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Env. Document Type: Solid Waste Correspondence

July 19, 2005

Mr. David Fugate, P.G.
Geologist
Knoxville Environmental Field Office
Division of Solid Waste Management
Tennessee Department of Environment
and Conservation
2700 Middlebrook Pike, Suite 220
Knoxville, Tennessee 37921-5602

TENNESSEE VALLEY AUTHORITY – KINGSTON FOSSIL PLANT – ASH DISPOSAL AREA – IDL 73-0094 – JUNE 2005 GROUNDWATER MONITORING REPORT

Dear Mr. Fugate:

Please find enclosed the groundwater monitoring report for samples collected June 1, 2005 at designated compliance wells surrounding the subject facility. This represents the first compliance report following completion of two years of quarterly baseline monitoring.

Laboratory data from the analyses of groundwater samples collected during this monitoring event is summarized in Table 1. Analytical results indicate there were no primary MCL or statistical exceedences in any of the samples.

Other supporting information with this submittal includes:

- A description of groundwater conditions at the time of sampling including a potentiometric surface map based on water-level measurements made on June 1, 2005 in wells located in vicinity of the facility (Figure 1).
- Field Data Sheets (Appendix A).
- Sample custody record (Appendix B).
- Laboratory Data Sheets (Appendix C).
- Baseline Monitoring Data (Appendix D).
- Statistical Testing Methodology (Appendix E).

If you have questions regarding the report, please contact Amos Smith at (423) 751-3522 or Linda Campbell at (865) 717-2157.

I certify this information was prepared by a system designed to ensure qualified personnel properly gathered and evaluated the information submitted. The information submitted is to the best of my knowledge and belief true, accurate, and complete.

Gordon G. Park
Manager of Permitted Programs
Environmental Affairs
5D Lookout Place

ALS:SMF
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EDM, WT CA-K
Prepared by J. Mark Boggs, reviewed by Amos L. Smith

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Tennessee Valley Authority, 1101 Market Street, Chattanooga, Tennessee 37402-2801

July 19, 2005

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Knoxville Environmental Field Office
Division of Solid Waste Management
Tennessee Department of Environment
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Gordon G. Park
Manager of Permitted Programs
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5D Lookout Place

Enclosures

Tennessee Valley Authority
Kingston Fossil Plant
Ash Disposal Area (IDL 73-0094)

GROUNDWATER MONITORING REPORT
JUNE 2005 SAMPLING EVENT

Prepared by

J. Mark Boggs, PG (3671)

Tennessee Valley Authority
Knoxville, Tennessee

July 25, 2005

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INTRODUCTION

This report contains groundwater monitoring results for samples collected in June 2005 from the four designated compliance wells surrounding the Kingston Fossil Plant (KIF) ash disposal area. These data represent the first set of compliance monitoring data for the facility following two years of quarterly baseline monitoring. A summary of baseline monitoring data are provided in Appendix D along with an explanation of the statistical testing methodology applied to the compliance data (Appendix E). Groundwater samples were analyzed by the TVA Environmental Chemistry Laboratory, an EPA-certified laboratory. Sample collection and laboratory analyses were performed in accordance with Tennessee Department of Conservation and Environment (TDEC) Rule 1200-1-7-.04 and the facility groundwater monitoring plan approved by TDEC (August 1996).

GROUNDWATER SAMPLING

Groundwater sampling was performed on June 1 by S.A. Grindstaff and M.D. Williams at upgradient well 16A and downgradient wells 4B, 6A and 13B. A Grundfos Rediflow submersible pump was used for purging and sampling wells 13B and 16A, whereas wells 4B and 6A were purged until dry with the submersible pump and sampled with disposable bailers following recovery. Duplicate samples were collected from well 13B, and an equipment blank was collected between wells 4B and 6A. Field parameters (i.e., temperature, specific conductance, pH, dissolved oxygen, and oxidation-reduction potential) were monitored during well purging using a flow-through cell and calibrated instruments. Each well was considered properly evacuated when field parameters remained stable during purging a minimum of two well volumes or the well was purged to dryness. Field data sheets are included in Appendix A.

Please note that no samples of leachate were collected from the disposal facility. As described in the Facility Operations Manual, engineering measures incorporated in the facility design should result in minimal ash leachate production. Therefore, leachate sampling is not included in the approved groundwater monitoring plan.

Immediately following collection, samples were transferred to new sample bottles provided by the laboratory with appropriate preservatives, where applicable. The samples were then sealed, labeled, recorded on a custody form, and placed in an iced

cooler for transport. Samples were delivered to the TVA Environmental Chemistry Laboratory on June 2. A copy of the sample custody record is given in Appendix B.

ANALYTICAL RESULTS

Groundwater samples were analyzed for the 17 required inorganic constituents specified in Appendix I of TDEC Rule 1200-1-7. Laboratory results completed on June 23 are summarized in Table 1. The laboratory report presented in Appendix C includes analytical methods and detection limits for each constituent. Constituent concentrations reported for all samples were below drinking water maximum contaminant limits (MCL).

All analytical testing was performed within recommended sample holding times. There were no detections of the required 17 inorganic constituents in the equipment blank.

STATISTICAL EVALUATION

Statistical analysis of the sample analytical data was performed using non-parametric prediction intervals (NPI) applied on an intrawell basis. A description of the NPI method, the rationale for its selection, and specifics regarding application to the KIF facility groundwater detection monitoring program are presented in Appendix E. The analytical results presented in Table 1 indicate that none of the constituent concentrations for any of the groundwater samples exceed the upper prediction limits (UPL).

HYDROGEOLOGIC CONDITIONS

The Kingston plant site is located in the Valley and Ridge physiographic province of the Appalachian Highlands region. This region is characterized by a sequence of long narrow ridges and valleys trending northeast-southwest. In general, ridges are formed by relatively resistant sandstone, limestone, and dolomite units while the valleys are underlain by soluble limestone and easily weathered shale. The controlling structural feature of the site is a series of northeast-striking thrust faults which has forced older Cambrian and Ordovician rocks over younger units. Bedrock dips southeast at angles ranging from a few degrees to about 90 degrees.

The ash pond area is immediately underlain by Quaternary alluvium ranging in thickness from about 1.5 m along a portion of the northern perimeter of the site to maximum of

Table 1. June 2005 Groundwater Monitoring Results

Analytical Results for Appendix I Inorganic Constituents						Upper Prediction Limit (UPL)			MCL	Comparison to UPL[a]		
		Well No.				Well No.				Well No.		
Constituent	Units	4B downgradient	6A downgradient	13B[b] downgradient	16A upgradient	4B	6A	13B		4B	6A	13B
Antimony	µg/L	<3	4	<3	<3	6	6	6	6	L	L	L
Arsenic	µg/L	1	4	<1	1	10	14	10	50	L	L	L
Barium	µg/L	80	70	365	50	2000	2000	2000	2000	L	L	L
Beryllium	µg/L	<1	<1	<1	<1	4	4	4	4	L	L	L
Cadmium	µg/L	0.4	0.4	<0.1	<0.1	5	5	5	5	L	L	L
Chromium	µg/L	1	2	<1	<1	100	100	100	100	L	L	L
Cobalt	µg/L	10	17	1	<1	23	17	6	--	L	L	L
Copper	µg/L	<10	<10	<10	<10	1000	1000	1000	1000	L	L	L
Fluoride	µg/L	140	<100	190	460	4000	4000	4000	4000	L	L	L
Lead	µg/L	<1	<1	<1	<1	15	15	15	50	L	L	L
Mercury	µg/L	<0.1	<0.1	<0.1	<0.1	2	2	2	2	L	L	L
Nickel	µg/L	6	5	<2	<1	100	100	100	--	L	L	L
Selenium	µg/L	<1	<1	<1	<1	50	50	50	50	L	L	L
Silver	µg/L	<10	<10	<10	<10	100	190	100	100	L	L	L
Thallium	µg/L	<2	<2	<2	<2	2	2	2	2	L	L	L
Vanadium	µg/L	<10	70	<10	<10	10	150	10	--	L	L	L
Zinc	µg/L	50	<10	<10	<10	5000	5000	5000	5000	L	L	L

a - "L" = less than or equal to UPL, "G" = greater than UPL.

b - reported concentrations are averages of duplicate samples.

20 m on the western boundary. The alluvial deposits are unconsolidated and lenticular, and consist of clay, silt, and sand with occasional gravel. A thin layer of residuum is occasionally present directly above bedrock. The residuum is typically composed of clay and silt with weathered fissile shale fragments.

Bedrock beneath the alluvial deposits at the disposal site is primarily represented by the Conasauga Group (middle to upper Cambrian age). The only exception is a small area along the northern margin of the site underlain by the Rome formation (lower Cambrian age). Specific geologic units within the Conasauga Group represented at the site include the Nolichucky, Maryville, Rogersville, Rutledge, and Pumpkin Valley formations. These formations are locally of low water-producing capacity, and predominantly consist of shale with interbedded siltstone, limestone, and conglomerate. Total thickness of the Conasauga Group beneath the site is unknown but is estimated to be approximately 450 meters. The Rome formation is generally composed of interbedded shale, sandstone, and siltstone. The elevation of the top of rock in the ash pond area is relatively uniform, varying from approximately 213 to 218 m-MSL. Outside this area the bedrock surface rises steeply to the west and southwest. The lower bedrock terrace corresponding to the disposal area represents an erosion surface associated with the ancestral Emory River.

Groundwater movement at the site generally follows topography with groundwater flowing eastward and southeastward from Pine Ridge toward the reservoir. Groundwater originating on, or flowing beneath, the ash pond area ultimately discharges to the reservoir without traversing private property.

Groundwater levels measured in site monitoring wells on June 1 prior to sample collection are presented in Table 2. The groundwater potentiometric surface derived from these measurements is shown on Figure 1. Groundwater generally flows eastward across the ash disposal area toward the reservoir. An average hydraulic gradient of approximately 0.009 is estimated between the western and eastern boundaries of the disposal area. The shallow alluvial aquifer underlying the ash disposal area exhibits a mean horizontal hydraulic conductivity of 0.006 m/d. The local Darcy flux is therefore estimated to be approximately 5.4×10^{-5} m/d.

Table 2. Groundwater Levels Measured on June 1, 2004

Well No.	Top of Casing Elevation (m)	Depth to Water (m)	Water Elevation (m mls)	Well Bottom Depth (m)
4B	230.72	4.11	226.61	12.72
6A	230.13	3.46	226.67	8.88
13B	234.85	3.10	231.75	25.68
16A	234.26	1.23	233.03	20.16

CONCLUSIONS

Groundwater analytical data for the June 1, 2005 sampling event showed no evidence of groundwater contamination from the dry fly ash disposal area. Concentrations of the 17 Appendix I inorganic constituents were below MCLs in all samples. Furthermore, statistical analysis of sample data indicated no constituent concentrations above established upper prediction limits.

