

RCN 218-070-07-20

**DEMONSTRATION OF INNOVATIVE APPLICATIONS
OF TECHNOLOGY FOR THE CT-121 FGD PROCESS**

Plant Yates

**Environmental Monitoring Program Report:
Second Quarter of 1994
(Final)**

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Executive Summary

This progress report summarizes activities associated with the environmental monitoring program (EMP) during the second calendar quarter of 1994 for the U.S. Department of Energy's Innovative Clean Coal Technology project entitled "Demonstration of Innovative Applications of Technology for the CT-121 FGD Process." This demonstration project is being conducted at Georgia Power Company's Plant Yates Unit 1, located near Newnan, Georgia.

This document discusses progress made in EMP activities during the second calendar quarter of 1994. With the exception of certain compliance data, results are not presented in detail; instead, results will be reported in periodic reports focusing on discrete test periods.

During the months of April and May, the high-particulate parametric block tests were completed. The high-particulate load-following tests began in late May and continued through June. The long-term tests began with the ESP energized to provide approximately 90% particulate removal efficiency; this condition was selected to approximate a CT-121 retrofit downstream of a marginally performing particulate collection device. Initial scrubber operating conditions (pH = 4.5, JBR Δ P = 14 in. WC) for the long-term testing were identical to those used for the majority of the Low-Particulate Long-Term test block. Because of inhibited limestone dissolution, possibly caused by aluminum fluoride blinding, the pH was lowered to 4.0; following this change, the remainder of the month of June passed without significant incident.

Operational phase groundwater monitoring continued during the quarter. Also, compliance monitoring was conducted and compliance reports were submitted by Georgia Power Company to the Environmental Protection Division of the Georgia Department of Natural Resources.

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1.0 Introduction

This quarterly progress report summarizes activities associated with the environmental monitoring program (EMP) during the second calendar quarter of 1994 for the U.S. Department of Energy's Innovative Clean Coal Technology project entitled "Demonstration of Innovative Applications of Technology for the CT-121 FGD Process." This demonstration project is being conducted at Georgia Power Company's Plant Yates Unit 1, located near Newnan, Georgia. The Cooperative Agreement for this project was signed by DOE on April 2, 1990.

The EMP was developed to fulfill the following specific objectives:

- ▶ To provide monitoring data to fulfill environmental compliance requirements of local, state, and federal regulatory agencies;
- ▶ To define and describe additional supplemental monitoring activities, if needed; and
- ▶ To ensure that emissions and environmental impacts are consistent with projections provided in NEPA documents.

This document discusses progress made in EMP activities during the second calendar quarter of 1994. Results are presented for groundwater monitoring and compliance (air emissions and wastewater) monitoring, but the results of FGD process monitoring will be presented in periodic reports focusing on discrete test phases.

2.0 Project Summary

This section provides a brief description of the plant and process in addition to the demonstration project.

2.1 Plant and Process Description

Plant Yates consists of seven steam turbine electric generating units providing a total nameplate capacity of 1,250,000 kW. Units 1 through 5 (operational since the 1950s) are operated as intermediate load units and are located in one building that features a common 825-

foot stack for venting emissions from all five units. Units 6 and 7, operational since 1974, are operated as base load units. A common 800-foot stack is used to vent emissions from Units 6 and 7, which are housed in a separate building. All of Plant Yates' units are equipped with electrostatic precipitators for particulate control.

Plant Yates typically uses coal that is a 50-50 blend of Arch Mineral and Old Ben coals from the Illinois Basin. The target coal sulfur content for the demonstration project is 2.5 percent. Raw water for process needs is drawn from the Chattahoochee River. Solid waste, in the form of bottom ash and fly ash, is sluiced to a series of wet ash disposal ponds.

2.2 Project Description

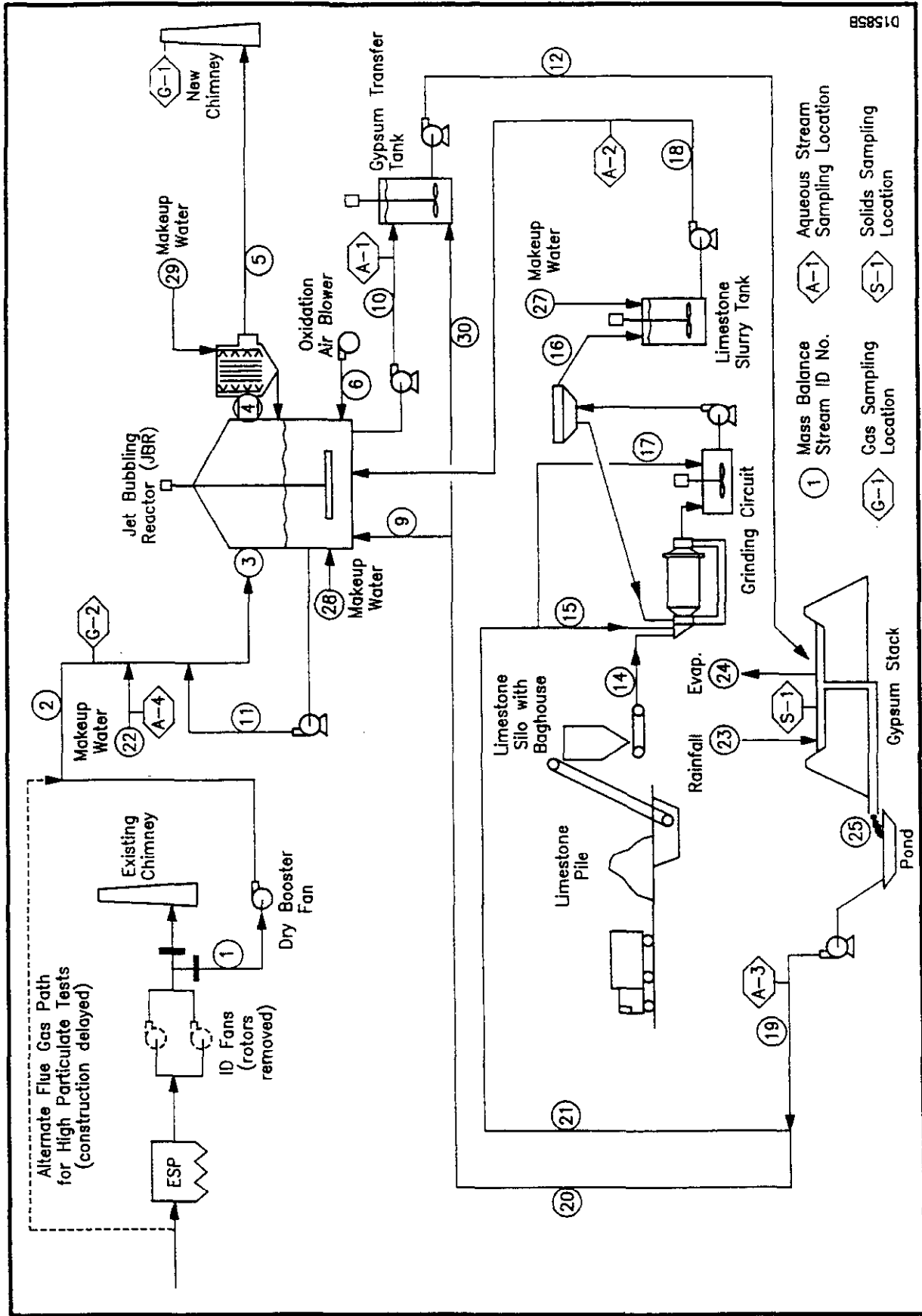
The CT-121 flue gas desulfurization project was constructed and is operated to treat the entire flue gas stream from Unit 1 (100 MW), which is approximately 12% of the total flue gas generated at Plant Yates. A 258-foot stack was constructed to vent emissions from the CT-121 process.

A simplified process flow diagram of the flue gas desulfurization process is shown in Figure 1. Major process sampling locations are shown in that diagram.

3.0 Project Status

The CT-121 demonstration project at Plant Yates consists of four distinct environmental test periods, including:

- ▶ Period 0: Site Preparation, Construction, and Startup of the Demonstration Project;
- ▶ Period 1: Testing at Low Fly Ash Loading—With ESP In Service;
- ▶ Period 2: Testing at High Fly Ash Loading—ESP Detuned or Out of Service; and



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Figure 1. Yates 100 MW CT-121 Process Flow Diagram

- ▶ Period 3: Post Demonstration Groundwater Testing.

Monitoring during Period 0 consisted solely of background (i.e., prior to project operation) groundwater monitoring. Samples were obtained during seven periods between September 6, 1990, and October 14, 1992.

On October 26, 1992, the CT-121 wet scrubber became operational for the first time. During the remainder of 1992, shakedown of the process equipment and data collection procedures was conducted.

In April 1994, the high-particulate parametric test block continued, following an inspection of the scrubber internals and flushing of the gas cooling piping and nozzles.

During the month of May, the high-particulate parametric test series was completed and the long-term, load-following portion of the high-particulate test phase was begun. The parametric testing was performed with the ESP completely de-energized to determine the effects of high flue-gas particulate loading on the scrubber system. The long-term tests began with the ESP energized to provide approximately 90% particulate removal efficiency; this condition was selected to approximate a CT-121 retrofit downstream of a marginally performing particulate collection device. Initial scrubber operating conditions (pH = 4.5, JBR ΔP = 14 in. WC) for the long-term testing were identical to those used for the majority of the low-particulate long-term test block.

The long-term high-particulate testing continued in June. Because of inhibited limestone dissolution, possibly caused by aluminum fluoride blinding, the pH was lowered to 4.0; following this change, the remainder of the month passed without significant incident.

4.0 Compliance Monitoring and Reporting

Wastewater samples collected during the quarter for compliance purposes were as follows:

Stream/Parameter	Ash Transport Water	Final Plant Discharge
Total Suspended Solids	✓	
Oil and Grease	✓	
pH		✓

During the quarter, compliance reports were submitted by Georgia Power Company, as required, to the Environmental Protection Division of the Georgia Department of Natural Resources. These reports are reproduced as Appendices A and B. Appendix A contains excess emission and monitoring system performance reports. Appendix B contains wastewater data.

During the third quarter of 1994, a semiannual progress report will be submitted by GPC to the DNR, in accordance with an amendment (effective December 28, 1990) to the air operating permit for Source 1 (comprising Units 1, 2, and 3) (No. 4911-038-4838-0).

5.0 Supplemental Monitoring

5.1 Groundwater Monitoring

Operational-phase groundwater monitoring was conducted during the quarter on June 21-22, 1994. The samples collected, shown in Table 1, were analyzed for the parameters shown in Table 2. Results for these samples will be available in the next quarterly EMP progress report.

A report containing the results of groundwater monitoring conducted during the first quarter of 1994 is provided as Appendix C. The results from previous quarters have been attached to previously submitted EMP reports.

5.2 FGD Process Monitoring

The monitoring schedules for gaseous, aqueous, and solid streams are shown in Tables 3, 4, and 5, respectively. Tables 6, 7, and 8 are summaries of the EMP monitoring conducted during the quarter. It appears that most, if not all, of the FGD process monitoring was performed as planned during the quarter.

