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).
- GMA 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).

Samples in 2008 were collected according to the frequencies described in the GWLMP. Constituent sampling lists are provided in Table 2−1, Table 2−2, and Table 2−3 of Appendix B of the GWLMP. In 2008, the Cell 1 LDS was dry in May, August, and November.

A.5.1.1 Refined Baseline Monitoring Results

As defined in the GWLMP, refined baseline constituents are those constituents that have been monitored at least eight times, and detected at least 25 percent of the time in the LCS, LDS, HTW, and GMA wells. Results from 2008 sampling are provided in a summary statistics table (Table A.5.1-2) and concentration plots (Figures A.5.1-6A to A.5.1-10B). The five refined baseline constituents are total uranium, boron, TOC, TOX, and sulfate.

Flow in the LDS in 2008 was well below the OSDF facility design action level, indicating that the water quality trends observed in the HTW and GMA wells in 2008 are attributable to concentration fluctuations taking place beneath the facility and not to a potential leak from the facility.

The 2009 GWLMP identifies the data evaluation techniques that will be used to further evaluate the association between water quality changes observed beneath the facility and the potential that they are being caused by a leak from the facility. Control charts will be added back to the program along with the use of bivariate plots.

Beginning in January 2009, the refined baseline constituents will become a subset of a larger group of fifteen constituents that will be monitored annually in all four monitoring horizons (LCS, LDS, HTW, and GMA wells) of each cell. Monitoring at the LCS will include all of the 15 constituents listed below, as well as the rest of the initial baseline constituents defined for the facility.

Constituent Sampling List for the LDS, HTW, and GMA Wells of Each Cell in 2009	
Constituent	**Reason**
Boron	Refined Baseline Parameter
Sulfate	Refined Baseline Parameter
Uranium	Refined Baseline Parameter
TOC	Refined Baseline Parameter
TOX	Refined Baseline Parameter
Iron	Common Ion Study[a]
Manganese	Common Ion Study[a]
Sodium	Common Ion Study[a]
Lithium	Common Ion Study[a]
Arsenic	Appendix I Statistical Analysis
Cobalt	Appendix I Statistical Analysis
Nickel	Appendix I Statistical Analysis
Selenium	Appendix I Statistical Analysis
TDS	Appendix I Statistical Analysis
Zinc	Appendix I Statistical Analysis

[a] Also known as the *Evaluation of Aqueous Ions in the Monitoring Systems of the On-Site Disposal Facility* (DOE 2008b)

Table A.5.1−1. Cell 1 – 2008 Monthly Liner Efficiencies

Month	Cell 1 Apparent Liner Efficiency (%)
January	99.54
February	99.66
March	99.61
April	99.74
May	99.52
June	99.93
July	99.85
August	100.00
September	100.00
October	99.95
November	100.00
December	100.00

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	43	43	100.0	74.1	Normal	Up, Significant	Detected	0 (Q1-99)							
	LDS	12338D	35	35	100.0	12.1	Normal	No Significant	Detected								
	HTW	12338	38	40	95.0	5.05	Undefined	Up, Significant	Detected								
	GMA-U	22201	44	47	93.6	2.75	Undefined	Up, Significant	Detected	0 (Q1-98)							
	GMA-D	22198	47	47	100.0	5.19	Undefined	Up, Significant	Detected								
Boron (mg/L)	LCS	12338C	43	44	97.7	1.34	Normal	No Significant	Not Detected	0.0642(Q1-98)	0.128(Q2-98)	0.337 (Q3-98)					
	LDS	12338D	33	34	97.1	0.235	Lognormal	Down, Marginal	Not Detected	0.0296(Q1-98)	0.001(Q3-00)						
	HTW	12338	38	41	92.7	0.150	Undefined	Up, Significant	Detected								
	GMA-U	22201	46	48	95.8	0.105	Normal	Up, Significant	Detected								
	GMA-D	22198	44	47	93.6	0.058	Undefined	Up, Significant	Not Detected	0.131(Q1-07)							
Total Organic Carbon (mg/L)	LCS	12338C	41	43	95.3	22.9	Undefined	Down, Marginal	Detected	123(Q2-98)							
	LDS	12338D	30	34	88.2	6.36	Normal	No Significant	Not Detected	80.9 (Q2-98)							
	HTW	12338	27	40	67.5	1.69	Lognormal	No Significant	Not Detected	7.24 (Q1-00)	4.25(Q1-04)						
	GMA-U	22201	35	48	72.9	3.83	Undefined	Down, Significant	Not Detected	59.7 (Q2-98)							
	GMA-D	22198	29	47	61.2	1.25	Normal	No Significant	Not Detected	3.14(Q2-97)	9.814(Q3-97)	15.8(Q4-97)	52.5(Q2-98)	4.7(Q3-98)	3.56(Q1-99)	5.85(Q2-99)	13(Q1-00)
Total Organic Halogens (mg/L)	LCS	12338C	39	44	88.6	0.21	Undefined	No Significant	Detected	1.52 (Q3-02)							
	LDS	12338D	25	34	73.5	0.037	Undefined	Up, Marginal	Not Detected	0.361 (Q2-00)							
	HTW	12338	18	41	43.9	0.0079	Undefined	No Significant	Not Detected	0.0332 (Q4-99)							
	GMA-U	22201	18	48	37.5	0.0098	Undefined	Down, Significant	Not Detected	0.078(Q1-97)	0.308(Q2-00)						
	GMA-D	22198	9	47	19.1	0.0074	Undefined	Down, Significant	Detected	0.0473 (Q2-98)	0.092 (Q2-00)						
Sulfate (mg/L)	LCS	12338C	28	28	100.0	1210	Normal	Up, Significant	Detected								
	LDS	12338D	16	16	100.0	1550	Normal	Up, Significant	Detected								
	HTW	12338	24	24	100.0	743	Normal	Down, Significant	Not Detected								
	GMA-U	22201	24	24	100.0	274	Lognormal	No Significant	Detected	1980 (Q4-04)							
	GMA-D	22198	24	24	100.0	246	Lognormal	Down, Significant	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 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 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.

[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]	DETECTED IN 2008?	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
General Chemistry												
Alkalinity as CaCO3 (mg/L)	17	17	100%	Yes	227	721	466	-	422 mg/L(10)	430 mg/L(9)	-	10 mg/L
Ammonia (mg/L)	11	7	63.6%	Yes	0.03	4.5	1.06	-	4.2 mg/L(1)	4.34 mg/L(1)	220 mg/L(0)	0.1 mg/L
Chloride (mg/L)	17	17	100%	Yes	21.8	40.9	35.5	-	7.3 mg/L(17)	45 mg/L(0)	6300 mg/L(0)	5 mg/L
Nitrate/Nitrite (mg/L)	28	16	57.1%	Yes	0.00793	45.5	5.13	11 mg/L[g](2)	11 mg/L(2)	0.29 mg/L(11)	2670 mg/L(0)	1.1 mg/L
Total Dissolved Solids (mg/L)	22	22	100%	Yes	1790	3130	2330	-	-	-	-	10 mg/L
Inorganic												
Arsenic (mg/L)	11	4	36.4%	No	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)	11	11	100%	Yes	0.0335	0.205	0.0763	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)	11	2	18.2%	No	0.0000674	0.00012	-	0.004 mg/L(0)	-	-	0.0343 mg/L(0)	0.001 mg/L
Cadmium (mg/L)	11	3	27.3%	No	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)	17	17	100%	Yes	377	1500	607	-	159 mg/L(17)	172 mg/L(17)	1800 mg/L(0)	5 mg/L
Chromium (mg/L)	11	4	36.4%	Yes	0.0012	0.003	0.0019	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)	11	10	90.9%	Yes	0.0025	0.0575	0.0176	0.17 mg/L(0)	0.0086 mg/L(6)	-	0.0886 mg/L(0)	0.034 mg/L
Copper (mg/L)	11	11	100%	Yes	0.00094	0.0159	0.0096	1.3 mg/L(0)	0.035 mg/L(0)	0.029 mg/L(0)	0.298 mg/L(0)	0.008 mg/L
Iron (mg/L)	17	16	94.1%	No	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)	11	1	9.1%	No	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)	17	17	100%	Yes	71.4	319	163	-	38.5 mg/L(17)	50.7 mg/L(17)	690 mg/L(0)	5 mg/L
Manganese (mg/L)	17	16	94.1%	No	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)	24	2	8.3%	No	0.00000024	0.00047	-	0.002 mg/L(0)	-	-	0.0018 mg/L(0)	0.0002 mg/L
Nickel (mg/L)	11	11	100%	Yes	0.0119	0.0535	0.03	0.1 mg/L(0)	0.0514 mg/L(1)	0.0072 mg/L(11)	0.981 mg/L(0)	0.02 mg/L
Potassium (mg/L)	17	17	100%	Yes	10.8	25.9	17.9	-	1.96 mg/L(17)	17.2 mg/L(9)	12400 mg/L(0)	5 mg/L
Selenium (mg/L)	11	4	36.4%	Yes	0.0048	0.017	0.0089	0.05 mg/L(0)	0.00075 mg/L(4)	-	0.0494 mg/L(0)	0.005 mg/L
Silver (mg/L)	11	1	9.1%	No	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)	17	17	100%	Yes	11.7	29.3	16.3	-	47.1 mg/L(0)	50 mg/L(0)	1300 mg/L(0)	5 mg/L
Thallium (mg/L)	11	2	18.2%	No	0.0007	0.00756	-	-	-	-	0.0028 mg/L(1)	0.02 mg/L
Zinc (mg/L)	11	8	72.7%	Yes	0.0099	0.575	0.111	0.021 mg/L(5)	0.02 mg/L(5)	0.35 mg/L(1)	1.78 mg/L(0)	0.015 mg/L
Radionuclide												
Technetium-99 (pCi/L)	26[i]	7	26.9%	Yes[i]	1.81	18.28	9.92	94 pCi/L(0)	22 pCi/L(0)	30 pCi/L(0)	6130 pCi/L(0)	10 pCi/L
Organic												
4-Nitroaniline (ug/L)	23	1	4.3%	No	1.01	-	-	-	-	-	-	3 ug/L[h]

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 minumun 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.
[h]Detection Limit of 4-Nitroaniline is sometimes less than the value, depending on the laboratory doing the analysis.
[i]Technetium-99 was monitored in third and fourth quarter 2008 as required under the OSDF PSP to verify an earlier detection.

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. Even though active operations ended in 2006, this sampling continued in 2007 and 2008.

In 2008, annual sampling of the Cell 1 LCS took place in February. Table A.5.1−3 summarizes the annual LCS sampling results for Cell 1, along with the data collected in previous years. Table A.5.1–3 presents the non-refined baseline site-specific constituents that were monitored in 2008. All of the constituents listed have been monitored at least 8 times, and 21 of them have been detected at least 25 percent of the time.

The potential monitoring usefulness of nine of the 21 constituents (alkalinity, calcium, chloride, iron, magnesium, manganese, nitrate/nitrite, potassium, and sodium) was addressed in the *Evaluation of Aqueous Ions in the Monitoring Systems of the On-Site Disposal Facility* (DOE 2008b) (Common Ion Study). The potential monitoring usefulness of the other 12 constituents (ammonia, arsenic, barium, cadmium, chromium, cobalt, copper, nickel, selenium, technetium-99, TDS, and zinc) was addressed in the statistical analysis that was presented in the 2007 SER (see Table A.5.1–4 in the 2007 SER).

Confirmatory Sampling in the LCS

In 2009, confirmatory sampling procedures were modified in the GWLMP. Because confirmatory sampling identified in 2008 will take place in 2009, the modified procedure will be followed. Therefore, if a constituent was detected in the 2008 LCS sample that was not going to be monitored in the LDS in 2009, the constituent was added for confirmatory monitoring in 2009.

Two consecutive detects for that constituent in the cell's LCS will trigger monitoring for that constituent in the cell's LDS during the next scheduled sampling event. However, if the usefulness of the constituent as a monitoring constituent has already been rejected through the Common Ion Study or the Appendix I constituent statistics presented in the 2007 SER, the constituent will not be added for confirmatory monitoring.

As discussed in the 2007 SER, the Cell 1 LCS was monitored for technetium-99 three times in 2008 (February, August, and November). Technetium-99 was detected in the February sample, but was not detected in either the August or November samples. Furthermore, no constituent detections were measured in 2008 requiring confirmatory monitoring in 2009.

A.5.1.3 LDS Monitoring Results

In 2008, the LDS of Cell 1 was monitored for site-specific constituents listed in Table 2−1 of Appendix B of the GWLMP. The objective of the sampling was to determine if any initial baseline constituents not on the refined baseline list were present in the LDS.

Sampling of the Cell 1 LDS took place in February 2008. Results indicate that all of the initial baseline constituents that have been monitored in the Cell 1 LDS and detected at least 25 percent of the time are being monitored for in the Cell 1 HTW and GMA wells in 2009.

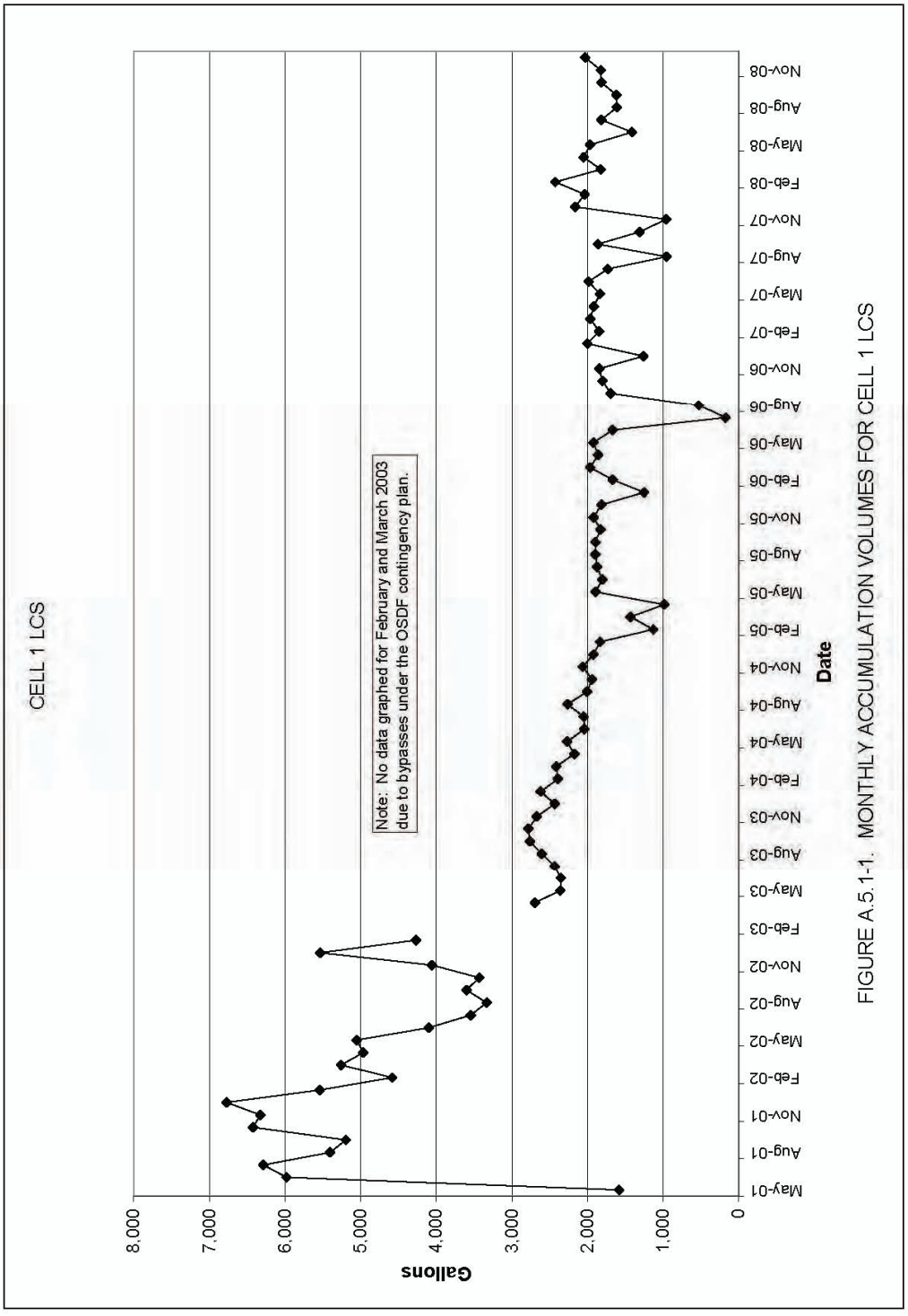


FIGURE A.5.1-1. MONTHLY ACCUMULATION VOLUMES FOR CELL 1 LCS

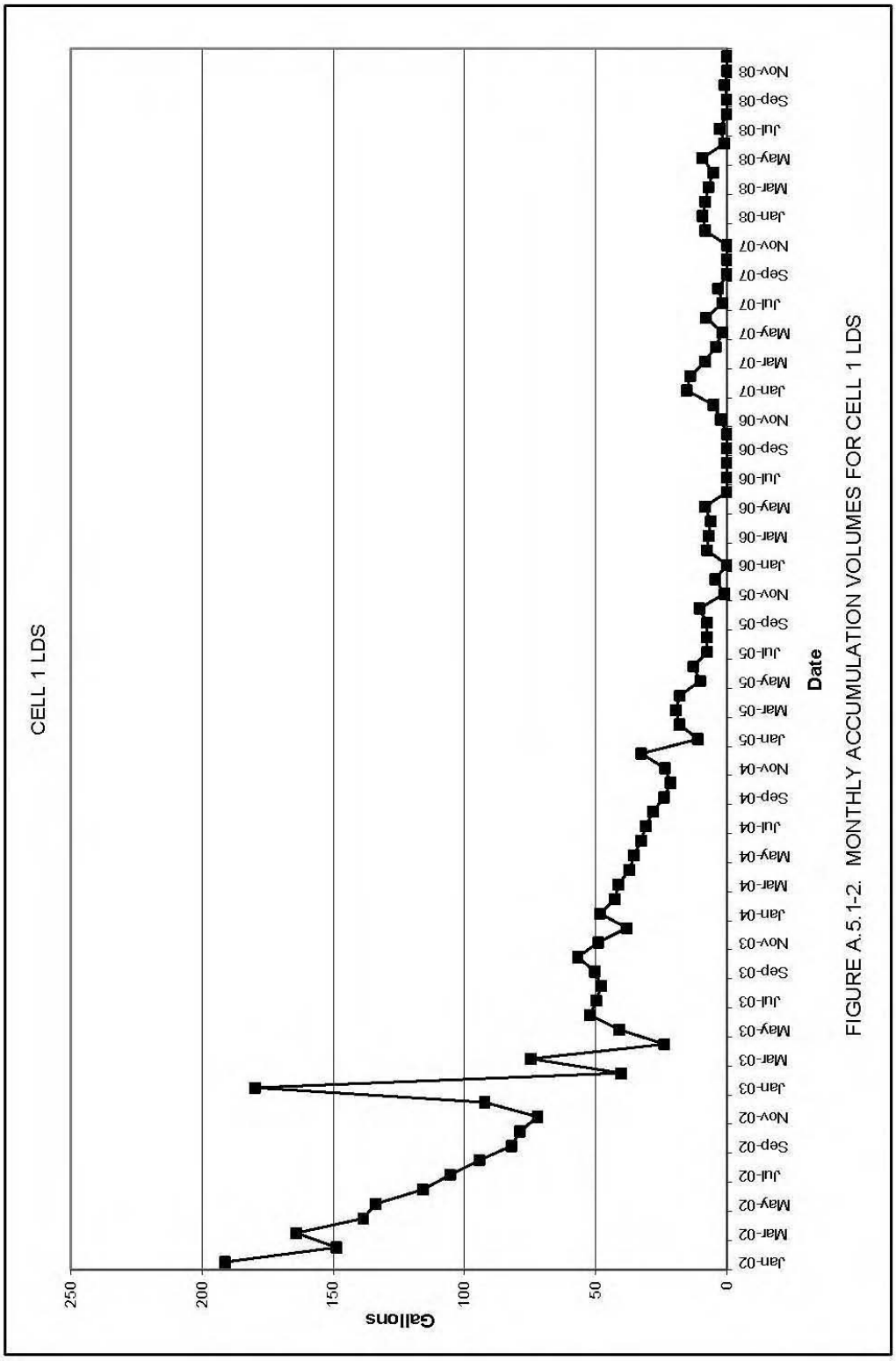
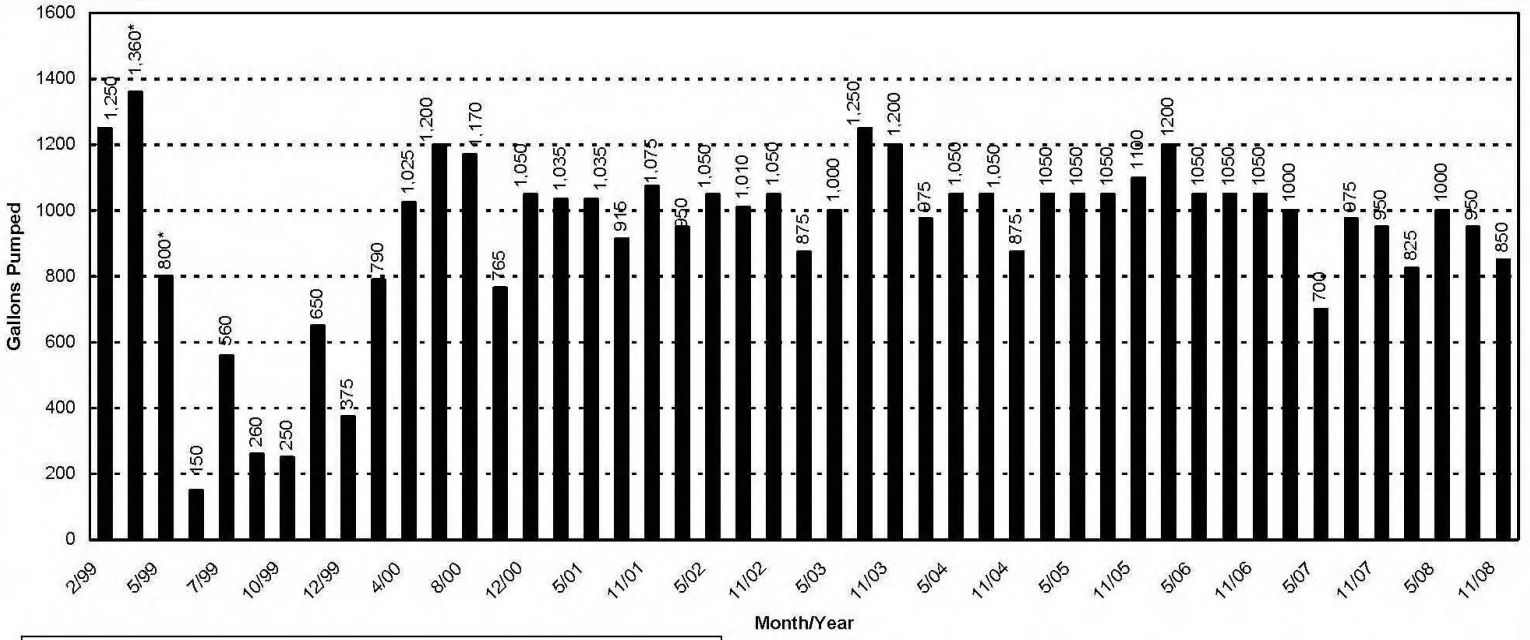


FIGURE A.5.1-2. MONTHLY ACCUMULATION VOLUMES FOR CELL 1 LDS



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
2008:	3625	n=4	906
Overall:			934

*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

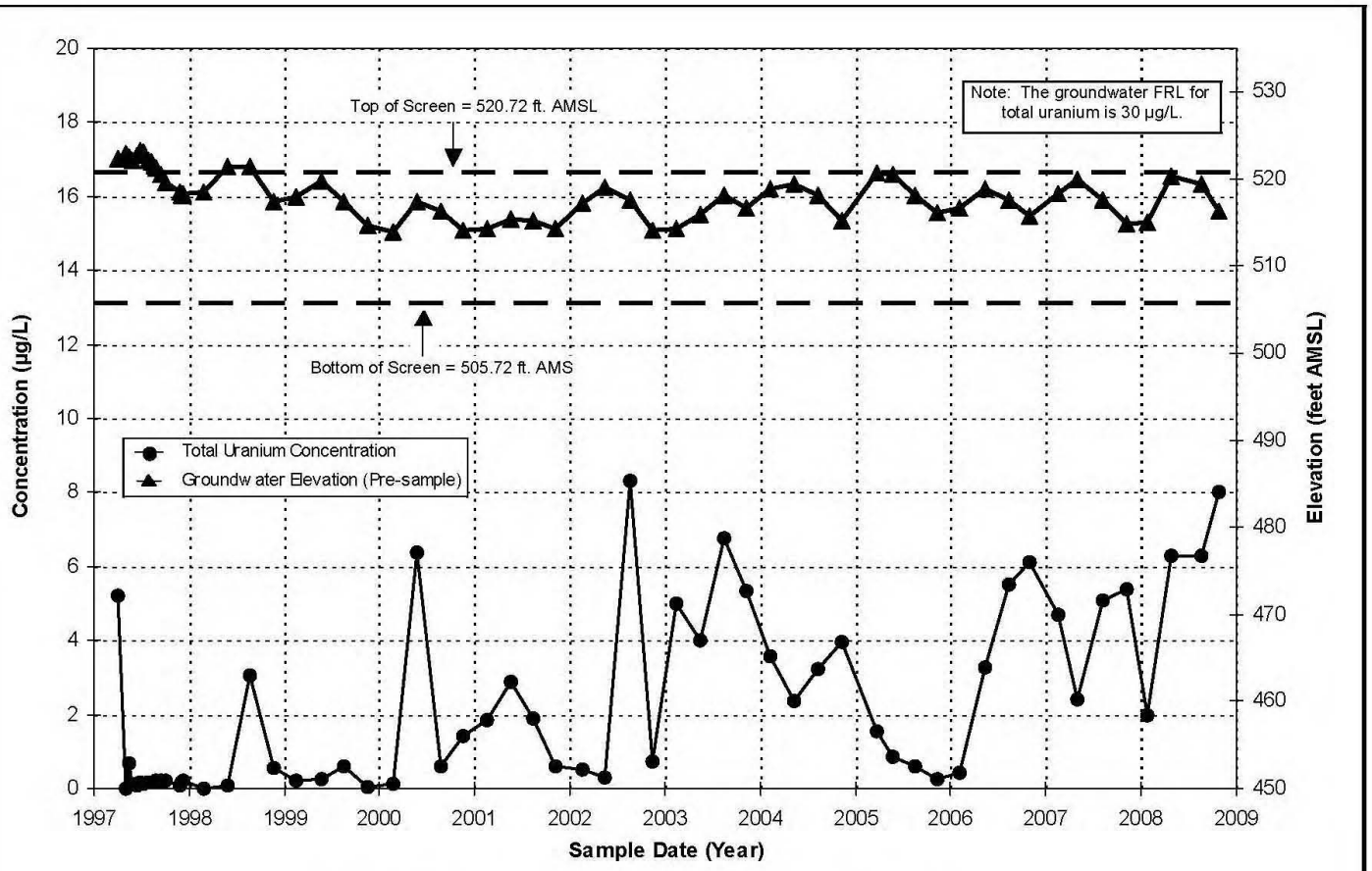


Figure A.5.1-4. Total Uranium Concentration and Groundwater Elevation vs. Time Plot for Cell 1 Upgradient Monitoring Well 22201

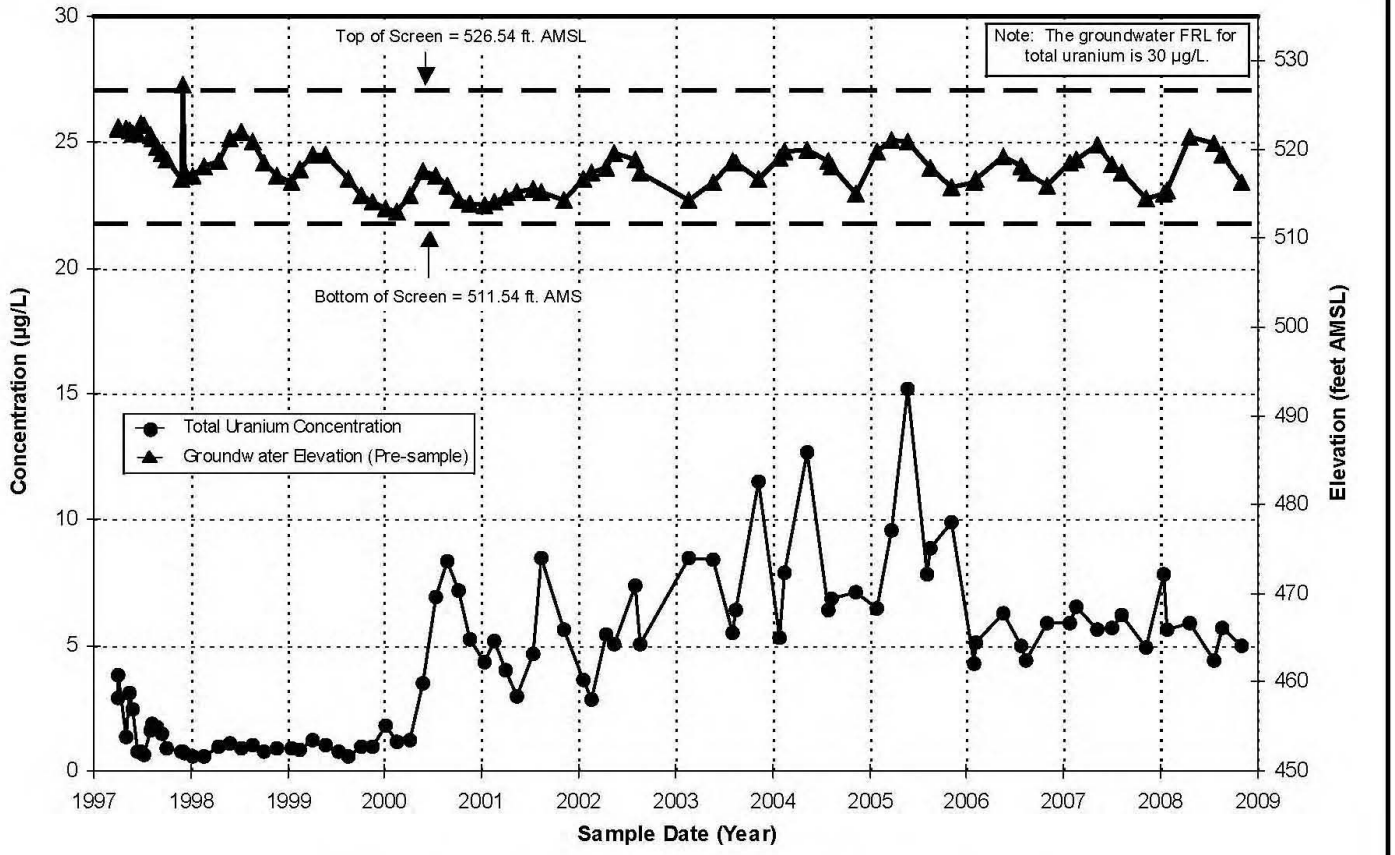


Figure A.5.1-5. Total Uranium Concentration and Groundwater Elevation vs. Time Plot for Cell 1 Downgradient Monitoring Well 22198

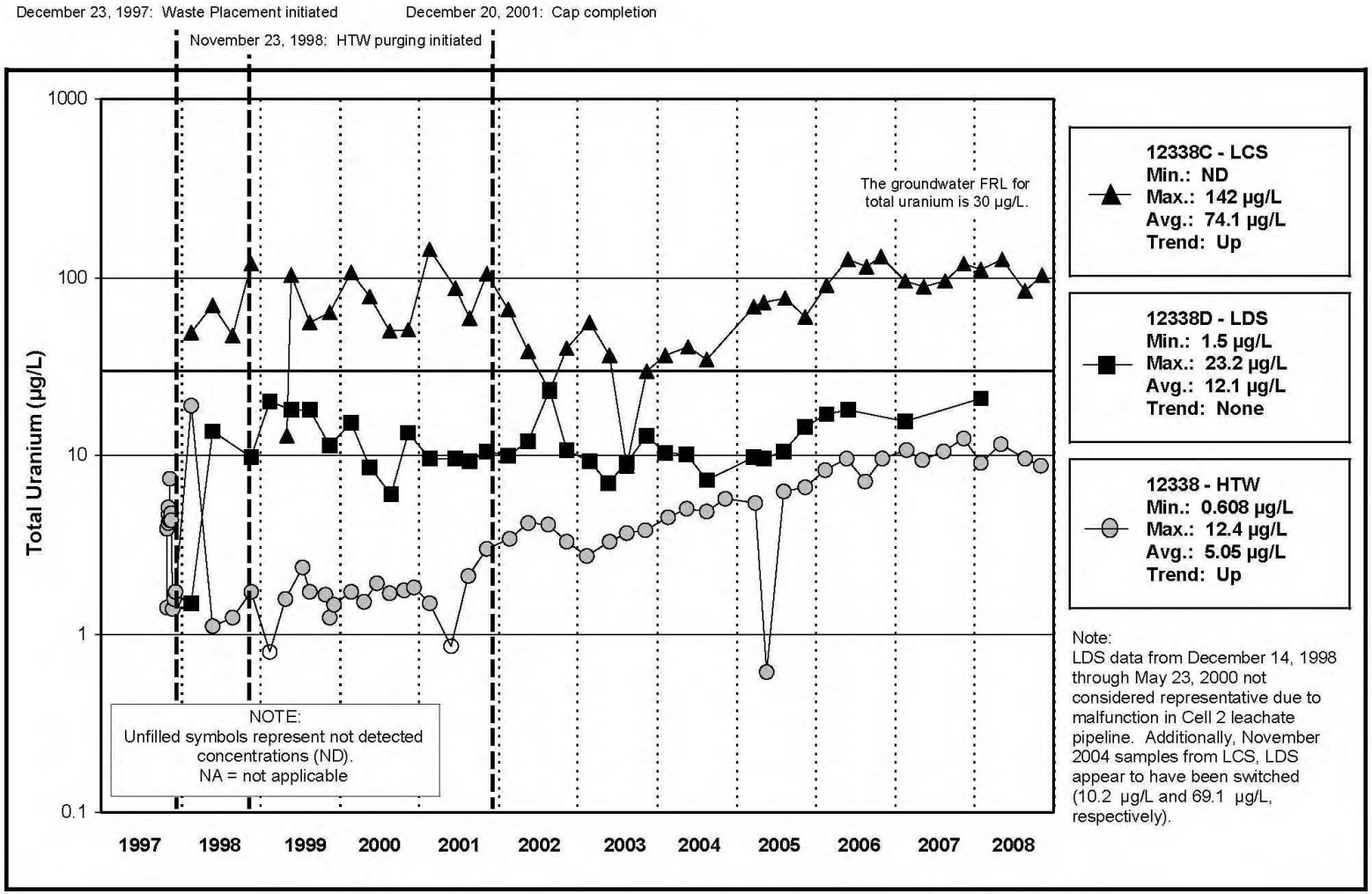


Figure A.5.1-6A. Cell 1 Total Uranium Concentration vs. Time Plot for LCS, LDS, AND HTW

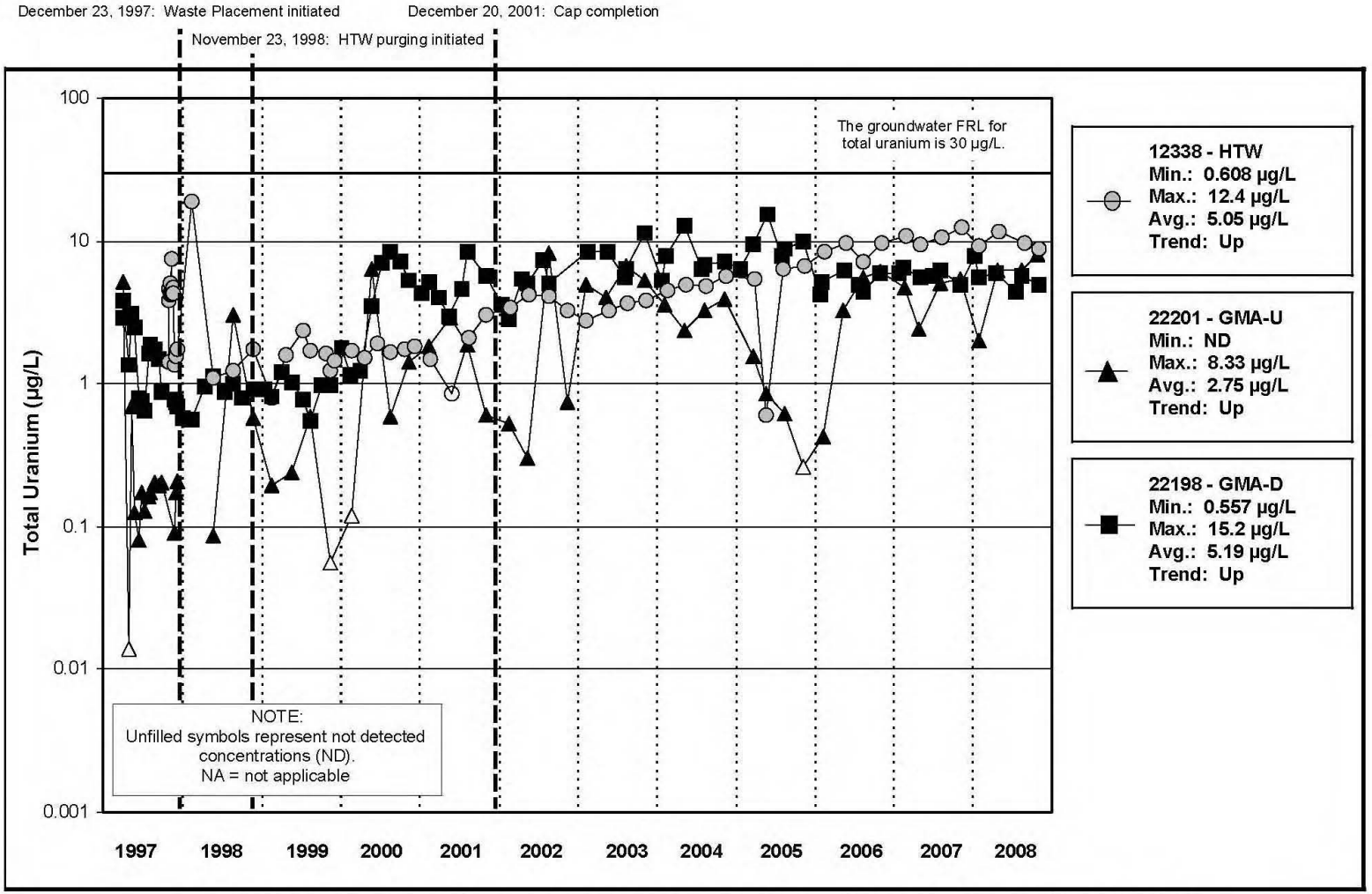


Figure A.5.1-6B. Cell 1 Total Uranium Concentration vs. Time Plot for HTW, GMA-U Well, AND GMA-D Well

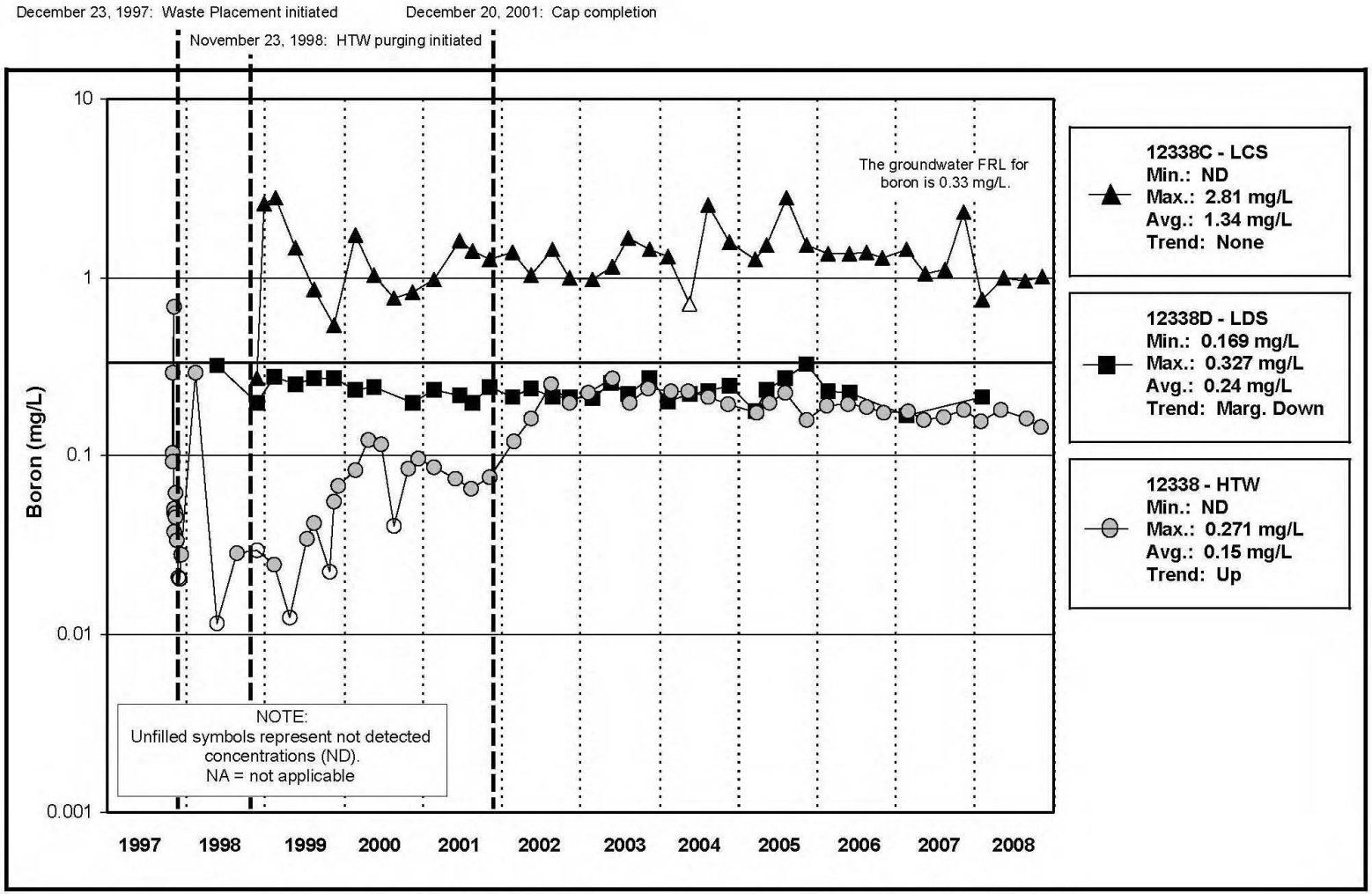


Figure A.5.1-7A. Cell 1 Boron Concentration vs. Time Plot for LCS, LDS, AND HTW

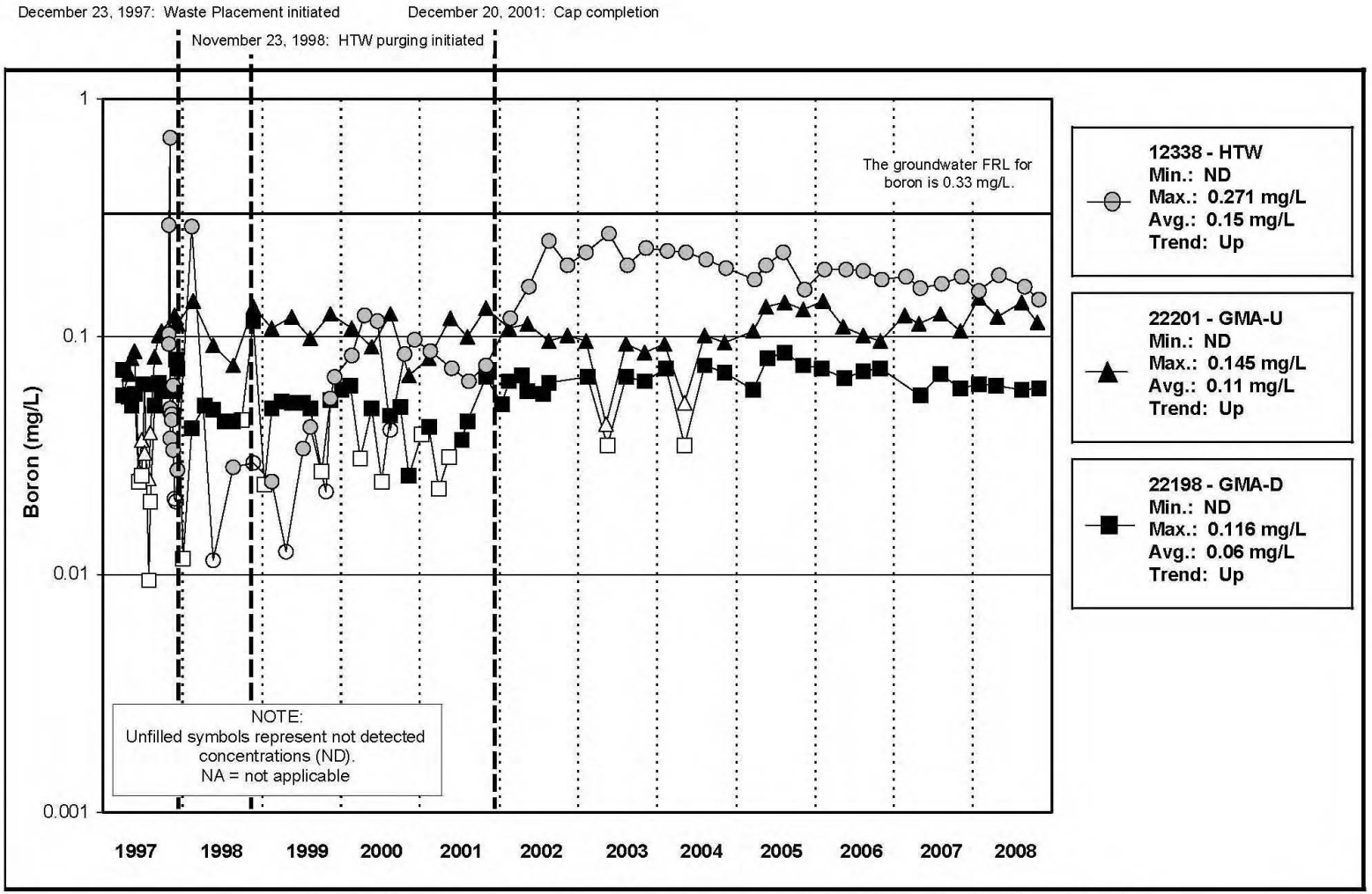


Figure A.5.1-7B. Cell 1 Boron Concentration vs. Time Plot for HTW, GMA-U Well, AND GMA-D Well

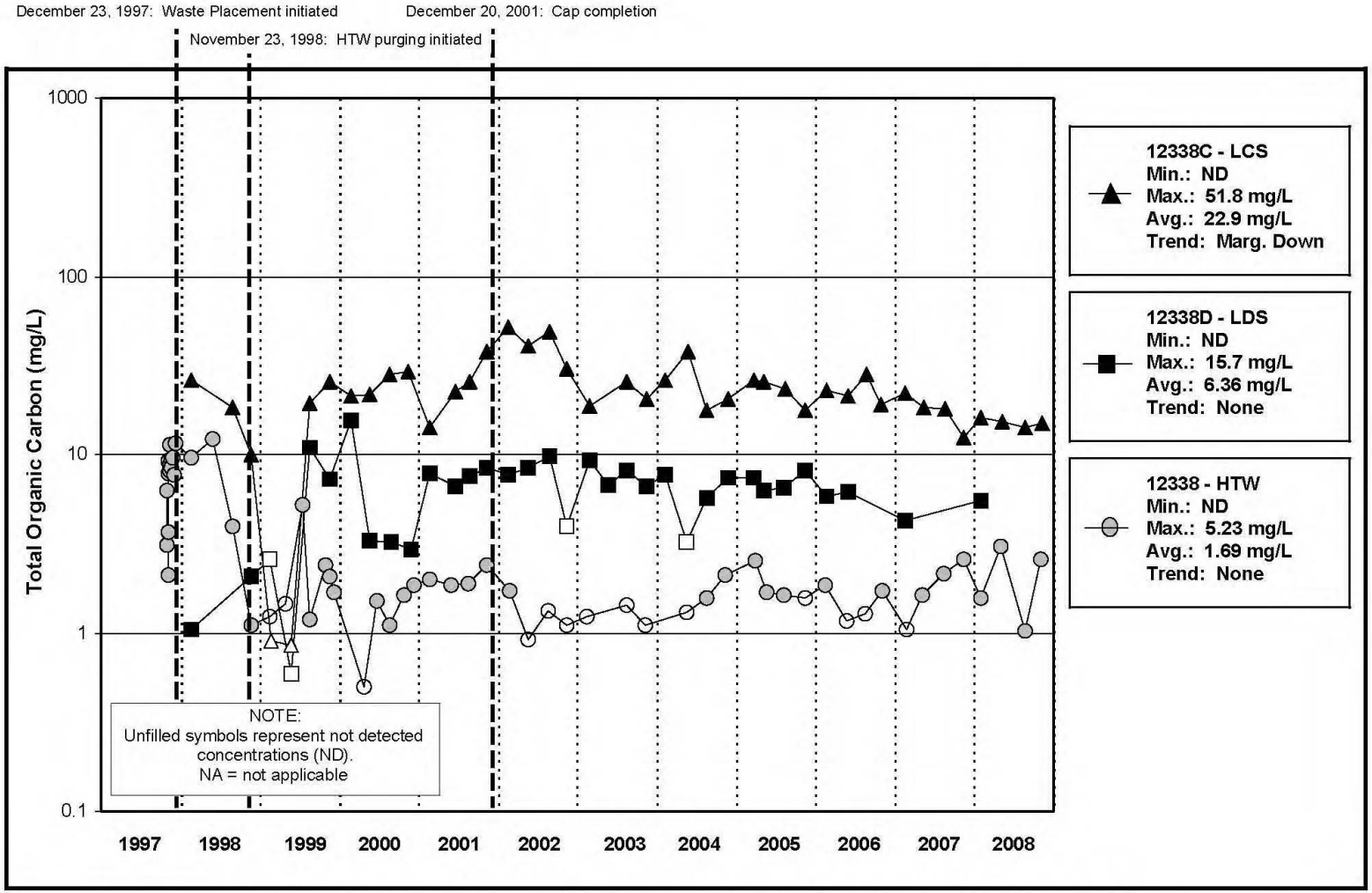


Figure A.5.1-8A. Cell 1 Total Organic Carbon Concentration vs. Time Plot for LCS, LDS, AND HTW

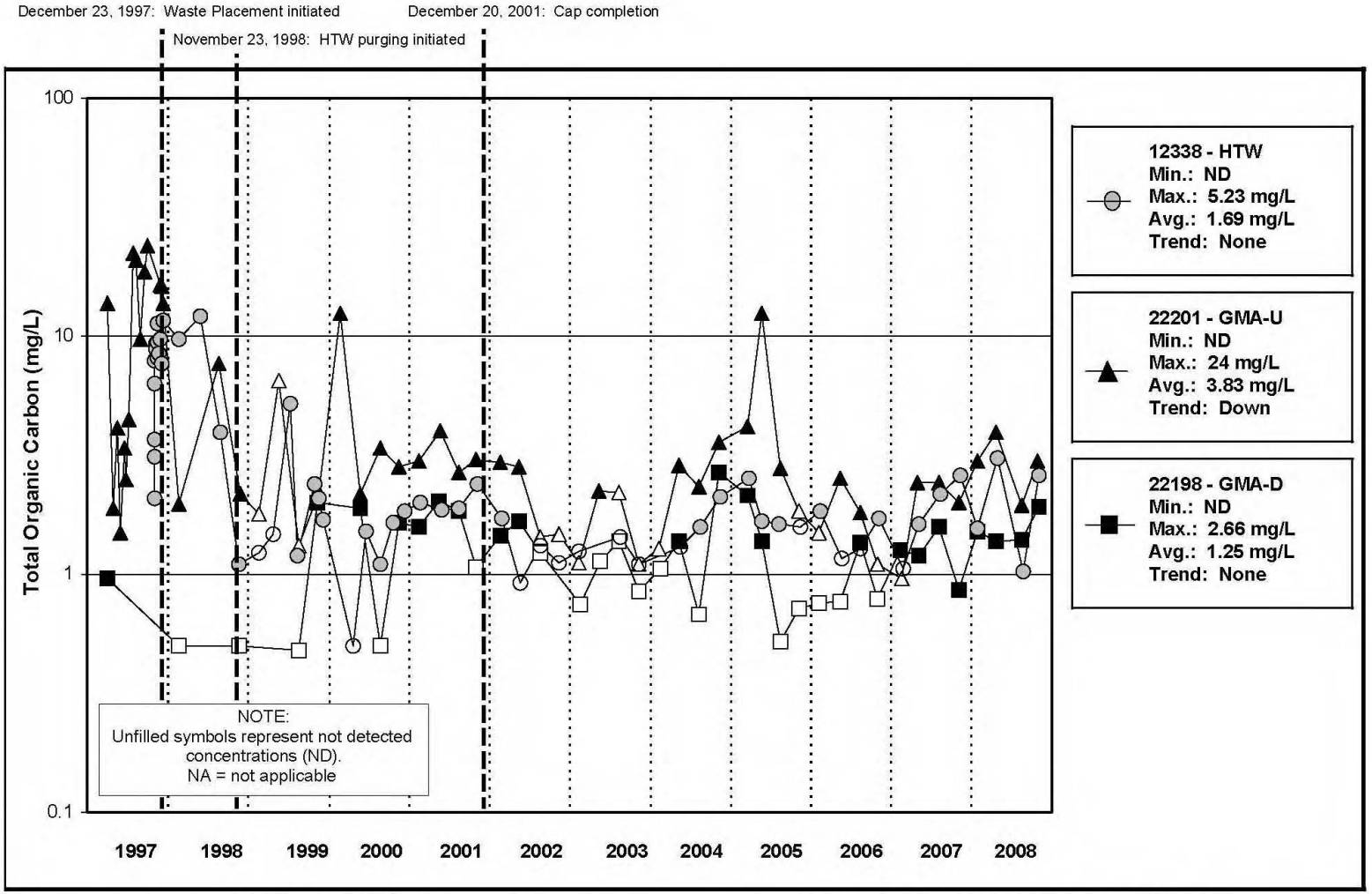


Figure A.5.1-8B. Cell 1 Total Organic Carbon Concentration vs. Time Plot for HTW, GMA-U Well, AND GMA-D Well

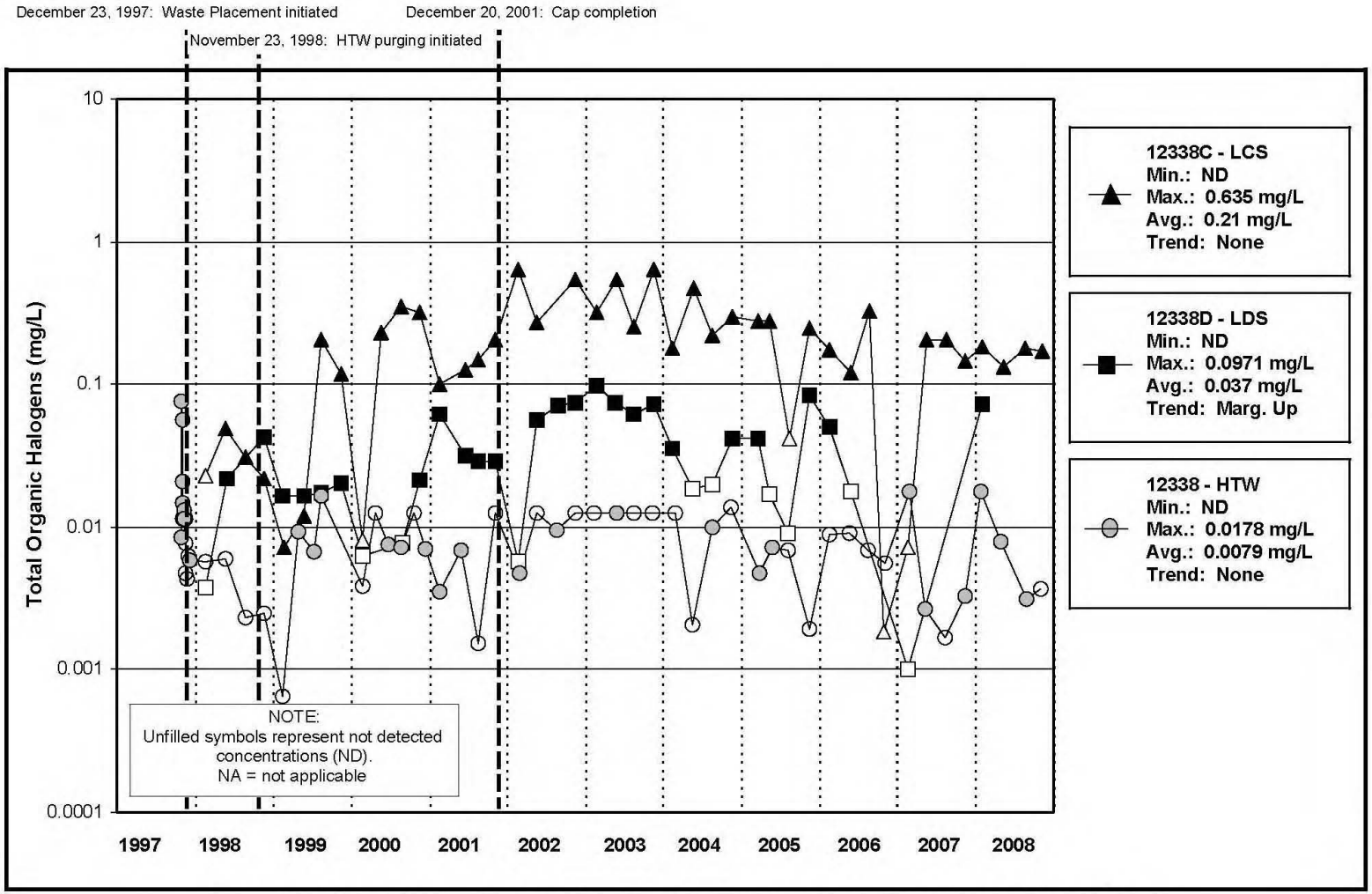


Figure A.5.1-9A. Cell 1 Total Organic Halogens Concentration vs. Time Plot for LCS, LDS, AND HTW

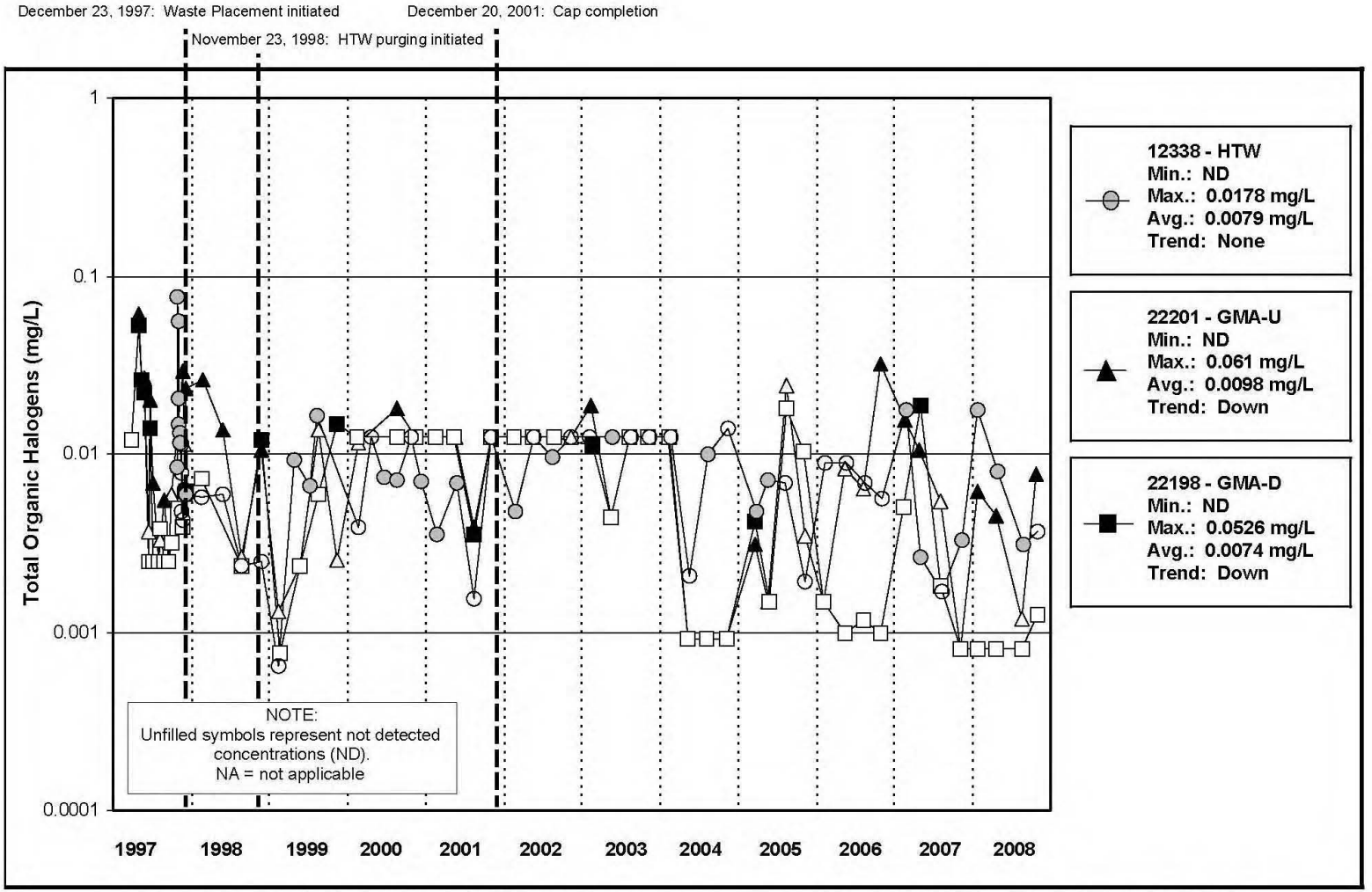


Figure A.5.1-9B. Cell 1 Total Organic Halogens Concentration vs. Time Plot for HTW, GMA-U Well, AND GMA-D Well

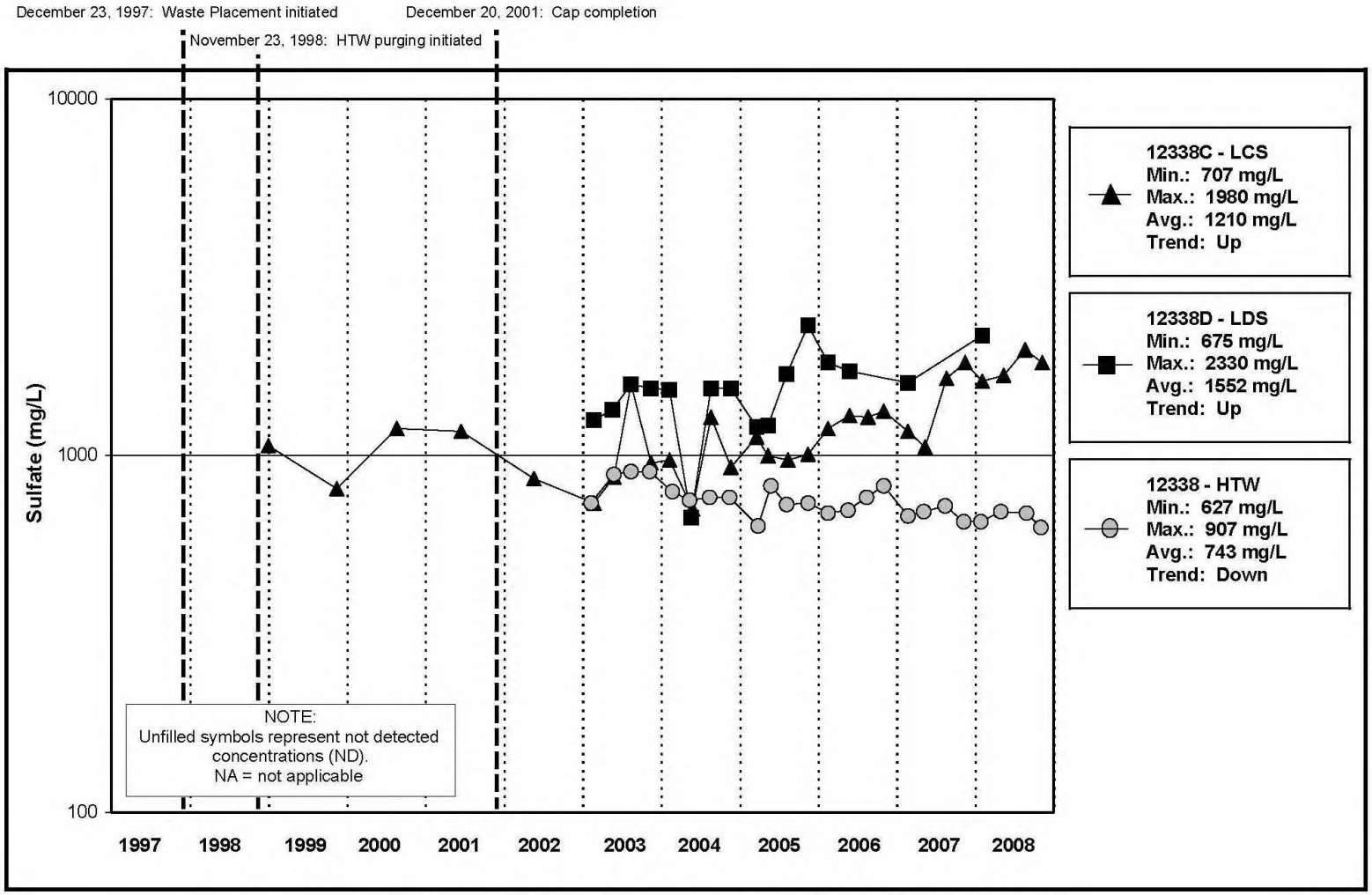


Figure A.5.1-10A. Cell 1 Sulfate Concentration vs. Time Plot for LCS, LDS, AND HTW

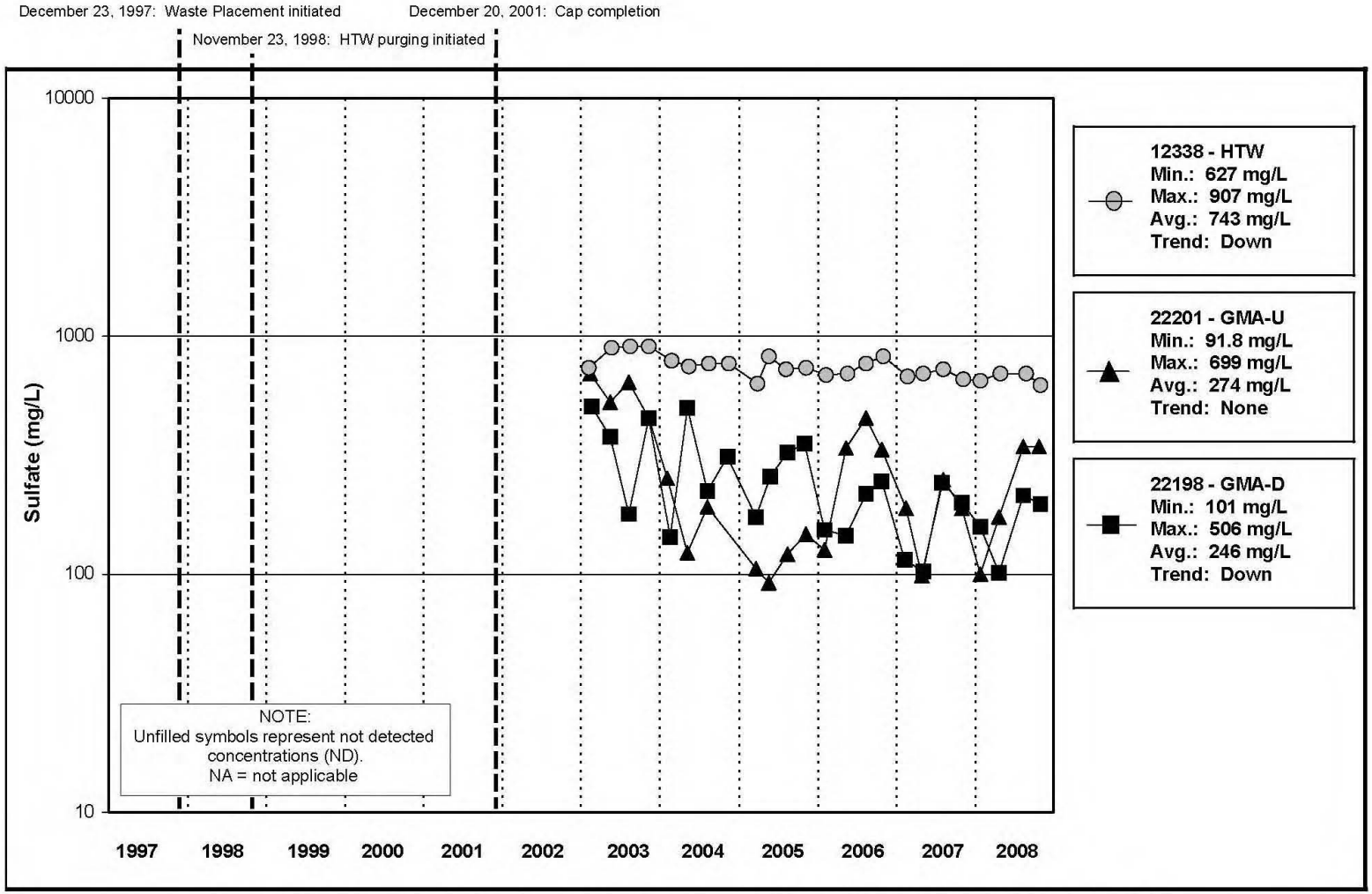


Figure A.5.1-10B. Cell 1 Sulfate Concentration vs. Time Plot for HTW, GMA-U Well, AND GMA-D Well

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).
- GMA 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).