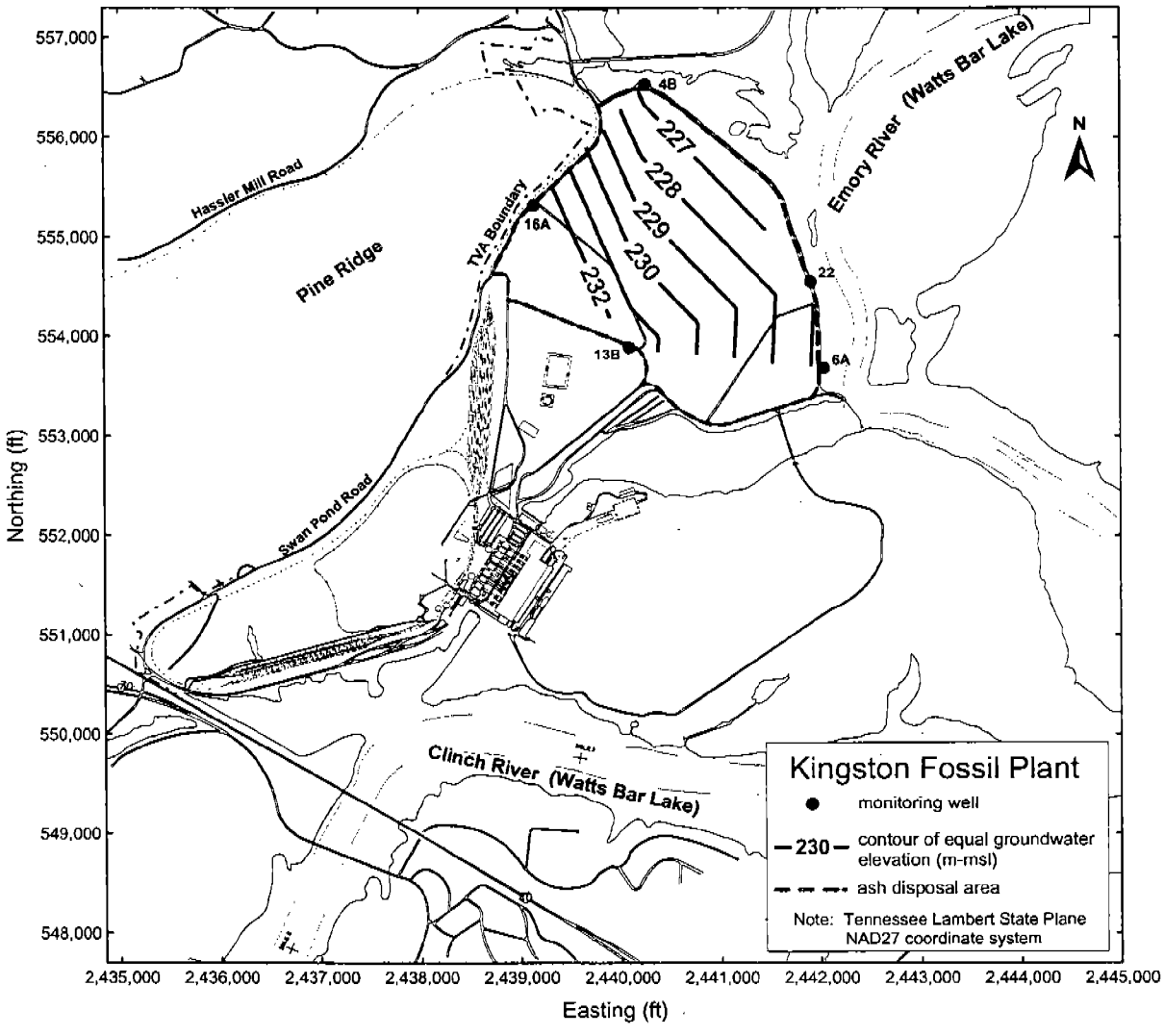

Figure 1. Groundwater Potentiometric Surface on June 1, 2004

APPENDIX A

FIELD DATA SHEETS

Preliminary Groundwater Data Field Worksheet

Sheet 1 of 1

Project/Site	Well Number	Purge Date	Year	Month	Day
KINGSTON	4B 84068		05	06	01

Depth to Water (m)	Bottom of Well (m)	Well Diameter (mm)	Survey Leader	Field Crew
4.11 4195	12.72 4194	102 4188	JES	SAC

☑ Depth of Screen ☐ Open Bore Hole

(m)	To	(m)	Sample Label	☑ Unfiltered ☐ Filtered ☐ Both
12.37 4191	To	12.82 4190	KIF-4B-060105	Filter Type and Size:

[Bottom of Well - Depth to Water] x Volume Factor = Well Volume | Target Purge Volume | Actual Purge Volume

[(12.72)m - (4.11)m] x (8.107)L/m = 69.8 (L) | 139.6 (L) | 85 (L) 4186

Purge Pump: ☐ Bladder ☐ Centrifugal ☐ Peristaltic ☐ Dedicated Other (list): Redi-flo

Sample Pump: ☐ Bladder ☐ Centrifugal ☐ Peristaltic ☐ Dedicated Other (list): Redi-flo

Notes and WQ Observations	Time ☑ET CT	Pump Rate (L/min)	Depth to Water (m)	Pump Depth (m)	Temp °C	pH (s.u.)	DO (mg/L)	COND (umhos/cm)	(+/-) ORP (mV)	Turbidity (NTU)
Begin Purge 145 ft →	0959	6.5	4.11	12.5	—					
	1000	—	—	12.5	15.9	6.4	1.5	1027	328	—
13	1001	6.5	5.87	12.5	15.7	6.4	1.5	1019	347	—
26	10:03	5.9	7.92	12.5	15.5	6.4	1.4	1011	339	—
38	1005	5.4	—	12.5	15.5	6.4	1.4	1006	323	—
49	1007	5.0	9.40	12.5	15.4	6.4	1.4	1000	319	—
54	1008	4.8	10.34	12.5	15.5	6.4	1.4	1000	320	—
63	1010	4.0	11.1	12.5	15.6	6.4	1.3	999	322	—
71	1012	3.0	11.87	12.5	15.7	6.4	1.3	994	315	—
77	1014		12.5	12.5	15.9	6.4	1.3	994	312	—
—	WAIT FOR RECHARGE —									
140ft	1050	4.1	9.0	12.5	—					
85	1052		9.70	12.5	16.6	6.4	0.7	944	275	—

Remarks: ______

Reviewed By: [signature] Survey Leader 06-02-05 Date [signature] Project Leader 6/2/05 Date

Sample Collector: JES/SAC

Sample Date Year	Month	Day	Time ☑ET CT
05	05	31	

Pump Duration 17 min 72004 "999" = 2 days

Sample Readings

Analysis Time ☑ET CT	Pump Rate (L/min) 4193	Depth to Water (m)	Pump Depth (m) 4192	Temp °C 10 EPA 170.1	pH (s.u.) 400 EPA 150.1	DO (mg/L) 300 EPA 360.1	COND (umhos/cm) 94 EPA 120.1	(+/-) ORP (mV) 90 SM 2580B	Turbidity (NTU) EPA 180.1
1052 ~~1050~~	4.1	9.7	12.5	16.6	6.4	0.7	944	275	—

Additional Sample Data

Analyst: JES

Date Analyzed: Year 05 Month 06 Day 01

	415 Phenol Alkalinity mg/L (EPA 310.1)	431 Total Alk. mg/L (EPA 310.1)	436 Mineral Acidity mg/L (EPA 305.1)	437 CO_2 Acidity mg/L (EPA 305.1)
Value	/	250	/	88
Time:	/	1105	/	1058
Initial:	/	JES	/	JES

Well Diameter (mm)		Vol. Factor (L/m)
12.7	(0.5 in)	0.127
51	(2 in)	2.027
76	(3 in)	4.560
102	(4 in)	8.107
127	(5 in)	12.668
153	(6 in)	18.228

Turbidity 1350 ☑ Clear ☐ Turbid ☐ Slightly Turbid ☐ Highly Turbid

Color: —

Odor: —

Bottles Required: ☐ BOD ☐ COD ☐ TOC ☑ TIC ☐ Ferrous ☑ Metals ☐ Dis. Metals ☑ Mineral ☐ Dis. Mineral ☑ Nutrient ☐ Phenol ☐ Filt TIC ☐ TSS/TDS Others (list): F

Distribution: (1) Original - Data Mgmt. (2) Pink - Survey Leader (3) Yellow - EDS Files

Preliminary Groundwater Data Field Worksheet

Sheet 1 of 1

Project/Site	Well Number	Purge Date	Year	Month	Day
KINGSTON	6A 84068		05	06	01

Depth to Water (m)	Bottom of Well (m)	Well Diameter (mm)	Survey Leader	Field Crew
3.46 4195	8.88 4194	102 4188	JES	SAG

☑ Depth of Screen ☐ Open Bore Hole

(m)	To	(m)	Sample Label	Filter Type and Size:
8.47 4191		8.92 4190	KIF-6A-060105	☑ Unfiltered ☐ Filtered ☐ Both

(Bottom of Well − Depth to Water)	x Volume Factor =	Well Volume (L)	Target Purge Volume (L)	Actual Purge Volume (L)
(8.88)m − (3.46)m	x (8.107)L/m =	43.9	87.9	44 4186

Purge Pump: ☐ Bladder ☐ Centrifugal ☐ Peristaltic ☐ Dedicated Other (list): Redi Flo

Sample Pump: ☐ Bladder ☐ Centrifugal ☐ Peristaltic ☐ Dedicated Other (list): BAILER

Notes and WO Observations	Time ET CT	Pump Rate (L/min)	Depth to Water (m)	Pump Depth (m)	Temp °C	pH (s.u.)	DO (mg/L)	COND (umhos/cm)	(+/-) ORP (mV)	Turbidity (NTU)
Begin Purge 150 Hz	09:12	7.5	3.46	8.6	—					—
15	0914	7.2	5.29	8.6	17.4	5.7	0.4	3797	158	—
29.4	0916	7.0	6.25	8.6	17.2	5.7	0.2	3771	124	—
44	0918	6.8	8.6	8.6	17.3	5.5	0.3	3099	176	—
	1156	Bailed	6.1	—	17.8	5.6	2.2	2909	205	—

Remarks: _____

Reviewed By: _____ Survey Leader 6-02-05 Date _____ Project Leader 6/2/05 Date

Sample Collector: JES/SAG			
Sample Date			Time
Year	Month	Day	
05	05	31	ET CT
Pump Duration	6		min
			72004

"9999" = 2 days

Sample Readings

1156	Bailed	6.1	Bailed	17.8	5.6	2.2	2909	205	—
Analysis Time ET CT	4193 Pump Rate (L/min)	Depth to Water (m)	4192 Pump Depth (m)	10 Temp °C EPA 170.1	400 pH (s.u.) EPA 150.1	300 DO (mg/L) EPA 360.1	94 COND (umhos/cm) EPA 120.1	90 (+/-) ORP (mV) SM 2580B	Turbidity (NTU) EPA 180.1

Additional Sample Data

Analyst: JES

Date Analyzed: Year 05 Month 06 Day 01

Turbidity 1350: ☑ Clear ☐ Turbid ☐ Slightly Turbid ☐ Highly Turbid

Color: —

Odor: —

415 Phenol Alkalinity mg/L (EPA 310.1)	431 Total Alk. mg/L (EPA 310.1)	436 Mineral Acidity mg/L (EPA 305.1)	437 CO_2 Acidity mg/L (EPA 305.1)
Time:	Time: 1207	Time:	Time: 1215
Initial:	Initial: JES	Initial:	Initial: JES

Bottles Required: ☐ Ferrous ☑ Mineral ☐ Phenol Others (list): F

☐ BOD ☐ TOC ☑ Metals ☐ Dis. Mineral ☐ Filt TIC

☐ COD ☑ TIC ☐ Dis. Metals ☑ Nutrient ☐ TSS/TDS

Well Diameter (mm)		Vol. Factor (L/m)
12.7	(0.5 in)	0.127
51	(2 in)	2.027
76	(3 in)	4.560
102	(4 in)	8.107
127	(5 in)	12.668
153	(6 in)	18.228

Distribution: (1) Original - Data Mgmt. (2) Pink - Survey Leader (3) Blue - Project Manager (4) Green - Customer (5) Yellow - ERS Files

TVA 9999A (9-1999)

Preliminary Groundwater Data Field Worksheet

Sheet ___ of ___

Project/Site	Well Number	Purge Date: Year	Month	Day
KINGSTON	13B 84068	05	06	01

Depth to Water (m)	Bottom of Well (m)	Well Diameter (mm)	Survey Leader	Field Crew
3.10 4195	25.68 4194	51 4188	JES	SAG

☑ Depth of Screen ☐ Open Bore Hole

(m)	To	(m)	Sample Label	Filter Type and Size:
22.29 4191	To	25.34 4190	KIF-13B-060105 KIF-13B-060105-Dup	☑ Unfiltered ☐ Filtered ☐ Both

(Bottom of Well − Depth to Water)	x Volume Factor =	Well Volume (L)	Target Purge Volume (L)	Actual Purge Volume (L)
(25.7)m − (3.10)m] x (2.027)L/m =		45.8	91.6	129 4186

Purge Pump: ☐ Bladder ☐ Centrifugal ☐ Peristaltic ☐ Dedicated Other (list): Redi Flo

Sample Pump: ☐ Bladder ☐ Centrifugal ☐ Peristaltic ☐ Dedicated Other (list): Redi Flo

Notes and WQ Observations	Time (ET) CT	Pump Rate (L/min)	Depth to Water (m)	Pump Depth (m)	Temp °C	pH (s.u.)	DO (mg/L)	COND (umhos/cm)	(+/-) ORP (mV)	Turbidity (NTU)
Begin Purge 150 HZ	1112	6.7	3.10	10.0						
20	1115	6.5	7.60	10.0	16.4	7.8	0.0	333	101	
52.5	1120	5.1	9.50	10.0	16.8	7.8	0.0	345	70	
78	1125	5.1	9.70	10.0	16.8	7.9	0.0	342	48	
103.5	1130	5.1	9.80	10.0	16.9	7.9	0.0	338	38	
129	1135		9.90	10.0	16.9	7.9	0.0	336	30	

Remarks: Duplicate Samples

Reviewed By: [signature] Survey Leader 06-02-05 Date [signature] Project Leader 6/2/05 Date

