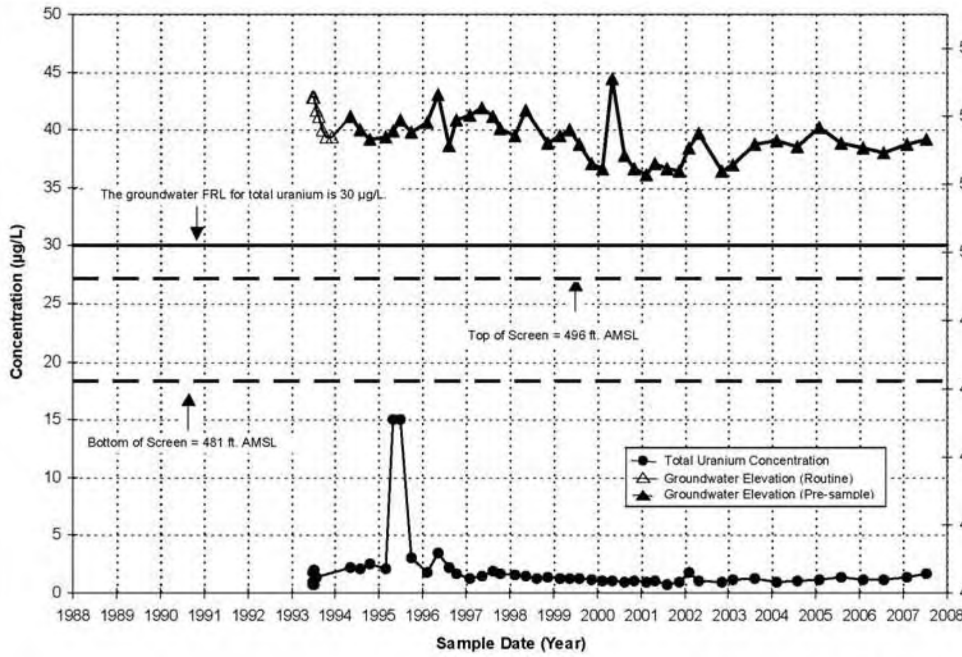


FIGURE A.2-89. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 21063

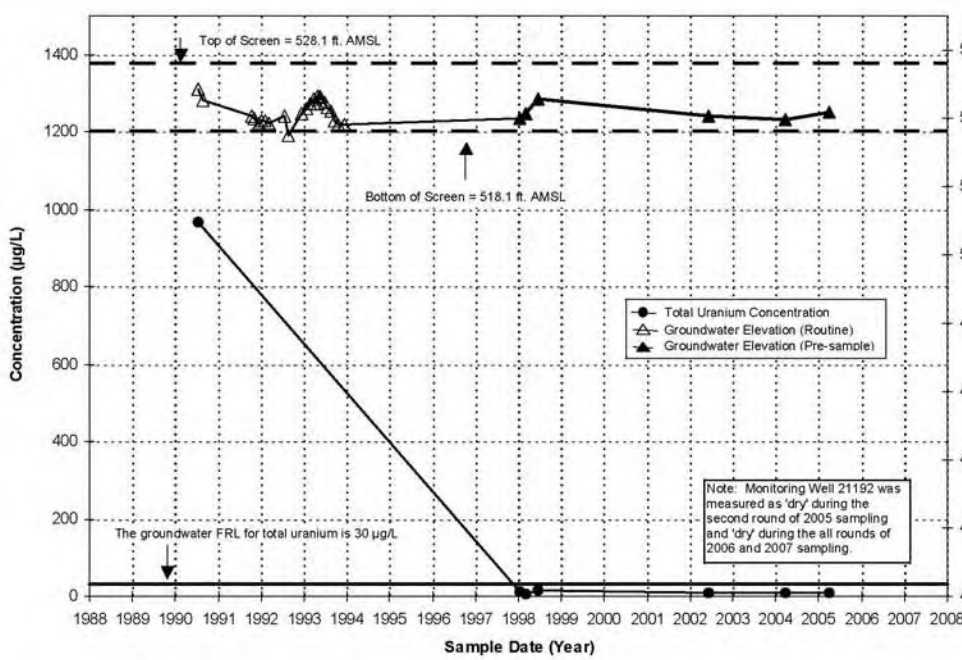


FIGURE A.2-90. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 21192

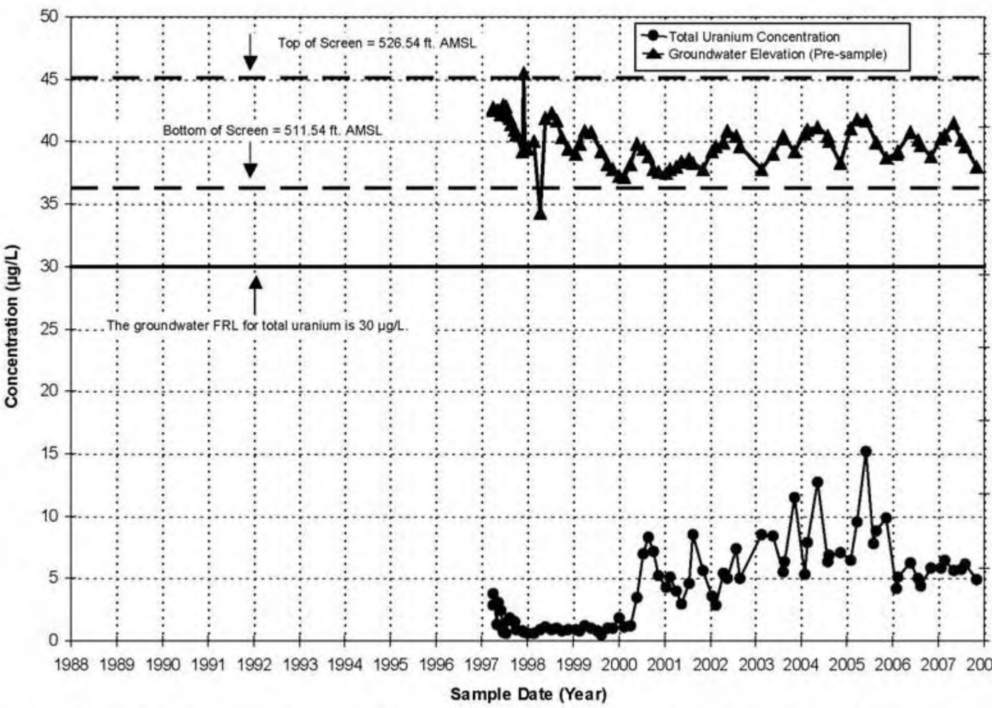


FIGURE A.2-91. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 22198

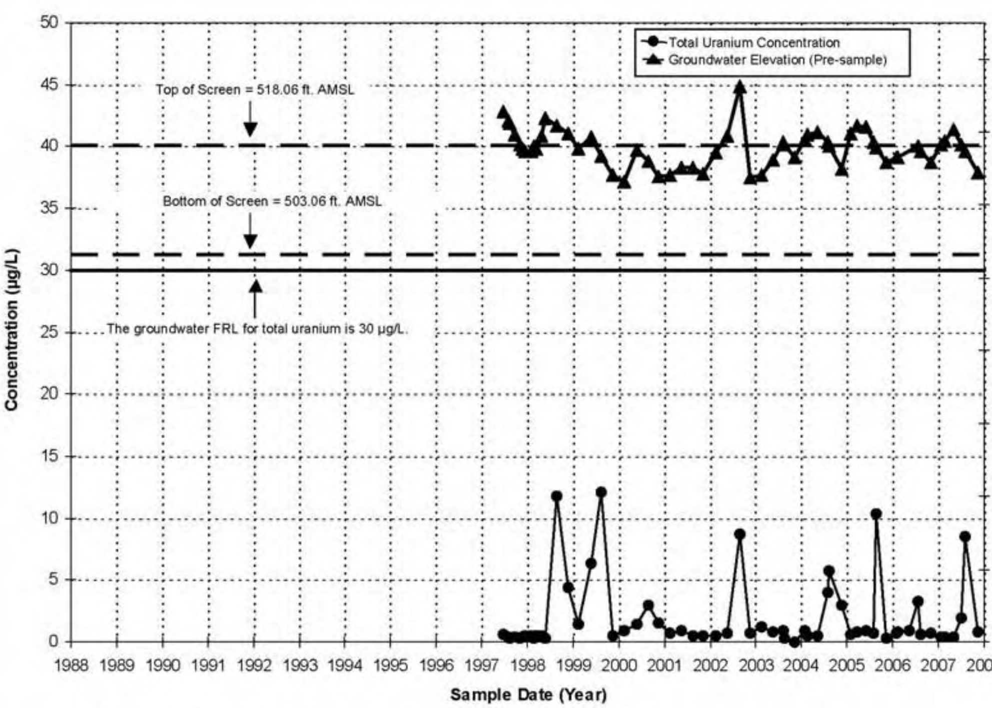


FIGURE A.2-92. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 22199

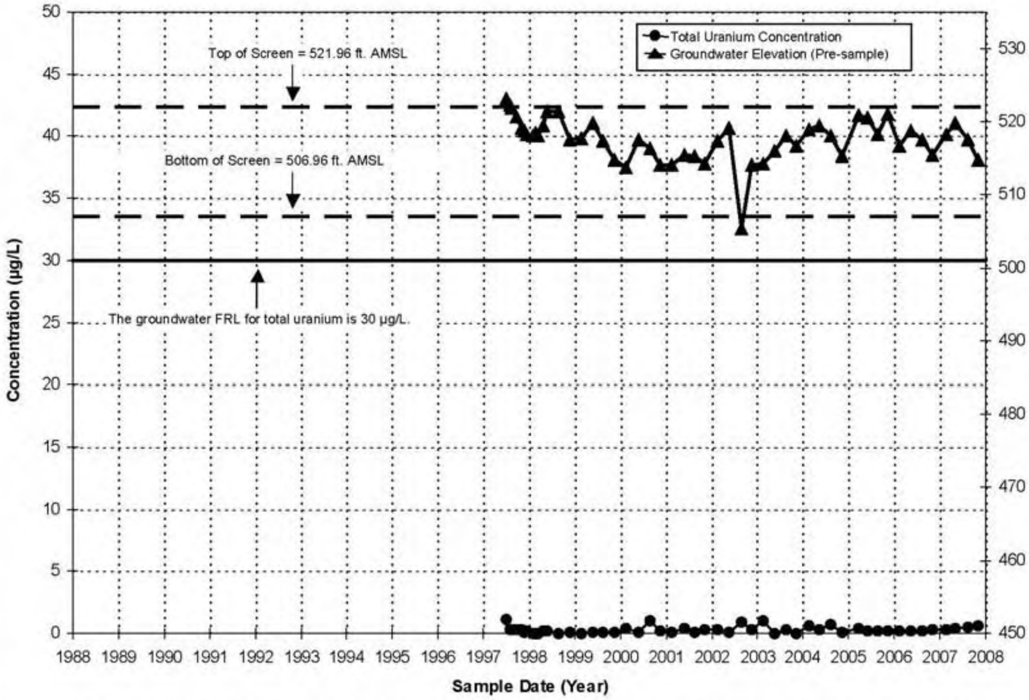


FIGURE A.2-93. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 22200

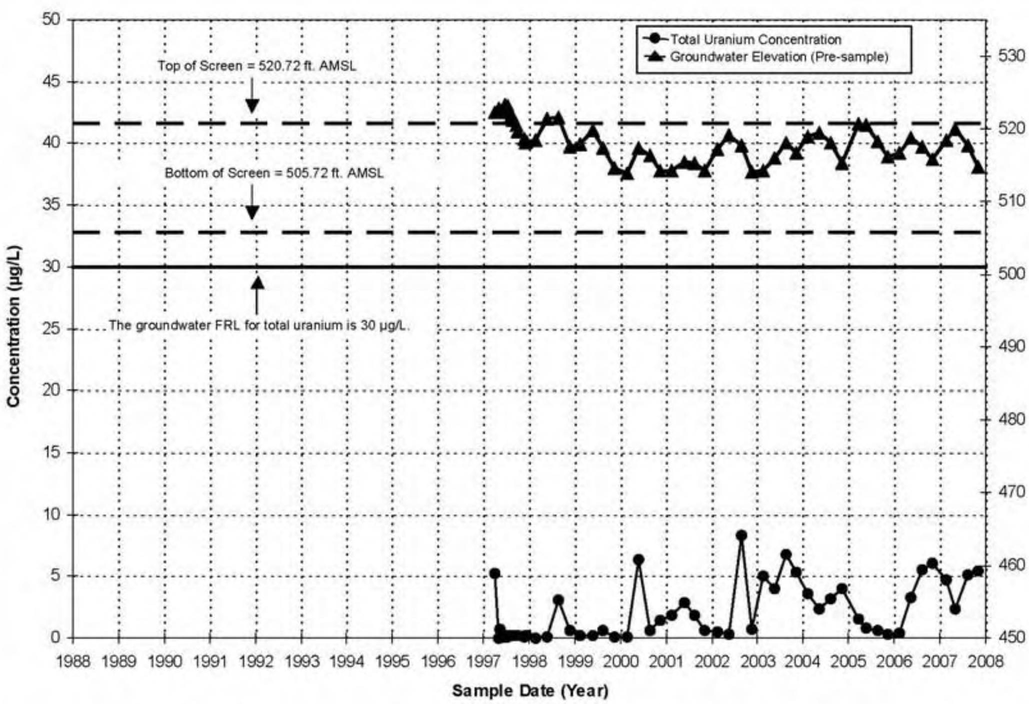


FIGURE A.2-94. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 22201

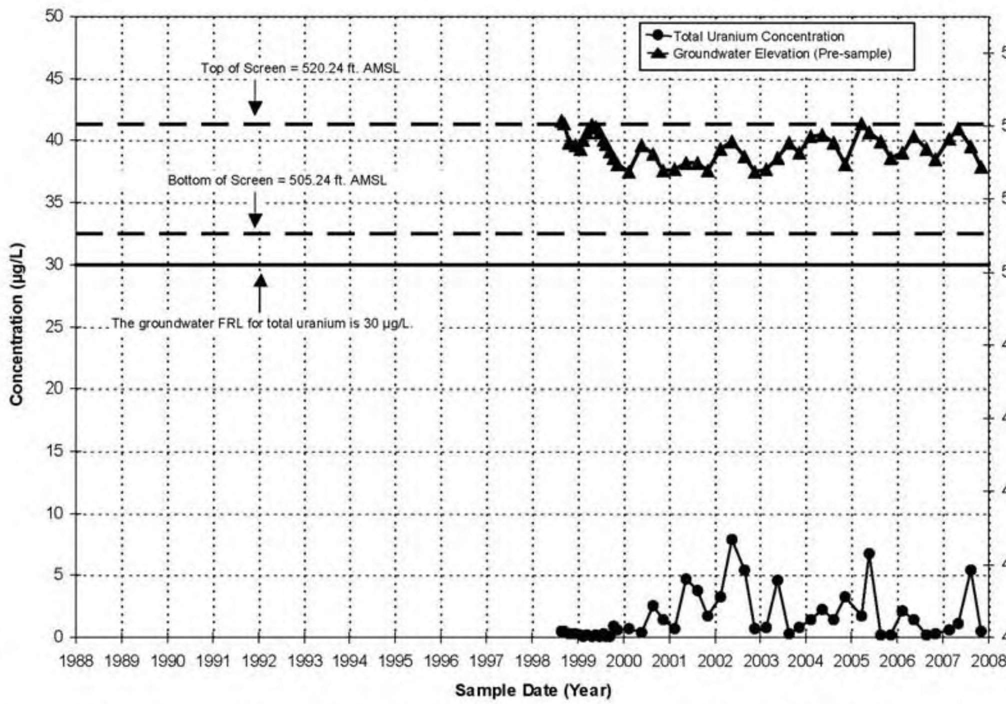


FIGURE A.2-95. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 22203

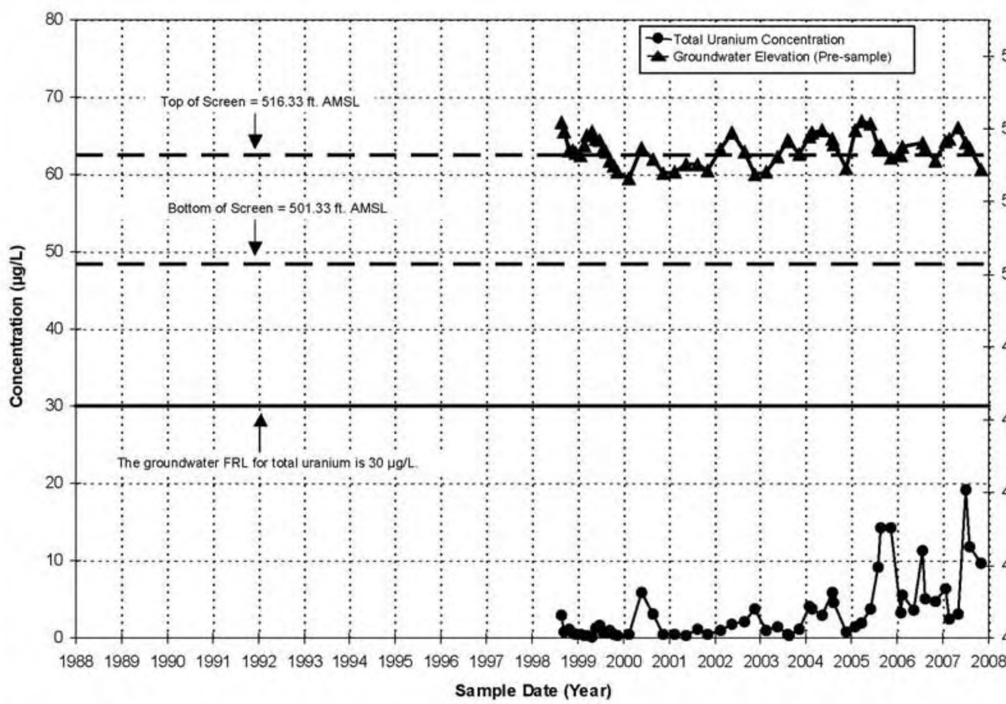


FIGURE A.2-96. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 22204

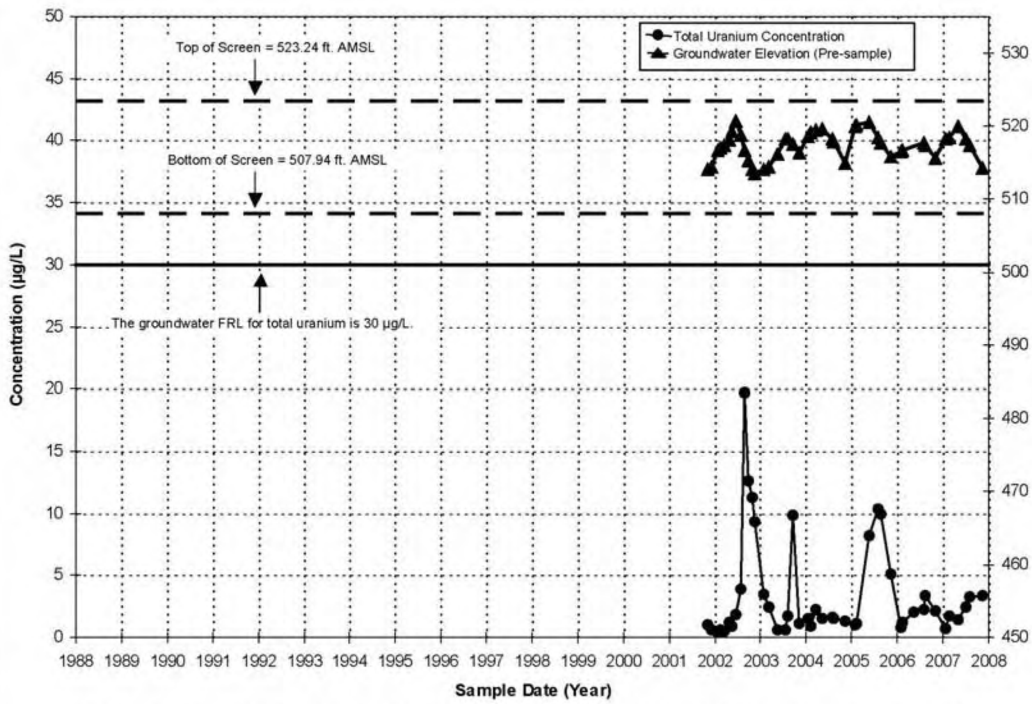


FIGURE A.2-97. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 22205

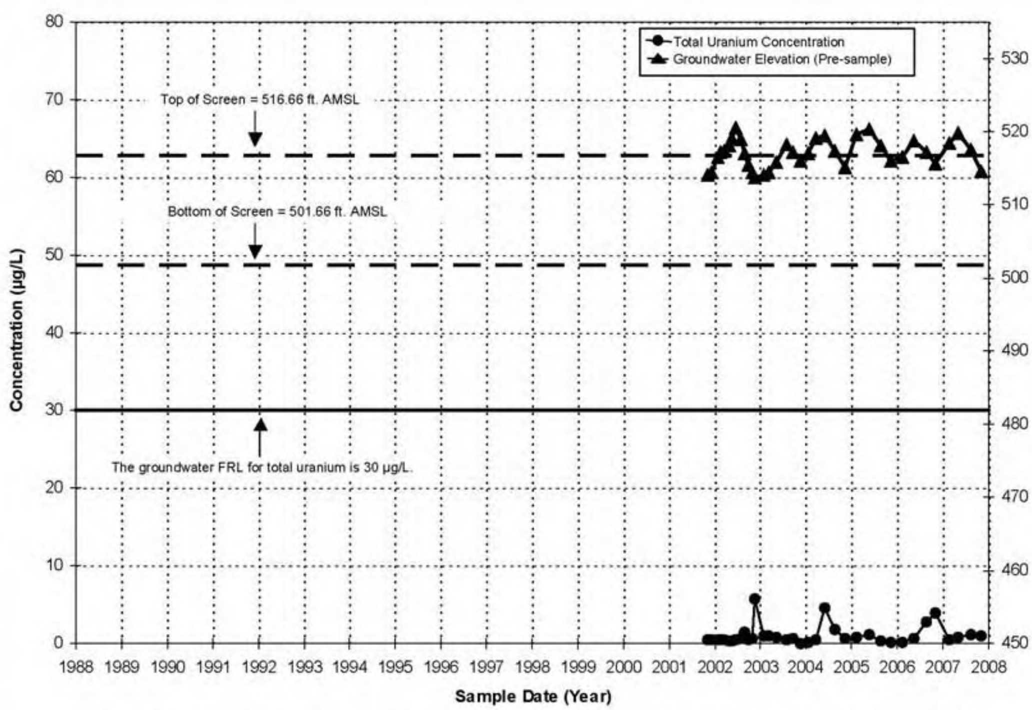


FIGURE A.2-98. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 22206

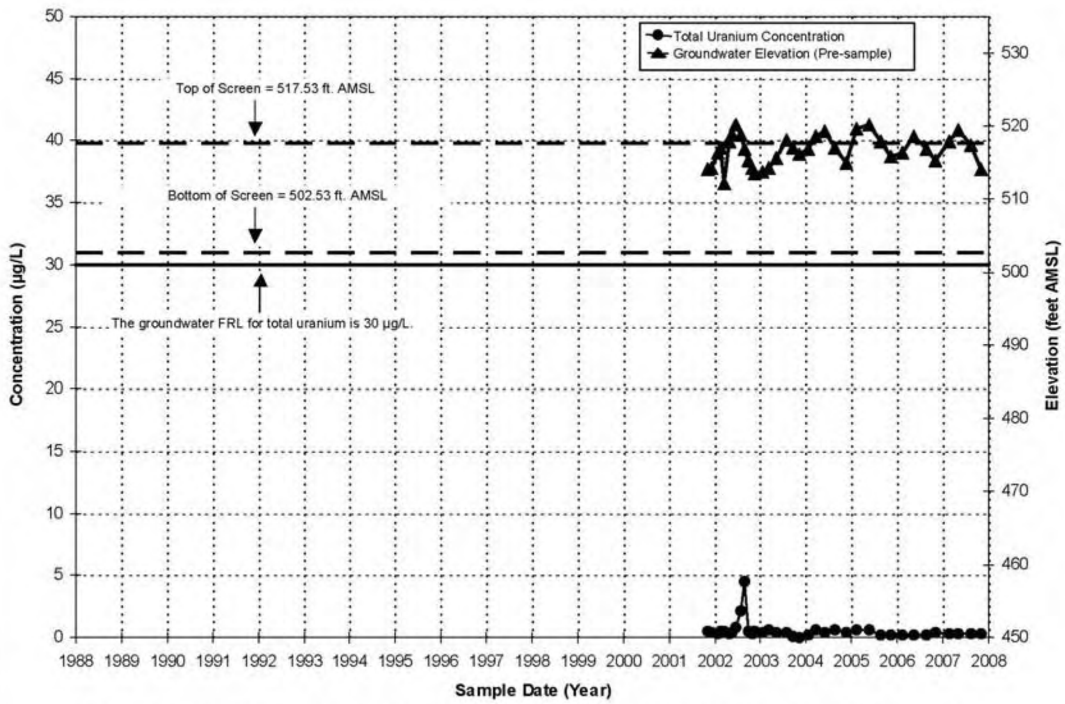


FIGURE A.2-99. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 22207

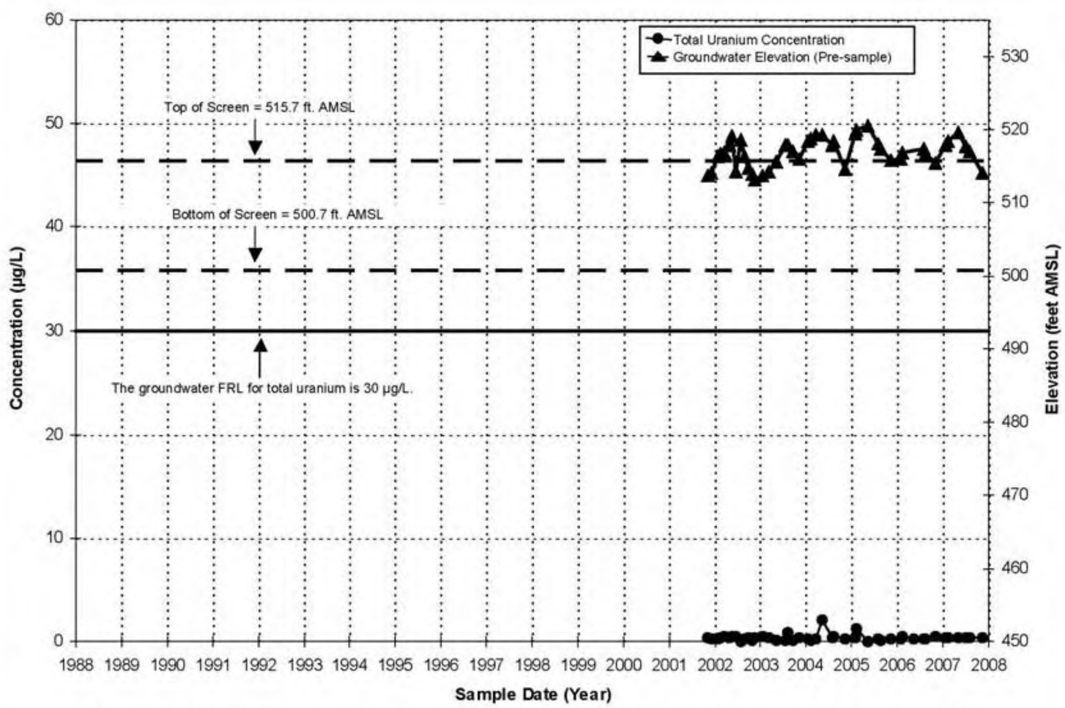


FIGURE A.2-100. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 22208

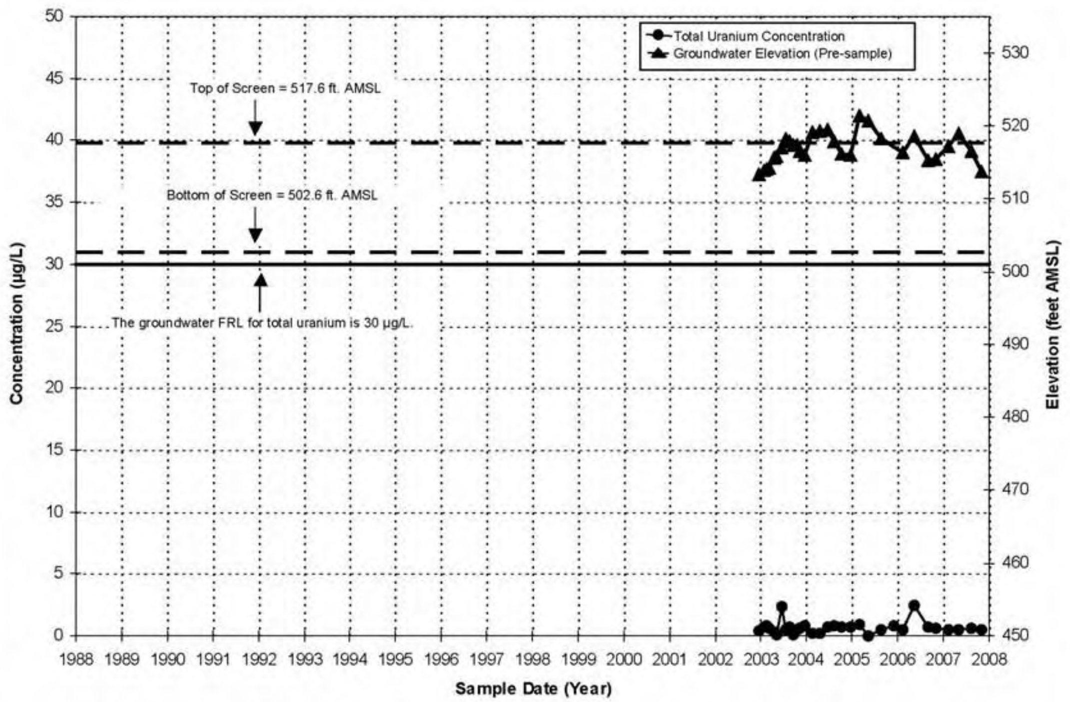


FIGURE A.2-101. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 22209

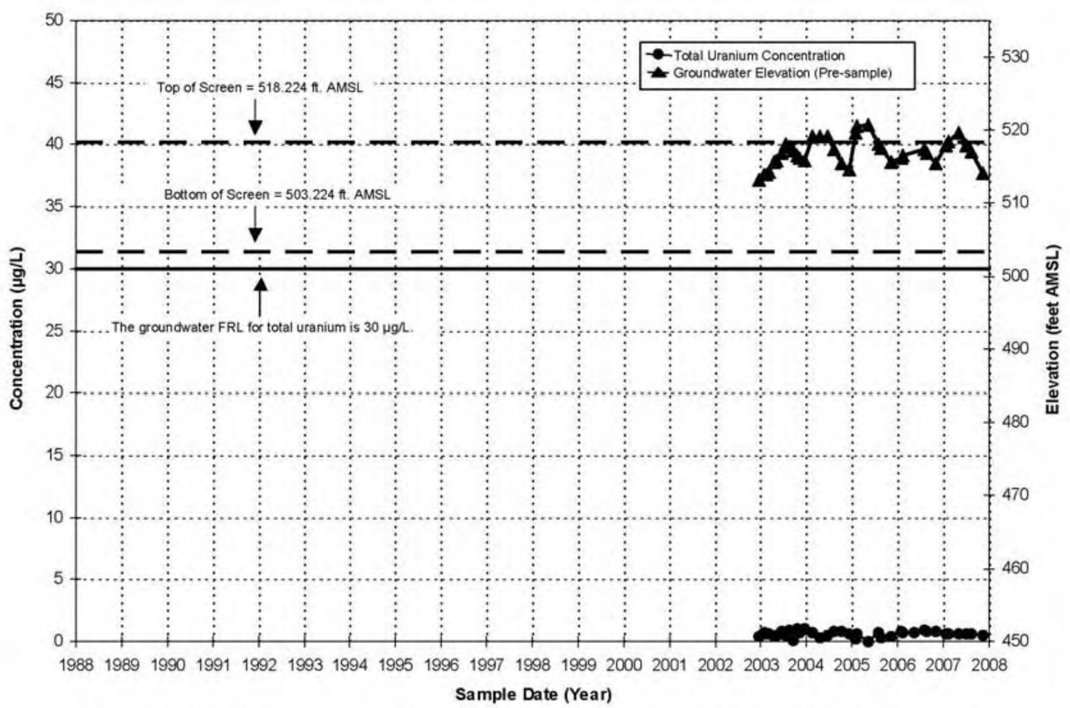


FIGURE A.2-102. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 22210

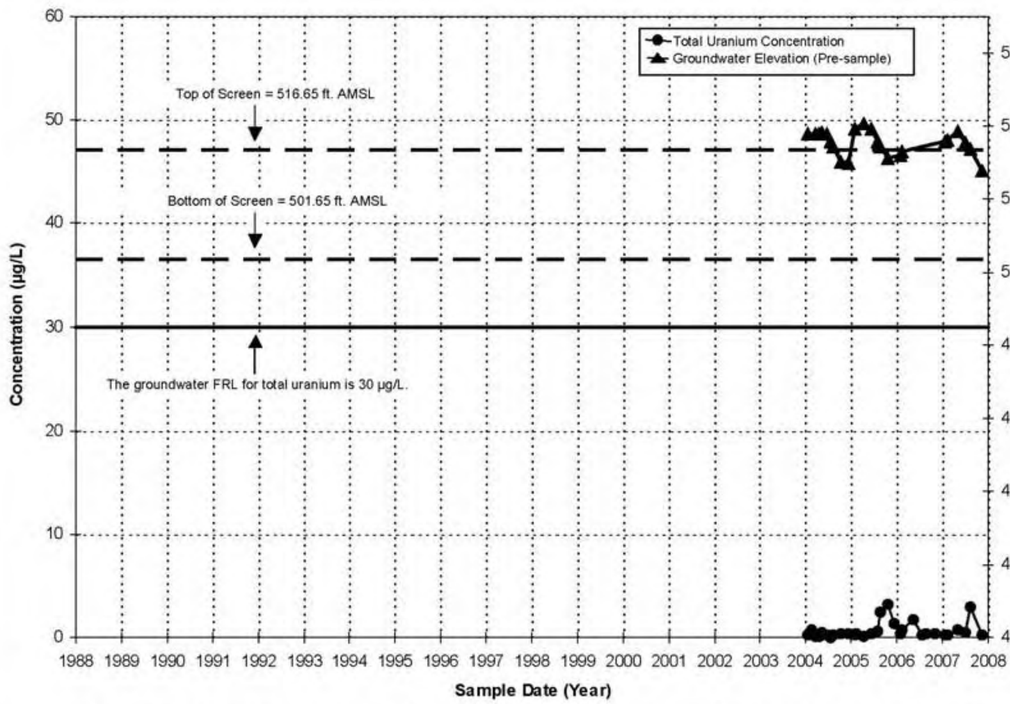


FIGURE A.2-103. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 22211

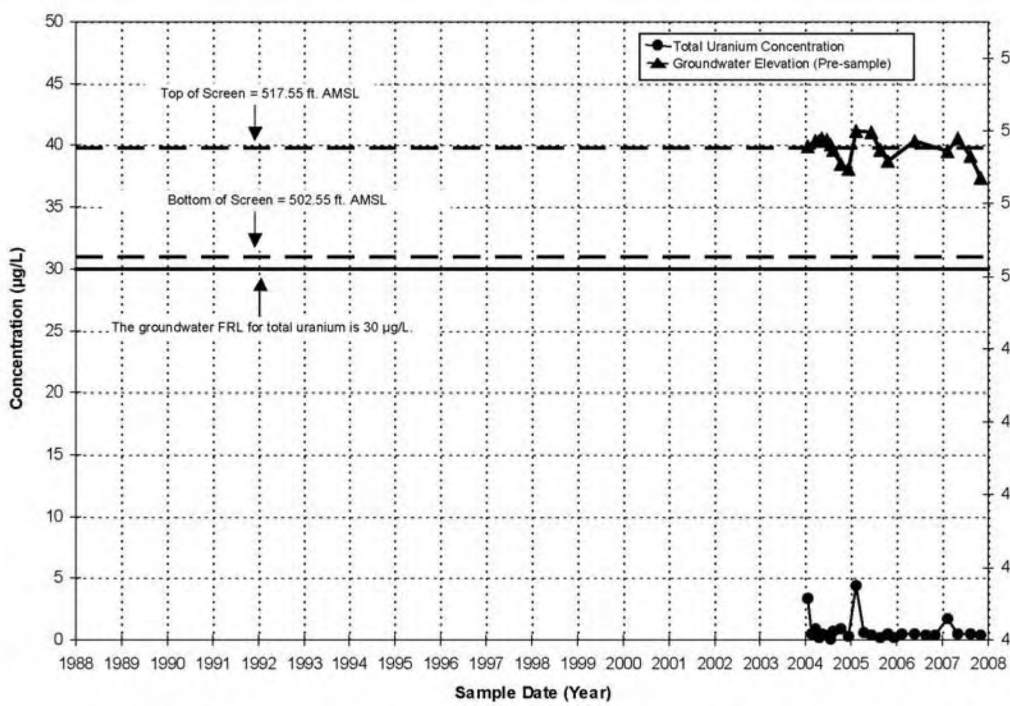


FIGURE A.2-104. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 22212

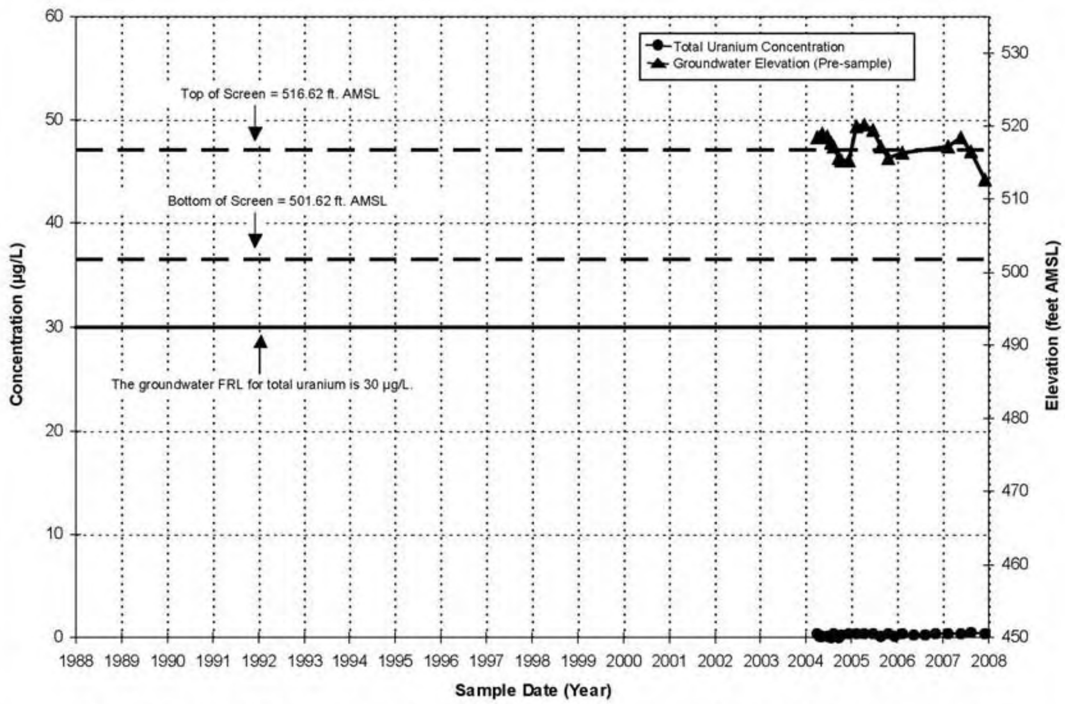


FIGURE A.2-105. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 22213

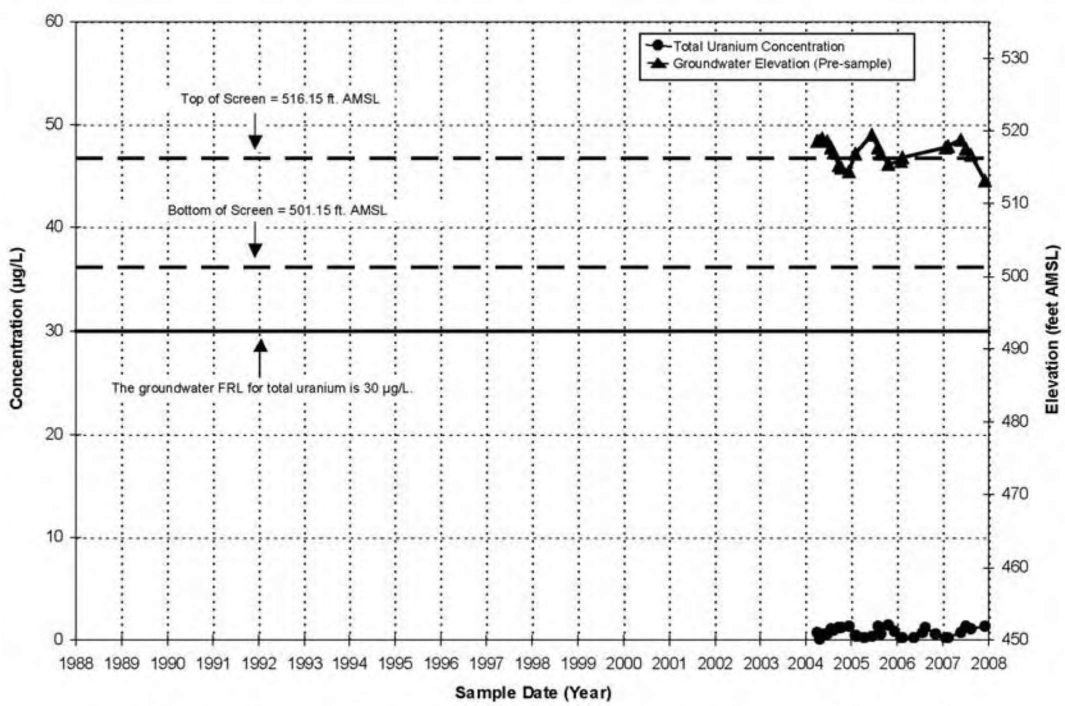


FIGURE A.2-106. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 22214

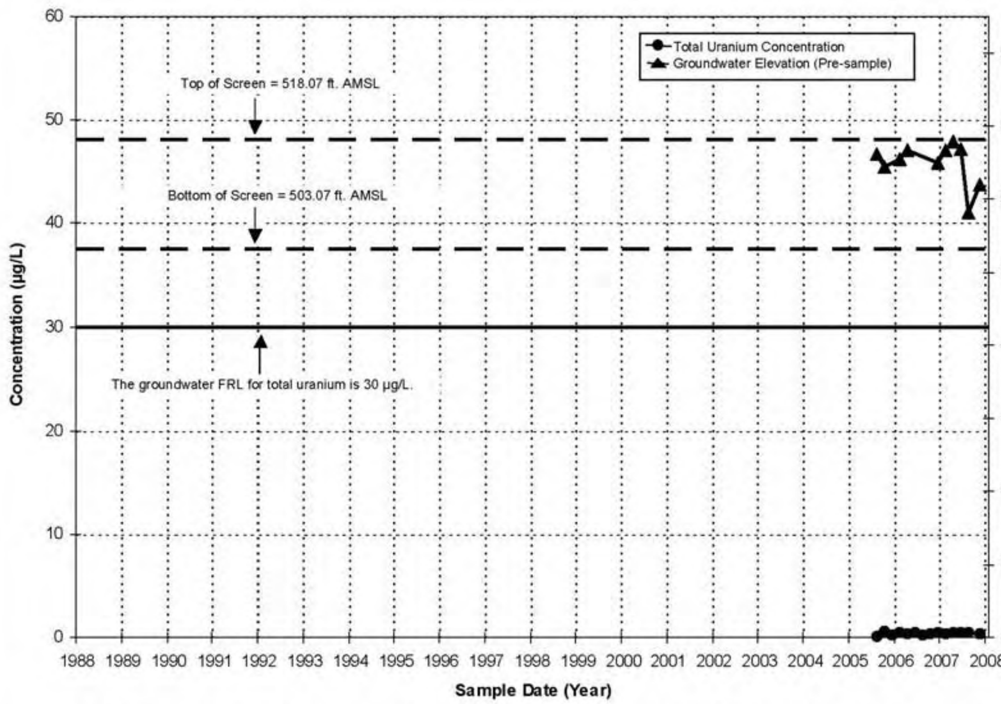


FIGURE A.2-107. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 22215

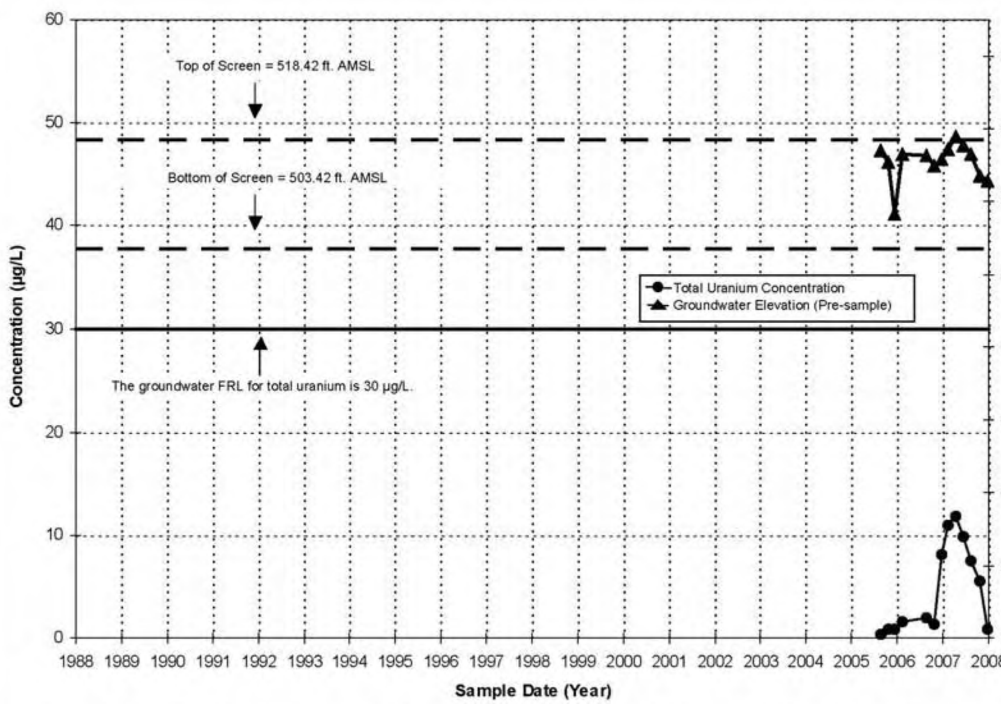


FIGURE A.2-108. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 22216/22217

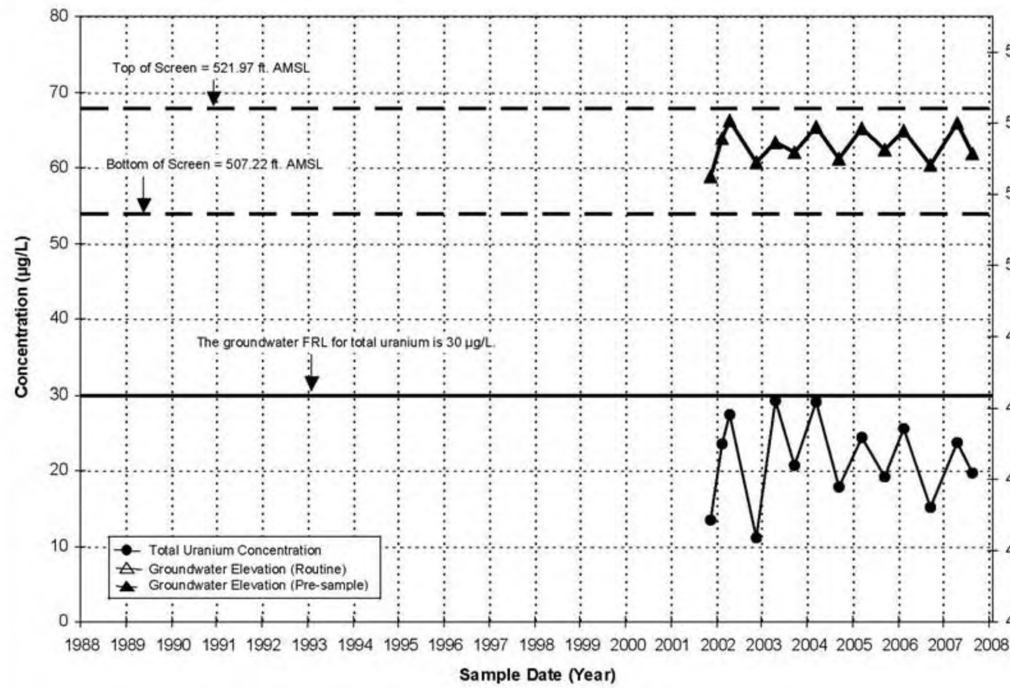


FIGURE A.2-109. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 23064

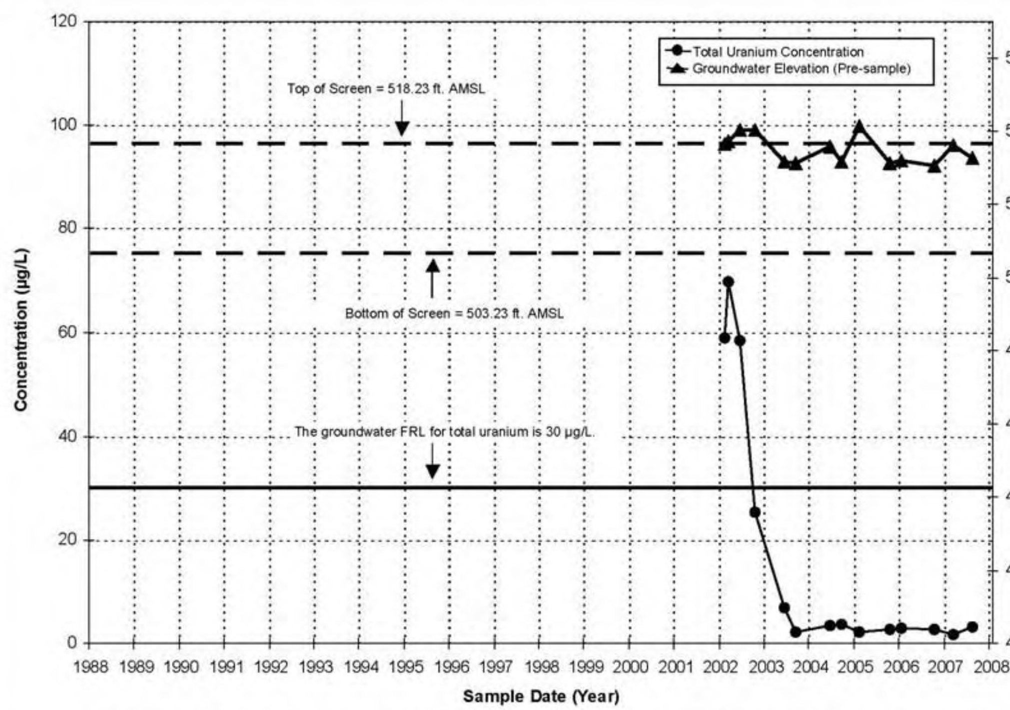


FIGURE A.2-110. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 23118

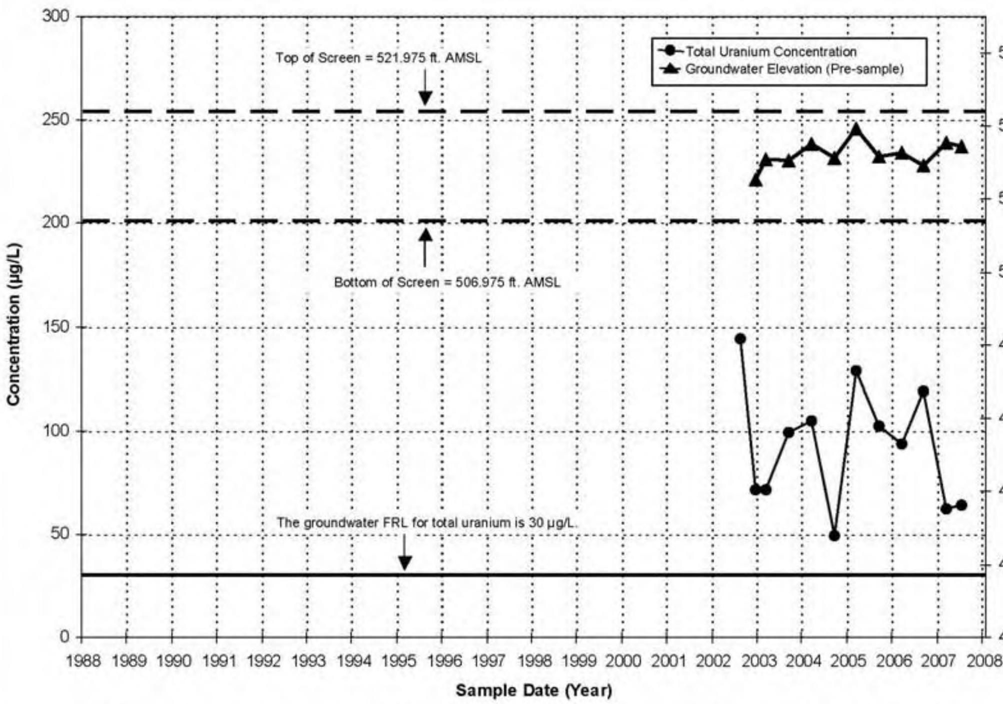


FIGURE A.2-111. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 23271

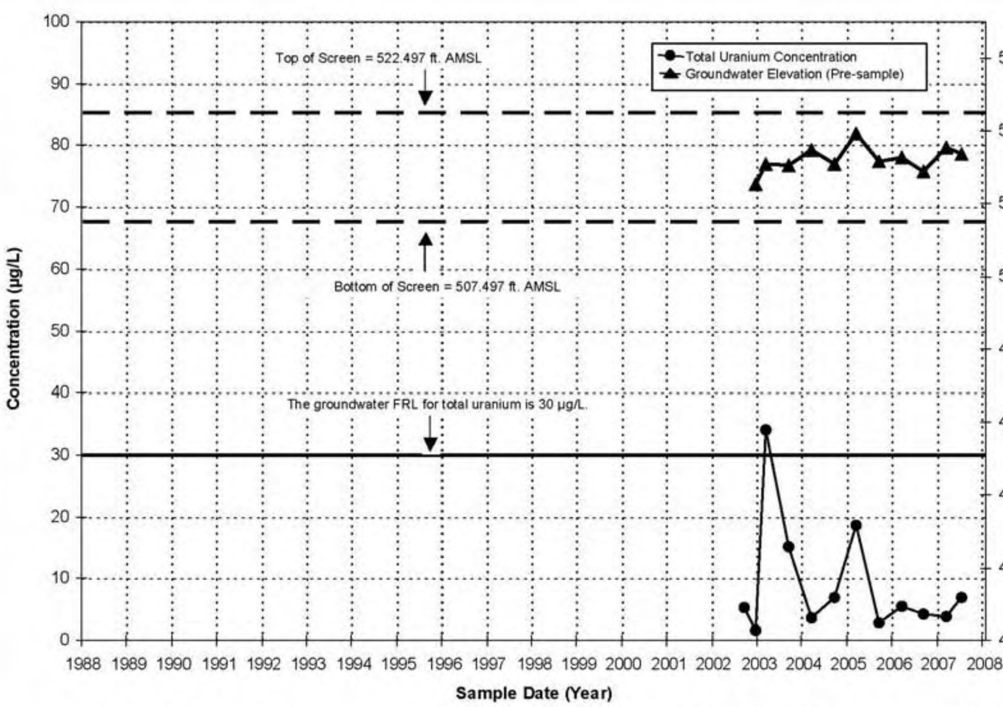


FIGURE A.2-112. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 23272

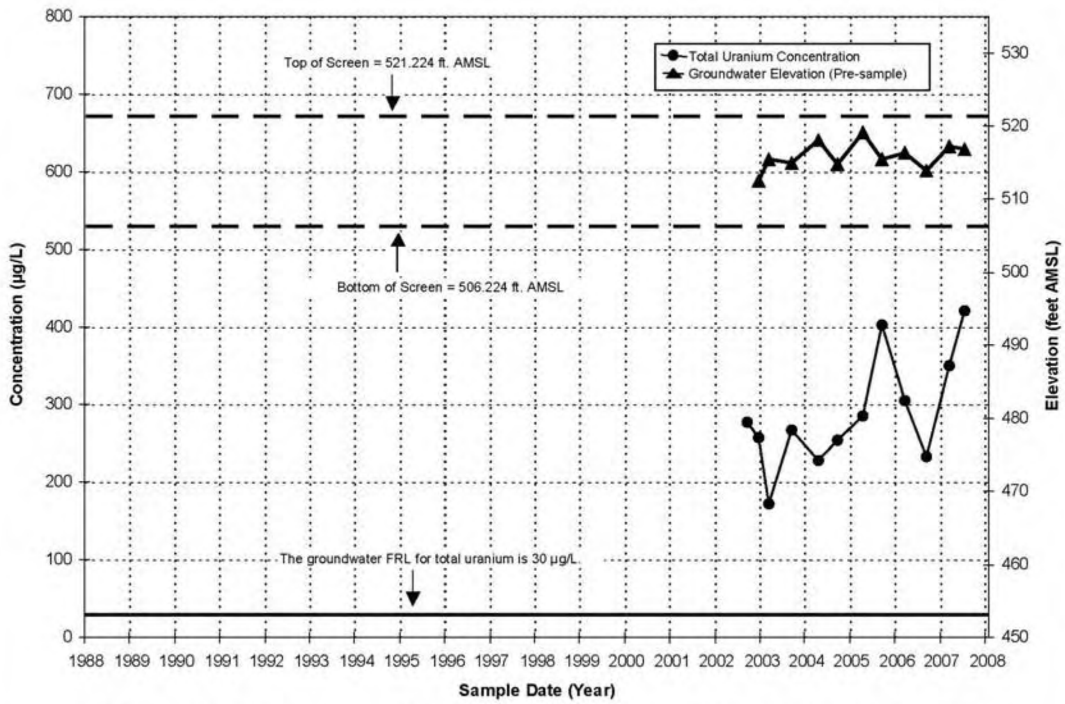


FIGURE A.2-113. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 23273

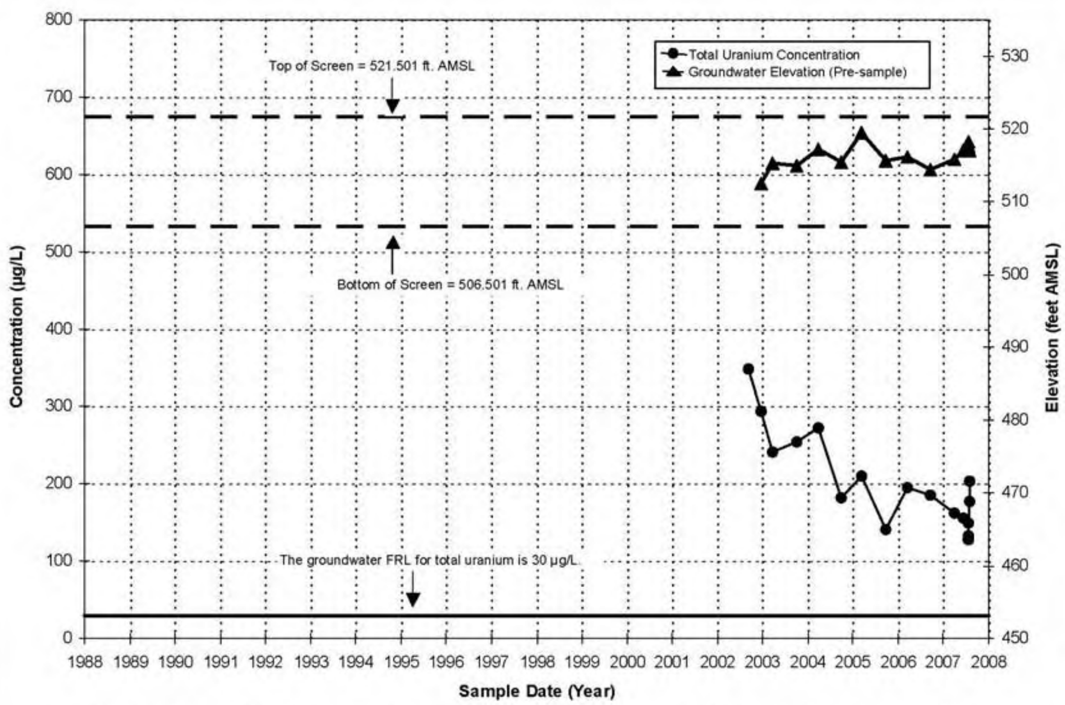


FIGURE A.2-114. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 23274

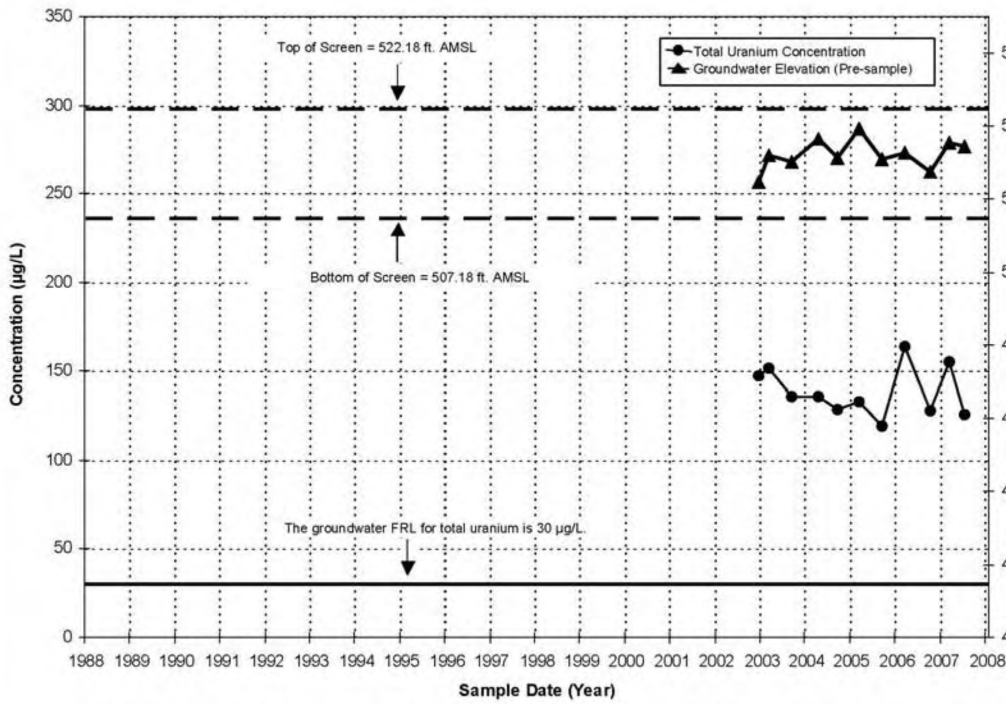


FIGURE A.2-115. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 23275

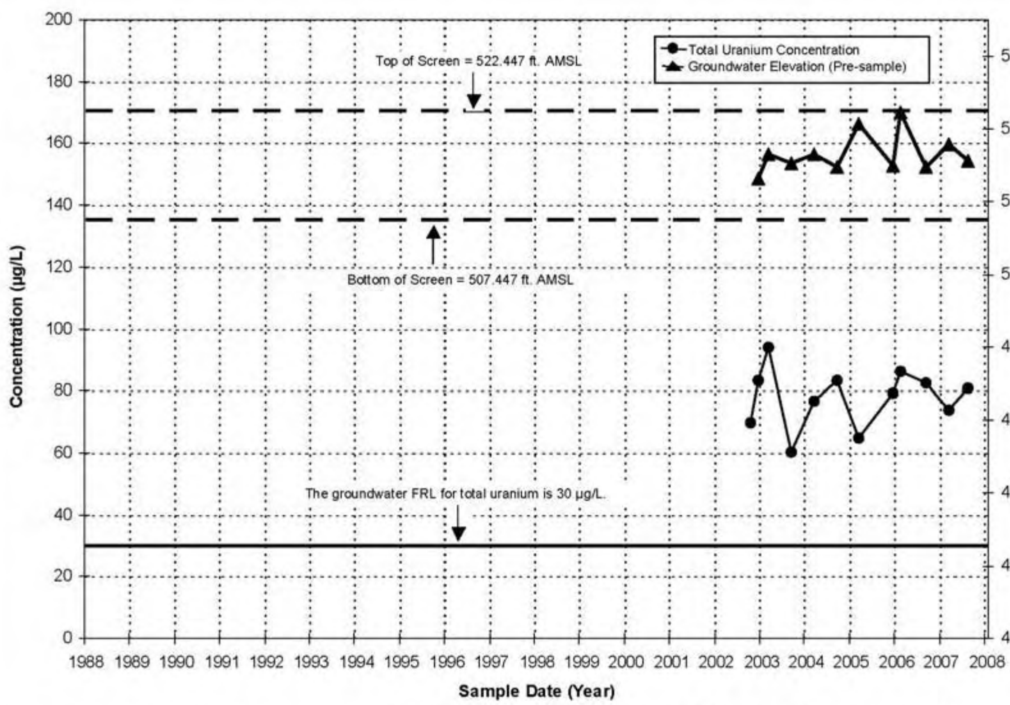


FIGURE A.2-116. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 23276

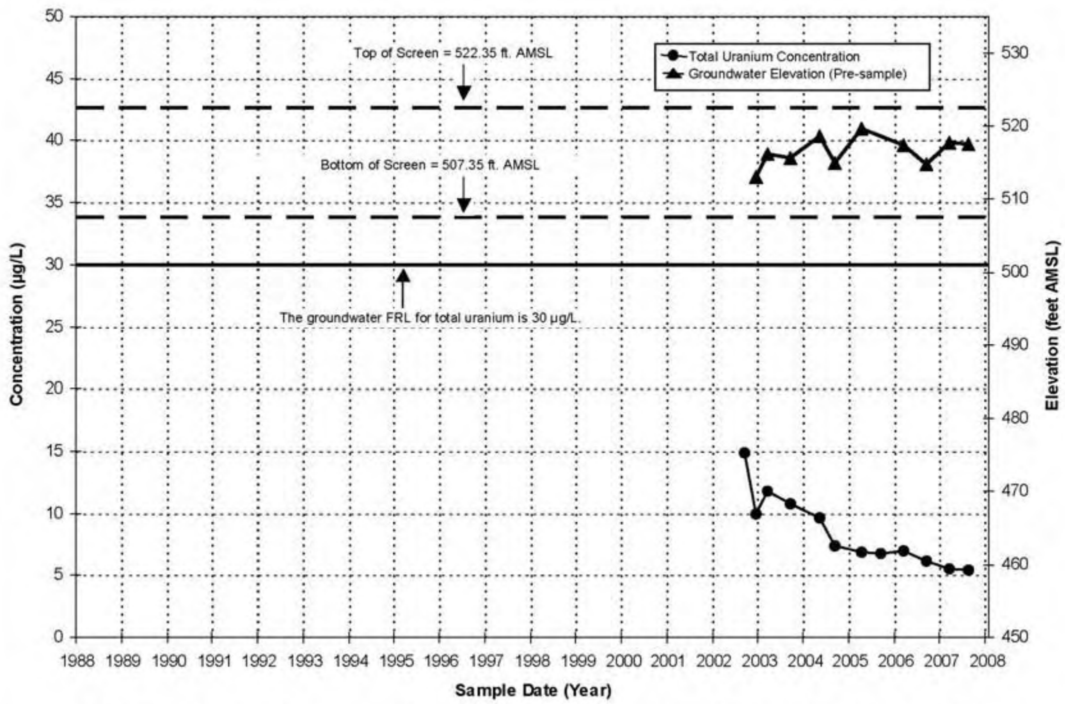


FIGURE A.2-117. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 23277

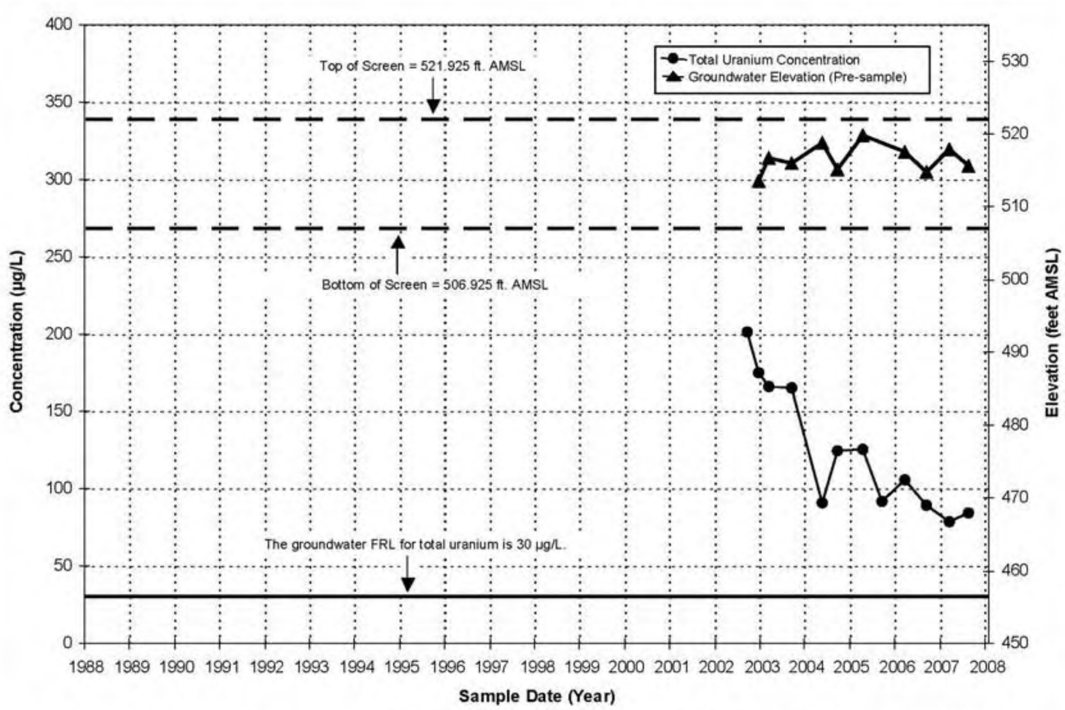


FIGURE A.2-118. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 23278

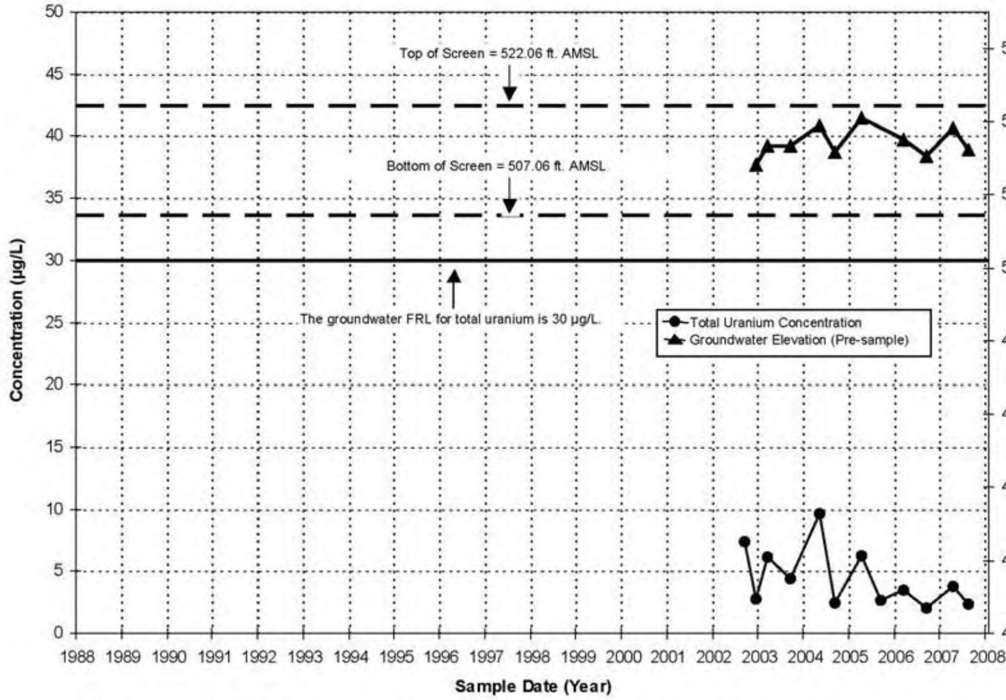


FIGURE A.2-119. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 23279

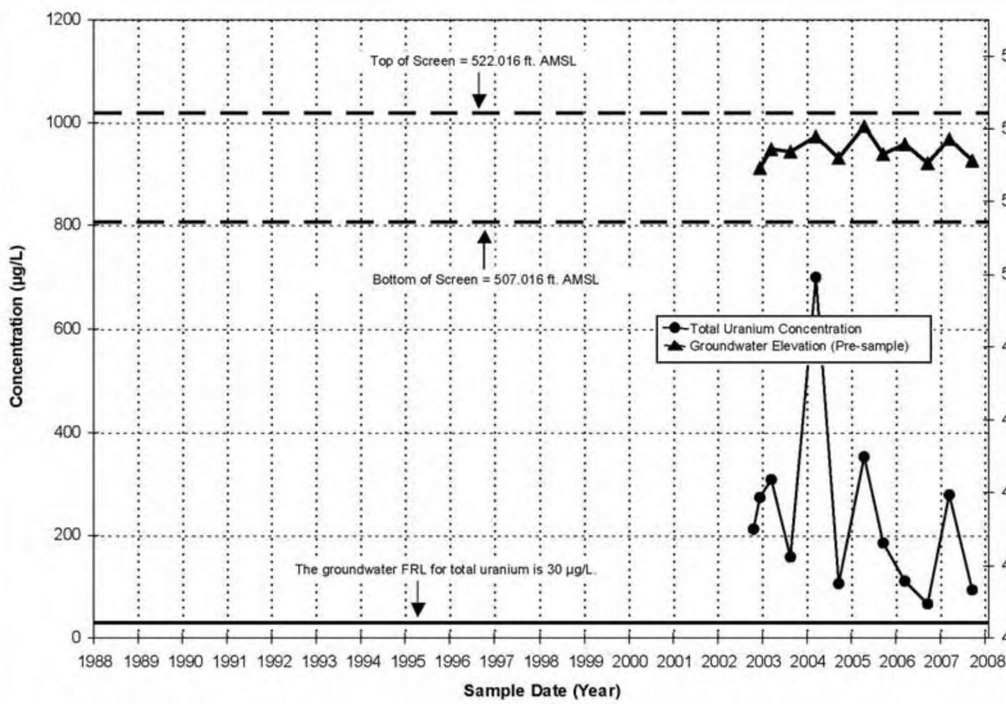


FIGURE A.2-120. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 23280

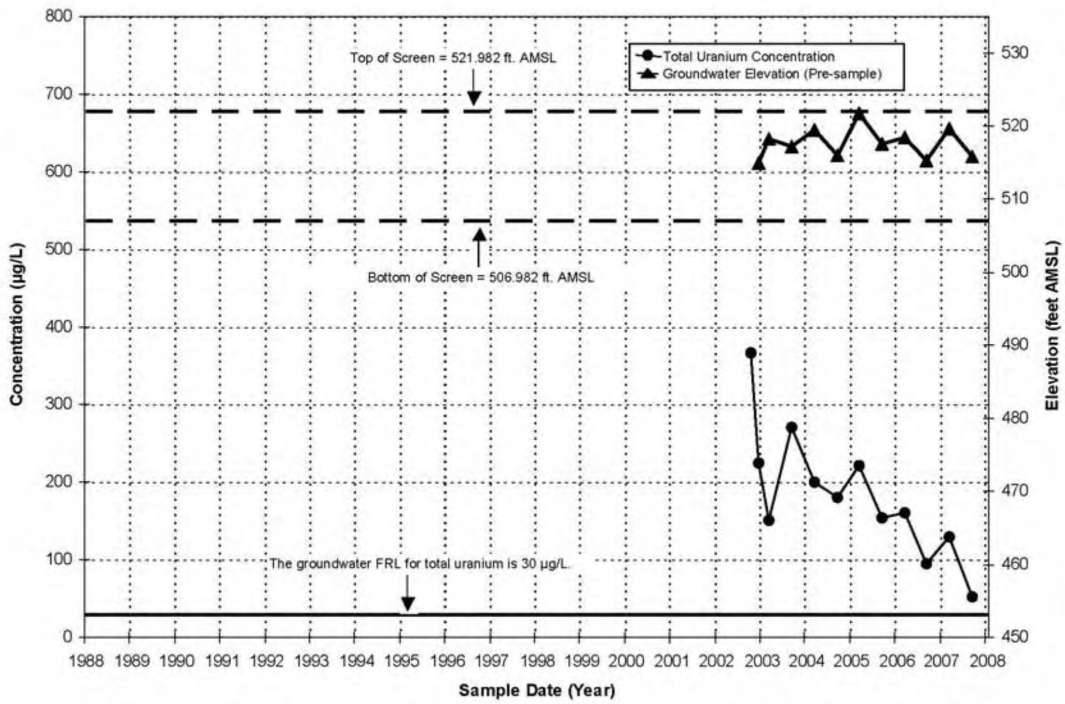


FIGURE A.2-121. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 23281

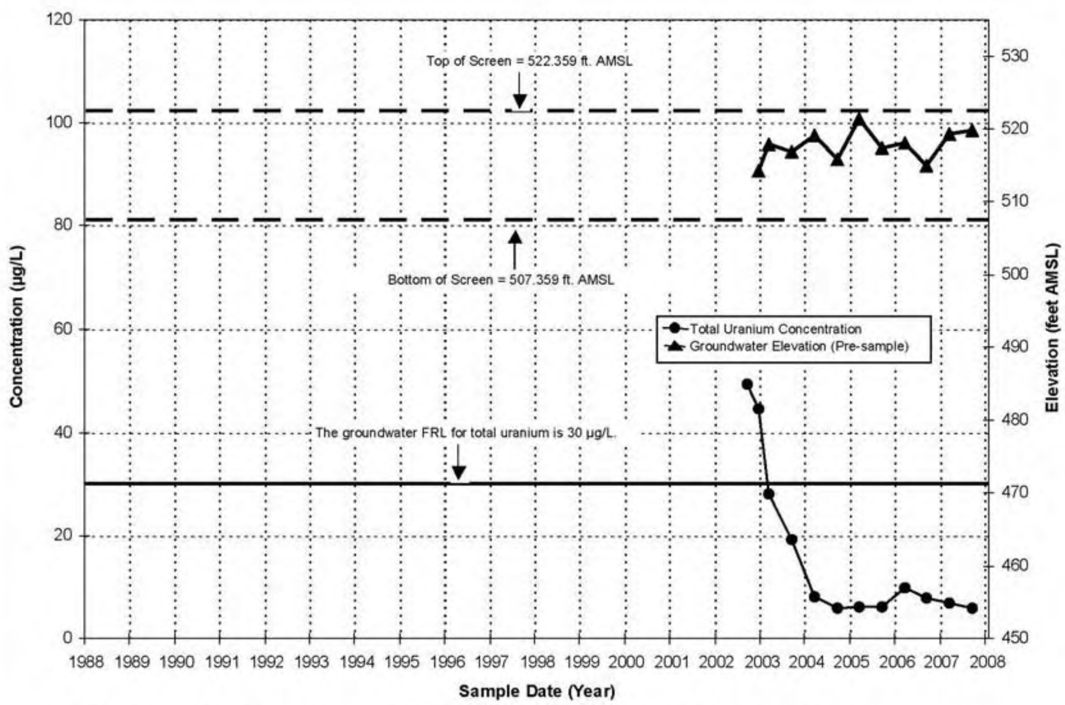


FIGURE A.2-122. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 23282

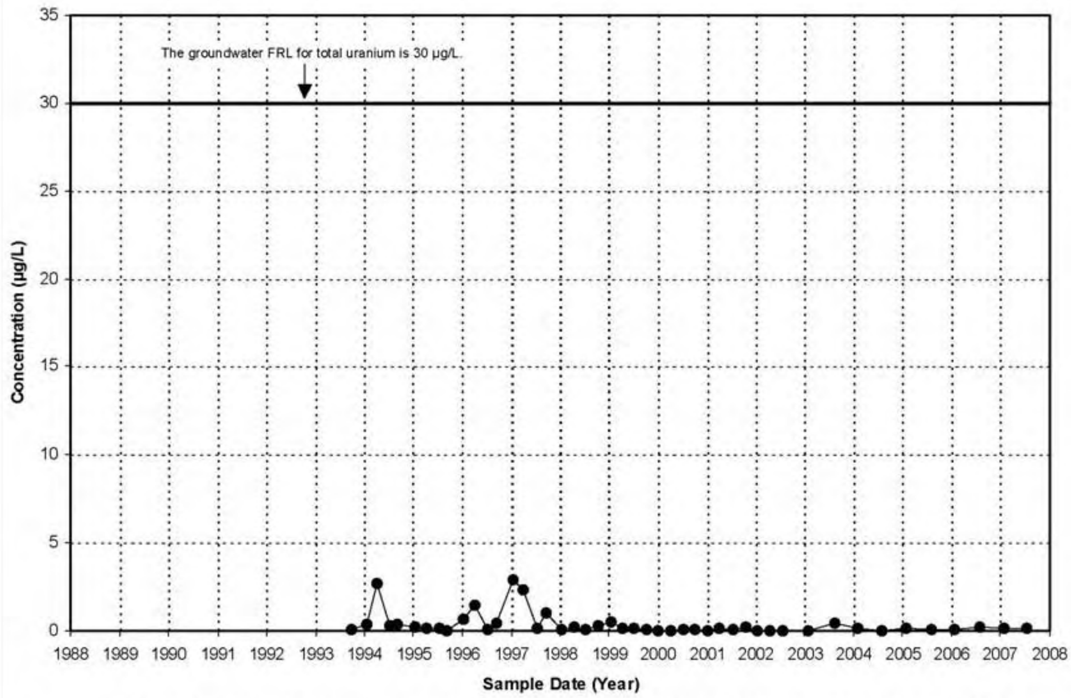


FIGURE A.2-123. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 31217

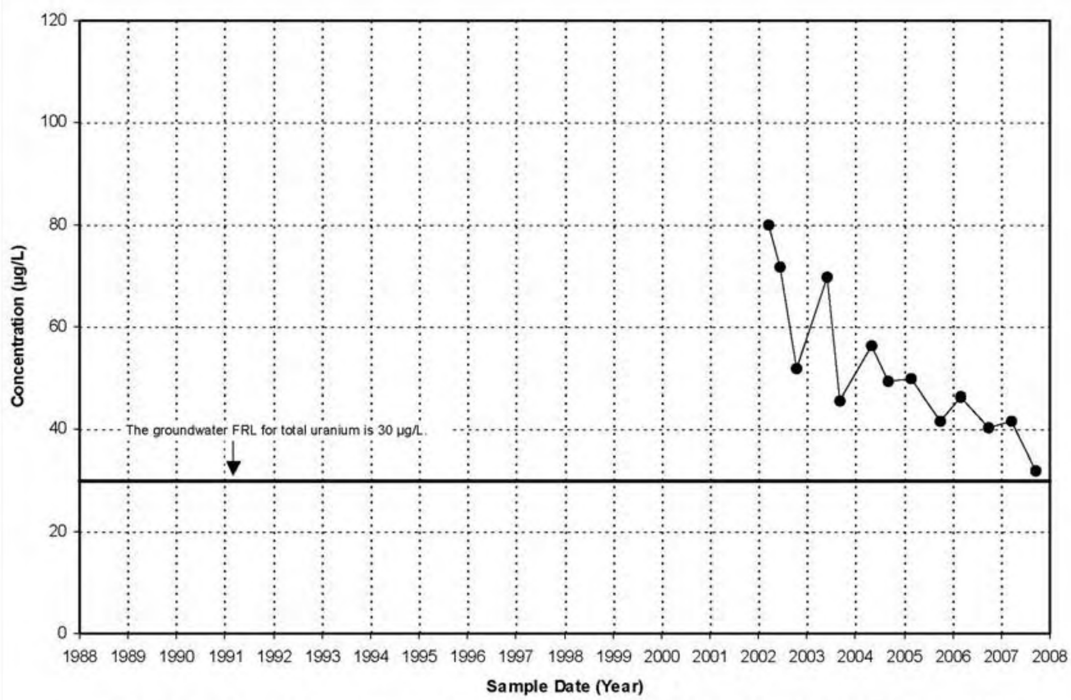


FIGURE A.2-124. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 32766

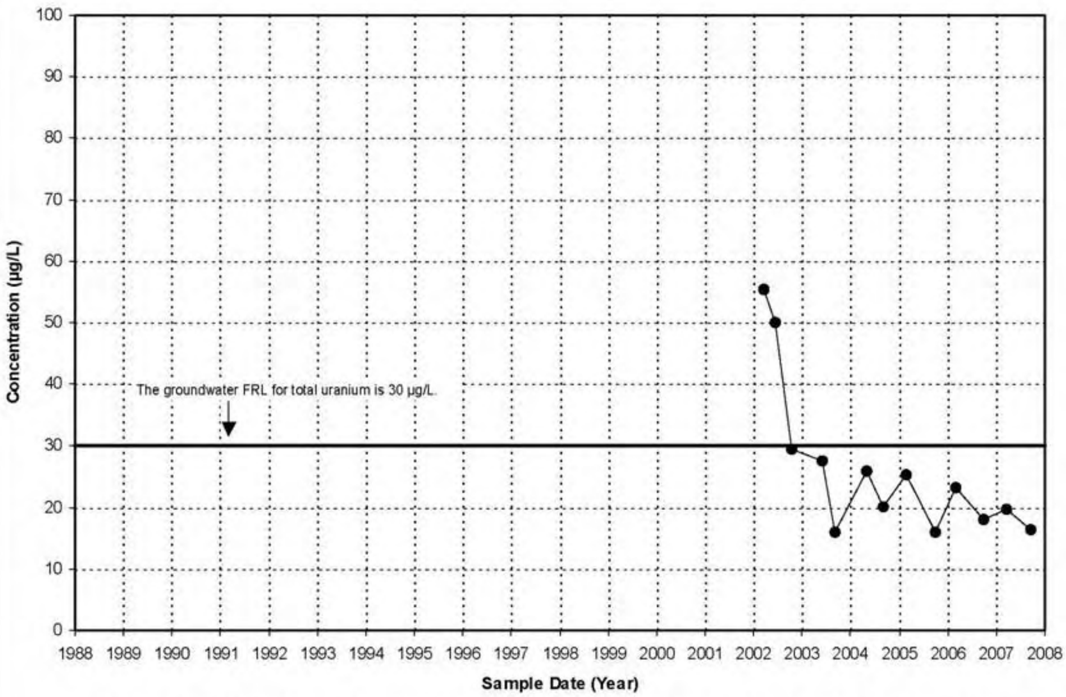


FIGURE A.2-125. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 32768

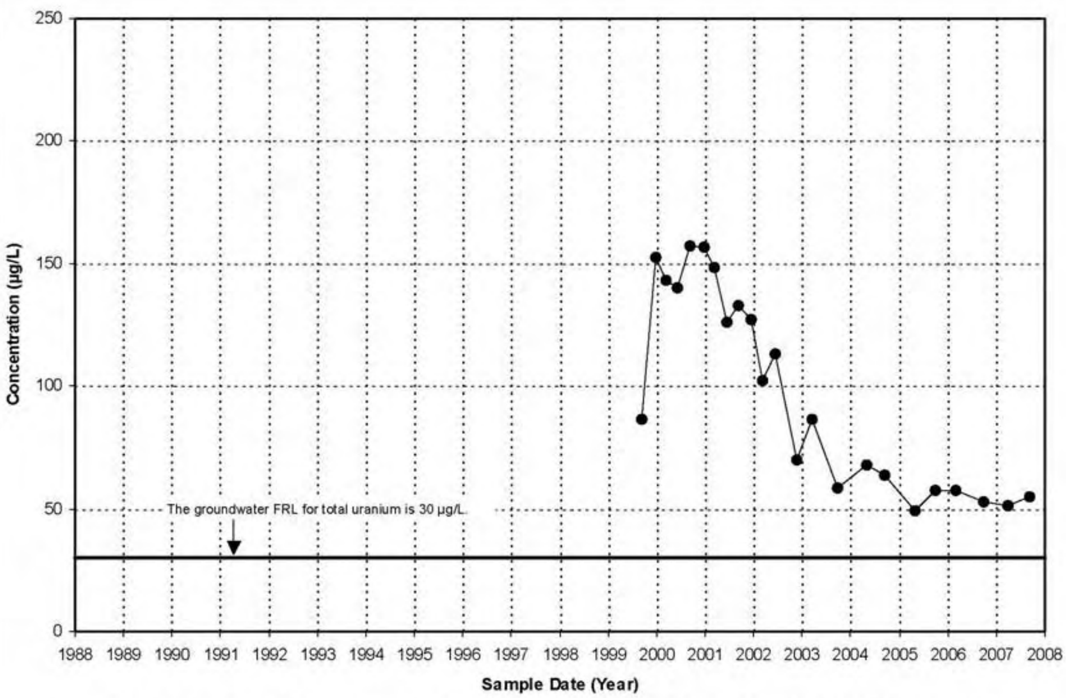


FIGURE A.2-126. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 62408

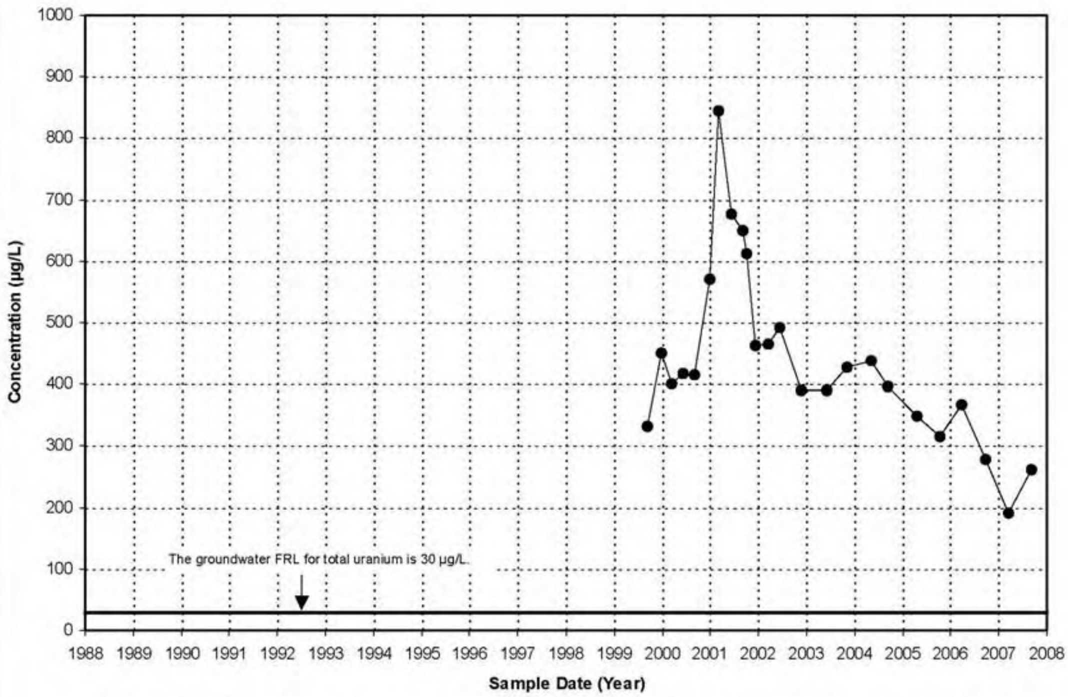


FIGURE A.2-127. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 62433

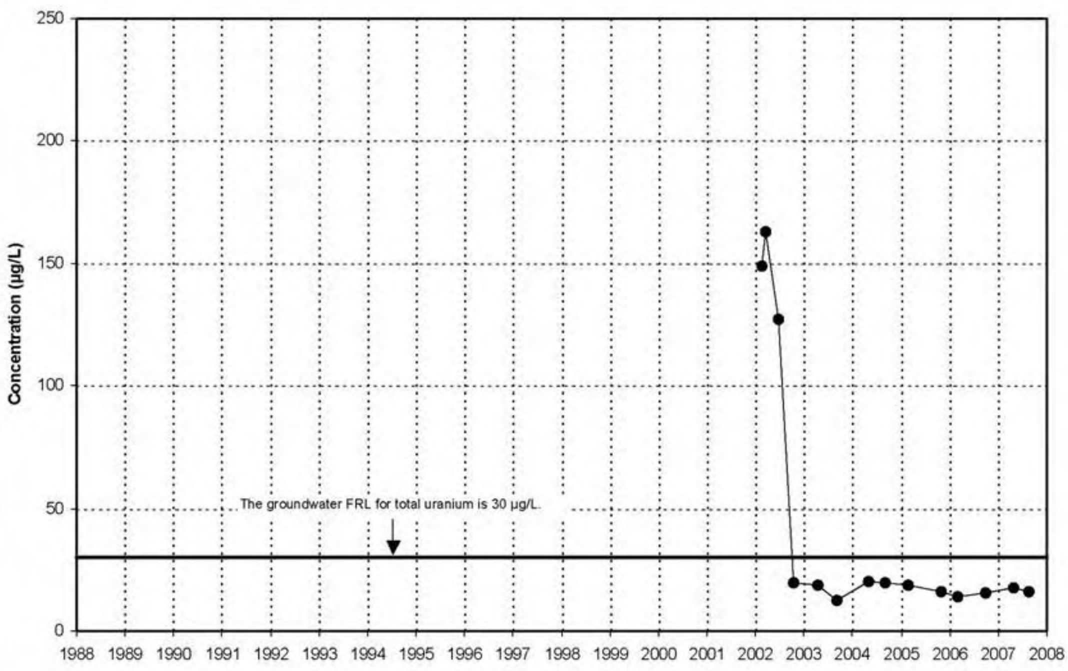


FIGURE A.2-128. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 63116

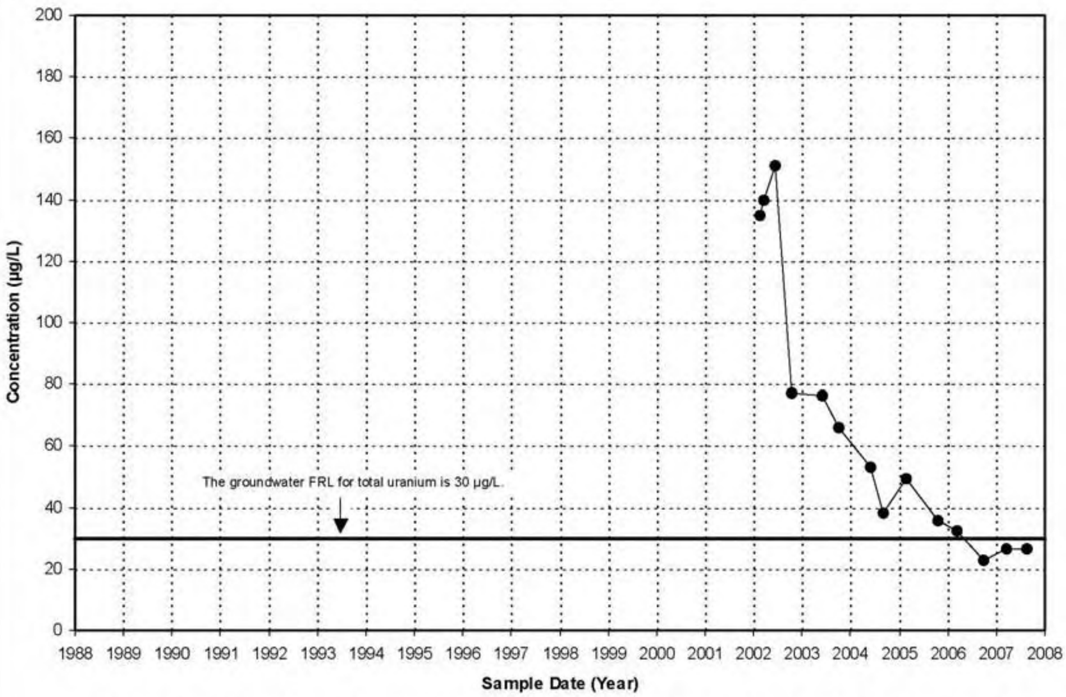


FIGURE A.2-129. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 63119

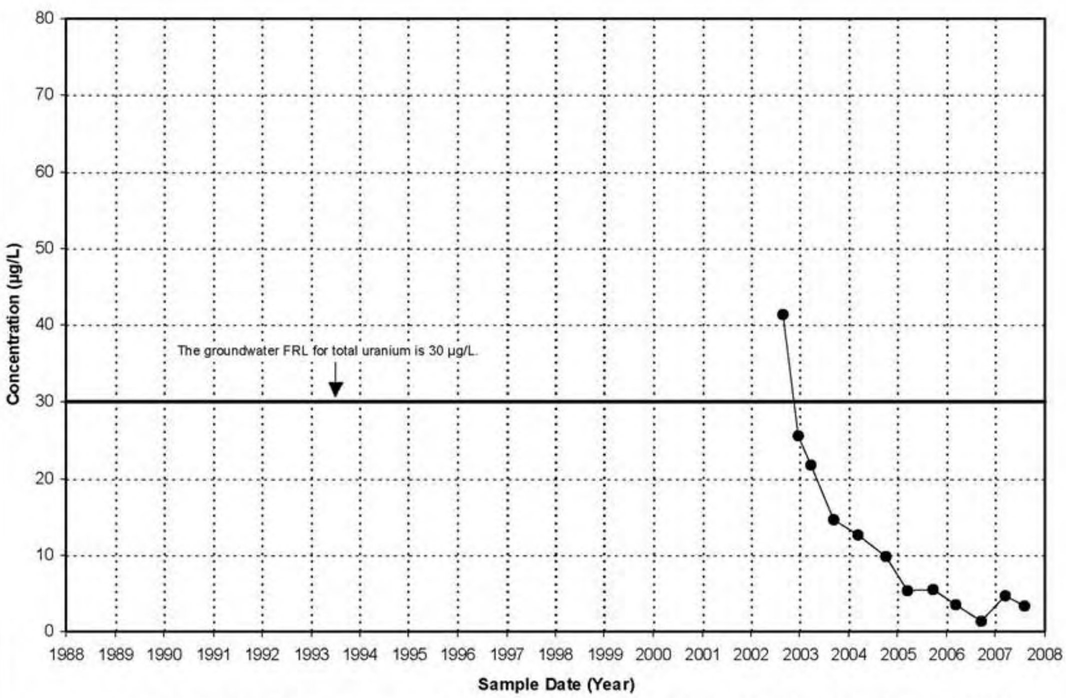


FIGURE A.2-130. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 63283

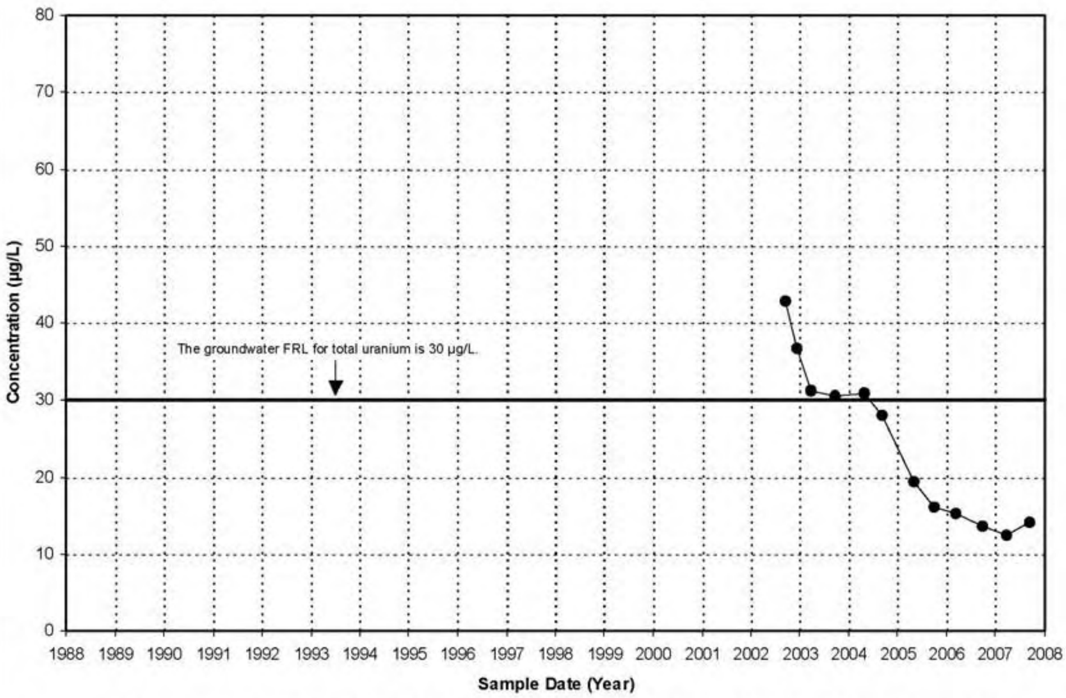


FIGURE A.2-131. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 63284

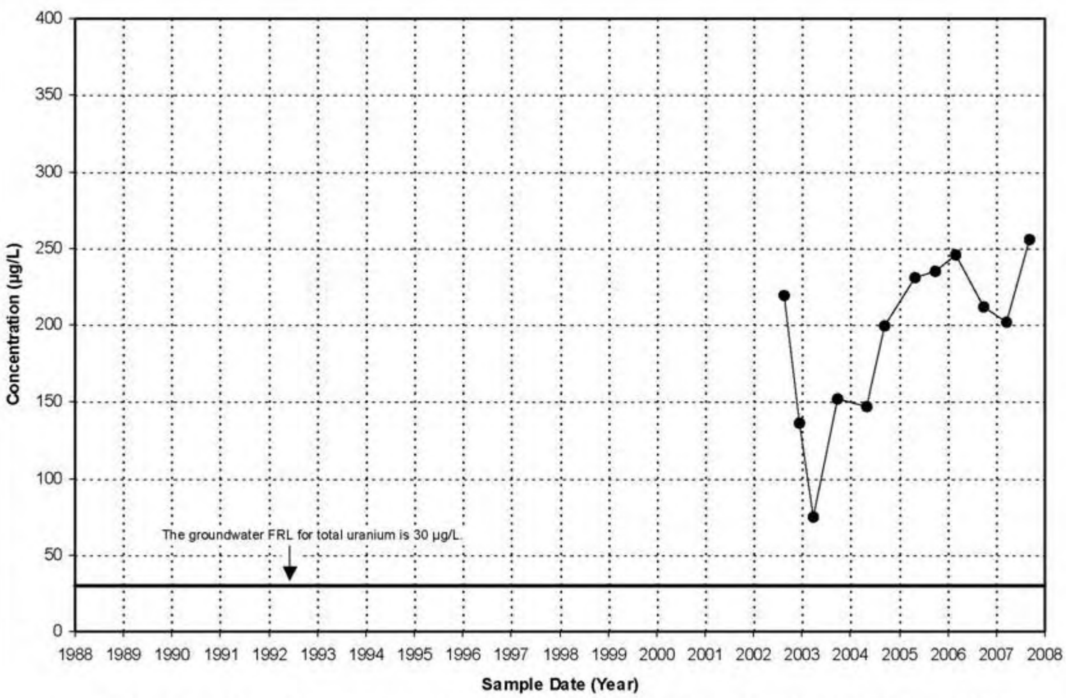


FIGURE A.2-132. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 63285

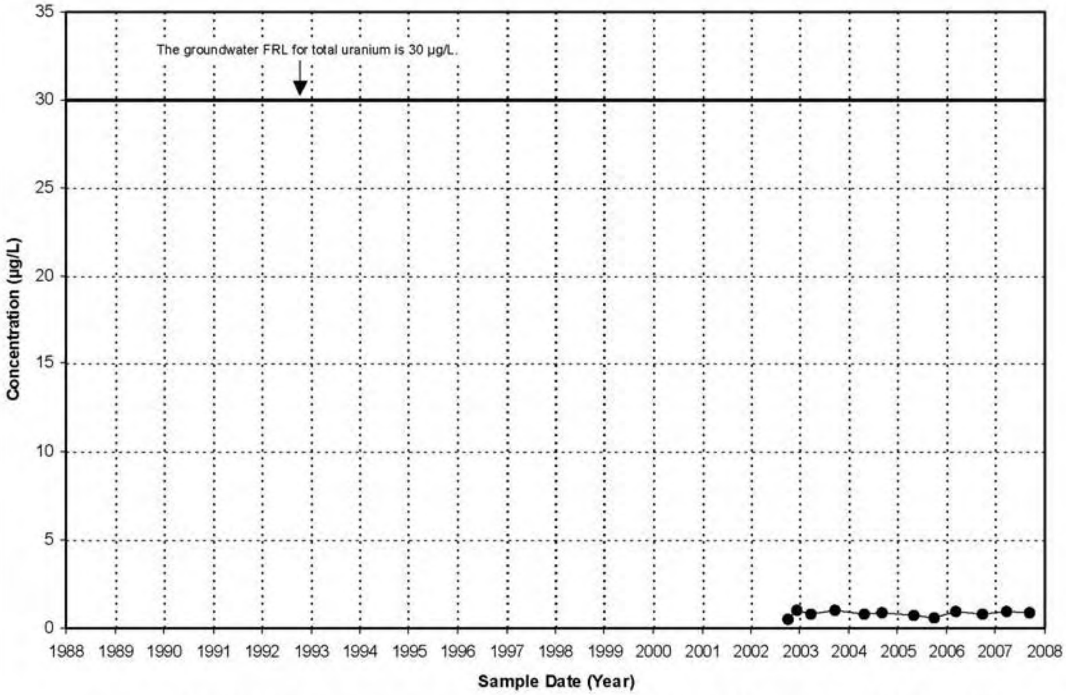


FIGURE A.2-133. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 63286

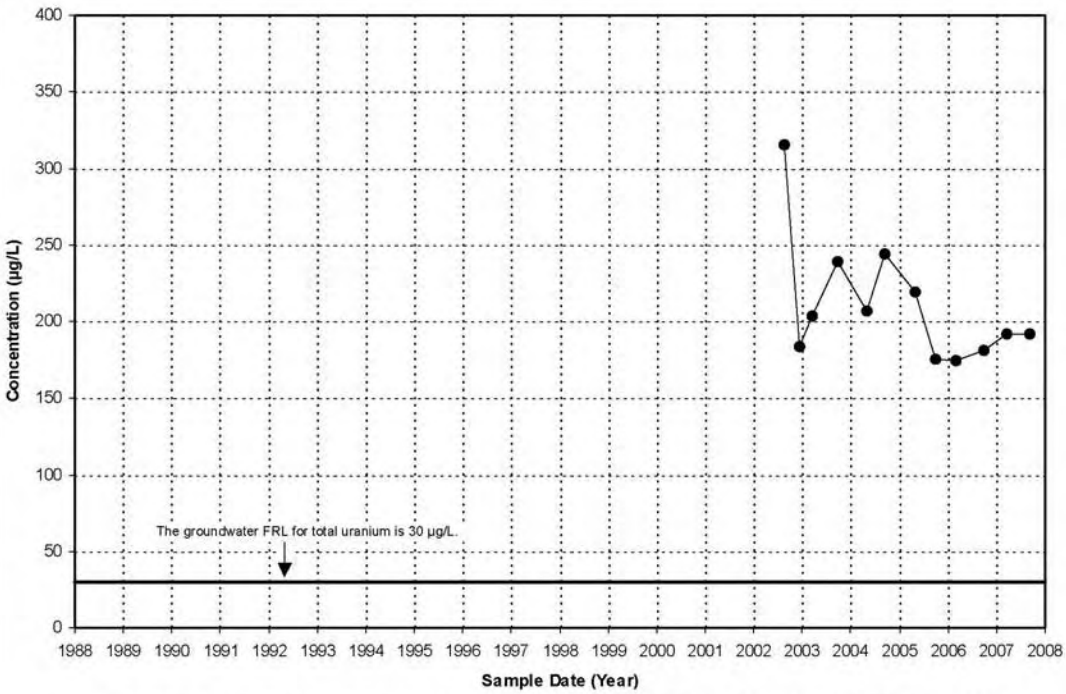


FIGURE A.2-134. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 63287

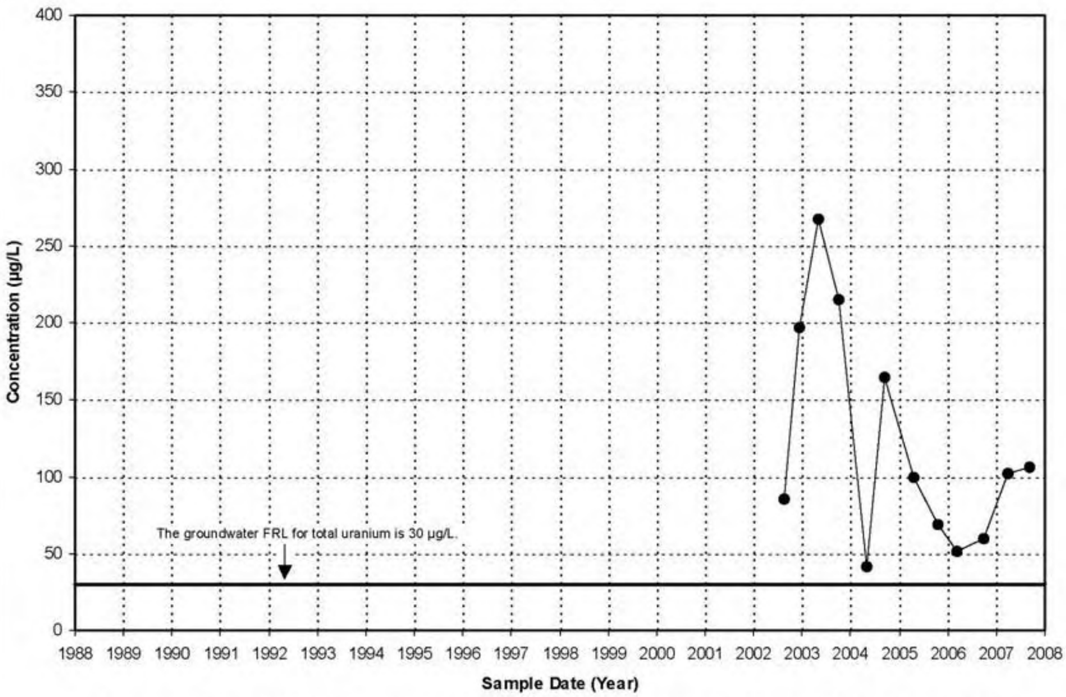


FIGURE A.2-135. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 63288

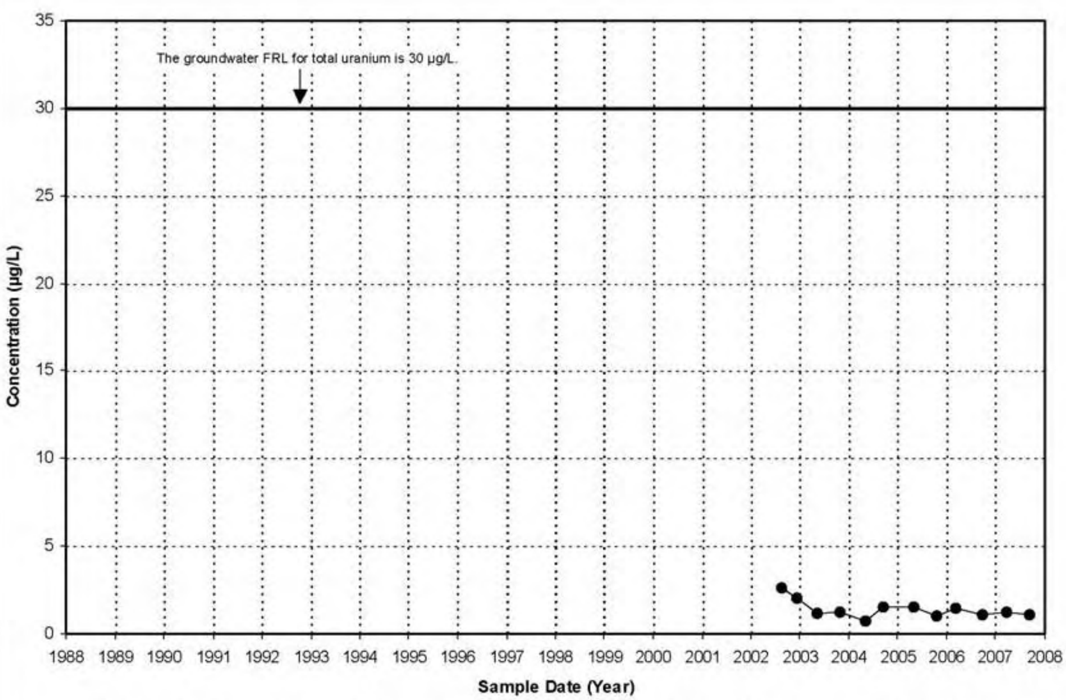


FIGURE A.2-136. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 63289

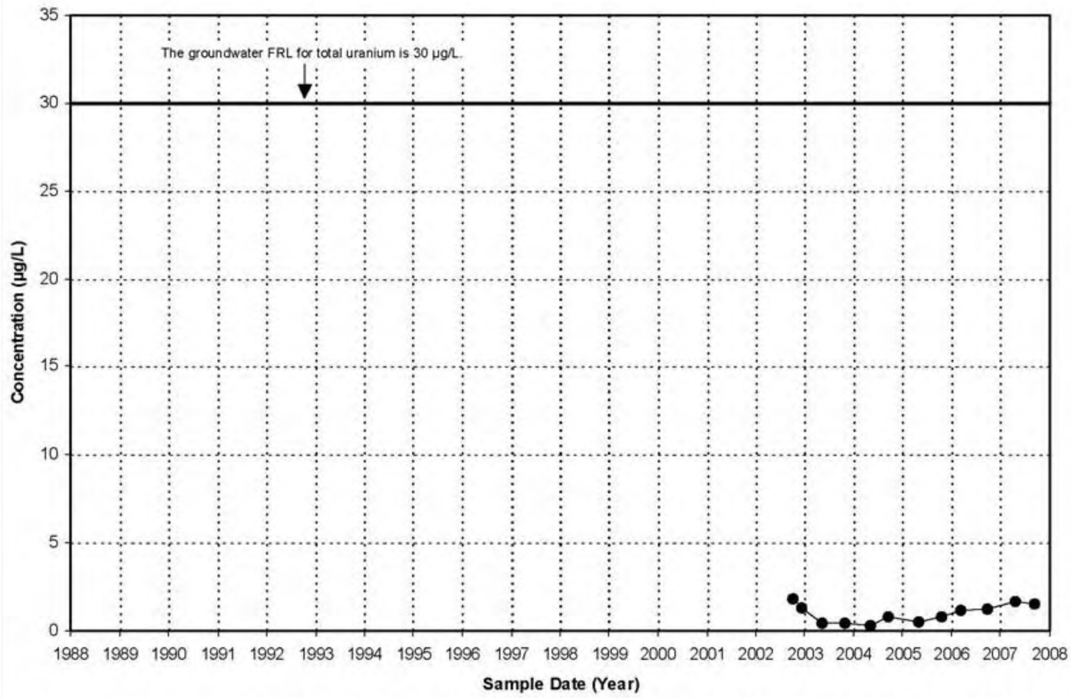


FIGURE A.2-137. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 63290

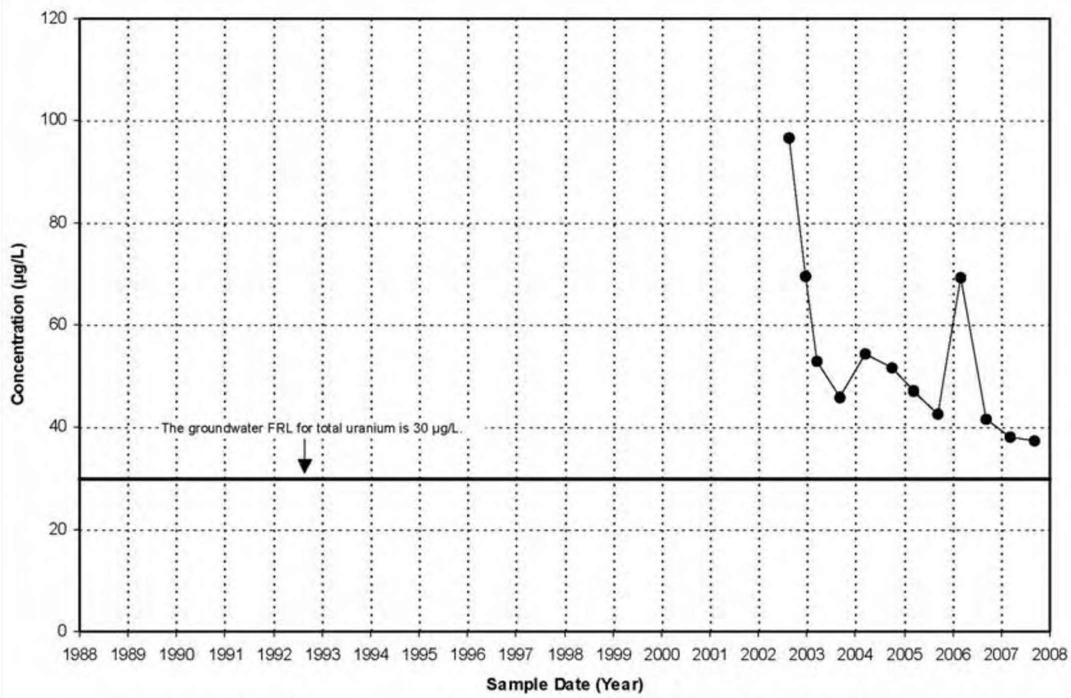


FIGURE A.2-138. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 63291

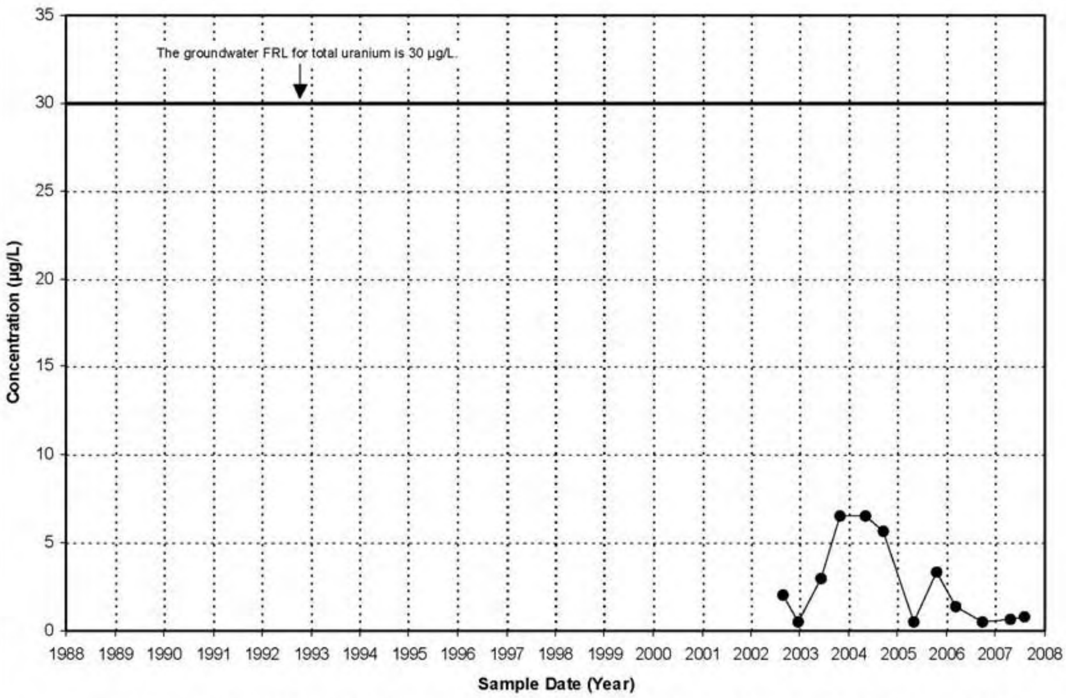


FIGURE A.2-139. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 63292

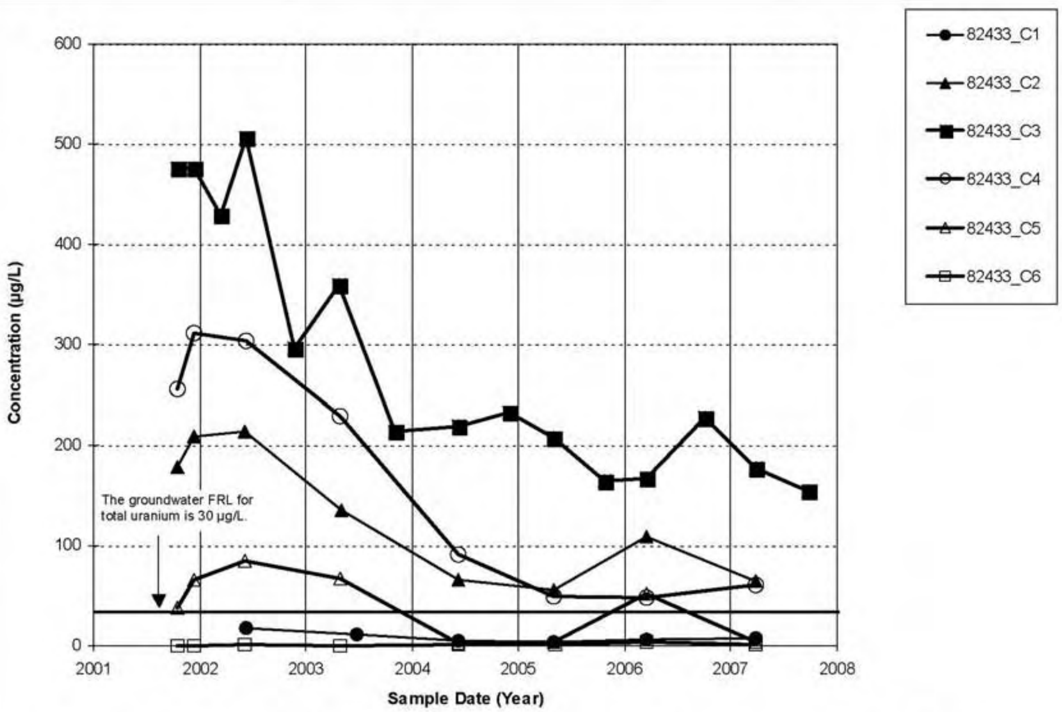


FIGURE A.2-140. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 82433

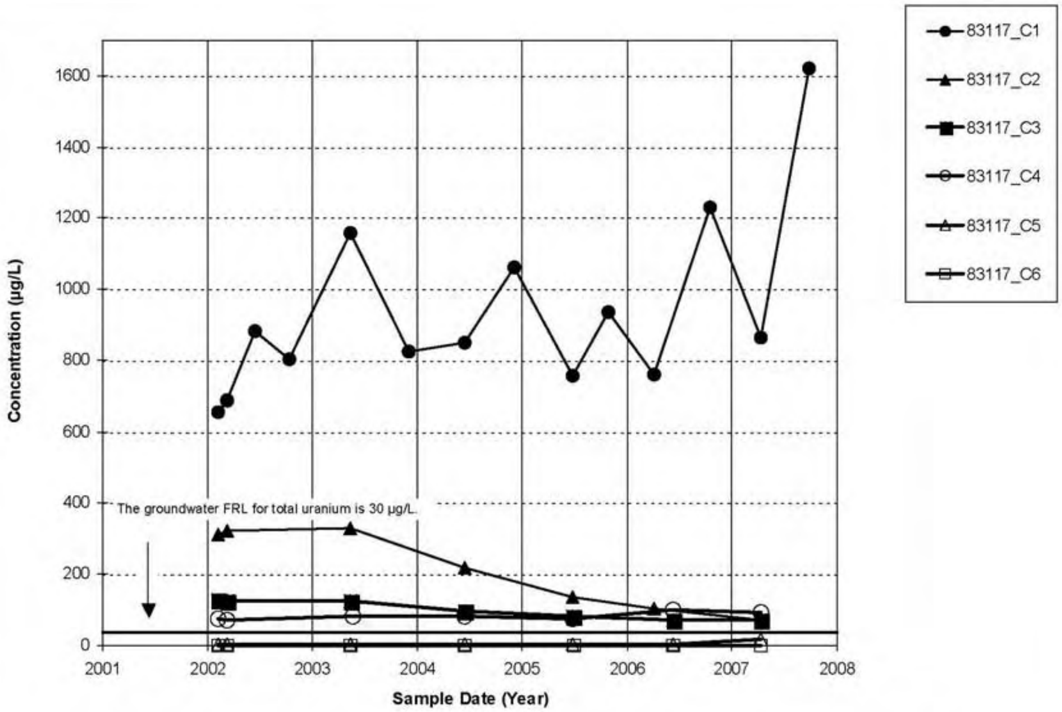


FIGURE A.2-141. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 83117

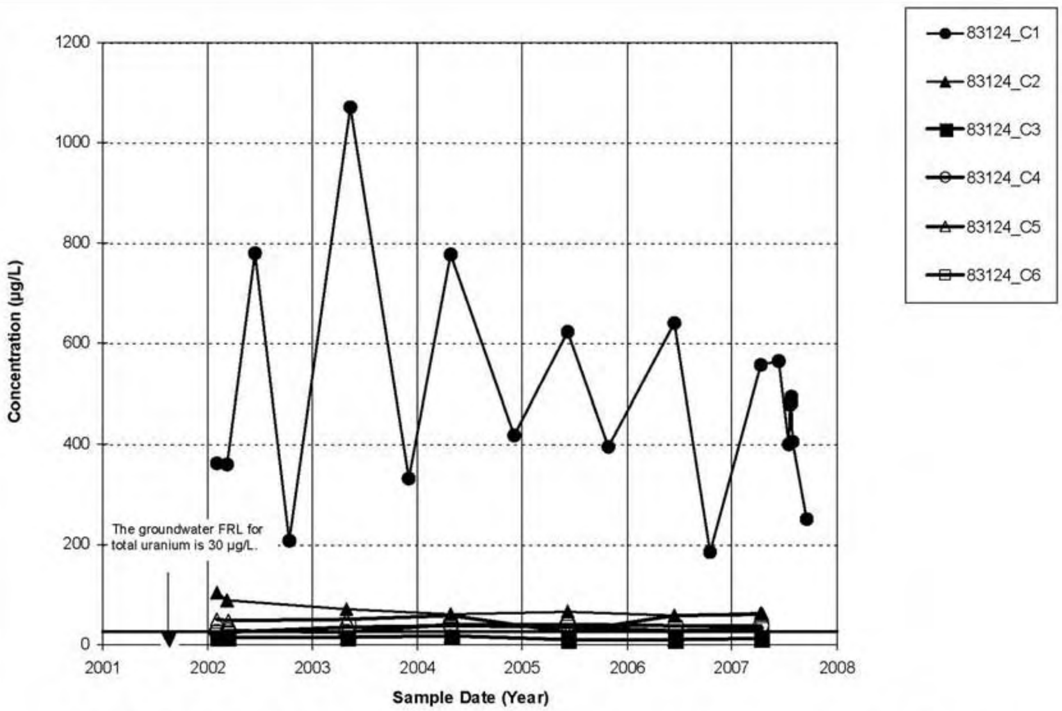


FIGURE A.2-142. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 83124

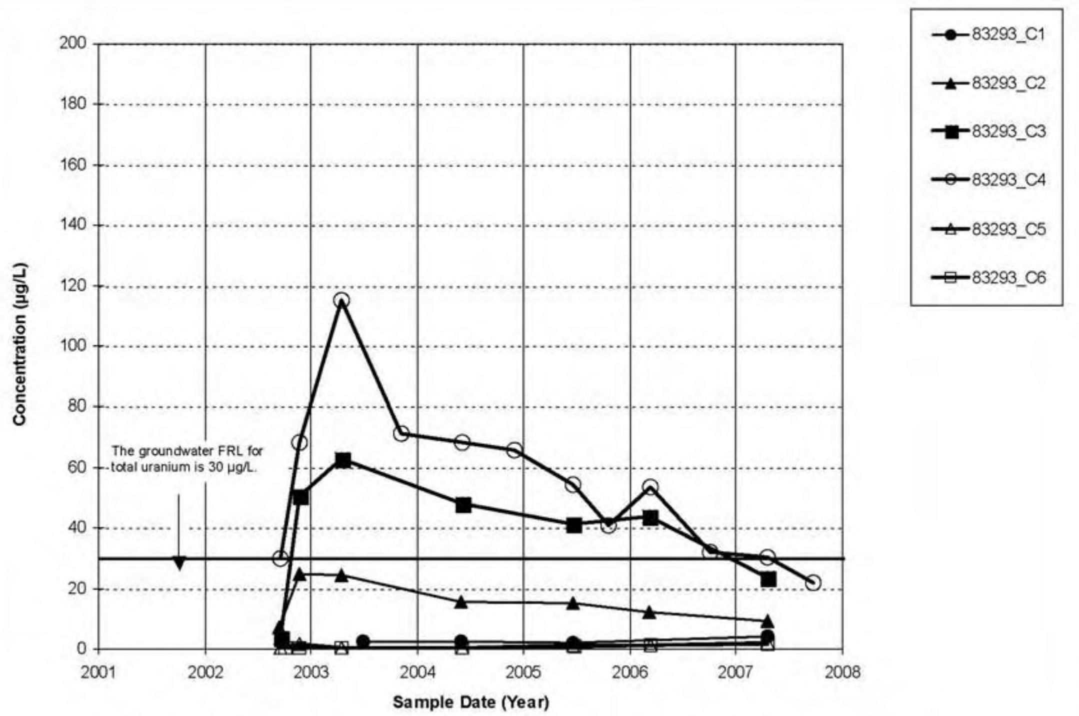


FIGURE A.2-143. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 83293

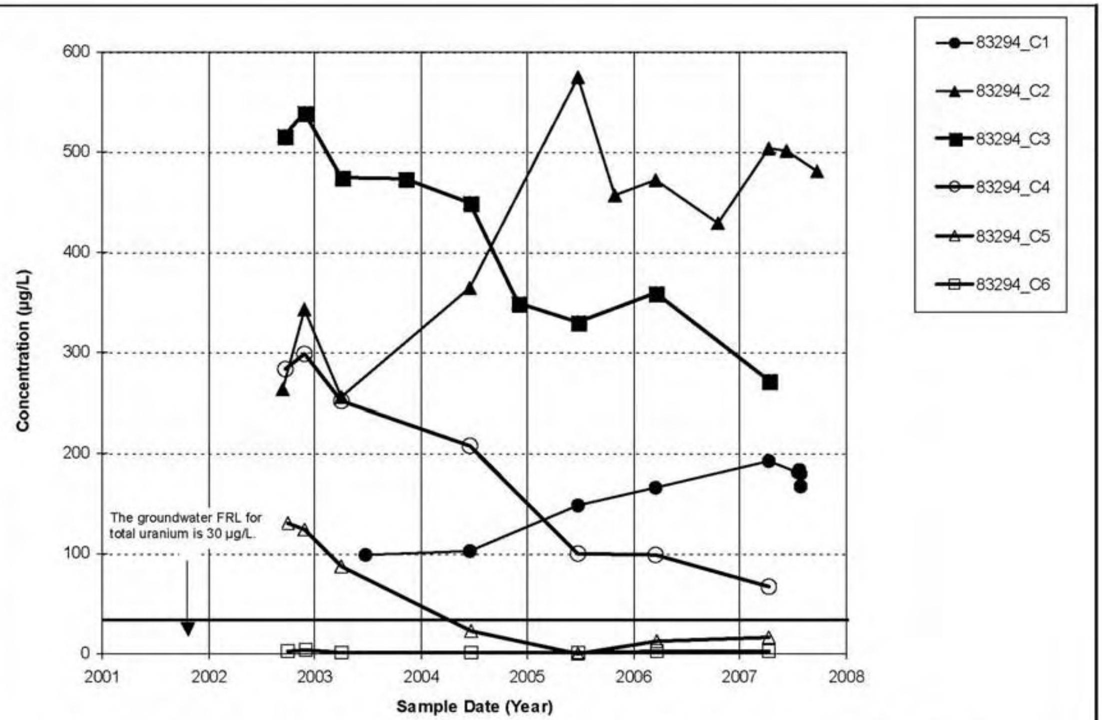


FIGURE A.2-144. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 83294

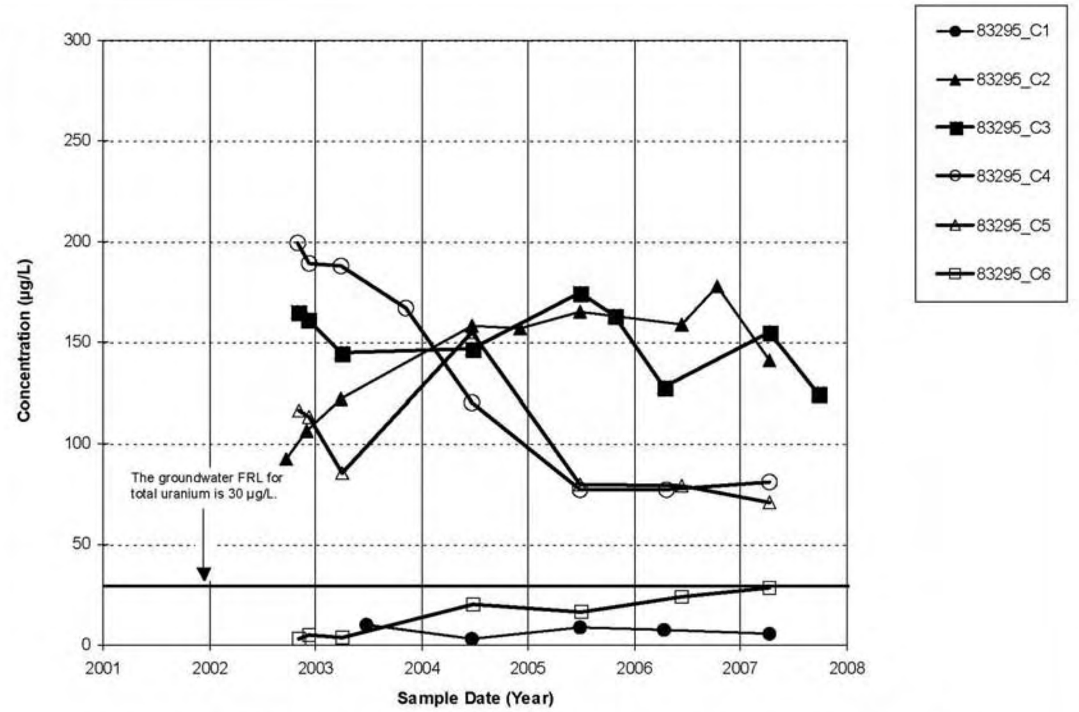


FIGURE A.2-145. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 83295

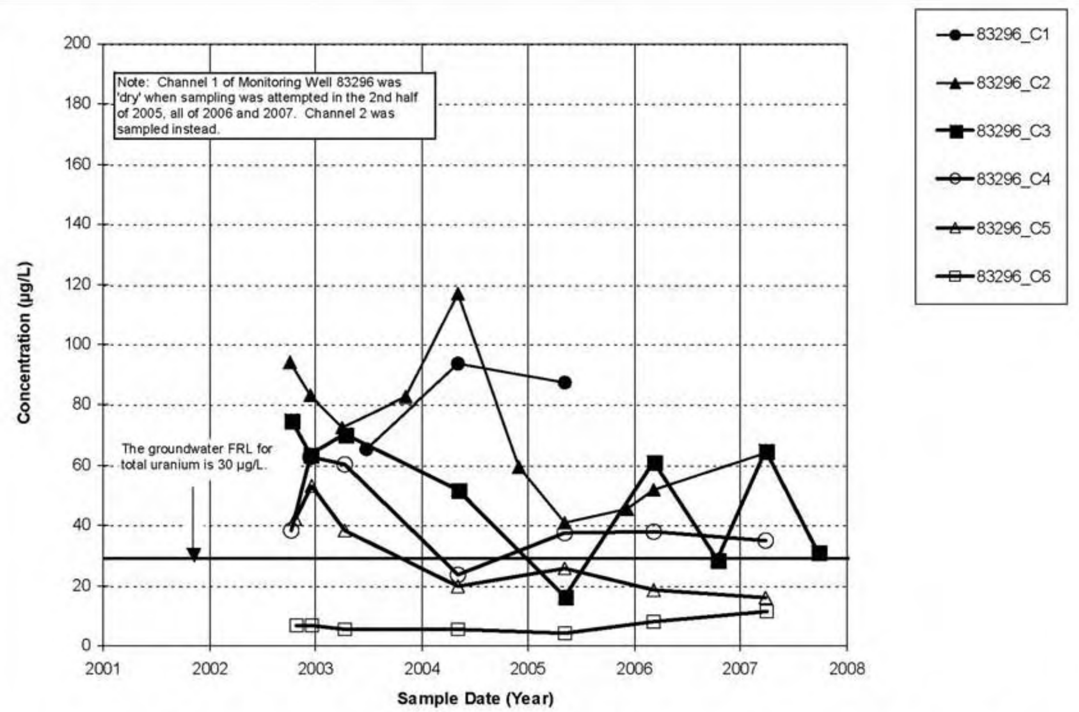


FIGURE A.2-146. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 83296

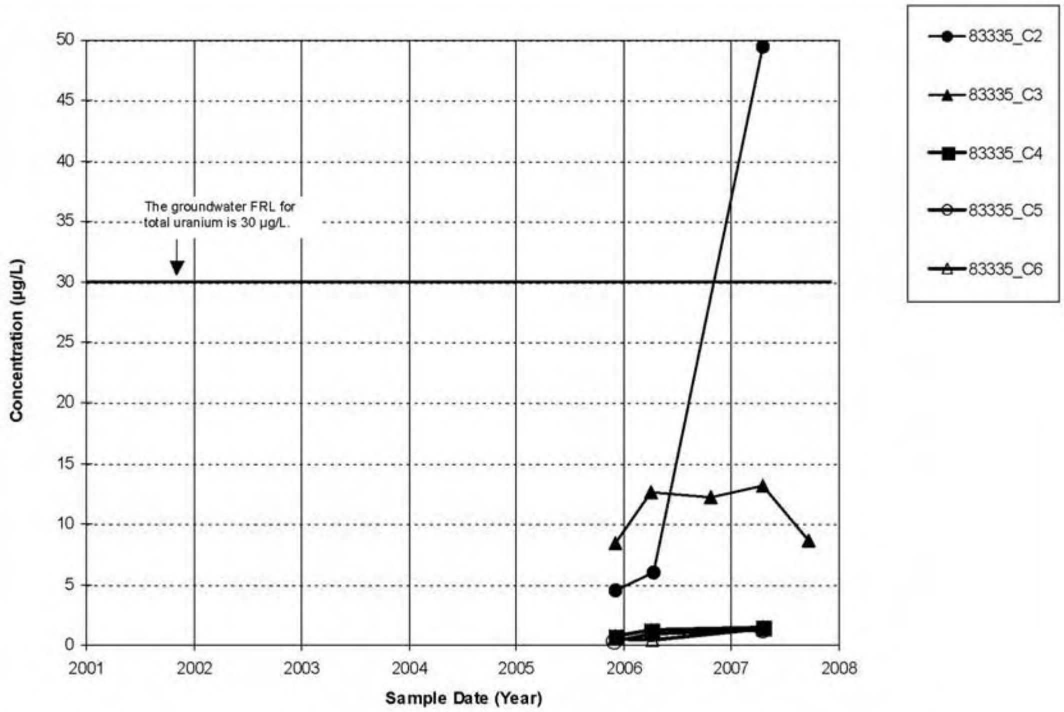


FIGURE A.2-147. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 83335

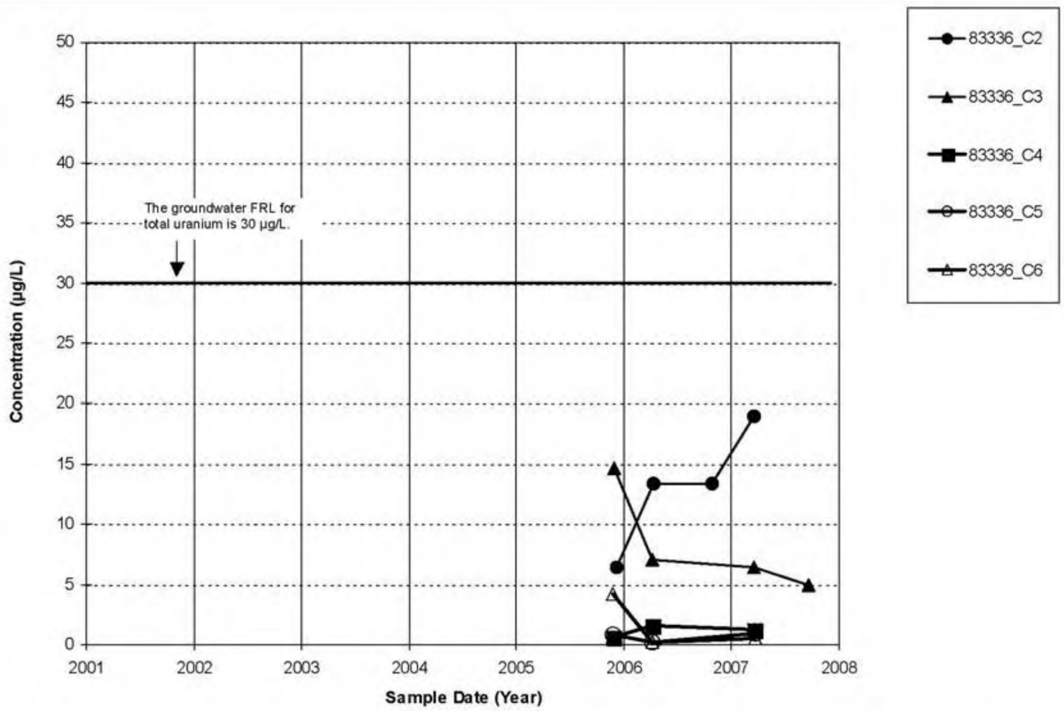


FIGURE A.2-148. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 83336

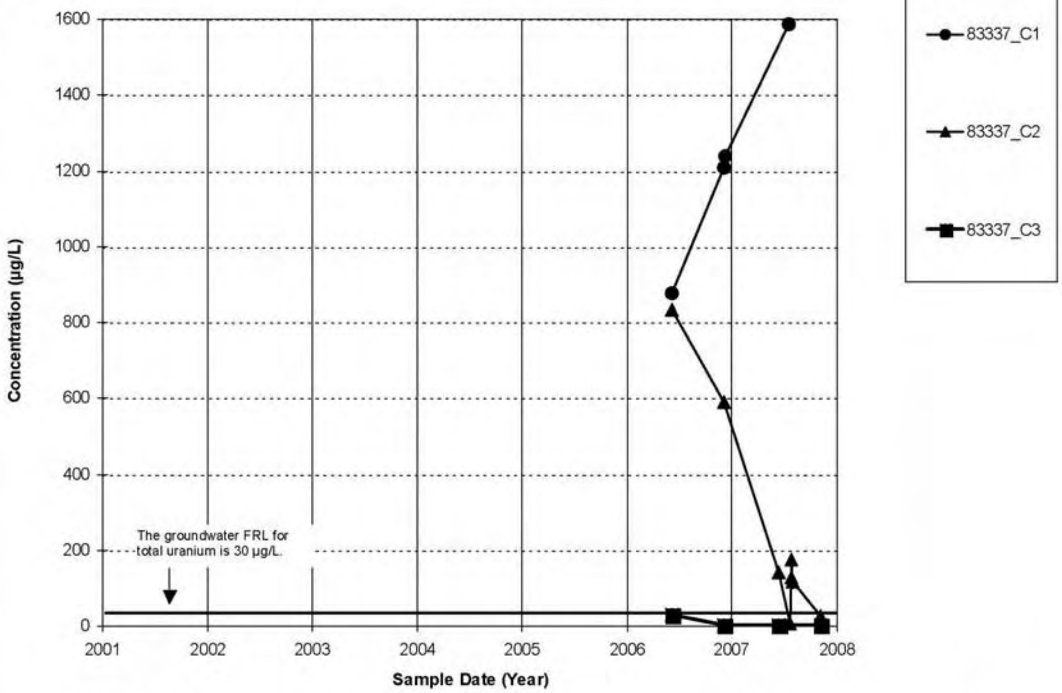


FIGURE A.2-149. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 83337

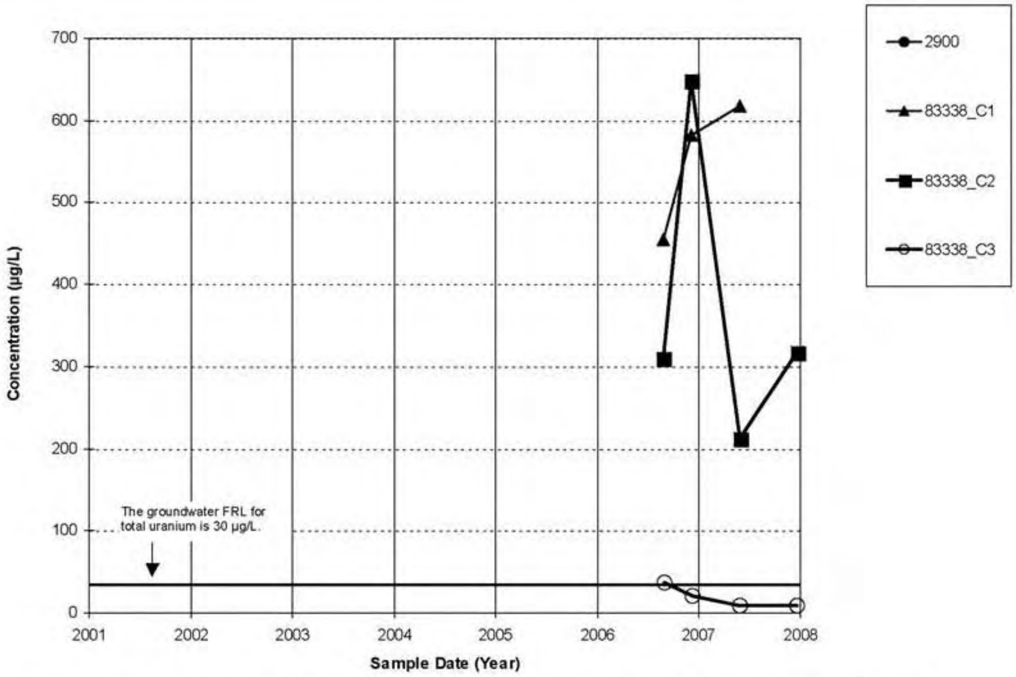


FIGURE A.2-150. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 83338

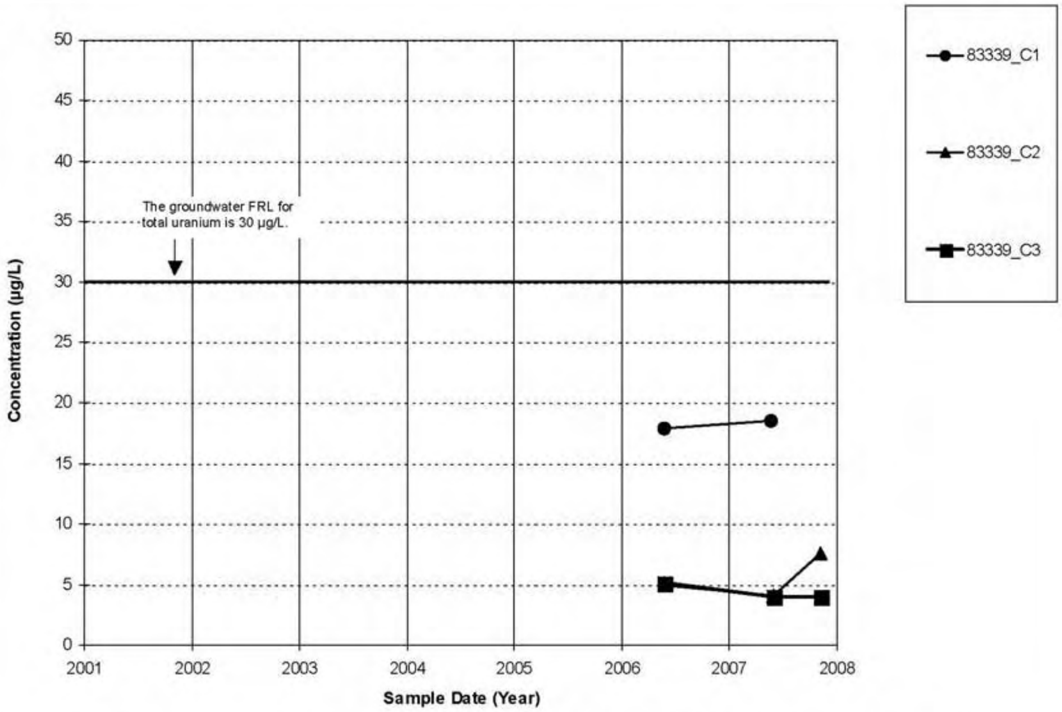


FIGURE A.2-151. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 83339

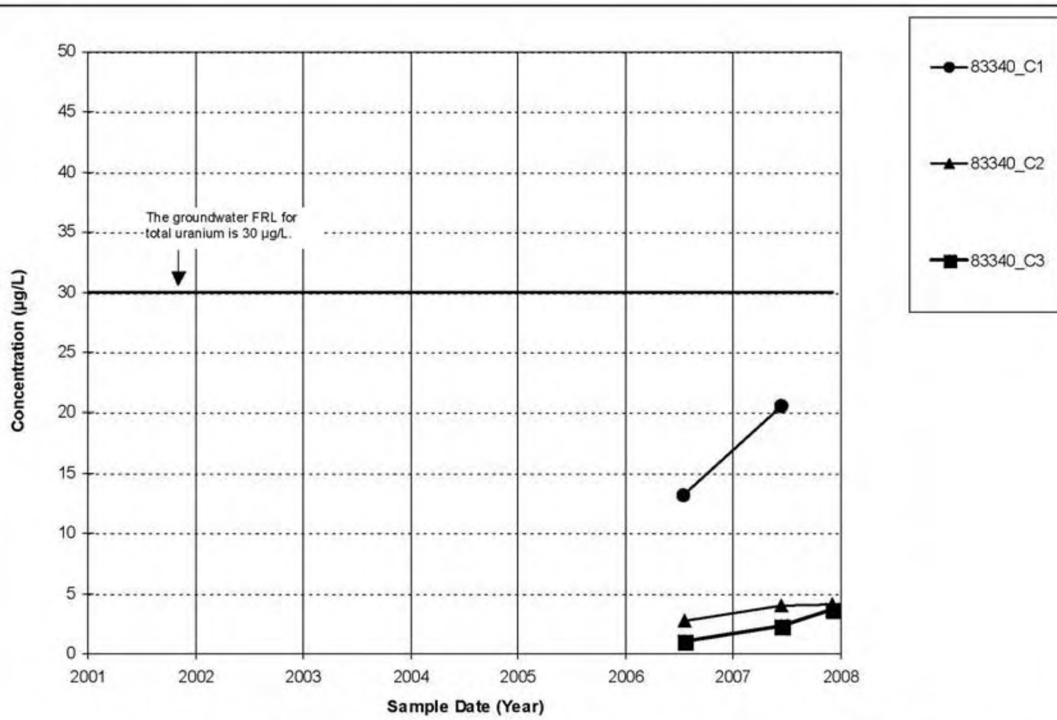


FIGURE A.2-152. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 83340

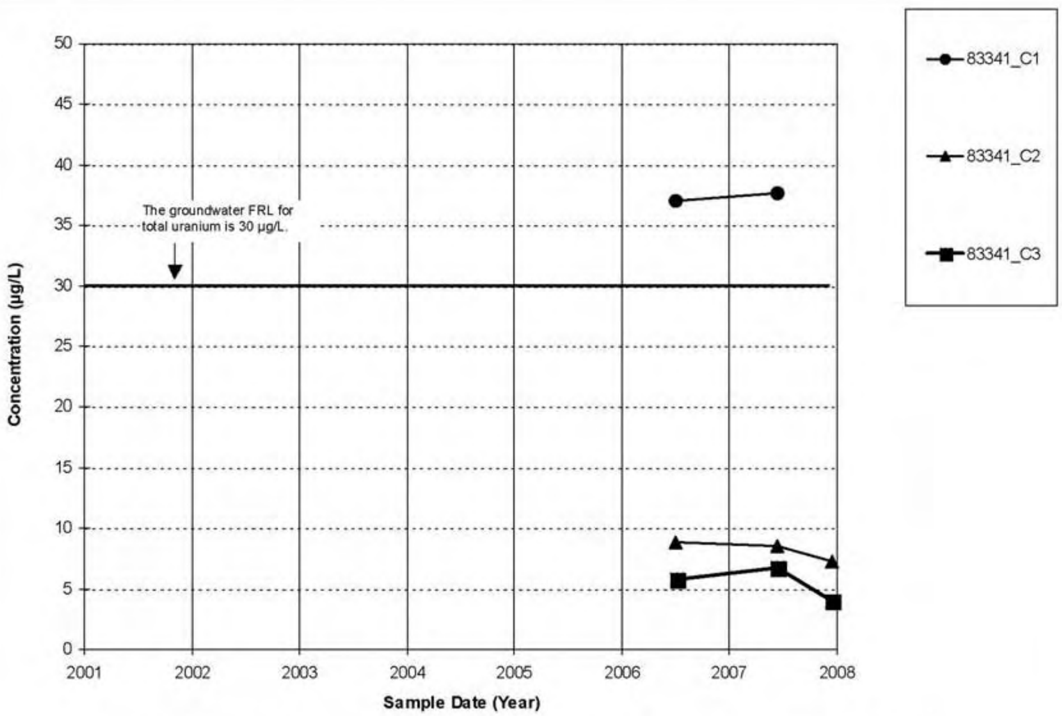


FIGURE A.2-153. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 83341

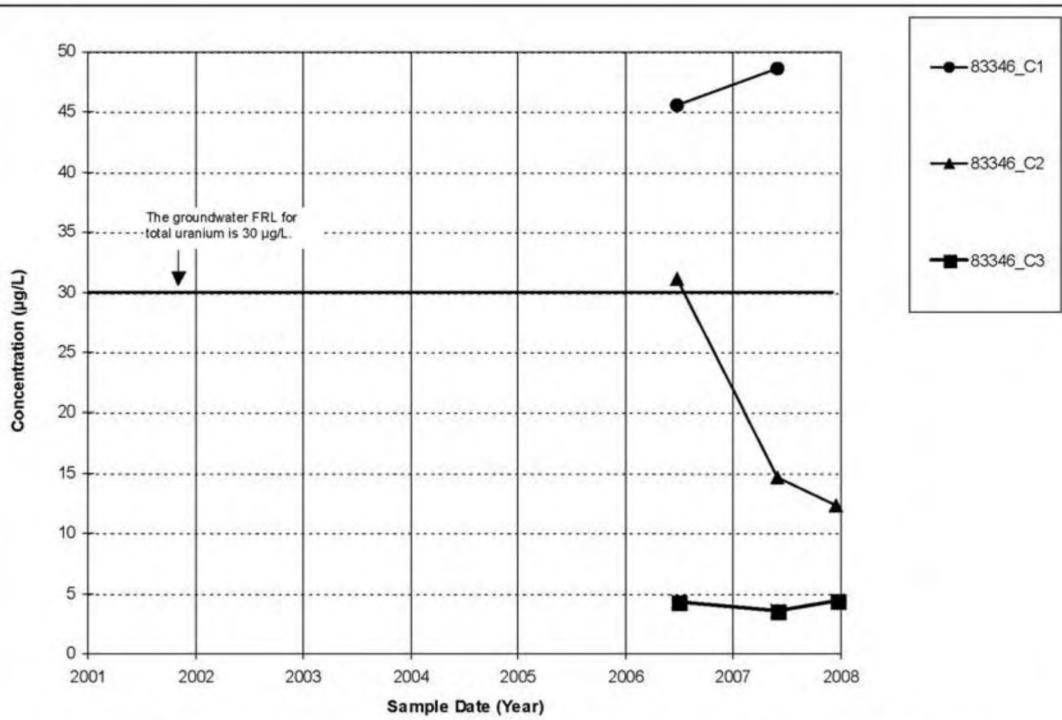
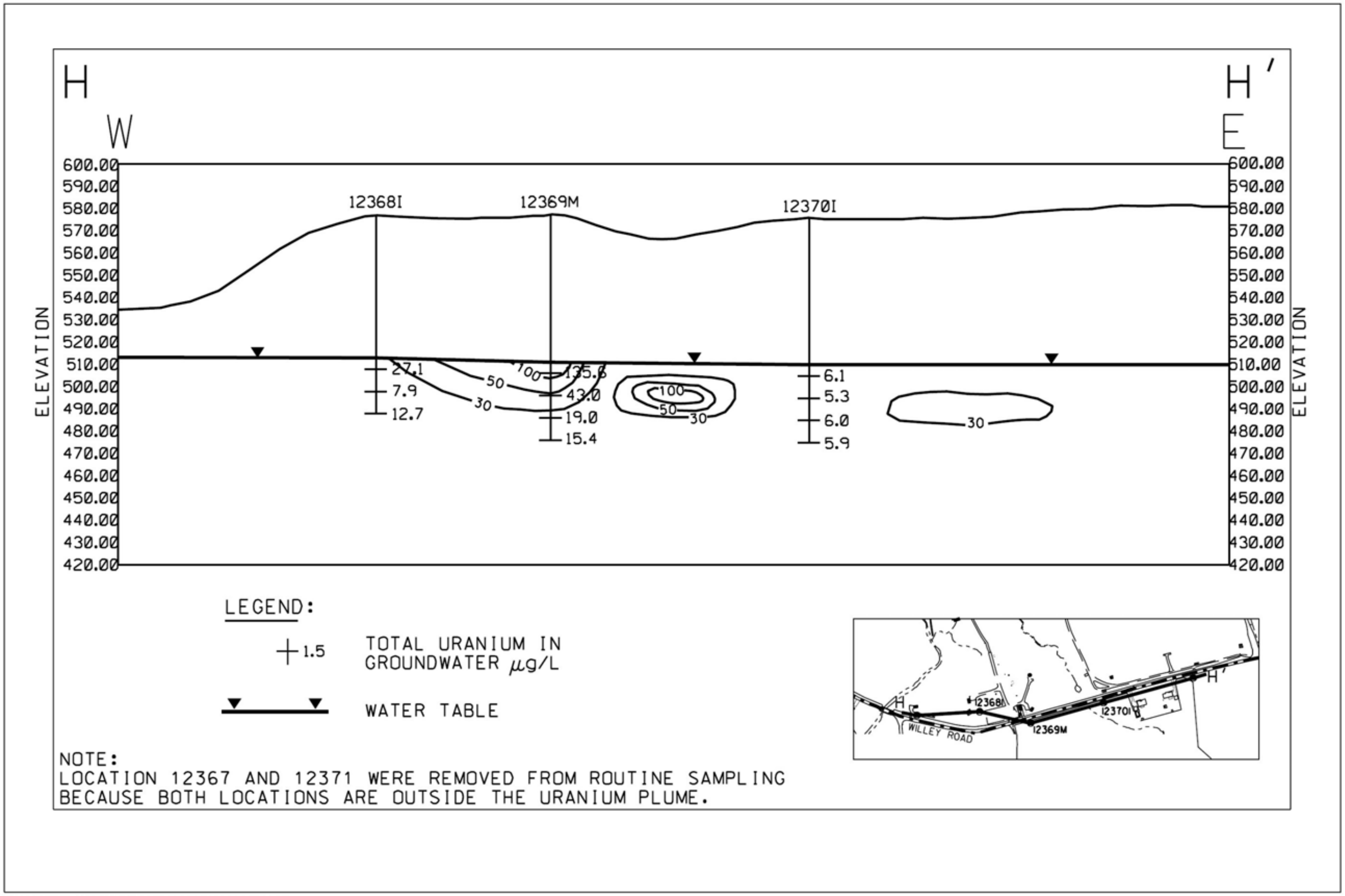


FIGURE A.2-154. TOTAL URANIUM CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 83346



V:/LTS/111/0051/17/002/S03876/S0387600.DGN

Figure A.2−155. Total Uranium in Groundwater (2007) South of Former Re-Injection Wells

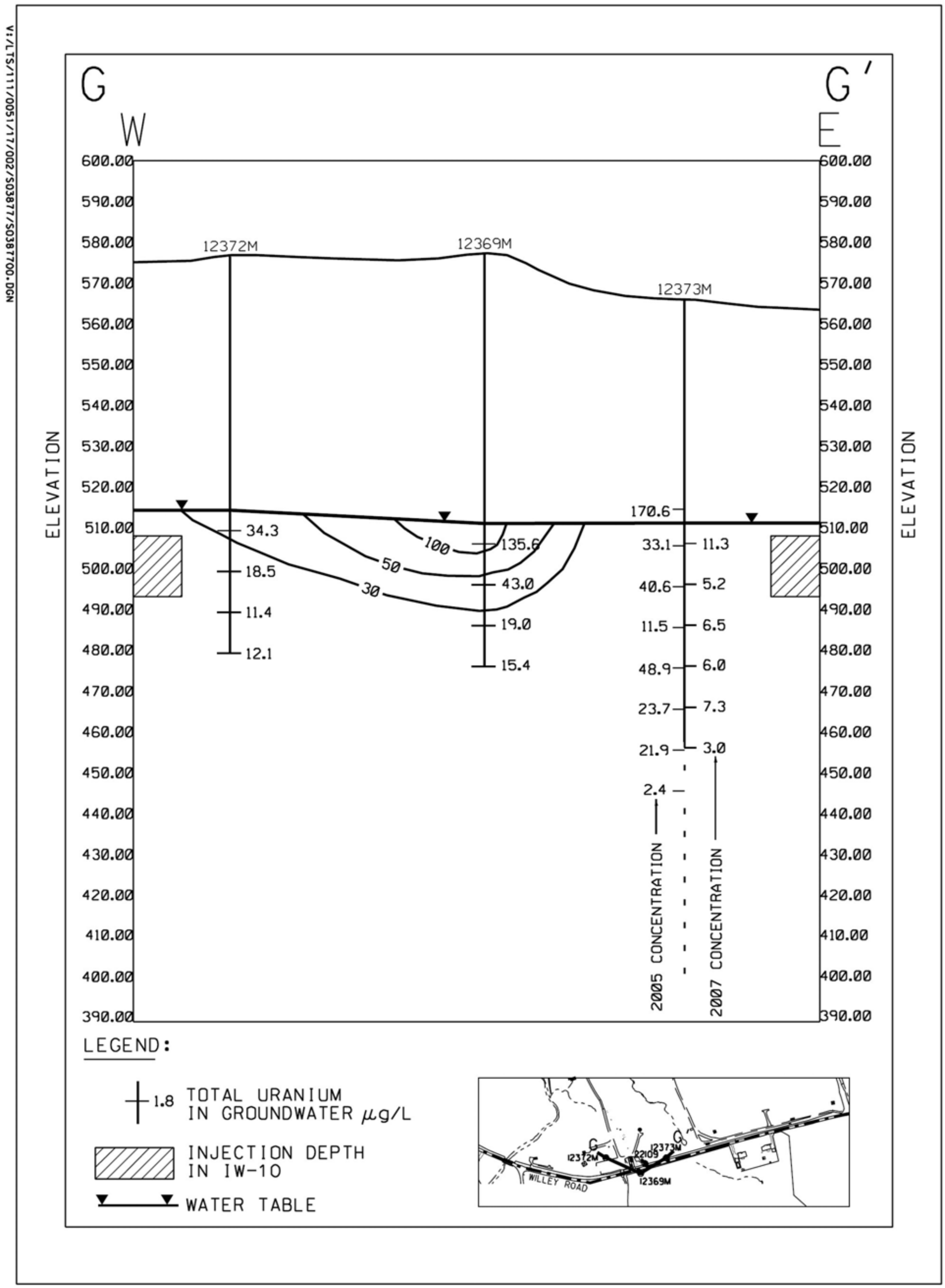
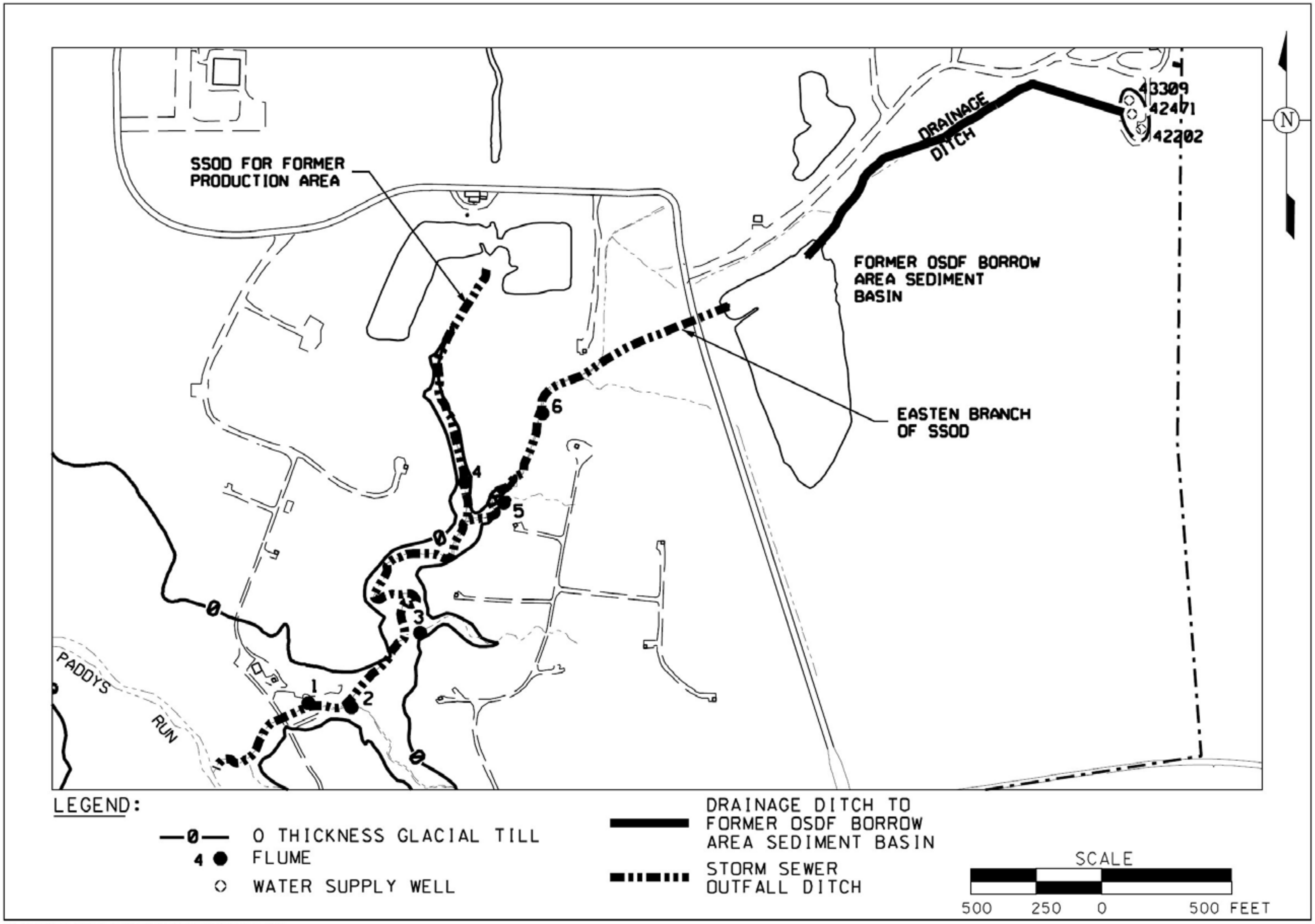


Figure A.2−156. Total Uranium in Groundwater (2007) Next to and South of IW−10



V:/LTS/111/0051/17/002/S03863/S0386300.DGN

Figure A.2−157. SSOD Flumes and Water Supply Wells

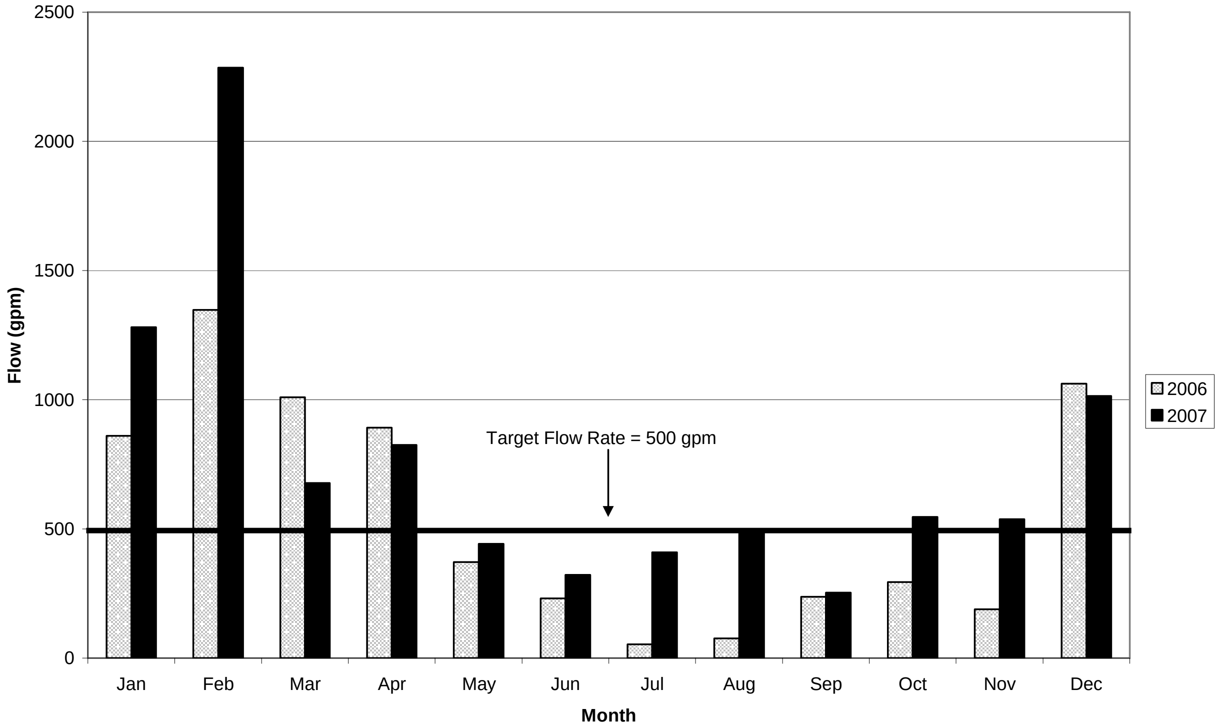


Figure A.2-158. Flow into SSOD: 2006 vs. 2007

Figure A.2−159.

Figure A.2−160.

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Attachment A.3

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A.3.0 Groundwater Elevations and Capture Assessment

A.3.1 Groundwater Elevations and Capture Assessment

This section discusses groundwater elevation and capture assessment. Figures A.3−1 through A.3−4 present groundwater elevation maps for the four quarters of 2007. Each groundwater elevation map contains the following quarter specific information:

- Groundwater elevation data and resulting water table contours
- Interpreted capture zones and flow divides
- Bedrock highs
- Waste Storage Area (Phase II) Design particle track remediation footprint
- Extent of the maximum 30 μg/L total uranium plume
- Module specific pumping rates during the time period in which the groundwater elevation measurements were collected.

Water levels in 2007 were measured at 178 locations, as specified in the IEMP. Measurements were collected over a time period of 2 to 4 days, as noted below.

Quarter	Measurement Dates	Number of Days	Average Water Level
1	1/8/07 to 1/11/07	4	516.28 feet AMSL
2	4/2/07 to 4/4/07	2	518.46 feet AMSL
3	7/24/07 to 7/25/07	2	517.36 feet AMSL
4	10/1/07 to 10/4/07	4	514.01 feet AMSL

Nine monitoring wells were not measured at various times in 2007 either because the wells were dry or not accessible. A summary is provided below.

Well	First Quarter	Second Quarter	Third Quarter	Fourth Quarter
2014				Dry
2544				Dry
2128				No Access
2625				Dry
2636			Dry	Dry
2733				Dry
21192	Dry		Dry	Dry
83337_C1				Dry
83340_C1				Dry

Unplanned operational disruptions in 2007 were minimal. The entire well field though (excluding the South Plume Recovery Wells) was shut down in 2007 for 36 days from June 17 to July 23 as planned to allow water levels to recover to non-pumping elevations. The number of wells pumping in each restoration module, the average pumping rate for each restoration module, and water levels are indicated on the quarterly water level maps (i.e., Figures A.3−1 through A.3−4). Information on the figures indicates that extraction wells were sometimes turned off and on during the time period that water levels were collected. An example of this is water level measurements collected during the fourth quarter of 2007 from October 1 through October 4 (refer to Figure A.3−1). The number of extraction wells pumping in the South Plume went from 5 to 6 during this time period. This is noted on Figure A.3−1 by “5/6” for the South Plume extraction operational status. The pumping rates on the figures are averages of the actual pumping rates during the measurement period. Operational disruptions and pumping rate changes impact water levels and are avoided as much as possible during measurement periods. Quarterly monitoring was not conducted during the planned shut down from June 16 to July 23, but third quarter measurements were scheduled to coincide with re-start of the wells on July 24.

The 2007 quarterly groundwater elevation maps shown in Figures A.3−1 through A.3−4 illustrate capture of the maximum total uranium plume by means of capture zones interpreted from quarterly water level measurements; predicted capture based on Waste Storage Area (Phase II) design particle track modeling; and groundwater elevation contour lines.

It should be noted that the Waste Storage Area (Phase II) design remediation footprint used in this report was constructed using reverse, non retarded, particle path interpretations from the VAM 3D, Zoom Groundwater Model.

Figure A.3−5 shows the resulting particle tracks that were used to define the Waste Storage Area (Phase II) design remediation footprint. Model particles were seeded at each extraction well. The resulting particle tracks represent the individual path that each particle traveled over the time period of the Waste Storage Area (Phase II) design (2007 to 2023). The limits of most of the particle tracks are truncated because the particles reached the edge of the Zoom Groundwater Model domain.

Due to the discontinuance of re-injection along Willey Road, capture delineation between the South Field and South Plume could not be determined. In past years, re-injection along Willey Road created small areas of elevated water levels, which could be connected to illustrate the extent of the South Field capture. The groundwater flow divide between Paddys Run Outlet and the New Baltimore Outlet was not readily distinguishable for most of 2007.

The quarterly capture zone interpretations coupled with the Waste Storage Area (Phase II) particle track interpretations and contoured water table gradients indicate that the 30 µg/L total uranium plume was being captured in 2007.

During 2007 the water table in the measurement area fluctuated on average approximately 4.45 feet, and ranged from 1.7 feet to 7.7 feet. In 2006 the fluctuation was on average approximately 3.4 feet and ranged from 2 feet to 7.1 feet, depending on the location of the well being measured and its proximity to recharge areas.

Well cluster hydrographs are also provided in this attachment as a means to assess vertical groundwater gradients. The hydrographs depict groundwater elevations available from 1993 through 2007 from Type 2 and Type 3 wells in the same cluster. Hydrographs for the following monitoring well clusters appear in Figures A.3−6 through A.3−27: 014, 017, 045, 046, 049, 065, 069 (434), 095, 106, 125, 385, 387, 390, 396, 398, 402, 550, 552, 821, 880, 881, and 900. (Note: The last three digits of the monitoring wells identify the well clusters, e.g., cluster 552 consists of monitoring wells 2552 and 3552). Figure A.3−28 identifies the well cluster locations.

Analysis of these hydrographs for 2007 indicates that elevations in the Type 2 and Type 3 monitoring wells within the majority of the clusters are almost always identical for each measurement event. An occasional slight difference can be seen, but these differences do not appear to be indicative of vertical hydraulic gradients. Rather, they are attributed to measurement, transcription, or error during data collection and processing.

A.3.2 Annual Planned Well Field Shutdown