Samples in 2008 were collected according to the frequencies described in the GWLMP. Constituent sampling lists are provided in Table 2−1, Table 2−2, and Table 2−3 of Appendix B of the GWLMP. In 2008, the Cell 2 LDS was dry during all four sampling quarters (February, May, August, and November).

A.5.2.1 Refined Baseline Monitoring Results

As defined in the GWLMP, refined baseline constituents are those constituents that have been monitored at least eight times, and detected at least 25 percent of the time in the LCS, LDS, HTW, and GMA wells. Results from 2008 sampling are provided in a summary statistics table (Table A.5.2-2) and concentration plots (Figures A.5.2-6A to A.5.2-10B). The five refined baseline constituents are total uranium, boron, TOC, TOX, and sulfate.

Flow in the LDS in 2008 was well below the OSDF facility design action level, indicating that the water quality trends observed in the HTW and GMA wells in 2008 are attributable to concentration fluctuations taking place beneath the facility and not to a potential leak from the facility.

The 2009 revision of the GWLMP identifies the data evaluation techniques that will be used to further evaluate the association between water quality changes observed beneath the facility and the potential that they are being caused by a leak from the facility. Control charts will be added back to the program along with the use of bivariate plots.

Beginning in January 2009, the refined baseline constituents will become a subset of a larger group of fifteen constituents that will be monitored annually in all four monitoring horizons (LCS, LDS, HTW, and GMA wells) of each cell. Monitoring at the LCS will include all of the 15 constituents listed below, as well as the rest of the initial baseline constituents defined for the facility.

Constituent Sampling List for the LDS, HTW, and GMA Wells of Each Cell in 2009	
Constituent	**Reason**
Boron	Refined Baseline Parameter
Sulfate	Refined Baseline Parameter
Uranium	Refined Baseline Parameter
TOC	Refined Baseline Parameter
TOX	Refined Baseline Parameter
Iron	Common Ion Study[a]
Manganese	Common Ion Study[a]
Sodium	Common Ion Study[a]
Lithium	Common Ion Study[a]
Arsenic	Appendix I Statistical Analysis
Cobalt	Appendix I Statistical Analysis
Nickel	Appendix I Statistical Analysis
Selenium	Appendix I Statistical Analysis
TDS	Appendix I Statistical Analysis
Zinc	Appendix I Statistical Analysis

[a] Also known as the *Evaluation of Aqueous Ions in the Monitoring Systems of the On-Site Disposal Facility* (DOE 2008b)

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. Even though active operations ended in 2006, this sampling continued in 2007 and 2008.

Annual sampling of the Cell 2 LCS took place in February 2008. Table A.5.2-3 summarizes the annual LCE sampling results for Cell 2, along with the data collected in previous years. Table A.5.2-3 presents the non-refined baseline site-specific constituents that were monitored in 2008. All of these constituents listed have been monitored for at least eight times, and 21 of them have been detected at least 25 percent of the time.

The potential monitoring usefulness of nine of the 21 constituents (alkalinity, calcium, chloride, iron, magnesium, manganese, nitrate/nitrite, potassium, and sodium) was addressed in the Common Ion Study. The potential monitoring usefulness of the other 12 constituents (ammonia, arsenic, barium, cadmium, chromium, cobalt, copper, nickel, selenium, thallium, TDS, and zinc) was addressed by a statistical analysis that was presented in the 2007 SER (see Table A.5.2-4 in the 2007 SER).

Confirmatory Sampling in the LCS

In 2009, confirmatory sampling procedures were modified in the GWLMP. Because confirmatory sampling identified in 2008 will take place in 2009, the modified procedure will be followed. Therefore, if a constituent was detected in the 2008 LCS sample that was not going to

be monitored in the LDS in 2009, the constituent was added for confirmatory monitoring in 2009.

Two consecutive detects for that constituent in the cell's LCS will trigger monitoring for that constituent in the cell's LDS during the next scheduled sampling event. However, if the usefulness of the constituent as a monitoring constituent has already been rejected through the Common Ion Study or the Appendix I constituent statistics presented in the 2007 SER, the constituent will not be added for confirmatory monitoring.

In 2008 no confirmatory monitoring was identified for the Cell 2 LCS.

A.5.2.3 LDS Monitoring Results

In 2008, the LDS of Cell 2 was monitored for site-specific constituents listed in Table 2−1 of Appendix B of the GWLMP. The objective of the sampling was to determine if any initial baseline constituents, not on the refined baseline list, were present in the LDS.

In 2008, the Cell 2 LDS was dry all year. Sampling attempts were made on February 4, May 13, August 21, and November 10, 2008.

Table A.5.2−1. Cell 2 – 2008 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

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Table A.5.2−2. Summary Statistics for Cell 2

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	12339C	40	40	100	69.8	Lognormal	Up, Significant	Detected							
	LDS	12339D	26	26	100	14.5	Normal	No Significant	Not Detected	71 (Q4-98)	50.4 (Q1-99)	41.5 (Q2-99)				
	HTW	12339	41	41	100	6.49	Undefined	Up, Significant	Detected							
	GMA-U	22200	31	47	66	0.34	Undefined	Up, Significant	Not Detected	0 (Q1-98)	0 (Q4-03)					
	GMA-D	22199	45	47	95.7	1.41	Undefined	No Significant	Not Detected	11.8 (Q3-98)	12.1 (Q3-99)	8.77 (Q3-02)	0 (Q4-03)			
Boron (mg/L)	LCS	12339C	41	41	100	1.71	Undefined	Up, Significant	Detected							
	LDS	12339D	25	25	100	0.39	Normal	Up, Significant	Not Detected	0.904 (Q4-98)	2.22 (Q1-99)	0.841 (Q2-99)	0.865 (Q2-04)			
	HTW	12339	38	41	92.7	0.09	Undefined	Up, Significant	Detected							
	GMA-U	22200	35	47	74.5	0.05	Undefined	No Significant	Not Detected							
	GMA-D	22199	38	47	80.9	0.05	Normal	Up, Significant	Detected							
Total Organic Carbon (mg/L)	LCS	12339C	30	40	75	2.75	Lognormal	Up, Significant	Not Detected							
	LDS	12339D	17	25	68	3.13	Lognormal	Down, Signficant	Detected	26.1 (Q3-99)	11.5 (Q1-00)					
	HTW	12339	26	39	66.7	1.73	Normal	Up, Significant	Not Detected	11.1 (Q1-00)						
	GMA-U	22200	35	47	74.5	1.57	Lognormal	No Significant	Not Detected	15.3(Q3-97)	11.5(Q4-97)	40.1(Q2-98)	5.44(Q3-98)	7.84(Q1-99)	16.2 (Q3-99)	14.4(Q1-00)
	GMA-D	22199	31	47	66	1.41	Normal	No Significant	Not Detected	3.5 (Q2-97)	16.5 (Q3-97)	10.5 (Q4-97)	48.1 (Q2-98)	3.7 (Q3-98)	9.68 (Q1-00)	
Total Organic Halogens (mg/L)	LCS	12339C	14	41	34.1	0.01	Undefined	No Significant	Detected	0.0576 (Q2-00)	0.0637(Q2-06)	0.0715(Q3-06)	0.0826(Q4-06)			
	LDS	12339D	8	26	30.8	0.0096	Undefined	No Significant	Not Detected	0.069 (Q2-00)						
	HTW	12339	29	41	70.7	0.023	Undefined	No Significant	Not Detected							
	GMA-U	22200	13	47	27.7	0.0067	Undefined	Down, Signficant	Detected	0.124 (Q4-98)	0.177 (Q2-00)					
	GMA-D	22199	11	47	23.4	0.0072	Undefined	Down, Signficant	Detected	0.0272 (Q1-99)	0.0775 (Q2-00)					
Sulfate (mg/L)	LCS	12339C	28	28	100	1260	Normal	Up, Significant	Detected							
	LDS	12339D	9	9	100	2910	Normal	No Significant	Not Detected	8110 (Q4-05)						
	HTW	12339	24	24	100	671	Normal	Down, Signficant	Detected							
	GMA-U	22200	24	24	100	228	Normal	No Significant	Not Detected							
	GMA-D	22199	24	24	100	194	Lognormal	No Significant	Not Detected	540 (Q2-05)	511(Q3-05)					

[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 data fit the normal distribution better than the lognormal distribution.

Approx. Lognormal (Approximately Lognormal): Normal and lognormal assumptions were rejected at the 5 percent level. However, the data fit the lognormal distribution 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.

[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]	DETECTED IN 2008?	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
General Chemistry												
Alkalinity as CaCO3 (mg/L)	17	17	100%	Yes	60.5	683	450	-	422 mg/L(11)	430 mg/L(11)	-	10 mg/L
Ammonia (mg/L)	11	3	27.3%	No	0.109	0.2	0.142	-	4.2 mg/L(0)	4.34 mg/L(0)	220 mg/L(0)	0.1 mg/L
Chloride (mg/L)	17	17	100%	Yes	3.95	41.2	14.2	-	7.3 mg/L(16)	45 mg/L(0)	6300 mg/L(0)	5 mg/L
Nitrate/Nitrite (mg/L)	27	18	66.7%	Yes	0.039	4.1	1.61	11 mg/L[g](0)	11 mg/L(0)	0.29 mg/L(14)	2670 mg/L(0)	1.1 mg/L
Total Dissolved Solids (mg/L)	21	21	100%	Yes	557	3220	1870	-	-	-	-	10 mg/L
Inorganics												
Antimony (mg/L)	11	2	18.2%	Yes	0.00053	0.0006	-	0.006 mg/L(0)	-	-	0.0987 mg/L(0)	0.005 mg/L
Arsenic (mg/L)	11	4	36.4%	Yes	0.00091	0.14	0.0473	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)	11	11	100%	Yes	0.0367	0.228	0.0785	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)	11	3	27.3%	No	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)	17	17	100%	Yes	165	984	561	-	159 mg/L(17)	172 mg/L(16)	1800 mg/L(0)	5 mg/L
Chromium (mg/L)	11	5	45.5%	Yes	0.0009	0.0069	0.0041	0.022 mg/L[g](0)	0.021 mg/L(0)	0.0046 mg/L(3)	0.818 mg/L(0)	0.005 mg/L
Cobalt (mg/L)	11	7	63.6%	Yes	0.000283	0.17	0.0506	0.17 mg/L(0)	0.0086 mg/L(5)	-	0.0886 mg/L(2)	0.034 mg/L
Copper (mg/L)	11	10	90.9%	Yes	0.00093	0.0215	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
Iron (mg/L)	17	16	94.1%	Yes	0.088	253	54.3	-	5.72 mg/L(10)	6.35 mg/L(10)	21.3 mg/L(6)	0.1 mg/L
Lead (mg/L)	11	2	18.2%	No	0.0007	0.0046	-	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)	17	17	100%	Yes	32.4	375	174	-	38.5 mg/L(16)	50.7 mg/L(15)	690 mg/L(0)	5 mg/L
Manganese (mg/L)	17	15	88.2%	Yes	0.0106	12.7	5.17	0.9 mg/L(11)	0.9 mg/L(11)	0.21 mg/L(11)	35 mg/L(0)	0.09 mg/L
Nickel (mg/L)	11	11	100%	Yes	0.00495	0.166	0.0498	0.1 mg/L(2)	0.0514 mg/L(4)	0.0072 mg/L(9)	0.981 mg/L(0)	0.02 mg/L
Potassium (mg/L)	17	17	100%	Yes	3.93	32.3	19.0	-	1.96 mg/L(17)	17.2 mg/L(12)	12400 mg/L(0)	5 mg/L
Selenium (mg/L)	11	6	54.5%	No	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
Sodium (mg/L)	17	17	100%	No	3.32	26.7	14.7	-	47.1 mg/L(0)	50 mg/L(0)	1300 mg/L(0)	5 mg/L
Thallium (mg/L)	11	3	27.3%	No	0.00057	0.0107	0.0041	-	-	-	0.0028 mg/L(1)	0.02 mg/L
Vanadium (mg/L)	11	2	18.2%	No	0.00158	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
Zinc (mg/L)	11	5	45.5%	Yes	0.0152	0.178	0.0667	0.021 mg/L(3)	0.02 mg/L(3)	0.35 mg/L(0)	1.78 mg/L(0)	0.015 mg/L
Radionuclides												
Technetium-99 (pCi/L)	21	1	4.8%	No	21.25	-	-	94 pCi/L(0)	22 pCi/L(0)	30 pCi/L(0)	6130 pCi/L(0)	10 pCi/L
Organics												
Trichlorofluoromethane (ug/L)	11	1	9.1%	No	0.27	-	-	-	-	-	-	1 ug/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 minumun 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.

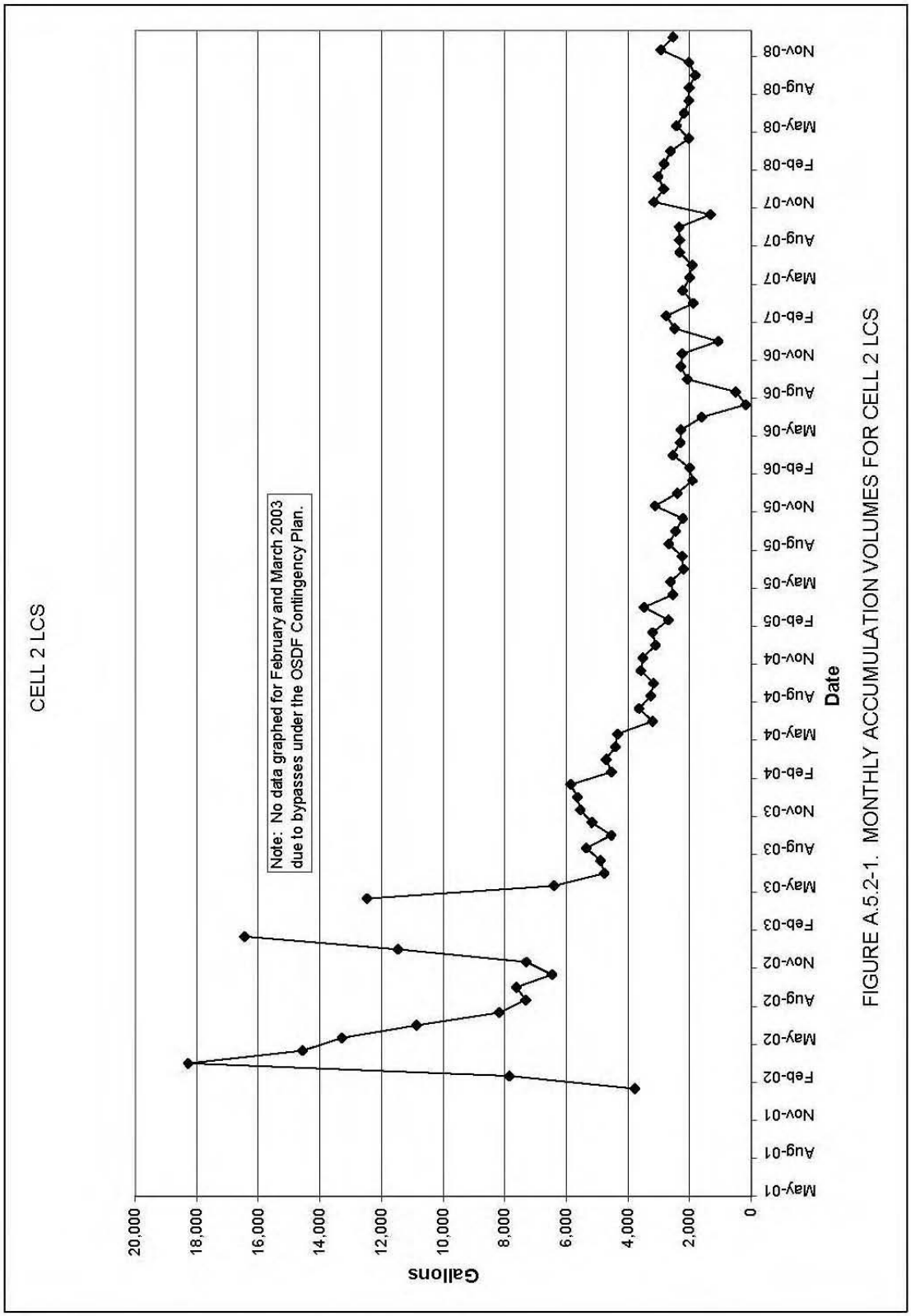


FIGURE A.5.2-1. MONTHLY ACCUMULATION VOLUMES FOR CELL 2 LCS

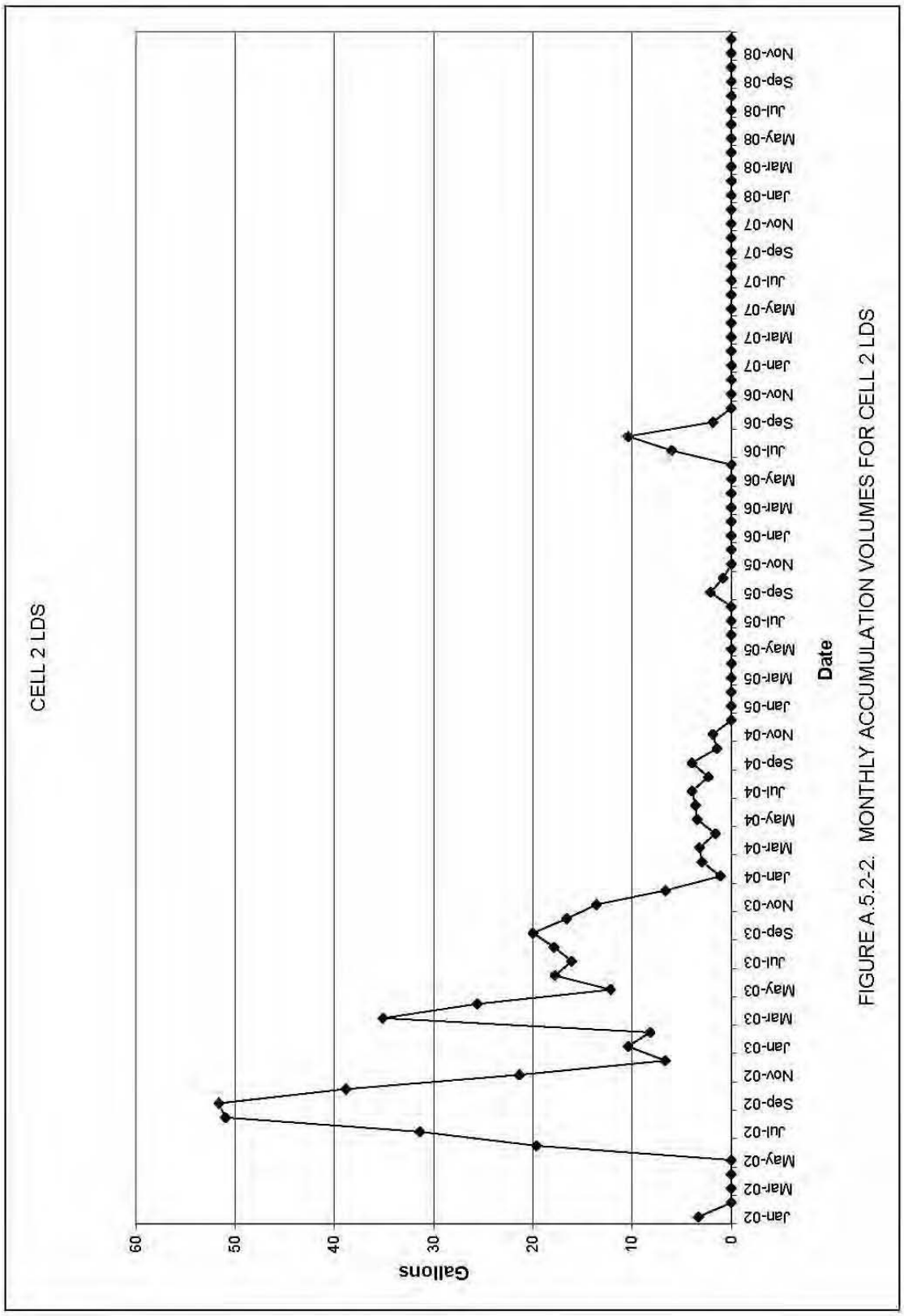
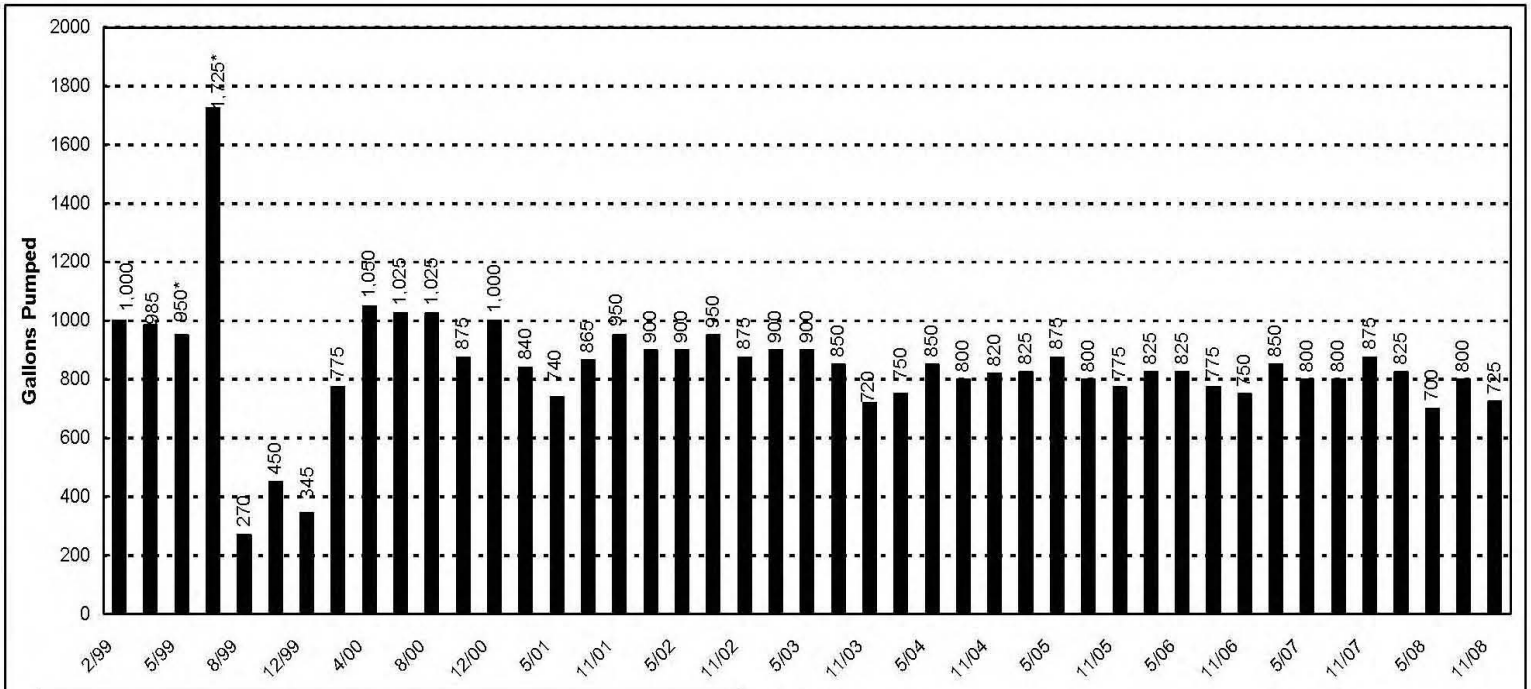


FIGURE A.5.2-2. MONTHLY ACCUMULATION VOLUMES FOR CELL 2 LDS



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
2008:	3050	n=4	763
Overall:			842

*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

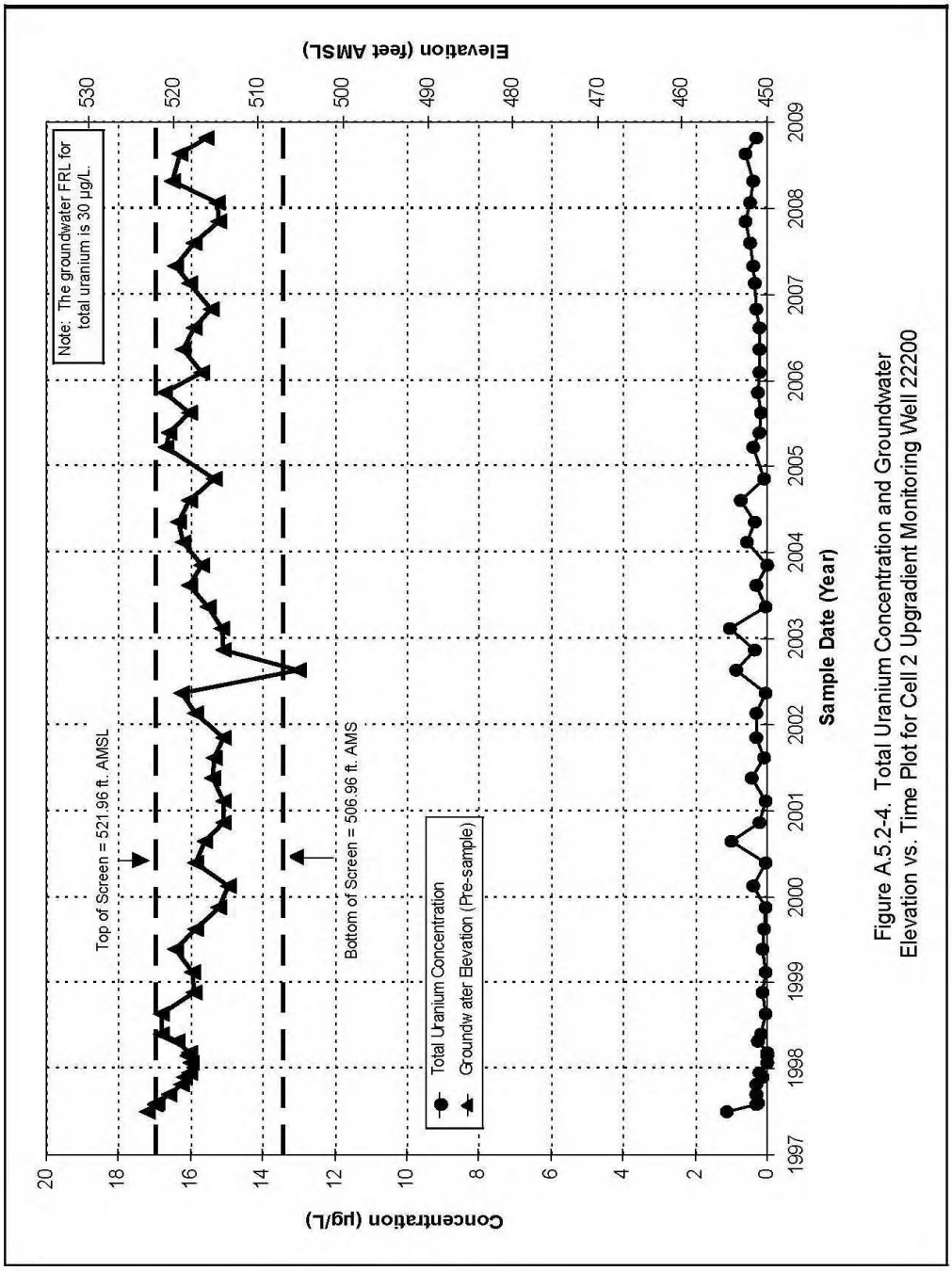


Figure A.5.2-4. Total Uranium Concentration and Groundwater Elevation vs. Time Plot for Cell 2 Upgradient Monitoring Well 22200

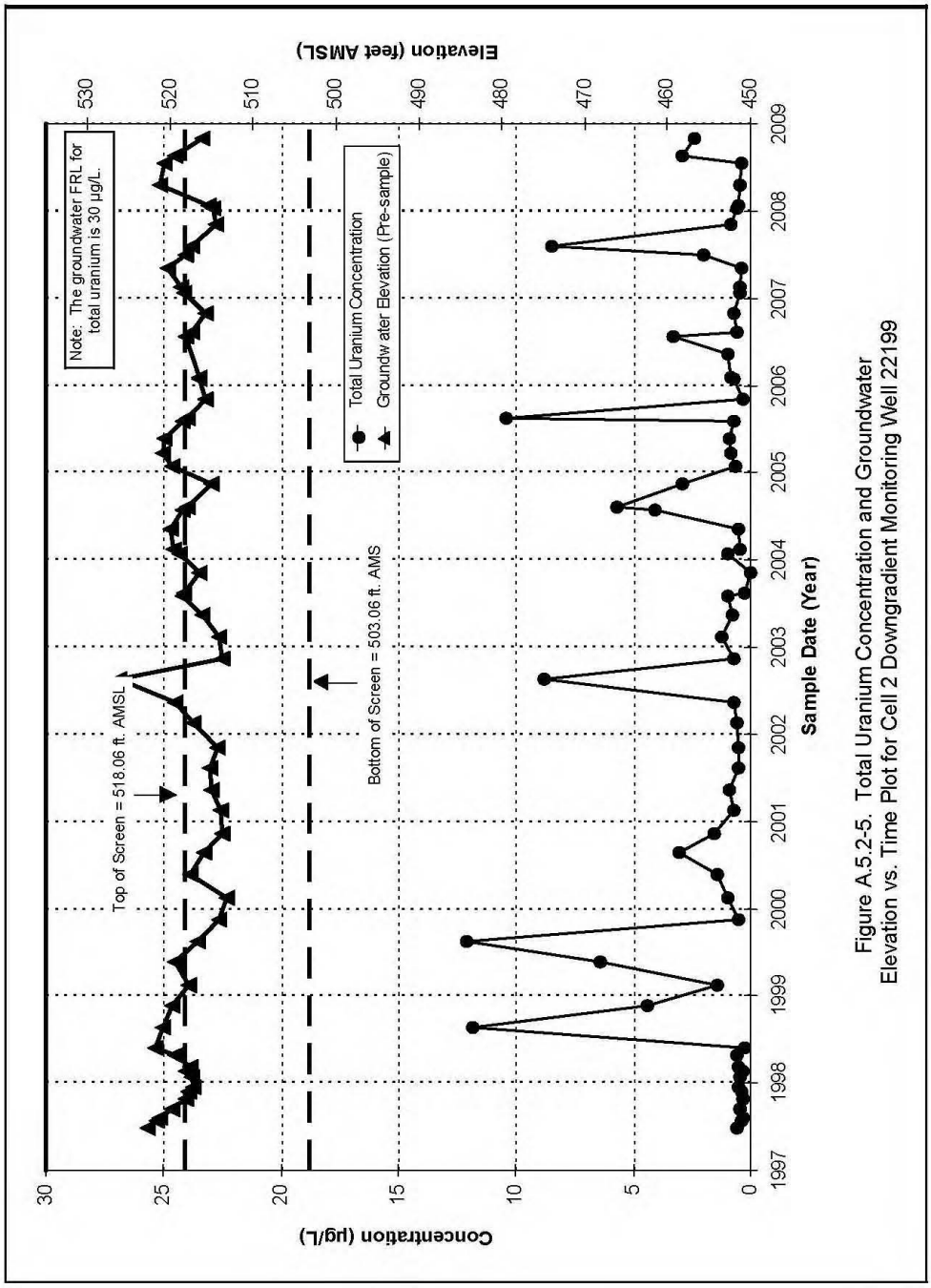


Figure A.5.2-5. Total Uranium Concentration and Groundwater Elevation vs. Time Plot for Cell 2 Downgradient Monitoring Well 22199

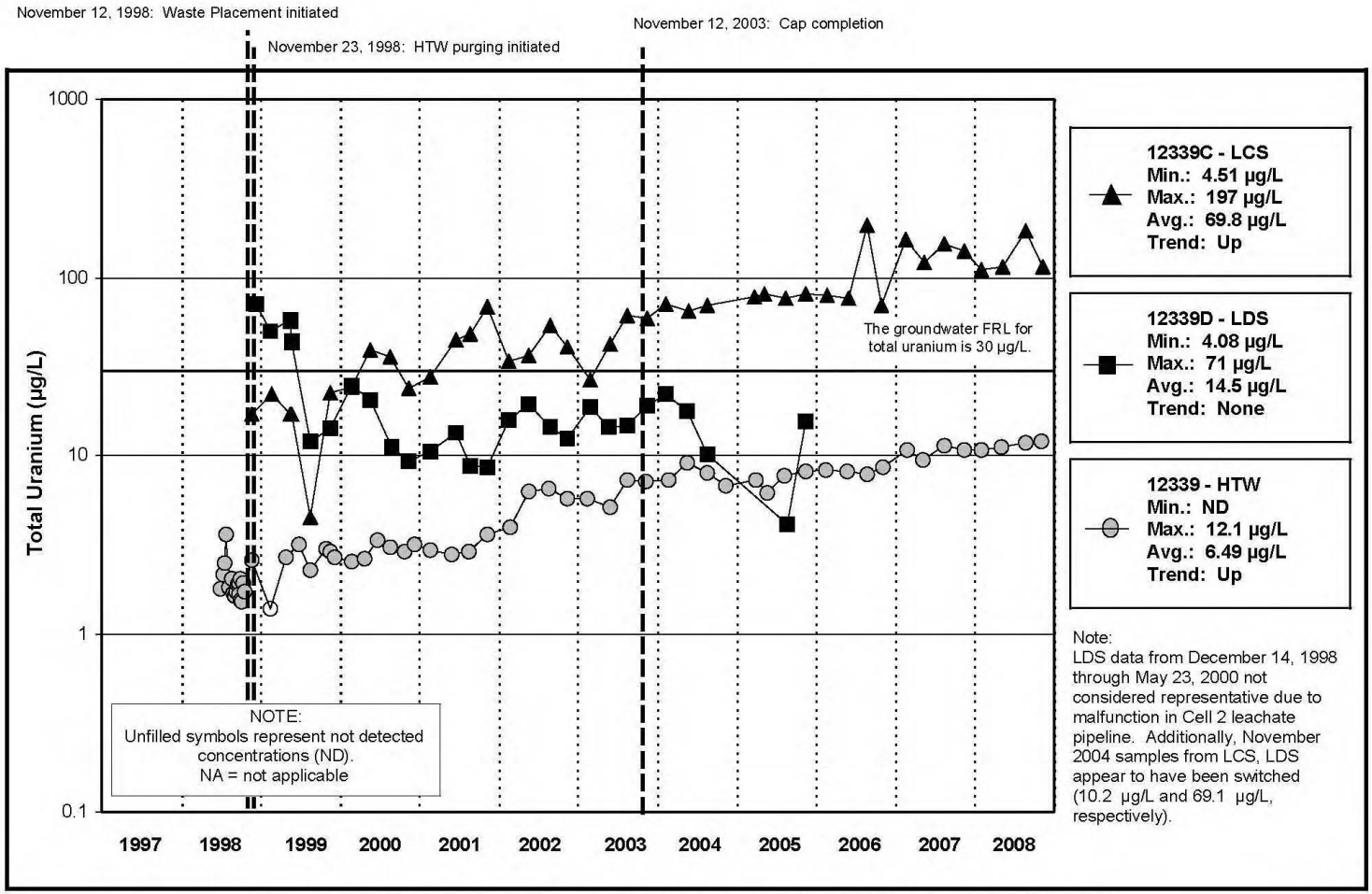


Figure A.5.2-6A. Cell 2 Total Uranium Concentration vs. Time Plot for LCS, LDS, AND HTW

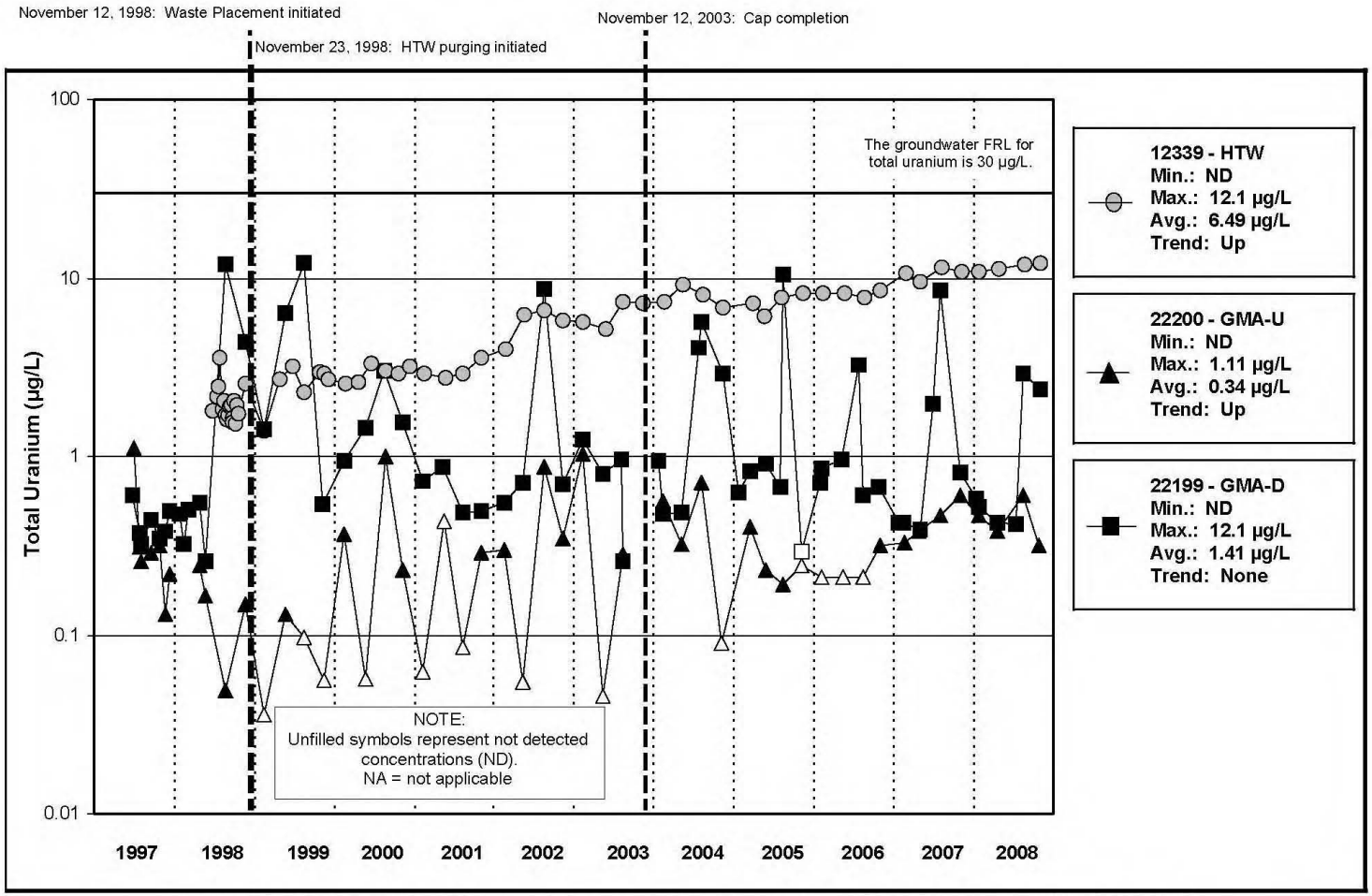


Figure A.5.2-6B. Cell 2 Total Uranium Concentration vs. Time Plot for HTW, GMA-U Well, AND GMA-D Well

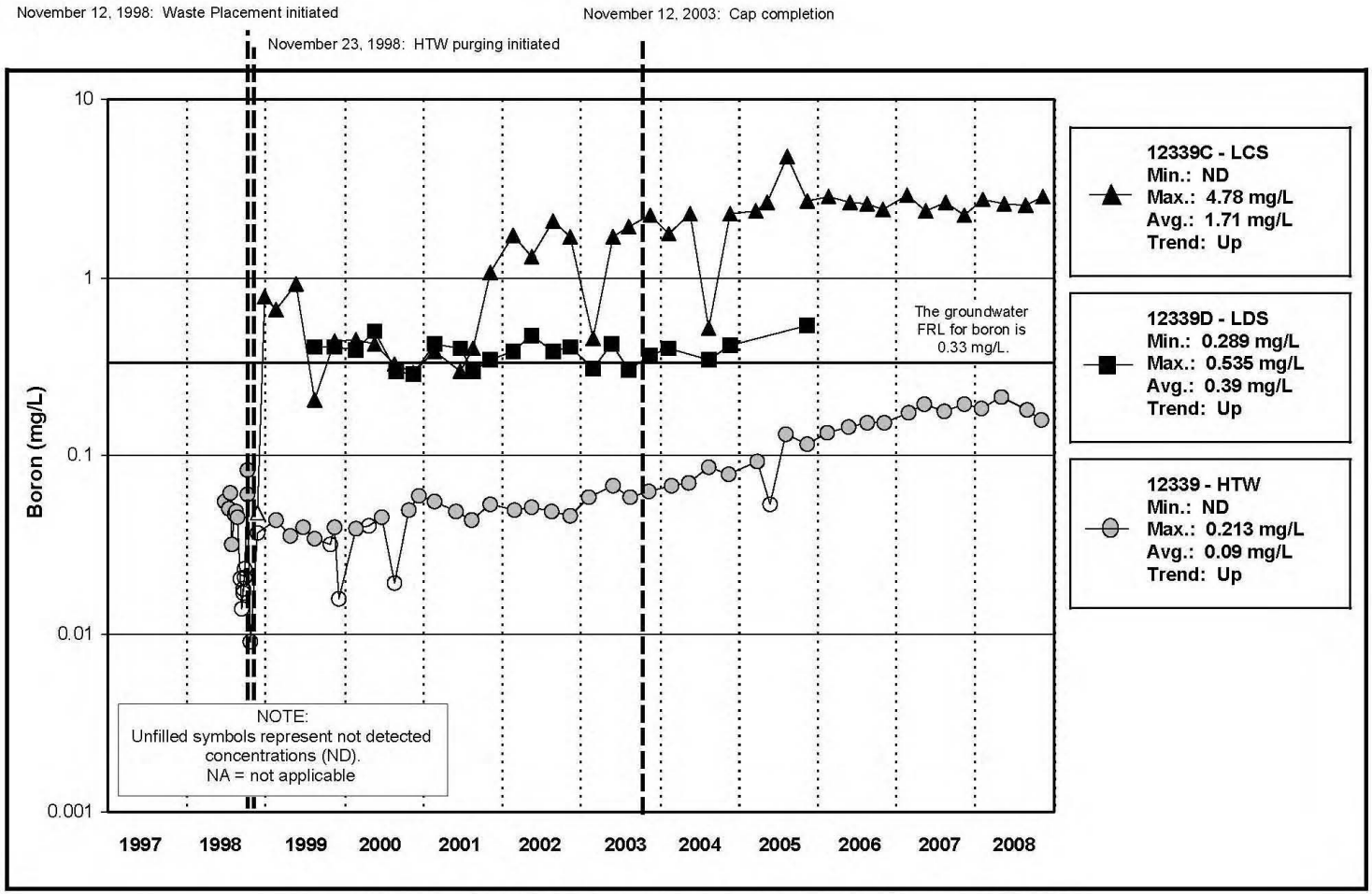


Figure A.5.2-7A. Cell 2 Boron Concentration vs. Time Plot for LCS, LDS, AND HTW

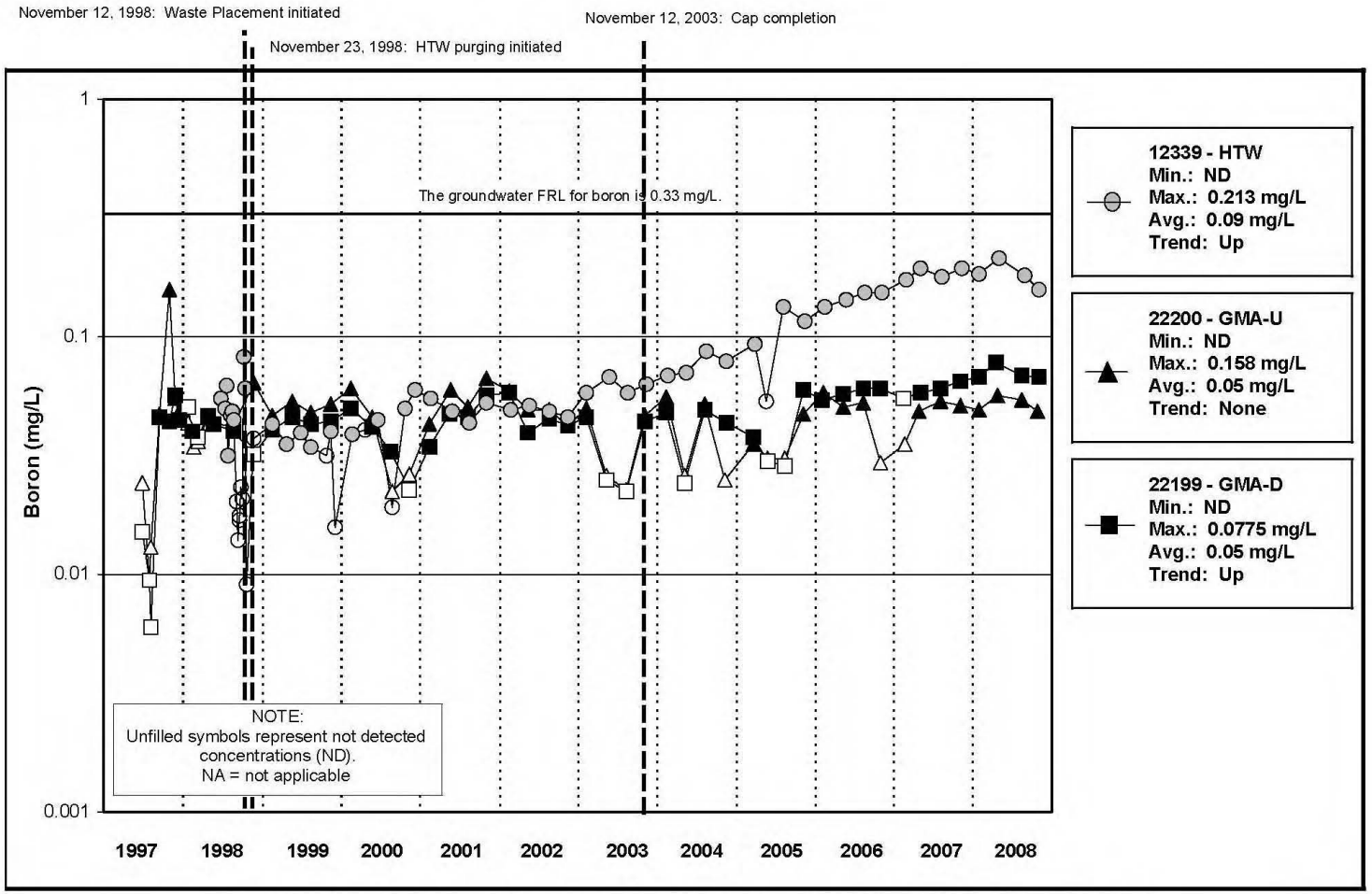


Figure A.5.2-7B. Cell 2 Boron Concentration vs. Time Plot for HTW, GMA-U Well, AND GMA-D Well

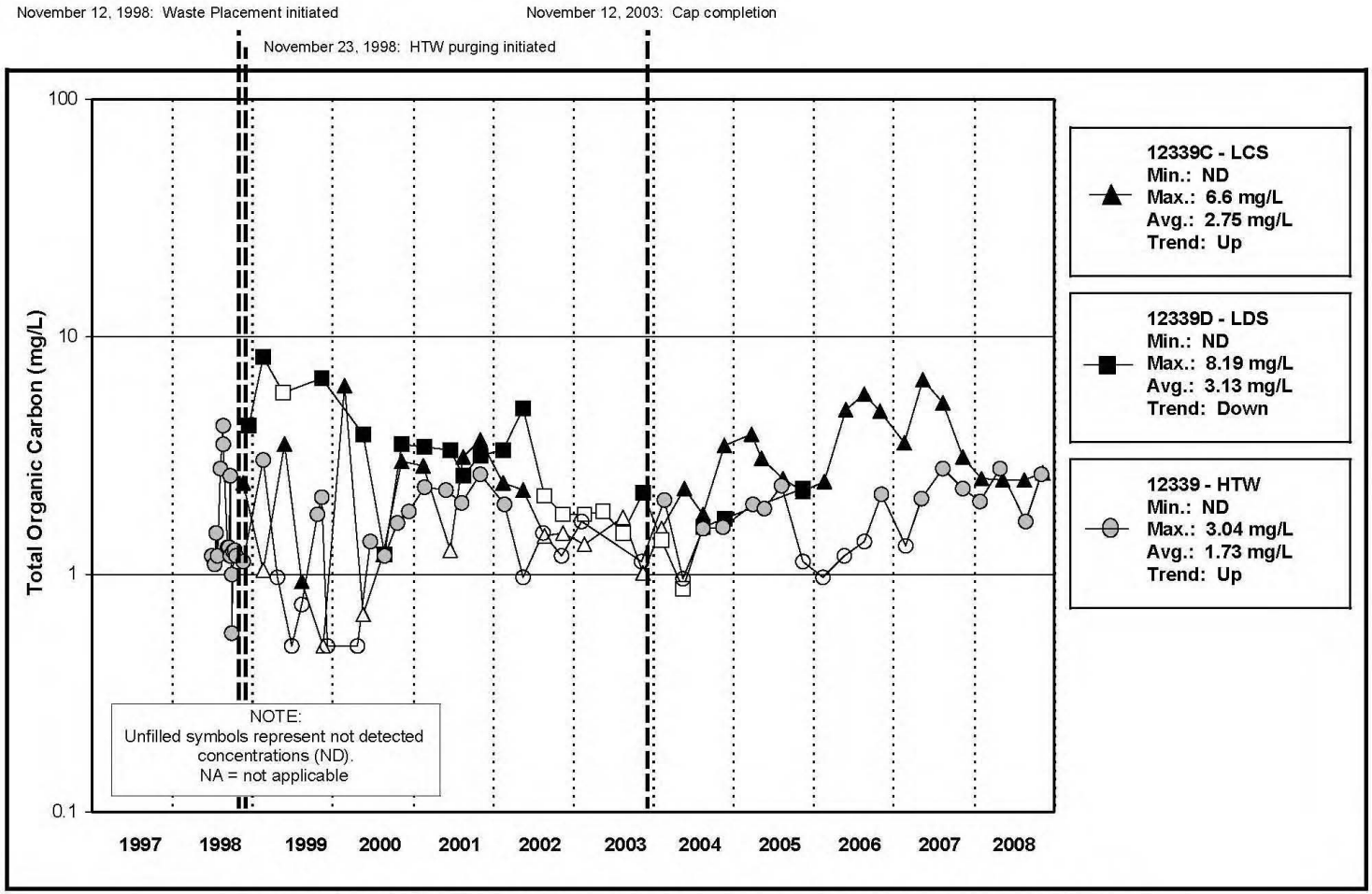


Figure A.5.2-8A. Cell 2 Total Organic Carbon Concentration vs. Time Plot for LCS, LDS, AND HTW

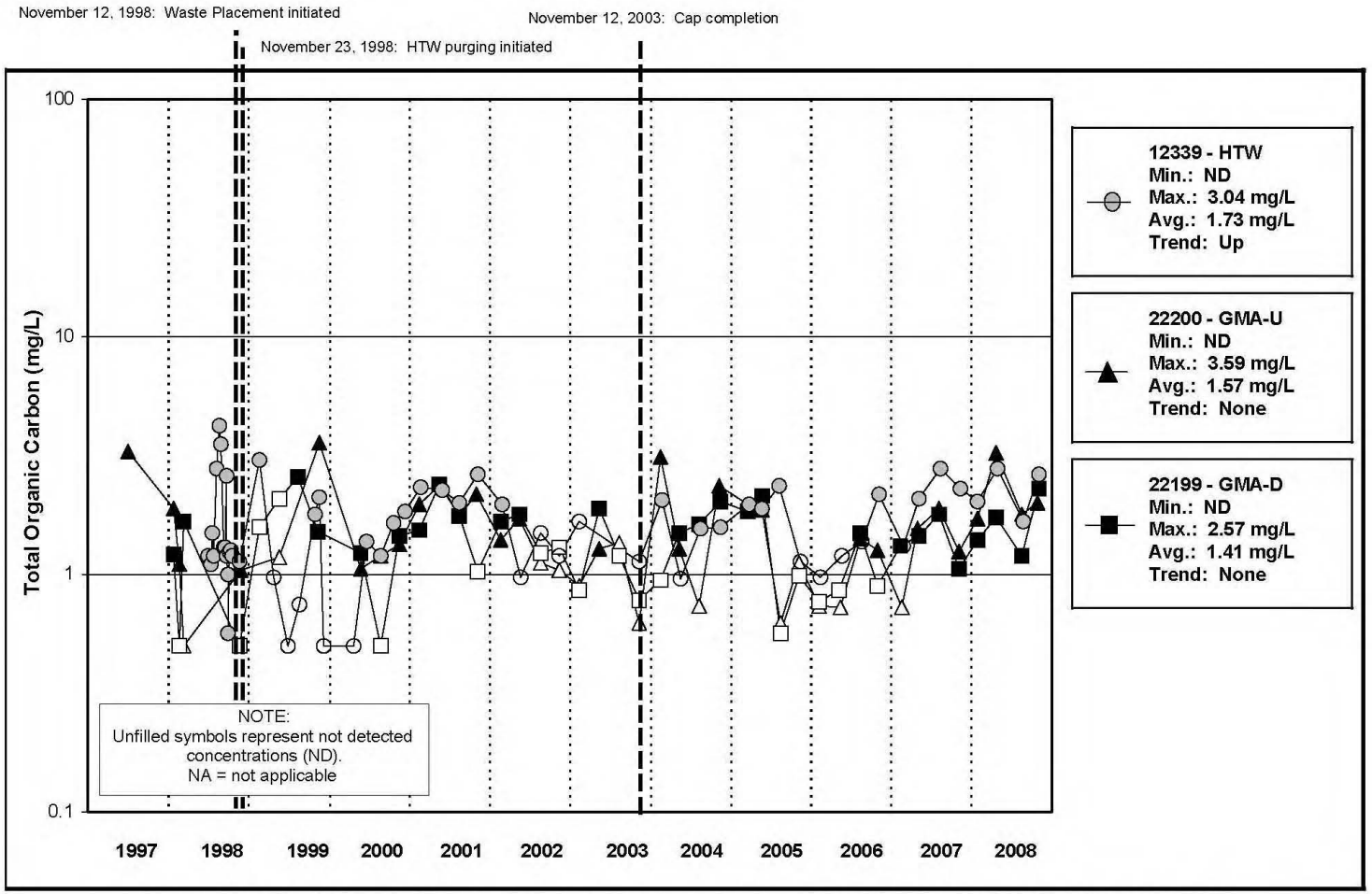


Figure A.5.2-8B. Cell 2 Total Organic Carbon Concentration vs. Time Plot for HTW, GMA-U Well, AND GMA-D Well

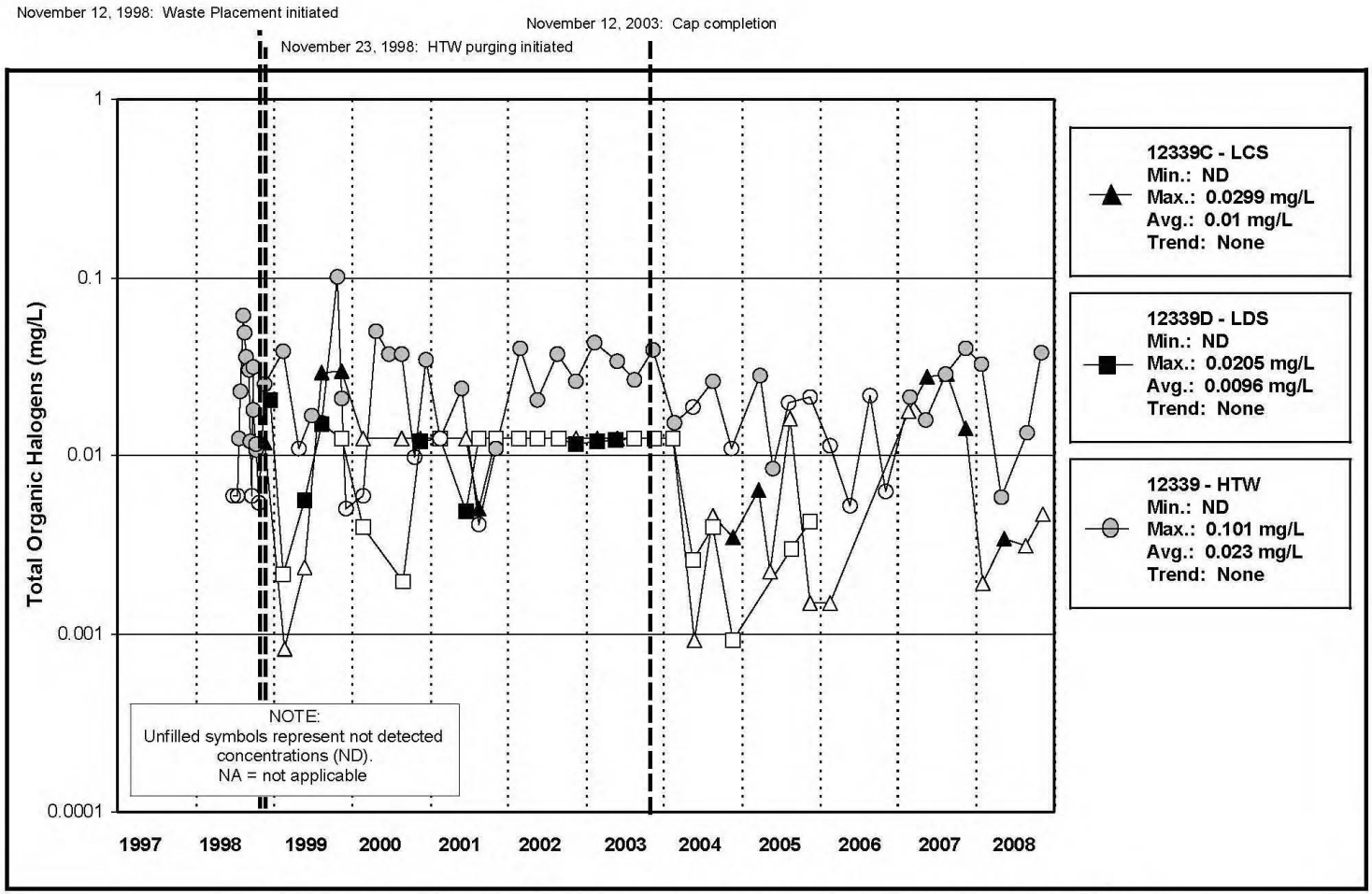


Figure A.5.2-9A. Cell 2 Total Organic Halogens Concentration vs. Time Plot for LCS, LDS, AND HTW

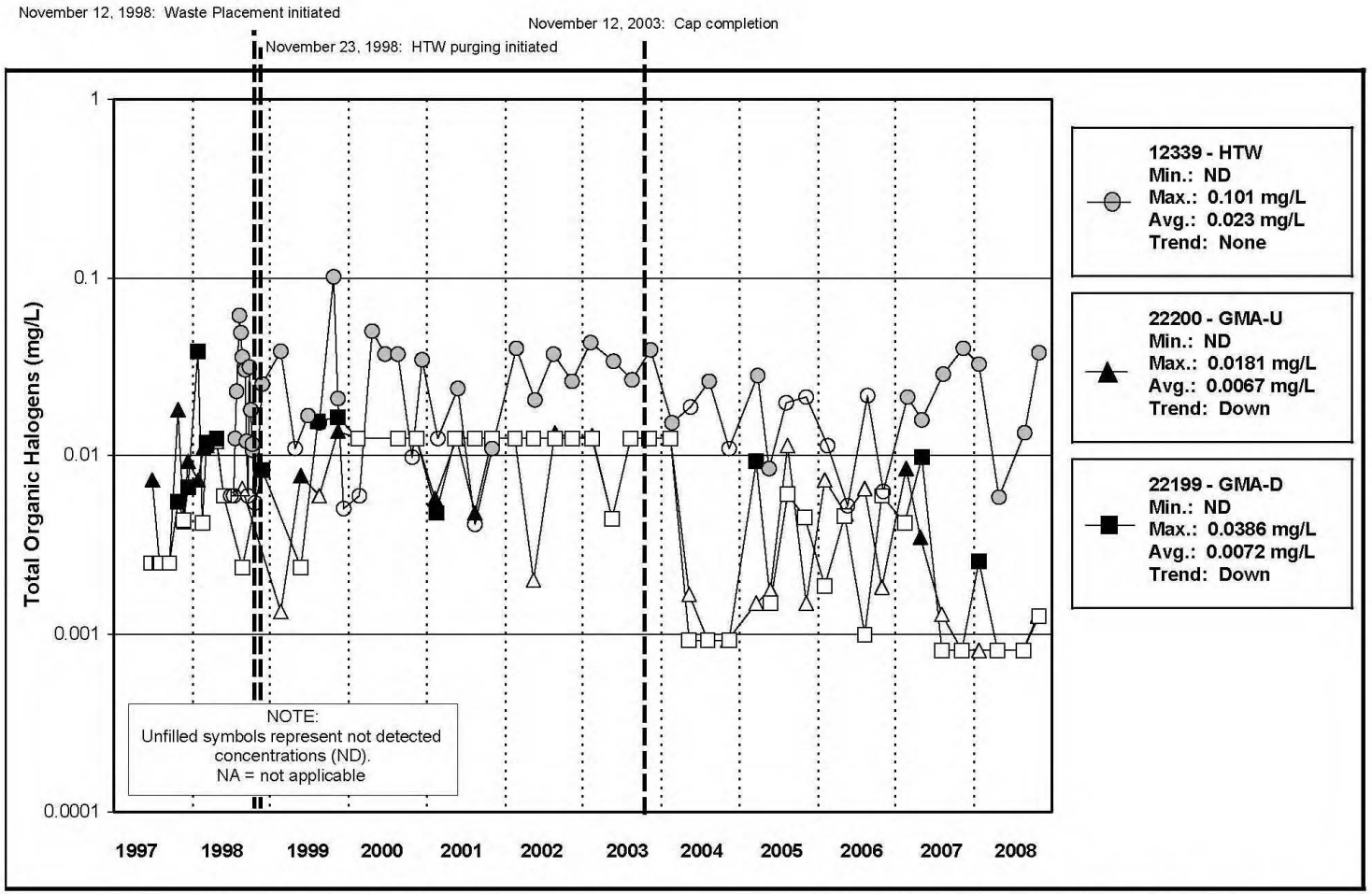


Figure A.5.2-9B. Cell 2 Total Organic Halogens Concentration vs. Time Plot for HTW, GMA-U Well, AND GMA-D Well

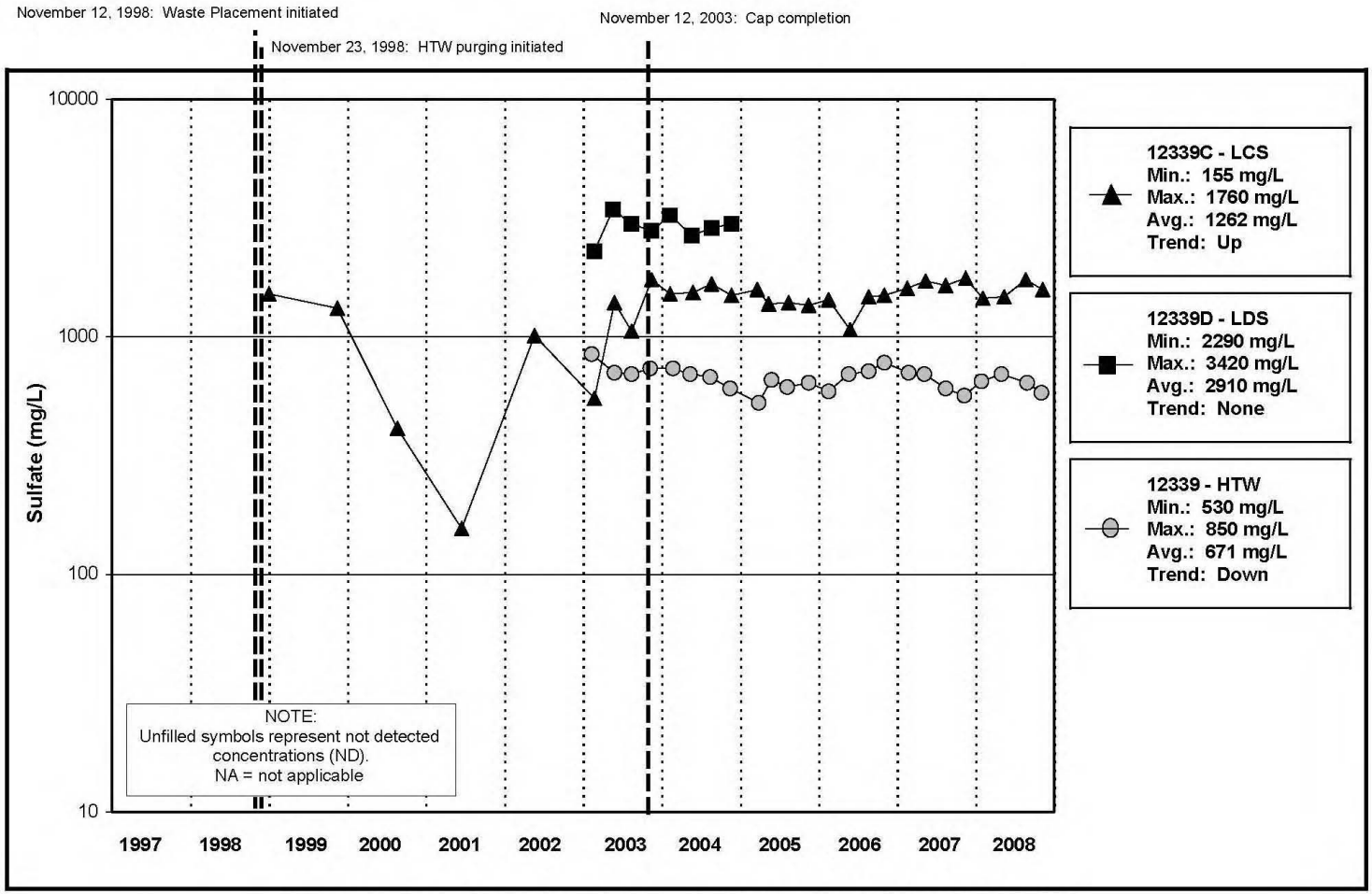


Figure A.5.2-10A. Cell 2 Sulfate Concentration vs. Time Plot for LCS, LDS, AND HTW

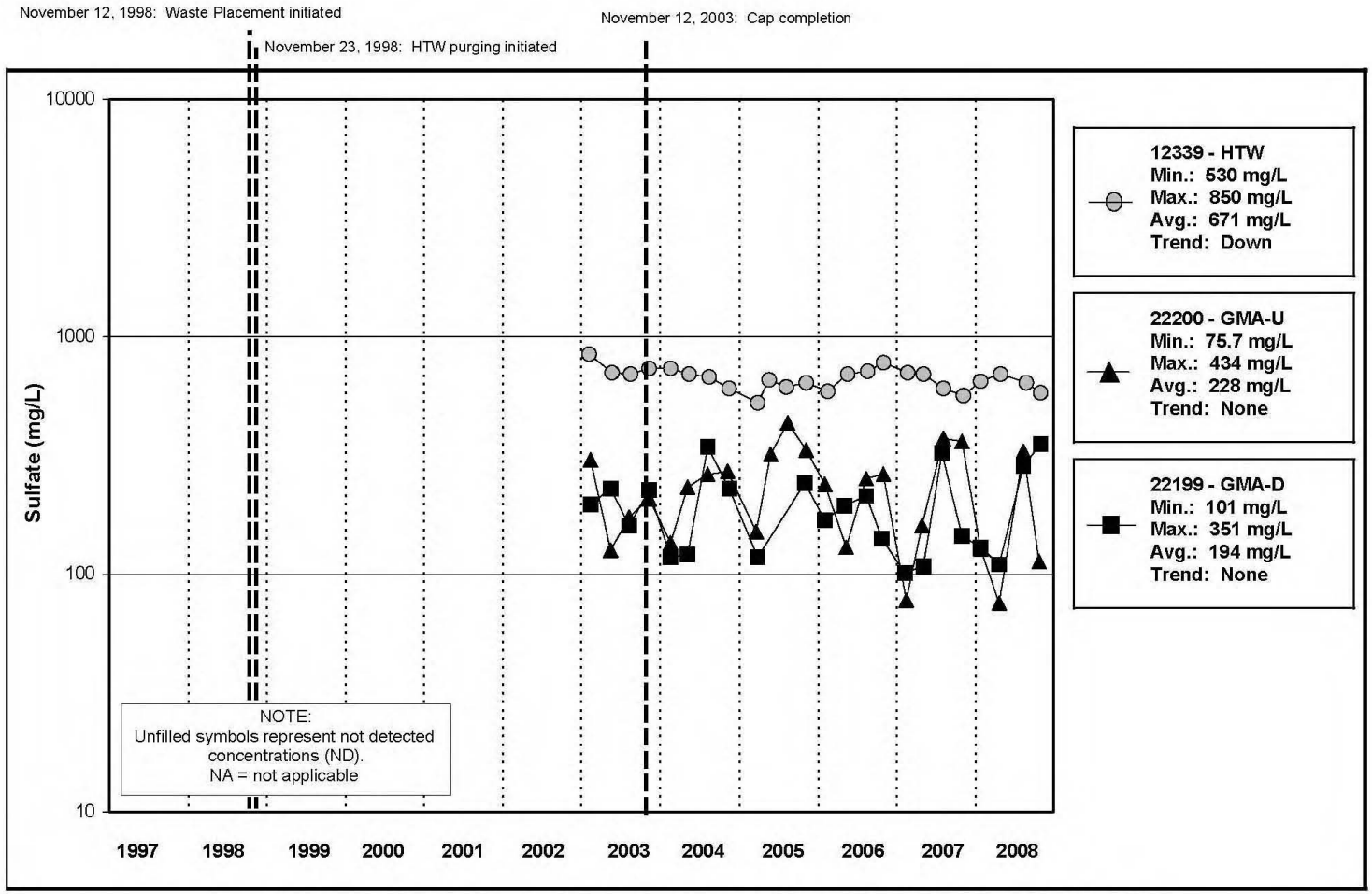


Figure A.5.2-10B. Cell 2 Sulfate Concentration vs. Time Plot for HTW, GMA-U Well, AND GMA-D Well

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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).
- GMA 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).