**Table 1. Summary of Groundwater Samples Collected
at Plant Yates on June 21-22, 1994**

Well ID	Sample ID	Analyses
GWA-1	None	Well dry; no samples collected
GWC-1	GWC-1-14-1	Anions, TOC, TOX, VOCs, and Metals
GWC-2	GWC-2-14-1	Anions, TOC, TOX, VOCs, and Metals
GWC-3	GWC-3-14-1	Anions, TOC, TOX, VOCs, and Metals
	GWC-3-14-2	Anions, TOC, TOX, VOCs, and Metals
GWC-4	GWC-4-14-1	Anions, TOC, TOX, VOCs, and Metals
GWC-5	GWC-5-14-1	Anions, TOC, TOX, VOCs, and Metals
GWC-6	None	Well dry; no samples collected

Table 2. EMP Groundwater Monitoring Parameters

pH	Conductivity	Temperature
Eh	Alkalinity	Total Dissolved Solids
Bromide	Chloride	Total Organic Carbon
Fluoride	Nitrate-Nitrite	Sulfate
Trace Elements (Dissolved)		
Silver	Aluminum	Arsenic
Boron	Barium	Beryllium
Bismuth	Calcium	Cadmium
Cobalt	Copper	Chromium
Mercury	Iron	Potassium
Lithium	Magnesium	Manganese
Molybdenum	Sodium	Nickel
Phosphorus	Lead	Sulfur
Antimony	Selenium	Silicon
Tin	Strontium	Tellurium
Titanium	Thallium	Uranium
Vanadium	Tungsten	Zinc
Other		
TOX	VOCs	

Table 3. Gaseous Streams: Integrated Monitoring Schedule

Parameter	Stack Gas Stream	Flue Gas Inlet to JBR
Opacity	None	Continuous
SO ₂	Continuous	Continuous
O ₂	Continuous	Continuous
Moisture Content	9/Parametric Test Period	9/Parametric Test Period
SO ₃ , H ₂ SO ₄ Mist (contingent upon funding availability)	36/Parametric Test Period	36/Parametric Test Period
Particulate Matter:		
Loading	9/Parametric Test Period and Annually	9/Parametric Test Period
Particle Size Distribution (contingent upon funding availability)	9/Parametric Test Period	9/Parametric Test Period

Table 4. Aqueous Stream Monitoring Schedule

Parameter	JBR Overflow			JBR Underflow		
	P	L	L	P	L	L
Liquid Phase						
pH	7/M	4/M	4/M	7/M		4/M
Chloride	7/M		4/M			
Sulfite	7/M		4/M			
Sulfate	7/M		4/M			
Carbonate	7/M		4/M			
Trace Elements			1/M			
Solid Phase						
Solids Content	7/M		4/M	7/M		4/M
Inert Content	7/M		4/M	7/M		4/M
Calcium	7/M		4/M	7/M		4/M
Magnesium				7/M		4/M
Sulfite				7/M		4/M
Sulfate	7/M		4/M	7/M		4/M
Carbonate	7/M		4/M	7/M		4/M
Trace Elements						1/M
TCLP						1/P

Table 4 (continued)

Parameter	Limestone Slurry Feed		Gypsum Stack Return		Makeup Water	
	P	L	P	L	P	L
Liquid Phase						
pH			7/M	4/M	1/M	1/M
Chloride			7/M	4/M	1/M	1/M
Sulfite					1/M	1/M
Sulfate			7/M	4/M	1/M	1/M
Carbonate			7/M	4/M	1/M	1/M
Trace Elements			1/M	1/M		
Solid Phase						
Solids Content	7/M	4/M				
Inert Content	7/M	4/M				
Calcium	7/M	4/M				
Magnesium	7/M	4/M				
Carbonate	7/M	4/M				

Table 4 (continued)

Abbreviations:

- n/D = *n times per day;*
- n/W = *n times per week;*
- n/M = *n times per month;*
- n/Q = *n times per quarter;*
- 1/nM = *once per n months;*
- P = *Parametric test;* and
- L = *Long-term test. (Each of the two testing periods consists of a parametric test and a long-term test.)*

Trace elements are the following:

Aluminum	Copper	Phosphorus
Arsenic	Iron	Lead
Boron	Potassium	Sulfur
Barium	Magnesium	Antimony
Beryllium	Manganese	Selenium
Calcium	Mercury	Silicon
Cadmium	Molybdenum	Titanium
Cobalt	Sodium	Uranium
Chromium	Nickel	Vanadium

Table 5. Solid Stream Monitoring Schedule

Parameter	Coal Feed
Proximate Analysis	Daily
Ultimate Analysis, Cl, and F	Twice Yearly
Trace Elements	Twice Yearly

Note: In addition to the monitoring shown, analysis of coal feed for sulfur, moisture, heating value, and ash content once per week is a regulatory compliance requirement.

Table 6. Gaseous Streams: Numbers of Samples Collected During the Second Quarter of 1994

Parameter	Stack Gas Stream	Flue Gas Inlet to JBR
Opacity	NA	Continuous
SO ₂	Continuous	Continuous
O ₂	Continuous	Continuous
Moisture Content	0	0
SO ₃ , H ₂ SO ₄ Mist	0	0
PM Loading	0	0
PM Size Distribution	0	0

**Table 7. Aqueous Streams: Numbers of Samples Collected
During the Second Quarter of 1994**

Parameters	JBR Overflow and Underflow	Limestone Slurry Feed	Gypsum Stack Return	Makeup Water
pH	Twice daily when operating	NA	Daily when operating	Monthly
Anions (liquid and solid phases) and solids/inerts/Ca/Mg (solid phase)	18	21	18	4
Metals (liquid and solid phases)	2	NA	2	NA

**Table 8. Solid Streams: Numbers of Samples Collected
During the Second Quarter of 1994**

Parameters	Coal Feed
Proximate Analysis	Daily when operating
Ultimate Analysis, Cl, and F	0
Trace Elements	0

6.0 Quality Assurance/quality Control Activities

QA/QC activities for process data consist of calibrations, calibration checks, and related maintenance activities, all of which are recorded in log books. Six log books are used:

1. CEM flow rates and gas concentrations;
2. pH calibrations;
3. ΔP cells;
4. Density measurements;
5. Flow meters; and
6. Level meters.

Radian Corporation personnel were on site on June 14-15 to perform a quality assurance audit of the Plant Yates laboratory. The audit indicated that all of the quality control procedures established for the laboratory had been implemented and are being complied with, and that an appropriate level of quality control is being practiced. A report presenting the results of this audit will be included in the third quarter EMP Report.

Appendix A

**Quarterly Air Emission Report
for the Second Quarter of 1994**

PLANT: YATES
 UNIT : 1-3
 CURRENT DATE : 04/13/1994
 CURRENT TIME : 00:00:02

DAILY EMISSIONS REPORT FOR
 DATE : 04/12/1994

TIME	OPACITY		OPACITY INDEX	
	# OF 6 MIN ALM	AVG%	# OF EXCESSES	AVG INDEX
0000-0100				
0100-0200				
0200-0300	5	60.96		
0300-0400				
0400-0500				
0500-0600				
0600-0700				
0700-0800				
0800-0900				
0900-1000				
1000-1100				
1100-1200				
1200-1300				
1300-1400				
1400-1500				
1500-1600				
1600-1700				
1700-1800				
1800-1900				
1900-2000				
2000-2100				
2100-2200				
2200-2300				
2300-2400				
SUMMARY	5	60.96		
LIMITS		40.00		34.00

RLS 1489094

PLANT: YATES
 UNIT : 1-3
 CURRENT DATE : 04/15/1994
 CURRENT TIME : 00:00:02

DAILY EMISSIONS REPORT FOR
 DATE : 04/14/1994

TIME	# OF 6 MIN ALM	CAPACITY AVG%	# OF EXCESSES	CAPACITY INDEX AVG INDEX
0000-0100				
0100-0200				
0200-0300				
0300-0400				
0400-0500				
0500-0600				
0600-0700				
0700-0800				
0800-0900				
0900-1000				
1000-1100				
1100-1200				
1200-1300				
1300-1400	1	52.12		
1400-1500				
1500-1600				
1600-1700				
1700-1800				
1800-1900				
1900-2000	1	61.33		
2000-2100				
2100-2200				
2200-2300				
2300-2400				
SUMMARY	2	56.72		
LIMITS		40.00		34.00

PLANT: YATES
 UNIT : 1-3
 CURRENT DATE : 04/17/1994
 CURRENT TIME : 00:00:02

DAILY EMISSIONS REPORT FOR
 DATE : 04/16/1994

TIME	OPACITY		OPACITY INDEX	
	# OF 6 MIN ALM	AVG%	# OF EXCESSES	AVG INDEX
0000-0100				
0100-0200				
0200-0300				
0300-0400				
0400-0500				
0500-0600				
0600-0700				
0700-0800				
0800-0900				
0900-1000				
1000-1100				
1100-1200				
1200-1300	3	72.67		
1300-1400				
1400-1500				
1500-1600	1	62.98		
1600-1700				
1700-1800				
1800-1900	3	57.95		
1900-2000				
2000-2100				
2100-2200				
2200-2300				
2300-2400				
SUMMARY	7	64.53		
LIMITS		40.00		34.00

PLANT: YATES
 UNIT : 1-3
 CURRENT DATE : 04/18/1994
 CURRENT TIME : 00:00:02

DAILY EMISSIONS REPORT FOR
 DATE : 04/17/1994

TIME	OPACITY		OPACITY INDEX	
	# OF 6 MIN ALM	AVG%	# OF EXCESSES	AVG INDEX
0000-0100				
0100-0200				
0200-0300				
0300-0400				
0400-0500				
0500-0600				
0600-0700				
0700-0800				
0800-0900				
0900-1000				
1000-1100				
1100-1200				
1200-1300				
1300-1400				
1400-1500	6	57.40		
1500-1600	10	74.85		
1600-1700	8	47.86	1	42.55
1700-1800				
1800-1900				
1900-2000	1	41.37		
2000-2100				
2100-2200				
2200-2300				
2300-2400				
SUMMARY	25	55.37	1	42.55
LIMITS		40.00		34.00

PLANT: YATES
 UNIT : 1-3
 CURRENT DATE : 04/23/1994
 CURRENT TIME : 00:00:02

DAILY EMISSIONS REPORT FOR
 DATE : 04/22/1994

TIME	OPACITY		OPACITY INDEX	
	# OF 6 MIN ALM	AVG%	# OF EXCESSES	AVG INDEX
0000-0100				
0100-0200				
0200-0300				
0300-0400				
0400-0500				
0500-0600				
0600-0700				
0700-0800				
0800-0900				
0900-1000				
1000-1100				
1100-1200				
1200-1300				
1300-1400				
1400-1500				
1500-1600				
1600-1700				
1700-1800				
1800-1900				
1900-2000				
2000-2100				
2100-2200				
2200-2300				
2300-2400	1	74.17		
SUMMARY	1	74.17		
LIMITS		40.00		34.00

PLANT: YATES
 UNIT : 1-3
 CURRENT DATE : 04/24/1994
 CURRENT TIME : 00:00:02

DAILY EMISSIONS REPORT FOR
 DATE : 04/23/1994

TIME	OPACITY		OPACITY INDEX	
	# OF 6 MIN ALM	AVG%	# OF EXCESSIES	AVG INDEX
0000-0100	9	78.92		
0100-0200				
0200-0300				
0300-0400	2	63.66		
0400-0500				
0500-0600				
0600-0700				
0700-0800				
0800-0900				
0900-1000				
1000-1100				
1100-1200				
1200-1300				
1300-1400				
1400-1500				
1500-1600				
1600-1700				
1700-1800				
1800-1900				
1900-2000				
2000-2100				
2100-2200				
2200-2300				
2300-2400				
SUMMARY	11	71.29		
LIMITS		40.00		34.00

PLANT: YATES
 UNIT : 1-3
 CURRENT DATE : 04/26/1994
 CURRENT TIME : 00:00:02

DAILY EMISSIONS REPORT FOR
 DATE : 04/25/1994

TIME	OPACITY		OPACITY INDEX	
	# OF 6 MIN ALM	AVG%	# OF EXCESSES	AVG INDEX
0000-0100				
0100-0200				
0200-0300				
0300-0400				
0400-0500				
0500-0600				
0600-0700				
0700-0800				
0800-0900				
0900-1000				
1000-1100				
1100-1200				
1200-1300				
1300-1400				
1400-1500				
1500-1600				
1600-1700				
1700-1800				
1800-1900				
1900-2000	1	77.79		
2000-2100	1	45.93		
2100-2200				
2200-2300				
2300-2400				
SUMMARY	2	61.86		
LIMITS		40.00		34.00

PLANT: YATES
 UNIT : 1-3
 CURRENT DATE : 04/27/1994
 CURRENT TIME : 00:00:02

DAILY EMISSIONS REPORT FOR
 DATE : 04/26/1994

TIME	CAPACITY		CAPACITY INDEX	
	# OF 6 MIN ALM	AVG%	# OF EXCESSSES	AVG INDEX
0000-0100				
0100-0200				
0200-0300				
0300-0400				
0400-0500				
0500-0600				
0600-0700				
0700-0800				
0800-0900				
0900-1000				
1000-1100				
1100-1200	1	43.31		
1200-1300				
1300-1400				
1400-1500				
1500-1600				
1600-1700				
1700-1800				
1800-1900				
1900-2000				
2000-2100				
2100-2200				
2200-2300				
2300-2400				
SUMMARY	1	43.31		
LIMITS		40.00		34.00

RLS 1489101

PLANT: YATES
 UNIT : 1-3
 CURRENT DATE : 04/29/1994
 CURRENT TIME : 00:00:02

DAILY EMISSIONS REPORT FOR
 DATE : 04/28/1994

TIME	OPACITY		OPACITY INDEX	
	# OF 6 MIN ALM	AVG%	# OF EXCESSES	AVG INDEX
0000-0100				
0100-0200				
0200-0300				
0300-0400				
0400-0500				
0500-0600				
0600-0700				
0700-0800	2	55.16		
0800-0900				
0900-1000				
1000-1100				
1100-1200	1	45.00		
1200-1300				
1300-1400				
1400-1500				
1500-1600				
1600-1700				
1700-1800				
1800-1900				
1900-2000				
2000-2100				
2100-2200				
2200-2300				
2300-2400				
SUMMARY	3	50.12		
LIMITS		40.00		34.00