A planned shutdown of the well field was conducted for 36 days (June 17 to July 23). All extraction wells, except for the South Plume Recovery Wells were shut down during this period. The South Plume Recovery Wells remained pumping to maintain a hydraulic barrier at the southern extent of the off-property uranium plume.

The objective of the well field shutdown was to allow water levels in the aquifer to rise as high as possible. Uranium contamination bound to aquifer sediments in the unsaturated portion of the Great Miami Aquifer is present under some former contamination source areas. Uranium contamination bound to unsaturated aquifer sediment will remain bound unless water levels rise, saturate the contaminated sediments, and allow the contamination to dissolve into the groundwater.

Based on water level data collected since 1988, water levels in the GMA are usually at their highest in June and July following the spring rainy season. This time period was therefore targeted for the well field shut down in 2007. Unfortunately (as discussed below) the Fernald Preserve experienced lower than normal precipitation in 2007 resulting in drought conditions in June and July. Water levels therefore did not rebound as high as they had in past years.

As shown in Figure A.3−29, January through April received normal amounts of precipitation based on the previous 4 years. Beginning in April, precipitation amounts decreased, creating a drought that persisted into September. Although precipitation increased during the late summer and fall of 2007, the precipitation total for 2007 was not enough to achieve the historical average. Annual precipitation in 2007 (as recorded at the Butler county Regional Airport) was 37.39 inches, compared to the historic average of approximately 41 inches per year. Due to drought conditions, the maximum height that the water table normally reaches during its seasonal fluctuation was lower in June and July of 2007 than in past years. Unfortunately this meant that during the well field shut down, water levels did not rise as high as was hoped for.

A.3.2.1 Shutdown Measurements / Sampling

Water levels were measured four times at all IEMP Water Level Wells:

1)	Prior to shut down	(June 4, 2007 to June 6, 2007)
2)	Just after shut-down	(June 18, 2007 to June 20, 2007)
3)	Prior to re-start	(July 9, 2007 to July 11, 2007)
4)	After re-start	(July 24, 2007 to July 25, 2007)

Pressure transducers were installed in six groundwater monitoring wells (2045, 2046, 2649, 23274, 62433, and 32763), Figure A.3−30. Water level measurements were recorded at the top of each hour beginning on May 25, 2007.

Uranium concentrations were measured six times in six groundwater monitoring wells (2045, 2046, 23274, 83124, 83337, and 83294) Figure A.3−31. Samples were collected prior to the wells being turned off, prior to re-starting the wells, and four times after the wells were re-started.

Uranium concentrations were also measured daily for four days in the extraction wells after the wells were restarted (with the exception of EW-17a, EW-20, and EW-24 which could not be re-started right away due to iron fouling of the pumps. The first water sample was collected after the well had been pumping for approximately five minutes.

A.3.2.2 Water Level Results

The maximum water level rise measured during the shut down at each transducer was as follows:

Transducer Location	Maximum Water Level Rise (feet)
2045	1.278
2046	1.160
2649	1.335
23274	1.478
32763	2.360
62433	2.575

Area water level changes resulting from the shut down are shown in Figure A.3−32 which compares the water level measured just prior to shut down to the water level measured just after shut down. Water levels inside the 0 water level change contour marks the areas where water level rises were observed. The water level rise areas correspond to the location of the extraction wells in the South Field and Waste Storage Areas.

A.3.2.3 Uranium Concentration Results

Uranium concentration measurements collected at the six monitoring wells during and after the shut down are provided in Table A.3−1. At Type-8 wells the shallowest channel in the saturated zone was sampled. Prior to shut down, channel 1 (the shallowest channel) was dry in both monitoring wells 83294 and 83337. During shut down, the water level rose high enough to enable sampling of Channel 1 at both monitoring well 83294 and 83337. Channel 1 in monitoring well 83294 remained saturated for the four days of sampling following re-start, but Channel 1 in monitoring well 83337 went dry again after re-start.

A large uranium concentration change was measured at monitoring well 83337. Prior to shut down the concentration in channel 2 was 139.4 µg/L. Just prior to re-start the uranium concentration in Channel 1 was 1,586.5 µg/L. Once pumping began again, Channel 1 went dry and samples had to be collected from Channel 2.

Uranium concentrations measured at the extraction wells after the wells were re-started are provided in Table A.3−2, along with the average concentrations for each well measured in June or May 2007. The minimum, maximum, and range of uranium concentrations measured just after the wells were re-started are also provided in Table A.3−2, along with the difference between the maximum re-start concentration and the average concentration measured in the well prior to the shut down exercise. Shading indicates those wells that had uranium concentrations upon re-start that were equal to or higher than the average concentration measured in the wells prior to the shut down exercise.

Uranium concentrations measured at 6 of the extraction wells (RW-7, EW-19, EW-22, EW-23, EW-30, and EW-33a) following re-start were less than the average concentration measured in the wells prior to conducting the shutdown exercise (Table A.3−2).

The uranium concentration of EW-33a upon re-start of the well was less than the average concentration measured in the well prior to conducting the shut down exercise. A uranium concentration increase of 1,586.5 µg/L uranium was recorded in the nearby monitoring well (MW-83337) during the same time period when the water level rose and Channel 1 could be sampled.

A.3.2.4 Conclusions

- Water levels during the shut down period did not rebound to historical highs. This is attributed to low regional water levels that were present at the start of the exercise as a result of low precipitation amounts in 2007.
- The exercise did not take place when water levels were at their annual high for 2007. Higher aquifer water levels were measured in March and April of 2007. By June water levels in the aquifer were falling due to low precipitation levels and subsequently low recharge.
- Uranium concentrations measured at monitoring well 83337 confirm that contamination is present in the vadose zone at this area. After the system was shut down the water level was high enough to allow sampling of Channel 1. The uranium concentration measured in Channel 1 (1,586.5 µg/L) was approximately 11 times higher than the concentration measured in Channel 2 (139.4 µg/L).
- The maximum recorded water level rise achieved by shutting down the well field was approximately 2.6 feet (monitoring well 62433).
- At current pumping rates, the system shut down exercise is effective in re-saturating up to 2.6 feet of aquifer material in areas close to the pumping wells. If the exercise is repeated in future years when regional water levels are higher, the exercise will be more beneficial in flushing out the vadose zone.
- Uranium concentrations at monitoring well 83337 indicate that contamination is present in the vadose zone. Decreasing the pumping rate of the nearby extraction well (EW-33a) should decrease drawdown of the water surface in this area and lead to an increase in the uranium concentration of the pumped water. EW-33a is being pumped at a set point rate of 330 gpm. The uranium concentration of the pumped water at this rate is below 30 µg/L. The uranium removal efficiency of extraction well EW-33a may be improved if the pumping rate is decreased, effectively decreasing the pull of clean water into the well from beneath the uranium plume due to partial penetration effects.
- Uranium concentration data from the extraction wells (Table A.3−2) indicate that the maximum pumped uranium concentrations increase was 19.1 µg/L (EW-15a). By the fourth day of sampling only five extraction wells had pumping uranium concentrations which were equal to or greater than the average concentration of the pumped water coming from the wells before the shutdown exercise.

A.3.2.5 Lessons Learned

- Although historical water level measurements indicate that on average, seasonal water levels in the aquifer are at their highest from June 15 to July 16, it is difficult to predict in any one year when water levels in the aquifer will actually reach their highest levels. The difficulty in timing this event arises from changing recharge rates and changing annual precipitation amounts. It may be beneficial to move the timing of future shutdown exercises into the late April to May time frame. Such a move should increase the probability that the exercise would be conducted while water levels are still rising for the year, rather than falling.
- Future annual exercises should not be conducted in years when area water levels are low due to extended periods of below average precipitation.
- Operators had difficulty starting three of the extraction wells following completion of the shut down (EW-17a, EW-20, and EW-24). The cause is attributed to iron fouling of the pumps. Chlorine treatments were successful in achieving the eventual re-start of the motors. In the future, the pumps could be turned on periodically during the testing period in order to keep the motors from locking up due to iron fouling. The length of time the motors are periodically operated during the shut down would need to be short in order to minimize disruption of the rebound exercise.
- When sampling Type-8 wells, a better representation of concentration profile changes could be obtained if more channels are sampled. Specifically, if sampling begins in Channel 2 because Channel 1 is dry, sampling in Channel 2 should continue during the exercise along with Channel 1 should the water level raise high enough to sample Channel 1 also. This would provide a better profile interpretation of the resulting concentration changes.

A.3.3 Continued Transducer Monitoring

Although not required by the IEMP, pressure transducers installed to support the 2007 shut down were left operating throughout the remainder of 2007 and into 2008. The intent is to leave these transducers operating so that daily changes in water levels can be recorded on a continuous routine basis at key points in the aquifer. The transducers are programmed to record a water level measurement at the top of each hour. Data from three of the six locations (Former Waste Storage Area (MW 2649), East Side of the South Field (2046), and West Side of the South Field (62433)) are plotted in Figure A.3−33 along with precipitation for data collected through March 25, 2008. The intent is to leave these transducers running until several yearly water level cycles have been recorded. The data will provide a more complete record of seasonal and short term water table fluctuations and should prove helpful for planning the timing of future well field shutdowns. Again, the intent is to target time periods during the year when the regional water level is at its highest.

Table A.3–1. Uranium Concentrations at Monitoring Wells during the 2007 System Shutdown

Well	Easting	Northing	Uranium Concentration (µg/L)					
			Pre Shut Dn	Pre-Start Up	Post Start Up			
			6/11/2007	7/19/2007	7/24/2007	7/25/2007	7/26/2007	7/30/2007
2045	1348291.0	477158.9	102.7	115.0	110.3	111.5	105.4	104.9
2046	1347949.7	478087.8	44.1	33.3	42.4	42.9	45.5	49.3
23274	1349406.0	478337.0	155.8	149.9	132.6	128.5	129.6	177.8
83124_C1	1346826.3	479977.2	564.4	400.9	479.0	493.4	480.8	405.7
83294_C1	1349599.5	477189.5	Dry	180.9	183.8	180.6	180.6	166.9
83294_C2	1349599.5	477189.5	500.8					
83337_C1	1346704.3	481051.9	Dry	1586.5	Dry	Dry	Dry	Dry
83337_C2	1346704.3	481051.9	139.4		6.5[a]	129.1	176.1	119.4

[a]Relatively low result was re-ran and confirmed

Table A.3–2. Uranium Concentrations at Extraction Wells Before and After Planned Shutdown

Ext. Well ID	Avg. U Conc. May or June[a]	Uranium Concentrations after Re-Start[b]								Max after Re-start minus May/June Avg.
		7/23/2007	7/24/2007	7/25/2007	7/26/2007	7/30/2007	Min	Max	Range	
	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)
RW-01	**18.9**	**19.5**	**19.7**	18.4	17.2	17.6	17.2	19.7	2.5	0.8
RW-02	**19.5**	**22.7**	**22.9**	**21.6**	**20.0**	**19.8**	19.8	22.9	3.1	3.4
RW-03	**27.6**	**29.4**	**29.3**	27.2	25.7	24.9	24.9	29.4	4.5	1.8
RW-04	**3.3**	**3.3**	**3.3**	3.2	3.0	2.8	2.8	3.3	0.5	0.0
RW-06	**34.2**	**39.0**	**36.8**	32.5	**41.1**	**34.3**	32.5	41.1	8.6	6.9
RW-07	**40.5**	38.5	37.4	32.0	38.8	35.2	32.0	38.8	6.8	-1.7
EW-15a	**46.4**	**65.5**	43.3	34.4	33.7	42.9	33.7	65.5	31.8	19.1
EW-17a	**25.7**									
EW-18	**46.4**	18.3	**46.4**	41.8	45.0	45.4	18.3	46.4	28.1	0.0
EW-19	**40.1**	22.9	33.3	30.9	30.6	33.4	22.9	33.4	10.5	-6.7
EW-20	**27.8**									
EW-21a	**58.0**	45.5	**67.1**	**63.3**	**59.3**	56.7	45.5	67.1	21.6	9.1
EW-22	**49.7**	39.9	44.4	38.2	44.0	43.7	38.2	44.4	6.2	-5.3
EW-23	**75.5**	49.8	71.3	65.5	69.7	68.9	49.8	71.3	21.5	-4.2
EW-24	**48.4**									
EW-25	**42.3**	38.4	**55.2**	**44.6**	**42.6**	36.8	36.8	55.2	18.4	12.9
EW-26	**44.7**	**52.9**	42.9	38.9	41.6	42.0	38.9	52.9	14.0	8.2
EW-27	**43.9**	**57.8**	**49.1**	**45.5**	**48.8**	**48.7**	45.5	57.8	12.3	13.9
EW-28a	**20.6**	10.9	**22.8**	**21.3**	19.7	18.9	10.9	22.8	11.9	2.2
EW-30	**73.4**	47.4	72.0	64.7	70.8	64.8	47.4	72.0	24.6	-1.4
EW-31	**19.3**	12.4	**21.5**	**19.8**	18.3	**19.4**	12.4	21.5	9.1	2.2
EW-32	**10.4**	**11.5**	**14.9**	**13.4**	**12.5**	**11.7**	11.5	14.9	3.4	4.5
EW-33a	**29.2**	24.5	26.7	24.6	24.0	23.5	23.5	26.7	3.2	-2.5

[a]Results with a red font are for the May average.

[b]Shading identifies start up concentrations that are higher than or equal to the average concentration in the well prior to the shutdown exercise.

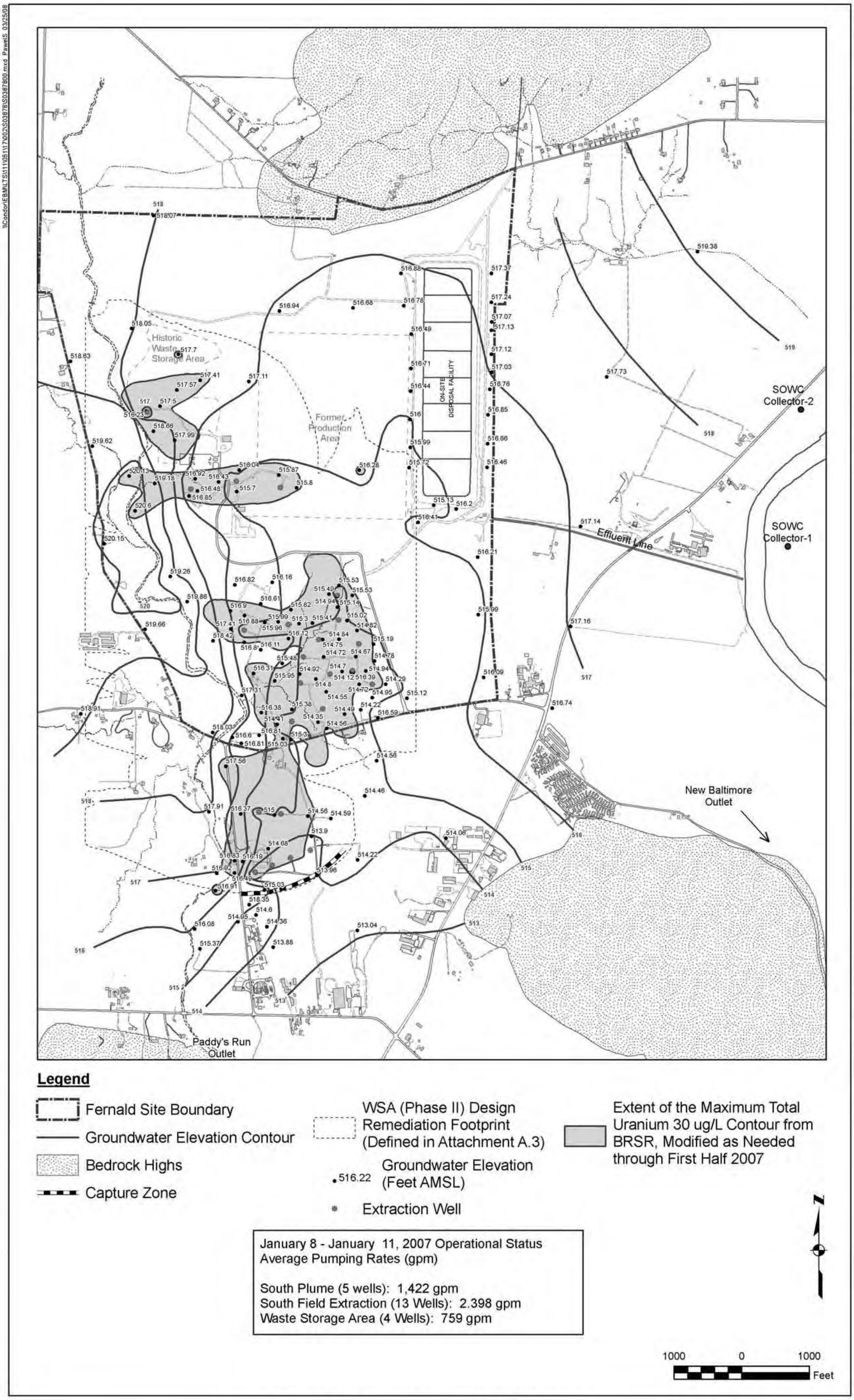

Figure A.3−1. Routine Groundwater Elevation Map, First Quarter 2007 (January 8 through January 11, 2007)

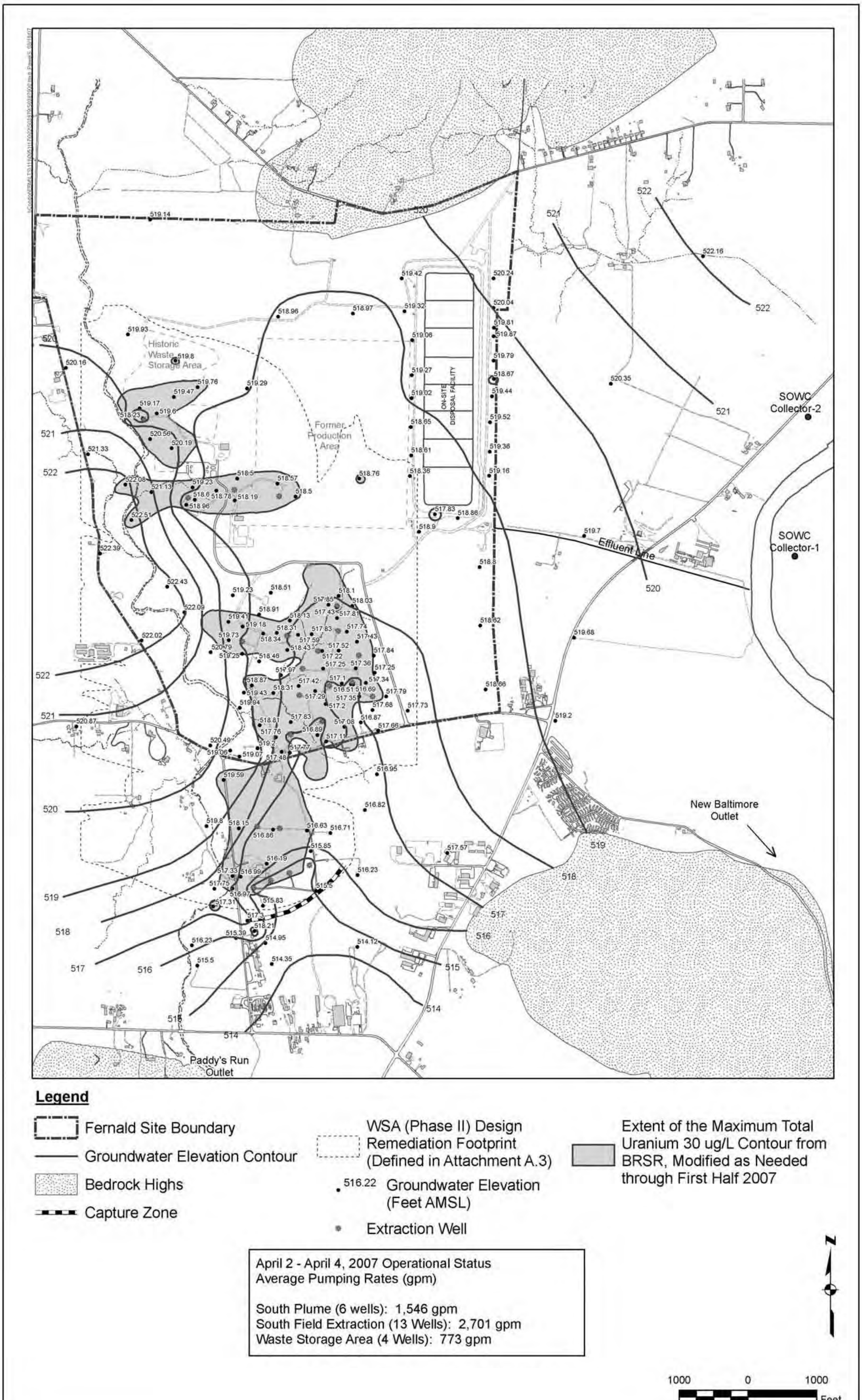

Figure A.3−2. Routine Groundwater Elevation Map, Second Quarter 2007 (April 2 through April 4, 2007)

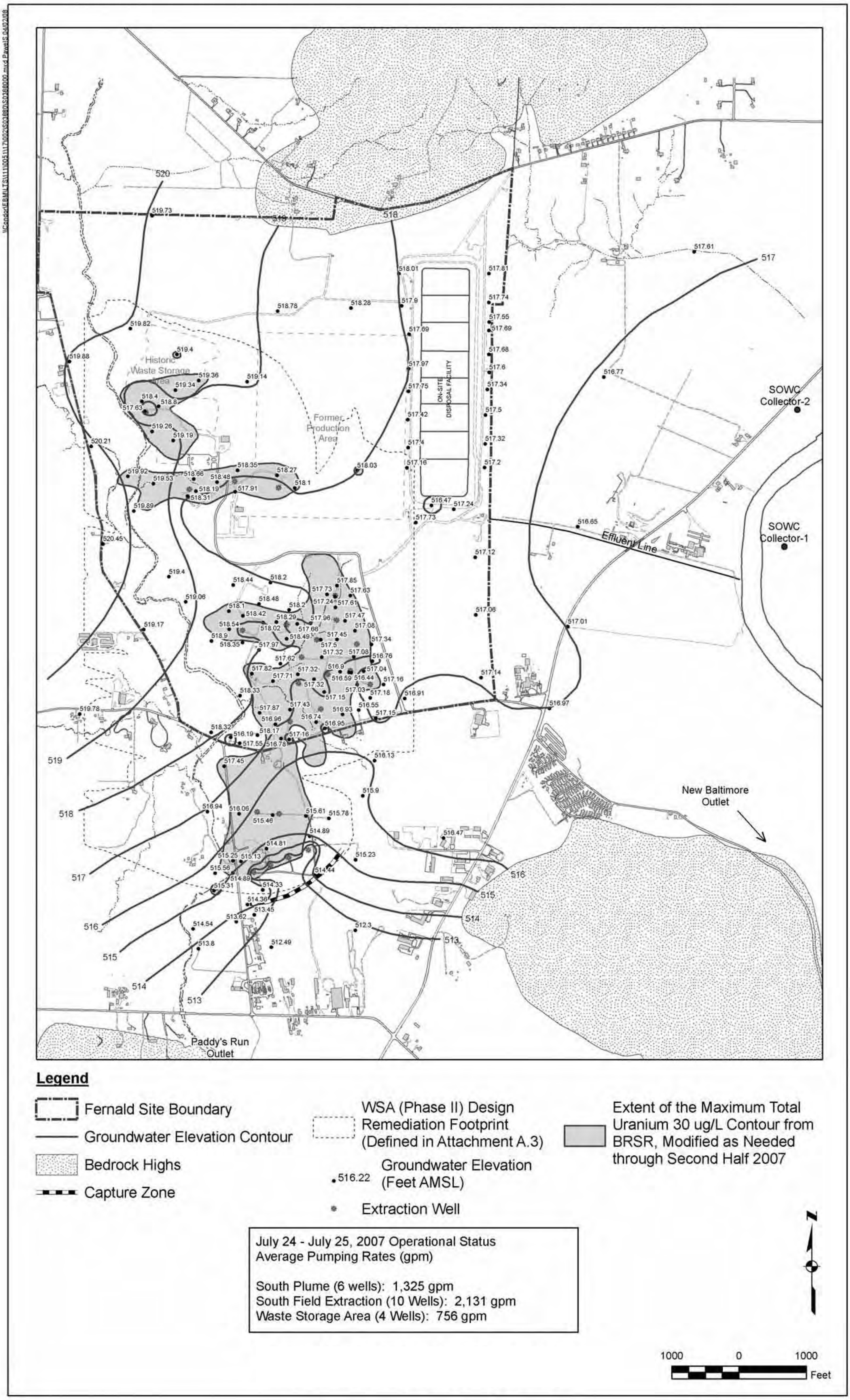

Figure A.3−3. Routine Groundwater Elevation Map, Third Quarter 2007 (July 24 through July 25, 2007)

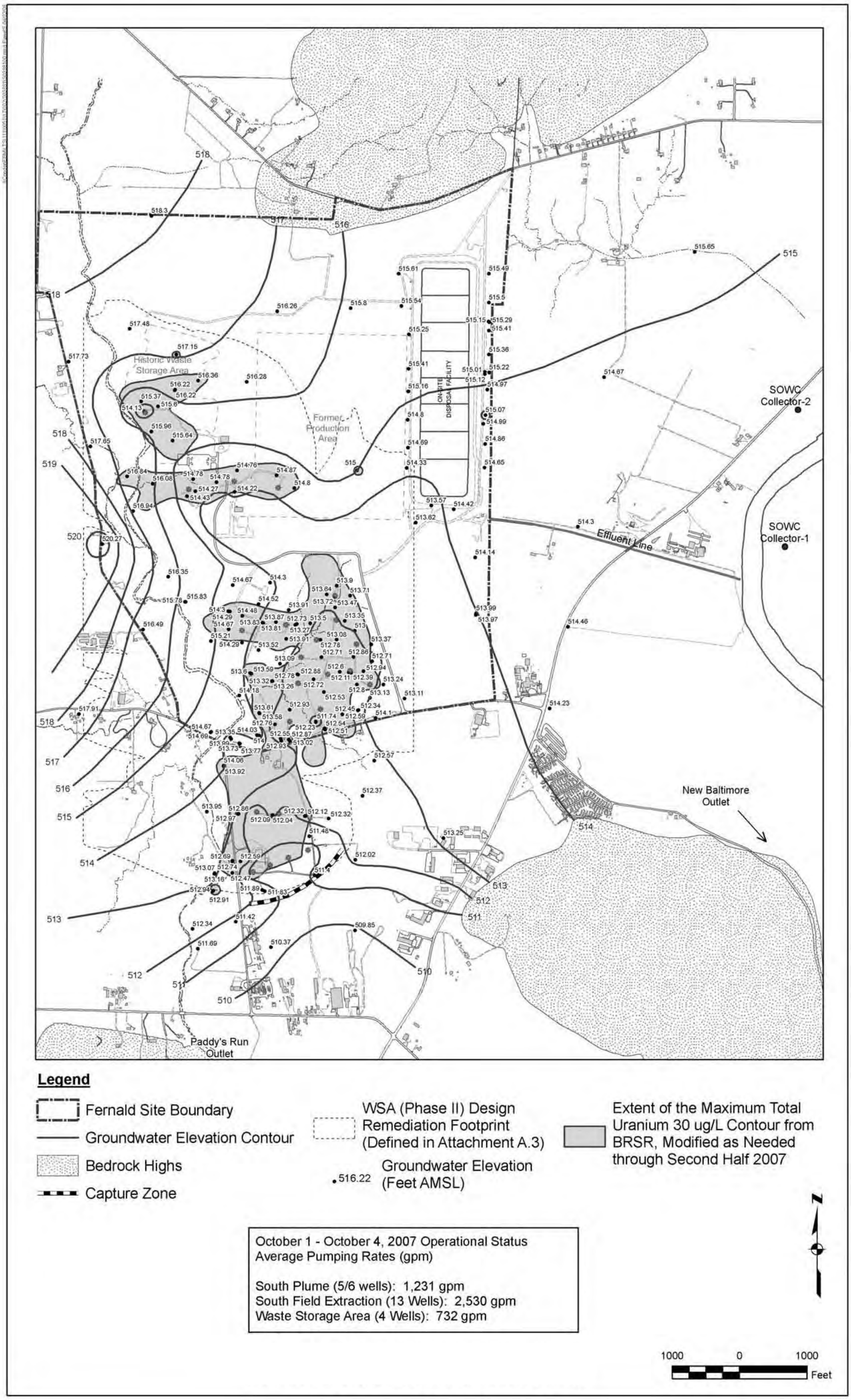

Figure A.3−4. Routine Groundwater Elevation Map, Fourth Quarter 2007 (October 1 through October 4, 2007)