Samples in 2008 were collected according to the frequencies described in the GWLMP. Constituent sampling lists are provided in Table 2−1, Table 2−2, and Table 2−3 of Appendix B of the GWLMP.

In 2008, monitoring for the LCS also included 1,1-dichloroethene due to the need to conduct confirmatory monitoring identified in the 2007 SER.

A.5.3.1 Refined Baseline Monitoring Results

As defined in the GWLMP, refined baseline constituents are those constituents that have been monitored at least eight times, and detected at least 25 percent of the time in the LCS, LDS, HTW, and GMA wells. A summary statistics table (Table A.5.3−2), and concentration plots (Figures A.5.3-6A and A.5.3-10B) are provided for the five refined baseline constituents of Cell 3: total uranium, boron, TOC, TOX, and sulfate.

Flow in the LDS in 2008 was well below the OSDF design action level, indicating that the water quality trends observed in the HTW and GMA wells in 2008 are attributable to concentration fluctuations taking place beneath the facility and not to a potential leak from the facility.

The 2009 revision of the GWLMP identifies the data evaluation techniques that will be used to further evaluate the association between water quality changes observed beneath the facility and the potential that they are being caused by a leak from the facility. Control charts will be added back to the program along with the use of bivariate plots.

Beginning in January 2009, the refined baseline constituents will become a subset of a larger group of fifteen constituents that will be monitored annually in all four monitoring horizons (LCS, LDS, HTW, and GMA wells) of each cell. Monitoring at the LCS will include all of the 15 constituents listed below, as well as the rest of the initial baseline constituents defined for the facility.

Constituent Sampling List for the LDS, HTW, and GMA Wells of Each Cell in 2009	
Constituent	**Reason**
Boron	Refined Baseline Parameter
Sulfate	Refined Baseline Parameter
Uranium	Refined Baseline Parameter
TOC	Refined Baseline Parameter
TOX	Refined Baseline Parameter
Iron	Common Ion Study[a]
Manganese	Common Ion Study[a]
Sodium	Common Ion Study[a]
Lithium	Common Ion Study[a]
Arsenic	Appendix I Statistical Analysis
Cobalt	Appendix I Statistical Analysis
Nickel	Appendix I Statistical Analysis
Selenium	Appendix I Statistical Analysis
TDS	Appendix I Statistical Analysis
Zinc	Appendix I Statistical Analysis

[a] Also known as the *Evaluation of Aqueous Ions in the Monitoring Systems of the On-Site Disposal Facility* (DOE 2008b)

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. Even though active operations ended in 2006, this sampling continued in 2007 and 2008.

In 2008, annual sampling of the Cell 3 LCS took place in February. Table A.5.3−3 summarizes the annual LCS sampling results for Cell 3 along with the data collected in previous years. Table A.5.3-3 presents the non-refined baseline site-specific constituents that were monitored in 2008. All of the constituents listed have been monitored for at least eight times, and 20 of them have been detected at least 25 percent of the time.

The potential monitoring usefulness of eleven of the 20 constituents (alkalinity, cadmium, calcium, chloride, iron, magnesium, manganese, nitrate/nitrite, potassium, sodium, and vanadium) was addressed in the Common Ion Study. The potential monitoring usefulness of the other nine constituents (1,1-dichloroethene, barium, chromium, cobalt, copper, nickel, selenium, TDS, and zinc) was addressed by a statistical analysis that was presented in the 2007 SER (see Table A.5.3-4 in the 2007 SER).

Confirmatory Sampling in the LCS

In 2009, confirmatory sampling procedures were modified in the GWLMP. Because confirmatory sampling identified in 2008 will take place in 2009, the modified procedure will be followed. Therefore, if a constituent was detected in the 2008 LCS sample that was not going to be monitored in the LDS in 2009, that constituent was added for confirmatory monitoring in 2009.

Two consecutive detects for that constituent in the cell's LCS will trigger monitoring for that constituent in the cell's LDS during the next scheduled sampling event. However, if the usefulness of the constituent as a monitoring constituent has already been rejected through the Common Ion Study or the Appendix I constituent statistics presented in the 2007 SER, the constituent will not be added for confirmatory monitoring.

In 2008, 4-nitroaniline and vinyl chloride were detected in the Cell 3 LCS. Detection of either constituent in the Cell 3 LCS in 2009 would count as two consecutive hits and trigger sampling for both constituents in the Cell 3 LDS beginning in 2010.

A.5.3.3 LDS Monitoring Results

In 2008, the LDS of Cell 3 was monitored for site-specific constituents listed in Table 2−1 of Appendix B of the GWLMP. The objective of the sampling was to determine if any initial baseline constituents, not on the refined baseline list, were present in the LDS. In 2008, sampling of the Cell 3 LDS took place in February.

Results of the LDS monitoring at Cell 3 in 2008 indicate that all of the initial baseline constituents that have been monitored in the Cell 3 LDS and detected at least 25 percent of the time are being monitored in the Cell 3 HTW and GMA wells in 2009 with the exception of molybdenum. Molybdenum was not added to the monitoring program in 2009 because it was concluded in the Common Ion Report that it would not make a useful monitoring constituent due to the similar concentrations being detected in the different monitoring horizons.

Table A.5.3−1. Cell 3 – 2008 Monthly Liner Efficiencies

Month	Cell 3 Apparent Liner Efficiency (%)
January	100.00
February	100.00
March	100.00
April	100.00
May	99.97
June	100.00
July	100.00
August	100.00
September	100.00
October	100.00
November	100.00
December	100.00

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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]
Total Uranium (µg/L)	LCS	12340C	36	36	100	54.7	Undefined	Up, Significant	Detected	
	LDS	12340D	20	20	100	17.0	Normal	Down, Significant	Not Detected	
	HTW	12340	40	40	100	17.2	Undefined	Up, Significant	Detected	
	GMA-U	22203	39	42	92.9	1.86	Lognormal	No Significant	Detected	
	GMA-D	22204	41	42	97.6	4.01	Lognormal	Up, Significant	Detected	
Boron (mg/L)	LCS	12340C	37	38	97.4	2.87	Undefined	Up, Significant	Detected	
	LDS	12340D	19	20	95	0.2	Undefined	Down, Significant	Detected	
	HTW	12340	40	40	100	0.13	Lognormal	No Significant	Detected	0.96 (Q3-06)
	GMA-U	22203	31	42	73.8	0.04	Undefined	No Significant	Not Detected	
	GMA-D	22204	35	42	83.3	0.04	Normal	Up, Significant	Detected	0.0887 (Q3-99)
Total Organic Carbon (mg/L)	LCS	12340C	23	35	65.7	1.95	Normal	No Significant	Marg. Detect	17.4 (Q4-99)
	LDS	12340D	17	21	81	5.36	Undefined	No Significant	Not Detected	
	HTW	12340	29	39	74.4	2.0	Normal	Up, Marginal	Not Detected	9.81 (Q1-00)
	GMA-U	22203	28	42	66.7	1.49	Normal	No Significant	Not Detected	5.66 (Q1-00) 14.1(Q4-00)
	GMA-D	22204	25	42	59.5	1.43	Normal	No Significant	Not Detected	8.83 (Q1-00)
Total Organic Halogens (mg/L)	LCS	12340C	11	37	29.7	0.016	Undefined	No Significant	Detected	0.141 (Q4-99)
	LDS	12340D	10	20	50.0	0.02	Normal	No Significant	Not Detected	0.0838 (Q1-06)
	HTW	12340	29	41	70.7	0.018	Undefined	Down, Marginal	Detected	0.0670 (Q4-99)
	GMA-U	22203	17	42	40.5	0.007	Undefined	Down, Significant	Detected	0.213 (Q2-00)
	GMA-D	22204	9	42	21.4	0.007	Undefined	Down, Significant	Detected	0.165 (Q2-00)
Sulfate (mg/L)	LCS	12340C	28	28	100	1380	Normal	Up, Significant	Not Detected	
	LDS	12340D	19	19	100	1500	Undefined	Down, Significant	Not Detected	
	HTW	12340	24	24	100	715	Undefined	No Significant	Not Detected	
	GMA-U	22203	24	24	100	276	Lognormal	Down, Significant	Detected	735 (Q1-04)
	GMA-D	22204	24	24	100	524	Normal	No Significant	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 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 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.

[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.5.3−3. 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]	DETECTED IN 2008?	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
General Chemistry												
Alkalinity as CaCO3 (mg/L)	17	17	100%	Yes	72	1080	439	-	422 mg/L(11)	430 mg/L(11)	-	10 mg/L
Chloride (mg/L)	17	17	100%	Yes	4.7	42.8	26.4	-	7.3 mg/L(15)	45 mg/L(0)	6300 mg/L(0)	5 mg/L
Nitrate/Nitrite (mg/L)	24	16	66.7%	No	0.024	2.2	0.860	11 mg/L[h](0)	11 mg/L(0)	0.29 mg/L(13)	2670 mg/L(0)	1.1 mg/L
Total Dissolved Solids (mg/L)	18	18	100%	Yes	233	3210	1690	-	-	-	-	10 mg/L
Inorganics												
Arsenic (mg/L)	11	1	9.1%	No	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)	11	11	100%	Yes	0.0307	0.118	0.0536	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)	11	1	9.1%	No	0.0002	-	-	0.004 mg/L(0)	-	-	0.0343 mg/L(0)	0.001 mg/L
Cadmium (mg/L)	11	3	27.3%	Yes	0.000065	0.00044	0.0002	0.014 mg/L(0)	0.014 mg/L(0)	-	0.05 mg/L(0)	0.002 mg/L
Calcium (mg/L)	17	17	100%	Yes	50.3	1200	490	-	159 mg/L(13)	172 mg/L(13)	1800 mg/L(0)	5 mg/L
Chromium (mg/L)	11	6	54.5%	Yes	0.00093	0.006	0.0027	0.022 mg/L[h](0)	0.021 mg/L(0)	0.0046 mg/L(2)	0.818 mg/L(0)	0.005 mg/L
Cobalt (mg/L)	11	6	54.5%	Yes	0.000288	0.0431	0.0172	0.17 mg/L(0)	0.0086 mg/L(4)	-	0.0886 mg/L(0)	0.034 mg/L
Copper (mg/L)	11	11	100%	Yes	0.00118	0.016	0.0082	1.3 mg/L(0)	0.035 mg/L(0)	0.029 mg/L(0)	0.298 mg/L(0)	0.008 mg/L
Iron (mg/L)	17	16	94.1%	Yes	0.205	16.6	3.81	-	5.72 mg/L(3)	6.35 mg/L(2)	21.3 mg/L(0)	0.1 mg/L
Lead (mg/L)	11	1	9.1%	No	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)	17	17	100%	Yes	10.2	380	148	-	38.5 mg/L(13)	50.7 mg/L(13)	690 mg/L(0)	5 mg/L
Manganese (mg/L)	17	16	94.1%	Yes	0.0014	7.27	3.40	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)	11	11	100%	Yes	0.0021	0.0918	0.0298	0.1 mg/L(0)	0.0514 mg/L(3)	0.0072 mg/L(7)	0.981 mg/L(0)	0.02 mg/L
Potassium (mg/L)	17	17	100%	No	0.575	31.9	19.6	-	1.96 mg/L(16)	17.2 mg/L(12)	12400 mg/L(0)	5 mg/L
Selenium (mg/L)	11	3	27.3%	No	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
Sodium (mg/L)	17	17	100%	Yes	4.35	49.9	20.6	-	47.1 mg/L(1)	50 mg/L(0)	1300 mg/L(0)	5 mg/L
Thallium (mg/L)	11	1	9.1%	No	0.0021	-	-	-	-	-	0.0028 mg/L(0)	0.02 mg/L
Vanadium (mg/L)	11	3	27.3%	Yes	0.0034	0.00959	0.0056	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)	11	6	54.5%	Yes	0.0144	0.0278	0.0203	0.021 mg/L(3)	0.02 mg/L(3)	0.35 mg/L(0)	1.78 mg/L(0)	0.015 mg/L
Radionuclides												
Technetium-99 (pCi/L)	20	2	10%	No	3.84	9.89	-	94 pCi/L(0)	22 pCi/L(0)	30 pCi/L(0)	6130 pCi/L(0)	10 pCi/L
Organics												
Bromodichloromethane (ug/L)	19	1	5.3%	No	0.5	-	-	100 ug/L(0)	-	-	-	1 ug/L
Chlorodibromomethane (ug/L)	11	1	9.1%	No	1	-	-	-	-	-	-	1 ug/L
1,1-Dichloroethane (ug/L)	10	2	20%	No	0.351	0.79	-	280 ug/L(0)	-	-	-	1 ug/L
1,1-Dichloroethene (ug/L)	27[g]	10	37%	Yes[g]	0.112	13.1	4.45	7 ug/L(3)	-	-	-	1 ug/L
trans-1,3-Dichloropropene (ug/L)	10	1	10%	No	1	-	-	-	-	-	-	1 ug/L
4-Nitroaniline	18	1	5.6%	Yes	2.94	-	-	-	-	-	-	3 ug/L
1,1,1-Trichloroethane (ug/L)	11	2	18.2%	No	0.54	0.64	-	-	-	-	-	1 ug/L
Vinyl chloride (ug/L)	19	2	10.5%	Yes	0.539	16.1	-	2 ug/L(1)	-	-	-	1 ug/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 minumun 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] 1,1-Dichloroethene was monitored in second quarter 2008 as required under the OSDF PSP to verify an earlier detection.

[h] FRL based on hexavalent chromium and nitrate, from Operable Unit 5 Record of Decision, Table 9-4.

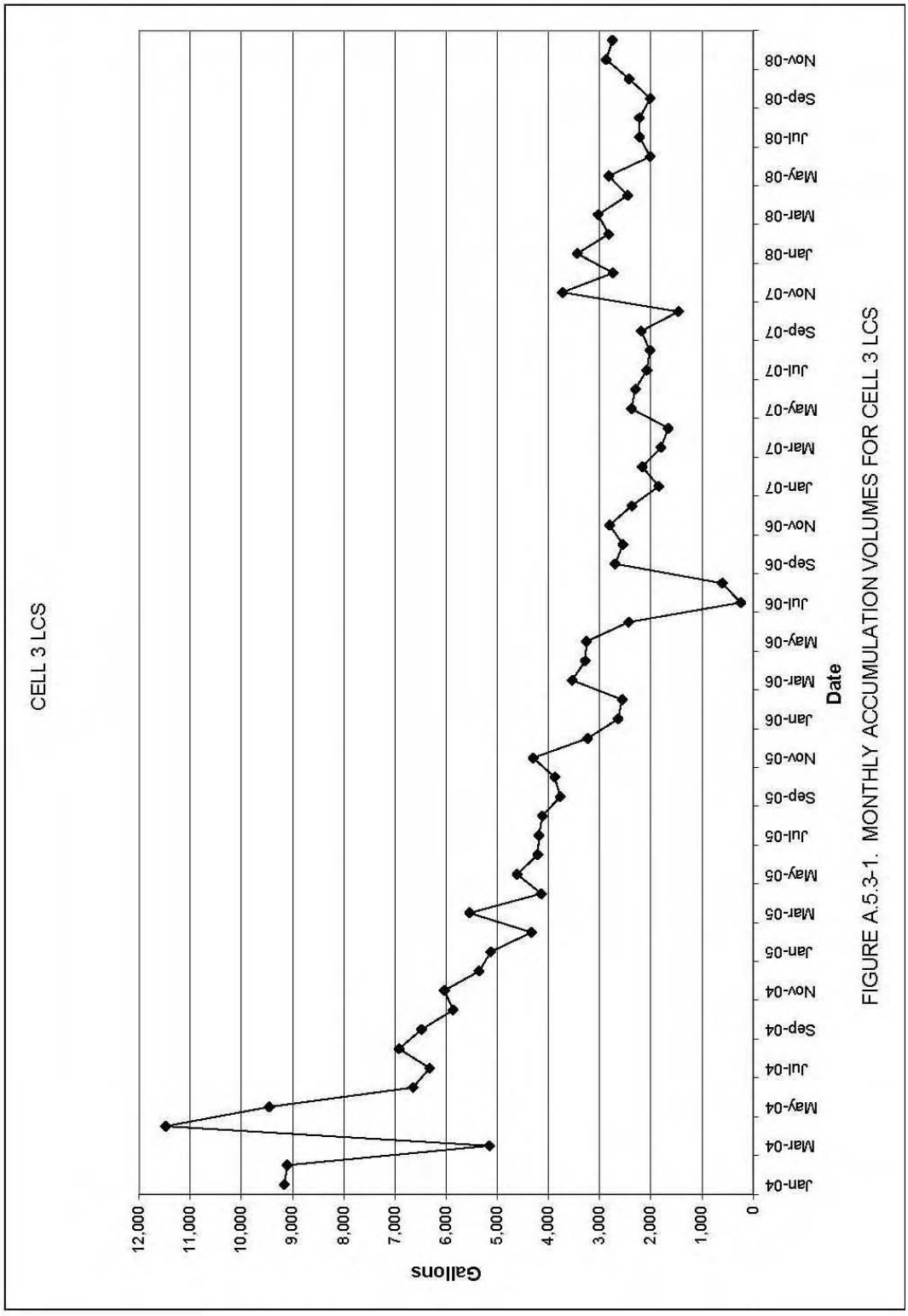


FIGURE A.5.3-1. MONTHLY ACCUMULATION VOLUMES FOR CELL 3 LCS

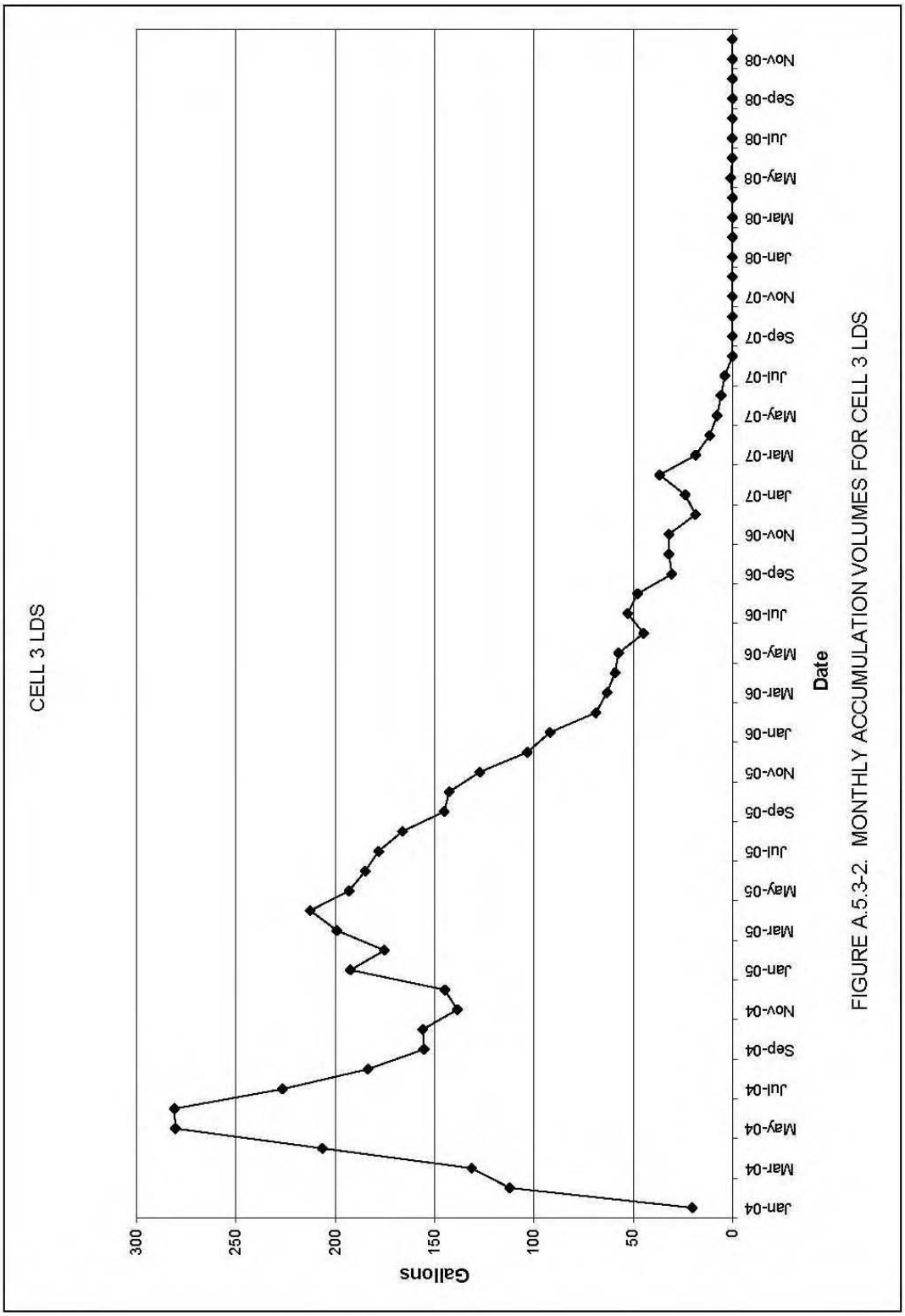
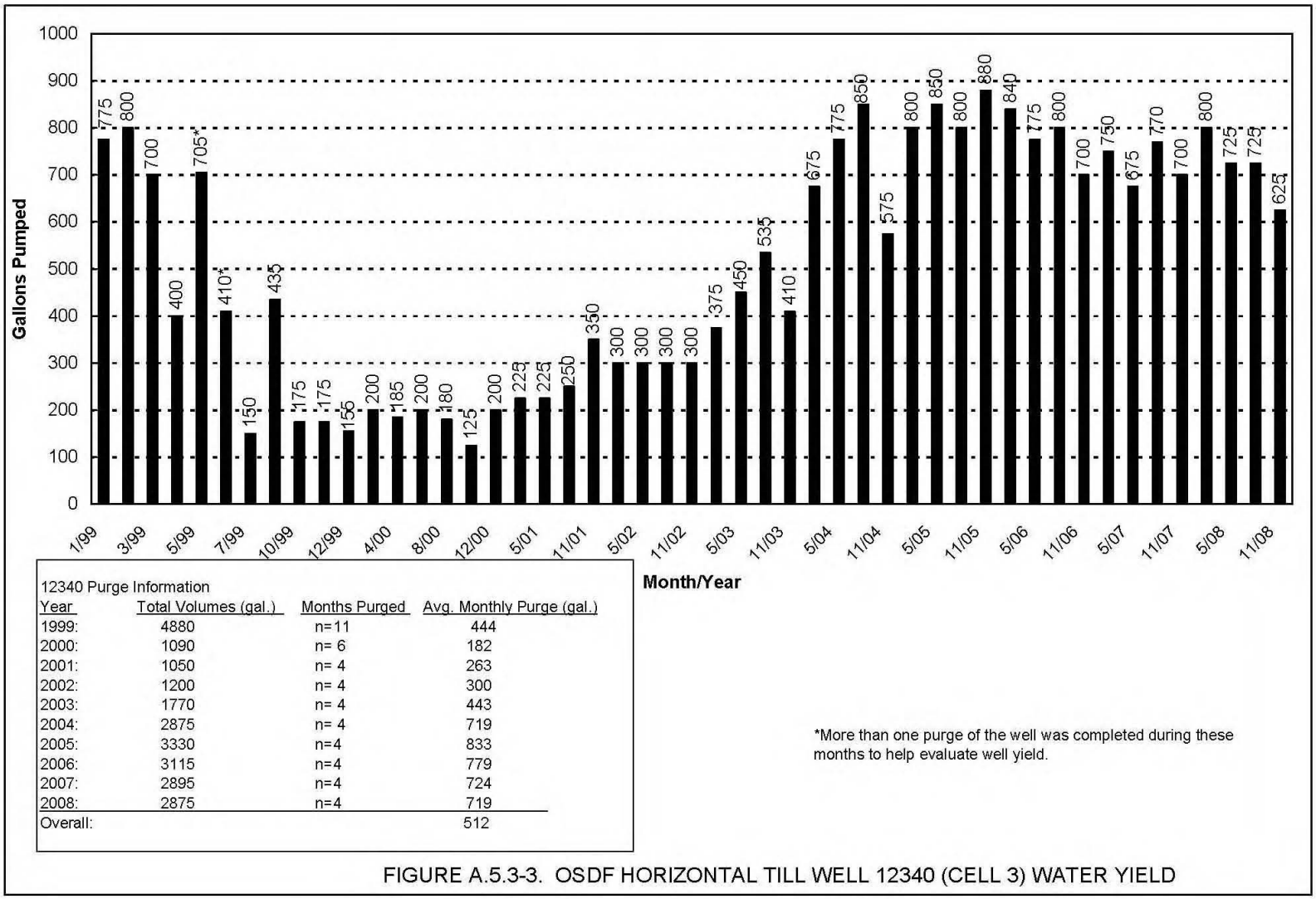


FIGURE A.5.3-2. MONTHLY ACCUMULATION VOLUMES FOR CELL 3 LDS



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
2008:	2875	n=4	719
Overall:			512

*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

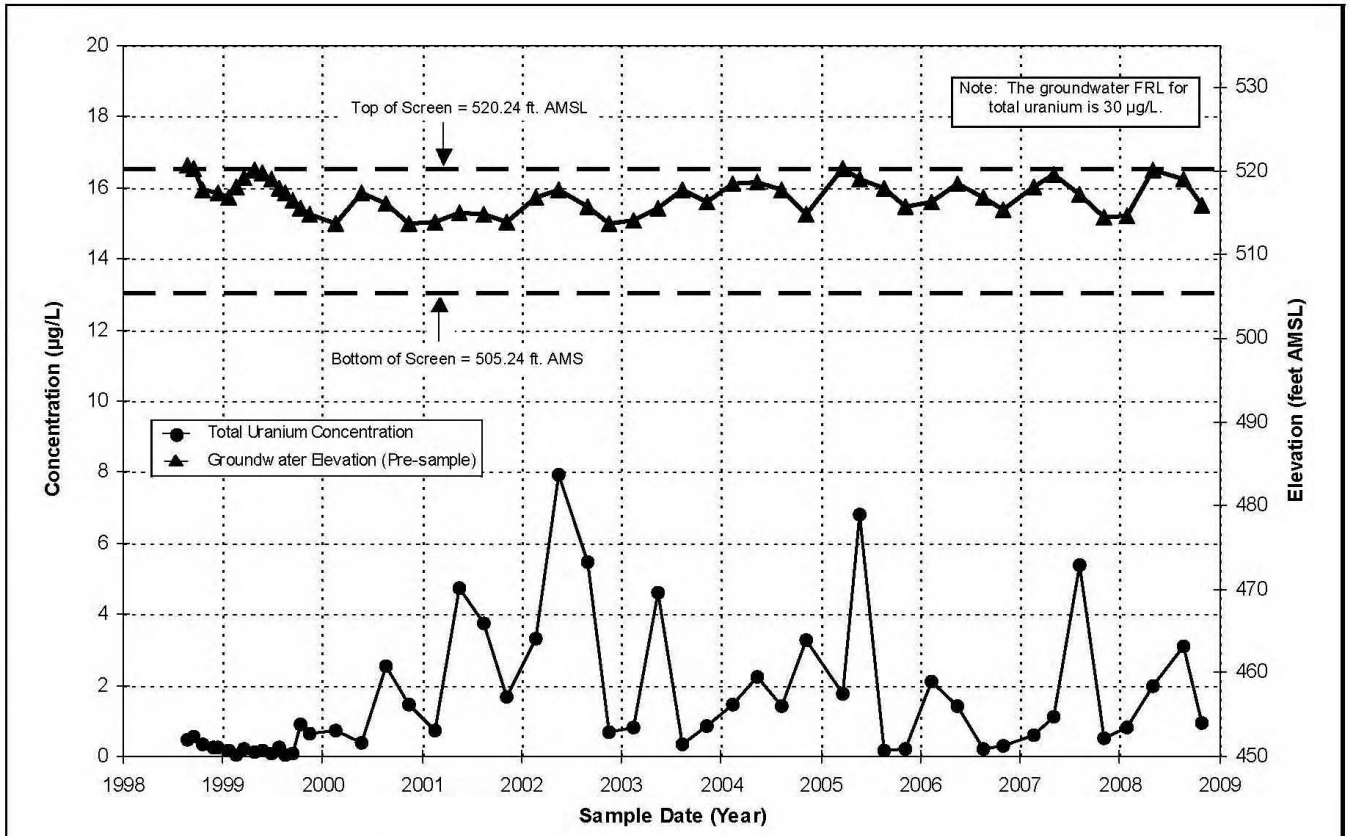


Figure A.5.3-4. Total Uranium Concentration and Groundwater Elevation vs. Time Plot for Cell 3 Upgradient Monitoring Well 22203

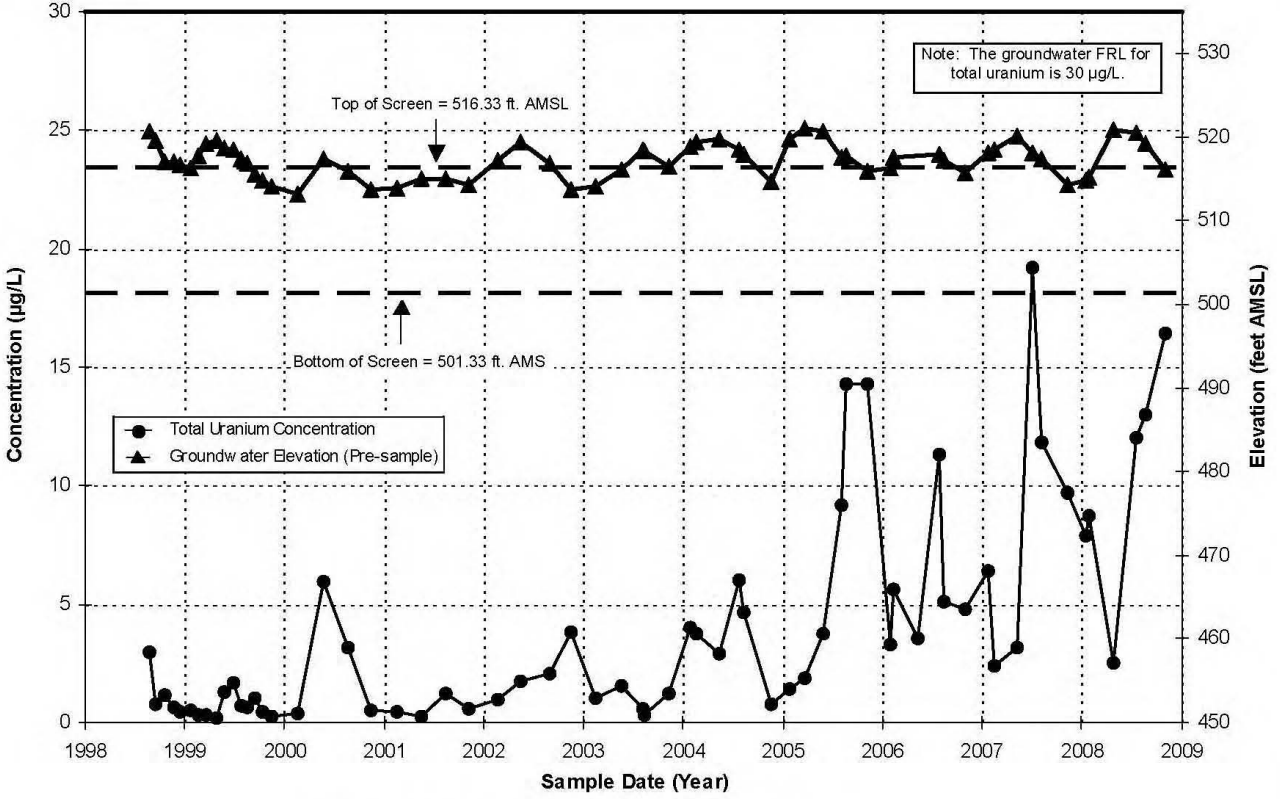


Figure A.5.3-5. Total Uranium Concentration and Groundwater Elevation vs. Time Plot for Cell 3 Downgradient Monitoring Well 22204

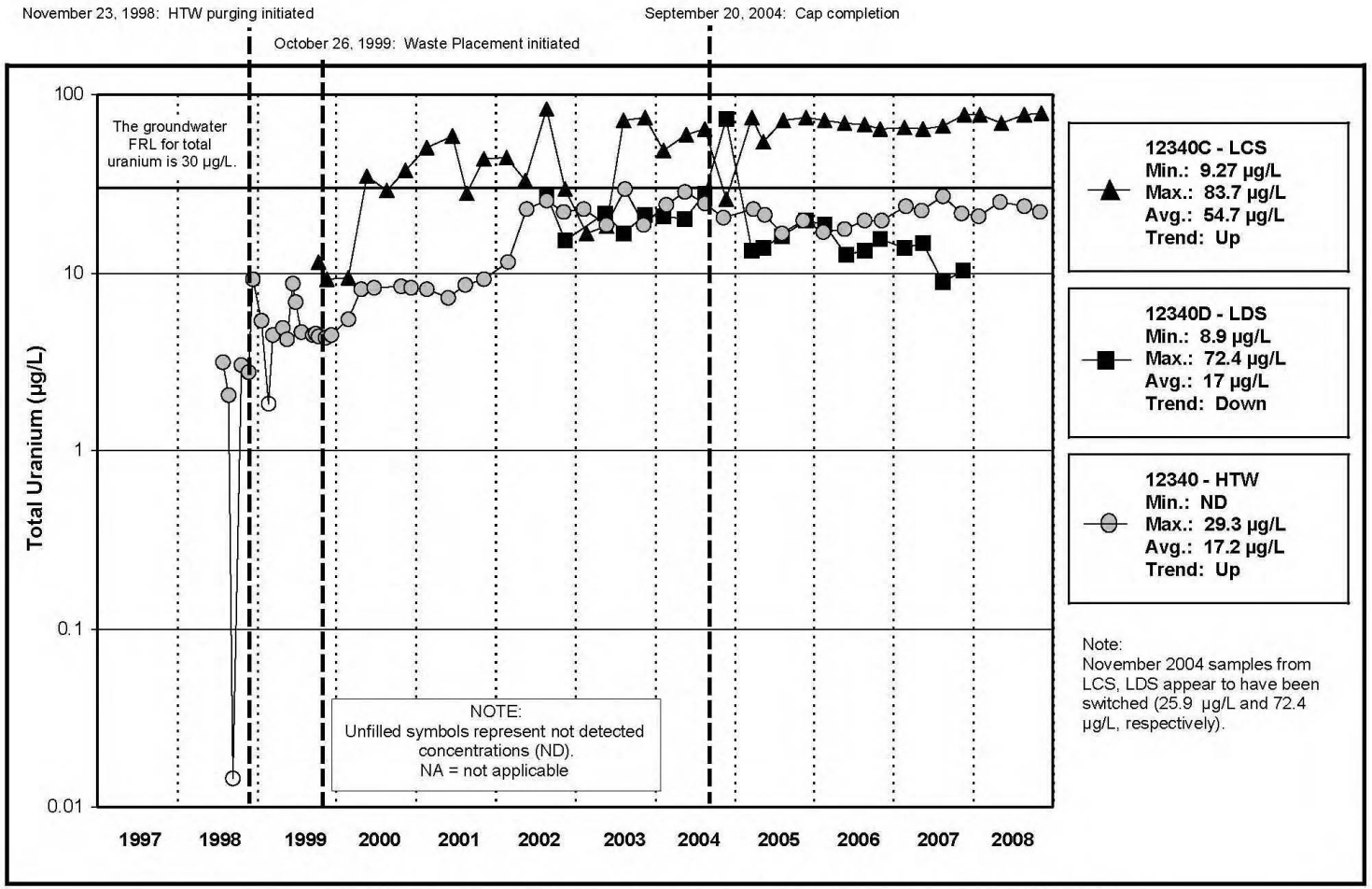


Figure A.5.3-6A. Cell 3 Total Uranium Concentration vs. Time Plot for LCS, LDS, AND HTW

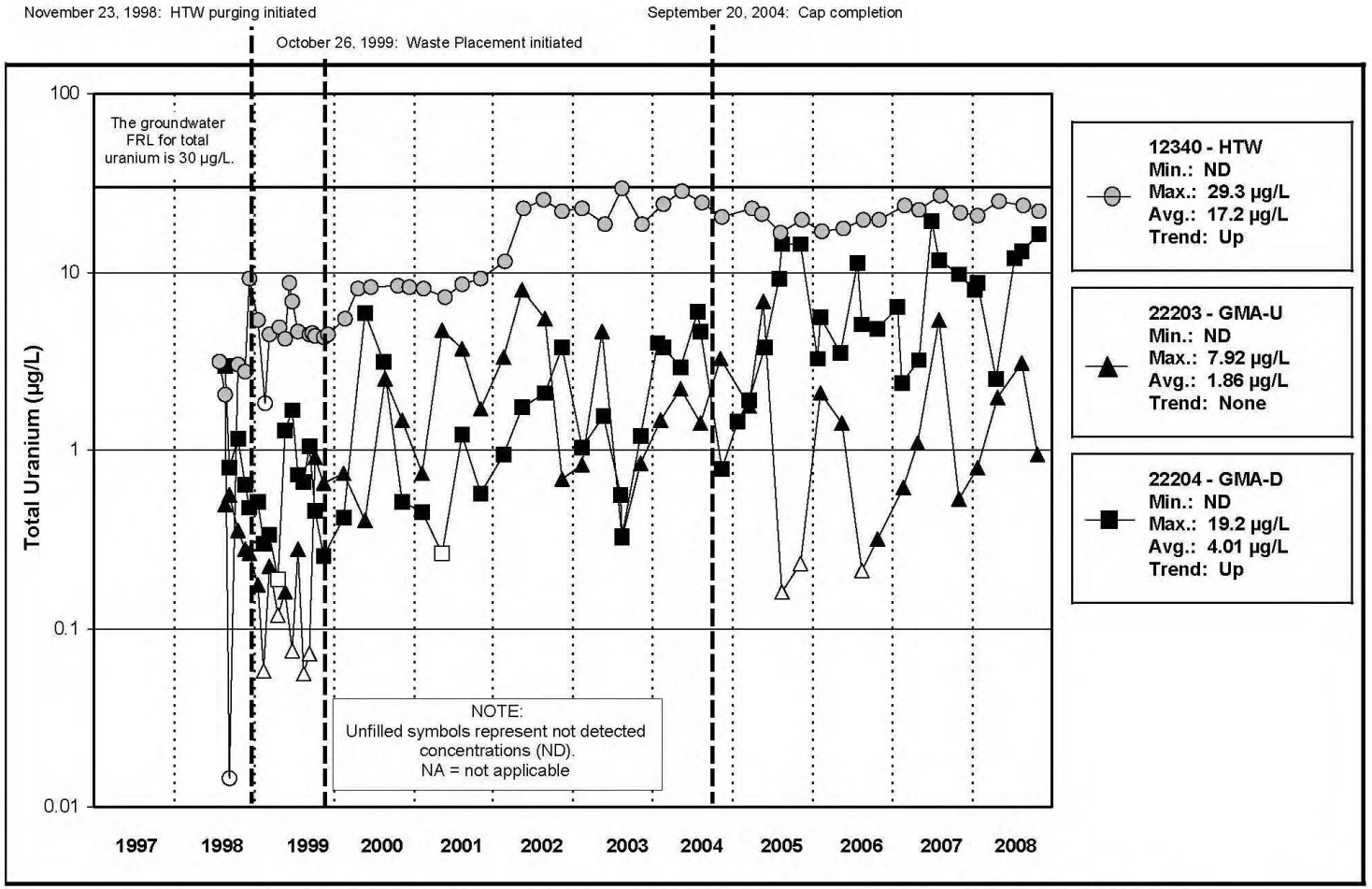


Figure A.5.3-6B. Cell 3 Total Uranium Concentration vs. Time Plot for HTW, GMA-U Well, AND GMA-D Well

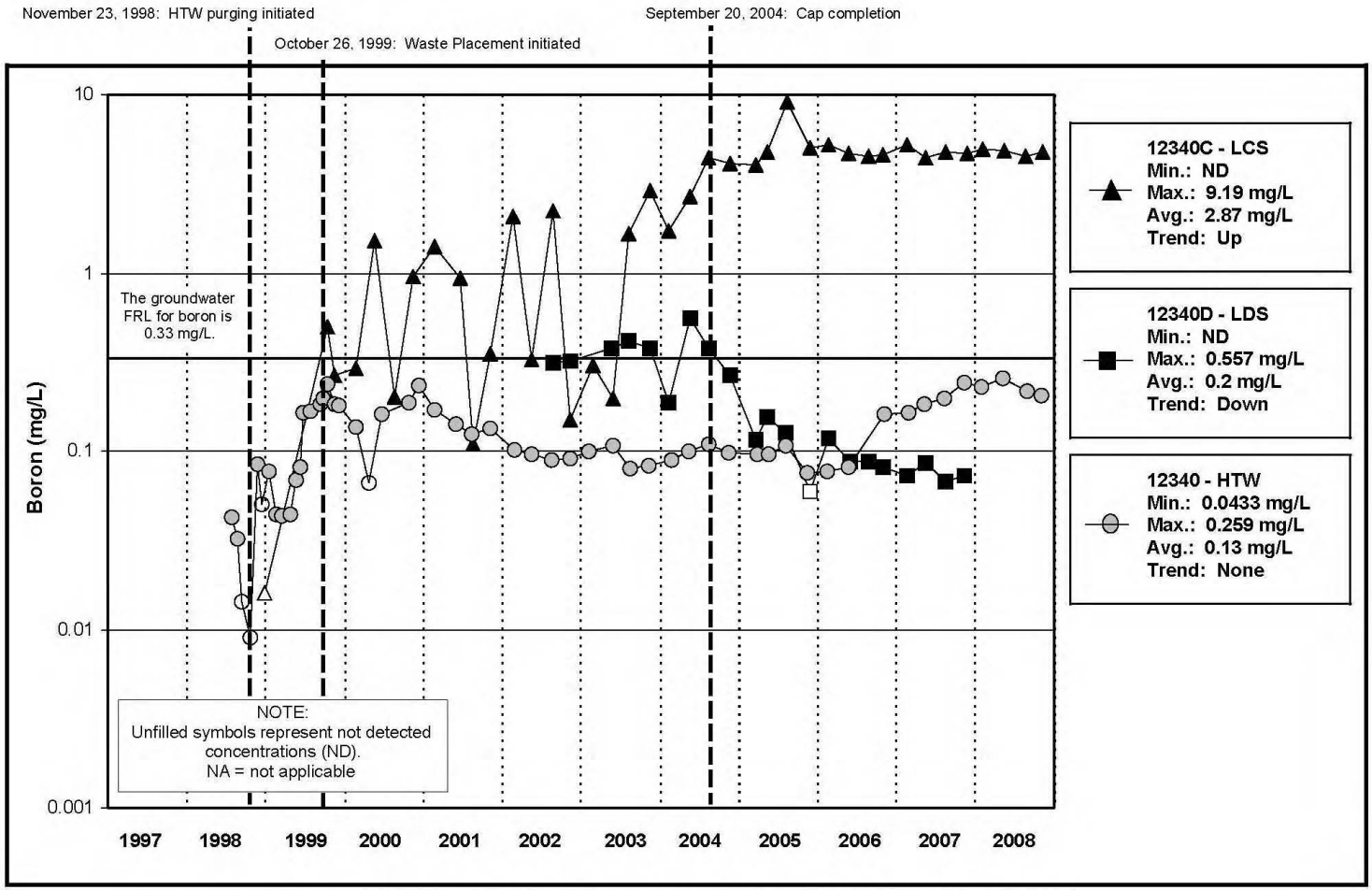


Figure A.5.3-7A. Cell 3 Boron Concentration vs. Time Plot for LCS, LDS, AND HTW

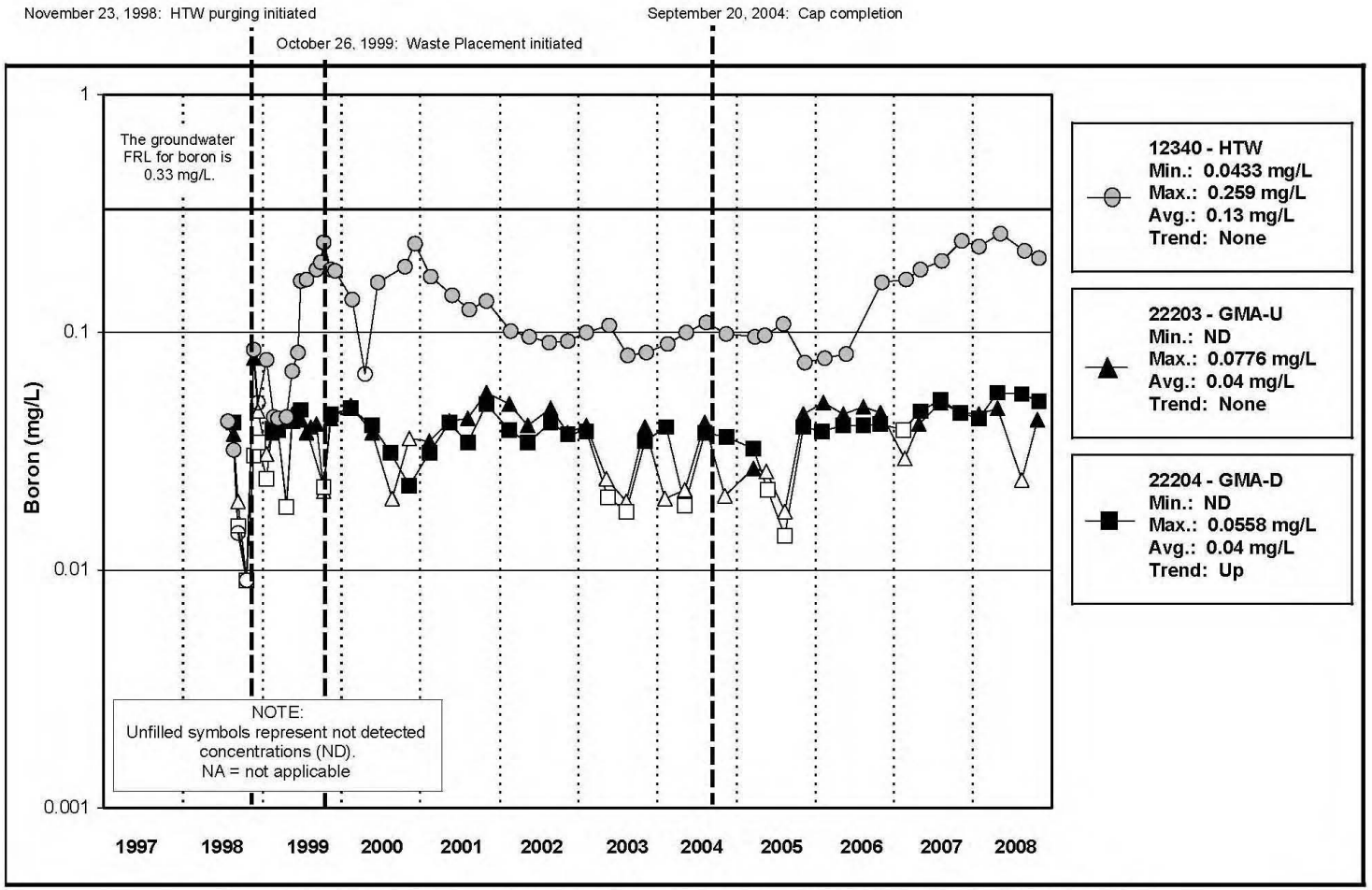


Figure A.5.3-7B. Cell 3 Boron Concentration vs. Time Plot for HTW, GMA-U Well, AND GMA-D Well

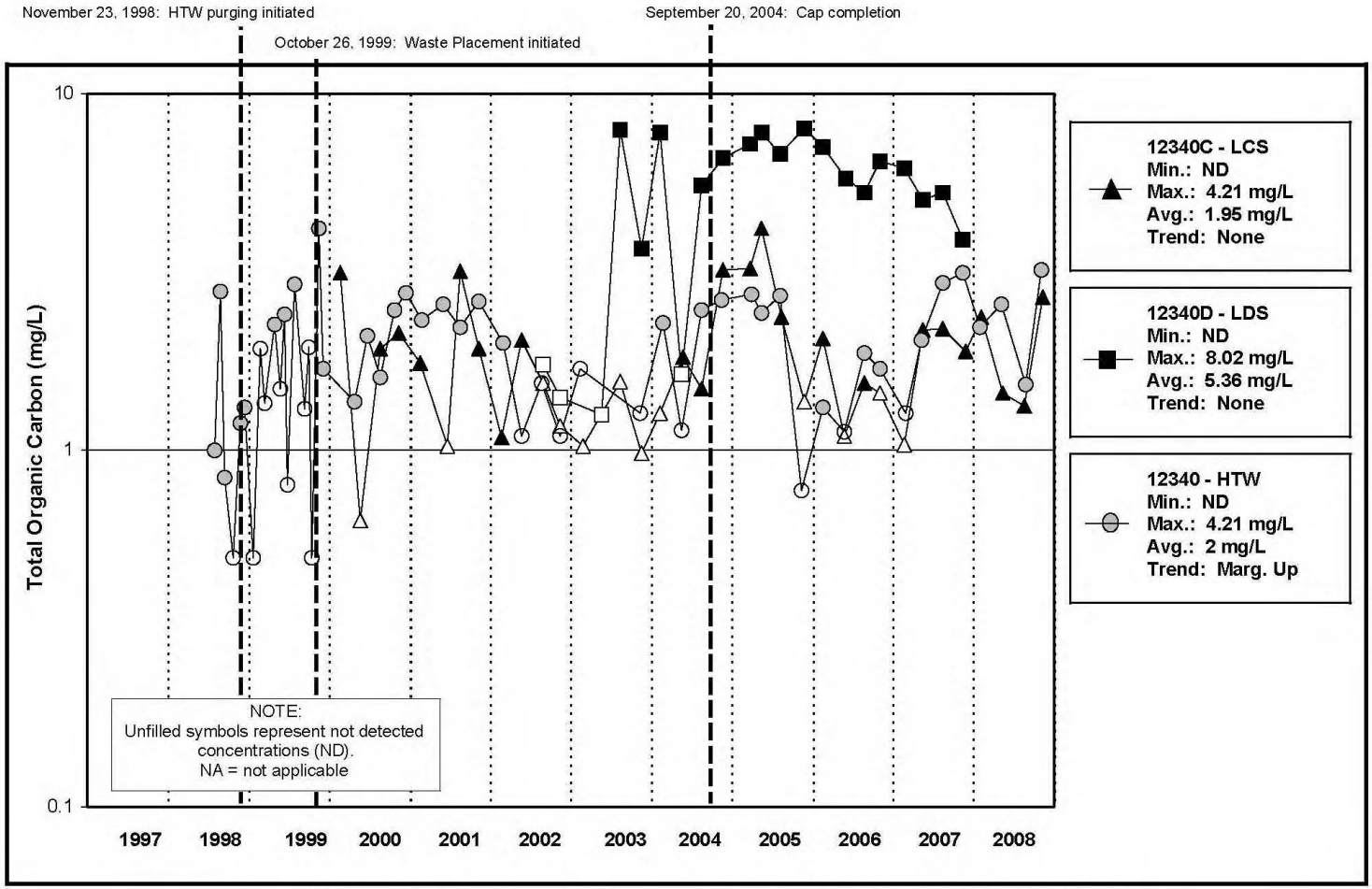


Figure A.5.3-8A. Cell 3 Total Organic Carbon Concentration vs. Time Plot for LCS, LDS, AND HTW

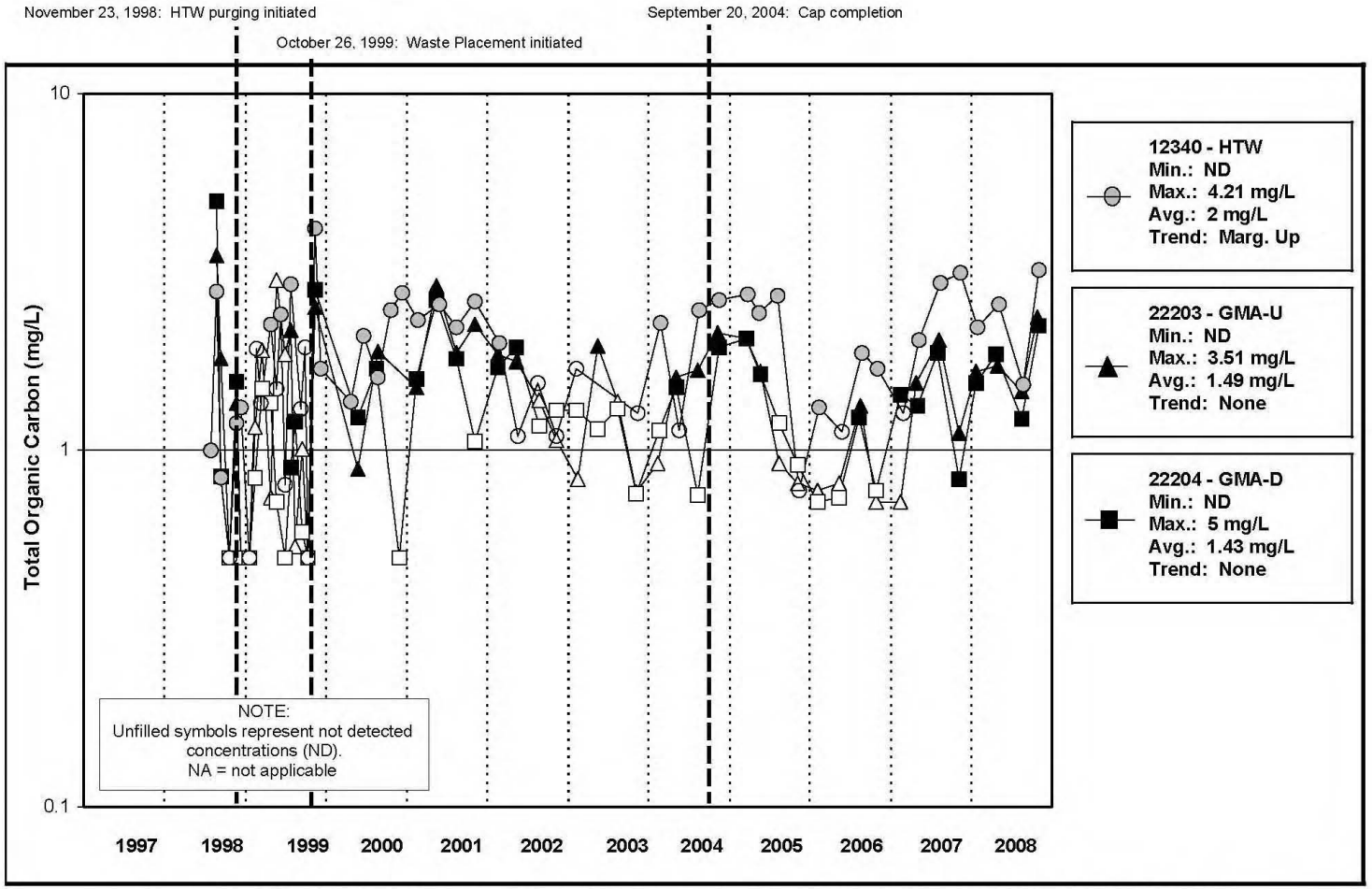


Figure A.5.3-8B. Cell 3 Total Organic Carbon Concentration vs. Time Plot for HTW, GMA-U Well, AND GMA-D Well

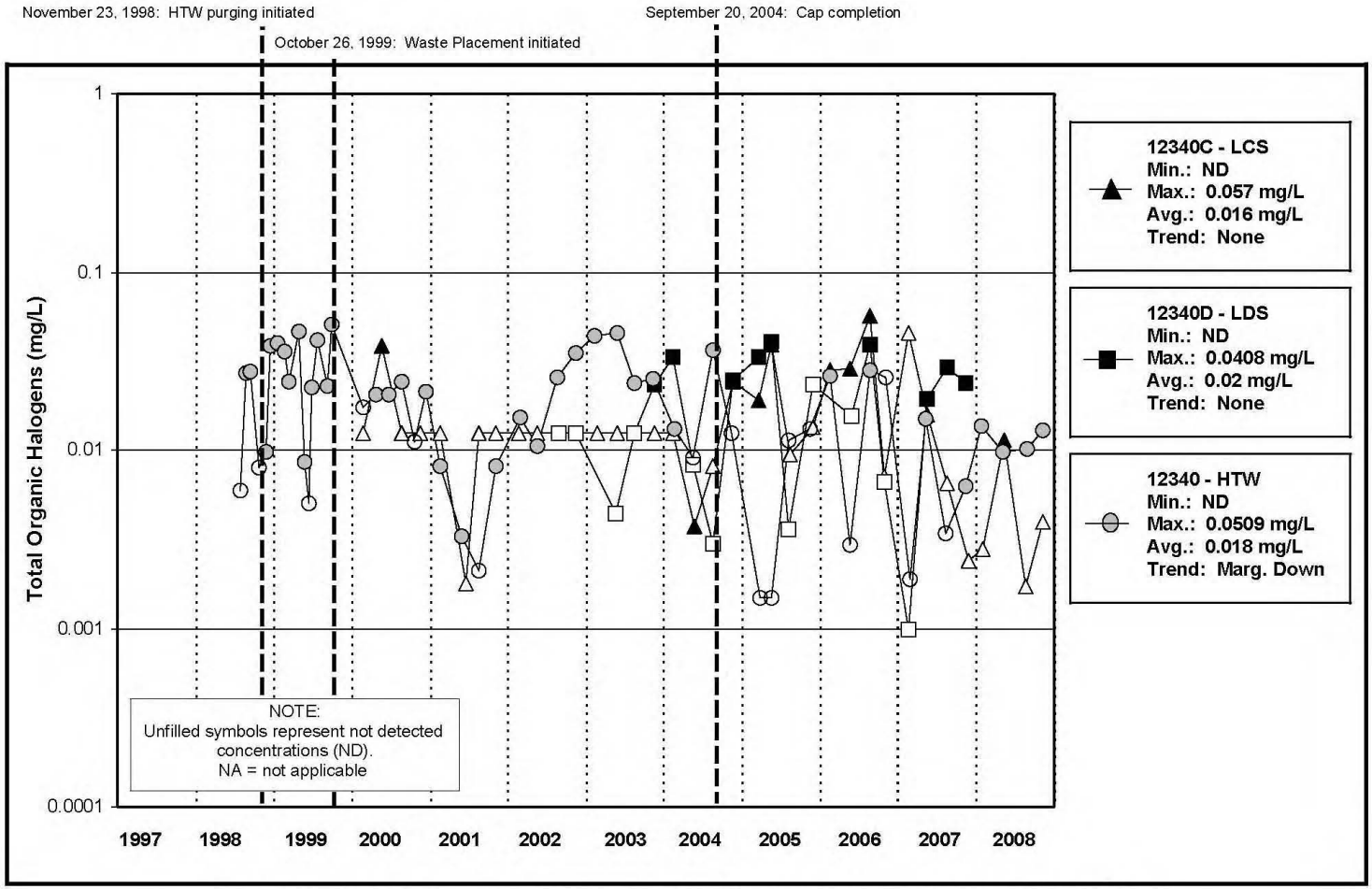


Figure A.5.3-9A. Cell 3 Total Organic Halogens Concentration vs. Time Plot for LCS, LDS, AND HTW

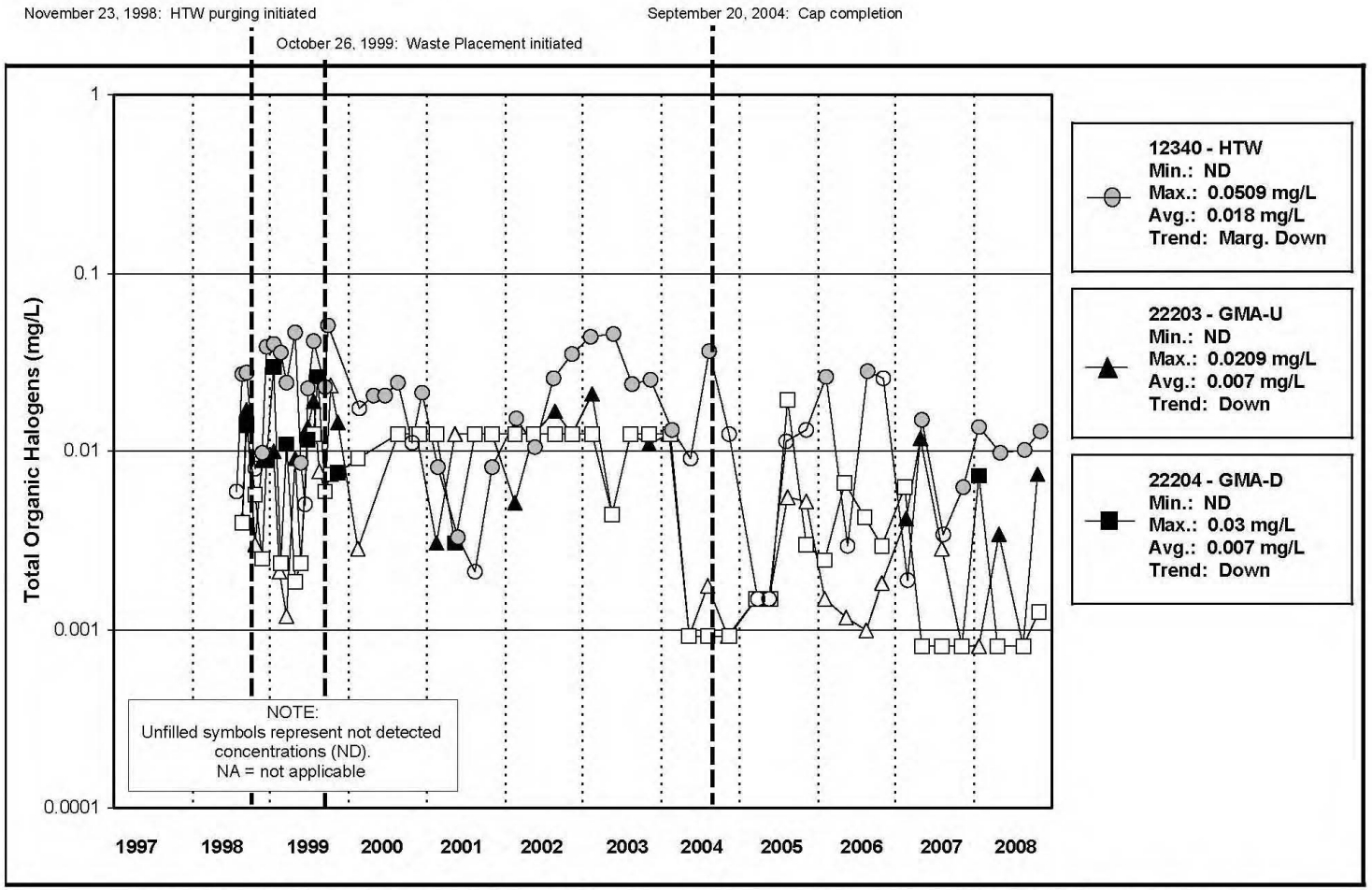


Figure A.5.3-9B. Cell 3 Total Organic Halogens Concentration vs. Time Plot for HTW, GMA-U Well, AND GMA-D Well

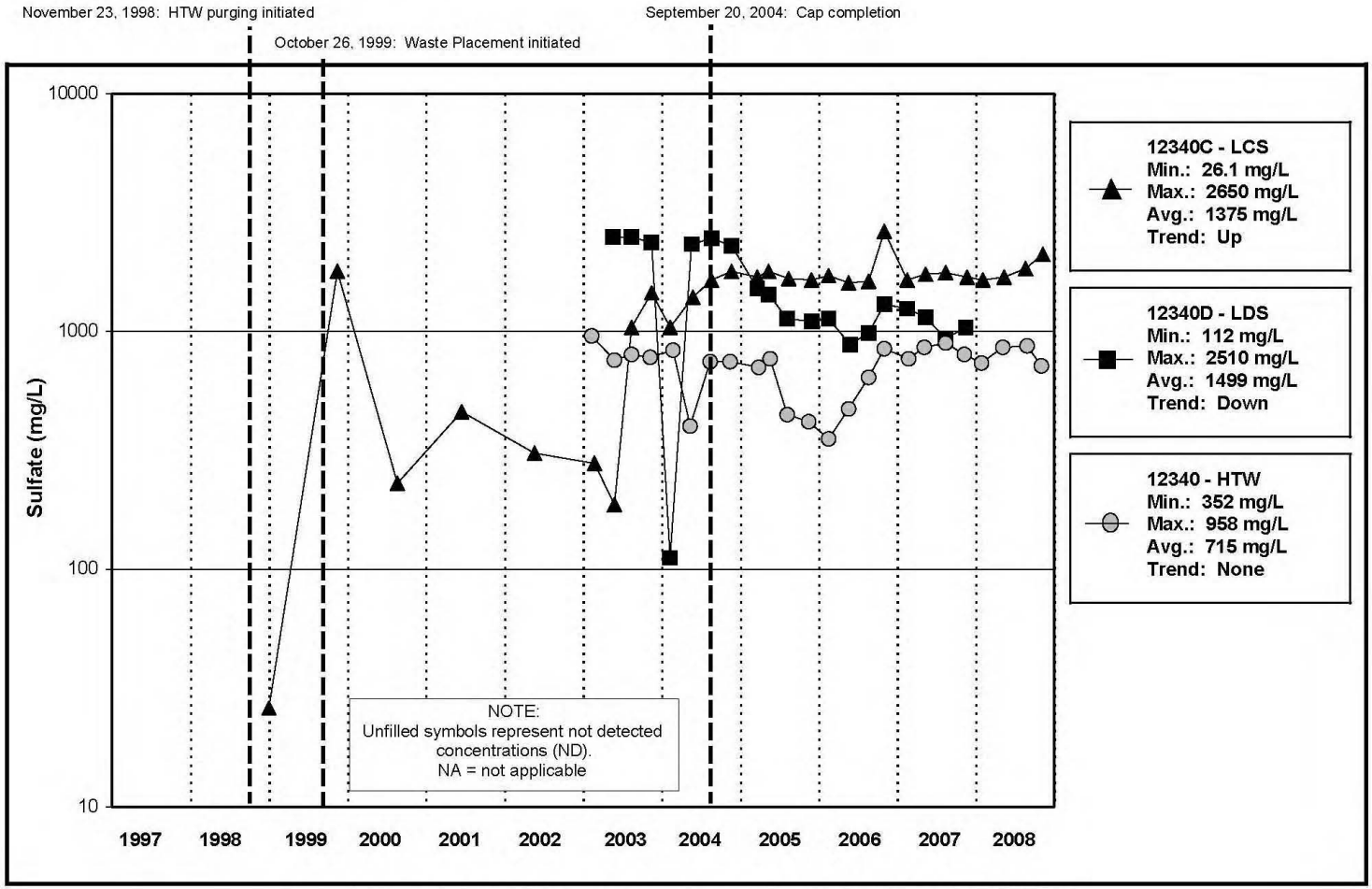


Figure A.5.3-10A. Cell 3 Sulfate Concentration vs. Time Plot for LCS, LDS, AND HTW

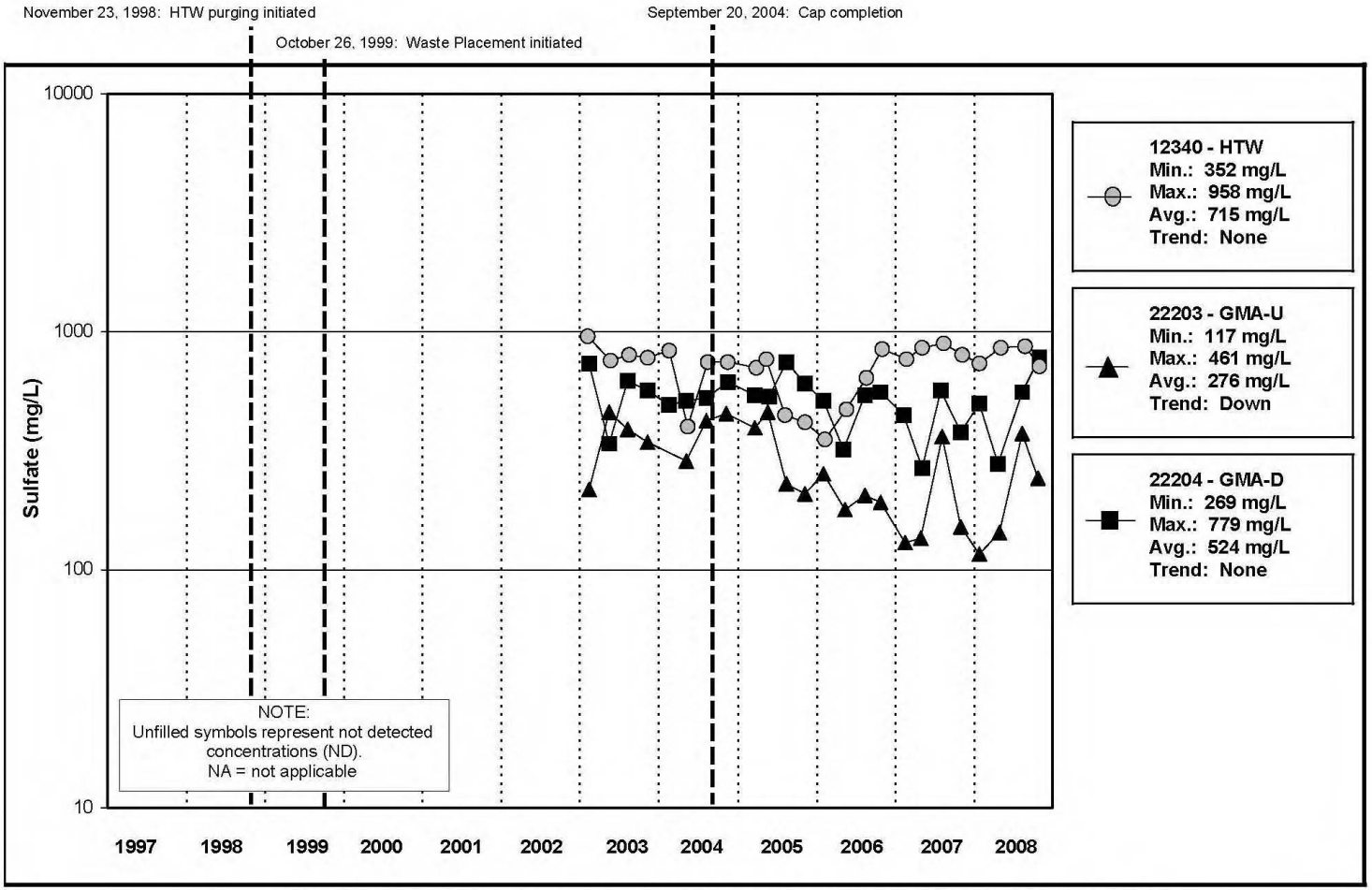


Figure A.5.3-10B. Cell 3 Sulfate Concentration vs. Time Plot for HTW, GMA-U Well, AND GMA-D Well

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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).
- GMA 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 in 2008 were collected according to the frequencies described in the GWLMP. Constituent sampling lists are provided in Table 2−1, Table 2−2, and Table 2−3 of Appendix B of the GWLMP. In 2008, all samples were collected for Cell 4 monitoring horizons.