PLANT: YATES
 UNIT : 1-3
 CURRENT DATE : 05/03/1994
 CURRENT TIME : 00:00:02

DAILY EMISSIONS REPORT FOR
 DATE : 05/02/1994

TIME	OPACITY		OPACITY INDEX	
	# OF 6 MIN ALM	AVG%	# OF EXCESSES	AVG INDEX
0000-0100				
0100-0200				
0200-0300				
0300-0400				
0400-0500				
0500-0600				
0600-0700				
0700-0800				
0800-0900				
0900-1000				
1000-1100				
1100-1200				
1200-1300				
1300-1400				
1400-1500				
1500-1600				
1600-1700				
1700-1800				
1800-1900				
1900-2000				
2000-2100				
2100-2200				
2200-2300				
2300-2400	1	44.52		
SUMMARY	1	44.52		
LIMITS		40.00		34.00

PLANT: YATES
 UNIT : 1-3
 CURRENT DATE : 05/04/1994
 CURRENT TIME : 00:00:02

DAILY EMISSIONS REPORT FOR
 DATE : 05/03/1994

TIME	OPACITY		OPACITY INDEX	
	# OF 6 MIN ALM	AVG%	# OF EXCESSES	AVG INDEX
0000-0100	1	40.67		
0100-0200				
0200-0300				
0300-0400				
0400-0500				
0500-0600				
0600-0700				
0700-0800				
0800-0900				
0900-1000				
1000-1100				
1100-1200				
1200-1300				
1300-1400				
1400-1500				
1500-1600				
1600-1700				
1700-1800				
1800-1900				
1900-2000				
2000-2100				
2100-2200				
2200-2300				
2300-2400				
SUMMARY	1	40.67		
LIMITS		40.00		34.00

RLS 1489104

PLANT: YATES
 UNIT : 1-3
 CURRENT DATE : 05/16/1994
 CURRENT TIME : 00:00:06

DAILY EMISSIONS REPORT FOR
 DATE : 05/15/1994

TIME	CAPACITY		CAPACITY INDEX	
	# OF 6 MIN ALM	AVG%	# OF EXCESSES	AVG INDEX
0000-0100				
0100-0200				
0200-0300				
0300-0400				
0400-0500				
0500-0600				
0600-0700				
0700-0800				
0800-0900				
0900-1000				
1000-1100				
1100-1200				
1200-1300				
1300-1400	2	68.90		
1400-1500	1	40.37		
1500-1600	4	46.19		
1600-1700	1	40.71		
1700-1800	1	42.13		
1800-1900				
1900-2000				
2000-2100				
2100-2200	5	58.31		
2200-2300	1	51.01		
2300-2400				
SUMMARY	15	49.66		
LIMITS		40.00		34.00

PLANT: YATES
 UNIT : 1-3
 CURRENT DATE : 05/17/1994
 CURRENT TIME : 00:00:06

DAILY EMISSIONS REPORT FOR
 DATE : 05/16/1994

TIME	OPACITY		OPACITY INDEX	
	# OF 6 MIN ALM	AVG%	# OF EXCESSES	AVG INDEX
0000-0100				
0100-0200				
0200-0300	1	40.51		
0300-0400	1	41.05		
0400-0500				
0500-0600	1	48.71		
0600-0700				
0700-0800				
0800-0900				
0900-1000				
1000-1100				
1100-1200				
1200-1300				
1300-1400				
1400-1500				
1500-1600				
1600-1700				
1700-1800				
1800-1900				
1900-2000				
2000-2100				
2100-2200				
2200-2300				
2300-2400				
SUMMARY	3	43.42		
LIMITS		40.00		34.00

PLANT: YATES
 UNIT : 1-3
 CURRENT DATE : 05/23/1994
 CURRENT TIME : 00:00:06

DAILY EMISSIONS REPORT FOR
 DATE : 05/22/1994

TIME	CAPACITY		CAPACITY INDEX	
	# OF 6 MIN ALM	AVG%	# OF EXCESSES	AVG INDEX
0000-0100				
0100-0200				
0200-0300				
0300-0400				
0400-0500				
0500-0600				
0600-0700				
0700-0800				
0800-0900				
0900-1000				
1000-1100				
1100-1200				
1200-1300				
1300-1400				
1400-1500				
1500-1600	1	45.76		
1600-1700				
1700-1800				
1800-1900				
1900-2000	2	52.25		
2000-2100				
2100-2200				
2200-2300				
2300-2400				
SUMMARY	3	49.02		
LIMITS		40.00		34.00

RLS 1489107

PLANT: YATES
 UNIT : 1-3
 CURRENT DATE : 05/24/1994
 CURRENT TIME : 00:00:06

DAILY EMISSIONS REPORT FOR
 DATE : 05/23/1994

TIME	CAPACITY		CAPACITY INDEX	
	# OF 6 MIN ALM	AVG%	# OF EXCESSES	AVG INDEX
0000-0100				
0100-0200				
0200-0300				
0300-0400	3	45.83		
0400-0500	2	48.75		
0500-0600				
0600-0700				
0700-0800				
0800-0900				
0900-1000				
1000-1100				
1100-1200				
1200-1300	1	41.70		
1300-1400				
1400-1500				
1500-1600				
1600-1700				
1700-1800				
1800-1900				
1900-2000				
2000-2100				
2100-2200				
2200-2300				
2300-2400				
SUMMARY	6	45.43		
LIMITS		40.00		34.00

PLANT: YATES
 UNIT : 1-3
 CURRENT DATE : 05/28/1994
 CURRENT TIME : 00:00:06

DAILY EMISSIONS REPORT FOR
 DATE : 05/27/1994

TIME	OPACITY		OPACITY INDEX	
	# OF 6 MIN ALM	AVG%	# OF EXCESSES	AVG INDEX
0000-0100				
0100-0200				
0200-0300				
0300-0400				
0400-0500				
0500-0600	1	42.28		
0600-0700				
0700-0800				
0800-0900				
0900-1000				
1000-1100				
1100-1200				
1200-1300				
1300-1400				
1400-1500				
1500-1600				
1600-1700				
1700-1800				
1800-1900				
1900-2000				
2000-2100				
2100-2200				
2200-2300				
2300-2400				

SUMMARY 1 42.28
 LIMITS 40.00

34.00

PLANT: YATES
 UNIT : 1-3
 CURRENT DATE : 06/03/1994
 CURRENT TIME : 00:00:03

DAILY EMISSIONS REPORT FOR
 DATE : 06/02/1994

TIME	OPACITY		OPACITY INDEX	
	# OF 6 MIN ALM	AVG%	# OF EXCESSES	AVG INDEX
0000-0100				
0100-0200				
0200-0300				
0300-0400				
0400-0500				
0500-0600				
0600-0700				
0700-0800				
0800-0900				
0900-1000				
1000-1100				
1100-1200				
1200-1300				
1300-1400				
1400-1500	1	49.19		
1500-1600				
1600-1700				
1700-1800				
1800-1900				
1900-2000				
2000-2100				
2100-2200				
2200-2300				
2300-2400				
SUMMARY	1	49.19		
LIMITS		40.00		34.00

PLANT: YATES
 UNIT : 1-3
 CURRENT DATE : 06/04/1994
 CURRENT TIME : 00:00:03

DAILY EMISSIONS REPORT FOR
 DATE : 06/03/1994

TIME	CAPACITY		CAPACITY INDEX	
	# OF 6 MIN ALM	AVG%	# OF EXCESSES	AVG INDEX
0000-0100				
0100-0200				
0200-0300				
0300-0400				
0400-0500				
0500-0600				
0600-0700				
0700-0800				
0800-0900				
0900-1000				
1000-1100				
1100-1200				
1200-1300				
1300-1400	1	40.30		
1400-1500				
1500-1600				
1600-1700				
1700-1800				
1800-1900				
1900-2000				
2000-2100				
2100-2200				
2200-2300				
2300-2400				
SUMMARY	1	40.30		
LIMITS		40.00		34.00

PLANT: YATES
 UNIT : 1-3
 CURRENT DATE : 06/05/1994
 CURRENT TIME : 00:00:03

DAILY EMISSIONS REPORT FOR
 DATE : 06/04/1994

TIME	OPACITY		OPACITY INDEX	
	# OF 6 MIN ALM	AVG%	# OF EXCESSES	AVG INDEX
0000-0100				
0100-0200				
0200-0300				
0300-0400				
0400-0500				
0500-0600				
0600-0700				
0700-0800				
0800-0900				
0900-1000				
1000-1100				
1100-1200				
1200-1300	1	46.89		
1300-1400				
1400-1500				
1500-1600				
1600-1700				
1700-1800				
1800-1900				
1900-2000				
2000-2100				
2100-2200				
2200-2300				
2300-2400				
SUMMARY	1	46.89		
LIMITS		40.00		34.00

PLANT: YATES
 UNIT : 1-3
 CURRENT DATE : 06/09/1994
 CURRENT TIME : 00:00:03

DAILY EMISSIONS REPORT FOR
 DATE : 06/08/1994

TIME	CAPACITY		CAPACITY INDEX	
	# OF 6 MIN ALM	AVG%	# OF EXCESSES	AVG INDEX
0000-0100				
0100-0200				
0200-0300				
0300-0400				
0400-0500				
0500-0600				
0600-0700				
0700-0800				
0800-0900				
0900-1000				
1000-1100				
1100-1200				
1200-1300				
1300-1400				
1400-1500				
1500-1600				
1600-1700				
1700-1800				
1800-1900				
1900-2000	1	49.45		
2000-2100				
2100-2200				
2200-2300				
2300-2400				
SUMMARY	1	49.45		
LIMITS		40.00		34.00

PLANT: YATES
 UNIT : 1-3
 CURRENT DATE : 06/11/1994
 CURRENT TIME : 00:00:03

DAILY EMISSIONS REPORT FOR
 DATE : 06/10/1994

TIME	OPACITY		OPACITY INDEX	
	# OF 6 MIN ALM	AVG%	# OF EXCESSES	AVG INDEX
0000-0100				
0100-0200				
0200-0300				
0300-0400				
0400-0500				
0500-0600				
0600-0700				
0700-0800				
0800-0900				
0900-1000	1	44.26		
1000-1100				
1100-1200				
1200-1300				
1300-1400				
1400-1500				
1500-1600				
1600-1700				
1700-1800				
1800-1900				
1900-2000				
2000-2100				
2100-2200				
2200-2300				
2300-2400				
SUMMARY	1	44.26		
LIMITS		40.00		34.00

PLANT: YATES
 UNIT : 1-3
 CURRENT DATE : 06/14/1994
 CURRENT TIME : 00:00:03

DAILY EMISSIONS REPORT FOR
 DATE : 06/13/1994

TIME	OPACITY		OPACITY INDEX	
	# OF 6 MIN ALM	AVG%	# OF EXCESSES	AVG INDEX
0000-0100				
0100-0200				
0200-0300				
0300-0400				
0400-0500				
0500-0600				
0600-0700				
0700-0800				
0800-0900				
0900-1000				
1000-1100	1	84.38		
1100-1200	3	49.45		
1200-1300				
1300-1400				
1400-1500				
1500-1600				
1600-1700				
1700-1800				
1800-1900				
1900-2000				
2000-2100				
2100-2200				
2200-2300				
2300-2400				
SUMMARY	4	66.92		
LIMITS		40.00		34.00

PLANT: YATES
 UNIT : 1-3
 CURRENT DATE : 06/21/1994
 CURRENT TIME : 00:00:03

DAILY EMISSIONS REPORT FOR
 DATE : 06/20/1994

TIME	CAPACITY		CAPACITY INDEX	
	# OF 6 MIN ALM	AVG%	# OF EXCESSES	AVG INDEX
0000-0100				
0100-0200				
0200-0300				
0300-0400				
0400-0500				
0500-0600				
0600-0700				
0700-0800				
0800-0900				
0900-1000				
1000-1100	1	59.90		
1100-1200				
1200-1300				
1300-1400				
1400-1500				
1500-1600				
1600-1700				
1700-1800				
1800-1900				
1900-2000				
2000-2100				
2100-2200				
2200-2300				
2300-2400				
SUMMARY	1	59.90		
LIMITS		40.00		34.00

PLANT: YATES
 UNIT : 1-3
 CURRENT DATE : 06/26/1994
 CURRENT TIME : 00:00:03

DAILY EMISSIONS REPORT FOR
 DATE : 06/25/1994

TIME	OPACITY		OPACITY INDEX	
	# OF 6 MIN ALM	AVG%	# OF EXCESSES	AVG INDEX
0000-0100				
0100-0200	2	68.25		
0200-0300				
0300-0400				
0400-0500	1	46.07		
0500-0600				
0600-0700				
0700-0800				
0800-0900				
0900-1000				
1000-1100				
1100-1200				
1200-1300				
1300-1400				
1400-1500				
1500-1600				
1600-1700	3	61.83		
1700-1800				
1800-1900				
1900-2000				
2000-2100				
2100-2200				
2200-2300				
2300-2400				
SUMMARY	6	58.78		
LIMITS		40.00		34.00