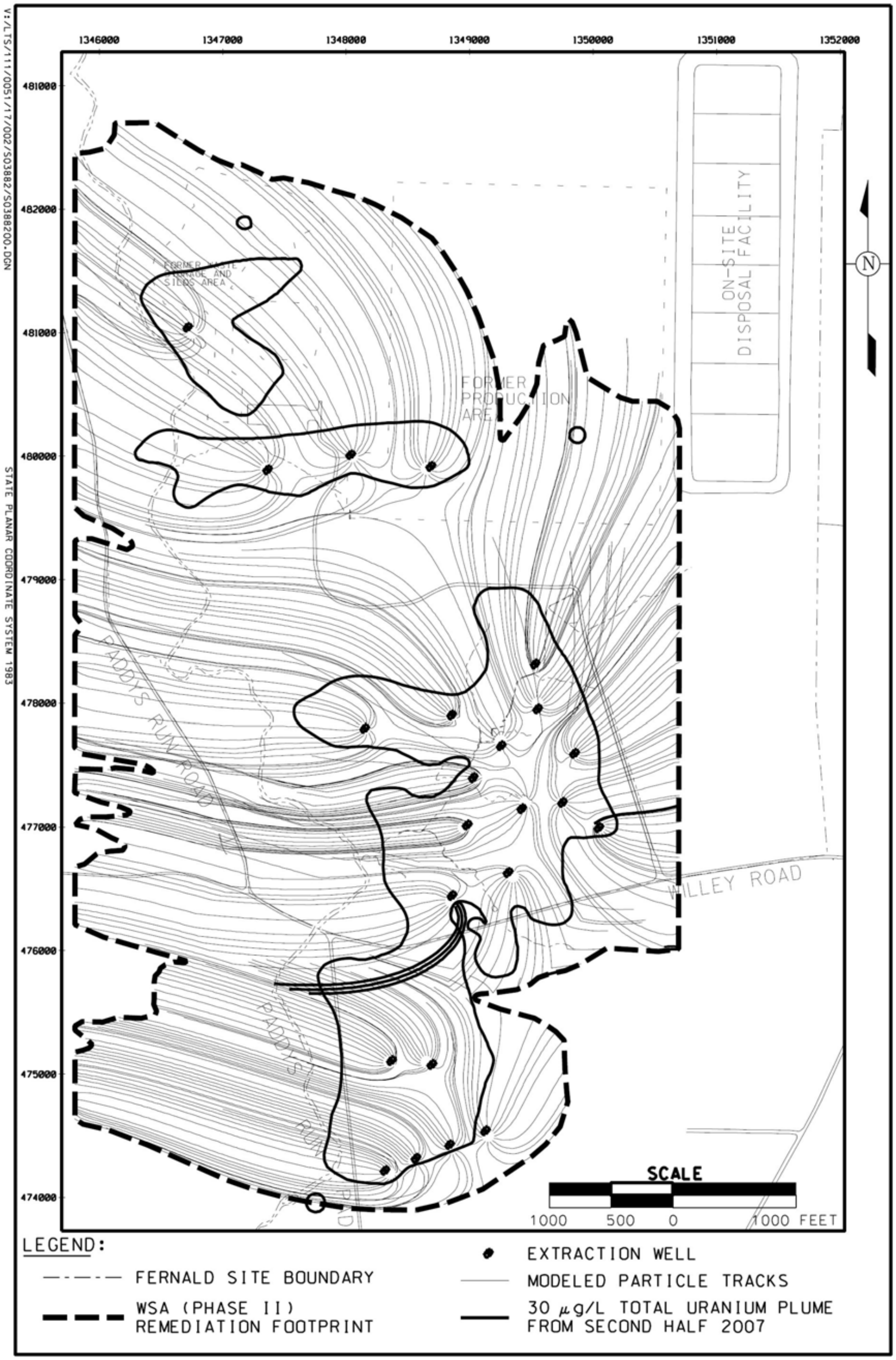

Figure A.3−5. WSA (Phase-II) Design Remediation Footprint

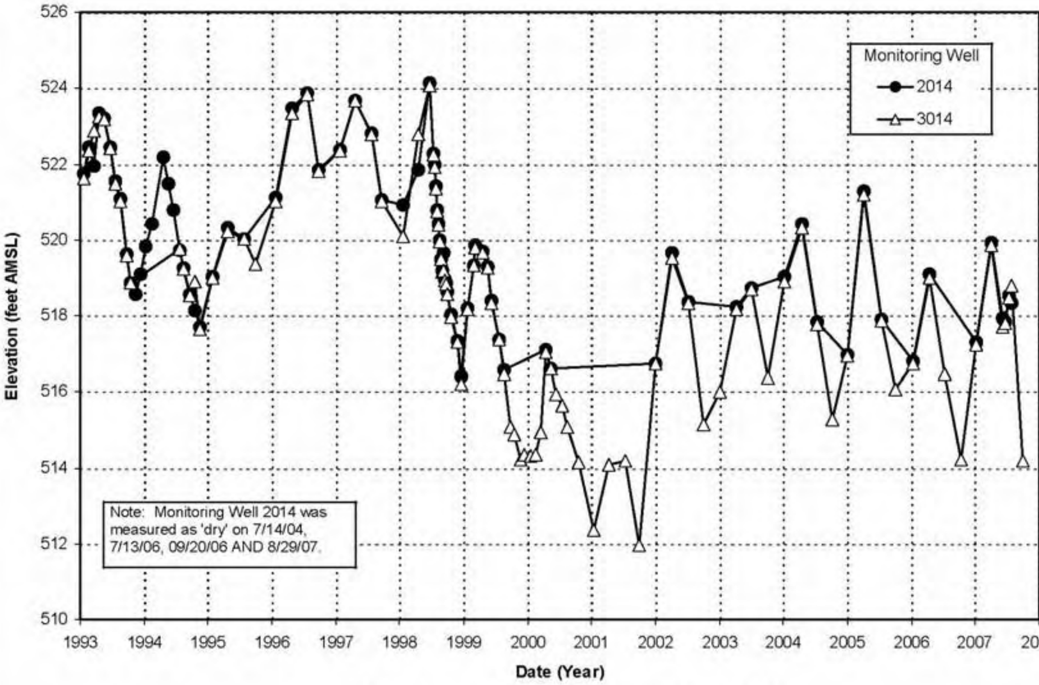

FIGURE A.3-6. HYDROGRAPH FOR WELL CLUSTER 014

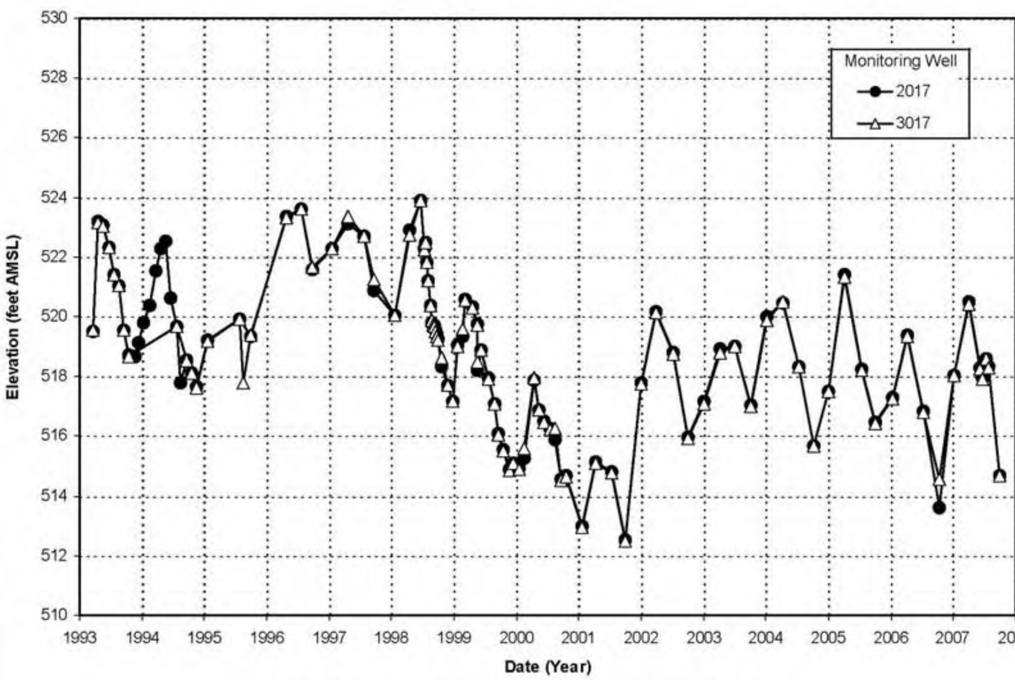

FIGURE A.3-7. HYDROGRAPH FOR WELL CLUSTER 017

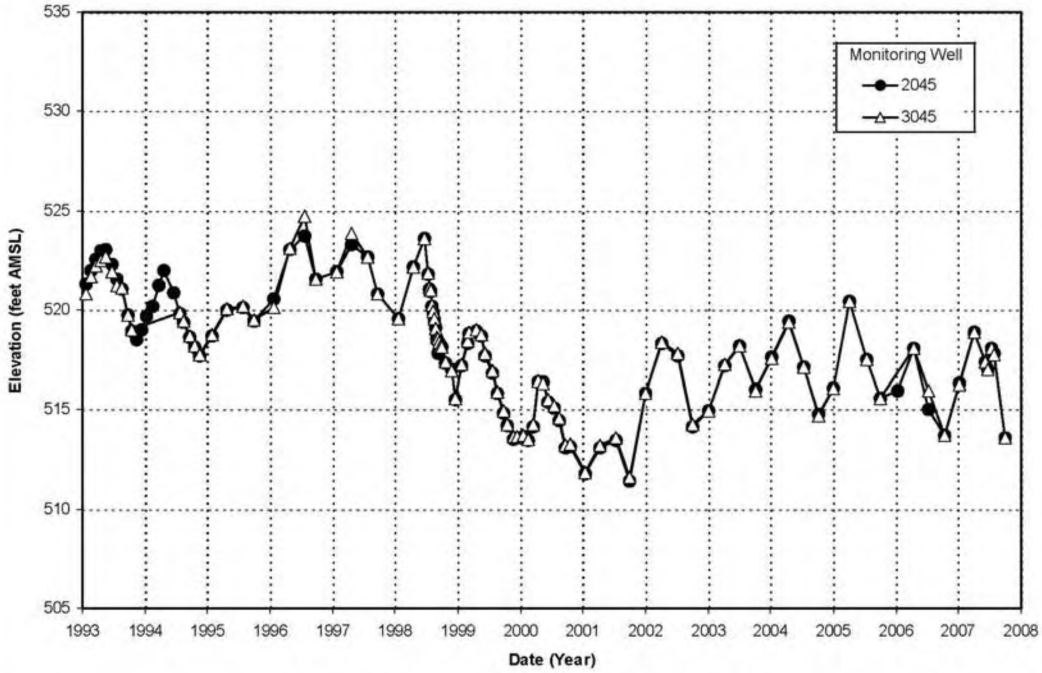

FIGURE A.3-8. HYDROGRAPH FOR WELL CLUSTER 045

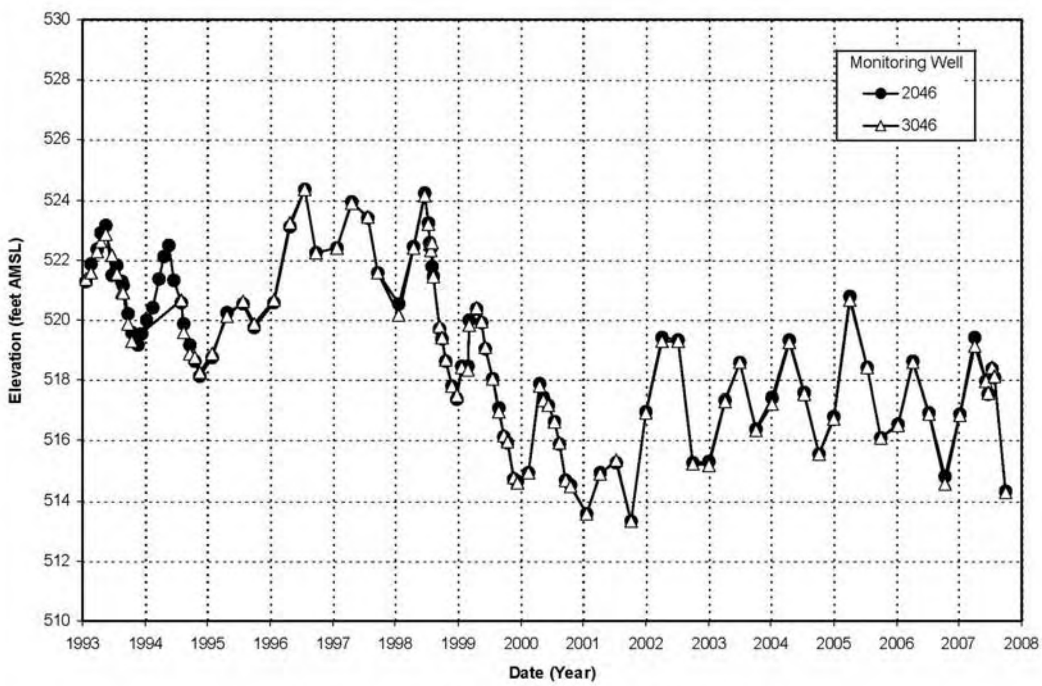

FIGURE A.3-9. HYDROGRAPH FOR WELL CLUSTER 046

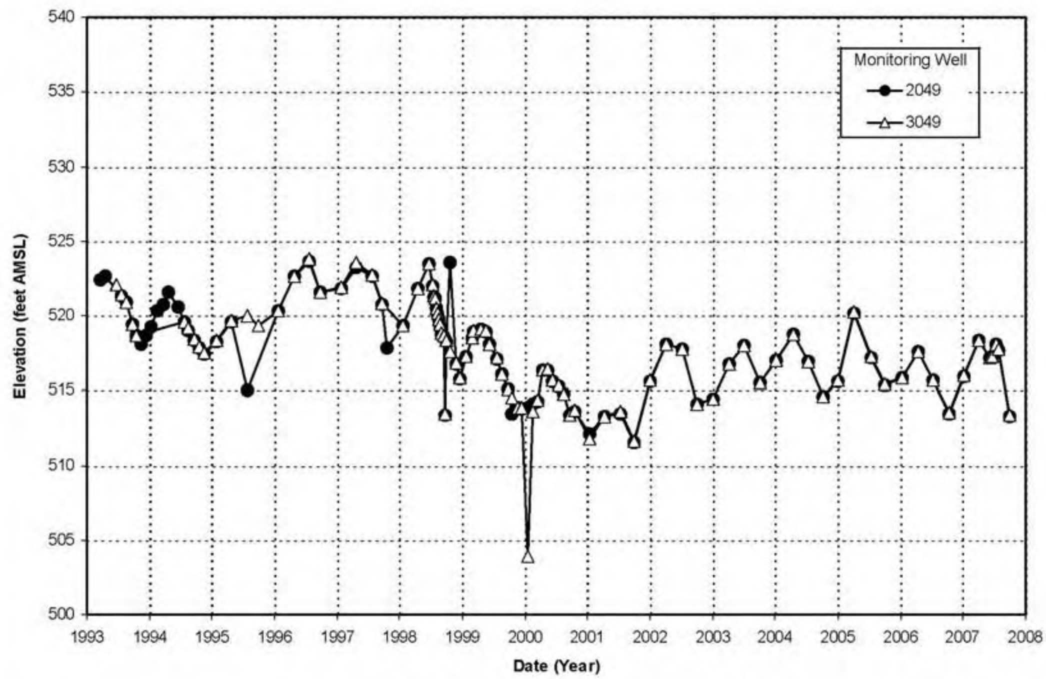

FIGURE A.3-10. HYDROGRAPH FOR WELL CLUSTER 049

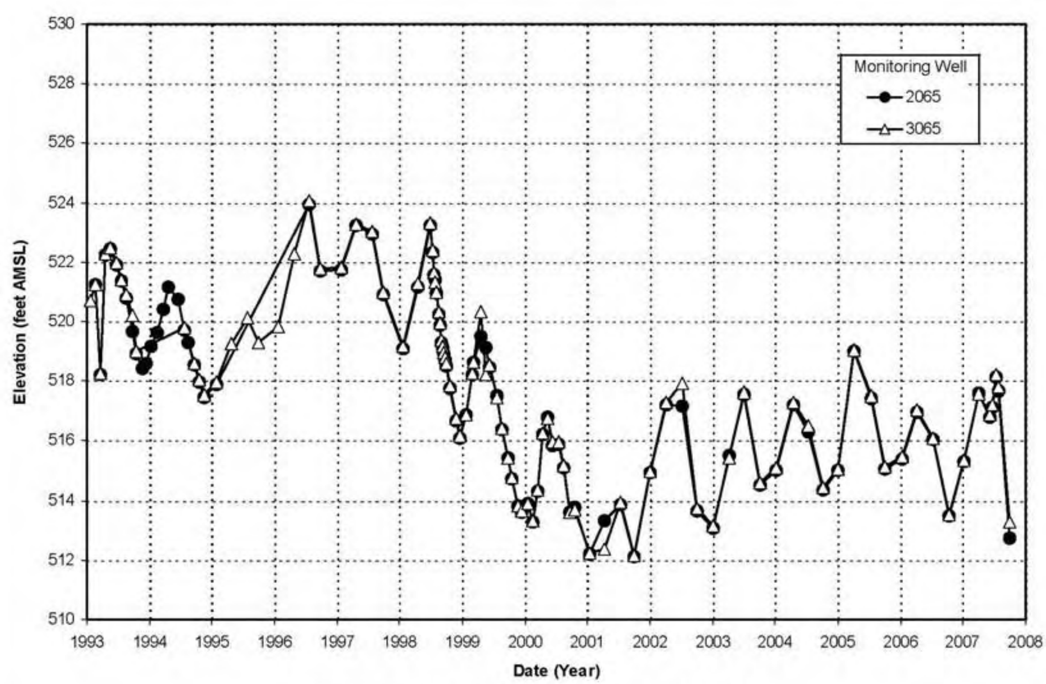

FIGURE A.3-11. HYDROGRAPH FOR WELL CLUSTER 065

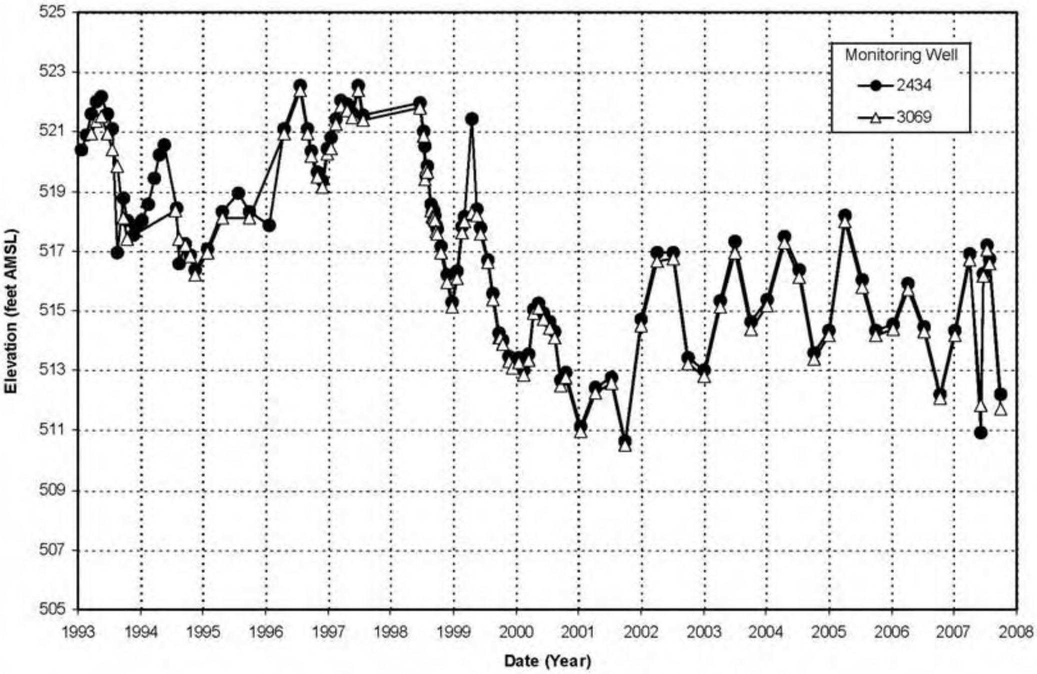

FIGURE A.3-12. HYDROGRAPH FOR WELLS 2434 AND 3069

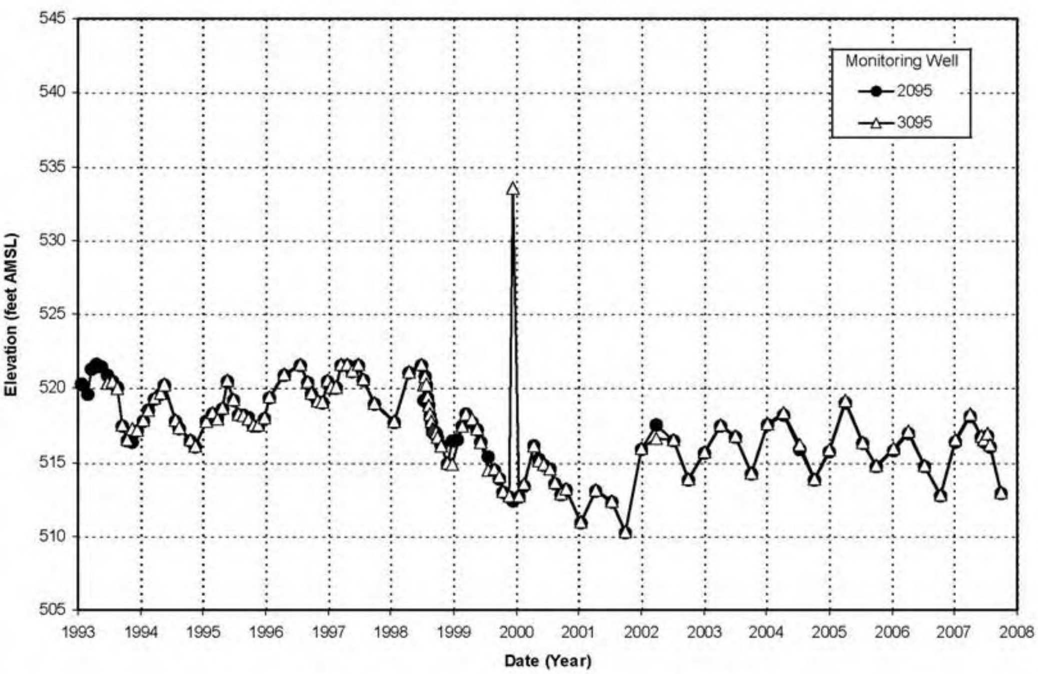

FIGURE A.3-13. HYDROGRAPH FOR WELL CLUSTER 095

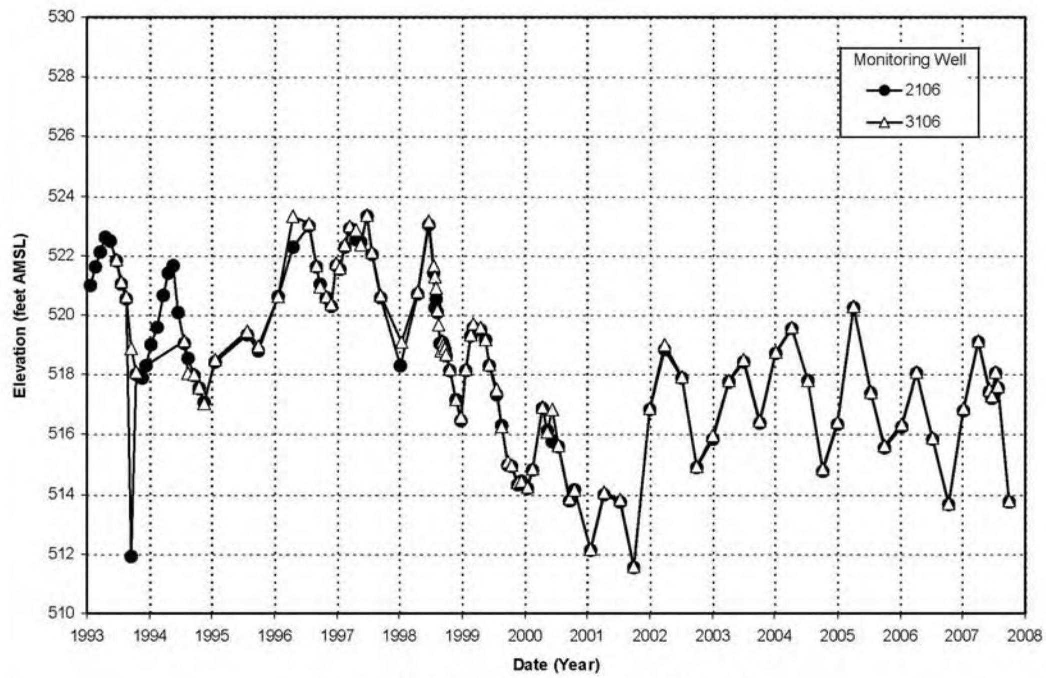

FIGURE A.3-14. HYDROGRAPH FOR WELL CLUSTER 106

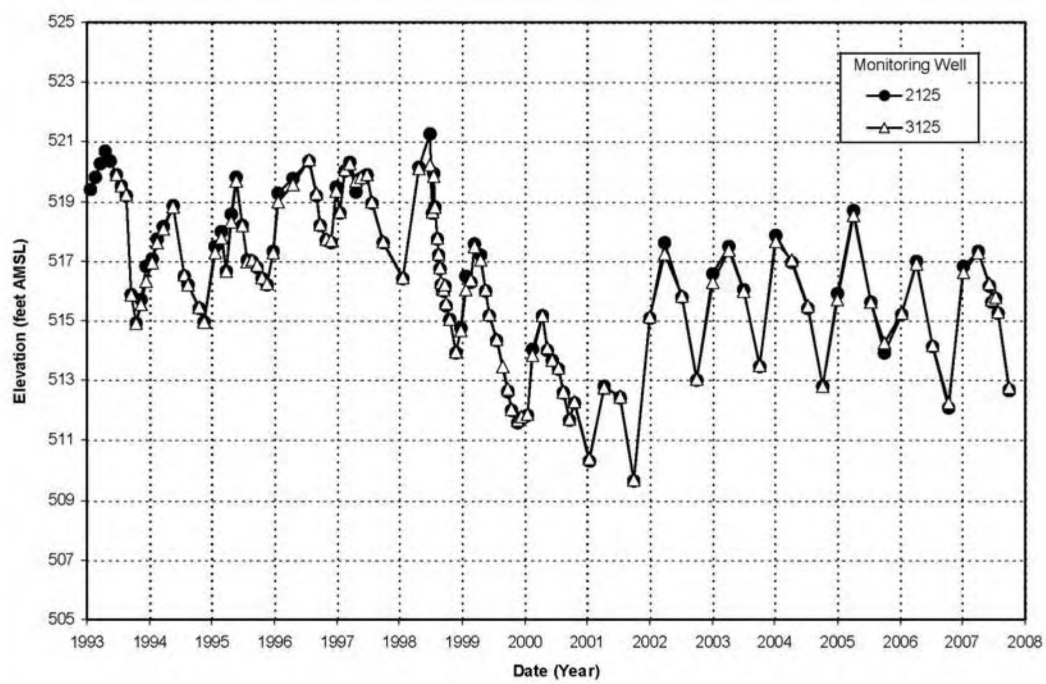

FIGURE A.3-15. HYDROGRAPH FOR WELL CLUSTER 125

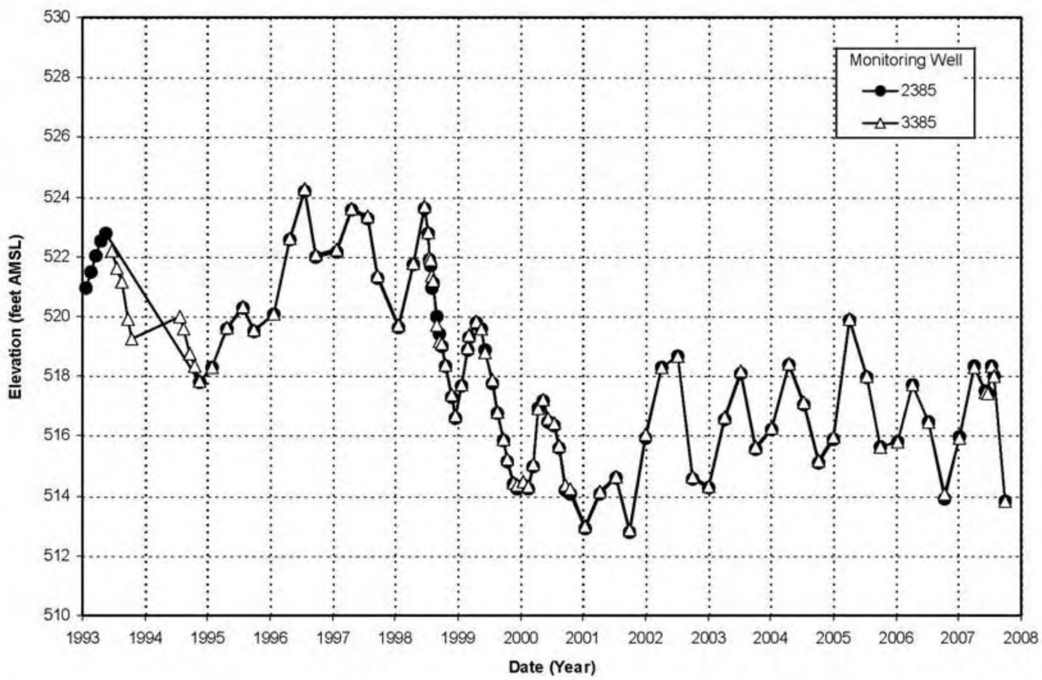

FIGURE A.3-16. HYDROGRAPH FOR WELL CLUSTER 385

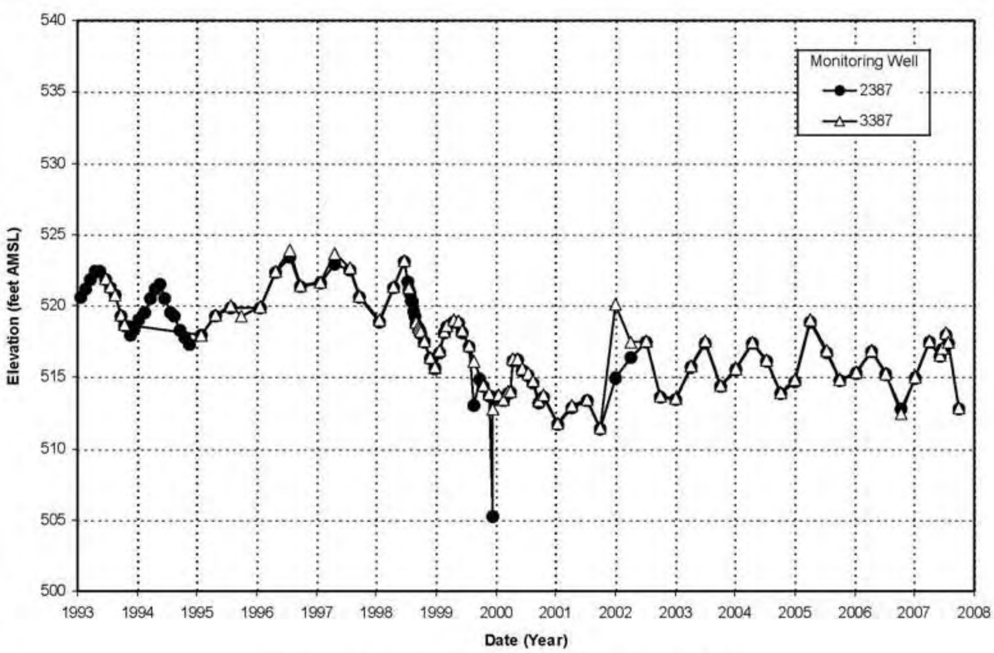

FIGURE A.3-17. HYDROGRAPH FOR WELL CLUSTER 387

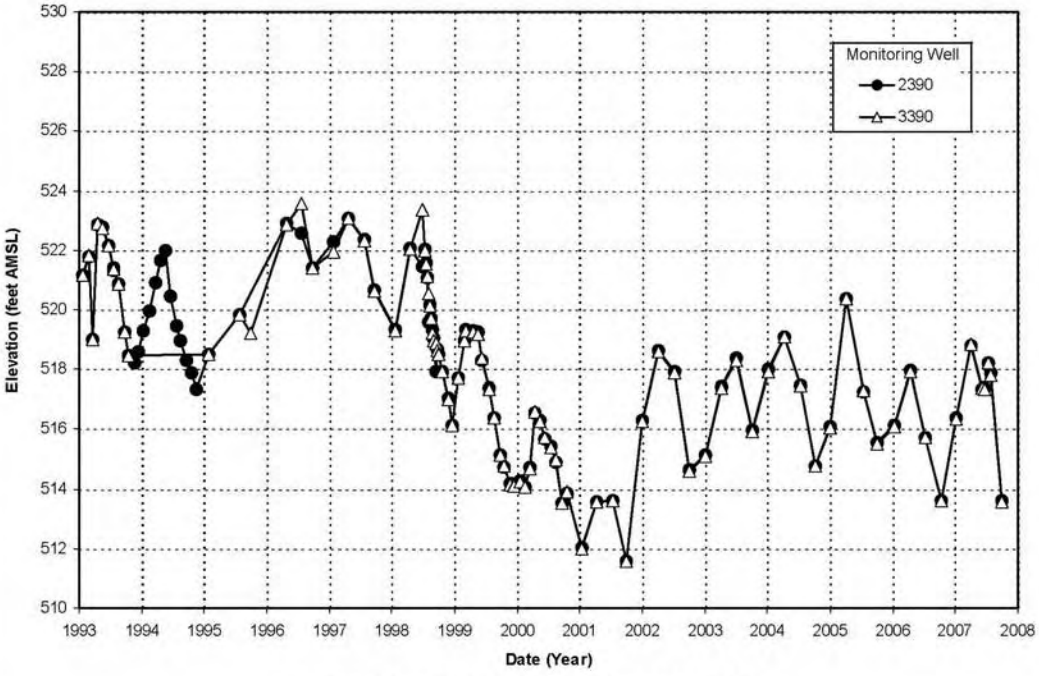

FIGURE A.3-18. HYDROGRAPH FOR WELL CLUSTER 390

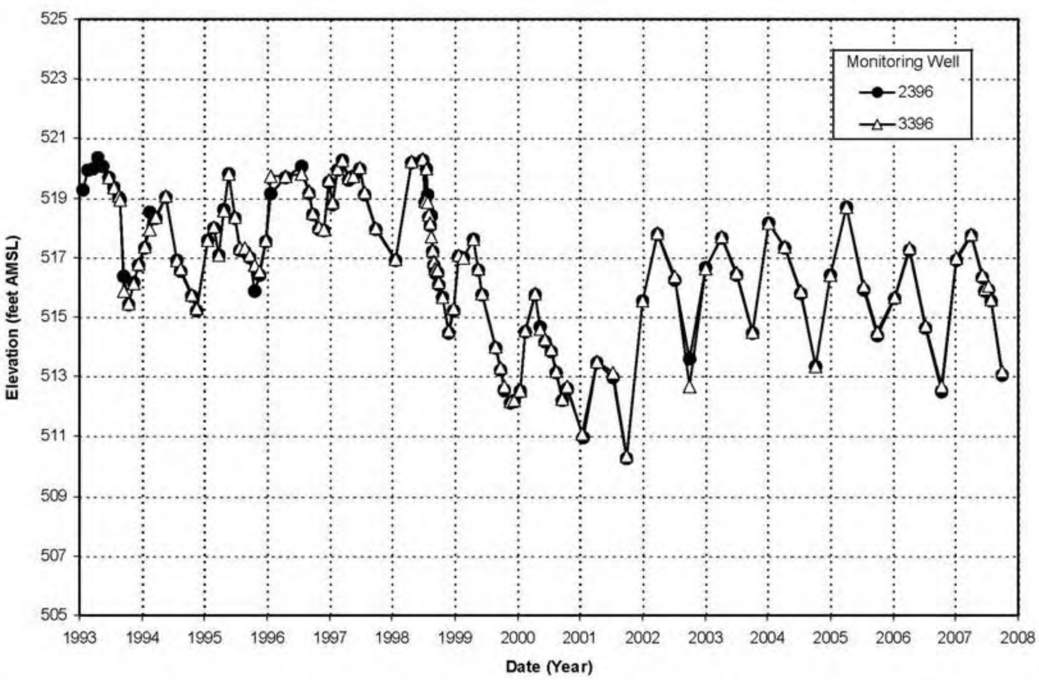

FIGURE A.3-19. HYDROGRAPH FOR WELL CLUSTER 396

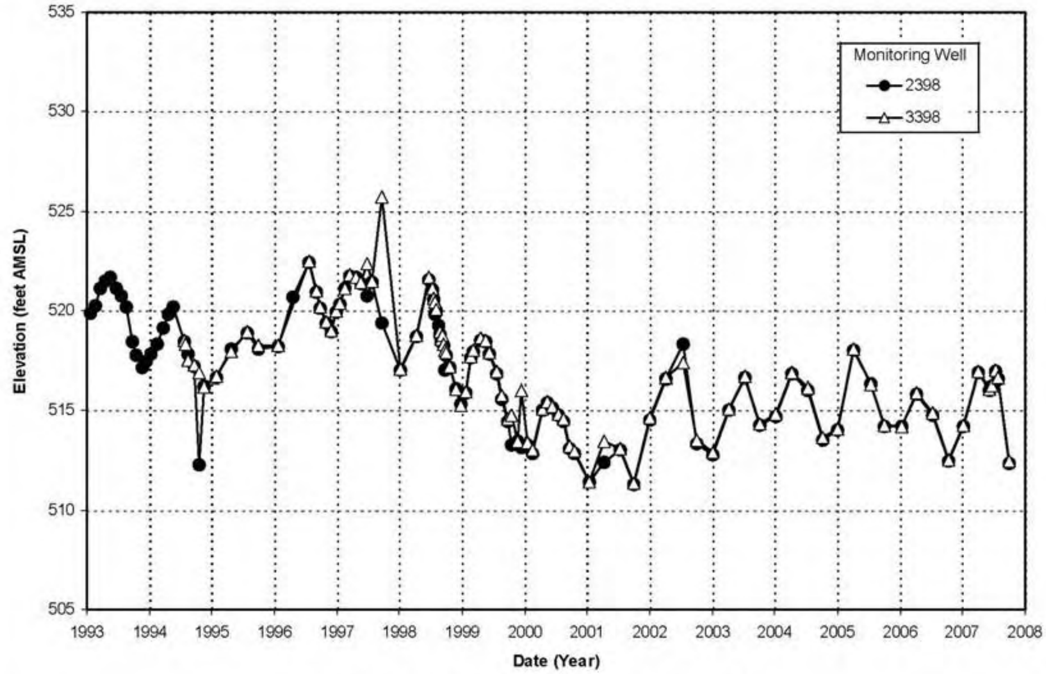

FIGURE A.3-20. HYDROGRAPH FOR WELL CLUSTER 398

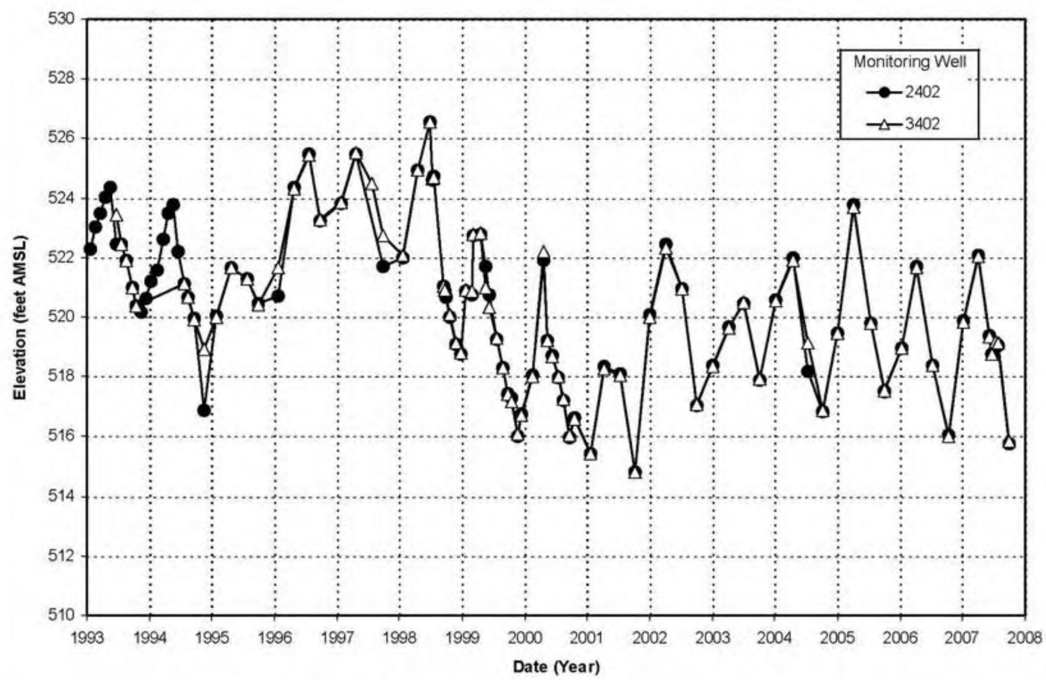

FIGURE A.3-21. HYDROGRAPH FOR WELL CLUSTER 402

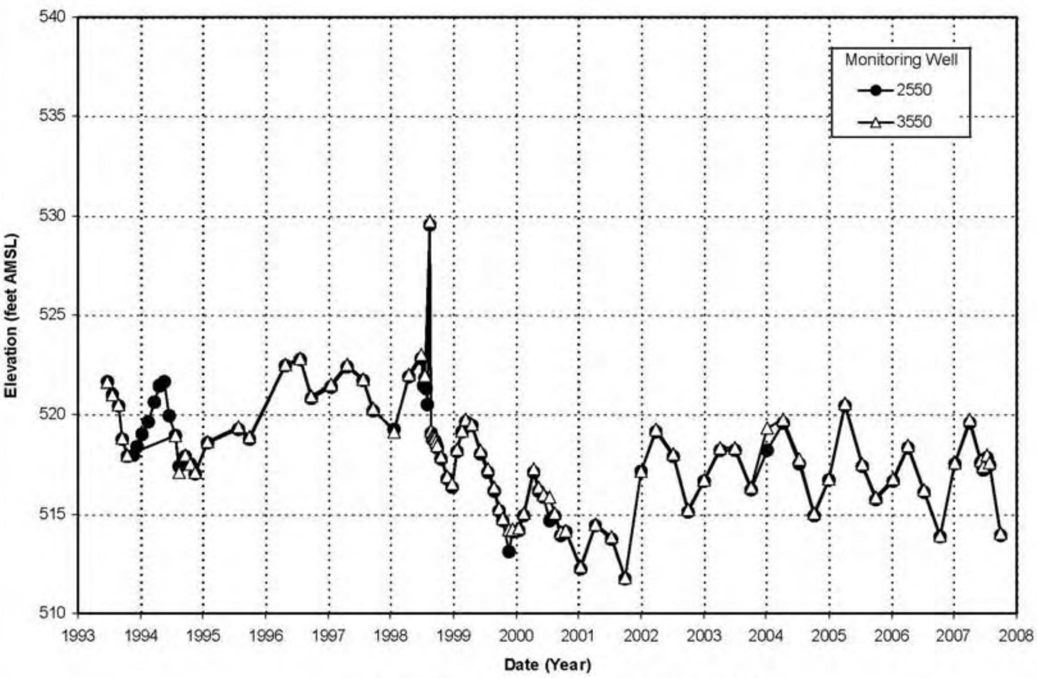

FIGURE A.3-22. HYDROGRAPH FOR WELL CLUSTER 550

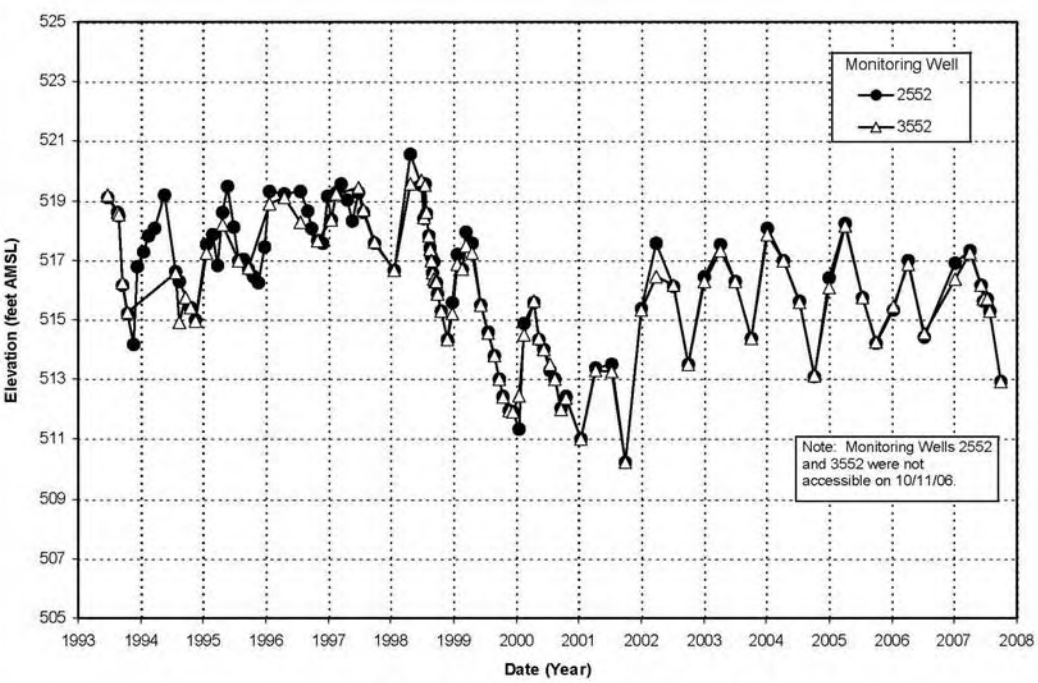

FIGURE A.3-23. HYDROGRAPH FOR WELL CLUSTER 552

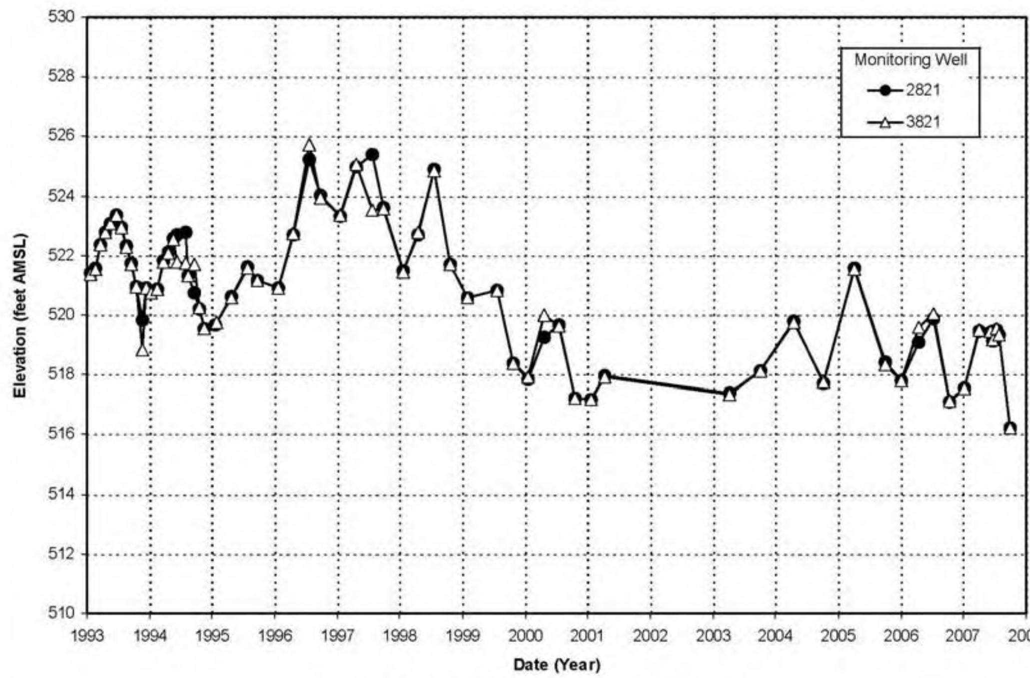

FIGURE A.3-24. HYDROGRAPH FOR WELL CLUSTER 821

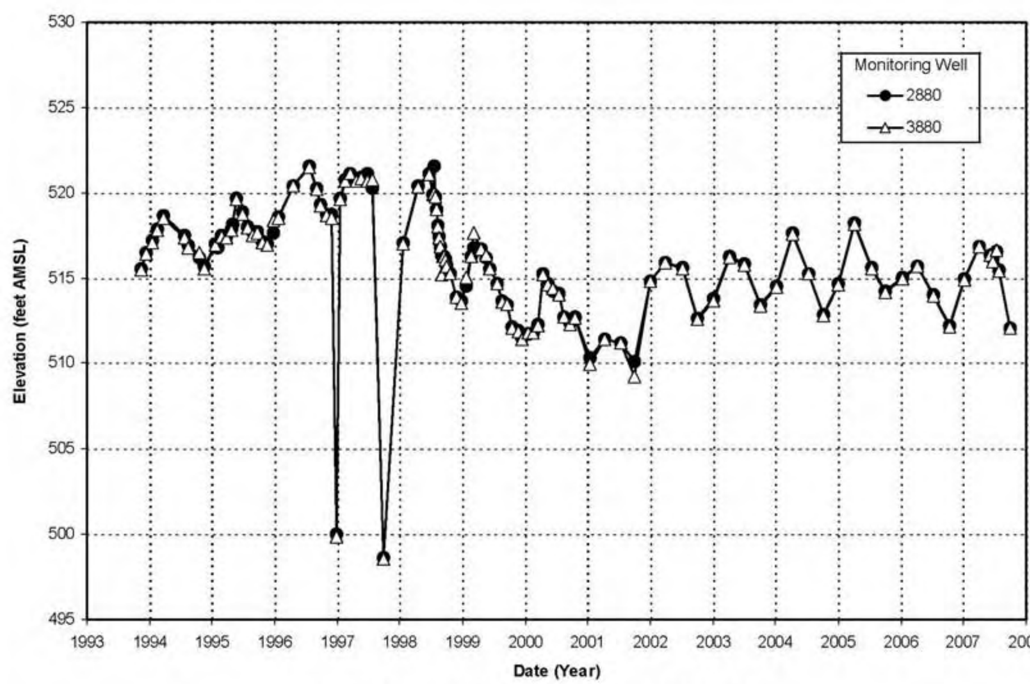

FIGURE A.3-25. HYDROGRAPH FOR WELL CLUSTER 880

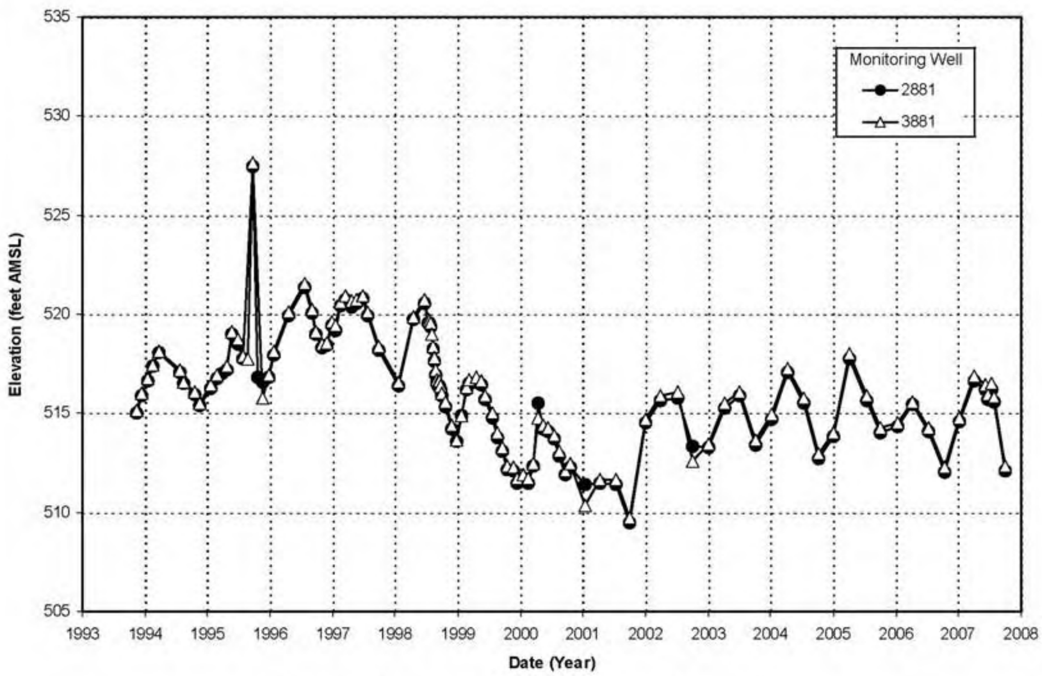

FIGURE A.3-26. HYDROGRAPH FOR WELL CLUSTER 881

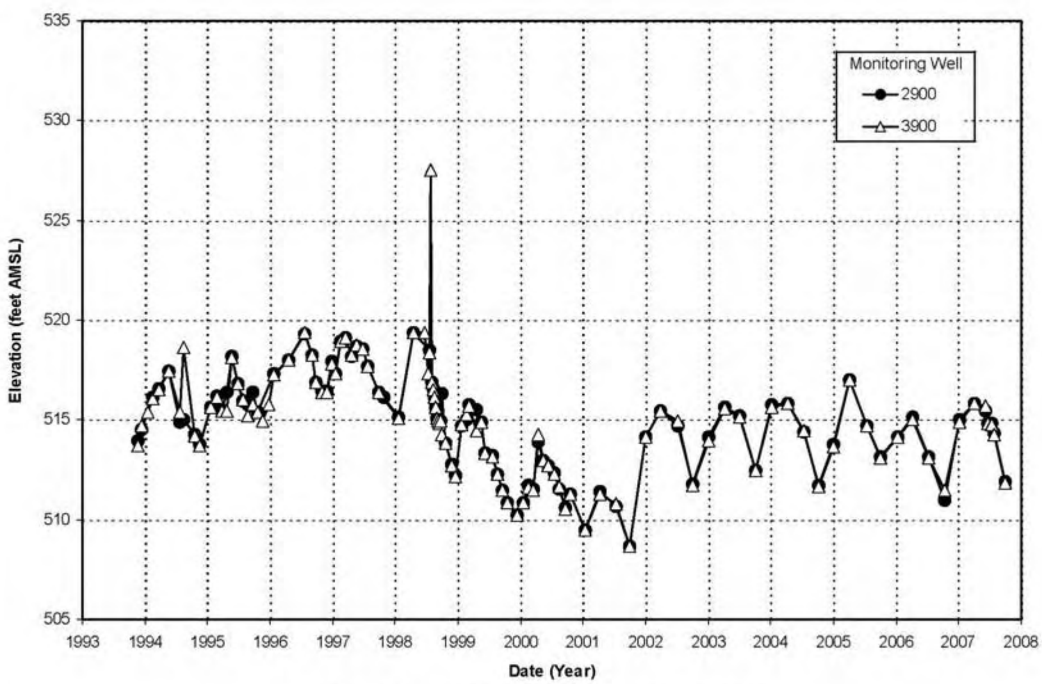

FIGURE A.3-27. HYDROGRAPH FOR WELL CLUSTER 900

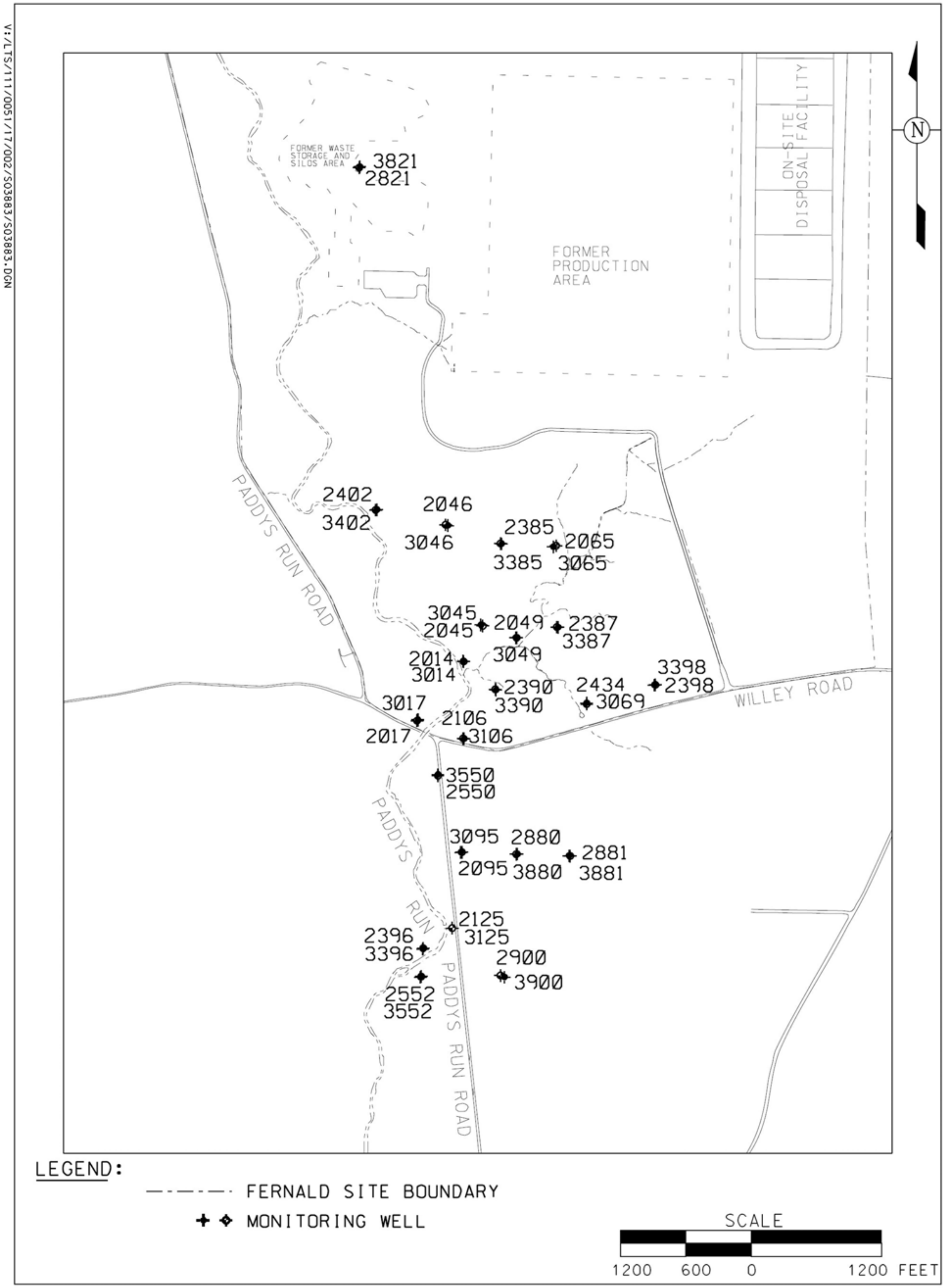

Figure A.3−28. Monitoring Well Locations for Well Cluster Hydrographs

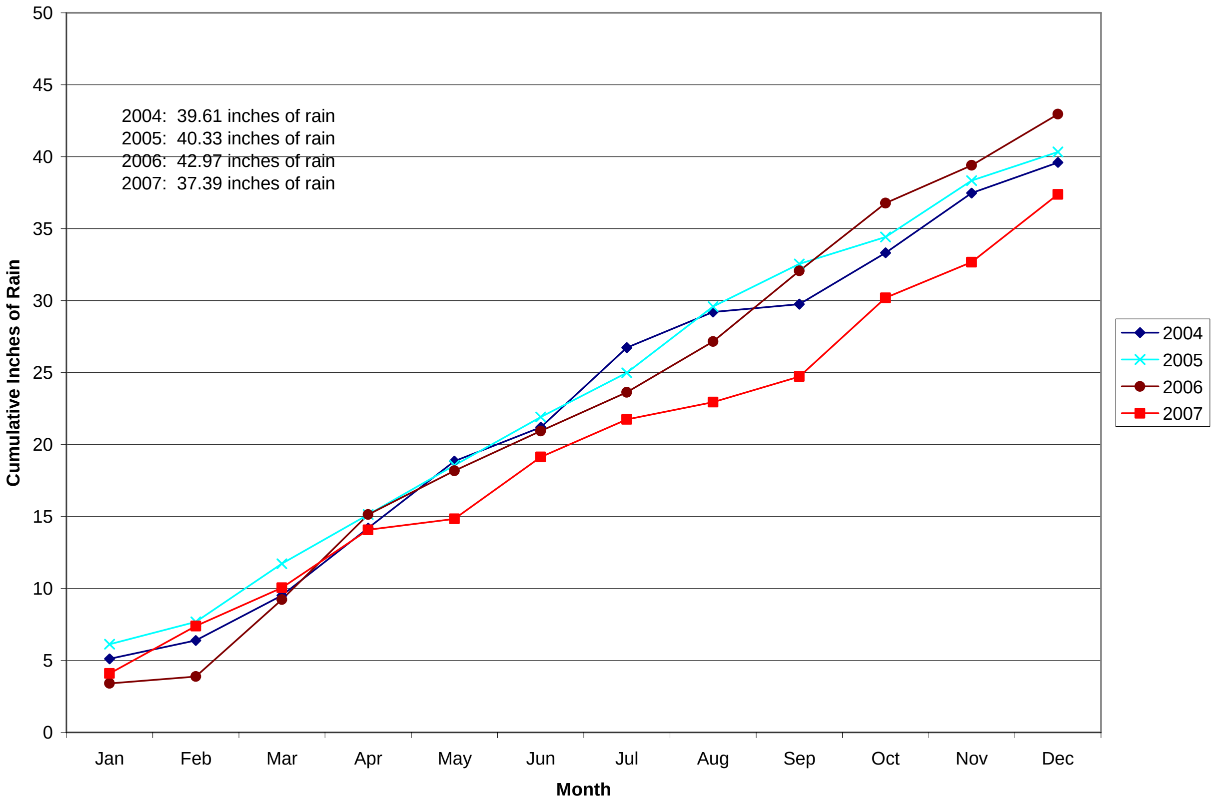

Figure A.3−29. Cumulative Annual Precipitation: 2004 through 2007 As Recorded at The Butler County Regional Airport

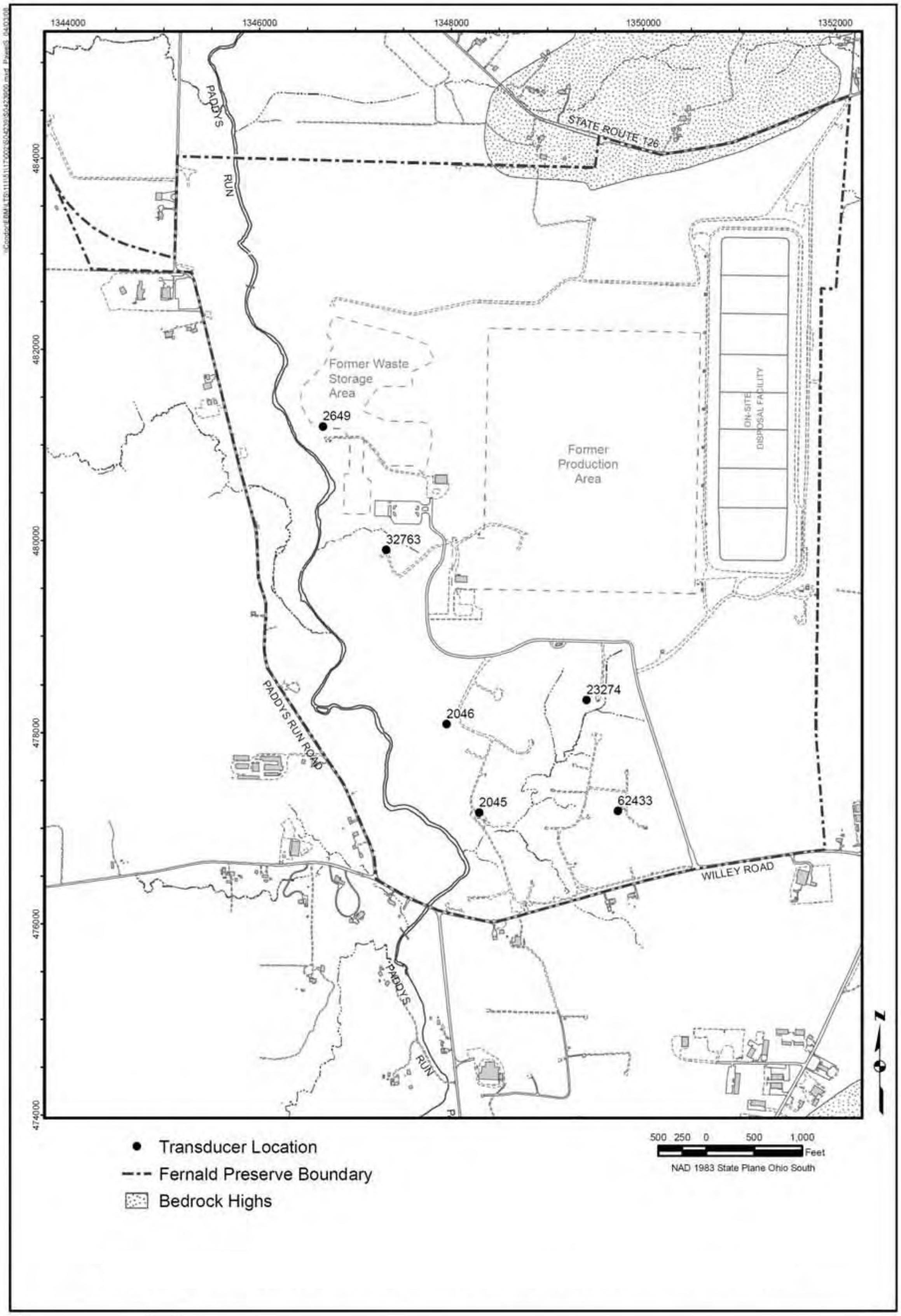

Figure A.3−30. Transducer Locations for the 2007 Operational Shutdown

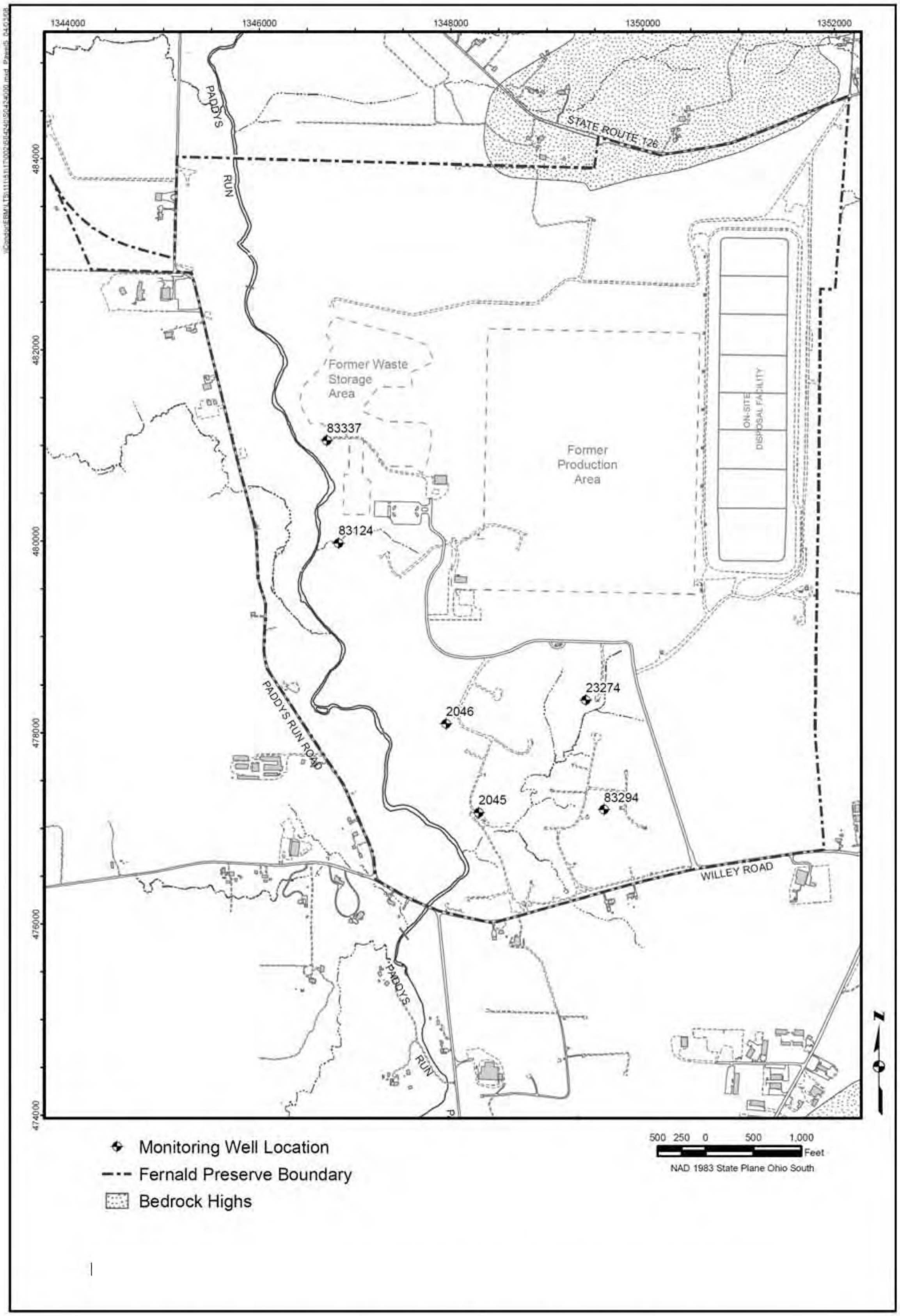

Figure A.3−31. Monitoring Well Locations for the 2007 Operational Shutdown

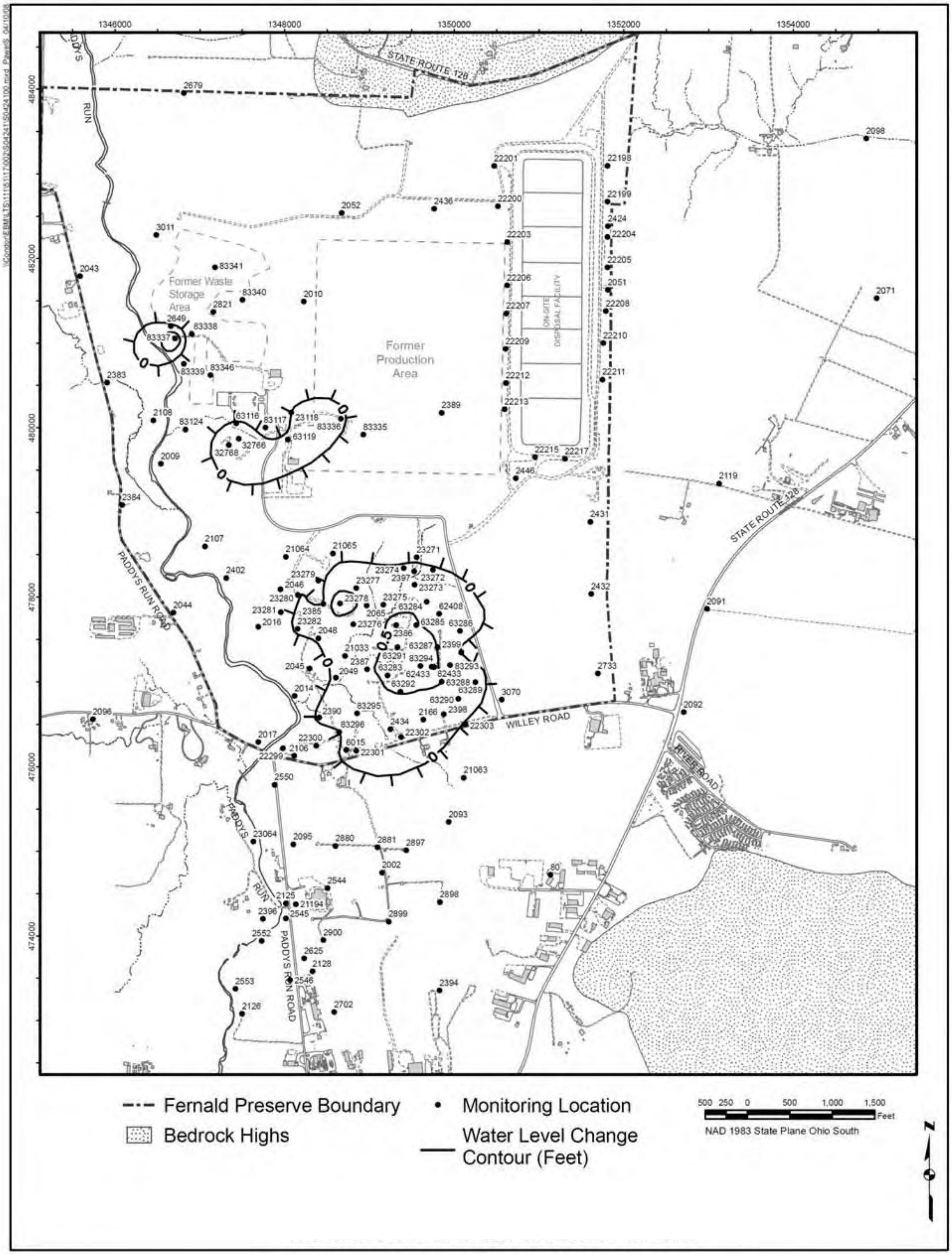

Figure A.3−32. Water Level Change in Feet Pre-Shutdown vs. Post-Shutdown for 2007

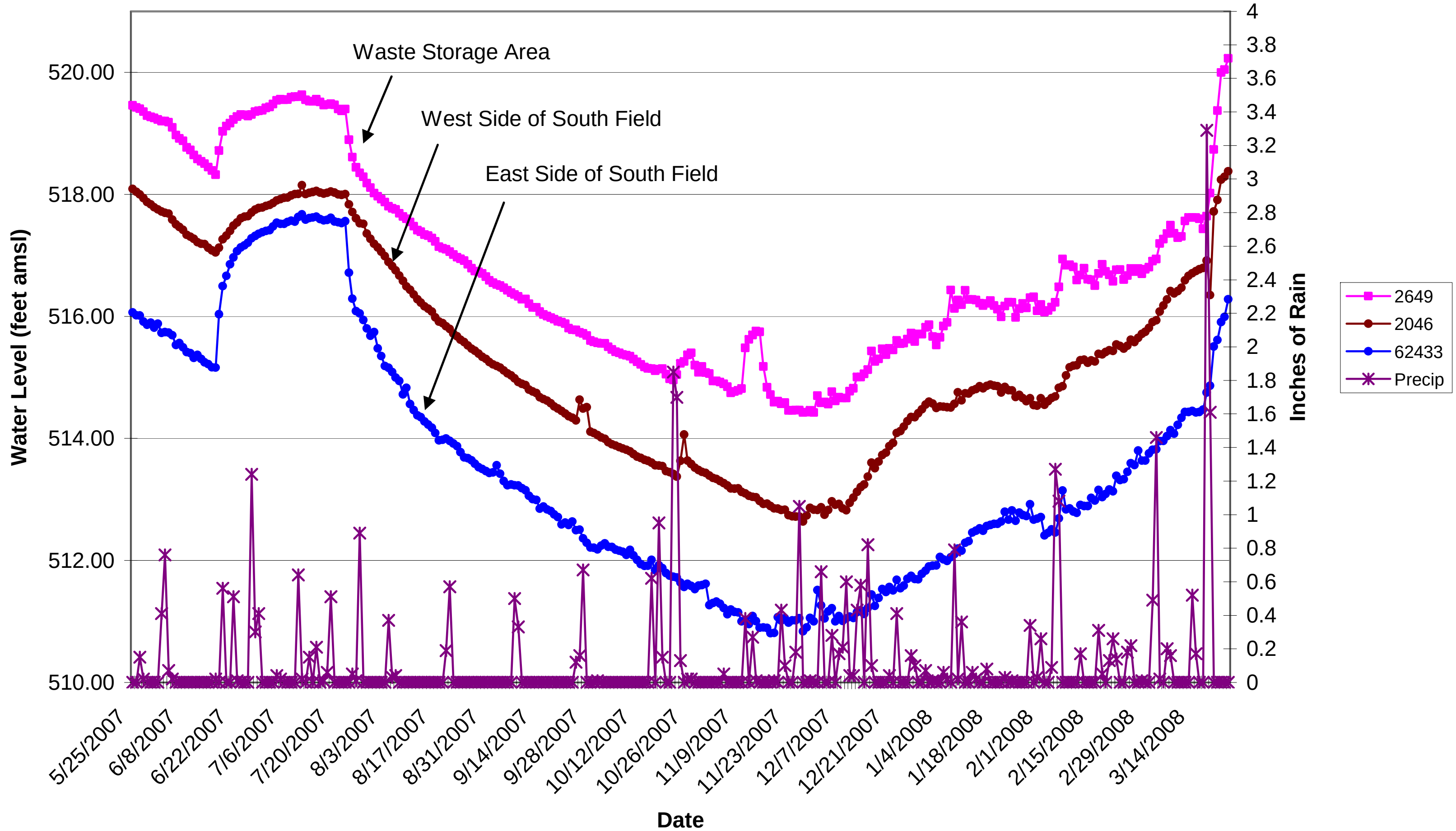

Figure A.3−33. Water Levels vs Precipitation May 25, 2007 through March 25, 2008

Attachment A.4

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A.4.0 Non-Uranium FRL Results

This attachment evaluates non-uranium FRL results for 2007. The purpose of the evaluation is to:

- Identify 2007 non-uranium FRL exceedances (Section A.4.1)
- Determine the persistence of non-uranium FRL exceedances outside the Waste Storage Area (Phase II) design remediation footprint (Section A.4.2)
- Present conclusions (Section A.4.3).

A.4.1 Non-Uranium FRL Exceedances For 2007

Table A.4−1 identifies the summary statistics and trend analysis for the 2007 non-uranium FRL exceedances from monitoring wells both inside and outside the Waste Storage Area (Phase II) design footprint. As indicated in Table A.4−1, seven non-uranium FRL constituents had one or more FRL exceedances during 2007. Figure A.4−1 identifies the location of these FRL exceedances.
Figure A.4−1 shows that the non-uranium FRL exceedances in 2007 for monitoring wells were located in the waste storage area, along the eastern site boundary, in the south field, and in the PRRS area. Those in the waste storage area were within the Waste Storage Area (Phase II) design remediation footprint, while those along the eastern property boundary and one in the PRRS area were located outside the Waste Storage Area (Phase II) design remediation footprint. Specific discussion regarding exceedances and persistence outside the footprint is provided in Section A.4.2. Further discussion regarding exceedances inside the footprint follows.

A revised groundwater monitoring approach was implemented in January 2003. In support of that change, a table was presented in the IEMP, Revision 3 (DOE 2003), which identified all non-uranium FRL exceedances from 1997 through 2002. Table A.4−2 was revised in 2003 to present all locations and constituents that are monitored and the location of all non-uranium exceedances for each year. Prior to 2003, only the locations where exceedances occurred were presented. By showing all of the monitoring locations and constituents, it was possible to see the limited number of exceedances that actually occur with respect to the monitoring programs. In an effort to streamline readability and usability emphasizing only those locations and constituents with FRL exceedances, it was decided that for this year's report the table would show only the locations where exceedances have occurred. Table A.4−2 has been updated to include the data from 2007.

The first column in Table A.4−2 lists the groundwater FRL constituents monitored in 2007. The second column identifies the wells monitored that have had an exceedance since 1997, for each constituent. The third column identifies the associated aquifer zone monitored. The fourth column identifies the associated monitoring program for each well/constituent. The remaining columns show monitoring years divided into quarters through 2002 and into halves beginning in 2003, to reflect the semiannual sampling frequency. An X denotes the time period in which an exceedance occurred. Table A.4−2 also indicates whether exceedances occurred inside or outside of the footprint (shading indicates the well is located outside the footprint).

There were 13 non-uranium constituents monitored in 2007 and, as indicated above, seven had exceedances. The following summarizes the 2007 non-uranium monitoring information:

Constituent	Monitoring Program	2007 Monitoring Summary
Antimony	Property/Plume Boundary for PRRS Constituents	Exceedances in property/plume boundary and PRRS wells
Arsenic	Property/Plume Boundary for PRRS Constituents	No exceedances
Boron	South Field	No exceedances
Carbon Disulfide	Waste Storage Area	No exceedances
Fluoride	Property/Plume Boundary	No exceedances
Lead	Property/Plume Boundary	No exceedances
Manganese	Property/Plume Boundary, Waste Storage Area	Exceedances in waste storage area wells and one well along the eastern site boundary
Molybdenum	Waste Storage Area	Exceedance in one waste storage area well
Nickel	Property/Plume Boundary	No exceedances
Nitrate/Nitrite	Waste Storage Area	Exceedances in waste storage area wells
Technetium 99	Waste Storage Area	Exceedances in waste storage area wells
Trichloroethene	Waste Storage Area	Exceedances in waste storage area wells
Zinc	Property/Plume Boundary	Exceedance in one PRRS well

Direct Push Sampling

In addition to routine monitoring well sampling in the Waste Storage Area, four locations were sampled using a direct-push sampling tool. The four locations were 13349, 13350, 13369 and 13370. In addition to uranium, these four locations were sampled for Waste Storage Area parameters (technetium-99, nitrate/nitrite, manganese, molybdenum, and nickel). Results for direct push locations 13349, 13350, 13369, and 13370 are provided in Tables A.2−22, A.2−23, A.2−29, and A.2−30, respectively.

No non-uranium FRL exceedances were detected at Location 13349. Non-Uranium FRL exceedances for Nitrate/Nitrate and Manganese were measured at Location 13350. A non-uranium FRL exceedance for manganese was measured at Location 13369. Non-Uranium FRL exceedances for Technetium-99, Nitrate/Nitrite, and manganese were measured at Location 13370. These locations and exceedances are noted in Figure A.4−1.

A.4.2 Evaluation of 2007 Non-Uranium FRL Exceedances Outside the Waste Storage Area (Phase II) design Remediation Footprint

This section presents an evaluation of the persistence of non-uranium FRL exceedances outside the Waste Storage Area (Phase II) design remediation footprint.

A.4.2.1 Background

The Restoration Area Verification Sampling Program Summary Report (DOE 1998) states that any FRL exceedance detected at the property boundary during routine monitoring outside the 10 year uranium based restoration footprint (DOE 1997a) would also be evaluated for persistence. The evaluation would be performed using the same conservative data evaluation method approved in the Restoration Area Verification Sampling Program Project Specific Plan

(DOE 1997c) to determine if a change in the aquifer restoration remedy is required. This evaluation was expanded beginning with the 2000 Site Environmental Report (DOE 2001) to include all non-uranium FRL exceedances detected outside of the 10 year uranium based restoration footprint not just those detected at the property boundary. In the 2003 SER, the 10 year uranium based restoration footprint was replaced with a 10 year time-of-travel remediation footprint based on 2003 target pumping rates and using the VAM 3D Zoom Model. The footprint has since been updated to reflect capture during the time period modeled for the Waste Storage Area (Phase II) remediation design.

Analytical data from samples collected immediately following an FRL exceedance are evaluated to determine if the exceedance is persistent. In accordance with the approved Restoration Area Verification Sampling method, if two or more consecutive sampling events following an FRL exceedance indicate that the concentration in question has decreased below the groundwater FRL, then the exceedance is not considered persistent. If an FRL exceedance outside the Waste Storage Area (Phase II) design remediation footprint is determined to not be persistent, then no additional action is required above and beyond the routine groundwater monitoring specified in the current IEMP. If an FRL exceedance is determined to be persistent, then the cause of the persistent exceedance must be identified and its effect on the aquifer remedy design assessed. Ultimately, the cause needs to be addressed either through a modification of the aquifer remedy or by other means, as applicable.

A.4.2.2 Evaluation and Discussion

Three possible persistent FRL exceedances were identified in 2006 requiring additional data collection in 2007. The exceedances were: antimony in monitoring well 2636; arsenic in monitoring well 2636, and zinc in monitoring wells 22210. The non-uranium FRL exceedances for 2007 along with the possible persistent exceedances identified in 2006 are addressed below.

Figure A.4−1 and Table A.4−1 identify the 2007 non-uranium FRL exceedances outside the Waste Storage Area (Phase II) design remediation footprint. These wells are shaded in Table A.4−1. In 2007, two constituents had one or more FRL exceedance at seven wells located outside the Waste Storage Area (Phase II) design remediation footprint:

- Antimony at monitoring wells 2432, 2636, 2733, 3424, 3426, 3432
- Manganese at monitoring well 22204

Table A.4−3 is used as an evaluation tool to address the possible persistent FRL exceedances for those that occur outside the Waste Storage Area (Phase II) design remediation footprint. It includes the exceedances for 2007 listed in the bullets above, as well as those still being evaluated or deemed persistent from the 2006 Site Environmental Report. If two or more sampling events immediately following an FRL exceedance indicate that the concentration decreased below the FRL, then the exceedance is identified as not persistent in Table A.4−3. As shown in Table A.4−3, an FRL exceedance was identified as being persistent in 2007 for manganese at monitoring well 22204.

The following is a summary of results presented in Table A.4−3:

- Additional data, to be collected in 2008, are necessary to determine the persistence of the following FRL exceedances:
  - Antimony at monitoring wells 2636, 3424, 3426, 3432, 2432, and 2733
  - Arsenic at monitoring well 2636
- The following FRL exceedance in 2006 was not persistent:
  - Zinc at monitoring well 22210.
- The FRL exceedance recorded for manganese at monitoring well 22204 in 2007 was persistent.

Figures A.4−2 through A.4−5 present individual concentration versus time graphs for antimony at Well 2636, arsenic at Well 2636, manganese at Well 22204, and Zinc at Well 22210. Antimony exceedances at the other wells listed on Table A.4−3 are one time occurrences and do not require a graph.

The evaluation for persistence of non-uranium FRL exceedances in wells located outside the Waste Storage Area (Phase II) design remediation footprint in 2007 marks the eleventh year that an evaluation has been conducted as part of the IEMP. In the past, exceedances identified as persistent became non persistent in later years.

This year, an exceedance for manganese at monitoring well 22204 was identified again as persistent. At this time, no change to the aquifer remedy is planned to address the manganese exceedance at this monitoring well, but additional monitoring will be conducted. In response to an Ohio EPA comment on the 2006 SER, DOE agreed to conduct direct-push sampling west of the OSDF to see if manganese FRL exceedances are present.

Antimony Exceedances

Ten groundwater monitoring wells had anomalous groundwater FRL exceedances for antimony in January of 2007. As shown in Table A.4−2, only one of the 10 wells (2636) had ever had a prior antimony FRL exceedance. All of the antimony FRL exceedances measured in January of 2007 were low, ranging from 0.0061 mg/L to 0.0082 mg/L. The groundwater FRL for antimony is 0.006 mg/L. No laboratory error could be found to account for the antimony exceedances measured in January at these 10 wells. None of the 10 wells had an antimony FRL exceedance in the second half of 2007, and preliminary data for the first half of 2008 (for all of the wells except Well 2636) also indicates no antimony FRL exceedances. Since two sampling events have occurred since the exceedances were measured, and no new exceedances have been measured (except at Well 2636) no action is being considered, other than continued monitoring.

Monitoring Well 2636

Monitoring well 2636 is located south of the administrative boundary in the Paddys Run Road Site contaminant plume area. The administrative boundary is located between the Fernald site uranium plume and the Paddys Run Road Site contaminant plume area. The Paddys Run Road Site consists of documented releases of inorganic constituents (including arsenic), volatile organic compounds, and semivolatile organic compounds. Groundwater monitoring is occurring south of the administrative boundary to assess the impact of pumping the South Plume extraction wells on the Paddys Run Road Site plumes.

As shown in Table A.4−2 Well 2636 has had two prior antimony FRL exceedances and 6 prior arsenic FRL exceedances. The chemical traits of antimony are similar to arsenic, and arsenic is a known contaminant in the PRRS area. In short, out of the 10 antimony exceedances measured in 2007, only Well 2636 appears to be significant at this time. It should also be noted that monitoring well 2636 is often dry. It was dry the second half of 2005, all of 2006, and the second half of 2007. In a response to an Ohio EPA comment on the 2006 SER, DOE agreed to make more of an effort to sample Well 2636 when water levels are seasonally high. If Well 2636 is found to be dry during a sampling event, additional attempts to sample the well when water levels are higher will be made. Well 2636 was successfully sampled during the first half of 2008, but only after making two attempts. Preliminary results were not available to include in this report.

A.4.3 Conclusions

From the information provided in this attachment, the following conclusions can be made:

- Non-uranium FRL exceedances occurring in the waste storage area were taken into consideration for the Waste Storage Area (Phase II) Remediation Module Design.
- There was one persistent non-uranium FRL exceedance outside the Waste Storage Area (Phase II) design footprint identified in 2007: manganese at monitoring well 22204. A change in the design of the aquifer remedy to address the exceedance at this monitoring well is not being considered at this time, but direct push sampling will be conducted west of the OSDF to see if any manganese exceedances are present.
- Nine of the 10 antimony FRL exceedances measured in January of 2007 do not appear to be of significance.
- Additional data are needed to verify whether antimony, and arsenic exceedances outside the Waste Storage Area (Phase II) design footprint are persistent.

Table A.4-1. Summary Statistics And Trend Analysis For Non-Uranium Constituents With 2007 Results Above Final Remediation Levels

Constituent (FRL)[a]	Monitoring well	No. of Samples[b,c,d]	No. of Samples Above FRL[b,c,d]	No. of Samples Above FRL for 2007[c,d]	Minimum[b,c,d,e,f,]	Maximum[b,c,d,e,f,g]	Average[b,c,d,e,f,g]	Standard Deviation[b,c,d,e,f,g]	Trend[b,c,d,e,f,g,h]
Antimony (0.0060 mg/L)	2398	29	1	1	0.00005	0.0074	0.0011	0.0014	No Significant Trend
	2432	30	1	1	0.000095	0.0064	0.0010	0.0014	No Significant Trend
	2636	3	3	1	0.0065	0.00741	0.0070	NA	NA
	2733	24	1	1	0.00005	0.0075	0.0012	0.0018	No Significant Trend
	3070	30	1	1	0.00005	0.0076	0.0011	0.0017	No Significant Trend
	3398	30	1	1	0.00004	0.0080	0.0009	0.0015	No Significant Trend
	3424	30	1	1	0.00005	0.0079	0.0011	0.0016	No Significant Trend
	3426	30	1	1	0.0000865	0.0082	0.0011	0.0016	No Significant Trend
	3432	30	1	1	0.00004	0.0073	0.0010	0.0014	No Significant Trend
	4398	30	1	1	0.00005	0.0076	0.0011	0.0014	No Significant Trend
Manganese (0.90 mg/L)	2010	12	11	2	0.600	6.14	2.99	1.94	No Significant Trend
	22204	10	8	2	0.418	3.01	1.38	0.71	**Up, Significant**
	3821	16	11	2	0.145	11.4	2.61	2.89	No Significant Trend
	83338_C2	3	1	1	0.001	1.12	0.43	NA	NA
	83339_C1	1	1	1	3.36	NA	NA	NA	NA
	83341_C1	1	1	1	4.7	NA	NA	NA	NA
	83341_C2	2	2	2	1.09	2.16	NA	NA	NA
	83346_C1	1	1	1	1.48	NA	NA	NA	NA
	83346_C2	2	2	2	0.937	1.61	NA	NA	NA
Molybdenum (0.10 mg/L)	2649	14	14	1	0.207	0.69	0.46	0.13	No Significant Trend
Nitrate/Nitrite (11 mg/L)[i]	2649	22	21	1	0.805	102	52.4	26.3	No Significant Trend
	2821	24	7	2	1.38	41.5	11.2	11.3	**Up, Significant**
	3821	24	3	1	0.010	37.8	3.6	10	Up, Marginal
	83338_C2	3	1	1	1.98	109	38.1	NA	NA
	83338_C3	3	1	1	2.42	73.2	26.1	NA	NA
	83340_C1	1	1	1	58.2	NA	NA	NA	NA
	83340_C2	2	2	2	58.8	61.6	NA	NA	NA
	83340_C3	2	2	2	67.7	116	NA	NA	NA
	83341_C1	1	1	1	12.6	NA	NA	NA	NA
	83341_C3	2	1	1	0.005	42	NA	NA	NA

Table A.4-1 (continued). Summary Statistics And Trend Analysis For Non-Uranium Constituents With 2007 Results Above Final Remediation Levels

Constituent (FRL)[a]	Monitoring well	No. of Samples[b,c,d]	No. of Samples Above FRL[b,c,d]	No. of Samples Above FRL for 2007[c,d]	Minimum[b,c,d,e,f,]	Maximum[b,c,d,e,f,g]	Average[b,c,d,e,f,g]	Standard Deviation[b,c,d,e,f,g]	Trend[b,c,d,e,f,g,h]
Zinc (0.021 mg/L)	2900	15	3	1	0.0001	0.155	0.021	0.041	No Significant Trend
					(pCi/L)	(pCi/L)	(pCi/L)	(pCi/L)	
Technetium-99 (94 pCi/L)	2649	22	22	1	101	1352	638	409	No Significant Trend
	2821	24	12	2	0.253	651	154	182	**Up, Significant**
	83338_C2	3	1	1	7.12	587	223	NA	NA
	83338_C3	3	1	1	0.059	179	60	NA	NA
	83340_C1	1	1	1	369	NA	NA	NA	NA
	83340_C2	2	2	2	225	313	NA	NA	NA
	83340_C3	2	2	2	265	292	NA	NA	NA
					(µg/L)	(µg/L)	(µg/L)	(µg/L)	
Trichloroethene (5.0 µg/L)	2649	14	13	1	0.50	120	63	27	Down, Significant
	2821	16	2	2	0.50	10.4	2.0	3.1	No Significant Trend

Note: Shading indicates well is outside the Waste Storage Area (Phase-II) design remediation footprint.

[a]From Operable Unit 5 Record of Decision, Table 9-4.
[b]Based on samples from August 1997 through 2007.
[c]If more than one sample is collected per well per day (e.g., duplicate), then only one sample is counted for the total number of samples, and the sample with the maximum representative concentration is used for determining the summary statistics (minimum, maximum, average, and standard deviation) and Mann-Kendall test for trend.
[d]Rejected data qualified with either an R or Z were not included in the count, the summary statistics, or Mann-Kendall test for trend.
[e]If the number of samples is greater than or equal to four, then the Mann-Kendall test for trend and all of the summary statistics are reported. If the total number of samples is equal to three, then the minimum, maximum, and average are reported. If the total number of samples is equal to two, then the minimum and maximum are reported. If the total number of samples is equal to one, then the data point is reported as the minimum.
[f]For results where the concentrations are below the detection limit, the results used in the summary statistics and Mann-Kendall test for trend are each set at half the detection limit.
[g]NA = not applicable
[h]Mann-Kendall test for trend is performed using data from third quarter 1998 through 2007.
[i]FRL based upon nitrate from Operable Unit 5 Record of Decision, Table 9-4.

Table A.4−2. Groundwater FRL Exceedances From 1997 Through 2007 Quarterly/Semiannually

Constituent	Well[a]	Aquifer Zone	Project[b]	1997		1998				1999				2000				2001				2002				2003		2004		2005		2006		2007	
				3[c]	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	1	2	1	2	1	2	1	2
Antimony																																			
	22208	0	OSDF																								X								
	2398	2	P/PB																															X	
	2431	0	P/PB																								X								
	2432	0	P/PB																															X	
	2636	4	PRRS																									X		X				X	
	2733	0	P/PB																															X	
	3070	2	P/PB																															X	
	3398	2	P/PB																															X	
	3424	0	P/PB																															X	
	3426	0	P/PB																															X	
	3432	0	P/PB																															X	
	4398	2	P/PB																															X	
Arsenic																																			
	2625	4	PRRS												X																				
	2636	4	PRRS		X	X				X	X											X						X							
	2898	4	PRRS											X																					
	2900	4	PRRS											X																					
Boron																																			
	2045	2	SF								X		X		X																				
	2049	2	SF	X	X			X	X	X	X	X	X	X	X		X								X										
Carbon disulfide																																			
	2649	1	WSA						X																										
	3821	1	WSA										X																X						
Fluoride																																			
	2431	0	P/PB						X																										

Table A.4−2 (continued). Groundwater FRL Exceedances From 1997 Through 2007 Quarterly/Semiannually

				1997		1998				1999				2000				2001				2002				2003		2004		2005		2006		2007	
Constituent	Well[a]	Aquifer Zone	Project[b]	3[c]	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	1	2	1	2	1	2	1	2
Lead																																			
	2431	0	PRRS											X																					
	3733	0	P/PB	X													X																		
Manganese																																			
	2010	1	WSA													X				X						X	X	X	X		X	X	X	X	X
	22198	0	OSDF																					X											
	22204	0	OSDF																							X			X	X	X	X	X	X	X
	22205	0	OSDF																												X				
	2431	0	P/PB			X	X																												
	2432	0	P/PB														X			X	X		X			X									
	2648	1	WSA		X				X				X		X				X				X						X	X		X			
	2898	4	PRRS																				X					X							
	2899	4	PRRS													X																			
	2900	4	PRRS													X																			
	3821	1	WSA										X		X				X				X			X	X	X			X	X		X	X
	83338_C2	1	WSA																															X	
	83339_C1	1	WSA																															X	
	83341_C1	1	WSA																															X	
	83341_C2	1	WSA																															X	X
	83346_C1	1	WSA																															X	
	83346_C2	1	WSA																															X	X
Molybdenum																																			
	2649	1	WSA	X					X				X		X				X				X			X	X	X	X	X	X	X		X	
Nickel																																			
	22198	0	OSDF										X																						
	2398	2	P/PB	X		X	X	X	X			X	X																						
	4398	2	P/PB							X				X																					

Table A.4−2 (continued). Groundwater FRL Exceedances From 1997 Through 2007 Quarterly/Semiannually

Constituent	Well[a]	Aquifer Zone	Project[b]	1997		1998				1999				2000				2001				2002				2003		2004		2005		2006		2007	
				3[c]	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	1	2	1	2	1	2	1	2
Nitrate/Nitrite																																			
	2648	1	WSA				X						X		X			X									X	X	X			X			
	2649	1	WSA		X		X		X		X		X		X		X	X	X	X	X	X	X		X	X	X	X	X		X	X		X	
	2821	1	WSA										X													X				X		X	X	X	X
	3821	1	WSA														X				X										X				X
	83338_C2	1	WSA																																X
	83338_C3	1	WSA																																X
	83340_C1	1	WSA																															X	
	83340_C2	1	WSA																															X	X
	83340_C3	1	WSA																															X	X
	83341_C1	1	WSA																															X	
	83341_C3	1	WSA																															X	
Technetium-99																																			
	2648	1	WSA										X					X	X							X									
	2649	1	WSA		X		X		X		X		X		X		X	X	X	X	X	X	X		X	X	X	X	X	X	X	X		X	
	2821	1	WSA										X												X	X	X	X	X	X	X	X	X	X	X
	83338_C2	1	WSA																																X
	83338_C3	1	WSA																																X
	83340_C1	1	WSA																															X	
	83340_C2	1	WSA																															X	X
	83340_C3	1	WSA																															X	X
Trichloroethene																																			
	2649	1	WSA						X				X		X				X				X			X	X	X	X	X	X	X		X	
	2821	1	WSA																															X	X

Table A.4−2 (continued). Groundwater FRL Exceedances From 1997 Through 2007 Quarterly/Semiannually

Constituent	Well[a]	Aquifer Zone	Project[b]	1997		1998				1999				2000				2001				2002				2003		2004		2005		2006		2007	
				3[c]	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	1	2	1	2	1	2	1	2
Zinc																																			
	22199	0	OSDF																							X									
	22204	0	OSDF																							X									
	22210	0	OSDF																											X		X			
	2398	2	P/PB				X																												
	2431	0	P/PB					X	X					X																					
	2432	0	P/PB							X				X			X																		
	2733	0	P/PB								X																								
	2900	4	PRRS													X												X							X
	3128	4	PRRS																											X					
	3426	0	P/PB								X		X																						
	3429	0	P/PB							X	X																								
	3431	0	P/PB																			X													
	3733	0	P/PB																							X									
	3899	4	PRRS																X																

Note: Shading indicates well is outside the Waste Storage Area (Phase-II) design remediation footprint.

[a]As defined in the IEMP, Rev. 3, all monitoring is semiannual (as of 2003).

[b]WSA = Waste Storage Area

SF = South Field

P/PB = Property/Plume Boundary for FRL Exceedances

PRRS = Property/Plume Boundary for Paddys Run Road Site

OSDF = Property/Plume Boundary for on-site disposal facility

[c]Sampling for the IEMP was initiated in August 1997.

Table A.4-3. Summary of Persistence Evaluation of Non-Uranium FRL Exceedances Outside the Waste Storage Area (Phase-II) Design Remediation Footprint

Constituent	Monitoring well	Pertinent 2006 Results	2007 FRL Exceedance[a]		Evaluation Results for 2007	Figure No.
			1st Semiannual	2nd Semiannual		
Antimony	2636[b]	Additional Data Required Exceedance in the first half of 2004 No Exceedance in the 1st half of 2005	Yes	NS	Additional Data Required	A.4-2
	3424		Yes	No	Additional Data Required	
	3426		Yes	No	Additional Data Required	
	3432		Yes	No	Additional Data Required	
	2432		Yes	No	Additional Data Required	
	2733		Yes	No	Additional Data Required	
Arsenic	2636[b]	Additional Data Required Persistent in 2004	No	NS	Additional Data Required	A.4-3
Manganese	22204	Persistent	Yes	Yes	Persistent	A.4-4
Zinc	22210[c]	Additional Data Required	No	No	Not Persistent	A.4-5

[a]NS = not sampled
[b]This monitoring well is often dry and cannot be sampled. In the first quarter of 2002 it had an FRL exceedance for arsenic. In the second quarter of 2002 it did not have an FRL exceedance for arsenic. The well was dry from the third quarter of 2002 through 2003. In the first half of 2004, the well had another FRL exceedance for arsenic and a first-time-ever FRL exceedance for antimony. The well was dry in the second half of 2004, the second half of 2005, and all of 2006.
[c]Monitoring well 22210 replaced monitoring well 2426 which was plugged and abandoned August 2, 2005.

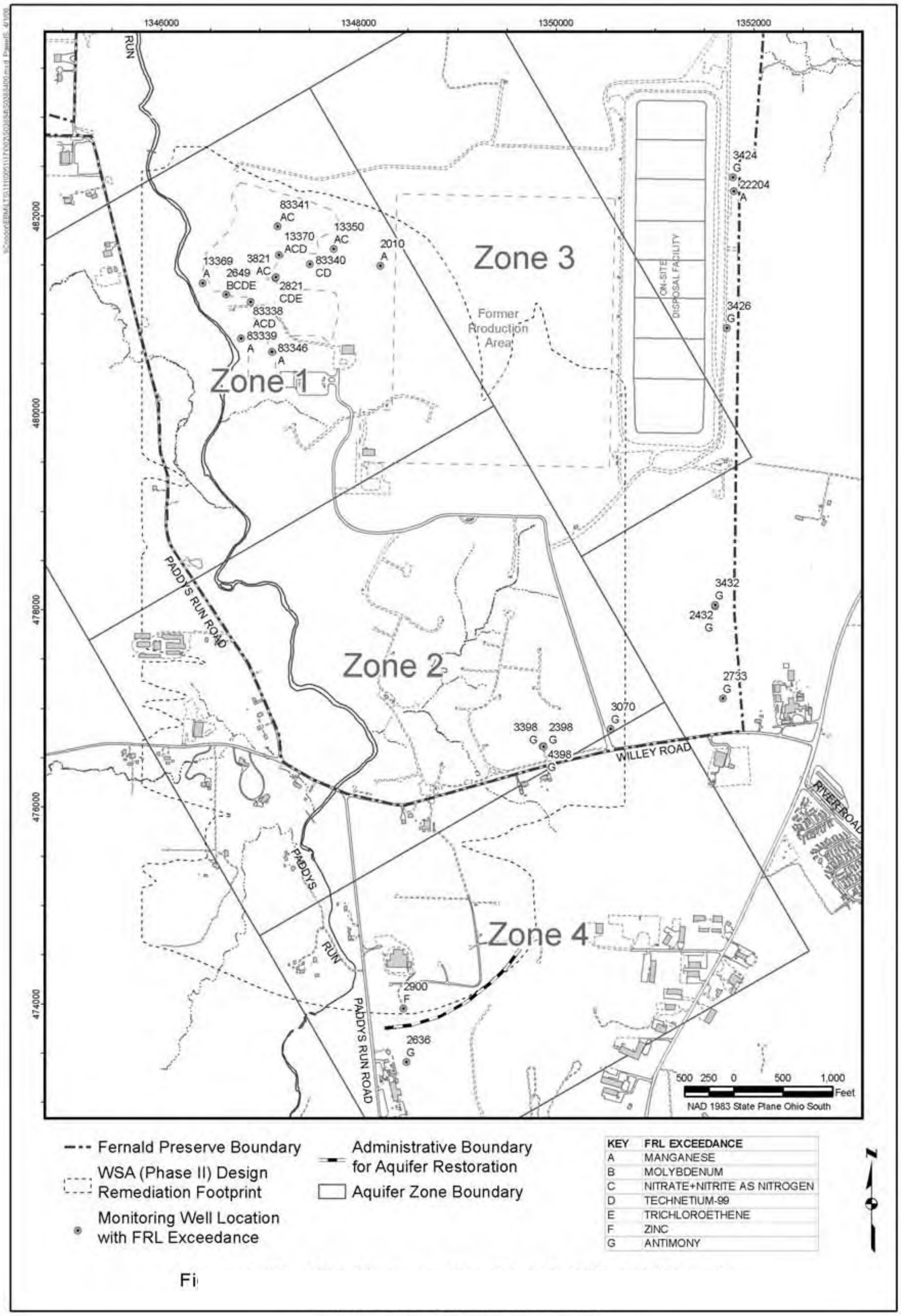

Figure A.4−1. Non-Uranium Constituents With 2007 Results Above Final Remediation Levels

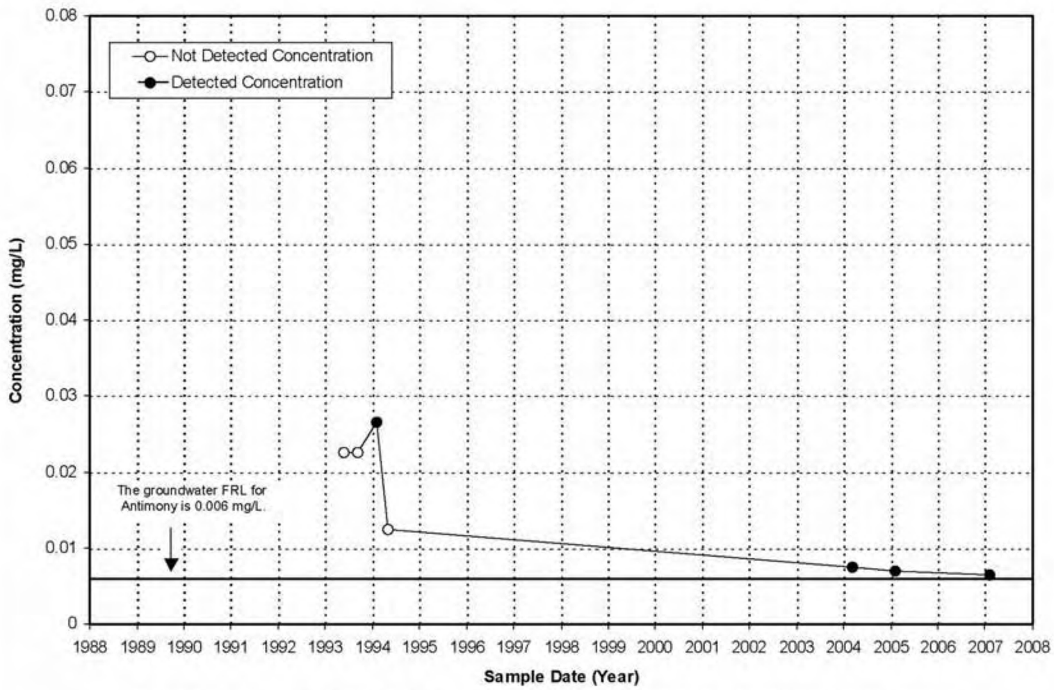

FIGURE A.4-2. ANTIMONY CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 2636

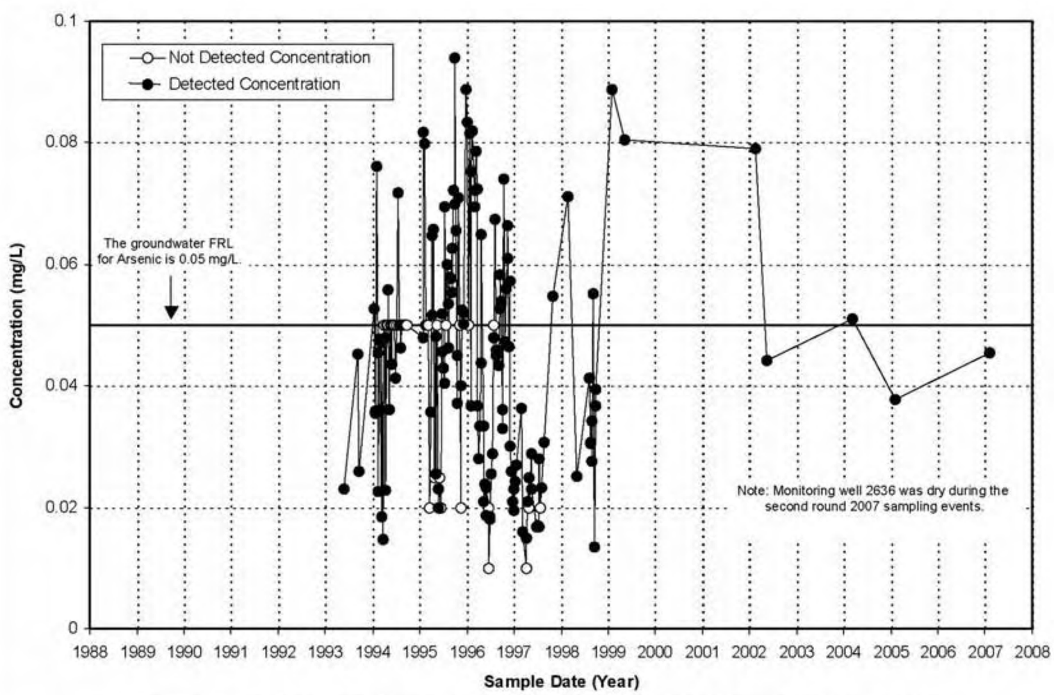

FIGURE A.4-3. ARSENIC CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 2636

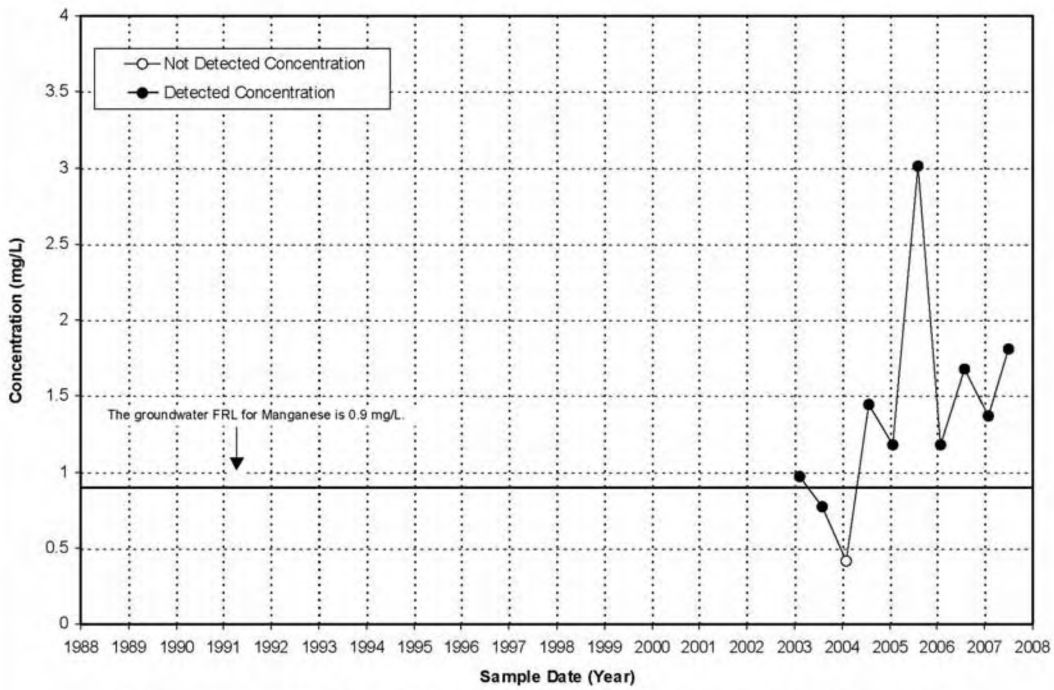

FIGURE A.4-4. MANGANESE CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 22204

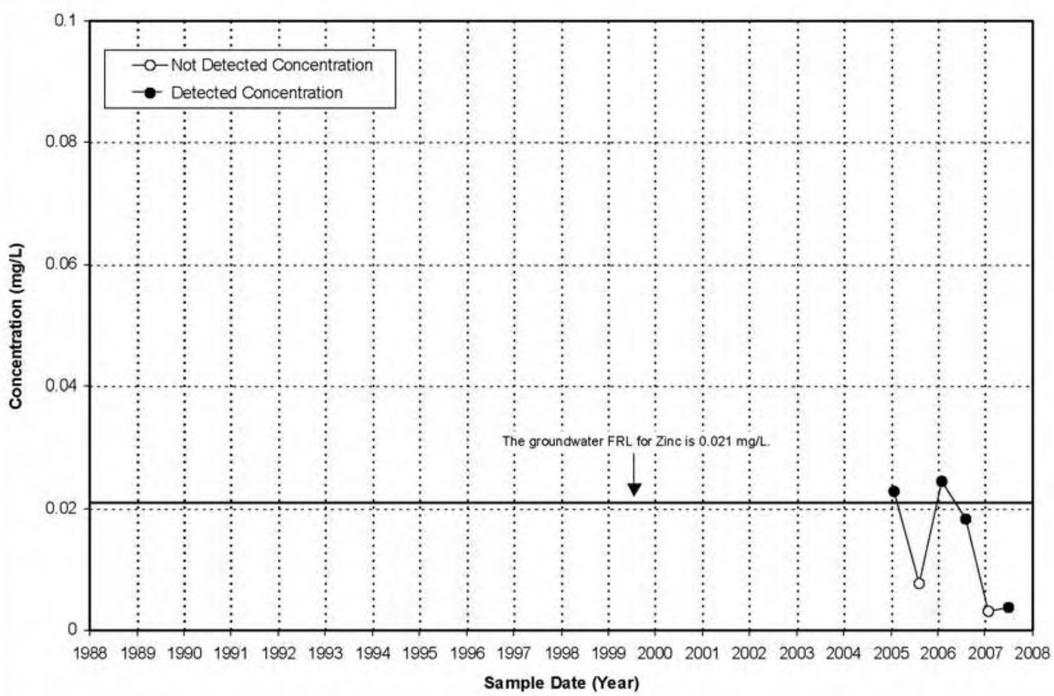

FIGURE A.4-5. ZINC CONCENTRATION VS. TIME PLOT FOR MONITORING WELL 22210

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Attachment A.5

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A.5.0 On-Site Disposal Facility Monitoring Results

This attachment provides the 2007 results for the on-site disposal facility (OSDF) leak detection and leachate monitoring program described in the 2006 Legacy Management and Institutional Controls Plan, Attachment C (Groundwater/Leak Detection and Leachate Monitoring Plan [GWLMP]) (DOE 2006). The objective of the GWLMP is to meet regulatory requirements for groundwater detection monitoring in the Great Miami Aquifer and perched groundwater system and to provide leachate monitoring information.

<u>Facility Description</u>

The OSDF is situated in the northeast area of the Fernald Preserve. It has a capacity of 2.96 million cubic yards (yd^3) (2.26 cubic meters [m^3]); a maximum height of approximately 65 feet (ft) (20 meters [m]); and covers an area of approximately 90 acres (36 hectares). The facility consists of eight individual cells. All eight cells were 100 percent full and capped by October 2006.

Protection of the Great Miami Aquifer and the overlying perched groundwater system includes the following measures for each of the eight cells (refer to Figure A.5−1 for a cross section of the liner system):

- Leachate collection system (LCS)
- Leak detection system (LDS)
- Multi-layer composite liner system
- Multi-layer composite cap system.

The LCS consists of a gravel layer installed beneath the waste to collect rainwater that comes in contact with the waste during cell construction and additional moisture that drains from the waste following capping. The LDS is located beneath both the LCS and the primary geosynthetic liner system, and provides a mechanism for collecting and monitoring leakage from the OSDF prior to any releases to the environment. Both systems drain to the west and extend beyond the synthetic liner systems into valve houses, where leachate becomes accessible for monitoring.

Horizontal till wells (HTWs) are set beneath the compacted clay liner of each cell. These wells provide monitoring of the perched groundwater quality beneath the point where the LCS and LDS pipes exit the liner system. The Great Miami Aquifer is monitored via both an upgradient and a downgradient monitoring well for each cell. Figure A.5−2 identifies the well locations associated with the OSDF. Table A.5−1 identifies specific dates for the following cell activities:

- Sample initiation for each monitoring horizon
- Waste placement initiation
- LDS volume measurement initiation
- Cap geomembrane layer completion
- Cap completion (through seeding).

Information Organization

The 2007 OSDF leak detection and leachate monitoring information is organized in the following sections: Water Balance (Section A.5.1), Analytical (Section A.5.2), Cell Cap Inspections (Section A.5.3), and Summary of Overall Performance and Recommendations (Section A.5.4). Sub-attachments A.5.1 through A.5.8 provide cell-specific information for disposal cells 1 through 8, respectively. Each sub-attachment includes figures, tables, and analytical information.

A.5.1 Water Balance

This section provides the following information:

- Overall LCS Volumes (A.5.1.1)
- LDS Accumulation Rates and Volumes (A.5.1.2)
- Liner Efficiencies (A.5.1.3)
- HTW Water Yields (A.5.1.4)

A.5.1.1 Overall LCS Volumes

Leachate volumes were measured in 2007 at a meter within the OSDF leachate conveyance system lift station located immediately south of the valve houses. The volumes measured include water pumped from the LDS tanks from each cell. LDS volumes are subtracted from the total meter reading to obtain a measurement that represents the collective leachate volume from all OSDF cells.

Leachate volumes have been measured since waste placement was initiated. Figure A.5−3 is a graph showing monthly leachate volumes for 2007. According to the data collected in 2007, approximately 342,253 gallons of leachate were collected and pumped to the Backwash Basin for subsequent treatment at the Converted Advanced Wastewater Treatment Facility (CAWWT). The total volume measured in 2007 (342,253 gallons) was down considerably from the total volume measured in 2006 (7.6 million gallons). This is attributed to the all of the cells being capped in 2007, and Cells 7 and 8 still being open for most of 2006. The volume of precipitation that fell on the OSDF in 2007 was approximately 54.9million gallons (37.4 inches of rain over 54.1 acres). The facility cap inhibits rainwater from permeating into the OSDF. Collected leachate in 2007 represents only about 0.6 percent of the precipitation that fell on the OSDF in 2007 indicating that the cap is performing as designed to reduce infiltration.

The OSDF GWLMP identifies that trend analysis of the LCS flow monitoring measurements will be conducted for capped cells in order to provide an indication of changes in system performance. Monthly accumulation volumes for Cells 1 through 8 are plotted and provided in Sub-attachments A.5.1 through A.5.8 respectively. The plots indicate that leachate volumes from the capped cells are diminishing over time, as expected.

A.5.1.2 LDS Accumulation Rates and Volumes

Quantitative measurement of the volumes accumulating in and pumped from the LDS was initiated according to the various dates in Table A.5−1. These measurements are taken from a pressure transducer installed in the primary containment vessel and attached to a data logger that measures and records water levels hourly. The water level data are downloaded and converted into volumes based on the tank manufacturer's design specifications for the LCS and LDS tanks. These data are used to determine both accumulation rates (in gallons per acre per day [gpad]) and accumulation volumes (in gallons) for each cell’s LDS. In each cell-specific sub-attachment (Sub-attachments A.5.1 through A.5.8), monthly accumulation rates are graphically displayed.

The OSDF GWLMP states that trend analysis of the LDS flow monitoring measurements will be conducted for capped cells to provide an indication of changes in system performance. Monthly accumulation volumes for Cells 1 through Cell 8 are provided in Sub-attachments A.5.1 through A.5.8, respectively

The OSDF Final Design Calculation Package (DOE 1997b) defines an initial response leakage rate for individual cells of 20 gallons per acre per day (gpad). The 2007 maximum LDS accumulation rates and the percent of the initial response leakage rate for each cell are as follows:

Cell	LDS Maximum Accumulation Rate (gpad)	Percent of Initial Response Leakage Rate
1	0.07	0.4
2	0.00	0.0
3	0.13	0.7
4	0.74	3.7
5	4.40	22.0
6	2.83	14.1
7	6.54	32.7
8	4.33	21.6

These LDS accumulation rates indicate that the liner systems for the cells are performing well within the specifications outlined in the approved OSDF design. Because all of the cells are closed and capped, it is expected LDS accumulation rates will continue to diminish over time. Rates will continue to be closely tracked to document if the primary liner systems continue to perform as designed.

A.5.1.3 Liner Efficiencies

Cell-specific apparent liner hydraulic efficiencies can be calculated via the following equation:

$$[1-(Vol_{LDS}/Vol_{LCS})] \times 100$$

Apparent liner hydraulic efficiency is a measure of how a cell’s liner is performing. The above equation considers *all* the LDS volume to be leakage through the primary liner, which is a conservative measure. In the EPA report of the 1995 Workshop on Geosynthetic Clay Liners,

Appendix F (EPA 1996), several sources of flow from leak detection layers are identified. These sources include:

- Top liner leakage
- Construction water and compression water
- Consolidation water
- Water from groundwater infiltration.

