M-1977-300

From:

Whetstone Associates

SCHWARTZWALDER MINE HYDROLOGIC EVALUATION OF MINE CLOSURE AND RECLAMATION

Prepared for

cotter

Cotter Corporation
7800 E. Dorado Place, Suite 210
Englewood, CO 80111

Prepared by

Whetstone Associates, Inc.
137 W. Ryus Street
P.O. Box 1156
La Veta, Colorado 81055
719-742-5155

Document 4109B.071107

November 7, 2007

Whetstone Associates

SCHWARTZWALDER MINE HYDROLOGIC EVALUATION OF MINE CLOSURE AND RECLAMATION

Prepared for

cotter

Cotter Corporation
7800 E. Dorado Place, Suite 210
Englewood, CO 80111

Prepared by

Whetstone Associates, Inc.
137 W. Ryus Street
P.O. Box 1156
La Veta, Colorado 81055
719-742-5155

Document 4109B.071107

November 7, 2007

TABLE OF CONTENTS

1. INTRODUCTION 1

2. SITE DESCRIPTION 1
   - 2.1 Location 1
   - 2.2 Terrain 4
   - 2.3 Climate 4
   - 2.4 Economic Geology 5
   - 2.5 Mine History 8
   - 2.6 Mine Layout 8

3. SURFACE WATER FLOW 9
   - 3.1 Flow in Ralston Creek at Ralston Reservoir 9
   - 3.2 Flow in Ralston Creek at the Schwartzwalder Mine 12

4. GROUNDWATER 16
   - 4.1 Groundwater in Bedrock 16
     - 4.1.1 Depth to Water and Groundwater Flow 17
     - 4.1.2 Bedrock Permeability Tests 19
   - 4.2 Groundwater in Alluvium 20
     - 4.2.1 Thickness and Extent of the Alluvium 21
     - 4.2.2 Alluvial Permeability Tests 21
     - 4.2.3 Sump Pumping 23
   - 4.3 Seeps 27

5. MINE HYDROLOGY 27
   - 5.1 Conceptual Hydrologic Model 27
   - 5.2 Mine Inflow 29
     - 5.2.1 Pumping Records 29
     - 5.2.2 Sources of Inflow 32
     - 5.2.3 Observed Rate of Mine Flooding 34
     - 5.2.4 Projected Final Water Level 39
   - 5.3 Evaluation of the Hydraulic Connection Between Ralston Creek and the Mine 41
     - 5.3.1 Evidence from Stream Flow Data 41
     - 5.3.2 Evidence from Mine Pumping Rates 41
     - 5.3.3 Stable Isotopic Analysis of Mine Water and Ralston Creek 41
     - 5.3.4 Tritium Dating of Mine Water 43
     - 5.3.5 Summary 43

6. SURFACE WATER QUALITY 43
6.1 Surface Water Quality Standards 44
6.1.1 Discharge Permit Limits 44
6.1.2 Stream Standards 44
6.2 Previous Studies of Surface Water Quality 48
6.3 Surface Water Sample Stations 48
6.3.1 Compliance Monitoring Stations 48
6.3.2 Additional Non-Routine Sampling 48
6.3.3 1998 – 1999 Baseline StudyData 49
6.4 Potential Loading Sources 50
6.4.1 Upgradient Sources 50
6.4.2 Alluvium and Fill 50
6.4.3 Mineralized Bedrock 50
6.5 Ralston Creek Water Quality 52
6.5.1 Water Quality During Operation of the Sumps and WTP 53
6.5.2 Water Quality After Turning off the Sumps and WTP 53

7. GROUNDWATER QUALITY 91
7.1 Groundwater Quality Standards and Point of Compliance 92
7.2 Alluvial Water Quality 94
7.3 Sump Water Quality 115
7.4 Seep Water Quality 115
7.5 Shallow Bedrock Water Quality 119
7.6 Underground Mine Water Quality 120
7.6.1 Deep Mine Water 121
7.6.2 Shallow Mine Water 125
7.6.3 Water Quality in the Reflooded Mine 127
7.6.3.1 Evaluation of Mine Water Mine Water Quality with Depth 130
7.6.3.2 Evaluation of Chemical Trends in Mine Water as a Function of Time 130
7.6.3.3 Concentration Correlation Plots 139