PLANT: YATES
 UNIT: 1-3
 CURRENT DATE: 06/27/1994
 CURRENT TIME: 00:00:03

DAILY EMISSIONS REPORT FOR
 DATE: 06/26/1994

TIME	OPACITY		OPACITY INDEX	
	# OF 6 MIN ALM	AVG%	# OF EXCESSES	AVG INDEX
0000-0100				
0100-0200				
0200-0300				
0300-0400				
0400-0500				
0500-0600				
0600-0700				
0700-0800				
0800-0900				
0900-1000				
1000-1100				
1100-1200	1	55.47		
1200-1300	3	51.97		
1300-1400				
1400-1500				
1500-1600	10	54.32	1	36.74
1600-1700				
1700-1800				
1800-1900				
1900-2000	7	63.44		
2000-2100				
2100-2200				
2200-2300				
2300-2400				
SUMMARY	21	56.30	1	36.74
LIMITS		40.00		34.00

PLANT: YATES
 UNIT : 1-3
 CURRENT DATE : 06/28/1994
 CURRENT TIME : 06:47:56

DEMAND FOR DAILY EMISSIONS REPORT FOR
 DATE : 06/27/1994

TIME	OPACITY		OPACITY INDEX	
	# OF 6 MIN ALM	AVG%	# OF EXCESSES	AVG INDEX
0000-0100				
0100-0200	2	59.07		
0200-0300				
0300-0400	1	48.00		
0400-0500				
0500-0600				
0600-0700				
0700-0800				
0800-0900				
0900-1000	1	58.51		
1000-1100				
1100-1200				
1200-1300				
1300-1400				
1400-1500				
1500-1600				
1600-1700				
1700-1800				
1800-1900				
1900-2000				
2000-2100				
2100-2200				
2200-2300				
2300-2400				
SUMMARY	4	58.25		
LIMITS		40.00		34.00

PLANT: YATES
 UNIT : 1-3
 CURRENT DATE : 06/30/1994
 CURRENT TIME : 00:00:02

DAILY EMISSIONS REPORT FOR
 DATE : 06/29/1994

TIME	OPACITY		OPACITY INDEX	
	# OF 5 MIN ALM	AVG%	# OF EXCEEDED	AVG INDEX
0000-0100				
0100-0200				
0200-0300	3	61.46		
0300-0400	2	66.32		
0400-0500				
0500-0600				
0600-0700				
0700-0800				
0800-0900				
0900-1000				
1000-1100				
1100-1200				
1200-1300				
1300-1400				
1400-1500				
1500-1600				
1600-1700				
1700-1800				
1800-1900				
1900-2000				
2000-2100				
2100-2200				
2200-2300				
2300-2400				
SUMMARY	5	63.89		
LIMITS		40.00		34.00

Appendix B

**Quarterly Operational Monitoring Report
for the Second Quarter of 1994**

QUARTERLY OPERATION MONITORING REPORT

Georgia Power Company
Plant Yates
P.O. Box 718
Newnan, Georgia 30264


From: 04-01-94
To: 06-30-94

Permit Number: GA0001473

There were no discharges from the following outfalls during the quarter covered by this report:

01L	Building Sump Overflow
01M	Building Sump Overflow
01N	Building Sump Overflow
02	Ash Pond Emergency Overflow
04	Low Volume Waste Sump
05	Coal Pile Runoff Emergency Overflow

"I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."



M. J. Knowles
Plant Manager

Attachment

Appendix C

**Groundwater Monitoring Report
for the First Quarter of 1994**

RCN 218-070-07-20

**DEMONSTRATION OF INNOVATIVE APPLICATIONS
OF TECHNOLOGY FOR THE CT-121 FGD PROCESS**

Plant Yates

**Environmental Monitoring Program Report:
Groundwater Monitoring for the First Quarter of 1994
(Final)**

**DOE DE-FC22-90PC89650
SCS C-90-002284**

Prepared for:

**Southern Company Services, Inc.
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Birmingham, Alabama 35291-1195**

Prepared by:

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Cleared by DOE Patent Counsel on September 11, 1995.

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1.0 INTRODUCTION

This report summarizes the results of groundwater monitoring performed during the first calendar quarter of 1994 as part of the environmental monitoring program (EMP) for the U.S. Department of Energy's Innovative Clean Coal Technology project entitled "Demonstration of Innovative Applications of Technology for the CT-121 FGD Process." This demonstration project is being conducted at Georgia Power Company's Plant Yates Unit 1, located near Newnan, Georgia.

1.1 Project Summary

The purpose of this ICCT project is to demonstrate the use of the Chiyoda Thoroughbred-121 flue gas desulfurization process as a means of reducing SO₂ and particulate emissions from pulverized-coal utility boilers that use medium-sulfur coal. This project is also designed to demonstrate the lower cost and higher reliability of the CT-121 process compared to conventional wet limestone FGD processes.

The demonstration project at Plant Yates consists of four distinct environmental test periods:

- Period 0: Site Preparation, Construction, and Startup of the Demonstration Project (including background groundwater monitoring [29 months]);
- Period 1: Baseline Testing at Low Particulate Loading--ESP In Service (12 months);
- Period 2: Testing at High Particulate Loading--ESP Detuned or Out of Service (12 months); and
- Period 3: Post Demonstration Groundwater Testing and Gypsum Byproduct Evaluation.

Groundwater monitoring was initiated in Period 0 and will continue through Period 3.

1.2 Purpose and Scope of Groundwater Monitoring

The CT-121 process produces gypsum, which is being disposed of in an on-site stacking area, where the solids are concentrated as they are allowed to settle, dewater, and dry. The gypsum and gypsum/fly ash stacking area is lined with a synthetic liner to minimize the potential for adverse impacts on the groundwater. Requirements for the liner, leachate collection system, and groundwater monitoring are specified in the permit issued by the Georgia Department of Natural Resources (DNR). One requirement is the regular monitoring of groundwater before, during, and for two years after the demonstration program. The purpose of this monitoring is to demonstrate that the gypsum stacking area can be operated in an environmentally benign and acceptable manner.

In 1990, five groundwater monitoring wells were installed in the vicinity of the proposed gypsum stacking area. These wells were used to monitor baseline groundwater quality prior to construction of the stacking area. Monitoring was conducted every two months from September 1990 through July 1991. Table 1 is a summary of the parameters that were monitored during this period. The results of this monitoring activity were summarized in the report "Environmental Monitoring Program Report of Preconstruction Monitoring: 1990-1991 Background Water Quality."

Following the preconstruction monitoring period, and as a DNR permit requirement, two additional monitoring wells were installed in 1992. The locations of all seven monitoring wells are shown in Figure 1. Because of a delay in the commencement of Phase 1 testing, an additional round of preoperational groundwater monitoring was conducted on September 3-4 and October 14, 1992. The results from this monitoring effort were presented in the report "Interim Data Report of Preoperational Groundwater Monitoring: September 3-4 and October 14, 1992."

Table 1

EMP Groundwater Monitoring Parameters

pH	Conductivity	Temperature
Eh	Alkalinity	Total Dissolved Solids
Bromide	Chloride	Total Organic Carbon
Fluoride	Nitrate-Nitrite	Sulfate
Trace Elements (Dissolved)		
Silver	Aluminum	Arsenic
Boron	Barium	Beryllium
Bismuth	Calcium	Cadmium
Cobalt	Copper	Chromium
Mercury	Iron	Potassium
Lithium	Magnesium	Manganese
Molybdenum	Sodium	Nickel
Phosphorus	Lead	Sulfur
Antimony	Selenium	Silicon
Tin	Strontium	Tellurium
Titanium	Thallium	Uranium
Vanadium	Tungsten	Zinc
Other		
Radionuclides		

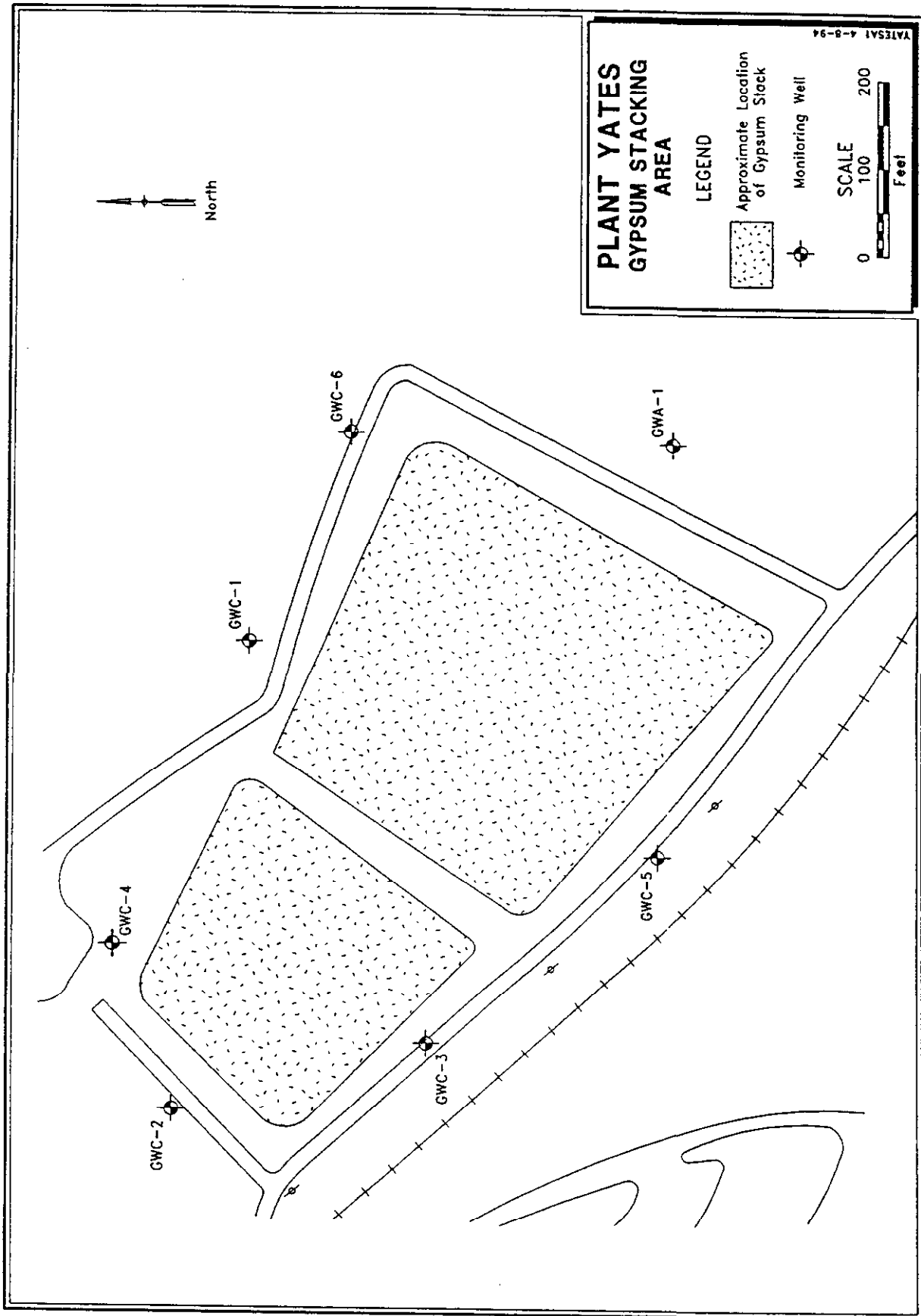


Figure 1. Location of Groundwater Monitoring Wells

Operati
basis, was initiated in
parameters shown pre
ters shown except for

1.3 **Report**

To ensure the collection of a representative sample, standing water was removed from each well by purging a minimum of three wetted casing volumes. Conductivity, pH, redox potential, and temperature were monitored and recorded on field sampling forms during purging. Samples were collected when these indicator parameters stabilized after at least three wetted casing volumes of water were removed or immediately following recovery if a well was purged dry.

Samples were obtained from five of the six downgradient wells (GWC-1, GWC-2, GWC-3, GWC-4, and GWC-5). As has been the case during previous rounds of monitoring, well GWC-6 could not be sampled since it was unproductive and contained no water. The upgradient well (GWA-1) was also dry again this quarter, as it was during the fourth quarter 1993 round of groundwater monitoring. Table 2 summarizes the groundwater samples collected during this monitoring period.

To preserve the integrity of the groundwater samples before analyses, proper sample container, preservation, holding time duration, shipment, and chain-of-custody procedures were followed. Sample bottles, preservation methods, and maximum holding times are summarized in Table 3.

2.2 Analytical Procedures

The analytical methods used in this program are listed in Table 4. There were no deviations from these methods.

3.0 SUMMARY OF RESULTS

The results of the first-quarter 1994 groundwater monitoring are presented in Table 5. The concentrations of all of the monitored dissolved constituents in the groundwater near the gypsum stacking area continue to be low.