A.5.4.1 Refined Baseline Monitoring Results

As defined in the GWLMP, refined baseline constituents are those constituents that have been monitored at least 8 times, and detected at least 25 percent of the time in the LCS, LDS, HTW, and GMA wells. Results from 2008 sampling are provided in a summary statistics table (Table A.5.1-2) and concentration plots (Figures A.5.1-6A to A.5.1-10B). The five refined baseline constituents are total uranium, boron, TOC, TOX, and sulfate.

Flow in the LDS in 2008 was well below the OSDF design action level, indicating that the water quality trends observed in the HTW and GMA wells in 2008 are attributable to concentration fluctuations taking place beneath the facility and not to a potential leak from the facility.

The 2009 revision of the GWLMP identifies the data evaluation techniques that will be used to further evaluate the association between water quality changes observed beneath the facility and the potential that they are being caused by a leak from the facility. Control charts will be added back to the program along with the use of bivariate plots.

Beginning in January 2009, the refined baseline constituents will become a subset of a larger group of 15 constituents that will be monitored annually in all 4 monitoring horizons (LCS, LDS, HTW, and GMA wells) of each cell. Monitoring at the LCS will include all of the 15 constituents listed below, as well as the rest of the initial baseline constituents defined for the facility.

Constituent Sampling List for the LDS, HTW, and GMA Wells of Each Cell in 2009	
Constituent	**Reason**
Boron	Refined Baseline Parameter
Sulfate	Refined Baseline Parameter
Uranium	Refined Baseline Parameter
TOC	Refined Baseline Parameter
TOX	Refined Baseline Parameter
Iron	Common Ion Study[a]
Manganese	Common Ion Study[a]
Sodium	Common Ion Study[a]
Lithium	Common Ion Study[a]
Arsenic	Appendix I Statistical Analysis
Cobalt	Appendix I Statistical Analysis
Nickel	Appendix I Statistical Analysis
Selenium	Appendix I Statistical Analysis
TDS	Appendix I Statistical Analysis
Zinc	Appendix I Statistical Analysis

[a] Also known as the *Evaluation of Aqueous Ions in the Monitoring Systems of the On-Site Disposal Facility* (DOE 2008b)

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. Even though active operations ended in 2006, this sampling continued in 2007 and 2008.

In 2008, annual sampling of the Cell 4 LCS took place in February. Table A.5.4−3 summarizes the annual LCS sampling results for Cell 4, along with the data collected in previous years. Table A.5.4–3 presents the non-refined baseline site-specific constituents that were monitored in 2008. Eleven of the twenty constituents listed in Table A.5.4–3 have been monitored eight or more times. Of those 11 constituents, all have been detected at least 25 percent of the time.

The potential monitoring usefulness of 9 of the 11 constituents (alkalinity, calcium, chloride, iron, magnesium, manganese, nitrate/nitrite, potassium, and sodium) was addressed in the Common Ion Study. Of the two remaining constituents (TDS and Technetium-99) TDS has been added to the monitoring program and will be sampled for in the LCS, LDS, HTW, and GMA wells of each cell in 2009.

Technetium-99 has been detected over 25 percent of the time in the Cell 4 LCS. Statistics conducted for Cell 1 on the potential usefulness of technetium-99 as a monitoring constituent for the OSDF indicated that it would not be a useful constituent at Cell 1. As described in the 2009 revision of the GWLMP results from Cells 1, 2, and 3 are being applied to Cells 4 through 8. This means that in 2009 technetium-99 will not be sampled for in the LDS, HTW, or GMA wells of Cells 4 through 8. Given the consistency of detects though seen in 2008 at Cells 4 through 8, DOE will conduct a statistical analysis in 2009 for the usefulness of technetium-99 as a monitoring constituent at Cells 4 through 8 similar to the one conducted for Cells 1, 2, and 3. This exception is warranted given that technetium-99 is being detected rather consistently, and the extra effort could result in adding an additional useful constituent to the monitoring program for those cells. Results of the analysis will be reported in the 2009 SER.

Confirmatory Sampling in the LCS

In 2009, confirmatory sampling procedures were modified in the GWLMP. Because confirmatory sampling identified in 2008 will take place in 2009, the modified procedure will be followed. Therefore, if a constituent was detected in the 2008 LCS sample, that was not going to be monitored in the LDS in 2009, the constituent was added for confirmatory monitoring in 2009.

Two consecutive detects for that constituent in the cell's LCS will trigger monitoring for that constituent in the cell's LDS during the next scheduled sampling event. However, if the usefulness of the constituent as a monitoring constituent has already been rejected through the Common Ion Study , the constituent will not be added for confirmatory monitoring.

In 2008, technetium-99 was detected in the Cell 4 LCS. No detects were measured in 2007. If technetium-99 is detected in the Cell 4 LCS in 2009, it will be added to the constituent sampling list for the Cell 4 LDS beginning in 2010, pending the result of the statistical analysis discussed above.

A.5.4.3 LDS Monitoring Results

In 2008, the LDS of Cell 4 was monitored for site-specific constituents listed in Table 2−1 of Appendix B of the GWLMP. The objective of the sampling was to determine if any initial baseline constituents, not on the refined baseline list, were present in the LDS. In 2008, sampling of the Cell 4 LDS took place in February.

Results of the LDS sampling at Cell 4 in 2008 indicate that all of the initial baseline constituents that have been monitored in the Cell 4 LDS and detected at least 25 percent of the time are being monitored in the Cell 4 HTW and GMA wells in 2009.

Table A.5.4−1. Cell 4 – 2008 Monthly Liner Efficiencies

Month	Cell 4 Apparent Liner Efficiency (%)
January	100.00
February	98.67
March	98.67
April	99.32
May	98.76
June	98.73
July	98.98
August	99.80
September	98.76
October	99.11
November	99.18
December	99.29

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	23	23	100	99.5	Normal	Up, Significant	Not detected				
	LDS	12341D	24	24	100	14.2	Normal	No Significant	Not Detected	5.74 (Q4-02)	21.3 (Q1-06)		
	HTW	12341	28	28	100	6.0	Normal	No Significant	Not detected				
	GMA-U	22206	25	29	86.2	1.23	Lognormal	No Significant	Not detected	0 (Q4-03)			
	GMA-D	22205	29	29	100	1.74	Lognormal	No Significant	Not Detected	12.1 (Q3-02)	10.3 (Q4-02)	8.2 (Q2-05)	10.2 (Q3-05)
Boron (mg/L)	LCS	12341C	23	23	100	0.86	Undefined	Up, Significant	Detected				
	LDS	12341D	24	24	100	0.74	Undefined	Down, Significant	Detected				
	HTW	12341	26	28	92.9	0.14	Normal	Down, Significant	Detected	1.240 (Q1-02)	0.908 (Q2-02)		
	GMA-U	22206	23	29	79.3	0.04	Normal	Down, Significant	Not detected				
	GMA-D	22205	24	29	82.8	0.03	Normal	No Significant	Not Detected				
Total Organic Carbon (mg/L)	LCS	12341C	16	23	69.6	2.77	Normal	No Significant	Not Detected				
	LDS	12341D	21	24	87.5	4.77	Normal	No Significant	Detected				
	HTW	12341	21	27	77.8	2.29	Normal	No Significant	Detected				
	GMA-U	22206	18	29	94.7	1.31	Normal	No Significant	Not Detected	9.84 (Q2-03)			
	GMA-D	22205	18	29	62.1	1.4	Normal	No Significant	Detected				
Total Organic Halogens (mg/L)	LCS	12341C	13	23	56.5	0.02	Normal	Up, Significant	Not Detected				
	LDS	12341D	16	24	66.7	0.02	Normal	No Significant	Not Detected				
	HTW	12341	17	28	60.7	0.01	Lognormal	No Significant	Not Detected	0.0428 (Q1-06)			
	GMA-U	22206	9	29	31.0	0.006	Normal	Down, Significant	Detected	0.027 (Q1-05)			
	GMA-D	22205	5	29	17.2	0.006	Undefined	Down, Significant	Detected				
Sulfate (mg/L)	LCS	12341C	23	23	100	1912	Undefined	Up, Significant	Detected				
	LDS	12341D	24	24	100	2040	Normal	No Significant	Detected				
	HTW	12341	24	24	100	202	Normal	No Significant	Detected	313 (Q3-05)			
	GMA-U	22206	24	24	100	299	Undefined	No Significant	Not Detected				
	GMA-D	22205	24	24	100	324	Normal	No Significant	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 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 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.

[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.5.4−3. 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]	DETECTED IN 2008?	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
General Chemistry												
Alkalinity as CaCO3 (mg/L)	13	13	100%	Yes	48	583	369	-	422 mg/L(5)	430 mg/L(5)	-	10 mg/L
Ammonia (mg/L)	7	1	14.3%	No	0.0328	-	-	-	4.2 mg/L(0)	4.34 mg/L(0)	220 mg/L(0)	0.1 mg/L
Chloride (mg/L)	13	12	92.3%	Yes	26	109	82.1	-	7.3 mg/L(12)	45 mg/L(10)	6300 mg/L(0)	5 mg/L
Nitrate/Nitrite (mg/L)	17	8	47.1%	Yes	0.245	6.34	2.13	11 mg/L[g](0)	11 mg/L(0)	0.29 mg/L(7)	2670 mg/L(0)	1.1 mg/L
Total Dissolved Solids (mg/L)	11	11	100%	Yes	351	4550	2550	-	-	-	-	10 mg/L
Inorganic												
Barium (mg/L)	7	7	100%	Yes	0.0266	0.058	0.0363	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)	13	13	100%	Yes	52.9	1110	519	-	159 mg/L(12)	172 mg/L(12)	1800 mg/L(0)	5 mg/L
Chromium (mg/L)	7	3	42.9%	Yes	0.003	0.0137	0.0076	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)	7	6	85.7%	Yes	0.00046	0.0057	0.0024	0.17 mg/L(0)	0.0086 mg/L(0)	-	0.0886 mg/L(0)	0.034 mg/L
Copper (mg/L)	7	5	71.4%	Yes	0.00076	0.0215	0.0129	1.3 mg/L(0)	0.035 mg/L(0)	0.029 mg/L(0)	0.298 mg/L(0)	0.008 mg/L
Iron (mg/L)	13	10	76.9%	Yes	0.0294	4.18	2.12	-	5.72 mg/L(0)	6.35 mg/L(0)	21.3 mg/L(0)	0.1 mg/L
Magnesium (mg/L)	13	13	100%	Yes	15	732	340	-	38.5 mg/L(12)	50.7 mg/L(12)	690 mg/L(1)	5 mg/L
Manganese (mg/L)	13	13	100%	Yes	0.00563	2.14	0.321	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)	7	7	100%	Yes	0.00112	0.0375	0.0149	0.1 mg/L(0)	0.0514 mg/L(0)	0.0072 mg/L(5)	0.981 mg/L(0)	0.02 mg/L
Potassium (mg/L)	13	13	100%	Yes	3.81	78.4	23.2	-	1.96 mg/L(13)	17.2 mg/L(11)	12400 mg/L(0)	5 mg/L
Selenium (mg/L)	7	3	42.9%	No	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
Sodium (mg/L)	13	13	100%	Yes	22	117	51.4	-	47.1 mg/L(5)	50 mg/L(2)	1300 mg/L(0)	5 mg/L
Zinc (mg/L)	7	2	28.6%	Yes	0.0181	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
Radionuclides												
Technetium-99 (pCi/L)	12	5	41.7%	Yes	1.21	37.8	14.5	94 pCi/L(0)	22 pCi/L(1)	30 pCi/L(1)	6130 pCi/L(0)	10 pCi/L
Organics												
1,1-Dichloroethane (ug/L)	7	1	14.3%	No	0.332	-	-	280 ug/L(0)	-	-	-	1 ug/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 minumun 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.

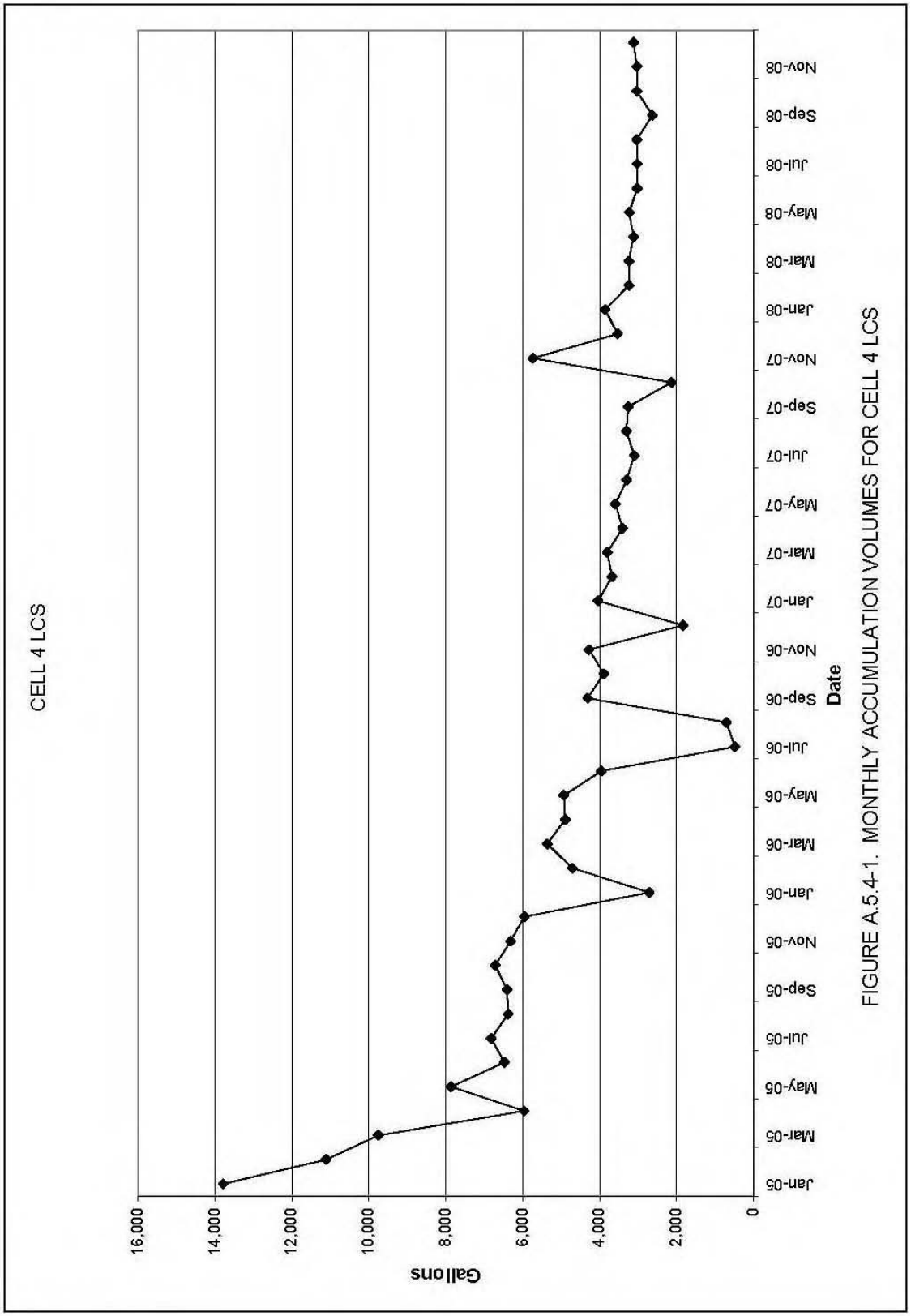

FIGURE A.5.4-1. MONTHLY ACCUMULATION VOLUMES FOR CELL 4 LCS

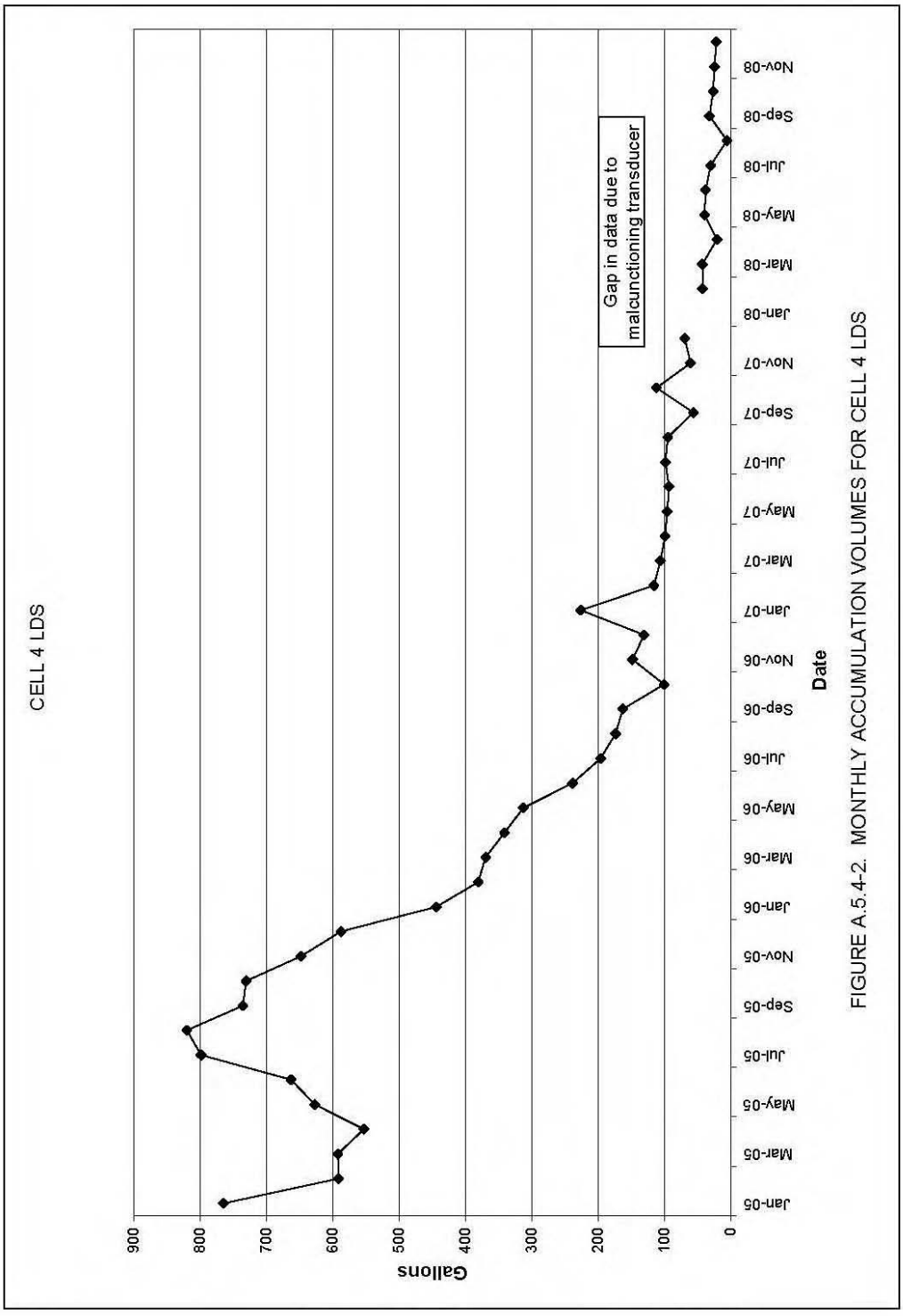

FIGURE A.5.4-2. MONTHLY ACCUMULATION VOLUMES FOR CELL 4 LDS

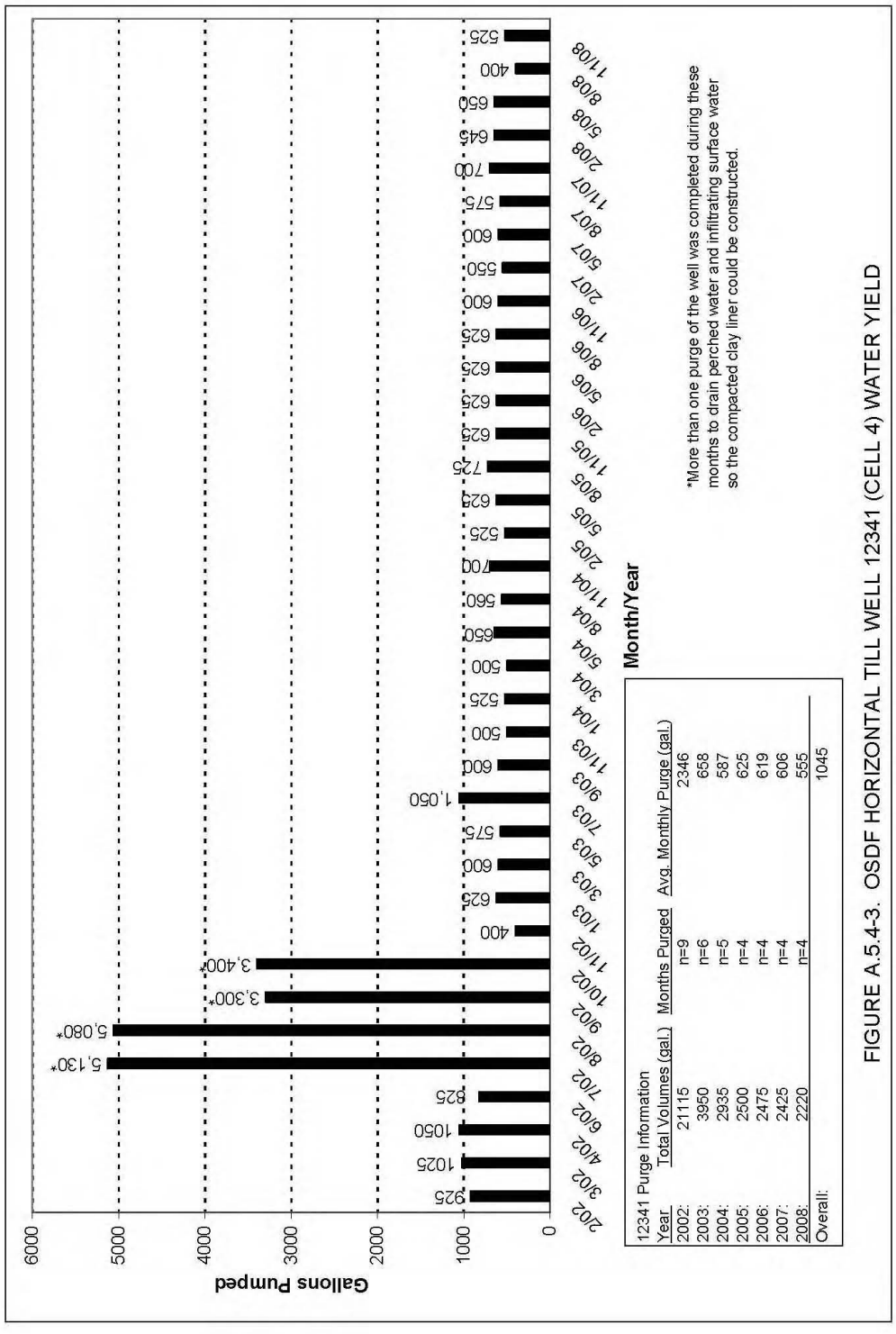

FIGURE A.5.4-3. OSDF HORIZONTAL TILL WELL 12341 (CELL 4) WATER YIELD

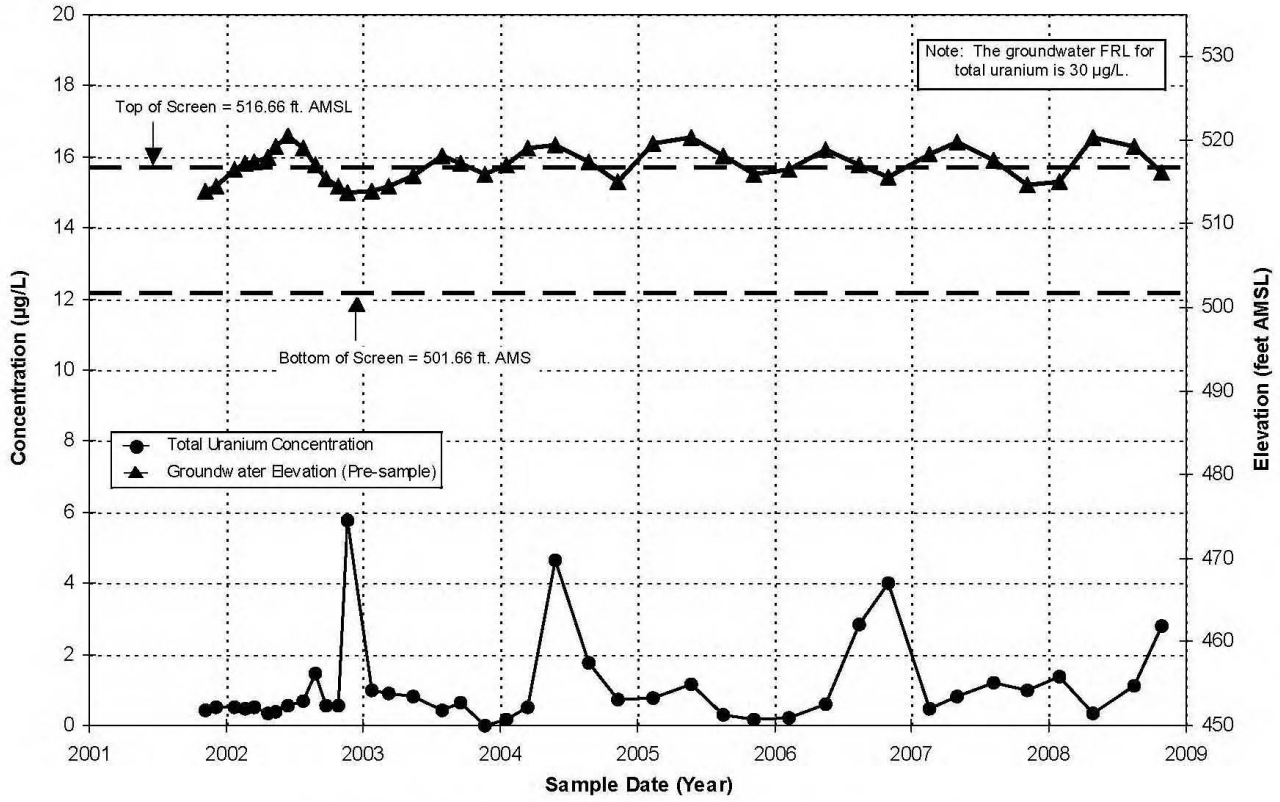

Figure A.5.4-4. Total Uranium Concentration and Groundwater Elevation vs. Time Plot for Cell 4 Upgradient Monitoring Well 22206

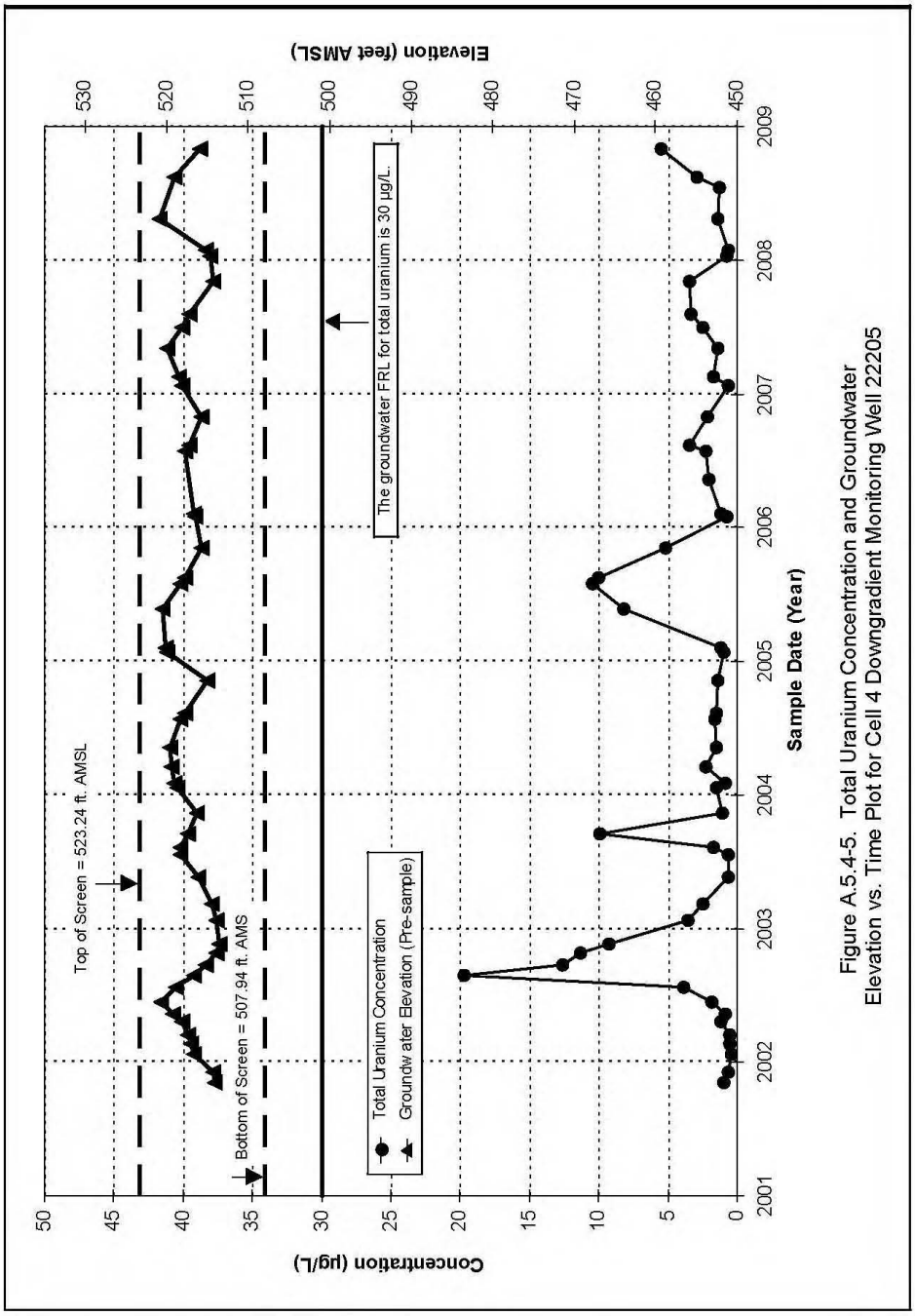

Figure A.5.4-5. Total Uranium Concentration and Groundwater Elevation vs. Time Plot for Cell 4 Downgradient Monitoring Well 22205

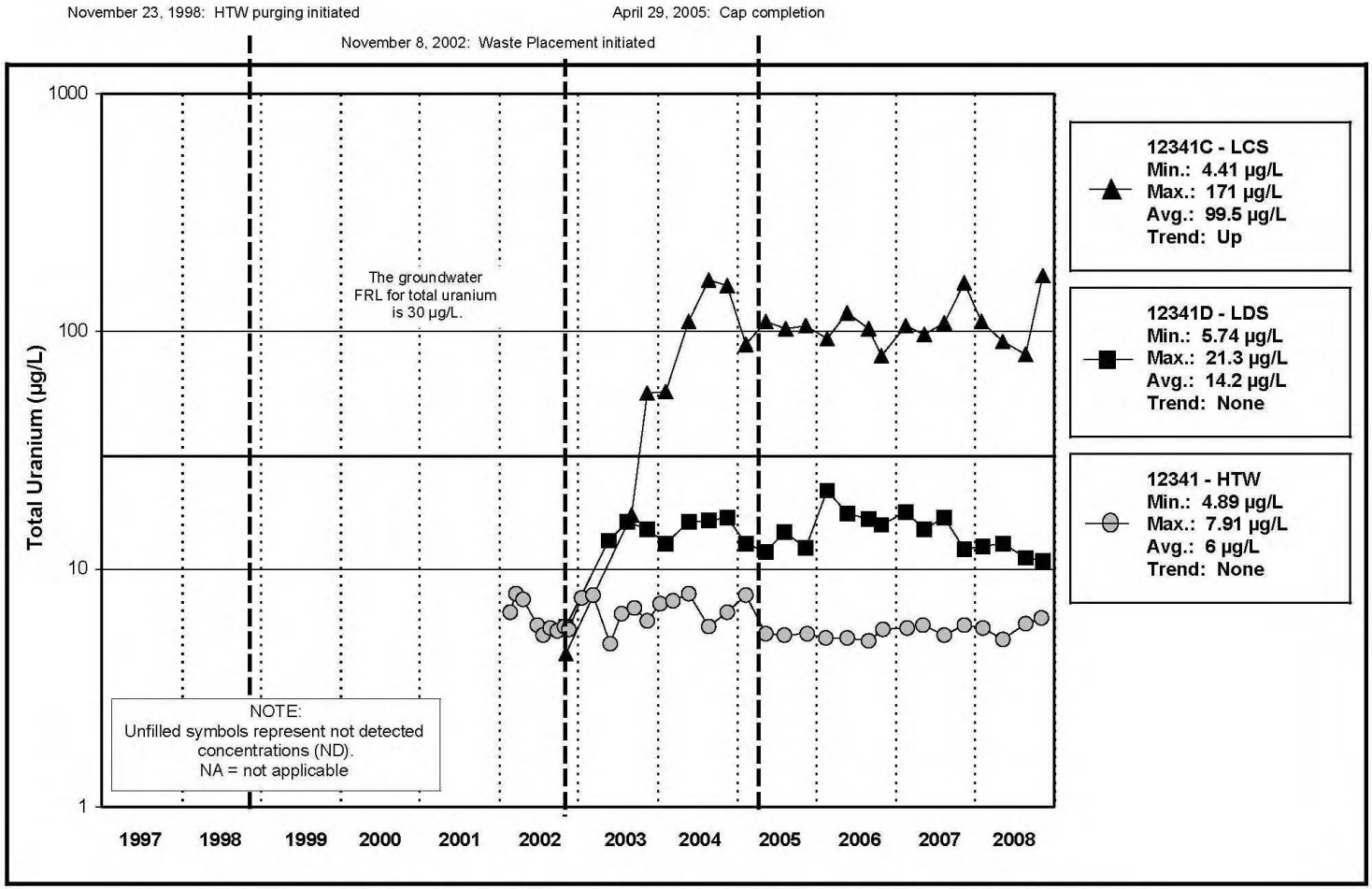

Figure A.5.4-6A. Cell 4 Total Uranium Concentration vs. Time Plot for LCS, LDS, AND HTW

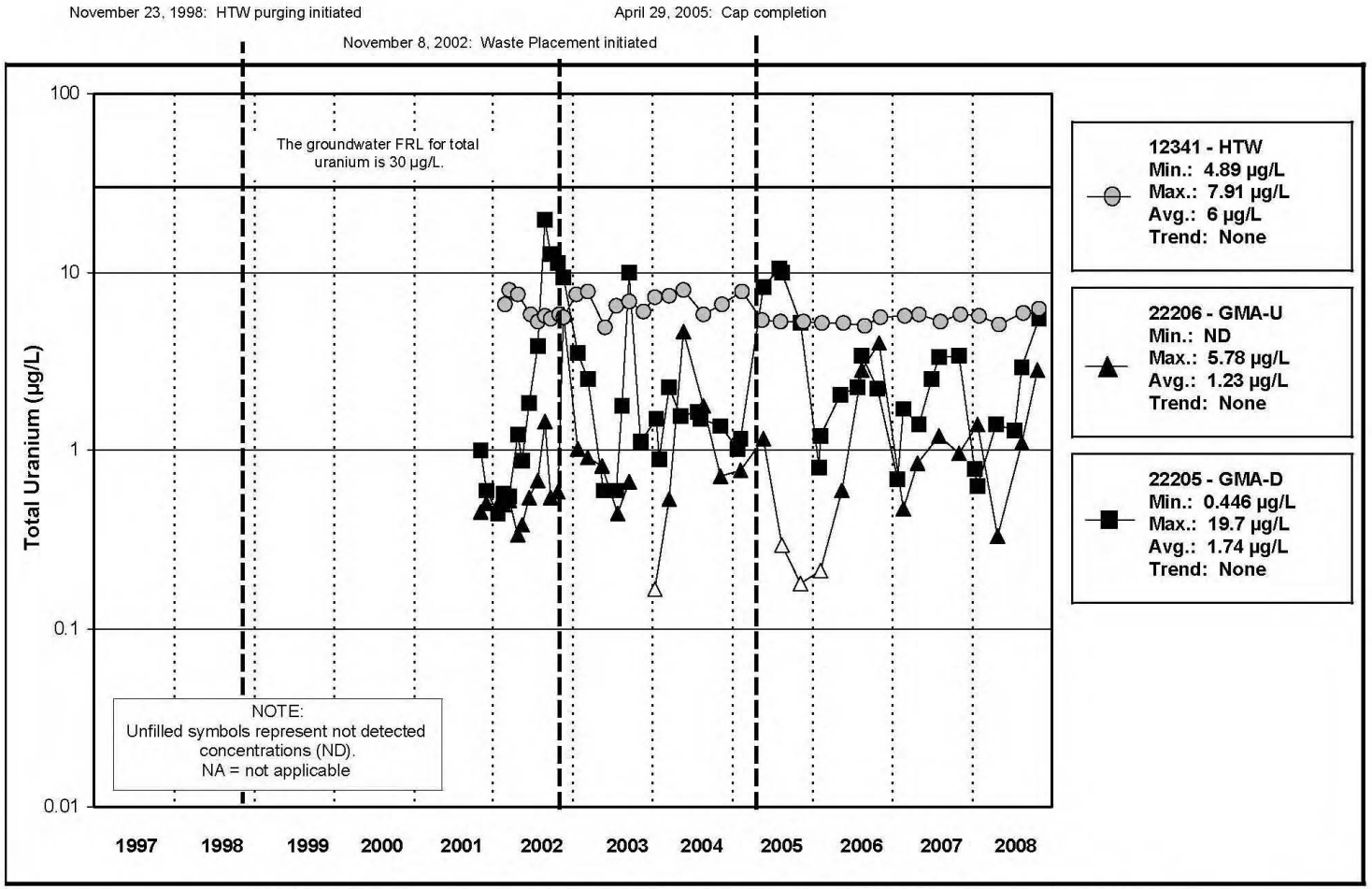

Figure A.5.4-6B. Cell 4 Total Uranium Concentration vs. Time Plot for HTW, GMA-U Well, AND GMA-D Well

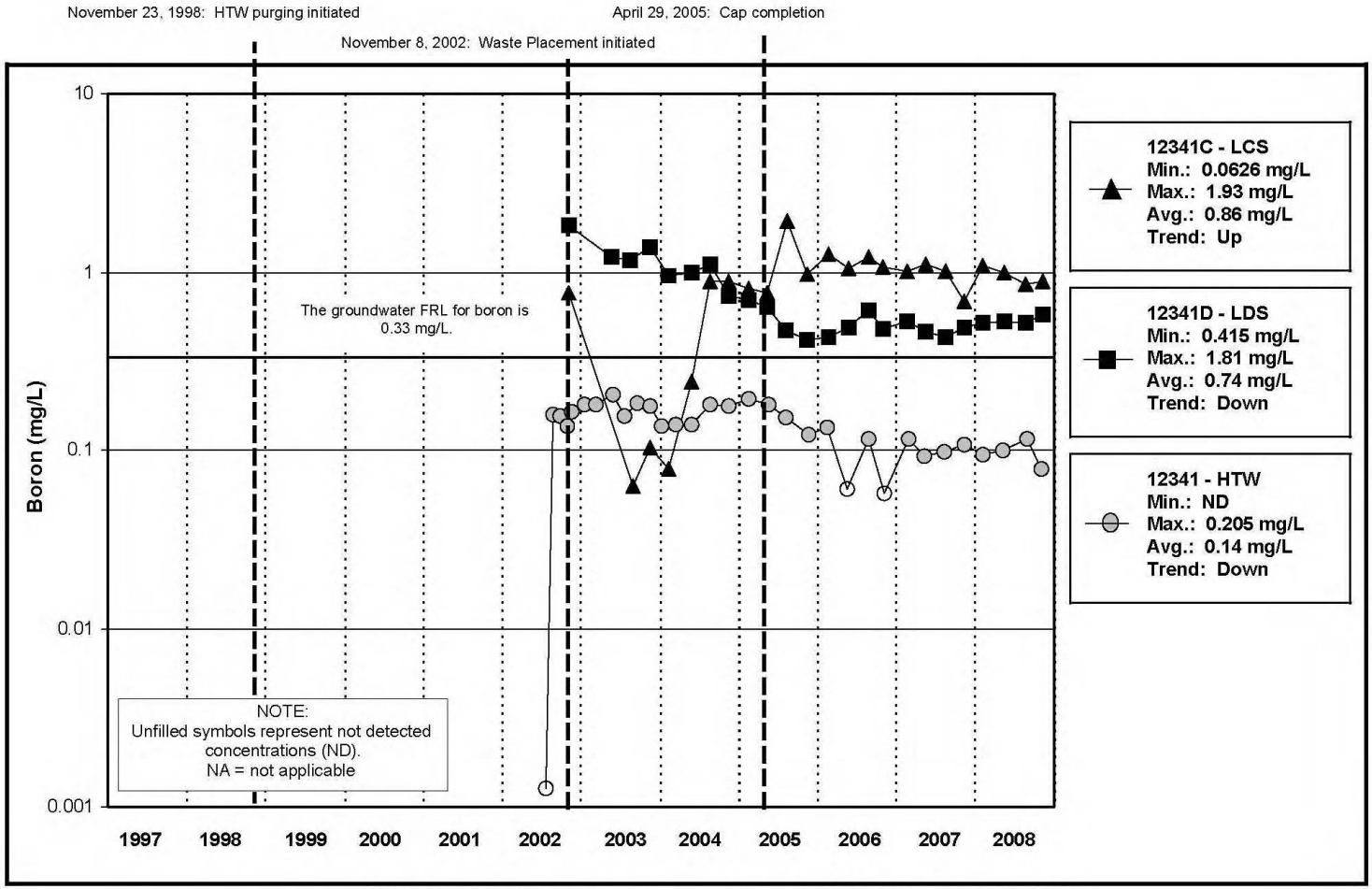

Figure A.5.4-7A. Cell 4 Boron Concentration vs. Time Plot for LCS, LDS, AND HTW

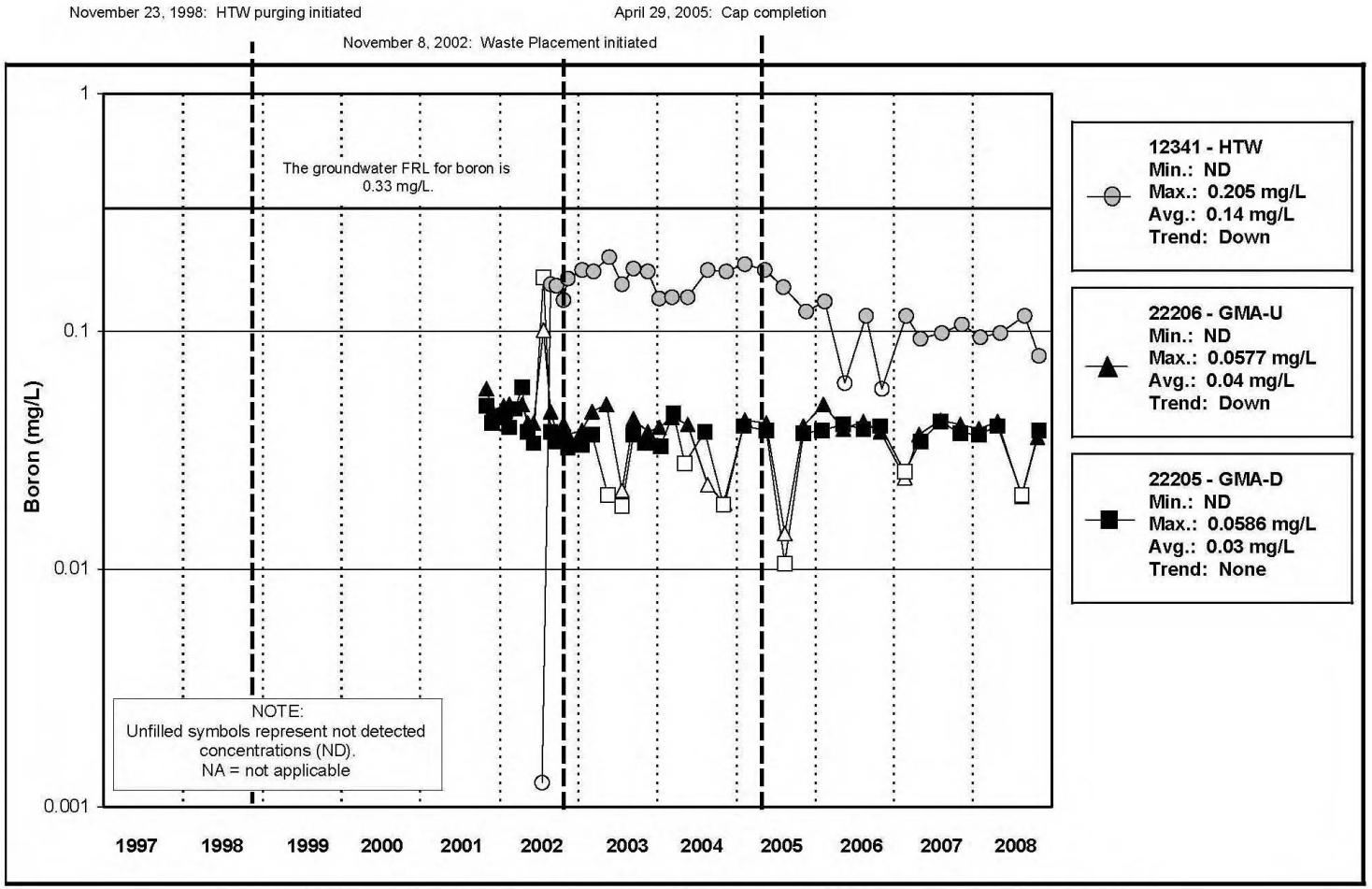

Figure A.5.4-7B. Cell 4 Boron Concentration vs. Time Plot for HTW, GMA-U Well, AND GMA-D Well

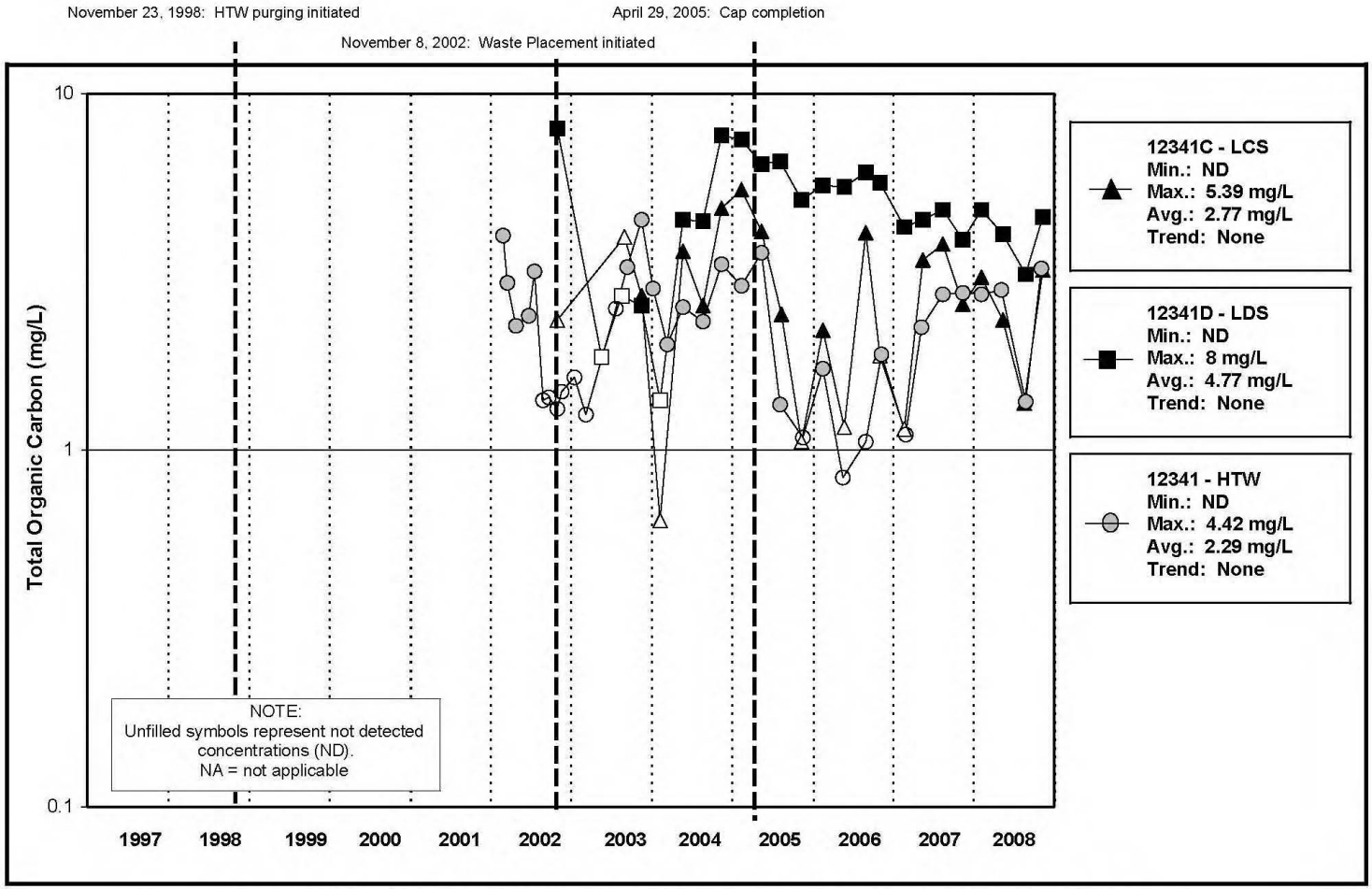

Figure A.5.4-8A. Cell 4 Total Organic Carbon Concentration vs. Time Plot for LCS, LDS, AND HTW

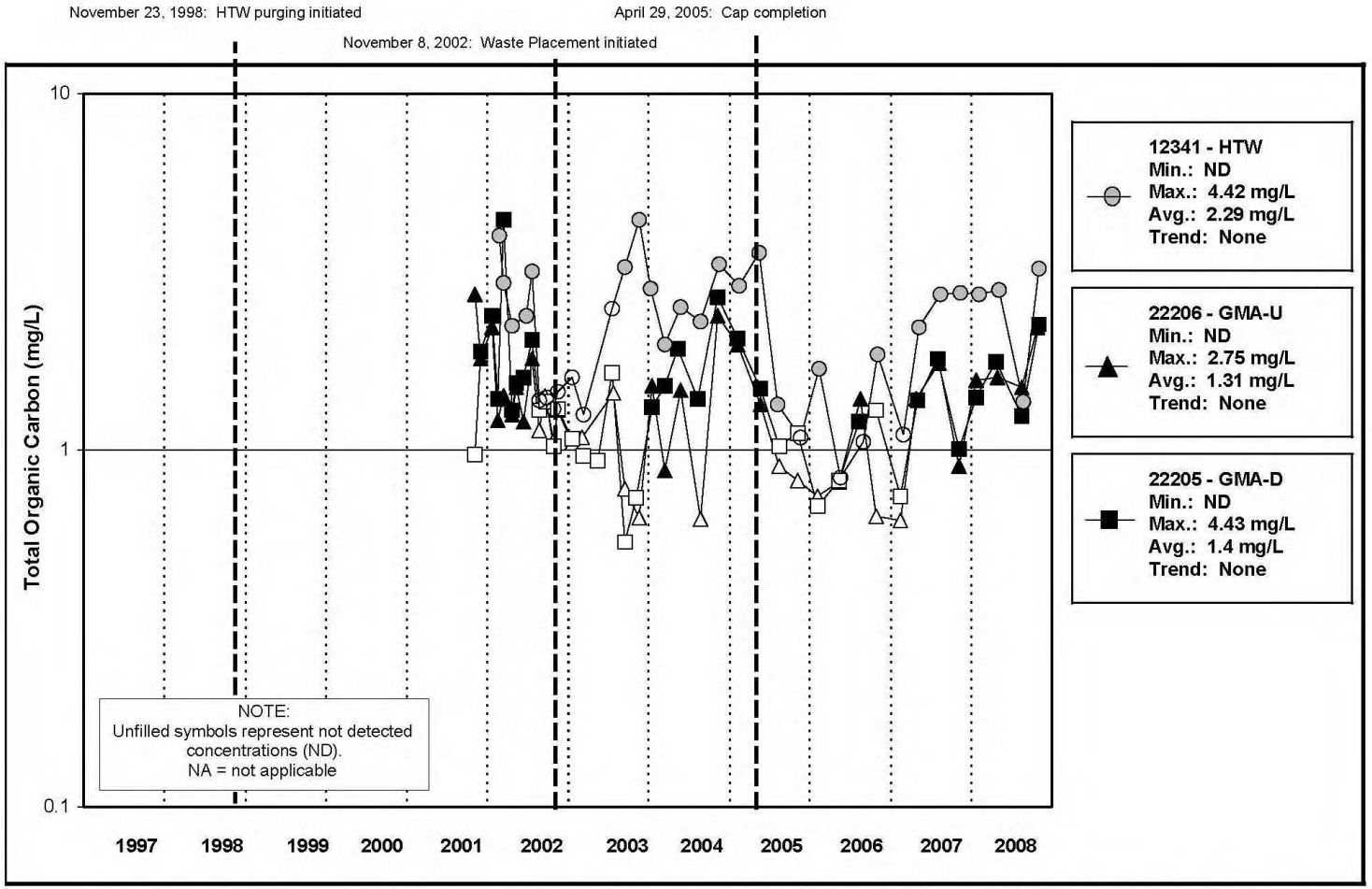

Figure A.5.4-8B. Cell 4 Total Organic Carbon Concentration vs. Time Plot for HTW, GMA-U Well, AND GMA-D Well

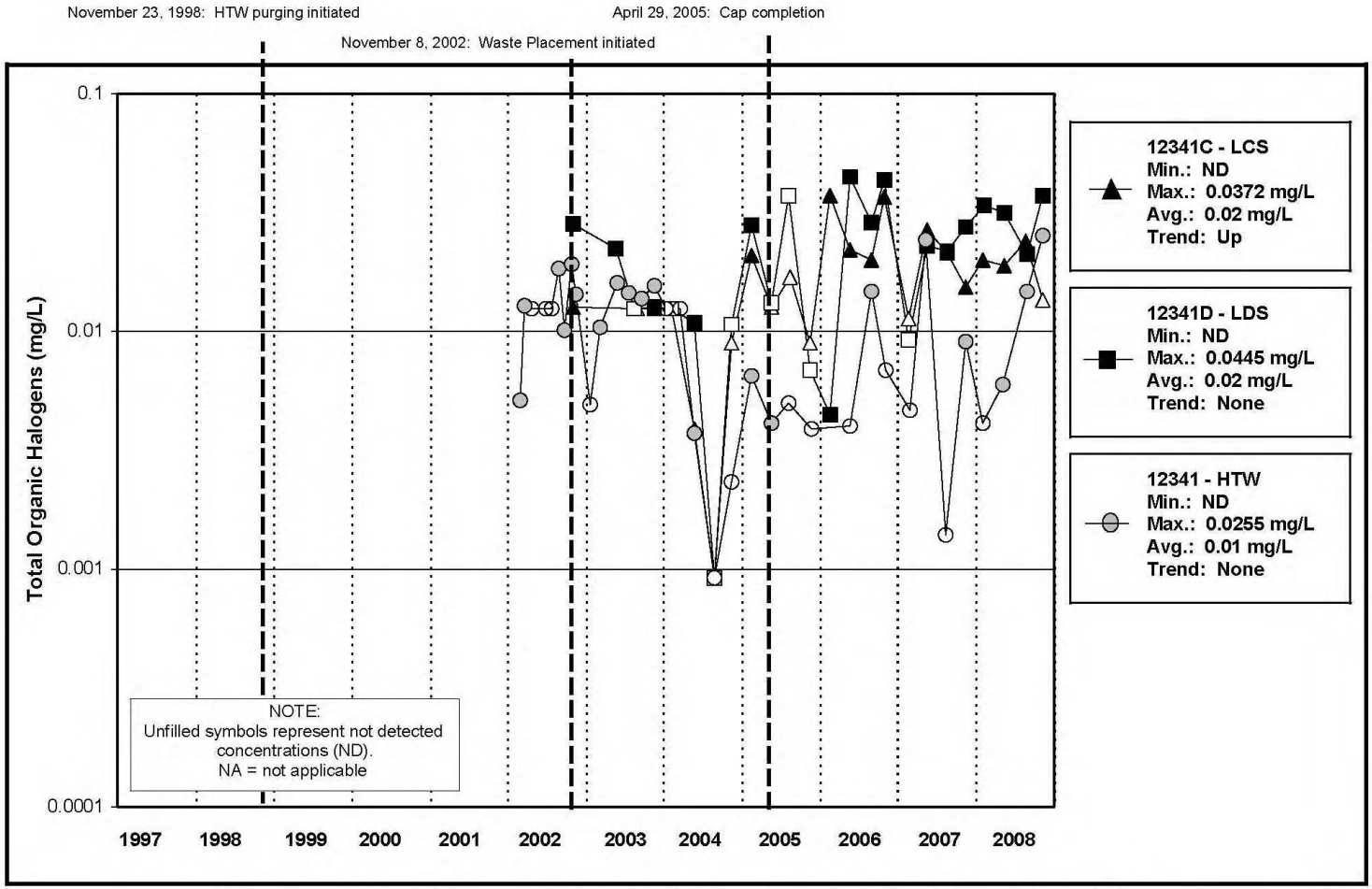

Figure A.5.4-9A. Cell 4 Total Organic Halogens Concentration vs. Time Plot for LCS, LDS, AND HTW

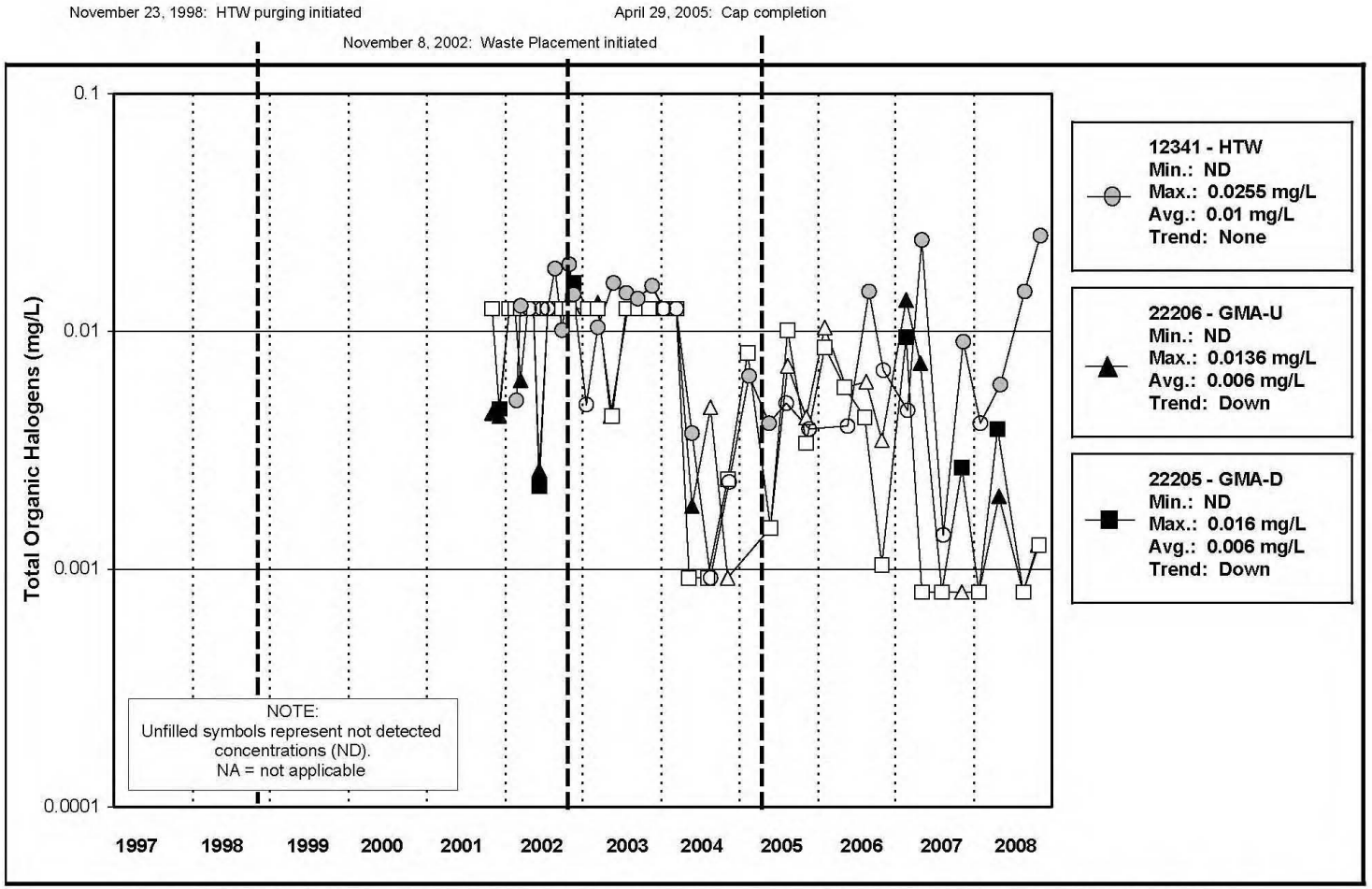

Figure A.5.4-9B. Cell 4 Total Organic Halogens Concentration vs. Time Plot for HTW, GMA-U Well, AND GMA-D Well

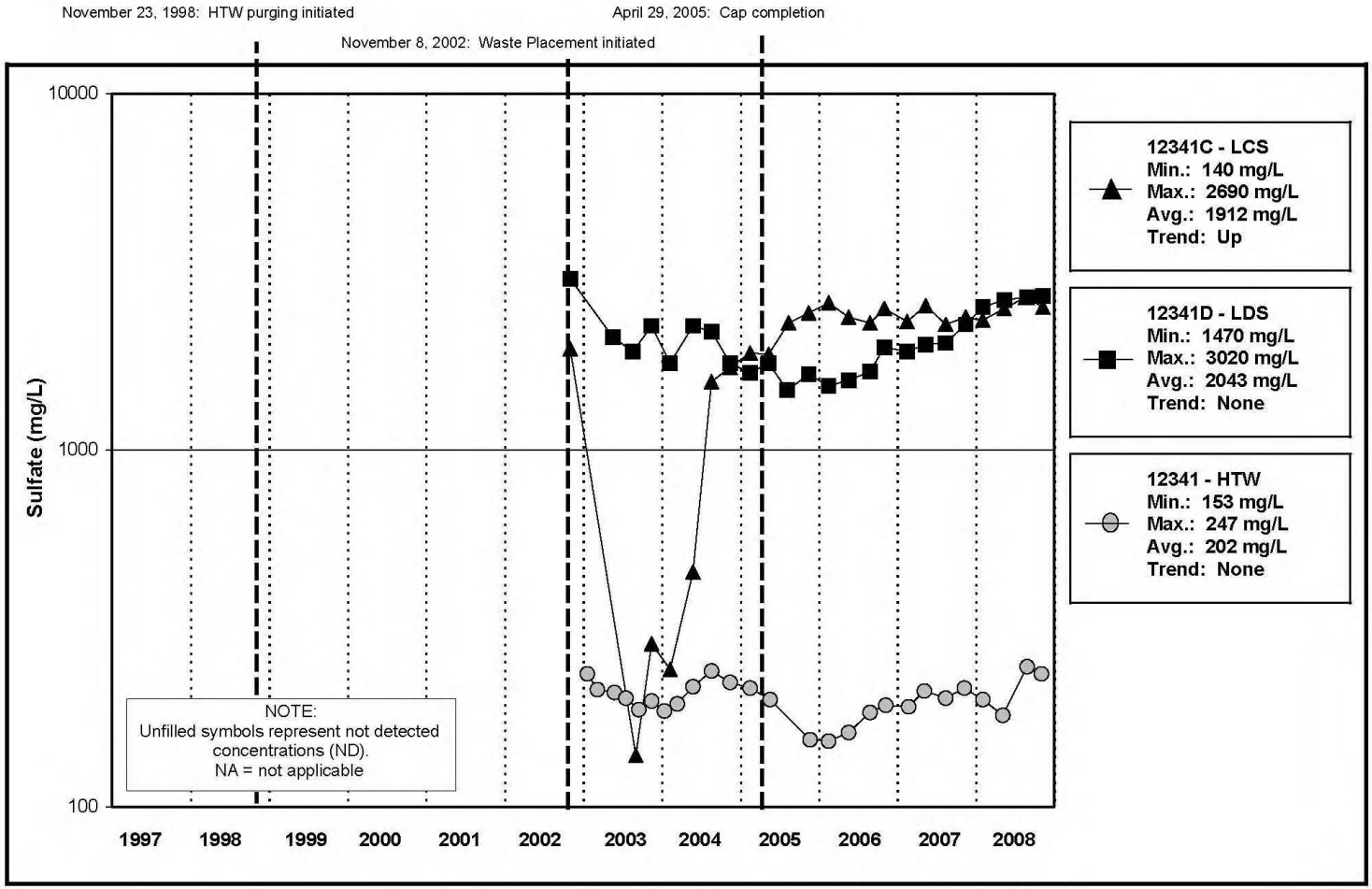

Figure A.5.4-10A. Cell 4 Sulfate Concentration vs. Time Plot for LCS, LDS, AND HTW

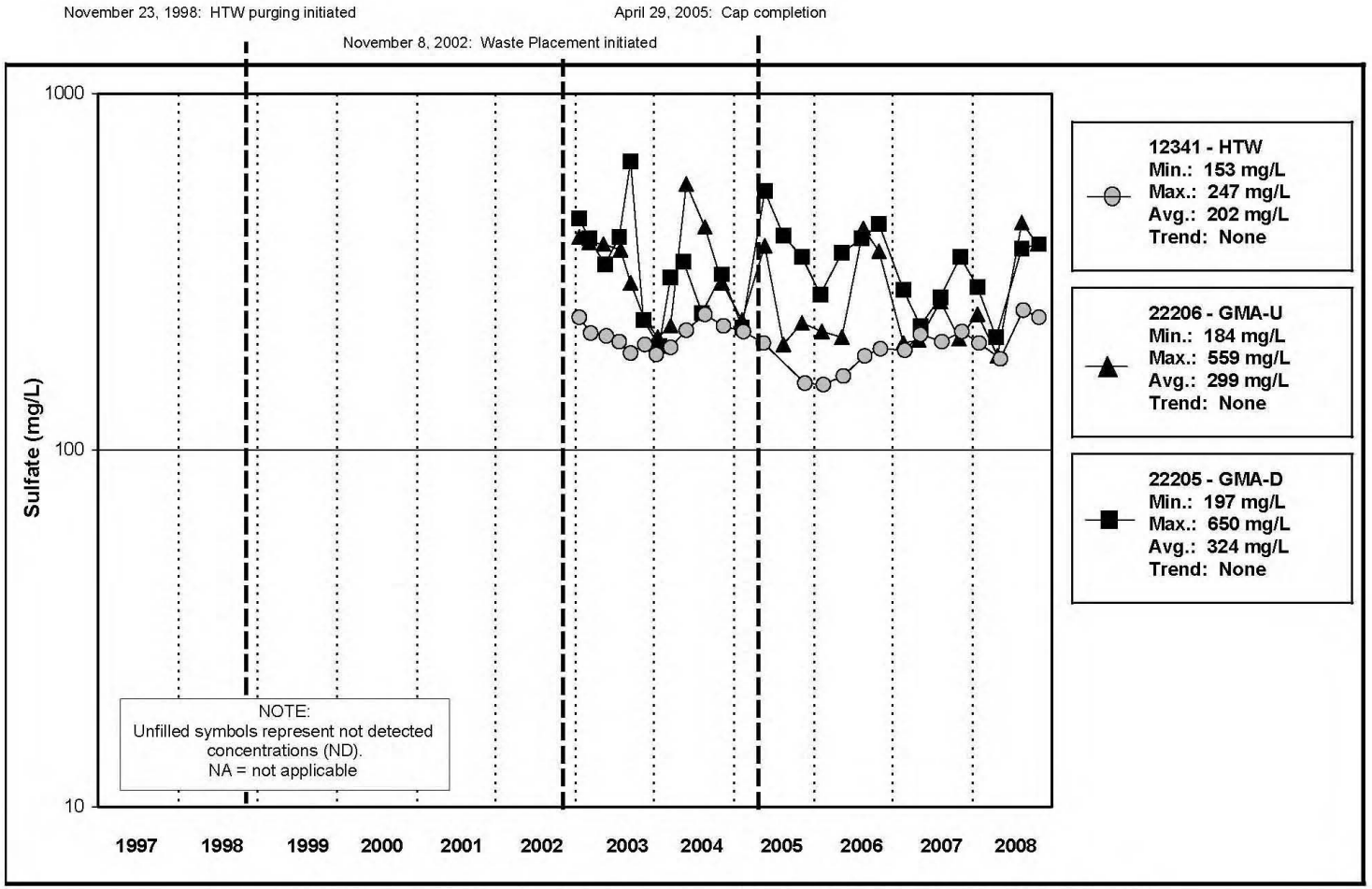

Figure A.5.4-10B. Cell 4 Sulfate Concentration vs. Time Plot for HTW, GMA-U Well, AND GMA-D Well

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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).
- GMA 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 in 2008 were collected according to the frequencies described in the GWLMP. Constituent sampling lists are provided in Table 2−1, Table 2−2, and Table 2−3 of Appendix B of the GWLMP. In 2008, all samples were collected for Cell 5 monitoring horizons.