8. CHARACTERIZATION OF WASTE ROCK AND FILL 140
8.1 Whole Rock Analysis 140
8.2 Acid-Base Accounting 141
8.3 Acid Consumption Tests 142

9. IMPACT ANALYSIS 142
9.1 Waste Rock Piles 142
9.2 Alluvium and Fill 144
9.3 Mine Refilling 145

9.4 Mine Water Chemistry 145
9.4.1 Geochemical Modeling Approach 145
9.4.1.1 Mass Balance Mixing Model 146
9.4.1.2 Evaluation of Precipitation and Dissolution Reactions Controlling Mine Water Chemistry 148

10. MINE CLOSURE AND RECLAMATION 151
10.1 Mine Reclamation Plan 151
10.2 Closure Activities Performed to Date 151
10.2.1 Mine Reclamation 151
10.2.2 Technologies Research 152
10.3 Closure and Mitigation Strategies 153
10.3.1 Waste Rock Piles 153
10.3.2 Alluvium and Fill 154
10.3.3 Underground Mine 154

11. CONCLUSIONS 155

12. REFERENCES 157

LIST OF APPENDICES

Appendix A Ralston Creek Flow Data
Appendix B Packer Test Methods and Results
Appendix C Monitoring Well Logs
Appendix D Pumping Test Methods and Results
Appendix E Mine Pumping Data
Appendix F Water Quality Data Base
Appendix G Sump Shut-Down Test Data
Appendix H Geochemical Model

LIST OF TABLES

Table 1. Monthly Climate Summary at Ralston Reservoir 4
Table 2. Monthly Precipitation at Ralston Reservoir 5
Table 3. Elevations of Upper Levels at the Schwartzwalder Mine 8
Table 4. Flow Rates in Ralston Creek vs. Monthly Mean Precipitation at Ralston Reservoir 11
Table 5. Stream Gaging Stations on Ralston Creek 13
Table 6. Stream Gaging Results for Ralston Creek Near Schwartzwalder Mine 15
Table 7. Seasonal Distribution of Average Flows in Ralston Creek 16
Table 8. Water Levels and Well Data for Bedrock Monitoring Wells MW10 and MW11 17
Table 9. Calculation of Vertical Gradients in Shallow Bedrock 18
Table 10. Summary of Packer Permeability Test Results 20

Table 11. Completion Data for Alluvial Monitoring Wells 21
Table 12. Summary of Single Well Permeability Tests in Alluvium 21
Table 13. Sump Pumping Rates 24
Table 14. Average Monthly Inflow to the Mine from Infiltration of Precipitation, 1995 - 1999 31
Table 15. Average Rate of Water Level Rise in Mine Shaft 36
Table 16. Mine Void Volumes and Observed Inflow Rates During Refilling 38
Table 17. Calculation of Final Static Water Level in the Flooded Mine 40
Table 18. Summary of Isotopic Data for Water Samples 41
Table 19. Discharge Permit Effluent Limitations 44
Table 20. Determination of Hardness Values Used in Calculating Hardness-Based Aquatic Standards 46
Table 21. Water Quality Standards for Ralston Creek Stream Segment 17b 47
Table 22. Compliance Monitoring Stations and Non-Routine Sampling Stations in Ralston Creek 49
Table 23. Surface Water Quality Sampling Stations From the 1998-1999 Baseline Hydrology Study 49
Table 24. Water Quality in Ralston Creek, 1998 - 2007 62
Table 25. Comparison of Water Quality with Location in Ralston Creek, November 1998 87
Table 26. Uranium Concentrations in Ralston Creek, 1990 – 2007 88
Table 27. Location and Frequency of Groundwater Quality Samples 91
Table 28. Groundwater Quality Standards 93
Table 29. Water Quality in the Alluvium 97
Table 30. Water Quality in the Sumps 116
Table 31. Uranium Concentrations in Sumps and Seep, 1998 - 2007 117
Table 32. Water Quality in Shallow Bedrock 119
Table 33. Locations of Underground Water Quality Samples 121
Table 34. Water Quality at Underground Sampling Stations in the Lower Mine Levels 123
Table 35. Flow Rates at Underground Sampling Stations in the Upper Mine Levels 125
Table 36. Water Quality at Underground Sampling Stations in the Upper Mine Levels 127
Table 37 Summary Statistics for Water Samples Collected from Flooded Mine 129
Table 38. Summary of Geochemical Characterization Data for Waste Rock and Fill 140
Table 39. Average Mineral and Chemical Analyses of Schwartzwalder Rocks 141
Table 40. Summary of Acid-Base Accounting Results 142
Table 41. Average Water Quality for Samples Collected from Deep Mine Workings 147
Table 42. Weighted Average Water Quality for the Upper Mine Workings 148
Table 43. Controlling Mineral Phases in Deep Mine Water 149
Table 44. Controlling Mineral Phases in Flooded Mine Water 150
Table 45. Effect of pH and Eh on Controlling Mineral Phases 150
Table 46. Summary of Reclamation Activities 152