Table 2

**Summary of Groundwater Samples Collected
at Plant Yates on March 22-23, 1994**

Well ID	Sample ID	Analyses
GWA-1	None	Well dry; no samples collected
GWC-1	GWC-1-13-1	Anions, TOC, Metals, and Radionuclides
GWC-2	GWC-2-13-1	Anions, TOC, Metals, and Radionuclides
GWC-3	GWC-3-13-1 GWC-3-13-2	Anions, TOC, Metals, and Radionuclides Anions, TOC, Metals, and Radionuclides
GWC-4	GWC-4-13-1	Anions, TOC, Metals, and Radionuclides
GWC-5	GWC-5-13-1	Anions, TOC, Metals, and Radionuclides
GWC-6	None	Well dry; no samples collected

Table 3
Sample Containers, Preservation Method, and Maximum Holding Times

Bottle Label	Containers *	Parameter	Preservation Method	Maximum Holding Time (days)
Total Organic Carbon	500-mL Amber Glass	Total Organic Carbon	H ₂ SO ₄ pH < 2	28
Anions/TDS	1-L Plastic	Bromide	4 °C	28
		Chloride	4 °C	28
		Fluoride	4 °C	28
		Nitrate-Nitrite	4 °C	28
		Sulfate	4 °C	28
Metals	1-L Plastic	Total Dissolved Solids	4 °C	7
		Trace Metals	Filtered On Site Ultrex II HNO ₃ pH < 2	180
Radioactivity	(3) 1-L Plastic	Radium 226, Radium 228, Gross Alpha, Gross Beta, Gross Gamma	Filtered On Site Ultrex II HNO ₃ pH < 2	180

* Sample containers supplied by either I-Chem or Eagle Picher.

Table 4
Analytical Methods

Parameter	Technique	Reference
pH	Potentiometry	EPA 150.1
Conductivity	Specific Conductance	EPA 120.1
Temperature	Temperature Probe	EPA 170.1
Eh	Electrometry	ASTM D1498
Alkalinity	Titrimetric or Colorimetric	EPA 310.1 or 310.2
Bromide	Ion Chromatography	EPA 300
Chloride	Ion Chromatography	EPA 300
Total Organic Carbon	Combustion/IR	EPA 415.1
Fluoride	SIE	EPA 340.2
Nitrate/Nitrite	Colorimetry	EPA 353.1
Sulfate	Ion Chromatography	EPA 300
Total Dissolved Solids	Filtration/Evaporation/Gravimetry	EPA 160.2
Mercury	On-site Filtration/Cold Vapor AA	EPA 245.1
Trace Elements	On-site Filtration/AA and ICP-AES	EPA 200.7, 7421 (Cr), 7060 (As), 7421 (Pb), 7041 (Sb), 7740 (Se), and 7841 (Tl)
Radium 226 and 228	Proportional Counter	ASTM D2460
Gross Alpha	Proportional Counter	ASTM D1943
Gross Beta	Proportional Counter	ASTM D1890
Gross Gamma	Gamma Ray Spectrometer	ASTM D2459

Legend:

AA = Atomic absorption spectrophotometry;
 SIE = Specific ion electrode;
 ICP-AES = Inductively coupled plasma-atomic emission spectrometry; and
 IR = Infrared detection.

References:

EPA "Methods for Chemical Analysis of Water and Wastes," EPA-600/4-79-020, revised March 1983.
 ASTM = American Society for Testing and Material, *Annual Book of ASTM Standards*.

Table 5

Results of Groundwater Monitoring Conducted March 22-23, 1994 (1st Quarter 1994)

Parameter	GWA-1-13-1 *	GWC-1-13-1	GWC-2-13-1	GWC-3-13-1	GWC-4-13-1	GWC-5-13-1
pH		5.89	5.50	5.18	4.98	5.38
Conductivity (μ S/cm)		61	57	28	72	43
Temperature ($^{\circ}$ C)		16.5	17.4	17.2	16	17.8
Eh (mV)		126	149	161	299	206
Alkalinity (mg/L CaCO ₃)		25	14	7.5	5.0	8.6
Total Dissolved Solids (mg/L)		66	76	42 ^c	64	53
Bromide (mg/L)		<0.0277	<0.0277	<0.0277	0.133 ^c	<0.0277
Chloride (mg/L)		2.43	3.70	2.77	11.3	2.34
Total Organic Carbon (mg/L)		<0.357	<0.357	<0.357	<0.357	<0.357
Fluoride (mg/L)		0.0557 ^b	0.0390 ^b	0.0372 ^b	0.0357 ^b	0.0320 ^b
Nitrate-Nitrite (mg/L as N)		0.414	0.443	0.0827	0.943	0.0433 ^c
Sulfate (mg/L)		1.75	5.97	1.38	4.64	6.56
Radium 226 and 228 (pCi/L)		-0.06 \pm 0.13 1.14 \pm 0.57	0.06 \pm 0.13 0.77 \pm 0.51	-0.03 \pm 0.14 0.97 \pm 0.52	-0.14 \pm 0.16 0.79 \pm 0.49	-0.09 \pm 0.17 0.89 \pm 0.51
Gross Alpha (pCi/L)		0.92 \pm 0.42	1.44 \pm 0.5	1.00 \pm 0.40	1.16 \pm 0.43	0.94 \pm 0.41
Gross Beta (pCi/L)		2.05 \pm 0.73	1.58 \pm 0.73	1.53 \pm 0.71	0.99 \pm 0.69	0.75 \pm 0.68
Gross Gamma (pCi/L)						
Ac-227		NR	NR	NR	NR	NR
Ac-228		NR	NR	NR	NR	NR
Bi-212		<109	<100	<136	<89.7	<93.7
Bi-214		157 \pm 26	60 \pm 19	43 \pm 19	45 \pm 21	37 \pm 19
Co-60		<9.13	<8.8	<11.1	<6.76	<11.0
Cs-134		<23.9	<18.4	<17.7	<19.0	<18.0
Cs-137		<6.33	<7.75	<10.9	<6.73	<10.1
K-40		<148	<146	<132	<163	<146

Table 5 (Continued)

Parameter	GWA-1-13-1 ^a	GWC-1-13-1	GWC-2-13-1	GWC-3-13-1	GWC-4-13-1	GWC-5-13-1
Pb-211		NR	NR	NR	NR	NR
Pb-212		<28.1	<20.5	<21.3	<22.3	<22.1
Pb-214		200 ± 27	89 ± 25	41 ± 22	66 ± 24	46 ± 23
Ra-223		<62.2	<37.7	<53.7	<50.9	<47.5
Ra-226		<195	<120	<180	<83.3	<165
Rn-219		<77.9	<65.1	<73.9	<72.9	<63.3
Th-227		<45.5	<90.1	<95.3	<55.9	<91.3
Th-228		<423	<623	<637	<592	<522
Th-231		<186	<187	<367	<323	<323
Th-234		<159	<202	<211	<247	<180
Tl-208		<11.6	<9.50	<11.1	<10.8	<9.80
U-235		<46.6	<38.6	<39.8	<53.7	<53.8
U-238		NR	NR	NR	NR	NR
Silver (mg/L)		<0.00492	<0.00492	<0.00492	0.0171 ^c	<0.00492
Aluminum (mg/L)		<0.0284 ^b	<0.0284 ^b	<0.0284 ^b	<0.0284 ^b	<0.0284 ^b
Arsenic (mg/L)		<0.000647	<0.000647	<0.000647	<0.000647	<0.000647
Boron (mg/L)		<0.0151	<0.0151	<0.0151	0.023	<0.0151
Barium (mg/L)		0.0142 ^b	0.0119 ^b	0.00783 ^b	0.0286 ^b	0.0375 ^b
Beryllium (mg/L)		0.00268 ^c	0.00075 ^c	<0.000554	0.0165	0.00563
Bismuth (mg/L)		<0.132	<0.132	<0.132	<0.132	<0.132
Calcium (mg/L)		4.72	2.19	0.392 ^c	1.81	1.65
Cadmium (mg/L)		<0.00172	<0.00172	<0.00172	0.0159	0.00381 ^c
Cobalt (mg/L)		0.0041 ^c	<0.00340	<0.00340	0.0183	0.00693 ^c
Copper (mg/L)		<0.00381	<0.00381	<0.00381	<0.00381	<0.00381
Chromium (mg/L)		0.00466 ^c	0.00695 ^c	<0.00249	0.0187	0.00937 ^c
Mercury (mg/L)		<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Iron (mg/L)		0.0502 ^b	0.0282 ^b	0.0142 ^b	0.188 ^b	0.179 ^b
Potassium (mg/L)		0.708 ^c	<0.370	<0.370	0.569 ^c	0.402 ^c

Table 5 (Continued)

Parameter	GWA-1-13-1 ^a	GWC-1-13-1	GWC-2-13-1	GWC-3-13-1	GWC-4-13-1	GWC-5-13-1
Lithium (mg/L)	<0.00543	<0.00543	<0.00543	<0.00543	<0.00543	<0.00543
Magnesium (mg/L)	3.14	1.92	0.00980	0.962	5.05	1.60
Manganese (mg/L)	0.00298	0.00980	0.00206	0.00206	0.0760	0.0134
Molybdenum (mg/L)	<0.00463	<0.00463	<0.00463	<0.00463	0.0179 ^c	<0.00463
Sodium (mg/L)	4.12	7.15	4.35	4.35	5.33	5.74
Nickel (mg/L)	0.0119 ^c	0.0767	<0.00986	<0.00986	0.0319 ^c	0.0121 ^c
Phosphorus (mg/L)	<0.0610	<0.0610	<0.0610	<0.0610	<0.0610	<0.0610
Lead (mg/L)	<0.00106	<0.00106	<0.00106	<0.00106	<0.00106	<0.00106
Sulfur (mg/L)	0.682	1.59	0.227	0.227	1.02	2.39
Antimony (mg/L)	<0.00156	<0.00156	<0.00156	<0.00156	<0.00156	<0.00156
Selenium (mg/L)	0.00120 ^{b,c}	0.00151 ^{b,c}	0.000730 ^{b,c}	0.000730 ^{b,c}	0.000830 ^{b,c}	<0.000592
Silicon (mg/L)	11.9	13.3	10.1	10.1	9.91	11.8
Tin (mg/L)	<0.0145	<0.0145	<0.0145	<0.0145	<0.0145	0.0213 ^c
Strontium (mg/L)	0.0117	0.0112	0.00513 ^c	0.00513 ^c	0.0112	0.0121
Tellurium (mg/L)	<0.0317	<0.0317	<0.0317	<0.0317	<0.0317	<0.0317
Titanium (mg/L)	<0.00159	<0.00159	<0.00159	<0.00159	<0.00159	<0.00159
Thallium (mg/L)	<0.00103	<0.00103	<0.00103	<0.00103	<0.00103	<0.00103
Uranium (mg/L)	<0.199	<0.199	<0.199	<0.199	<0.199	<0.199
Vanadium (mg/L)	0.00561 ^c	<0.00236	<0.00236	<0.00236	0.0168	0.00586 ^c
Tungsten (mg/L)	<0.0408	<0.0408	<0.0408	<0.0408	<0.0408	<0.0408
Zinc (mg/L)	0.00623 ^c	0.00669 ^c	0.00239 ^c	0.00239 ^c	0.0169	0.00771

^a Well was dry; no samples collected.

^b Detected in the method blank.

^c Less than five times the detection limit; results are expected to be less accurate as concentrations approach the detection limit.

NR = Not reported.

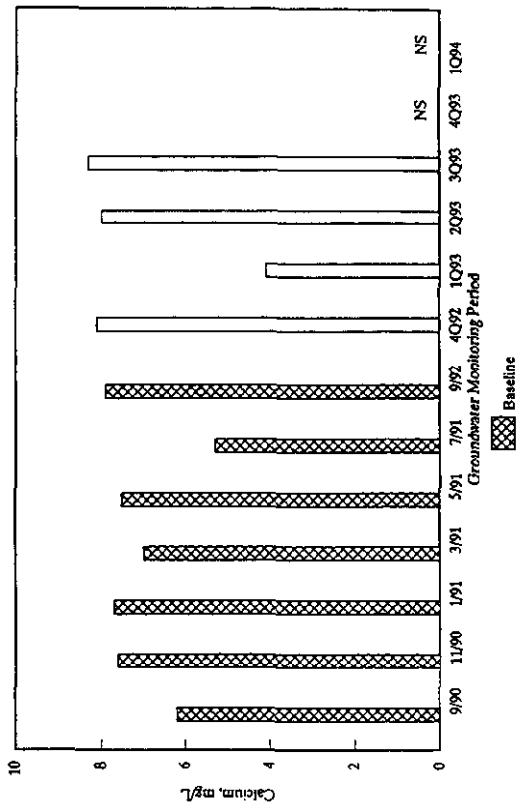
To help determine whether the material in the gypsum stacking area is having an impact on groundwater quality, the monitoring data for a selected number of representative species from all of the monitoring rounds conducted to date were tabulated and examined. The representative species selected are those present in appreciable concentrations in the gypsum slurry, including the major cations and anions (i.e., calcium, magnesium, chloride, and sulfate), as well as several other indicator parameters such as pH, TDS, conductivity, and alkalinity. The complete set of historical data for these species is provided in Appendix A. Examples of time versus concentration plots for several species are provided in Figures 2 through 4. Data are presented for the upgradient well, GWA-1, and two downgradient wells, GWC-2 and GWC-4. The location of these wells were shown previously in Figure 1. Since the upgradient well was dry this quarter, no additional data were obtained for this location.