Monthly apparent liner efficiencies were consistently greater than 90 percent for Cells 1 through 4 throughout 2007. As shown below, monthly apparent liner efficiencies for all cells (with the exception of Cell-2 which started the year at 100%) improved from January 2007 to December 2007. Monthly liner efficiencies (in percentages) are provided for capped Cells 1 through 8 in Sub-attachments A.5.1 through A.5.8, respectively.

Apparent Liner Efficiency (%), January 2007 compared to December 2007

Month	Cell-1	Cell-2	Cell-3	Cell-4	Cell-5	Cell-6	Cell-7	Cell-8
January 07	99.23	100	98.71	94.39	78.34	81.68	56.47	81.32
December 07	99.62	100	100	98.07	90.98	94.02	89.10	93.91

A.5.1.4 HTW Water Yields

HTW water yields are monitored at each cell to document trends in perched water purge volumes. In 2007 the horizontal wells were purged four times (February, May, August, and November). Average purge water yields from the HTWs ranged from 89 gallons beneath Cell 6 to 1,063 gallons beneath Cell 5. The Cell 3 HTW water yield, which had been trending upward from 2001 through 2005, showed a second year decline in average yield. The HTW water yields will continue to be tracked and factored into the OSDF leak detection evaluation, where appropriate. The water-yield graphs, provided in each cell’s sub-attachment, are updated with purge volume data collected prior to each sampling event.

A.5.2 Analytical

This section provides the following information:

- Data Presentations and Evaluations (Section A.5.2.1)
- Development of Cell-specific Refined Baseline Monitoring Lists (Section A.5.2.2).

Detailed text for each cell is provided in the cell-specific sub-attachments.

A.5.2.1 Data Presentations and Evaluations

The OSDF GWLMP states that the Fernald Preserve will conduct up to 12 rounds of initial baseline sampling for both the perched system and the Great Miami Aquifer for all initial site-specific leak detection monitoring parameters for the purpose of defining refined baseline parameters for each cell.

Refined baseline parameters have previously been defined for Cells 1 through 7. The 12 rounds of initial baseline sampling necessary to define refined baseline parameters for Cell 8 were completed in 2007. Refined baseline parameters for Cells 1 through 8 are similar for each cell and consist of 5 parameters (boron, sulfate, uranium, total organic carbon (TOC), and total organic halogens (TOX).

Initial baseline sampling results for Cell 8 are presented in Sub-attachment A.5.8 in a data summary table. Concentration plots for each refined baseline parameter are presented for all cells in the appropriate cell sub-attachment.

The following subsections describe specifics pertaining to the different types of data presentations:

- Summary Tables (Section A.5.2.1.1)
- Concentration Plots (Section A.5.2.1.2).

A.5.2.1.1 Summary Tables

Summary tables are used to evaluate initial baseline conditions and to summarize analytical data prior to evaluating initial baseline conditions. One summary table is presented in this year's report, being a summary table for Cell 8 in Sub-attachment A.5.8. The Cell 8 summary table includes overall sample numbers, number of detections, and sample ranges. Trend analysis prior to establishment of baseline is only required for the LCS and LDS per the OSDF GWLMP; however, it is provided for all horizons, where possible.

A.5.2.1.2 Concentration Plots

There have been at least 12 samples collected from the HTWs and Great Miami Aquifer wells for Cells 1 through 8. Therefore, concentration plots are provided for these cells in Sub-attachments A.5.1 through A.5.8.

In previous SERs, control charts for refined baseline parameters were also provided. Technically it did not make sense to continue providing control charts because constituent-specific steady state conditions had not been established. Therefore, control charts are not provided in this year's SER. A common ion study was completed in 2007 to address the steady state issue and the use of control charts. Results of this study are currently under review. Statistical tests (presented in the common ion study) identify the parameters and monitoring horizons where baseline data are considered sufficient to establish control charts. Pending review and approval of the common ion study, control charts will be included in future SERs for those parameters and monitoring horizons.

Summary statistics tables for Cells 1 through 8 are provided in each cell-specific sub-attachment. Each table summarizes, for constituents detected greater than 25 percent of the time the: average, distribution type, trend, presence of serial correlation, and outliers. The information provided in each table is based on a standardized sampling frequency, which is quarterly for all cells. Information in each table is also included on the concentration plots provided in the cell-specific sub-attachments. Note that minimum and maximum results provided on concentration plots are based on the non-standardized data (i.e., all results provided on the charts with the exception of pre-purge HTW results). Averages and trends presented on concentration plots are based on the standardized frequency data sets (e.g., quarterly) so that concentrations are weighted appropriately for trend analysis and to account for outlier removal. Outliers have been removed from cell-specific concentration plots.

Concentration plots (for those constituents detected more than 25 percent of the time) for each cell are provided on two plots in each sub-attachment: one showing the LCS, LDS, and HTW; and one showing the HTW and Great Miami Aquifer wells. The HTW is provided on both plots to serve as a reference horizon.

With respect to trend analysis, it is not unexpected that concentrations in any one or a number of horizons might be trending upward. Upward trends are not necessarily indicative of a leak, but possibly an indication of the changes in the environment surrounding the system. For example, the LCS concentrations could reflect more concentrated water as the leachate ages do to capping of the cells and the resultant cut-off of infiltrating “fresh” rainwater. Also, there is the pre-existing contamination in the Great Miami Aquifer, which could cause upward trends in concentrations as well. It is important to look at the overall LCS and LDS flow trends and concentration levels to evaluate the integrity of all components in the system.

For Cells 1 through 8, four of the 16 original leak detection indicator parameters (i.e., TOC, TOX, boron, and total uranium) were detected more than 25 percent of the time. In 2003, sulfate was added to the leak detection indicator parameter list due to its high mobility and the presence of a sulfate source in the crushed stone comprising the LCS and LDS drainage layers. Sulfate was also detected more than 25 percent of the time.

A.5.2.2 Development of Cell-specific Refined Baseline Monitoring Lists

The process used to develop cell-specific refined baseline constituent monitoring lists for each of the eight cells in the OSDF is currently evolving from what is defined in the GWLMP. DOE is working with the EPA and OEPA on two separate studies, the objective being to identify those constituents that would significantly enhance the early detection capability of the monitoring program. The two studies are:

1) A common ion study, and
2) A statistical analysis of site-specific leachate monitoring parameters.

<u>Background</u>

An annual grab sample of leachate is collected from the LCS of each cell and analyzed for the Appendix I and polychlorinated biphenyl (PCB) parameters specified in the Ohio Administrative Code (OAC) 3745-27-10 and 19. This sampling is being performed to determine whether the initial site-specific indicator parameter list is sufficient for leak detection purposes. Results are reported in the annual site environmental report in accordance with the OCA 3745-27-19(M) reporting requirement.

The DOE would like to discontinue the annual Appendix I and PCB sampling after eight rounds of sampling have been completed in the LCS of a specific cell for the following reasons:

- The sampling is applicable to "active" sanitary landfills, and the OSDF is a "closed" engineered repository.
- A detailed accounting of what went into the OSDF is available and was used to define an alternate site-specific sampling list for OSDF monitoring purposes. Use of this alternate site-specific sampling list has been approved by the EPA and OEPA. This alternate site-specific sampling list has factored into it the extensive databases that were used to develop Waste Acceptance Criteria (WAC) for the OSDF. The WACs were developed with consideration of the types, quantities, and concentrations of wastes that would be placed into the OSDF; and also considered the leachibility, mobility, persistence, and stability of the waste constituents in the environment.
- Most of the Appendix I constituents have already been detected in perched groundwater at the Fernald Preserve and were considered when selecting the alternate site-specific sampling list.
- Although constituents that are not part of the alternate site-specific sampling list for leak detection may be detected in the annual grab samples; it is not anticipated that the concentrations will be high enough to warrant revision of the alternate site-specific sampling list, or that the constituents will be useful leak detection indicators.

As a result, in order to facilitate the decision to drop annual Appendix I and PCB sampling, and to instead generate final cell-specific refined baseline monitoring lists, DOE in conjunction with EPA and OEPA conducted a common ion study. Sampling for the common ion study began in 2005 and ended in 2007. As explained below a report was issued in March 2008, and is currently undergoing review by EPA and OEPA.

In an effort to improve the early detection capability of the monitoring program via the common ion study, it was agreed that a separate but complementary strategy could add to the goal of enhanced early detection by applying a statistical approach to the site-specific leachate monitoring parameter selection process. A more thorough discussion of the statistical approach and some preliminary results for Cells 1 through 3 are presented below and in cell-specific sub-attachments for Cells 1 through 3.

<u>Common Ion Study</u>

The purpose of the common ion study was to identify monitoring parameters that could be used as useful indicators of a potential leak emanating from the OSDF. At the March 8, 2005, TIE meeting, it was agreed upon by DOE, EPA, and OEPA that eight rounds of common ion monitoring would be conducted in the LCS, LDS, and horizontal till wells of each cell. Monitoring was initiated in 2005 and completed in 2007. Results are reported in; *Fernald Site, Evaluation of Aqueous Ions in the Monitoring Systems of the On-site Disposal Facility*, issued March 2008. Common ions included in the study were: calcium, iron, magnesium, manganese, phosphorous, potassium, silicon, sodium, alkalinity, chloride, fluoride, nitrate/nitrite, and oxidation reduction potential. Common ion sampling stopped with completion of the eighth sampling round. The common ion report is currently undergoing review by the EPA and OEPA. A decision concerning the resumption of common ion monitoring activities will be determined after EPA, OEPA, and DOE have had a chance to discuss the results.

The common ion study was a comprehensive geochemical and statistical evaluation performed on the reported concentrations of aqueous ions in fluid samples collected from the LCS, LDS, and HTW of each cell in the OSDF. The study concluded that:

- No one ion can serve as a leak indicator for all cells of the disposal facility, but useful indicator ions for specific target horizons of each cell were identified. For the indicator ions that were identified, baseline data are sufficient to establish control charts.
- Fluid volume appears to be the key monitoring parameter to indicate the potential for leachate migration from the OSDF, and sampling of and analysis for indicator ions are useful only if the hydraulic conditions permit leachate to migrate.

The study determined that for an ion to serve as a useful indicator ion of leachate leaking from the LCS to the LDS, or from the LDS to the HTW, it must be present at a much higher concentration in the source horizon, relative to the target horizon. This is due to the very small volume of source fluid that migrates to the target horizon (relative to the volume of fluid in the target horizon) and the mathematics behind calculating an ion concentration in a mixture of two fluids. For the common ion study a conservatively high source-volume/target-volume ratio (1 gallon LCS/10 gallons LDS) was used to evaluate the ion concentrations, and this ratio indicates that the ion concentration in the source must be at least 4 times greater than in the target horizon if the ion is to be used as an indicator.

Results from the statistical analysis indicate that no ion can serve as a universal leak indicator for all cells because trends occur in the data sets or the data show serial correlation. Useful ions and target horizons for each cell are presented in cell-specific sub-attachments, and summarized below:

	Target Horizon	Indicator Ion
Cell 1	LCS	None
	LDS	B, Mn
	HTW	None
Cell 2	LCS	None
	LDS	Fe
	HTW	Mn, SO_4
Cell 3	LCS	None
	LDS	Mn, U
	HTW	Na
Cell 4	LCS	None
	LDS	U
	HTW	Na
Cell 5	LCS	None
	LDS	Mn
	HTW	None
Cell 6	LCS	None
	LDS	Mn, U
	HTW	Na
Cell 7	LCS	None
	LDS	Mn, U
	HTW	U
Cell 8	LCS	None
	LDS	U
	HTW	B

Cell-specific monitoring change proposals based on results of the common ion study are presented in the cell-specific sub-attachments of this report.

Statistical Approach to OSDF Site-specific Leachate Monitoring Parameter Selection

Based on comments received on the 2005 SER, DOE and OEPA, over the course of 2006 and 2007, discussed ideas to develop a more systematic approach to determine how an annual LCS monitoring parameter will be added to the site-specific monitoring list. The resulting selection approach is presented in (Figures A.5−4A and A.5−4B). The selection approach calls for any Appendix I or PCB constituent that has been sampled for eight times and has a 25 percent detection rate to be considered a "potential" site-specific monitoring constituent. Incorporation to the site-specific monitoring list would only be done if it can be demonstrated that adding the constituent would significantly enhance the early detection capability of the monitoring program.

Under the approach, adding a constituent to the site-specific monitoring list is based on a statistical test to determine if there is a significant difference between the potential site-specific parameter concentration and either the pre-design or background data sets that are specific to the Fernald Preserve. Statistical tests include a t-Test, Wilcoxen Rank Sum and Quantile Test, and Poisson Prediction Limits Test. Use of a specific test depends upon dataset conditions presented in Figure A.5−4B. It is possible that some Appendix I or PCB constituents that have no site-specific pre-design or background data will meet the eight samples, and greater than 25 percent detect criteria. If this occurs, inclusion of the constituents on the site-specific monitoring list will need to be considered on a case-by-case basis to determine if adding the constituent would significantly enhance the early detection capability of the monitoring program.

The objective of the statistical approach is to determine if the mean concentration of a particular LCS monitored constituent, that has been sampled more than 8 times and detected more than 25% of the time, is statistically greater than the mean concentration of either the pre-design or background data for the constituent. If the mean is greater, then the constituent could be a useful monitoring parameter for the OSDF.

As outlined in Figure A.5−4B, the statistical approach consists of three routes.

- If the LCS data set has 0-15% non-detects a t-Test is used.
- If the LCS data set has greater than 15% non-detects but less than 50% non-detects a Wilcoxen Rank Sum and Quantile Test is used.
- If the LCS data set has greater than 50% non-detects a Poisson Prediction Limits Test is used.

0% - 15% non-detects

A t-Test is used to compare the data sets. One-half the value of the detection limit is used to define non-detects. The rationale behind the comparison is that this is a standard comparison of two sample populations that are not unduly influenced by a small proportion of non-detects. The assumptions are:

- Data has either a normal or lognormal distribution, that is tested using the Shapiro-Wilk procedure.
- Equal variances are assessed using an F-Test. If the F-Test passes, a t-Test will be performed using a pool variance estimate. If the F-Test fails, then the t-Test will be run using separate variances.

15% - 50% non-detects

A combination Wilcoxon Rank Sum (WRS) Test and Quantile Test is used to compare the data sets. If either test fails, it is concluded that the two data sets are different. By using these two tests in conjunction with one another, each compensates for the limitations of the other. The WRS Test is particularly strong at identifying shifts or differences between central tendency (mean or median) levels. The WRS Test is less effective at discerning differences in the tails of the distributions. In other words, if the shapes of the two distributions are dissimilar, the WRS Test may not identify divergences in the tail areas if the medians are similar. This is often the case when one or both of the distributions are asymmetrical.

The Quantile Test is designed to identify differences in the tails of the distributions. In this case we are only concerned with differences between the upper tail portions of the two distributions. The Quantile Test will identify significant deviations in the upper tail regions irrespective of the underlying distribution shapes. But, the Quantile Test has very limited use in detecting differences in central tendency.

Used in conjunction, the strengths of the Quantile Test mitigate the weaknesses of the WRS Test and vice versa. The combined usage of these two tests is an ideal solution to population comparison when there are too many non-detects to use the more powerful t-Test. These tests used in conjunction can identify either a difference in central tendency and/or differences in the tail regions. This in effect, is a comparison of the underlying distribution shapes. An assumption being that the data come from a continuous, homogenous distribution.

50% non-detects

A Poisson Prediction Limits Test is used. The rationale behind the use of this test is that when the proportion of non-detects becomes large, the method for handling these results becomes more critical. Choice of a substitution value for non-detects and differing detection limits both have a significant influence on the assessment of the difference between the distributions. The Poisson Prediction Limits procedure bypasses (or minimizes) these problems by only looking at the detected results. In simple terms, the test compares the summation of all detected values within each respective data set and compares these totals relative to the sample size of each data set. If one dataset has a disproportionately larger summation (relative to the respective sample size) then the test identifies a significant difference between the data sets.

In this case, the pre-design data is compared to a prediction limit on the expected summation of detected concentrations from a hypothetically similar data set (the monitoring data) with a given sample size. Exceedance of this limit indicates that the second data set is not similar and is in fact exhibiting greater concentration levels than the pre-design data set.

The strength of this method is that it can identify two different types of differences. First, if the monitoring data has abnormally large results, then the Poisson Prediction Limits will be exceeded and thus be identified as failing because of “upper tail” differences. If the individual detected monitoring results are not appreciably different than the pre-design monitoring results, but the proportion of detects in the monitoring data is appreciably larger than the pre-design data, then the test will fail due to an apparent elevated mean concentration level in the monitoring data. This assumes that the data come from a continuous, homogenous distributions.

Results

At the end of 2007, the data sets at Cells 1, 2, and 3 were of adequate size (eight sampling rounds) to test the statistical approach. Data collected in 2007 were used to update the list of potential site-specific leak detection monitoring constituents that were identified in last year’s report for Cells 1, 2, and 3. Results specific to each cell are presented in the cell-specific sub-attachments. Results are tabulated in Table A.5.1−4 for Cell 1, Table A.5.2−4 for Cell 2, and Table A.5.3−4 for Cell 3. A summary of the results is provided below.

The null hypothesis used for each test was that the mean concentration of the LCS data set was less than or equal to the mean of the pre-design data set. Therefore, failure of the null hypothesis for a specific constituent indicates that the mean of the LCS data set is greater than the mean of the pre-design or background data set, and the constituent could be a useful leak detection parameter.

The pre-design data set appears to consist of two different statistical populations. The change occurs in 1995. There are a lot more detects in pre-1995 data than there are in post-1995 data. As an example, refer to arsenic in Table A.5.1−4. The entire pre-design data set for arsenic, at the Cell 1 LCS, consist of 40 samples and 16 detects. The pre-1995 data contains 19 samples and 14 detects. The post-1995 data contains 21 samples and 2 detects. To be conservative, statistics were run against both the pre-1995 data set, and the post-1995 data set. Failure of the null hypothesis using either data set resulted in the parameter being identified as a potentially useful site-specific monitoring parameter. Tests results were as follows:

Mean LCS Concentration > Pre-Design or Background Mean Concentration	**Cell 1**	**Cell 2**	**Cell 3**
Arsenic	X	X	
Cobalt	X	X	X
Nickel	X	X	X
Selenium	X	X	X
TDS	X	X	X
Zinc	X	X	X

This is the first time that these results have been presented. Therefore, these statistical results should be considered preliminary. It is anticipated that EPA, OEPA, and DOE will work together over the next few months to discuss these results and decide a path forward.

DOE proposes discontinuing the annual Appendix I and PCB monitoring in the Cells 1, 2, and 3 LCS because eight rounds of sampling have been completed, and the statistical evaluation of the results indicate that the only useful leak detection parameters are the 6 constituents listed above.

Annual Appendix I and PCB sampling would end in August 2008 at Cells 1, 2, and 3, but would continue at Cells 4 through 8 until eight rounds of sampling have been completed to support running the statistical tests. Approval from EPA and OEPA on this proposal is requested by July 2008.

Similarly to the rationale provided above for discontinuing the annual Appendix I and PCB monitoring in the Cells 1, 2, and 3 LCS, DOE proposes discontinuing annual baseline sampling in the Cells 1, 2, and 3 LDS. In addition, this monitoring is not a regulatory requirement.

A.5.3 Cell Cap Inspections

OSDF cell cap inspections are conducted on a quarterly basis. The inspection team typically includes representatives from Tetra Tech, Inc. (supporting the EPA); OEPA; Ohio Department of Health; S.M. Stoller Corporation; and the DOE Office of Legacy Management. During OSDF construction, a cell cap was included in the quarterly inspection once it was seeded and vegetation was becoming established. Issues identified during inspections typically include small erosion rills, rocks that surface as top soil settles, animal burrows and digging, small areas that require reseeding, and the presence of woody vegetation and thistle. The issues are addressed as follows:

- Erosion rills are repaired if they exceed 3 inches wide by 6 inches deep.
- Rocks that surface are removed, especially if they will interfere with mowing activities or may be a source location for erosion.
- Animal burrows and holes are filled in and reseeded, if necessary.
- Areas that require reseeding are seeded and covered with jute matting to help prevent erosion of the seed.
- Woody vegetation is removed and herbicide is applied to the noxious weeds.

Following each inspection, a report is submitted to DOE documenting the inspection and any findings. In 2007, inspections were conducted in February, June, September, and December.

A.5.4 Summary of Overall Performance/Findings and Recommendations

<u>Performance/Findings</u>

- LCS volumes have stabilized and continue to diminish with time. In 2007, 342,253 gallons of leachate were collected and pumped to the Backwash Basin.
- LDS accumulation rates indicate that the liner systems are performing well within the specification outlined in the approved cell design.
- Monthly liner efficiencies are consistently greater than 90 percent for Cells 1 through 4, greater than 80 percent for Cells 5, 6, and 8, and greater than 75 percent for Cell 7.
- Average per purge water yields from the HTWs in 2007 ranged from 89 gallons (beneath Cell 6) to 1,063 gallons (beneath Cell 5).
- The 12 rounds of initial baseline sampling necessary to define refined baseline parameters for Cell 8 were completed in 2007. Refined baseline parameters for Cells 1 through 8 consist of 5 parameters (boron, sulfate, uranium, TOC, and TOX).

- Common ion study results indicate that no one ion can serve as a leak indicator in the LCS, LDS, and HTW for all cells of the disposal facility, but useful indicator ions for specific target horizons for each cell were identified. For the indicator ions identified, baseline data are sufficient to establish control charts.
- Common ion study results indicate that fluid volume appears to be the key monitoring parameter to indicate the potential for leachate migration from the OSDF, and sampling of and analysis for indicator ions are useful only if the hydraulic conditions permit leachate to migrate.
- Useful common ions and target horizons for each cell are:

	Target Horizon	Indicator Ion
Cell 1	LCS	None
	LDS	B, Mn
	HTW	None
Cell 2	LCS	None
	LDS	Fe
	HTW	Mn, SO_4
Cell 3	LCS	None
	LDS	Mn, U
	HTW	Na
Cell 4	LCS	None
	LDS	U
	HTW	Na
Cell 5	LCS	None
	LDS	Mn
	HTW	None
Cell 6	LCS	None
	LDS	Mn, U
	HTW	Na
Cell 7	LCS	None
	LDS	Mn, U
	HTW	U
Cell 8	LCS	None
	LDS	U
	HTW	B

- DOE completed a statistical analysis of annual LCS data from Cells 1, 2, and 3 for the purpose of identifying potentially useful site-specific leachate monitoring parameters. This statistical analysis is separate from but complimentary to the Common Ion Study. The list of parameters is based on the mean LCS concentration exceeding the pre-design or background mean concentration. Results are as follows:

Parameter	**Cell 1**	**Cell 2**	**Cell 3**
Arsenic	X	X	
Cobalt	X	X	X
Nickel	X	X	X
Selenium	X	X	X
TDS	X	X	X
Zinc	X	X	X

Recommendations

- DOE recommends discontinuing the annual Appendix I and PCB monitoring at the LCS in Cells 1 through 3 starting in August 2008. Approval from EPA and OEPA is requested by July 2008.
- Work with EPA and OEPA to determine a path forward on Appendix I parameters that failed statistical tests.
- Similarly, DOE recommends discontinuing the annual baseline monitoring at the LDS in Cells 1 through 3 starting August 2008. Approval from EPA and OEPA is requested by July 2008.

Table A.5−1. OSDF Initiation and Completion Dates

Cell	Sample Initiation per Horizon[a]	Waste Placement Initiation	LDS Volume Measurement Initiation[b]	Cap Geomembrane Layer Completion[c]	Cap Completion[d]
1	LCS: February 17, 1998 LDS: February 18, 1998 HTW: October 30, 1997 GMA-U: March 31, 1997 GMA-D: March 31, 1997	December 23, 1997	May 1999	August 17, 2001	December 20, 2001
2	LCS: November 23, 1998 LDS: December 14, 1998 HTW: June 29, 1998 GMA-U: June 30, 1997 GMA-D: June 25, 1997	November 12, 1998	May 1999	July 17, 2003	November 12, 2003
3	LCS: October 13, 1999 LDS: August 26, 2002 HTW: July 28, 1998 GMA-U: August 24, 1998 GMA-D: August 24 1998	October 26, 1999	October 1999	July 16, 2004	September 20, 2004
4	LCS: November 4, 2002 LDS: November 4, 2002 HTW: February 26, 2002 GMA-U: November 6, 2001 GMA-D: November 5, 2001	November 08, 2002	November 2002	December 18, 2004	April 29, 2005
5	LCS: November 4, 2002 LDS: November 4, 2002 HTW: February 26, 2002 GMA-U: November 6, 2001 GMA-D: November 5, 2001	November 19, 2002	November 2002	June 22, 2005	August 29, 2005
6	LCS: October 27, 2003 LDS: October 27, 2003 HTW: March 14, 2003 GMA-U: December 16, 2002 GMA-D: December 16, 2002	November 18, 2003	January 2004	October 28, 2005	January 12, 2006

Table A.5−1 (continued). OSDF Initiation and Completion Dates

Cell	Sample Initiation per Horizon[a]	Waste Placement Initiation	LDS Volume Measurement Initiation[b]	Cap Geomembrane Layer Completion[c]	Cap Completion[d]
7	LCS: September 2, 2004 LDS: September 2, 2004 HTW: February 24, 2004 GMA-U: January 21, 2004 GMA-D: January 21, 2004	September 9, 2004	September 2004	July 2006	October 25, 2006
8	LCS: October 18, 2004 LDS: October 18, 2004 HTW: May 19, 2004 GMA-U: March 31, 2004 GMA-D: March 31, 2004 GMA-SW: August 22, 2005 GMA-SE: August 22, 2005	December 2, 2004	December 2004	September 24, 2006	October 25, 2006

[a]LCS = leachate collection system; LDS = leak detection system; HTW = horizontal till well; GMA-U = upgradient Great Miami Aquifer; GMA-D = downgradient Great Miami Aquifer; GMA-SW = southwest Great Miami Aquifer; and GMA-SE = southeast Great Miami Aquifer
[b]Prior to 1999, overall LDS volumes were measured. From 1999 on, LDS volumes were measured by cell.
[c]The cap geomembrane layer is made of high density polyethylene.
[d]Cap completion includes seeding.

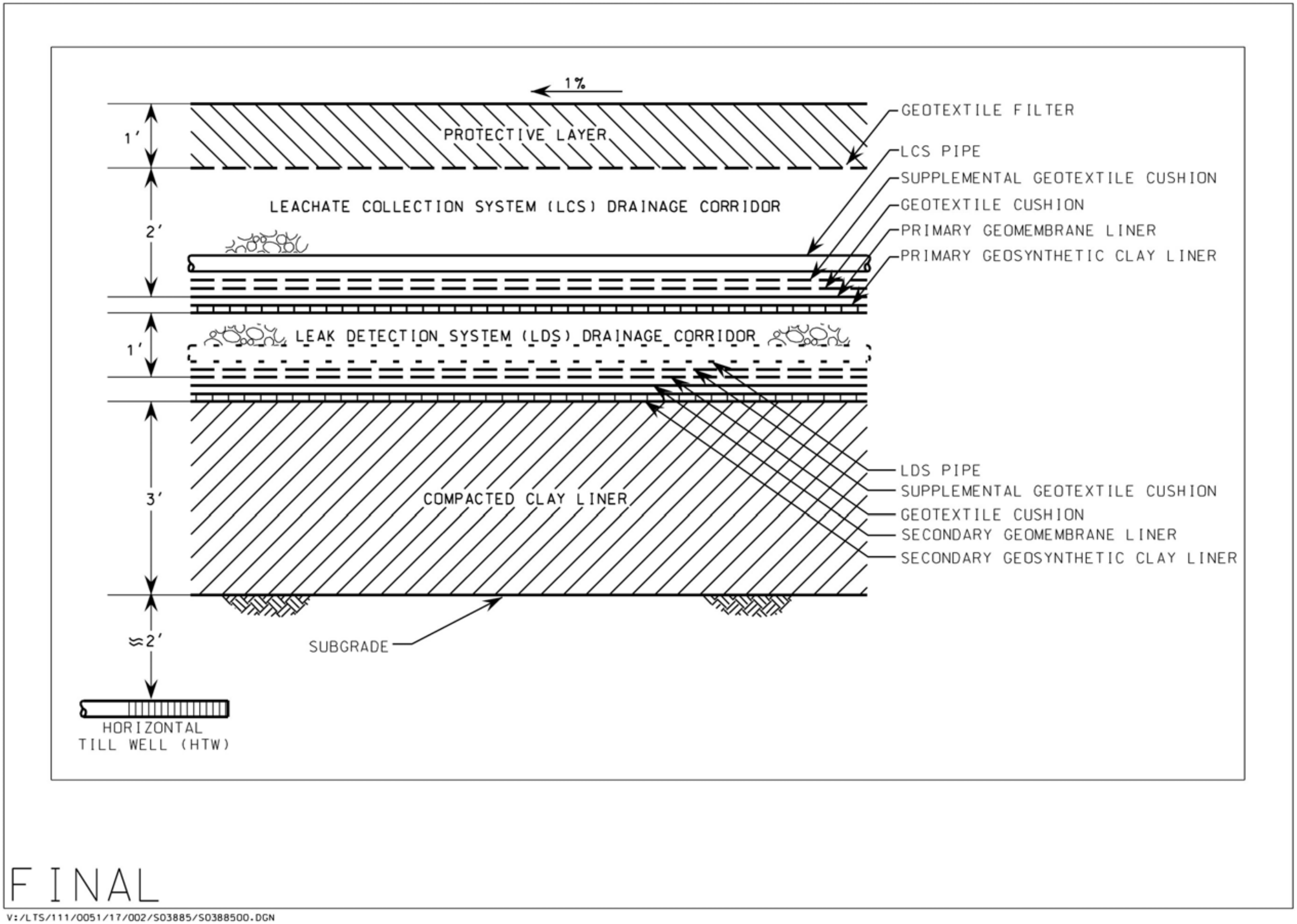

Figure A.5−1. On-Site Disposal Facility Liner System with HTW at the Drainage Corridor

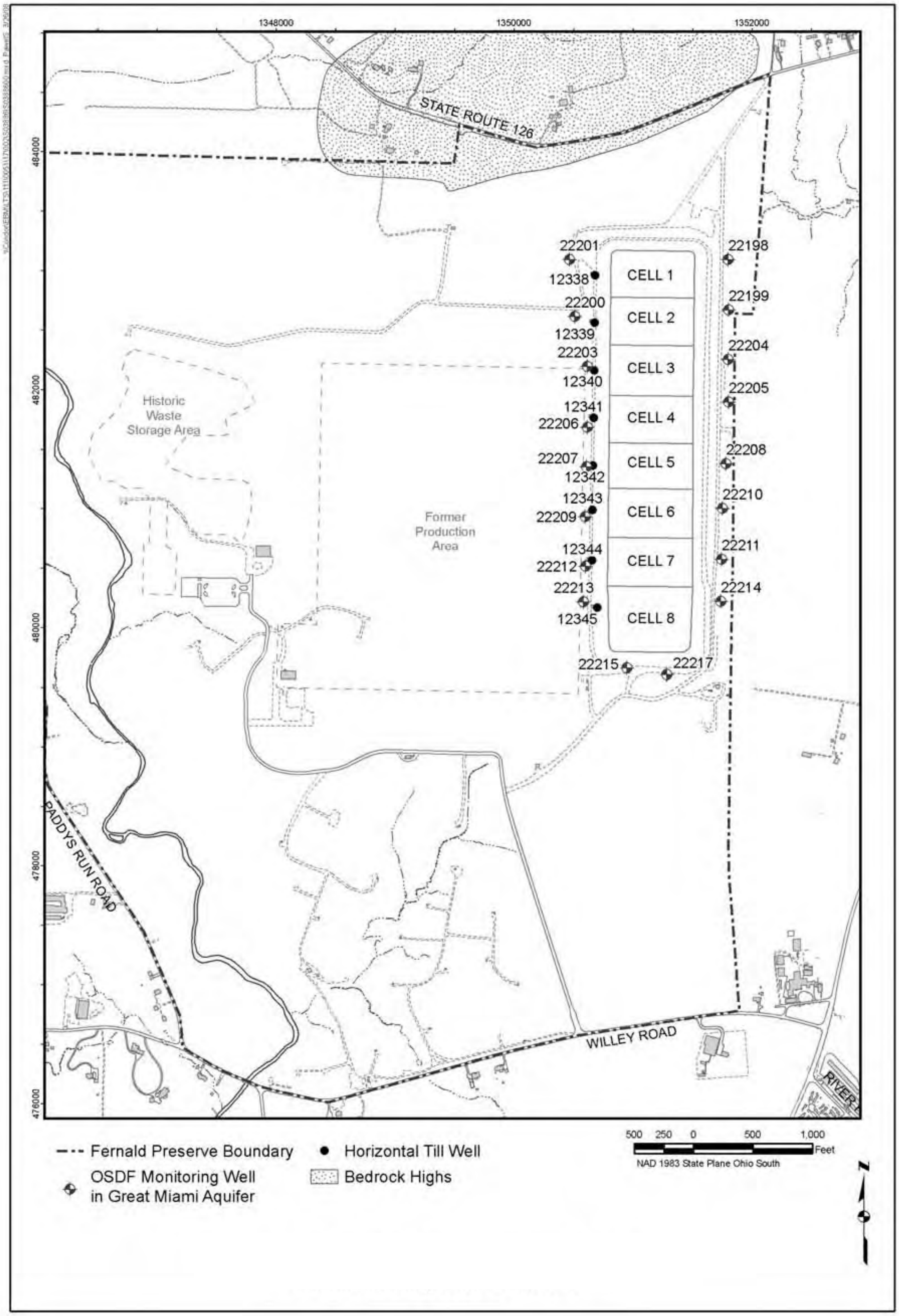

Figure A.5−2. On-Site Disposal Facility Footprint and Monitoring Well Locations

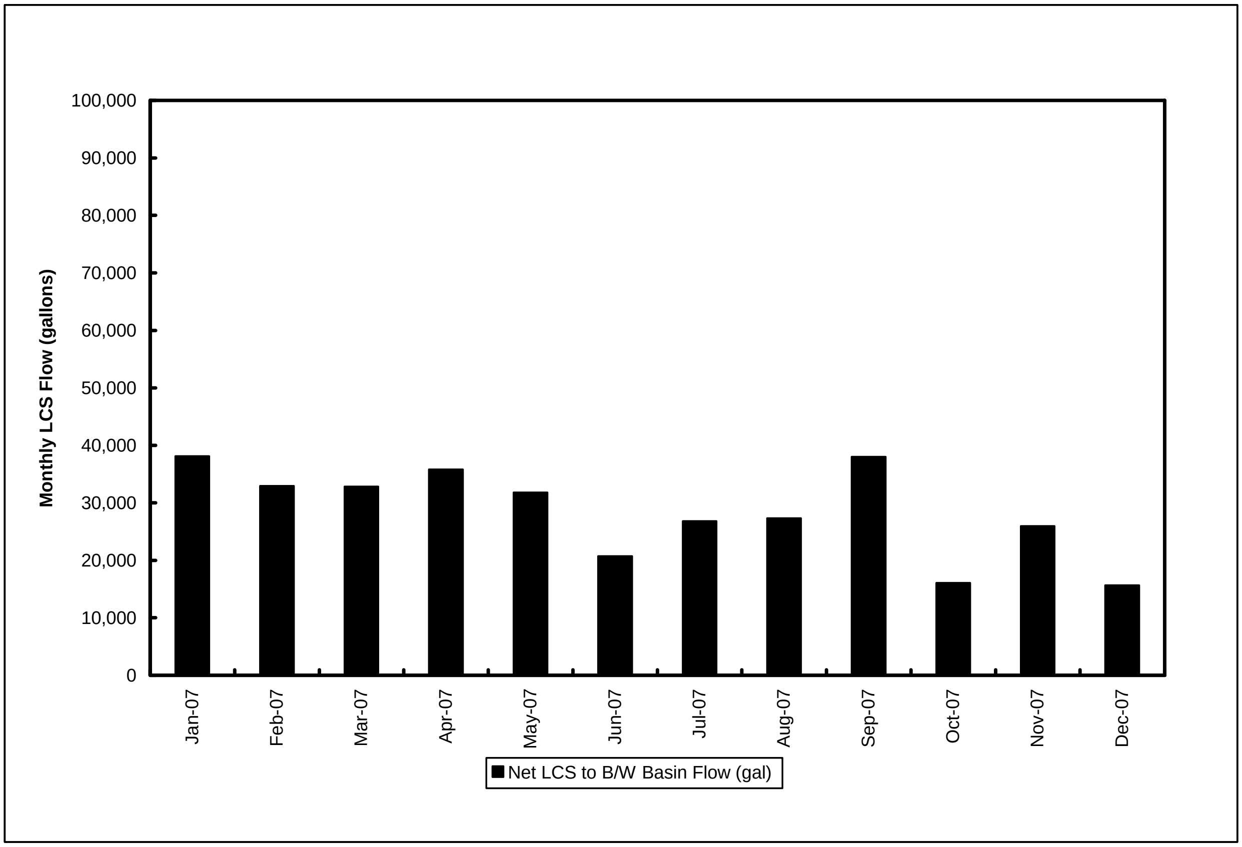

Figure A.5−3. OSDF LCS to Backwash Basin Flow

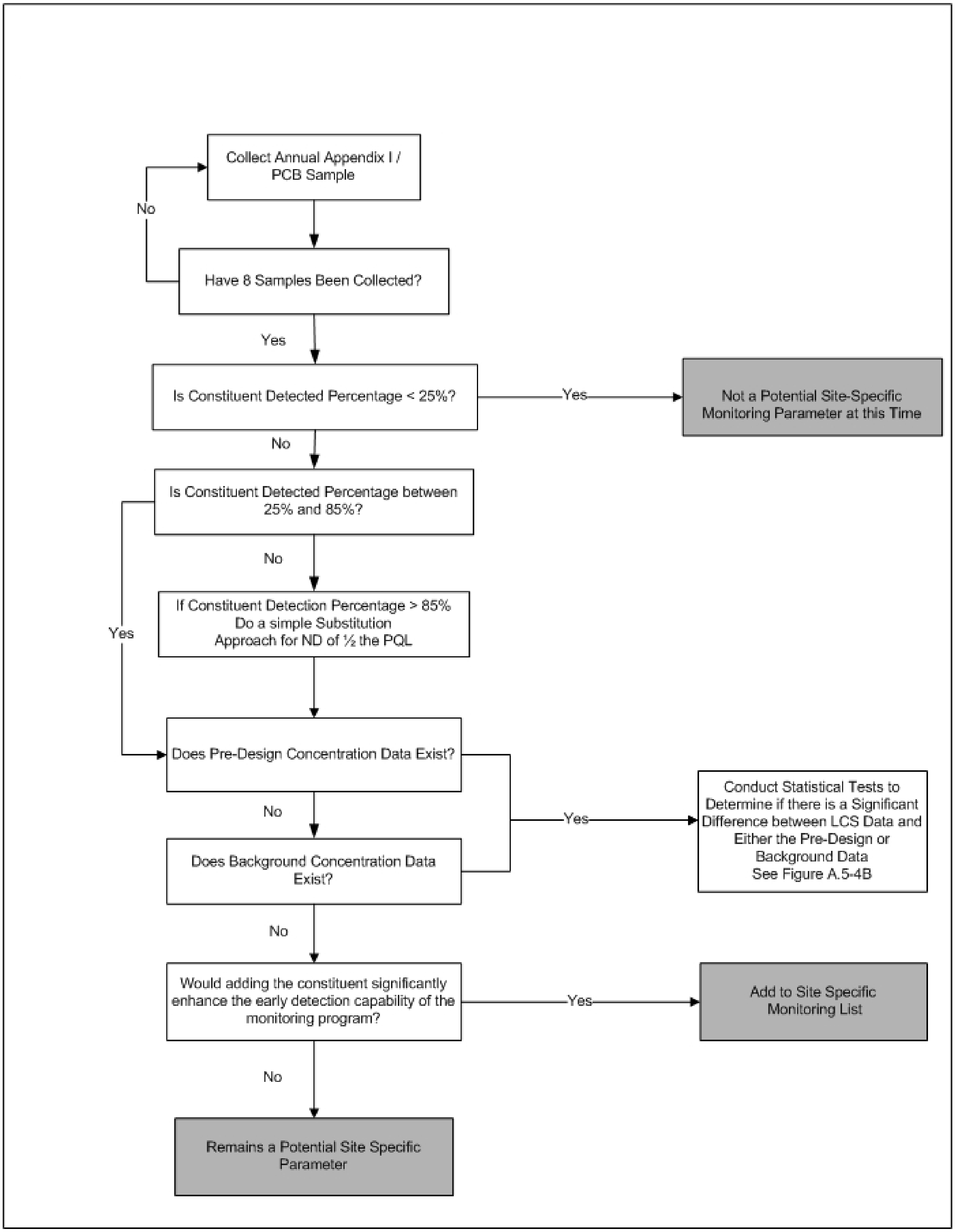

Figure A.5−4A. OSDF Site-Specific Leachate Monitoring Parameter Selection Approach

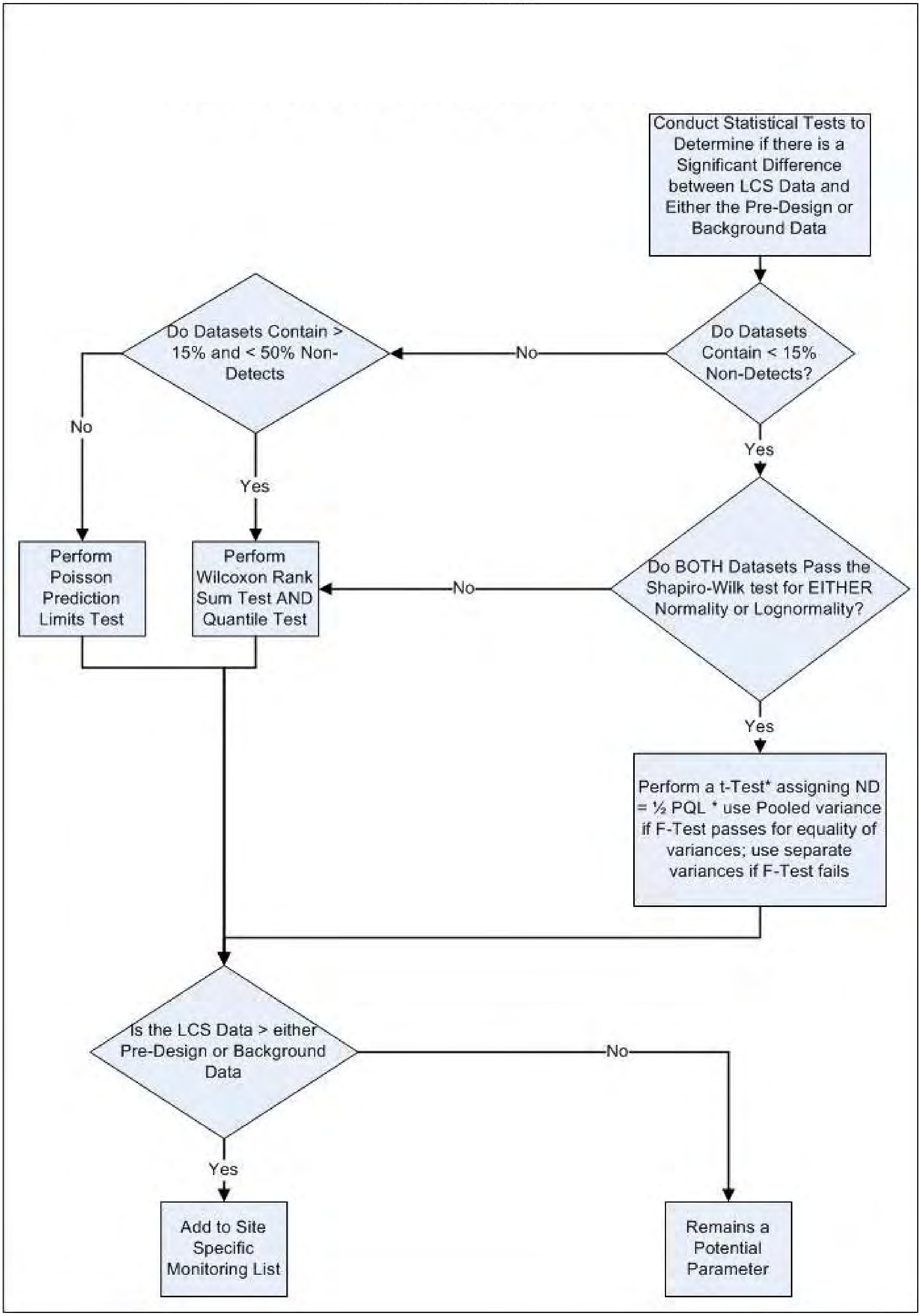

Figure A.5−4B. OSDF Site-Specific Leachate Monitoring Parameter Selection Approach

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Sub-Attachment A.5.1

Cell 1

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The following information is provided in this sub-attachment:

- LCS monthly accumulation volumes (refer to Figure A.5.1−1)
- LDS monthly accumulation volumes (refer to Figure A.5.1−2)
- Monthly liner efficiencies (refer to Table A.5.1−1)
- HTW water yield (refer to Figure A.5.1−3)
- Great Miami Aquifer water levels and uranium concentrations versus time (refer to Figures A.5.1−4 and A.5.1−5)
- Summary statistics for refined baseline constituents (refer to Section A.5.1.1 and Table A.5.1−2)
- Concentration plots for refined baseline constituents (refer to Section A.5.1.1 and Figures A.5.1−6A through A.5.1−10B)
- Annual LCS monitoring results (refer to Section A.5.1.2 and Table A.5.1−3)
- Annual LDS monitoring results (refer to Section A.5.1.3)
- Potential site-specific leak detection monitoring constituents' statistics (refer to Table A.5.1-4).

Samples for the OSDF monitoring horizons were collected according to the frequencies described in the OSDF GWLMP. Constituent sampling lists are provided in Table 2−1, Table 2−2, and Table 2−3 of Appendix B of the OSDF GWLMP. In 2007 Cell 1 LDS was dry three of four quarters; all samples were collected from the other Cell 1 monitoring horizons.

A.5.1.1 Refined Baseline Monitoring Results

Refined baseline constituents are those constituents that have been sampled at least eight times, and detected at least 25 percent of the time in the LCS, LDS, HTW, and GMA wells. Refined baseline constituents are listed in Table 2−3 of Appendix B of the OSDF GWLMP. Also included in Table 2−3 are common ion constituents. A summary statistics table (Table A.5.1−2), and concentration plots (Figures A.5.1−6A through A.5.1−10B) are provided for the five baseline constituents of Cell 1: total uranium, boron, TOC, TOX, and sulfate.

A.5.1.2 LCS Monitoring Results

During active operations (pre-closure), Ohio Solid Waste Regulations (OAC 3745-27-19(M)(5)) require collection and analysis of leachate annually for Appendix I and PCB constituents listed in OAC 3745-27-10. The objective of the annual LCS sampling is to determine if the composition of the leachate within the facility is changing enough to impact monitoring activities beneath the facility. A list of annual LCS sampling constituents is provided in Table 2−2 of Appendix B of the OSDF GWLMP. In 2007, annual sampling of the Cell 1 LCS took place in May. Table A.5.1−3 summarizes the annual LCS sampling results for Cell 1, along with the data collected in previous years.

Of the non-refined baseline site-specific constituents that have been sampled at least eight times in Cell 1, 24 have been detected at least 25 percent of the time. Twelve of these 24 constituents are common ion constituents (alkalinity, calcium, chloride, fluoride, iron, magnesium, manganese, nitrate/nitrite, phosphorous, potassium, silicon, and sodium). The other twelve are *potential* site-specific leak detection monitoring constituents for Cell 1.

Common Ions

A common ion study was completed in 2007, and a report, *Fernald Site, Evaluation of Aqueous Ions in the Monitoring Systems of the On-site Disposal Facility*, was issued in March 2008. This report is currently undergoing review by the EPA and OEPA.

As discussed in Section A.5.2.2 the common ion study concluded that fluid volume appears to be the key monitoring constituent to indicate the potential for leachate migration from the OSDF, and the sampling of and analysis for indicator ions are useful only if the hydraulic conditions permit leachate to migrate.

The common ion study also concluded that no one ion can serve as a leak indicator for all cells of the disposal facility, but useful indicator ions for specific target horizons of each cell can be identified. Specifically, boron and manganese were the only useful indicator constituents identified for the Cell 1 LDS and that sufficient data exists to establish control charts for both boron and manganese for Cell 1. In addition, no other useful indicator constituents were found for Cell 1. Since boron is already included as a refined baseline constituent for Cell 1, it is recommended that manganese also be added to the refined baseline constituent list for the Cell 1 LDS and control charts will be included in future SERs for these two constituents upon approval of the common ion study.

Potential Site-Specific Leak Detection Monitoring Constituents

The remaining twelve constituents (considered to be "*potential*" site-specific leak detection monitoring constituents for Cell 1) are: ammonia, arsenic, barium, cadmium, chromium, cobalt, copper, nickel, selenium, technetium-99, total dissolved solids (TDS), and zinc. These potential Cell 1 site-specific leak detection monitoring constituents were assessed using the statistical approach presented in Figures A.5−4A and A.5−4B, and discussed in Section A.5.2.2. Results of the assessment are presented in Table A.5.1−4.

The objective of the statistical approach is to determine if the mean concentration of a particular LCS monitored constituent, that has been sampled more than eight times and detected more than 25 percent of the time, is statistically greater than the mean concentration of either the pre-design or background data for the constituent. If the mean is greater, then the constituent could be a useful monitoring constituent for the OSDF.

As outlined in Figure A.5−4B, the statistical approach consists of three routes.

- If the LCS data set has 0-15 percent non-detects a t-Test is used.
- If the LCS data set has greater than 15 percent non-detects but less than 50 percent non-detects a Wilcoxen Rank Sum and Quantile Test is used.
- If the LCS data set has greater than 50 percent non-detects a Poisson Prediction Limits Test is used.

The null hypothesis used for each test was that the mean concentration of the LCS data set was less than or equal to the mean of the pre-design or background data set. Therefore, failure of the null hypothesis for a specific constituent indicates that the mean of the LCS data set is greater than the mean of the pre-design or background data set.

Results for Cell 1 are presented in Table A.5.1−4. Out of the 12 constituents that were tested for Cell 1, 6 failed the null hypothesis indicating that they may be useful monitoring constituents.

- Arsenic – failed the Poisson Prediction Limit Test
- Cobalt – failed the Poisson Prediction Limit Test
- Nickel – failed the Poisson Prediction Limit Test
- Selenium – failed the Poisson Prediction Limit Test
- TDS – failed the t-Test
- Zinc – failed the Poisson Prediction Limits Test

This is the first time that these results have been presented. These statistical results should therefore be considered preliminary. It is anticipated that EPA, OEPA, and DOE will work together over the next few months to discuss these results and decide on a path forward.

<u>Confirmatory Sampling</u>

Mercury and technetium-99 are both site-specific leak detection constituents; however, they are not on the refined baseline list for Cell 1. If a site-specific constituent (not on the refined baseline list) is detected in the LCS or LDS, then confirmatory sampling for that constituent will take place. As shown in Table A.5.1−3, mercury and technetium-99 have been detected in the Cell 1 LCS. The detections for mercury occurred prior to the establishment of the refined baseline for Cell 1. Therefore, confirmatory sampling for mercury in the Cell 1 LCS is not required. One of the technetium-99 detects occurred in 2007. Therefore, confirmatory sampling for technetium-99 in the Cell 1 LCS will begin in August 2008 for at least three sampling rounds as required under the 2008 Legacy Management and Institutional Controls Plan, Attachment C, Appendix B, Section 2.1.

A.5.1.3 LDS Monitoring Results

Each year the LDS of Cell 1 is sampled for site-specific baseline constituents listed in Table 2−1 of Appendix B of the OSDF GWLMP. The objective of the annual LDS sampling is to determine if any initial baseline constituents, not on the refined baseline list, are present in the LDS. In 2007, annual sampling of the Cell 1 LDS took place in May.

Of the non-refined baseline constituents that have been sampled at least eight times, eleven have been detected at least 25 percent of the time. All eleven of the constituents are common ion constituents (alkalinity, calcium, chloride, fluoride, iron, magnesium, manganese, nitrate/nitrite, potassium, silicon, and sodium).

Table A.5.1−1. Cell 1 – 2007 Monthly Liner Efficiencies

Month	Cell 1 Apparent Liner Efficiency (%)
January	99.23
February	99.25
March	99.57
April	99.78
May	99.91
June	99.60
July	99.90
August	99.65
September	100.00
October	100.00
November	100.00
December	99.62

Table A.5.1−2. Summary Statistics for Cell 1

Note: The data used in this table has been standardized to quarterly.

Parameter	Horizon[a]	Monitoring Location	No. of Detected Samples	Total No. of Samples	Percent of Detects	Average[b]	Distribution Type[c]	Trend[d]	Serial Correlation[e]	Outliers[f,g]
Total Uranium (µg/L)	LCS	12338C	39	39	100	70.8	Normal	None	Detected	0 (Q1-99)
	LDS	12338D	34	34	100	11.8	Normal	None	Detected	
	HTW	12338	34	36	94.4	4.68	Lognormal	Up	Detected	
	GMA-U	22201	40	43	93	1.84	Undefined	Up	Detected	0 (Q1-98)
	GMA-D	22198	43	43	100	5.6	Undefined	Up	Detected	
Boron (mg/L)	LCS	12338C	39	40	97.5	1.33	Undefined	Up	Detected	
	LDS	12338D	31	31	100	0.236	Lognormal	Marg. Down	Not Detected	0.001 (Q3-00) 0.0296 (Q1-98)
	HTW	12338	34	37	91.9	0.175	Undefined	Up	Detected	
	GMA-U	22201	42	44	95.5	0.103	Normal	Marg. Up	Detected	
	GMA-D	22198	39	42	92.9	0.0606	Undefined	Up	Detected	0.131 (Q1-07)
Total Organic Carbon (mg/L)	LCS	12338C	36	38	94.7	22.4	Undefined	None	Detected	123 (Q2-98)
	LDS	12338D	27	31	87.1	6.08	Normal	None	Not Detected	80.9 (Q2-98) 15.7 (Q1-00)
	HTW	12338	20	33	60.6	1.59	Lognormal	None	Marg. Detect	4.25 (Q1-04) 7.24 (Q1-00) 3.21 (Q3-99)
	GMA-U	22201	30	43	69.8	2.44	Undefined	Down	Detected	59.7 (Q2-98)
	GMA-D	22198	19	36	52.8	1.28	Lognormal	None	Not Detected	52.5 (Q2-98) 15.825 (Q4-97) 13 (Q1-00) 9.814 (Q3-97) 5.85 (Q2-99) 4.7 (Q3-98) 3.56 (Q1-99)
Total Organic Halogens (mg/L)	LCS	12338C	34	39	87.2	0.205	Undefined	Marg. Up	Detected	1.52 (Q3-02)
	LDS	12338D	23	32	71.9	0.0287	Undefined	Marg. Up	Marg. Detect	0.361 (Q2-00)
	HTW	12338	16	36	44.4	0.00788	Normal	None	Marg. Detect	0.0332 (Q4-99)
	GMA-U	22201	14	43	32.6	0.0125	Undefined	Down	Detected	0.308 (Q2-00)
	GMA-D	22198	8	41	19.5	0.00725	Undefined	Down	Detected	0.0473 (Q2-98) 0.092 (Q2-00)
Sulfate (mg/L)	LCS	12338C	24	24	100	1120	Lognormal	Up	Detected	
	LDS	12338D	14	14	100	1550	Undefined	Up	Detected	2330 (Q4-05)
	HTW	12338	20	20	100	758	Lognormal	Down	Marg. Detect	
	GMA-U	22201	19	19	100	284	Lognormal	Down	Detected	1980 (Q4-04)
	GMA-D	22198	20	20	100	263	Lognormal	Down	Not Detected	

[a]LCS = leachate collection system; LDS = leak detection system; HTW = horizontal till well; GMA-U = upgradient Great Miami Aquifer; and GMA-D = downgradient Great Miami Aquifer

[b]Averages were determined based on the distribution assumption. "Approx. Normal" was treated as if it was normal, and "Approx. Lognormal" was treated as if it was lognormal. This was done to compensate for the skewed (lognormal) or non-skewed (normal) nature of the data to give a better estimate of the underlying average.

[c]Data distribution based on the Shapiro-Wilk statistic.

Normal: Normal assumption could not be rejected at the 5 percent level and has a higher probability value than the lognormal assumption.

Lognormal: Lognormal assumption could not be rejected at the 5 percent level and has a higher probability value than the normal assumption.

Approx. Normal (Approximately Normal): Normal and lognormal assumptions were rejected at the 5 percent level. However, the normal assumption was not rejected at the 10 % level. Additionally, for cases where neither assumption was rejected at the 10% level, the data fit the normal destribution better than the lognormal distribution.

Approx. Lognormal (Approximately Lognormal): Normal and lognormal assumptions were rejected at the 5 percent level. However, the lognormal assumption was not rejected at the 10 % level. Additionally, for cases where neither assumption was rejected at the 10% level, the data fit the lognormal destribution better than the normal distribution.

Undefined: Normal and Lognormal Distribution assumptiions are both rejected or there are less than 25% detected values. "Average" is defined as the Median of the data.

[d]Trend based on nonparametric Mann-Kendall procedure. Note that "Marg. Down" is a marginally downward trend and "Marg. Up" is a marginally upward trend.

[e]Serial correlation based on Rank Von Neumann test. Note that "Insuff." = Insufficient.

[f]Outliers determined by Rosner's (for sample sizes greater than 25) or Dixon procedure (for sample sizes less than or equal to 25).

[g]Q = quarterly

Table A.5.1−3. Cell 1 Annual LCS Sample Summary

PARAMETER (UNIT)	NUMBER OF SAMPLES[a,b]	NUMBER OF SAMPLES WITH DETECTIONS[a,b]	PERCENT OF DETECTIONS[a,b]	MIN DETECTED CONCENTRATION[a,b,c]	MAX DETECTED CONCENTRATION[a,b,c]	AVG DETECTED CONCENTRATION[a,b,c]	GW FRL[d] (# OF SAMPLES>GWFRL)	GW BACKGROUND[a,b,e] (# OF SAMPLES>PW BACKGROUND)	PW BACKGROUND[a,b,e] (# OF SAMPLES>PW BACKGROUND)	MAX PW DETECTED CONCENTRATION [a,b,f] (# OF SAMPLES>MAX PW)	DETECTION LIMIT
4-Nitroaniline (µg/L)	22	1	4.50%	1.01	-	-	-	-	-	-	3 µg/L[h]
Alkalinity as CaCO3 (mg/L)	16	16	100%	252	721	481	-	422 mg/L(10)	430 mg/L(9)	-	10 mg/L
Ammonia (mg/L)	10	6	60%	0.03	4.5	1.23	-	4.2 mg/L(1)	4.34 mg/L(1)	220 mg/L(0)	0.1 mg/L
Arsenic (mg/L)	10	4	40%	0.0038	0.0786	0.0248	0.05 mg/L(1)	0.029 mg/L(1)	0.019 mg/L(1)	0.191 mg/L(0)	0.02 mg/L
Barium (mg/L)	10	10	100%	0.0434	0.205	0.0806	2 mg/L(0)	0.77 mg/L(0)	0.45 mg/L(0)	0.589 mg/L(0)	0.029 mg/L
Beryllium (mg/L)	10	2	20%	0.0000674	0.00012	0.0001	0.004 mg/L(0)	-	-	0.0343 mg/L(0)	0.001 mg/L
Cadmium (mg/L)	10	3	30%	0.00014	0.00084	0.0004	0.014 mg/L(0)	0.014 mg/L(0)	-	0.05 mg/L(0)	0.002 mg/L
Calcium (mg/L)	16	16	100%	377	1500	612	-	159 mg/L(16)	172 mg/L(16)	1800 mg/L(0)	5 mg/L
Chloride (mg/L)	16	16	100%	21.8	40.9	35.4	-	7.3 mg/L(16)	45 mg/L(0)	6300 mg/L(0)	5 mg/L
Chromium (mg/L)	10	3	30%	0.0012	0.0017	0.0015	0.022 mg/L[g](0)	0.021 mg/L(0)	0.0046 mg/L(0)	0.818 mg/L(0)	0.005 mg/L
Cobalt (mg/L)	10	9	90%	0.0033	0.0575	0.0192	0.17 mg/L(0)	0.0086 mg/L(6)	-	0.0886 mg/L(0)	0.034 mg/L
Copper (mg/L)	10	10	100%	0.00094	0.0159	0.009	1.3 mg/L(0)	0.035 mg/L(0)	0.029 mg/L(0)	0.298 mg/L(0)	0.008 mg/L
Fluoride (mg/L)	9	9	100%	0.173	0.391	0.232	4 mg/L(0)	0.89 mg/L(0)	1.3 mg/L(0)	6.8 mg/L(0)	0.2 mg/L
Iron (mg/L)	16	16	100%	0.475	101	13.2	-	5.72 mg/L(7)	6.35 mg/L(7)	21.3 mg/L(2)	0.1 mg/L
Lead (mg/L)	10	1	10%	0.00066	-	-	0.015 mg/L(0)	0.022 mg/L(0)	0.0016 mg/L(0)	0.0114 mg/L(0)	0.008 mg/L
Magnesium (mg/L)	16	16	100%	71.4	319	159	-	38.5 mg/L(16)	50.7 mg/L(16)	690 mg/L(0)	5 mg/L
Manganese (mg/L)	16	16	100%	0.0104	7.7	2.02	0.9 mg/L(10)	0.9 mg/L(10)	0.21 mg/L(15)	35 mg/L(0)	0.09 mg/L
Mercury (mg/L)	23	2	8.70%	0.00000024	0.00047	0.0002	0.002 mg/L(0)	-	-	0.0018 mg/L(0)	0.0002 mg/L
Nickel (mg/L)	10	10	100%	0.0119	0.0535	0.0315	0.1 mg/L(0)	0.0514 mg/L(1)	0.0072 mg/L(10)	0.981 mg/L(0)	0.02 mg/L
Nitrate/Nitrite (mg/L)	27	15	55.60%	0.00793	11.1	2.43	11 mg/L[g](1)	11 mg/L(1)	0.29 mg/L(10)	2670 mg/L(0)	1.1 mg/L
Phosphorus (mg/L)	9	4	44.40%	0.0873	0.19	0.127	-	-	-	-	0.1 mg/L
Potassium (mg/L)	16	16	100%	10.8	25.9	17.4	-	1.96 mg/L(16)	17.2 mg/L(8)	12400 mg/L(0)	5 mg/L
Selenium (mg/L)	10	3	30%	0.0048	0.017	0.0097	0.05 mg/L(0)	0.00075 mg/L(3)	-	0.0494 mg/L(0)	0.005 mg/L
Silicon (mg/L)	9	9	100%	3.77	7.39	5.86	-	-	-	15 mg/L(0)	0.015 mg/L
Silver (mg/L)	10	1	10%	0.00014	-	-	0.05 mg/L(0)	0.0117 mg/L(0)	0.0031 mg/L(0)	0.264 mg/L(0)	0.005 mg/L
Sodium (mg/L)	16	16	100%	11.7	29.3	16.1	-	47.1 mg/L(0)	50 mg/L(0)	1300 mg/L(0)	5 mg/L
Technetium-99 (pCi/L)	23	6	26.10%	1.81	18.28	10.9	94 pCi/L(0)	22 pCi/L(0)	30 pCi/L(0)	6130 pCi/L(0)	10 pCi/L
Thallium (mg/L)	10	2	20%	0.0007	0.00756	0.0041	-	-	-	0.0028 mg/L(1)	0.02 mg/L
TDS (mg/L)	21	21	100%	1792	2660	2290	-	-	-	-	10 mg/L
Zinc (mg/L)	10	7	70%	0.0162	0.575	0.125	0.021 mg/L(5)	0.02 mg/L(5)	0.35 mg/L(1)	1.78 mg/L(0)	0.015 mg/L

Note: Shading indicates that at least one detected sample is greater than the FRL, groundwater background, PW background, or PW maximum.

[a]If more than one sample is collected per well per day (e.g., duplicates), then only one sample is counted for the total number of samples, and the sample with the maximum representative concentration is used for all the summary information.
[b]Rejected data qualified with an R or Z were not included.
[c]If the number of detected samples is equal to two, then the minimum and maximum are reported. If the number of detected is equal to one, then the data point is reported as the minimum. The "AVG DETECTED CONCENTRATION" is not reported for either of these cases.
[d]From Operable Unit 5 Record of Decision, Table 9-4.
[e]From the Characterization of Background Water Quality for Streams and Groundwater which was developed for Operable Unit 5 RI/FS documents.
[f]Max PW - maximum detected concentration in perched water as defined in the Remedial Investigation Report for Operable Unit 5.
[g]FRL based on hexavalent chromium and nitrate, from Operable Unit 5 Record of Decision, Table 9-4.
[h]Detection Limit of 4-Nitroaniline is sometimes less than the value, depending on the laboratory doing the analysis.

Table A.5.1−4. Parameter Selection Criteria - Statistical Comparison Of Leachate Collection System Data To Pre-Design Data For Cell 1

					I. t-Test												II. Wilcoxon + Quantile				III. Poisson PL	
Parameter	**Dataset**	**Samples**	**Detects**	**Detect %**	**Shapiro-Wilk (N)**	**Shapiro-Wilk (LN)**	**Min**	**Max**	**Mean (mg/L)**	**Median**	**Variance**	**Std. Dev.**	**Log Mean**	**Log SD**	**F-Test**	**t-Test Prob**	**Median (mg/L)**	**Wilcoxon Prob**	**Quantile Test [q = .90]**	**Quantile Test Prob.**	**Poisson Prediction Limits (mg/L)**	
Ammonia	LCS	10	6	60%			0.010	4.5	0.112	0.752	2.152	1.47					0.752					
	PreDesign	9	7	78%			0.015	450	54.980	0.604	22134.00	149					0.604	0.923	1/3	0.124		
	PreDesign+	7	5	71%			0.015	0.848	0.377	0.262	0.124	0.352					0.262	0.768	- -	insuf. data		
	+ outliers removed																					
Arsenic	LCS	9	7	78%			0.000	0.079	0.011	0.002	0.001	0.024					0.002				1060	
	PreDesign	40	16	40%			0.001	0.072	0.011	0.004	0.000	0.016					0.004	0.716	1/5	0.048	1196	PASS
	PreDesign*	19	14	74%			0.001	0.072	0.020	0.011	0.000	0.021					0.011	0.965	1/2	0.103		
	PreDesign**	21	2	10%			0.002	0.017	0.004	0.004	0.000	0.003					0.004	0.256	2/8	ND in R	405	FAIL
	* before 2/10/95																					
	** after 2/10/95																					
Barium	LCS	10	10	100%	Fail	Pass	0.043	0.205	0.081	0.071	0.002	0.046					0.071					
	PreDesign	40	39	98%	Fail	Fail	0.002	2.390	0.326	0.264	0.148	0.385					0.264	1.000	0/3	0.098		
	PreDesign*	19	18	95%	Fail	Fail	0.002	2.390	0.470	0.343	0.260	0.510					0.343	1.000	0/2	0.111		
	PreDesign**	21	21	100%			0.066	0.424	0.195	0.129	0.018	0.133					0.129	0.998	0/2	0.097		
	* before 2/10/95																					
	** after 2/10/95																					
Cadmium	LCS	10	3	30%			0.00002	0.00084	0.00028	0.00020	0.00000	0.00026					0.00020				28	
	PreDesign	40	16	40%			0.00050	0.07800	0.00991	0.002	0.000	0.020					0.00200	0.944	0/5	0.048	1051	PASS
	PreDesign*	19	9	47%			0.001	0.078	0.015	0.0020	0.0008	0.0282					0.002	0.965	1/8	0.066	1542	PASS
	PreDesign**	21	7	33%			0.00050	0.02390	0.00568	0.002	0.000	0.007					0.00200	0.933	0/8	ND in R	618	PASS
	* before 2/10/95																					
	** after 2/10/95																					
Chromium	LCS	10	3	30%			0.0000	0.0025	0.0009	0.0009	0.0000	0.00083					0.0009				94	
	PreDesign	40	19	48%			0.002	0.478	0.046	0.004	0.008	0.087					0.004	0.986	0/5	0.048	4748	PASS
	PreDesign*	19	17	89%			0.004	0.478	0.093	0.051	0.012	0.110					0.051	1.000	0/8	0.066	9524	PASS
	PreDesign**	21	2	10%			0.002	0.012	0.004	0.004	0.000	0.002					0.004	0.592	0/8	ND in R	412	PASS
	* before 2/10/95																					
	** after 2/10/95																					
Cobalt	LCS	10	9	90%			0.0015	0.058	0.018	0.013	2.89E-04	0.017					0.013				4664	
	PreDesign	40	11	28%			0.002	0.382	0.025	0.006	0.004	0.062					0.006	0.276	1/5	0.048	2598	FAIL
	PreDesign*	19	10	53%			0.006	0.382	0.047	0.016	0.007	0.085					0.016	0.789	0/8	0.066		
	PreDesign**	21	1	5%			0.002	0.018	0.005	0.006	0.000	0.004					0.006	0.020	5/8	ND in R	589	FAIL
	* before 2/10/95																					
	** after 2/10/95																					
Copper	LCS	10	10	100%			0.00094	0.016	0.009	0.0107	0.0000	0.0056					0.011				903	
	PreDesign	40	16	40%			0.002	0.794	0.068	0.006	0.020	0.140					0.006	0.843	0/5	0.048	7273	PASS
	PreDesign*	19	15	79%			0.006	0.794	0.139	0.108	0.033	0.180					0.108	0.999	0/8	0.066		
	PreDesign**	21	1	5%			0.002	0.017	0.005	0.006	0.000	0.003					0.006	0.150	3/8	ND in R	959	PASS
	* before 2/10/95																					
	** after 2/10/95																					
Nickel	LCS	10	10	**100%**	Pass	**Pass**	0.012	0.054	0.032	0.030	0.000	0.014	-3.56	0.497			0.030				3148	
	PreDesign	40	20	50%			0.003	0.978	0.089	0.015	0.030	0.173					0.015	0.353	0/3	0.098		
	PreDesign*	19	16	**84%**	Fail	**Pass**	0.007	0.978	0.175	0.122	0.050	0.224	-2.35	1.189	0.011	0.998	0.122	0.996	0/8	0.066		
	PreDesign**	21	4	19%			0.003	0.045	0.011	0.007	0.000	0.013					0.007	**0.001**	**5/8**	**0.048**	1180	FAIL
	* before 2/10/95																					
	** after 2/10/95																					
Selenium	LCS	10	3	30%			0.0005	0.017	0.004	0.0023	0.0000	0.0050					0.0023				4353	
	PreDesign	40	12	30%			0.001	0.016	0.004	0.0025	0.0000	0.0030					0.0025	0.358	2/5	ND in R	3941	FAIL
	PreDesign*	19	7	37%			0.0005	0.016	0.004	0.0025	0.0000	0.0035					0.0025	0.418	3/8	ND in R	4134	FAIL
	PreDesign**	21	5	24%			0.002	0.010	0.004	0.0025	0.0000	0.0025					0.0025	0.336	3/8	ND in R	3794	FAIL
	* before 2/10/95																					
	** after 2/10/95																					
Technetium-99	LCS	23	6	26%			0.000	18.280	1.810	3.954	25.183	5.018					3.954				9096	
	Background PW	22	0	0%			15.000	15.000	15.000	15.000	- -	- -					15.000	0.505	0/5	ND in R	34959	PASS
	Background GW	114	1	1%			15.000	36.000	15.000	15.207	3.902	1.975					15.207	0.528	0/5	ND in R	35317	PASS
TDS	LCS	21	21	100%	Pass	Pass	1792.000	2660.000	2340.000	2291.714	50279.614	224.231					2291.714					
	Background GW	23	23	100%	Pass	Fail	318.000	673.000	484.000	480.217	11976.723	109.438			0.002	0.000	480.217	**0.000**	**6/6**	**0.074**		
Zinc	LCS	10	7	70%			0.001	0.575	0.089	0.027	0.030	0.174					0.027				7639	
	PreDesign	40	20	50%			0.002	1.860	0.136	0.006	0.102	0.320					0.006	0.442	1/3	0.098		
	PreDesign*	19	17	89%			0.003	1.860	0.282	0.113	0.179	0.423					0.113	0.984	1/8	0.066		
	PreDesign**	21	3	14%			0.002	0.016	0.004	0.003	0.000	0.003					0.003	**0.014**	7/8	ND in R	384	FAIL
	* before 2/10/95																					
	** after 2/10/95																					

Color Codes

- LCS Poisson summation
- No significant difference (Pass)
- LCS significantly GREATER than PreDesign (Fail)
- LCS data
- Post 2/10/95 data (suggested comparison)
- Pass Normality/Lognormality test
- Fail Normality/Lognormality test - **can not use t-Test**

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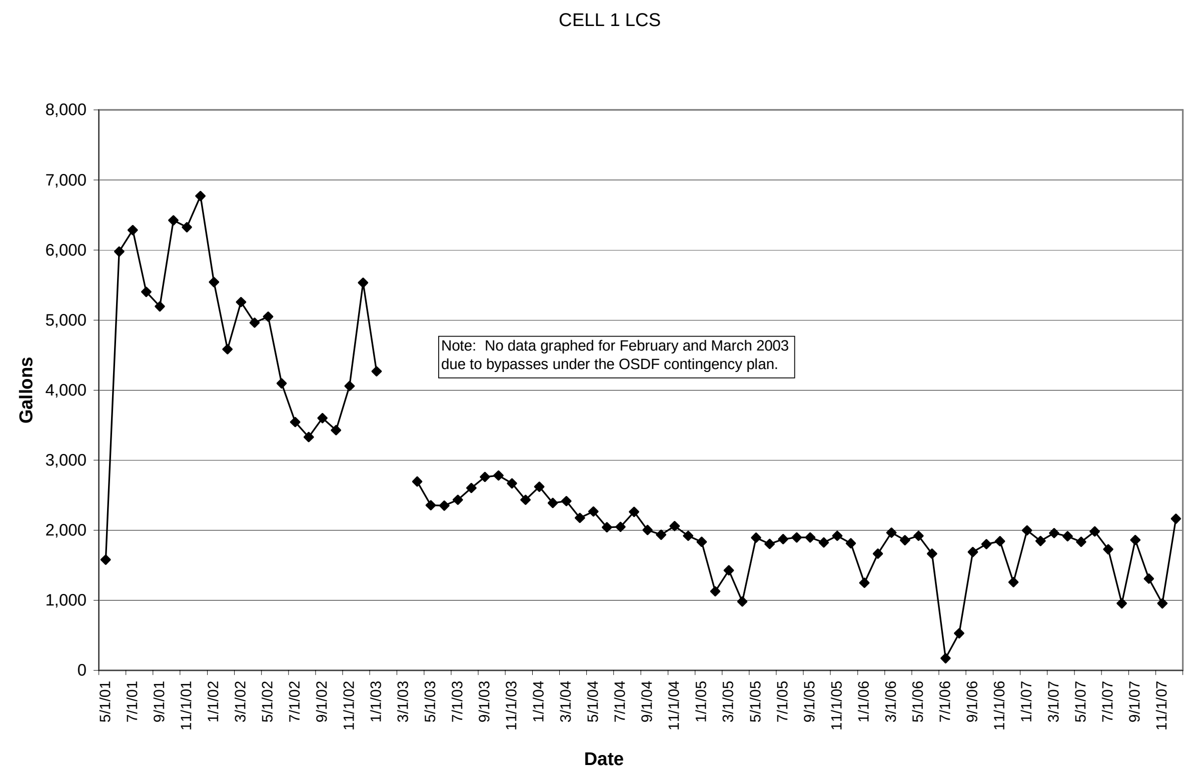


FIGURE A.5.1-1. MONTHLY ACCUMULATION VOLUMES FOR CELL 1 LCS

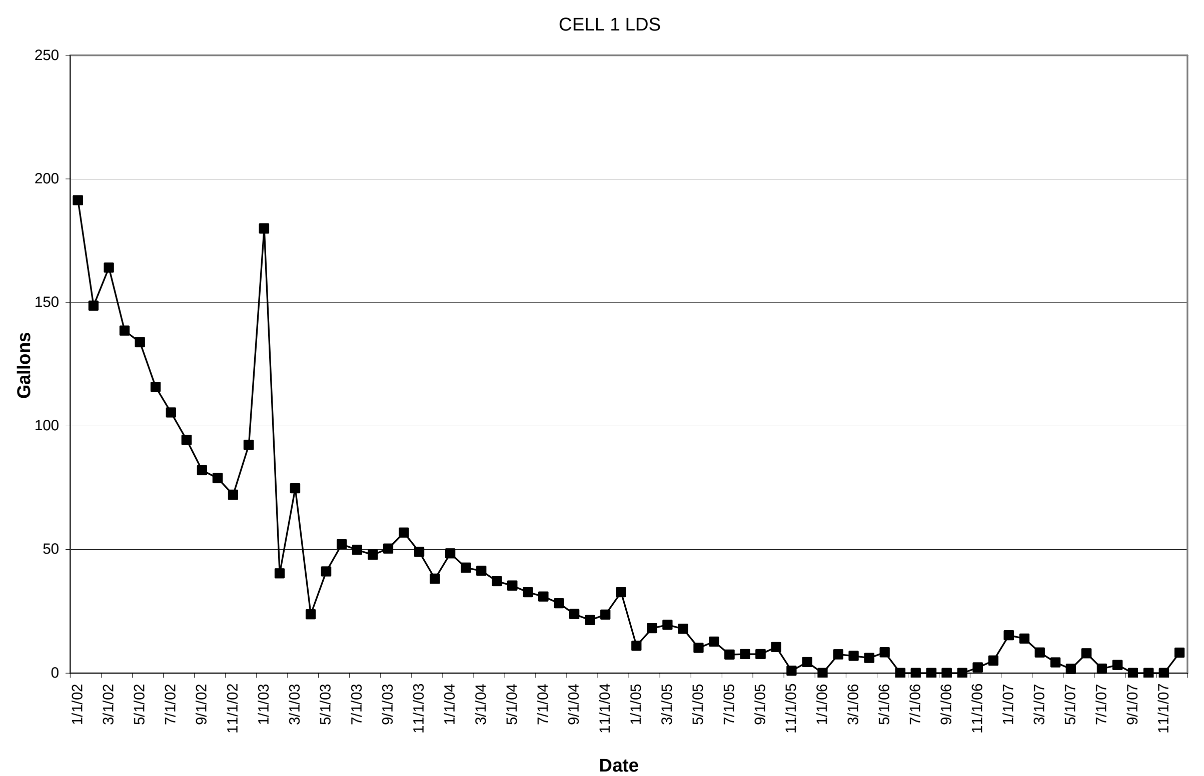
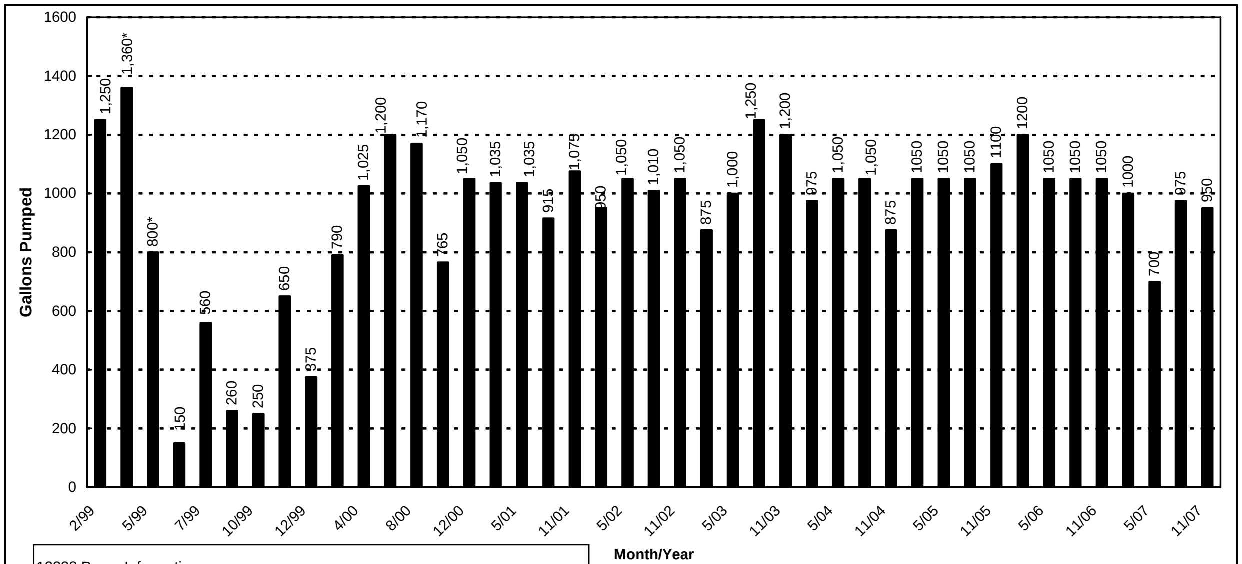


FIGURE A.5.1-2. MONTHLY ACCUMULATION VOLUMES FOR CELL 1 LDS



12338 Purge Information

Year	Total Volumes (gal.)	Months Purged	Avg. Monthly Purge (gal.)
1999:	5655	n=9	628
2000:	6000	n=6	1000
2001:	4060	n=4	1015
2002:	4060	n=4	1015
2003:	4325	n=4	1081
2004:	3950	n=4	988
2005	4250	n=4	1063
2006	4350	n=4	1088
2007	3625	n=4	906
Overall:			937

*More than one purge of the well was completed during these months to help evaluate well yield.

FIGURE A.5.1-3. OSDF HORIZONTAL TILL WELL 12338 (CELL 1) WATER YIELD

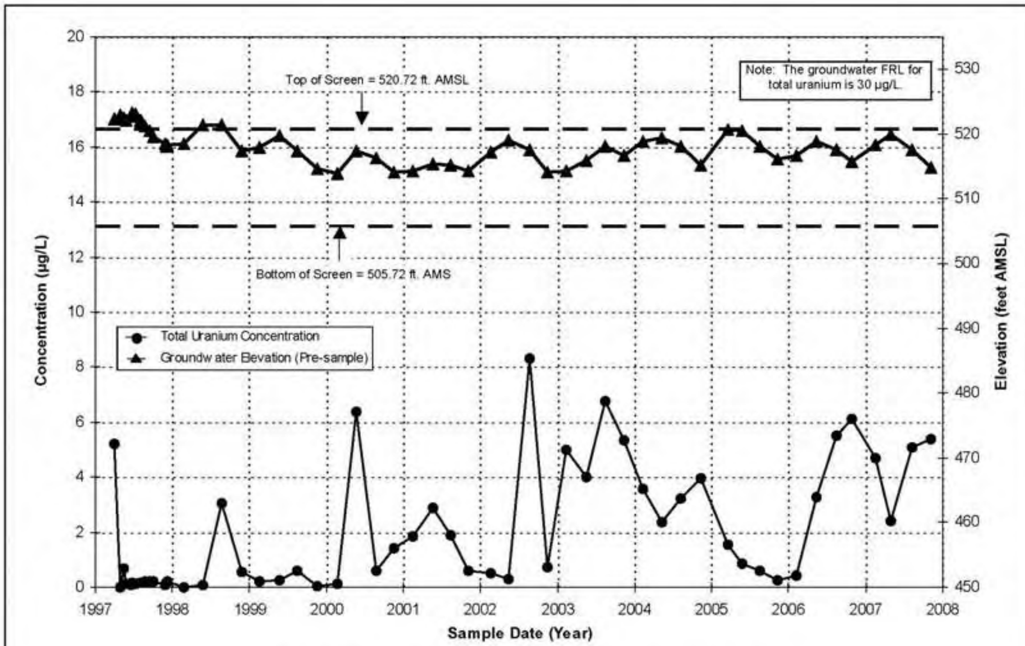


Figure A.5.1-4. Total Uranium Concentration and Groundwater Elevation vs. Time Plot for Cell 1 Upgradient Monitoring Well 22201

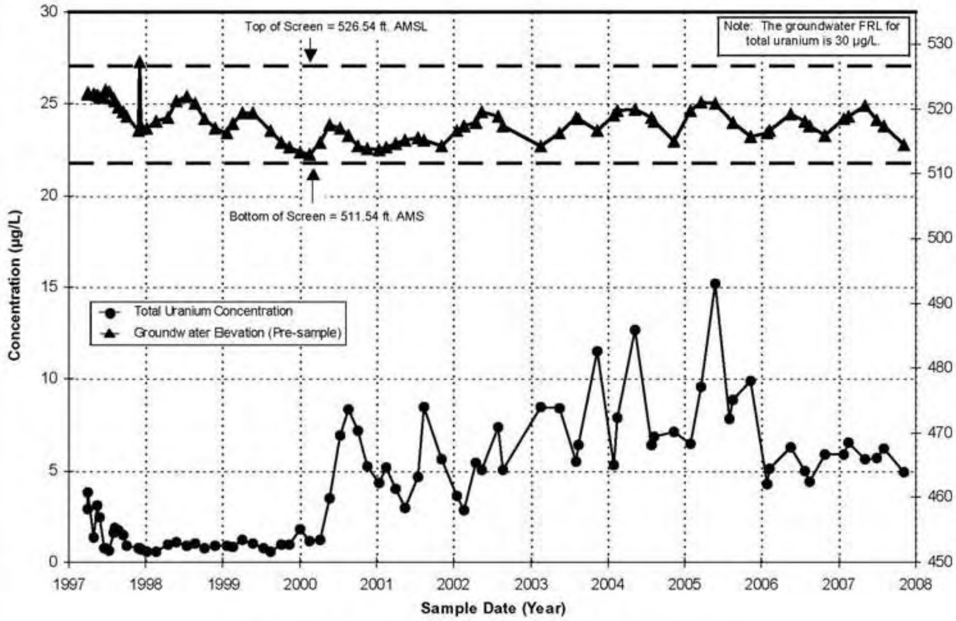


Figure A.5.1-5. Total Uranium Concentration and Groundwater Elevation vs. Time Plot for Cell 1 Downgradient Monitoring Well 22198

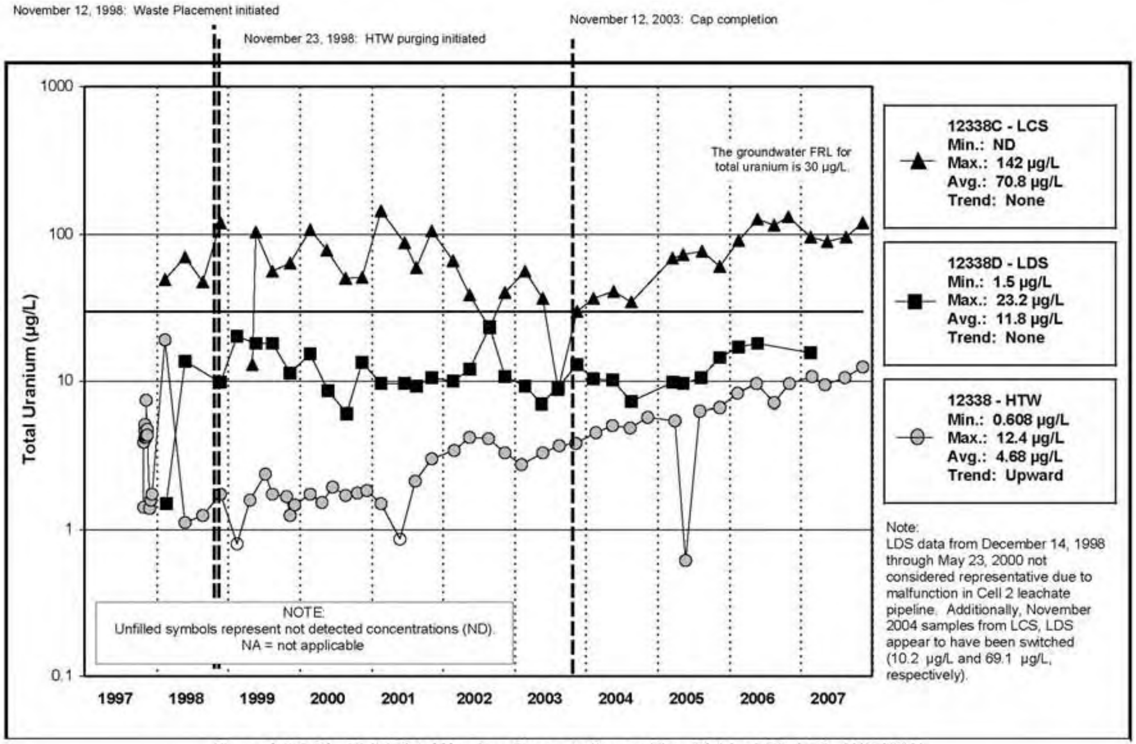


Figure A.5.1-6A. Cell 1 Total Uranium Concentration vs. Time Plot for LCS, LDS, AND HTW

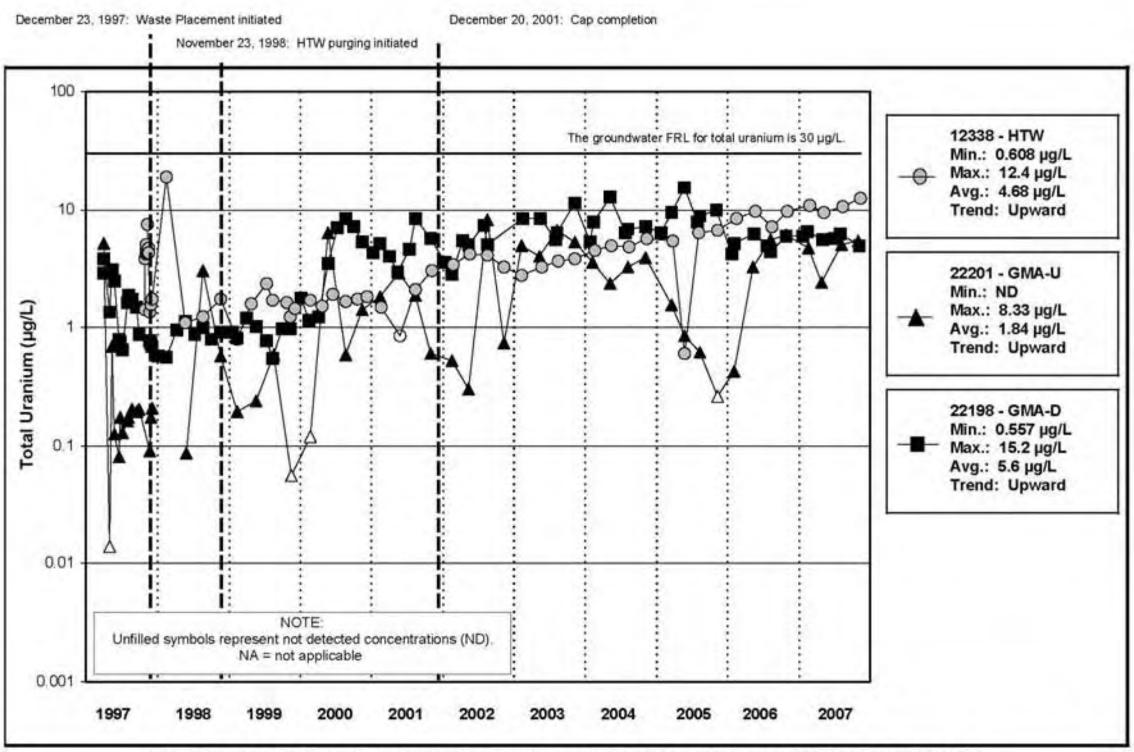


Figure A.5.1-6B. Cell 1 Total Uranium Concentration vs. Time Plot for HTW, GMA-U Well, AND GMA-D Well

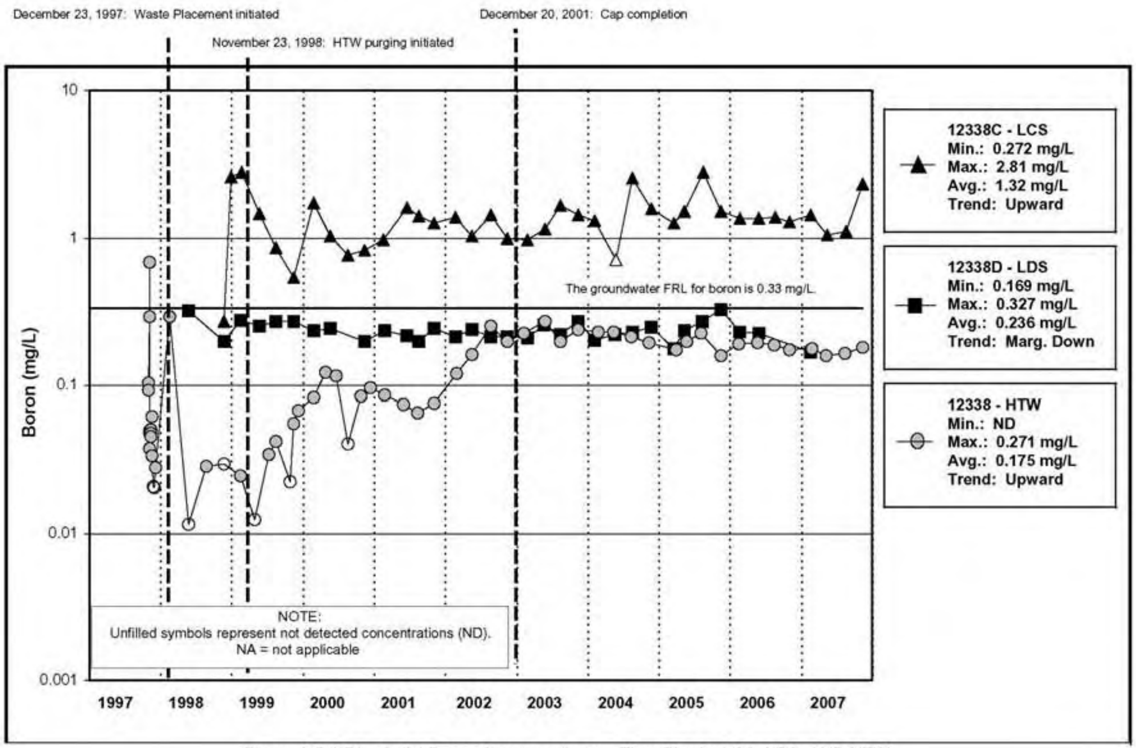


Figure A.5.1-7A. Cell 1 Boron Concentration vs. Time Plot for LCS, LDS, AND HTW

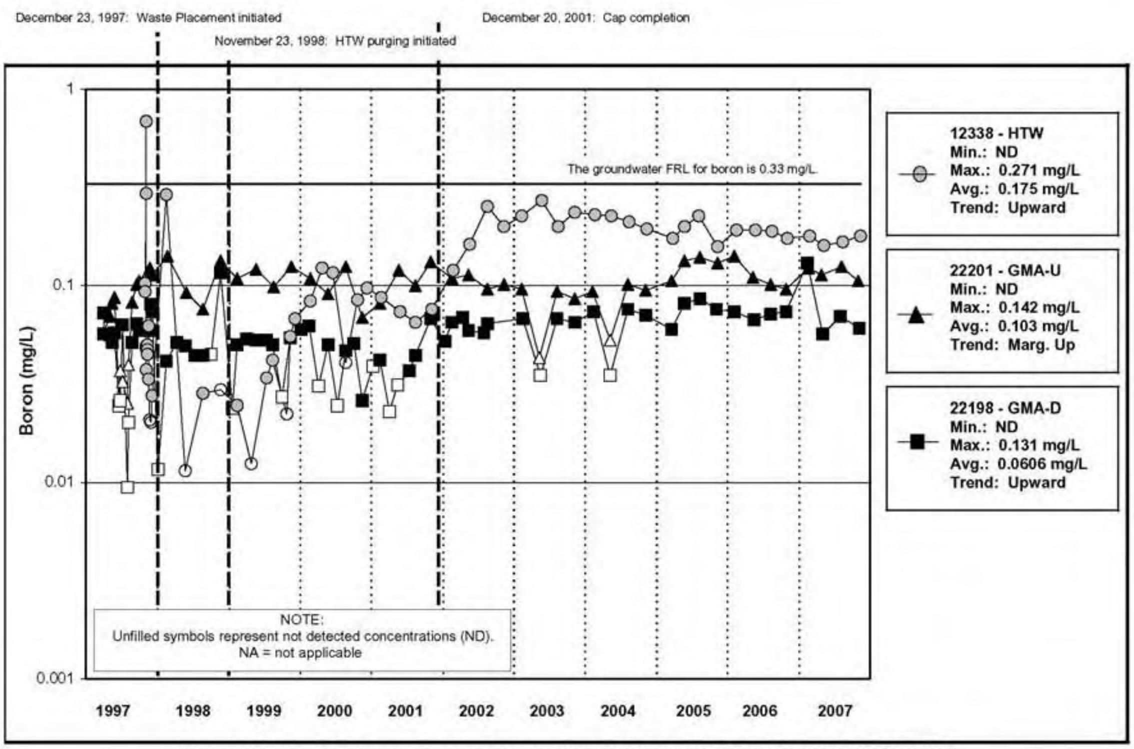


Figure A.5.1-7B. Cell 1 Boron Concentration vs. Time Plot for HTW, GMA-U Well, AND GMA-D Well

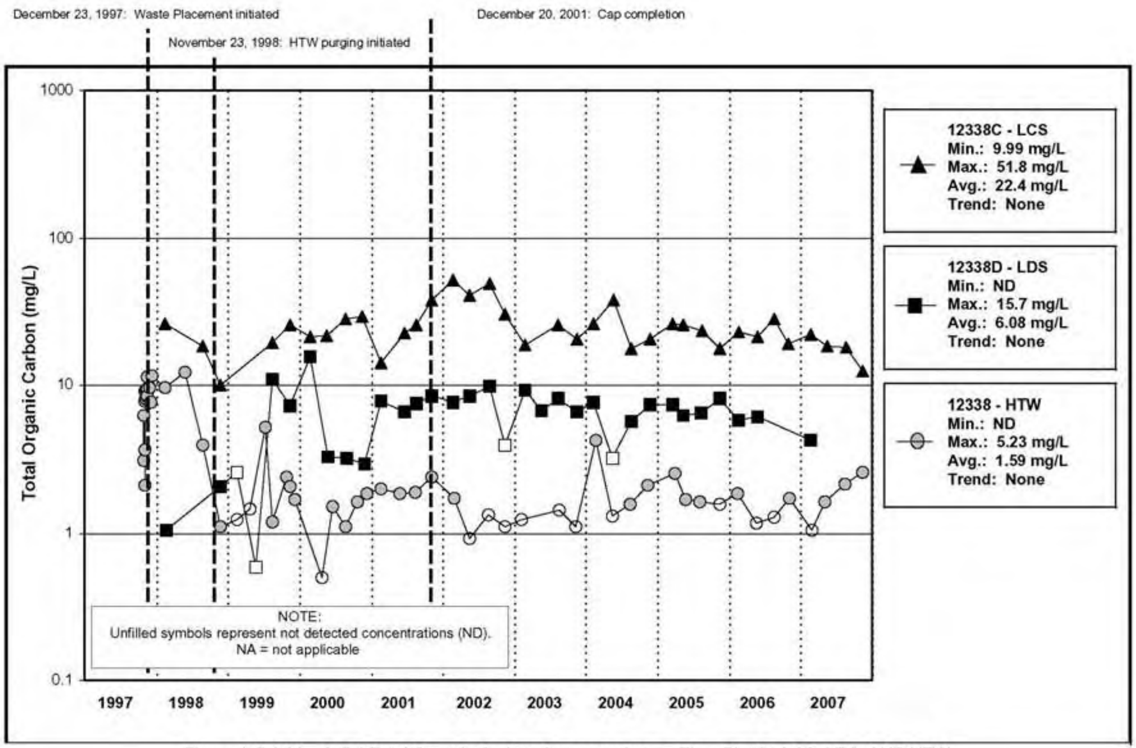


Figure A.5.1-8A. Cell 1 Total Organic Carbon Concentration vs. Time Plot for LCS, LDS, AND HTW

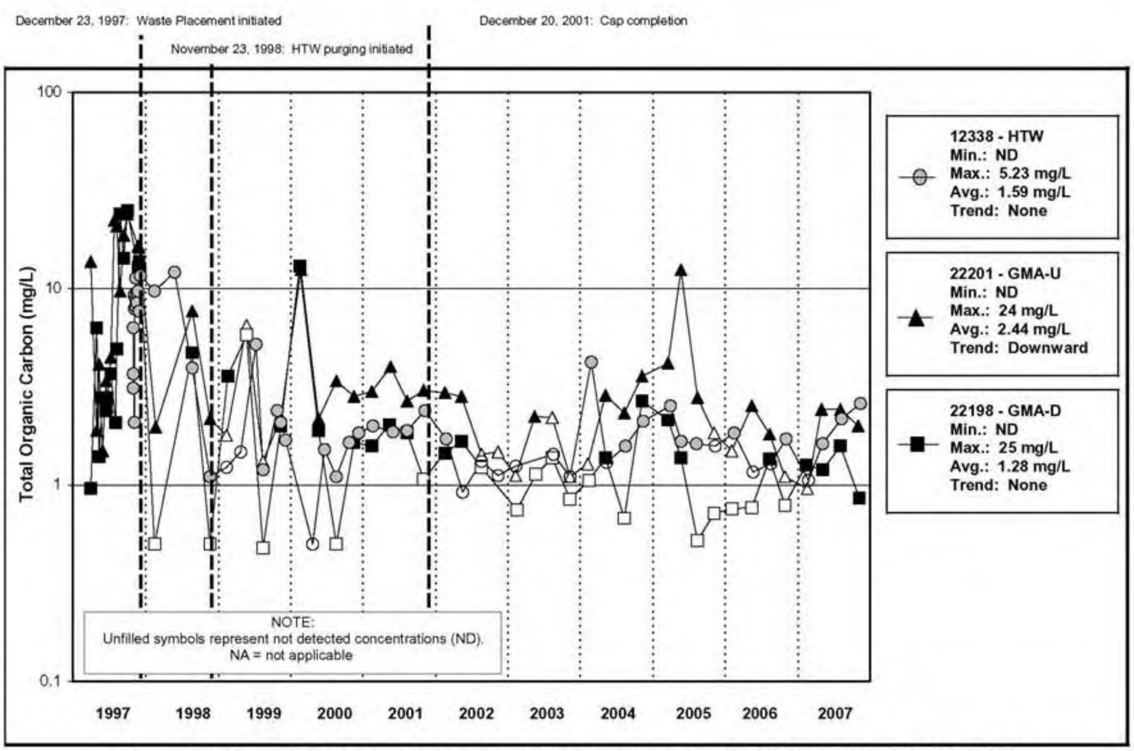


Figure A.5.1-8B. Cell 1 Total Organic Carbon Concentration vs. Time Plot for HTW, GMA-U Well, AND GMA-D Well

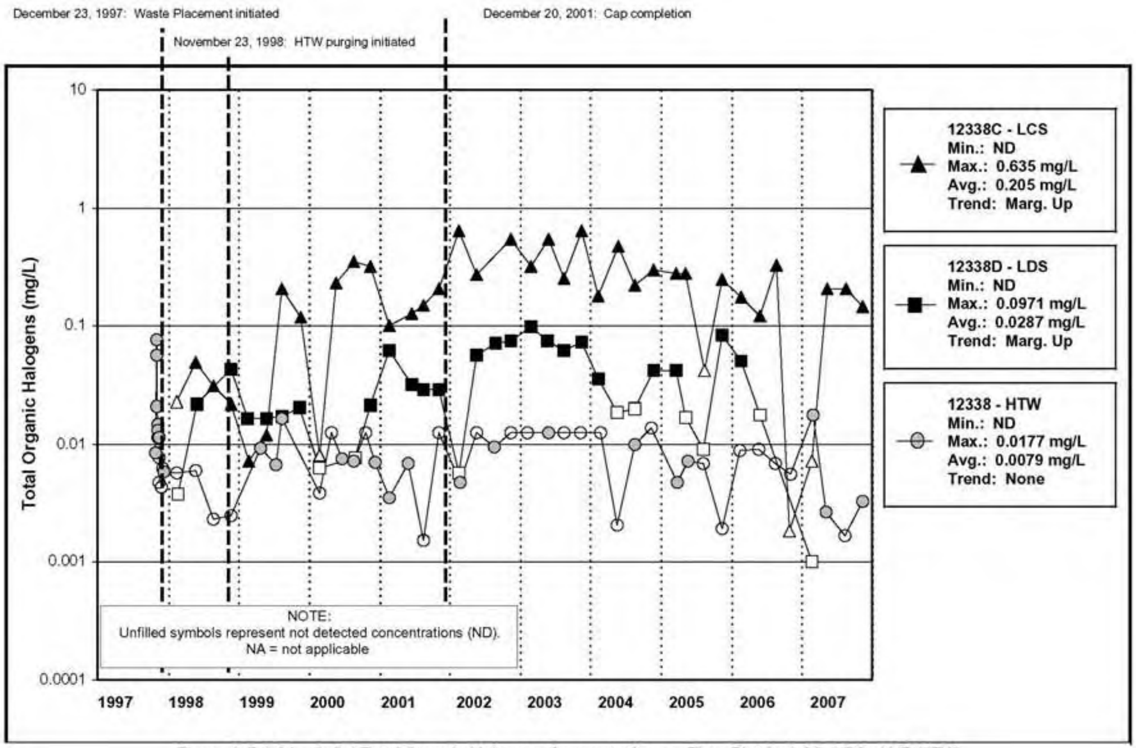


Figure A.5.1-9A. Cell 1 Total Organic Halogens Concentration vs. Time Plot for LCS, LDS, AND HTW

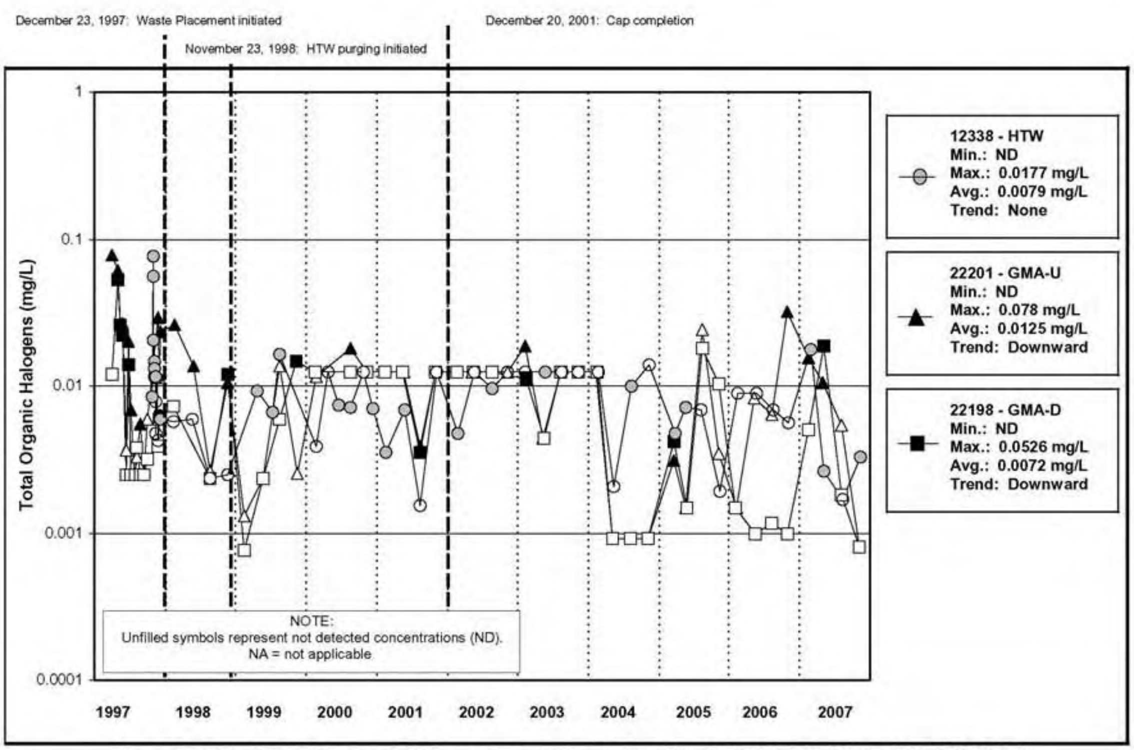


Figure A.5.1-9B. Cell 1 Total Organic Halogens Concentration vs. Time Plot for HTW, GMA-U Well, AND GMA-D Well

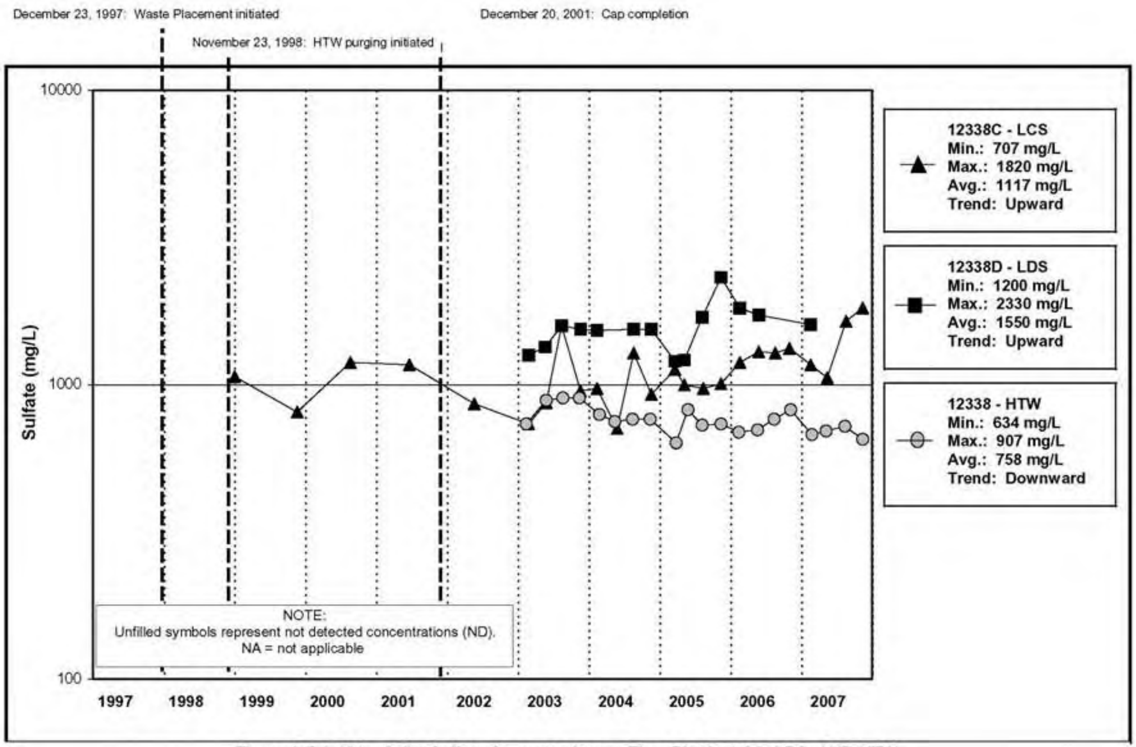


Figure A.5.1-10A. Cell 1 Sulfate Concentration vs. Time Plot for LCS, LDS, AND HTW

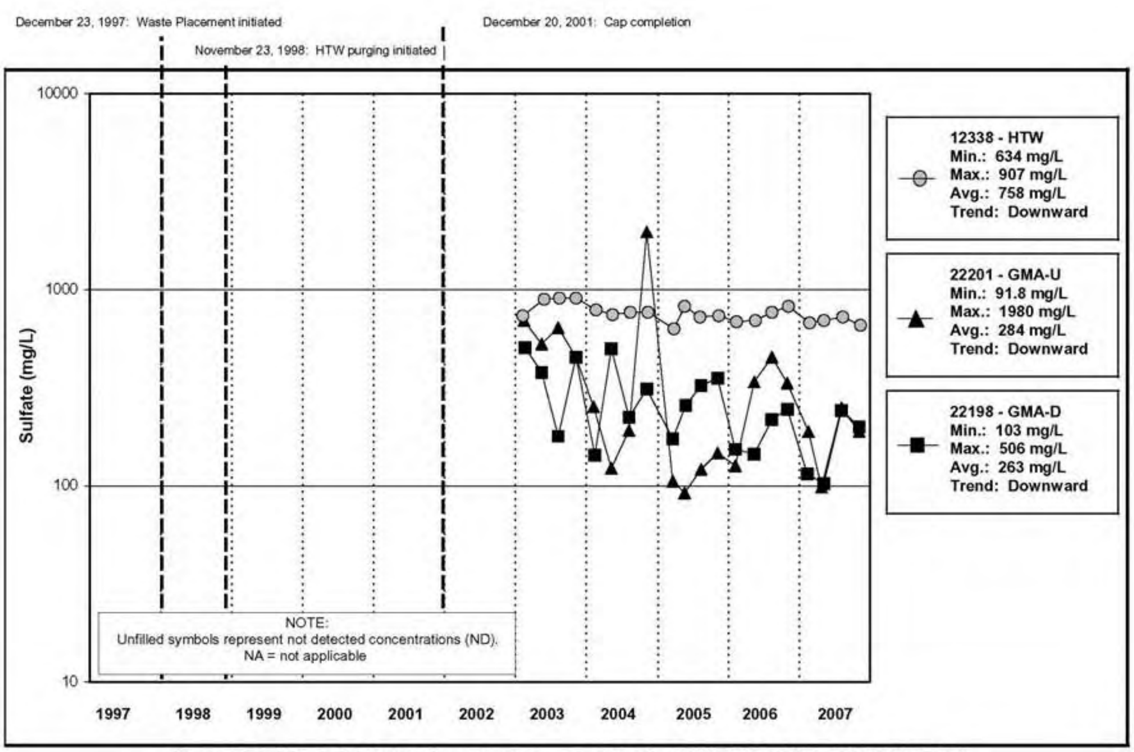


Figure A.5.1-10B. Cell 1 Sulfate Concentration vs. Time Plot for HTW, GMA-U Well, AND GMA-D Well

Sub-Attachment A.5.2

Cell 2

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The following information is provided in this sub-attachment:

- LCS monthly accumulation volumes (refer to Figure A.5.2−1)
- LDS monthly accumulation volumes (refer to Figure A.5.2−2)
- Monthly liner efficiencies (refer to Table A.5.2−1)
- HTW Water Yield (refer to Figure A.5.2−3)
- Great Miami Aquifer water levels and uranium concentrations versus time (refer to Figures A.5.2−4 and A.5.2−5)
- Summary statistics for refined baseline constituents (refer to Section A.5.2.1 and Table A.5.2−2)
- Concentration plots for refined baseline constituents (refer to Section A.5.2.1 and Figures A.5.2−6A through A.5.2−10B)
- Annual LCS monitoring results (refer to Section A.5.2.2 and Table A.5.2−3)
- Annual LDS monitoring results (refer to Section A.5.2.3)
- Potential site-specific leak detection monitoring constituents' statistics (refer to Table A.5.1-4).