LIST OF FIGURES

Figure 1. Schwartzwalder Mine Location Map 2
Figure 2. Locations of Monitoring Wells and Surface Water Stations near the Mine Site 3
Figure 3. Generalized Geologic Map 6
Figure 4. Detailed Geologic Map of a Portion of the Ralston Butte 7.5' Quad 7
Figure 5. Cross Section Showing Mine Workings, Major Fault Systems, and Underground Water Sample Locations 10
Figure 6. Average Flow Rates in Ralston Creek vs. Monthly Mean Precipitation 12
Figure 7. Flow Rates Measured in Ralston Creek near the Schwartzwalder Mine, by Month, 1998 - 1999 13
Figure 8. Flow Rates Measured in Ralston Creek near the Schwartzwalder Mine, by Station, 1998 – 199914

Figure 9. Seasonal Variation in Water Levels in Deep Bedrock Monitoring Well MW11 18
Figure 10. Sump Locations 22
Figure 11. Sump Pumping Rates, 1995 - 2002 25
Figure 12. Monthly Average Sump Pumping Rates vs. Long-term Average Precipitation 25
Figure 13. Monthly Average Sump Pumping Rates vs. Long-term Average Flow Rates in Ralston Creek 26
Figure 14. Correlation Between Monthly Average Sump Pumping Rates, Precipitation, and Flow Rates in Ralston Creek 26
Figure 15. Conceptual Model of Groundwater Flow—Pre-Mining 27
Figure 16. Conceptual Model of Groundwater Flow—During Mining 28
Figure 17. Conceptual Model of Groundwater Flow—Post-Mining 29
Figure 18. Groundwater Inflow to the Schwartzwalder Mine, 1973-1999 30
Figure 19. Average Groundwater Inflow by Month, 1995-1999 31
Figure 20. Mine Recharge Capture Areas 33
Figure 21. Observed Water Levels in the Schwartzwalder Mine During Refilling 34
Figure 22. Rate of Water Level Rise During Mine Refilling 35
Figure 23. Volume of Mine Voids by Level 37
Figure 24. Void Volume vs. Inflow and Rate of Water Level Rise 37
Figure 25. Average Level Elevation vs. Inflow and Rate of Water Level Rise 37
Figure 26. Stable Isotope Evaluation of Water Samples 42
Figure 27. Map of Radiometric Readings (counts per second) in the Vicinity of Ralston Creek (Young, 1985) 51
Figure 28. Change in TDS, Sulfate, Specific Conductance, Alkalinity, and pH in with Location in Ralston Creek, December 1998. 54
Figure 29. Seasonal Variation in TDS Components in Ralston Creek Water Downstream of Schwartzwalder Mine 55
Figure 30. Piper Diagram Showing Major Ion Composition of Ralston Creek Samples, 1997 – 2003 (Averaged by Station) 56
Figure 31. Trends in Major Ion Concentrations at Station SW-BPL, 1998 - 2007 57
Figure 32. Correlation of Uranium, Sulfate, Bicarbonate, and TDS Concentrations at SW-BPL 57
Figure 33. Trends in Uranium Concentrations at Stations SW-AWD, SW-A001, SW-BPL, SW-FBRG, SW-ARH, and SW-LLHG 58
Figure 34. Uranium Concentrations in Ralston Creek at Upstream Stations SW-AWD and SW-A001, 1990 – 2007 59
Figure 35. Uranium Concentrations in Ralston Creek at Downstream Stations SW-BPL and SW-FBRG, 1990 – 2007 60
Figure 36. Uranium Concentrations in Ralston Creek at Downstream Stations SW-ARH and SW-LLHG, 1990 – 2007 61
Figure 37. Piper Diagram Showing Major Ion Composition of Groundwater Samples (Averaged by Well)95