For well GWC-2, the measured concentrations for all monitored parameters are generally close to the historically observed concentrations of these species. For well GWC-4, the concentrations of chloride, magnesium, and possibly calcium were higher than the historically observed values. The observed increases may be due to the effects of a break in the gypsum pond dike that occurred on July 24, 1993, in the vicinity of this well. Close attention should be paid to future groundwater monitoring data to observe any continuing increases in concentration of chloride, magnesium, and calcium, and to identify potential causes.

4.0 SUMMARY OF QA/QC ACTIVITIES

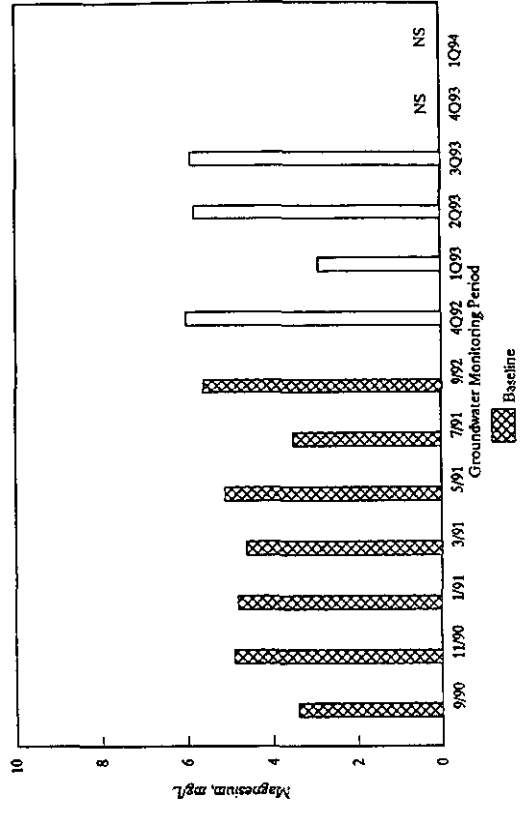
A number of QA/QC activities are being performed, as specified in the project's EMP, to assure that the data obtained meet project objectives. These include the following:

- Groundwater samples were split for independent analysis by a laboratory selected by SCS.



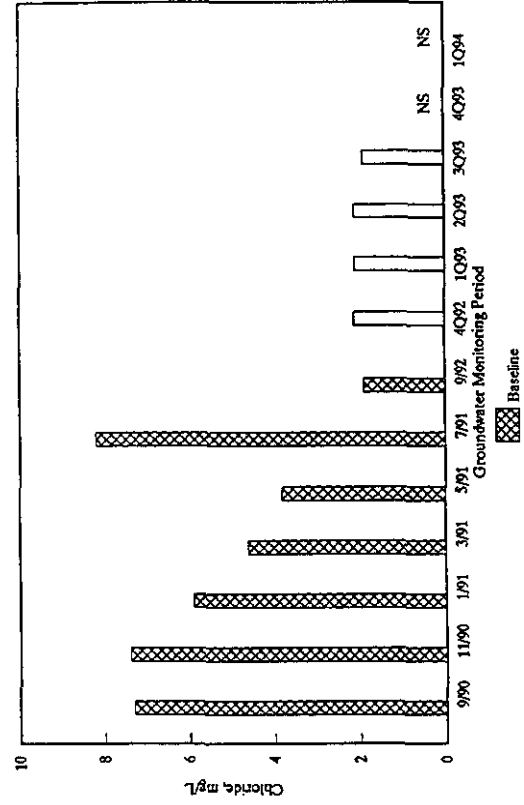
NS = Not Sampled

(a) Calcium



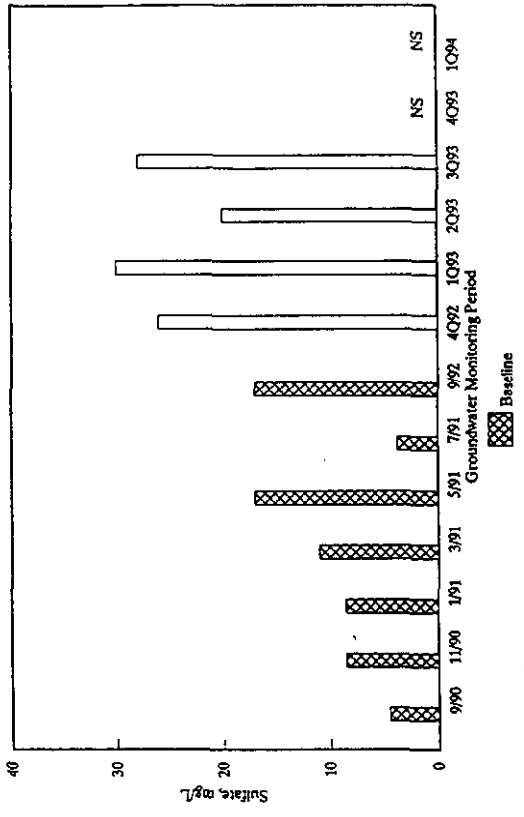
NS = Not Sampled

(b) Magnesium



NS = Not Sampled

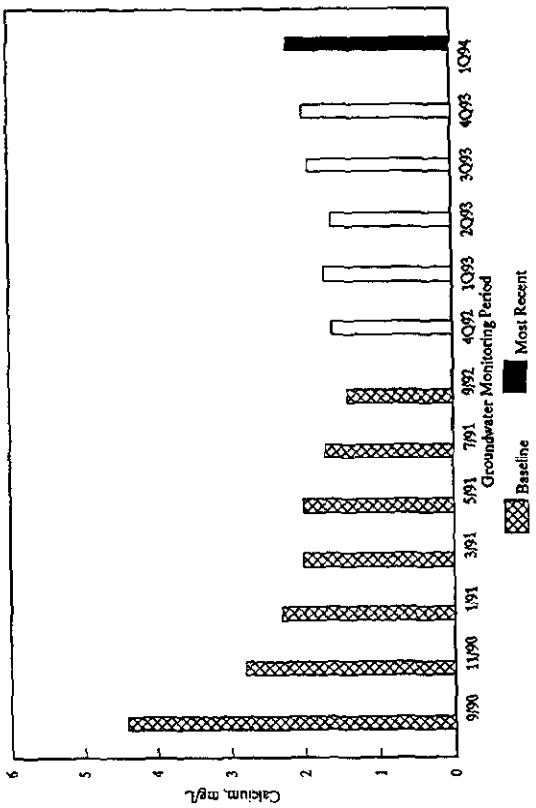
(c) Chloride



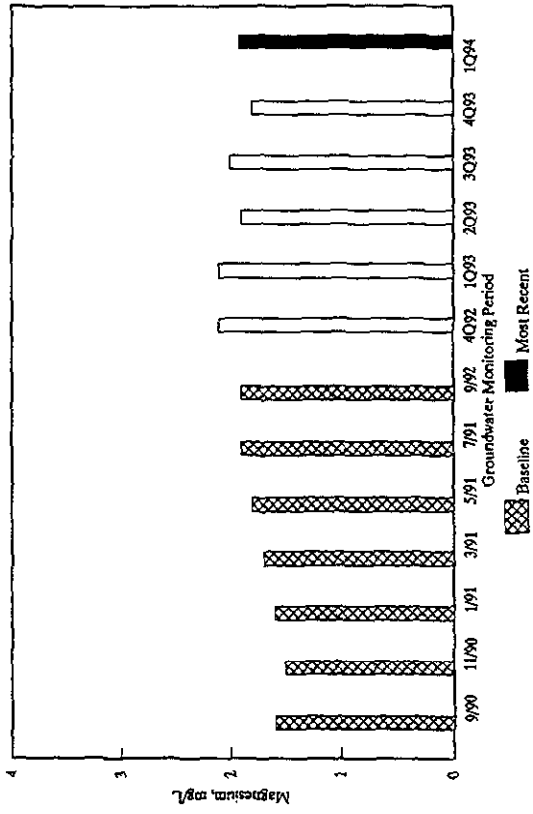
NS = Not Sampled

(d) Sulfate

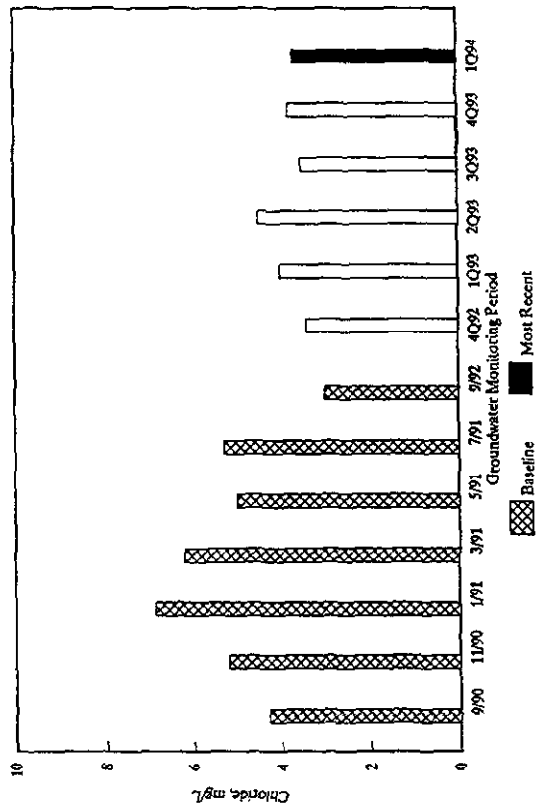
Figure 2. Historical Data for Representative Species from Well GWA-1 (Upgradient)