Samples for the OSDF monitoring horizons were collected according to the frequencies described in the OSDF GWLMP. Constituent sampling lists are provided in Table 2−1, Table 2−2, and Table 2−3 of Appendix B of the OSDF GWLMP. In 2007, the Cell 2 LDS was dry during all four sampling quarters. All samples were collected from the other Cell 2 monitoring horizons.

A.5.2.1 Refined Baseline Monitoring Results

Refined baseline constituents are those constituents that have been sampled at least eight times, and detected at least 25 percent of the time in the LCS, LDS, HTW, and GMA wells. Refined baseline constituents are listed in Table 2−3 of Appendix B of the OSDF GWLMP. Also included in Table 2−3 are common ion constituents. A summary statistics table for Cell 2 (Table A.5.2−2) and concentration plots (Figures A.5.2−6A through A.5.2−10B) are provided for the five refined baseline constituents of Cell 2: total uranium, boron, TOC, TOX, and sulfate.

A.5.2.2 LCS Monitoring Results

During active operations (pre-closure) Ohio Solid Waste Regulations (OAC 3745-27-19(M)(5)) require collection and analysis of leachate annually for Appendix I and PCB constituents listed in OAC 3745-27-10. The objective of the annual LCS sampling is to determine if the composition of the leachate within the facility is changing enough to impact monitoring activities beneath the facility. A list of annual LCS sampling constituents is provided in Table 2−2 of Appendix B of the OSDF GWLMP. In 2007, annual sampling of the Cell 2 LCS took place in May. Table A.5.2−3 summarizes the annual LCS sampling results for Cell 2, along with the data collected in previous years.

Of the non-refined site specific baseline constituents that have been sampled at least eight times in Cell 2, 24 have been detected at least 25 percent of the time. Twelve of the 24 constituents are common ion constituents (alkalinity, calcium, chloride, fluoride, iron, magnesium, manganese, nitrate/nitrite, phosphorous, potassium, silicon, and sodium). The other twelve are *potential* site specific leak detection monitoring constituents for Cell 2.

<u>Common Ions</u>

A common ion study was completed in 2007, and a report, *Fernald Site, Evaluation of Aqueous Ions in the Monitoring Systems of the On-site Disposal Facility*, was issued in March 2008. This report is currently undergoing review by the EPA and OEPA.

As discussed in Section A.5.2.2 the common ion study concluded that fluid volume appears to be the key monitoring constituent to indicate the potential for leachate migration from the OSDF, and the sampling of and analysis for indicator ions are useful only if the hydraulic conditions permit leachate to migrate.

The common ion study also concluded that no one ion can serve as a leak indicator for all cells of the disposal facility, but useful indicator ions for specific target horizons of each cell can be identified. Specifically, sulfate and manganese in the HTW and iron in the LDS were the only useful indicator constituents identified for the Cell 2 HTW and LDS, and that sufficient data exists to establish control charts for these three constituents at the same specified locations for Cell 2. In addition, no other useful common ion indicator constituents were found for Cell 2. Since sulfate is already included as a refined baseline constituent for Cell 2, it is recommended that manganese be added to the refined baseline constituent list for the Cell 2 HTW and iron be added to the refined baseline constituent list for the Cell 2 LDS. Also, control charts will be included in future SERs for sulfate and manganese in the Cell 2 HTW and iron in the Cell 2 LDS upon approval of the common ion study.

<u>Potential Site-Specific Leak Detection Monitoring Constituents</u>

The remaining twelve constituents (considered to be "*potential*" site-specific leak detection monitoring constituents for Cell 2) are ammonia, arsenic, barium, cadmium, chromium, cobalt, copper, nickel, selenium, thallium, total dissolved solids (TDS), and zinc. These potential Cell 2 site specific leak detection monitoring constituents were assessed using the statistical approach presented in Figures A.5−4A and A.5−4B, and discussed in Section A.5.2.2. Results of the assessment are presented in Table A.5.2−4.

The objective of the statistical approach is to determine if the mean concentration of a particular LCS monitored constituent, that has been sampled more than eight times and detected more than 25 percent of the time, is statistically greater than the mean concentration of either the pre-design or background data for the constituent. If the mean is greater, then the constituent could be a useful monitoring constituent for the OSDF.

As outlined in Figure A.5−4B, the statistical approach consists of three routes.

- If the LCS data set has 0-15 percent non-detects a t-Test is used.
- If the LCS data set has greater than 15 percent non-detects but less than 50 percent non-detects a Wilcoxen Rank Sum and Quantile Test is used.

- If the LCS data set has greater than 50 percent non-detects a Poisson Prediction Limits Test is used.

The null hypothesis used for each test was that the mean concentration of the LCS data set was less than or equal to the mean of the pre-design or background data set. Therefore, failure of the null hypothesis for a specific constituent indicates that the mean of the LCS data set is greater than the mean of the pre-design or background data set.

Results for Cell 2 are presented in Table A.5.2−4. Out of the 12 constituents that were tested for Cell 2, six failed the null hypothesis indicating that they might be useful monitoring constituents.

- Arsenic – failed the Poisson Prediction Limit Test
- Cobalt – failed the Poisson Prediction Limit Test
- Nickel – failed the Poisson Prediction Limit Test
- Selenium – failed the Poisson Prediction Limit Test
- TDS – failed the Wilcoxen an Quantile Test
- Zinc – failed the Poisson Prediction Limits Test

This is the first time that these results have been presented. These statistical results should therefore be considered preliminary. It is anticipated that EPA, OEPA, and DOE will work together over the next few months to discuss these results and decide on a path forward.

Confirmatory Sampling

Technetium-99 is a site specific leak detection constituent; however, it is not on the refined baseline list for Cell 2. If a site specific constituent (not on the refined baseline list) is detected in the LCS or LDS, then confirmatory sampling for that constituent will take place. As shown in Table A.5.2−3, technetium-99 has been detected in the Cell 2 LCS, but this detection occurred prior to the establishment of the refined baseline for Cell 2. Therefore, confirmatory sampling for technetium-99 in the Cell 2 LCS is not required.

A.5.2.3 LDS Monitoring Results

Each year the LDS of Cell 2 is sampled for site-specific baseline constituents listed in Table 2−1 of Appendix B of the OSDF GWLMP. The objective of the annual LDS sampling is to determine if any initial baseline constituents, not on the refined baseline list, are present in the LDS.

In 2007, annual sampling of the Cell 2 LDS was scheduled for May. In May the LDS was dry. Two other attempts were made in 2007 to sample the LDS for Table 2−1 constituents (August and November). The LDS was dry both times.

Table A.5.2−1. Cell 2 – 2007 Monthly Liner Efficiencies

Month	Cell 2 Apparent Liner Efficiency (%)
January	100.00
February	100.00
March	100.00
April	100.00
May	100.00
June	100.00
July	100.00
August	100.00
September	100.00
October	100.00
November	100.00
December	100.00

Table A.5.2−2. Summary Statistics for Cell 2

Parameter	Horizon[a]	Monitoring Location	No. of Detected Samples	Total No. of Samples	Percent of Detects	Average[b]	Distribution Type[c]	Trend[d]	Serial Correlation[e]	Outliers[f,g]						
Total Uranium (µg/L)	LCS	12339C	35	35	100	62.1	Lognormal	Up	Detected	197 (Q3-06)						
	LDS	12339D	23	23	100	14.5	Normal	None	Detected	71 (Q4-98)	50.37 (Q1-99)	41.5 (Q2-99)				
	HTW	12339	36	37	97.3	6.25	Undefined	Up	Detected							
	GMA-U	22200	27	41	65.9	0.344	Lognormal	Up	Not Detected	0 (Q1-98)	0 (Q4-03)					
	GMA-D	22199	37	38	97.4	0.729	Undefined	None	Detected	0 (Q4-03)	6.41 (Q2-99)	8.77 (Q3-02)	11.826 (Q3-98)	12.1 (Q3-99)		
Boron (mg/L)	LCS	12339C	37	37	100	1.72	Undefined	Up	Detected							
	LDS	12339D	21	21	100	0.386	Lognormal	None	Not Detected	0.841 (Q2-99)	0.865 (Q2-04)	0.904 (Q4-98)	2.22 (Q1-99)			
	HTW	12339	34	37	91.9	0.0812	Lognormal	Up	Detected							
	GMA-U	22200	31	43	72.1	0.0449	Normal	None	Marg. Detect							
	GMA-D	22199	34	43	79.1	0.0434	Normal	Up	Detected							
Total Organic Carbon (mg/L)	LCS	12339C	26	36	72.2	2.83	Lognormal	Up	Detected							
	LDS	12339D	15	23	65.2	3.15	Lognormal	Down	Detected	26.1 (Q3-99)	11.5 (Q1-00)					
	HTW	12339	21	34	61.8	1.67	Lognormal	Marg. Up	Not Detected	11.1 (Q1-00)						
	GMA-U	22200	24	36	66.7	1.5	Lognormal	None	Not Detected	5.44 (Q3-98)	7.84 (Q1-99)	11.5 (Q4-97)	14.4 (Q1-00)	15.3 (Q3-97)	16.2 (Q3-99)	40.1 (Q2-98)
	GMA-D	22199	21	37	56.8	1.39	Normal	None	Not Detected	9.68 (Q1-00)	10.5 (Q4-97)	16.5 (Q3-97)	48.1 (Q2-98)	3.5 (Q2-97)	3.7 (Q3-98)	
Total Organic Halogens (mg/L)	LCS	12339C	9	33	27.3	0.0125	Undefined	None	Detected	0.0576 (Q2-00)	0.0637 (Q2-06)	0.0715 (Q3-06)	0.0826 (Q4-06)			
	LDS	12339D	8	25	32	0.0123	Undefined	None	Not Detected	0.069 (Q2-00)						
	HTW	12339	25	37	67.6	0.0216	Undefined	None	Not Detected							
	GMA-U	22200	11	41	26.8	0.00725	Undefined	Down	Detected	0.124 (Q4-98)	0.177 (Q2-00)					
	GMA-D	22199	9	41	22	0.00835	Undefined	Down	Detected	0.0272 (Q1-99)	0.0775 (Q2-00)					
Sulfate (mg/L)	LCS	12339C	24	24	100	1380	Undefined	Up	Detected							
	LDS	12339D	8	8	100	2910	Normal	None	Insuff. Data	8110 (Q4-05)						
	HTW	12339	20	20	100	677	Lognormal	Down	Detected							
	GMA-U	22200	20	20	100	241	Normal	None	Not Detected							
	GMA-D	22199	19	19	100	205	Lognormal	None	Not Detected	540 (Q2-05)						

[a]LCS = leachate collection system; LDS = leak detection system; HTW = horizontal till well; GMA-U = upgradient Great Miami Aquifer; and GMA-D = downgradient Great Miami Aquifer

[b]Averages were determined based on the distribution assumption. "Approx. Normal" was treated as if it was normal, and "Approx. Lognormal" was treated as if it was lognormal. This was done to compensate for the skewed (lognormal) or non-skewed (normal) nature of the data to give a better estimate of the underlying average.

[c]Data distribution based on the Shapiro-Wilk statistic.

Normal: Normal assumption could not be rejected at the 5 percent level and has a higher probability value than the lognormal assumption.

Lognormal: Lognormal assumption could not be rejected at the 5 percent level and has a higher probability value than the normal assumption.

Approx. Normal (Approximately Normal): Normal and lognormal assumptions were rejected at the 5 percent level. However, the normal assumption was not rejected at the 10 % level. Additionally, for cases where neither assumption was rejected at the 10% level, the data fit the normal destribution better than the lognormal distribution.

Approx. Lognormal (Approximately Lognormal): Normal and lognormal assumptions were rejected at the 5 percent level. However, the lognormal assumption was not rejected at the 10 % level. Additionally, for cases where neither assumption was rejected at the 10% level, the data fit the lognormal destribution better than the normal distribution.

Undefined: Normal and Lognormal Distribution assumptions are both rejected or there are less than 25% detected values. "Average" is defined as the Median of the data.

[d]Trend based on nonparametric Mann-Kendall procedure. Note that "Marg. Down" is a marginally downward trend and "Marg. Up" is a marginally upward trend.

[e]Serial correlation based on Rank Von Neumann test. Note that "Insuff." = Insufficient.

[f]Outliers determined by Rosner's (for sample sizes greater than 25) or Dixon procedure (for sample sizes less than or equal to 25).

[g]Q = quarterly

Table A.5.2−3. Cell 2 Annual LCS Sample Summary

PARAMETER(UNIT)	NUMBER OF SAMPLES[a,b]	NUMBER OF SAMPLES WITH DETECTIONS[a,b]	PERCENT OF DETECTIONS[a,b]	MIN DETECTED CONCENTRATION[a,b,c]	MAX DETECTED CONCENTRATION[a,b,c]	AVG DETECTED CONCENTRATION[a,b,c]	GW FRL[d] (# OF SAMPLES>GWFRL)	GW BACKGROUND[a,b,e] (# OF SAMPLES>PW BACKGROUND)	PW BACKGROUND[a,b,e] (# OF SAMPLES>PW BACKGROUND)	MAX PW DETECTED CONCENTRATION [a,b,f] (# OF SAMPLES>MAX PW)	DETECTION LIMIT
Alkalinity as CaCO3 (mg/L)	16	16	100%	60.5	683	440	-	422 mg/L(10)	430 mg/L(10)	-	10 mg/L
Ammonia (mg/L)	10	3	30%	0.109	0.2	0.142	-	4.2 mg/L(0)	4.34 mg/L(0)	220 mg/L(0)	0.1 mg/L
Antimony (mg/L)	10	1	10%	0.00053	-	-	0.006 mg/L(0)	-	-	0.0987 mg/L(0)	0.005 mg/L
Arsenic (mg/L)	10	3	30%	0.00091	0.14	0.0619	0.05 mg/L(1)	0.029 mg/L(2)	0.019 mg/L(2)	0.191 mg/L(0)	0.02 mg/L
Barium (mg/L)	10	10	100%	0.0367	0.228	0.081	2 mg/L(0)	0.77 mg/L(0)	0.45 mg/L(0)	0.589 mg/L(0)	0.029 mg/L
Cadmium (mg/L)	10	3	30%	0.000091	0.00041	0.0003	0.014 mg/L(0)	0.014 mg/L(0)	-	0.05 mg/L(0)	0.002 mg/L
Calcium (mg/L)	16	16	100%	165	984	561	-	159 mg/L(16)	172 mg/L(15)	1800 mg/L(0)	5 mg/L
Chloride (mg/L)	16	16	100%	3.95	41.2	14.3	-	7.3 mg/L(15)	45 mg/L(0)	6300 mg/L(0)	5 mg/L
Chromium (mg/L)	10	4	40%	0.0009	0.0069	0.0038	0.022 mg/L[g](0)	0.021 mg/L(0)	0.0046 mg/L(2)	0.818 mg/L(0)	0.005 mg/L
Cobalt (mg/L)	10	6	60%	0.000283	0.17	0.0551	0.17 mg/L(0)	0.0086 mg/L(4)	-	0.0886 mg/L(2)	0.034 mg/L
Copper (mg/L)	10	9	90%	0.00093	0.0215	0.0083	1.3 mg/L(0)	0.035 mg/L(0)	0.029 mg/L(0)	0.298 mg/L(0)	0.008 mg/L
Fluoride (mg/L)	9	9	100%	0.092	0.245	0.173	4 mg/L(0)	0.89 mg/L(0)	1.3 mg/L(0)	6.8 mg/L(0)	0.2 mg/L
Iron (mg/L)	16	15	93.80%	0.088	253	56.9	-	5.72 mg/L(9)	6.35 mg/L(9)	21.3 mg/L(6)	0.1 mg/L
Lead (mg/L)	10	2	20%	0.0007	0.0046	0.0026	0.015 mg/L(0)	0.022 mg/L(0)	0.0016 mg/L(1)	0.0114 mg/L(0)	0.008 mg/L
Magnesium (mg/L)	16	16	100%	32.4	375	172	-	38.5 mg/L(15)	50.7 mg/L(14)	690 mg/L(0)	5 mg/L
Manganese (mg/L)	16	14	87.50%	0.0106	12.7	5.41	0.9 mg/L(10)	0.9 mg/L(10)	0.21 mg/L(10)	35 mg/L(0)	0.09 mg/L
Nickel (mg/L)	10	10	100%	0.00495	0.166	0.0503	0.1 mg/L(2)	0.0514 mg/L(4)	0.0072 mg/L(8)	0.981 mg/L(0)	0.02 mg/L
Nitrate/Nitrite (mg/L)	26	17	65.40%	0.039	4.1	1.69	11 mg/L[g](0)	11 mg/L(0)	0.29 mg/L(14)	2670 mg/L(0)	1.1 mg/L
Phosphorus (mg/L)	9	6	66.70%	0.0361	0.438	0.184	-	-	-	-	0.1 mg/L
Potassium (mg/L)	16	16	100%	3.93	32.3	18.2	-	1.96 mg/L(16)	17.2 mg/L(11)	12400 mg/L(0)	5 mg/L
Selenium (mg/L)	10	6	60%	0.00417	0.0422	0.015	0.05 mg/L(0)	0.00075 mg/L(6)	-	0.0494 mg/L(0)	0.005 mg/L
Silicon (mg/L)	9	9	100%	8.42	22.5	13.5	-	-	-	15 mg/L(3)	0.015 mg/L
Sodium (mg/L)	16	16	100%	3.32	26.7	14.5	-	47.1 mg/L(0)	50 mg/L(0)	1300 mg/L(0)	5 mg/L
Technetium-99 (pCi/L)	20	1	5%	21.25	-	-	94 pCi/L(0)	22 pCi/L(0)	30 pCi/L(0)	6130 pCi/L(0)	10 pCi/L
Thallium (mg/L)	10	3	30%	0.00057	0.0107	0.0041	-	-	-	0.0028 mg/L(1)	0.02 mg/L
TDS (mg/L)	20	20	100%	557	3220	1810	-	-	-	-	10 mg/L
Trichlorofluoromethane (µg/L)	10	1	10%	0.27	-	-	-	-	-	-	1 µg/L
Vanadium (mg/L)	10	2	20%	0.00158	0.0066	0.0041	0.038 mg/L(0)	0.012 mg/L(0)	0.005 mg/L(1)	0.299 mg/L(0)	0.02 mg/L
Zinc (mg/L)	10	4	40%	0.016	0.178	0.0796	0.021 mg/L(3)	0.02 mg/L(3)	0.35 mg/L(0)	1.78 mg/L(0)	0.015 mg/L

Note: Shading indicates that at least one detected sample is greater than the FRL, groundwater background, PW background, or PW maximum.

[a]If more than one sample is collected per well per day (e.g., duplicates), then only one sample is counted for the total number of samples, and the sample with the maximum representative concentration is used for all the summary information

[b]Rejected data qualified with an R or Z were not included.

[c]If the number of detected samples is equal to two, then the minimum and maximum are reported. If the number of detected is equal to one, then the data point is reported as the minimum. The "AVG DETECTED CONCENTRATION" is not reported for either of these cases.

[d]From Operable Unit 5 Record of Decision, Table 9-4.

[e]From the Characterization of Background Water Quality for Streams and Groundwater which was developed for Operable Unit 5 RI/FS documents.

[f]Max PW - maximum detected concentration in perched water as defined in the Remedial Investigation Report for Operable Unit 5.

[g]FRL based on hexavalent chromium and nitrate, from Operable Unit 5 Record of Decision, Table 9-4.

Table A.5.2−4. Parameter Selection Criteria - Statistical Comparison Of Leachate Collection System Data To Pre-Design Data For Cell 2

					I. t-Test												II. Wilcoxon + Quantile				III. Poisson PL	
Parameter	Dataset	Samples	Detects	Detect %	Shapiro-Wilk (N)	Shapiro-Wilk (LN)	Min	Max	Mean (mg/L)	Median	Variance	Std. Dev.	Log Mean	Log SD	F-Test	t-Test Prob	Median (mg/L)	Wilcoxon Prob	Quantile Test [q = .90]	Quantile Test Prob.	Poisson Prediction Limits (mg/L)	
Ammonia	LCS	10	3	30%			0.008	0.2	0.066	0.050	0.004	0.06					0.050				67	
	PreDesign	9	7	78%			0.015	450	54.980	0.604	22134.00	149					0.604	0.995	0/4	0.054	55619	PASS
	PreDesign+	7	5	71%			0.015	0.848	0.377	0.262	0.124	0.352					0.262	0.982	- -	insuf. data	440	PASS
	+ outliers removed																					
Arsenic	LCS	10	3	30%			0.000	0.140	0.020	0.002	0.002	0.044					0.002				1967	
	PreDesign	40	16	40%			0.001	0.072	0.011	0.004	0.000	0.016					0.004	0.647	2/5	0.048	1196	FAIL
	PreDesign*	19	14	74%			0.001	0.072	0.020	0.011	0.000	0.021					0.011	0.932	2/8	0.066	2077	PASS
	PreDesign**	21	2	10%			0.002	0.017	0.004	0.004	0.000	0.003					0.004	0.243	2/8	ND in R	405	FAIL
	* before 2/10/95																					
	** after 2/10/95																					
Barium	LCS	10	10	100%	Fail	Pass	0.037	0.228	0.081	0.061	0.003	0.056					0.061					
	PreDesign	40	39	98%	Fail	Fail (outlier?)	0.002	2.390	0.326	0.264	0.148	0.385					0.264	1.000	0/5	0.048		
	PreDesign*	19	18	95%	Fail	Fail	0.002	2.390	0.470	0.343	0.260	0.510					0.343	1.000	0/8	0.066		
	PreDesign**	21	21	100%	Fail	Fail	0.066	0.424	0.195	0.129	0.018	0.133					0.129	0.998	1/8	0.048		
	* before 2/10/95																					
	** after 2/10/95																					
Cadmium	LCS	10	3	30%			0.00005	0.00050	0.00024	0.00018	0.00000	0.00018					0.00018				243	
	PreDesign	40	16	40%			0.00050	0.07800	0.00991	0.002	0.000	0.020					0.00200	0.944	0/5	0.048	10100	PASS
	PreDesign*	19	9	47%			0.001	0.078	0.015	0.0020	0.0008	0.0282					0.002	0.919	0/8	ND in R	14854	PASS
	PreDesign**	21	7	33%			0.00050	0.02390	0.00568	0.002	0.000	0.007					0.00200	0.933	0/8	ND in R	5835	PASS
	* before 2/10/95																					
	** after 2/10/95																					
Chromium	LCS	10	4	40%			0.0001	0.0069	0.0020	0.0009	0.0000	0.00222					0.0009				203	
	PreDesign	40	19	48%			0.002	0.478	0.046	0.004	0.008	0.087					0.004	0.986	0/5	0.048	4279	PASS
	PreDesign*	19	17	89%			0.004	0.478	0.093	0.051	0.012	0.110					0.051	1.000	0/8	0.066	8578	PASS
	PreDesign**	21	2	10%			0.002	0.012	0.004	0.004	0.000	0.002					0.004	0.592	0/8	ND in R	372	PASS
	* before 2/10/95																					
	** after 2/10/95																					
Cobalt	LCS	10	6	60%			0.0002	0.170	0.033	0.00165	0.00401	0.0633					0.002				1993	
	PreDesign	40	11	28%			0.002	0.382	0.025	0.006	0.004	0.062					0.006	0.485	2/5	0.048	2598	PASS
	PreDesign*	19	10	53%			0.006	0.382	0.047	0.016	0.007	0.085					0.016	0.815	2/8	0.066		
	PreDesign**	21	1	5%			0.002	0.018	0.005	0.006	0.000	0.004					0.006	0.243	3/8	ND in R	589	FAIL
	* before 2/10/95																					
	** after 2/10/95																					
Copper	LCS	10	10	100%	Fail	Pass	0.00082	0.022	0.008	0.0057	0.0001	0.0076					0.006				756	
	PreDesign	40	16	40%			0.002	0.794	0.068	0.006	0.020	0.140					0.006	0.834	0/5	0.048	7273	PASS
	PreDesign*	19	15	79%	Fail	Fail+	0.006	0.794	0.139	0.108	0.033	0.180					0.108	0.999	0/8	0.066		
	PreDesign**	21	1	5%			0.002	0.017	0.005	0.006	0.000	0.003					0.006	0.136	3/8	ND in R	959	PASS
	* before 2/10/95				+ Pass using Regression Order Statistics																	
	** after 2/10/95																					
Nickel	LCS	10	10	**100%**	Fail	**Pass**	0.005	0.166	0.050	0.016	0.003	0.059	-3.715	1.312			0.016				5026	
	PreDesign	40	20	50%			0.003	0.978	0.089	0.015	0.030	0.173					0.015	0.582	0/5	0.048		
	PreDesign*	19	16	**84%**	Fail	**Pass**	0.007	0.978	0.175	0.122	0.050	0.224	-2.457	1.382	0.912	0.987	0.122	0.984	1/8	0.066		
	PreDesign**	21	4	19%			0.003	0.045	0.011	0.007	0.000	0.013					0.007	0.054	4/8	0.048	1180	FAIL
	* before 2/10/95																					
	** after 2/10/95																					
Selenium	LCS	10	6	60%			0.0013	0.042	0.010	0.0062	0.0002	0.0124					0.006				10442	
	PreDesign	40	12	30%			0.001	0.016	0.004	0.0025	0.0000	0.0030					0.002	0.195	4/5	ND in R	3941	FAIL
	PreDesign*	19	7	37%			0.0005	0.016	0.004	0.0025	0.0000	0.0035					0.002	0.253	6/8	ND in R	4134	FAIL
	PreDesign**	21	5	24%			0.002	0.010	0.004	0.0025	0.0000	0.0025					0.002	0.193	6/8	ND in R	3794	FAIL
	* before 2/10/95																					
	** after 2/10/95																					
Thalium	LCS	10	3	30%			0.000	0.011	0.002	0.001	0.000	0.003					0.001				1963	
	PreDesign	40	3	8%			0.001	0.020	0.003	0.004	0.000	0.003					0.004	0.367	1/5	ND in R	3426	PASS
	PreDesign*	19	1	5%			0.001	0.004	0.003	0.004	0.000	0.001					0.004	0.340	1/8	ND in R	2989	PASS
	PreDesign**	21	2	10%			0.002	0.020	0.004	0.004	0.000	0.004					0.004	0.425	1/8	ND in R	3848	PASS
	* before 2/10/95																					
	** after 2/10/95																					
TDS	LCS	20	20	100%	Fail	Fail	557.000	3220.000	1867.500	1810.500	827622.684	909.738					1810.500					
	Background GW	23	23	100%	Pass	Fail	318.000	673.000	484.000	480.217	11976.723	109.438					480.217	0.000	6/6	0.065		
Zinc	LCS	10	4	40%			0.001	0.178	0.034	0.008	0.003	0.059					0.008				659	
	PreDesign	40	20	50%			0.002	1.860	0.136	0.006	0.102	0.320					0.006	0.759	0/5	0.048	13840	PASS
	PreDesign*	19	17	89%			0.003	1.860	0.282	0.113	0.179	0.423					0.113	0.997	1/8	ND in R	28556	PASS
	PreDesign**	21	3	14%			0.002	0.016	0.004	0.003	0.000	0.003					0.003	0.095	5/8	ND in R	477	FAIL
	* before 2/10/95																					
	** after 2/10/95																					

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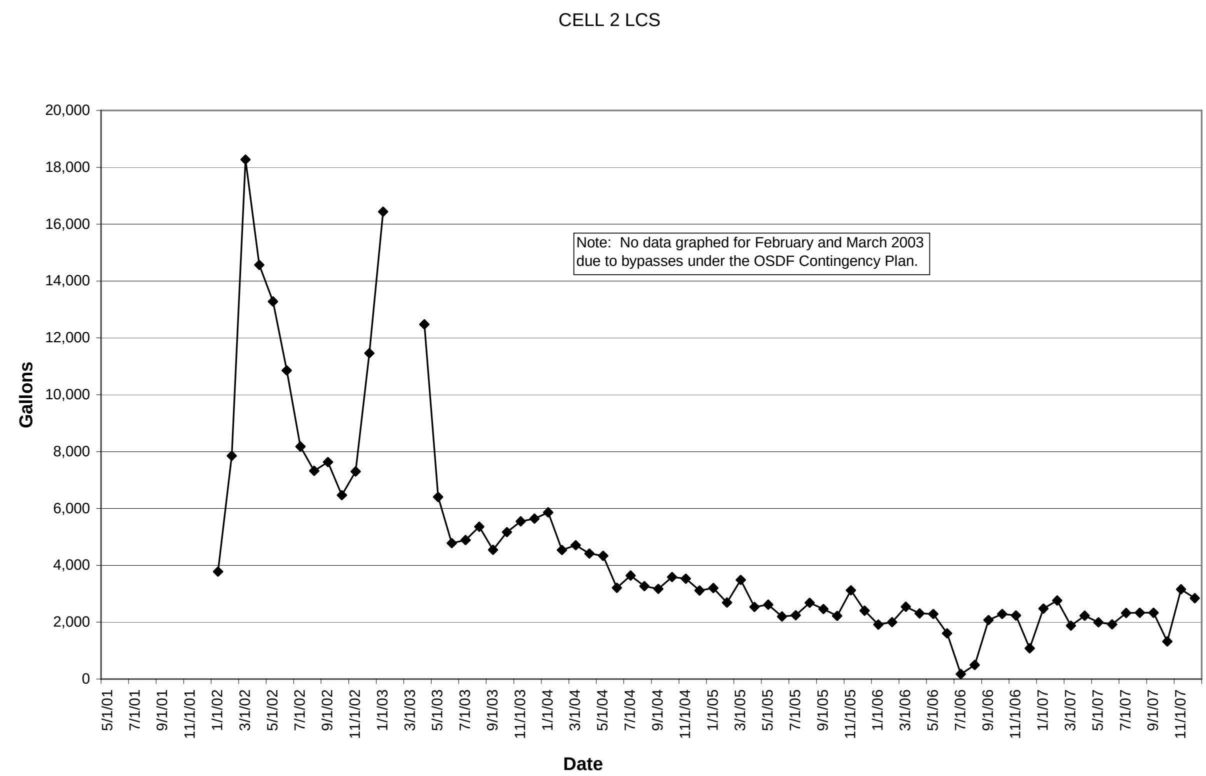


FIGURE A.5.2-1. MONTHLY ACCUMULATION VOLUMES FOR CELL 2 LCS

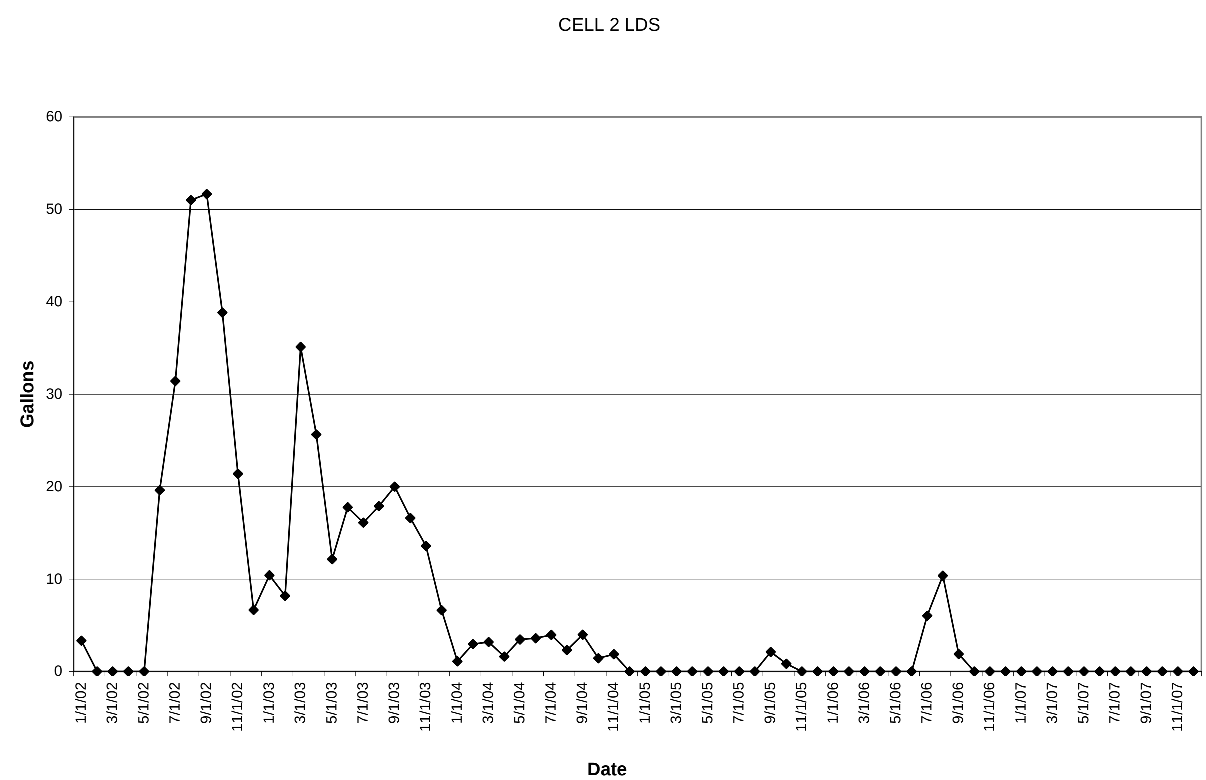
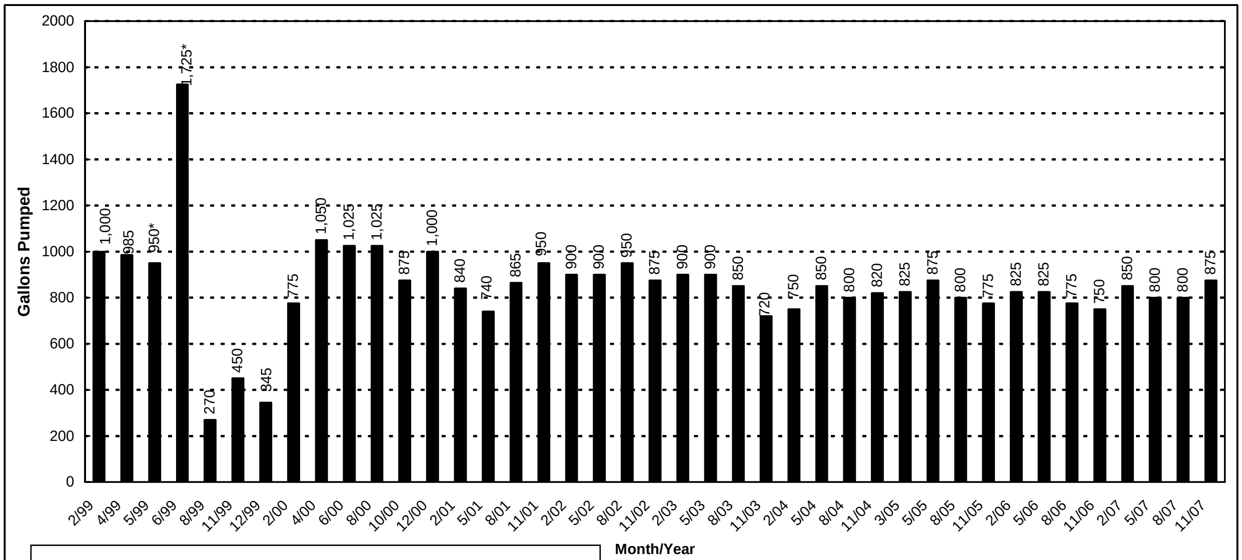


FIGURE A.5.2-2. MONTHLY ACCUMULATION VOLUMES FOR CELL 2 LDS



12339 Purge Information

Year	Total Volumes (gal.)	Months Purged	Avg. Monthly Purge (gal.)
1999:	5725	n=7	818
2000:	5750	n=6	958
2001:	3395	n=4	849
2002:	3625	n=4	906
2003:	3370	n=4	843
2004:	3220	n=4	805
2005:	3275	n=4	819
2006:	3175	n=4	1088
2007:	3325	n=4	831
Overall:			850

*More than one purge of the well was completed during these months to help evaluate well yield.

FIGURE A.5.2-3. OSDF HORIZONTAL TILL WELL 12339 (CELL 2) WATER YIELD

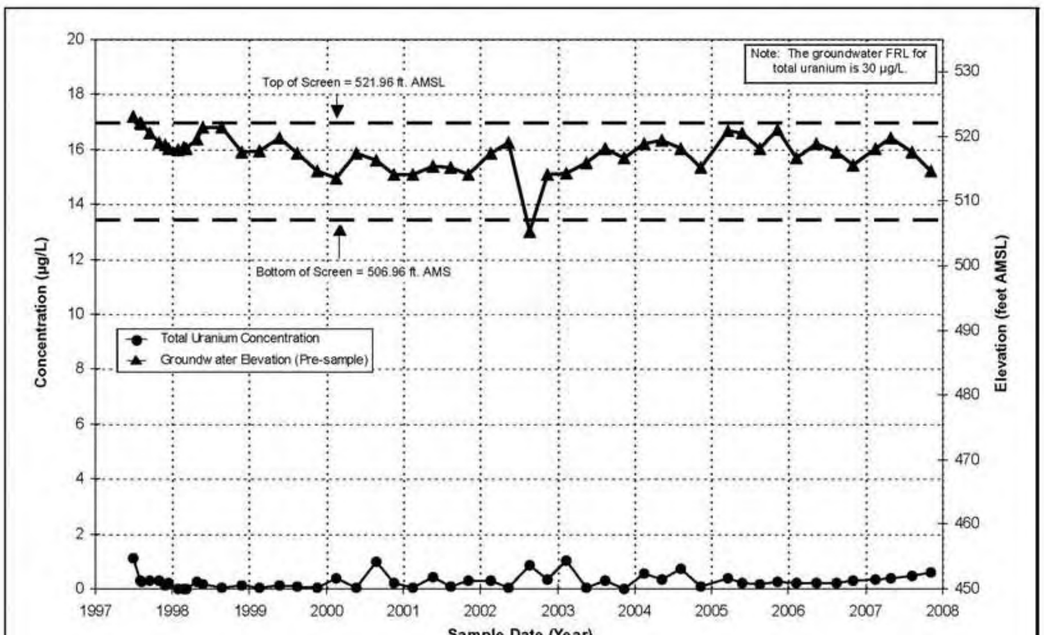


Figure A.5.2-4. Total Uranium Concentration and Groundwater Elevation vs. Time Plot for Cell 2 Upgradient Monitoring Well 22200

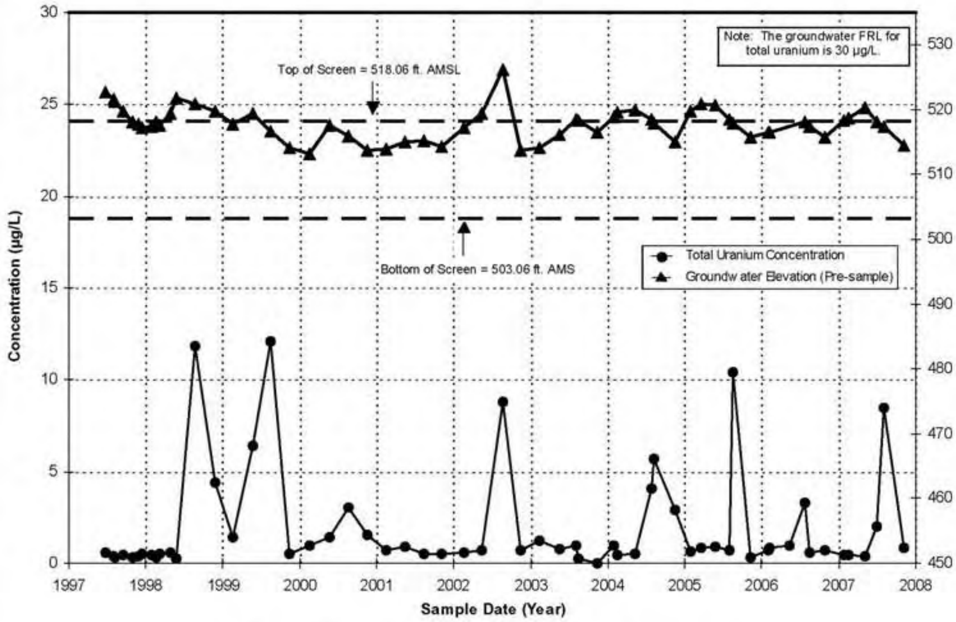


Figure A.5.2-5. Total Uranium Concentration and Groundwater Elevation vs. Time Plot for Cell 2 Downgradient Monitoring Well 22199

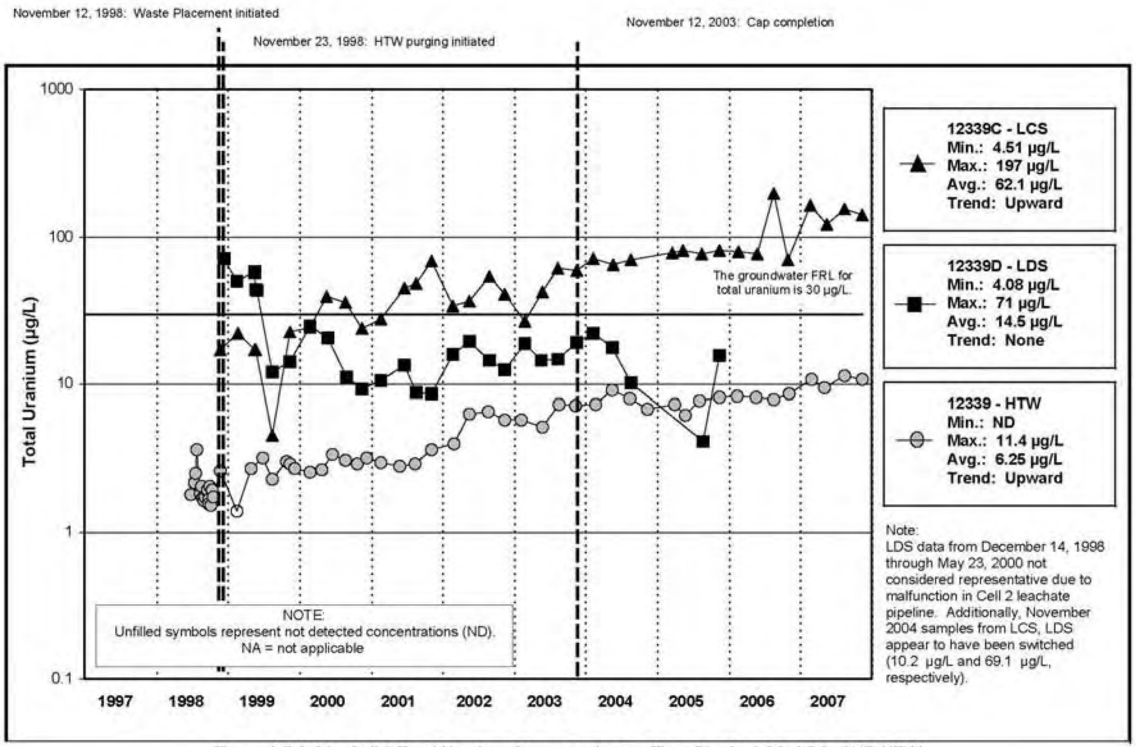


Figure A.5.2-6A. Cell 2 Total Uranium Concentration vs. Time Plot for LCS, LDS, AND HTW

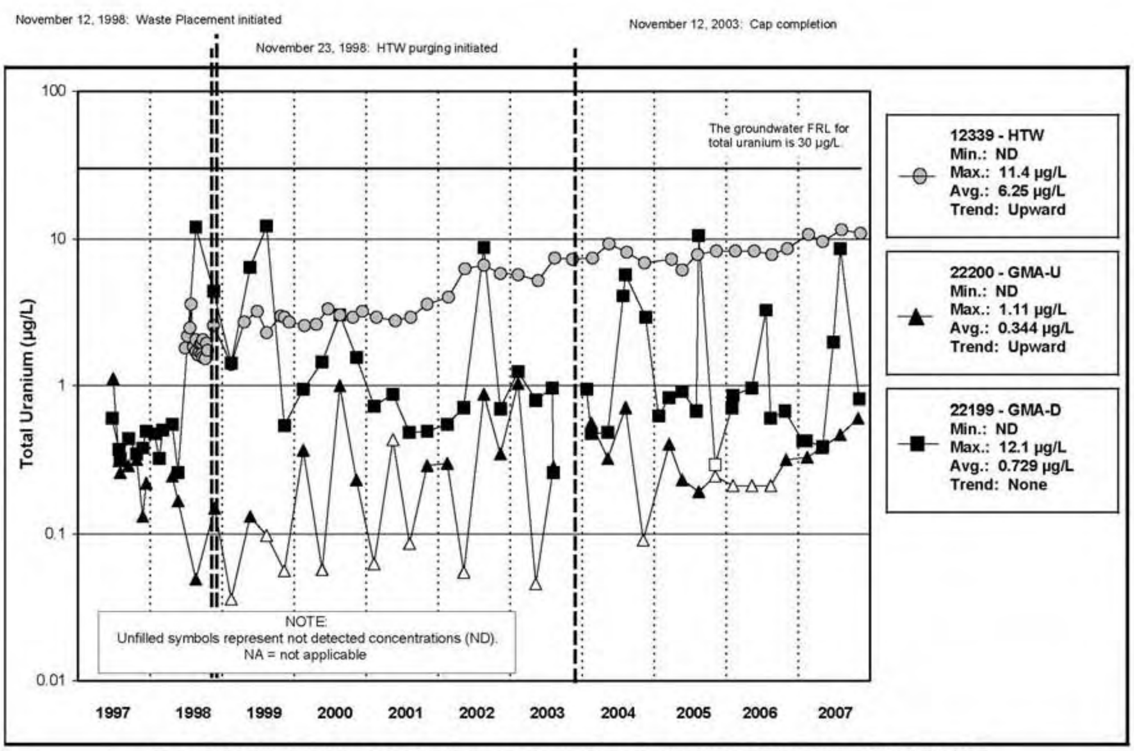


Figure A.5.2-6B. Cell 2 Total Uranium Concentration vs. Time Plot for HTW, GMA-U Well, AND GMA-D Well

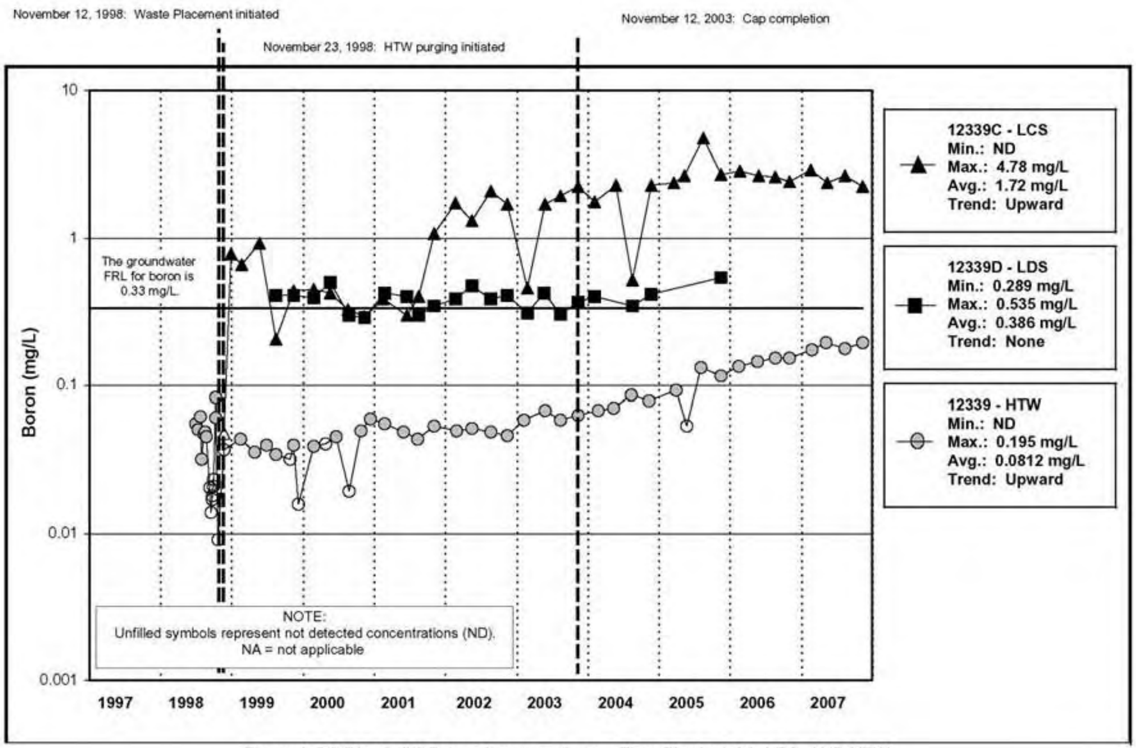


Figure A.5.2-7A. Cell 2 Boron Concentration vs. Time Plot for LCS, LDS, AND HTW

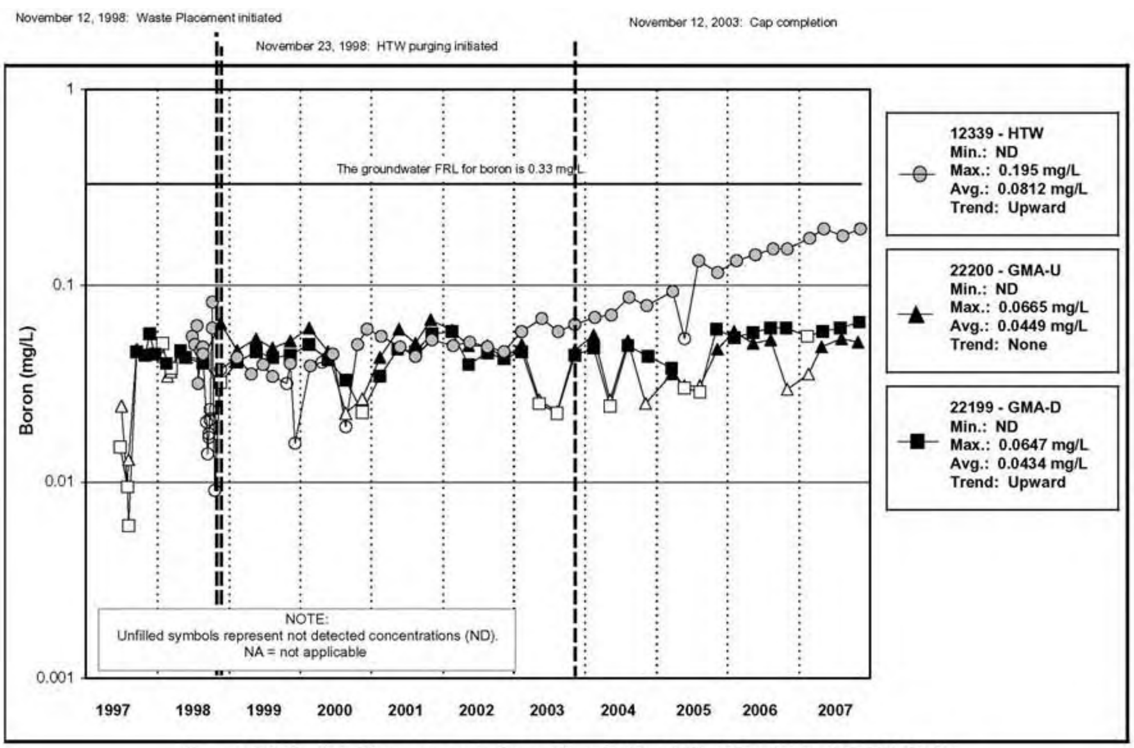


Figure A.5.2-7B. Cell 2 Boron Concentration vs. Time Plot for HTW, GMA-U Well, AND GMA-D Well

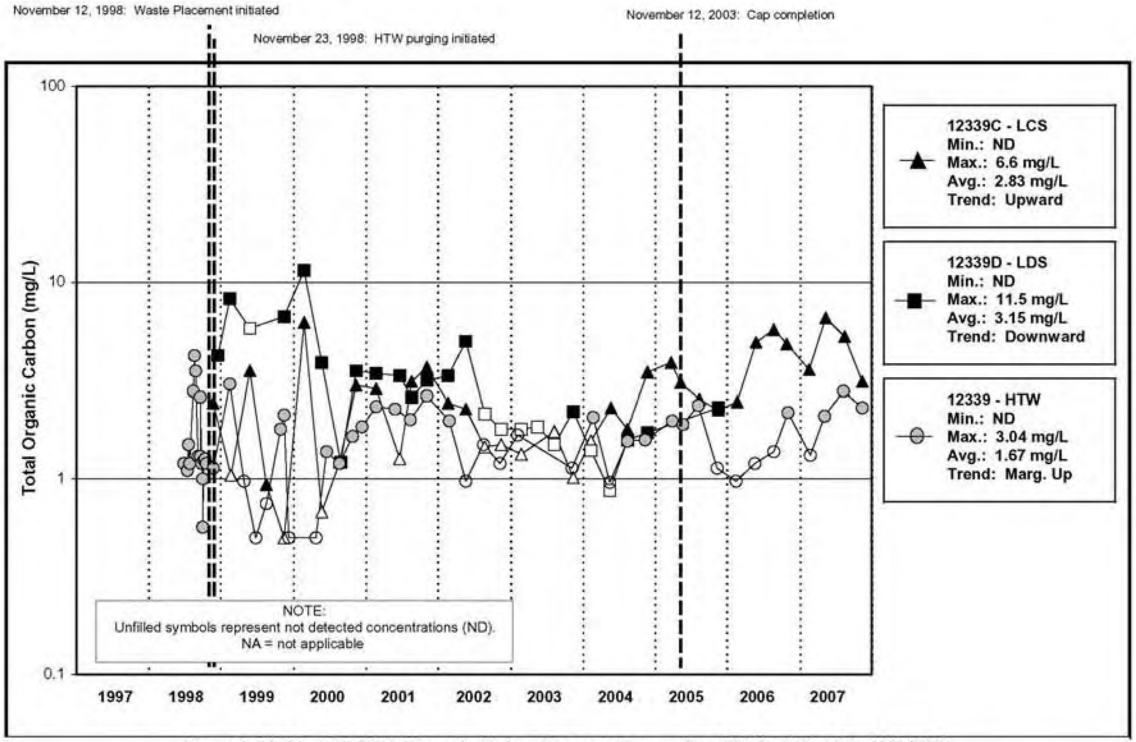


Figure A.5.2-8A. Cell 2 Total Organic Carbon Concentration vs. Time Plot for LCS, LDS, AND HTW

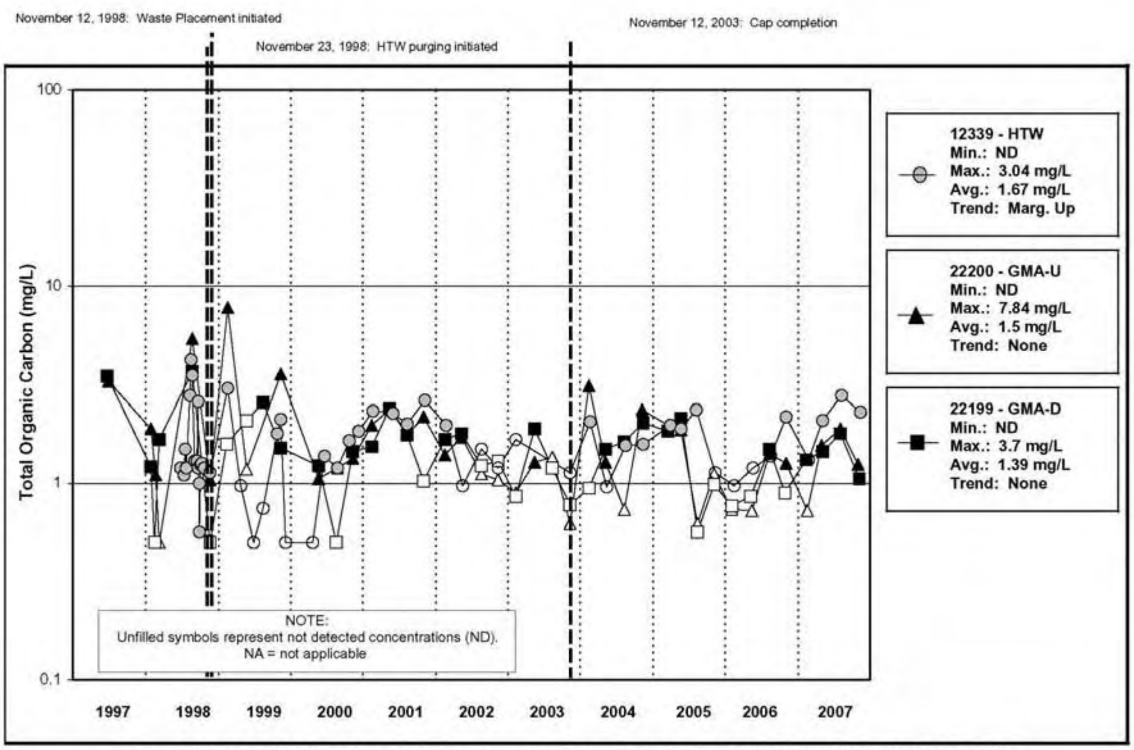


Figure A.5.2-8B. Cell 2 Total Organic Carbon Concentration vs. Time Plot for HTW, GMA-U Well, AND GMA-D Well

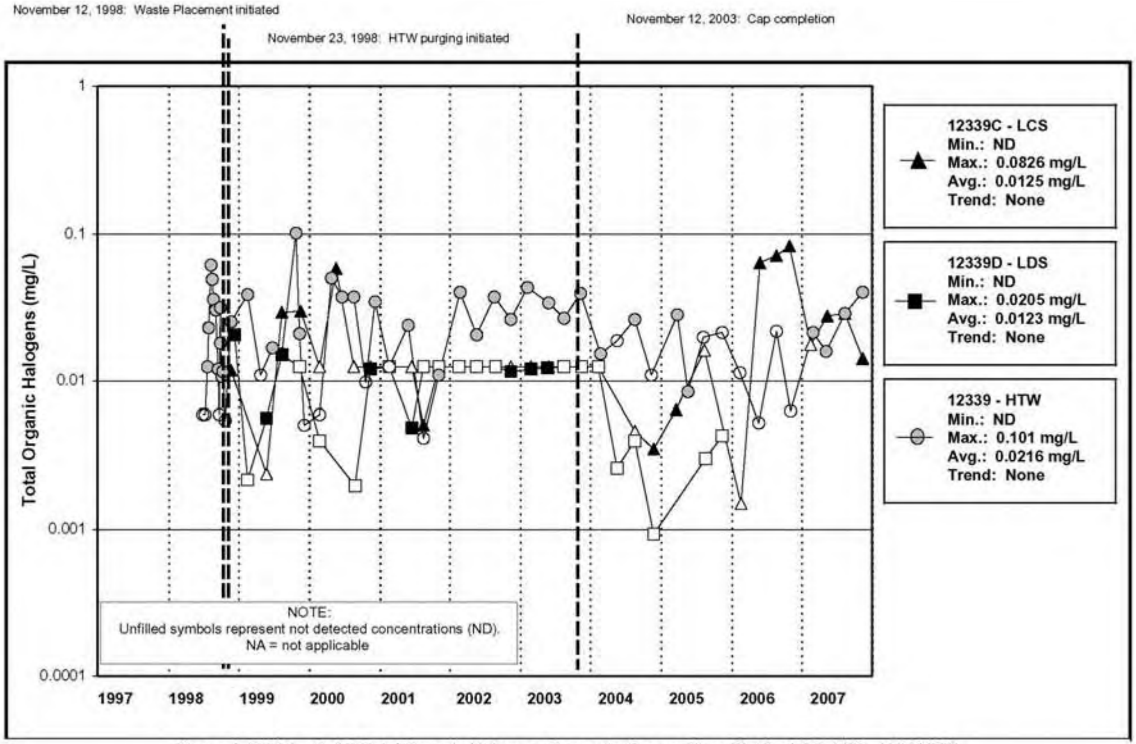


Figure A.5.2-9A. Cell 2 Total Organic Halogens Concentration vs. Time Plot for LCS, LDS, AND HTW

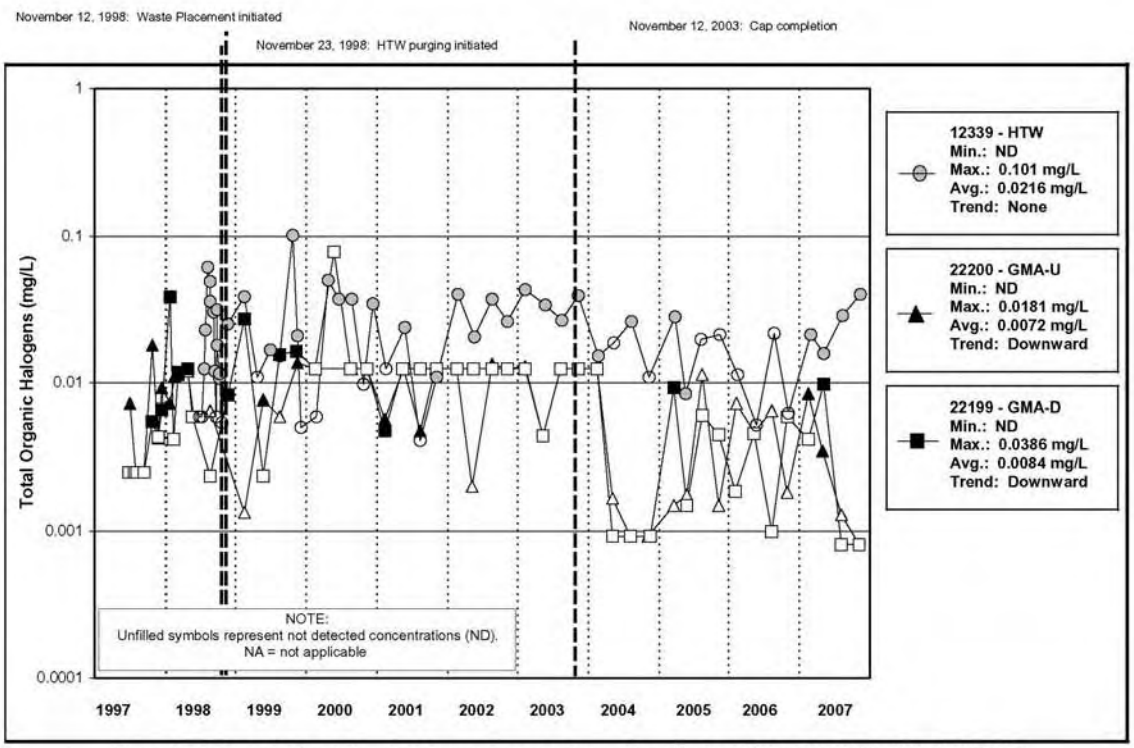


Figure A.5.2-9B. Cell 2 Total Organic Halogens Concentration vs. Time Plot for HTW, GMA-U Well, AND GMA-D Well

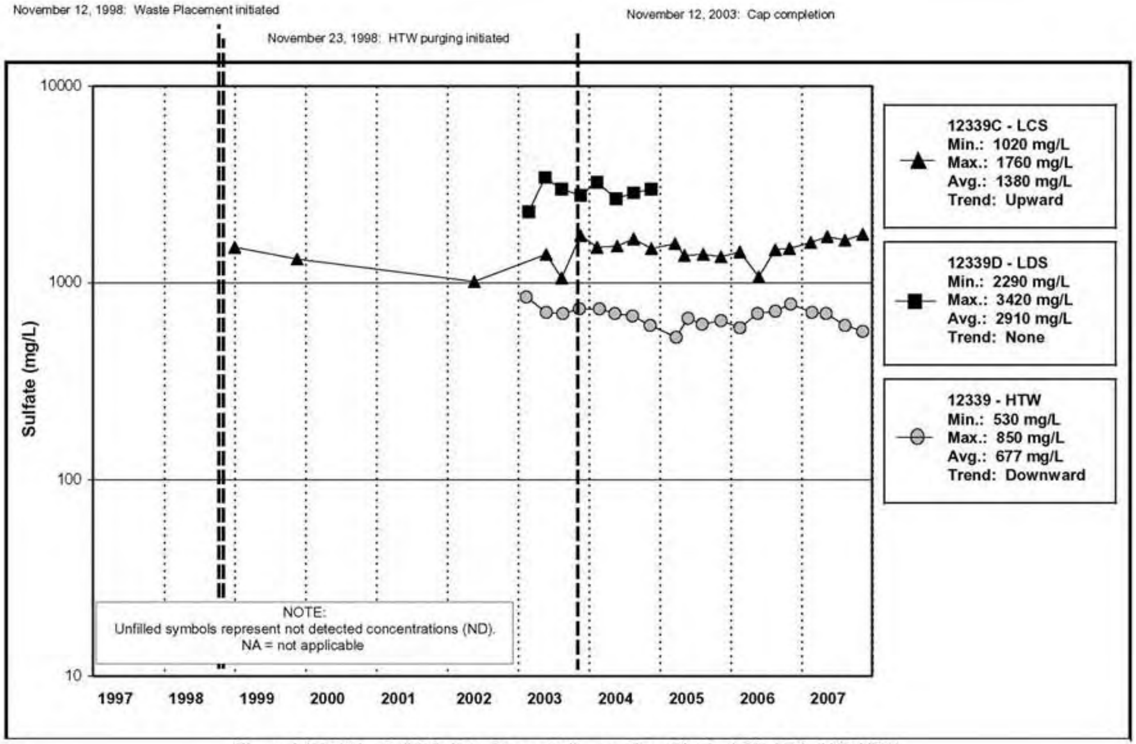


Figure A.5.2-10A. Cell 2 Sulfate Concentration vs. Time Plot for LCS, LDS, AND HTW

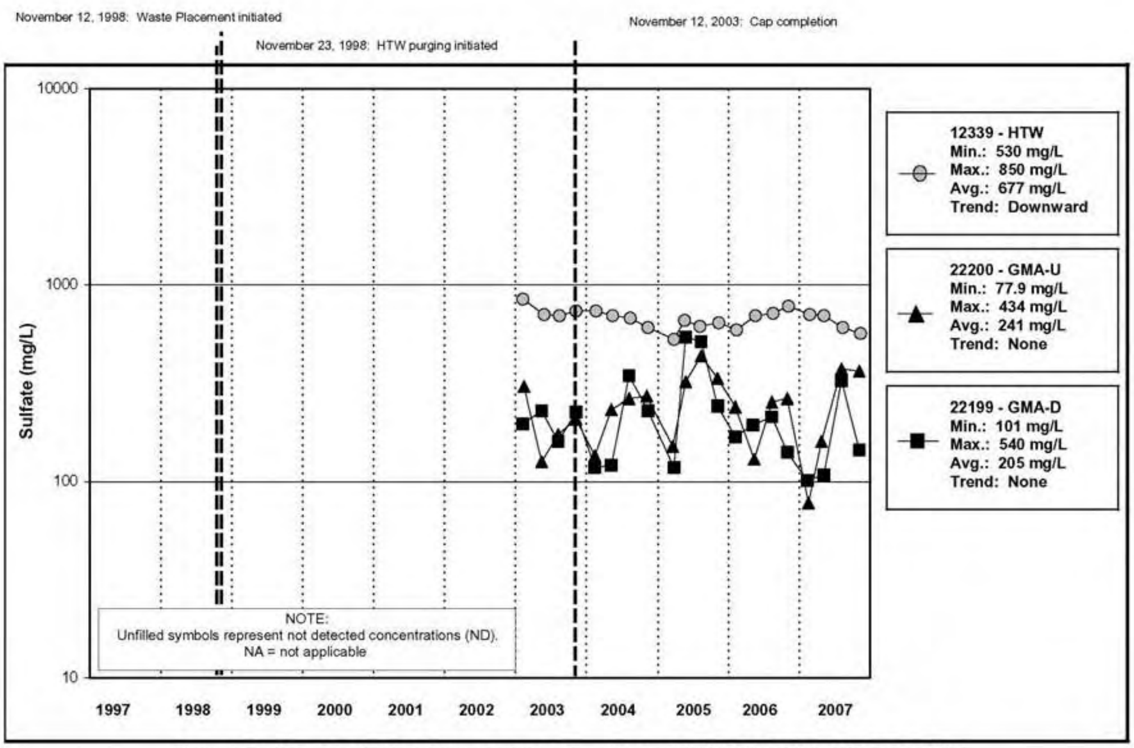


Figure A.5.2-10B. Cell 2 Sulfate Concentration vs. Time Plot for HTW, GMA-U Well, AND GMA-D Well

Sub-Attachment A.5.3

Cell 3

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The following information is provided in this sub-attachment:

- LCS monthly accumulation volumes (refer to Figure A.5.3−1)
- LDS monthly accumulation volumes (refer to Figure A.5.3−2)
- Monthly liner efficiencies (refer to Table A.5.3−1)
- HTW Water Yield (refer to Figure A.5.3−3)
- Great Miami Aquifer water levels and uranium concentrations versus time (refer to Figures A.5.3−4 and A.5.3−5)
- Summary statistics for refined baseline constituents (refer to Section A.5.3.1 and Table A.5.3−2)
- Concentration plots for refined baseline constituents (refer to Section A.5.3.1 and Figures A.5.3−6A through A.5.3−10B)
- Annual LCS monitoring results (refer to Section A.5.3.2 and Table A.5.3−3).
- Annual LDS monitoring results (refer to Section A.5.3.3)
- Potential site-specific leak detection monitoring constituents' statistics (refer to Table A.5.3-4).

Samples for the OSDF monitoring horizons were collected according to the frequencies described in the OSDF GWLMP. Constituent sampling lists are provided in Table 2−1, Table 2−2, and Table 2−3 of Appendix B of the OSDF GWLMP. The LCS constituent sampling list for Cell 3 also includes 1,1-dichloroethene due to confirmatory sampling identified for 2007 in the 2006 SER. In 2007, all samples were collected for the Cell 3 monitoring horizons.

A.5.3.1 Refined Baseline Monitoring Results

Refined baseline constituents are those constituents that have been sampled at least eight times, and detected at least 25 percent of the time in the LCS, LDS, HTW, and GMA wells. Refined baseline constituents are listed in Table 2−3 of Appendix B of the OSDF GWLMP. Also listed in Table 2−3 are common ion constituents. A summary statistics table (Table A.5.3−2), and concentration plots are provided for the five refined baseline constituents of Cell 3: total uranium, boron, TOC, TOX, and sulfate.

A.5.3.2 LCS Monitoring Results

During active operations (pre-closure) Ohio Solid Waste Regulations (OAC 3745-27-19(M)(5)) require collection and analysis of leachate annually for Appendix I and PCB constituents listed in OAC 3745-27-10. The objective of the annual LCS sampling is to determine if the composition of the leachate within the facility is changing enough to impact monitoring activities beneath the facility. A list of annual LCS sampling constituents is provided in Table 2−2 of Appendix B of the OSDF GWLMP. In 2007, annual sampling of the Cell 3 LCS took place in May. Table A.5.3−3 summarizes the annual LCS sampling results for Cell 3 along with the data collected in previous years.

Of the non-refined site-specific baseline constituents that have been sampled at least eight times in Cell 3, 20 have been detected at least 25 percent of the time. Eleven of the 20 constituents are common ion constituents (alkalinity, calcium, chloride, fluoride, iron, magnesium, manganese, nitrate/nitrite, potassium, silicon, and sodium). The other nine are *potential* site-specific leak detection monitoring constituents for Cell 3.

Common Ions

A common ion study was completed in 2007, and a report, *Fernald Site, Evaluation of Aqueous Ions in the Monitoring Systems of the On-site Disposal Facility*, was issued in March 2008. This report is currently undergoing review by the EPA and OEPA.

As discussed in Section A.5.2.2, the common ion study concluded that fluid volume appears to be the key monitoring constituent to indicate the potential for leachate migration from the OSDF, and the sampling of and analysis for indicator ions are useful only if the hydraulic conditions permit leachate to migrate.

The common ion study also concluded that no one ion can serve as a leak indicator for all cells of the disposal facility, but useful indicator ions for specific target horizons of each cell can be identified. Specifically, uranium and manganese in the LDS and sodium in the HTW were the only useful indicator constituents identified for the Cell 3 LDS and HTW, and that sufficient data exists to establish control charts for these three constituents at the same specified locations for Cell 3. In addition, no other useful common ion indicator constituents were found for Cell 3. Since uranium is already included as a refined baseline constituent for Cell 3, it is recommended that manganese be added to the refined baseline constituent list for the Cell 3 LDS and sodium be added to the refined baseline constituent list for the Cell 3 HTW. Also, control charts will be included in future SERs for uranium and manganese in the Cell 3 LDS and sodium in the Cell 3 HTW upon approval of the common ion study.

Potential Site-Specific Leak Detection Monitoring Constituents

The remaining nine constituents (considered to be "*potential*" site-specific leak detection monitoring constituents for Cell 3) are: 1,1-dichlororthene, barium, chromium, cobalt, copper, nickel, selenium, total dissolved solids (TDS), and zinc. These potential Cell 3 site-specific leak detection monitoring constituents were assessed using the statistical approach presented in Figures A.5−4A and A.5−4B, and discussed in Section A.5.2.2. Results of the assessment are presented in Table A.5.3−4.

The objective of the statistical approach is to determine if the mean concentration of a particular LCS monitored constituent, that has been sampled more than eight times and detected more than 25 percent of the time, is statistically greater than the mean concentration of either the pre-design or background data for the constituent. If the mean is greater, then the constituent could be a useful monitoring constituent for the OSDF.

As outlined in Figure A.5−4B, the statistical approach consists of three routes.

- If the LCS data set has 0-15 percent non-detects a t-Test is used.
- If the LCS data set has greater than 15 percent non-detects but less than 50 percent non-detects a Wilcoxen Rank Sum and Quantile Test is used.

- If the LCS data set has greater than 50 percent non-detects a Poisson Prediction Limits Test is used.

The null hypothesis used for each test was that the mean concentration of the LCS data set was less than or equal to the mean of the pre-design or background data set. Therefore, failure of the null hypothesis for a specific constituent indicates that the mean of the LCS data set is greater than the mean of the pre-design or background data set.

Results for Cell 3 are presented in Table A.5.3−4. Out of the nine constituents that were tested for Cell 3, five failed the null hypothesis indicating that they might be useful monitoring constituents.

- Cobalt – failed the Poisson Prediction Limit Test
- Nickel – failed the Poisson Prediction Limit Test
- Selenium – failed the Poisson Prediction Limit Test
- TDS – failed the t-Test
- Zinc – failed the Poisson Prediction Limits Test

This is the first time that these results have been presented. These statistical results should therefore be considered preliminary. It is anticipated that EPA, OEPA, and DOE will work together over the next few months to discuss these results and decide on a path forward.

<u>Confirmatory Sampling</u>

1,1-dichloroethene is a site-specific leak detection constituent; however, it is not on the refined baseline list for Cell 3. If a site-specific constituent (not on the refined baseline list) is detected in the LCS or LDS, then confirmatory sampling for that constituent will take place. As reported in the 2006 SER, confirmatory sampling for 1,1-dichloroethene in the Cell 3 LCS began in the fourth quarter of 2005. Confirmatory sampling in the Cell 3 LDS began in August 2006. All samples in the LDS were non-detect, so confirmatory sampling in the LDS ended in 2006. Confirmatory sampling in the LCS continued in 2007, and was to continue until its usefulness as a potential indicator constituent could be determined using the potential site-specific constituent approach discussed above. Since the statistical analysis indicates that 1,1-dichloroethene would not be a useful indicator constituent for Cell 3, it is proposed that confirmatory sampling for 1,1-dichloroethene in the Cell 3 LCS cease in August 2008. Therefore, approval from EPA and OEPA is requested by July 2008.

As shown in Figure A.5.3−3, technetium-99 is a site-specific leak detection constituent that has been detected 10.5 percent of the time in the Cell 3 LCS; however, it is not on the refined baseline list for Cell 3. If a site-specific constituent (not on the refined baseline list) is detected in the LCS or LDS, then confirmatory sampling for that constituent will take place. As shown in Table A.5.3−3, technetium-99 has been detected in the Cell 3 LCS, but these detections occurred prior to the establishment or the refined baseline for Cell 3. Therefore, confirmatory sampling for technetium-99 in the Cell 3 LCS is not required.

A.5.3.3 LDS Monitoring Results

Each year the LDS of Cell 3 is sampled for site-specific constituents listed in Table 2−1 of Appendix B of the OSDF GWLMP. The objective of the annual LDS sampling is to determine if any initial baseline constituents, not on the refined baseline list, are present in the LDS. In 2007, annual sampling of the Cell 3 LDS took place in May.

Of the non-refined baseline constituents that have been sampled at least eight times, eleven have been detected at least 25 percent of the time. All eleven of the constituents are common ions (alkalinity, calcium, chloride, fluoride, iron, magnesium, manganese, nitrate/nitrite, potassium, silicon, and sodium).

Table A.5.3−1. Cell 3 – 2007 Monthly Liner Efficiencies

Month	Cell 3 Apparent Liner Efficiency (%)
January	98.71
February	98.31
March	98.97
April	99.31
May	99.68
June	99.75
July	99.81
August	100.00
September	100.00
October	100.00
November	100.00
December	100.00

Table A.5.3−2. Summary Statistics For Cell 3

Note: The data used in this table have been standardized to quarterly.

Parameter	Horizon[a]	Monitoring Location	No. of Detected Samples	Total No. of Samples	Percent of Detects	Average[b]	Distribution Type[c]	Trend[d]	Serial Correlation[e]	Outliers[f,g]			
	LCS	12340C	32	32	100	59.0	Undefined	Up	Detected				
	LDS	12340D	20	20	100	17.1	Lognormal	Down	Detected				
Total Uranium (µg/L)	HTW	12340	36	36	100	19.2	Undefined	Up	Detected				
	GMA-U	22203	35	38	92.1	2.08	Lognormal	None	Detected				
	GMA-D	22204	35	36	97.2	2.55	Lognormal	Up	Detected	9.7 (Q4-07)	14.3 (Q3-05)	14.3 (Q4-05)	15.5 (Q3-07)
	LCS	12340C	33	34	97.1	2.16	Undefined	Up	Detected				
	LDS	12340D	19	20	95	0.124	Undefined	Down	Detected				
Boron (mg/L)	HTW	12340	35	35	100	0.122	Lognormal	None	Detected	0.96 (Q3-06)			
	GMA-U	22203	28	38	73.7	0.0397	Undefined	None	Detected				
	GMA-D	22204	30	37	81.1	0.0353	Normal	Up	Detected	0.0887 (Q3-99)			
	LCS	12340C	18	30	60	1.97	Lognormal	None	Marg. Detect	17.35 (Q4-99)			
	LDS	12340D	17	21	81	5.77	Undefined	None	Not Detected				
Total Organic Carbon (mg/L)	HTW	12340	24	34	70.6	1.96	Normal	None	Detected	9.81 (Q1-00)			
	GMA-U	22203	22	36	61.1	1.46	Lognormal	Down	Detected	14.1 (Q4-00)	5.66 (Q1-00)		
	GMA-D	22204	19	36	52.8	1.36	Lognormal	None	Not Detected	8.83 (Q1-00)	2.925 (Q3-98)		
	LCS	12340C	9	32	28.1	0.0125	Undefined	Marg. Up	Detected	0.141 (Q4-99)			
	LDS	12340D	9	19	47.4	0.0205	Normal	None	Not Detected	0.0838 (Q1-06)			
Total Organic Halogens (mg/L)	HTW	12340	24	36	66.7	0.0159	Undefined	Marg. Down	Detected	0.0670 (Q4-99)			
	GMA-U	22203	13	37	35.1	0.0055	Undefined	Down	Detected	0.213 (Q2-00)			
	GMA-D	22204	7	37	18.9	0.00753	Undefined	Down	Detected	0.165 (Q2-00)			
	LCS	12340C	24	24	100	1640	Undefined	Up	Detected				
	LDS	12340D	19	19	100	1250	Undefined	Down	Detected				
Sulfate (mg/L)	HTW	12340	20	20	100	762	Undefined	None	Detected				
	GMA-U	22203	19	19	100	290	Lognormal	Down	Detected	735 (Q1-04)			
	GMA-D	22204	20	20	100	523	Normal	Marg. Down	Not Detected				

[a]LCS = leachate collection system; LDS = leak detection system; HTW = horizontal till well; GMA-U = upgradient Great Miami Aquifer; and GMA-D = downgradient Great Miami Aquifer

[b]Averages were determined based on the distribution assumption. "Approx. Normal" was treated as if it was normal, and "Approx. Lognormal" was treated as if it was lognormal. This was done to compensate for the skewed (lognormal) or non-skewed (normal) nature of the data to give a better estimate of the underlying average.

[c]Data distribution based on the Shapiro-Wilk statistic.

Normal: Normal assumption could not be rejected at the 5 percent level and has a higher probability value than the lognormal assumption.

Lognormal: Lognormal assumption could not be rejected at the 5 percent level and has a higher probability value than the normal assumption.

Approx. Normal (Approximately Normal): Normal and lognormal assumptions were rejected at the 5 percent level. However, the normal assumption was not rejected at the 10 % level. Additionally, for cases where neither assumption was rejected at the 10% level, the data fit the normal destribution better than the lognormal distribution.

Approx. Lognormal (Approximately Lognormal): Normal and lognormal assumptions were rejected at the 5 percent level. However, the lognormal assumption was not rejected at the 10 % level. Additionally, for cases where neither assumption was rejected at the 10% level, the data fit the lognormal destribution better than the normal distribution.

Undefined: Normal and Lognormal Distribution assumptions are both rejected or there are less than 25% detected values. "Average" is defined as the Median of the data.

[d]Trend based on nonparametric Mann-Kendall procedure. Note that "Marg. Down" is a marginally downward trend and "Marg. Up" is a marginally upward trend.

[e]Serial correlation based on Rank Von Neumann test.

[f]Outliers determined by Rosner's (for sample sizes greater than 25) or Dixon procedure (for sample sizes less than or equal to 25).

[g]Q = quarterly

Table A.5.3−3. Cell 3 Annual LCS Sample Summary Information

PARAMETER(UNIT)	NUMBER OF SAMPLES[a,b]	NUMBER OF SAMPLES WITH DETECTIONS[a,b]	PERCENT OF DETECTIONS[a,b]	MIN DETECTED CONCENTRATION[a,b,c]	MAX DETECTED CONCENTRATION[a,b,c]	AVG DETECTED CONCENTRATION[a,b,c]	GW FRL[d] (# OF SAMPLES>GWFRL)	GW BACKGROUND[a,b,e] (# OF SAMPLES>PW BACKGROUND)	PW BACKGROUND[a,b,e] (# OF SAMPLES>PW BACKGROUND)	MAX PW DETECTED CONCENTRATION [a,b,f] (# OF SAMPLES>MAX PW)	DETECTION LIMIT
1,1,1-Trichloroethane (µg/L)	10	2	20%	0.54	0.64	0.59	-	-	-	-	1 µg/L
1,1-Dichloroethane (µg/L)	9	2	22.20%	0.351	0.79	0.571	280 µg/L(0)	-	-	-	1 µg/L
1,1-Dichloroethene (µg/L)	25	9	36%	0.112	13.1	4.89	7 µg/L(3)	-	-	-	1 µg/L
Alkalinity as CaCO3 (mg/L)	16	16	100%	72	1080	438	-	422 mg/L(10)	430 mg/L(10)	-	10 mg/L
Arsenic (mg/L)	10	1	10%	0.0013	-	-	0.05 mg/L(0)	0.029 mg/L(0)	0.019 mg/L(0)	0.191 mg/L(0)	0.02 mg/L
Barium (mg/L)	10	10	100%	0.0307	0.118	0.0544	2 mg/L(0)	0.77 mg/L(0)	0.45 mg/L(0)	0.589 mg/L(0)	0.029 mg/L
Beryllium (mg/L)	10	1	10%	0.0002	-	-	0.004 mg/L(0)	-	-	0.0343 mg/L(0)	0.001 mg/L
Bromodichloromethane (µg/L)	18	1	5.60%	0.5	-	-	100 µg/L(0)	-	-	-	1 µg/L
Cadmium (mg/L)	10	2	20%	0.000065	0.00044	0.0003	0.014 mg/L(0)	0.014 mg/L(0)	-	0.05 mg/L(0)	0.002 mg/L
Calcium (mg/L)	16	16	100%	50.3	1200	481	-	159 mg/L(12)	172 mg/L(12)	1800 mg/L(0)	5 mg/L
Chloride (mg/L)	16	16	100%	4.7	42.8	25.5	-	7.3 mg/L(14)	45 mg/L(0)	6300 mg/L(0)	5 mg/L
Chlorodibromomethane (µg/L)	10	1	10%	1	-	-	-	-	-	-	1 µg/L
Chromium (mg/L)	10	5	50%	0.00093	0.00564	0.0021	0.022 mg/L[g](0)	0.021 mg/L(0)	0.0046 mg/L(1)	0.818 mg/L(0)	0.005 mg/L
Cobalt (mg/L)	10	5	50%	0.000288	0.0431	0.0176	0.17 mg/L(0)	0.0086 mg/L(3)	-	0.0886 mg/L(0)	0.034 mg/L
Copper (mg/L)	10	10	100%	0.00118	0.0128	0.0074	1.3 mg/L(0)	0.035 mg/L(0)	0.029 mg/L(0)	0.298 mg/L(0)	0.008 mg/L
Fluoride (mg/L)	9	7	77.80%	0.056	0.223	0.158	4 mg/L(0)	0.89 mg/L(0)	1.3 mg/L(0)	6.8 mg/L(0)	0.2 mg/L
Iron (mg/L)	16	15	93.80%	0.205	16.6	3.98	-	5.72 mg/L(3)	6.35 mg/L(2)	21.3 mg/L(0)	0.1 mg/L
Lead (mg/L)	10	1	10%	0.00146	-	-	0.015 mg/L(0)	0.022 mg/L(0)	0.0016 mg/L(0)	0.0114 mg/L(0)	0.008 mg/L
Magnesium (mg/L)	16	16	100%	10.2	380	146	-	38.5 mg/L(12)	50.7 mg/L(12)	690 mg/L(0)	5 mg/L
Manganese (mg/L)	16	15	93.80%	0.0014	7.27	3.50	0.9 mg/L(9)	0.9 mg/L(9)	0.21 mg/L(9)	35 mg/L(0)	0.09 mg/L
Nickel (mg/L)	10	10	100%	0.0021	0.0918	0.0279	0.1 mg/L(0)	0.0514 mg/L(3)	0.0072 mg/L(6)	0.981 mg/L(0)	0.02 mg/L
Nitrate/Nitrite (mg/L)	23	16	69.60%	0.024	2.2	0.860	11 mg/L[g](0)	11 mg/L(0)	0.29 mg/L(13)	2670 mg/L(0)	1.1 mg/L
Phosphorus (mg/L)	9	1	11.10%	0.0853	-	-	-	-	-	-	0.1 mg/L
Potassium (mg/L)	16	16	100%	0.575	31.9	19.1	-	1.96 mg/L(15)	17.2 mg/L(11)	12400 mg/L(0)	5 mg/L
Selenium (mg/L)	10	3	30%	0.0019	0.0133	0.0065	0.05 mg/L(0)	0.00075 mg/L(3)	-	0.0494 mg/L(0)	0.005 mg/L
Silicon (mg/L)	9	9	100%	9.75	11.9	10.6	-	-	-	15 mg/L(0)	0.015 mg/L
Sodium (mg/L)	16	16	100%	4.35	49.9	20.3	-	47.1 mg/L(1)	50 mg/L(0)	1300 mg/L(0)	5 mg/L
Technetium-99 (pCi/L)	19	2	10.50%	3.84	9.89	6.87	94 pCi/L(0)	22 pCi/L(0)	30 pCi/L(0)	6130 pCi/L(0)	10 pCi/L
Thallium (mg/L)	10	1	10%	0.0021	-	-	-	-	-	0.0028 mg/L(0)	0.02 mg/L
TDS (mg/L)	17	17	100%	233	3210	1600	-	-	-	-	10 mg/L
trans-1,3-Dichloropropene (µg/L)	9	1	11.10%	1	-	-	-	-	-	-	1 µg/L
Vanadium (mg/L)	10	2	20%	0.00371	0.00959	0.0066	0.038 mg/L(0)	0.012 mg/L(0)	0.005 mg/L(1)	0.299 mg/L(0)	0.02 mg/L
Vinyl chloride (µg/L)	18	1	5.60%	16.1	-	-	2 µg/L(1)	-	-	-	1 µg/L
Zinc (mg/L)	10	5	50%	0.0144	0.0278	0.021	0.021 mg/L(3)	0.02 mg/L(3)	0.35 mg/L(0)	1.78 mg/L(0)	0.015 mg/L

Note: Shading indicates that at least one detected sample is greater than the FRL, groundwater background, PW background, or PW maximum.

[a]If more than one sample is collected per well per day (e.g., duplicates), then only one sample is counted for the total number of samples, and the sample with the maximum representative concentration is used for all the summary information

[b]Rejected data qualified with an R or Z were not included.

[c]If the number of detected samples is equal to two, then the minimum and maximum are reported. If the number of detected is equal to one, then the data point is reported as the minimum. The "AVG DETECTED CONCENTRATION" is not reported for either of these cases.

[d]From Operable Unit 5 Record of Decision, Table 9-4.

[e]From the Characterization of Background Water Quality for Streams and Groundwater which was developed for Operable Unit 5 RI/FS documents.

[f]Max PW - maximum detected concentration in perched water as defined in the Remedial Investigation Report for Operable Unit 5.

[g]FRL based on hexavalent chromium and nitrate, from Operable Unit 5 Record of Decision, Table 9-4.

Table A.5.3−4. Parameter Selection Criteria - Statistical Comparison Of Leachate Collection System Data To Pre-Design Data For Cell 3

					I. t-Test												II. Wilcoxon + Quantile				III. Poisson PL	
Parameter	**Dataset**	**Samples**	**Detects**	**Detect %**	**Shapiro-Wilk (N)**	**Shapiro-Wilk (LN)**	**Min**	**Max**	**Mean (mg/L)**	**Median**	**Variance**	**Std. Dev.**	**Log Mean**	**Log SD**	**F-Test**	**t-Test Prob**	**Median (mg/L)**	**Wilcoxon Prob**	**Quantile Test [q = .90]**	**Quantile Test Prob.**	**Poisson Prediction Limits (mg/L)**	
1,1-Dichloroethene	LCS	24	8	33%			0.112	11.700	2.500	2.532	7.009	2.647					2.532				**605**	
	Background GW	22	1	5%			2.000	5.000	5.000	4.295	1.397	1.182					4.295	0.409	1/5	ND in R	**1067**	**PASS**
Barium	LCS	10	10	100%	Fail	Pass	0.031	0.118	0.054	0.0446	6.79E-04	0.0261					0.045					
	PreDesign	40	39	98%	Fail	Fail (outlier?)	0.002	2.390	0.326	0.264	0.148	0.385					0.264	**1.000**	0/5	**0.048**		
	PreDesign*	19	18	95%	Fail	Fail	0.002	2.390	0.470	0.343	0.260	0.510					0.343	**1.000**	0/8	**0.066**		
	PreDesign**	21	21	100%	Fail	Fail	0.066	0.424	0.195	0.129	0.018	0.133					0.129	**1.000**	0/8	**0.048**		
	* before 2/10/95																					
	** after 2/10/95																					
Chromium	LCS	10	5	50%			0.00010	0.00564	0.00174	0.00120	0.00000	0.00155					0.00120				**174**	
	PreDesign	40	19	48%			0.002	0.478	0.046	0.004	0.008	0.087					0.004	0.986	0/5	0.048	**4748**	**PASS**
	PreDesign*	19	17	89%			0.004	0.478	0.093	0.051	0.012	0.110					0.051	**1.000**	0/8	**0.066**	9524	
	PreDesign**	21	2	10%			0.002	0.012	0.004	0.004	0.000	0.002					0.004	0.592	0/8	ND in R	**412**	**PASS**
	* before 2/10/95																					
	** after 2/10/95																					
Cobalt	LCS	10	5	50%			0.0002	0.043	0.009	6.55E-04	2.40E-04	0.0155					0.001				**908**	
	PreDesign	40	11	28%			0.002	0.382	0.025	0.006	0.004	0.062					0.006	0.582	0/5	0.048	**2598**	**PASS**
	PreDesign*	19	10	53%			0.006	0.382	0.047	0.016	0.007	0.085					0.016	**0.912**	1/8	**0.066**	4822	
	PreDesign**	21	1	5%			0.002	0.018	0.005	0.006	0.000	0.004					0.006	0.243	3/8	ND in R	**589**	**FAIL**
	* before 2/10/95																					
	** after 2/10/95																					
Copper	LCS	10	10	100%	Pass	Fail	0.00118	0.013	0.0074	0.0083	0.000024	0.0049					0.008				**739**	
	PreDesign	40	16	40%			0.002	0.794	0.068	0.0060	0.020	0.140					0.006	0.911	0/5	0.048	**7273**	**PASS**
	PreDesign*	19	15	79%	Fail	Fail+	0.006	0.794	0.139	0.108	0.033	0.180					0.108	**0.999**	0/8	**0.066**	14242	
	PreDesign**	21	1	5%			0.002	0.017	0.0049	0.0060	0.000012	0.0034					0.006	0.270	3/8	ND in R	**959**	**PASS**
	* before 2/10/95				+ Pass using Regression Order Statistics																	
	** after 2/10/95																					
Nickel	LCS	10	10	100%	Fail	**Pass**	0.002	0.092	0.028	0.009	0.001	0.034					0.009				**2794**	
	PreDesign	40	20	50%			0.003	0.978	0.089	0.015	0.030	0.173					0.015	**0.785**	0/5	**0.048**	9083	
	PreDesign*	19	16	**84%**	Fail	**Pass**	0.007	0.978	0.175	0.122	0.050	0.224			0.003	**0.515**	0.122	0.997	0/8	0.066	17805	
	PreDesign**	21	4	19%			0.003	0.045	0.011	0.007	0.000	0.013					0.007	0.131	4/8	0.048	**1180**	**FAIL**
	* before 2/10/95																					
	** after 2/10/95																					
Selenium	LCS	10	3	30%			0.0005	0.013	0.005	0.0025	0.0000	0.0046					0.002				**4514**	
	PreDesign	40	12	30%			0.001	0.016	0.0038	0.0025	0.000009	0.0030					0.0025	0.505	3/5	ND in R	**3941**	**FAIL**
	PreDesign*	19	7	37%			0.0005	0.016	0.0040	0.0025	0.000012	0.0035					0.0025	0.509	3/8	ND in R	**4134**	**FAIL**
	PreDesign**	21	5	24%			0.002	0.010	0.0037	0.0025	0.000006	0.0025					0.0025	0.508	3/8	ND in R	**3794**	**FAIL**
	* before 2/10/95																					
	** after 2/10/95																					
TDS	LCS	17	17	100%	Fail	Pass	233	3210	1450	1599	1173180	1083					**1599.059**					
	Background GW	23	23	100%	Pass	Fail	318	673	484	480	11977	109					480.217	**0.000**	**3/3**	**0.069**		
Zinc	LCS	10	5	50%			0.003	0.028	0.013	0.0116	8.22E-05	0.00907					0.012				**1318**	
	PreDesign	40	20	50%			0.002	1.860	0.136	0.006	0.102	0.320					0.006	**0.732**	0/5	**0.048**	13840	
	PreDesign*	19	17	89%			0.003	1.860	0.282	0.113	0.179	0.423					0.113	**0.999**	0/8	**0.066**	28556	
	PreDesign**	21	3	14%			0.002	0.016	0.004	0.003	0.000	0.003					0.003	0.040	7/8	0.048	**477**	**FAIL**
	* before 2/10/95																					
	** after 2/10/95																					

Color Codes

- LCS Poisson summation
- No significant difference (Pass)
- LCS significantly GREATER than PreDesign
- LCS data
- Post 2/10/95 data (suggested comparison)
- Pass Normality/Lognormality test
- Fail Normality/Lognormality test - **can not u**

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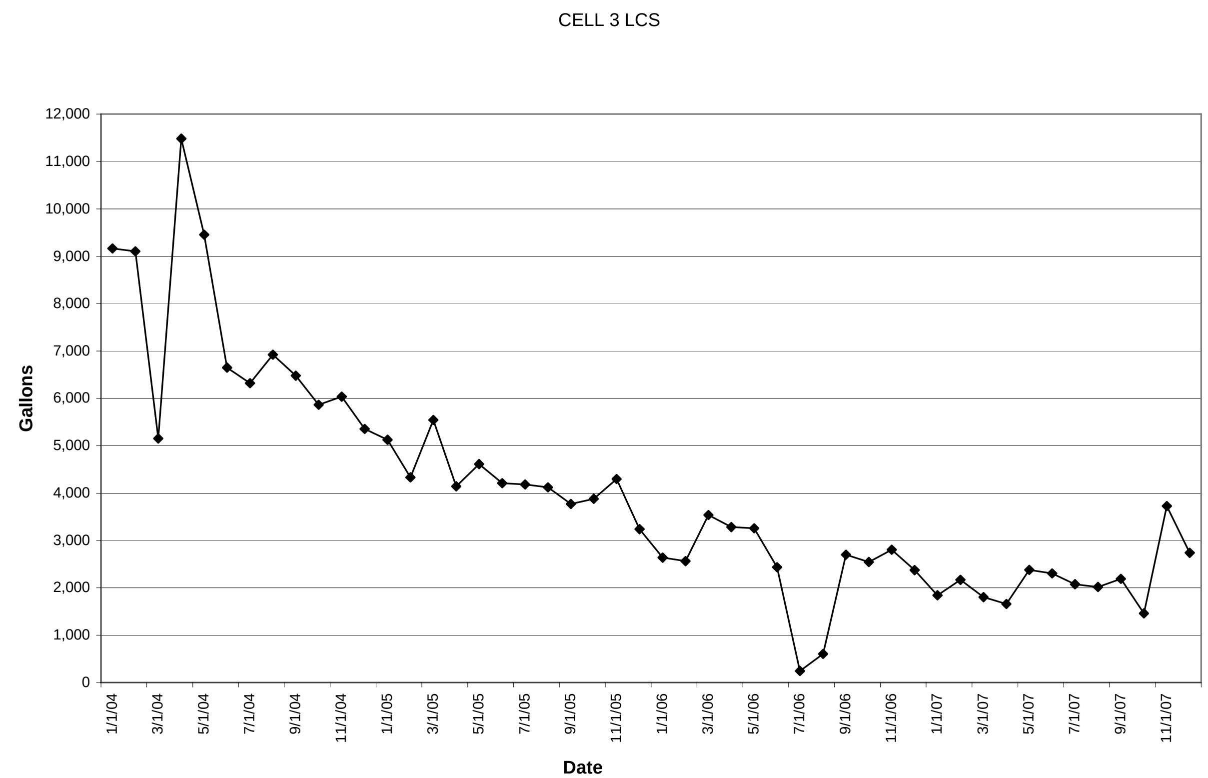


FIGURE A.5.3-1. MONTHLY ACCUMULATION VOLUMES FOR CELL 3 LCS

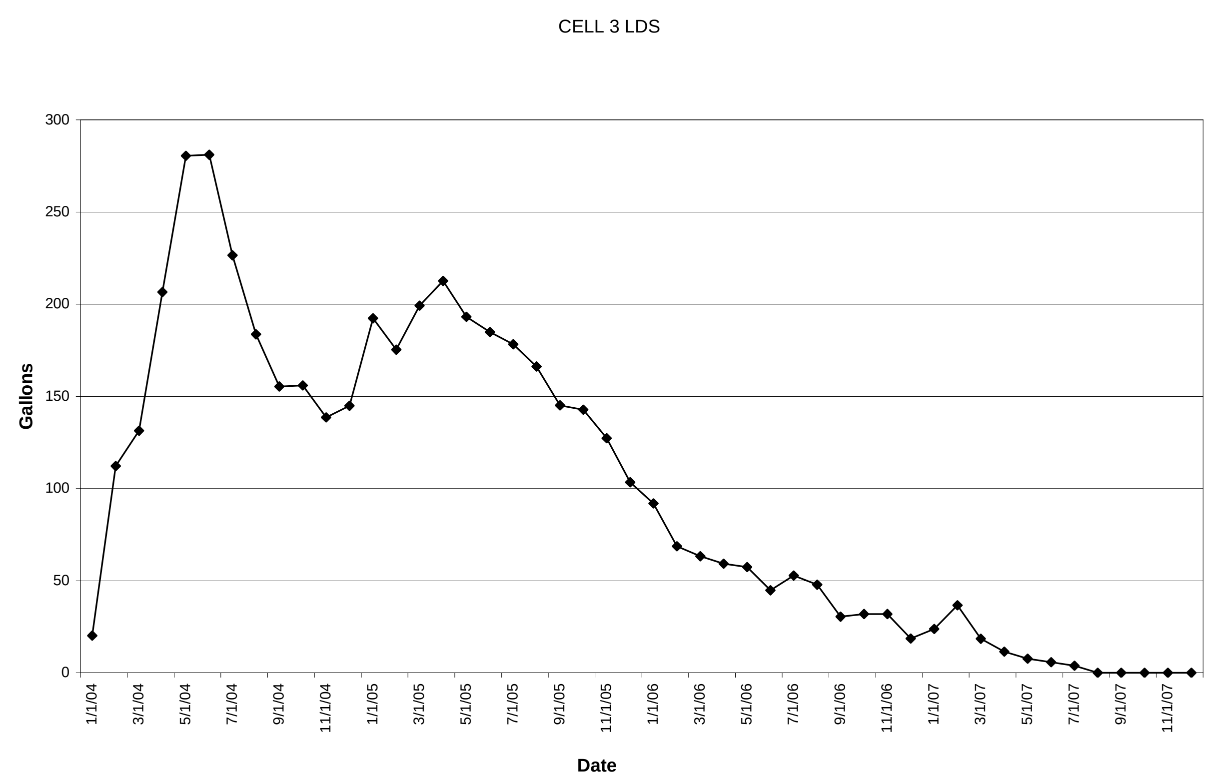
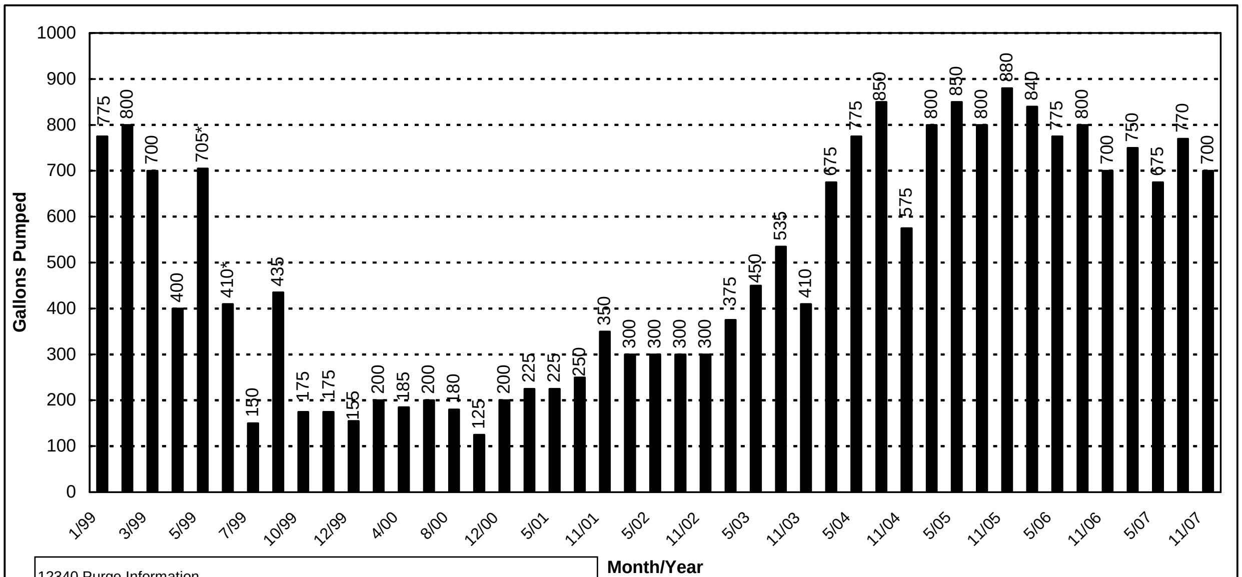


FIGURE A.5.3-2. MONTHLY ACCUMULATION VOLUMES FOR CELL 3 LDS



12340 Purge Information

Year	Total Volumes (gal.)	Months Purged	Avg. Monthly Purge (gal.)
1999:	4880	n=11	444
2000:	1090	n= 6	182
2001:	1050	n= 4	263
2002:	1200	n= 4	300
2003:	1770	n= 4	443
2004:	2875	n= 4	719
2005:	3330	n=4	833
2006:	3115	n=4	779
2007:	2895	n=4	724
Overall:			493

*More than one purge of the well was completed during these months to help evaluate well yield.