Sample Collector: JES/SAG

Sample Date			Time
Year	Month	Day	
05	06	01	(ET) CT

Pump Duration 22 min 72004

"9999" = 2 days

Sample Readings

1135	5.1	9.9 ~~10.0~~	10.0 ~~10.0~~	16.9	7.9	0.0	336	30	—
Analysis Time (ET) CT	4193 Pump Rate (L/min)	Depth to Water (m)	4192 Pump Depth (m)	10 Temp °C EPA 170.1	400 pH (s.u.) EPA 150.1	300 DO (mg/L) EPA 360.1	94 COND (umhos/cm) EPA 120.1	90 (+/-) ORP (mV) SM 2580B	Turbidity (NTU) EPA 180.1

Additional Sample Data

Analyst: JES/SAG

Date Analyzed: Year 05 Month 06 Day 01

Turbidity 1350: ☑ Clear ☐ Turbid ☐ Slightly Turbid ☐ Highly Turbid

Color: —

Odor: —

415	431	436	437
Phenol Alkalinity mg/L (EPA 310.1)	Total Alk. mg/L (EPA 310.1)	Mineral Acidity mg/L (EPA 305.1)	CO_2 Acidity mg/L (EPA 305.1)
Time:	Time: 1146 1148	Time:	Time: 1140 1142
Initial:	Initial: JES JES	Initial:	Initial: JES JES

195	194	4	4

Well Diameter (mm)		Vol. Factor (L/m)
12.7	(0.5 in)	0.127
51	(2 in)	2.027
76	(3 in)	4.560
102	(4 in)	8.107
127	(5 in)	12.668
153	(6 in)	18.228

Bottles Required: ☐ 800 ☐ TOC ☑ Metals ☐ Ferrous ☑ Mineral ☐ Dis. Mineral ☐ Phenol ☐ Filt TIC

☐ COD ☑ TIC ☐ Dis. Metals ☑ Nutrient ☐ TSS/TDS

Others (list): E

Distribution: (1) Original - Data Mgmt. (2) Pink - Survey Leader (3) Blue - Project Manager (4) Green - Customer (5) Yellow - ERS Files

TVA XXXXA (8-1999)

Preliminary Groundwater Data Field Worksheet

Sheet 1 of

Project/Site	Well Number	Purge Date Year	Month	Day
KINGSTON	16A (84058)	05	06	01

Depth to Water (m)	Bottom of Well (m)	Well Diameter (mm)	Survey Leader	Field Crew
1.23 (4195)	20.16 (4194)	51 (4188)	JES	SAG

☑ Depth of Screen ☐ Open Bore Hole

Depth of Screen (m)	To (m)	Sample Label	Filter
16.98 (4191)	20.03 (4190)	KIF-16A-060105	☑ Unfiltered ☐ Filtered ☐ Both; Filter Type and Size:

[Bottom of Well - Depth to Water] x Volume Factor =	Well Volume (L)	Target Purge Volume (L)	Actual Purge Volume (L)
[(20.16)m - (1.23)m] x (2.027)L/m=	38.4	76.8	83.2 (4188)

Purge Pump: ☐ Bladder ☐ Centrifugal ☐ Peristaltic ☐ Dedicated Other (list): Rediflo

Sample Pump: ☐ Bladder ☐ Centrifugal ☐ Peristaltic ☐ Dedicated Other (list): Rediflo

Notes and WQ Observations	Time (ET) CT	Pump Rate (L/min)	Depth to Water (m)	Pump Depth (m)	Temp °C	pH (s.u.)	DO (mg/L)	COND (umhos/cm)	(+/-) ORP (mV)	Turbidity (NTU)
Begin Purge 140 HZ →	1214	7.3	1.23	6	—	—	—	—	—	—
7.3	1215	7.3	3.0	6	16.2	7.0	0.2	300	179	—
43.8	1220	6.7	4.44	6	16.6	7.1	0.2	304	103	—
57.2	1222	6.5	5.0	6	16.7	7.1	0.3	308	100	—
70.2	1224	6.5	5.32	6	16.7	7.1	0.3	310	103	—
83.2	1226		5.86	6	16.7	7.1	0.2	311	106	—

Remarks:

Reviewed By: [illegible] (Survey Leader) 06-02-05 (Date) [illegible] (Project Leader) 6/2/05 (Date)

Sample Collector: JES/SAG

Sample Date Year	Month	Day	Time
05	06	01	(ET) CT

Pump Duration 12 min (72004) "999" = 2 days

Sample Readings

Analysis Time (ET) CT	Pump Rate (L/min) (4193)	Depth to Water (m)	Pump Depth (m) (4192)	Temp °C (10) EPA 170.1	pH (s.u.) (400) EPA 150.1	DO (mg/L) (300) EPA 360.1	COND (umhos/cm) (94) EPA 120.1	(+/-) ORP (mV) (90) SM 2580B	Turbidity (NTU) EPA 180.1
1226	6.5	5.86	6	16.7	7.1	0.2	311	106	—

Additional Sample Data

Analyst: JES/SAG

Date Analyzed: Year 05 Month 06 Day 01

415 Phenol Alkalinity mg/L (EPA 310.1)	431 Total Alk. mg/L (EPA 310.1)	436 Mineral Acidity mg/L (EPA 305.1)	437 CO_2 Acidity mg/L (EPA 305.1)
/	143	/	17
Time:	Time: 1230	Time:	Time: 1235
Initial:	Initial: JES	Initial:	Initial: JES

Well Diameter (mm)		Vol. Factor (L/m)
12.7	(0.5 in)	0.127
51	(2 in)	2.027
76	(3 in)	4.560
102	(4 in)	8.107
127	(5 in)	12.668
153	(6 in)	18.228

Turbidity 1350: ☑ Clear ☐ Turbid ☐ Slightly Turbid ☐ Highly Turbid

Color: —

Odor: —

Bottles Required: ☐ Ferrous ☑ Mineral ☐ Phenol Others (list): ☐ BOD ☐ TOC ☑ Metals ☐ Dis. Mineral ☐ Filt TIC ☐ COD ☑ TIC ☐ Dis. Metals ☑ Nutrient ☐ TSS/TDS

Distribution: (1) Original - Data Mgmt. (2) Pink - Survey Leader (3) Blue - Project Manager (4) Green - Customer (5) Yellow - ERS Files

TVA 10066A (0-1990)

APPENDIX B

SAMPLE CUSTODY RECORD

KIF
RCRA
100

TENNESSEE VALLEY AUTHORITY WATER MANAGEMENT
ENVIRONMENTAL CHEMISTRY ANALYSIS REQUEST AND CUSTODY RECORD

FORM CONTROL # 18124

PROJECT ID Kingston G. W.

REFERENCE: ☑ WORKPLAN ☐ OTHER

ACCT NO.

DATE REQUIRED 6-23-05

RESULTS TO Mark Boggs, WT 9C-K, 632-6941

LAB USE ONLY

TEST IDC'S DIGICP*ICPW2 *ICPW2 DIGHGA SEW ASW CDW CRW COW PBW NIW SEW TLW K W NAW DIGSVA HGW *TSS *TDS CLW FLW SO4W *TKNW TICW NO32NW NH3NW

Notes: *ICPW2 - Scratch Si, Sn, Ti "

DATE RECEIVED 6/2/05

DAYS DUE 6/20/05

PROJECT LEADER RA

LIF-05060054

NO. LABELS

LAB USE ONLY LAB ID	FIELD ID	SAMPLE DESCRIPTION	SAMPLE MATRIX	DATE/TIME COLLECTED		NO. OF BOTTLES	ADDITIONAL IDC'S
AF22033	KIF-4B-060105	Groundwater	H2O	6.1	1052	4	
22034	KIF-6A-060105	↓	↓	6.1	1156	4	
22035	KIF-13B-060105			6.1	1135	4	
22036	KIF-13B-060105-DUP			6.1	1135	4	
22037	KIF-16A-060105			6.1	1226	4	only!
22038	KIF-22-060105			6.1	0941	1	← NH3NW ~~NO32NW~~ TKNW
22039	KP-Equipment Blank-060105	Super Q thru equipment	↓	6.1	1056	4	

FIELD COMMENTS

ANALYSIS REQUESTED Per workplan: MIN, M, N, TIC / Well 22 - N only

JUN 2'05 13:54

SUBMITTED BY S. Grindstaff DATE/TIME 6.2.05 0931

LABORATORY COMMENTS

RECEIVED BY ________ DATE/TIME ________

DISTRIBUTION OF COPIES 1 - LABORATORY 2 - RETURN TO REQUESTOR 3 - RETAINED BY REQUESTOR

TVA 30468 (RG-WM 3-94)

PAGE 1 OF 1

7

TVA-00026891

APPENDIX C

LABORATORY DATA SHEETS

Data Report Number: 050623-155226
Report of Results: STANDARD

TENNESSEE VALLEY AUTHORITY
CENTRAL LABORATORIES SERVICES
1101 Market Street, PSC 1B-C
Chattanooga, Tennessee 37402-2801
Phone: (423) 876 - 4318 • Fax: (423) 876 - 4137

Shipping Address:
Chickamauga Power Service Center
North Side Chickamauga Reservation
Chattanooga, Tennessee 37415

Customer Address: MARK BOGGS
WT 9C-K
Phone: 632-6941
Fax : Not Available
E-Mail: EDM
Location Code: KIF
Field ID: KIF-4B-060105
Sample Description: GROUNDWATER

Sample ID: AF22033 **LRF ID:** 05060054
Matrix: Water **Reg:** RCRA
Date Collected: 06/01/2005
Time Collected: 10:52 EST
Date Received: 06/02/2005
Time Received: 13:54
Project Manager: Randall L. Howell

Analyte	CAS Number[1]	Result	Units	MDL[2]	Analysis Date	Analysis Time	Analyst	Method Reference
Aluminum, Total	7429-90-5	0.94	mg/L	0.05	06/07/2005	11:52	LMJ	EPA 6010B
Ammonia as N	7664-41-7	0.15	mg/L	0.01	06/09/2005	10:04	ADP	EPA 350.1
Antimony,Total	7440-36-0	< MDL	mg/L	0.003	06/07/2005	9:42	JBR	EPA 7041A
Arsenic, Total	7440-38-2	0.001	mg/L	0.001	06/06/2005	13:36	JBR	EPA 7060A
Barium, Total	7440-39-3	0.08	mg/L	0.01	06/07/2005	11:52	LMJ	EPA 6010B
Beryllium, Total	7440-41-7	< MDL	mg/L	0.001	06/07/2005	11:52	LMJ	EPA 6010B
Boron, Total	7440-42-8	< MDL	mg/L	0.2	06/07/2005	11:52	LMJ	EPA 6010B
Cadmium, Total	7440-43-9	0.0004	mg/L	0.0001	06/08/2005	13:53	JBR	EPA 7131A
Calcium, Total	7440-70-2	210	mg/L	0.1	06/07/2005	11:52	LMJ	EPA 6010B
Chloride, Total	16887-00-6	3.6	mg/L	1.	06/17/2005	16:18	GMP	EPA 325.2
Chromium, Total	7440-47-3	0.001	mg/L	0.001	06/08/2005	16:27	JBR	EPA 7191
Cobalt, Total	7440-48-4	0.010	mg/L	0.001	06/09/2005	8:07	JBR	EPA 7201
Copper, Total	7440-50-8	< MDL	mg/L	0.01	06/07/2005	11:52	LMJ	EPA 6010B
Filterable Residue		780.	mg/L	10.	06/06/2005	10:59	AJH	EPA 160.1
Fluoride, Total	16984-48-8	0.14	mg/L	0.1	06/07/2005	10:00	GMP	EPA 340.2
Inorganic Carbon, Total		92	mg/L	1.	06/14/2005	7:54	ADP	ASTM477988
Iron, Total	7439-89-6	2.8	mg/L	0.01	06/07/2005	11:52	LMJ	EPA 6010B
Lead , Total	7439-92-1	< MDL	mg/L	0.001	06/06/2005	11:08	JBR	EPA 7421
Magnesium, Total	7439-95-4	18	mg/L	0.01	06/07/2005	11:52	LMJ	EPA 6010B
Manganese, Total	7439-96-5	1.7	mg/L	0.005	06/07/2005	11:52	LMJ	EPA 6010B
Mercury, Total	7439-97-6	< MDL	mg/L	0.0001	06/17/2005	13:51	CLS	EPA 7470A
Molybdenum, Total	7439-98-7	< MDL	mg/L	0.02	06/07/2005	11:52	LMJ	EPA 6010B
Nickel, Total	7440-02-0	0.006	mg/L	0.001	06/08/2005	18:38	JBR	EPA 7521
Nitrate-Nitrite as N		0.11	mg/L	0.01	06/09/2005	10:04	ADP	EPA 353.2
Non-Filterable Residue		22.	mg/L	1.	06/03/2005	8:01	AJH	EPA 160.2
Potassium, Total	7440-09-7	5.8	mg/L	0.1	06/16/2005	10:14	JBR	EPA 7610
Selenium, Total	7782-49-2	< MDL	mg/L	0.001	06/06/2005	16:07	JBR	EPA 7740
Silver, Total	7440-22-4	< MDL	mg/L	0.01	06/07/2005	11:52	LMJ	EPA 6010B
Sodium, Total	7440-23-5	8.8	mg/L	0.1	06/10/2005	15:13	JBR	EPA 7770
Strontium, Total	7440-24-6	0.43	mg/L	0.05	06/07/2005	11:52	LMJ	EPA 6010B
Sulfate, Total	14808-79-8	355	mg/L	1.	06/20/2005	14:19	CLS	EPA 375.4
Thallium, Total	7440-28-0	< MDL	mg/L	0.002	06/08/2005	10:11	JBR	EPA 7841
Total Kjeldahl Nitrogen		0.42	mg/L	0.02	06/07/2005	13:52	GMP	EPA 351.2
Vanadium, Total	7440-62-2	< MDL	mg/L	0.01	06/07/2005	11:52	LMJ	EPA 6010B
Zinc, Total	7440-66-6	0.05	mg/L	0.01	06/07/2005	11:52	LMJ	EPA 6010B