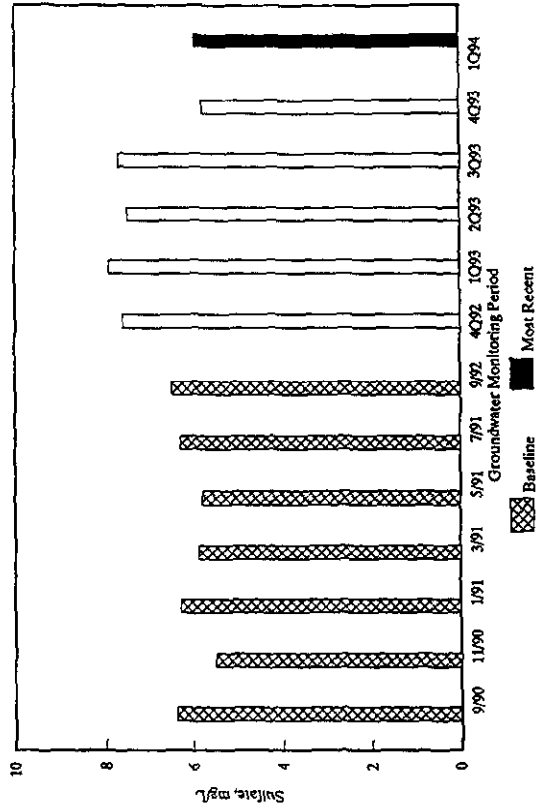
(a) Calcium



(b) Magnesium

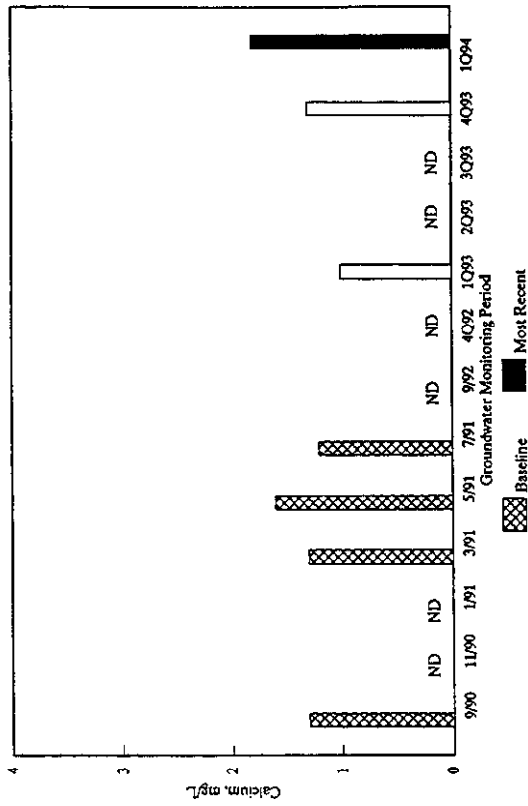


(c) Chloride

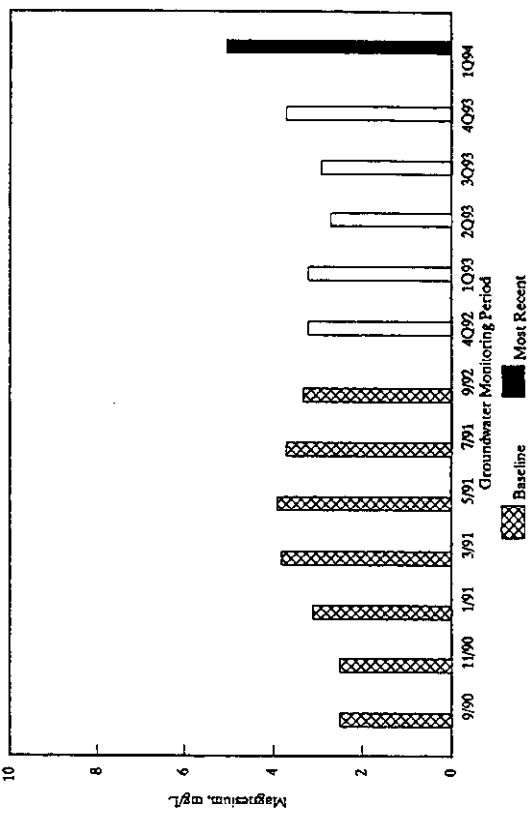


(d) Sulfate

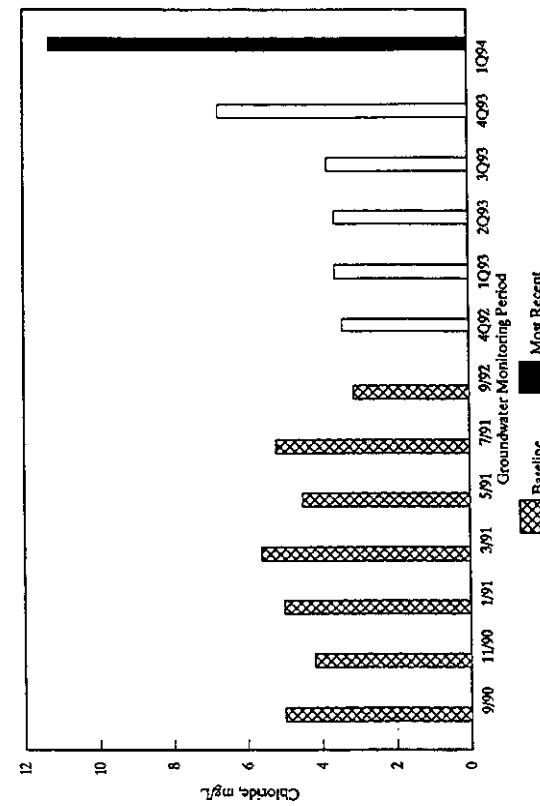
Figure 3. Historical Data for Representative Species from Well GWC-2 (Downgradient)



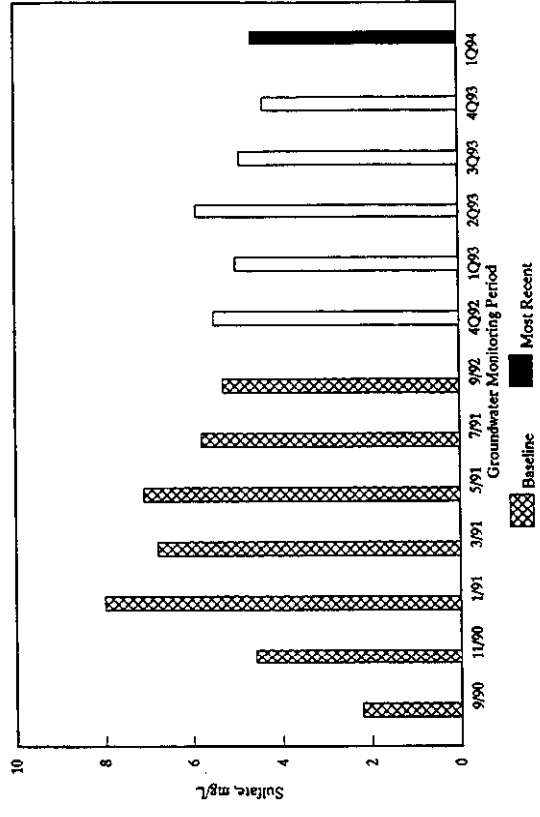
(a) Calcium



(b) Magnesium



(c) Chloride



(d) Sulfate

Figure 4. Historical Data for Representative Species from Well GWC-4 (Downgradient)

- Established sampling and analytical methods were specified and used. All samples were analyzed within the specified holding times, as outlined in Section 2. There were no deviations from the specified methods during this quarter's monitoring effort.
- Chain-of-custody procedures established in the test plan for this project were observed.
- In the laboratory, method blanks, control samples, and matrix spikes were analyzed in conjunction with the sample analyses, following recognized good laboratory practice. Specified recovery limits (typically 80 to 120%) were met for all analytes in the laboratory control samples and matrix spikes except TOC; matrix spike recoveries were slightly above the 120% upper specified recovery limit for this parameter.
- Duplicate samples were obtained in the field and analyzed for all parameters. Replicate analyses were performed for a smaller number of parameters.

The results of the analysis of field and laboratory duplicates are summarized in Table 6 for those parameters measured above the detection limit. Complete results are provided in Appendix B. Differences in the duplicate analyses results were small for most species (i.e., less than 10%). For iron and selenium the measured concentrations in both samples were less than five times the detection limit, a region where less accurate results can be expected. Somewhat anomalous results were obtained for sulfate; the concentration in the original sample was 1.38 mg/L, while the concentration for the field duplicate was less than the detection limit of 0.0471 mg/L. Historically the sulfate concentration from this well has shown similar variability, but not during a given sampling campaign. The results for sulfate are, therefore, suspect. Results of duplicate analyses showed good reproducibility.

Table 6

Results for Duplicate Samples—1st Quarter 1994

Parameter	Units	Sample GWC-3-13-1	Field Duplicate GWC-3-13-2	% Diff ^a	Duplicate Analysis GWC-3-13-2	% RPD ^b	Spec. Limit
Total Dissolved Solids	mg/L	42.0 ^d	41.0 ^d	-2.4	41.0 ^d	0.0	15
Chloride	mg/L	2.77	2.70	-2.5	2.71	0.37	20
Fluoride	mg/L	0.0372 ^c	0.0345 ^c	-7.3			
Nitrate-Nitrite as N	mg/L	0.0827	0.0835	1.0	0.0817	2.2	20
Sulfate	mg/L	1.38	<0.0471	NC	<0.0471	NC	20
Radium 228	pCi/L	0.97 ± 0.52	0.96 ± 0.52	-1.0			
Gross Alpha	pCi/L	1.00 ± 0.40	0.98 ± 0.44	-2.0			
Gross Beta	pCi/L	1.53 ± 0.71	1.80 ± 0.72	17.6			
Gross Gamma							
Bi-214	pCi/L	43 ± 19	34 ± 18	-21			
Pb-214	pCi/L	41 ± 22	41 ± 24	0			
Barium	mg/L	0.00783 ^c	0.00747 ^c	-4.6			
Calcium	mg/L	0.392 ^d	0.361 ^d	-7.9			
Iron	mg/L	0.0142 ^c	0.00816 ^{c,d}	-42.5			
Magnesium	mg/L	0.962	0.964	0.2			
Manganese	mg/L	0.00206	0.00187	-9.2			
Sodium	mg/L	4.35	4.43	1.8			
Sulfur	mg/L	0.227	0.227	0.0			
Selenium	mg/L	0.000730 ^{c,d}	0.000870 ^{c,d}	19.2	<0.000592 ^d		
Silicon	mg/L	10.1	10.3	2.0			
Strontium	mg/L	0.00513	0.00467 ^d	-9.0			

^a % Difference = (GWC-3-12-2 - GWC-3-12-1)/GWC-3-12-1 * 100 percent.

^b RPD = Relative Percent Difference, defined as follows:

$$RPD = \frac{(\text{Larger Value} - \text{Smaller Value})}{(\text{Larger Value} + \text{Smaller Value})/2} \times 100 \text{ percent.}$$

^c Detected in the method blank.

^d Value is less than five times the detection limit; results are expected to be less accurate as concentrations approach the detection limit.

NC = Not computed.

APPENDIX A

Historical Monitoring Data for Selected Parameters

Table A-1

Historical Monitoring Data for Selected Parameters

Parameter	Baseline Monitoring												
	Round 1 6 Sep 90	Round 2 2 Nov 90	Round 3 8-9 Jan 91	Round 4 11 Mar 91	Round 5 8 May 91	Round 6 1-2 Jul 91	Round 7 3-4 Sep 92	Round 8 29-30 Dec 92	Round 9 30-31 Mar 93	Round 10 21 Jun 93	Round 11 23-24 Sep 93		
Well: GWA-1 (Formerly CW-1)													
pH	5.86	6.27	5.6	6.7	6.05	5.94	6.4	5.7	6.82	6.1	5.9		
Conductivity	98	114	112	121	104	85	116	101	128	100	110		
Alkalinity	15.6	22.3	25.8	27.1	25	16.4	35.4	22.7	28	27	24.8		
TDS	94	87	86	84	90	77	99	110	110	116	99		
Chloride	7.3	7.4	5.9	4.6	3.8	8.2	1.9	2.1	2.1	2.1	1.9		
Sulfate	4.5	8.5	8.5	11	17	3.7	17	26	30	20	28		
Calcium	6.2	7.6	7.7	7	7.5	5.3	7.9	8.1	4.1	8.0	8.3		
Magnesium	3.4	4.9	4.8	4.6	5.1	3.5	5.6	6.0	2.9	5.8	5.9		
Sodium	4.2	4.8	4.9	4.3	4.4	3.8	4.1	4.2	4.0	4.4	4.3		
Silicon	9.8	11	14	16	17	9.6	15	17	11	18	17		
Parameter	Round 12 5 Jan 94	Round 13 22-23 Mar 94											
Well: GWA-1 (Formerly CW-1 Continued)													
pH	NS	NS											
Conductivity	NS	NS											
Alkalinity	NS	NS											
TDS	NS	NS											
Chloride	NS	NS											
Sulfate	NS	NS											
Calcium	NS	NS											
Magnesium	NS	NS											
Sodium	NS	NS											
Silicon	NS	NS											

Table A-1 (Continued)

Parameter	Baseline Monitoring										
	Round 1 6 Sep 90	Round 2 2 Nov 90	Round 3 8-9 Jan 91	Round 4 11 Mar 91	Round 5 8 May 91	Round 6 1-2 Jul 91	Round 7 3-4 Sep 92	Round 8 29-30 Dec 92	Round 9 30-31 Mar 93	Round 10 21 Jun 93	Round 11 23-24 Sep 93
Well: GWC-1 (Formerly CW-2)											
pH	6.09	5.79	5.62	5.93	6.04	5.96	6.1	4.5	5.83	6.0	6.0
Conductivity	81	70	72	63	63	66	78	57	67	57	61
Alkalinity	21.7	22.9	24.4	22.1	20.5	25.8	27.8	23.3	22.5	24.1	27.3
TDS	81	51	59	52	48	64	64	68	43	74	70
Chloride	3.5	2.8	3.1	3.4	2.8	2.5	2.5	2.6	2.6	2.6	2.5
Sulfate	7.6	5	2.8	<0.05	1.2	1.5	3.2	3.3	2.2	<2.5	2.6
Calcium	3.9	3.6	3.8	3.2	3.4	3.6	4.3	4.0	8.8	4.1	4.1
Magnesium	2.3	2.5	2.8	2.2	2.4	2.5	3.2	3.0	6.2	2.9	3.0
Sodium	5.9	5.2	4.3	4.1	4.2	4.1	4.0	4.0	4.2	4.0	3.8
Silicon	9	9	9.2	11	11	11	11	12	16	12	12
Well: GWC-1 (Formerly CW-2 Continued)											
Parameter	Round 12 5 Jan 94	Round 13 21-23 Mar 94									
pH	6.1	5.89									
Conductivity	74	61									
Alkalinity	29.9	25									
TDS	22	66									
Chloride	3.5	2.43									
Sulfate	3.3	1.75									
Calcium	5.1	4.72									
Magnesium	3.7	3.14									
Sodium	4.3	4.12									
Silicon	12.7	11.9									

Table A-1 (Continued)