FIGURE A.5.3-3. OSDF HORIZONTAL TILL WELL 12340 (CELL 3) WATER YIELD

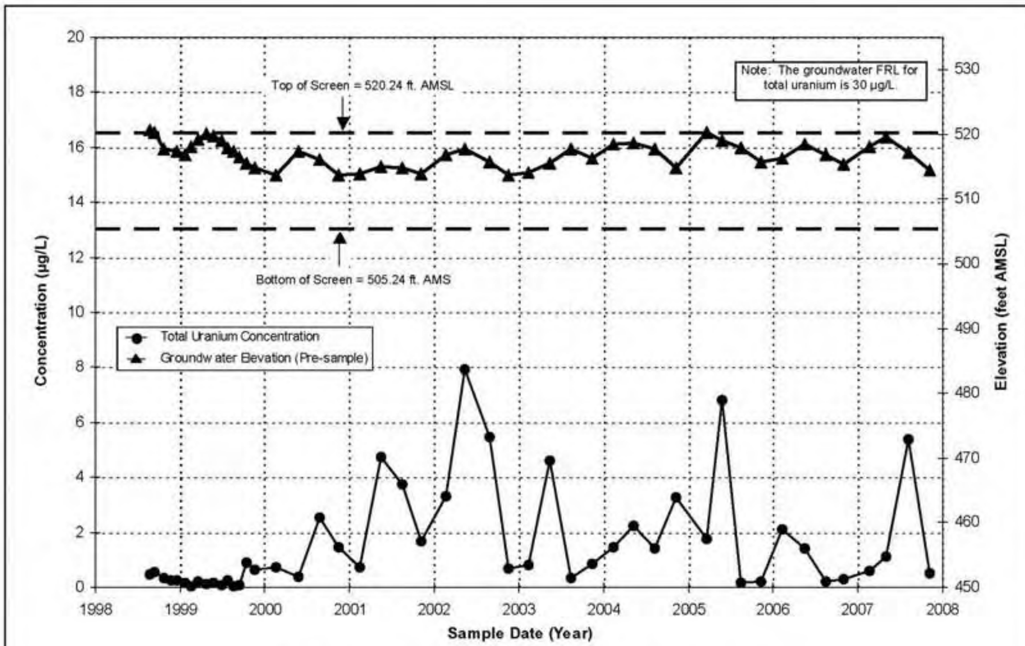


Figure A.5.3-4. Total Uranium Concentration and Groundwater Elevation vs. Time Plot for Cell 3 Upgradient Monitoring Well 22203

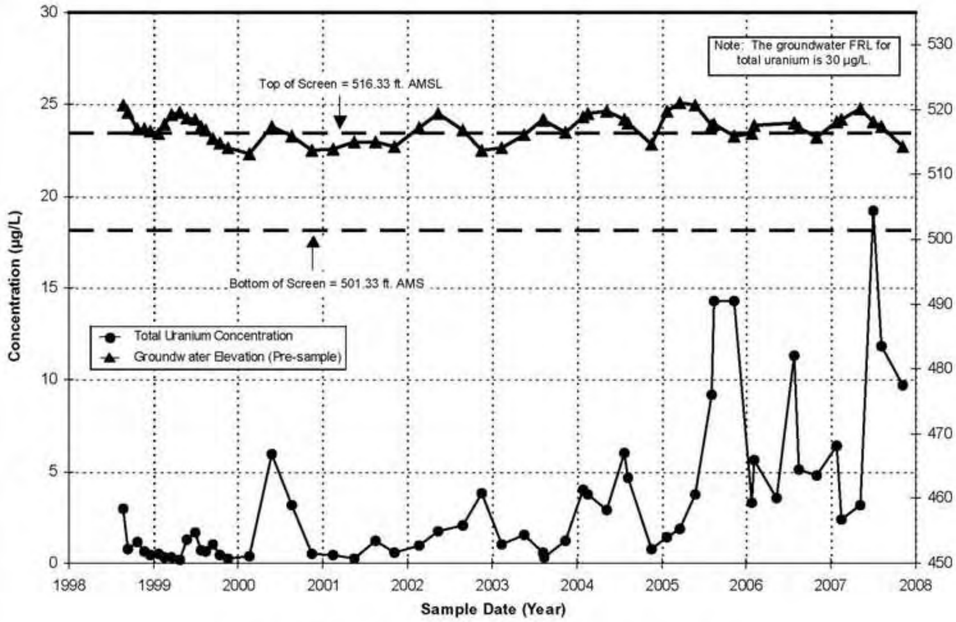


Figure A.5.3-5. Total Uranium Concentration and Groundwater Elevation vs. Time Plot for Cell 3 Downgradient Monitoring Well 22204

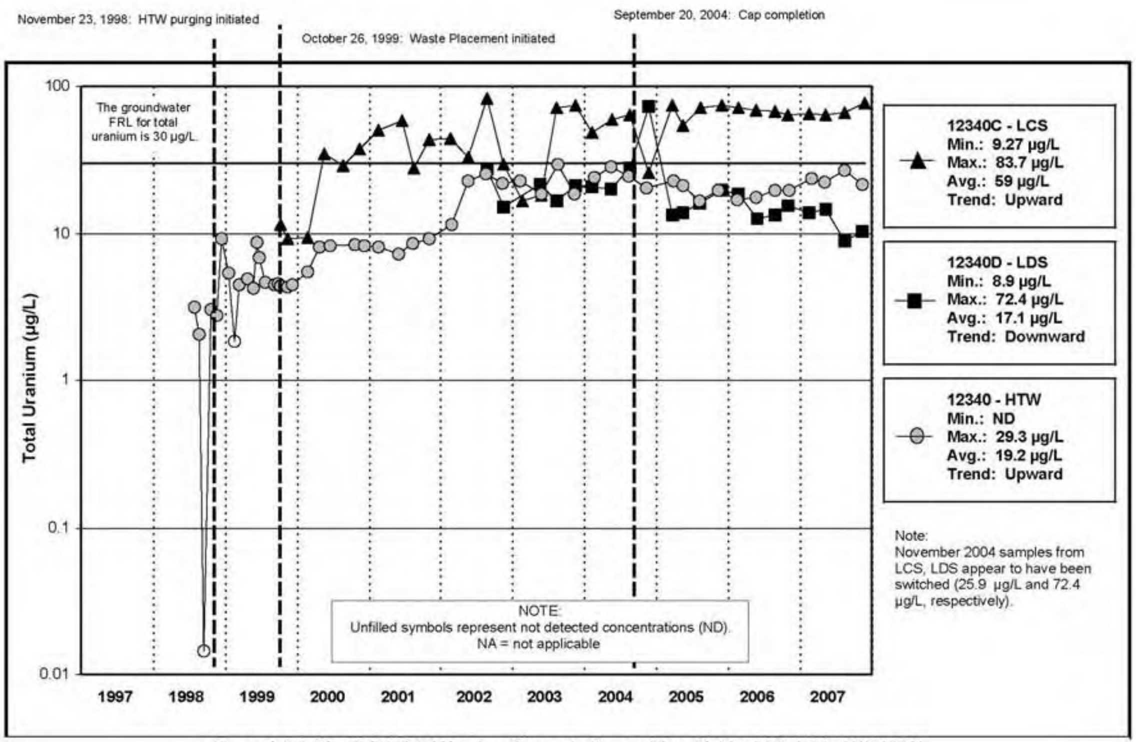


Figure A.5.3-6A. Cell 3 Total Uranium Concentration vs. Time Plot for LCS, LDS, AND HTW

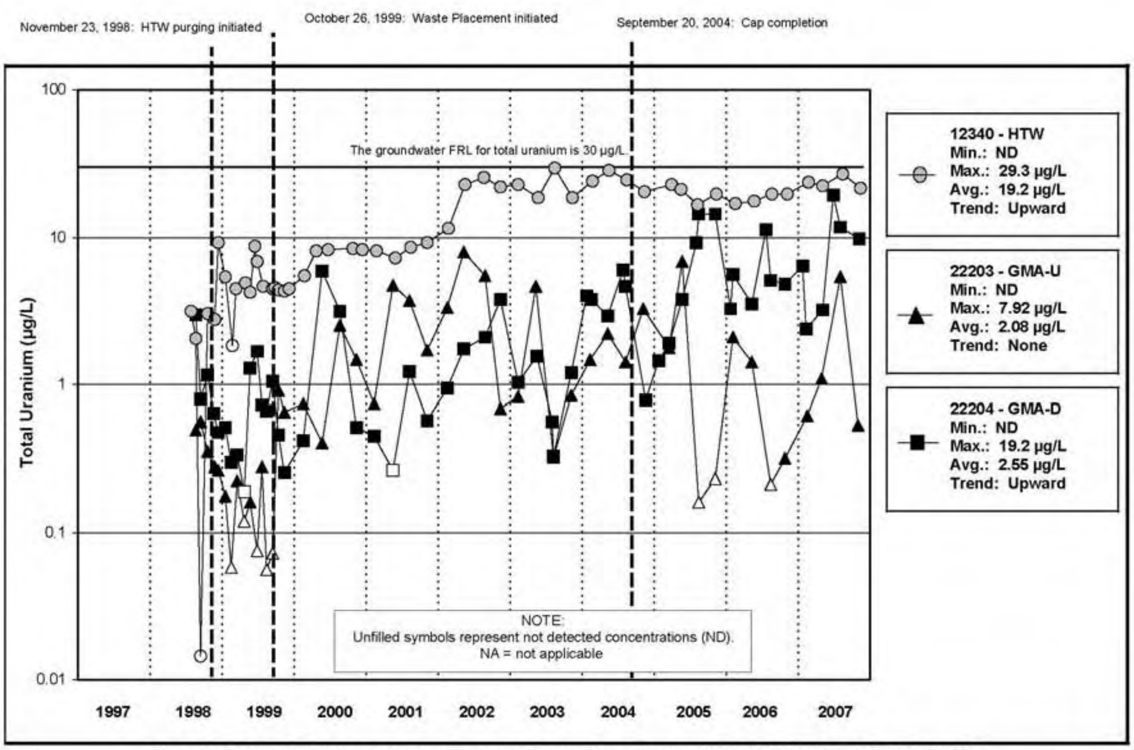


Figure A.5.3-6B. Cell 3 Total Uranium Concentration vs. Time Plot for HTW, GMA-U Well, AND GMA-D Well

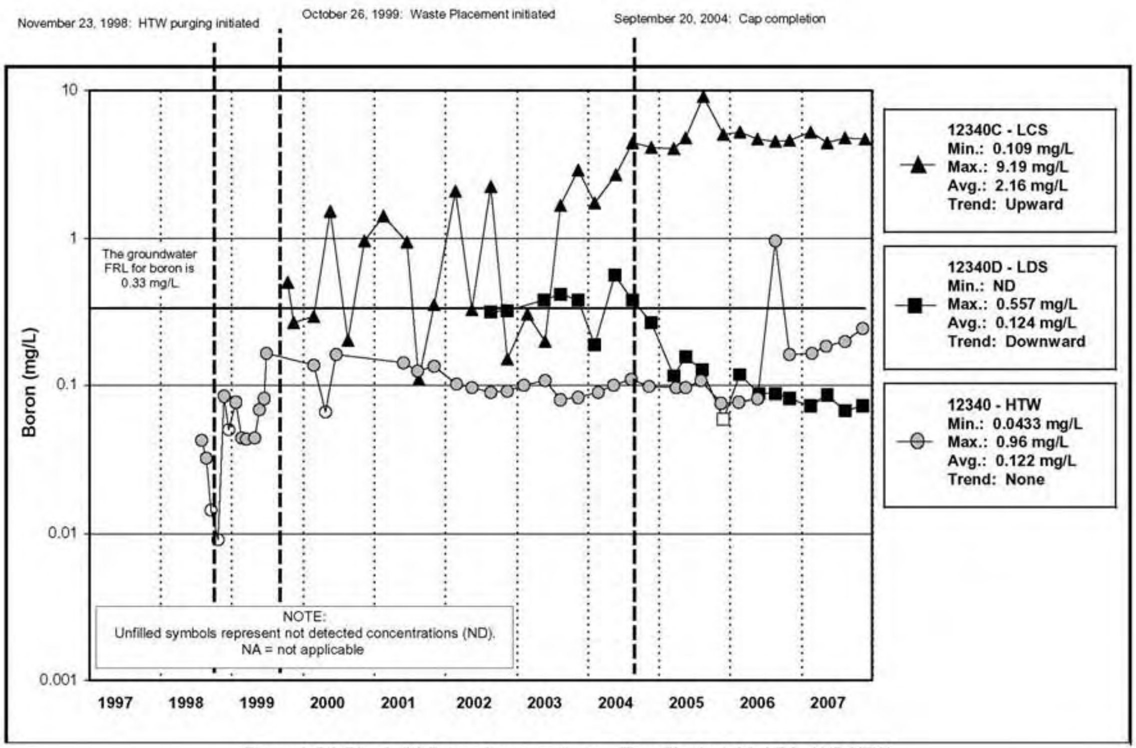


Figure A.5.3-7A. Cell 3 Boron Concentration vs. Time Plot for LCS, LDS, AND HTW

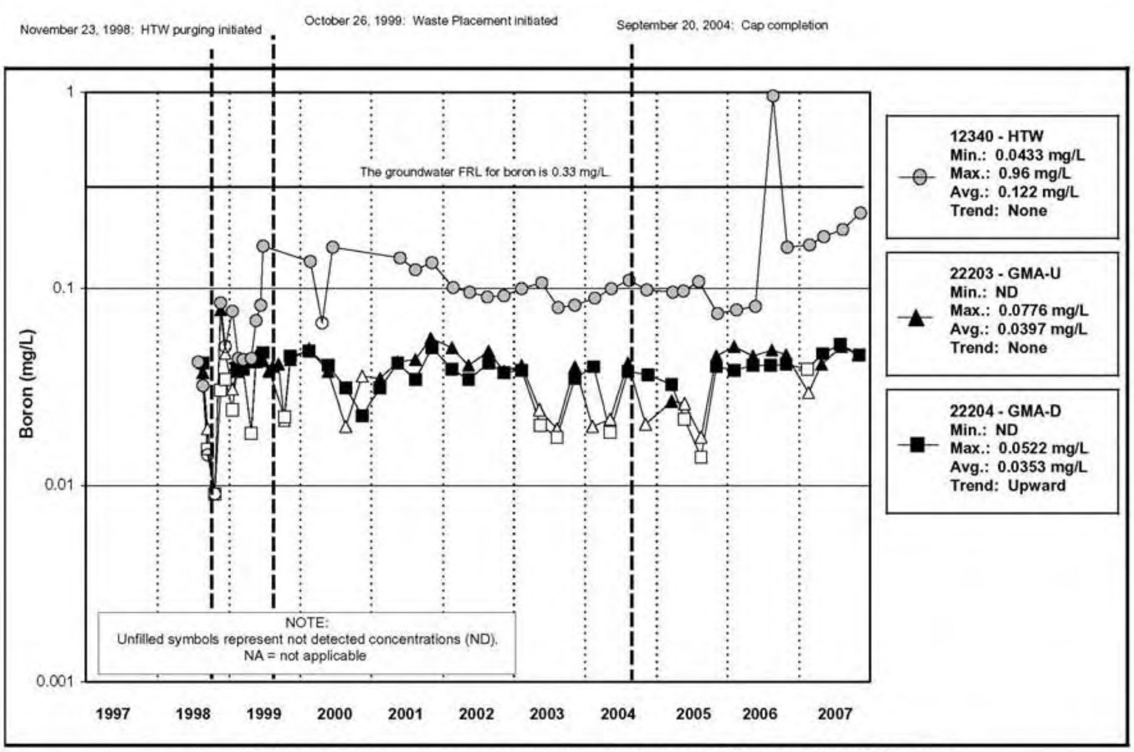


Figure A.5.3-7B. Cell 3 Boron Concentration vs. Time Plot for HTW, GMA-U Well, AND GMA-D Well

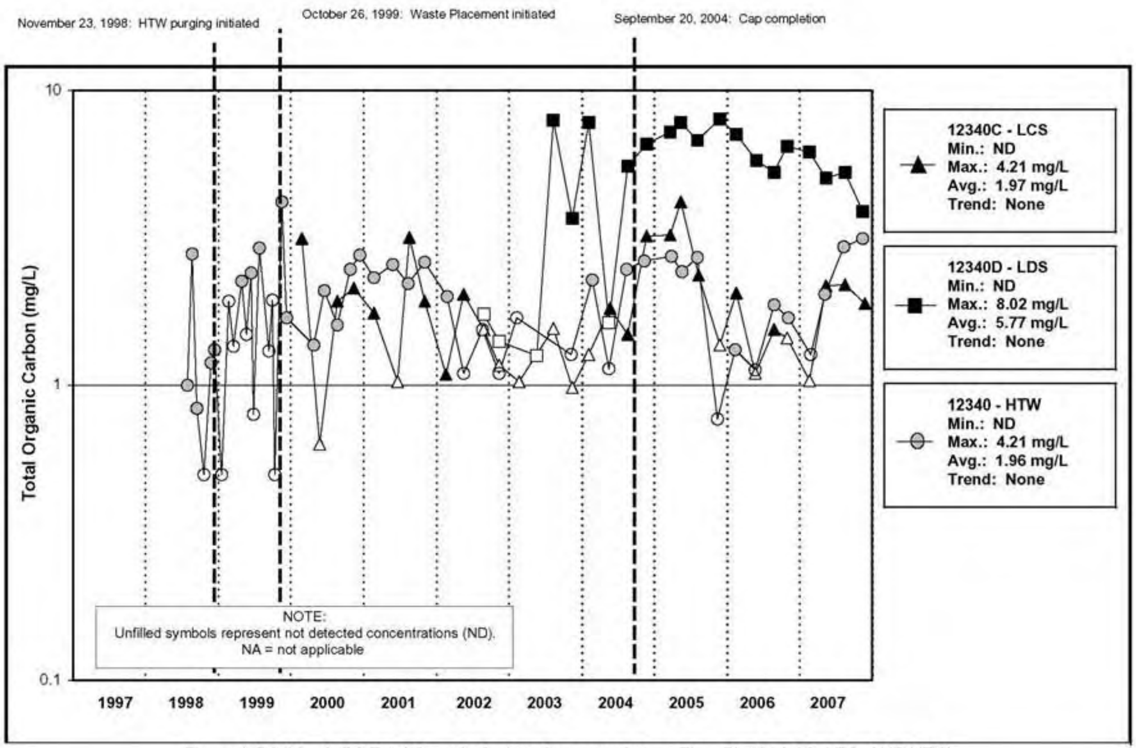


Figure A.5.3-8A. Cell 3 Total Organic Carbon Concentration vs. Time Plot for LCS, LDS, AND HTW

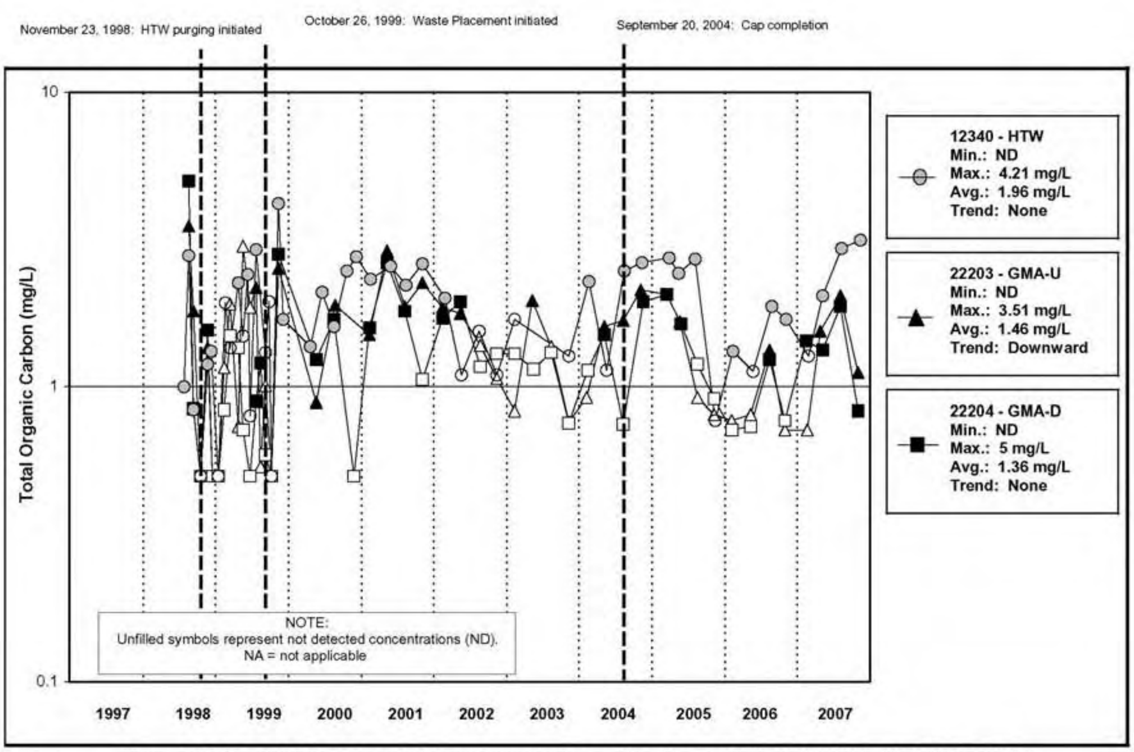


Figure A.5.3-8B. Cell 3 Total Organic Carbon Concentration vs. Time Plot for HTW, GMA-U Well, AND GMA-D Well

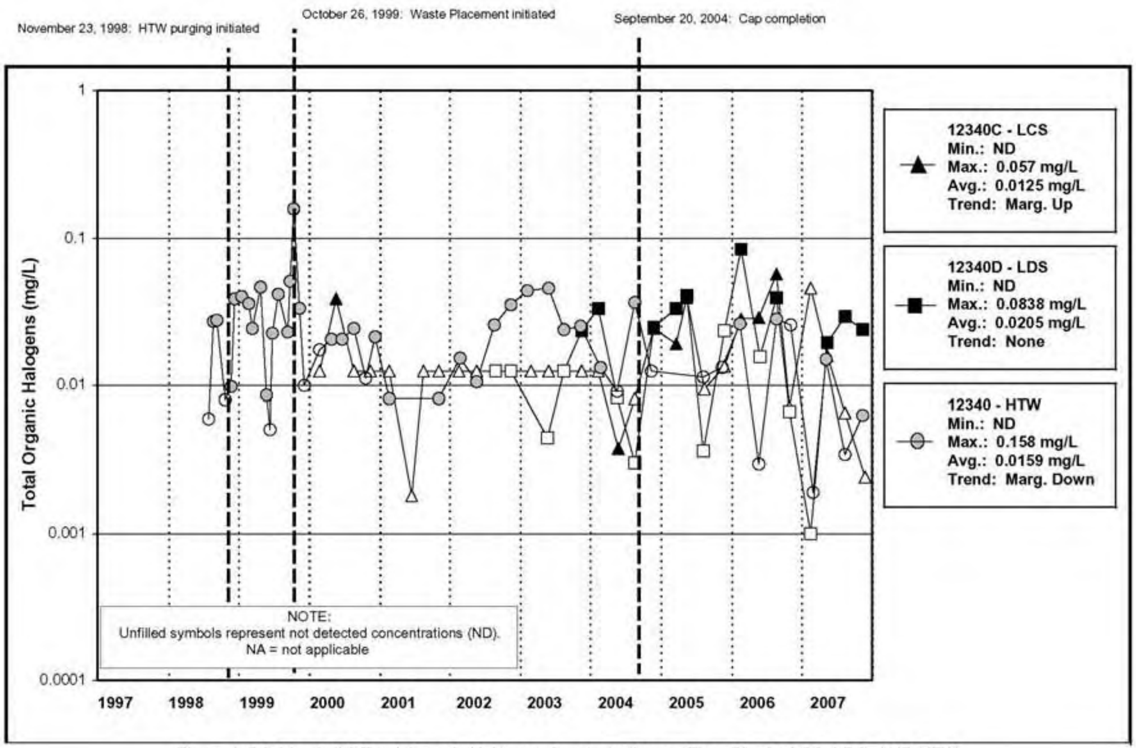


Figure A.5.3-9A. Cell 3 Total Organic Halogens Concentration vs. Time Plot for LCS, LDS, AND HTW

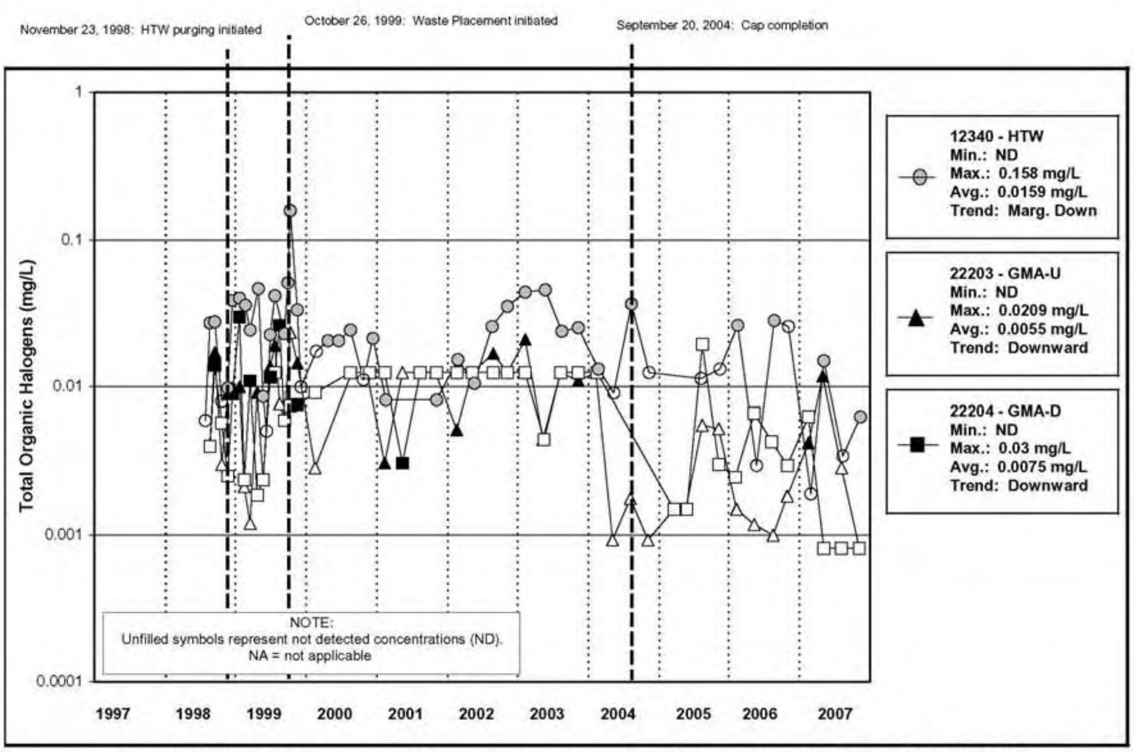


Figure A.5.3-9B. Cell 3 Total Organic Halogens Concentration vs. Time Plot for HTW, GMA-U Well, AND GMA-D Well

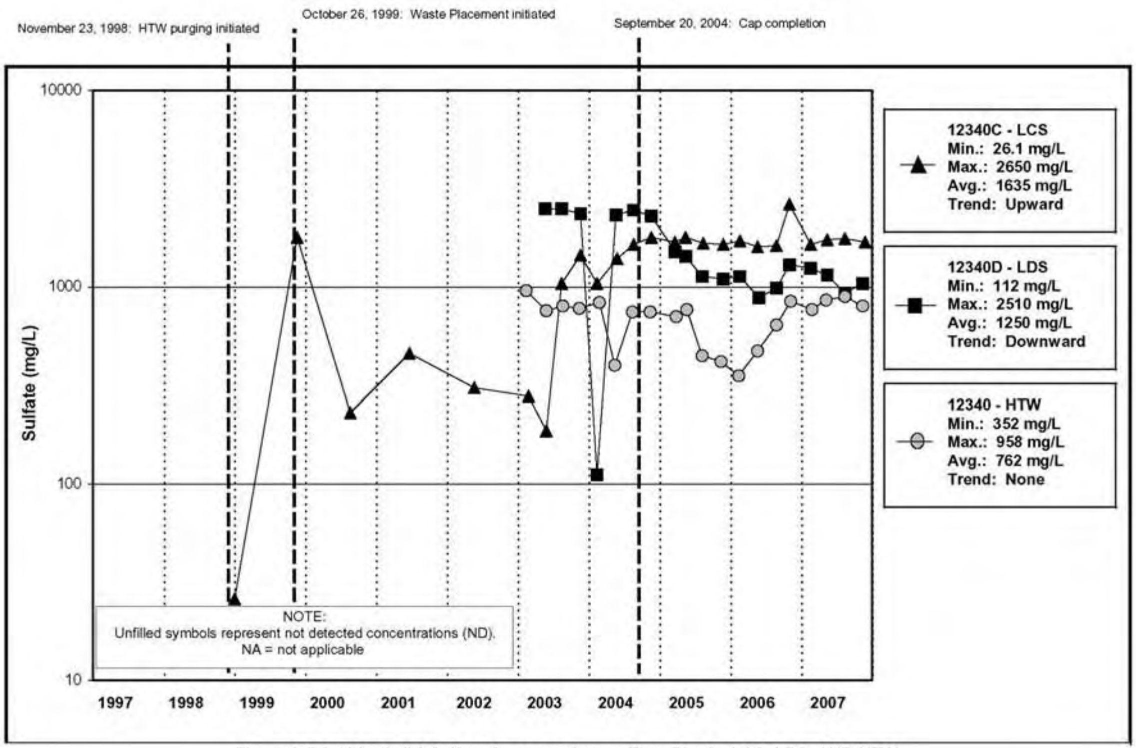


Figure A.5.3-10A. Cell 3 Sulfate Concentration vs. Time Plot for LCS, LDS, AND HTW

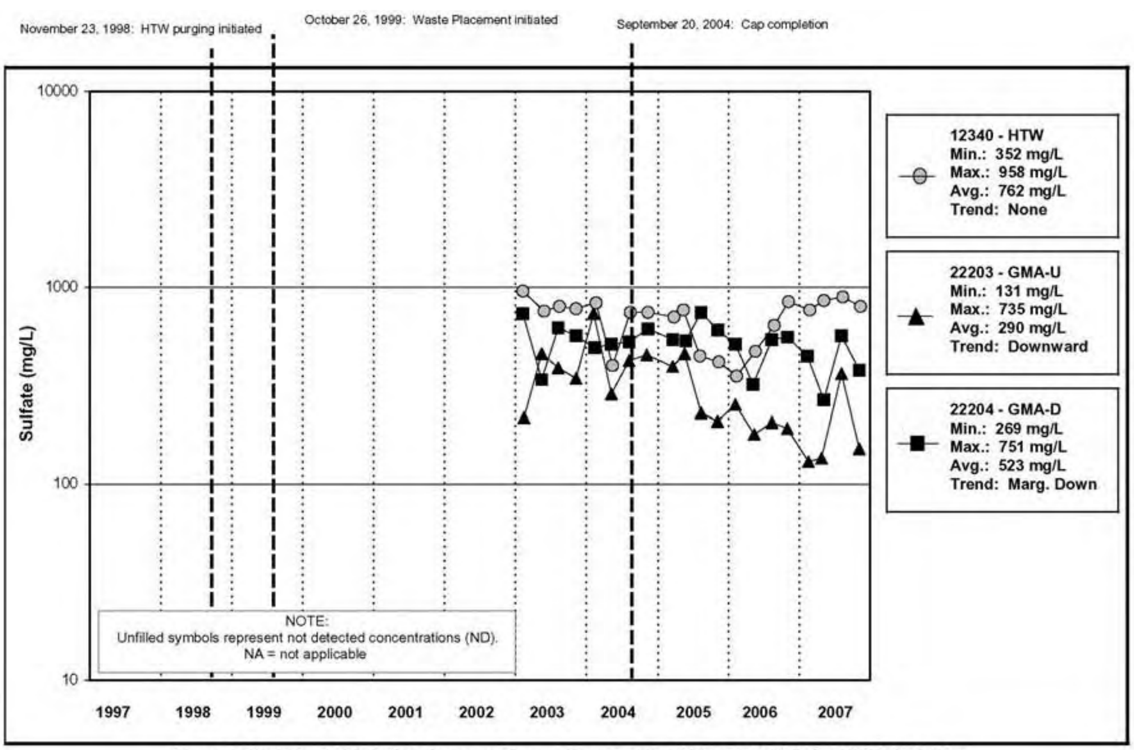


Figure A.5.3-10B. Cell 3 Sulfate Concentration vs. Time Plot for HTW, GMA-U Well, AND GMA-D Well

Sub-Attachment A.5.4

Cell 4

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The following information is provided in this sub-attachment:

- LCS monthly accumulation volumes (refer to Figure A.5.4−1)
- LDS monthly accumulation volumes (refer to Figure A.5.4−2)
- Monthly liner efficiencies (refer to Table A.5.4−1)
- HTW Water Yield (refer to Figure A.5.4−3)
- Great Miami Aquifer water levels and uranium concentrations versus time (refer to Figures A.5.4−4 and A.5.4−5.
- Summary statistics for refined baseline constituents (refer to Section A.5.4.1 and Table A.5.4−2)
- Concentration plots for refined baseline constituents (refer to Section A.5.4.1 and Figures A.5.4−6A through A.5.4−10B)
- Annual LCS monitoring results (refer to Section A.5.4.2 and Table A.5.4−3)
- Annual LDS monitoring results (refer to Section A.5.4.3).

Samples for the OSDF monitoring horizons were collected according to the frequencies described in the OSDF GWLMP. Constituent sampling lists are provided in Table 2−1, Table 2−2, and Table 2−3 of Appendix B of the OSDF GWLMP. In 2007, all samples were collected for Cell 4 monitoring horizons.

A.5.4.1 Refined Baseline Monitoring Results

Refined baseline constituents are those constituents that have been sampled at least eight times, and detected at least 25 percent of the time in the LCS, LDS, HTW, and GMA wells. Refined baseline constituents are listed in Table 2−3 of Appendix B of the OSDF GWLMP. Also included in Table 2−3 are common ion constituents. A summary statistics table (Table A.5.4−2) and concentration plots (Figures A.5.4−6A through A.5.4−10B) are provided for the five refined baseline constituents of Cell 4. For Cell 4, these five constituents are: total uranium, boron, TOC, TOX, and sulfate.

A.5.4.2 LCS Monitoring Results

During active operations (pre-closure) Ohio Solid Waste Regulations (OAC 3745-27-19(M)(5)) require collection and analysis of leachate annually for Appendix I and PCB constituents listed in OAC 3745-27-10. The objective of the annual LCS sampling is to determine if the composition of the leachate within the facility is changing enough to impact monitoring activities beneath the facility. A list of annual LCS sampling constituents is provided in Table 2−2 of Appendix B of the OSDF GWLMP. In 2007, annual sampling of the Cell 4 LCS took place in May. Table A.5.4−3 summarizes the annual LCS sampling results for Cell 4, along with the data collected in previous years.

Of the non-refined baseline site-specific constituents that have been sampled at least eight times in Cell 4, 13 have been detected at least 25 percent of the time. Eleven of the 13 constituents are common ion constituents (alkalinity, calcium, chloride, fluoride, iron, magnesium, manganese, nitrate/nitrite, potassium, silicon, and sodium). The other 2 [total dissolved solids (TDS) and technetium-99] are *potential* site-specific leak detection monitoring constituents for Cell 4.

Common Ions

A common ion study was completed in 2007, and a report, *Fernald Site, Evaluation of Aqueous Ions in the Monitoring Systems of the On-site Disposal Facility*, was issued in March 2008. This report is currently undergoing review by the EPA and OEPA.

As discussed in Section A.5.2.2, the common ion study concluded that fluid volume appears to be the key monitoring constituent to indicate the potential for leachate migration from the OSDF, and the sampling of and analysis for indicator ions are useful only if the hydraulic conditions permit leachate to migrate.

The common ion study also concluded that no one ion can serve as a leak indicator for all cells of the disposal facility, but useful indicator ions for specific target horizons of each cell can be identified. Specifically, uranium in the LDS and sodium in the HTW were the only useful indicator constituents identified for the Cell 4 LDS and HTW, and that sufficient data exists to establish control charts for these two constituents at the same specified locations for Cell 4. In addition, no other useful common ion indicator constituents were found for Cell 4. Since uranium is already included as a refined baseline constituent for Cell 4, it is recommended that sodium be added to the refined baseline constituent list for the Cell 4 HTW. Also, control charts will be included in future SERs for uranium in the Cell 4 LDS and sodium in the Cell 4 HTW upon approval of the common ion study.

Potential Site-Specific Leak Detection Monitoring Constituents

The remaining two constituents (considered to be "*potential*" site-specific leak detection monitoring constituents for Cell 4) are TDS and technetium-99. These potential Cell 4 site-specific leak detection monitoring constituents will be assessed using the statistical approach presented in Figures A.5−4A and A.5−4B, and discussed in Section A.5.2.2, when eight sampling rounds for the Cell 4 LCS have been completed, which should occur in 2009. Results of the assessment will be presented to the EPA and OEPA as soon as they are available and they will also be reported in the SER.

Confirmatory Sampling

Technetium-99 is a site-specific leak detection constituent; however, it is not on the refined baseline list of Cell 4. If a site-specific constituent (not on the refined baseline list) is detected in the LCS or LDS, then confirmatory sampling for that constituent will take place. As shown in Table A.5.4−3, technetium-99 has been detected in the Cell 4 LCS, but these detections occurred prior to the establishment of the refined baseline for Cell 4. Therefore, confirmatory sampling for technetium-99 in the Cell 4 LCS is not required.

A.5.4.3 LDS Monitoring Results

Each year the LDS of Cell 4 is sampled for site-specific constituents listed in Table 2−1 of Appendix B of the OSDF GWLMP. The objective of the annual LDS sampling is to determine if any baseline constituents, not on the refined baseline list, are present in the LDS. In 2007, annual sampling of the Cell 4 LDS took place in May.

Of the non-refined baseline constituents that have been sampled at least eight times, ten have been detected at least 25 percent of the time. All ten of the constituents are common ion constituents (alkalinity, calcium, chloride, fluoride, iron, magnesium, manganese, potassium, silicon, and sodium).

Table A.5.4−1. Cell 4 – 2007 Monthly Liner Efficiencies

Month	Cell 4 Apparent Liner Efficiency (%)
January	94.39
February	96.84
March	97.19
April	97.07
May	97.32
June	97.16
July	96.81
August	97.12
September	98.26
October	94.72
November	98.93
December	98.07

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Table A.5.4−2. Summary Statistics For Cell 4

Note: The data used in this table have been standardized to quarterly.

Parameter	Horizon[a]	Monitoring Location	No. of Detected Samples	Total No. of Samples	Percent of Detects	Average[b]	Distribution Type[c]	Trend[d]	Serial Correlation[e]	Outliers[f,g]
Total Uranium (µg/L)	LCS	12341C	19	19	100	96.6	Normal	Up	Detected	
	LDS	12341D	18	18	100	14.8	Normal	None	Not Detected	5.74 (Q4-02) 21.3 (Q1-06)
	HTW	12341	24	24	100	5.74	Undefined	Down	Marg. Detect	
	GMA-U	22206	21	24	87.5	1.19	Lognormal	None	Detected	0 (Q4-03)
	GMA-D	22205	21	21	100	2.00	Lognormal	Up	Not Detected	8.2 (Q2-05) 10.2 (Q3-05) 10.31 (Q4-02) 12.0567 (Q3-02)
Boron (mg/L)	LCS	12341C	19	19	100	0.836	Normal	Up	Detected	
	LDS	12341D	20	20	100	0.627	Undefined	Down	Detected	
	HTW	12341	21	23	91.3	0.139	Undefined	Down	Detected	1.245 (Q1-02)
	GMA-U	22206	19	24	79.2	0.0375	Normal	None	Marg. Detect	
	GMA-D	22205	21	25	84	0.0392	Undefined	Down	Not Detected	0.0807 (Q3-02)
Total Organic Carbon (mg/L)	LCS	12341C	12	19	63.2	2.83	Normal	None	Not Detected	
	LDS	12341D	17	20	85	4.91	Normal	None	Detected	
	HTW	12341	17	23	73.9	2.27	Lognormal	None	Detected	
	GMA-U	22206	13	24	54.2	1.24	Lognormal	Marg. Down	Not Detected	9.84 (Q2-03)
	GMA-D	22205	12	23	52.2	1.26	Lognormal	None	Detected	2.68 (Q4-04) 2.7367 (Q1-02)
Total Organic Halogens (mg/L)	LCS	12341C	10	19	52.6	0.0166	Normal	Up	Not Detected	
	LDS	12341D	12	20	60	0.0199	Normal	None	Not Detected	
	HTW	12341	13	23	56.5	0.00985	Lognormal	Marg. Down	Not Detected	0.0428 (Q1-06)
	GMA-U	22206	7	24	29.2	0.00665	Undefined	Down	Not Detected	0.027 (Q1-05)
	GMA-D	22205	5	25	20	0.0081	Undefined	Down	Detected	
Sulfate (mg/L)	LCS	12341C	19	19	100	2250	Undefined	Up	Detected	
	LDS	12341D	19	19	100	1870	Lognormal	None	Detected	3020 (Q4-02)
	HTW	12341	19	19	100	199	Normal	None	Detected	313 (Q3-05)
	GMA-U	22206	20	20	100	247	Undefined	Down	Not Detected	
	GMA-D	22205	20	20	100	338	Lognormal	None	Not Detected	

[a]LCS = leachate collection system; LDS = leak detection system; HTW = horizontal till well; GMA-U = upgradient Great Miami Aquifer; and GMA-D = downgradient Great Miami Aquifer

[b]Averages were determined based on the distribution assumption. "Approx. Normal" was treated as if it was normal, and "Approx. Lognormal" was treated as if it was lognormal. This was done to compensate for the skewed (lognormal) or non-skewed (normal) nature of the data to give a better estimate of the underlying average.

[c]Data distribution based on the Shapiro-Wilk statistic.

Normal: Normal assumption could not be rejected at the 5 percent level and has a higher probability value than the lognormal assumption.

Lognormal: Lognormal assumption could not be rejected at the 5 percent level and has a higher probability value than the normal assumption.

Approx. Normal (Approximately Normal): Normal and lognormal assumptions were rejected at the 5 percent level. However, the normal assumption was not rejected at the 10 % level. Additionally, for cases where neither assumption was rejected at the 10% level, the data fit the normal destribution better than the lognormal distribution.

Approx. Lognormal (Approximately Lognormal): Normal and lognormal assumptions were rejected at the 5 percent level. However, the lognormal assumption was not rejected at the 10 % level. Additionally, for cases where neither assumption was rejected at the 10% level, the data fit the lognormal destribution better than the normal distribution.

Undefined: Normal and Lognormal Distribution assumptions are both rejected or there are less than 25% detected values. "Average" is defined as the Median of the data.

[d]Trend based on nonparametric Mann-Kendall procedure. Note that "Marg. Down" is a marginally downward trend and "Marg. Up" is a marginally upward trend.

[e]Serial correlation based on Rank Von Neumann test.

[f]Outliers determined by Rosner's (for sample sizes greater than 25) or Dixon procedure (for sample sizes less than or equal to 25).

[g]Q = quarterly

Table A.5.4−3. Cell 4 Annual LCS Sample Summary

PARAMETER(UNIT)	NUMBER OF SAMPLES[a,b]	NUMBER OF SAMPLES WITH DETECTIONS[a,b]	PERCENT OF DETECTIONS[a,b]	MIN DETECTED CONCENTRATION[a,b,c]	MAX DETECTED CONCENTRATION[a,b,c]	AVG DETECTED CONCENTRATION[a,b,c]	GW FRL[d] (# OF SAMPLES>GWFRL)	GW BACKGROUND[a,b,e] (# OF SAMPLES>PW BACKGROUND)	PW BACKGROUND[a,b,e] (# OF SAMPLES>PW BACKGROUND)	MAX PW DETECTED CONCENTRATION [a,b,f] (# OF SAMPLES>MAX PW)	DETECTION LIMIT
1,1-Dichloroethane (µg/L)	6	1	16.70%	0.332	-	-	280 µg/L(0)	-	-	-	1 µg/L
Alkalinity as CaCO3 (mg/L)	12	12	100%	48	583	358	-	422 mg/L(4)	430 mg/L(4)	-	10 mg/L
Ammonia (mg/L)	6	1	16.70%	0.0328	-	-	-	4.2 mg/L(0)	4.34 mg/L(0)	220 mg/L(0)	0.1 mg/L
Barium (mg/L)	6	6	100%	0.0266	0.058	0.0373	2 mg/L(0)	0.77 mg/L(0)	0.45 mg/L(0)	0.589 mg/L(0)	0.029 mg/L
Calcium (mg/L)	12	12	100%	52.9	1110	512	-	159 mg/L(11)	172 mg/L(11)	1800 mg/L(0)	5 mg/L
Chloride (mg/L)	12	11	91.70%	26	103	79.7	-	7.3 mg/L(11)	45 mg/L(9)	6300 mg/L(0)	5 mg/L
Chromium (mg/L)	6	2	33.30%	0.003	0.0137	0.0084	0.022 mg/L[g](0)	0.021 mg/L(0)	0.0046 mg/L(1)	0.818 mg/L(0)	0.005 mg/L
Cobalt (mg/L)	6	5	83.30%	0.00046	0.0057	0.0021	0.17 mg/L(0)	0.0086 mg/L(0)	-	0.0886 mg/L(0)	0.034 mg/L
Copper (mg/L)	6	4	66.70%	0.00076	0.0192	0.0107	1.3 mg/L(0)	0.035 mg/L(0)	0.029 mg/L(0)	0.298 mg/L(0)	0.008 mg/L
Fluoride (mg/L)	9	8	88.90%	0.172	0.43	0.29	4 mg/L(0)	0.89 mg/L(0)	1.3 mg/L(0)	6.8 mg/L(0)	0.2 mg/L
Iron (mg/L)	12	9	75%	0.543	4.18	2.35	-	5.72 mg/L(0)	6.35 mg/L(0)	21.3 mg/L(0)	0.1 mg/L
Magnesium (mg/L)	12	12	100%	15	732	335	-	38.5 mg/L(11)	50.7 mg/L(11)	690 mg/L(1)	5 mg/L
Manganese (mg/L)	12	12	100%	0.00563	2.14	0.344	0.9 mg/L(2)	0.9 mg/L(2)	0.21 mg/L(3)	35 mg/L(0)	0.09 mg/L
Nickel (mg/L)	6	6	100%	0.00112	0.0375	0.0136	0.1 mg/L(0)	0.0514 mg/L(0)	0.0072 mg/L(4)	0.981 mg/L(0)	0.02 mg/L
Nitrate/Nitrite (mg/L)	16	7	43.80%	0.351	6.34	2.39	11 mg/L[g](0)	11 mg/L(0)	0.29 mg/L(7)	2670 mg/L(0)	1.1 mg/L
Potassium (mg/L)	12	12	100%	3.81	78.4	23.4	-	1.96 mg/L(12)	17.2 mg/L(10)	12400 mg/L(0)	5 mg/L
Selenium (mg/L)	6	3	50%	0.0025	0.0178	0.0077	0.05 mg/L(0)	0.00075 mg/L(3)	-	0.0494 mg/L(0)	0.005 mg/L
Silicon (mg/L)	9	9	100%	3.11	5.6	4.02	-	-	-	15 mg/L(0)	0.015 mg/L
Sodium (mg/L)	12	12	100%	22	117	51.5	-	47.1 mg/L(4)	50 mg/L(2)	1300 mg/L(0)	5 mg/L
Technetium-99 (pCi/L)	11	4	36.40%	8.16	37.8	17.9	94 pCi/L(0)	22 pCi/L(1)	30 pCi/L(1)	6130 pCi/L(0)	10 pCi/L
TDS (mg/L)	10	10	100%	351	4550	2370	-	-	-	-	10 mg/L
Zinc (mg/L)	6	1	16.70%	0.0197	-	-	0.021 mg/L(0)	0.02 mg/L(0)	0.35 mg/L(0)	1.78 mg/L(0)	0.015 mg/L

Note: Shading indicates that at least one detected sample is greater than the FRL, groundw ater background, PW background, or PW maximum.

[a]If more than one sample is collected per w ell per day (e.g., duplicates), then only one sample is counted for the total number of samples, and the sample w ith the maximum representative concentration is used for all the summary information

[b]Rejected data qualified w ith an R or Z w ere not included.

[c]If the number of detected samples is equal to tw o, then the minimum and maximum are reported. If the number of detected is equal to one, then the data point is reported as the minimum. The "AVG DETECTED CONCENTRATION" is not reported for either of these cases.

[d]From Operable Unit 5 Record of Decision, Table 9-4.

[e]From the Characterization of Background Water Quality for Streams and Groundw ater w hich w as developed for Operable Unit 5 RI/FS documents.

[f]Max PW - maximum detected concentration in perched w ater as defined in the Remedial Investigation Report for Operable Unit 5.

[g]FRL based on hexavalent chromium and nitrate, from Operable Unit 5 Record of Decision, Table 9-4.

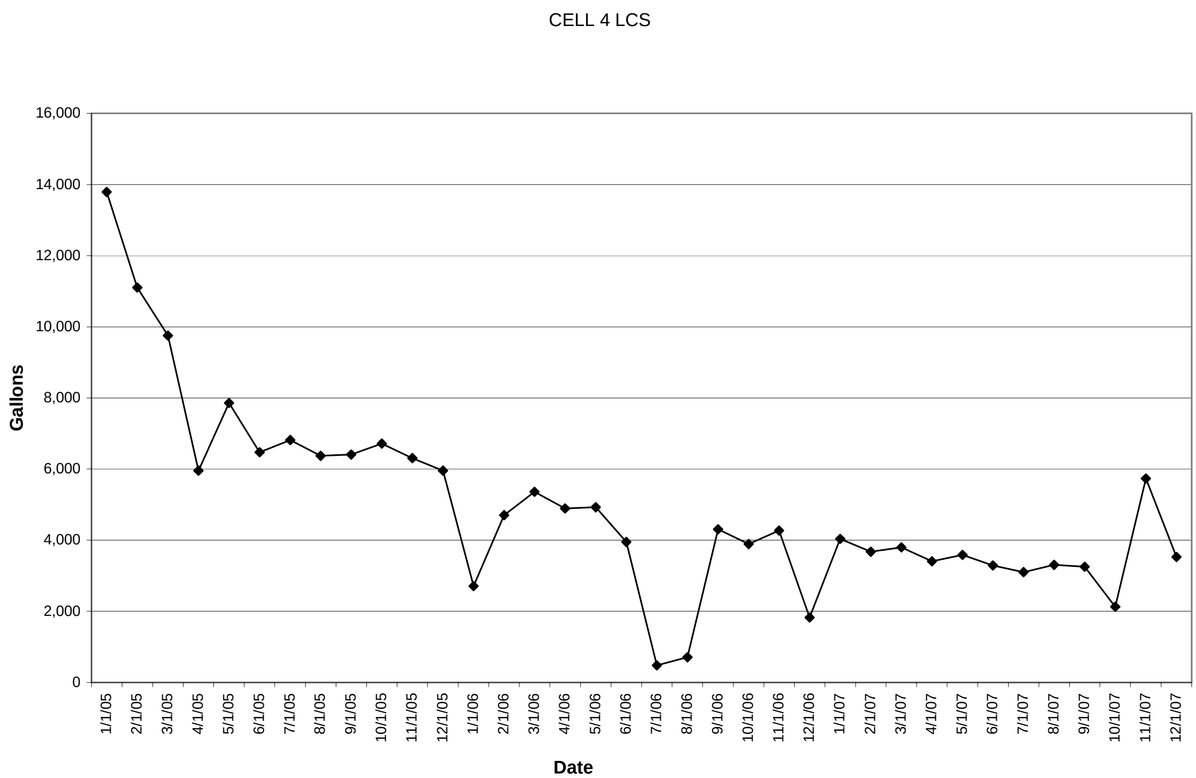


FIGURE A.5.4-1. MONTHLY ACCUMULATION VOLUMES FOR CELL 4 LCS

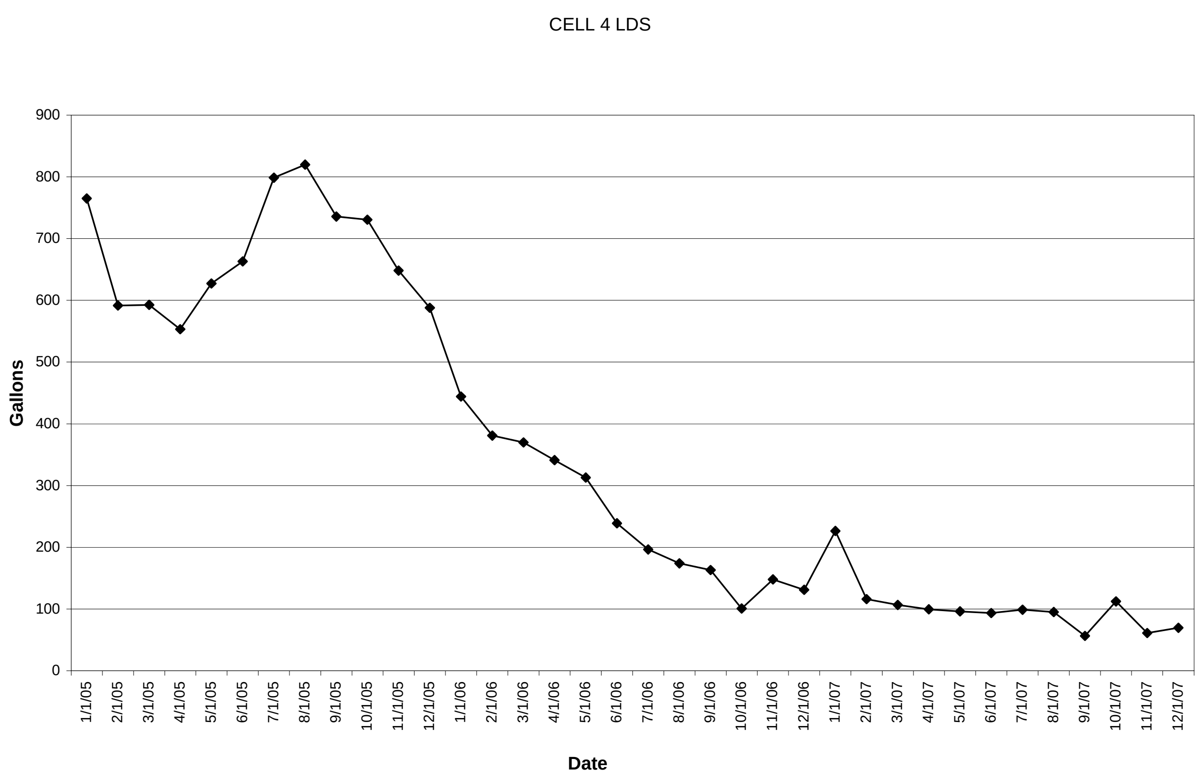
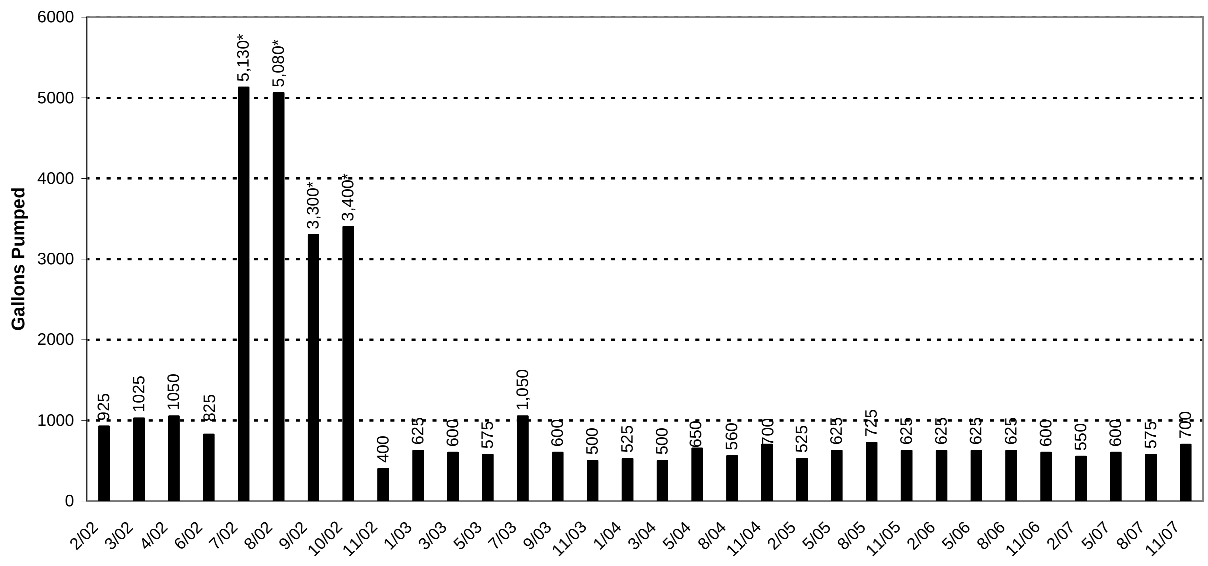


FIGURE A.5.4-2. MONTHLY ACCUMULATION VOLUMES FOR CELL 4 LDS



12341 Purge Information

Year	Total Volumes (gal.)	Months Purged	Avg. Monthly Purge (gal.)
2002:	21115	n=9	2346
2003:	3950	n=6	658
2004:	2935	n=5	587
2005:	2500	n=4	625
2006:	2475	n=4	619
2007:	2425	n=4	606
Overall:			1106

*More than one purge of the well was completed during these months to drain perched water and infiltrating surface water so the compacted clay liner could be constructed.

FIGURE A.5.4-3. OSDF HORIZONTAL TILL WELL 12341 (CELL 4) WATER YIELD

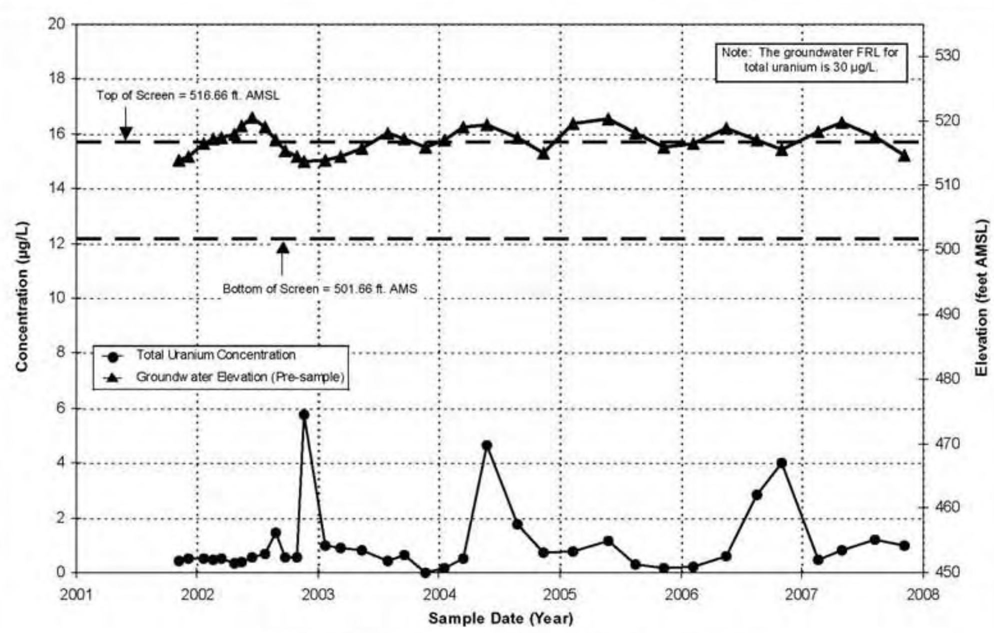


Figure A.5.4-4. Total Uranium Concentration and Groundwater Elevation vs. Time Plot for Cell 4 Upgradient Monitoring Well 22206

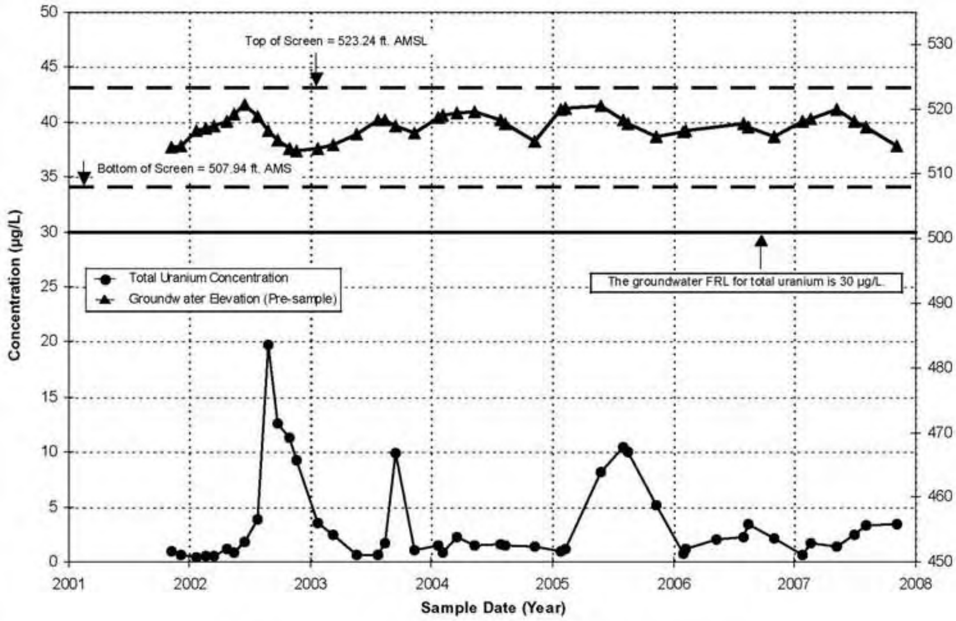


Figure A.5.4-5. Total Uranium Concentration and Groundwater Elevation vs. Time Plot for Cell 4 Downgradient Monitoring Well 22205

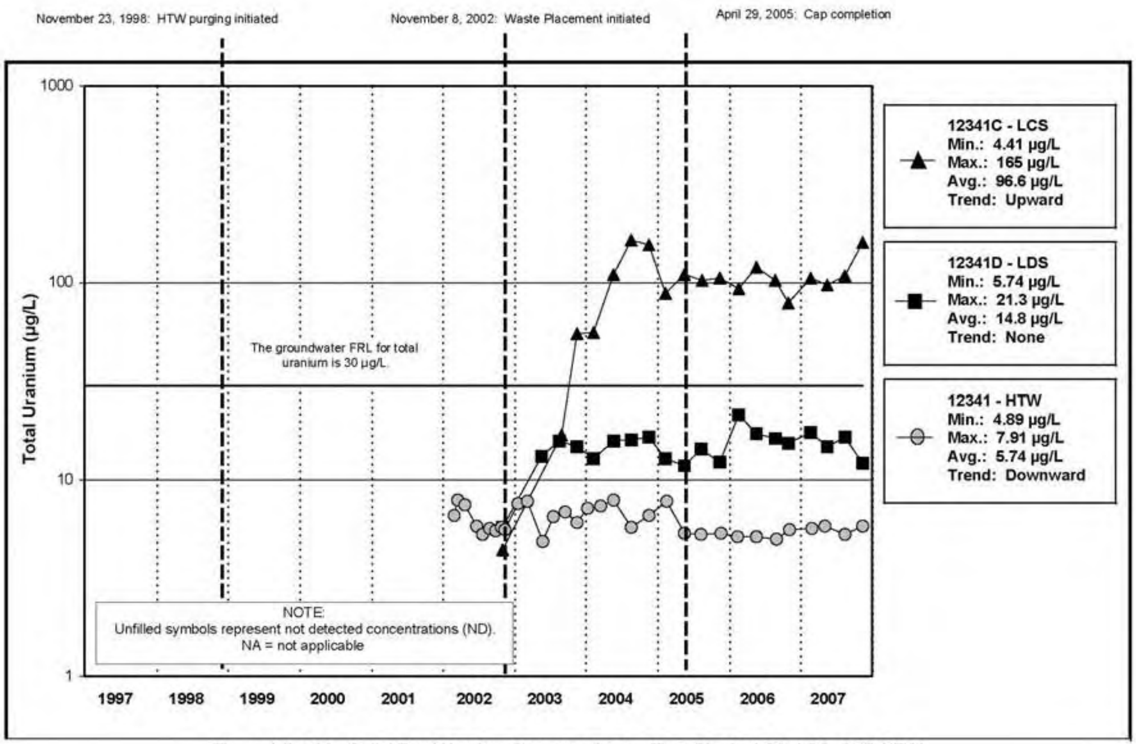


Figure A.5.4-6A. Cell 4 Total Uranium Concentration vs. Time Plot for LCS, LDS, AND HTW

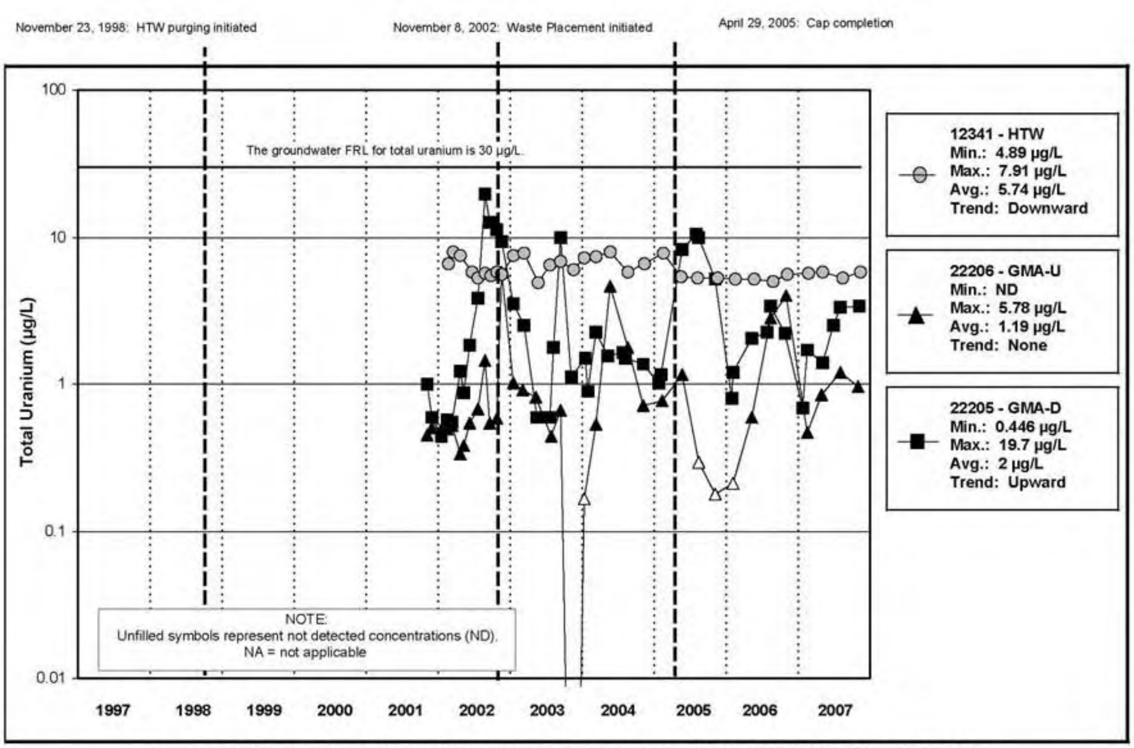


Figure A.5.4-6B. Cell 4 Total Uranium Concentration vs. Time Plot for HTW, GMA-U Well, AND GMA-D Well

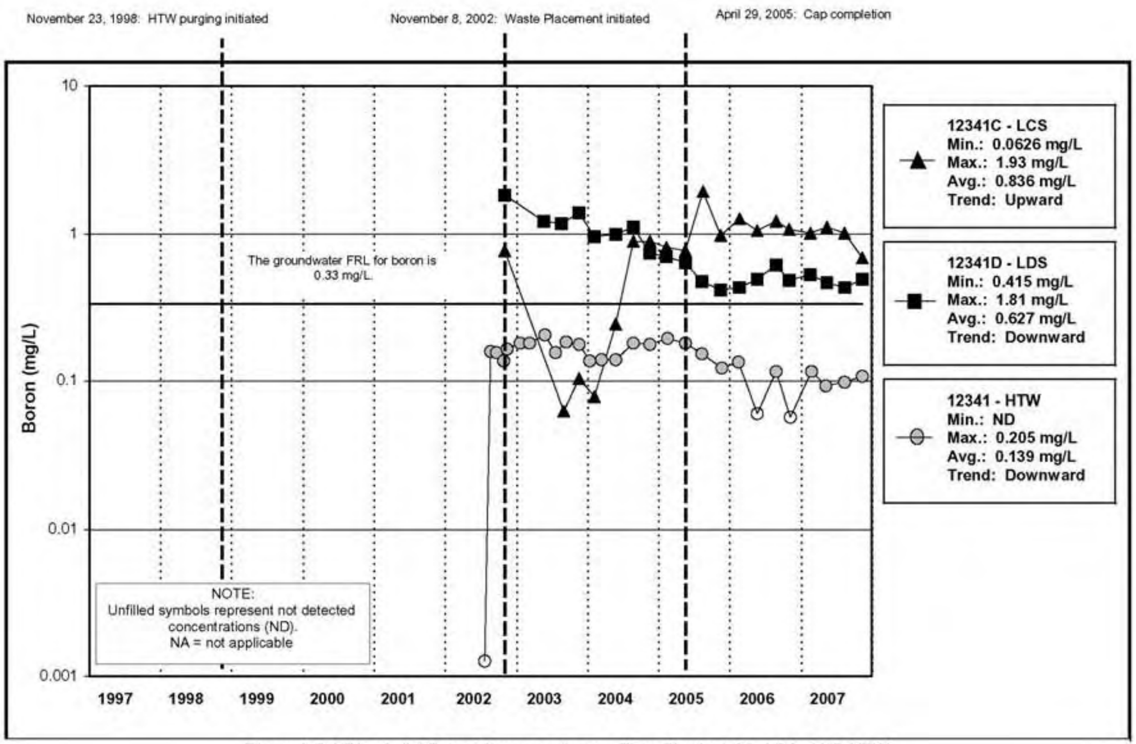


Figure A.5.4-7A. Cell 4 Boron Concentration vs. Time Plot for LCS, LDS, AND HTW

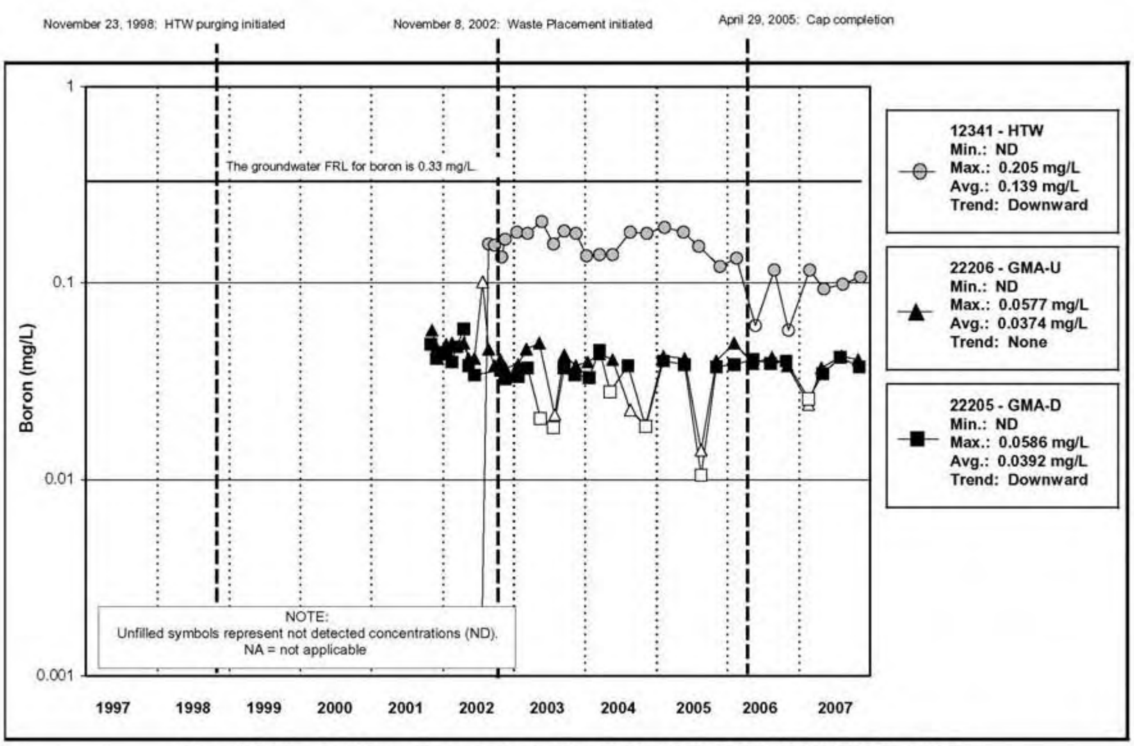


Figure A.5.4-7B. Cell 4 Boron Concentration vs. Time Plot for HTW, GMA-U Well, AND GMA-D Well

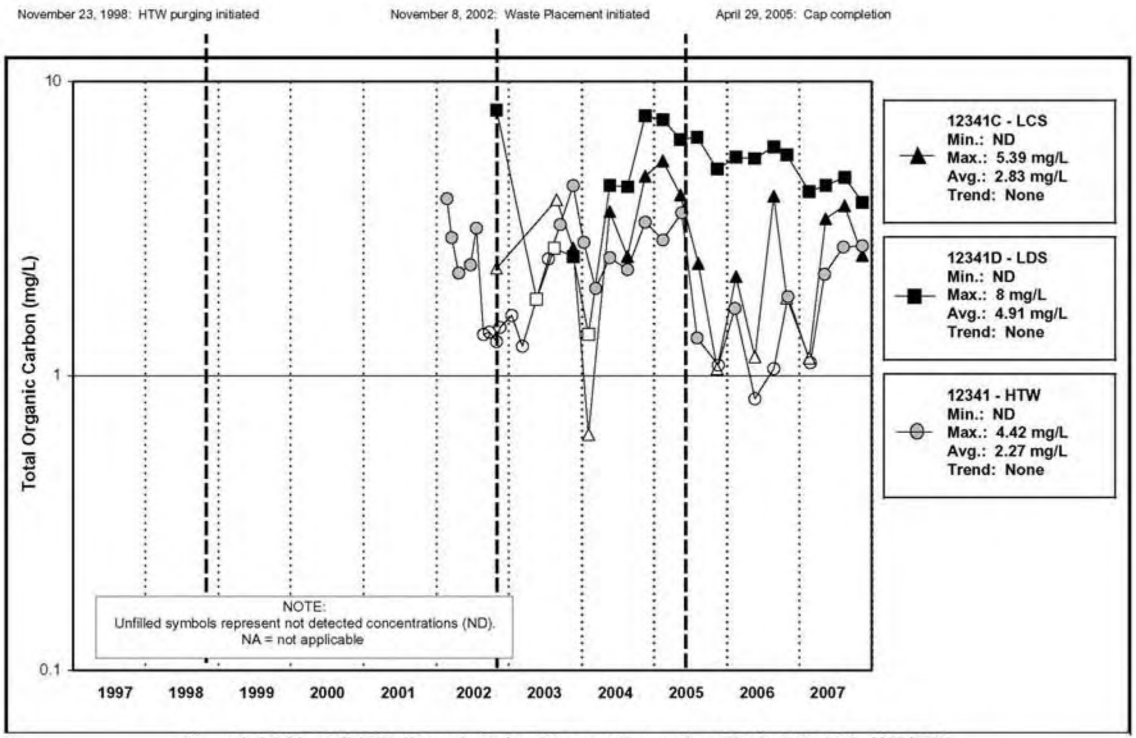


Figure A.5.4-8A. Cell 4 Total Organic Carbon Concentration vs. Time Plot for LCS, LDS, AND HTW

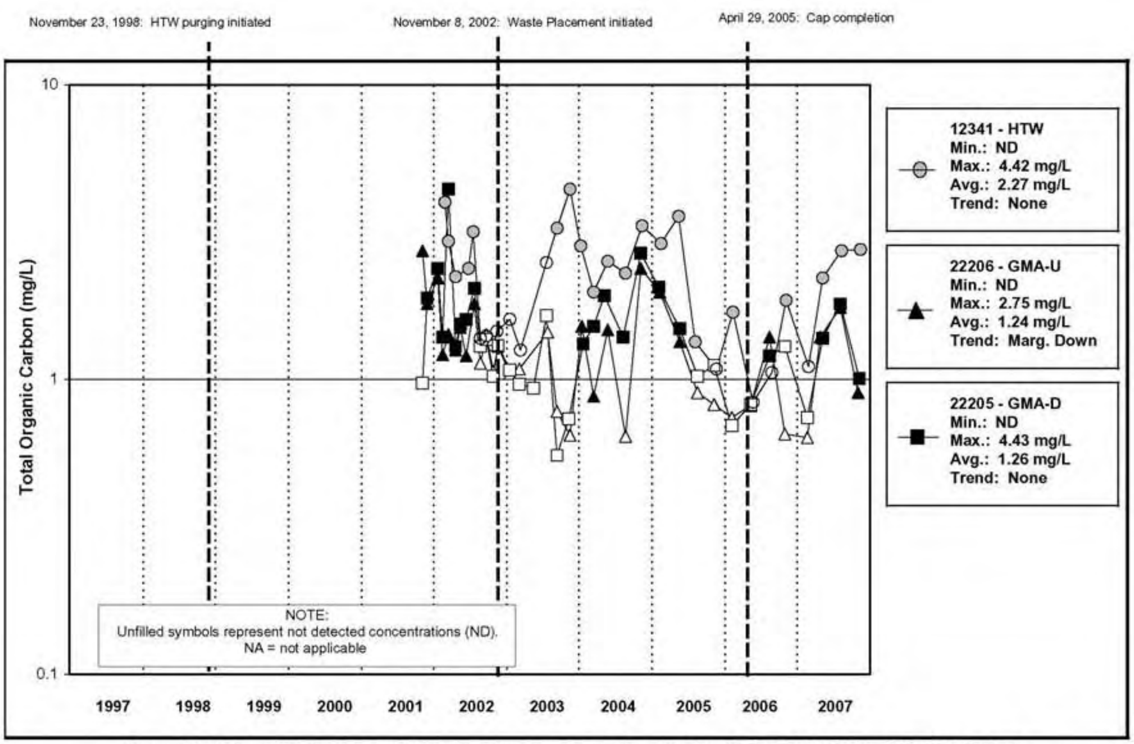


Figure A.5.4-8B. Cell 4 Total Organic Carbon Concentration vs. Time Plot for HTW, GMA-U Well, AND GMA-D Well

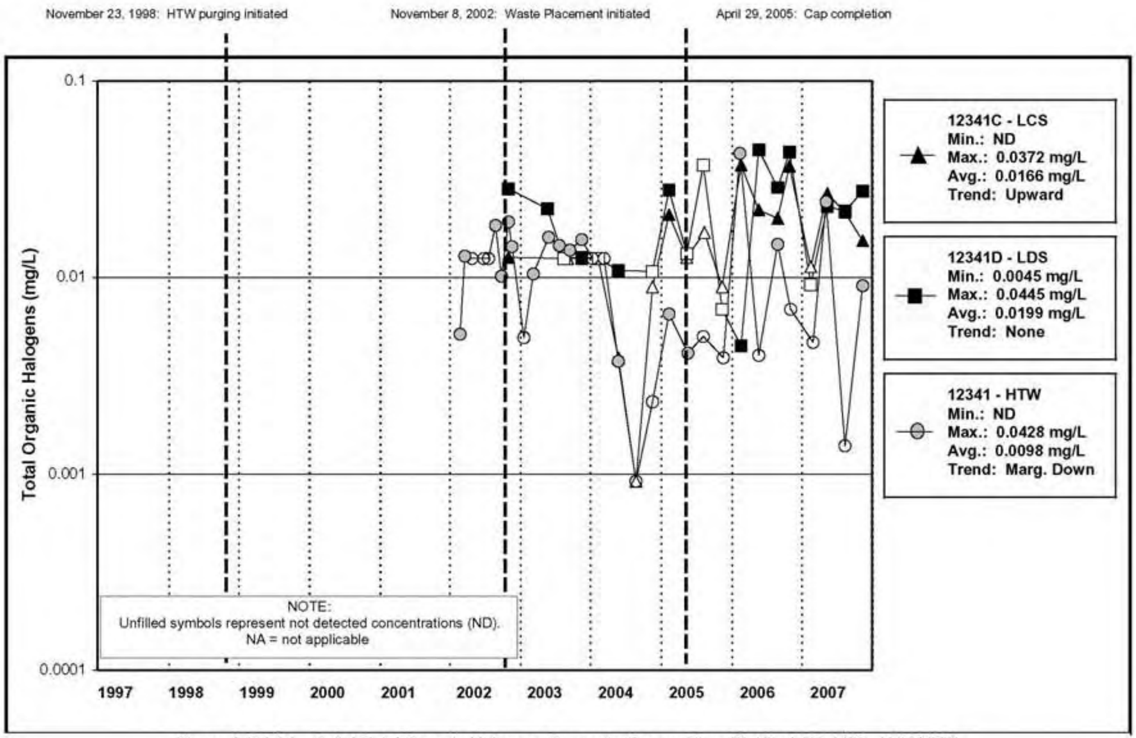


Figure A.5.4-9A. Cell 4 Total Organic Halogens Concentration vs. Time Plot for LCS, LDS, AND HTW

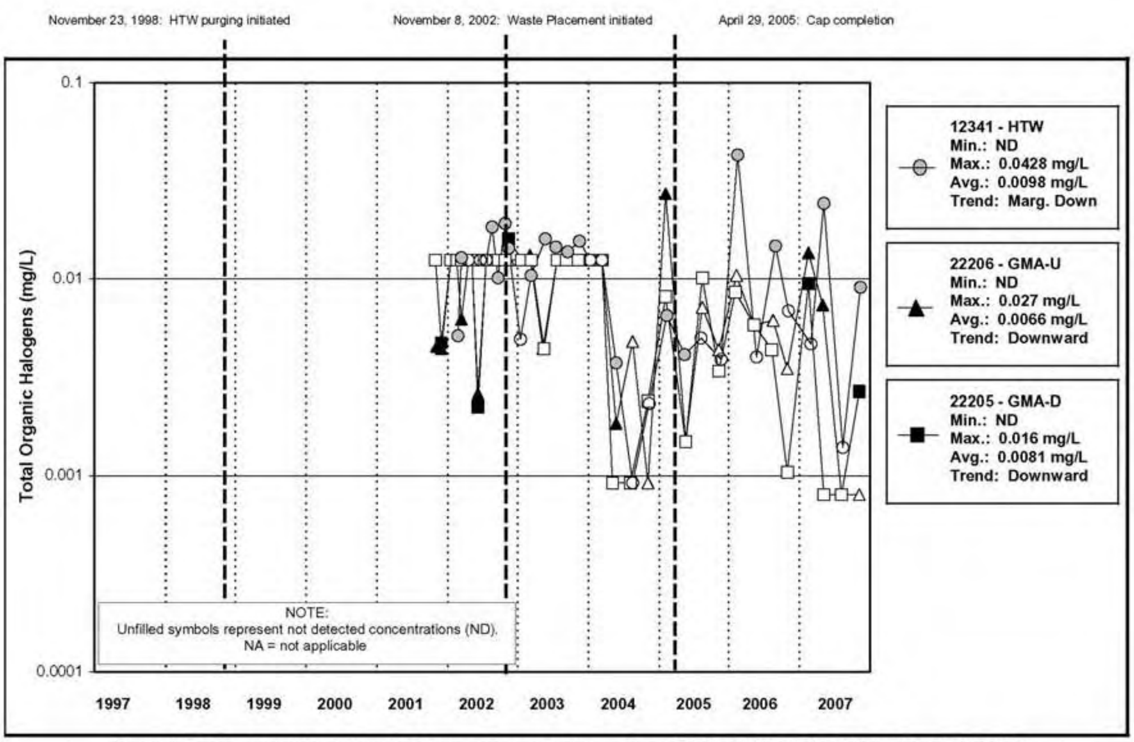


Figure A.5.4-9B. Cell 4 Total Organic Halogens Concentration vs. Time Plot for HTW, GMA-U Well, AND GMA-D Well

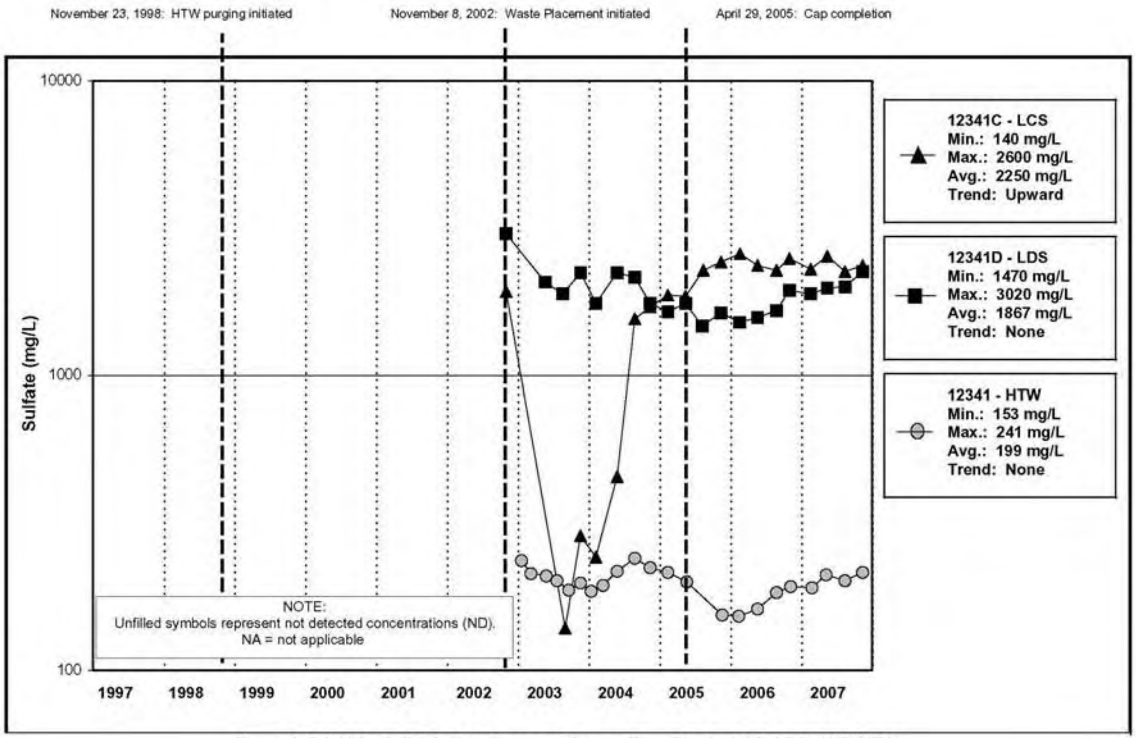


Figure A.5.4-10A. Cell 4 Sulfate Concentration vs. Time Plot for LCS, LDS, AND HTW

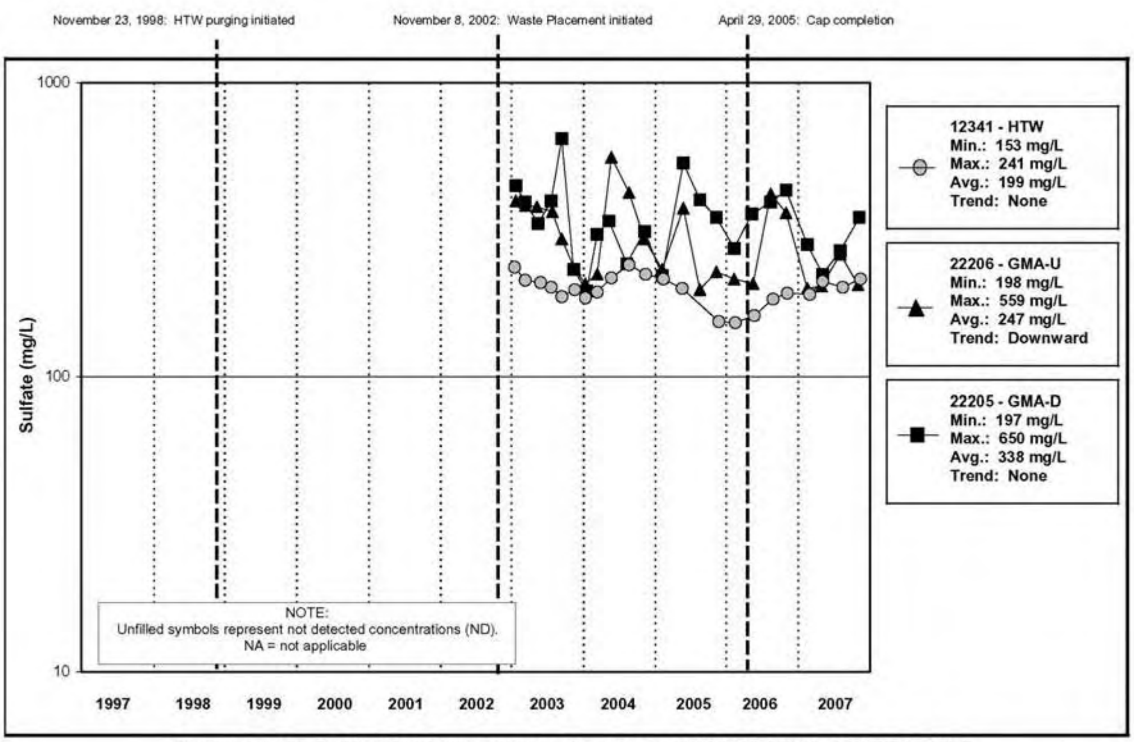


Figure A.5.4-10B. Cell 4 Sulfate Concentration vs. Time Plot for HTW, GMA-U Well, AND GMA-D Well

Sub-Attachment A.5.5

Cell 5

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The following information is provided in this sub-attachment:

- LCS monthly accumulation volumes (refer to Figure A.5.5−1)
- LDS monthly accumulation volumes (refer to Figure A.5.5−2)
- Monthly liner efficiencies (refer to Table A.5.5−1)
- HTW Water Yield (refer to Figure A.5.5−3)
- Great Miami Aquifer water levels and uranium concentrations versus time (refer to Figures A.5.5−4 and A.5.5−5)
- Summary statistics for refined baseline constituents (refer to Section A.5.5.1 and Table A.5.5−2)
- Concentration plots refined baseline constituents (refer to Section A.5.5.1 and Figures A.5.5−6A through A.5.5−10B)
- Annual LCS monitoring results (refer to Section A.5.5.2 and Table A.5.5−3)
- Annual LDS monitoring results (refer to Section A.5.5.3).

Samples for the OSDF monitoring horizons were collected according to the frequencies described in the OSDF GWLMP. Constituent sampling lists are provided in Table 2−1, Table 2−2, and Table 2−3 of Appendix B of the OSDF GWLMP. In 2007, all samples were collected for Cell 5 monitoring horizons.

A.5.5.1 Refined Baseline Monitoring Results

Refined baseline constituents are those constituents that have been sampled at least eight times, and detected at least 25 percent of the time in the LCS, LDS, HTW, and GMA wells. Refined baseline constituents are listed in Table 2−3 of Appendix B of the OSDF GWLMP. Also included in Table 2−3 are common ion constituents. A summary statistics table (Table A.5.5−2) and concentration plots (Figures A.5.5−6A through A.5.5−10B) are provided for the five refined baseline constituents of Cell 5; total uranium, boron, TOC, TOX, and sulfate.

A.5.5.2 LCS Monitoring Results

During active operations (pre-closure) Ohio Solid Waste Regulations (OAC 3745-27-19(M)(5)) require collection and analysis of leachate annually for Appendix I and PCB constituents listed in OAC 3745-27-10. The objective of the annual LCS sampling is to determine if the composition of the leachate within the facility is changing enough to impact monitoring activities beneath the facility. A list of annual LCS sampling constituents is provided in Table 2−2 of Appendix B of the OSDF GWLMP. In 2007, annual sampling of the Cell 5 LCS took place in May. Table A.5.5−3 summarizes the annual LCS sampling results for Cell 5, along with the data collected in previous years.

Of the non-refined site-specific baseline constituents that have been sampled at least eight times, 13 have been detected at least 25 percent of the time. Eleven of the 13 constituents are common ion constituents (alkalinity, calcium, chloride, fluoride, iron, magnesium, manganese, nitrate/nitrite, potassium, silicon, and sodium). The other two [total dissolved solids (TDS), and technetium-99] are *potential* site-specific leak detection monitoring constituents for Cell 5.

Common Ions

A common ion study was completed in 2007, and a report, *Fernald Site, Evaluation of Aqueous Ions in the Monitoring Systems of the On-site Disposal Facility*, was issued in March 2008. This report is currently undergoing review by the EPA and OEPA.

As discussed in Section A.5.2.2, the common ion study concluded that fluid volume appears to be the key monitoring constituent to indicate the potential for leachate migration from the OSDF, and the sampling of and analysis for indicator ions are useful only if the hydraulic conditions permit leachate to migrate.

The common ion study also concluded that no one ion can serve as a leak indicator for all cells of the disposal facility, but useful indicator ions for specific target horizons of each cell can be identified. Specifically, manganese was the only useful indicator constituent identified for the Cell 5 LDS and that sufficient data exists to establish a control chart for manganese for Cell 5. In addition, no other useful common ion indicator constituents were found for Cell 5. Therefore, DOE recommends that manganese be added to the refined baseline constituent list for the Cell 5 LDS and a control chart will be included in future SERs for this constituent at this location upon approval of the common ion study.

Potential Site-Specific Leak Detection Monitoring Constituents

The remaining two constituents (considered to be "*potentia*l" site-specific leak detection monitoring constituents for Cell 5) are TDS and technetium-99. These potential Cell 5 site-specific leak detection monitoring constituents will be assessed using the statistical approach presented in Figures A.5−4A and A.5−4B, and discussed in Section A.5.2.2, when eight sampling rounds for the Cell 5 LCS have been completed, which should occur in 2009. Results of the assessment will be presented to the EPA and OEPA as soon as they are available and they will also be reported in the SER.

Confirmatory Sampling

Technetium-99 is a site-specific leak detection constituent; however, it is not on the refined baseline list for Cell 5. If a site-specific constituent (not on the refined baseline list) is detected in the LCS or LDS, then confirmatory sampling for that constituent will take place. As shown in Table A.5.5−3, technetium-99 has been detected in the Cell 5 LCS, but these detections were prior to the establishment of the refined baseline for Cell 5. Therefore, confirmatory sampling for technetium-99 in the Cell 5 LCS is not required.

A.5.5.3 LDS Monitoring Results

Each year the LDS of Cell 5 is sampled for site-specific baseline constituents listed in Table 2−1 of Appendix B of the OSDF GWLMP. The objective of the annual LDS sampling is to determine if any initial baseline constituents, not on the refined baseline list, are present in the LDS. In 2007, annual sampling of the Cell 5 LDS took place in May.

In 2007, of the non-refined baseline constituents that have been sampled at least eight times, ten have been detected at least 25 percent of the time. All ten of these constituents are common ion constituents (alkalinity, calcium, chloride, fluoride, iron, magnesium, manganese, potassium, silicon, and sodium).

Table A.5.5−1. Cell 5 – 2007 Monthly Liner Efficiencies

Month	Cell 5 Apparent Liner Efficiency (%)
January	78.34
February	82.72
March	82.14
April	83.07
May	84.52
June	85.84
July	86.10
August	87.87
September	89.33
October	84.94
November	88.48
December	90.98

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Table A.5.5−2. Summary Statistics for Cell 5

Note: The data used in this table have been standardized to quarterly.

Parameter	Horizon[a]	Monitoring Location	No. of Detected Samples	Total No. of Samples	Percent of Detects	Average[b]	Distribution Type[c]	Trend[d]	Serial Correlation[e]	Outliers[f,g]
	LCS	12342C	21	21	100	131	Normal	Up	Detected	
	LDS	12342D	19	19	100	17.9	Normal	Up	Detected	
Total Uranium (µg/L)	HTW	12342	24	24	100	8.81	Undefined	Down	Detected	
	GMA-U	22207	18	23	78.3	0.384	Normal	Down	Detected	2.389 (Q3-02) 0 (Q4-03)
	GMA-D	22208	18	24	75	0.313	Normal	None	Not Detected	0.7995 (Q1-05)
	LCS	12342C	19	21	90.5	0.657	Normal	Up	Detected	
	LDS	12342D	19	19	100	0.269	Undefined	Down	Detected	
Boron (mg/L)	HTW	12342	23	24	95.8	0.114	Lognormal	Down	Detected	
	GMA-U	22207	21	25	84	0.0357	Undefined	None	Marg. Detect	
	GMA-D	22208	20	25	80	0.0274	Normal	None	Detected	
	LCS	12342C	12	20	60	2.13	Normal	Up	Detected	
	LDS	12342D	16	19	84.2	6.46	Normal	None	Detected	
Total Organic Carbon (mg/L)	HTW	12342	18	23	78.3	2.74	Lognormal	None	Marg. Detect	
	GMA-U	22207	13	24	54.2	1.22	Lognormal	Down	Not Detected	4.15 (Q4-03)
	GMA-D	22208	14	24	58.3	1.24	Lognormal	Marg. Down	Detected	8.93 (Q4-01)
	LCS	12342C	5	20	25	0.0103	Undefined	None	Not Detected	0.0604 (Q1-06)
	LDS	12342D	9	19	47.4	0.0375	Lognormal	Up	Not Detected	
Total Organic Halogens (mg/L)	HTW	12342	13	23	56.5	0.00925	Undefined	None	Not Detected	0.0237 (Q1-06)
	GMA-U	22207	7	25	28	0.00915	Undefined	Down	Detected	
	GMA-D	22208	5	25	20	0.00535	Undefined	Down	Detected	
	LCS	12342C	21	21	100	2170	Undefined	Up	Detected	
	LDS	12342D	19	19	100	1340	Undefined	Down	Detected	
Sulfate (mg/L)	HTW	12342	20	20	100	151	Undefined	None	Detected	
	GMA-U	22207	19	19	100	243	Undefined	None	Detected	770 (Q2-05)
	GMA-D	22208	20	20	100	393	Normal	None	Not Detected	

[a]LCS = leachate collection system; LDS = leak detection system; HTW = horizontal till well; GMA-U = upgradient Great Miami Aquifer; and GMA-D = downgradient Great Miami Aquifer

[b]Averages were determined based on the distribution assumption. "Approx. Normal" was treated as if it was normal, and "Approx. Lognormal" was treated as if it was lognormal. This was done to compensate for the skewed (lognormal) or non-skewed (normal) nature of the data to give a better estimate of the underlying average.

[c]Data distribution based on the Shapiro-Wilk statistic.

Normal: Normal assumption could not be rejected at the 5 percent level and has a higher probability value than the lognormal assumption.

Lognormal: Lognormal assumption could not be rejected at the 5 percent level and has a higher probability value than the normal assumption.

Approx. Normal (Approximately Normal): Normal and lognormal assumptions were rejected at the 5 percent level. However, the normal assumption was not rejected at the 10 % level. Additionally, for cases where neither assumption was rejected at the 10% level, the data fit the normal destribution better than the lognormal distribution.

Approx. Lognormal (Approximately Lognormal): Normal and lognormal assumptions were rejected at the 5 percent level. However, the lognormal assumption was not rejected at the 10 % level. Additionally, for cases where neither assumption was rejected at the 10% level, the data fit the lognormal destribution better than the normal distribution.

Undefined: Normal and Lognormal Distribution assumptions are both rejected or there are less than 25% detected values. "Average" is defined as the Median of the data.

[d]Trend based on nonparametric Mann-Kendall procedure. Note that "Marg. Down" is a marginally downward trend and "Marg. Up" is a marginally upward trend.

[e]Serial correlation based on Rank Von Neumann test.

[f]Outliers determined by Rosner's (for sample sizes greater than 25) or Dixon procedure (for sample sizes less than or equal to 25).

[g]Q = quarterly

Table A.5.5−3. Cell 5 Annual LCS Sample Summary Information

PARAMETER(UNIT)	NUMBER OF SAMPLES[a,b]	NUMBER OF SAMPLES WITH DETECTIONS[a,b]	PERCENT OF DETECTIONS[a,b]	MIN DETECTED CONCENTRATION[a,b,c]	MAX DETECTED CONCENTRATION[a,b,c]	AVG DETECTED CONCENTRATION[a,b,c]	GW FRL[d] (# OF SAMPLES>GWFRL)	GW BACKGROUND[a,b,e] (# OF SAMPLES>PW BACKGROUND)	PW BACKGROUND[a,b,e] (# OF SAMPLES>PW BACKGROUND)	MAX PW DETECTED CONCENTRATION [a,b,f] (# OF SAMPLES>MAX PW)	DETECTION LIMIT
1,1-Dichloroethane (µg/L)	6	1	16.70%	0.498	-	-	280 µg/L(0)	-	-	-	1 µg/L
4-Methyl-2-pentanone (µg/L)	6	1	16.70%	0.46	-	-	-	-	-	-	5 µg/L
Alkalinity as CaCO3 (mg/L)	12	12	100%	58	563	431	-	422 mg/L(9)	430 mg/L(8)	-	10 mg/L
Ammonia (mg/L)	6	1	16.70%	0.815	-	-	-	4.2 mg/L(0)	4.34 mg/L(0)	220 mg/L(0)	0.1 mg/L
Barium (mg/L)	6	6	100%	0.0226	0.0707	0.0417	2 mg/L(0)	0.77 mg/L(0)	0.45 mg/L(0)	0.589 mg/L(0)	0.029 mg/L
Beryllium (mg/L)	6	1	16.70%	0.000038	-	-	0.004 mg/L(0)	-	-	0.0343 mg/L(0)	0.001 mg/L
Calcium (mg/L)	12	12	100%	163	990	499	-	159 mg/L(12)	172 mg/L(11)	1800 mg/L(0)	5 mg/L
Carbon disulfide (µg/L)	6	1	16.70%	0.33	-	-	5.5 µg/L(0)	-	-	-	5 µg/L
Chloride (mg/L)	12	12	100%	16.9	94.7	67.2	-	7.3 mg/L(12)	45 mg/L(9)	6300 mg/L(0)	5 mg/L
Chromium (mg/L)	6	1	16.70%	0.0013	-	-	0.022 mg/L[g](0)	0.021 mg/L(0)	0.0046 mg/L(0)	0.818 mg/L(0)	0.005 mg/L
Cobalt (mg/L)	6	5	83.30%	0.00035	0.0116	0.0034	0.17 mg/L(0)	0.0086 mg/L(1)	-	0.0886 mg/L(0)	0.034 mg/L
Copper (mg/L)	6	4	66.70%	0.0097	0.0862	0.0305	1.3 mg/L(0)	0.035 mg/L(1)	0.029 mg/L(1)	0.298 mg/L(0)	0.008 mg/L
Fluoride (mg/L)	9	8	88.90%	0.204	0.34	0.284	4 mg/L(0)	0.89 mg/L(0)	1.3 mg/L(0)	6.8 mg/L(0)	0.2 mg/L
Iron (mg/L)	12	11	91.70%	0.0998	4.61	2.51	-	5.72 mg/L(0)	6.35 mg/L(0)	21.3 mg/L(0)	0.1 mg/L
Magnesium (mg/L)	12	12	100%	57.7	913	382	-	38.5 mg/L(12)	50.7 mg/L(12)	690 mg/L(1)	5 mg/L
Manganese (mg/L)	12	9	75%	0.0061	2.96	1.29	0.9 mg/L(5)	0.9 mg/L(5)	0.21 mg/L(5)	35 mg/L(0)	0.09 mg/L
Nickel (mg/L)	6	6	100%	0.00403	0.0438	0.0188	0.1 mg/L(0)	0.0514 mg/L(0)	0.0072 mg/L(3)	0.981 mg/L(0)	0.02 mg/L
Nitrate/Nitrite (mg/L)	18	11	61.10%	0.00366	4.18	1.25	11 mg/L[g](0)	11 mg/L(0)	0.29 mg/L(8)	2670 mg/L(0)	1.1 mg/L
Potassium (mg/L)	12	12	100%	6.22	65.5	24.4	-	1.96 mg/L(12)	17.2 mg/L(10)	12400 mg/L(0)	5 mg/L
Selenium (mg/L)	6	2	33.30%	0.0027	0.0194	0.0111	0.05 mg/L(0)	0.00075 mg/L(2)	-	0.0494 mg/L(0)	0.005 mg/L
Silicon (mg/L)	9	9	100%	2.92	3.84	3.29	-	-	-	15 mg/L(0)	0.015 mg/L
Sodium (mg/L)	12	11	91.70%	16.4	108	62.7	-	47.1 mg/L(9)	50 mg/L(9)	1300 mg/L(0)	5 mg/L
Technetium-99 (pCi/L)	13	7	53.80%	7.77	19	11.5	94 pCi/L(0)	22 pCi/L(0)	30 pCi/L(0)	6130 pCi/L(0)	10 pCi/L
Toluene (µg/L)	6	1	16.70%	0.416	-	-	-	-	-	-	1 µg/L
TDS (mg/L)	12	12	100%	436	4640	2080	-	-	-	-	10 mg/L
Vanadium (mg/L)	6	2	33.30%	0.00089	0.00157	0.0012	0.038 mg/L(0)	0.012 mg/L(0)	0.005 mg/L(0)	0.299 mg/L(0)	0.02 mg/L
Zinc (mg/L)	6	1	16.70%	0.017	-	-	0.021 mg/L(0)	0.02 mg/L(0)	0.35 mg/L(0)	1.78 mg/L(0)	0.015 mg/L

Note: Shading indicates that at least one detected sample is greater than the FRL, groundwater background, PW background, or PW maximum.

[a]If more than one sample is collected per well per day (e.g., duplicates), then only one sample is counted for the total number of samples, and the sample with the maximum representative concentration is used for all the summary information

[b]Rejected data qualified with an R or Z were not included.

[c]If the number of detected samples is equal to two, then the minimum and maximumn are reported. If the number of detected is equal to one, then the data point is reported as the minimum. The "AVG DETECTED CONCENTRATION" is not reported for either of these cases.

[d]From Operable Unit 5 Record of Decision, Table 9-4.

[e]From the Characterization of Background Water Quality for Streams and Groundwater which was developed for Operable Unit 5 RI/FS documents.

[f]Max PW - maximum detected concentration in perched water as defined in the Remedial Investigation Report for Operable Unit 5.

[g]FRL based on hexavalent chromium and nitrate, from Operable Unit 5 Record of Decision, Table 9-4.