[1] Chemical Abstracts Service Registry Number [2] Method Detection Limit

Data Report Number: 050623-155226
Report of Results: STANDARD

TENNESSEE VALLEY AUTHORITY
CENTRAL LABORATORIES SERVICES
1101 Market Street, PSC 1B-C
Chattanooga, Tennessee 37402-2801
Phone: (423) 876 - 4318 • Fax: (423) 876 - 4137

Shipping Address:
Chickamauga Power Service Center
North Side Chickamauga Reservation
Chattanooga, Tennessee 37415

Customer Address: MARK BOGGS
WT 9C-K
Phone: 632-6941
Fax : Not Available
E-Mail: EDM
Location Code: KIF
Field ID: KIF-4B-060105
Sample Description: GROUNDWATER

Sample ID: AF22033
Matrix: Water
Date Collected: 06/01/2005
Time Collected: 10:52 EST
Date Received: 06/02/2005
Time Received: 13:54
Project Manager: Randall L. Howell

LRF ID: 05060054
Reg: RCRA

Analyte	CAS Number[1]	Result	Units	MDL[2]	Analysis Date	Analysis Time	Analyst	Method Reference

Sample Comments: Sulfate analyzed by EPA Method 300.1 (Ion Chromatography).

[1] Chemical Abstracts Service Registry Number [2] Method Detection Limit

Data Report Number: 050623-155226
Report of Results: STANDARD

TENNESSEE VALLEY AUTHORITY
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Shipping Address:
Chickamauga Power Service Center
North Side Chickamauga Reservation
Chattanooga, Tennessee 37415

Customer Address: MARK BOGGS
WT 9C-K
Phone: 632-6941
Fax : Not Available
E-Mail: EDM
Location Code: KIF
Field ID: KIF-6A-060105
Sample Description: GROUNDWATER

Sample ID: AF22034 **LRF ID:** 05060054
Matrix: Water **Reg:** RCRA
Date Collected: 06/01/2005
Time Collected: 11:56 EST
Date Received: 06/02/2005
Time Received: 13:54
Project Manager: Randall L. Howell

Analyte	CAS Number[1]	Result	Units	MDL[2]	Analysis Date	Analysis Time	Analyst	Method Reference
Aluminum, Total	7429-90-5	< MDL	mg/L	0.05	06/07/2005	11:56	LMJ	EPA 6010B
Ammonia as N	7664-41-7	19.	mg/L	0.01	06/09/2005	11:25	ADP	EPA 350.1
Antimony,Total	7440-36-0	0.004	mg/L	0.003	06/07/2005	9:47	JBR	EPA 7041A
Arsenic, Total	7440-38-2	0.004	mg/L	0.001	06/06/2005	13:41	JBR	EPA 7060A
Barium, Total	7440-39-3	0.07	mg/L	0.01	06/07/2005	11:56	LMJ	EPA 6010B
Beryllium, Total	7440-41-7	< MDL	mg/L	0.001	06/07/2005	11:56	LMJ	EPA 6010B
Boron, Total	7440-42-8	0.2	mg/L	0.2	06/07/2005	11:56	LMJ	EPA 6010B
Cadmium, Total	7440-43-9	0.0004	mg/L	0.0001	06/08/2005	13:59	JBR	EPA 7131A
Calcium, Total	7440-70-2	200	mg/L	0.1	06/07/2005	11:56	LMJ	EPA 6010B
Chloride, Total	16887-00-6	10	mg/L	1.	06/17/2005	16:18	GMP	EPA 325.2
Chromium, Total	7440-47-3	0.002	mg/L	0.001	06/08/2005	16:39	JBR	EPA 7191
Cobalt, Total	7440-48-4	0.017	mg/L	0.001	06/09/2005	8:13	JBR	EPA 7201
Copper, Total	7440-50-8	< MDL	mg/L	0.01	06/07/2005	11:56	LMJ	EPA 6010B
Filterable Residue		3900.	mg/L	10.	06/06/2005	11:00	AJH	EPA 160.1
Fluoride, Total	16984-48-8	< MDL	mg/L	0.1	06/07/2005	10:00	GMP	EPA 340.2
Inorganic Carbon, Total		91	mg/L	1.	06/14/2005	8:01	ADP	ASTM477988
Iron, Total	7439-89-6	740	mg/L	0.01	06/07/2005	11:56	LMJ	EPA 6010B
Lead , Total	7439-92-1	< MDL	mg/L	0.001	06/06/2005	11:14	JBR	EPA 7421
Magnesium, Total	7439-95-4	66	mg/L	0.01	06/07/2005	11:56	LMJ	EPA 6010B
Manganese, Total	7439-96-5	140	mg/L	0.005	06/07/2005	11:56	LMJ	EPA 6010B
Mercury, Total	7439-97-6	< MDL	mg/L	0.0001	06/17/2005	13:53	CLS	EPA 7470A
Molybdenum, Total	7439-98-7	< MDL	mg/L	0.02	06/07/2005	11:56	LMJ	EPA 6010B
Nickel, Total	7440-02-0	0.005	mg/L	0.001	06/08/2005	18:44	JBR	EPA 7521
Nitrate-Nitrite as N		0.02	mg/L	0.01	06/09/2005	10:04	ADP	EPA 353.2
Non-Filterable Residue		57.	mg/L	1.	06/03/2005	8:01	AJH	EPA 160.2
Potassium, Total	7440-09-7	9.3	mg/L	0.1	06/16/2005	10:15	JBR	EPA 7610
Selenium, Total	7782-49-2	< MDL	mg/L	0.001	06/06/2005	16:13	JBR	EPA 7740
Silver, Total	7440-22-4	< MDL	mg/L	0.01	06/07/2005	11:56	LMJ	EPA 6010B
Sodium, Total	7440-23-5	11	mg/L	0.1	06/10/2005	15:14	JBR	EPA 7770
Strontium, Total	7440-24-6	0.63	mg/L	0.05	06/07/2005	11:56	LMJ	EPA 6010B
Sulfate, Total	14808-79-8	2350	mg/L	1.	06/20/2005	14:48	CLS	EPA 375.4
Thallium, Total	7440-28-0	< MDL	mg/L	0.002	06/08/2005	10:17	JBR	EPA 7841
Total Kjeldahl Nitrogen		17	mg/L	0.02	06/22/2005	9:27	GMP	EPA 351.2
Vanadium, Total	7440-62-2	0.07	mg/L	0.01	06/07/2005	11:56	LMJ	EPA 6010B
Zinc, Total	7440-66-6	< MDL	mg/L	0.01	06/07/2005	11:56	LMJ	EPA 6010B

[1] Chemical Abstracts Service Registry Number [2] Method Detection Limit

Data Report Number: 050623-155226
Report of Results: STANDARD

TENNESSEE VALLEY AUTHORITY
CENTRAL LABORATORIES SERVICES
1101 Market Street, PSC 1B-C
Chattanooga, Tennessee 37402-2801
Phone: (423) 876 - 4318 Fax: (423) 876 - 4137

Shipping Address:
Chickamauga Power Service Center
North Side Chickamauga Reservation
Chattanooga, Tennessee 37415

Customer Address: MARK BOGGS
WT 9C-K
Phone: 632-6941
Fax : Not Available
E-Mail: EDM
Location Code: KIF
Field ID: KIF-6A-060105
Sample Description: GROUNDWATER

Sample ID: AF22034 **LRF ID:** 05060054
Matrix: Water **Reg:** RCRA
Date Collected: 06/01/2005
Time Collected: 11:56 EST
Date Received: 06/02/2005
Time Received: 13:54
Project Manager: Randall L. Howell

Analyte	CAS Number[1]	Result	Units	MDL[2]	Analysis Date	Analysis Time	Analyst	Method Reference

Sample Comments: Sulfate analyzed by EPA Method 300.1 (Ion Chromatography).

[1] Chemical Abstracts Service Registry Number [2] Method Detection Limit

Data Report Number: 050623-155226
Report of Results: STANDARD

TENNESSEE VALLEY AUTHORITY
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Shipping Address:
Chickamauga Power Service Center
North Side Chickamauga Reservation
Chattanooga, Tennessee 37415

Customer Address: MARK BOGGS
WT 9C-K
Phone: 632-6941
Fax : Not Available
E-Mail: EDM
Location Code: KIF
Field ID: KIF-13B-060105
Sample Description: GROUNDWATER

Sample ID: AF22035 **LRF ID:** 05060054
Matrix: Water **Reg:** RCRA
Date Collected: 06/01/2005
Time Collected: 11:35 EST
Date Received: 06/02/2005
Time Received: 13:54
Project Manager: Randall L. Howell

Analyte	CAS Number[1]	Result	Units	MDL[2]	Analysis Date	Analysis Time	Analyst	Method Reference
Aluminum, Total	7429-90-5	< MDL	mg/L	0.05	06/07/2005	12:01	LMJ	EPA 6010B
Ammonia as N	7664-41-7	0.14	mg/L	0.01	06/09/2005	11:25	ADP	EPA 350.1
Antimony,Total	7440-36-0	< MDL	mg/L	0.003	06/07/2005	9:53	JBR	EPA 7041A
Arsenic, Total	7440-38-2	< MDL	mg/L	0.001	06/06/2005	13:47	JBR	EPA 7060A
Barium, Total	7440-39-3	0.36	mg/L	0.01	06/07/2005	12:01	LMJ	EPA 6010B
Beryllium, Total	7440-41-7	< MDL	mg/L	0.001	06/07/2005	12:01	LMJ	EPA 6010B
Boron, Total	7440-42-8	< MDL	mg/L	0.2	06/07/2005	12:01	LMJ	EPA 6010B
Cadmium, Total	7440-43-9	< MDL	mg/L	0.0001	06/08/2005	14:04	JBR	EPA 7131A
Calcium, Total	7440-70-2	14	mg/L	0.1	06/07/2005	12:01	LMJ	EPA 6010B
Chloride, Total	16887-00-6	2.8	mg/L	1.	06/17/2005	16:18	GMP	EPA 325.2
Chromium, Total	7440-47-3	< MDL	mg/L	0.001	06/08/2005	16:46	JBR	EPA 7191
Cobalt, Total	7440-48-4	0.001	mg/L	0.001	06/09/2005	8:18	JBR	EPA 7201
Copper, Total	7440-50-8	< MDL	mg/L	0.01	06/07/2005	12:01	LMJ	EPA 6010B
Filterable Residue		240.	mg/L	10.	06/06/2005	11:00	AJH	EPA 160.1
Fluoride, Total	16984-48-8	0.19	mg/L	0.1	06/07/2005	10:00	GMP	EPA 340.2
Inorganic Carbon, Total		51	mg/L	1.	06/14/2005	8:07	ADP	ASTM477988
Iron, Total	7439-89-6	0.06	mg/L	0.01	06/07/2005	12:01	LMJ	EPA 6010B
Lead , Total	7439-92-1	< MDL	mg/L	0.001	06/06/2005	11:19	JBR	EPA 7421
Magnesium, Total	7439-95-4	1.9	mg/L	0.01	06/07/2005	12:01	LMJ	EPA 6010B
Manganese, Total	7439-96-5	0.069	mg/L	0.005	06/07/2005	12:01	LMJ	EPA 6010B
Mercury, Total	7439-97-6	< MDL	mg/L	0.0001	06/17/2005	13:55	CLS	EPA 7470A
Molybdenum, Total	7439-98-7	< MDL	mg/L	0.02	06/07/2005	12:01	LMJ	EPA 6010B
Nickel, Total	7440-02-0	< MDL	mg/L	0.001	06/08/2005	18:49	JBR	EPA 7521
Nitrate-Nitrite as N		< MDL	mg/L	0.01	06/09/2005	11:25	ADP	EPA 353.2
Non-Filterable Residue		< MDL	mg/L	1.	06/03/2005	8:01	AJH	EPA 160.2
Potassium, Total	7440-09-7	2.5	mg/L	0.1	06/16/2005	10:17	JBR	EPA 7610
Selenium, Total	7782-49-2	< MDL	mg/L	0.001	06/06/2005	16:18	JBR	EPA 7740
Silver, Total	7440-22-4	< MDL	mg/L	0.01	06/07/2005	12:01	LMJ	EPA 6010B
Sodium, Total	7440-23-5	74	mg/L	0.1	06/10/2005	15:15	JBR	EPA 7770
Strontium, Total	7440-24-6	0.29	mg/L	0.05	06/07/2005	12:01	LMJ	EPA 6010B
Sulfate, Total	14808-79-8	2	mg/L	1.	06/20/2005	15:44	CLS	EPA 375.4
Thallium, Total	7440-28-0	< MDL	mg/L	0.002	06/08/2005	10:22	JBR	EPA 7841
Total Kjeldahl Nitrogen		0.20	mg/L	0.02	06/07/2005	13:52	GMP	EPA 351.2
Vanadium, Total	7440-62-2	< MDL	mg/L	0.01	06/07/2005	12:01	LMJ	EPA 6010B
Zinc, Total	7440-66-6	< MDL	mg/L	0.01	06/07/2005	12:01	LMJ	EPA 6010B