A.5.5.1 Refined Baseline Monitoring Results

As defined in the GWLMP, refined baseline constituents are those constituents that have been monitored for at least eight times, and detected at least 25 percent of the time in the LCS, LDS, HTW, and GMA wells. Results from 2008 sampling are provided in a summary statistics table (Table A.5.5-2) and concentration plots (Figures A.5.5-6A to A.5.5-10B). The five refined baseline constituents are total uranium, boron, TOC, TOX, and sulfate.

Flow in the LDS in 2008 was well below the OSDF design action level, indicating that the water quality trends observed in the HTW and GMA wells in 2008 are attributable to concentration fluctuations taking place beneath the facility and not to a potential leak from the facility.

The 2009 revision of the GWLMP identifies the data evaluation techniques that will be used to further evaluate the association between water quality changes observed beneath the facility and the potential that they are being caused by a leak from the facility. Control charts will be added back to the program along with the use of bivariate plots.

Beginning in January 2009, the refined baseline constituents will become a subset of a larger group of 15 constituents that will be monitored annually in all four monitoring horizons (LCS, LDS, HTW, and GMA wells) of each cell. Monitoring at the LCS will include all of the 15 constituents listed below, as well as the rest of the initial baseline constituents defined for the facility.

Constituent Sampling List for the LDS, HTW, and GMA Wells of Each Cell in 2009	
Constituent	**Reason**
Boron	Refined Baseline Parameter
Sulfate	Refined Baseline Parameter
Uranium	Refined Baseline Parameter
TOC	Refined Baseline Parameter
TOX	Refined Baseline Parameter
Iron	Common Ion Study[a]
Manganese	Common Ion Study[a]
Sodium	Common Ion Study[a]
Lithium	Common Ion Study[a]
Arsenic	Appendix I Statistical Analysis
Cobalt	Appendix I Statistical Analysis
Nickel	Appendix I Statistical Analysis
Selenium	Appendix I Statistical Analysis
TDS	Appendix I Statistical Analysis
Zinc	Appendix I Statistical Analysis

[a] Also known as the *Evaluation of Aqueous Ions in the Monitoring Systems of the On-Site Disposal Facility* (DOE 2008b)

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. Even though active operations ended in 2006, this sampling continued in 2007 and 2008.

In 2008, annual sampling of the Cell 5 LCS took place in February. Table A.5.5-3 summarizes the annual LCS sampling results for Cell 5, along with the data collected in previous years. Table A.5.5-3 presents the non-refined baseline site-specific constituents that were monitored in 2008. Eleven of the constituents listed have been monitored eight or more times. Of those 11 constituents, all have been detected at least 25 percent of the time.

The potential monitoring usefulness of nine of the 11 constituents (alkalinity, calcium, chloride, iron, magnesium, manganese, nitrate/nitrite, potassium, and sodium) was addressed in the Common Ion Study. Of the remaining constituents (TDS and Technetium-99) TDS has been added to the monitoring program and will be sampled for in the LCS, LDS, HTW, and GMA wells of each cell in 2009.

Technetium-99 has been detected over 25 percent of the time in the Cell 5 LCS. Statistics conducted for Cell 1 on the potential usefulness of technetium-99 as a monitoring constituent for the OSDF indicated that it would not be a useful constituent at Cell 1. As described in the 2009 revision of the GWLMP, results from Cells 1, 2, and 3 are being applied to Cells 4 through 8. This means that in 2009 technetium-99 will not be sampled for in the LDS, HTW, or GMA wells of Cells 4 through 8. Given the consistency of detects though seen in 2008 at Cells 4 through 8, DOE will conduct a statistical analysis in 2009 for the usefulness of technetium-99 as a

monitoring constituent at Cells 4 through 8 similar to the one conducted for Cells 1, 2, and 3. This exception is warranted given that technetium-99 is being detected rather consistently, and the extra effort could result in adding an additional useful constituent to the monitoring program for those cells. Results of the analysis will be reported in the 2010 SER.

Confirmatory Sampling in the LCS

In 2009, confirmatory sampling procedures were modified in the GWLMP. Because confirmatory sampling identified in 2008 will take place in 2009, the modified procedure will be followed. Therefore, if a constituent was detected in the 2008 LCS sample that was not going to be monitored in the LDS in 2009, the constituent was added for confirmatory monitoring in 2009.

Two consecutive detects for that constituent in the cell's LCS will trigger monitoring for that constituent in the cell's LDS during the next scheduled sampling event. However, if the usefulness of the constituent as a monitoring constituent has already been addressed through the Common Ion Study, the constituent will not be added for confirmatory monitoring.

Three constituents had detects in 2008 in the Cell 5 LCS, and are not being sampled for in the Cell 5 LDS in 2009 (barium, copper, and Technetium-99). Both barium and copper were addressed in the Common Ion Study. The conclusion from that report was that both constituents would not be useful monitoring constituents at Cell 5, because the concentrations measured in the different monitoring horizons are too similar.

In 2008, technetium-99 was detected in the Cell 5 LCS. No detects were measured in 2007. If technetium-99 is detected in the Cell 5 LCS in 2009, technetium will be added to the constituent monitoring list for the Cell 5 LDS beginning in 2010, pending the results of the statistical analysis discussed above.

A.5.5.3 LDS Monitoring Results

In 2008, the LDS of Cell 5 was monitored for site-specific constituents listed in Table 2−1 of Appendix B of the GWLMP. The objective of the sampling was to determine if any initial baseline constituents, not on the refined baseline list, were present in the LDS. In 2008, sampling of the Cell 5 LDS took place in February.

Results of the LDS sampling at Cell 5 in 2008 indicate that all of the initial baseline constituents that have been monitored in the Cell 5 LDS and detected at least 25 percent of the time are being monitored in the Cell 5 HTW and GMA wells in 2009.

Table A.5.5−1. Cell 5 – 2008 Monthly Liner Efficiencies

Month	Cell 5 Apparent Liner Efficiency (%)
January	93.28
February	93.68
March	93.97
April	93.92
May	94.08
June	94.33
July	94.81
August	94.73
September	96.53
October	96.25
November	96.46
December	96.85

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]	
Total Uranium (µg/L)	LCS	12342C	25	25	100	131	Normal	Up, Significant	Detected		
	LDS	12342D	23	23	100	18.2	Normal	No Significant	Detected	2.93 (Q4-02)	
	HTW	12342	28	28	100	10.2	Log-Normal	Down, Significant	Detected		
	GMA-U	22207	23	29	79.3	0.37	Normal	Down, Significant	Detected	2.39 (Q3-02)	0 (Q4-03)
	GMA-D	22208	23	29	79.3	0.35	Normal	No Significant	Not Detected		
Boron (mg/L)	LCS	12342C	23	25	92.0	0.69	Normal	Up, Significant	Detected		
	LDS	12342D	23	23	100	0.49	Undefined	Down, Significant	Detected		
	HTW	12342	27	28	96.4	0.11	Normal	Down, Significant	Detected		
	GMA-U	22207	24	29	82.8	0.03	Normal	No Significant	Not Detected		
	GMA-D	22208	23	29	79.3	0.03	Normal	No Significant	Not Detected		
Total Organic Carbon (mg/L)	LCS	12342C	16	24	66.7	2.08	Normal	Up, Significant	Detected		
	LDS	12342D	20	23	87.0	6.41	Normal	No Significant	Detected		
	HTW	12342	22	27	81.5	2.78	Normal	No Significant	Not Detected		
	GMA-U	22207	18	29	62.1	1.30	Normal	No Significant	Not Detected	4.15 (Q4-03)	
	GMA-D	22208	19	29	65.5	1.3	Normal	No Significant	Not Detected	8.93 (Q4-01)	
Total Organic Halogens (mg/L)	LCS	12342C	9	25	36.0	0.01	Undefined	No Significant	Not Detected	0.0604 (Q1-06)	
	LDS	12342D	13	23	56.5	0.03	Normal	Up, Significant	Not Detected		
	HTW	12342	16	28	57.1	0.008	Normal	No Significant	Not Detected		
	GMA-U	22207	6	29	20.7	0.007	Undefined	Down, Significant	Detected		
	GMA-D	22208	7	29	24.1	0.003	Undefined	No Significant	Not Detected		
Sulfate (mg/L)	LCS	12342C	25	25	100	1820	Undefined	Up, Significant	Detected		
	LDS	12342D	23	23	100	1540	Log-Normal	No Significant	Detected		
	HTW	12342	24	24	100	209	Log-Normal	No Significant	Detected		
	GMA-U	22207	24	24	100	294	Undefined	No Significant	Not Detected	770 (Q2-05)	
	GMA-D	22208	24	24	100	386	Normal	No Significant	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 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 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.

[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.5.5−3. 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]	DETECTED IN 2008?	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
General Chemistry												
Alkalinity as CaCO3 (mg/L)	13	13	100%	Yes	58	563	432	-	422 mg/L(10)	430 mg/L(9)	-	10 mg/L
Ammonia (mg/L)	7	1	14.3%	No	0.815	-	-	-	4.2 mg/L(0)	4.34 mg/L(0)	220 mg/L(0)	0.1 mg/L
Chloride (mg/L)	13	13	100%	Yes	16.9	103	69.9	-	7.3 mg/L(13)	45 mg/L(10)	6300 mg/L(0)	5 mg/L
Nitrate/Nitrite (mg/L)	19	12	63.2%	Yes	0.00366	4.18	1.31	11 mg/L[g](0)	11 mg/L(0)	0.29 mg/L(9)	2670 mg/L(0)	1.1 mg/L
Total Dissolved Solids (mg/L)	13	13	100%	Yes	436	4770	2290	-	-	-	-	10 mg/L
Inorganics												
Barium (mg/L)	7	7	100%	Yes	0.0226	0.0707	0.0394	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)	7	1	14.3%	No	0.000038	-	-	0.004 mg/L(0)	-	-	0.0343 mg/L(0)	0.001 mg/L
Calcium (mg/L)	13	13	100%	Yes	163	990	512	-	159 mg/L(13)	172 mg/L(12)	1800 mg/L(0)	5 mg/L
Chromium (mg/L)	7	1	14.3%	No	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)	7	6	85.7%	Yes	0.00035	0.0116	0.0032	0.17 mg/L(0)	0.0086 mg/L(1)	-	0.0886 mg/L(0)	0.034 mg/L
Copper (mg/L)	7	5	71.4%	Yes	0.0097	0.0862	0.0275	1.3 mg/L(0)	0.035 mg/L(1)	0.029 mg/L(1)	0.298 mg/L(0)	0.008 mg/L
Iron (mg/L)	13	11	84.6%	No	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)	13	13	100%	Yes	57.7	913	385	-	38.5 mg/L(13)	50.7 mg/L(13)	690 mg/L(1)	5 mg/L
Manganese (mg/L)	13	10	76.9%	Yes	0.0059	2.96	1.16	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)	7	7	100%	Yes	0.00403	0.0438	0.0203	0.1 mg/L(0)	0.0514 mg/L(0)	0.0072 mg/L(4)	0.981 mg/L(0)	0.02 mg/L
Potassium (mg/L)	13	13	100%	Yes	6.22	65.5	24.3	-	1.96 mg/L(13)	17.2 mg/L(11)	12400 mg/L(0)	5 mg/L
Selenium (mg/L)	7	2	28.6%	No	0.0027	0.0194	-	0.05 mg/L(0)	0.00075 mg/L(2)	-	0.0494 mg/L(0)	0.005 mg/L
Sodium (mg/L)	13	12	92.3%	Yes	16.4	108	63.5	-	47.1 mg/L(10)	50 mg/L(10)	1300 mg/L(0)	5 mg/L
Vanadium (mg/L)	7	2	28.6%	No	0.00089	0.00157	-	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)	7	2	28.6%	Yes	0.0156	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
Radionuclides												
Technetium-99 (pCi/L)	14	8	57.1%	Yes	2.04	19	10.3	94 pCi/L(0)	22 pCi/L(0)	30 pCi/L(0)	6130 pCi/L(0)	10 pCi/L
Organics												
Carbon disulfide (ug/L)	7	1	14.3%	No	0.33	-	-	5.5 ug/L(0)	-	-	-	5 ug/L
1,1-Dichloroethane (ug/L)	7	1	14.3%	No	0.498	-	-	280 ug/L(0)	-	-	-	1 ug/L
4-Methyl-2-pentanone (ug/L)	7	1	14.3%	No	0.46	-	-	-	-	-	-	5 ug/L
Toluene (ug/L)	7	1	14.3%	No	0.416	-	-	-	-	-	-	1 ug/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 minumun 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.

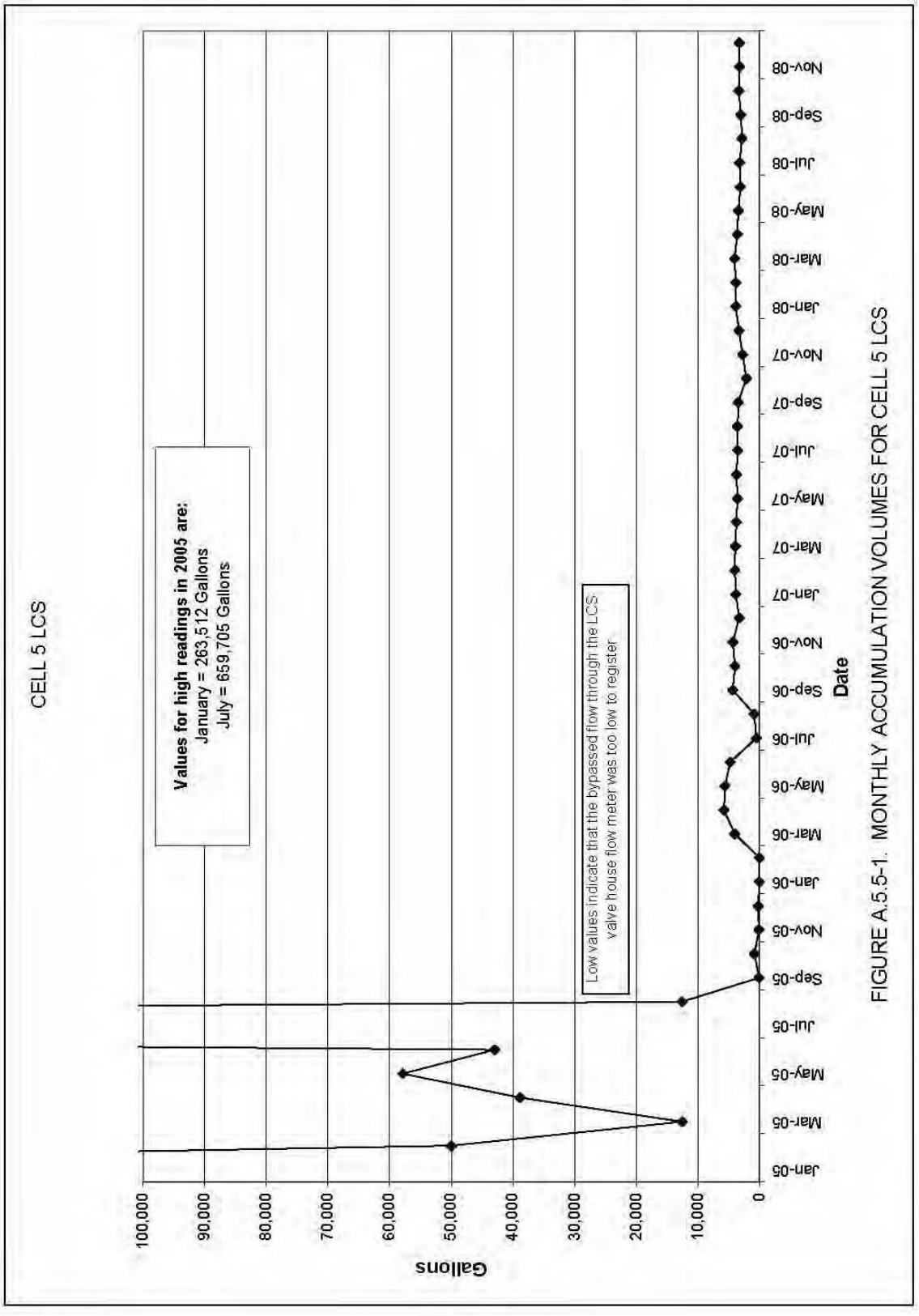


FIGURE A.5.5-1. MONTHLY ACCUMULATION VOLUMES FOR CELL 5 LCS

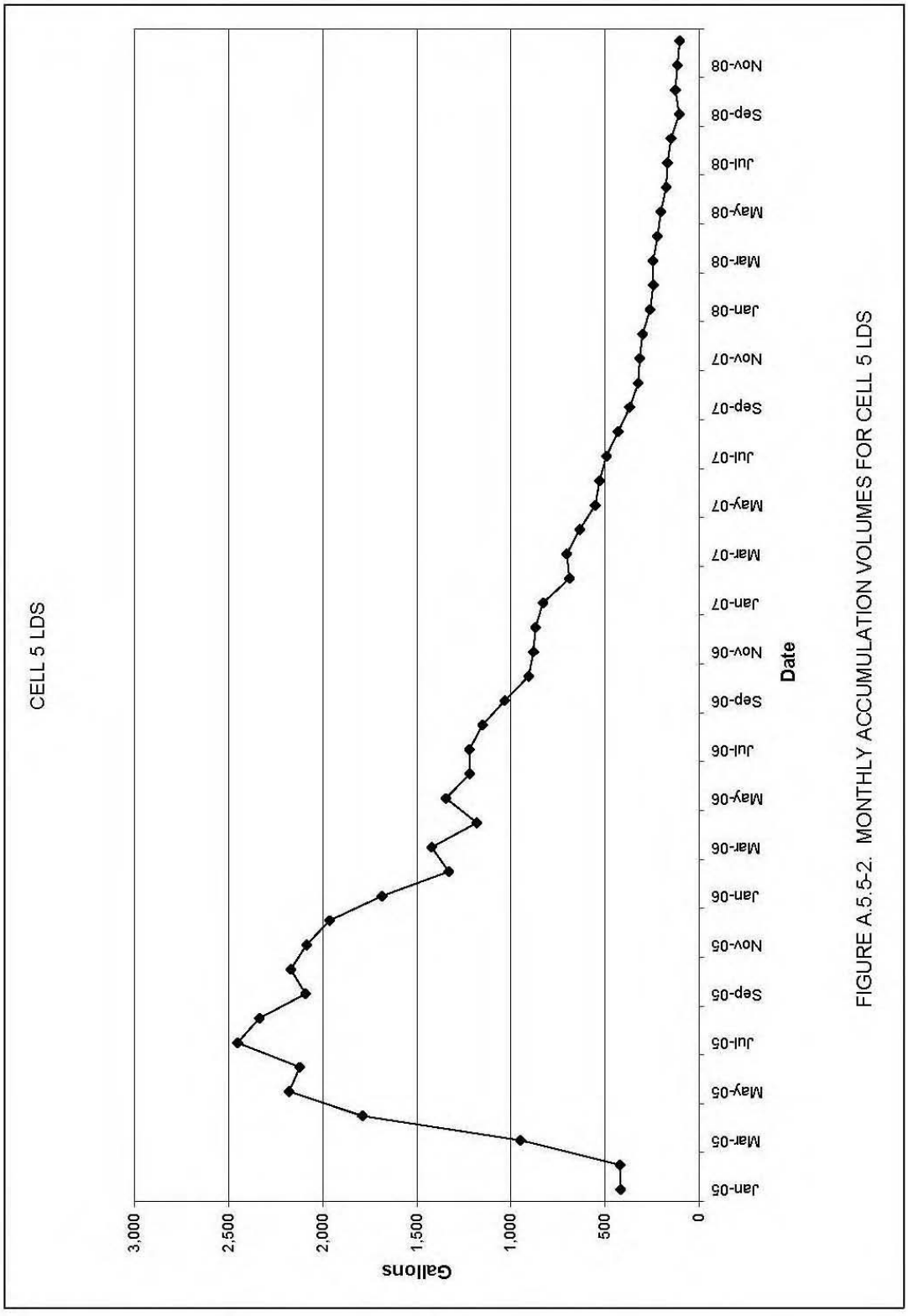
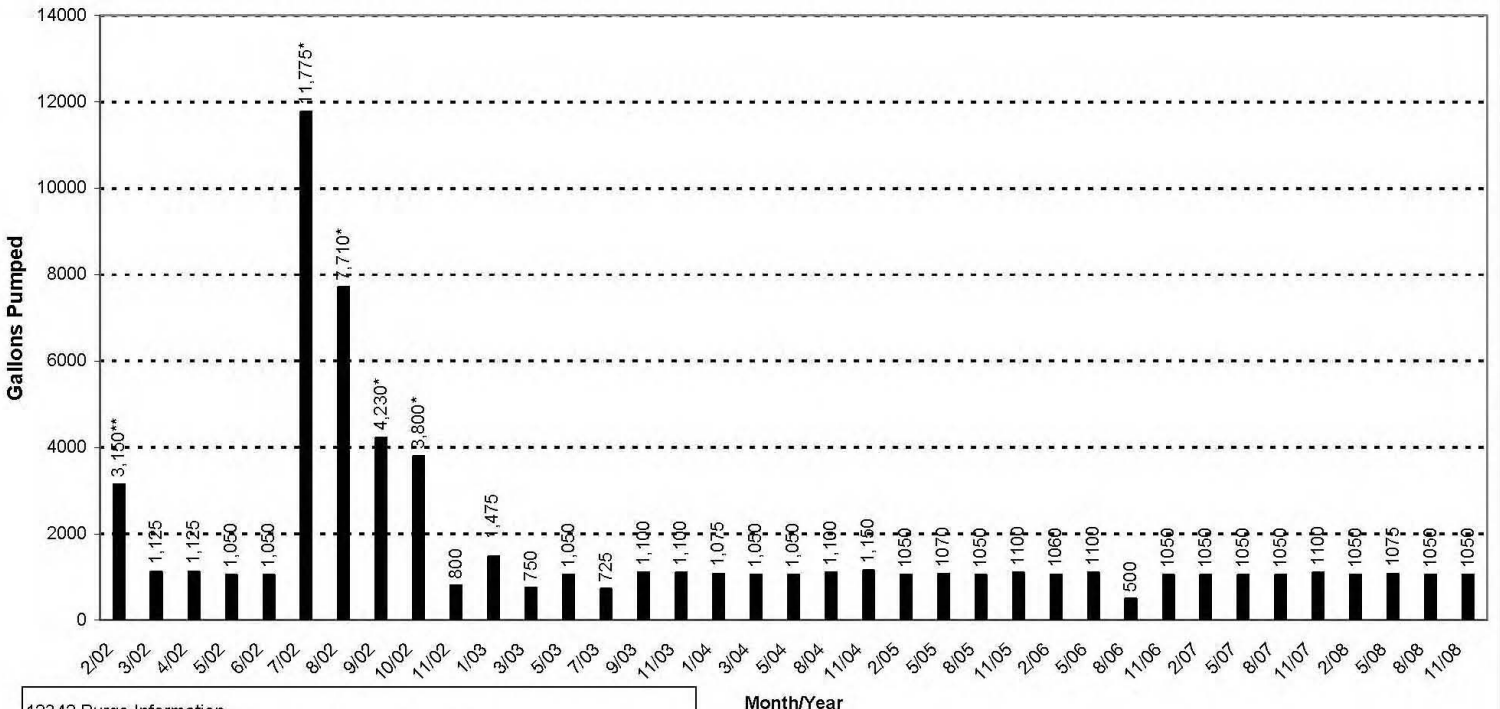


FIGURE A.5.5-2. MONTHLY ACCUMULATION VOLUMES FOR CELL 5 LDS



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
2008:	4225	n=4	1056
Overall:			1727

*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

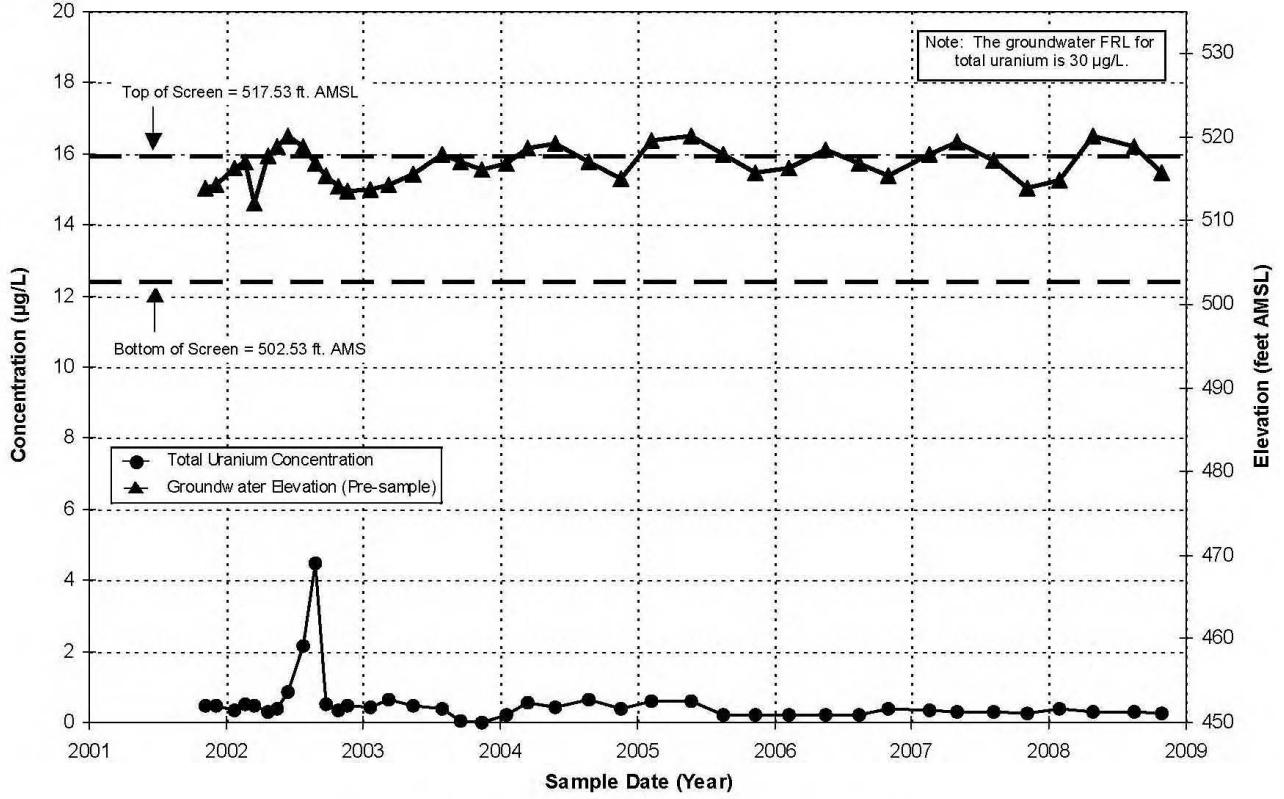


Figure A.5.5-4. Total Uranium Concentration and Groundwater Elevation vs. Time Plot for Cell 5 Upgradient Monitoring Well 22207

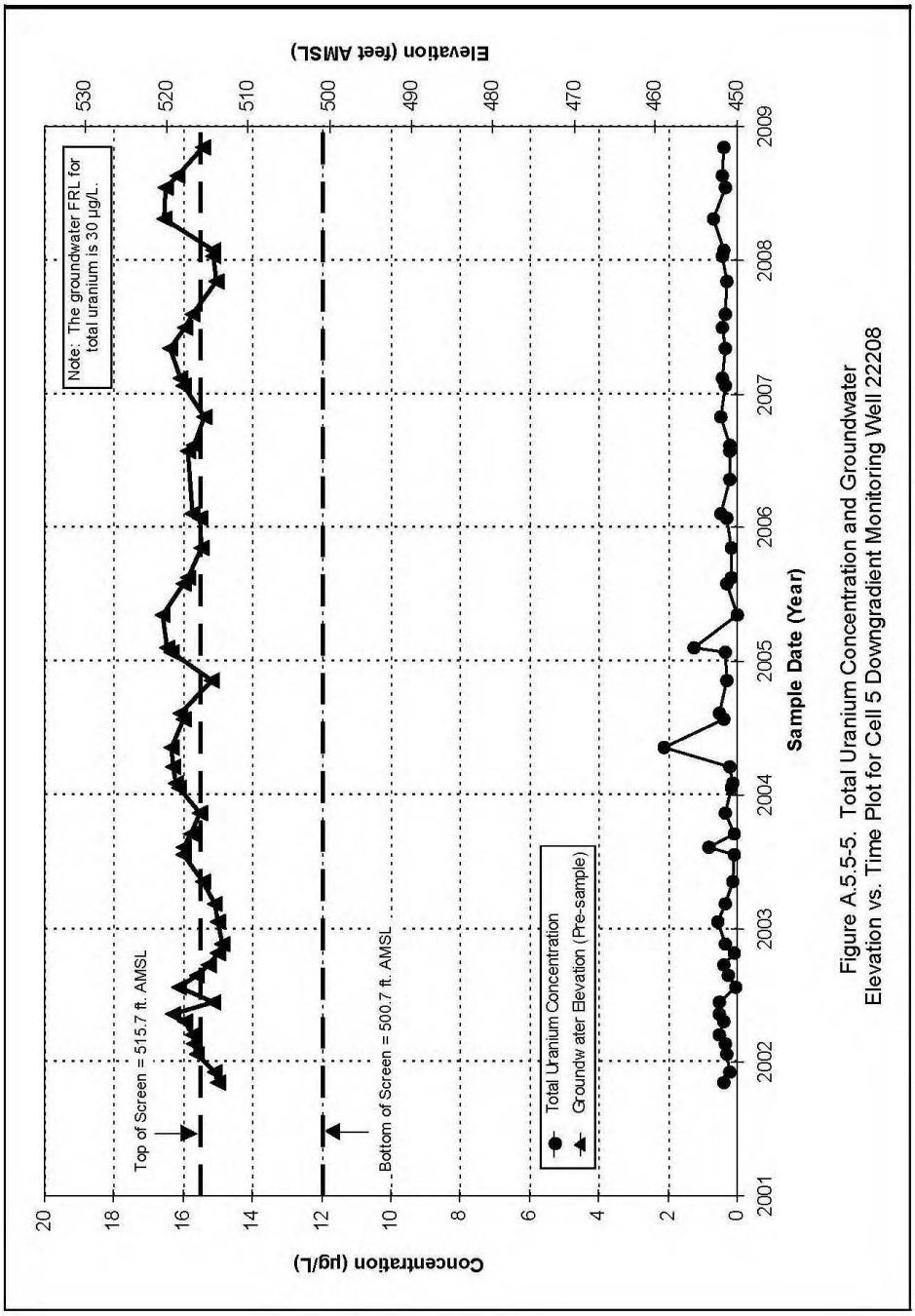


Figure A.5.5-5. Total Uranium Concentration and Groundwater Elevation vs. Time Plot for Cell 5 Downgradient Monitoring Well 22208

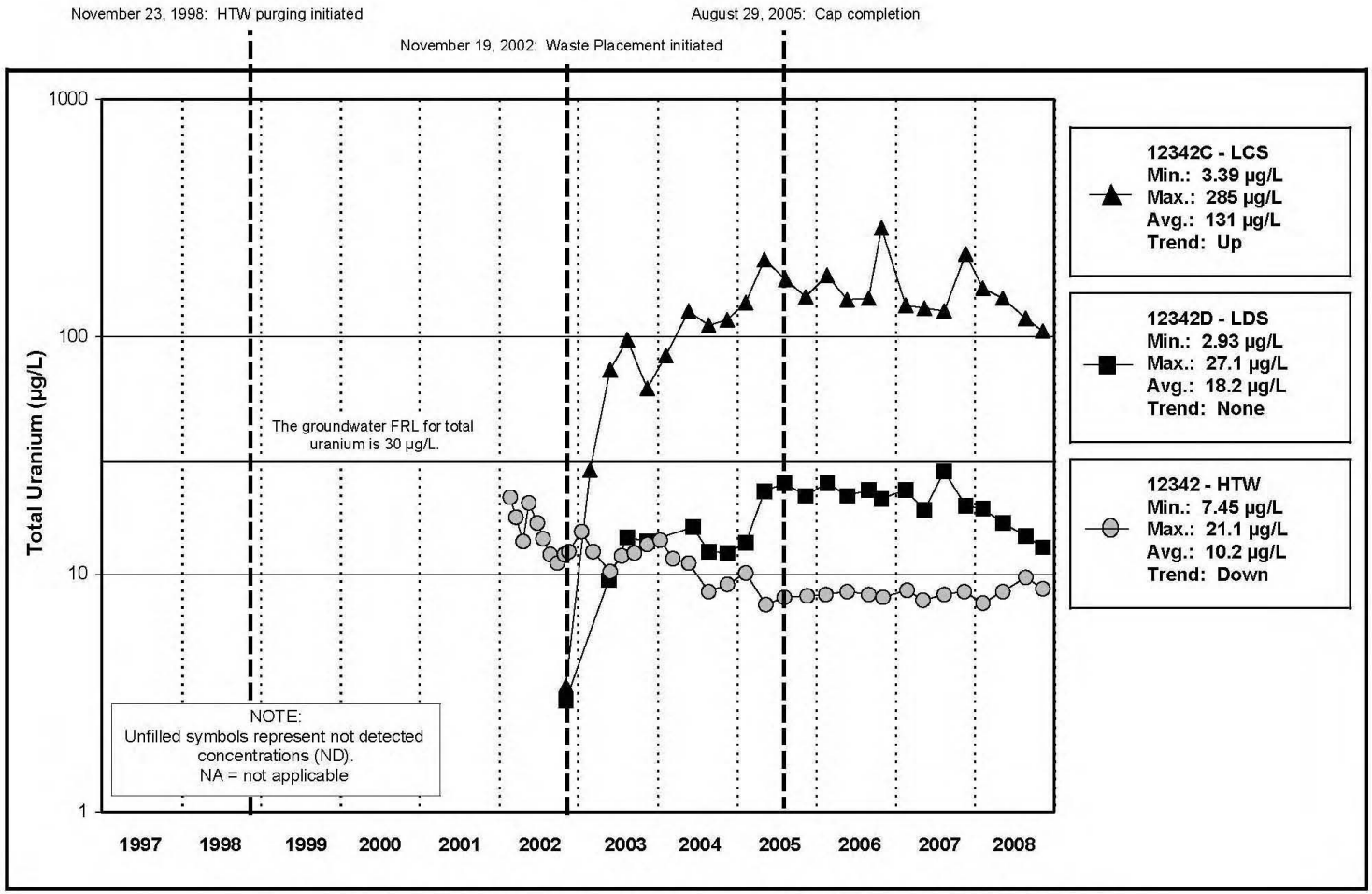


Figure A.5.5-6A. Cell 5 Total Uranium Concentration vs. Time Plot for LCS, LDS, AND HTW

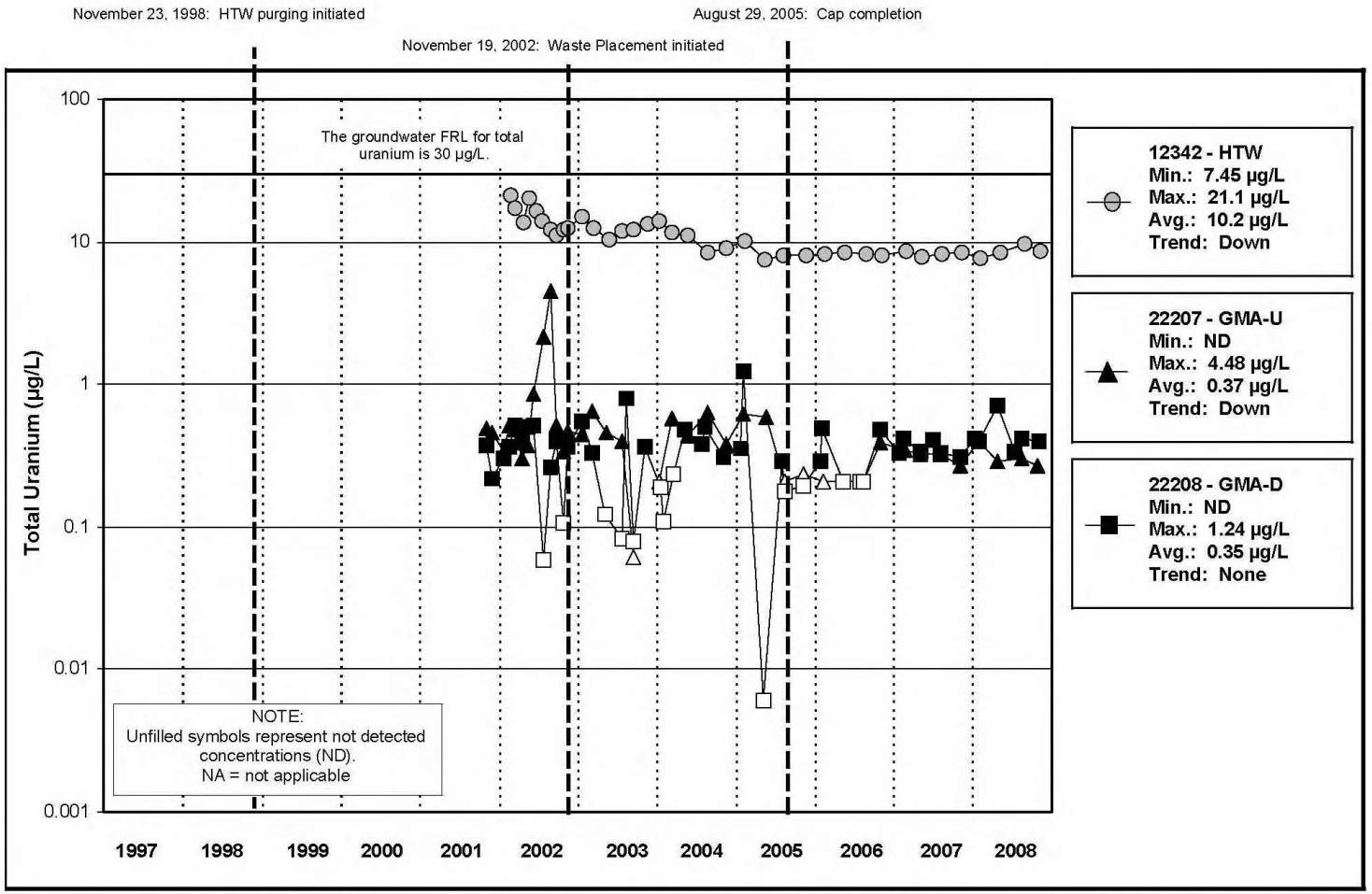


Figure A.5.5-6B. Cell 5 Total Uranium Concentration vs. Time Plot for HTW, GMA-U Well, AND GMA-D Well

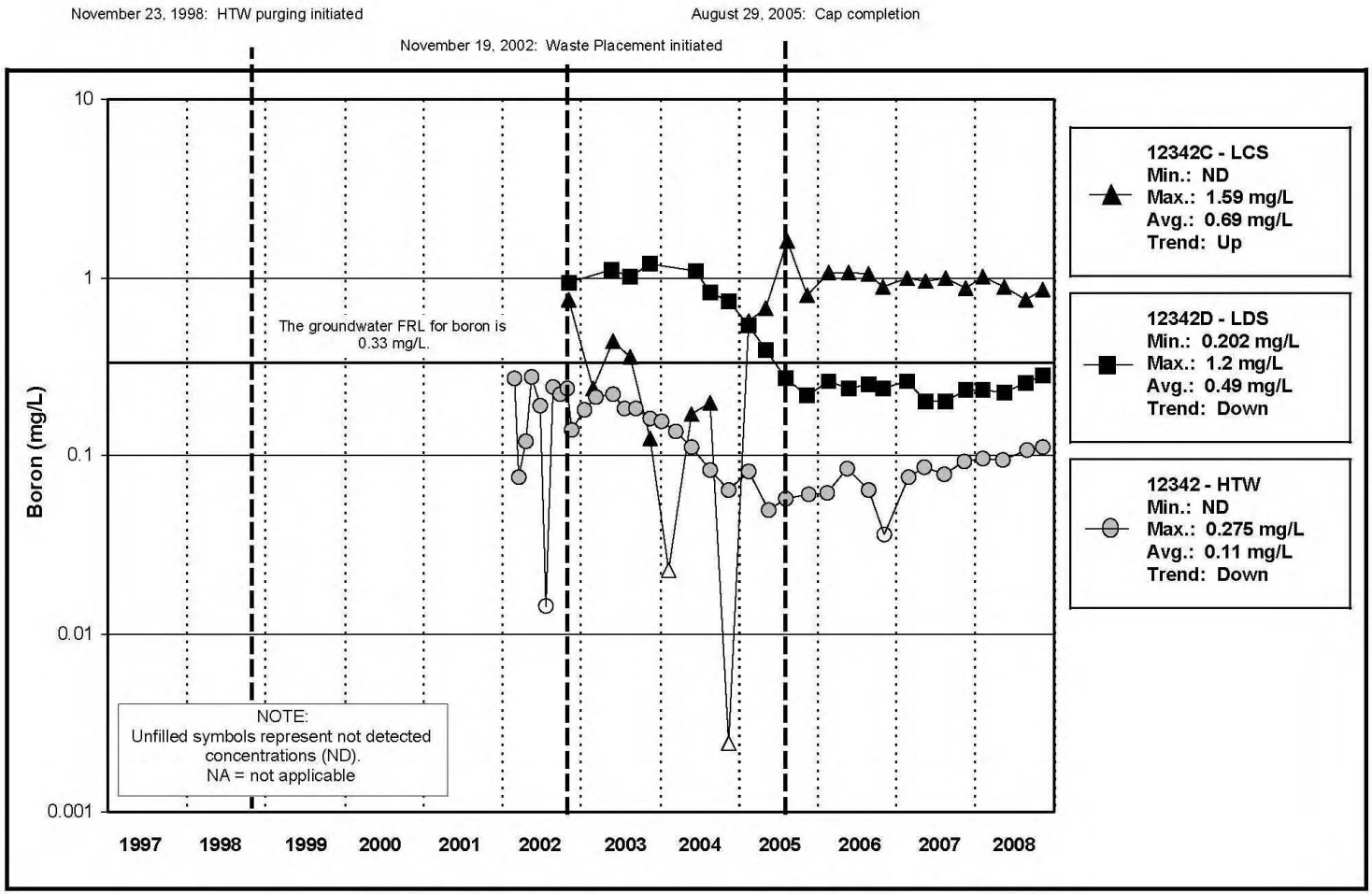


Figure A.5.5-7A. Cell 5 Boron Concentration vs. Time Plot for LCS, LDS, AND HTW

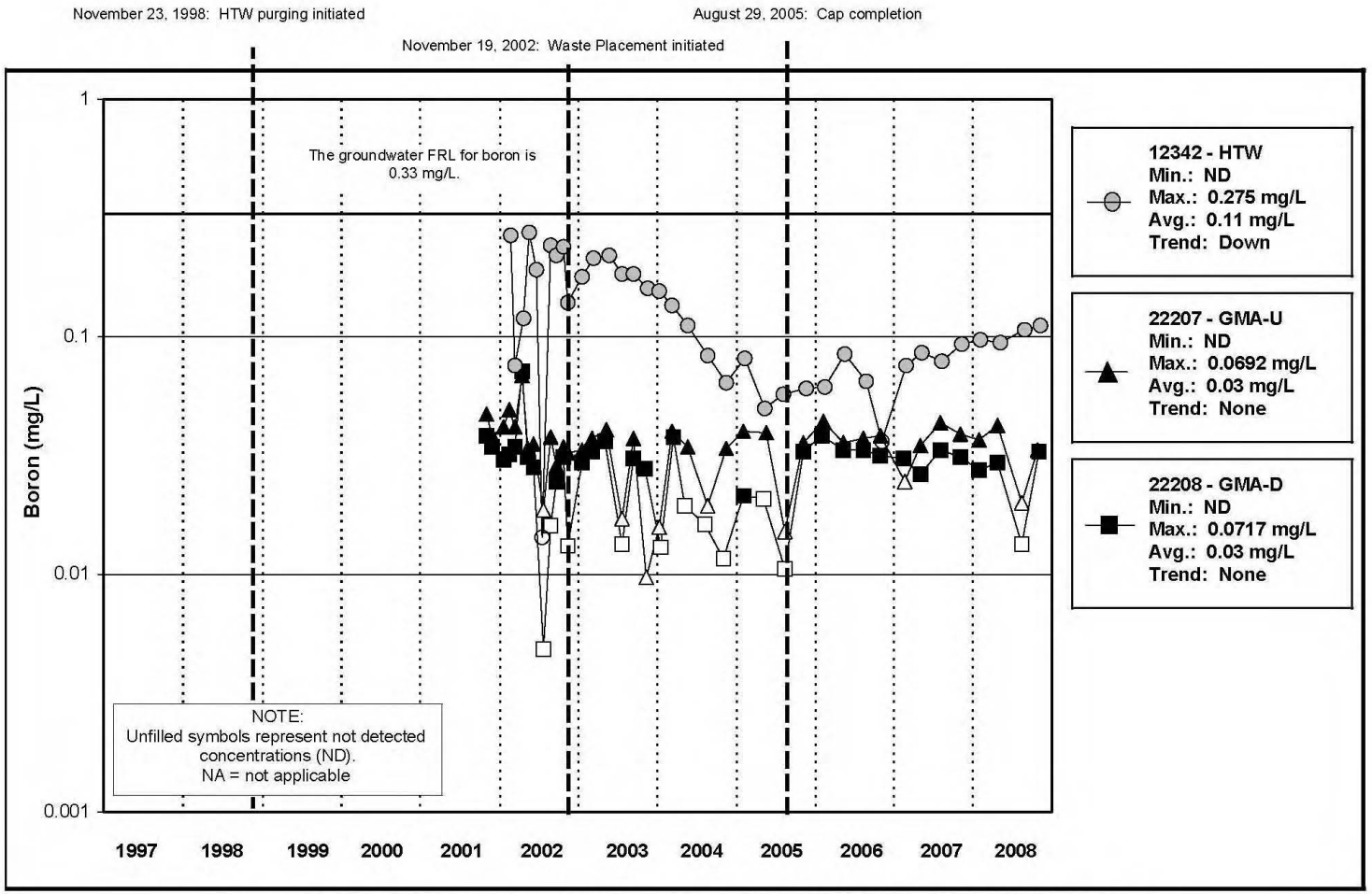


Figure A.5.5-7B. Cell 5 Boron Concentration vs. Time Plot for HTW, GMA-U Well, AND GMA-D Well

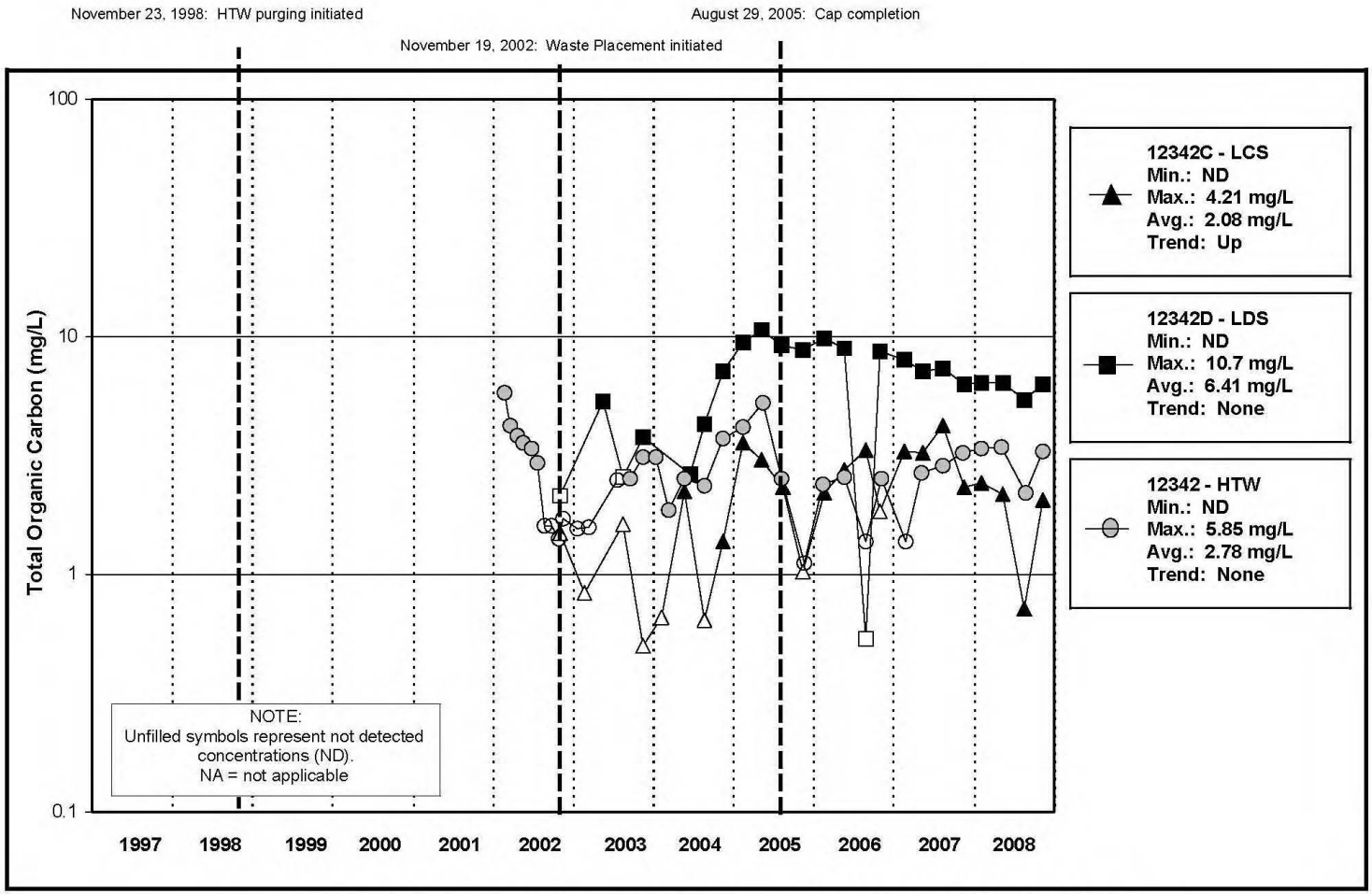


Figure A.5.5-8A. Cell 5 Total Organic Carbon Concentration vs. Time Plot for LCS, LDS, AND HTW

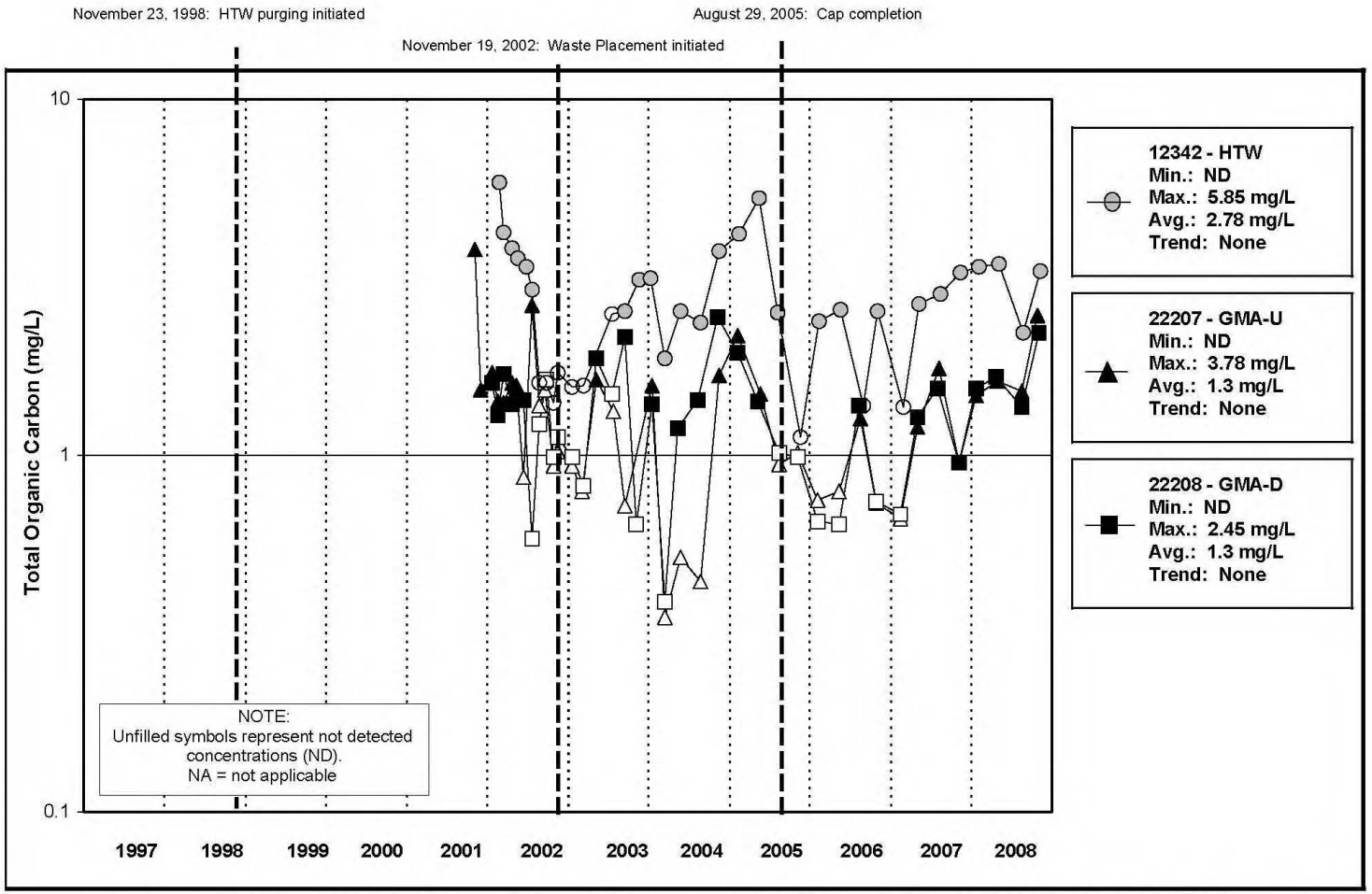


Figure A.5.5-8B. Cell 5 Total Organic Carbon Concentration vs. Time Plot for HTW, GMA-U Well, AND GMA-D Well

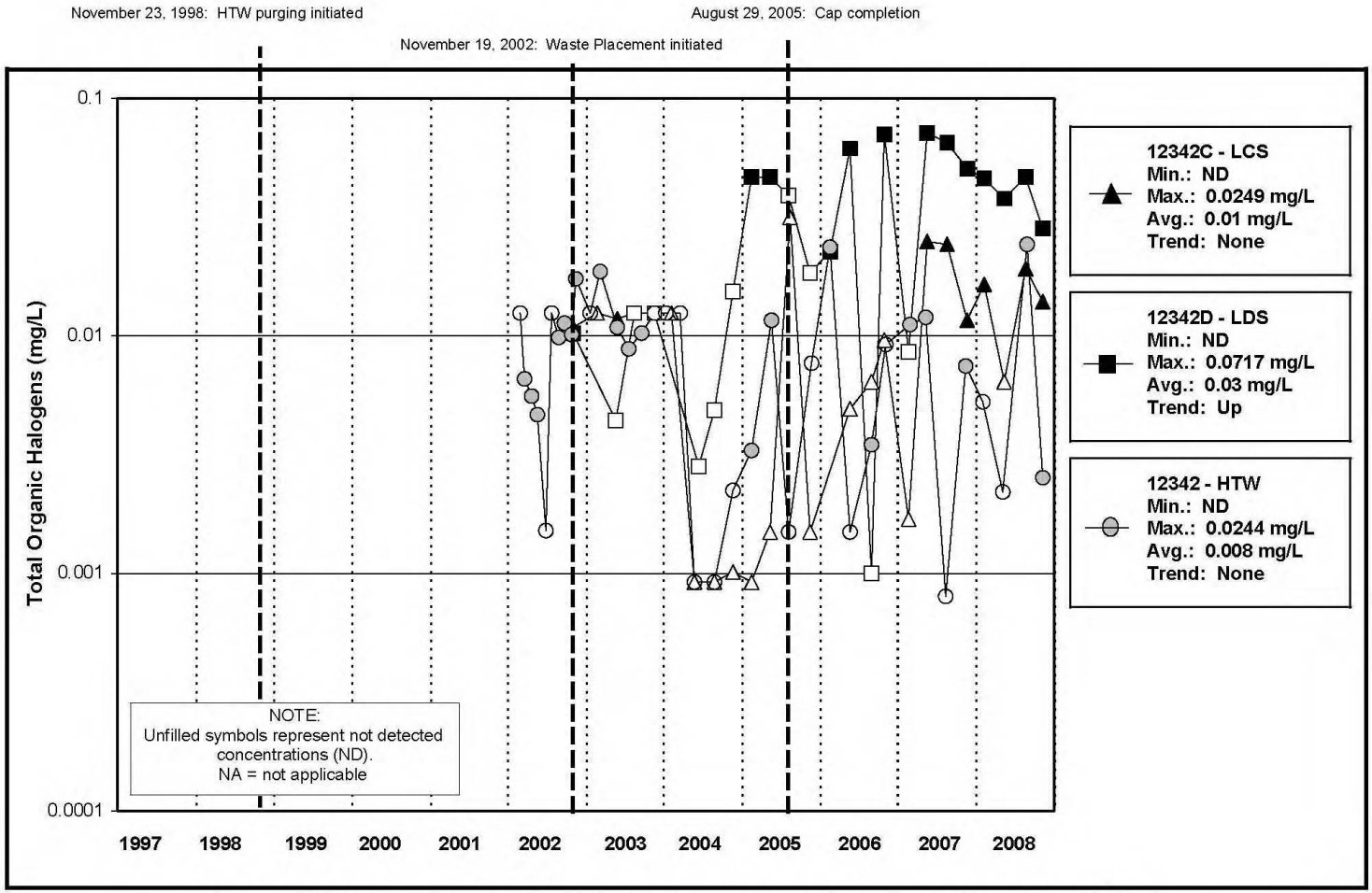


Figure A.5.5-9A. Cell 5 Total Organic Halogens Concentration vs. Time Plot for LCS, LDS, AND HTW

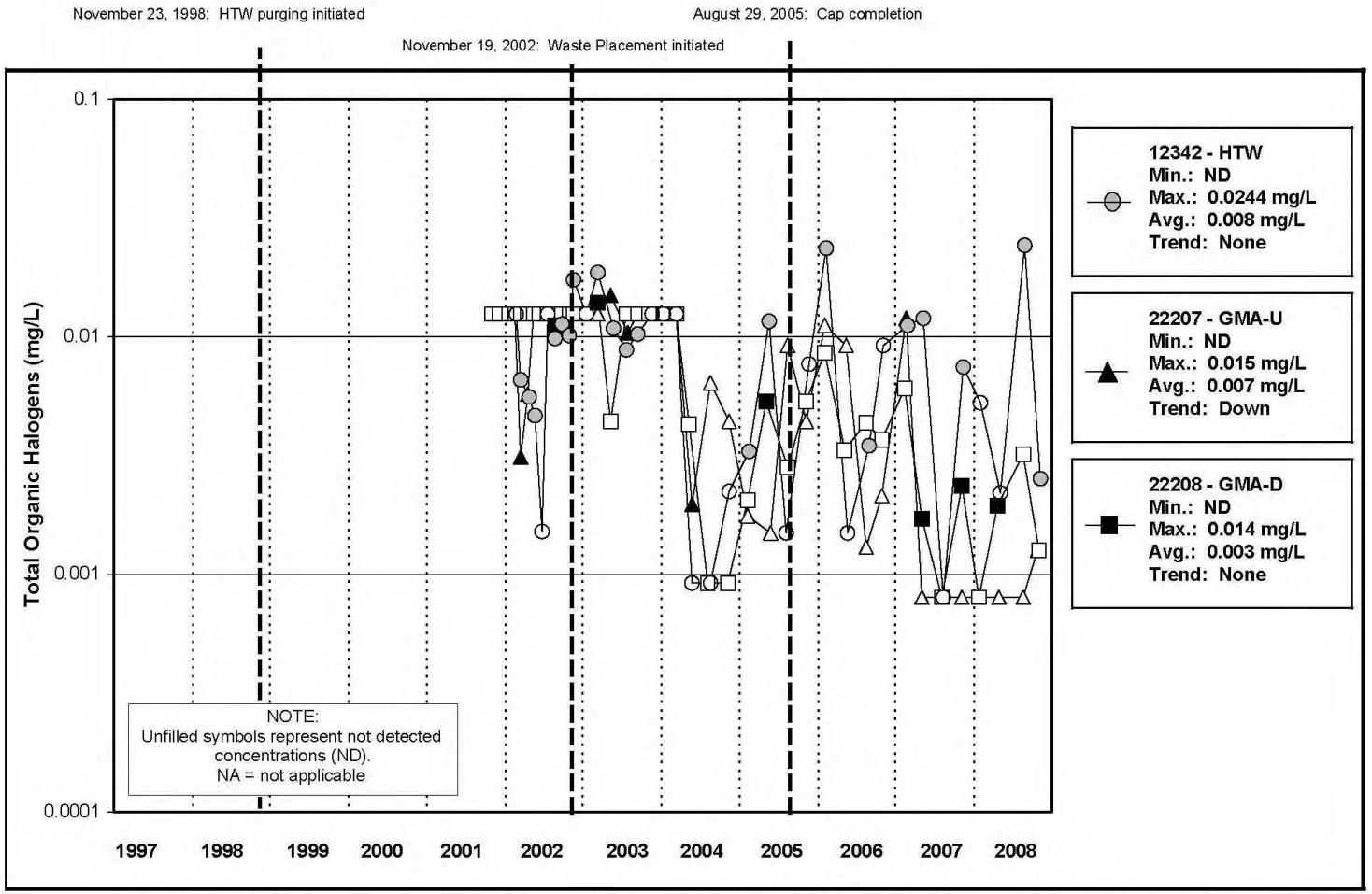


Figure A.5.5-9B. Cell 5 Total Organic Halogens Concentration vs. Time Plot for HTW, GMA-U Well, AND GMA-D Well

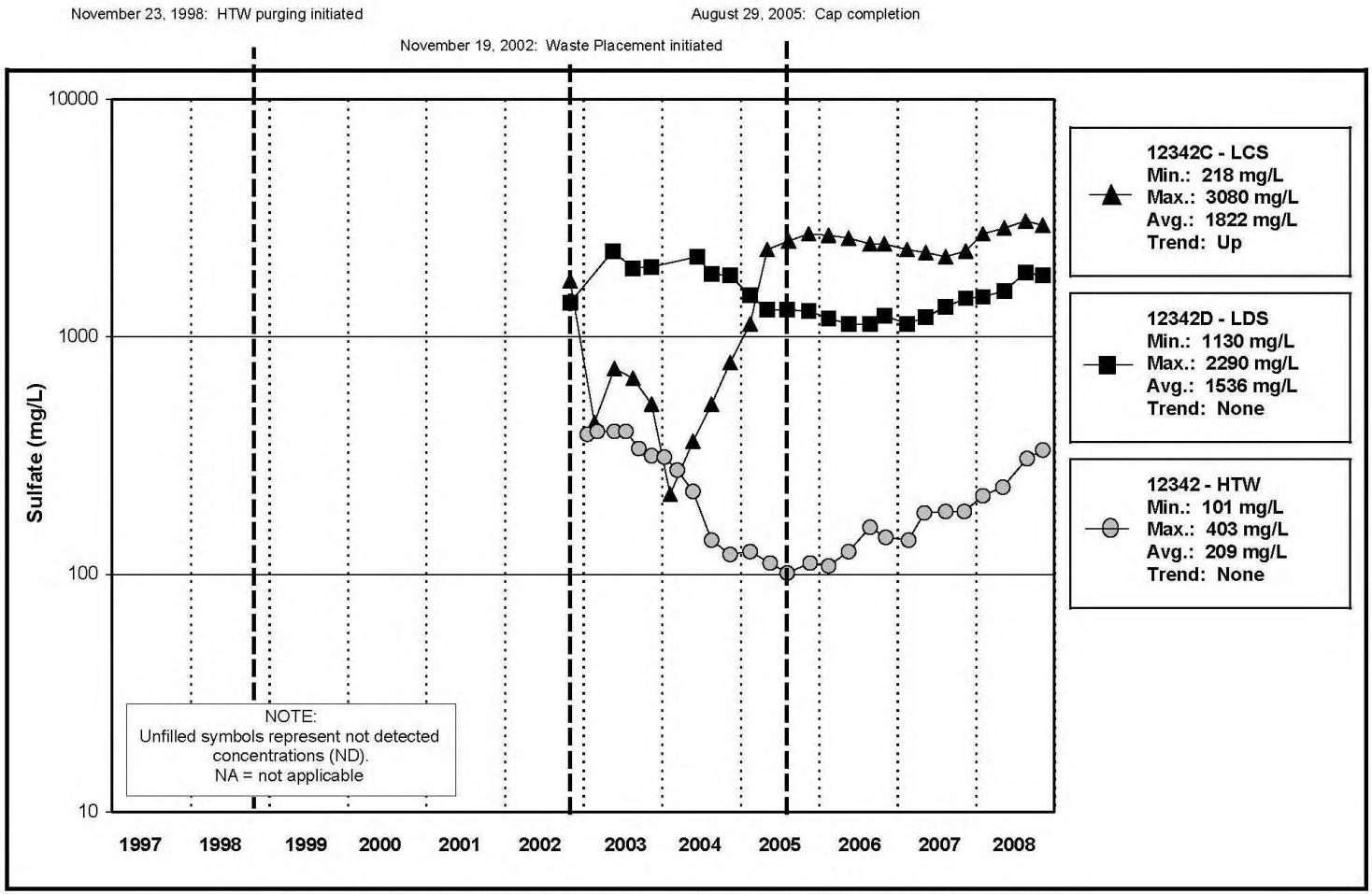


Figure A.5.5-10A. Cell 5 Sulfate Concentration vs. Time Plot for LCS, LDS, AND HTW

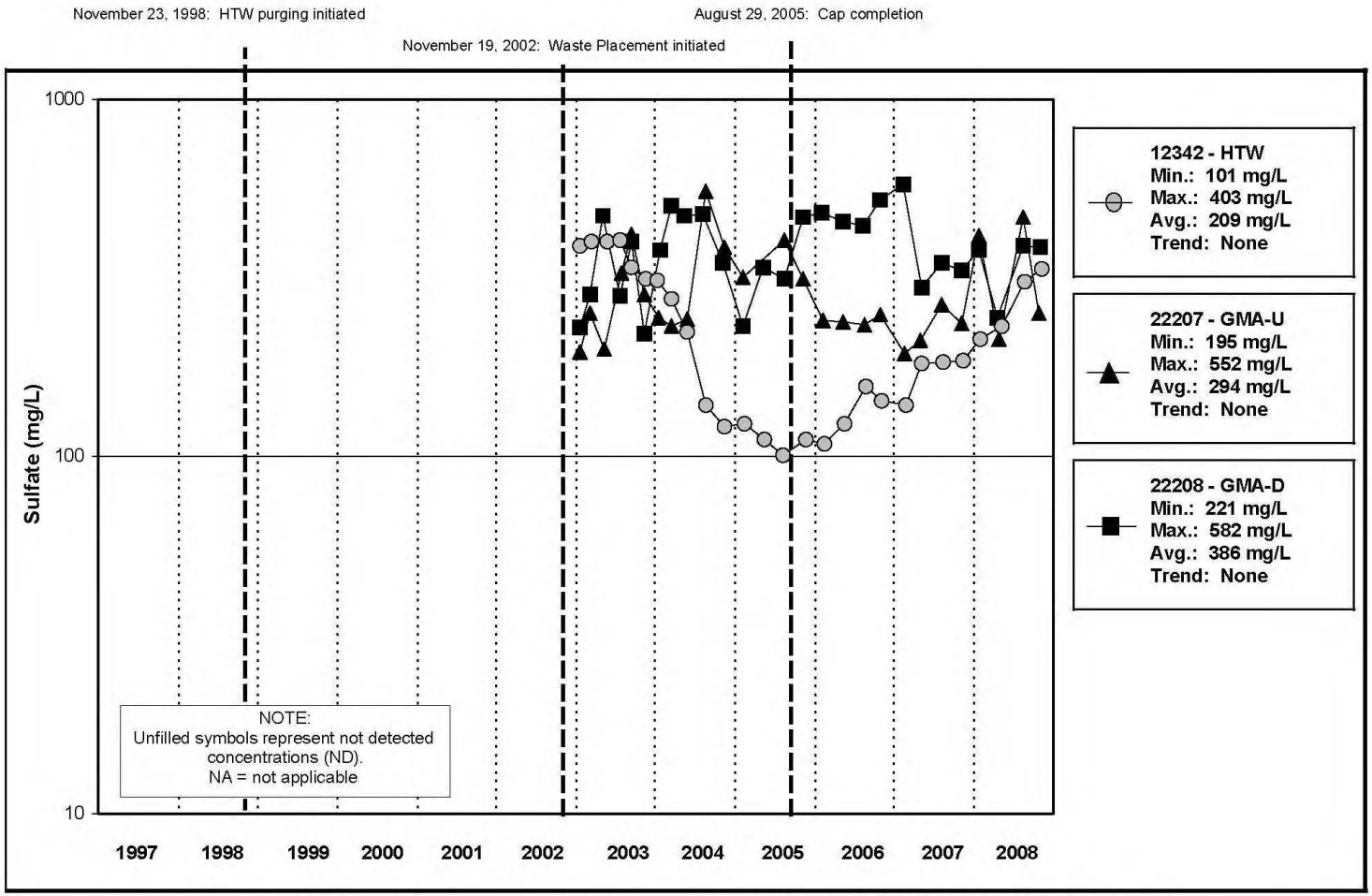


Figure A.5.5-10B. Cell 5 Sulfate Concentration vs. Time Plot for HTW, GMA-U Well, AND GMA-D Well

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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).
- GMA 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 in 2008 were collected according to the frequencies described in the GWLMP. Constituent sampling lists are provided in Table 2−1, Table 2−2, and Table 2−3 of Appendix B of the GWLMP. In 2008, the HTW in Cell 6 was dry in November.