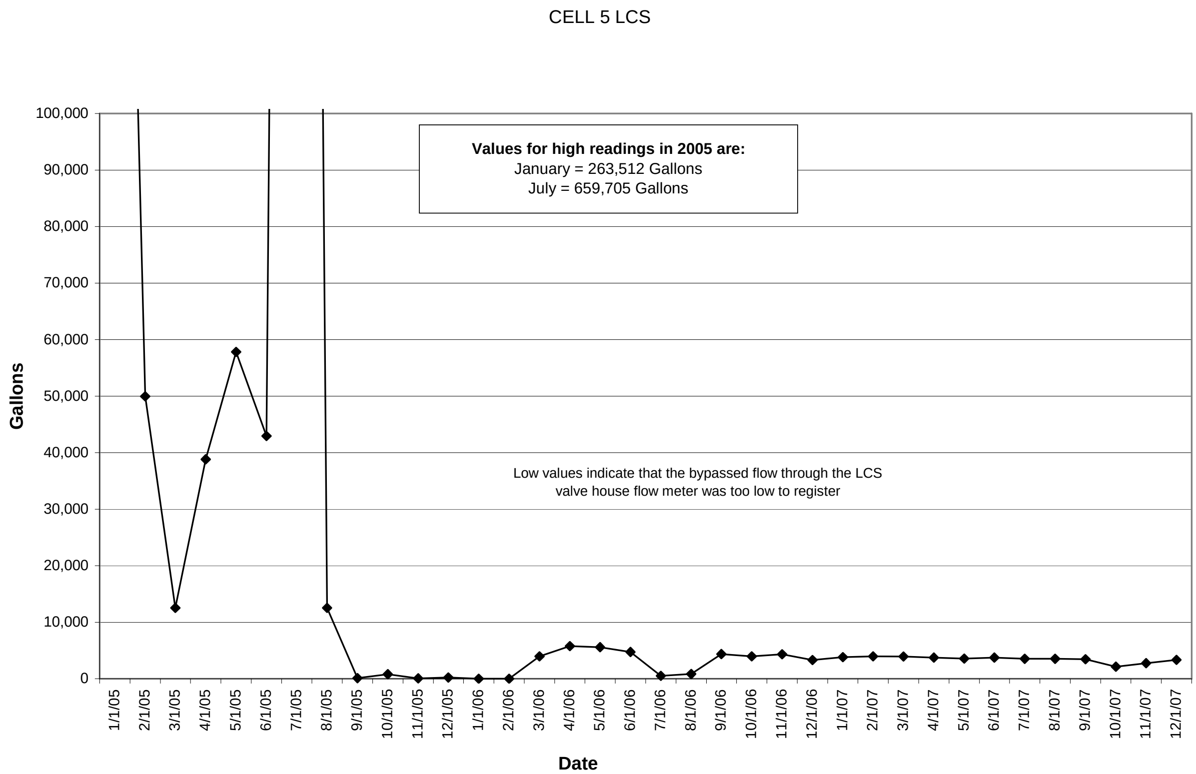


FIGURE A.5.5-1. MONTHLY ACCUMULATION VOLUMES FOR CELL 5 LCS

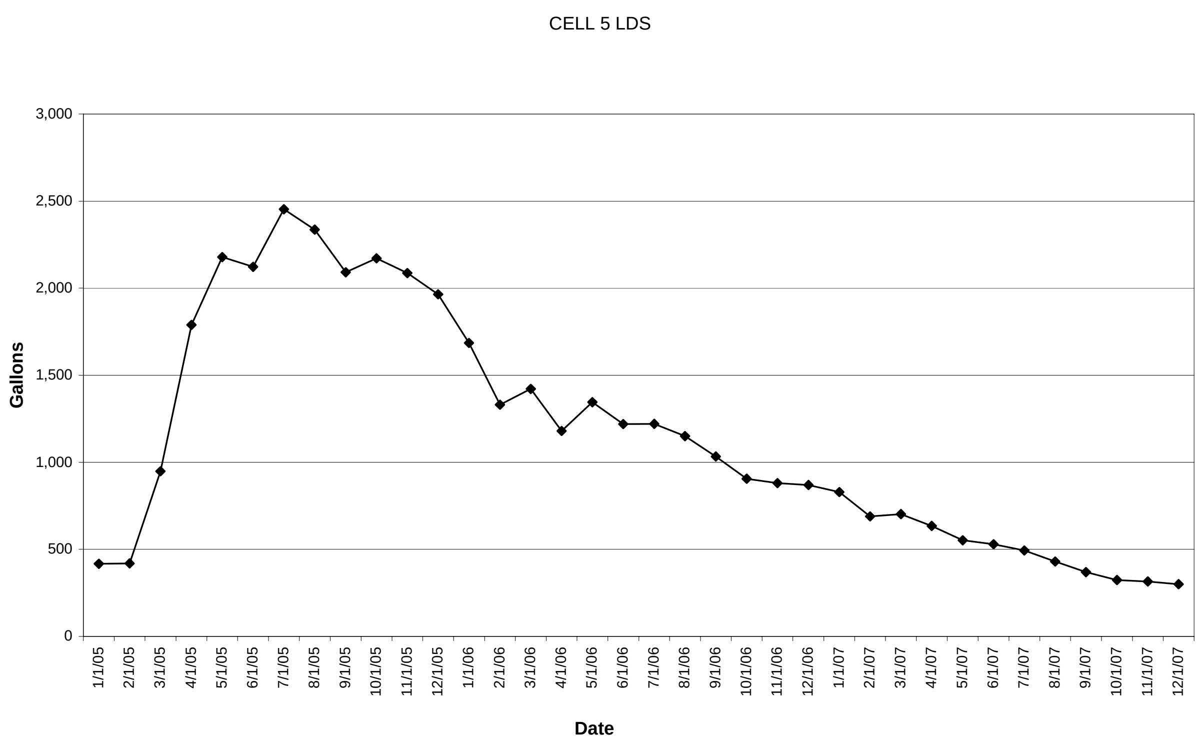
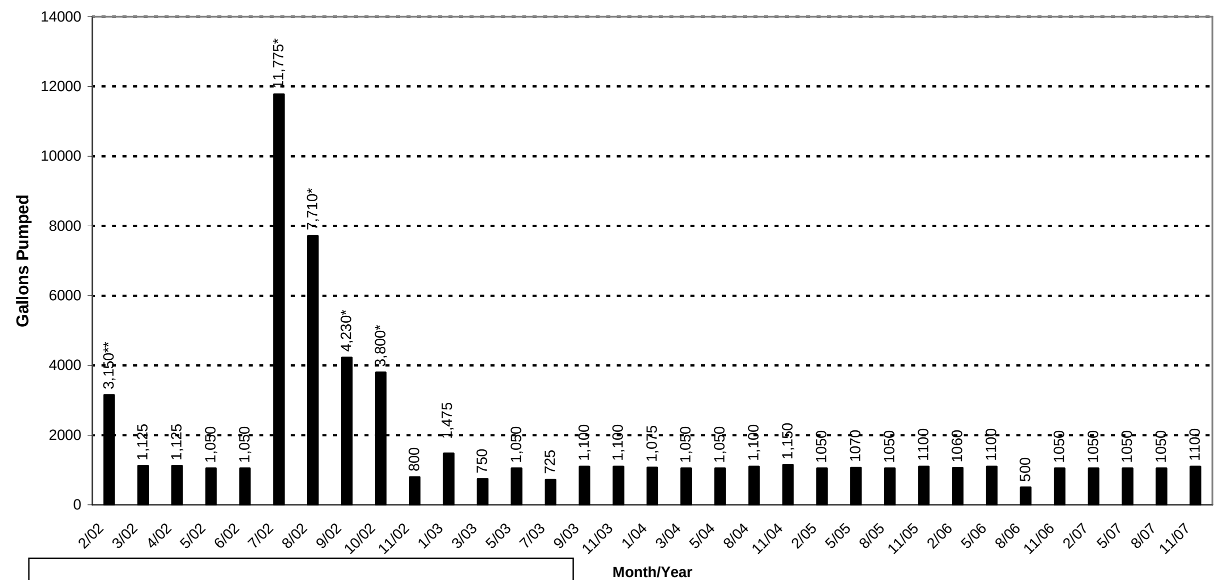


FIGURE A.5.5-2. MONTHLY ACCUMULATION VOLUMES FOR CELL 5 LDS



12342 Purge Information

Year	Total Volumes (gal.)	Months Purged	Avg. Monthly Purge (gal.)
2002	35815	n=10	3582
2003:	6200	n= 6	1033
2004:	5425	n= 5	1085
2005:	4270	n=4	1068
2006:	3710	n=4	928
2007:	4250	n=4	1063
Overall:			1808

*More than one purge of the well was completed during these months to drain perched water and infiltrating surface water so the compacted clay liner could be constructed.

**Excess water was pumped from this well in February 2002 for well development.

FIGURE A.5.5-3. OSDF HORIZONTAL TILL WELL 12342 (CELL 5) WATER YIELD

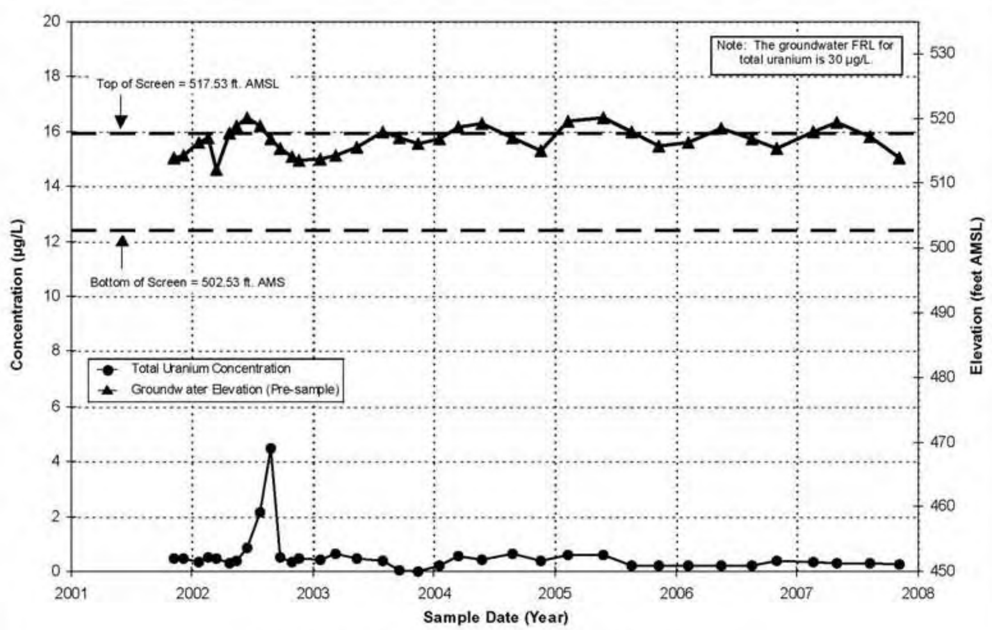


Figure A.5.5-4. Total Uranium Concentration and Groundwater Elevation vs. Time Plot for Cell 5 Upgradient Monitoring Well 22207

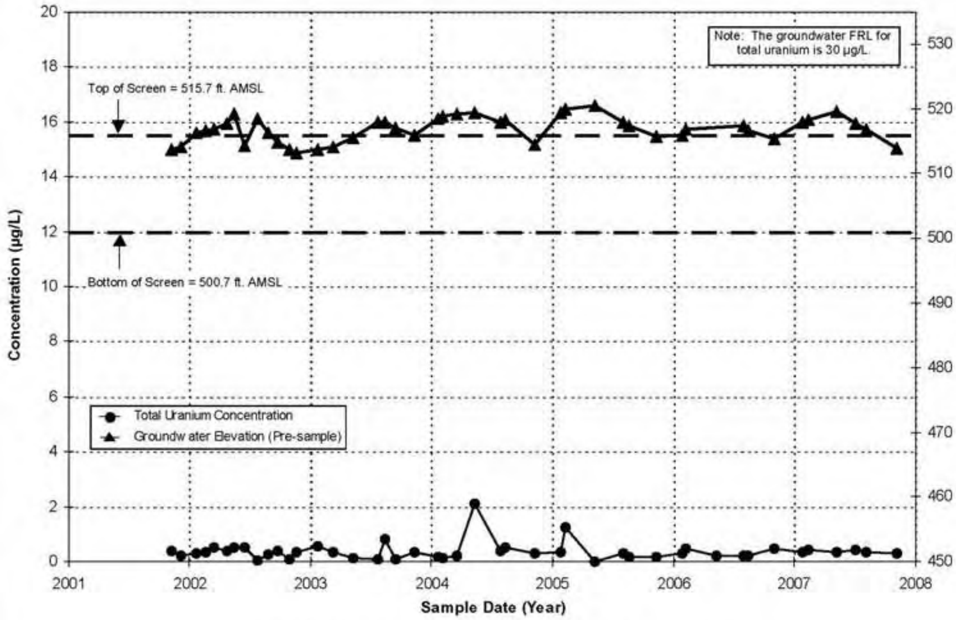


Figure A.5.5-5. Total Uranium Concentration and Groundwater Elevation vs. Time Plot for Cell 5 Downgradient Monitoring Well 22208

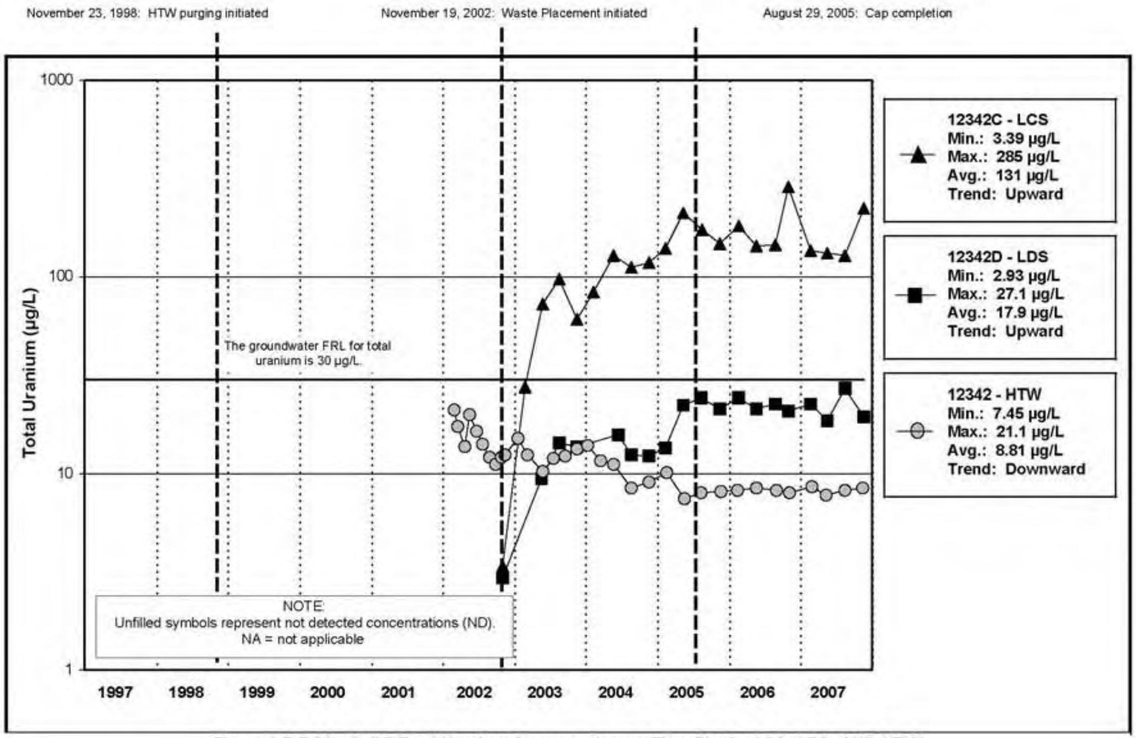


Figure A.5.5-6A. Cell 5 Total Uranium Concentration vs. Time Plot for LCS, LDS, AND HTW

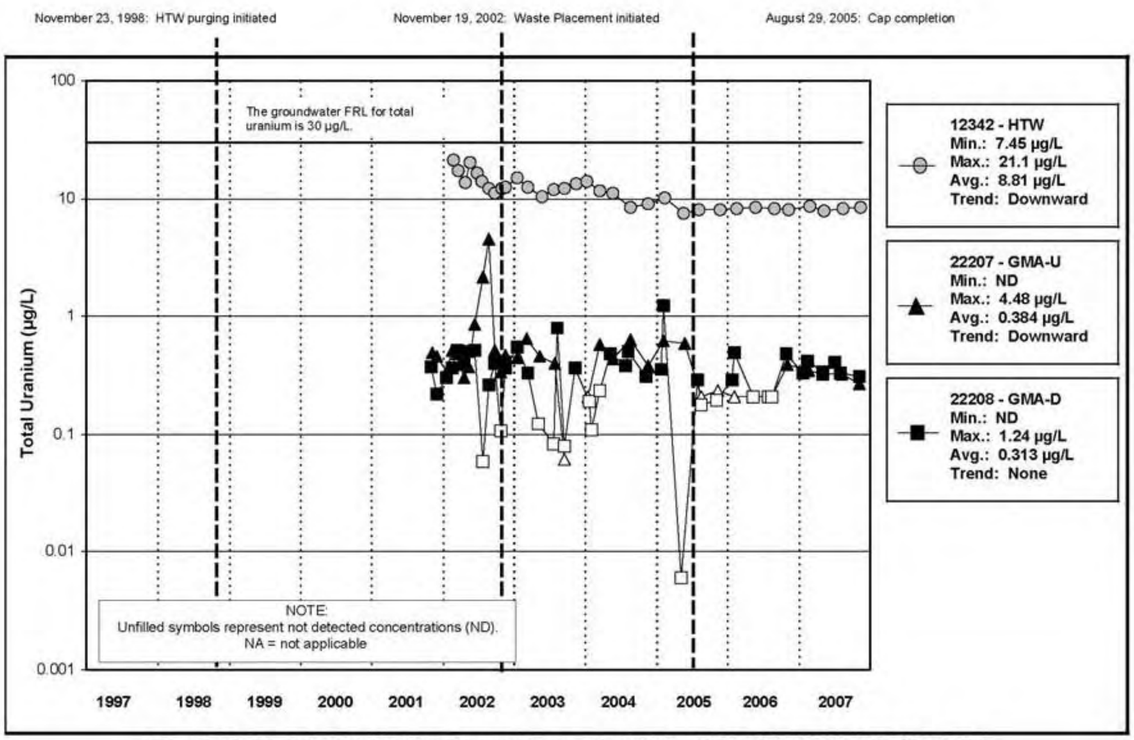


Figure A.5.5-6B. Cell 5 Total Uranium Concentration vs. Time Plot for HTW, GMA-U Well, AND GMA-D Well

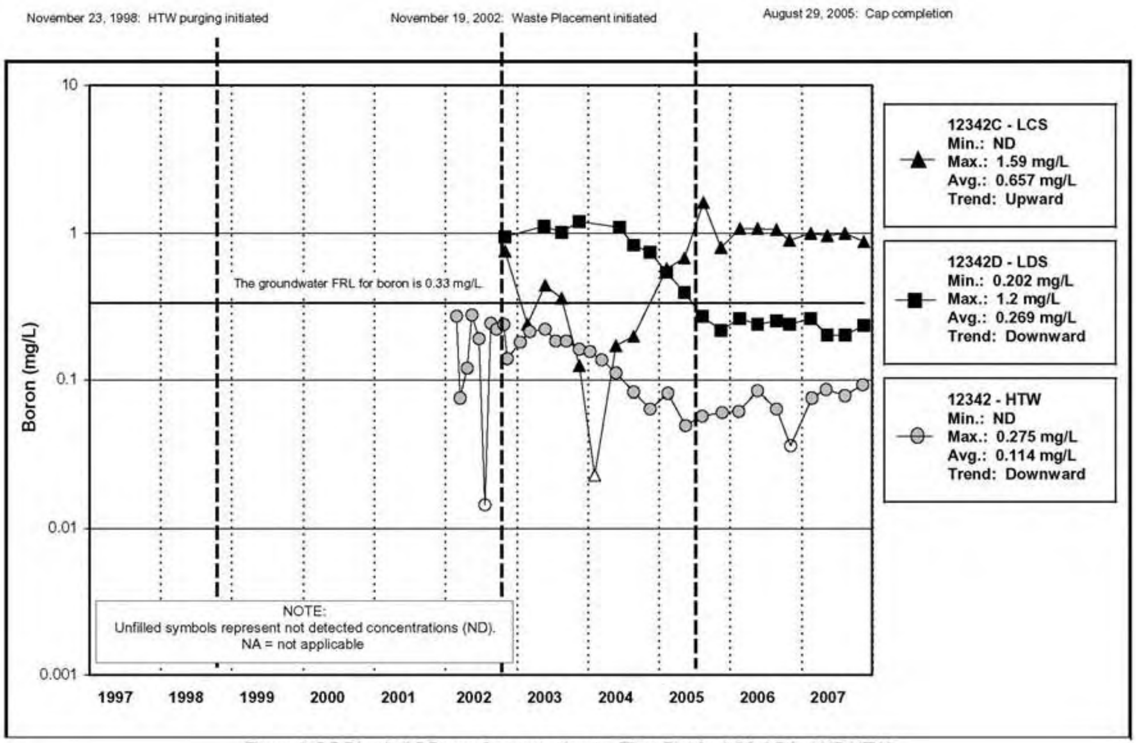


Figure A.5.5-7A. Cell 5 Boron Concentration vs. Time Plot for LCS, LDS, AND HTW

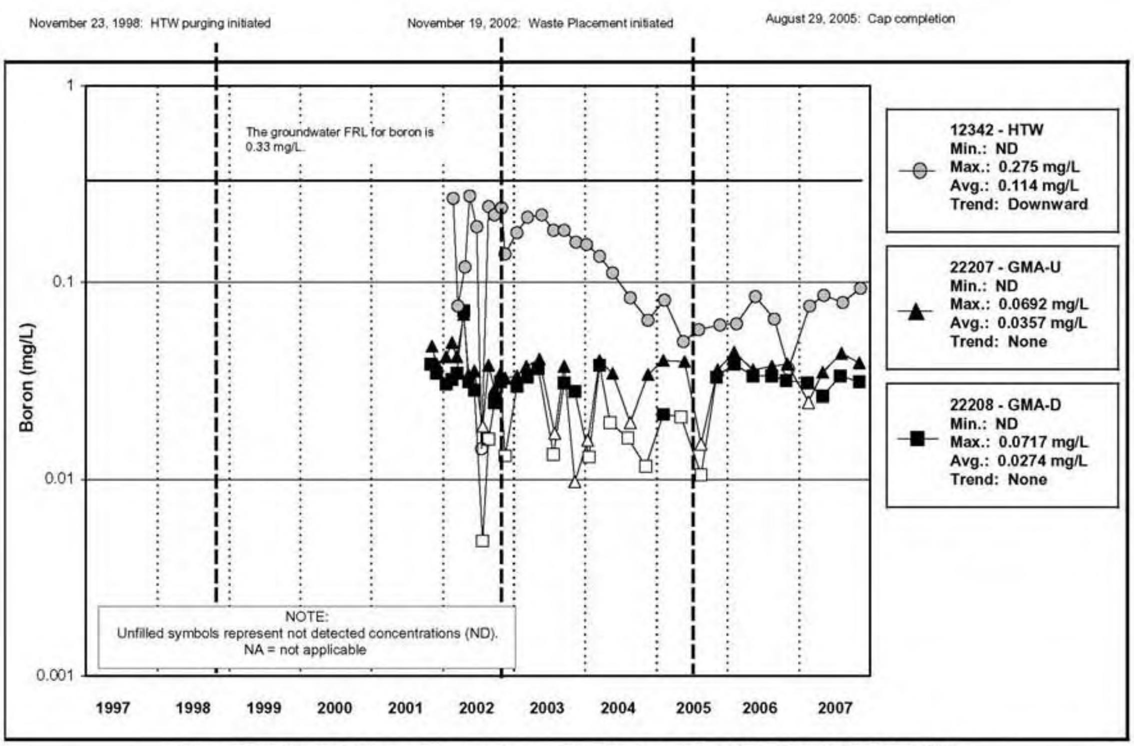


Figure A.5.5-7B. Cell 5 Boron Concentration vs. Time Plot for HTW, GMA-U Well, AND GMA-D Well

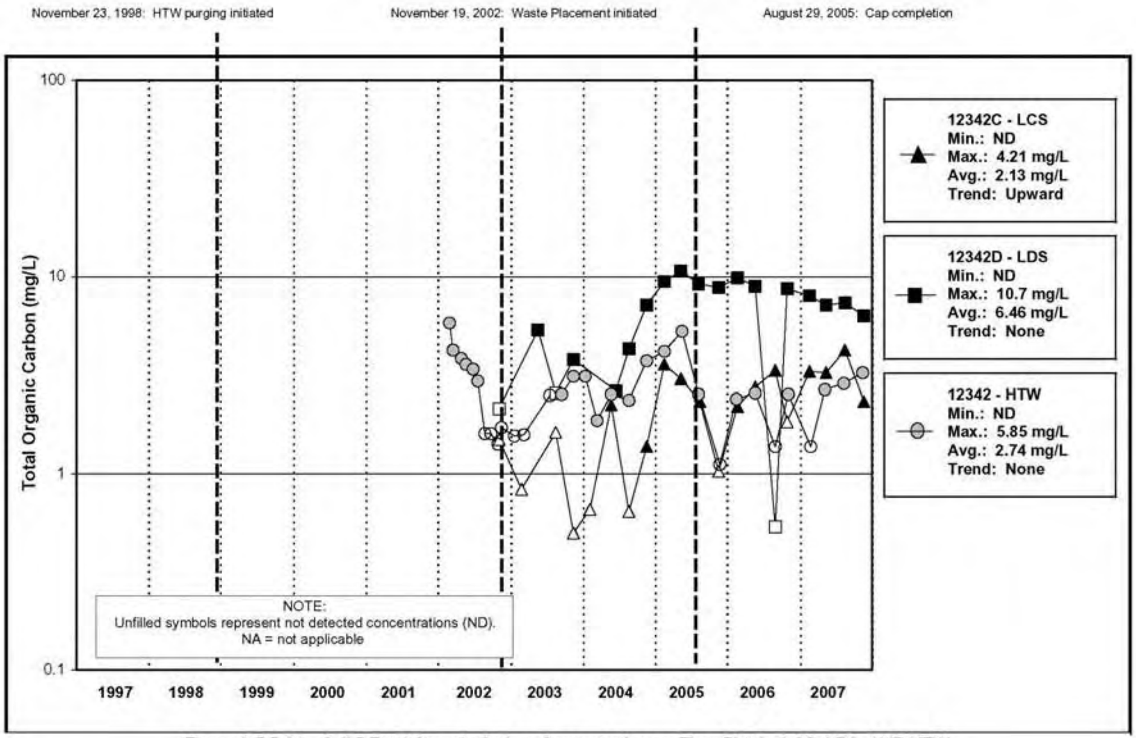


Figure A.5.5-8A. Cell 5 Total Organic Carbon Concentration vs. Time Plot for LCS, LDS, AND HTW

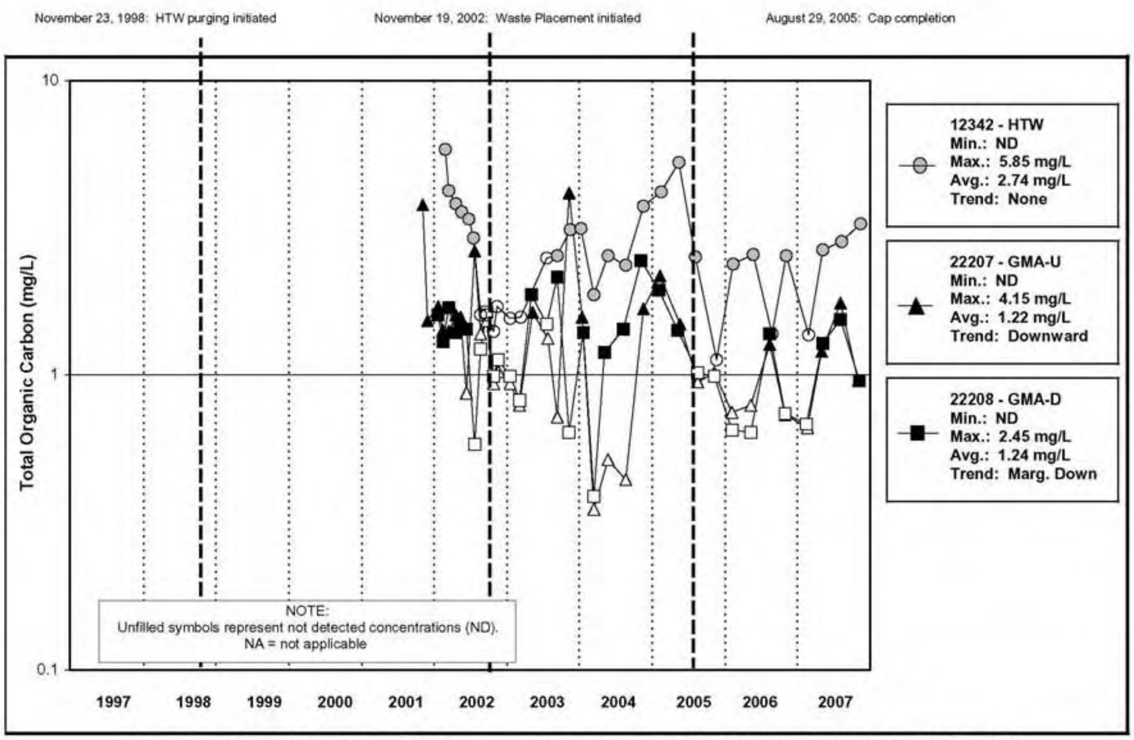


Figure A.5.5-8B. Cell 5 Total Organic Carbon Concentration vs. Time Plot for HTW, GMA-U Well, AND GMA-D Well

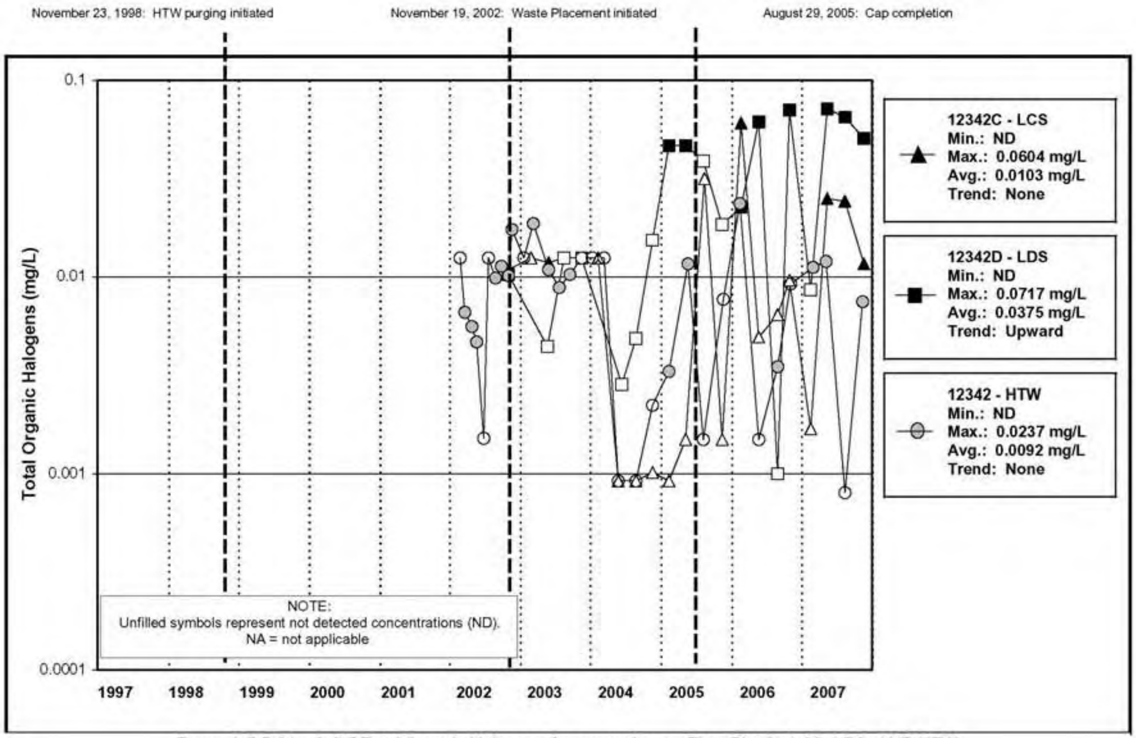


Figure A.5.5-9A. Cell 5 Total Organic Halogens Concentration vs. Time Plot for LCS, LDS, AND HTW

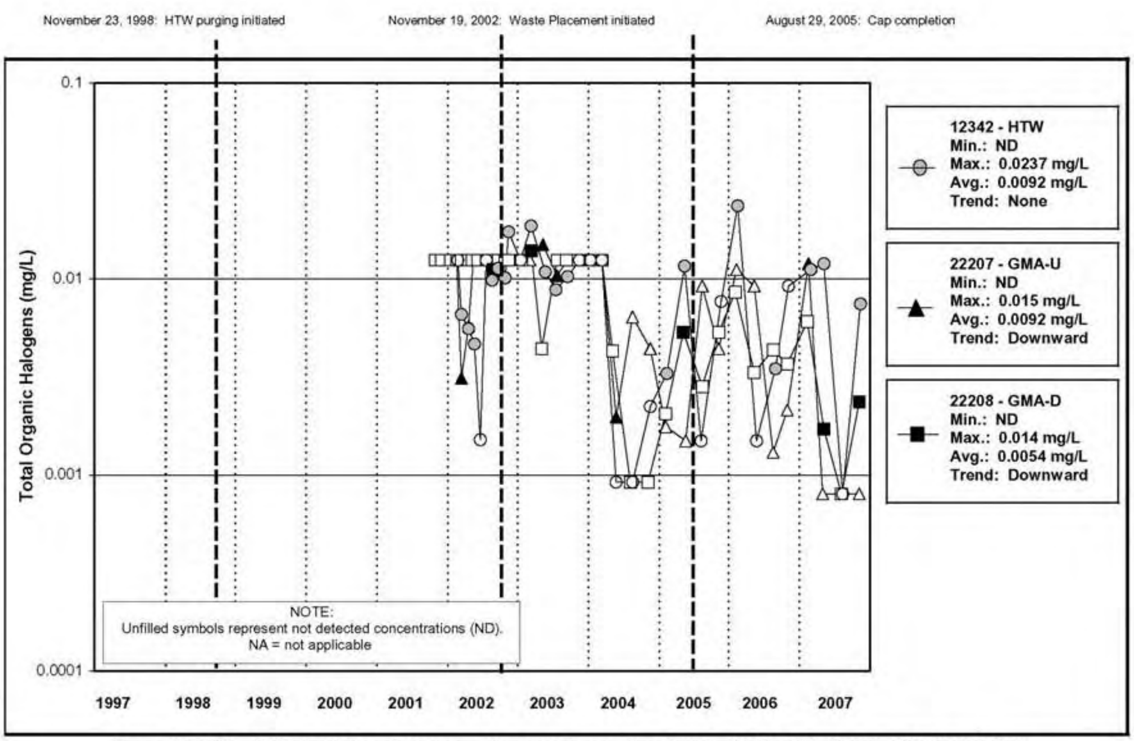


Figure A.5.5-9B. Cell 5 Total Organic Halogens Concentration vs. Time Plot for HTW, GMA-U Well, AND GMA-D Well

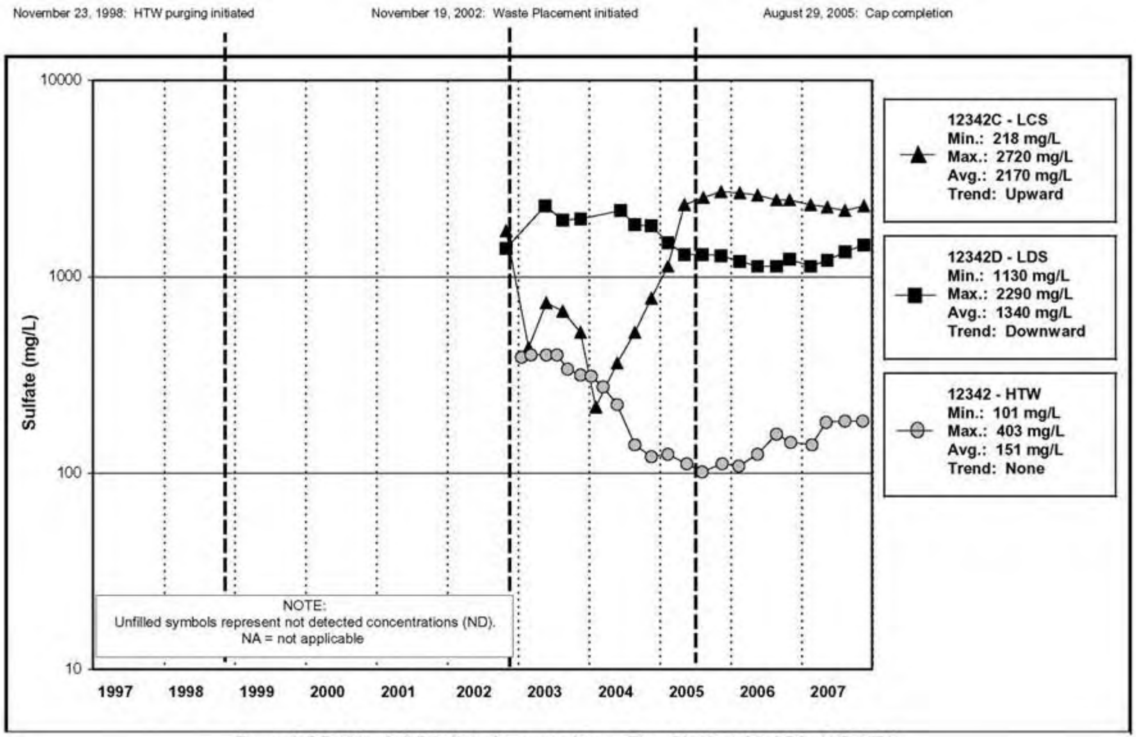


Figure A.5.5-10A. Cell 5 Sulfate Concentration vs. Time Plot for LCS, LDS, AND HTW

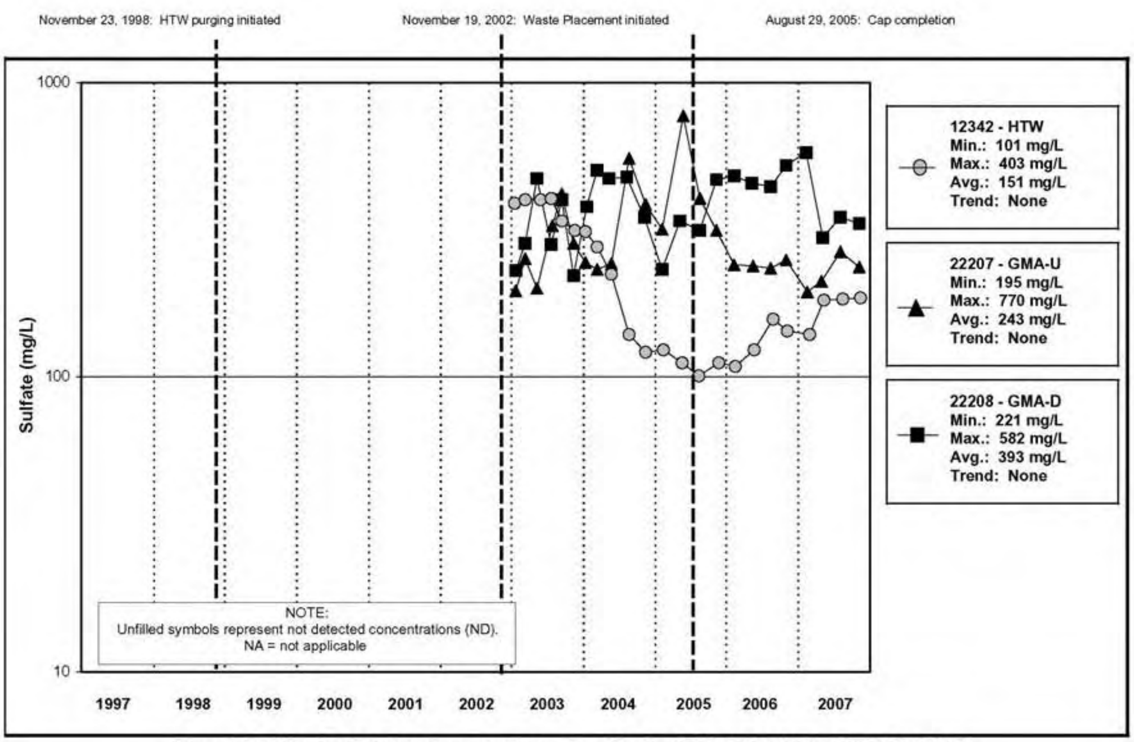


Figure A.5.5-10B. Cell 5 Sulfate Concentration vs. Time Plot for HTW, GMA-U Well, AND GMA-D Well

Sub-Attachment A.5.6

Cell 6

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The following information is provided in this sub-attachment:

- LCS monthly average accumulation volumes (refer to Figure A.5.6−1)
- LDS monthly accumulation rates and precipitation (refer to Figure A.5.6−2)
- Monthly liner efficiencies (refer to Table A.5.6−1)
- HTW Water Yield (refer to Figure A.5.6−3)
- Great Miami Aquifer water levels and uranium concentrations versus time (refer to Figures A.5.6−4 and A.5.6−5)
- Summary statistics for refined baseline constituents (refer to Section A.5.6.1 and Table A.5.6−2)
- Concentration plots for refined baseline constituents (refer to Section A.5.6.1 and Figures A.5.6−6A through A.5.6−10B)
- Annual LCS monitoring results (refer to Section A.5.6.2 Table A.5.6−3)
- Annual LDS monitoring results (refer to Section A.5.6.3).

Samples for the OSDF monitoring horizons were collected according to the frequencies described in the OSDF GWLMP. Constituent sampling lists are provided in Table 2−1, Table 2−2, and Table 2−3 of Appendix B of the OSDF GWLMP. In 2007, all samples were collected for Cell 6 monitoring horizons.

A.5.6.1 Refined Baseline Monitoring Results

Refined baseline constituents are those constituents that have been sampled at least eight times, and detected at least 25 percent of the time in the LCS, LDS, HTW, and GMA wells. Refined baseline constituents are listed in Table 2−3 of Appendix B of the OSDF GWLMP. Also included in Table 2−3 are common ion constituents. A summary statistics table (refer to Table A.5.6−2) and concentration plots (Figures A.5.6−6A through A.5.6−10B) are provided for the five baseline constituents of Cell 6: total uranium, boron, TOC, TOX, and sulfate.

A.5.6.2 LCS Monitoring Results

During active operations (pre-closure) Ohio Solid Waste regulations (OAC 3745-27-19(M)(5)) require collection and analysis of leachate annually for Appendix I and PCB constituents listed in OAC 3745-27-10. The objective of the annual LCS sampling is to determine if the composition of the leachate within the facility is changing enough to impact monitoring activities beneath the facility. A list of annual LCS sampling constituents is provided in Table 2−2 of Appendix B of the OSDF GWLMP. In 2007, annual sampling of the Cell 6 LCS took place in May. Table A.5.6−3 summarizes the annual LCS sampling results for Cell 6, along with the data collected in previous years.

Of the non-refined baseline site-specific constituents that have been sampled for at least eight times in Cell 6, 13 have been detected at least 25 percent of the time. Eleven of the 13 constituents are common ions (alkalinity, calcium, chloride, fluoride, iron, magnesium, manganese, nitrate/nitrite, potassium, silicon, and sodium). The other 2 [total dissolved solids

(TDS) and technetium-99] are *potential* site-specific leak detection monitoring constituents for Cell 6.

Common Ions

A common ion study was completed in 2007, and a report, *Fernald Site, Evaluation of Aqueous Ions in the Monitoring Systems of the On-site Disposal Facility*, was issued in March 2008. This report is currently undergoing review by the EPA and Ohio EPA.

As discussed in Section A.5.2.2, the common ion study concluded that fluid volume appears to be the key monitoring constituent to indicate the potential for leachate migration from the OSDF, and the sampling of and analysis for indicator ions are useful only if the hydraulic conditions permit leachate to migrate.

The common ion study also concluded that no one ion can serve as a leak indicator for all cells of the disposal facility, but useful indicator ions for specific target horizons of each cell can be identified. Specifically, uranium and manganese in the LDS and sodium in the HTW were the only useful indicator constituents identified for the Cell 6 LDS and HTW, and that sufficient data exists to establish control charts for these three constituents at the same specified locations for Cell 6. In addition, no other useful common ion indicator constituents were found for Cell 6. Since uranium is already included as a refined baseline constituent for Cell 6, it is recommended that manganese be added to the refined baseline constituent list for the Cell 6 LDS and sodium be added to the refined baseline constituent list for the Cell 6 HTW. Also, control charts will be included in future SERs for uranium and manganese in the Cell 6 LDS and sodium in the Cell 6 HTW upon approval of the common ion study.

Potential Site-Specific Leak Detection Monitoring Constituents

The remaining two constituents (considered to be "*potential*" site-specific leak detection monitoring constituents for Cell 6) are total dissolved solids (TDS) and technetium-99. These potential Cell 6 site-specific leak detection monitoring constituents will be assessed using the statistical approach presented in Figures A.5−4A and A.5−4B, and discussed in Section A.5.2.2, when eight sampling rounds for the Cell 6 LCS have been completed. Eight sampling rounds will be completed for the Cell 6 LCS in 2010. Results of the assessment will be presented to the EPA and OEPA as soon as they are available and they will also be reported in the SER.

Confirmatory Sampling

Technetium-99 is a site-specific leak detection constituent; however, it is not on the refined baseline list for Cell 6. If a site-specific constituent (not on the refined baseline list) is detected in the LCS or LDS, then confirmatory sampling for that constituent will take place. As shown in Table A.5.6−3, technetium-99 has been detected in the Cell 6 LCS, but these detections occurred prior to the establishment of the refined baseline for Cell 6. Therefore, confirmatory sampling for technetium-99 in the Cell 6 LCS is not required.

Mercury has been detected in the Cell 6 LCS 10 percent of the time. Because these detections were made prior to the establishment of the refined baseline list for Cell 6, confirmatory sampling for mercury in Cell 6 is not required.

A.5.6.3 LDS Monitoring Results

Each year the LDS of Cell 6 is sampled for site-specific baseline constituents listed in Table 2−1 of Appendix B of the OSDF GWLMP. The objective of the annual LDS sampling is to determine if any initial baseline conditions, not on the refined baseline list, are present in the LDS. In 2007, annual sampling of the Cell 6 LDS took place in May.

In 2007, of the non-refined baseline constituents that have been sampled at least eight times, ten have been detected at least 25 percent of the time. All ten of these constituents are common ion constituents (alkalinity, calcium, chloride, fluoride, iron, magnesium, manganese, potassium, silicon, and sodium).

Table A.5.6−1. Cell 6 – 2007 Monthly Liner Efficiencies

Month	Cell 6 Apparent Liner Efficiency (%)
January	81.68
February	82.59
March	82.79
April	84.46
May	87.90
June	86.98
July	87.63
August	88.32
September	92.69
October	89.79
November	95.06
December	94.02

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Table A.5.6−2. Summary Statistics For Cell 6

Note: The data used in this table have been standardized to quarterly.

Parameter	Horizon[a]	Monitoring Location	No. of Detected Samples	Total No. of Samples	Percent of Detects	Average[b]	Distribution Type[c]	Trend[d]	Serial Correlation[e]	Outliers[f,g]
Total Uranium (µg/L)	LCS	12343C	17	17	100	130	Normal	Up	Detected	
	LDS	12343D	17	17	100	19.7	Undefined	Up	Detected	
	HTW	12343	17	17	100	10.0	Lognormal	Up	Detected	24.2 (Q1-07)
	GMA-U	22209	17	20	85	0.582	Normal	None	Not Detected	2.43 (Q2-06)
	GMA-D	22210	19	20	95	0.629	Normal	None	Not Detected	0 (Q2-05)
Boron (mg/L)	LCS	12343C	17	17	100	0.746	Normal	Up	Marg. Detect	
	LDS	12343D	16	16	100	0.397	Undefined	Down	Detected	2.38 (Q3-04)
	HTW	12343	16	18	88.9	0.0842	Normal	Marg. Down	Detected	
	GMA-U	22209	17	21	81	0.0351	Undefined	None	Not Detected	
	GMA-D	22210	19	20	95	0.0327	Undefined	None	Marg. Detect	0.0086 (Q3-05)
Total Organic Carbon (mg/L)	LCS	12343C	13	16	81.3	2.23	Normal	Up	Not Detected	14.6 (Q4-03)
	LDS	12343D	15	16	93.8	6.31	Normal	Down	Detected	0.0146 (Q2-04)
	HTW	12343	12	17	70.6	0.00965	Lognormal	None	Not Detected	4.93 (Q4-07)
	GMA-U	22209	9	21	42.9	0.995	Lognormal	None	Detected	
	GMA-D	22210	9	20	45	0.995	Normal	None	Not Detected	2.15 (Q1-05)
Total Organic Halogens (mg/L)	LCS	12343C	7	17	41.2	0.0124	Lognormal	None	Detected	
	LDS	12343D	9	17	52.9	0.0258	Normal	None	Not Detected	
	HTW	12343	10	18	55.6	0.00881	Normal	Marg. Down	Not Detected	
	GMA-U	22209	4	20	20	0.00531	Undefined	Down	Detected	0.0365 (Q3-06)
	GMA-D	22210	3	21	14.3	0.00665	Undefined	Down	Detected	
Sulfate (mg/L)	LCS	12343C	16	16	100	1740	Normal	Up	Marg. Detect	491 (Q2-05)
	LDS	12343D	17	17	100	1730	Normal	Up	Detected	
	HTW	12343	17	17	100	417	Normal	None	Detected	191.5 (Q1-03)
	GMA-U	22209	20	20	100	192	Normal	Up	Not Detected	
	GMA-D	22210	19	19	100	210	Lognormal	Up	Detected	578 (Q1-07)

[a]LCS = leachate collection system; LDS = leak detection system; HTW = horizontal till well; GMA-U = upgradient Great Miami Aquifer; and GMA-D = downgradient Great Miami Aquifer

[b]Averages were determined based on the distribution assumption. "Approx. Normal" was treated as if it was normal, and "Approx. Lognormal" was treated as if it was lognormal. This was done to compensate for the skewed (lognormal) or non-skewed (normal) nature of the data to give a better estimate of the underlying average.

[c]Data distribution based on the Shapiro-Wilk statistic.

Normal: Normal assumption could not be rejected at the 5 percent level and has a higher probability value than the lognormal assumption.

Lognormal: Lognormal assumption could not be rejected at the 5 percent level and has a higher probability value than the normal assumption.

Approx. Normal (Approximately Normal): Normal and lognormal assumptions were rejected at the 5 percent level. However, the normal assumption was not rejected at the 10 % level. Additionally, for cases where neither assumption was rejected at the 10% level, the data fit the normal destribution better than the lognormal distribution.

Approx. Lognormal (Approximately Lognormal): Normal and lognormal assumptions were rejected at the 5 percent level. However, the lognormal assumption was not rejected at the 10 % level. Additionally, for cases where neither assumption was rejected at the 10% level, the data fit the lognormal destribution better than the normal distribution.

Undefined: Normal and Lognormal Distribution assumptions are both rejected or there are less than 25% detected values. "Average" is defined as the Median of the data.

[d]Trend based on nonparametric Mann-Kendall procedure. Note that "Marg. Down" is a marginally downward trend and "Marg. Up" is a marginally upward trend.

[e]Serial correlation based on Rank Von Neumann test.

[f]Outliers determined by Rosner's (for sample sizes greater than 25) or Dixon procedure (for sample sizes less than or equal to 25).

[g]Q = quarterly

Table A.5.6−3. Cell 6 Annual LCS Sample Summary

PARAMETER(UNIT)	NUMBER OF SAMPLES[a,b]	NUMBER OF SAMPLES WITH DETECTIONS[a,b]	PERCENT OF DETECTIONS[a,b]	MIN DETECTED CONCENTRATION[a,b,c]	MAX DETECTED CONCENTRATION[a,b,c]	AVG DETECTED CONCENTRATION[a,b,c]	GW FRL[d] (# OF SAMPLES>GWFRL)	GW BACKGROUND[a,b,e] (# OF SAMPLES>PW BACKGROUND)	PW BACKGROUND[a,b,e] (# OF SAMPLES>PW BACKGROUND)	MAX PW DETECTED CONCENTRATION [a,b,f] (# OF SAMPLES>MAX PW)	DETECTION LIMIT
Alkalinity as CaCO3 (mg/L)	11	11	100%	64	557	447	-	422 mg/L(9)	430 mg/L(9)	-	10 mg/L
Ammonia (mg/L)	5	1	20%	0.0882	-	-	-	4.2 mg/L(0)	4.34 mg/L(0)	220 mg/L(0)	0.1 mg/L
Barium (mg/L)	5	5	100%	0.0309	0.0868	0.0564	2 mg/L(0)	0.77 mg/L(0)	0.45 mg/L(0)	0.589 mg/L(0)	0.029 mg/L
Calcium (mg/L)	11	11	100%	225	996	485	-	159 mg/L(11)	172 mg/L(11)	1800 mg/L(0)	5 mg/L
Chloride (mg/L)	11	11	100%	20.1	139	93.5	-	7.3 mg/L(11)	45 mg/L(9)	6300 mg/L(0)	5 mg/L
Cobalt (mg/L)	5	3	60%	0.0006	0.0016	0.001	0.17 mg/L(0)	0.0086 mg/L(0)	-	0.0886 mg/L(0)	0.034 mg/L
Copper (mg/L)	5	5	100%	0.00421	0.0136	0.0073	1.3 mg/L(0)	0.035 mg/L(0)	0.029 mg/L(0)	0.298 mg/L(0)	0.008 mg/L
Fluoride (mg/L)	9	8	88.90%	0.24	0.379	0.297	4 mg/L(0)	0.89 mg/L(0)	1.3 mg/L(0)	6.8 mg/L(0)	0.2 mg/L
Iron (mg/L)	11	9	81.80%	0.989	4.48	2.81	-	5.72 mg/L(0)	6.35 mg/L(0)	21.3 mg/L(0)	0.1 mg/L
Magnesium (mg/L)	11	11	100%	92.4	609	299	-	38.5 mg/L(11)	50.7 mg/L(11)	690 mg/L(0)	5 mg/L
Manganese (mg/L)	11	9	81.80%	0.0069	1.41	0.288	0.9 mg/L(1)	0.9 mg/L(1)	0.21 mg/L(4)	35 mg/L(0)	0.09 mg/L
Mercury (mg/L)	10	1	10%	0.000338	-	-	0.002 mg/L(0)	-	-	0.0018 mg/L(0)	0.0002 mg/L
Nickel (mg/L)	5	5	100%	0.007	0.0285	0.0142	0.1 mg/L(0)	0.0514 mg/L(0)	0.0072 mg/L(3)	0.981 mg/L(0)	0.02 mg/L
Nitrate/Nitrite (mg/L)	15	9	60%	0.055	4.67	1.42	11 mg/L[g](0)	11 mg/L(0)	0.29 mg/L(6)	2670 mg/L(0)	1.1 mg/L
Potassium (mg/L)	11	11	100%	9	75.5	23.5	-	1.96 mg/L(11)	17.2 mg/L(9)	12400 mg/L(0)	5 mg/L
Selenium (mg/L)	5	1	20%	0.0097	-	-	0.05 mg/L(0)	0.00075 mg/L(1)	-	0.0494 mg/L(0)	0.005 mg/L
Silicon (mg/L)	9	9	100%	3.42	5.13	4.13	-	-	-	15 mg/L(0)	0.015 mg/L
Sodium (mg/L)	11	11	100%	23.1	107	53.1	-	47.1 mg/L(7)	50 mg/L(5)	1300 mg/L(0)	5 mg/L
Technetium-99 (pCi/L)	10	3	30%	6.54	11.7	9.01	94 pCi/L(0)	22 pCi/L(0)	30 pCi/L(0)	6130 pCi/L(0)	10 pCi/L
TDS (mg/L)	9	9	100%	267	4140	2310	-	-	-	-	10 mg/L
Vanadium (mg/L)	5	1	20%	0.00088	-	-	0.038 mg/L(0)	0.012 mg/L(0)	0.005 mg/L(0)	0.299 mg/L(0)	0.02 mg/L
Zinc (mg/L)	5	2	40%	0.0135	0.0253	0.0194	0.021 mg/L(1)	0.02 mg/L(1)	0.35 mg/L(0)	1.78 mg/L(0)	0.015 mg/L

Note: Shading indicates that at least one detected sample is greater than the FRL, groundwater background, PW background, or PW maximum.

[a]If more than one sample is collected per well per day (e.g., duplicates), then only one sample is counted for the total number of samples, and the sample with the maximum representative concentration is used for all the summary information

[b]Rejected data qualified with an R or Z were not included.

[c]If the number of detected samples is equal to two, then the minimum and maximum are reported. If the number of detected is equal to one, then the data point is reported as the minimum. The "AVG DETECTED CONCENTRATION" is not reported for either of these cases.

[d]From Operable Unit 5 Record of Decision, Table 9-4.

[e]From the Characterization of Background Water Quality for Streams and Groundwater which was developed for Operable Unit 5 RI/FS documents.

[f]Max PW - maximum detected concentration in perched water as defined in the Remedial Investigation Report for Operable Unit 5.

[g]FRL based on nitrate, from Operable Unit 5 Record of Decision, Table 9-4.

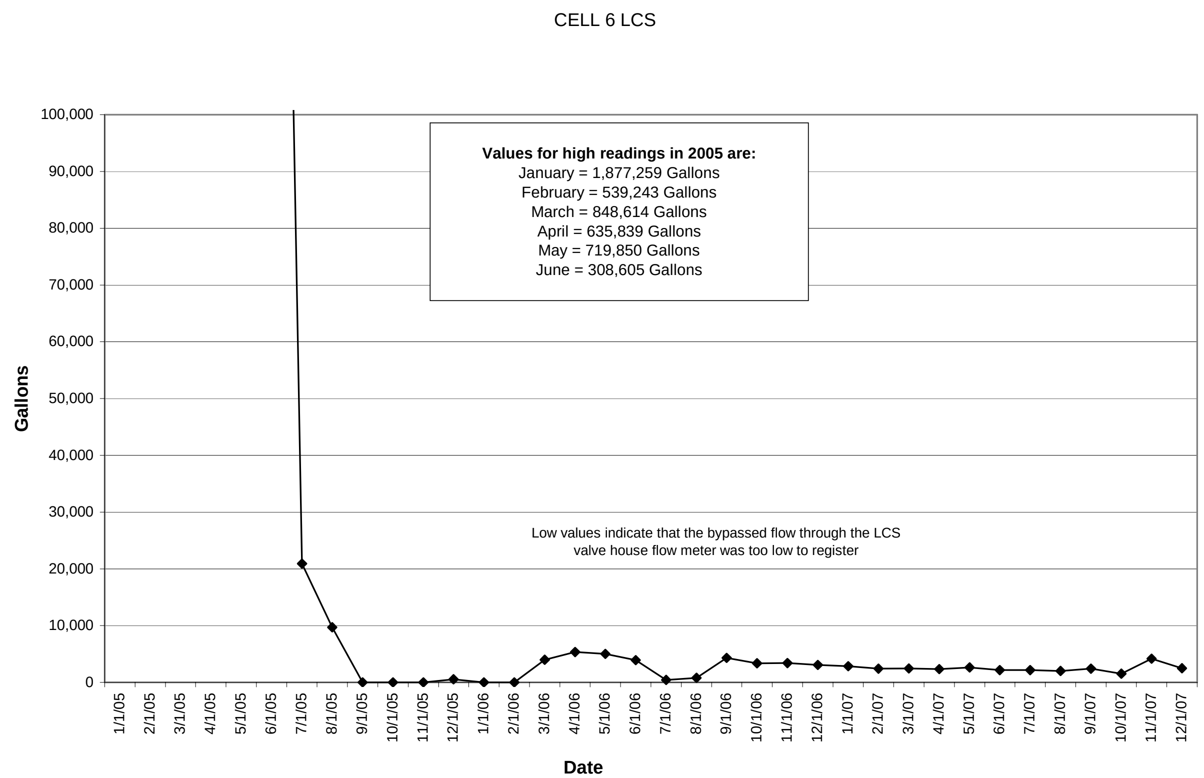


FIGURE A.5.6-1. MONTHLY ACCUMULATION VOLUMES FOR CELL 6 LCS

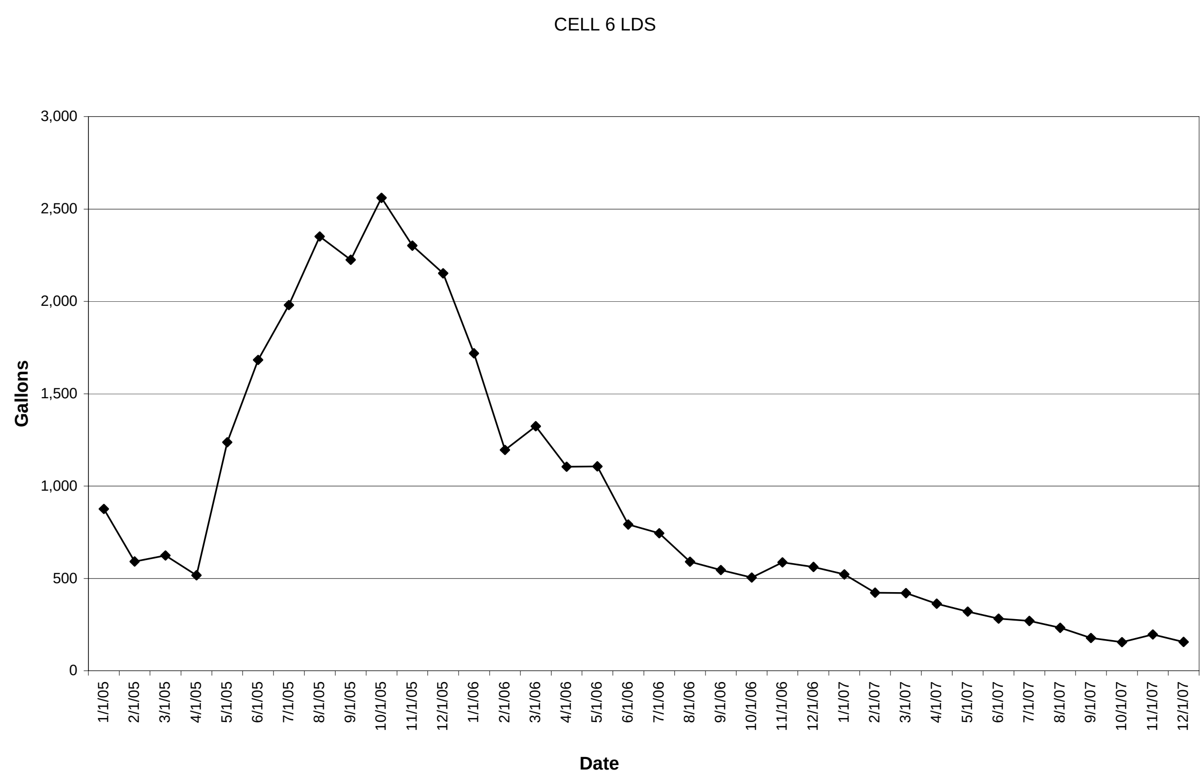
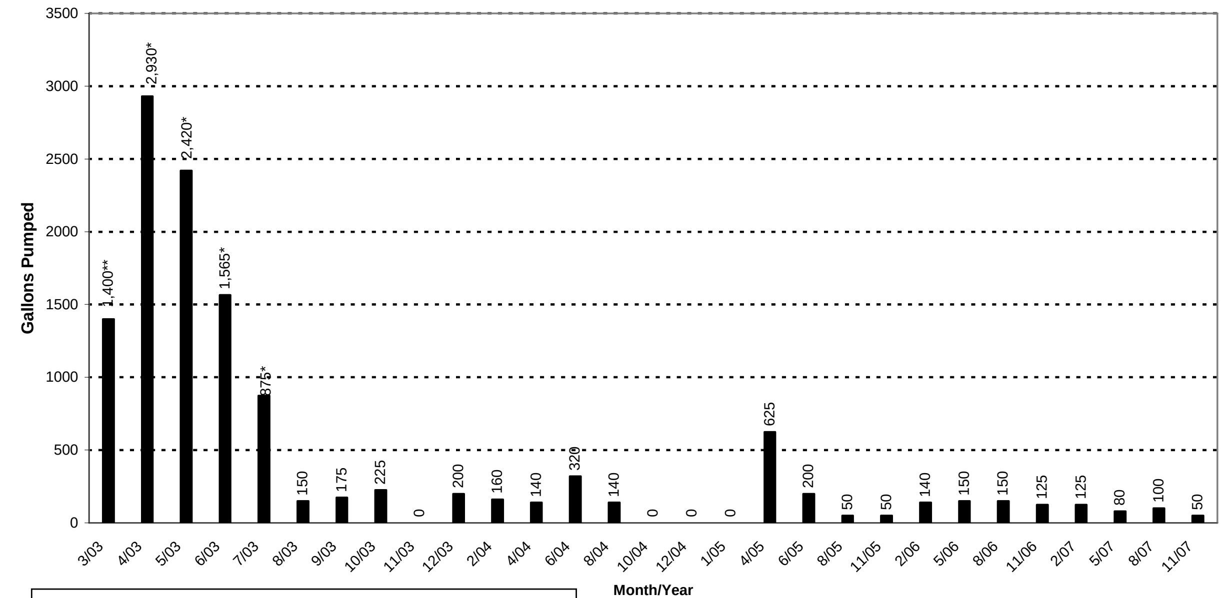


FIGURE A.5.6-2. MONTHLY ACCUMULATION VOLUMES FOR CELL 6 LDS



12343 Purge Information

Year	Total Volumes (gal.)	Months Purged	Avg. Monthly Purge (gal.)
2003:	9940	n=10	994
2004:	760	n= 6	127
2005:	925	n=5	185
2006:	565	n=4	141
2007:	355	n=4	89
Overall:			433

*More than one purge of the well was completed during these months to drain perched water and infiltrating surface water so the compacted clay liner could be constructed.

**Excess water was pumped from this well in March 2003 for well development.

FIGURE A.5.6-3. OSDF HORIZONTAL TILL WELL 12343 (CELL 6) WATER YIELD

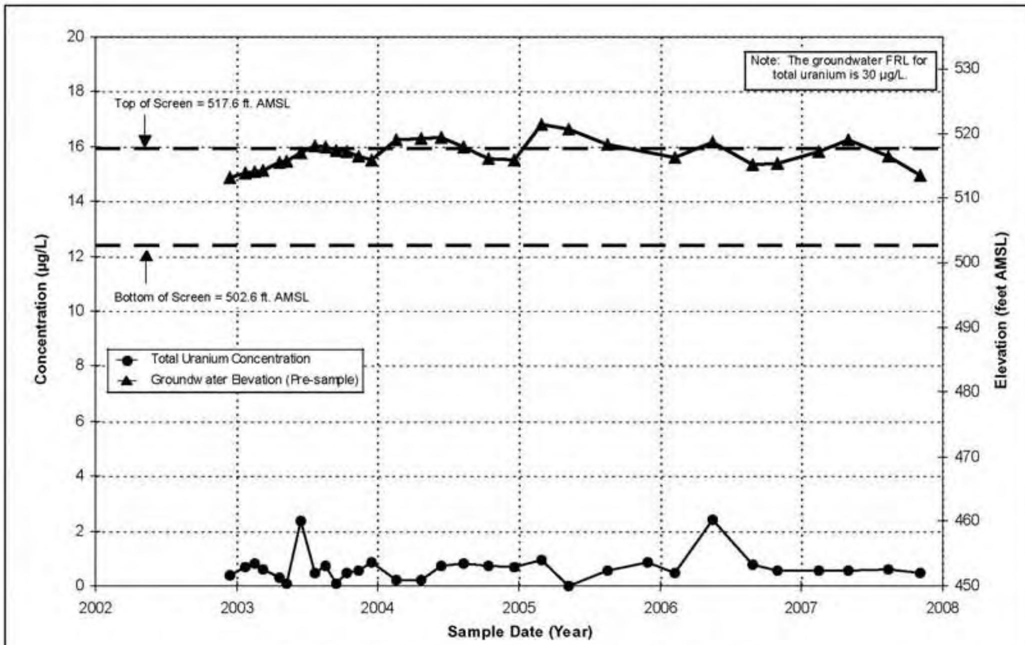


Figure A.5.6-4. Total Uranium Concentration and Groundwater Elevation vs. Time Plot for Cell 6 Upgradient Monitoring Well 22209

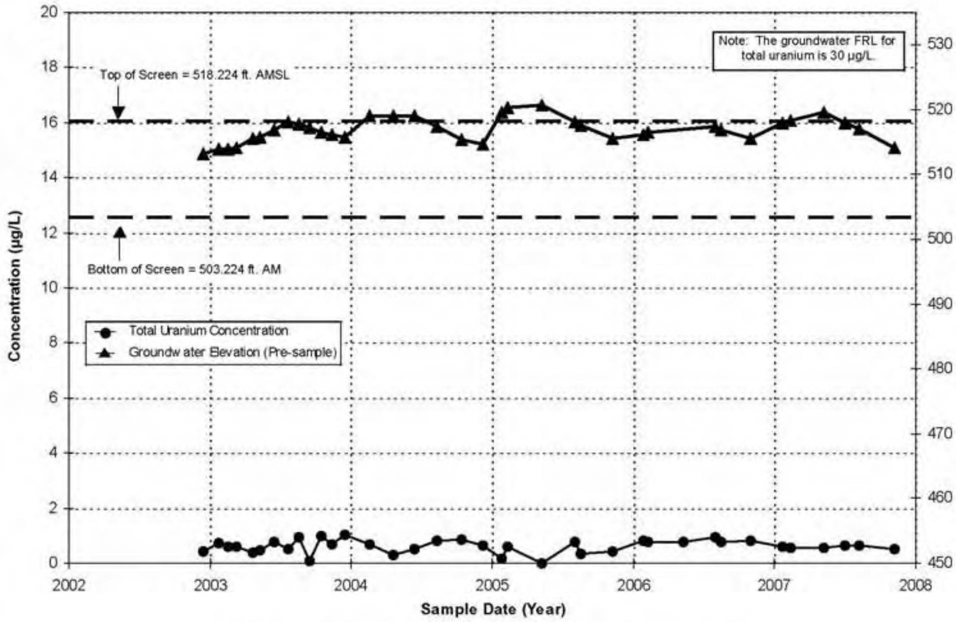


Figure A.5.6-5. Total Uranium Concentration and Groundwater Elevation vs. Time Plot for Cell 6 Downgradient Monitoring Well 22210

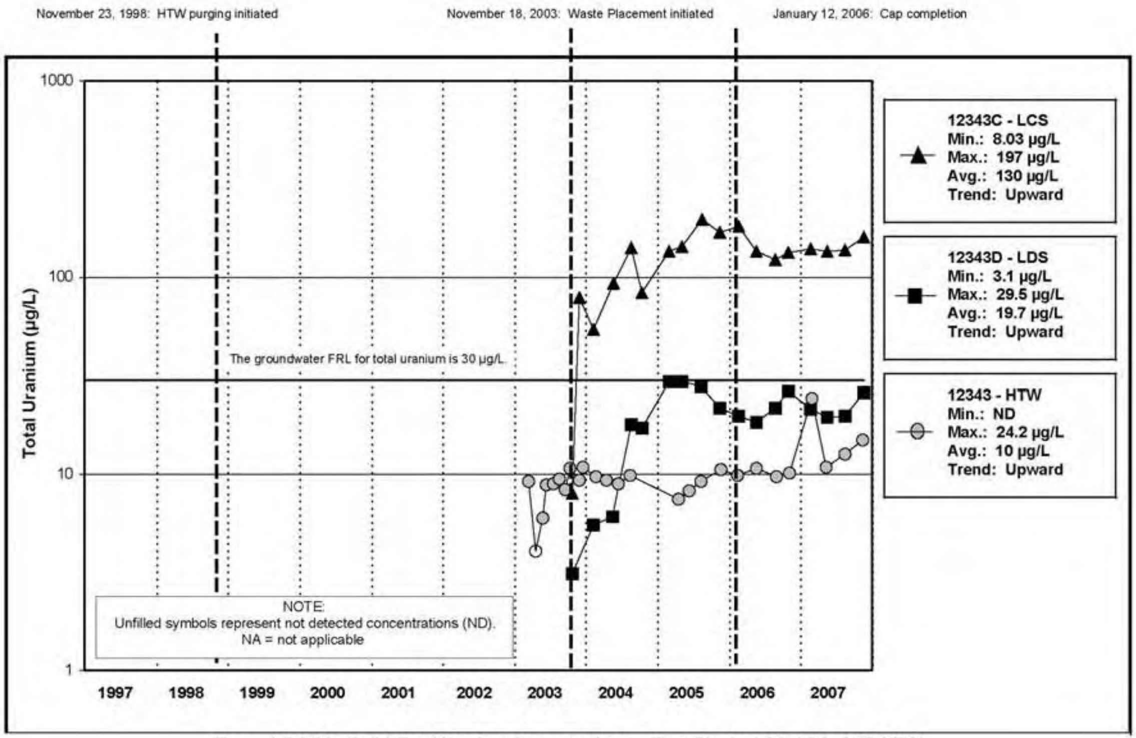


Figure A.5.6-6A. Cell 6 Total Uranium Concentration vs. Time Plot for LCS, LDS, AND HTW

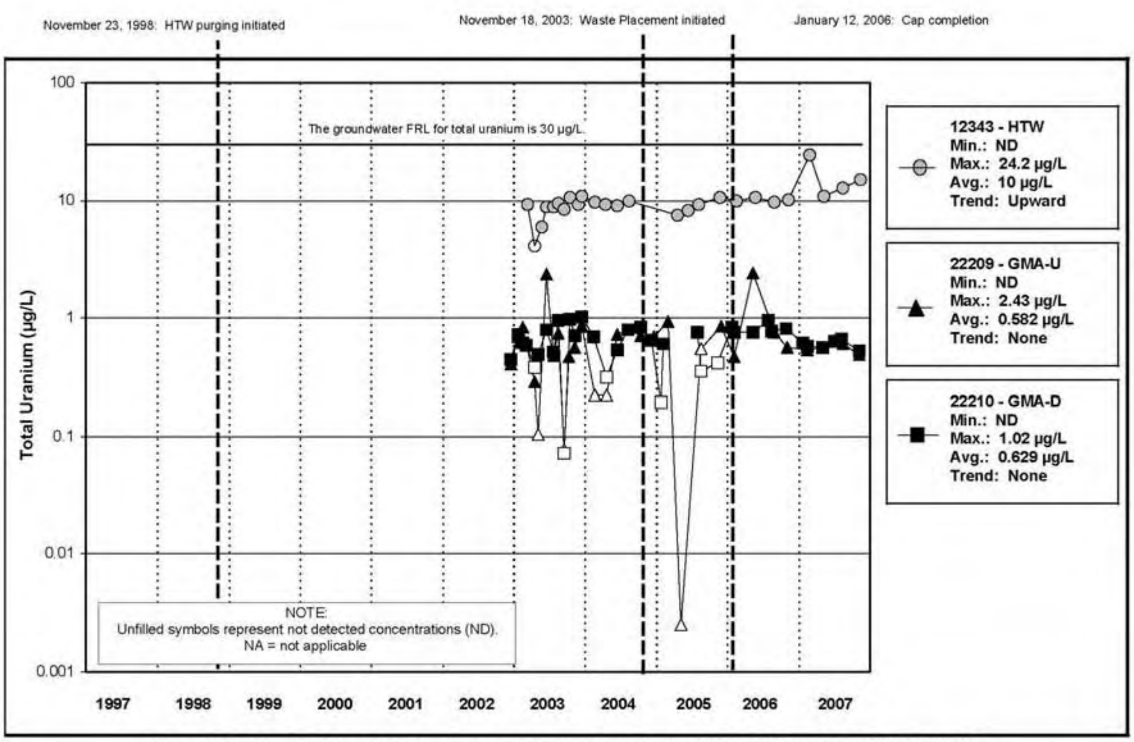


Figure A.5.6-6B. Cell 6 Total Uranium Concentration vs. Time Plot for HTW, GMA-U Well, AND GMA-D Well

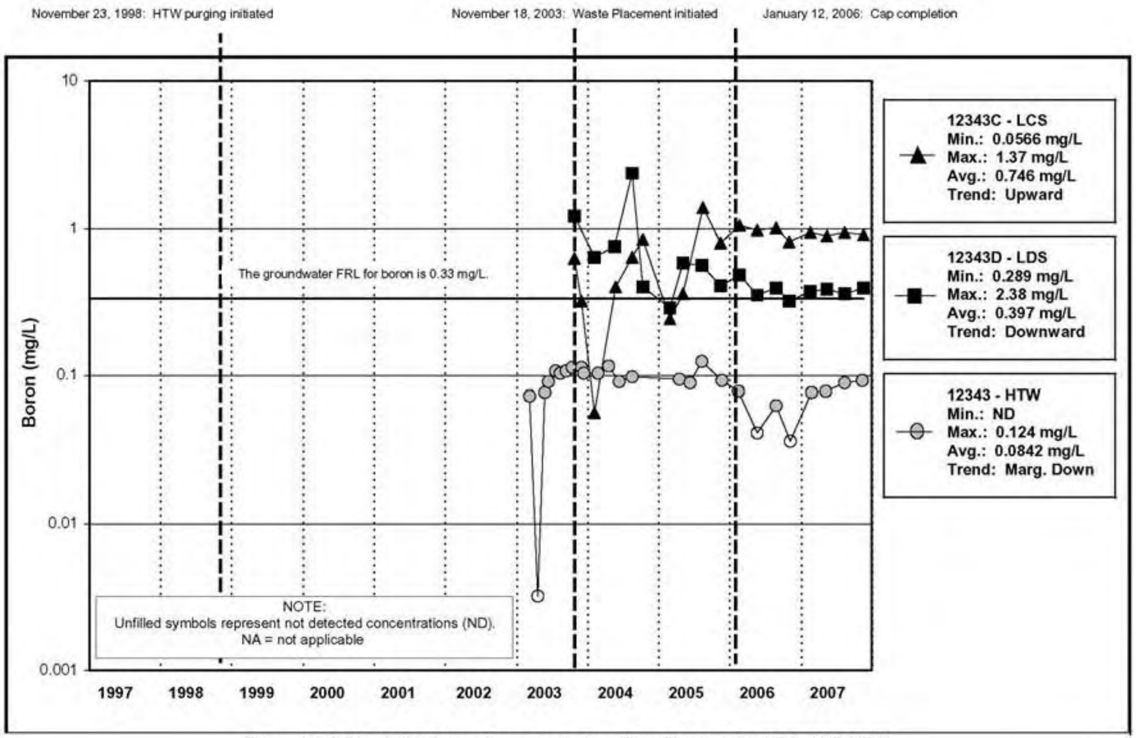


Figure A.5.6-7A. Cell 6 Boron Concentration vs. Time Plot for LCS, LDS, AND HTW

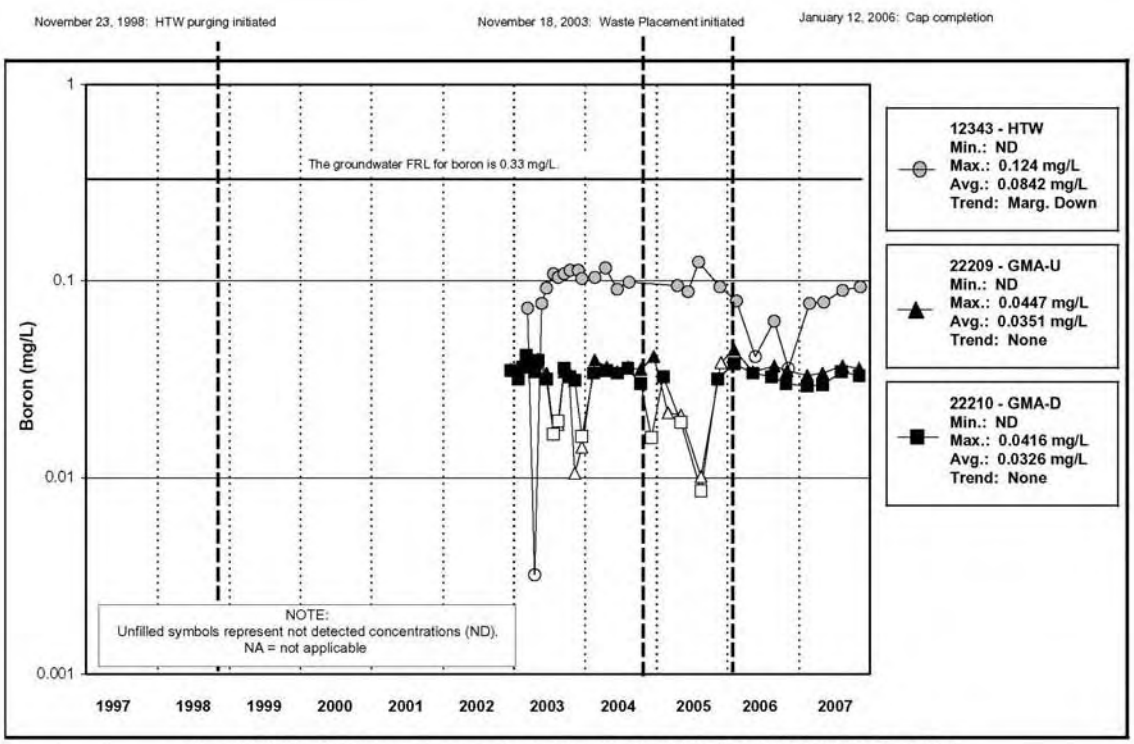


Figure A.5.6-7B. Cell 6 Boron Concentration vs. Time Plot for HTW, GMA-U Well, AND GMA-D Well

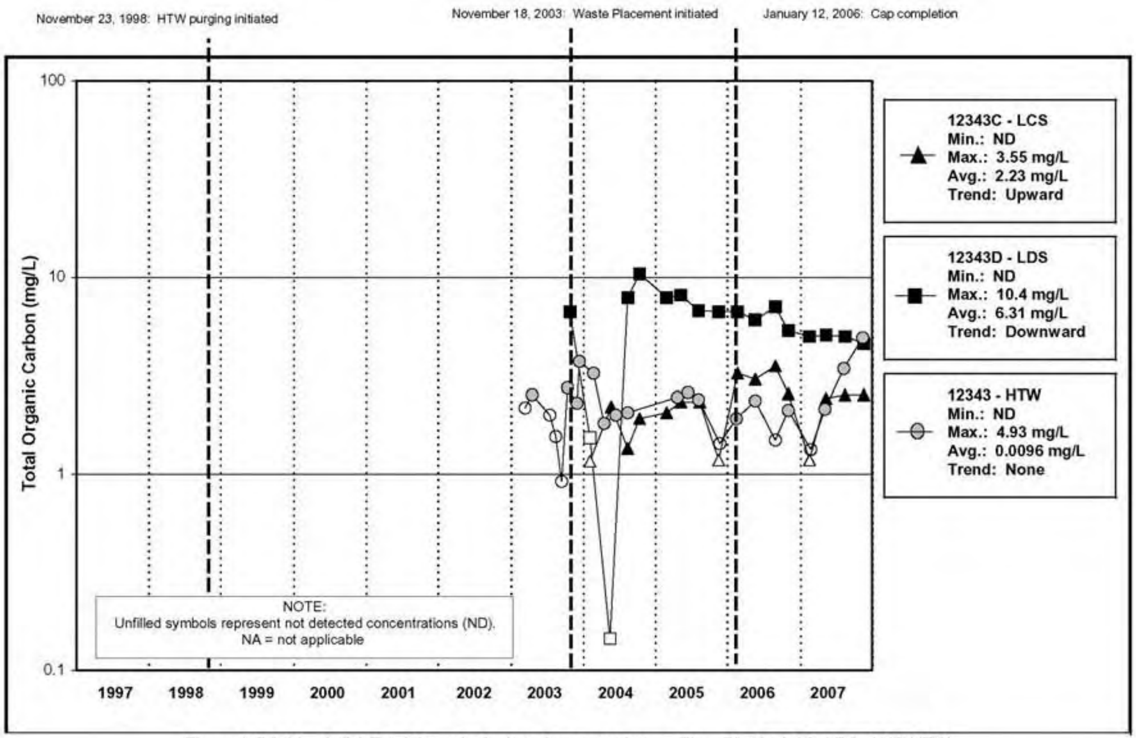


Figure A.5.6-8A. Cell 6 Total Organic Carbon Concentration vs. Time Plot for LCS, LDS, AND HTW

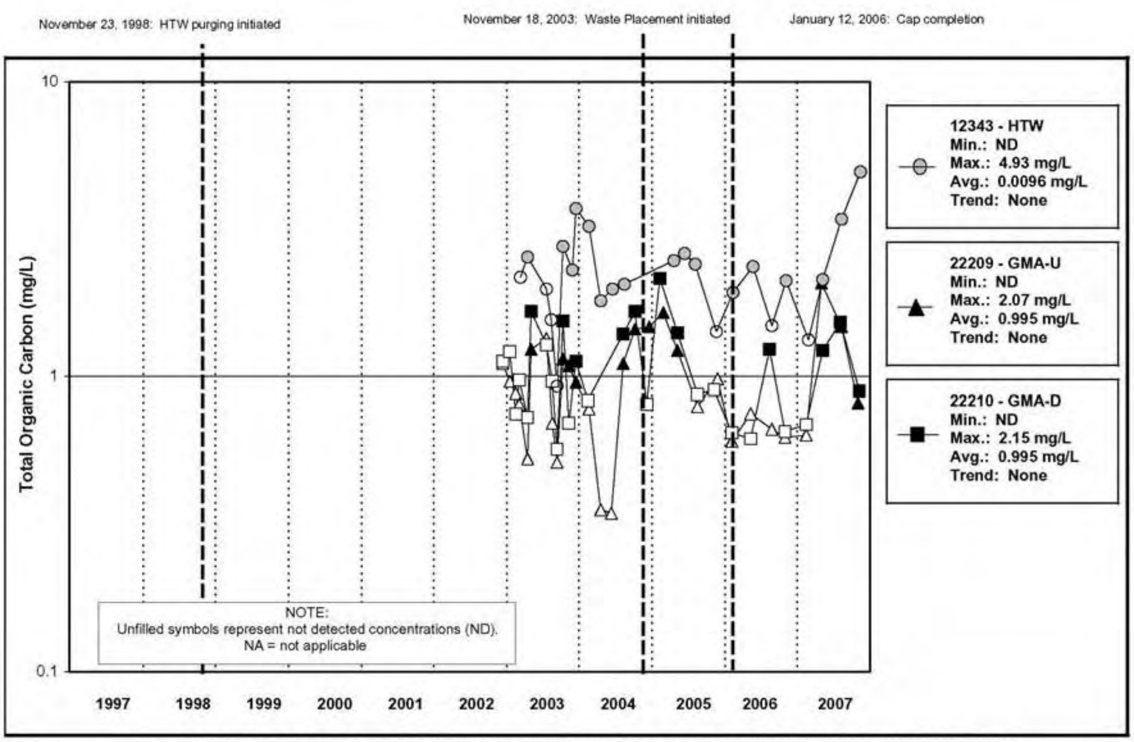


Figure A.5.6-8B. Cell 6 Total Organic Carbon Concentration vs. Time Plot for HTW, GMA-U Well, AND GMA-D Well

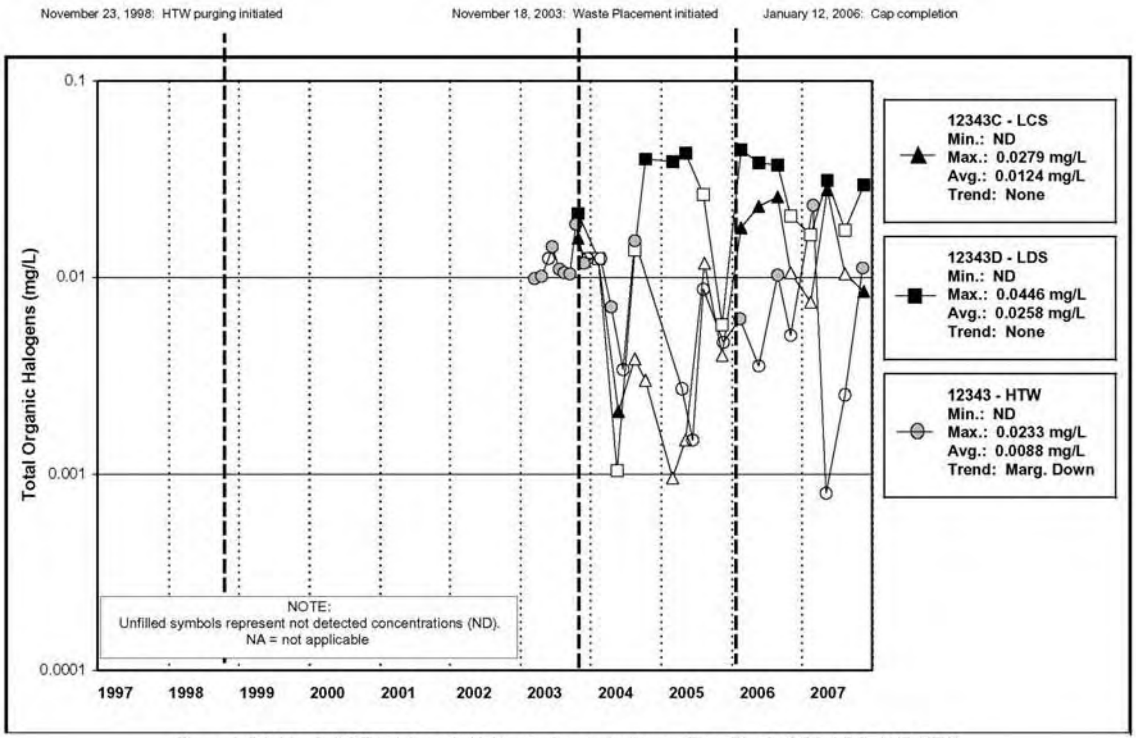


Figure A.5.6-9A. Cell 6 Total Organic Halogens Concentration vs. Time Plot for LCS, LDS, AND HTW

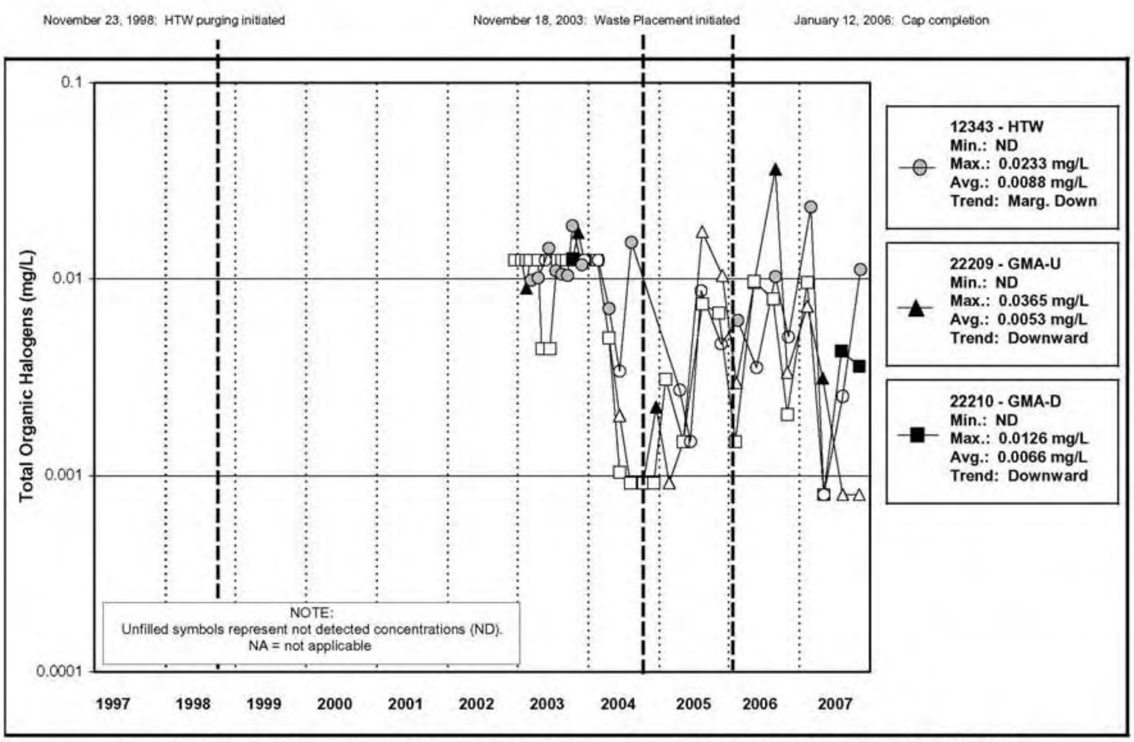


Figure A.5.6-9B. Cell 6 Total Organic Halogens Concentration vs. Time Plot for HTW, GMA-U Well, AND GMA-D Well

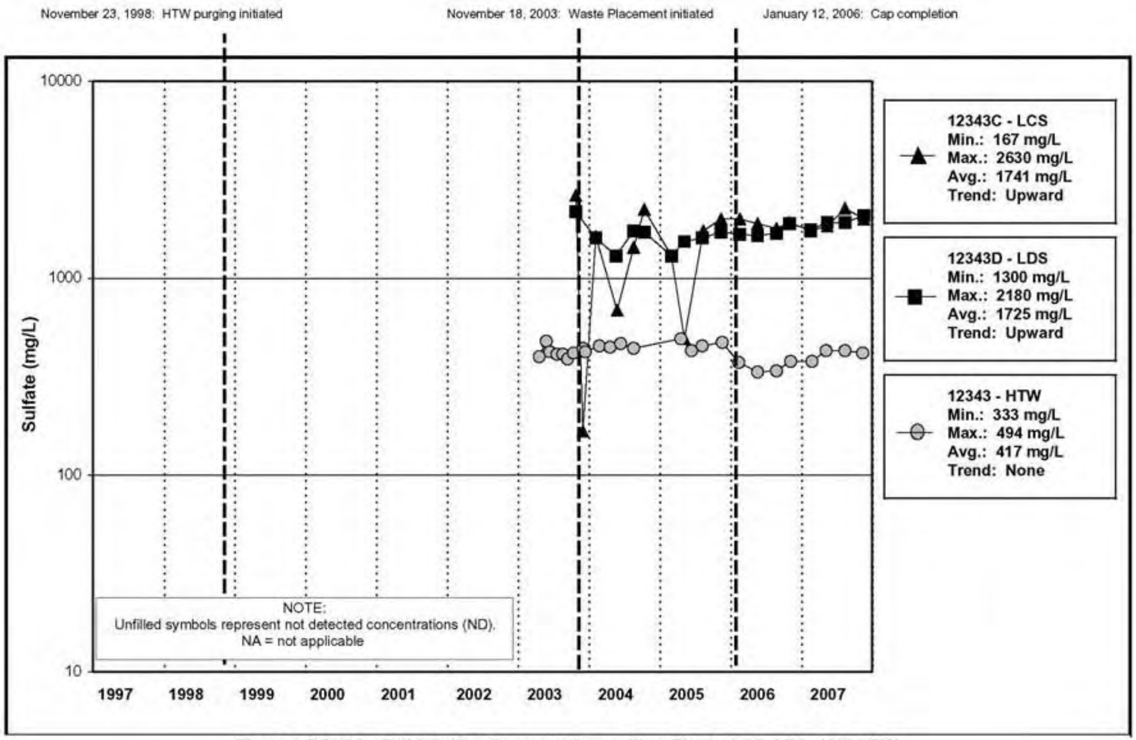


Figure A.5.6-10A. Cell 6 Sulfate Concentration vs. Time Plot for LCS, LDS, AND HTW

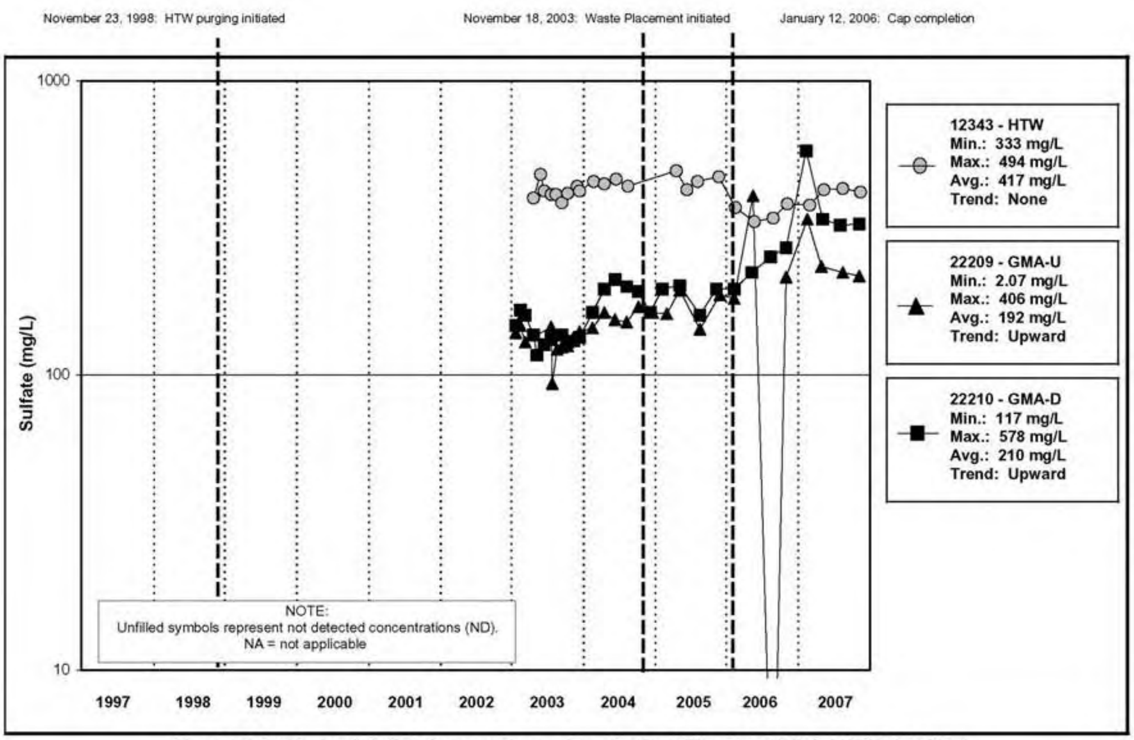


Figure A.5.6-10B. Cell 6 Sulfate Concentration vs. Time Plot for HTW, GMA-U Well, AND GMA-D Well

Sub-Attachment A.5.7

Cell 7

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The following information is provided in this sub-attachment:

- LCS monthly accumulation volumes (refer to Figures A.5.7−1)
- LDS monthly accumulation volumes (refer to Figures A.5.7−2)
- Monthly liner efficiencies (refer to Table A.5.7−1)
- HTW Water Yield (refer to Figure A.5.7−3)
- Great Miami Aquifer water levels and uranium concentrations versus time (refer to Figures A.5.7−4 and A.5.7−5)
- Summary statistics for refined baseline constituents (refer to Section A.5.7.1 and Table A.5.7−2)
- Concentration plots for refined baseline constituents (refer to Section A.5.7.1, and Figures A.5.7−6A through A.5.7−10B)
- Annual LCS monitoring results (refer to Section A.5.7.2 and Table A.5.7−3)
- Annual LDS monitoring results (refer to Section A.5.7.3).

Samples for the OSDF monitoring horizons were collected according to the frequencies described in the OSDF GWLMP. Constituent sampling lists are provided in Table 2−1, Table 2−2, and Table 2−3 of Appendix B of the OSDF GWLMP. In 2007, all samples were collected for Cell 7 monitoring horizons.

A.5.7.1 Refined Baseline Monitoring Results

Refined baseline constituents are those constituents that have been sampled at least eight times, and detected at least 25 percent of the time in the LCS, LDS, HTW, and GMA wells. Refined baseline constituents are listed in Table 2−3 of Appendix B of the OSDF GWLMP. Also included in Table 2−3 are common ion constituents. A summary statistics table (refer to Table A.5.7−2) and concentration plots (Figures A.5.7−6A through A.5.7−10B) are provided for the five baseline constituents of Cell 7: total uranium, boron, TOC, TOX, and sulfate.

A.5.7.2 LCS Monitoring Results

During active operations (pre-closure) Ohio Solid Waste Regulations (OAC 3745-27-19(M)(5)) require collection and analysis of leachate annually for Appendix I and PCB constituents listed in OAC 3745-27-10. The objective of the annual LCS sampling is to determine if the composition of the leachate within the facility is changing enough to impact monitoring activities beneath the facility. A list of annual LCS sampling constituents is provided in Table 2−2 of Appendix B of the OSDF GWLMP. In 2007, annual sampling of the Cell 7 LCS took place in May. Table A.5.7−3 summarizes the annual LCS sampling results for Cell 7, along with the data collected in previous years.

Of the non refined baseline site-specific constituents that have been sampled at least eight times in Cell 7, 13 have been detected at least 25 percent of the time. Twelve of the 13 constituents are common ion constituents (alkalinity, calcium, chloride, fluoride, iron, magnesium, manganese, nitrate/nitrite, phosphorous, potassium, silicon, and sodium). The remaining one (technetium-99) is a *potential* site-specific leak detection monitoring constituents for Cell 7.

Common Ions

A common ion study was completed in 2007, and a report, *Fernald Site, Evaluation of Aqueous Ions in the Monitoring Systems of the On-site Disposal Facility*, was issued in March 2008. This report is currently undergoing review by the EPA and Ohio EPA.

As discussed in Section A.5.2.2, the common ion study concluded that fluid volume appears to be the key monitoring constituent to indicate the potential for leachate migration from the OSDF, and the sampling of and analysis for indicator ions are useful only if the hydraulic conditions permit leachate to migrate.

The common ion study also concluded that no one ion can serve as a leak indicator for all cells of the disposal facility, but useful indicator ions for specific target horizons of each cell can be identified. Specifically, uranium and manganese in the LDS and uranium in the HTW were the only useful indicator constituents identified for the Cell 7 LDS and HTW, and that sufficient data exists to establish control charts for these parameters at the same specified locations for Cell 7. In addition, no other useful common ion indicator constituents were found for Cell 7. Since uranium is already included as a refined baseline constituent for Cell 7, it is recommended that manganese be added to the refined baseline constituent list for the Cell 7 LDS. Also, control charts will be included in future SERs for uranium and manganese in the Cell 7 LDS and uranium in the Cell 7 HTW upon approval of the common ion study.

Potential Site-Specific Leak Detection Monitoring Constituents

The remaining constituent (considered to be a "*potential*" site-specific leak detection monitoring constituent for Cell 7) is technetium-99. This potential Cell 7 site-specific leak detection monitoring constituent will be assessed using the statistical approach presented in Figure A.5−4A and A.5−4B, and discussed in Section A.5.2.2, when eight sampling rounds for the Cell 7 LCS have been completed. Eight sampling rounds will be completed for the Cell 7 LCS in 2011. Results of the assessment will be presented to the EPA and OEPA as soon as they are available and they will also be reported in the SER.

Confirmatory Sampling

Technetium-99 is a site-specific leak detection constituent. It is not on the refined baseline list for Cell 7. If a site-specific constituent (not of the refined baseline list) is detected in the LCS or LDS, then confirmatory sampling for that constituent will take place. As shown in Table A.5.7−3, technetium-99 has been detected in the Cell 7 LCS, and one of these detections was in 2007. Therefore confirmatory sampling for technetium-99 in the Cell 7 LCS will begin in August 2008 for at least three sampling rounds as required under the 2008 Legacy Management and Institutional Controls Plan, Attachment C, Appendix B, Section 2.1.

A.5.7.3 LDS Monitoring Results

Each year the LDS of Cell 7 is sampled for site-specific baseline constituents listed in Table 2−1 of Appendix B of the OSDF GWLMP. The objective of the annual LDS sampling is to determine if any initial baseline constituents, not on the refined baseline list, are present in the LDS. In 2007, annual sampling of the Cell 7 LDS took place in May.

In 2007, of the non-refined baseline constituents that have been sampled at least eight times, 12 have been detected at least 25 percent of the time. All twelve of these constituents are common ion constituents (alkalinity, calcium, chloride, fluoride, iron, magnesium, manganese, nitrate/nitrite, phosphorous, potassium, silicon, and sodium).

Table A.5.7−1 Cell 7 – 2007 Monthly Liner Efficiencies

Month	**Cell 7 Apparent Liner Efficiency (%)**
January	56.47
February	60.78
March	65.80
April	69.08
May	78.09
June	78.78
July	77.17
August	83.44
September	77.35
October	83.96
November	90.05
December	89.10

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Table A.5.7−2. Summary Statistics For Cell 7

Note: The data used in this table have been standardized to quarterly.

Parameter	Horizon[a]	Monitoring Location	No. of Detected Samples	Total No. of Samples	Percent of Detects	Average[b]	Distribution Type[c]	Trend[d]	Serial Correlation[e]	Outliers[f,g]
Total Uranium (µg/L)	LCS	12344C	14	14	100	178	Normal	Up	Detected	
	LDS	12344D	13	13	100	24.0	Normal	None	Not Detected	
	HTW	12344	16	16	100	2.61	Lognormal	None	Not Detected	
	GMA-U	22212	14	15	93.3	0.470	Undefined	None	Not Detected	4.46 (Q1-05)
	GMA-D	22211	16	16	100	0.358	Undefined	None	Not Detected	
Boron (mg/L)	LCS	12344C	14	14	100	1.12	Undefined	None	Not Detected	
	LDS	12344D	12	12	100	0.356	Lognormal	Marg. Down	Detected	2.1 (Q3-04)
	HTW	12344	11	16	68.8	0.0219	Lognormal	None	Detected	
	GMA-U	22212	15	15	100	0.0349	Undefined	None	Detected	0.0247 (Q3-04)
	GMA-D	22211	14	16	87.5	0.0273	Undefined	Up	Detected	
Total Organic Carbon (mg/L)	LCS	12344C	9	13	69.2	2.03	Normal	None	Not Detected	
	LDS	12344D	13	13	100	6.00	Normal	None	Detected	
	HTW	12344	13	16	81.3	2.05	Lognormal	None	Detected	
	GMA-U	22212	10	15	66.7	0.838	Lognormal	None	Not Detected	2.24 (Q1-05)
	GMA-D	22211	10	16	62.5	0.784	Undefined	None	Not Detected	
Total Organic Halogens (mg/L)	LCS	12344C	4	13	30.8	0.0059	Undefined	Up	Not Detected	0.0328 (Q2-07)
	LDS	12344D	6	13	46.2	0.0262	Lognormal	None	Not Detected	
	HTW	12344	6	15	40	0.0126	Lognormal	None	Not Detected	0.00084 (Q3-07)
	GMA-U	22212	4	16	25	0.00466	Undefined	None	Not Detected	
	GMA-D	22211	2	15	13.3	0.00296	Undefined	None	Not Detected	0.0125 (Q1-04)
Sulfate (mg/L)	LCS	12344C	14	14	100	1820	Undefined	Up	Detected	
	LDS	12344D	12	12	100	1550	Normal	Marg. Down	Detected	2240 (Q2-05)
	HTW	12344	16	16	100	111	Lognormal	Down	Detected	
	GMA-U	22212	15	15	100	171	Lognormal	Up	Detected	362 (Q1-07)
	GMA-D	22211	16	16	100	249	Lognormal	Up	Detected	

[a]LCS = leachate collection system; LDS = leak detection system; HTW = horizontal till well; GMA-U = upgradient Great Miami Aquifer; and GMA-D = downgradient Great Miami Aquifer

[b]Averages were determined based on the distribution assumption. "Approx. Normal" was treated as if it was normal, and "Approx. Lognormal" was treated as if it was lognormal. This was done to compensate for the skewed (lognormal) or non-skewed (normal) nature of the data to give a better estimate of the underlying average.

[c]Data distribution based on the Shapiro-Wilk statistic.

Normal: Normal assumption could not be rejected at the 5 percent level and has a higher probability value than the lognormal assumption.

Lognormal: Lognormal assumption could not be rejected at the 5 percent level and has a higher probability value than the normal assumption.

Approx. Normal (Approximately Normal): Normal and lognormal assumptions were rejected at the 5 percent level. However, the normal assumption was not rejected at the 10 % level. Additionally, for cases where neither assumption was rejected at the 10% level, the data fit the normal destribution better than the lognormal distribution.

Approx. Lognormal (Approximately Lognormal): Normal and lognormal assumptions were rejected at the 5 percent level. However, the lognormal assumption was not rejected at the 10 % level. Additionally, for cases where neither assumption was rejected at the 10% level, the data fit the lognormal destribution better than the normal distribution.

Undefined: Normal and Lognormal Distribution assumptions are both rejected or there are less than 25% detected values. "Average" is defined as the Median of the data.

[d]Trend based on nonparametric Mann-Kendall procedure. Note that "Marg. Down" is a marginally downward trend and "Marg. Up" is a marginally upward trend.

[e]Serial correlation based on Rank Von Neumann test.

[f]Outliers determined by Rosner's (for sample sizes greater than 25) or Dixon procedure (for sample sizes less than or equal to 25).