Parameter	Baseline Monitoring												
	Round 1 6 Sep 90	Round 2 2 Nov 90	Round 3 8-9 Jan 91	Round 4 11 Mar 91	Round 5 8 May 91	Round 6 1-2 Jul 91	Round 7 3-4 Sep 92	Round 8 29-30 Dec 92	Round 9 30-31 Mar 93	Round 10 21 Jun 93	Round 11 23-24 Sep 93		
Well: GWC-2 (Formerly CW-3)													
pH	5.64	5.6	5.04	5.5	4.97	5.65	5.5	4.6	5.29	5.4	5.6		
Conductivity	76	69	64	66	33	71	66	56	67	56	49		
Alkalinity	23.5	19.3	15.2	16.9	12.2	17.5	18.2	17.3	12.5	14.1	15.9		
TDS	76	50	55	55	63	65	79	71	68	77	60		
Chloride	4.3	5.2	6.9	6.2	5	5.3	3.0	3.4	4.0	4.5	3.5		
Sulfate	6.4	5.5	6.3	5.9	5.8	6.3	6.5	7.6	7.9	7.5	7.7		
Calcium	4.4	2.8	2.3	2	2	1.7	1.4	1.6	1.7	1.6	1.9		
Magnesium	1.6	1.5	1.6	1.7	1.8	1.9	1.9	2.1	2.1	1.9	2.0		
Sodium	7.3	7.4	6.9	7	7.5	7.6	7.5	7.4	7.5	6.7	6.8		
Silicon	10	10	9.3	12	11	11	11	13	12.0	11	13		
Parameter	Round 12 5 Jan 94	Round 13 22-23 Mar 94											
Well: GWC-2 (Formerly CW-3 Continued)													
pH	5.75	5.5											
Conductivity	53	57											
Alkalinity	15.7	14											
TDS	27	76											
Chloride	3.8	3.7											
Sulfate	5.78	5.97											
Calcium	2.0	2.19											
Magnesium	1.8	1.92											
Sodium	7.0	7.15											
Silicon	12.9	13.3											

Table A-1 (Continued)

Parameter	Baseline Monitoring										
	Round 1 6 Sep 90	Round 2 4 Nov 90	Round 3 8-9 Jan 91	Round 4 11 Mar 91	Round 5 8 May 91	Round 6 1-2 Jul 91	Round 7 3-4 Sep 92	Round 8 29-30 Dec 92	Round 9 30-31 Mar 93	Round 10 21 Jun 93	Round 11 23-24 Sep 93
Well: GWC-3 (Formerly CW-4)											
pH	5.4	5.15	4.8	4.73	6.19	5.08	5.25	3.8	5.23	5.2	5.3
Conductivity	40	35	30	34	32	35	32	27	33	27	27
Alkalinity	11.5	15.2	9.9	11	7	11.1	10.0	8.9	7.0	8.5	9.1
TDS	50	35	31	34	39	41	28	37	44	52	21
Chloride	3	2.8	3.2	3.4	3.1	3.1	2.0	2.3	2.7	2.9	2.8
Sulfate	2.6	2.1	<0.05	<0.05	0.9	1.5	1.7	2.6	1.6	<2.5	<2.5
Calcium	1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Magnesium	1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Sodium	4.4	4.5	4.3	4.1	4.6	4.3	4.1	4.0	4.1	3.9	3.8
Silicon	8	7.8	3.9	8.5	8.6	8.3	8.3	9.3	9.0	8.7	9.2
Well: GWC-3 (Formerly CW-4 Continued)											
Parameter	Round 12 5 Jan 94	Round 13 22-23 Mar 94									
pH	5.5	5.18									
Conductivity	22	28									
Alkalinity	9.3	7.5									
TDS	<8.7	42									
Chloride	2.8	2.77									
Sulfate	<0.06	1.38									
Calcium	<1.0	0.392									
Magnesium	<1.0	0.962									
Sodium	4.1	4.35									
Silicon	9.7	10.1									

Table A-1 (Continued)

Parameter	Baseline Monitoring										
	Round 1 6 Sep 90	Round 2 2 Nov 90	Round 3 8-9 Jan 91	Round 4 11 Mar 91	Round 5 8 May 91	Round 6 1-2 Jul 91	Round 7 3-4 Sep 92	Round 8 29-30 Dec 92	Round 9 30-31 Mar 93	Round 10 21 Jun 93	Round 11 23-24 Sep 93
Well: GWC-4 (Formerly CW-5)											
pH	5.34	4.97	4.8	4.6	5.03	5.4	5.05	3.9	5.04	5.2	5.2
Conductivity	62	62	66	72	54	70	72	58	64	52	54
Alkalinity	12.5	15.3	13.1	15.1	8.6	14.2	11.5	8.0	6.0	6.9	7.0
TDS	61	52	60	51	58	64	61	65	63	55	44
Chloride	5	4.2	5	5.6	4.5	5.2	3.1	3.4	3.6	3.6	3.8
Sulfate	2.2	4.6	8	6.8	7.1	5.8	5.3	5.5	5.0	5.9	4.9
Calcium	1.3	<1.0	<1.0	1.3	1.6	1.2	<1.0	<1.0	1.0	<1.0	<1.0
Magnesium	2.5	2.5	3.1	3.8	3.9	3.7	3.3	3.2	3.2	2.7	2.9
Sodium	5.4	5.8	5.3	5.1	5	5.2	4.8	4.9	4.7	4.4	4.4
Silicon	9.9	9.1	4.7	9.7	9.2	10	8.6	9.5	8.7	8.3	9.3
Parameter	Round 12 5 Jan 94	Round 13 22-23 Mar 94									
Well: GWC-4 (Formerly CW-5 Continued)											
pH	5.2	4.98									
Conductivity	63	72									
Alkalinity	9.2	5.0									
TDS	20	64									
Chloride	6.7	11.3									
Sulfate	4.4	4.64									
Calcium	1.3	1.81									
Magnesium	3.7	5.05									
Sodium	5.0	5.33									
Silicon	9.8	9.91									

Table A-1 (Continued)

Parameter	Baseline Monitoring												
	Round 1 6 Sep 90	Round 2 2 Nov 90	Round 3 8-9 Jan 91	Round 4 11 Mar 91	Round 5 8 May 91	Round 6 1-2 Jul 91	Round 7 3-4 Sep 92	Round 8 29-30 Dec 92	Round 9 30-31 Mar 93	Round 10 21 Jun 93	Round 11 23-24 Sep 93		
Well: GWC-5													
pH							5.6	4.4	6.13	5.4	5.6		
Conductivity							61	60	54	41	40		
Alkalinity							14.8	13.5	12.5	10.2	11.5		
TDS							91	86	67	56	50		
Chloride							1.8	2.6	2.7	2.9	2.5		
Sulfate							8.8	10	7.4	6.7	5.5		
Calcium							2.1	2.7	2.2	1.6	1.4		
Magnesium							1.9	2.3	1.8	1.5	1.4		
Sodium							6.0	6.2	5.7	5.5	5.2		
Silicon							12	14	13	12	12		
Parameter	Round 12 5 Jan 94	Round 13 22-23 Mar 94											
pH	7.0	5.38											
Conductivity	39	43											
Alkalinity	10.8	8.6											
TDS	29	53											
Chloride	2.6	2.34											
Sulfate	5.3	6.56											
Calcium	1.3	1.65											
Magnesium	1.3	1.6											
Sodium	5.5	5.74											
Silicon	11.4	11.8											

APPENDIX B
QA/QC Results

Table B-1

Results for Duplicate Samples—1st Quarter 1994

Parameter	Units	Sample GWC-3-13-1	Field Duplicate GWC-3-13-2	% Diff ^a	Duplicate Analysis GWC-3-13-2	% RPD ^b	Spec. Limit
Total Dissolved Solids	mg/L	42.0 ^d	41.0 ^d	-2.4	41.0 ^d	0.0	15
Bromide	mg/L	<0.0277	<0.0277	NC	<0.0277	NC	
Chloride	mg/L	2.77	2.70	-2.5	2.71	0.37	20
Total Organic Carbon	mg/L	<0.357	<0.357	NC	<0.357	NC	20
Fluoride	mg/L	0.0372 ^c	0.0345 ^c	-7.3			
Nitrate-Nitrite as N	mg/L	0.0827	0.0835	1.0	0.0817	2.2	20
Sulfate	mg/L	1.38	<0.0471	NC	<0.0471	NC	20
Radium 226 and 228	pCi/L	-0.03 ± 0.14 0.97 ± 0.52	-0.07 ± 0.13 0.96 ± 0.52	NC -1.0			
Gross Alpha	pCi/L	1.00 ± 0.40	0.98 ± 0.44	-2.0			
Gross Beta	pCi/L	1.53 ± 0.71	1.80 ± 0.72	17.6			
Gross Gamma							
Bi-212	pCi/L	<136	<119	NC			
Bi-214	pCi/L	43 ± 19	34 ± 18	-21			
Co-60	pCi/L	<11.1	<8.4	NC			
Cs-134	pCi/L	<17.7	<17.0	NC			
Cs-137	pCi/L	<10.9	<6.77	NC			
K-40	pCi/L	<132	<157	NC			
Pb-212	pCi/L	<21.3	<21.3	NC			
Pb-214	pCi/L	41 ± 22	41 ± 24	0			
Ra-223	pCi/L	<53.7	<41.1	NC			
Ra-226	pCi/L	<180	<185	NC			
Rn-219	pCi/L	<73.9	<64.6	NC			
Th-227	pCi/L	<95.3	<94.0	NC			
Th-228	pCi/L	<637	<523	NC			
Th-231	pCi/L	<367	<373	NC			
Th-234	pCi/L	<211	<151	NC			
Tl-208	pCi/L	<11.1	<11.9	NC			

Table B-1 (Continued)

Parameter	Units	Sample GWC-3-13-1	Field Duplicate GWC-3-13-2	% Diff ^a	Duplicate Analysis GWC-3-13-2	% RPD ^b	Spec. Limit
U-235	pCi/L	<39.8	<34.8	NC			
Silver	mg/L	<0.00492	<0.00492	NC			
Aluminum	mg/L	<0.0284	<0.0284	NC			
Arsenic	mg/L	<0.000647	<0.000647	NC			
Boron	mg/L	<0.0150	<0.0150	NC			
Barium	mg/L	0.00783 ^c	0.00747 ^c	-4.6			
Beryllium	mg/L	<0.000554	<0.000554	NC			
Bismuth	mg/L	<0.0132	<0.0132	NC			
Calcium	mg/L	0.392 ^d	0.361 ^d	-7.9			
Cadmium	mg/L	<0.00172	<0.00172	NC			
Cobalt	mg/L	<0.00340	<0.00340	NC			
Copper	mg/L	<0.00381	<0.00381	NC			
Chromium	mg/L	<0.00249	<0.00249	NC			
Mercury	mg/L	<0.000050	<0.000050	NC			
Iron	mg/L	0.0142 ^c	0.00816 ^{c,d}	-42.5			
Potassium	mg/L	<0.370	<0.370	NC			
Lithium	mg/L	<0.00543	<0.00543	NC			
Magnesium	mg/L	0.962	0.964	0.2			
Manganese	mg/L	0.00206	0.00187	-9.2			
Molybdenum	mg/L	<0.00463	<0.00463	NC			
Sodium	mg/L	4.35	4.43	1.8			
Nickel	mg/L	<0.00986	0.0144	NC			
Phosphorus	mg/L	<0.0610	<0.0610	NC			
Lead	mg/L	<0.00106	<0.00106	NC			
Sulfur	mg/L	0.227	0.227	0.0			
Antimony	mg/L	<0.00156	<0.00156	NC			
Selenium	mg/L	0.000730 ^{c,d}	0.000870 ^{c,d}	19.2	<0.000592 ^d	NC	
Silicon	mg/L	10.1	10.3	2.0			
Tin	mg/L	<0.0145	<0.0145	NC			

Table B-1 (Continued)

Parameter	Units	Sample GWC-3-13-1	Field Duplicate GWC-3-13-2	% Diff ^a	Duplicate Analysis GWC-3-13-2	% RPD ^b	Spec. Limit
Strontium	mg/L	0.00513	0.00467 ^d	-9.0			
Tellurium	mg/L	<0.0317	<0.0317	NC			
Titanium	mg/L	<0.00159	<0.00159	NC			
Thallium	mg/L	<0.00103	<0.00103	NC			
Uranium	mg/L	<0.199	<0.199	NC			
Vanadium	mg/L	<0.00236	<0.00236	NC			
Tungsten	mg/L	<0.0408	<0.0408	NC			
Zinc	mg/L	0.00239 ^d	<0.00153	NC			

^a % Difference = (GWC-3-12-2 - GWC-3-12-1)/GWC-3-12-1 * 100 percent.

^b RPD = Relative Percent Difference, defined as follows:

$$RPD = \frac{(\text{Larger Value} - \text{Smaller Value})}{(\text{Larger Value} + \text{Smaller Value})/2} \times 100 \text{ percent.}$$

^c Detected in the method blank.

^d Value is less than five times the detection limit; results are expected to be less accurate as concentrations approach the detection limit.

NC = Not computed.