A.5.6.1 Refined Baseline Monitoring Results

As defined in the GWLMP, refined baseline constituents are those constituents that have been monitored at least eight times, and detected at least 25 percent of the time in the LCS, LDS, HTW, and GMA wells. Results from 2008 sampling are provided in a summary statistics table (Table A.5.6-2) and concentration plots (Figures A.5.6-6A to A.5.6-10B). The five refined baseline constituents are total uranium, boron, TOC, TOX, and sulfate.

Flow in the LDS in 2008 was well below the OSDF facility design action level, indicating that the water quality trends observed in the HTW and GMA wells in 2008 are attributable to concentration fluctuations taking place beneath the facility and not to a potential leak from the facility.

The 2009 revision of the GWLMP identifies the data evaluation techniques that will be used to further evaluate the association between water quality changes observed beneath the facility and the potential that they are being caused by a leak from the facility. Control charts will be added back to the program along with the use of bivariate plots.

Beginning in January 2009, the refined baseline constituents will become a subset of a larger group of 15 constituents that will be monitored annually in all four monitoring horizons (LCS, LDS, HTW, and GMA wells) of each cell. Monitoring at the LCS will include all of the 15 constituents listed below, as well as the rest of the initial baseline constituents defined for the facility.

Constituent Sampling List for the LDS, HTW, and GMA Wells of Each Cell in 2009	
Constituent	**Reason**
Boron	Refined Baseline Parameter
Sulfate	Refined Baseline Parameter
Uranium	Refined Baseline Parameter
TOC	Refined Baseline Parameter
TOX	Refined Baseline Parameter
Iron	Common Ion Study[a]
Manganese	Common Ion Study[a]
Sodium	Common Ion Study[a]
Lithium	Common Ion Study[a]
Arsenic	Appendix I Statistical Analysis
Cobalt	Appendix I Statistical Analysis
Nickel	Appendix I Statistical Analysis
Selenium	Appendix I Statistical Analysis
TDS	Appendix I Statistical Analysis
Zinc	Appendix I Statistical Analysis

[a] Also known as the *Evaluation of Aqueous Ions in the Monitoring Systems of the On-Site Disposal Facility* (DOE 2008b)

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. Even though active operations ended in 2006, this sampling continued in 2007 and 2008.

In 2008, annual sampling of the Cell 6 LCS took place in February. Table A.5.6-3 summarizes the annual LCS sampling results for Cell 6, along with the data collected in previous years. Table A.5.6-3 presents the non-refined baseline site-specific constituents that were monitored in 2008. Twelve of the constituents listed have been monitored eight or more times. Of those, 11 have been detected at least 25 percent of the time.

The potential monitoring usefulness of nine of the 11 constituents (alkalinity, calcium, chloride, iron, magnesium, manganese, nitrate/nitrite, potassium, and sodium) was addressed in the Common Ion Study. Of the remaining two constituents (TDS and Technetium-99) TDS has been added to the monitoring program and will be sampled for in the LCS, LDS, HTW, and GMA wells of each cell in 2009.

Technetium-99 has been detected over 25 percent of the time in the Cell 6 LCS. Statistics conducted for Cell 1 on the potential usefulness of technetium-99 as a monitoring constituent for the OSDF indicated that it would not be a useful constituent at Cell 1. As described in the GWLMP, results from Cells 1, 2, and 3 are being applied to Cells 4 through 8. This means that in 2009, technetium-99 will not be sampled for in the LDS, HTW, or GMA wells of Cells 4 through 8. Given the consistency of detects though seen in 2008 at Cells 4 through 8, DOE will conduct a statistical analysis in 2009 for the usefulness of technetium-99 as a monitoring constituent at

Cells 4 through 8 similar to the one conducted for Cells 1, 2, and 3. This exception is warranted given that technetium-99 is being detected rather consistently, and the extra effort could result in adding an additional useful constituent to the monitoring program for those cells. Results of the analysis will be made reported in the 2010 SER.

Confirmatory Sampling in the LCS

In 2009, confirmatory sampling procedures were modified in the GWLMP. Because confirmatory sampling identified in 2008 will take place in 2009, the modified procedure will be followed. Therefore, if a constituent was detected in the 2008 LCS sample, that was not going to be monitored in the LDS in 2009, the constituent was added for confirmatory monitoring in 2009.

Two consecutive detects for that constituent in the cell's LCS will trigger monitoring for that constituent in the cell's LDS during the next scheduled sampling event. However, if the usefulness of the constituent as a monitoring constituent has already been rejected through the Common Ion Study, the constituent will not be added for confirmatory monitoring.

Three constituents had detects in 2008 in the Cell 6 LCS, and are not being monitored in the Cell 6 LDS in 2009 (barium, copper, and technetium-99). Both barium and copper were addressed in the Common Ion Report. The conclusion from that report was that both constituents would not be useful monitoring parameters at Cell 6, because the concentrations measured in different monitoring horizons are too similar.

In 2008, technetium-99 was detected in the Cell 6 LCS. No detects were measured in 2007. If technetium 99 is detected in the Cell 6 LCS in 2009, it will be added to the constituent monitoring list for the Cell 6 LDS beginning in 2010, pending the result of the statistical analysis discussed above.

A.5.6.3 LDS Monitoring Results

In 2008, the LDS of Cell 6 was monitored for site-specific constituents listed in Table 2−1 of Appendix B of the GWLMP. The objective of the sampling was to determine if any initial baseline constituents, not on the refined baseline list, were present in the LDS. In 2008, sampling of the Cell 6 LDS took place in February.

Results of the LDS sampling at Cell 6 in 2008 indicate that all of the initial baseline constituents that have been monitored in the Cell 6 LDS and detected at least 25 percent of the time are being monitored in the Cell 6 HTW and GMA wells in 2009.

Table A.5.6−1. Cell 6 – 2008 Monthly Liner Efficiencies

Month	Cell 6 Apparent Liner Efficiency (%)
January	92.91
February	100.00
March	100.00
April	96.30
May	96.36
June	95.82
July	96.54
August	96.78
September	96.67
October	97.83
November	98.02
December	97.77

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	21	21	100	131	Undefined	No Significant	Not Detected		
	LDS	12343D	21	21	100	19.6	Undefined	No Significant	Detected		
	HTW	12343	21	21	100	10.4	Lognormal	Up, Significant	Detected	24.2 (Q1-07)	
	GMA-U	22209	22	25	88	0.58	Normal	No Significant	Not Detected	2.43 (Q2-06)	2.1 (Q3-08)
	GMA-D	22210	23	25	92	0.63	Normal	No Significant	Not Detected	0 (Q2-05)	
Boron (mg/L)	LCS	12343C	21	21	100	0.77	Normal	Up, Significant	Not Detected		
	LDS	12343D	21	21	100	0.43	Undefined	Down, Significant	Not Detected	1.22 (Q4-03)	2.38 (Q3-04)
	HTW	12343	19	21	90.5	0.09	Normal	No Significant	Detected		
	GMA-U	22209	20	25	80	0.03	Undefined	No Significant	Not Detected		
	GMA-D	22210	22	25	88	0.03	Undefined	No Significant	Not Detected		
Total Organic Carbon (mg/L)	LCS	12343C	18	21	85.7	2.27	Normal	No Significant	Not Detected	14.6 (Q4-03)	
	LDS	12343D	19	21	90.5	5.57	Normal	Down, Significant	Detected		
	HTW	12343	16	21	76.2	2.23	Normal	No Significant	Not Detected	4.93 (Q4-07)	
	GMA-U	22209	13	25	52	1.09	Normal	No Significant	Detected		
	GMA-D	22210	14	25	56	1.04	Normal	No Significant	Not Detected	2.15 (Q1-05)	2.39 (Q4-08)
Total Organic Halogens (mg/L)	LCS	12343C	11	21	52.4	0.01	Normal	Up, Significant	Not Detected		
	LDS	12343D	13	21	61.9	0.03	Normal	No Significant	Not Detected		
	HTW	12343	10	21	47.6	0.008	Normal	Down, Significant	Not Detected		
	GMA-U	22209	6	25	24	0.006	Undefined	Down, Significant	Detected	0.0365 (Q3-06)	
	GMA-D	22210	3	25	12	0.006	Undefined	Down, Significant	Not Detected		
Sulfate (mg/L)	LCS	12343C	21	21	100	1860	Normal	Up, Significant	Not Detected	491 (Q2-05)	
	LDS	12343D	21	21	100	1860	Normal	Up, Significant	Detected		
	HTW	12343	20	21	95.2	427	Normal	No Significant	Detected	192 (Q1-03)	
	GMA-U	22209	24	24	100	208	Lognormal	Up, Significant	Not Detected	2.07 (Q3-06)	
	GMA-D	22210	24	24	100	230	Normal	Up, Significant	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 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 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.

[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.5.6−3. 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]	DETECTED IN 2008?	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
General Chemistry												
Alkalinity as CaCO3 (mg/L)	12	12	100%	Yes	64	557	451	-	422 mg/L(10)	430 mg/L(10)	-	10 mg/L
Ammonia (mg/L)	6	1	16.7%	No	0.0882	-	-	-	4.2 mg/L(0)	4.34 mg/L(0)	220 mg/L(0)	0.1 mg/L
Chloride (mg/L)	12	12	100%	Yes	20.1	139	95.3	-	7.3 mg/L(12)	45 mg/L(10)	6300 mg/L(0)	5 mg/L
Nitrate/Nitrite (mg/L)	16	9	56.2%	No	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
Total Dissolved Solids (mg/L)	10	10	100%	Yes	267	4140	2450	-	-	-	-	10 mg/L
Inorganic												
Barium (mg/L)	6	6	100%	Yes	0.0274	0.0868	0.0516	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%	Yes	225	996	491	-	159 mg/L(12)	172 mg/L(12)	1800 mg/L(0)	5 mg/L
Cobalt (mg/L)	6	4	66.7%	Yes	0.0006	0.0017	0.0012	0.17 mg/L(0)	0.0086 mg/L(0)	-	0.0886 mg/L(0)	0.034 mg/L
Copper (mg/L)	6	6	100%	Yes	0.00421	0.0136	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
Iron (mg/L)	12	9	75%	No	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)	12	12	100%	Yes	92.4	609	302	-	38.5 mg/L(12)	50.7 mg/L(12)	690 mg/L(0)	5 mg/L
Manganese (mg/L)	12	9	75%	No	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)	11	1	9.1%	No	0.000338	-	-	0.002 mg/L(0)	-	-	0.0018 mg/L(0)	0.0002 mg/L
Nickel (mg/L)	6	6	100%	Yes	0.007	0.0285	0.0155	0.1 mg/L(0)	0.0514 mg/L(0)	0.0072 mg/L(4)	0.981 mg/L(0)	0.02 mg/L
Potassium (mg/L)	12	12	100%	Yes	9	75.5	23.5	-	1.96 mg/L(12)	17.2 mg/L(10)	12400 mg/L(0)	5 mg/L
Selenium (mg/L)	6	1	16.7%	No	0.0097	-	-	0.05 mg/L(0)	0.00075 mg/L(1)	-	0.0494 mg/L(0)	0.005 mg/L
Sodium (mg/L)	12	12	100%	Yes	23.1	107	53.6	-	47.1 mg/L(8)	50 mg/L(6)	1300 mg/L(0)	5 mg/L
Vanadium (mg/L)	6	1	16.7%	No	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)	6	2	33.3%	No	0.0135	0.0253	-	0.021 mg/L(1)	0.02 mg/L(1)	0.35 mg/L(0)	1.78 mg/L(0)	0.015 mg/L
Radionuclides												
Technetium-99 (pCi/L)	11	4	36.4%	Yes	1.83	11.7	7.22	94 pCi/L(0)	22 pCi/L(0)	30 pCi/L(0)	6130 pCi/L(0)	10 pCi/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 minumun 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 nitrate, from Operable Unit 5 Record of Decision, Table 9-4.

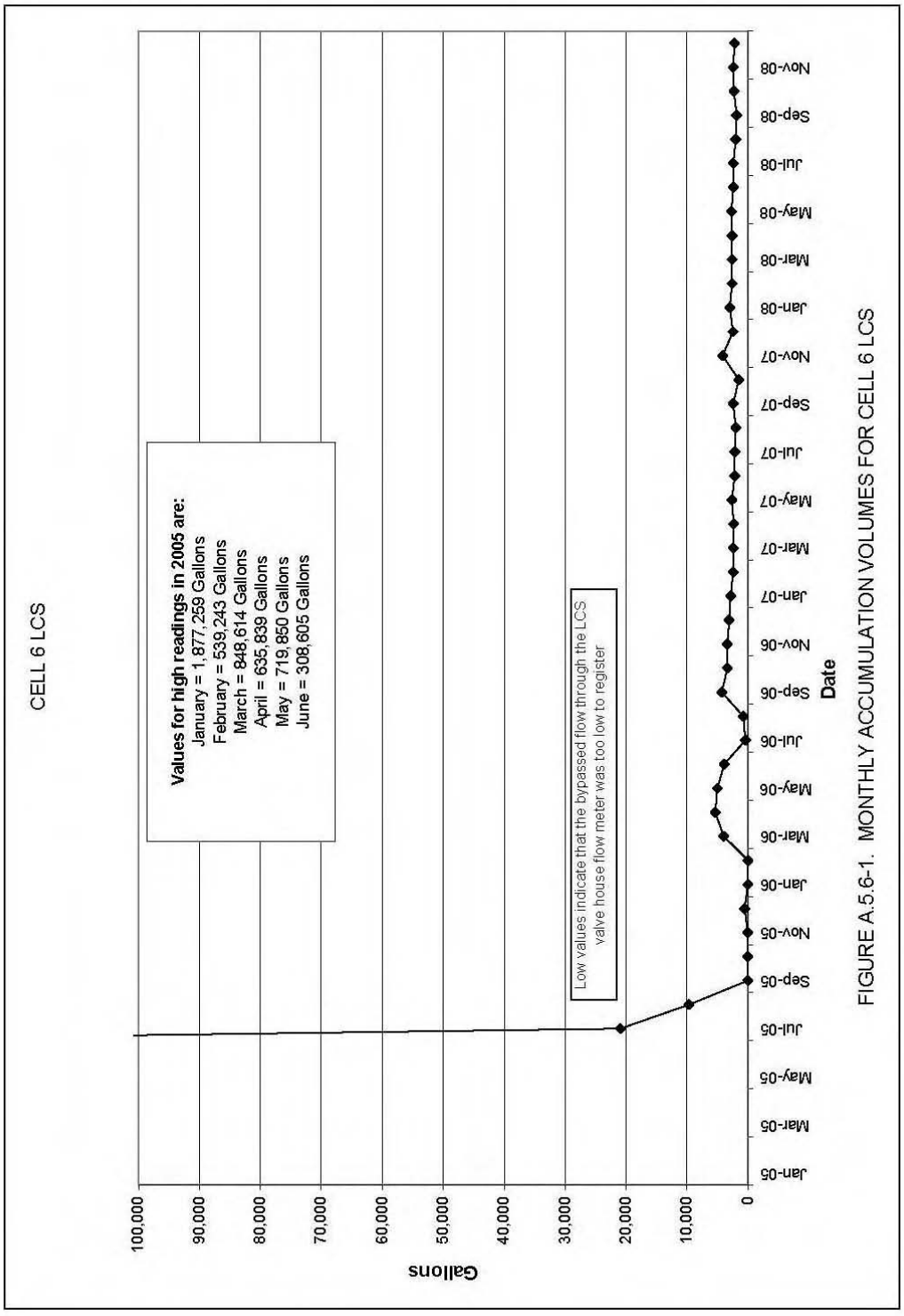


FIGURE A.5.6-1. MONTHLY ACCUMULATION VOLUMES FOR CELL 6 LCS

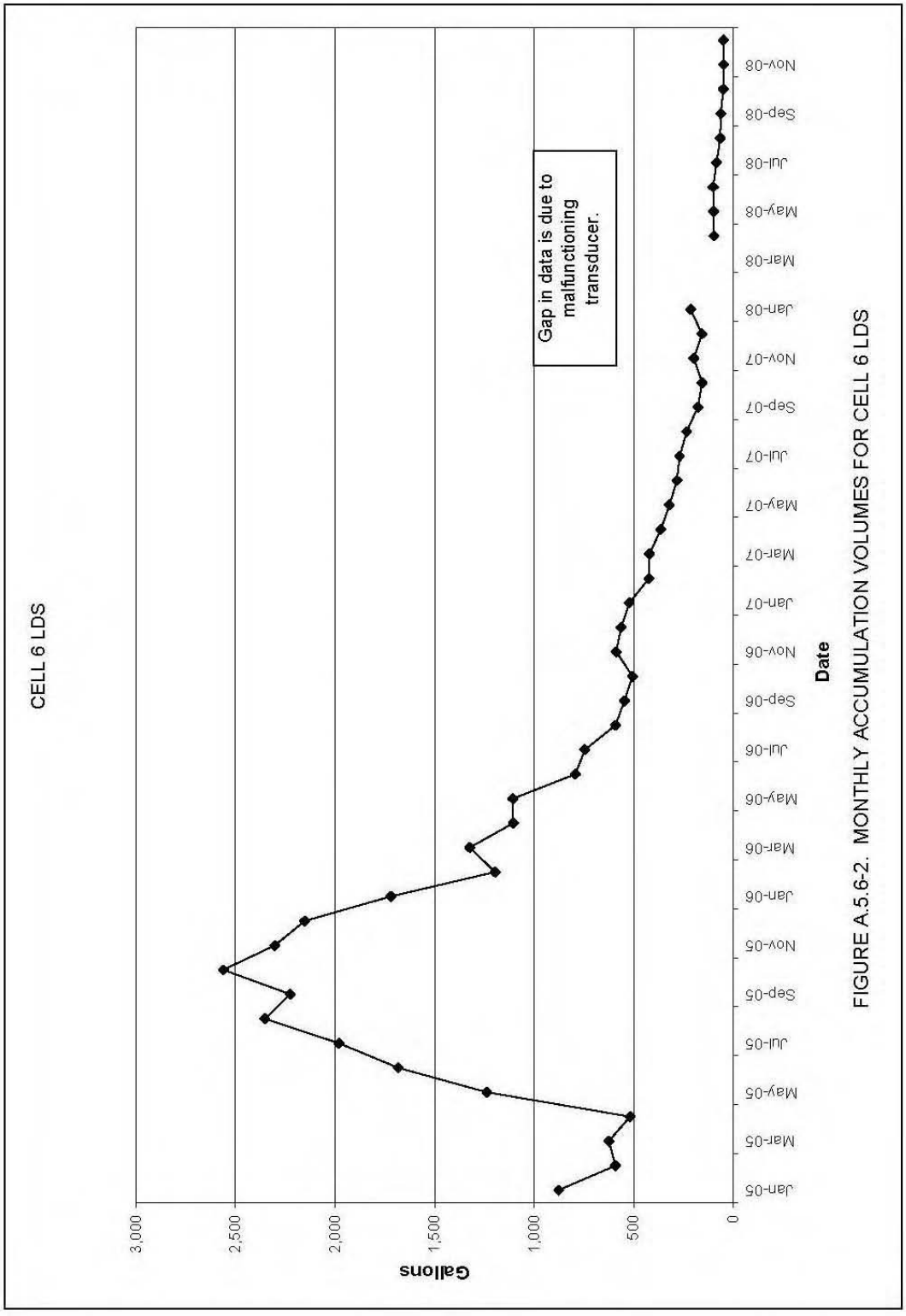
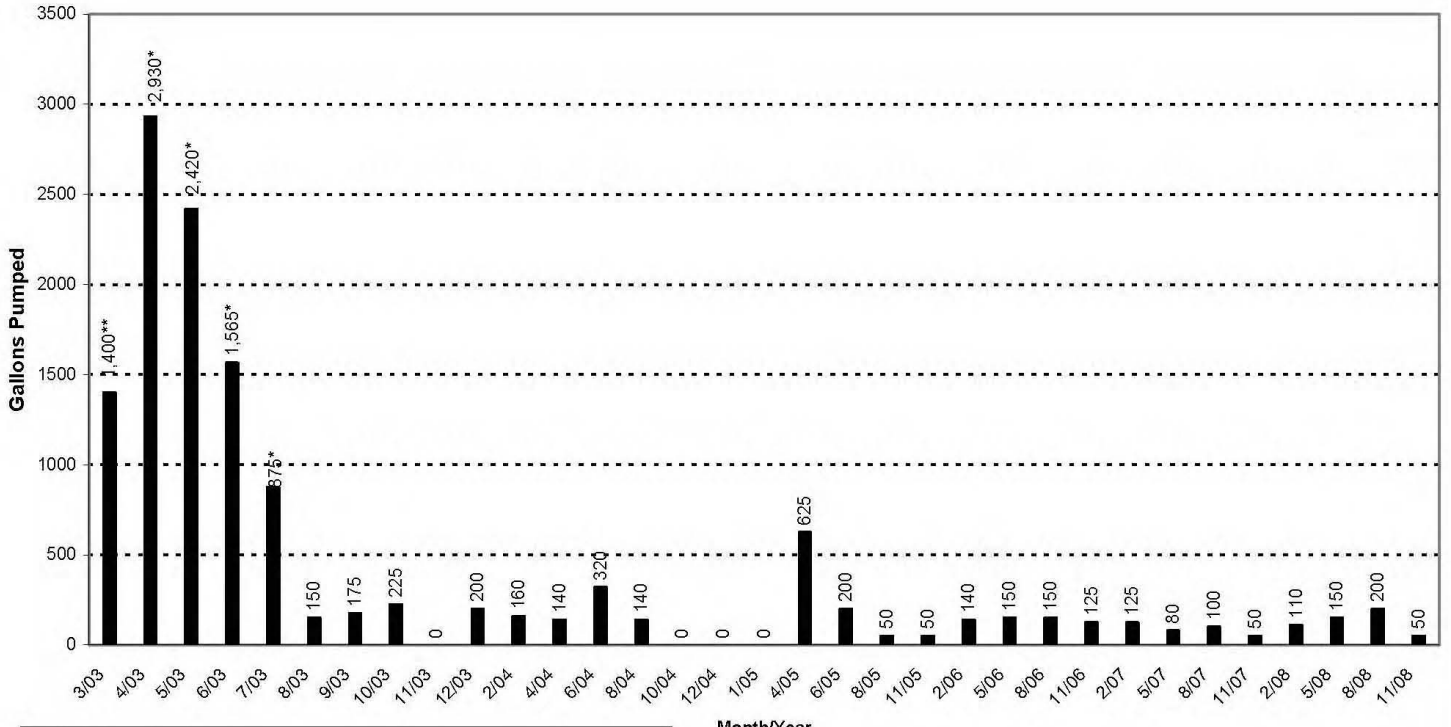


FIGURE A.5.6-2. MONTHLY ACCUMULATION VOLUMES FOR CELL 6 LDS



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
2008:	510	n=4	128
Overall:			396

*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

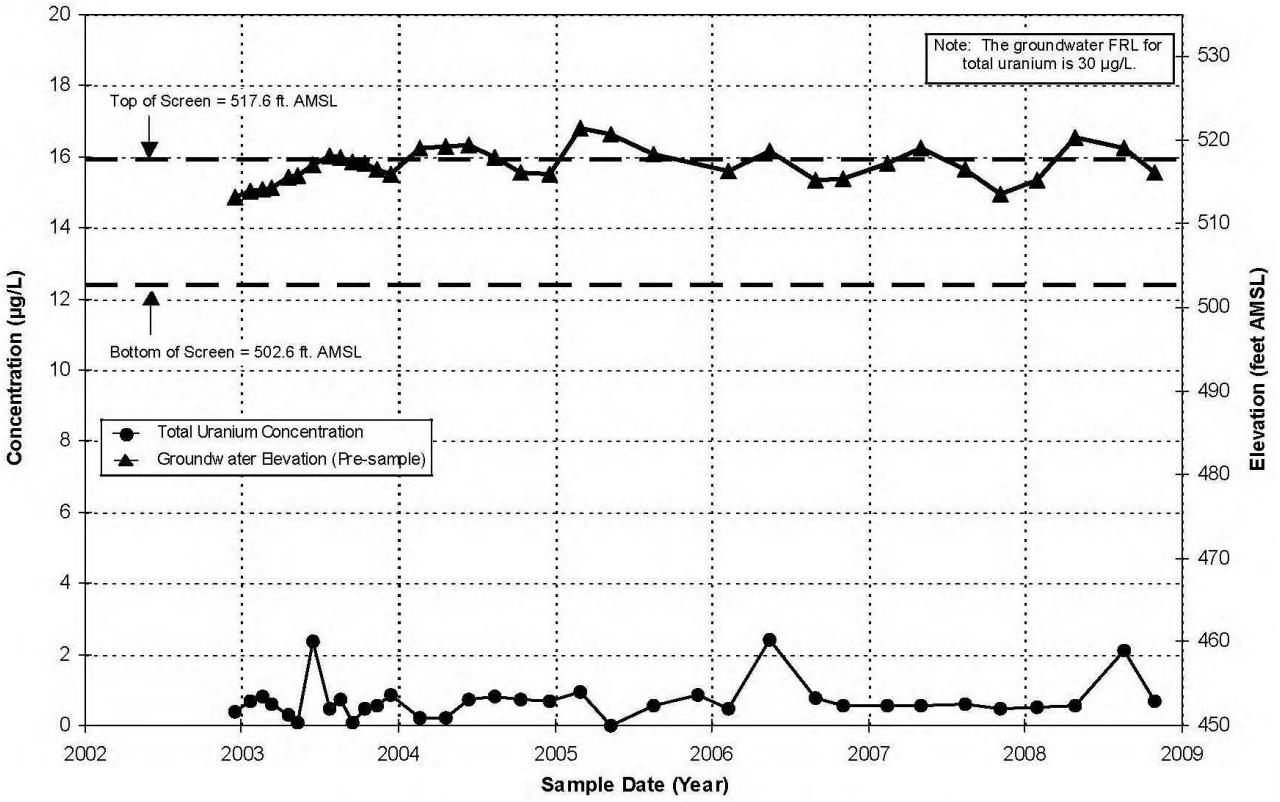


Figure A.5.6-4. Total Uranium Concentration and Groundwater Elevation vs. Time Plot for Cell 6 Upgradient Monitoring Well 22209

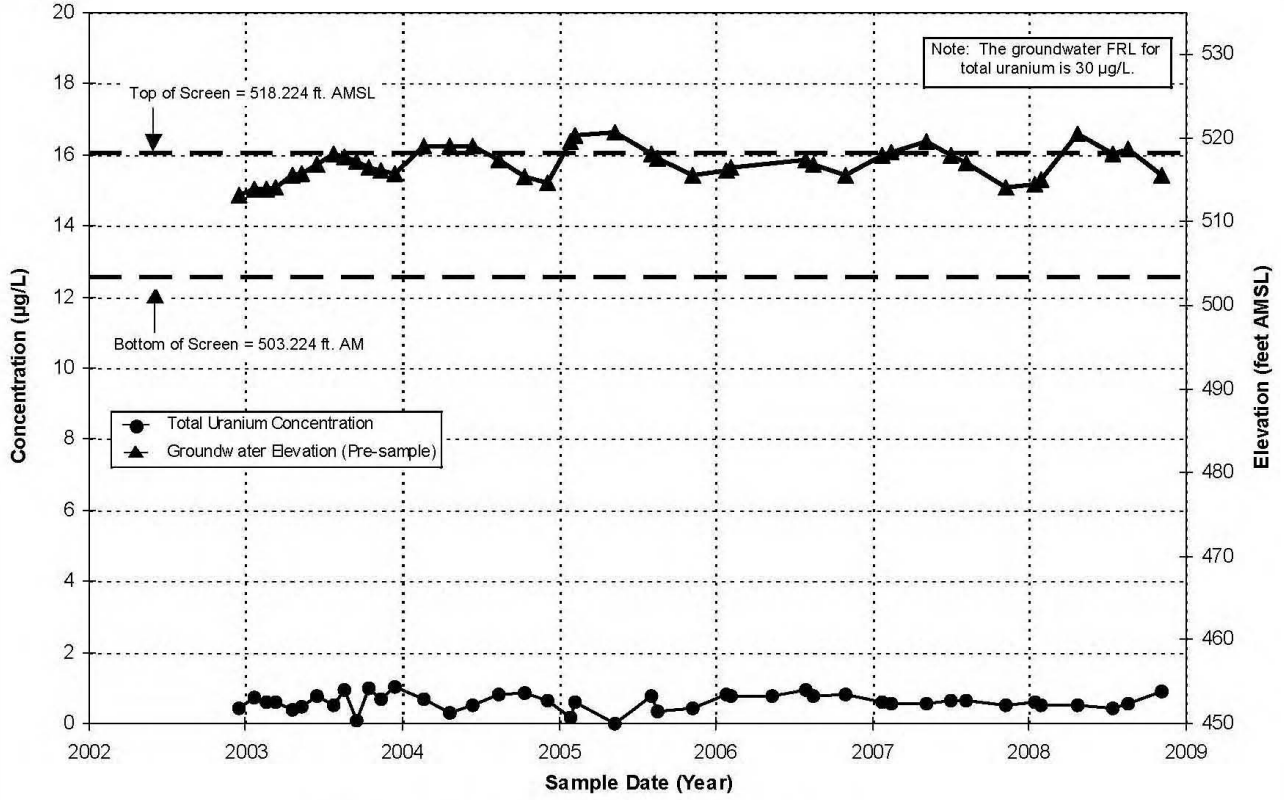


Figure A.5.6-5. Total Uranium Concentration and Groundwater Elevation vs. Time Plot for Cell 6 Downgradient Monitoring Well 22210

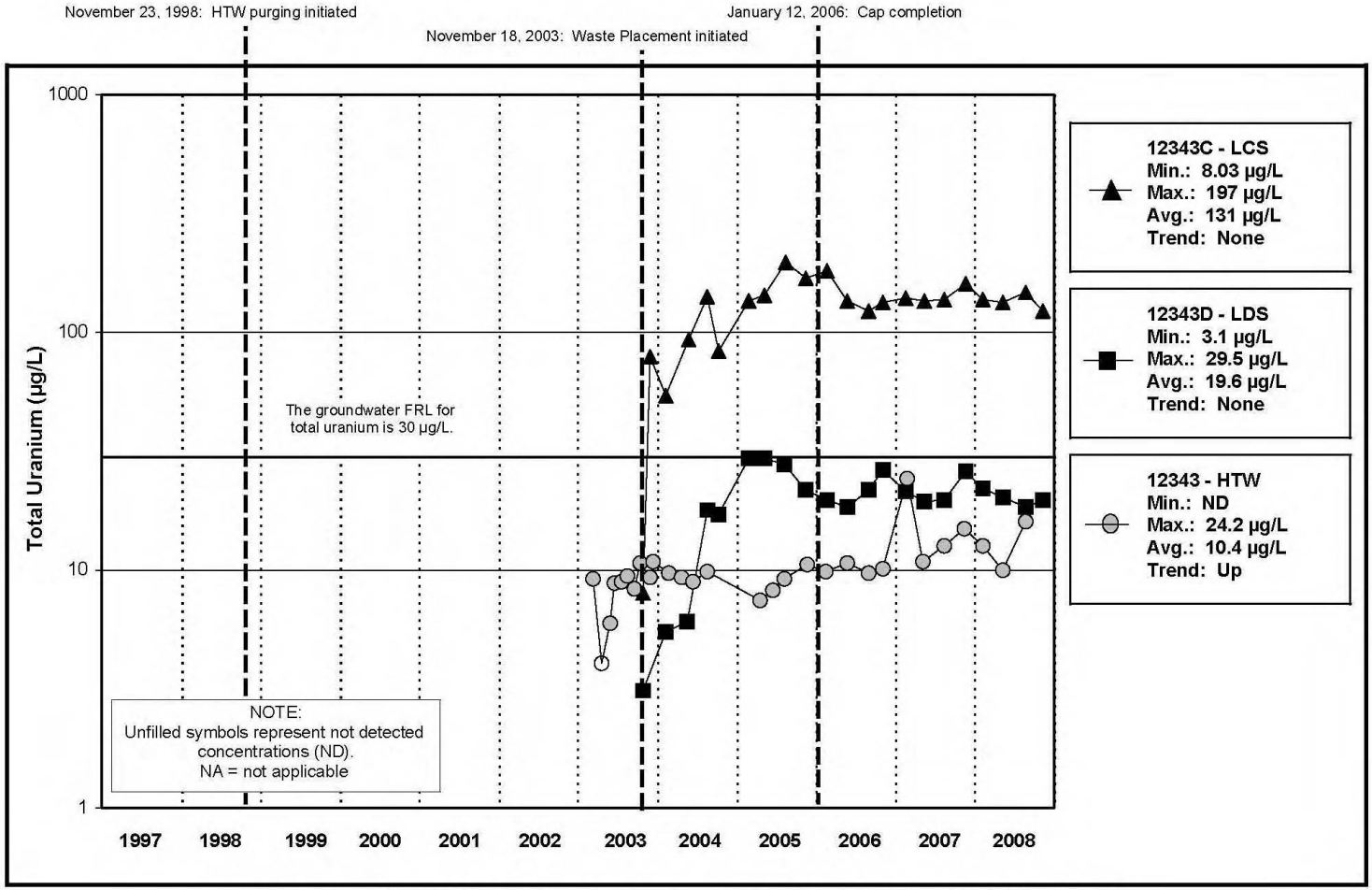


Figure A.5.6-6A. Cell 6 Total Uranium Concentration vs. Time Plot for LCS, LDS, AND HTW

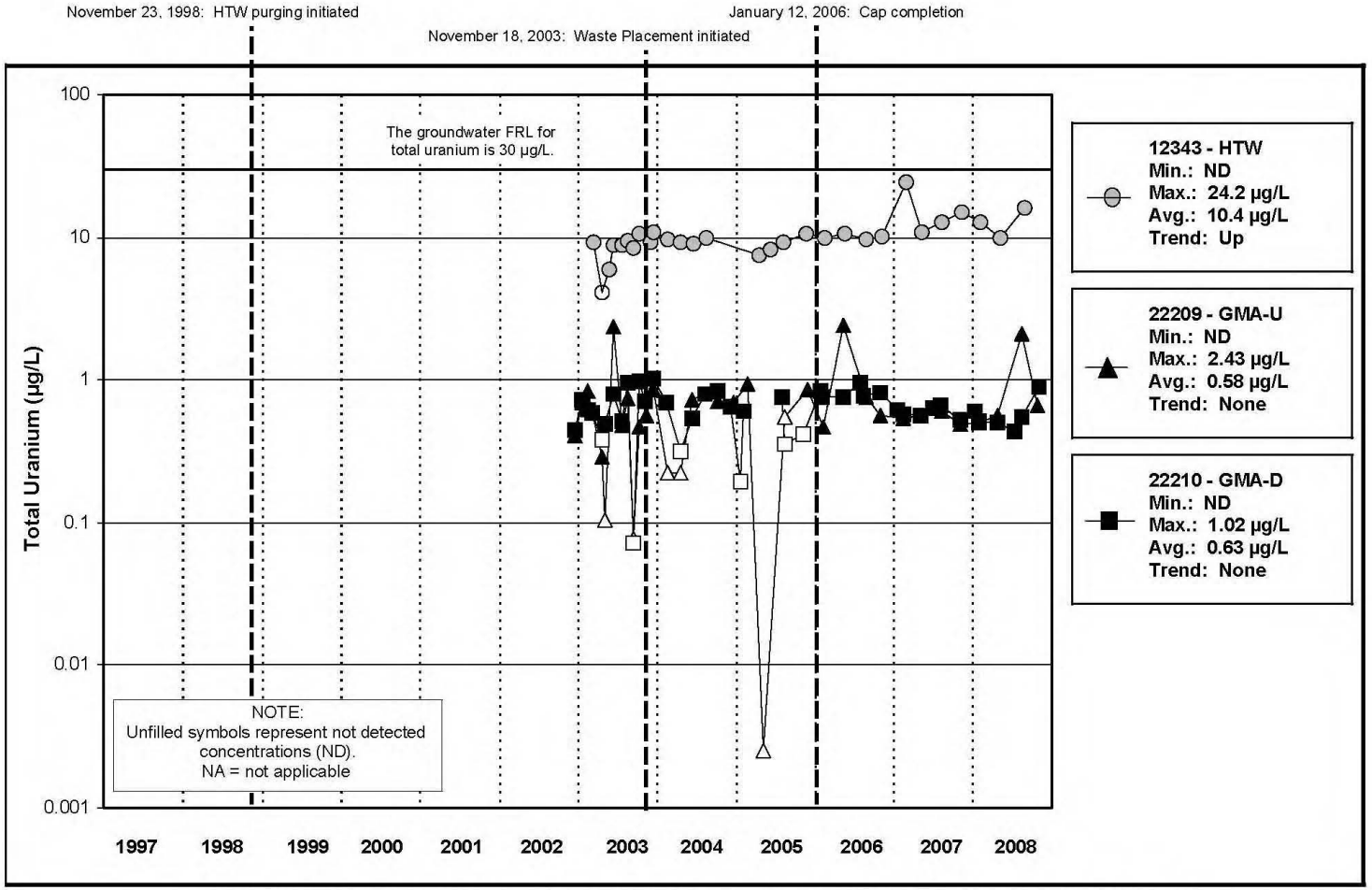


Figure A.5.6-6B. Cell 6 Total Uranium Concentration vs. Time Plot for HTW, GMA-U Well, AND GMA-D Well

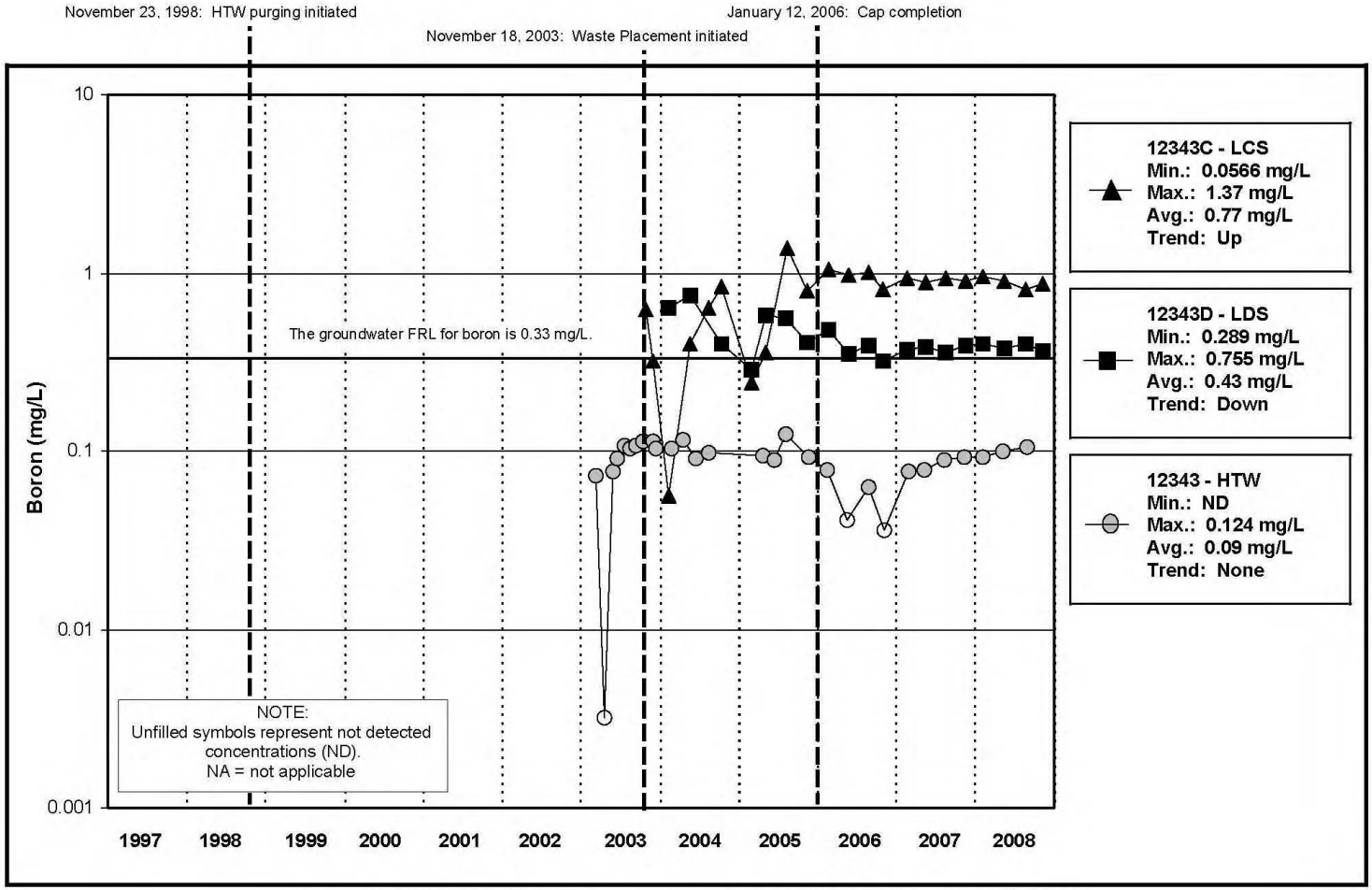


Figure A.5.6-7A. Cell 6 Boron Concentration vs. Time Plot for LCS, LDS, AND HTW

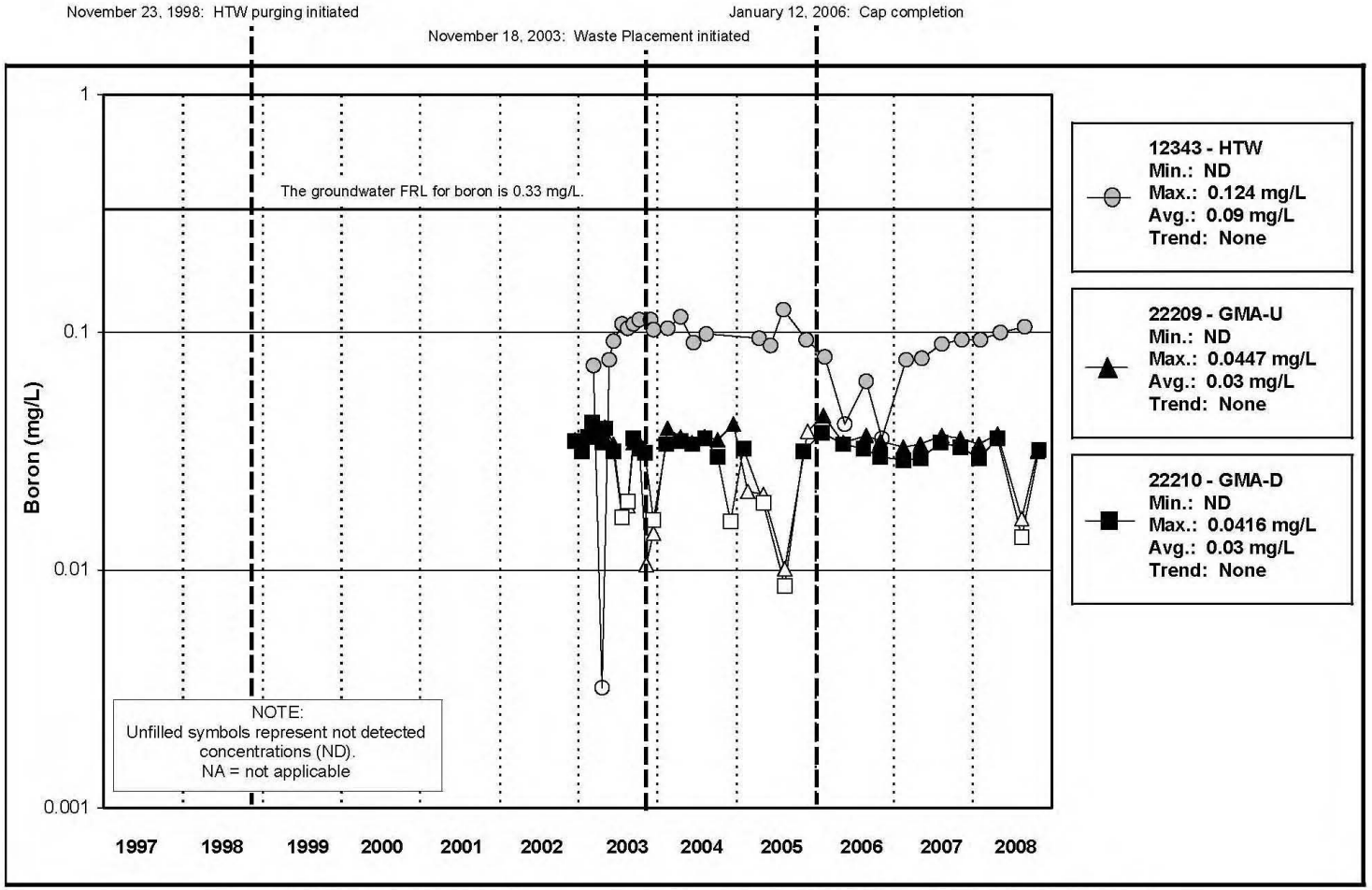


Figure A.5.6-7B. Cell 6 Boron Concentration vs. Time Plot for HTW, GMA-U Well, AND GMA-D Well

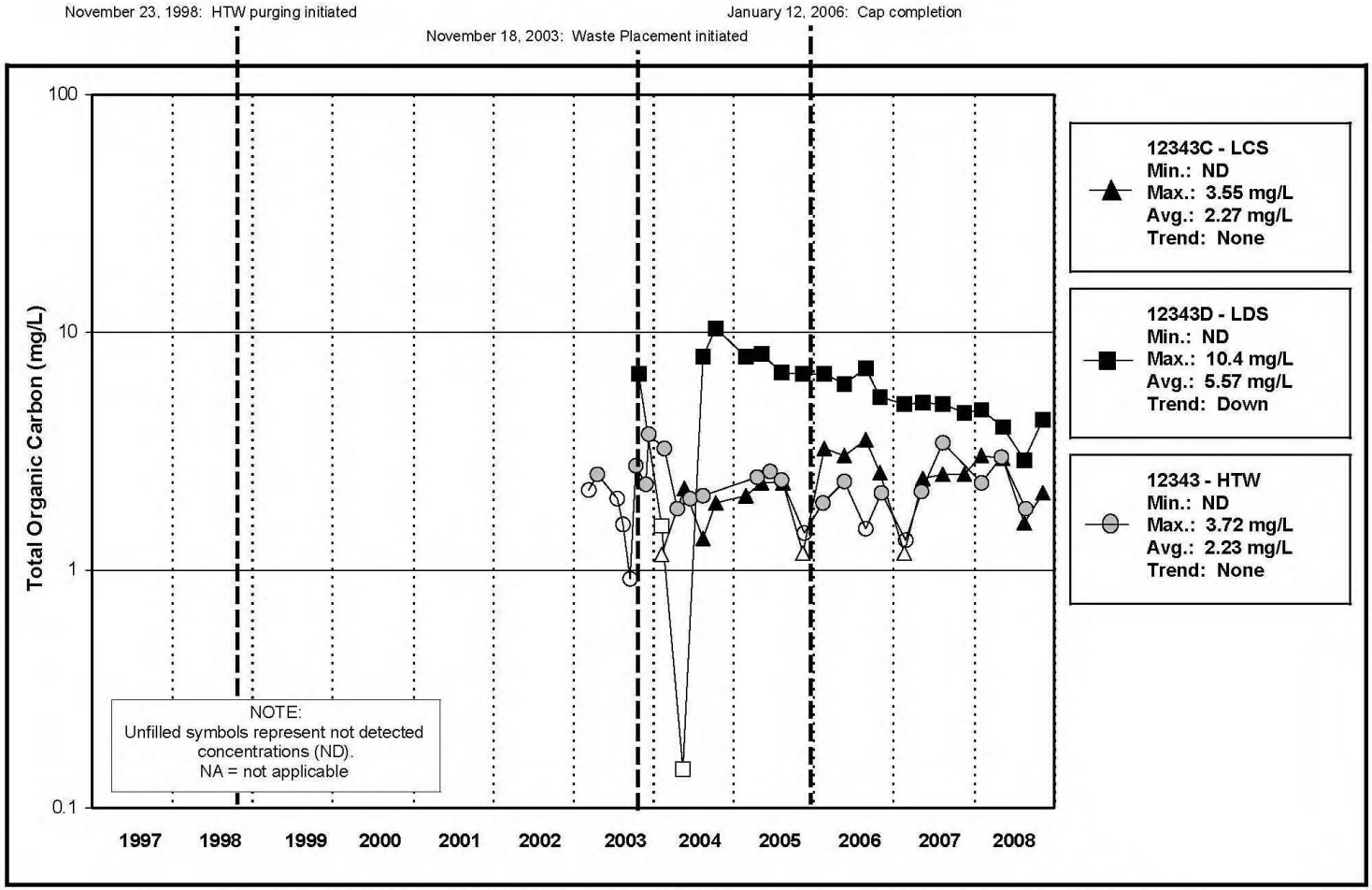


Figure A.5.6-8A. Cell 6 Total Organic Carbon Concentration vs. Time Plot for LCS, LDS, AND HTW

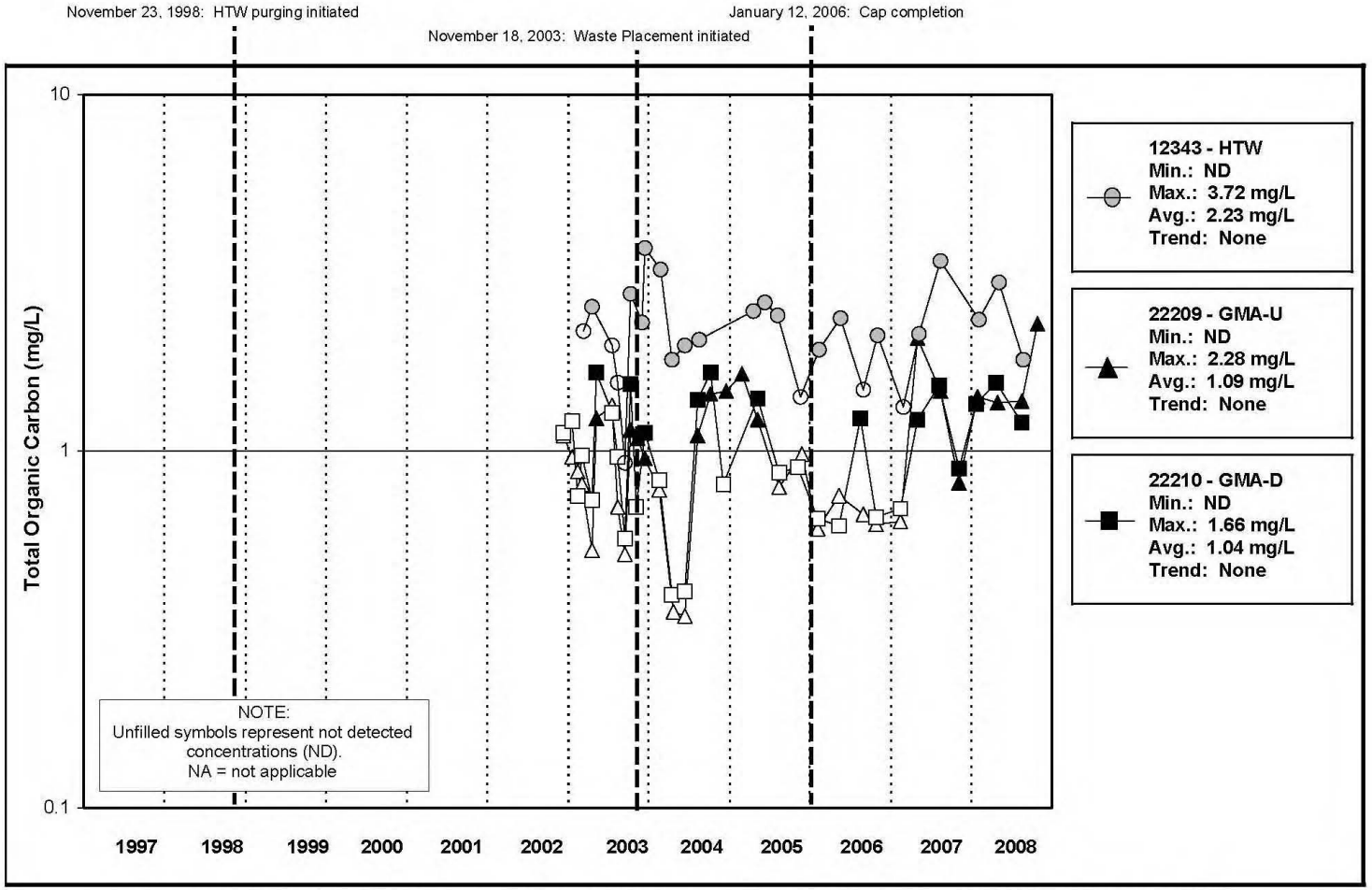


Figure A.5.6-8B. Cell 6 Total Organic Carbon Concentration vs. Time Plot for HTW, GMA-U Well, AND GMA-D Well

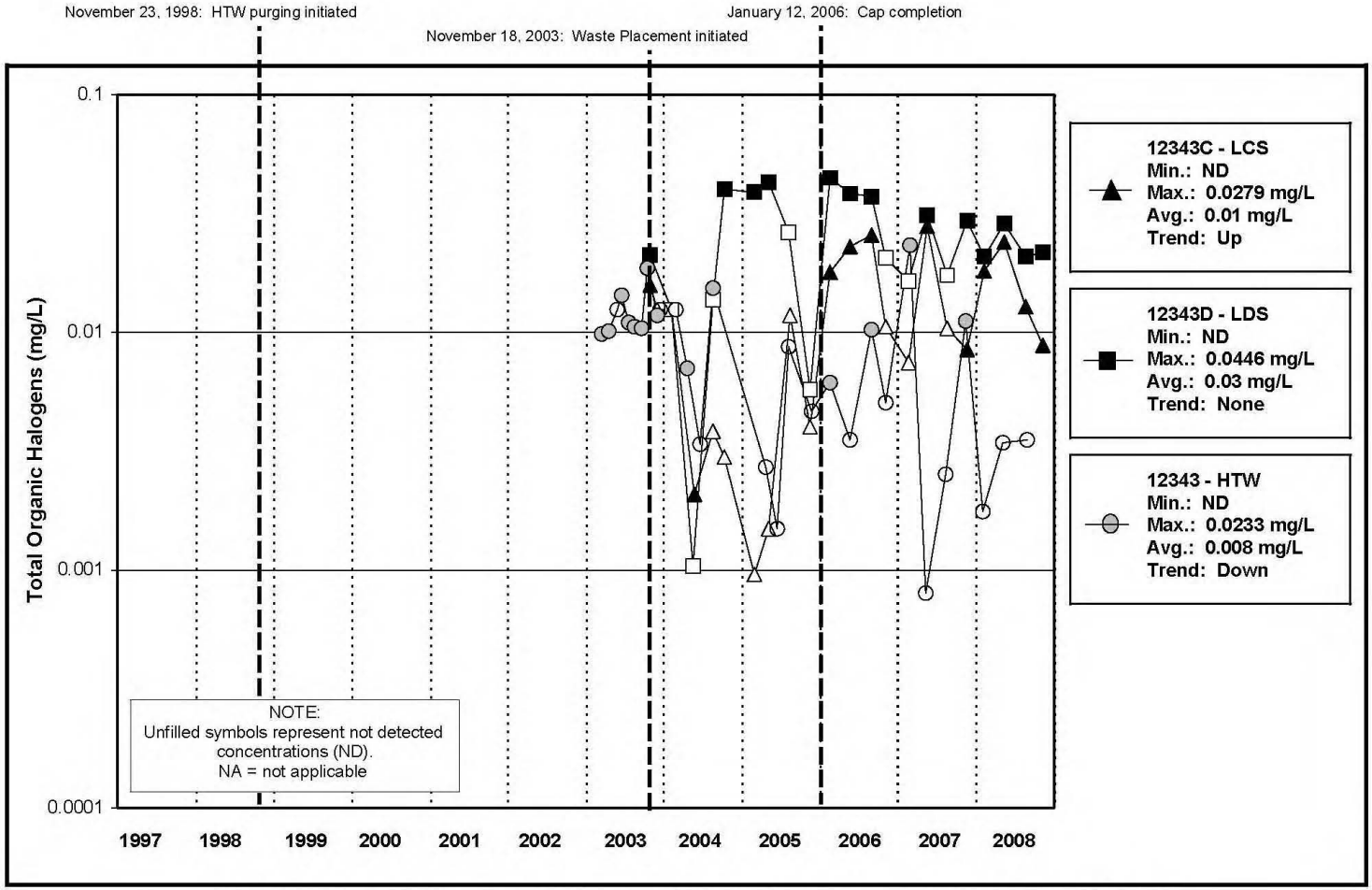


Figure A.5.6-9A. Cell 6 Total Organic Halogens Concentration vs. Time Plot for LCS, LDS, AND HTW

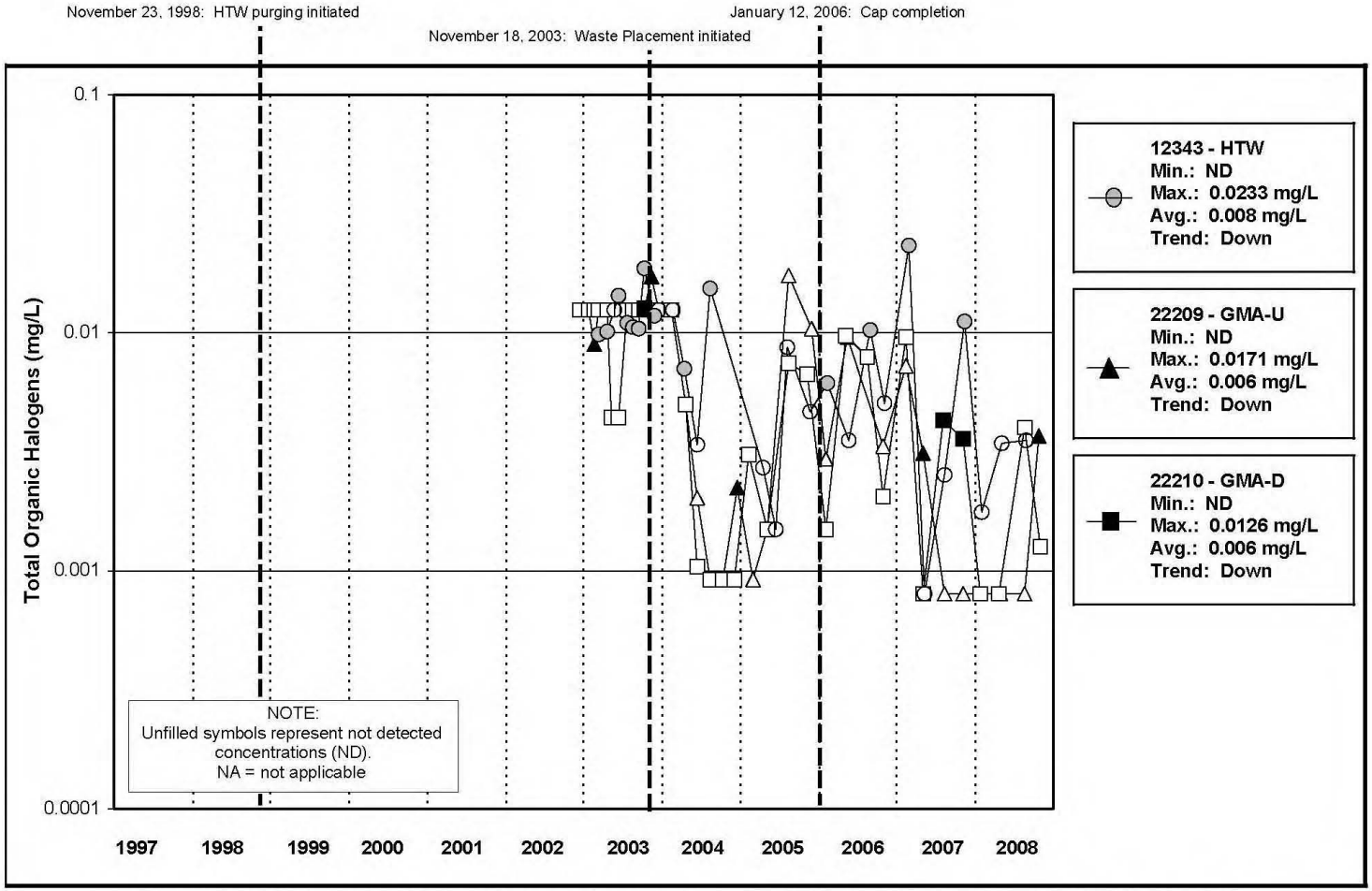


Figure A.5.6-9B. Cell 6 Total Organic Halogens Concentration vs. Time Plot for HTW, GMA-U Well, AND GMA-D Well

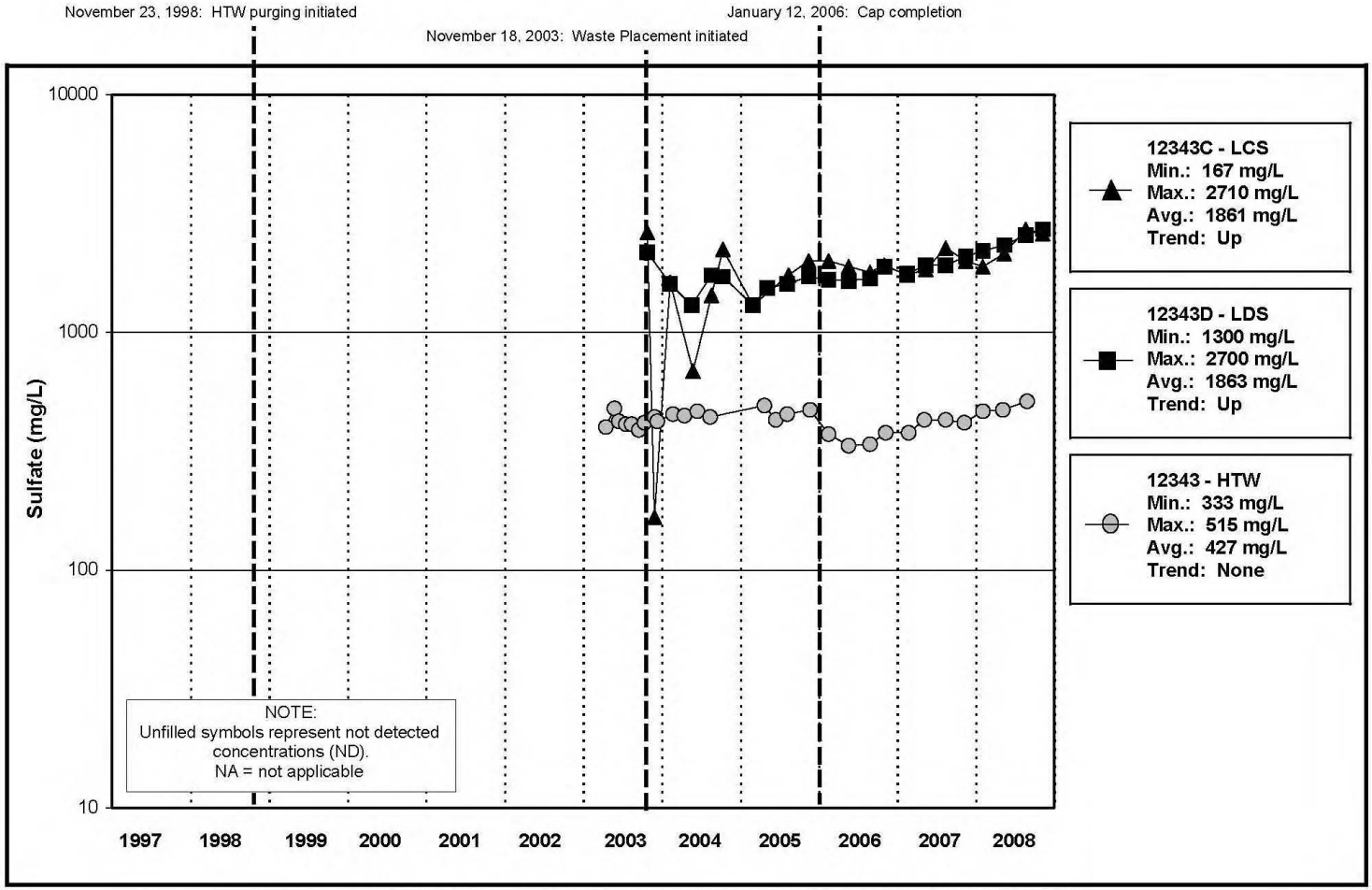


Figure A.5.6-10A. Cell 6 Sulfate Concentration vs. Time Plot for LCS, LDS, AND HTW

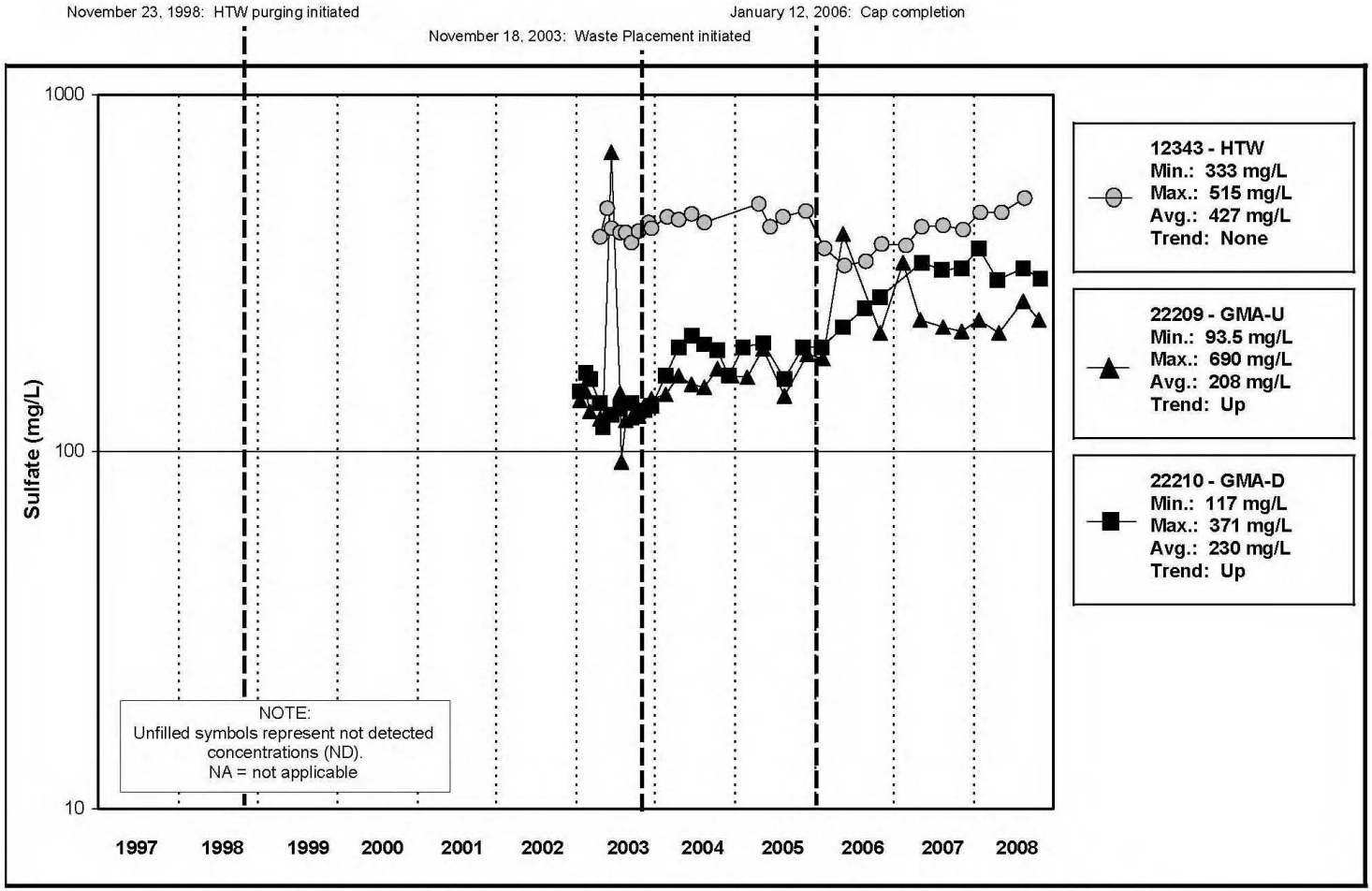


Figure A.5.6-10B. Cell 6 Sulfate Concentration vs. Time Plot for HTW, GMA-U Well, AND GMA-D Well

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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).
- GMA 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 in 2008 were collected according to the frequencies described in the GWLMP. Constituent sampling lists are provided in Table 2−1, Table 2−2, and Table 2−3 of Appendix B of the GWLMP. In 2008, all samples were collected for Cell 7 monitoring horizons.

A.5.7.1 Refined Baseline Monitoring Results

As defined in the GWLMP, refined baseline constituents are those constituents that have been monitored at least eight times, and detected at least 25 percent of the time in the LCS, LDS, HTW, and GMA wells. Results from 2008 sampling are provided in a summary statistics table (Table A.5.7-2) and concentration plots (Figures A.5.7-6A to A.5.7-10B). The five refined baseline constituents are total uranium, boron, TOC, TOX, and sulfate.

Flow in the LDS in 2008 was well below the OSDF design action level, indicating that the water quality trends observed in the HTW and GMA wells in 2008 are attributable to concentration fluctuations taking place beneath the facility and not to a potential leak from the facility.

The 2009 revision of the GWLMP identifies the data evaluation techniques that will be used to further evaluate the association between water quality changes observed beneath the facility and the potential that they are being caused by a leak from the facility. Control charts will be added back to the program along with the use of bivariate plots.

Beginning in January 2009, the refined baseline constituents will become a subset of a larger group of 15 constituents that will be monitored annually in all four monitoring horizons (LCS, LDS, HTW, and GMA wells) of each cell. Monitoring at the LCS will include all of the 15 constituents listed below, as well as the rest of the initial baseline constituents defined for the facility.

Constituent Sampling List for the LDS, HTW, and GMA Wells of Each Cell in 2009	
Constituent	**Reason**
Boron	Refined Baseline Parameter
Sulfate	Refined Baseline Parameter
Uranium	Refined Baseline Parameter
TOC	Refined Baseline Parameter
TOX	Refined Baseline Parameter
Iron	Common Ion Study[a]
Manganese	Common Ion Study[a]
Sodium	Common Ion Study[a]
Lithium	Common Ion Study[a]
Arsenic	Appendix I Statistical Analysis
Cobalt	Appendix I Statistical Analysis
Nickel	Appendix I Statistical Analysis
Selenium	Appendix I Statistical Analysis
TDS	Appendix I Statistical Analysis
Zinc	Appendix I Statistical Analysis

[a] Also known as the *Evaluation of Aqueous Ions in the Monitoring Systems of the On-Site Disposal Facility* (DOE 2008b)

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. Even though active operations ended in 2006, this sampling continued in 2007 and 2008.