Table A.5.7−3. Cell 7 Annual LCS Sample Summary Information

PARAMETER (UNIT)	NUMBER OF SAMPLES[a,b]	NUMBER OF SAMPLES WITH DETECTIONS[a,b]	PERCENT OF DETECTIONS[a,b]	MIN DETECTED CONCENTRATION[a,b,c]	MAX DETECTED CONCENTRATION[a,b,c]	AVG DETECTED CONCENTRATION[a,b,c]	GW FRL[d] (# OF SAMPLES>GWFRL)	GW BACKGROUND[a,b,e] (# OF SAMPLES>PW BACKGROUND)	PW BACKGROUND[a,b,e] (# OF SAMPLES>PW BACKGROUND)	MAX PW DETECTED CONCENTRATION [a,b,f] (# OF SAMPLES>MAX PW)	DETECTION LIMIT
Alkalinity as CaCO3 (mg/L)	10	10	100%	86	822	340	-	422 mg/L(2)	430 mg/L(2)	-	10 mg/L
Ammonia (mg/L)	4	1	25%	0.254	-	-	-	4.2 mg/L(0)	4.34 mg/L(0)	220 mg/L(0)	0.1 mg/L
Arsenic (mg/L)	4	2	50%	0.0015	0.0093	0.0054	0.05 mg/L(0)	0.029 mg/L(0)	0.019 mg/L(0)	0.191 mg/L(0)	0.02 mg/L
Barium (mg/L)	4	4	100%	0.0347	0.112	0.0744	2 mg/L(0)	0.77 mg/L(0)	0.45 mg/L(0)	0.589 mg/L(0)	0.029 mg/L
Beryllium (mg/L)	4	2	50%	0.00017	0.00025	0.0002	0.004 mg/L(0)	-	-	0.0343 mg/L(0)	0.001 mg/L
Cadmium (mg/L)	4	1	25%	0.0002	-	-	0.014 mg/L(0)	0.014 mg/L(0)	-	0.05 mg/L(0)	0.002 mg/L
Calcium (mg/L)	10	10	100%	153	759	454	-	159 mg/L(9)	172 mg/L(8)	1800 mg/L(0)	5 mg/L
Chloride (mg/L)	10	10	100%	26.7	130	83.0	-	7.3 mg/L(10)	45 mg/L(7)	6300 mg/L(0)	5 mg/L
Chromium (mg/L)	4	1	25%	0.0292	-	-	0.022 mg/L[g](1)	0.021 mg/L(1)	0.0046 mg/L(1)	0.818 mg/L(0)	0.005 mg/L
Cobalt (mg/L)	4	4	100%	0.0016	0.008	0.0041	0.17 mg/L(0)	0.0086 mg/L(0)	-	0.0886 mg/L(0)	0.034 mg/L
Copper (mg/L)	4	4	100%	0.0059	0.0247	0.014	1.3 mg/L(0)	0.035 mg/L(0)	0.029 mg/L(0)	0.298 mg/L(0)	0.008 mg/L
Fluoride (mg/L)	9	9	100%	0.21	0.536	0.343	4 mg/L(0)	0.89 mg/L(0)	1.3 mg/L(0)	6.8 mg/L(0)	0.2 mg/L
Iron (mg/L)	10	10	100%	0.683	18.7	6.59	-	5.72 mg/L(3)	6.35 mg/L(3)	21.3 mg/L(0)	0.1 mg/L
Lead (mg/L)	4	1	25%	0.0061	-	-	0.015 mg/L(0)	0.022 mg/L(0)	0.0016 mg/L(1)	0.0114 mg/L(0)	0.008 mg/L
Magnesium (mg/L)	10	10	100%	60.5	445	251	-	38.5 mg/L(10)	50.7 mg/L(10)	690 mg/L(0)	5 mg/L
Manganese (mg/L)	10	10	100%	0.0226	0.991	0.287	0.9 mg/L(1)	0.9 mg/L(1)	0.21 mg/L(4)	35 mg/L(0)	0.09 mg/L
Nickel (mg/L)	4	4	100%	0.0063	0.0261	0.0153	0.1 mg/L(0)	0.0514 mg/L(0)	0.0072 mg/L(3)	0.981 mg/L(0)	0.02 mg/L
Nitrate/Nitrite (mg/L)	11	7	63.60%	0.097	10.7	2.51	11 mg/L[g](0)	11 mg/L(0)	0.29 mg/L(5)	2670 mg/L(0)	1.1 mg/L
Phosphorus (mg/L)	9	4	44.40%	0.11	0.254	0.169	-	-	-	-	0.1 mg/L
Potassium (mg/L)	10	10	100%	8.12	61.4	33.3	-	1.96 mg/L(10)	17.2 mg/L(7)	12400 mg/L(0)	5 mg/L
Silicon (mg/L)	9	9	100%	2.84	10.6	5.67	-	-	-	15 mg/L(0)	0.015 mg/L
Sodium (mg/L)	10	10	100%	18.1	75.2	54.6	-	47.1 mg/L(7)	50 mg/L(7)	1300 mg/L(0)	5 mg/L
Technetium-99 (pCi/L)	9	5	55.60%	1.43	16.2	10.7	94 pCi/L(0)	22 pCi/L(0)	30 pCi/L(0)	6130 pCi/L(0)	10 pCi/L
Thallium (mg/L)	4	1	25%	0.00046	-	-	-	-	-	0.0028 mg/L(0)	0.02 mg/L
TDS (mg/L)	5	5	100%	960	4780	2620	-	-	-	-	10 mg/L
Total Xylenes (µg/L)	4	1	25%	1.01	-	-	-	-	-	-	10 µg/L
Vanadium (mg/L)	4	1	25%	0.0051	-	-	0.038 mg/L(0)	0.012 mg/L(0)	0.005 mg/L(1)	0.299 mg/L(0)	0.02 mg/L
Zinc (mg/L)	4	4	100%	0.0142	0.154	0.0823	0.021 mg/L(2)	0.02 mg/L(3)	0.35 mg/L(0)	1.78 mg/L(0)	0.015 mg/L

Note: Shading indicates that at least one detected sample is greater than the FRL, groundwater background, PW background, or PW maximum.

[a]If more than one sample is collected per well per day (e.g., duplicates), then only one sample is counted for the total number of samples, and the sample with the maximum representative concentration is used for all the summary information

[b]Rejected data qualified with an R or Z were not included.

[c]If the number of detected samples is equal to two, then the minimum and maximum are reported. If the number of detected is equal to one, then the data point is reported as the minimum. The "AVG DETECTED CONCENTRATION" is not reported for either of these cases.

[d]From Operable Unit 5 Record of Decision, Table 9-4.

[e]From the Characterization of Background Water Quality for Streams and Groundwater which was developed for Operable Unit 5 RI/FS documents.

[f]Max PW - maximum detected concentration in perched water as defined in the Remedial Investigation Report for Operable Unit 5.

[g]FRL based on hexavalent chromium and nitrate, from Operable Unit 5 Record of Decision, Table 9-4.

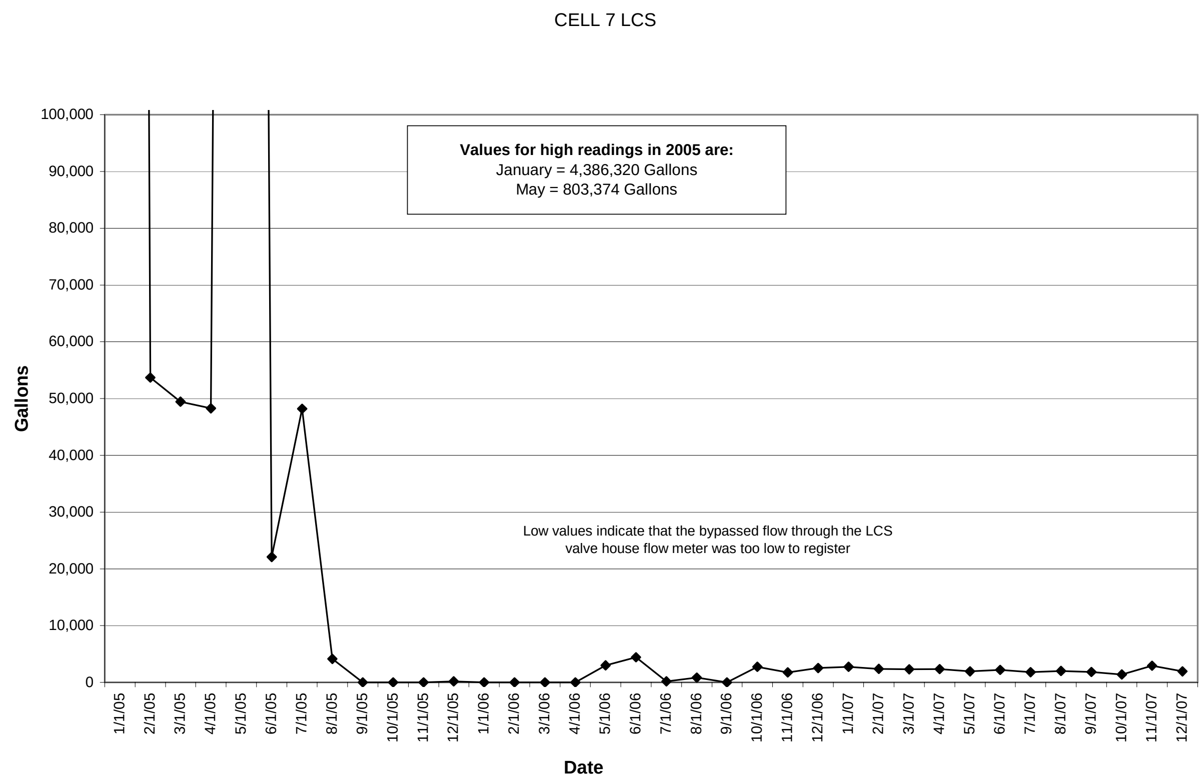
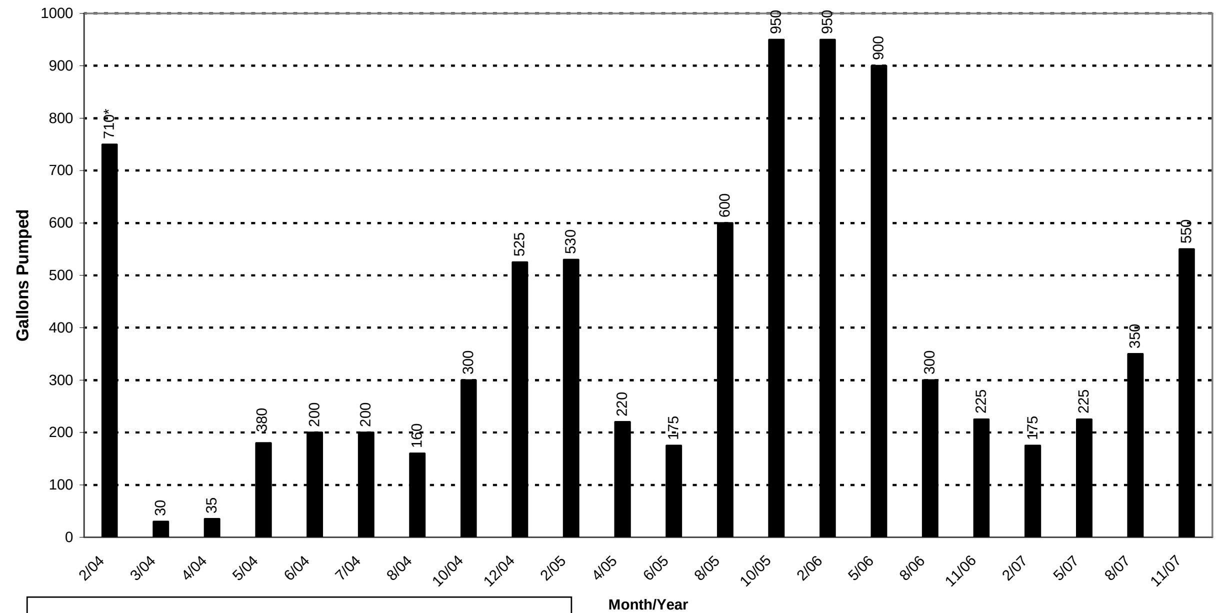


FIGURE A.5.7-1. MONTHLY ACCUMULATION VOLUMES FOR CELL 7 LCS

FIGURE A.5.7-2. MONTHLY ACCUMULATION VOLUMES FOR CELL 7 LDS



12344 Purge Information

Year	Total Volumes (gal.)	Months Purged	Avg. Monthly Purge (gal.)
2004:	2380	n=9	264
2005:	2475	n=5	495
2006:	2375	n=4	594
2007:	1300	n=4	325
Overall:			388

*More than one purge of the well was completed during this month to drain perched water and infiltrating surface water so the compacted clay liner could be constructed.

FIGURE A.5.7-3. OSDF HORIZONTAL TILL WELL 12344 (CELL 7) WATER YIELD

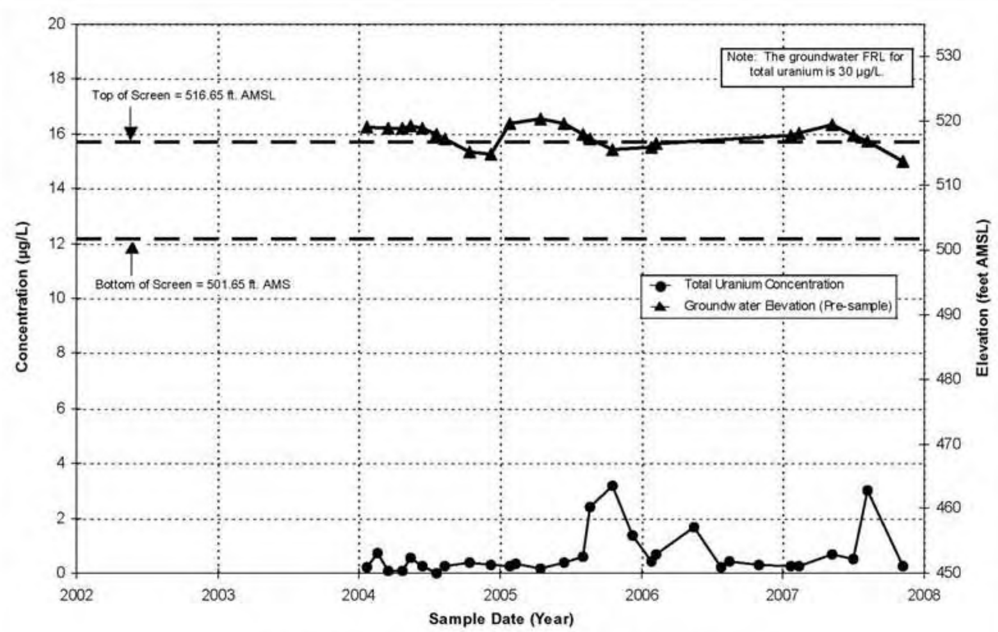


Figure A.5.7-4. Total Uranium Concentration and Groundwater Elevation vs. Time Plot for Cell 7 Upgradient Monitoring Well 22212

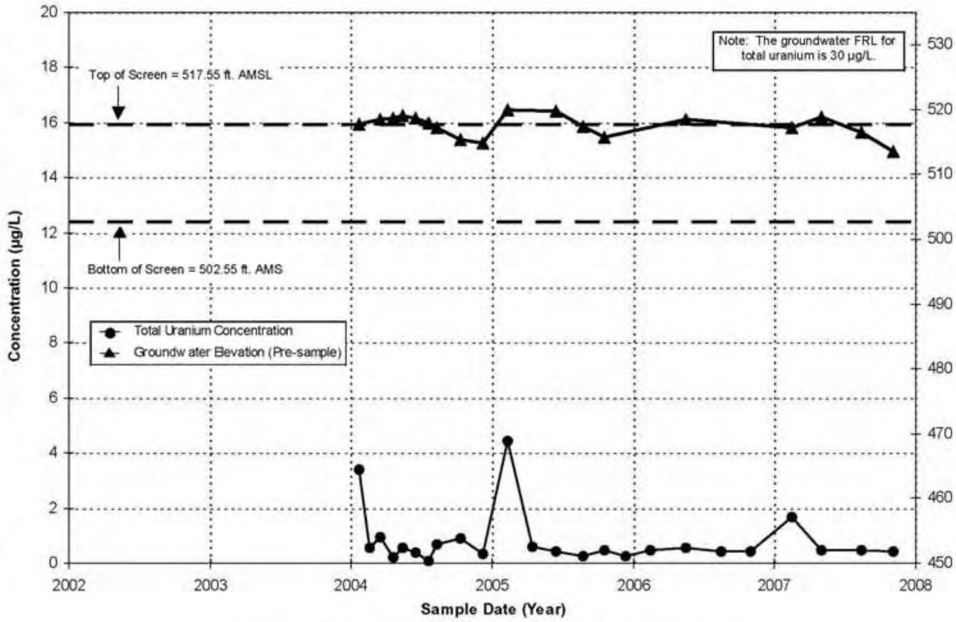


Figure A.5.7-5. Total Uranium Concentration and Groundwater Elevation vs. Time Plot for Cell 7 Downgradient Monitoring Well 22211

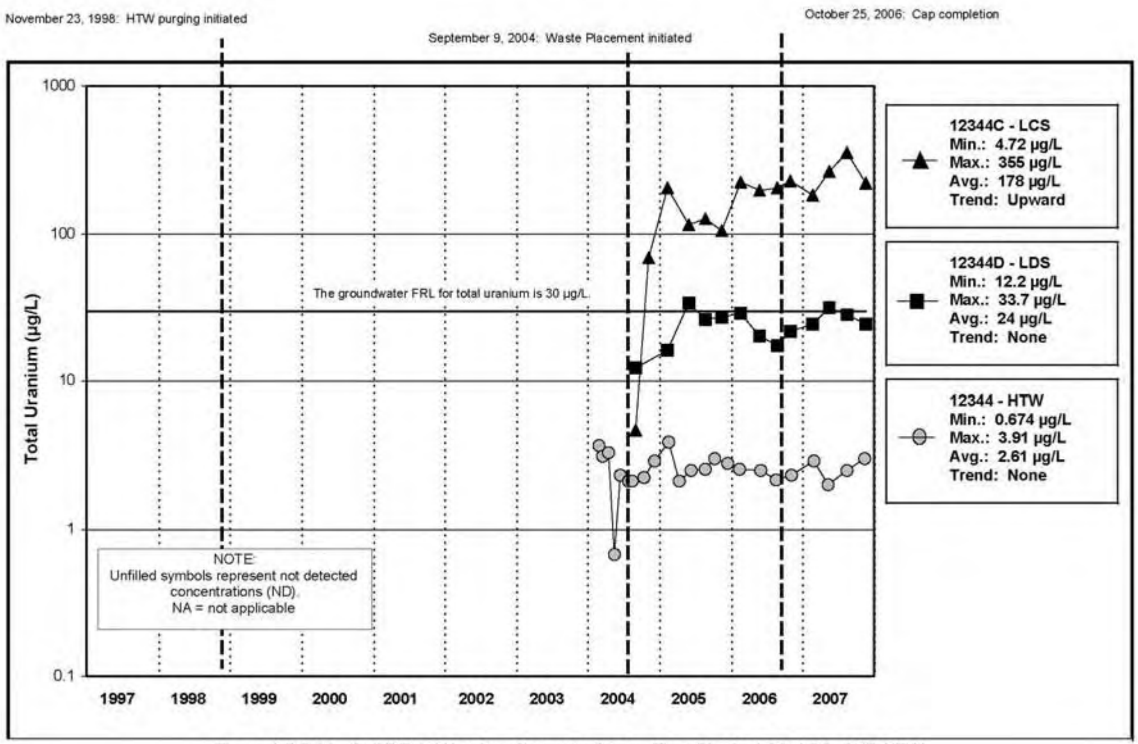


Figure A.5.7-6A. Cell 7 Total Uranium Concentration vs. Time Plot for LCS, LDS, AND HTW

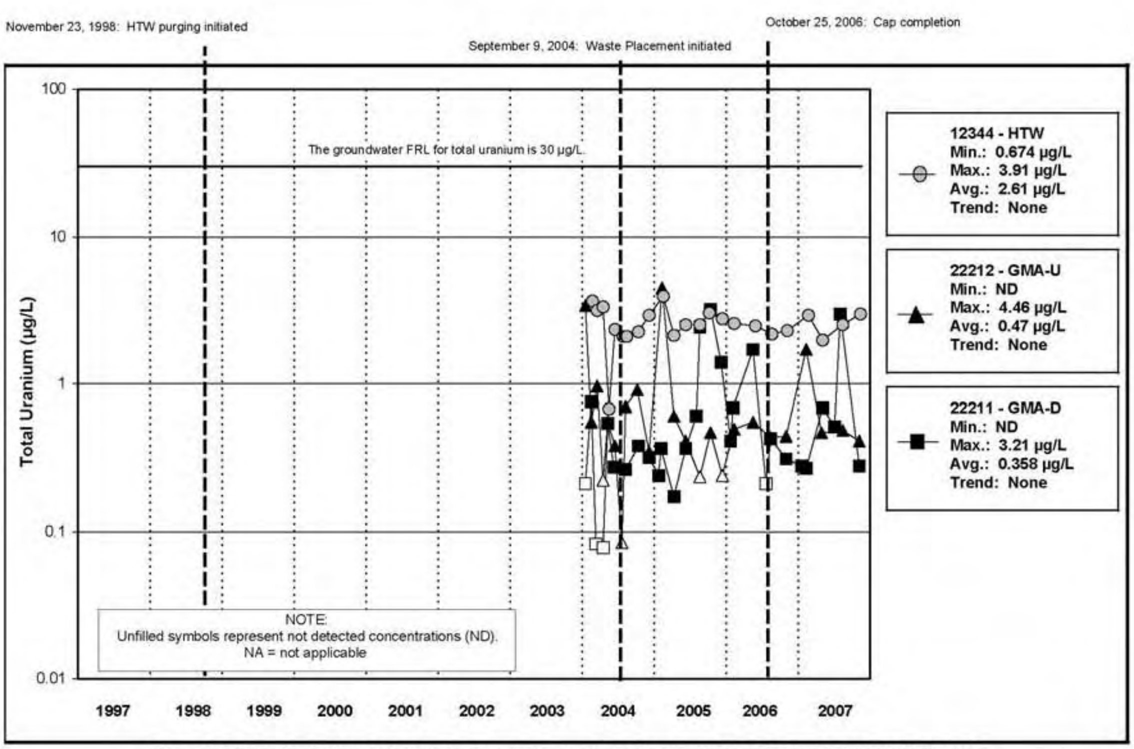


Figure A.5.7-6B. Cell 7 Total Uranium Concentration vs. Time Plot for HTW, GMA-U Well, AND GMA-D Well

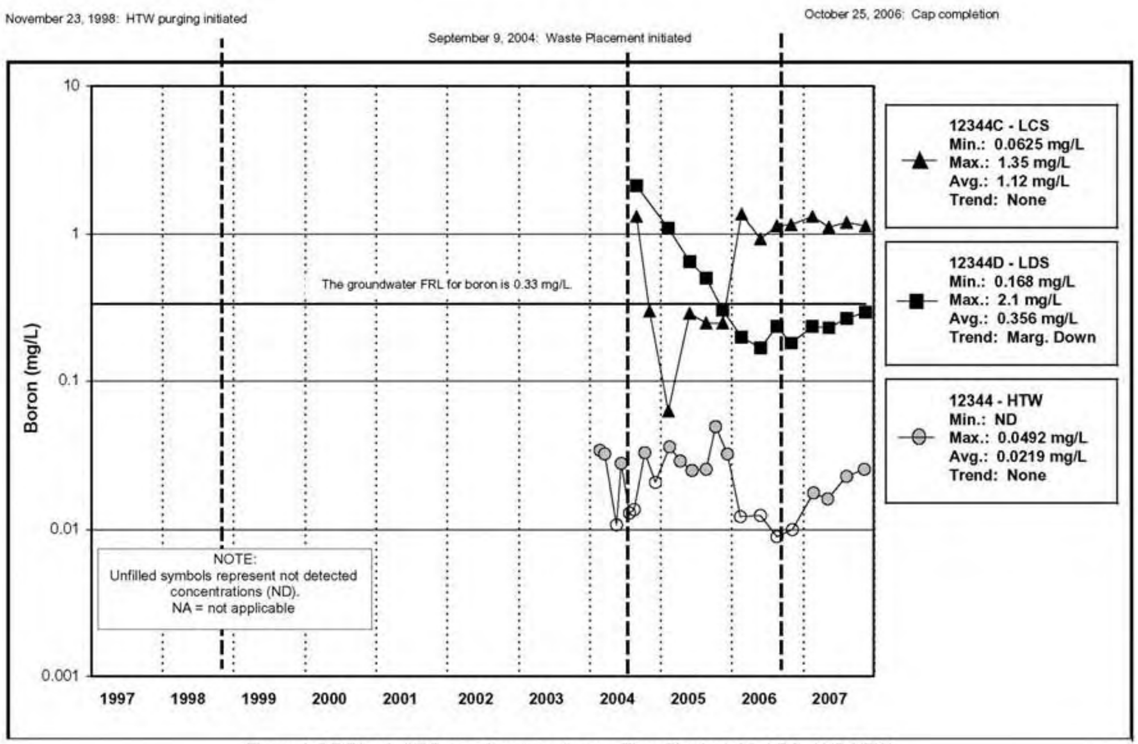


Figure A.5.7-7A. Cell 7 Boron Concentration vs. Time Plot for LCS, LDS, AND HTW

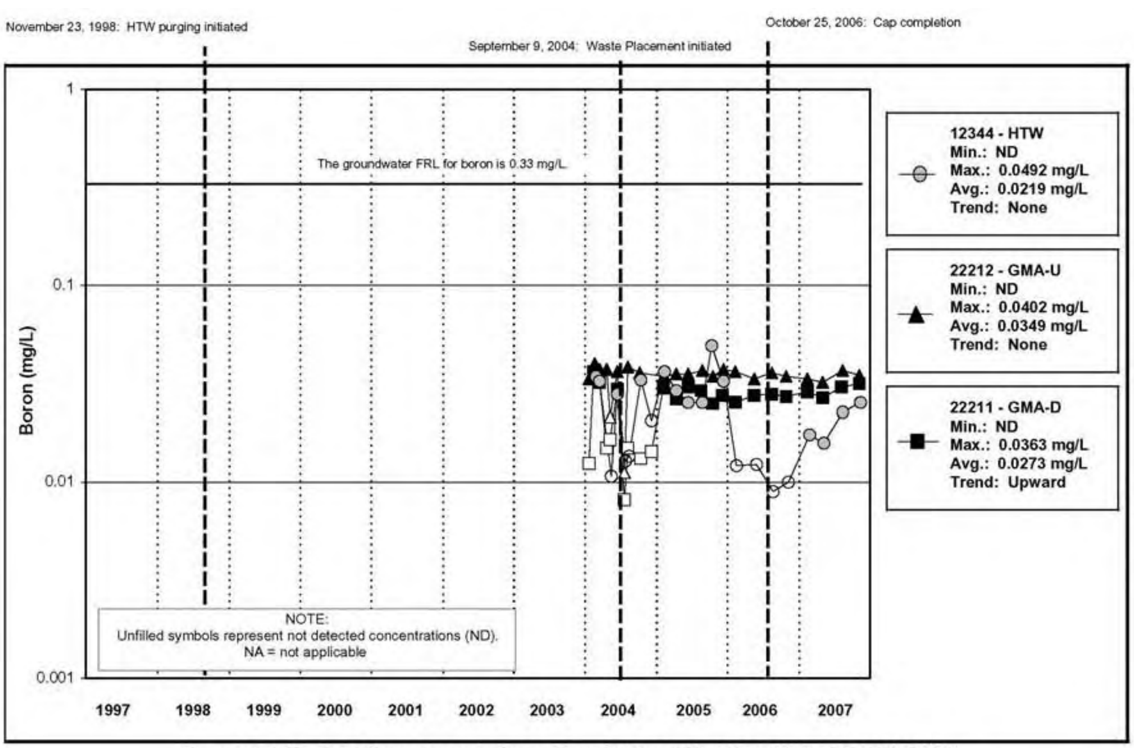


Figure A.5.7-7B. Cell 7 Boron Concentration vs. Time Plot for HTW, GMA-U Well, AND GMA-D Well

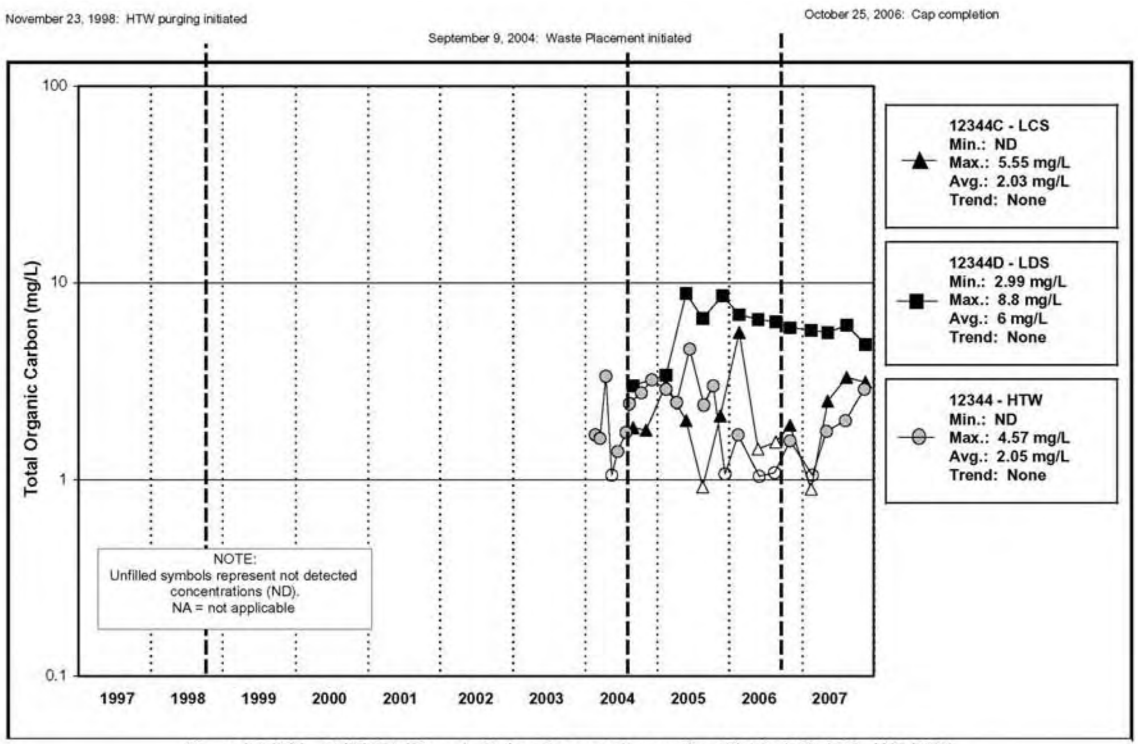


Figure A.5.7-8A. Cell 7 Total Organic Carbon Concentration vs. Time Plot for LCS, LDS, AND HTW

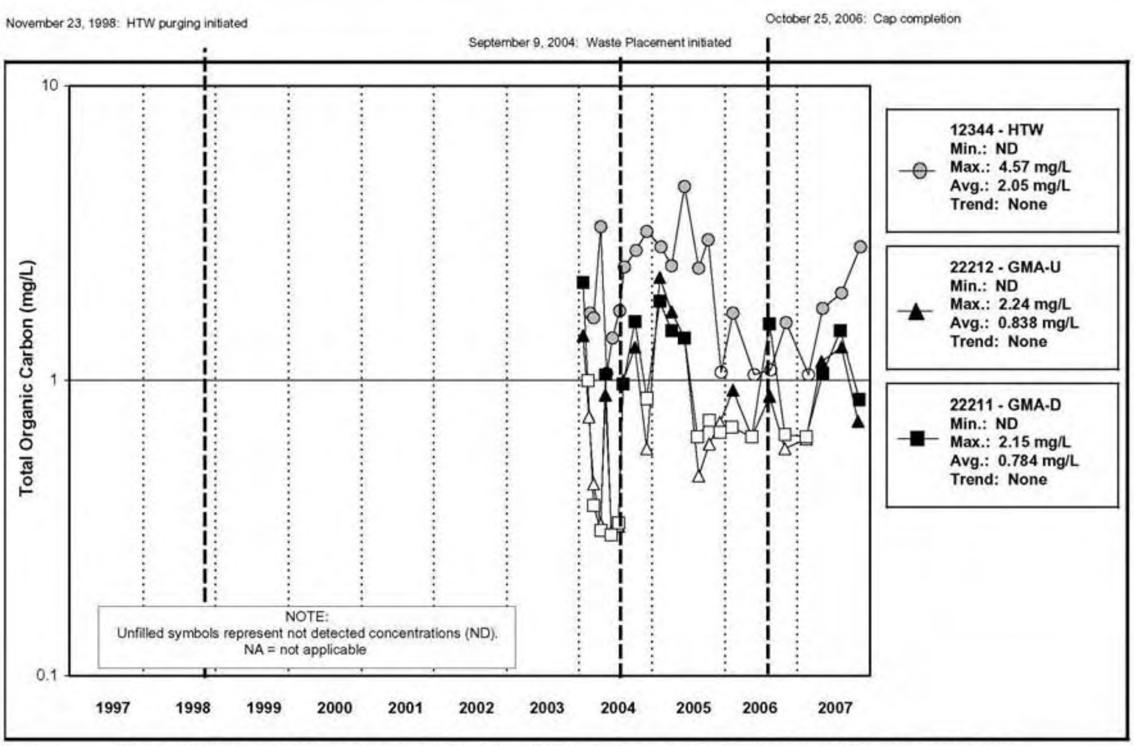


Figure A.5.7-8B. Cell 7 Total Organic Carbon Concentration vs. Time Plot for HTW, GMA-U Well, AND GMA-D Well

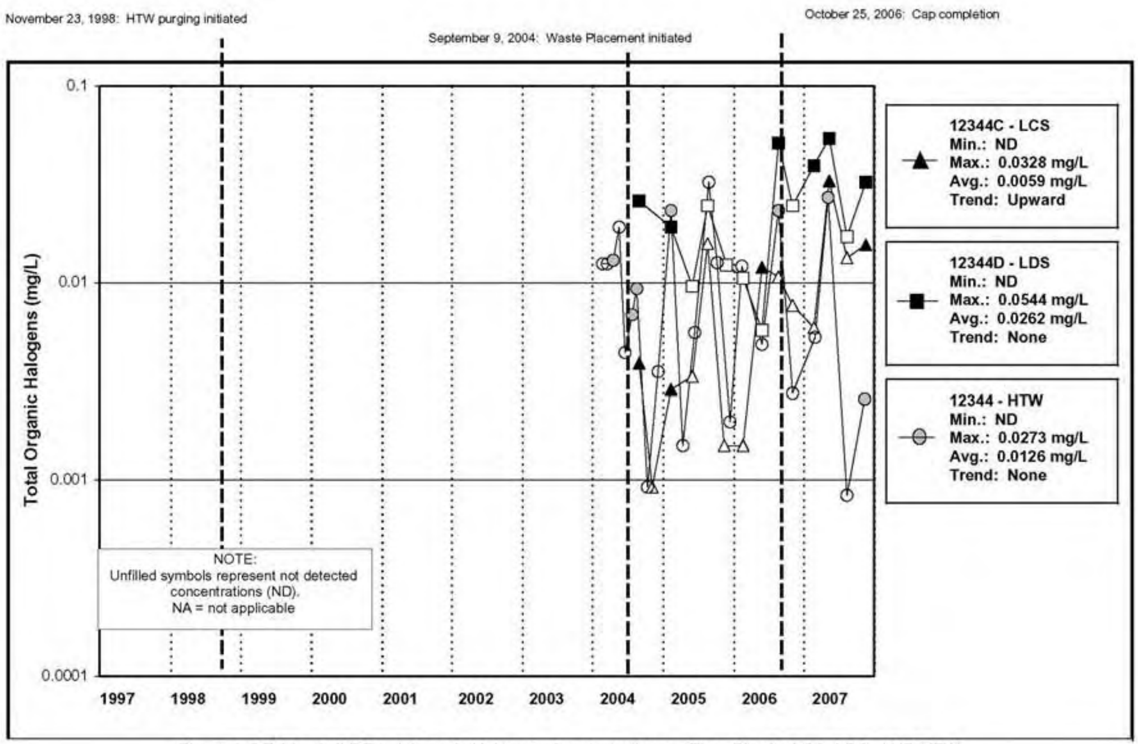


Figure A.5.7-9A. Cell 7 Total Organic Halogens Concentration vs. Time Plot for LCS, LDS, AND HTW

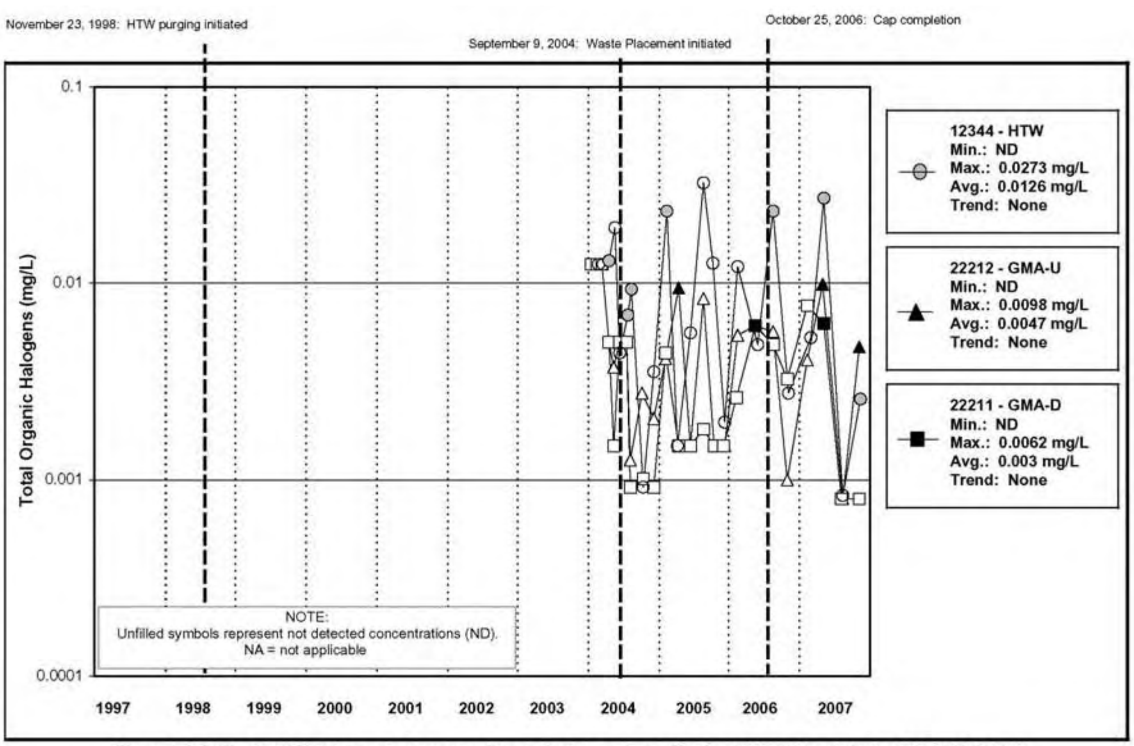


Figure A.5.7-9B. Cell 7 Total Organic Halogens Concentration vs. Time Plot for HTW, GMA-U Well, AND GMA-D Well

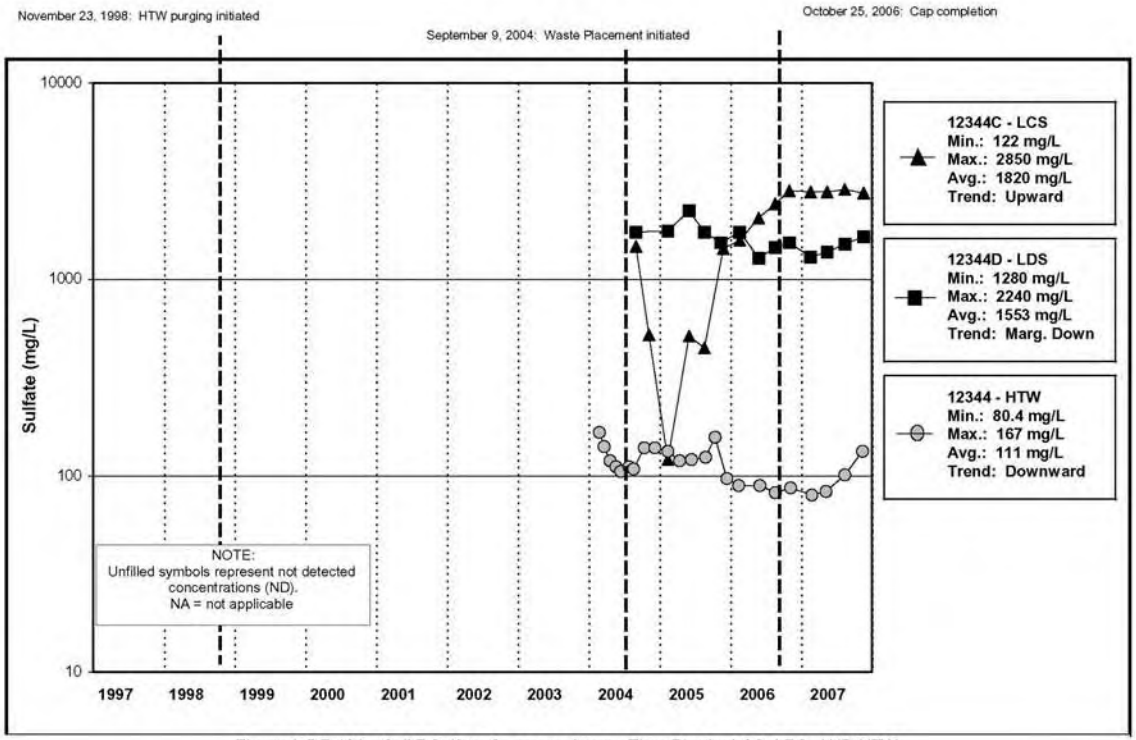


Figure A.5.7-10A. Cell 7 Sulfate Concentration vs. Time Plot for LCS, LDS, AND HTW

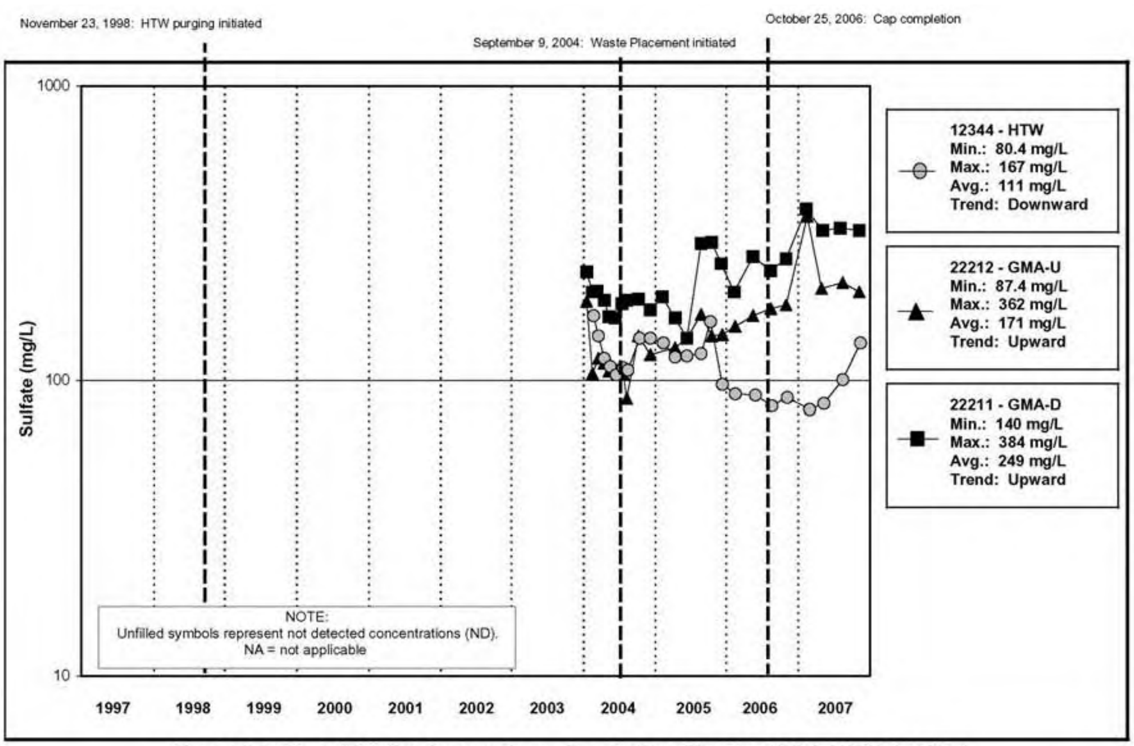


Figure A.5.7-10B. Cell 7 Sulfate Concentration vs. Time Plot for HTW, GMA-U Well, AND GMA-D Well

Sub-Attachment A.5.8

Cell 8

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The following information is provided in this sub-attachment:

- LCS monthly accumulation volumes (refer to Figure A.5.8−1)
- LDS monthly accumulation volumes (refer to Figure A.5.8−2)
- Monthly liner efficiencies (refer to Table A.5.8−1)
- HTW Water Yield (refer to Figure A.5.8−3)
- Great Miami Aquifer water levels and uranium concentrations versus time (refer to Figures A.5.8−4 and A.5.8−5)
- Summary of initial baseline constituents (refer to Section A.5.8.1 Table A.5.8−2)
- Summary statistics for potential refined baseline constituents (refer to Section A.5.8.1 and Table A.5.8−3)
- Concentration plots for refined baseline constituents (refer to Section A.5.8.1, and Figures A.5.8−6A through A.5.8−10B)
- Annual LCS monitoring results (refer to Section A.5.8.2, and Table A.5.8−4)
- Annual LDS monitoring results (refer to Section A.5.8.3).

Samples for the OSDF monitoring horizons were collected according to the frequencies described in the OSDF GWLMP. Constituent sampling lists are provided in Table 2−1, Table 2−2, and Table 2−3 of Appendix B of the OSDF GWLMP. In 2007, Cell 8 was sampled for initial baseline constituents, and all samples were collected from Cell 8 monitoring horizons.

A.5.8.1 Initial Baseline Monitoring Results

At the end of 2007, there were enough samples (more than 12 per horizon) to evaluate initial groundwater baseline conditions. Initial baseline constituents are listed in Table 2−1 of Appendix B of the OSDF GWLMP.

Table A.5.8−2 presents summary analytical information for Cell 8. The data presented in Table A.5.8−2 indicates that five initial baseline constituents have had greater than 25% detects in the Cell 8 LCS, LDS, HTW, and GMA wells. The five constituents are total uranium, boron, TOC, TOX, and sulfate. These are the same five constituents that are identified as refined baseline constituents in Cells 1 through 7. Based on the sampling results presented in table A.5.8−2, the monitoring approach for Cell 8 should be modified to be the same as the currently approved approach for Cells 1 through 7. The DOE would like to implement this monitoring change for Cell 8 in August 2008. Therefore, approval from EPA and OEPA is requested by July 2008.

A summary statistics table (refer to Table A.5.8−3) and concentration plots (Figures A.5.8−6A through A.5.8−10B) are provided for the five refined baseline constituents that have been identified for Cell 8.

A.5.8.2 LCS Sampling Results

During active operations (pre-closure) Ohio Solid Waste Regulations (OAC 3745-27-19(M)(5)) require collection and analysis of leachate annually for Appendix I and PCB constituents listed in OAC 3745-27-10. The objective of the annual LCS sampling is to determine whether the composition of the leachate within the facility is changing enough to impact monitoring activities beneath the facility. A list of annual LCS sampling constituents is provided in Table 2−2 of Appendix B of the OSDF GWLMP. In 2007, annual sampling of the Cell 8 LCS took place in May. Table A.5.8−4 summarizes the annual LCS sampling results for Cell 8, along with data collected in previous years.

Of the non refined baseline site-specific constituents that have been sampled at least eight times, eleven have been detected at least 25 percent of the time. Ten of the eleven constituents are common ion constituents (alkalinity, calcium, chloride, fluoride, iron, magnesium, manganese, nitrate/nitrite, potassium, and sodium). The remaining one (technetium-99) is a *potential* site-specific leak detection monitoring constituents for Cell 8.

Common Ions

A common ion study was completed in 2007, and a report, *Fernald Site, Evaluation of Aqueous Ions in the Monitoring Systems of the On-site Disposal Facility*, was issued in March 2008. This report is currently undergoing review by the EPA and OEPA.

As discussed in Section A.5.2.2, the common ion study concluded that fluid volume appears to be the key monitoring constituent to indicate the potential for leachate migration from the OSDF, and the sampling of and analysis for indicator ions are useful only if the hydraulic conditions permit leachate to migrate.

The common ion study also concluded that no one ion can serve as a leak indicator for all cells of the disposal facility, but useful indicator ions for specific target horizons of each cell can be identified. Specifically, uranium in the LDS and boron in the HTW were the only useful indicator constituents identified for the Cell 8 LDS and HTW, and that sufficient data exists to establish control charts for these two constituents at the same specified locations for Cell 8. In addition, no other useful common ion indicator constituents were found for Cell 8. Since uranium and boron are already included as refined baseline constituents for Cell 8, no additions to the refined baseline constituent list need to be made. Also, control charts will be included in future SERs for uranium in the Cell 8 LDS and boron in the Cell 8 HTW upon approval of the common ion study.

Potential Site-Specific Leak Detection Monitoring Constituents

The remaining constituent (considered to be a "*potential*" site-specific leak detection monitoring constituent for Cell 8) is technetium-99. This potential Cell 8 site-specific leak detection monitoring constituent will be assessed using the statistical approach presented in Figures A.5−4A and A.5−4B, and discussed in Section A.5.2.2, when 8 sampling rounds for the Cell 8 LCS have been completed. Eight sampling rounds will be completed for the Cell 8 LCS in 2011. Results of the assessment will be presented to the EPA and OEPA as soon as they are available and they will also be reported in the SER.

A.5.8.3 LDS Monitoring Results

Each year the LDS of Cell 8 is sampled for site-specific baseline constituents listed in Table 2−1 of Appendix B of the OSDF GWLMP. The objective of the annual LDS sampling is to determine if any baseline constituents, not on the refined baseline list, are present in the LDS. In 2007, annual sampling of the Cell 8 LDS took place in May.

Of the non-refined baseline constituents that have been sampled at least 8 times, 12 have been detected at least 25 percent of the time. All 12 of these constituents are common ion constituents (alkalinity, calcium, chloride, fluoride, iron, magnesium, manganese, nitrate/nitrite, phosphorous, potassium, silicon, and sodium).

Table A.5.8−1. Cell 8 – 2007 Monthly Liner Efficiencies

Month	**Cell 8 Apparent Liner Efficiency (%)**
January	81.32
February	85.21
March	86.62
April	86.95
May	88.33
June	89.19
July	90.05
August	90.23
September	92.57
October	91.84
November	94.86
December	93.91

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Table A.5.8−2. Cell 8 Data Summary For Constituents Detected Through 2007

Constituent (FRL)[a,b]	LCS [b,c,d] (12345C)		LDS [b,c,d] (12345D)		HTW [b,c,d] (12345)		Upgradient [b,c,d] (22213)		Downgradient [b,c,d] (22214)		Southwest [b,c,d,e] (22215)		Southeast [b,c,d,e,f] (22217)	
	No. of Samples with Detections No. of Samples	Range	No. of Samples with Detections No. of Samples	Range	No. of Samples with Detections No. of Samples	Range	No. of Samples with Detections No. of Samples	Range	No. of Samples with Detections No. of Samples	Range	No. of Samples with Detections No. of Samples	Range	No. of Samples with Detections No. of Samples	Range
Boron	13/13	0.0681 to 0.74	12/12	0.582 to 2.4	18/18	0.0683 to 0.101	20/23	ND to 0.0463	17/23	ND to 0.0393	13/14	ND to 0.0409	12/13	ND to 0.0329
(0.33 mg/L)	***4/4***	***0.541 to 0.72***	***4/4***	***0.582 to 0.906***	***4/4***	***0.0798 to 0.0926***	***4/4***	***0.0348 to 0.0463***	***4/4***	***0.0273 to 0.0393***	***5/5***	***0.0306 to 0.0409***	***6/6***	***0.0260 to 0.0329***
Trend	**Up, Significant**		Down, Significant		Down, Marginal		Up, Marginal		**Up, Significant**		**Up, Significant**		No Significant Trend	
Mercury	0/13	ND	0/12	ND	0/18	ND	2/23	ND to 0.000085	1/23	ND to 0.000085	1/14	ND to 0.00016	0/13	ND
(0.002 mg/L)	***0/4***	***ND***	***0/4***	***ND***	***0/4***	***ND***	***0/4***	***ND***	***0/4***	***ND***	***1/5***	***ND to 0.00016***	***0/6***	***ND***
Trend	No Significant Trend		No Significant Trend		No Significant Trend		No Significant Trend		No Significant Trend		No Significant Trend		No Significant Trend	
Sulfate	13/13	146 to 2340	13/13	1730 to 2870	18/18	92.4 to 152	23/23	84.4 to 266	23/23	177 to 348	13/14	ND to 145	13/13	163 to 1320
(N/A mg/L)	***4/4***	***2020 to 2340***	***4/4***	***2260 to 2630***	***4/4***	***121 to 140***	***4/4***	***164 to 266***	***4/4***	***290 to 348***	***5/5***	***94.1 to 145***	***6/6***	***190 to 1320***
Trend	**Up, Significant**		No Significant Trend		**Up, Significant**		**Up, Significant**		**Up, Significant**		Up, Marginal		No Significant Trend	
Technetium-99	9/13	ND to 101	2/12	ND to 2.29	0/18	ND	5/23	ND to 24.8	4/23	ND to 11.8	0/14	ND	2/13	ND to 8.9
(94 pCi/L)	***4/4***	***41.6 to 101***	***2/4***	***ND to 2.29***	***0/4***	***ND***	***1/4***	***ND to 1.2***	***1/4***	***ND to 3.38***	***0/5***	***ND***	***0/6***	***ND***
Trend	**Up, Significant**		No Significant Trend		No Significant Trend		Up, Marginal		No Significant Trend		Down, Marginal		Down, Significant	
Total Organic Carbon	10/13	ND to 5.31	11/12	ND to 5.45	9/18	ND to 3.12	14/23	ND to 3.77	13/23	ND to 3.28	6/14	ND to 1.42	7/13	ND to 1.88
(N/A mg/L)	***3/4***	***ND to 2.71***	***4/4***	***3.06 to 4.99***	***3/4***	***ND to 3.12***	***3/4***	***ND to 1.55***	***3/4***	***ND to 1.54***	***4/5***	***ND to 1.42***	***5/6***	***ND to 1.88***
Trend	No Significant Trend		**Up, Significant**		No Significant Trend		Down, Marginal		No Significant Trend		**Up, Significant**		**Up, Significant**	
Total Organic Halogens	3/13	ND to 0.0593	4/12	ND to 0.0794	12/18	ND to 0.0947	2/23	ND to 0.0231	3/23	ND to 0.00954	3/14	ND to 0.0238	4/13	ND to 0.0216
(N/A mg/L)	***1/4***	***ND to 0.0593***	***1/4***	***ND to 0.030***	***4/4***	***0.0441 to 0.0645***	***1/4***	***ND to 0.0231***	***1/4***	***ND to 0.00954***	***2/5***	***ND to 0.0238***	***3/6***	***ND to 0.0216***
Trend	**Up, Significant**		No Significant Trend		No Significant Trend		No Significant Trend		No Significant Trend		No Significant Trend		No Significant Trend	
Uranium, Total	13/13	1.51 to 221	12/12	9.38 to 36.4	18/18	3.48 to 6.2	13/23	ND to 0.47	25/28	ND to 1.53	10/14	ND to 0.625	12/13	ND to 11.8
(30 ug/L)	***4/4***	***176 to 221***	***4/4***	***28.2 to 36.4***	***4/4***	***4.5 to 6.2***	***4/4***	***0.34 to 0.47***	***6/6***	***0.24 to 1.3***	***5/5***	***0.41 to 0.54***	***6/6***	***0.88 to 11.8***
Trend	**Up, Significant**		**Up, Significant**		No Significant Trend		**Up, Significant**		No Significant Trend		No Significant Trend		**Up, Significant**	
Tetrachloroethene	3/13	ND to 1.24	0/12	ND	0/18	ND	0/23	ND	0/23	ND	0/14	ND	0/13	ND
(NA ug/L)	***2/4***	***ND to 0.778***	***0/4***	***ND***	***0/4***	***ND***	***0/4***	***ND***	***0/4***	***ND***	***0/5***	***ND***	***0/6***	***ND***
Trend	No Significant Trend		Down, Significant		Down, Significant		Down, Significant		Down, Significant		Down, Significant		Down, Significant	
Trichloroethene	3/13	ND to 1.11	0/12	ND	0/18	ND	0/23	ND	0/23	ND	0/14	ND	0/13	ND
(NA ug/L)	***2/4***	***ND to 0.404***	***0/4***	***ND***	***0/4***	***ND***	***0/4***	***ND***	***0/4***	***ND***	***0/5***	***ND***	***0/6***	***ND***
Trend	Down, Significant		Down, Significant		Down, Significant		Down, Significant		Down, Significant		Down, Significant		Down, Significant	

Note: Non-italicized pertains to total number of samples. ***Italicized/bold*** pertains to samples collected in 2007 only. ***Italicized/bold/larger font size*** pertains to new maximums.

Note: Shading indicates at least 25% detections for that constituent at that location.

[a]From Operable Unit 5 Record of Decision, Table 9-4.

[b]NA = not applicable; ND = not detected; LCS = leachate collection system; LDS = leak detection system; HTW = horizontal till well

[c]If there was more than one sample result per day (e.g., a duplicate sample), only the maximum sample concentration was counted and compared to the FRL.

[d]Rejected data qualified with either an R or Z were not used in this comparison.

[e]Southwest (22215) and Southeast (22217) Great Maimi Aquifer wells close-out the south side of the OSDF.

[f]Southeast (22217) also includes some data from its replacement well (22216), which was plugged and abandoned on April 12, 2006.

Table A.5.8−3. Summary Statistics For Cell 8

Note: The data used in this table have been standardized to quarterly.

Parameter	Horizon[a]	Monitoring Location	No. of Detected Samples	Total No. of Samples	Percent of Detects	Average[b]	Distribution Type[c]	Trend[d]	Serial Correlation[e]	Outliers[f,g]
Total Uranium (µg/L)	LCS	12345C	13	13	100	130	Normal	Up	Detected	
	LDS	12345D	12	12	100	21.6	Lognormal	Up	Detected	
	HTW	12345	14	14	100	4.76	Lognormal	None	Not Detected	
	GMA-U	22213	11	16	68.8	0.296	Normal	Up	Marg. Detect	
	GMA-D	22214	13	16	81.3	0.680	Undefined	None	Not Detected	
	GMA-SW	22215	8	10	80	0.438	Undefined	None	Not Detected	
	GMA-SE	22217[h]	8	9	88.9	5.69	Lognormal	Up	Insuff. Data	
Boron (mg/L)	LCS	12345C	13	13	100	0.419	Normal	Up	Detected	
	LDS	12345D	12	12	100	1.23	Lognormal	Down	Detected	
	HTW	12345	14	14	100	0.0831	Normal	None	Not Detected	
	GMA-U	22213	14	14	100	0.0349	Undefined	None	Not Detected	0.02598 (Q4-04) 0.0463 (Q4-07)
	GMA-D	22214	15	16	93.8	0.0278	Normal	Marg. Up	Detected	
	GMA-SW	22215	9	9	100	0.0309	Normal	None	Insuff. Data	0.0409 (Q4-07)
	GMA-SE	22217[h]	9	9	100	0.0283	Lognormal	None	Insuff. Data	
Total Organic Carbon (mg/L)	LCS	12345C	9	12	75	2.13	Lognormal	None	Not Detected	5.31 (Q4-04)
	LDS	12345D	11	12	91.7	3.57	Normal	Up	Detected	
	HTW	12345	7	13	53.8	1.46	Lognormal	None	Not Detected	3.12 (Q3-07)
	GMA-U	22213	11	16	68.8	1.02	Lognormal	Down	Not Detected	
	GMA-D	22214	10	16	62.5	1.06	Lognormal	Marg. Down	Not Detected	
	GMA-SW	22215	5	10	50	0.715	Undefined	None	Not Detected	
	GMA-SE	22217[h]	5	9	55.6	0.980	Undefined	Up	Insuff. Data	
Total Organic Halogens (mg/L)	LCS	12345C	2	12	16.7	0.00216	Undefined	Up	Marg. Detect	0.0593 (Q2-07)
	LDS	12345D	3	11	27.3	0.00665	Undefined	None	Not Detected	0.0794 (Q4-05)
	HTW	12345	10	14	71.4	0.0479	Normal	None	Detected	
	GMA-U	22213	1	15	6.7	0.00167	Undefined	None	Not Detected	0.0231 (Q2-07)
	GMA-D	22214	3	16	18.8	0.00327	Undefined	None	Not Detected	
	GMA-SW	22215	2	10	20	0.00393	Undefined	None	Marg. Detect	
	GMA-SE	22217[h]	3	9	33.3	0.00354	Undefined	None	Insuff. Data	
Sulfate (mg/L)	LCS	12345C	13	13	100	1360	Lognormal	Up	Detected	
	LDS	12345D	12	12	100	2350	Normal	None	Not Detected	
	HTW	12345	14	14	100	115	Lognormal	Marg. Up	Detected	
	GMA-U	22213	16	16	100	136	Lognormal	Up	Detected	
	GMA-D	22214	16	16	100	250	Lognormal	Up	Detected	
	GMA-SW	22215	9	9	100	107	Lognormal	None	Insuff. Data	46.2 (Q1-06)
	GMA-SE	22217[h]	8	8	100	259	Lognormal	None	Insuff. Data	1320 (Q1-07)

[a]LCS = leachate collection system; LDS = leak detection system; HTW = horizontal till well; GMA-U = upgradient Great Miami Aquifer; and GMA-D = downgradient Great Miami Aquifer

[b]Averages were determined based on the distribution assumption. "Approx. Normal" was treated as if it was normal, and "Approx. Lognormal" was treated as if it was lognormal. This was done to compensate for the skewed (lognormal) or non-skewed (normal) nature of the data to give a better estimate of the underlying average.

[c]Data distribution based on the Shapiro-Wilk statistic.

Normal: Normal assumption could not be rejected at the 5 percent level and has a higher probability value than the lognormal assumption.

Lognormal: Lognormal assumption could not be rejected at the 5 percent level and has a higher probability value than the normal assumption.

Approx. Normal (Approximately Normal): Normal and lognormal assumptions were rejected at the 5 percent level. However, the normal assumption was not rejected at the 10 % level. Additionally, for cases where neither assumption was rejected at the 10% level, the data fit the normal destribution better than the lognormal distribution.

Approx. Lognormal (Approximately Lognormal): Normal and lognormal assumptions were rejected at the 5 percent level. However, the lognormal assumption was not rejected at the 10 % level. Additionally, for cases where neither assumption was rejected at the 10% level, the data fit the lognormal destribution better than the normal distribution.

Undefined: Normal and Lognormal Distribution assumptiions are both rejected or there are less than 25% detected values. "Average" is defined as the Median of the data.

[d]Trend based on nonparametric Mann-Kendall procedure. Note that "Marg. Down" is a marginally downward trend and "Marg. Up" is a marginally upward trend.

[e]Serial correlation based on Rank Von Neumann test. Note that "Insuff." = Insufficient.

[f]Outliers determined by Rosner's (for sample sizes greater than 25) or Dixon procedure (for sample sizes less than or equal to 25).

[g]Q = quarterly

[h]Monitoring Location 22216 was plugged and abandoned in April 2006. Monitoring Location 22217 is its replacement. The results listed for Location 22217 also include the results for Location 22216.

Table A.5.8−4. Cell 8 Annual LCS Sample Summary

PARAMETER (UNIT)	NUMBER OF SAMPLES[a,b]	NUMBER OF SAMPLES WITH DETECTIONS[a,b]	PERCENT OF DETECTIONS[a,b]	MIN DETECTED CONCENTRATION[a,b,c]	MAX DETECTED CONCENTRATION[a,b,c]	AVG DETECTED CONCENTRATION[a,b,c]	GW FRL[d] (# OF SAMPLES>GWFRL)	GW BACKGROUND[a,b,e] (# OF SAMPLES>PW BACKGROUND)	PW BACKGROUND[a,b,e] (# OF SAMPLES>PW BACKGROUND)	MAX PW DETECTED CONCENTRATION [a,b,f] (# OF SAMPLES>MAX PW)	DETECTION LIMIT
Alkalinity as CaCO3 (mg/L)	10	10	100%	64.9	418	220	-	422 mg/L(0)	430 mg/L(0)	-	10 mg/L
Aroclor-1260 (µg/L)	4	1	25%	0.058	-	-	-	-	-	-	0.1 µg/L
Barium (mg/L)	4	4	100%	0.0331	0.103	0.0628	2 mg/L(0)	0.77 mg/L(0)	0.45 mg/L(0)	0.589 mg/L(0)	0.029 mg/L
Calcium (mg/L)	8	8	100%	65.4	550	273	-	159 mg/L(6)	172 mg/L(5)	1800 mg/L(0)	5 mg/L
Chloride (mg/L)	10	10	100%	18.9	235	107	-	7.3 mg/L(10)	45 mg/L(7)	6300 mg/L(0)	5 mg/L
Chromium (mg/L)	4	1	25%	0.0269	-	-	0.022 mg/L[g](1)	0.021 mg/L(1)	0.0046 mg/L(1)	0.818 mg/L(0)	0.005 mg/L
Cobalt (mg/L)	4	3	75%	0.00067	0.0019	0.0011	0.17 mg/L(0)	0.0086 mg/L(0)	-	0.0886 mg/L(0)	0.034 mg/L
Copper (mg/L)	4	3	75%	0.0035	0.0181	0.0089	1.3 mg/L(0)	0.035 mg/L(0)	0.029 mg/L(0)	0.298 mg/L(0)	0.008 mg/L
Fluoride (mg/L)	9	9	100%	0.105	0.519	0.327	4 mg/L(0)	0.89 mg/L(0)	1.3 mg/L(0)	6.8 mg/L(0)	0.2 mg/L
Iron (mg/L)	8	8	100%	0.0465	2.09	1.34	-	5.72 mg/L(0)	6.35 mg/L(0)	21.3 mg/L(0)	0.1 mg/L
Magnesium (mg/L)	8	8	100%	21.9	351	139	-	38.5 mg/L(7)	50.7 mg/L(5)	690 mg/L(0)	5 mg/L
Manganese (mg/L)	8	7	87.50%	0.0122	0.17	0.059	0.9 mg/L(0)	0.9 mg/L(0)	0.21 mg/L(0)	35 mg/L(0)	0.09 mg/L
Nickel (mg/L)	4	4	100%	0.0049	0.0155	0.0093	0.1 mg/L(0)	0.0514 mg/L(0)	0.0072 mg/L(3)	0.981 mg/L(0)	0.02 mg/L
Nitrate/Nitrite (mg/L)	10	9	90%	1.52	74.6	30.1	11 mg/L[g](5)	11 mg/L(5)	0.29 mg/L(9)	2670 mg/L(0)	1.1 mg/L
Phosphorus (mg/L)	7	2	28.60%	0.0511	0.103	0.0771	-	-	-	-	0.1 mg/L
Potassium (mg/L)	8	8	100%	4.86	26.3	14.5	-	1.96 mg/L(8)	17.2 mg/L(2)	12400 mg/L(0)	5 mg/L
Silicon (mg/L)	7	7	100%	1.76	12.4	4.95	-	-	-	15 mg/L(0)	0.015 mg/L
Sodium (mg/L)	8	8	100%	16.8	95.9	44.2	-	47.1 mg/L(2)	50 mg/L(2)	1300 mg/L(0)	5 mg/L
Technetium-99 (pCi/L)	13	9	69.20%	8.39	101	53.8	94 pCi/L(1)	22 pCi/L(7)	30 pCi/L(7)	6130 pCi/L(0)	10 pCi/L
Tetrachloroethene (µg/L)	13	3	23.10%	0.475	1.24	0.831	-	-	-	-	1 µg/L
Thallium (mg/L)	4	1	25%	0.00057	-	-	-	-	-	0.0028 mg/L(0)	0.02 mg/L
TDS (mg/L)	4	4	100%	882	4210	2090	-	-	-	-	10 mg/L
Trichloroethene (µg/L)	13	3	23.10%	0.246	1.11	0.587	5 µg/L(0)	-	-	-	1 µg/L
Vanadium (mg/L)	4	1	25%	0.016	-	-	0.038 mg/L(0)	0.012 mg/L(1)	0.005 mg/L(1)	0.299 mg/L(0)	0.02 mg/L
Zinc (mg/L)	4	2	50%	0.013	0.0138	0.0134	0.021 mg/L(0)	0.02 mg/L(0)	0.35 mg/L(0)	1.78 mg/L(0)	0.015 mg/L

Note: Shading indicates that at least one detected sample is greater than the FRL, groundwater background, PW background, or PW maximum.

[a]If more than one sample is collected per well per day (e.g., duplicates), then only one sample is counted for the total number of samples, and the sample with the maximum representative concentration is used for all the summary information

[b]Rejected data qualified with an R or Z were not included.

[c]If the number of detected samples is equal to two, then the minimum and maximum are reported. If the number of detected is equal to one, then the data point is reported as the minimum. The "AVG DETECTED CONCENTRATION" is not reported for either of these cases.

[d]From Operable Unit 5 Record of Decision, Table 9-4.

[e]From the Characterization of Background Water Quality for Streams and Groundwater which was developed for Operable Unit 5 RI/FS documents.

[f]Max PW - maximum detected concentration in perched water as defined in the Remedial Investigation Report for Operable Unit 5.

[g]FRL based on hexavalent chromium and nitrate, from Operable Unit 5 Record of Decision, Table 9-4.

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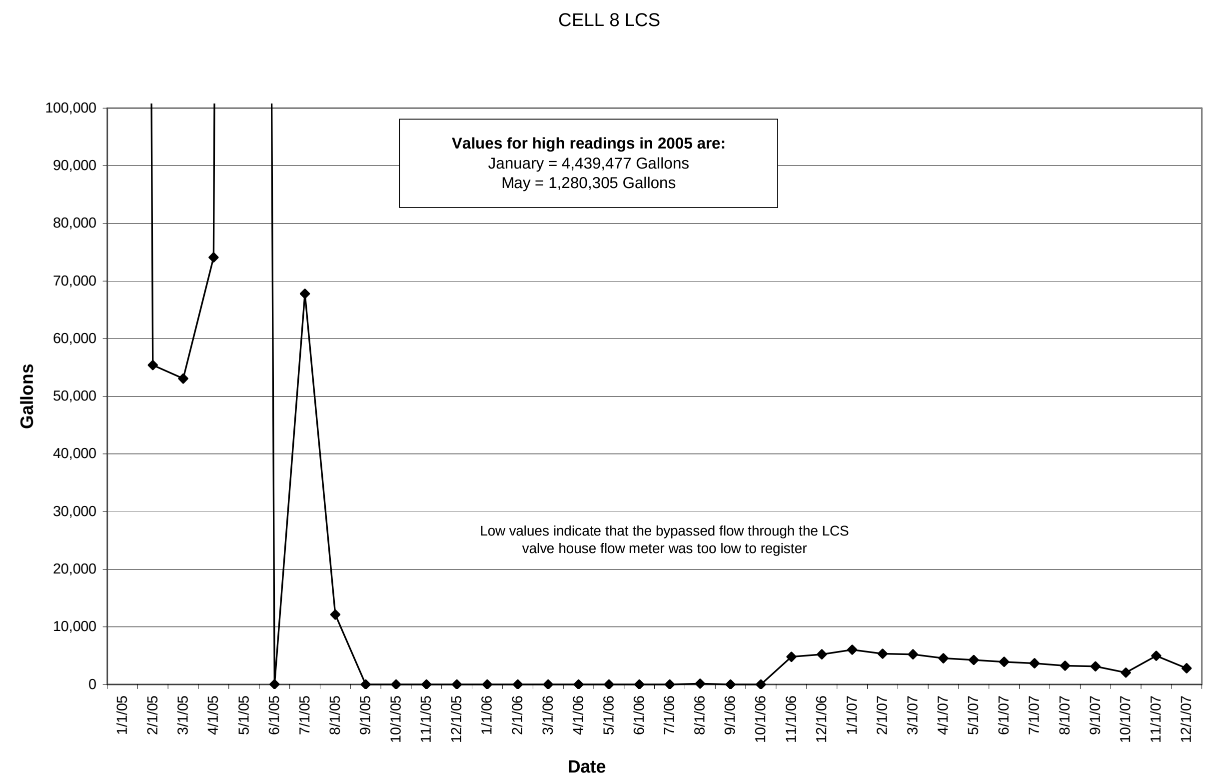


FIGURE A.5.8-1. MONTHLY ACCUMULATION VOLUMES FOR CELL 8 LCS

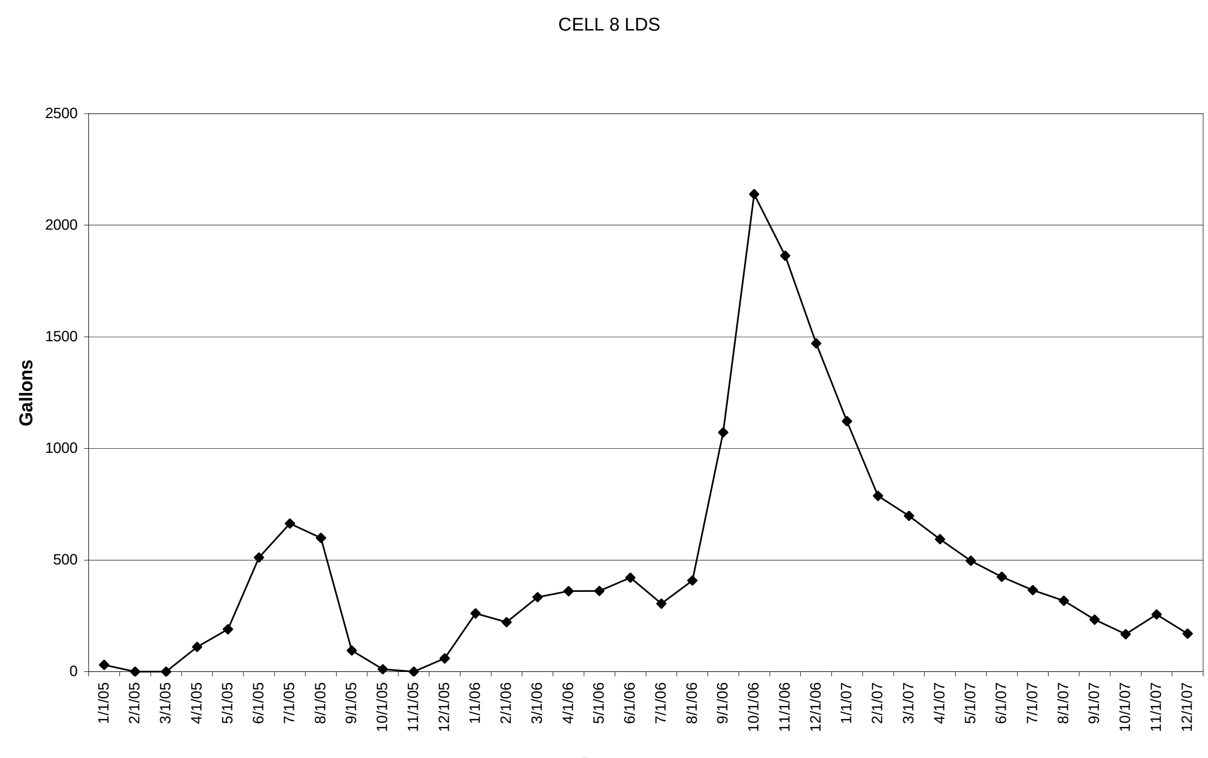
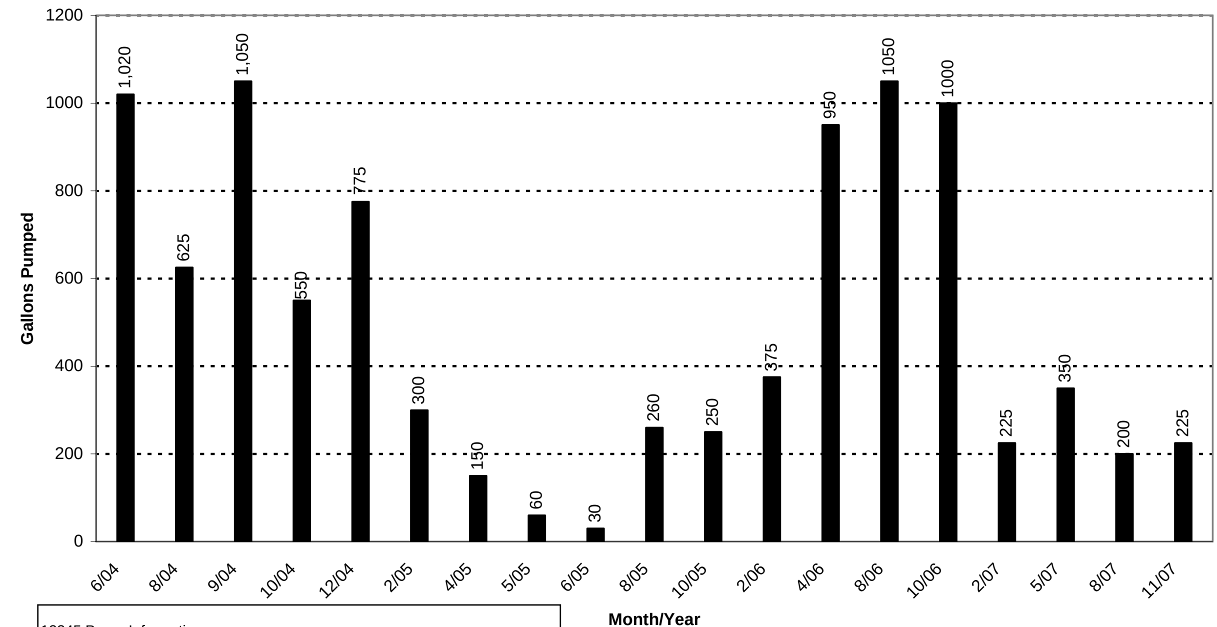


FIGURE A.5.8-2. MONTHLY ACCUMULATION VOLUMES FOR CELL 8 LDS



12345 Purge Information

Year	Total Volumes (gal.)	Months Purged	Avg. Monthly Purge (gal.)
2004:	4020	n=5	804
2005:	1050	n=6	175
2006:	3375	n=4	844
2007:	1000	n=4	250
Overall:			497

FIGURE A.5.8-3. OSDF HORIZONTAL TILL WELL 12345 (CELL 8) WATER YIELD

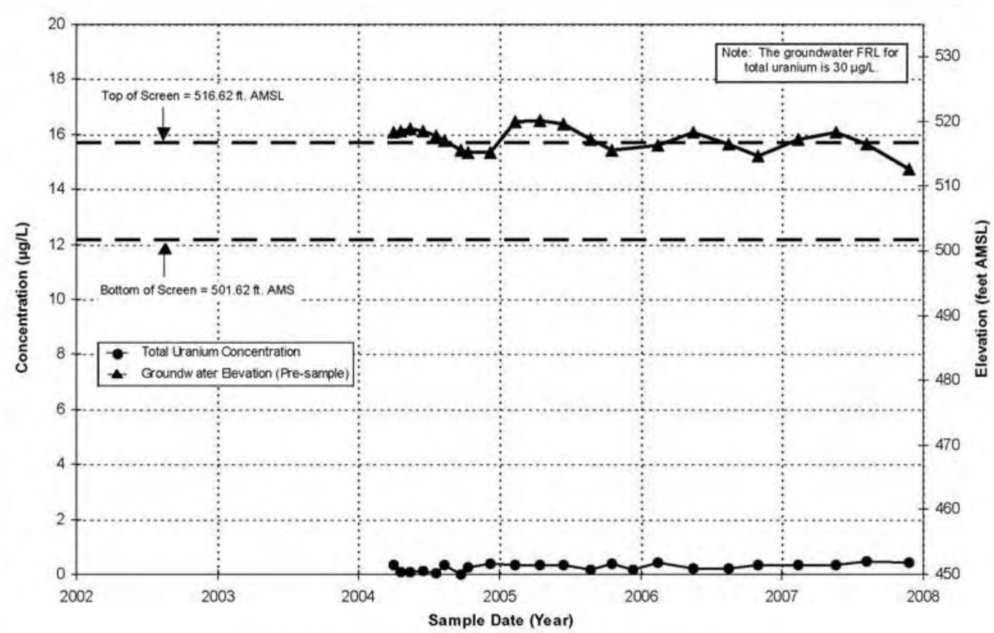


Figure A.5.8-4. Total Uranium Concentration and Groundwater Elevation vs. Time Plot for Cell 8 Upgradient Monitoring Well 22213

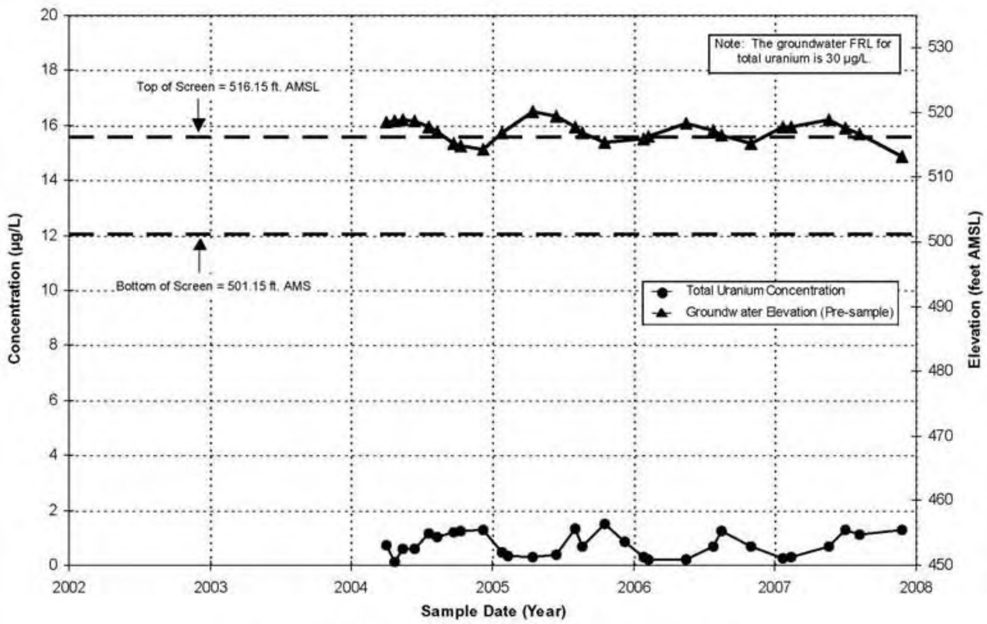


Figure A.5.8-5. Total Uranium Concentration and Groundwater Elevation vs. Time Plot for Cell 8 Downgradient Monitoring Well 22214

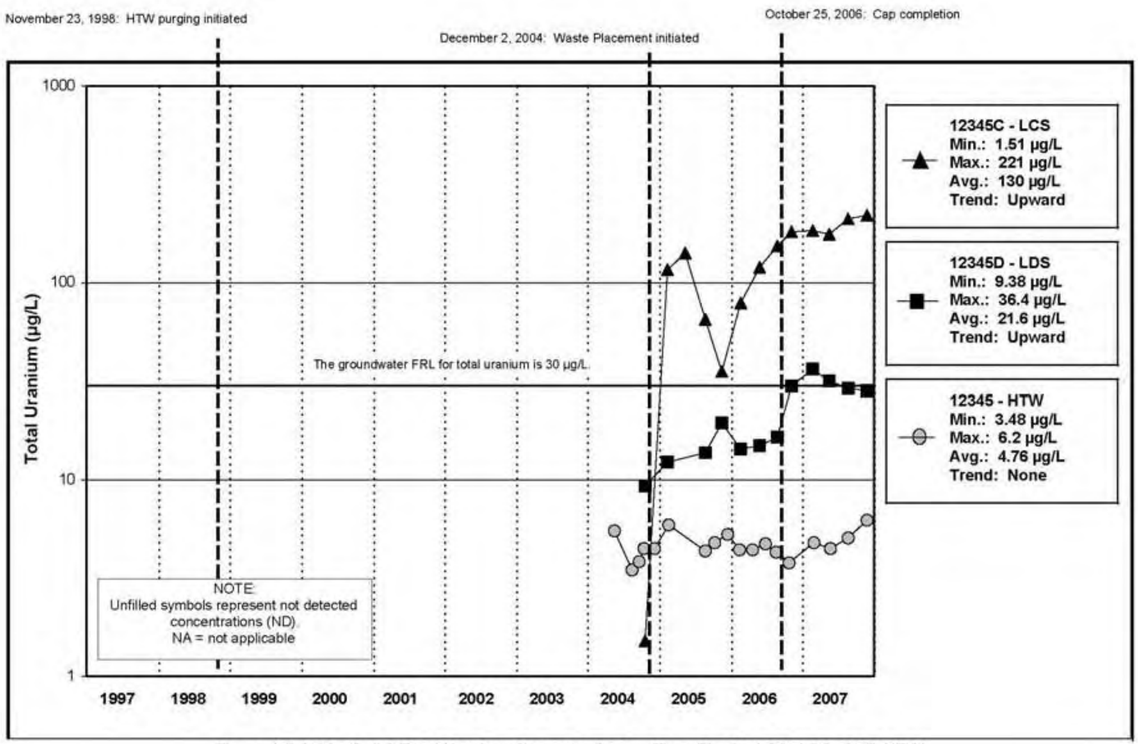


Figure A.5.8-6A. Cell 8 Total Uranium Concentration vs. Time Plot for LCS, LDS, AND HTW

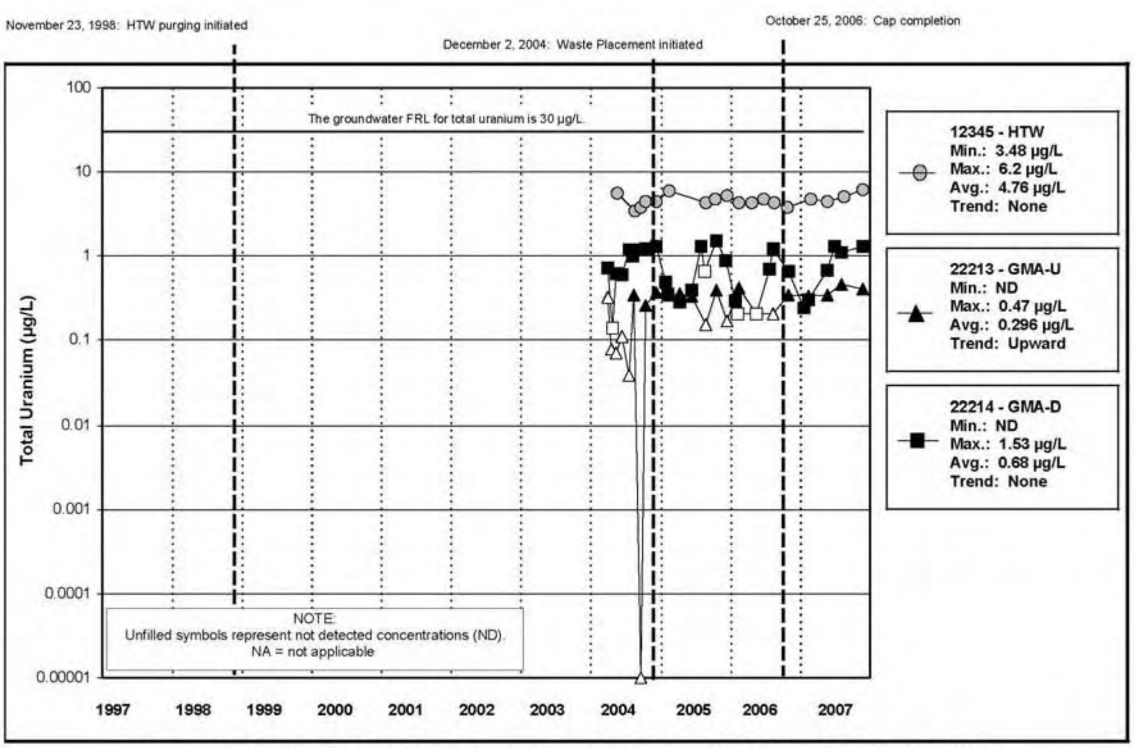


Figure A.5.8-6B. Cell 8 Total Uranium Concentration vs. Time Plot for HTW, GMA-U Well, AND GMA-D Well

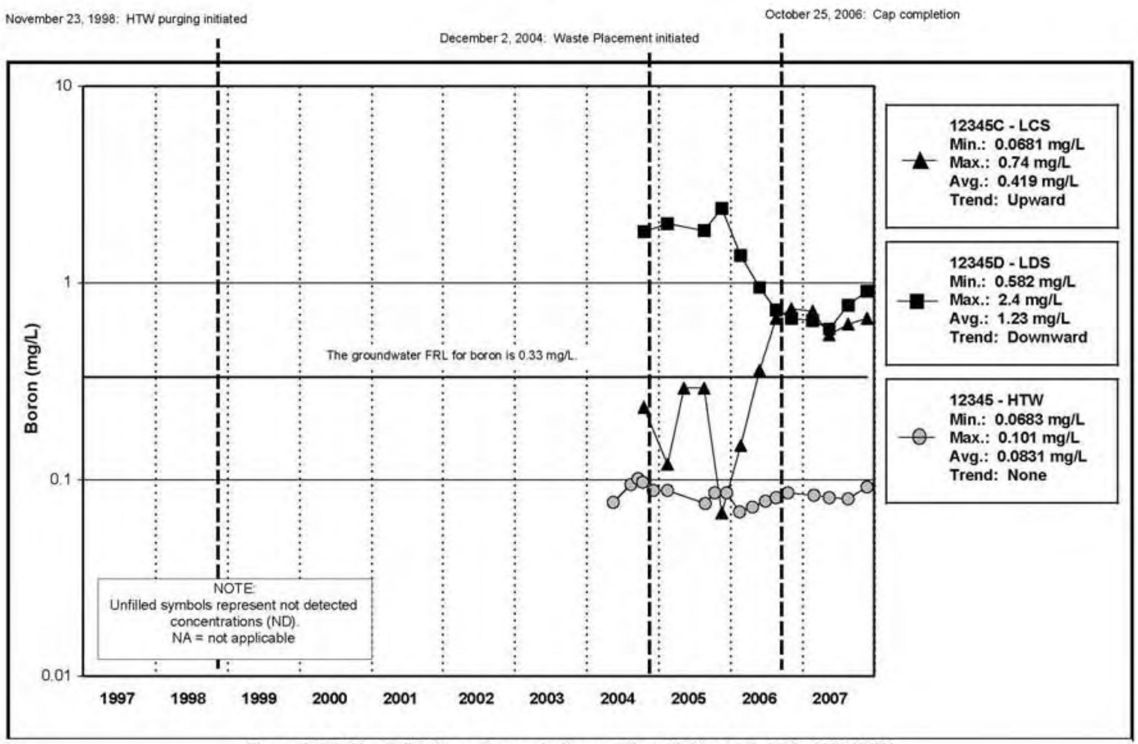


Figure A.5.8-7A. Cell 8 Boron Concentration vs. Time Plot for LCS, LDS, AND HTW

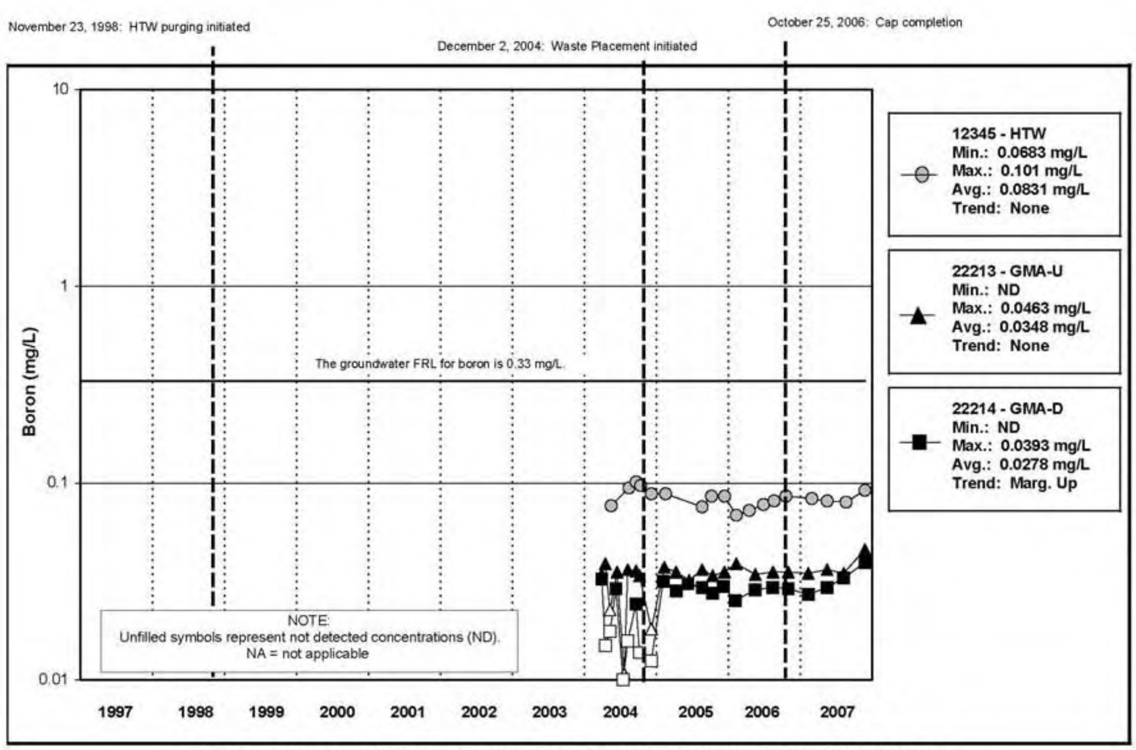


Figure A.5.8-7B. Cell 8 Boron Concentration vs. Time Plot for HTW, GMA-U Well, AND GMA-D Well

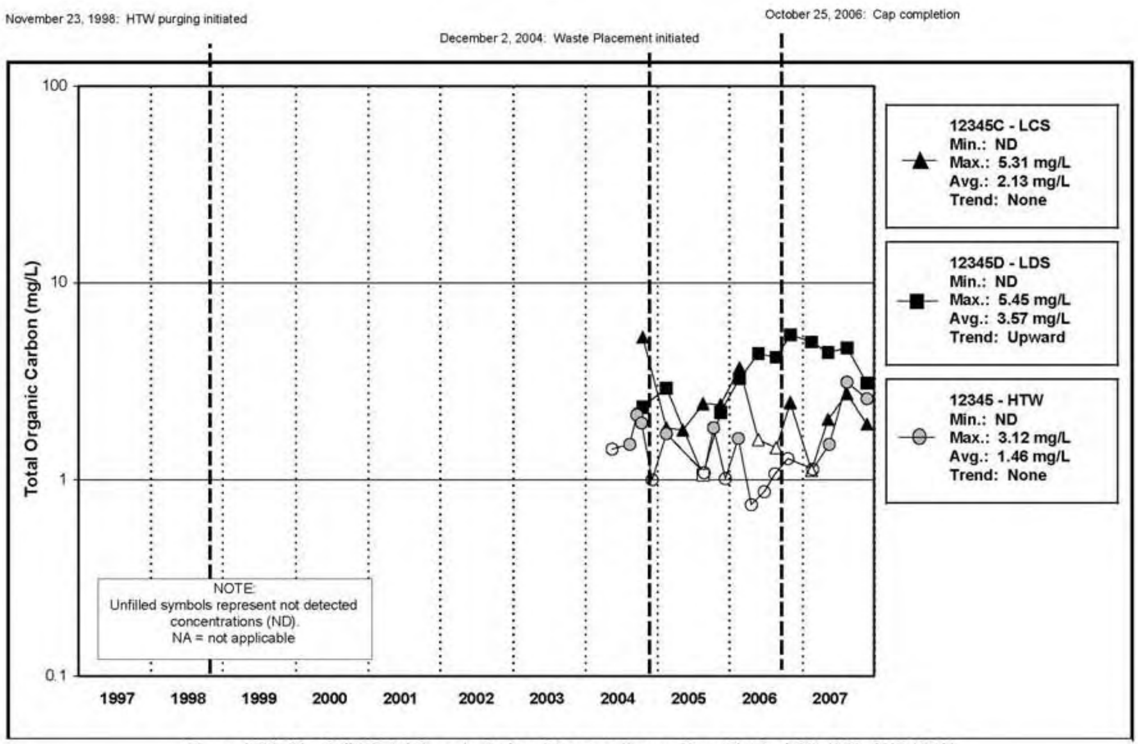


Figure A.5.8-8A. Cell 8 Total Organic Carbon Concentration vs. Time Plot for LCS, LDS, AND HTW

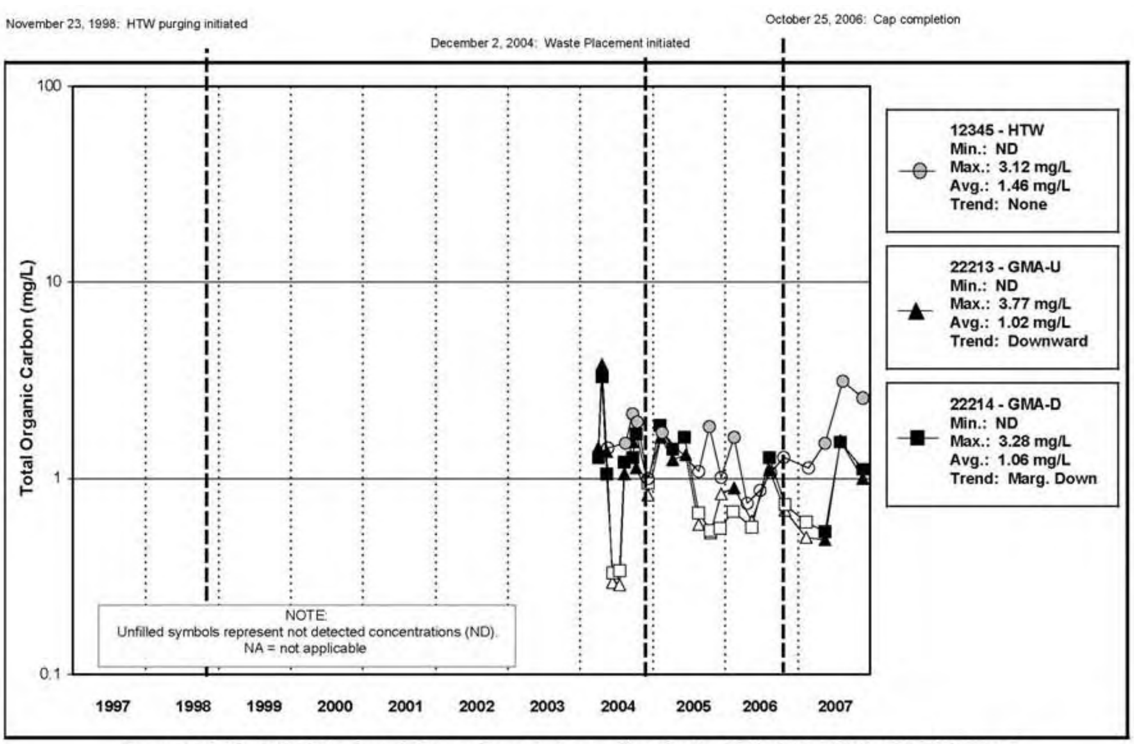


Figure A.5.8-8B. Cell 8 Total Organic Carbon Concentration vs. Time Plot for HTW, GMA-U Well, AND GMA-D Well

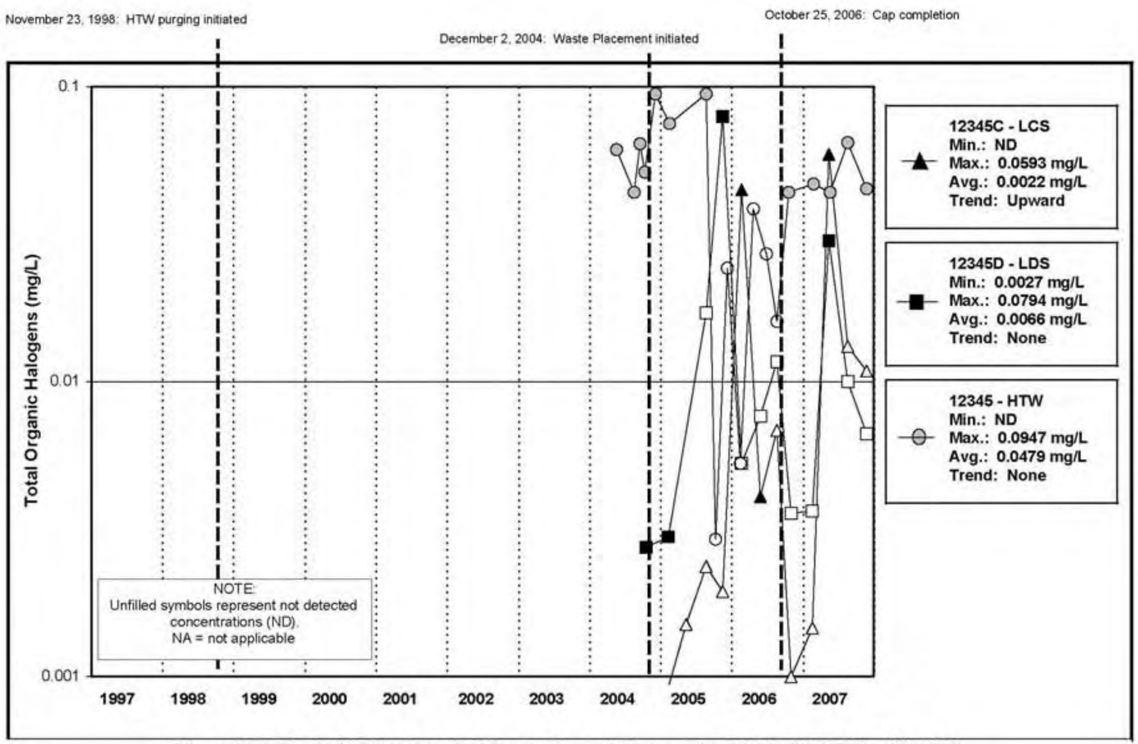


Figure A.5.8-9A. Cell 8 Total Organic Halogens Concentration vs. Time Plot for LCS, LDS, AND HTW

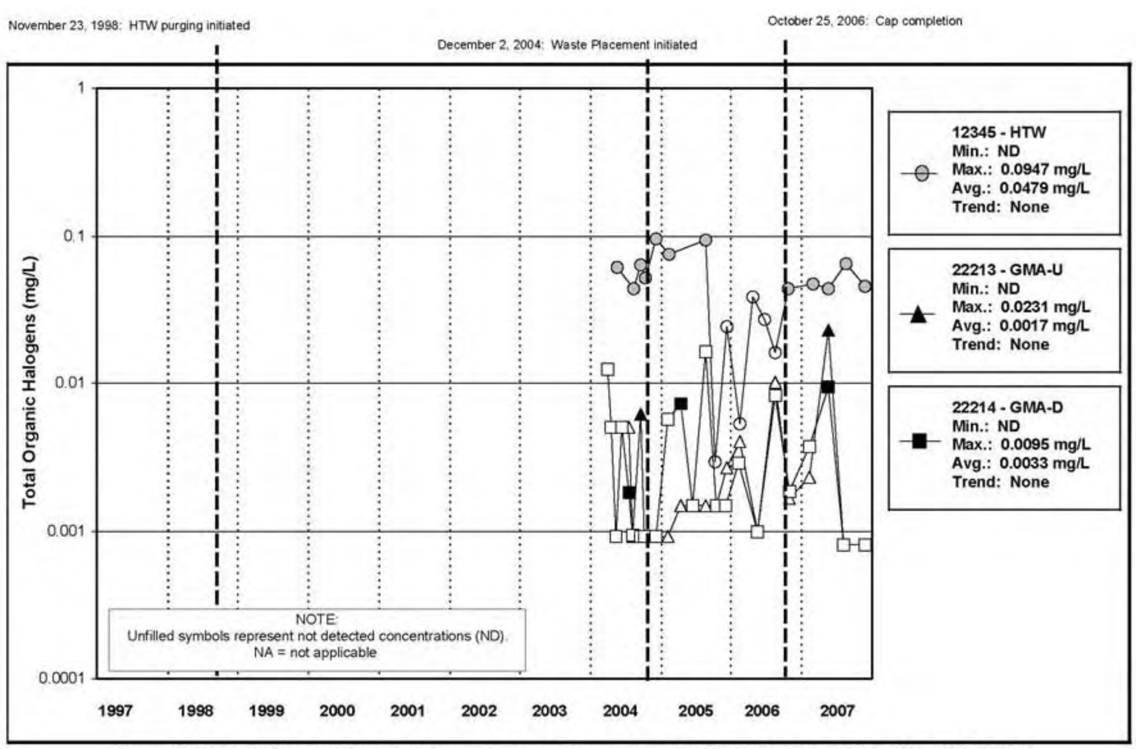


Figure A.5.8-9B. Cell 8 Total Organic Halogens Concentration vs. Time Plot for HTW, GMA-U Well, AND GMA-D Well

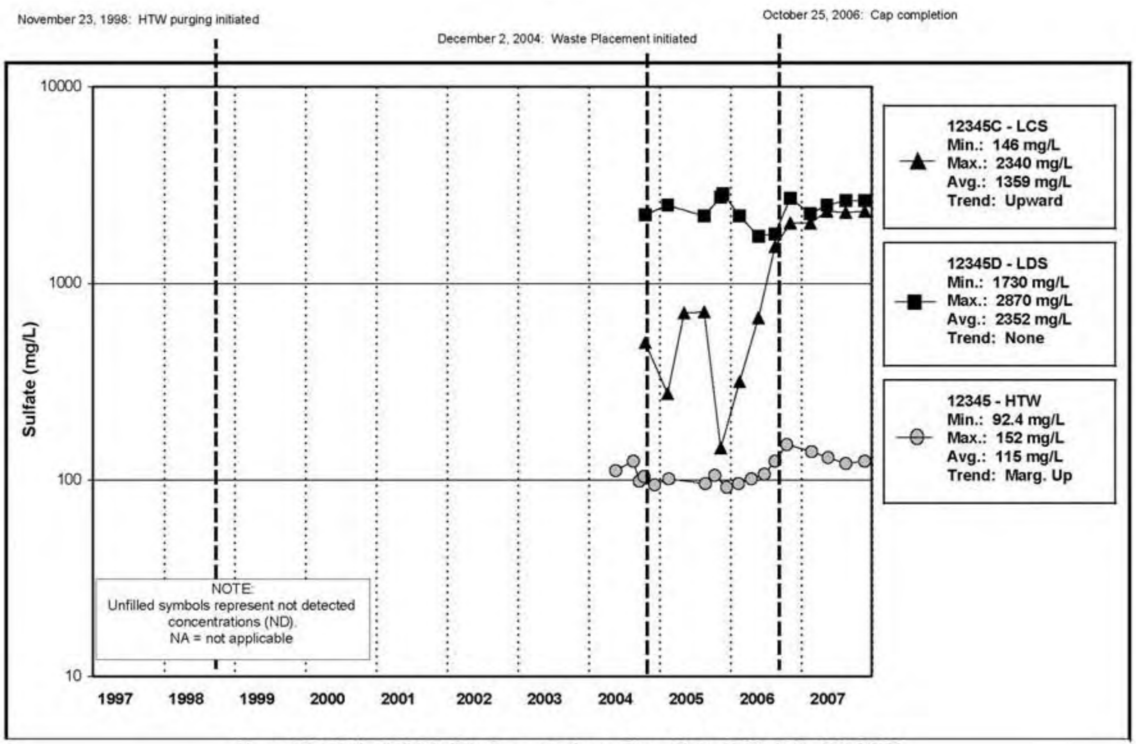


Figure A.5.8-10A. Cell 8 Sulfate Concentration vs. Time Plot for LCS, LDS, AND HTW

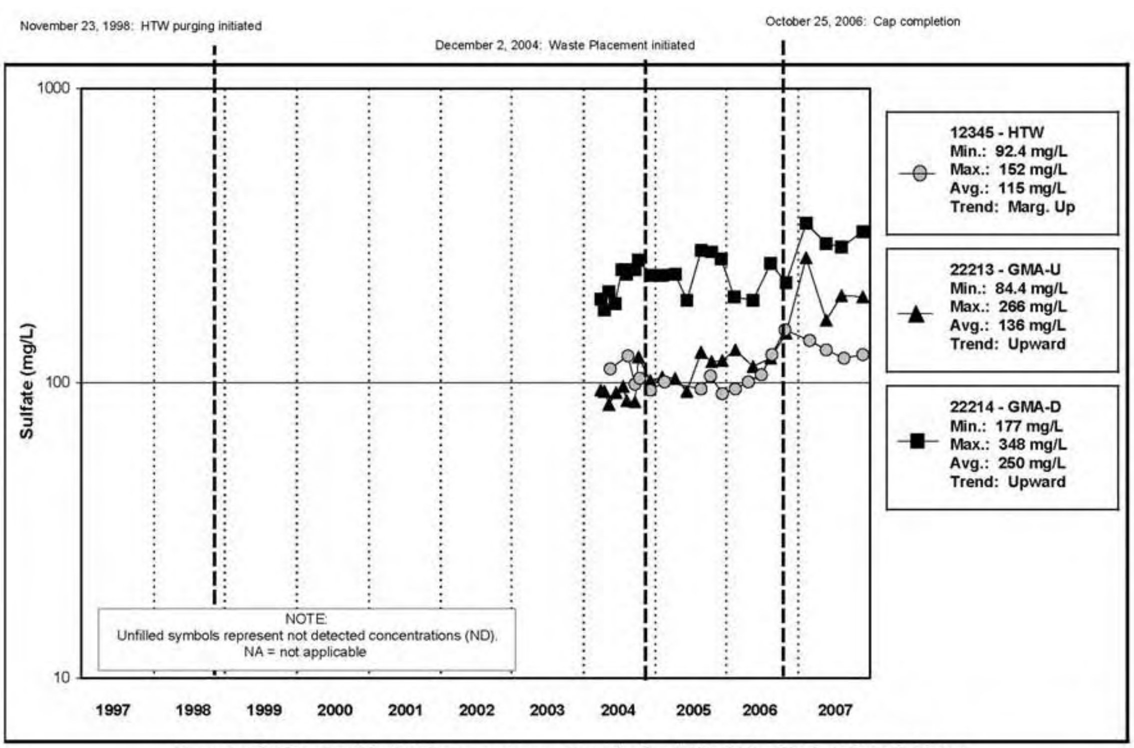


Figure A.5.8-10B. Cell 8 Sulfate Concentration vs. Time Plot for HTW, GMA-U Well, AND GMA-D Well