[1] Chemical Abstracts Service Registry Number [2] Method Detection Limit

Data Report Number: 050623-155226
Report of Results: STANDARD

TENNESSEE VALLEY AUTHORITY
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Chattanooga, Tennessee 37402-2801
Phone: (423) 876 - 4318 • Fax: (423) 876 - 4137

Shipping Address:
Chickamauga Power Service Center
North Side Chickamauga Reservation
Chattanooga, Tennessee 37415

Customer Address: MARK BOGGS
WT 9C-K
Phone: 632-6941
Fax : Not Available
E-Mail: EDM
Location Code: KIF
Field ID: KIF-13B-060105
Sample Description: GROUNDWATER

Sample ID: AF22035 **LRF ID:** 05060054
Matrix: Water **Reg:** RCRA
Date Collected: 06/01/2005
Time Collected: 11:35 EST
Date Received: 06/02/2005
Time Received: 13:54
Project Manager: Randall L. Howell

Analyte	CAS Number[1]	Result	Units	MDL[2]	Analysis Date	Analysis Time	Analyst	Method Reference

Sample Comments: Sulfate analyzed by EPA Method 300.1 (Ion Chromatography).

[1] Chemical Abstracts Service Registry Number [2] Method Detection Limit

Data Report Number: 050623-155226
Report of Results: STANDARD

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Customer Address: MARK BOGGS
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Phone: 632-6941
Fax : Not Available
E-Mail: EDM
Location Code: KIF
Field ID: KIF-13B-060105-DUP
Sample Description: GROUNDWATER

Sample ID: AF22036 **LRF ID:** 05060054
Matrix: Water **Reg:** RCRA
Date Collected: 06/01/2005
Time Collected: 11:35 EST
Date Received: 06/02/2005
Time Received: 13:54
Project Manager: Randall L. Howell

Analyte	CAS Number[1]	Result	Units	MDL[2]	Analysis Date	Analysis Time	Analyst	Method Reference
Aluminum, Total	7429-90-5	< MDL	mg/L	0.05	06/07/2005	12:05	LMJ	EPA 6010B
Ammonia as N	7664-41-7	0.12	mg/L	0.01	06/09/2005	10:04	ADP	EPA 350.1
Antimony,Total	7440-36-0	< MDL	mg/L	0.003	06/07/2005	9:58	JBR	EPA 7041A
Arsenic, Total	7440-38-2	< MDL	mg/L	0.001	06/06/2005	13:52	JBR	EPA 7060A
Barium, Total	7440-39-3	0.37	mg/L	0.01	06/07/2005	12:05	LMJ	EPA 6010B
Beryllium, Total	7440-41-7	< MDL	mg/L	0.001	06/07/2005	12:05	LMJ	EPA 6010B
Boron, Total	7440-42-8	< MDL	mg/L	0.2	06/07/2005	12:05	LMJ	EPA 6010B
Cadmium, Total	7440-43-9	< MDL	mg/L	0.0001	06/08/2005	14:09	JBR	EPA 7131A
Calcium, Total	7440-70-2	15	mg/L	0.1	06/07/2005	12:05	LMJ	EPA 6010B
Chloride, Total	16887-00-6	2.8	mg/L	1.	06/17/2005	16:18	GMP	EPA 325.2
Chromium, Total	7440-47-3	< MDL	mg/L	0.001	06/08/2005	16:52	JBR	EPA 7191
Cobalt, Total	7440-48-4	0.001	mg/L	0.001	06/09/2005	8:23	JBR	EPA 7201
Copper, Total	7440-50-8	< MDL	mg/L	0.01	06/07/2005	12:05	LMJ	EPA 6010B
Filterable Residue		240.	mg/L	10.	06/06/2005	11:00	AJH	EPA 160.1
Fluoride, Total	16984-48-8	0.19	mg/L	0.1	06/07/2005	10:00	GMP	EPA 340.2
Inorganic Carbon, Total		50	mg/L	1.	06/14/2005	8:13	ADP	ASTM477988
Iron, Total	7439-89-6	0.06	mg/L	0.01	06/07/2005	12:05	LMJ	EPA 6010B
Lead , Total	7439-92-1	< MDL	mg/L	0.001	06/06/2005	11:24	JBR	EPA 7421
Magnesium, Total	7439-95-4	2.0	mg/L	0.01	06/07/2005	12:05	LMJ	EPA 6010B
Manganese, Total	7439-96-5	0.073	mg/L	0.005	06/07/2005	12:05	LMJ	EPA 6010B
Mercury, Total	7439-97-6	< MDL	mg/L	0.0001	06/17/2005	13:57	CLS	EPA 7470A
Molybdenum, Total	7439-98-7	< MDL	mg/L	0.02	06/07/2005	12:05	LMJ	EPA 6010B
Nickel, Total	7440-02-0	0.003	mg/L	0.001	06/08/2005	18:55	JBR	EPA 7521
Nitrate-Nitrite as N		< MDL	mg/L	0.01	06/09/2005	10:04	ADP	EPA 353.2
Non-Filterable Residue		< MDL	mg/L	1.	06/03/2005	8:01	AJH	EPA 160.2
Potassium, Total	7440-09-7	2.0	mg/L	0.1	06/16/2005	10:18	JBR	EPA 7610
Selenium, Total	7782-49-2	< MDL	mg/L	0.001	06/06/2005	16:24	JBR	EPA 7740
Silver, Total	7440-22-4	< MDL	mg/L	0.01	06/07/2005	12:05	LMJ	EPA 6010B
Sodium, Total	7440-23-5	73	mg/L	0.1	06/10/2005	15:17	JBR	EPA 7770
Strontium, Total	7440-24-6	0.30	mg/L	0.05	06/07/2005	12:05	LMJ	EPA 6010B
Sulfate, Total	14808-79-8	2	mg/L	1.	06/20/2005	16:18	CLS	EPA 375.4
Thallium, Total	7440-28-0	< MDL	mg/L	0.002	06/08/2005	10:28	JBR	EPA 7841
Total Kjeldahl Nitrogen		0.18	mg/L	0.02	06/07/2005	13:52	GMP	EPA 351.2
Vanadium, Total	7440-62-2	< MDL	mg/L	0.01	06/07/2005	12:05	LMJ	EPA 6010B
Zinc, Total	7440-66-6	< MDL	mg/L	0.01	06/07/2005	12:05	LMJ	EPA 6010B

[1] Chemical Abstracts Service Registry Number [2] Method Detection Limit

Data Report Number: 050623-155226
Report of Results: STANDARD

TENNESSEE VALLEY AUTHORITY
CENTRAL LABORATORIES SERVICES
1101 Market Street, PSC 1B-C
Chattanooga, Tennessee 37402-2801
Phone: (423) 876 - 4318 • Fax: (423) 876 - 4137

Shipping Address:
Chickamauga Power Service Center
North Side Chickamauga Reservation
Chattanooga, Tennessee 37415

Customer Address: MARK BOGGS
WT 9C-K
Phone: 632-6941
Fax : Not Available
E-Mail: EDM
Location Code: KIF
Field ID: KIF-13B-060105-DUP
Sample Description: GROUNDWATER

Sample ID: AF22036 **LRF ID:** 05060054
Matrix: Water **Reg:** RCRA
Date Collected: 06/01/2005
Time Collected: 11:35 EST
Date Received: 06/02/2005
Time Received: 13:54
Project Manager: Randall L. Howell

Analyte	CAS Number[1]	Result	Units	MDL[2]	Analysis Date	Analysis Time	Analyst	Method Reference

Sample Comments: Sulfate analyzed by EPA Method 300.1 (Ion Chromatography).

[1] Chemical Abstracts Service Registry Number [2] Method Detection Limit

Data Report Number: 050623-155226
Report of Results: STANDARD

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Shipping Address:
Chickamauga Power Service Center
North Side Chickamauga Reservation
Chattanooga, Tennessee 37415

Customer Address: MARK BOGGS
WT 9C-K
Phone: 632-6941
Fax : Not Available
E-Mail: EDM
Location Code: KIF
Field ID: KIF-16A-060105
Sample Description: GROUNDWATER

Sample ID: AF22037 **LRF ID:** 05060054
Matrix: Water **Reg:** RCRA
Date Collected: 06/01/2005
Time Collected: 12:26 EST
Date Received: 06/02/2005
Time Received: 13:54
Project Manager: Randall L. Howell

Analyte	CAS Number[1]	Result	Units	MDL[2]	Analysis Date	Analysis Time	Analyst	Method Reference
Aluminum, Total	7429-90-5	0.05	mg/L	0.05	06/07/2005	12:09	LMJ	EPA 6010B
Ammonia as N	7664-41-7	0.48	mg/L	0.01	06/09/2005	10:04	ADP	EPA 350.1
Antimony,Total	7440-36-0	< MDL	mg/L	0.003	06/07/2005	10:04	JBR	EPA 7041A
Arsenic, Total	7440-38-2	0.001	mg/L	0.001	06/06/2005	13:57	JBR	EPA 7060A
Barium, Total	7440-39-3	0.05	mg/L	0.01	06/07/2005	12:09	LMJ	EPA 6010B
Beryllium, Total	7440-41-7	< MDL	mg/L	0.001	06/07/2005	12:09	LMJ	EPA 6010B
Boron, Total	7440-42-8	< MDL	mg/L	0.2	06/07/2005	12:09	LMJ	EPA 6010B
Cadmium, Total	7440-43-9	< MDL	mg/L	0.0001	06/08/2005	14:15	JBR	EPA 7131A
Calcium, Total	7440-70-2	44	mg/L	0.1	06/07/2005	12:09	LMJ	EPA 6010B
Chloride, Total	16887-00-6	< MDL	mg/L	1.	06/17/2005	16:18	GMP	EPA 325.2
Chromium, Total	7440-47-3	< MDL	mg/L	0.001	06/08/2005	16:58	JBR	EPA 7191
Cobalt, Total	7440-48-4	< MDL	mg/L	0.001	06/09/2005	8:29	JBR	EPA 7201
Copper, Total	7440-50-8	< MDL	mg/L	0.01	06/07/2005	12:09	LMJ	EPA 6010B
Filterable Residue		220.	mg/L	10.	06/06/2005	11:01	AJH	EPA 160.1
Fluoride, Total	16984-48-8	0.46	mg/L	0.1	06/07/2005	10:00	GMP	EPA 340.2
Inorganic Carbon, Total		40	mg/L	1.	06/14/2005	8:19	ADP	ASTM477988
Iron, Total	7439-89-6	0.92	mg/L	0.01	06/07/2005	12:09	LMJ	EPA 6010B
Lead , Total	7439-92-1	< MDL	mg/L	0.001	06/06/2005	11:30	JBR	EPA 7421
Magnesium, Total	7439-95-4	9.2	mg/L	0.01	06/07/2005	12:09	LMJ	EPA 6010B
Manganese, Total	7439-96-5	1.3	mg/L	0.005	06/07/2005	12:09	LMJ	EPA 6010B
Mercury, Total	7439-97-6	< MDL	mg/L	0.0001	06/17/2005	13:58	CLS	EPA 7470A
Molybdenum, Total	7439-98-7	< MDL	mg/L	0.02	06/07/2005	12:09	LMJ	EPA 6010B
Nickel, Total	7440-02-0	< MDL	mg/L	0.001	06/08/2005	19:00	JBR	EPA 7521
Nitrate-Nitrite as N		< MDL	mg/L	0.01	06/09/2005	10:04	ADP	EPA 353.2
Non-Filterable Residue		5.	mg/L	1.	06/03/2005	8:01	AJH	EPA 160.2
Potassium, Total	7440-09-7	2.0	mg/L	0.1	06/16/2005	10:20	JBR	EPA 7610
Selenium, Total	7782-49-2	< MDL	mg/L	0.001	06/06/2005	16:30	JBR	EPA 7740
Silver, Total	7440-22-4	< MDL	mg/L	0.01	06/07/2005	12:09	LMJ	EPA 6010B
Sodium, Total	7440-23-5	17	mg/L	0.1	06/10/2005	15:18	JBR	EPA 7770
Strontium, Total	7440-24-6	0.29	mg/L	0.05	06/07/2005	12:09	LMJ	EPA 6010B
Sulfate, Total	14808-79-8	35	mg/L	1.	06/20/2005	15:53	CLS	EPA 375.4
Thallium, Total	7440-28-0	< MDL	mg/L	0.002	06/08/2005	10:33	JBR	EPA 7841
Total Kjeldahl Nitrogen		0.53	mg/L	0.02	06/07/2005	13:52	GMP	EPA 351.2
Vanadium, Total	7440-62-2	< MDL	mg/L	0.01	06/07/2005	12:09	LMJ	EPA 6010B
Zinc, Total	7440-66-6	< MDL	mg/L	0.01	06/07/2005	12:09	LMJ	EPA 6010B