In 2008, annual sampling of the Cell 7 LCS took place in February. Table A.5.6-3 summarizes the annual LCS sampling results for Cell 7, along with the data collected in previous years. Table A.5.7-3 lists the non-refined baseline site specific constituents that were monitored in 2008. Ten of the constituents have been monitored 8 or more times and detected at least 25 percent of the time. Of these 10, the monitoring usefulness of nine of them (alkalinity, calcium, chloride, iron, magnesium, manganese, nitrate/nitrite, potassium, and sodium) was addressed in the Common Ion Report. The tenth constituent is technetium-99.

Technetium-99 has been detected over 25 percent of the time in the Cell 7 LCS. Statistics conducted for Cell 1 on the potential usefulness of technetium-99 as a monitoring constituent for the OSDF indicated that it would not be a useful constituent at Cell 1. As described in the 2009 revision of the GWLMP, results from Cells 1, 2, and 3 are being applied to Cells 4 through 8. This means that in 2009 technetium-99 will not be monitored in the LDS, HTW, or GMA wells of Cells 4 through 8. Given the consistency of detects though seen in 2008 at Cells 4 through 8, DOE will conduct a statistical analysis in 2009 for the usefulness of technetium-99 as a monitoring constituent at Cells 4 through 8 similar to the one conducted for Cells 1, 2, and 3. This exception is warranted given that technetium-99 is being detected rather consistently, and

the extra effort could result in adding an additional useful constituent to the monitoring program for those cells. Results of the analysis will be made reported in the 2010 SER.

Confirmatory Sampling in the LCS

In 2009 confirmatory sampling procedures were modified in the GWLMP. Because confirmatory sampling identified in 2008 will take place in 2009, the modified procedure will be followed. Therefore, if a constituent was detected in the 2008 LCS sample, that was not going to be monitored in the LDS in 2009, the constituent was added for confirmatory monitoring in 2009.

Two consecutive detects for that constituent in the cell's LCS will trigger monitoring for that constituent in the cell's LDS during the next scheduled sampling event. However, if the usefulness of the constituent as a monitoring constituent has already been rejected through the Common Ion Report, the constituent will not be added for confirmatory monitoring.

Seven constituents (other than the ones identified above) had detects in 2008 in the Cell 7 LCS (barium, cobalt, copper, nickel, technetium-99, TDS, and zinc). As presented in the 2009 revision of the GWLMP, cobalt nickel, TDS, and zinc will be sampled in the LDS, HTW, and GMA wells of Cell 7 in 2009.

Of the remaining three constituents (barium, copper, and technetium-99), both barium and copper were addressed in the Common Ion Report. The report stated that barium would not be a useful monitoring constituent, because the concentrations measured in the different monitoring horizons of Cell 7 are too similar. The potential usefulness of copper, though, was not ruled out. Copper was identified as a potentially useful monitoring constituent from the LDS to the HTW at Cell 7. Monitoring for copper in the Cell 7 LCS and LDS will be conducted beginning in 2009.

In 2008, technetium-99 was monitored three times in the Cell 7 LCS to confirm a detection that was measured in 2007 (February was 0.86 pCi/L, August was not detected, and November was 1.61 pCi/L). As discussed above, a statistical analysis for technetium-99 is being conducted for Cell 7. It will be added to the constituent sampling list for the Cell 7 LDS beginning in 2010, pending the result of the statistical analysis discussed above.

A.5.7.3 LDS Monitoring Results

In 2008, the LDS of Cell 7 was monitored for site-specific constituents listed in Table 2−1 of Appendix B of the GWLMP. The objective of the sampling was to determine if any initial baseline constituents, not on the refined baseline list, were present in the LDS. In 2008, sampling of the Cell 7 LDS took place in February.

Results of the LDS sampling at Cell 7 in 2008 indicate that all of the initial baseline constituents that have been monitored in the Cell 7 LDS and detected at least 25 percent of the time are being monitored in the Cell 7 HTW and GMA wells in 2009.

Table A.5.7−1 Cell 7 – 2008 Monthly Liner Efficiencies

Month	Cell 7 Apparent Liner Efficiency (%)
January	92.38
February	91.41
March	92.85
April	94.77
May	93.23
June	83.95
July	92.53
August	90.97
September	93.46
October	93.32
November	95.23
December	95.88

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	18	18	100	179	Normal	Up, Significant	Not Detected	
	LDS	12344D	17	17	100	23.5	Normal	No Significant	Not Detected	
	HTW	12344	20	20	100	2.76	Normal	Up, Marginal	Not Detected	
	GMA-U	22212	19	20	95	0.590	Normal	No Significant	Not Detected	4.46 (Q1-05)
	GMA-D	22211	20	20	100	0.72	Undefined	No Significant	Not Detected	
Boron (mg/L)	LCS	12344C	18	18	100	0.93	Undefined	Up, Significant	Not Detected	
	LDS	12344D	17	17	100	0.34	Undefined	No Significant	Detected	2.1 (Q3-04)
	HTW	12344	14	20	70	0.02	Normal	No Significant	Not Detected	
	GMA-U	22212	19	20	95	0.03	Undefined	No Significant	Not Detected	0.0151 (Q3-08)
	GMA-D	22211	17	20	85	0.03	Undefined	Up, Significant	Not Detected	
Total Organic Carbon (mg/L)	LCS	12344C	14	18	77.8	2.17	Normal	Up, Marginal	Not Detected	5.55 (Q1-06)
	LDS	12344D	17	17	100	5.74	Normal	Down, Marginal	Detected	
	HTW	12344	17	20	85	2.13	Normal	No Significant	Detected	
	GMA-U	22212	15	20	75	1.02	Lognormal	Up, Significant	Not Detected	
	GMA-D	22211	14	20	70	1.1	Undefined	Up, Marginal	Not Detected	
Total Organic Halogens (mg/L)	LCS	12344C	9	18	50	0.01	Normal	Up, Significant	Detected	
	LDS	12344D	10	17	58.8	0.03	Normal	Up, Marginal	Not Detected	
	HTW	12344	7	20	35	0.01	Lognormal	Down, Marginal	Not Detected	
	GMA-U	22212	7	20	35	0.005	Normal	No Significant	Not Detected	
	GMA-D	22211	3	20	15	0.004	Undefined	No Significant	Not Detected	
Sulfate (mg/L)	LCS	12344C	18	18	100	2030	Undefined	Up, Significant	Detected	
	LDS	12344D	17	17	100	1580	Normal	No Significant	Not Detected	2240 (Q2-05)
	HTW	12344	20	20	100	138	Undefined	No Significant	Detected	
	GMA-U	22212	20	20	100	202	Normal	Up, Significant	Not Detected	
	GMA-D	22211	20	20	100	270	Normal	Up, Significant	Detected	560 (Q3-08)

[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 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 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.

[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.5.7−3. 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]	DETECTED IN 2008?	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
General Chemistry												
Alkalinity as CaCO3 (mg/L)	11	11	100%	Yes	86	822	354	-	422 mg/L(3)	430 mg/L(3)	-	10 mg/L
Ammonia (mg/L)	5	1	20%	No	0.254	-	-	-	4.2 mg/L(0)	4.34 mg/L(0)	220 mg/L(0)	0.1 mg/L
Chloride (mg/L)	11	11	100%	Yes	26.7	131	87.4	-	7.3 mg/L(11)	45 mg/L(8)	6300 mg/L(0)	5 mg/L
Nitrate/Nitrite (mg/L)	12	7	58.3%	No	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
Total Dissolved Solids (mg/L)	6	6	100%	Yes	960	5020	3020	-	-	-	-	10 mg/L
Inorganics												
Arsenic (mg/L)	5	2	40%	No	0.0015	0.0093	-	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)	5	5	100%	Yes	0.0319	0.112	0.0659	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)	5	2	40%	No	0.00017	0.00025	-	0.004 mg/L(0)	-	-	0.0343 mg/L(0)	0.001 mg/L
Cadmium (mg/L)	5	1	20%	No	0.0002	-	-	0.014 mg/L(0)	0.014 mg/L(0)	-	0.05 mg/L(0)	0.002 mg/L
Calcium (mg/L)	11	11	100%	Yes	153	759	468	-	159 mg/L(10)	172 mg/L(9)	1800 mg/L(0)	5 mg/L
Chromium (mg/L)	5	1	20%	No	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)	5	5	100%	Yes	0.0016	0.008	0.0038	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%	Yes	0.0059	0.0247	0.0153	1.3 mg/L(0)	0.035 mg/L(0)	0.029 mg/L(0)	0.298 mg/L(0)	0.008 mg/L
Iron (mg/L)	11	11	100%	Yes	0.683	18.7	6.16	-	5.72 mg/L(3)	6.35 mg/L(3)	21.3 mg/L(0)	0.1 mg/L
Lead (mg/L)	5	1	20%	No	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)	11	11	100%	Yes	60.5	510	275	-	38.5 mg/L(11)	50.7 mg/L(11)	690 mg/L(0)	5 mg/L
Manganese (mg/L)	11	11	100%	Yes	0.0226	0.991	0.271	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)	5	5	100%	Yes	0.0063	0.0261	0.0162	0.1 mg/L(0)	0.0514 mg/L(0)	0.0072 mg/L(4)	0.981 mg/L(0)	0.02 mg/L
Potassium (mg/L)	11	11	100%	Yes	8.12	61.4	34.6	-	1.96 mg/L(11)	17.2 mg/L(8)	12400 mg/L(0)	5 mg/L
Sodium (mg/L)	11	11	100%	Yes	18.1	82.2	57.1	-	47.1 mg/L(8)	50 mg/L(8)	1300 mg/L(0)	5 mg/L
Thallium (mg/L)	5	1	20%	No	0.00046	-	-	-	-	-	0.0028 mg/L(0)	0.02 mg/L
Vanadium (mg/L)	5	1	20%	No	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)	5	5	100%	Yes	0.0142	0.154	0.07	0.021 mg/L(2)	0.02 mg/L(4)	0.35 mg/L(0)	1.78 mg/L(0)	0.015 mg/L
Radionuclides												
Technetium-99 (pCi/L)	12[h]	6	50%	Yes[h]	0.86	16.2	9.05	94 pCi/L(0)	22 pCi/L(0)	30 pCi/L(0)	6130 pCi/L(0)	10 pCi/L
Organics												
Total Xylenes (ug/L)	5	1	20%	No	1.01	-	-	-	-	-	-	10 ug/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 minumun 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.

[h] Technetium-99 was monitored in third and fourth quarter 2008 as required under the OSDF PSP to verify an earlier detection.

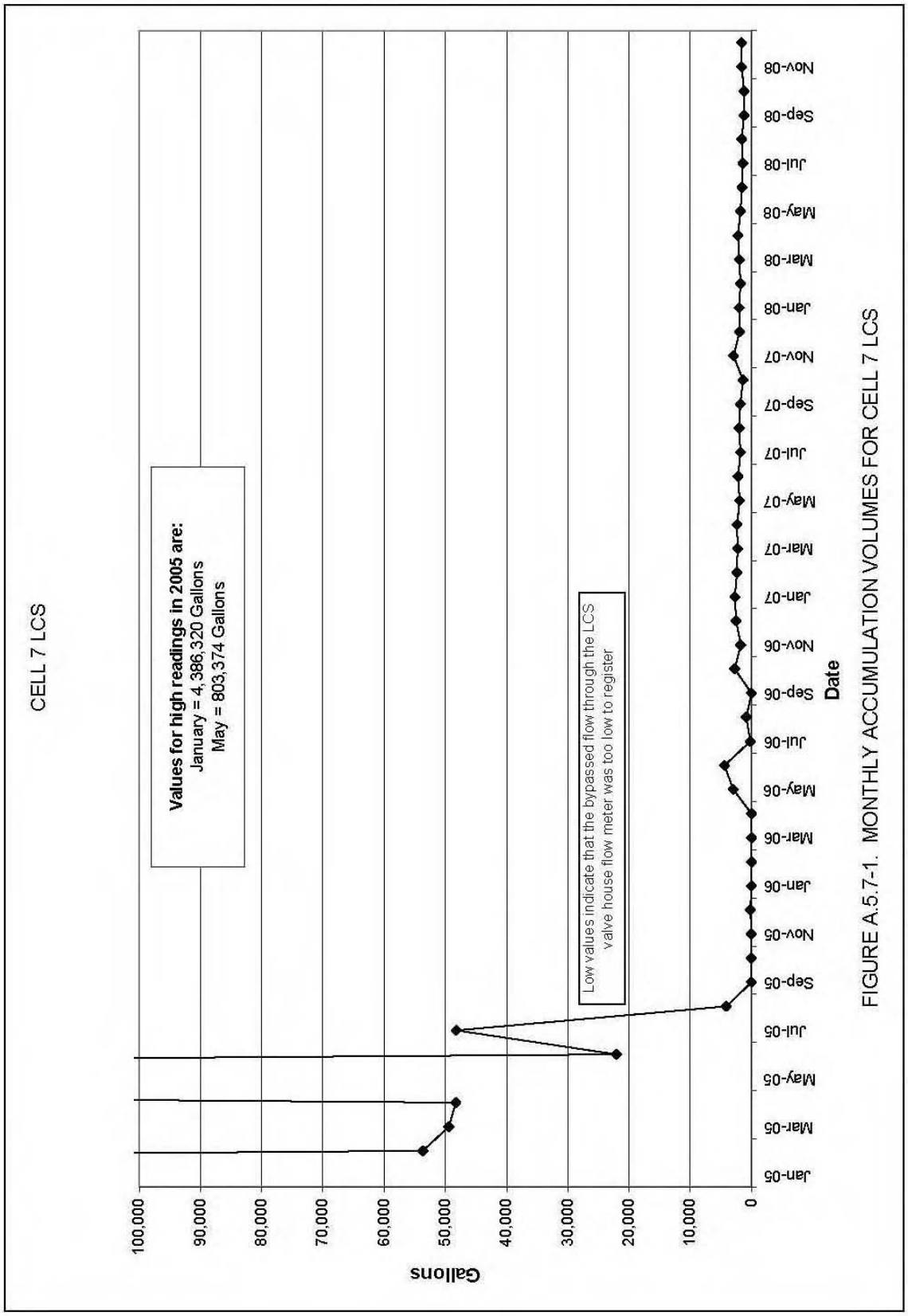


FIGURE A.5.7-1. MONTHLY ACCUMULATION VOLUMES FOR CELL 7 LCS

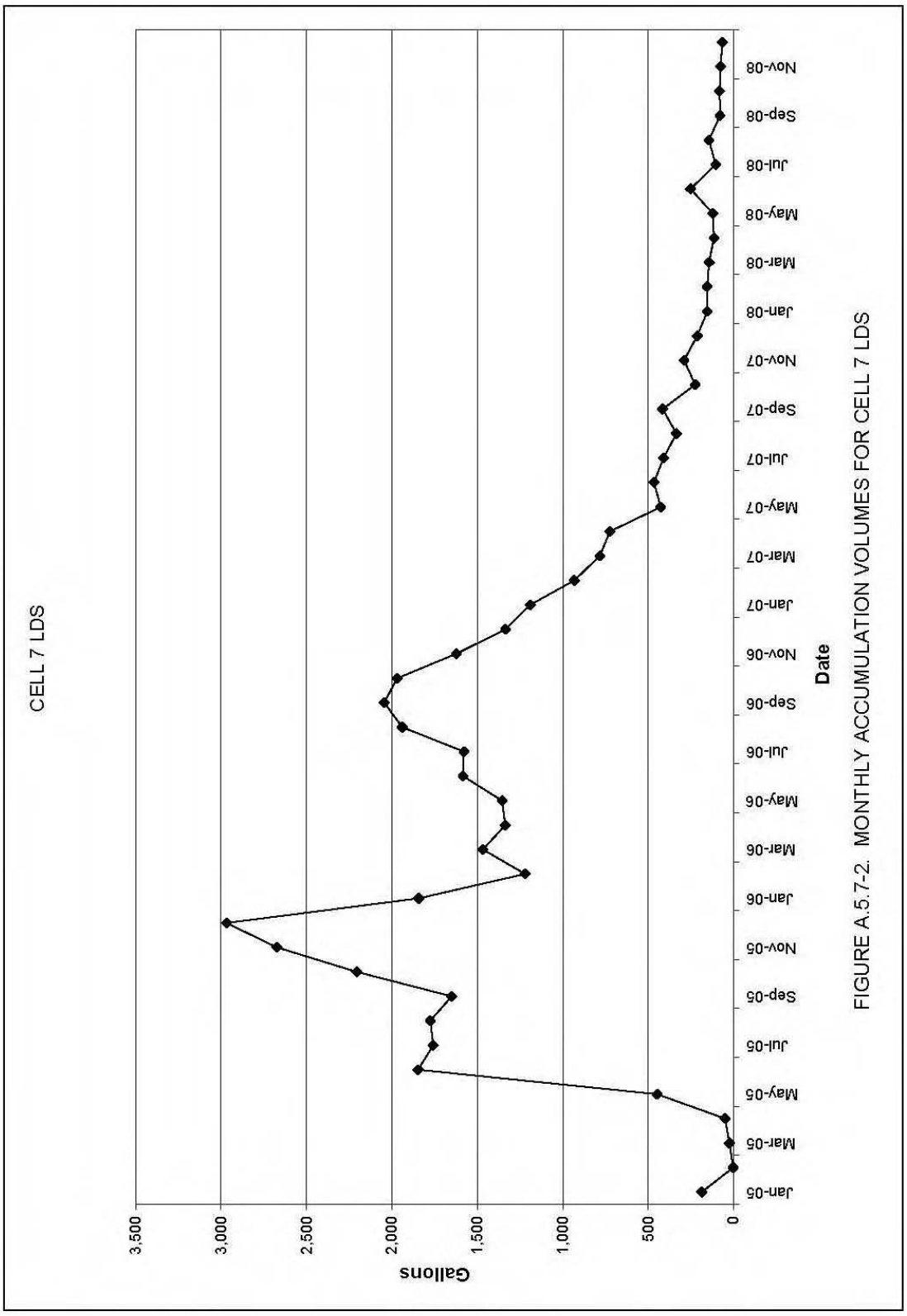
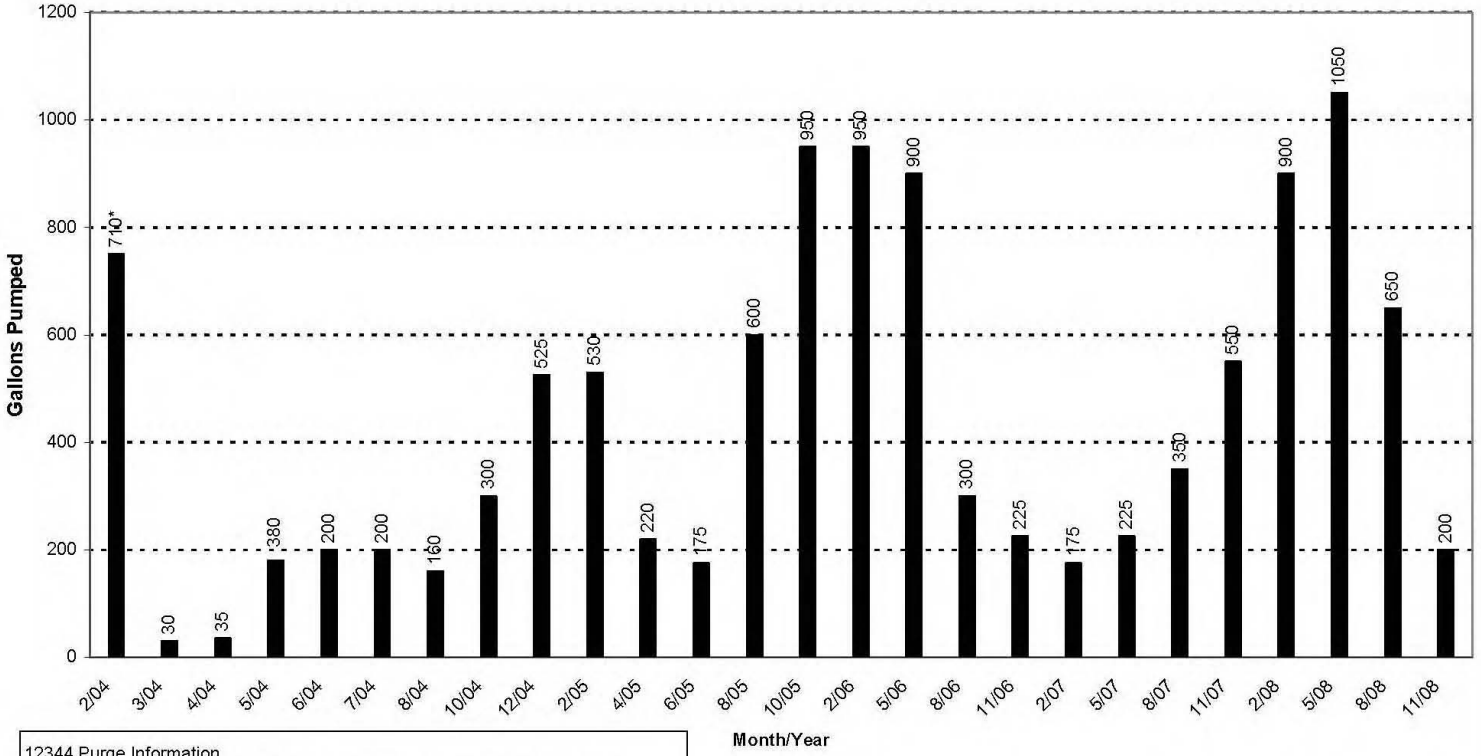


FIGURE A.5.7-2. MONTHLY ACCUMULATION VOLUMES FOR CELL 7 LDS



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
2008:	2800	n=4	700
Overall:			436

*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

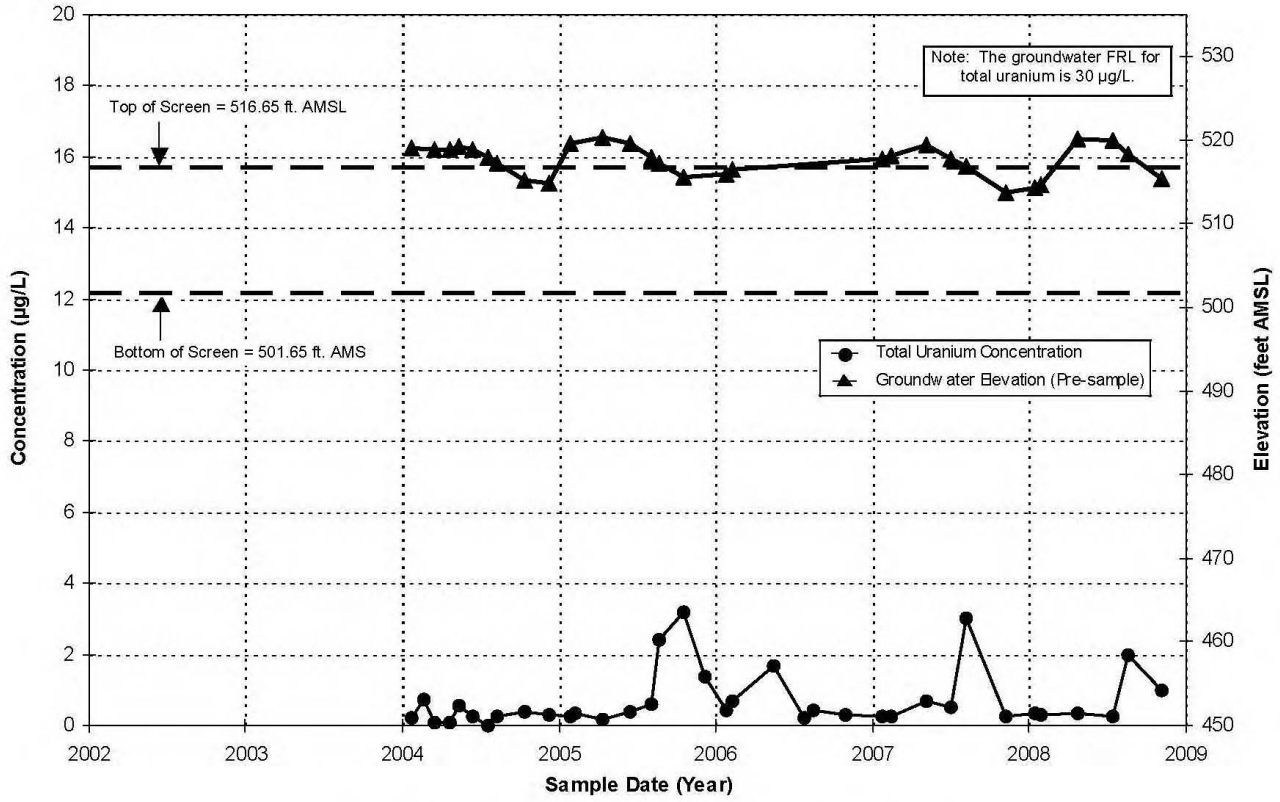


Figure A.5.7-4. Total Uranium Concentration and Groundwater Elevation vs. Time Plot for Cell 7 Upgradient Monitoring Well 22212

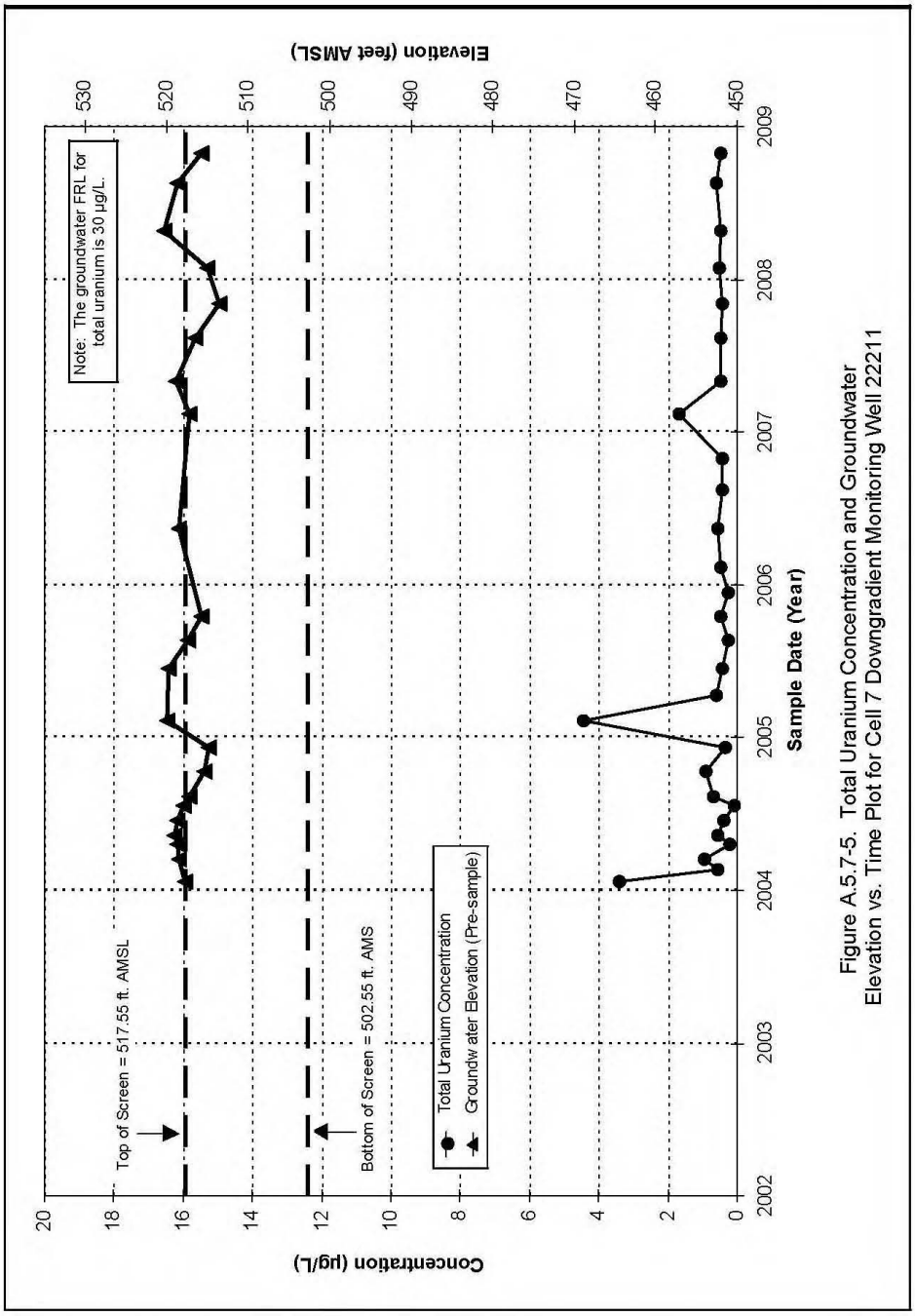


Figure A.5.7-5. Total Uranium Concentration and Groundwater Elevation vs. Time Plot for Cell 7 Downgradient Monitoring Well 22211

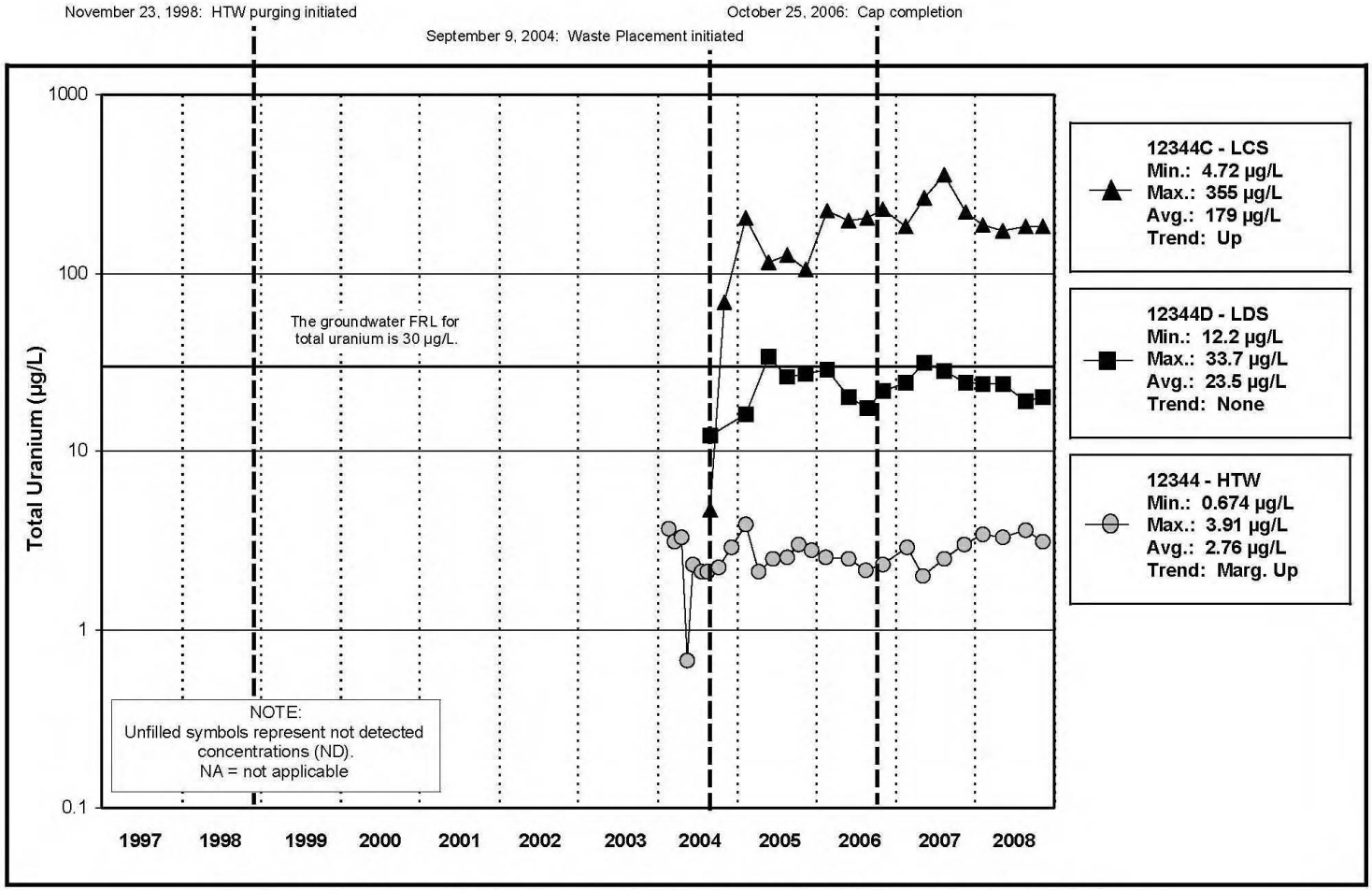


Figure A.5.7-6A. Cell 7 Total Uranium Concentration vs. Time Plot for LCS, LDS, AND HTW

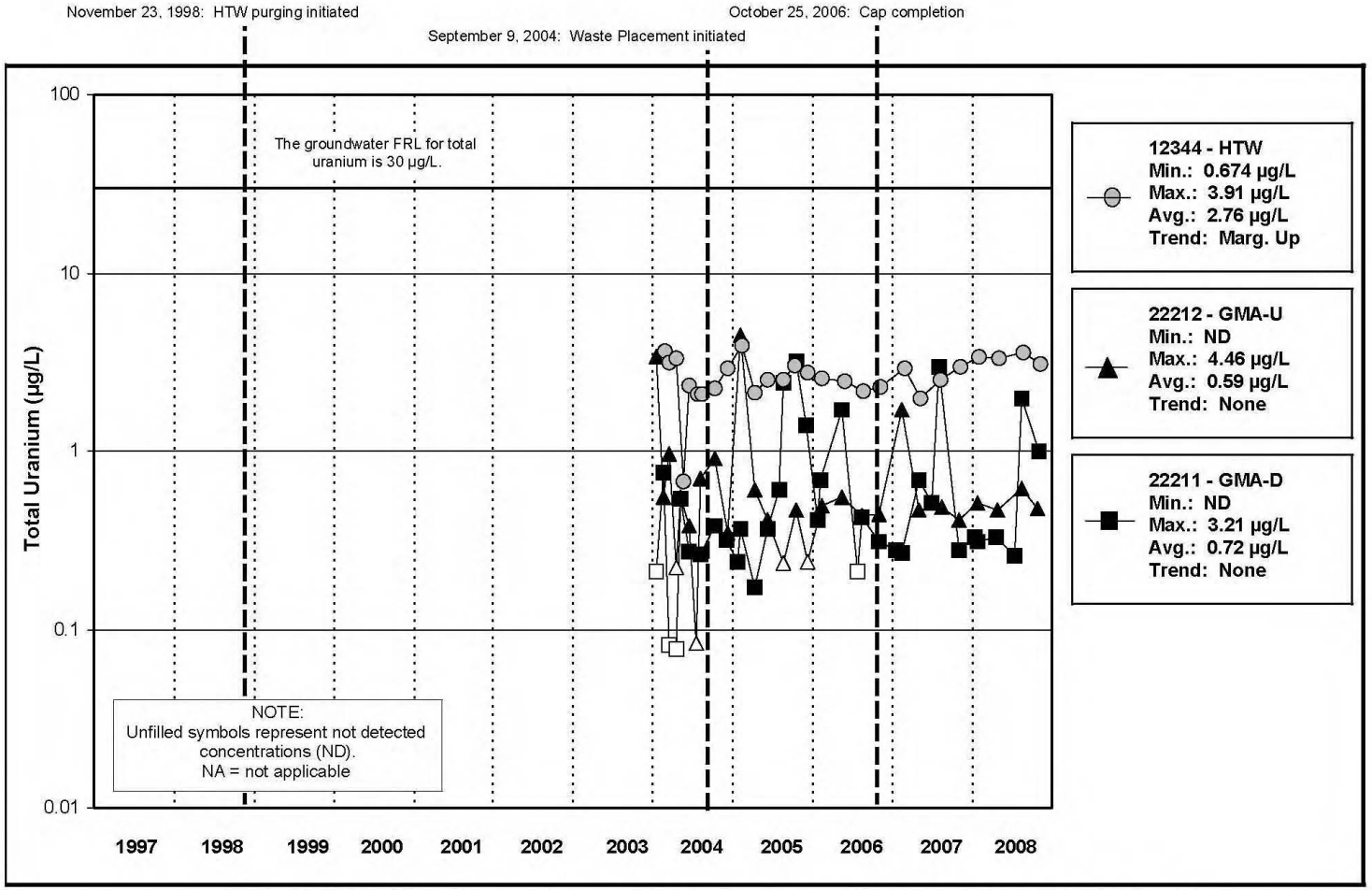


Figure A.5.7-6B. Cell 7 Total Uranium Concentration vs. Time Plot for HTW, GMA-U Well, AND GMA-D Well

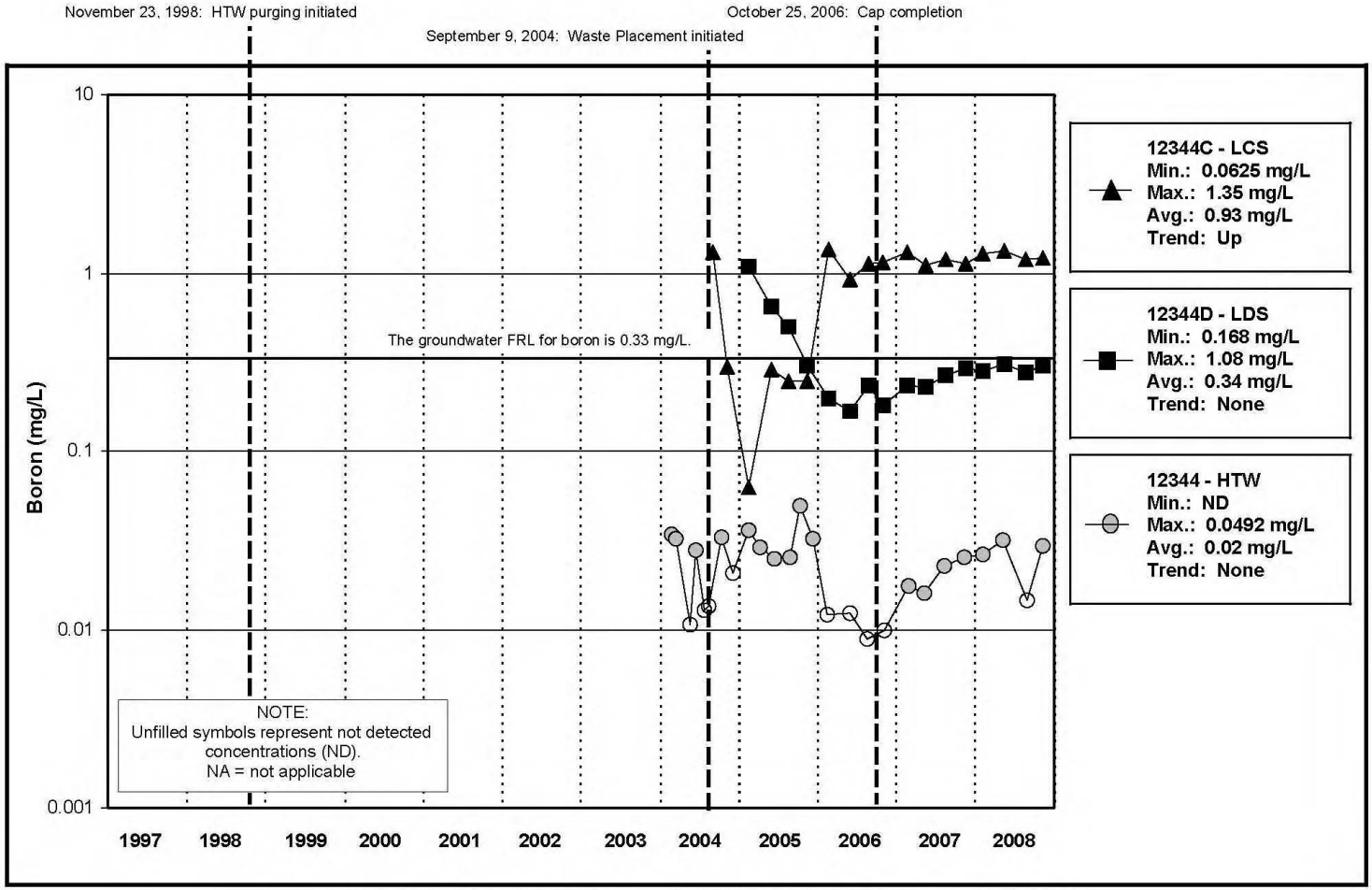


Figure A.5.7-7A. Cell 7 Boron Concentration vs. Time Plot for LCS, LDS, AND HTW

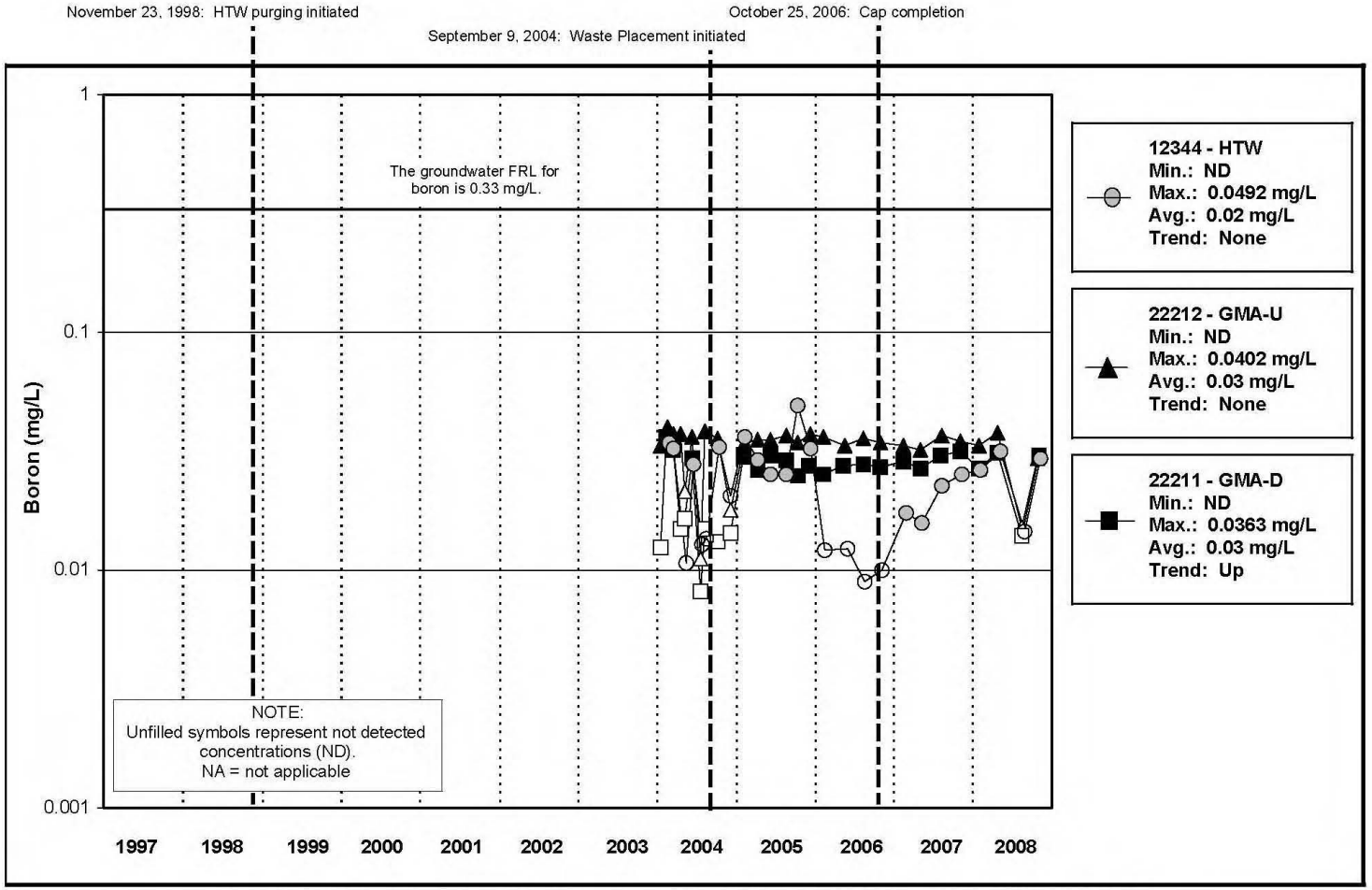


Figure A.5.7-7B. Cell 7 Boron Concentration vs. Time Plot for HTW, GMA-U Well, AND GMA-D Well

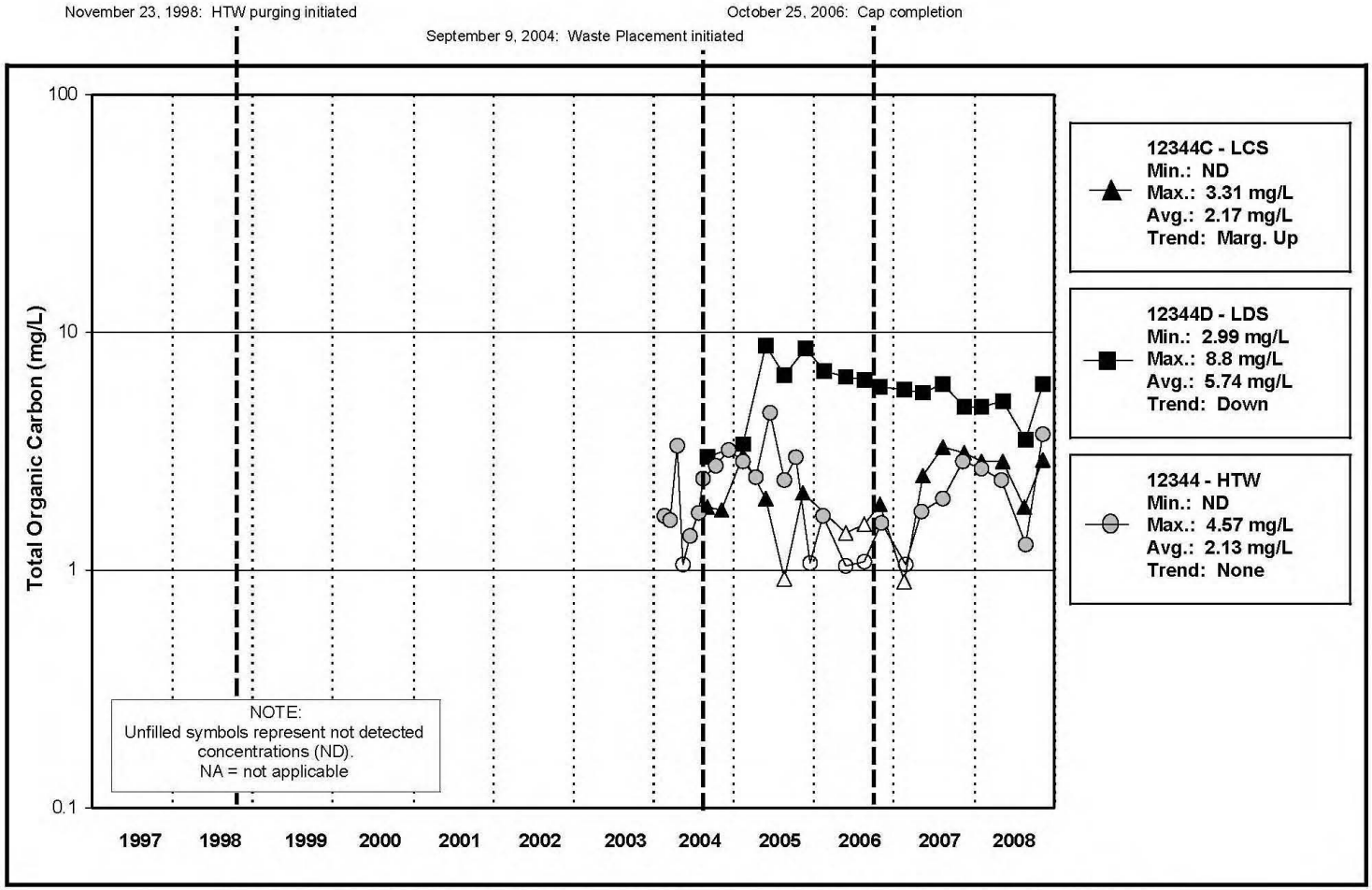


Figure A.5.7-8A. Cell 7 Total Organic Carbon Concentration vs. Time Plot for LCS, LDS, AND HTW

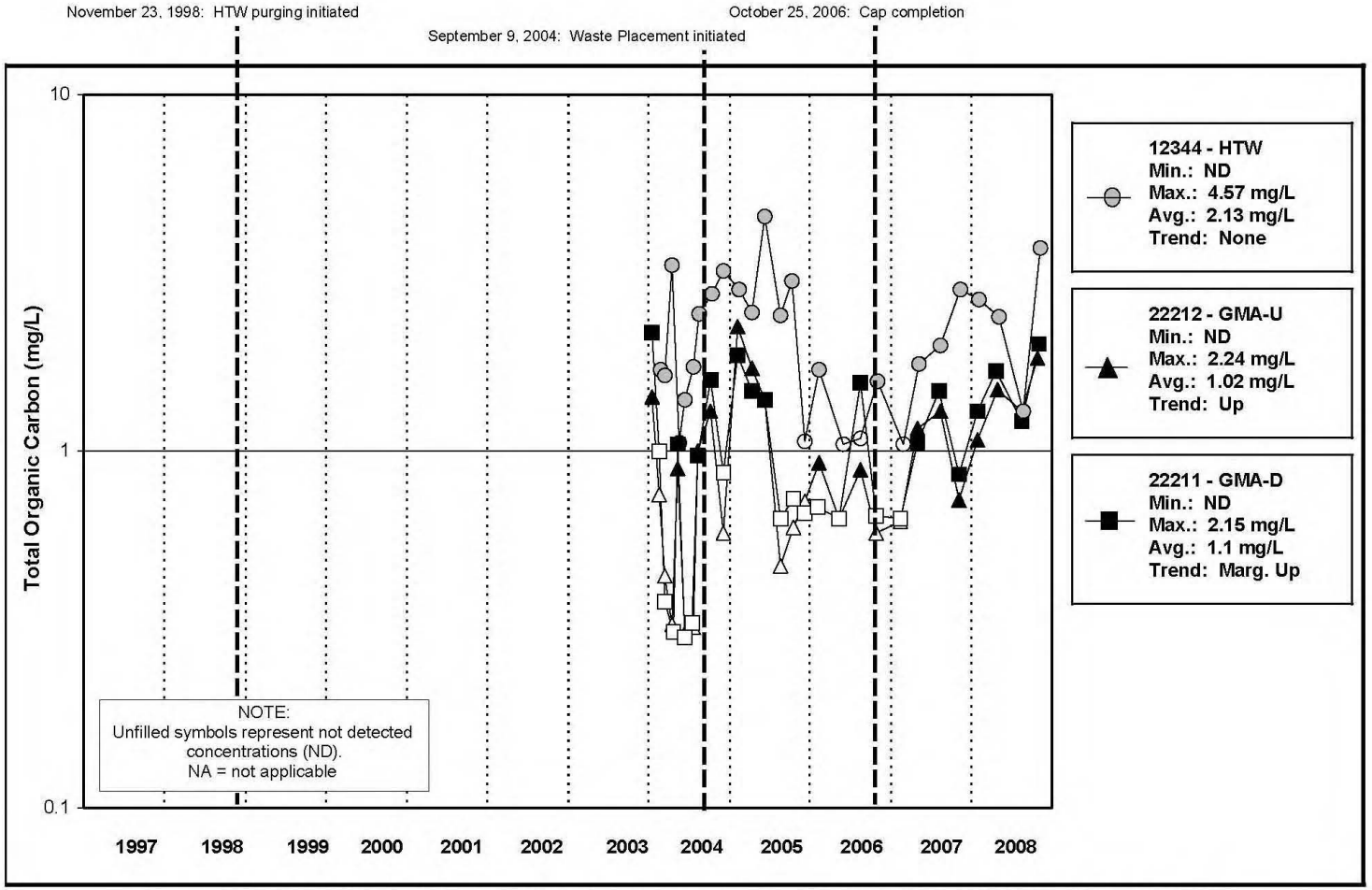


Figure A.5.7-8B. Cell 7 Total Organic Carbon Concentration vs. Time Plot for HTW, GMA-U Well, AND GMA-D Well

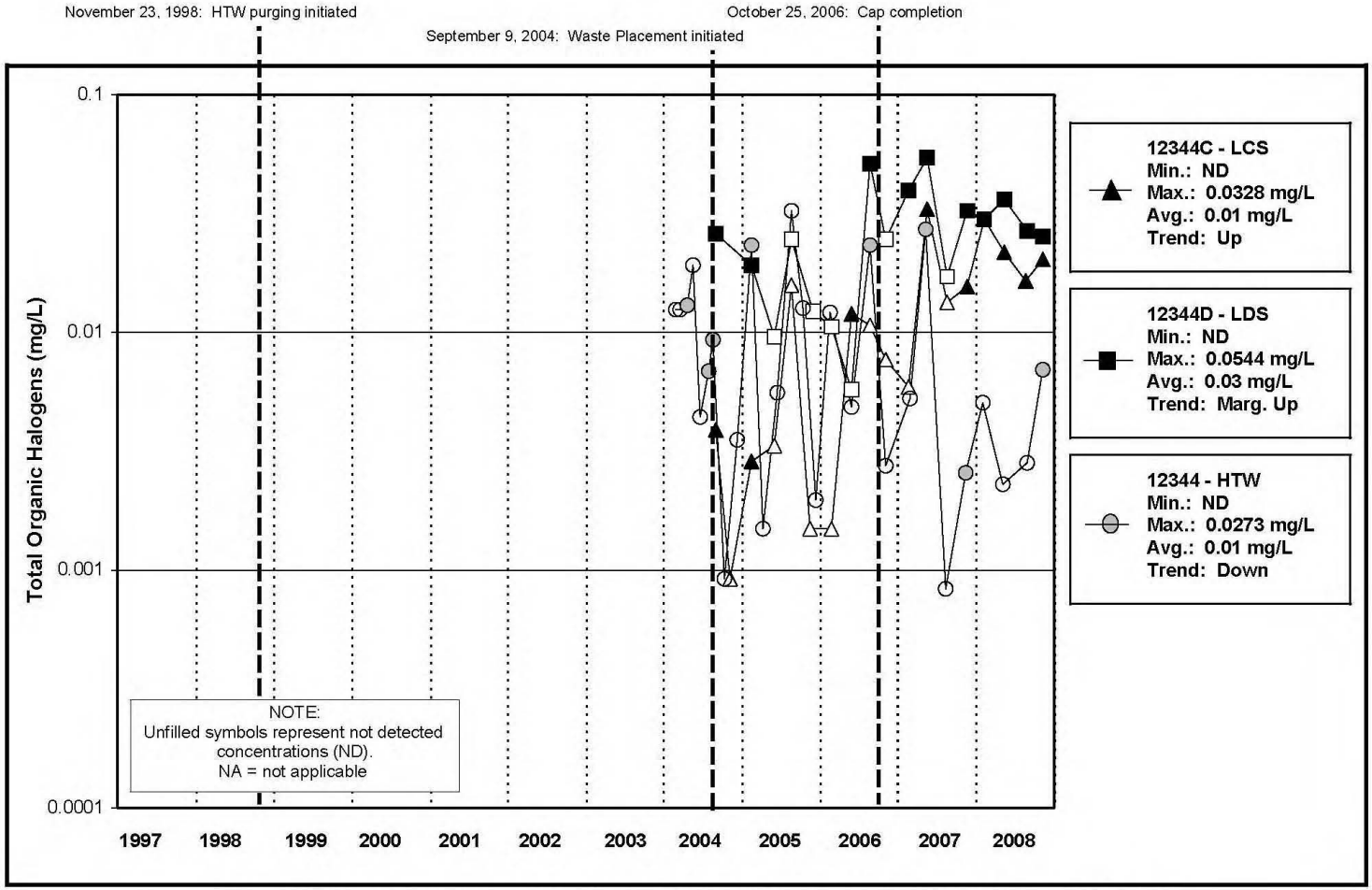


Figure A.5.7-9A. Cell 7 Total Organic Halogens Concentration vs. Time Plot for LCS, LDS, AND HTW

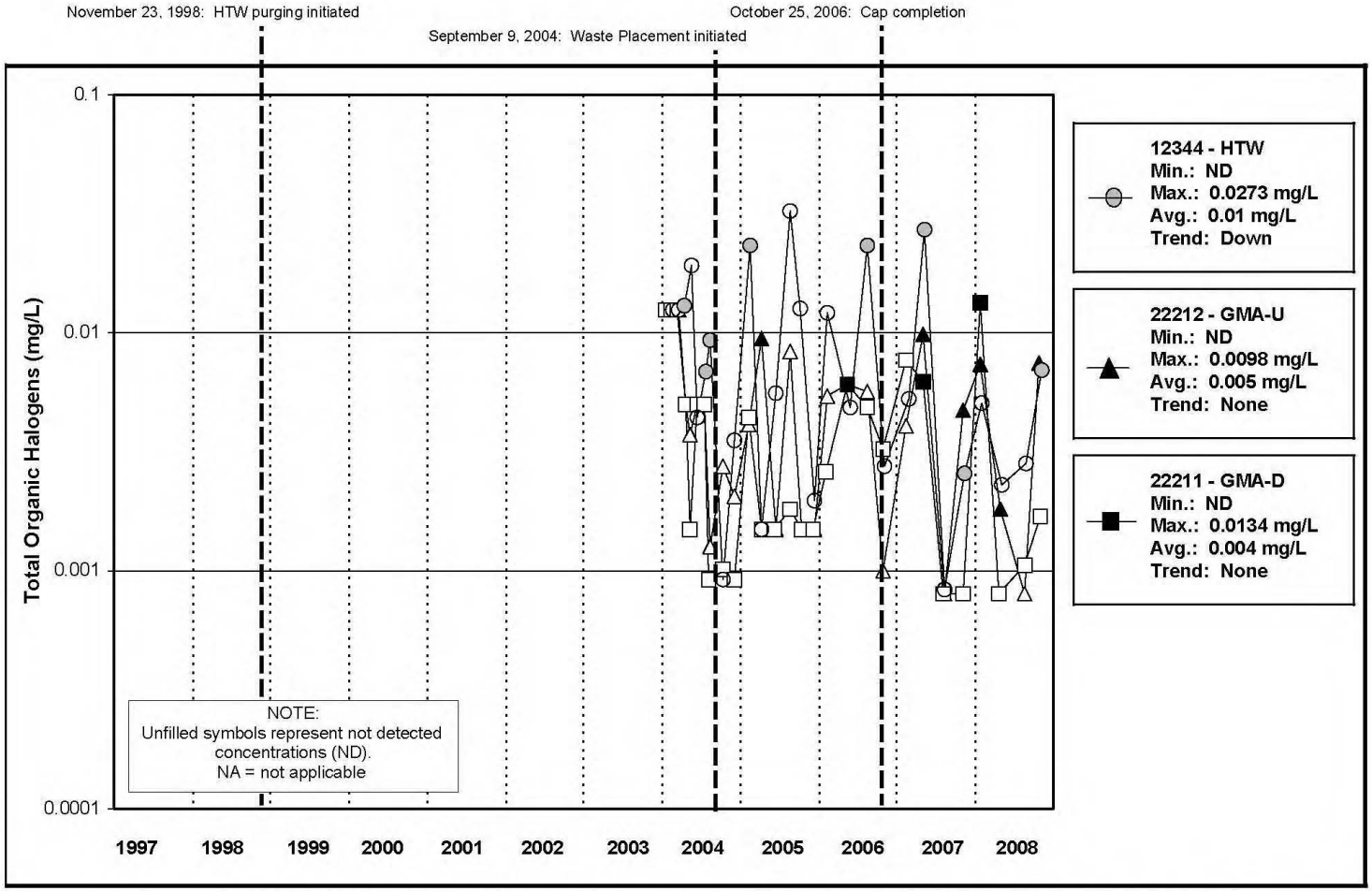


Figure A.5.7-9B. Cell 7 Total Organic Halogens Concentration vs. Time Plot for HTW, GMA-U Well, AND GMA-D Well

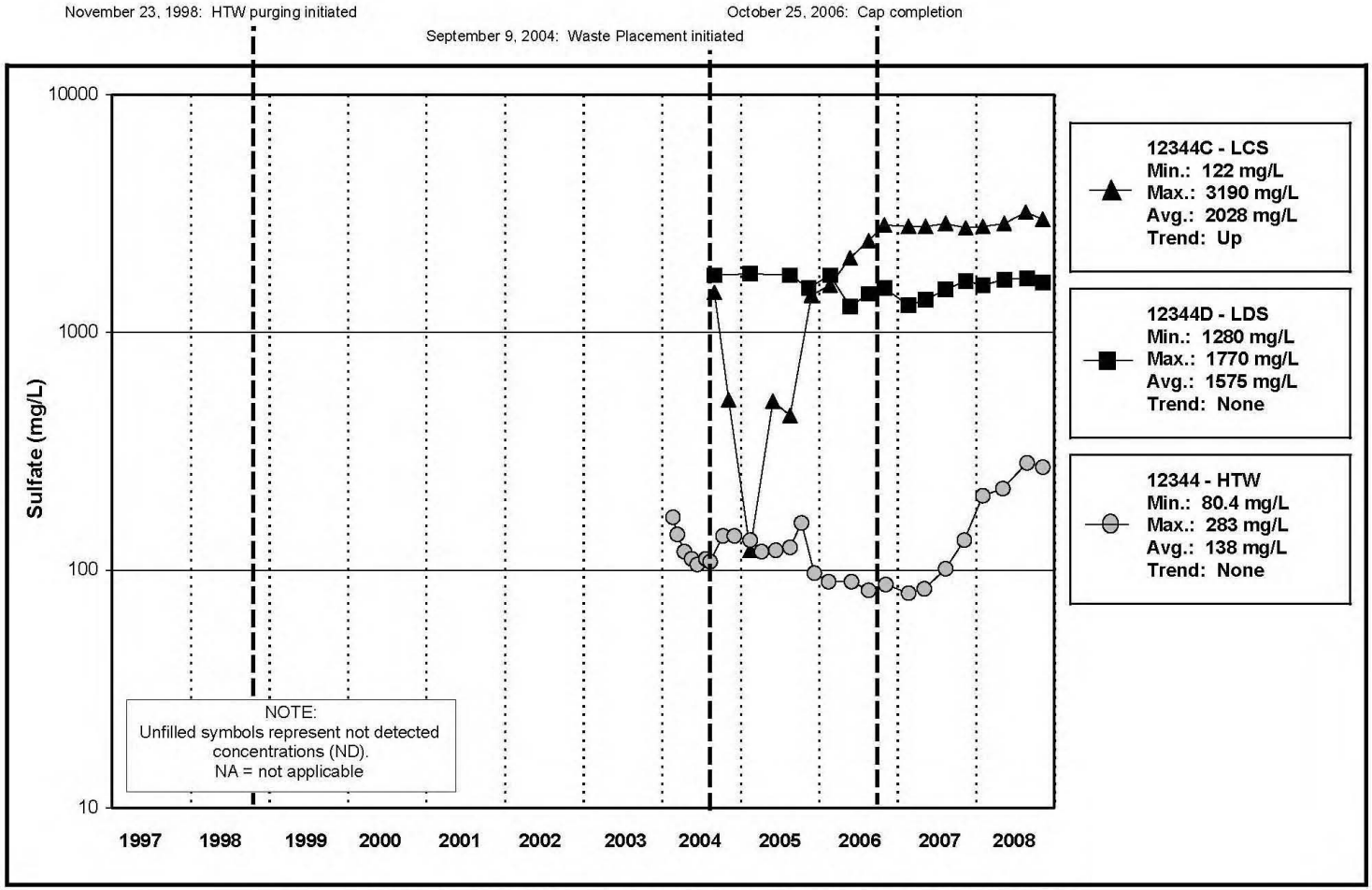


Figure A.5.7-10A. Cell 7 Sulfate Concentration vs. Time Plot for LCS, LDS, AND HTW

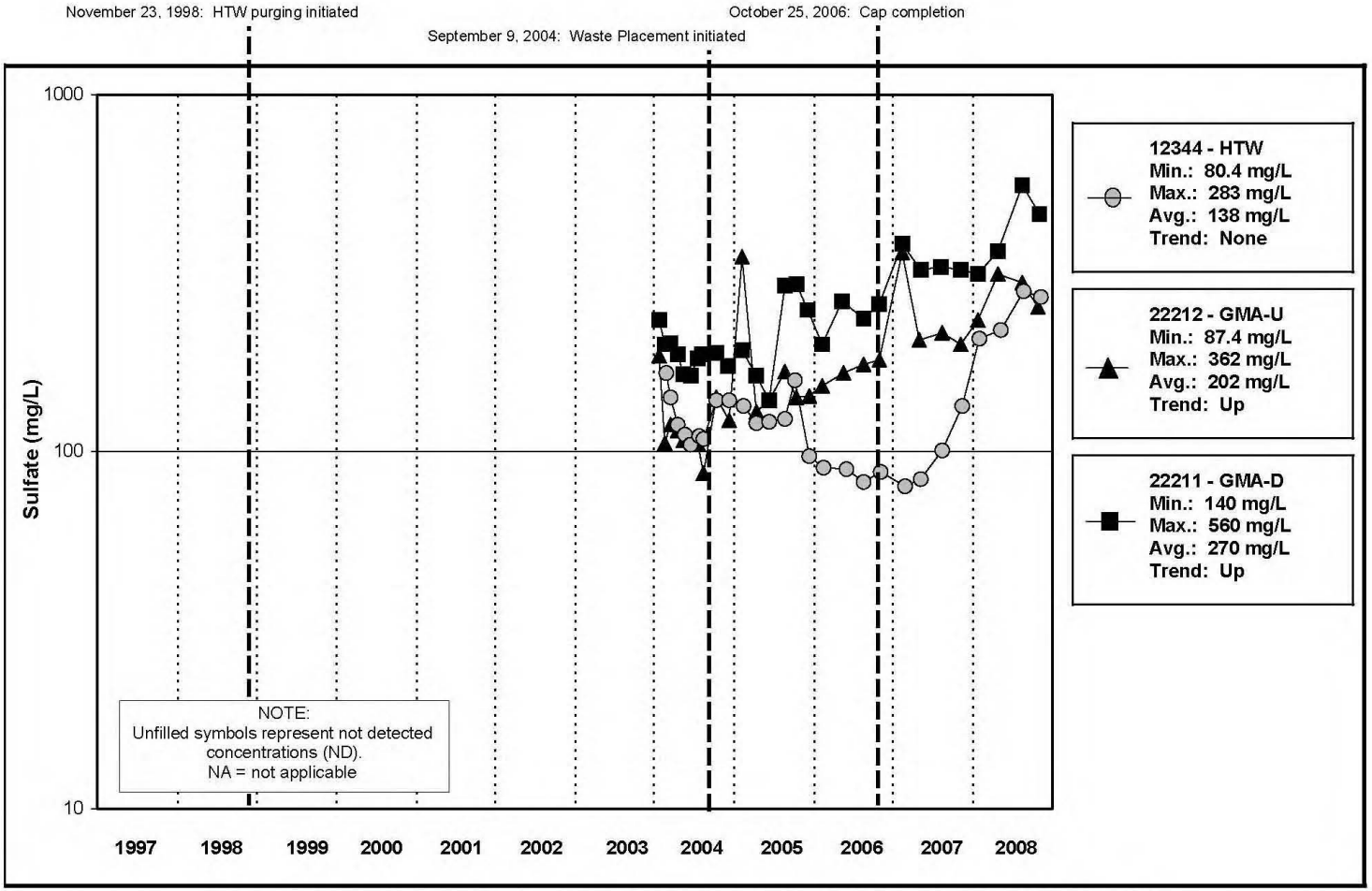


Figure A.5.7-10B. Cell 7 Sulfate Concentration vs. Time Plot for HTW, GMA-U Well, AND GMA-D Well

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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).
- GMA water levels and uranium concentrations versus time (refer to Figures A.5.8−4 and A.5.8−5).
- Summary statistics for refined baseline constituents (refer to Section A.5.8.1 and Table A.5.8−2).
- 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.5.8−3).
- Annual LDS monitoring results (refer to Section A.5.8.3).

Samples in 2008 were collected according to the frequencies described in the GWLMP. Constituent sampling lists are provided in Table 2−1, Table 2−2, and Table 2−3 of Appendix B of the GWLMP. In 2008, all samples were collected for Cell 8 monitoring horizons with the exception of the HTW. The HTW in Cell 8 was dry in August and November.

A.5.8.1 Refined Baseline Monitoring Results

As defined in the GWLMP, refined baseline constituents are those constituents that have been monitored at least eight times, and detected at least 25 percent of the time in the LCS, LDS, HTW, and GMA wells. Results from 2008 sampling are provided in a summary statistics table (Table A.5.8-2) and concentration plots (Figures A.5.8-6A to A.5.8-10B). The five refined baseline constituents are total uranium, boron, TOC, TOX, and sulfate.

Flow in the LDS in 2008 was well below the OSDF design action level, indicating that the water quality trends observed in the HTW and GMA wells in 2008 are attributable to concentration fluctuations taking place beneath the facility and not to a potential leak from the facility.

The 2009 revision of the GWLMP identifies the data evaluation techniques that will be used to further evaluate the association between water quality changes observed beneath the facility and the potential that they are being caused by a leak from the facility. Control charts will be added back to the program along with the use of bivariate plots.

Beginning in January 2009, the refined baseline constituents will become a subset of a larger group of 15 constituents that will be monitored annually in all four monitoring horizons (LCS, LDS, HTW, and GMA wells) of each cell. Monitoring at the LCS will include all of the 15 constituents listed below, as well as the rest of the initial baseline constituents defined for the facility.