[1] Chemical Abstracts Service Registry Number [2] Method Detection Limit

Data Report Number: 050623-155226
Report of Results: STANDARD

TENNESSEE VALLEY AUTHORITY
CENTRAL LABORATORIES SERVICES
1101 Market Street, PSC 1B-C
Chattanooga, Tennessee 37402-2801
Phone: (423) 876 - 4318 • Fax: (423) 876 - 4137

Shipping Address:
Chickamauga Power Service Center
North Side Chickamauga Reservation
Chattanooga, Tennessee 37415

Customer Address: MARK BOGGS
WT 9C-K
Phone: 632-6941
Fax : Not Available
E-Mail: EDM
Location Code: KIF
Field ID: KIF-16A-060105
Sample Description: GROUNDWATER

Sample ID: AF22037 **LRF ID:** 05060054
Matrix: Water **Reg:** RCRA
Date Collected: 06/01/2005
Time Collected: 12:26 EST
Date Received: 06/02/2005
Time Received: 13:54
Project Manager: Randall L. Howell

Analyte	CAS Number[1]	Result	Units	MDL[2]	Analysis Date	Analysis Time	Analyst	Method Reference

Sample Comments: Sulfate analyzed by EPA Method 300.1 (Ion Chromatography).

[1] Chemical Abstracts Service Registry Number [2] Method Detection Limit

Data Report Number: 050623-155226
Report of Results: STANDARD

TENNESSEE VALLEY AUTHORITY
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Chattanooga, Tennessee 37402-2801
Phone: (423) 876 - 4318 • Fax: (423) 876 - 4137

Shipping Address:
Chickamauga Power Service Center
North Side Chickamauga Reservation
Chattanooga, Tennessee 37415

Customer Address: MARK BOGGS
WT 9C-K
Phone: 632-6941
Fax : Not Available
E-Mail: EDM
Location Code: KIF
Field ID: KIF-22-060105
Sample Description: GROUNDWATER

Sample ID: AF22038 **LRF ID:** 05060054
Matrix: Water **Reg:** RCRA
Date Collected: 06/01/2005
Time Collected: 9:41 EST
Date Received: 06/02/2005
Time Received: 13:54
Project Manager: Randall L. Howell

Analyte	CAS Number[1]	Result	Units	MDL[2]	Analysis Date	Analysis Time	Analyst	Method Reference
Ammonia as N	7664-41-7	0.80	mg/L	0.01	06/09/2005	10:04	ADP	EPA 350.1
Nitrate-Nitrite as N		< MDL	mg/L	0.01	06/09/2005	10:04	ADP	EPA 353.2
Total Kjeldahl Nitrogen		0.84	mg/L	0.02	06/07/2005	13:52	GMP	EPA 351.2

Sample Comments: None

[1] Chemical Abstracts Service Registry Number [2] Method Detection Limit

Data Report Number: 050623-155226
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Shipping Address:
Chickamauga Power Service Center
North Side Chickamauga Reservation
Chattanooga, Tennessee 37415

Customer Address: MARK BOGGS
WT 9C-K
Phone: 632-6941
Fax : Not Available
E-Mail: EDM
Location Code: KIF
Field ID: KIF-EQUIPMENT BLANK-060105
Sample Description: GROUNDWATER

Sample ID: AF22039 **LRF ID:** 05060054
Matrix: Water **Reg:** RCRA
Date Collected: 06/01/2005
Time Collected: 10:56 EST
Date Received: 06/02/2005
Time Received: 13:54
Project Manager: Randall L. Howell

Analyte	CAS Number[1]	Result	Units	MDL[2]	Analysis Date	Analysis Time	Analyst	Method Reference
Aluminum, Total	7429-90-5	< MDL	mg/L	0.05	06/07/2005	11:30	LMJ	EPA 6010B
Ammonia as N	7664-41-7	< MDL	mg/L	0.01	06/09/2005	10:04	ADP	EPA 350.1
Antimony,Total	7440-36-0	< MDL	mg/L	0.003	06/07/2005	10:39	JBR	EPA 7041A
Arsenic, Total	7440-38-2	< MDL	mg/L	0.001	06/06/2005	14:14	JBR	EPA 7060A
Barium, Total	7440-39-3	< MDL	mg/L	0.01	06/07/2005	11:30	LMJ	EPA 6010B
Beryllium, Total	7440-41-7	< MDL	mg/L	0.001	06/07/2005	11:30	LMJ	EPA 6010B
Boron, Total	7440-42-8	< MDL	mg/L	0.2	06/07/2005	11:30	LMJ	EPA 6010B
Cadmium, Total	7440-43-9	< MDL	mg/L	0.0001	06/08/2005	14:49	JBR	EPA 7131A
Calcium, Total	7440-70-2	< MDL	mg/L	0.1	06/07/2005	11:30	LMJ	EPA 6010B
Chloride, Total	16887-00-6	< MDL	mg/L	1.	06/17/2005	16:18	GMP	EPA 325.2
Chromium, Total	7440-47-3	< MDL	mg/L	0.001	06/08/2005	17:17	JBR	EPA 7191
Cobalt, Total	7440-48-4	< MDL	mg/L	0.001	06/09/2005	8:51	JBR	EPA 7201
Copper, Total	7440-50-8	< MDL	mg/L	0.01	06/07/2005	11:30	LMJ	EPA 6010B
Filterable Residue		< MDL	mg/L	10.	06/06/2005	11:01	AJH	EPA 160.1
Fluoride, Total	16984-48-8	< MDL	mg/L	0.1	06/07/2005	10:00	GMP	EPA 340.2
Inorganic Carbon, Total		< MDL	mg/L	1.	06/14/2005	8:25	ADP	ASTM477988
Iron, Total	7439-89-6	< MDL	mg/L	0.01	06/07/2005	11:30	LMJ	EPA 6010B
Lead , Total	7439-92-1	< MDL	mg/L	0.001	06/06/2005	11:46	JBR	EPA 7421
Magnesium, Total	7439-95-4	< MDL	mg/L	0.01	06/07/2005	11:30	LMJ	EPA 6010B
Manganese, Total	7439-96-5	< MDL	mg/L	0.005	06/07/2005	11:30	LMJ	EPA 6010B
Mercury, Total	7439-97-6	< MDL	mg/L	0.0001	06/17/2005	14:00	CLS	EPA 7470A
Molybdenum, Total	7439-98-7	< MDL	mg/L	0.02	06/07/2005	11:30	LMJ	EPA 6010B
Nickel, Total	7440-02-0	< MDL	mg/L	0.001	06/08/2005	19:17	JBR	EPA 7521
Nitrate-Nitrite as N		< MDL	mg/L	0.01	06/09/2005	10:04	ADP	EPA 353.2
Non-Filterable Residue		< MDL	mg/L	1.	06/03/2005	8:01	AJH	EPA 160.2
Potassium, Total	7440-09-7	1.9	mg/L	0.1	06/16/2005	7:50	JBR	EPA 7610
Selenium, Total	7782-49-2	< MDL	mg/L	0.001	06/06/2005	17:01	JBR	EPA 7740
Silver, Total	7440-22-4	< MDL	mg/L	0.01	06/07/2005	11:30	LMJ	EPA 6010B
Sodium, Total	7440-23-5	2.1	mg/L	0.1	06/10/2005	15:20	JBR	EPA 7770
Strontium, Total	7440-24-6	< MDL	mg/L	0.05	06/07/2005	11:30	LMJ	EPA 6010B
Sulfate, Total	14808-79-8	<MDL	mg/L	1.	06/20/2005	15:24	CLS	EPA 375.4
Thallium, Total	7440-28-0	< MDL	mg/L	0.002	06/08/2005	10:50	JBR	EPA 7841
Total Kjeldahl Nitrogen		< MDL	mg/L	0.02	06/22/2005	9:27	GMP	EPA 351.2
Vanadium, Total	7440-62-2	< MDL	mg/L	0.01	06/07/2005	11:30	LMJ	EPA 6010B
Zinc, Total	7440-66-6	< MDL	mg/L	0.01	06/07/2005	11:30	LMJ	EPA 6010B

[1] Chemical Abstracts Service Registry Number [2] Method Detection Limit

Data Report Number: 050623-155226
Report of Results: STANDARD

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Chattanooga, Tennessee 37415.

Customer Address: MARK BOGGS
WT 9C-K
Phone: 632-6941
Fax : Not Available
E-Mail: EDM
Location Code: KIF
Field ID: KIF-EQUIPMENT BLANK-060105
Sample Description: GROUNDWATER

Sample ID: AF22039 **LRF ID:** 05060054
Matrix: Water **Reg:** RCRA
Date Collected: 06/01/2005
Time Collected: 10:56 EST
Date Received: 06/02/2005
Time Received: 13:54
Project Manager: Randall L. Howell

Analyte	CAS Number[1]	Result	Units	MDL[2]	Analysis Date	Analysis Time	Analyst	Method Reference

Sample Comments: Sulfate analyzed by EPA Method 300.1 (Ion Chromatography).

[1] Chemical Abstracts Service Registry Number [2] Method Detection Limit

Data Report Number: 050623-155226
Report of Results: STANDARD

Central Laboratories Services data report number 050623-155225 was electronically approved using Labworks Enterprise Version 5.7, Build 255 on **06/23/2005 at 3:44:00 PM by Randall L. Howell**

Vanessa L. Ramey, Lab Director
Lisa D. Ortiz, Department Manager
Randall L. Howell, Product Manager
James W. Dillard, Product Manager
Ricardo I. Gilbert, Senior Analytical Chemist

This report contains sample results for the following samples, Login Reference File number: 05060054

AF22033
AF22034
AF22035
AF22036
AF22037
AF22038
AF22039

[1] Chemical Abstracts Service Registry Number [2] Method Detection Limit

APPENDIX D

BASELINE MONITORING DATA SUMMARY

Summary of Baseline Groundwater Monitoring Data

Well	Date	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Copper	Fluoride	Lead	Mercury	Nickel	Selenium	Silver	Thallium	Vanadium	Zinc
KIF-4B	12/14/2000	<2	2	160	<1	<0.1	2.7	5.8	<10	0.16	6.5	<0.2	27	<1	<10	<2	<10	28
KIF-4B	06/28/2001	<1	1	56	<1	0.18	<1	11	12	0.16	<1	<0.2	2	<1	<10	<2	<10	11
KIF-4B	12/31/2001	<1	4.2	33	<1	1	<1	2.2	10	0.13	<1	<0.1	3.3	<1	<10	<2	<10	17
KIF-4B	06/28/2002	<1	1	55	<1	<0.1	3	23	10	0.11	<1	<0.1	7	<1	<10	<2	<10	<10
KIF-4B	01/08/2003	<1	4	60	<1	<0.1	<1	4.8	10	0.15	<1	<0.1	7.9	2.2	<10	<2	<10	10
KIF-4B	06/16/2003	<1	1	80	<1	0.5	<1	4	10	0.16	<1	<0.1	16	<1	0.2	<2	<10	40
KIF-4B	09/02/2003	<0.1	1.2	60	<1	0.32	<0.5	3	10	0.11	1.4	<0.1	8.4	0.9	<10	0.6	<10	20
KIF-4B	12/29/2003	<0.6	0.4	40	<1	0.29	2.3	1.9	<10	0.18	1.2	<0.1	7.9	0.3	<10	0.1	<10	<10
KIF-4B	03/10/2004	<0.6	2	70	<1	0.33	1.4	4.2	<10	0.11	1.7	<0.1	1.1	0.5	<10	0.2	<10	<10
KIF-4B	06/07/2004	<3	4	50	<1	0.4	<1	<1	<10	0.15	1	<0.1	4	<1	<10	<2	<10	30
KIF-4B	09/16/2004	<3	1	40	<1	0.1	1	5	<10	<0.1	<1	<0.1	<1	<1	<10	<2	<10	<10
KIF-4B	12/08/2004	<3	5	80	<1	0.9	4	9	<10	0.15	4	<0.1	13	2	<10	<2	<10	20
KIF-4B	03/15/2005	<3	3	90	<1	0.2	6	16	<10	<0.1	<1	0.1	16	<1	<10	<2	<10	10
KIF-6A	12/14/2000	<2	3	34	<1	0.83	1.7	2.2	10	<0.1	6.2	<0.2	2	<1	<10	<2	<10	32
KIF-6A	06/28/2001	<1	<1	51	<1	2.2	<1	5.6	<10	<0.1	15	<0.2	<1	<1	<10	<2	<10	56
KIF-6A	12/31/2001	<1	11	33	<1	1.1	<1	<1	<10	<0.1	3.3	<0.1	<1	<1	40	<2	20	100
KIF-6A	06/28/2002	<1	8	28	<1	0.77	1	14	<10	<0.1	2.6	<0.1	11	<1	<10	<2	<10	60
KIF-6A	01/08/2003	<1	6	40	<1	1.4	<1	6.6	<10	<0.1	<1	<0.1	<1	4.1	40	<2	<10	340
KIF-6A	06/16/2003	<1	<1	40	<1	0.7	<1	3	<10	<0.1	<1	<0.1	2	4	0.1	<2	80	1300
KIF-6A	09/02/2003	<0.1	11.5	60	<1	0.98	2.2	11.9	<10	<0.1	5.6	<0.1	7.7	2	70	0.2	140	<10
KIF-6A	12/29/2003	<0.6	5	80	<1	0.46	1.1	6.6	<10	<0.1	1.2	<0.1	6.7	1.4	70	<0.1	40	<10
KIF-6A	03/10/2004	<0.6	5.7	90	<1	0.5	1.8	3	<10	<0.1	2.8	<0.1	4.8	3.1	120	<0.1	80	<10
KIF-6A	06/07/2004	<3	11	100	<1	0.4	<2	13	<10	<0.1	1	<0.1	7	<1	<10	<2	<10	<10
KIF-6A	09/14/2004	<3	13	160	<1	<0.1	6	10	<10	<0.1	<1	<0.1	3	<1	190	<2	150	<10
KIF-6A	12/08/2004	6	14	110	<1	0.6	2	17	<10	<0.1	3	<0.1	9	4	<10	<2	<10	50
KIF-6A	03/15/2005	4	6	80	<1	0.2	3	12	<10	<0.1	<1	<0.1	3	<1	<10	<2	50	<10
KIF-13B	12/14/2000	<2	<1	280	<1	<0.1	<1	<1	<10	0.2	<1	<0.2	1	<1	<10	<2	<10	<10
KIF-13B	06/28/2001	<1	<1	290	<1	<0.1	<1	<1	<10	0.19	<1	<0.2	<1	<1	<10	<2	<10	<10
KIF-13B	12/31/2001	<1	<1	295	<1	0.2	<1	<1	<10	0.175	<1	<0.1	<1	<1	<10	<2	<10	<10
KIF-13B	06/28/2002	<1	2	30	<1	<0.1	<1	<1	<10	0.18	<1	<0.1	<1	<1	<10	<2	<10	<10
KIF-13B	01/08/2003	<1	<1	315	<1	<0.1	<1	<1	<10	0.185	<1	<0.1	<1	<1	<10	<2	<10	<10
KIF-13B	06/17/2003	<1	<1	350	<1	<0.1	<1	<1	<10	0.17	<1	<0.1	<1	<1	0.2	<2	<10	<10
KIF-13B	09/02/2003	<0.1	0.2	340	<1	0.05	<0.5	2.2	<10	0.15	<0.1	<0.1	0.5	<0.2	<10	<0.1	<10	<10
KIF-13B	12/29/2003	<0.6	<0.1	315	<1	0.05	<0.1	1.1	<10	0.18	<0.1	<0.1	0.45	<0.2	<10	<0.1	<10	<10
KIF-13B	03/10/2004	1.6	<0.1	340	<1	0.05	<0.1	1.8	<10	0.17	<0.1	<0.1	0.5	<0.2	<10	<0.1	<10	<10
KIF-13B	06/07/2004	<3	1	345	<1	<0.1	<1	<2	<10	0.185	<1	<0.1	<1	<1	<10	<2	<10	<10
KIF-13B	09/14/2004	4	2	330	<1	<0.1	<1	6	<10	0.19	<1	<0.1	<1	<1	<10	<2	<10	<10
KIF-13B	12/08/2004	<3	<1	375	<1	<0.1	<1	2	<10	0.185	<1	<0.1	<1	<1	<10	<2	<10	45
KIF-13B	03/15/2005	<3	<1	360	<1	<0.1	<1	1	<10	0.13	<1	<0.1	<1	<1	<10	<2	<10	<10
KIF-16A	12/14/2000	<1.5	<1	52	<1	<0.1	<1	<1	<10	0.46	<1	<0.2	2.5	<1	<10	<2	<10	<10
KIF-16A	06/28/2001	<1	<1	59	<1	<0.14	<1	<1	<10	0.455	<1.5	<0.2	<1	<1	<10	<2	<10	<10.5
KIF-16A	12/31/2001	<1	<1	43	<1	<0.1	<1	<1	<10	0.44	<1	<0.1	<1	<1	<10	<2	<10	<10
KIF-16A	06/28/2002	<1	<1	50	<1	<0.1	<1	<1	<10	0.44	<2.35	<0.1	<1	<1	<10	<2	<10	<10
KIF-16A	01/08/2003	<1	6	50	<1	<0.1	<1	<1	<10	0.42	<1	<0.1	<1	<1	<10	<2	<10	<10
KIF-16A	06/17/2003	<1	<1	60	<1	<0.1	<1	<1	<10	0.455	<1	<0.1	<1	<1	<0.1	<2	<10	<10
KIF-16A	09/02/2003	<0.1	0.9	60	<1	0.06	<0.5	1.8	<10	0.41	1.1	<0.1	<0.5	<0.2	<10	<0.1	<10	<10
KIF-16A	12/29/2003	<0.6	0.6	50	<1	0.09	<0.5	2.3	<10	0.39	0.5	<0.1	1.4	<0.2	<10	<0.1	<10	<10
KIF-16A	03/10/2004	<0.6	0.5	60	<1	<0.05	0.2	1.7	<10	0.455	0.25	<0.1	5.2	<0.2	<10	<0.1	<10	<10
KIF-16A	06/07/2004	<3	2	50	<1	<0.1	<1	5	<10	0.45	<1	<0.1	<1	<1	<10	<2	<10	<10
KIF-16A	09/14/2004	<3	<1.5	50	<1	<0.1	<1	2	<10	0.5	<1	<0.1	<1	<1	<10	<2	<10	<10
KIF-16A	12/08/2004	<3	1	50	<1	<0.1	<1	1	<10	0.42	<1	<0.1	<1	<1	<10	<2	<10	20
KIF-16A	03/17/2005	<3	<1	50	<1	<0.15	<1	<1	<10	0.355	<1	<0.1	<1	<1	<10	<2	<10	<10

NOTE: All units are ug/L except fluoride which are mg/L.

APPENDIX E

STATISTICAL TESTING METHODOLOGY

STATISTICAL TESTING METHODOLOGY

Considerations in Method Selection

The statistical characteristics of the baseline (background) groundwater quality data from the compliance wells surrounding the KIF ash disposal area were the primary consideration in selecting the method of statistical testing. First, Shapiro-Wilk normality testing of the baseline data for each constituent at each well indicates that only 37% of the data exhibit normal or log-normal distributions. On this basis, nonparametric statistical methods are clearly indicated for the facility groundwater detection monitoring program.

Second, the majority of constituents exhibit significant spatial variability of baseline measurements among the monitoring wells. For example, the quartile plots presented in Figures 1(a) through 1(c) generally indicate substantial differences between the concentration distributions of downgradient monitoring wells (4B, 6A and 13B) and those of upgradient well 16A. For example, fluoride concentrations in 16A are significantly higher than those observed in the three downgradient wells. Therefore, interwell statistical comparisons of the upgradient and downgradient sample data would be inappropriate.

Given the statistical characteristics of the groundwater quality data, we propose to conduct intrawell water quality comparisons using a nonparametric prediction interval (NPI) method adapted by Gibbons [1990, 1994] for groundwater detection monitoring.

General Description of Nonparametric Prediction Interval Method

The nonparametric prediction interval is an upper one-sided interval derived from a previous sample of n baseline measurements having a selected probability (e.g., 99%) of including at least one of m future observations. In the context of groundwater detection monitoring m is equal to a new measurement plus $m-1$ resamples. The method assumes the n baseline measurements are independent and constitute a continuous probability distribution of unknown form. Distributions of baseline and the future compliance monitoring data are assumed to be identical in the absence of contamination from the disposal facility.

The upper prediction limit (UPL) for each chemical parameter at a given well is defined as the maximum concentration observed during the baseline period. According to Gibbons [1990], the probability (P) that at least one of m future measurements will be less than or equal to the UPL in the absence of contamination from the facility is given by,

$$P \approx \left[\frac{n}{m+n} \sum_{j=1}^{m} \frac{\binom{m}{j}}{\binom{m+n-1}{j+n-1}} \right]^{k}$$

where,

$$\binom{m}{j} \equiv \frac{m!}{j!(m-j)!}$$

and *k* is the number of monitor wells (equal to one for intrawell comparisons). Since *n* is fixed, *m* is selected to achieve a desired level of confidence (e.g., 99%). In practice, each new parameter measurement from a given well during compliance monitoring is compared to its UPL. If the new measurement exceeds the UPL, *m-1* independent resamples are obtained from the well and compared to the UPL. Resamples are only analyzed for the chemical parameter(s) exceeding UPL(s). If all of the resample measurements are greater than the UPL, the original exceedence is deemed a statistically significant increase; otherwise, if at least one of the resamples is below the UPL it is considered insignificant.

Application of the NPI Method

We propose to test at the 1% significance level (99% confidence level) to maintain a reasonable balance between the false positive rate and protection of the environment. The probability of a false positive measurement during any given sampling event (P') is,

$$P' = 1 - (P)^{N}$$

where *N* is the number of independent measurements [Gibbons, 1990]. In the case of the KIF detection monitoring program, *N* is equal to 51 (i.e., 3 downgradient wells multiplied by 17 constituents equals 51). Testing at the 5% significance level (*P* = 0.95) yields a false positive rate *P'* = 0.93 which is too high for practical detection monitoring. A false positive rate of 0.40 is estimated for testing at the 1% significance level (*P* = 0.99). Therefore, testing at the 1% level appears to represent a reasonable compromise between false positive and false negative rates.

The proposed UPLs are listed by well and by constituent in Table E-1. The UPL for each constituent at a given well is generally equal to the maximum observed concentration during the baseline period, i.e., between December 2000 and March 2005. Where the maximum baseline measurement is less than the MCL, the UPL be set at the constituent's EPA-mandated MCL. This adjustment in the procedure is considered

Table E-1. Statistical Upper Prediction Limits for Downgradient Monitoring Wells

Constituent	*Well 4B*	*Well 6A*	*Well 13B*
Antimony	6	6	6
Arsenic	10	14	10
Barium	2000	2000	2000
Beryllium	4	4	4
Cadmium	5	5	5
Chromium	100	100	100
Cobalt	23	17	6
Copper	1000	1000	1000
Fluoride	4000	4000	4000
Lead	15	15	15
Mercury	2	2	2
Nickel	100	100	100
Selenium	50	50	50
Silver	100	190	100
Thallium	2	2	2

(*All units are µg/L*)

reasonable since constituent concentrations below the MCL are nonhazardous according to EPA. It is consistent with other statistical methods which test against MCL, e.g., confidence interval, tolerance interval [USEPA, 1992]. This approach also avoids the problem when the maximum baseline constituent concentration is equal to the method detection limit (MDL), and any concentration above the MDL would constitute a statistical exceedence (e.g., beryllium is >MDL in baseline data for all KIF wells). This result would imply that water quality was degraded when, in fact, small detectable quantities may be of no environmental concern.

In applying the NPI method to future compliance data for the facility, one resample would be required to confirm a UPL exceedence for testing performed at the 1% significance level. This resampling requirement is based on Gibbon's [1994] table of probabilities that at least one of two samples will be below the maximum of 13 baseline measurements at a single monitoring well. The NPI method requires that only the well(s) showing the UPL exceedence be resampled, and that sample analyses be limited only to the exceeded constituent(s).