Constituent Sampling List for the LDS, HTW, and GMA Wells of Each Cell in 2009	
Constituent	**Reason**
Boron	Refined Baseline Parameter
Sulfate	Refined Baseline Parameter
Uranium	Refined Baseline Parameter
TOC	Refined Baseline Parameter
TOX	Refined Baseline Parameter
Iron	Common Ion Study[a]
Manganese	Common Ion Study[a]
Sodium	Common Ion Study[a]
Lithium	Common Ion Study[a]
Arsenic	Appendix I Statistical Analysis
Cobalt	Appendix I Statistical Analysis
Nickel	Appendix I Statistical Analysis
Selenium	Appendix I Statistical Analysis
TDS	Appendix I Statistical Analysis
Zinc	Appendix I Statistical Analysis

[a] Also known as the *Evaluation of Aqueous Ions in the Monitoring Systems of the On-Site Disposal Facility* (DOE 2008b)

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 if the composition of the leachate within the facility is changing enough to impact monitoring activities beneath the facility. Even though active operations ended in 2006, this sampling continued in 2007 and 2008.

In 2008, annual sampling of the Cell 8 LCS took place in February. Table A.5.8-3 summarizes the annual LCS sampling results for Cell 8, along with the data collected in previous years. Table A.5.8-3 lists the non-refined baseline site specific constituents that were monitored in 2008. Ten of the constituents listed have been monitored at least 8 times and detected at least 25 percent of the time. On these 10, the monitoring usefulness of 9 of them (alkalinity, calcium, chloride, iron, magnesium, manganese, nitrate/nitrite, potassium, and sodium) was addressed in the Common Ion Report. The remaining constituent is technetium-99.

Technetium-99 has been detected over 25 percent of the time in the Cell 8 LCS. Statistics conducted for Cell 1 on the potential usefulness of technetium-99 as a monitoring constituent for the OSDF indicated that it would not be a useful constituent at Cell 1. As described in the 2009 revision of the GWLMP, results from Cells 1, 2, and 3 are being applied to Cells 4 through 8. This means that in 2009 technetium-99 will not be monitored in the LDS, HTW, or GMA wells of Cells 4 through 8. Given the consistency of detects though seen in 2008 at Cells 4 through 8, DOE will conduct a statistical analysis in 2009 for the usefulness of technetium-99 as a monitoring constituent at Cells 4 through 8 similar to the one conducted for Cells 1, 2, and 3. This exception is warranted given that technetium-99 is being detected rather consistently, and the extra effort could result in adding an additional useful constituent to the monitoring program for those cells. Results of the analysis will be made reported in the 2010 SER.

Confirmatory Sampling in the LCS

In 2009, confirmatory sampling procedures were modified in the GWLMP. Because confirmatory sampling identified in 2008 will take place in 2009, the modified procedure will be followed. Therefore, if a constituent was detected in the 2008 LCS sample, that was not going to be monitored in the LDS in 2009, the constituent was added for confirmatory monitoring in 2009.

Two consecutive detects for that constituent in the cell's LCS will trigger monitoring for that constituent in the cell's LDS during the next scheduled sampling event. However, if the usefulness of the constituent as a monitoring constituent has already been rejected through the Common Ion Study, the constituent will not be added for confirmatory monitoring.

Six constituents (other than the ones identified above) were detected in 2008 in the Cell 8 LCS (barium, chromium, cobalt, copper, technetium-99, and TDS).

As presented in the 2009 revision of the GWLMP, cobalt and TDS will be monitored in the LDS, HTW, and GMA wells of Cell 8 in 2009. It was reported in the Common Ion Study that barium would not be a useful monitoring parameter in Cell 8, because the concentrations measured in the different monitoring horizons of Cell 8 are too similar, so confirmatory monitoring for barium will not be conducted. Chromium was addressed in the Common Ion Study. The numerous non-detects for chromium do not make it a useful monitoring parameter.

In the Common Ion Study copper was identified as a potentially useful monitoring constituent from the LDS to the HTW of Cell 8. Monitoring for copper in the Cell 8 LCS and LDS will be conducted beginning in 2009.

In 2008, technetium-99 was detected in the Cell 8 LCS. A detect was also measured in 2007. As discussed above, a statistical analysis for technetium-99 is being conducted for Cell 8. It will be added to the constituent monitoring list for the Cell 7 LDS beginning in 2010, pending the result of the statistical analysis discussed above.

A.5.8.3 LDS Monitoring Results

In 2008, the LDS of Cell 8 was monitored for site-specific constituents listed in Table 2−1 of Appendix B of the GWLMP. The objective of the sampling was to determine if any initial baseline constituents, not on the refined baseline list, were present in the LDS. In 2008, sampling of the Cell 8 LDS took place in February.

Results of the LDS sampling at Cell 8 in 2008 indicate that all of the initial baseline constituents that have been monitored in the Cell 8 LDS and detected at least 25 percent of the time are being monitored in the Cell 8 HTW and GMA wells in 2009.

Table A.5.8−1. Cell 8 – 2008 Monthly Liner Efficiencies

Month	Cell 8 Apparent Liner Efficiency (%)
January	96.18
February	95.79
March	95.57
April	97.12
May	96.75
June	96.48
July	97.05
August	96.64
September	96.97
October	98.56
November	97.39
December	97.79

Table A.5.8−2. Cell 8 Data Summary For Constituents Detected Through 2008

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	17	17	100	146	Normal	Up, Significant	Detected			
	LDS	12345D	16	16	100	20.1	Lognormal	Up, Marginal	Detected			
	HTW	12345	16	16	100	5.01	Normal	Up, Significant	Not Detected			
	GMA-U	22213	15	20	75	0.34	Normal	Up, Significant	Detected			
	GMA-D	22214	17	20	85	0.740	Undefined	No Significant	Not Detected			
	GMA-SW	22215	12	14	85.7	0.46	Normal	No Significant	Not Detected	0.182 (Q3-05)	0.21 (Q3-06)	0.77 (Q2-08)
	GMA-SE	22217[h]	12	13	92.3	6.47	Lognormal	Up, Significant	Detected			
Boron (mg/L)	LCS	12345C	17	17	100	0.47	Undefined	Up, Significant	Detected			
	LDS	12345D	16	16	100	1.12	Undefined	Down, Significant	Detected			
	HTW	12345	15	15	100	0.08	Normal	No Significant	Not Detected			
	GMA-U	22213	19	20	95	0.04	Normal	Up, Significant	Not Detected	0.0159 (Q3-08)		
	GMA-D	22214	18	20	90	0.03	Undefined	No Significant	Not detected			
	GMA-SW	22215	13	14	92.9	0.03	Normal	Up, Significant	Not detected	0.0132 (Q3-08)		
	GMA-SE	22217[h]	12	13	92.3	0.03	Normal	No Significant	Not detected	0.0118 (Q3-08)		
Total Organic Carbon (mg/L)	LCS	12345C	14	17	82.4	2.08	Normal	No Significant	Not Detected	5.31 (Q4-04)		
	LDS	12345D	15	16	93.8	3.34	Normal	No Significant	Detected			
	HTW	12345	9	15	60	1.63	Normal	No Significant	Not Detected			
	GMA-U	22213	15	20	75	1.11	Normal	No Significant	Not Detected			
	GMA-D	22214	14	20	70	1.15	Normal	No Significant	Not Detected			
	GMA-SW	22215	9	14	64.3	1.03	Normal	Up, Significant	Not Detected			
	GMA-SE	22217[h]	9	13	69.2	1.33	Normal	Up, Significant	Detected			
Total Organic Halogens (mg/L)	LCS	12345C	7	17	41.2	0.008	Lognormal	Up, Significant	Detected	0.0449 (Q1-06)	0.0593 (Q2-07)	
	LDS	12345D	7	16	43.8	0.0099	Lognormal	No Significant	Not Detected	0.0794 (Q4-05)		
	HTW	12345	11	15	73.3	0.05	Normal	No Significant	Not detected			
	GMA-U	22213	3	20	15	0.002	Undefined	No Significant	Not Detected	0.0125 (Q1-04)	0.0102 (Q3-06)	0.0231 (Q2-07)
	GMA-D	22214	3	20	15	0.004	Undefined	Down, Significant	Not Detected			
	GMA-SW	22215	4	14	28.6	0.003	Normal	No Significant	Not detected	0.01755 (Q4-06)	0.0155 (Q2-07)	
	GMA-SE	22217[h]	5	13	38.5	0.002	Lognormal	No Significant	Not detected	0.0140 (Q4-06)	0.0149 (Q2-07)	
Sulfate (mg/L)	LCS	12345C	17	17	100	1490	Undefined	Up, Significant	Detected			
	LDS	12345D	16	16	100	2470	Normal	Up, Significant	Not Detected			
	HTW	12345	15	15	100	116	Normal	Up, Significant	Detected			
	GMA-U	22213	20	20	100	154	Lognormal	Up, Significant	Detected			
	GMA-D	22214	20	20	100	269	Lognormal	Up, Significant	Not detected			
	GMA-SW	22215	14	14	100	113	Normal	Up, Significant	Not detected			
	GMA-SE	22217[h]	13	13	100	319	Normal	Up, Marginal	Not detected	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 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 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.

[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.5.8−3. Summary Statistics For Cell 8

PARAMETER(UNIT)	NUMBER OF SAMPLES[a,b]	NUMBER OF SAMPLES WITH DETECTIONS[a,b]	PERCENT OF DETECTIONS[a,b]	DETECTED IN 2008?	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
General Chemistry												
Alkalinity as CaCO3 (mg/L)	11	11	100%	Yes	64.9	418	228	-	422 mg/L(0)	430 mg/L(0)	-	10 mg/L
Chloride (mg/L)	11	11	100%	Yes	18.9	235	118	-	7.3 mg/L(11)	45 mg/L(8)	6300 mg/L(0)	5 mg/L
Nitrate/Nitrite (mg/L)	11	10	90.9%	Yes	1.52	74.6	32.7	11 mg/L[g](5)	11 mg/L(6)	0.29 mg/L(10)	2670 mg/L(0)	1.1 mg/L
Total Dissolved Solids (mg/L)	5	5	100%	Yes	882	4520	2570	-	-	-	-	10 mg/L
Inorganics												
Barium (mg/L)	5	5	100%	Yes	0.0298	0.103	0.0562	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)	9	9	100%	Yes	65.4	638	314	-	159 mg/L(7)	172 mg/L(6)	1800 mg/L(0)	5 mg/L
Chromium (mg/L)	5	2	40%	Yes	0.0016	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)	5	4	80%	Yes	0.00067	0.0022	0.0014	0.17 mg/L(0)	0.0086 mg/L(0)	-	0.0886 mg/L(0)	0.034 mg/L
Copper (mg/L)	5	4	80%	Yes	0.0035	0.0181	0.0108	1.3 mg/L(0)	0.035 mg/L(0)	0.029 mg/L(0)	0.298 mg/L(0)	0.008 mg/L
Iron (mg/L)	9	8	88.9%	No	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)	9	9	100%	Yes	21.9	408	169	-	38.5 mg/L(8)	50.7 mg/L(6)	690 mg/L(0)	5 mg/L
Manganese (mg/L)	9	8	88.9%	Yes	0.0101	0.17	0.0529	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)	5	4	80%	No	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
Potassium (mg/L)	9	9	100%	Yes	4.86	26.3	15.7	-	1.96 mg/L(9)	17.2 mg/L(3)	12400 mg/L(0)	5 mg/L
Sodium (mg/L)	9	9	100%	Yes	16.8	98.2	50.2	-	47.1 mg/L(3)	50 mg/L(3)	1300 mg/L(0)	5 mg/L
Thallium (mg/L)	5	1	20%	No	0.00057	-	-	-	-	-	0.0028 mg/L(0)	0.02 mg/L
Vanadium (mg/L)	5	1	20%	No	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)	5	2	40%	No	0.013	0.0138	-	0.021 mg/L(0)	0.02 mg/L(0)	0.35 mg/L(0)	1.78 mg/L(0)	0.015 mg/L
Radionuclides												
Technetium-99 (pCi/L)	15	11	73.3%	Yes	8.39	101	49.7	94 pCi/L(1)	22 pCi/L(9)	30 pCi/L(8)	6130 pCi/L(0)	10 pCi/L
Organics												
Aroclor-1260 (ug/L)	5	1	20%	No	0.058	-	-	-	-	-	-	0.1 ug/L
Tetrachloroethene (ug/L)	15	3	20%	No	0.475	1.24	0.831	-	-	-	-	1 ug/L
Trichloroethene (ug/L)	15	3	20%	No	0.246	1.11	0.587	5 ug/L(0)	-	-	-	1 ug/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 minumun 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.

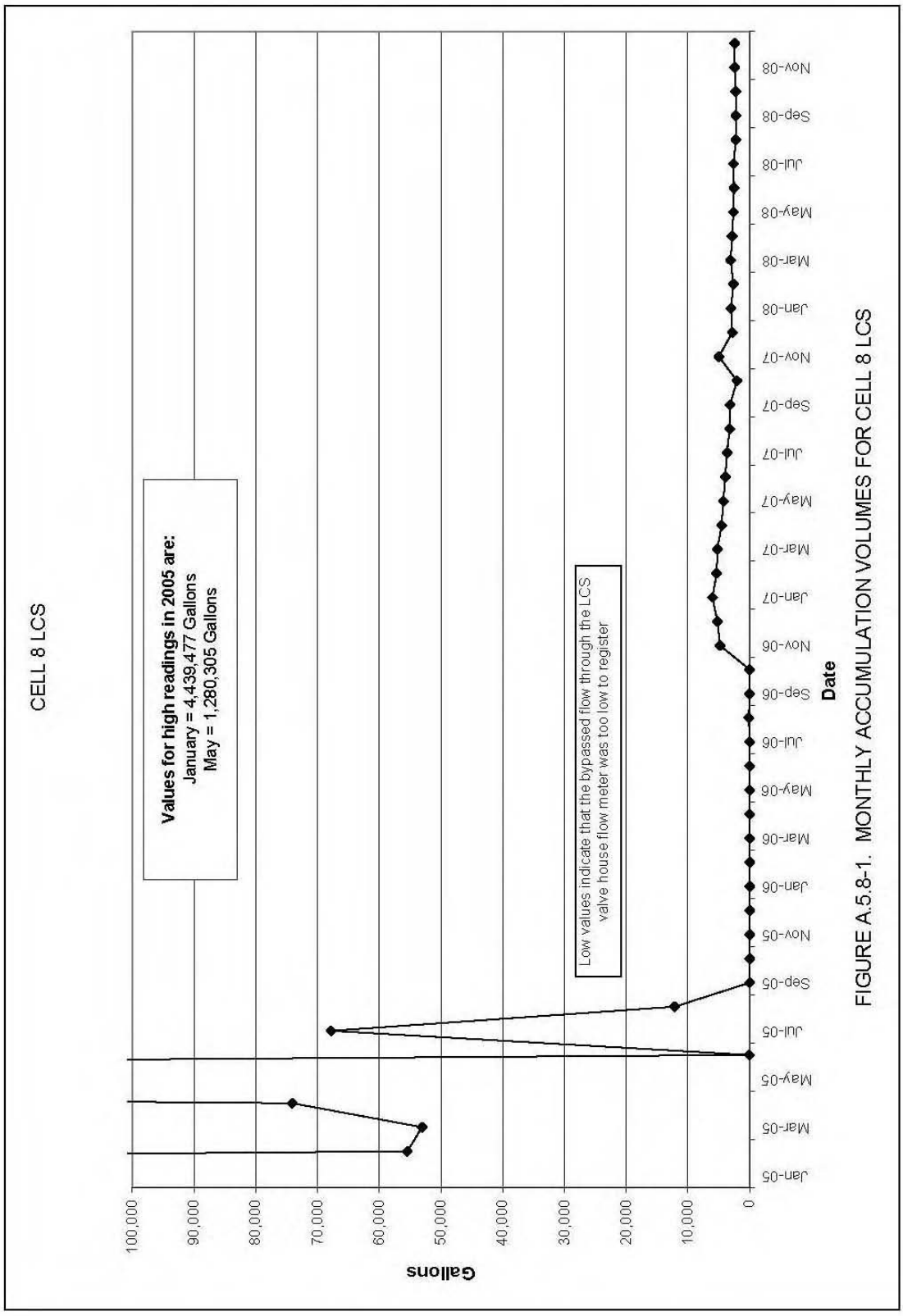

FIGURE A.5.8-1. MONTHLY ACCUMULATION VOLUMES FOR CELL 8 LCS

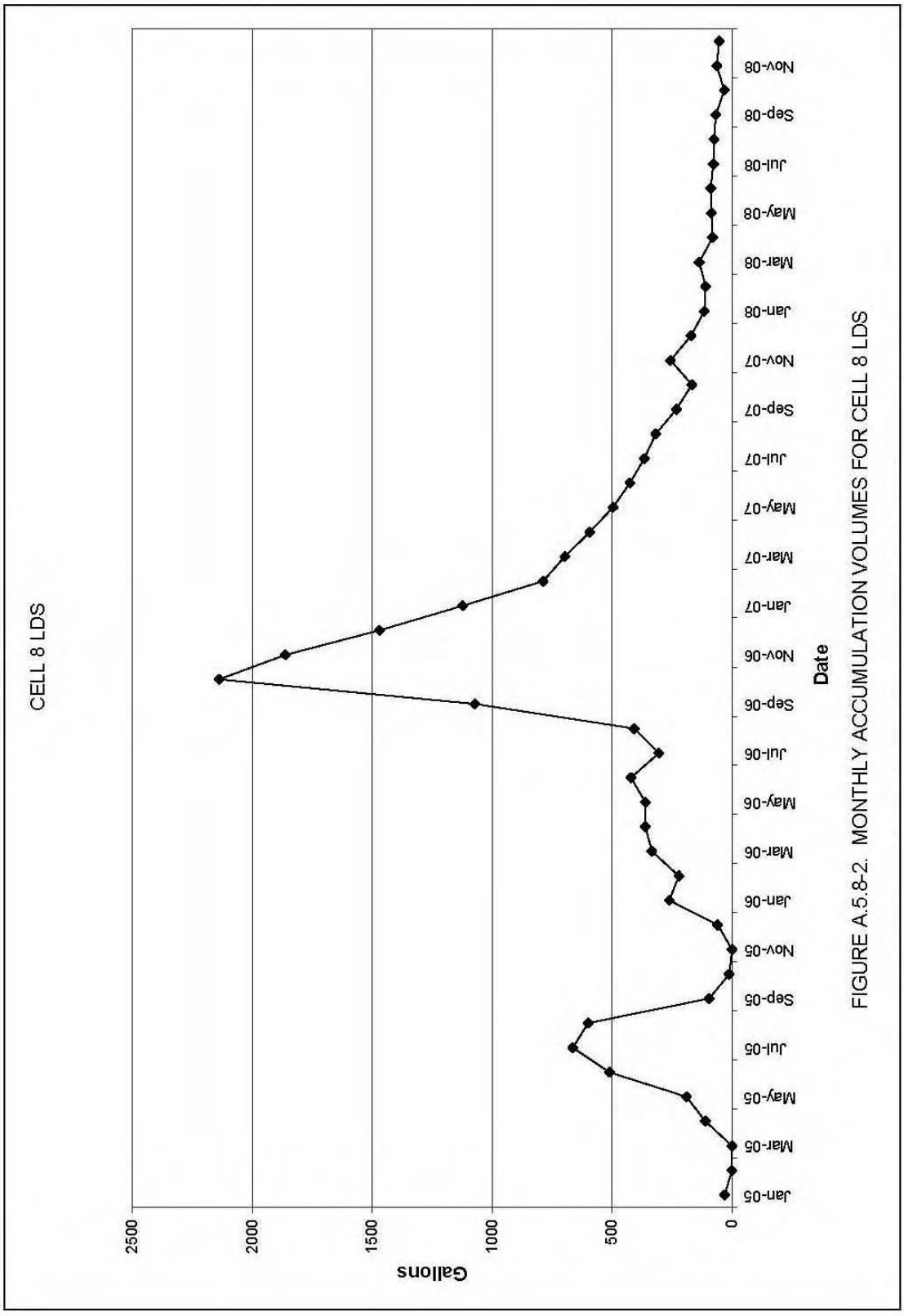

FIGURE A.5.8-2. MONTHLY ACCUMULATION VOLUMES FOR CELL 8 LDS

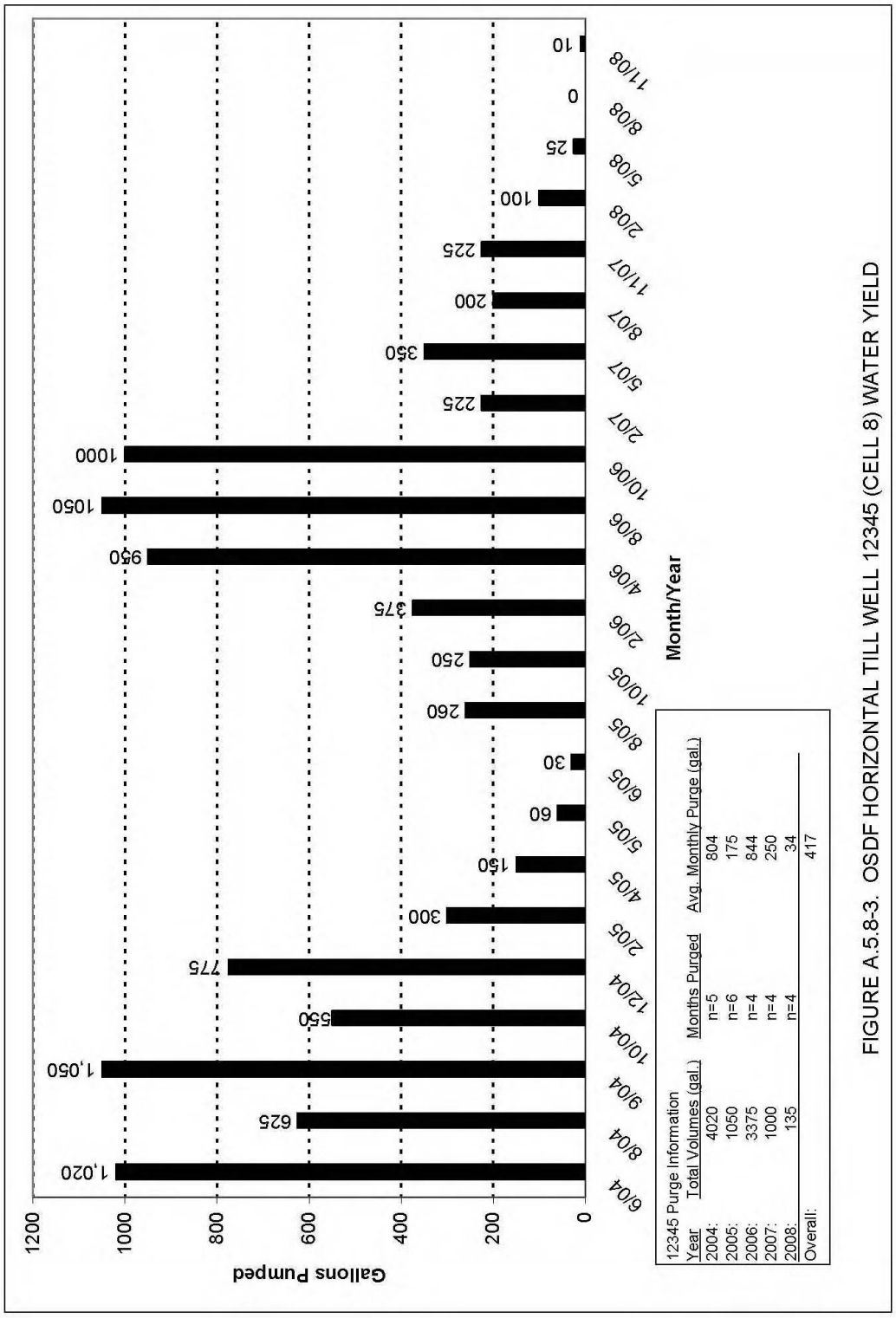

FIGURE A.5.8-3. OSDF HORIZONTAL TILL WELL 12345 (CELL 8) WATER YIELD

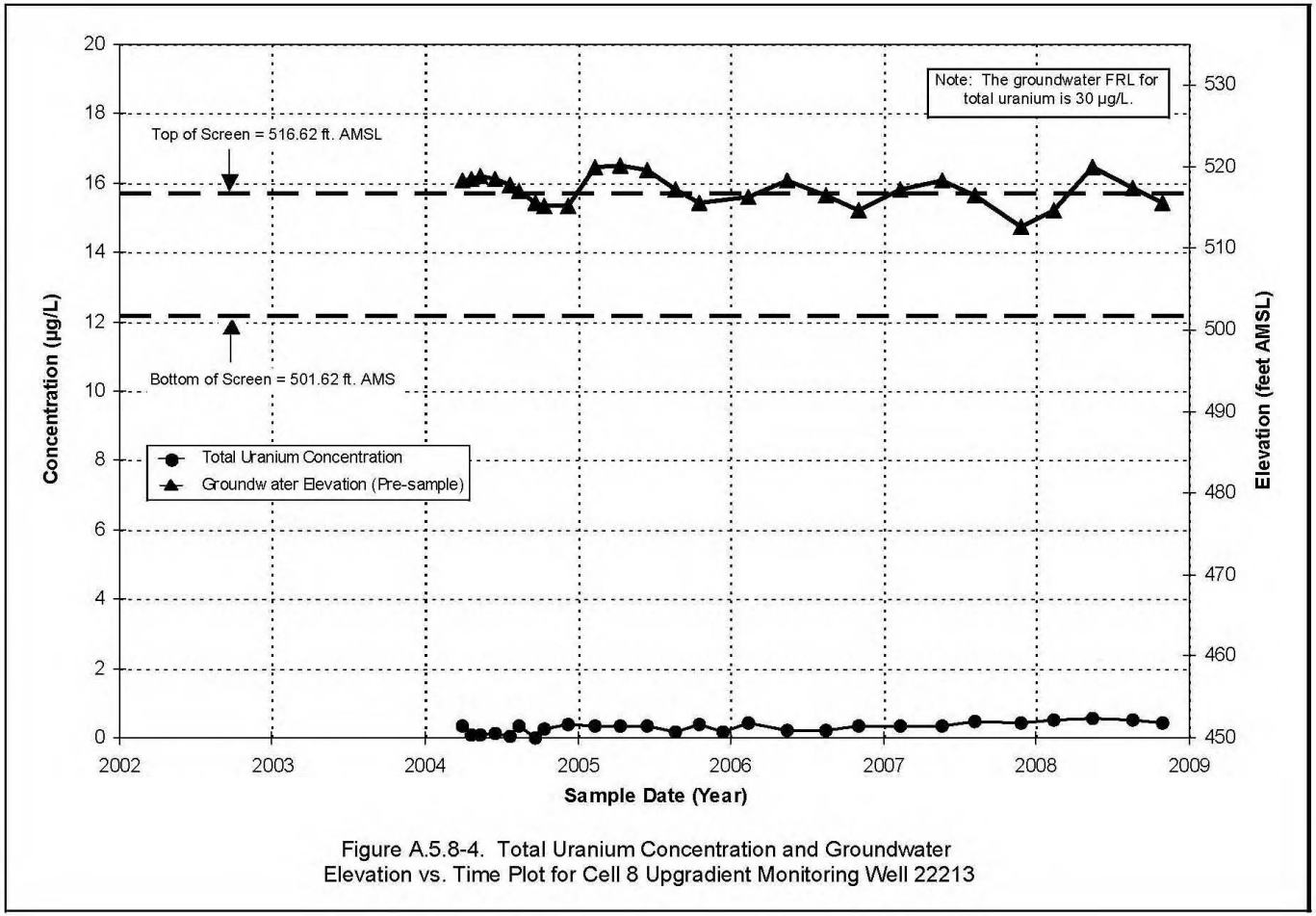

Figure A.5.8-4. Total Uranium Concentration and Groundwater Elevation vs. Time Plot for Cell 8 Upgradient Monitoring Well 22213

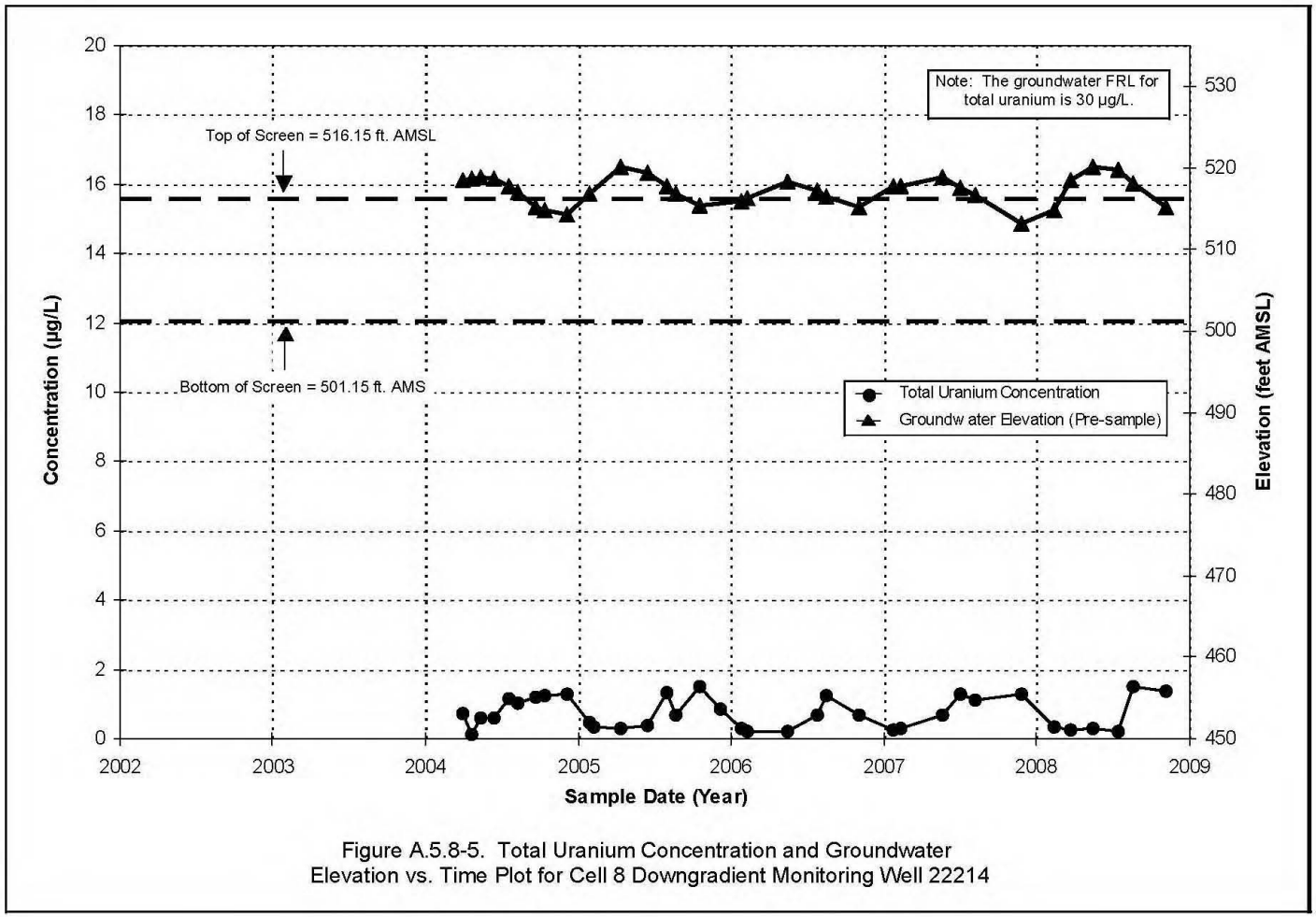

Figure A.5.8-5. Total Uranium Concentration and Groundwater Elevation vs. Time Plot for Cell 8 Downgradient Monitoring Well 22214

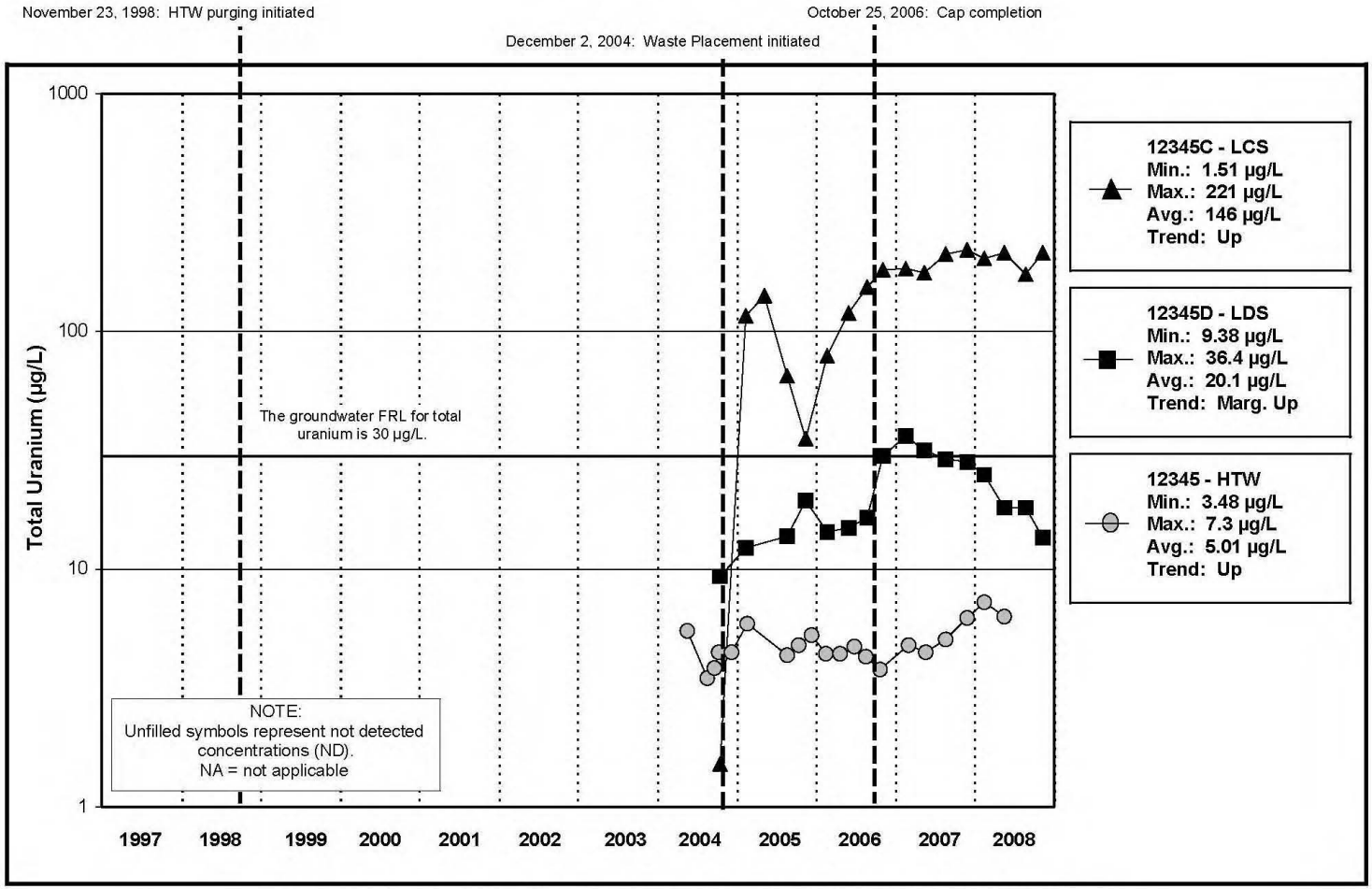

Figure A.5.8-6A. Cell 8 Total Uranium Concentration vs. Time Plot for LCS, LDS, AND HTW

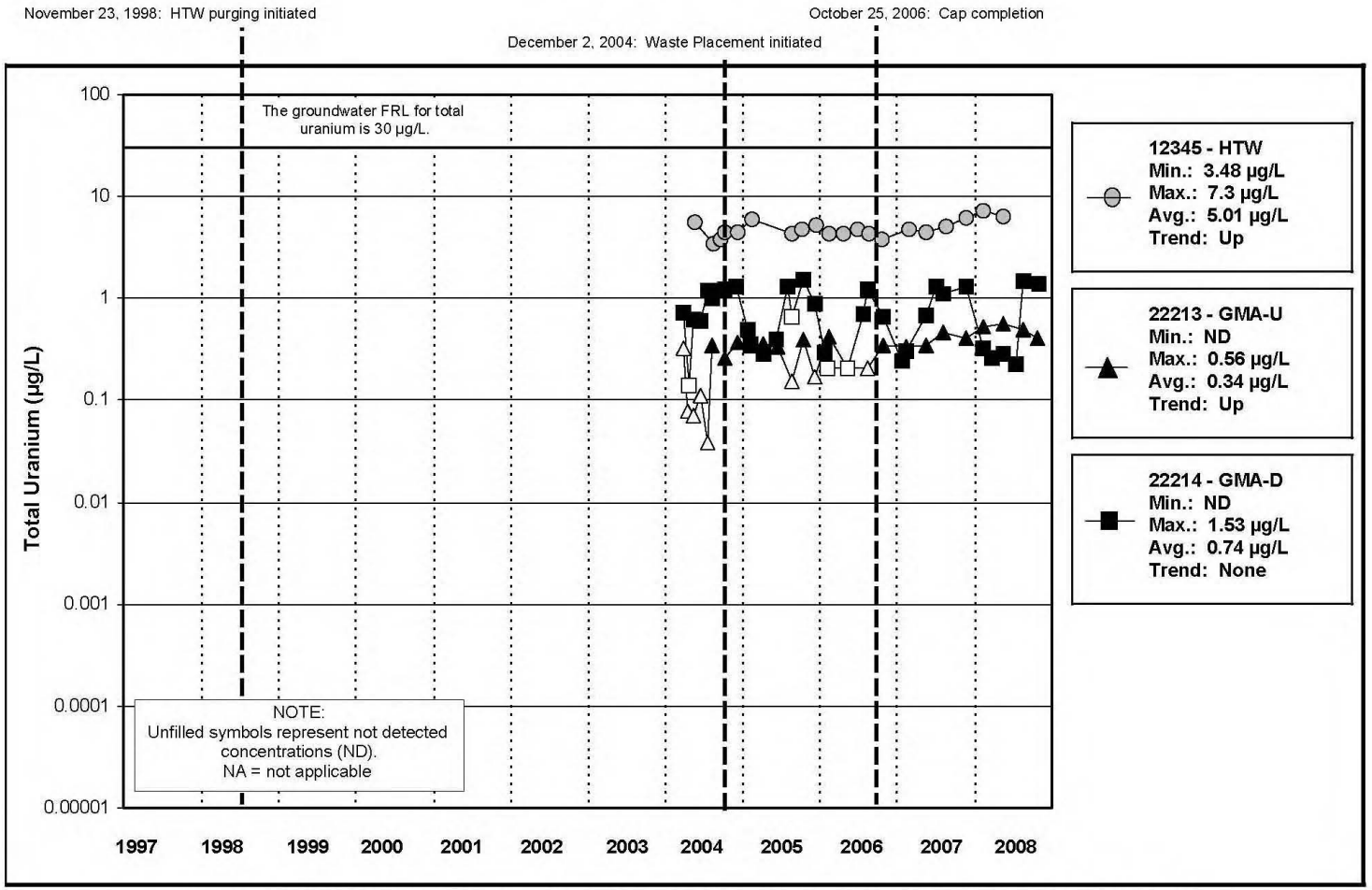

Figure A.5.8-6B. Cell 8 Total Uranium Concentration vs. Time Plot for HTW, GMA-U Well, AND GMA-D Well

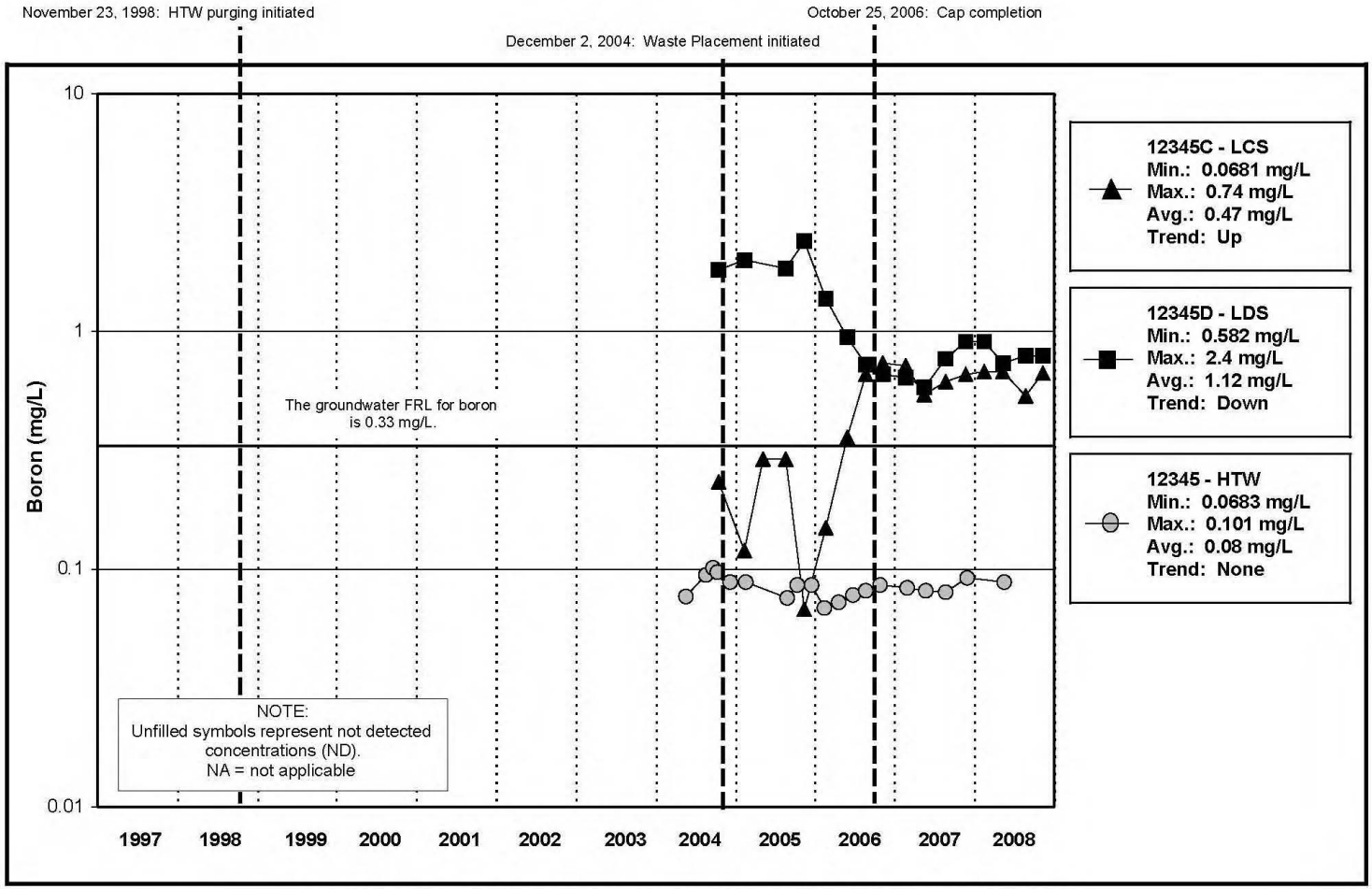

Figure A.5.8-7A. Cell 8 Boron Concentration vs. Time Plot for LCS, LDS, AND HTW

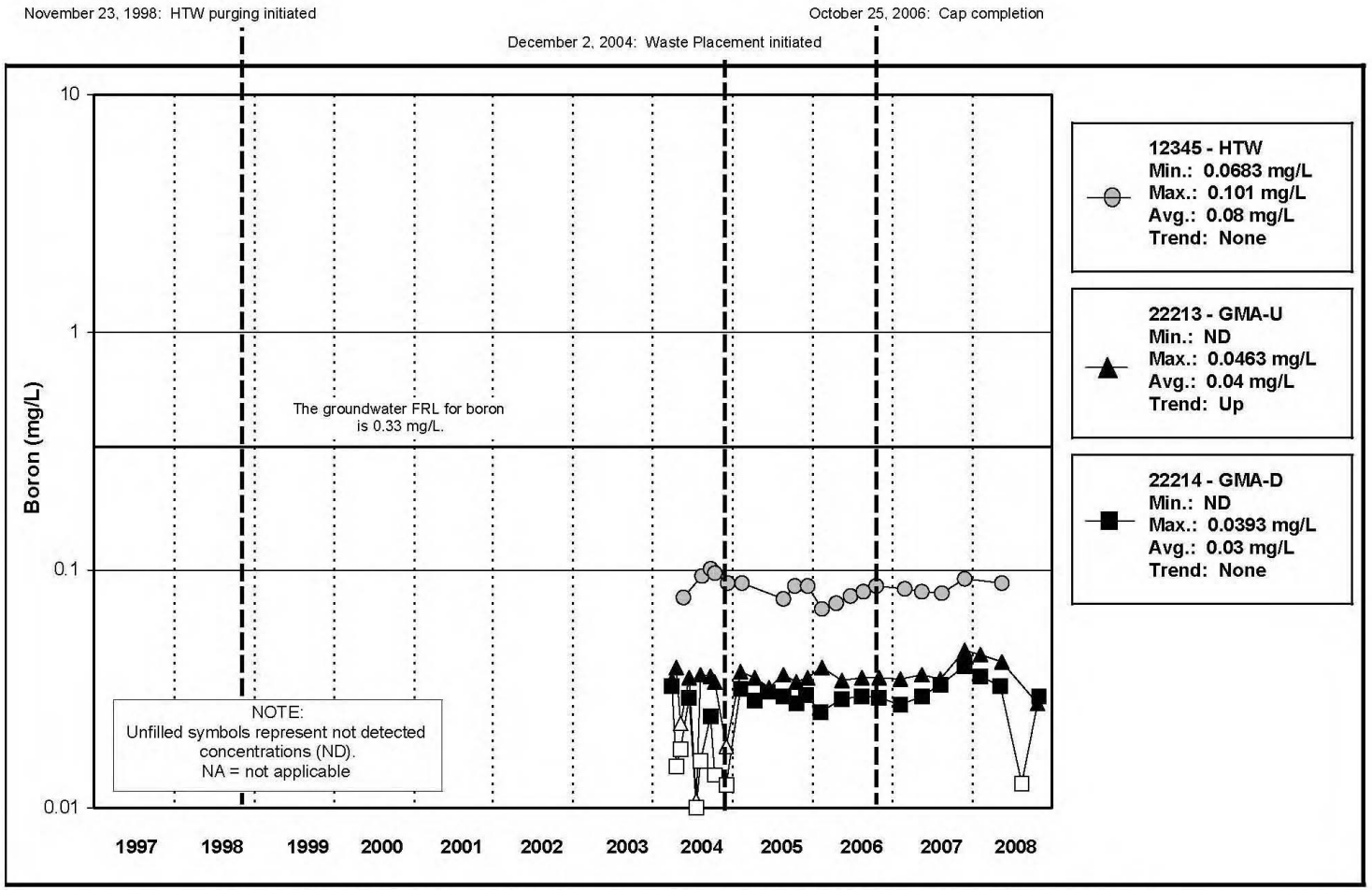

Figure A.5.8-7B. Cell 8 Boron Concentration vs. Time Plot for HTW, GMA-U Well, AND GMA-D Well

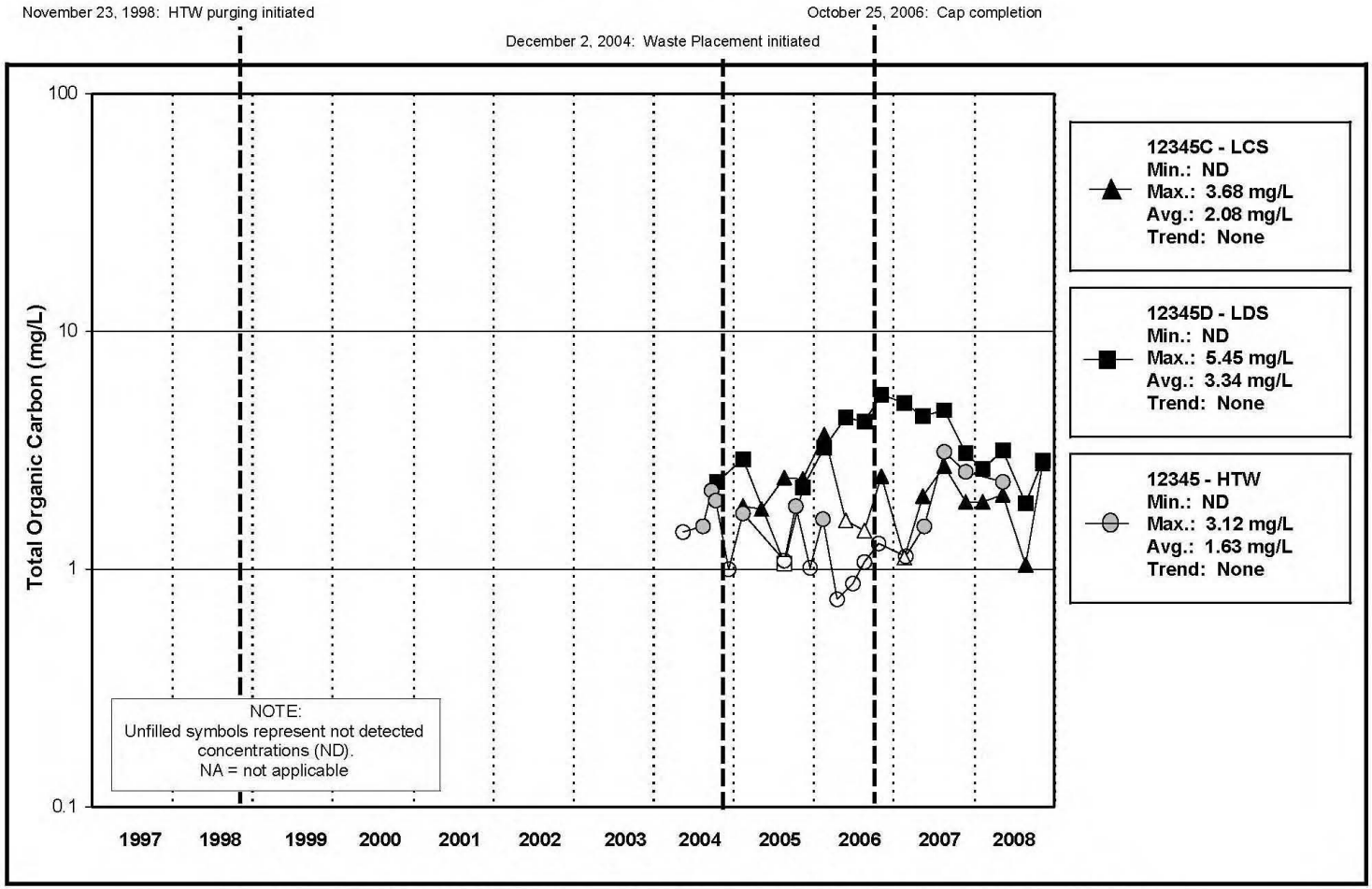

Figure A.5.8-8A. Cell 8 Total Organic Carbon Concentration vs. Time Plot for LCS, LDS, AND HTW

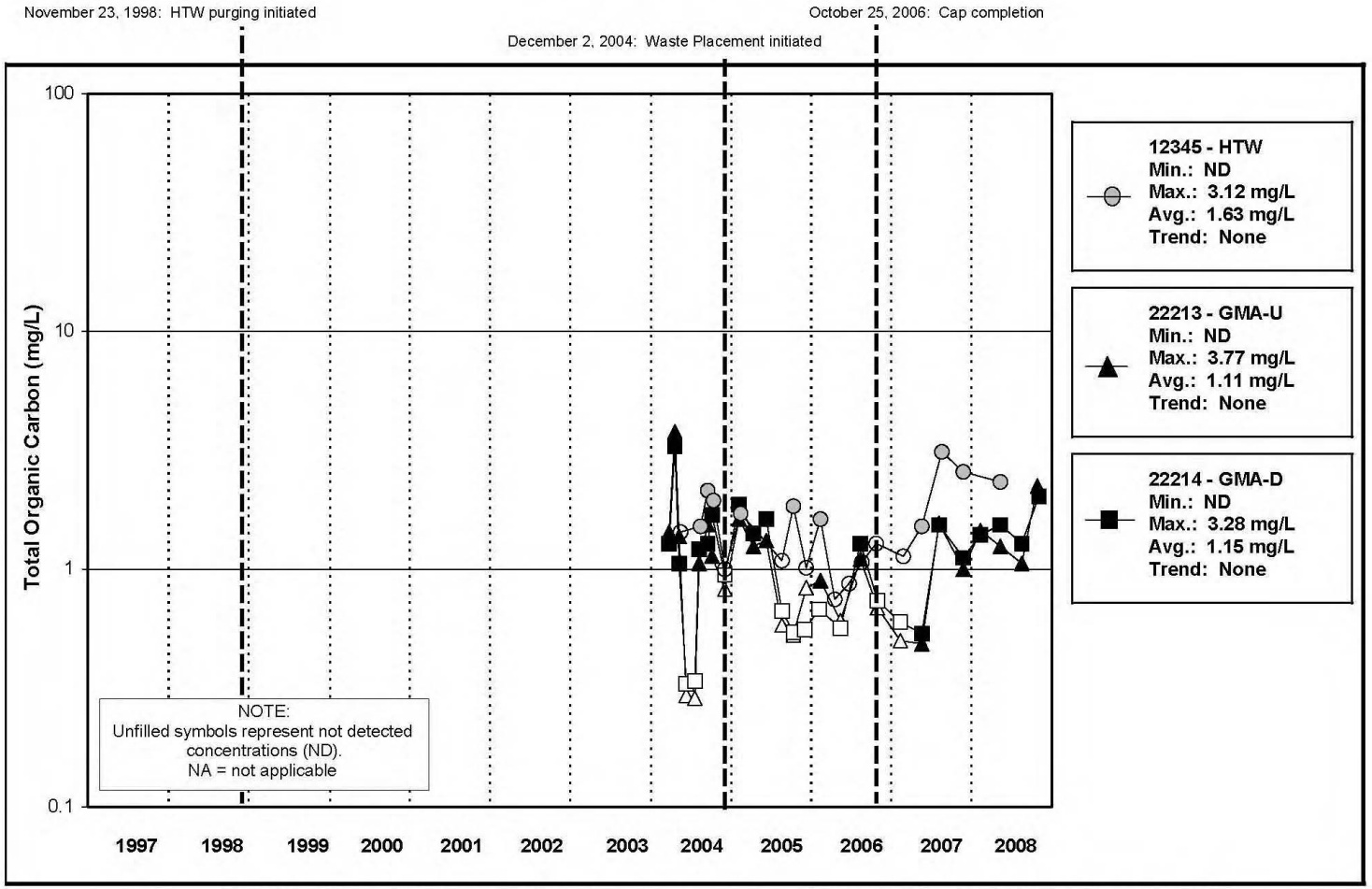

Figure A.5.8-8B. Cell 8 Total Organic Carbon Concentration vs. Time Plot for HTW, GMA-U Well, AND GMA-D Well

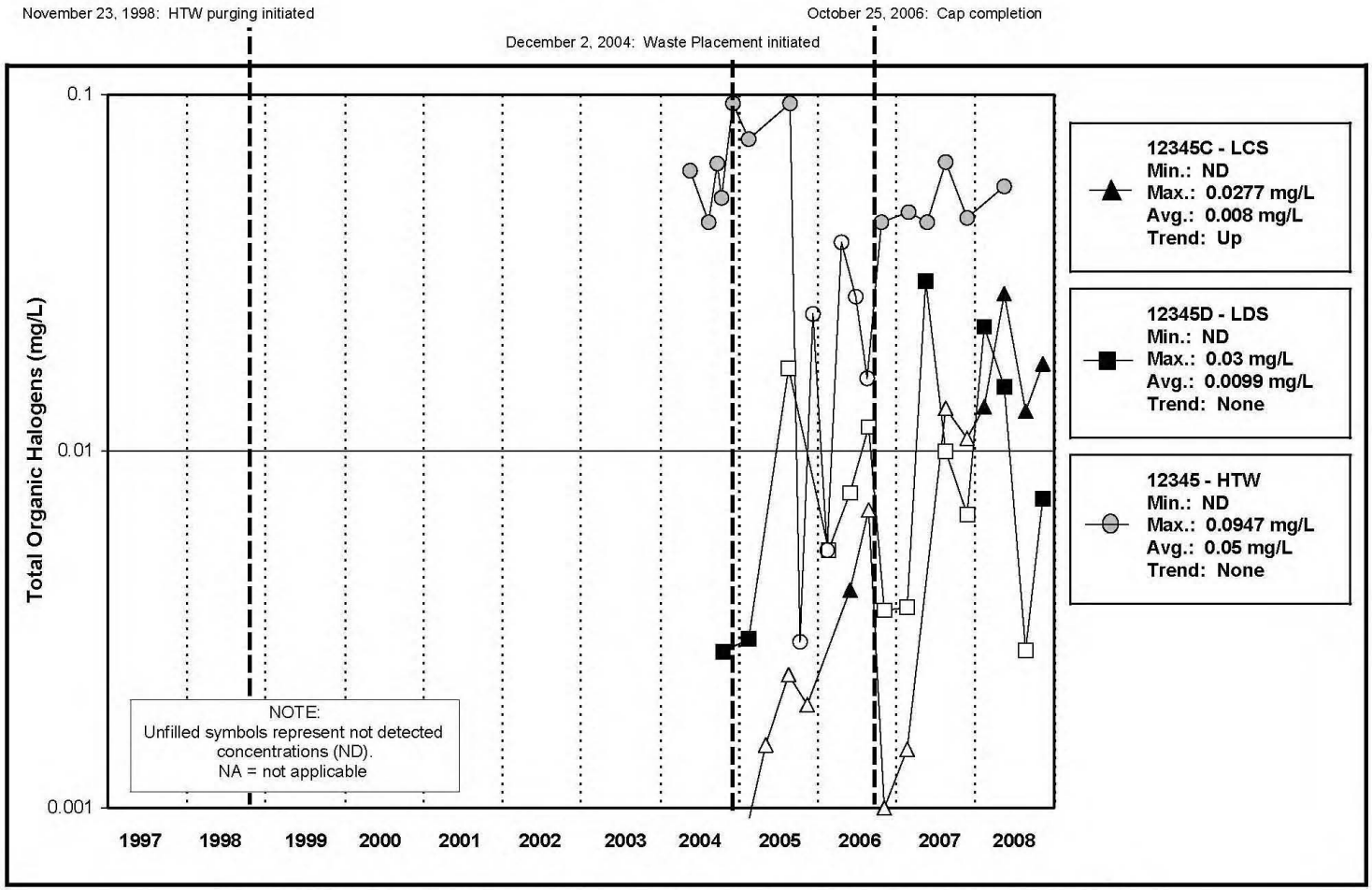

Figure A.5.8-9A. Cell 8 Total Organic Halogens Concentration vs. Time Plot for LCS, LDS, AND HTW

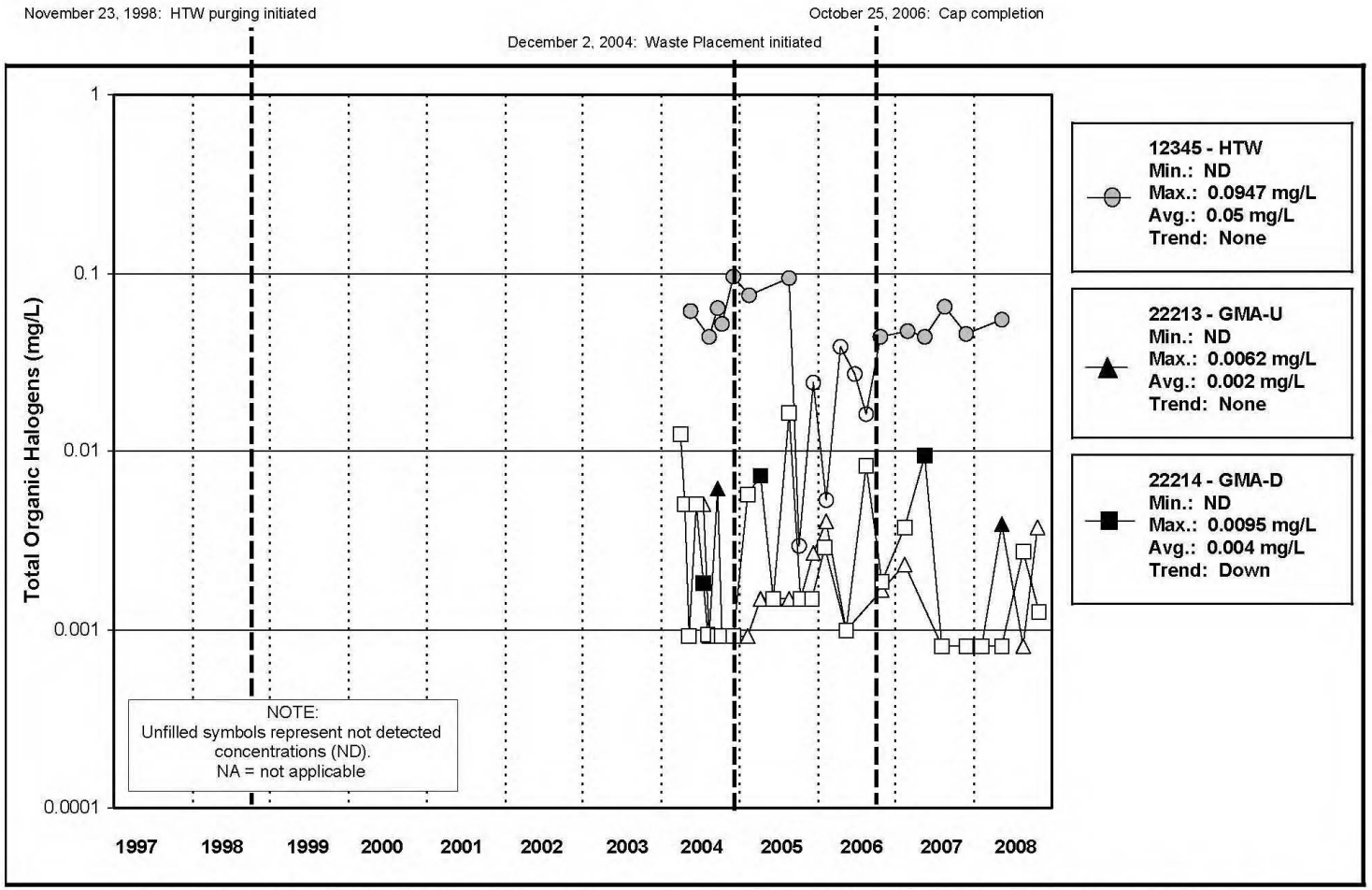

Figure A.5.8-9B. Cell 8 Total Organic Halogens Concentration vs. Time Plot for HTW, GMA-U Well, AND GMA-D Well

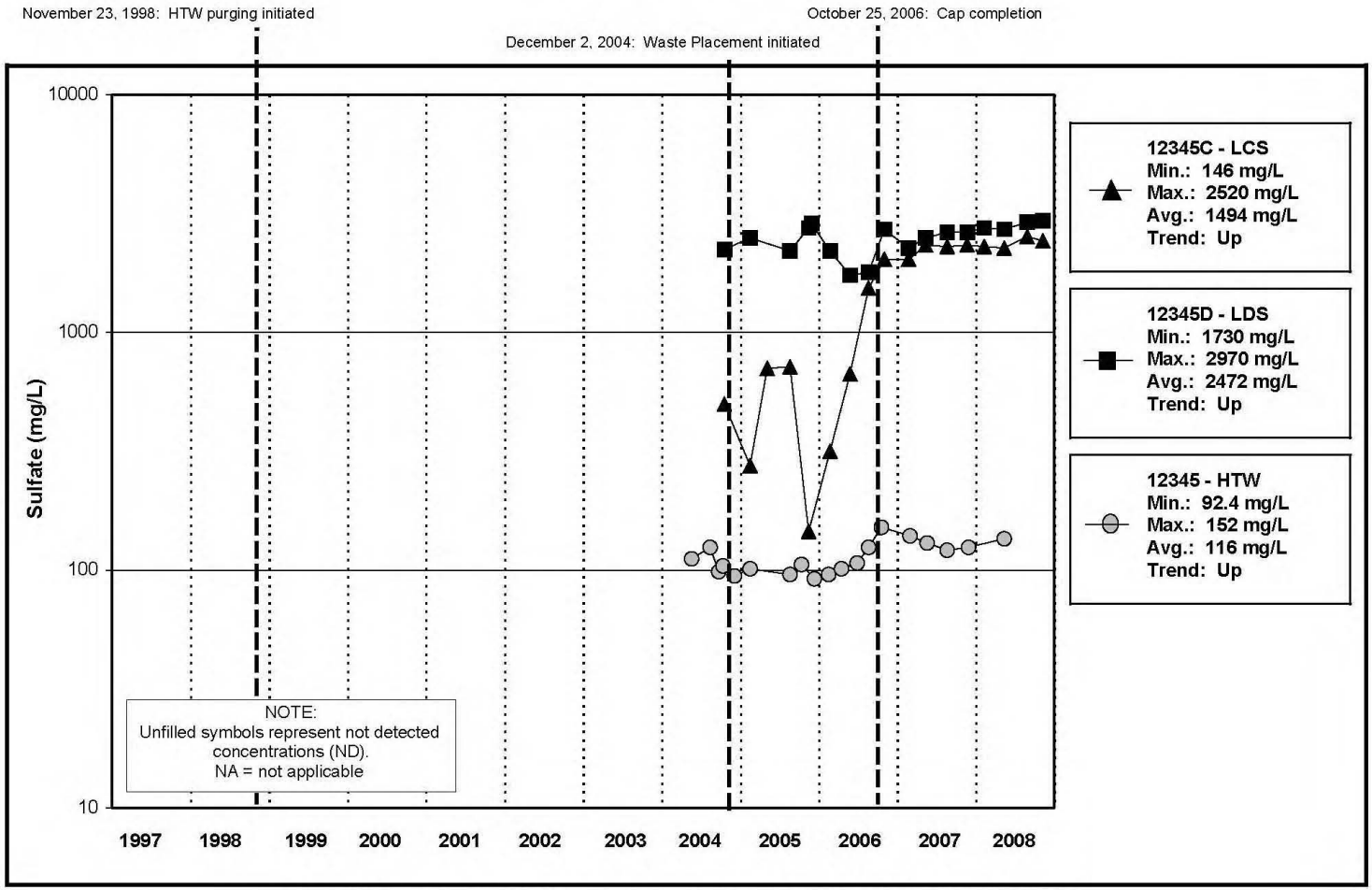

Figure A.5.8-10A. Cell 8 Sulfate Concentration vs. Time Plot for LCS, LDS, AND HTW

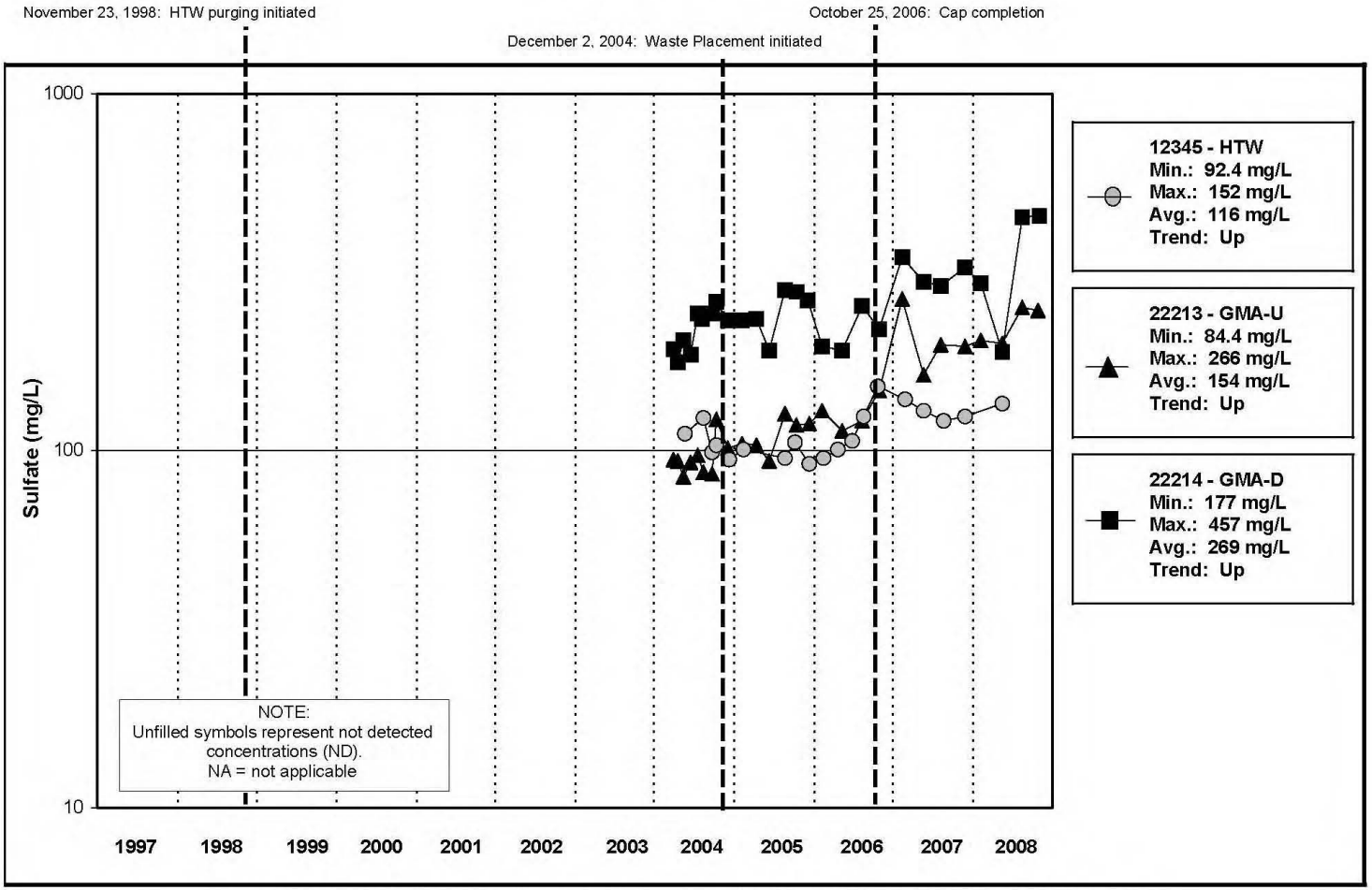

Figure A.5.8-10B. Cell 8 Sulfate Concentration vs. Time Plot for HTW, GMA-U Well, AND GMA-D Well

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