References

Gibbons, R. D., 1990, A general statistical procedure for groundwater detection monitoring at waste disposal facilities, *Groundwater*, 28(2), pp. 235-243.

Gibbons, R. D., 1994, Statistical Methods for Groundwater Monitoring, J. Wiley & Sons, Inc., New York, NY.

USEPA, 1992, User documentation for a groundwater information tracking system with statistical analysis capability, GRITS/STAT, v 4.2, EPA/625/11-91/002.

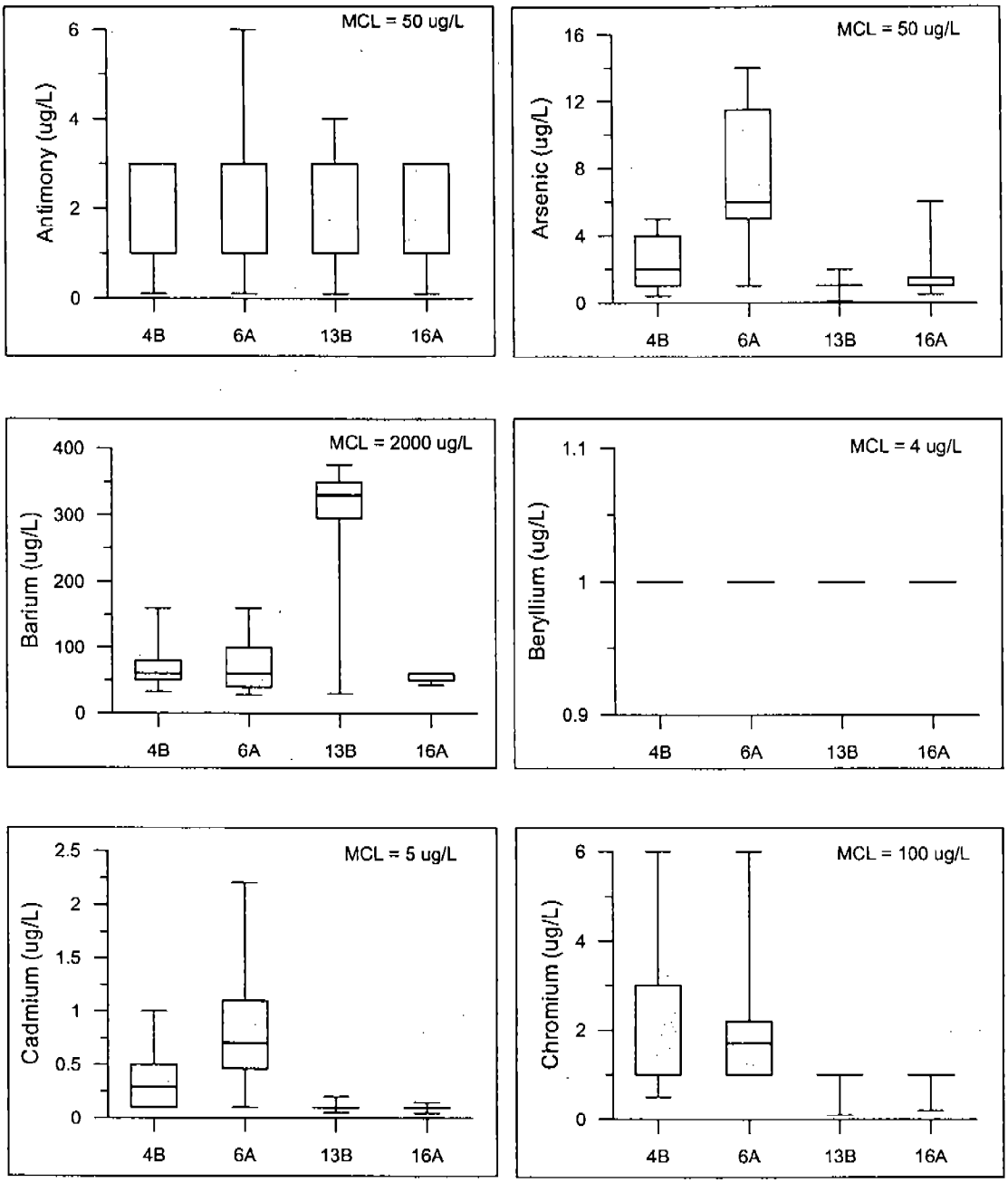

Figure E-1(a). Quartile Graphs of Baseline Groundwater Monitoring Data. (Box represents interquartile range encompassing 50% of data; horizontal line within box denotes median value; and endpoints of vertical lines extending from either side of box indicate extreme data values.)

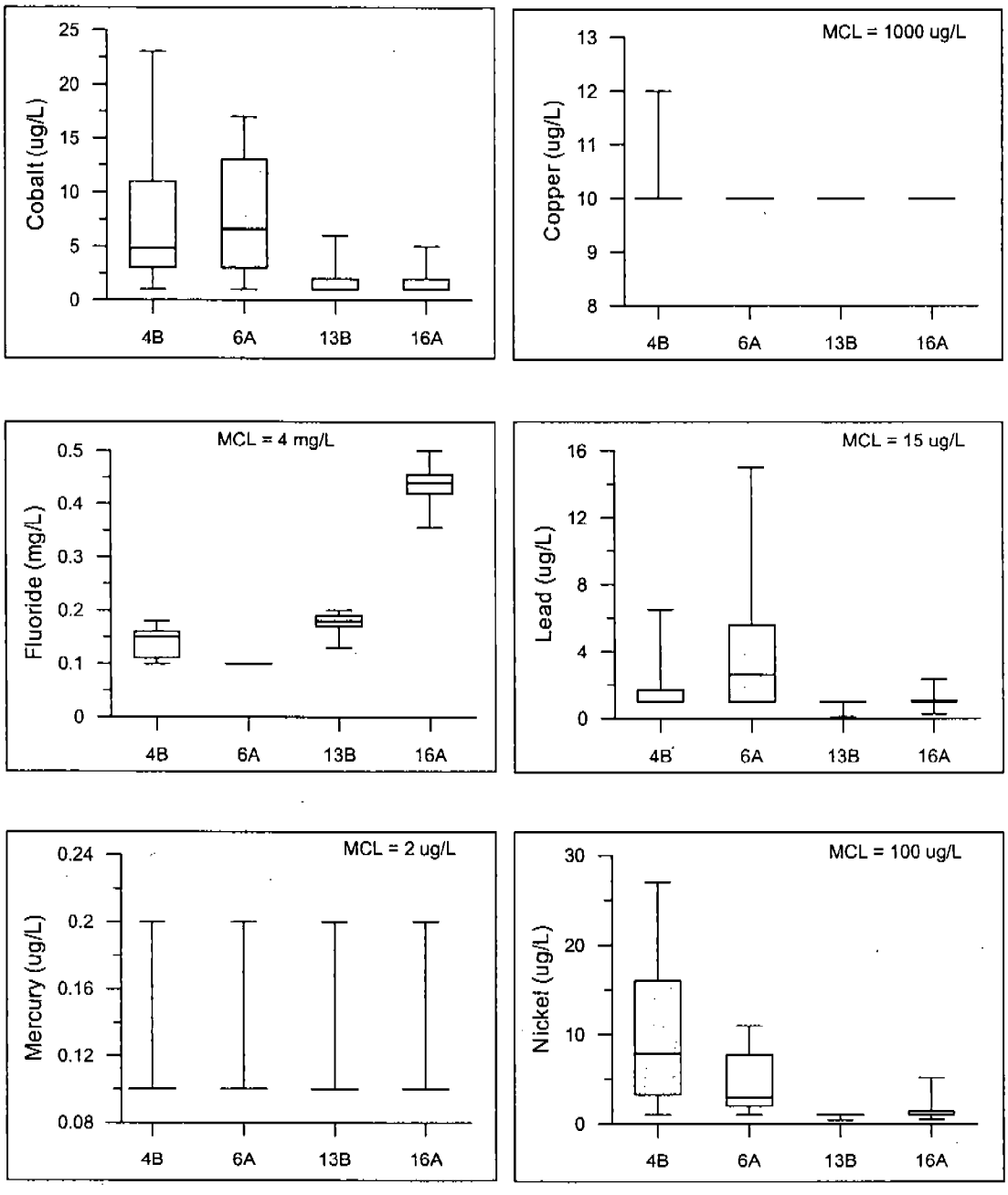

Figure E-1(b). Quartile Graphs of Baseline Groundwater Monitoring Data. (Box represents interquartile range encompassing 50% of data; horizontal line within box denotes median value; and endpoints of vertical lines extending from either side of box indicate extreme data values.)

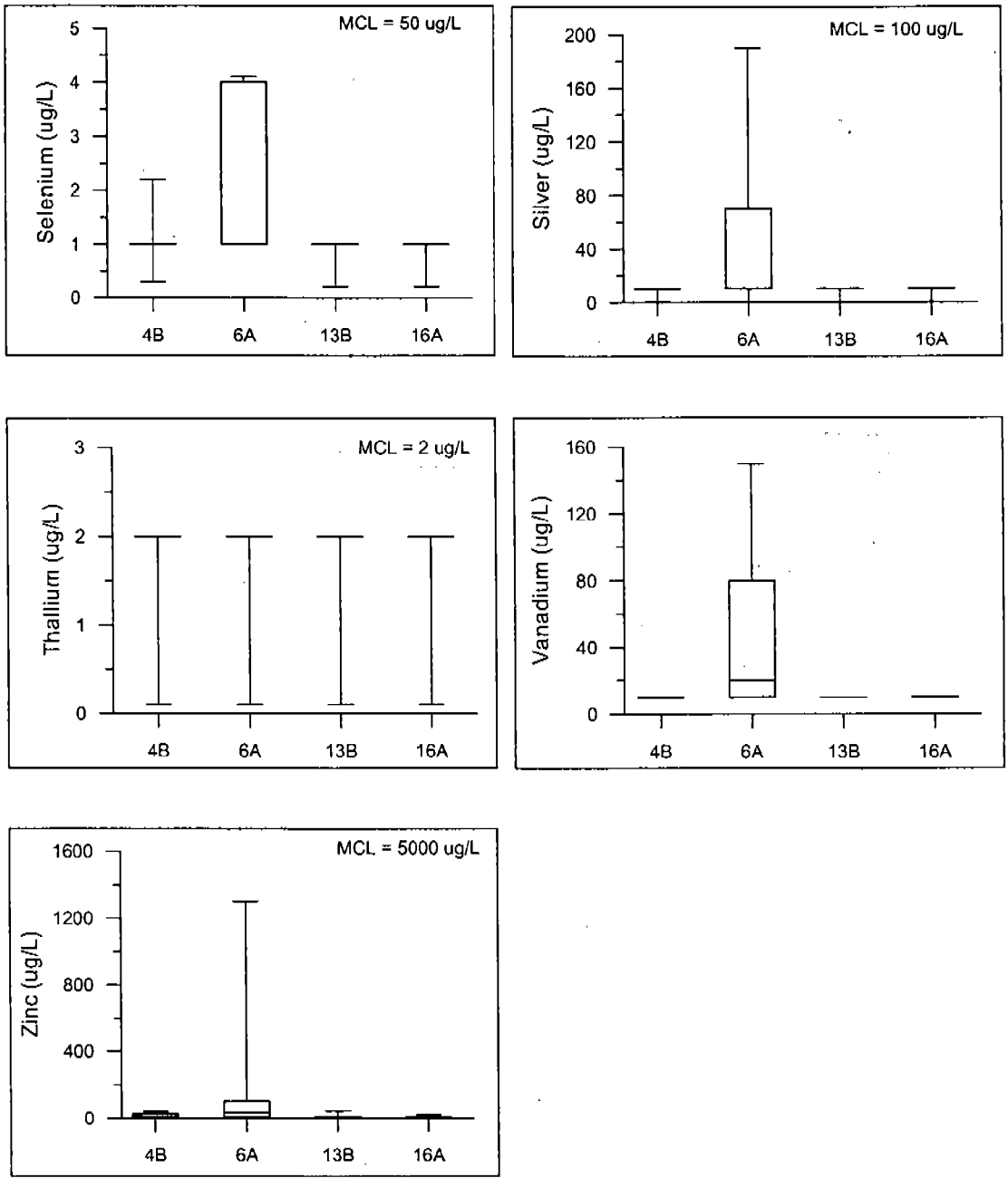

Figure E-1(c). Quartile Graphs of Baseline Groundwater Monitoring Data. (Box represents interquartile range encompassing 50% of data; horizontal line within box denotes median value; and endpoints of vertical lines extending from either side of box indicate extreme data values.)