Figure 38. Uranium Concentrations in Alluvial Monitoring Wells Over Time 96
Figure 39. Uranium Concentrations in Sumps, 1990 – 2007 118
Figure 40. Piper Diagram Showing Major Ion Composition of Deep Mine Water Samples (Averaged by Location) 122
Figure 41. Piper Diagram Showing Major Ion Composition of Upper Mine Water Samples 126
Figure 42. Piper Diagram Showing Major Ion Composition of Water in Reflooded Mine 128
Figure 43. Depth Profile for General Parameters in Flooded Mine Workings April 19, 2001 131
Figure 44. Depth Profile for General Parameters in Flooded Mine Workings April 18, 2002 132
Figure 45. Depth Profile for General Parameters in Flooded Mine Workings January 29, 2003 133
Figure 46. Depth Profile for General Parameters in Upper 40 ft of Flooded Mine Workings, Nov 12, 2007134
Figure 47. Time Concentration Plots for General Parameters (pH, ORP, TDS) in Mine Water 135
Figure 48. Time Concentration Plots for Major Anions (SO_4, HCO_3, and Cl) in Mine Water 136

Figure 49. Time Concentration Plots for Major Cations (Ca, Mg, Na, K) in Mine Water 137
Figure 50. Time Concentration Plots for Metals (Fe, Mn) in Mine Water 138
Figure 51. Time Concentration Plots for Trace Metals (U, Mo) in Mine Water 139
Figure 52. Concentration Plots of Manganese vs. Uranium and Molybdenum 139
Figure 53. Comparison of TDS and Uranium Concentrations in Ralston Creek, Upstream and Downstream of Waste Rock Dumps 144

1. INTRODUCTION

The Schwartzwalder Mine is an underground uranium mine located in Jefferson County near Golden Colorado, in the steep canyon of Ralston Creek (Figure 1). The mine was operated by Cotter Corporation (Cotter) from 1966 until May 2000, when mining operations ceased, dewatering pumps were shut off, and the mine was allowed to flood.

Significant quantities of hydrologic and hydrogeologic data were collected prior to mine shutdown and in the seven years that the mine has been refilling. Monitoring wells and surface water stations onsite (Figure 2) and offsite (Figure 1) have been monitored, many for more than 20 years. Data have been collected on mine refilling rates, mine water quality, Ralston Creek flow rates, and Ralston Creek water quality. Cotter has reclaimed several waste rock piles in Ralston Creek Canyon, decommissioned numerous buildings, and has conducted bench scale and pilot scale studies of water treatment options.

Hydrologic issues related to mine closure include the flooding of the underground workings, effects of waste rock dumps on water quality, and the interaction of surface water in Ralston Creek with alluvium and fill at the site.

The purpose of this hydrologic evaluation report is to:

- Summarize the available hydrologic and hydrogeologic data;
- Analyze the mine filling rates and predict the timing and final water level elevation in the mine;
- Evaluate trends in water quality in Ralston Creek and in the underground workings;
- Develop and present a geochemical model of the system; and
- Develop a list of potential strategies and recommendations for mine closure and mitigation.

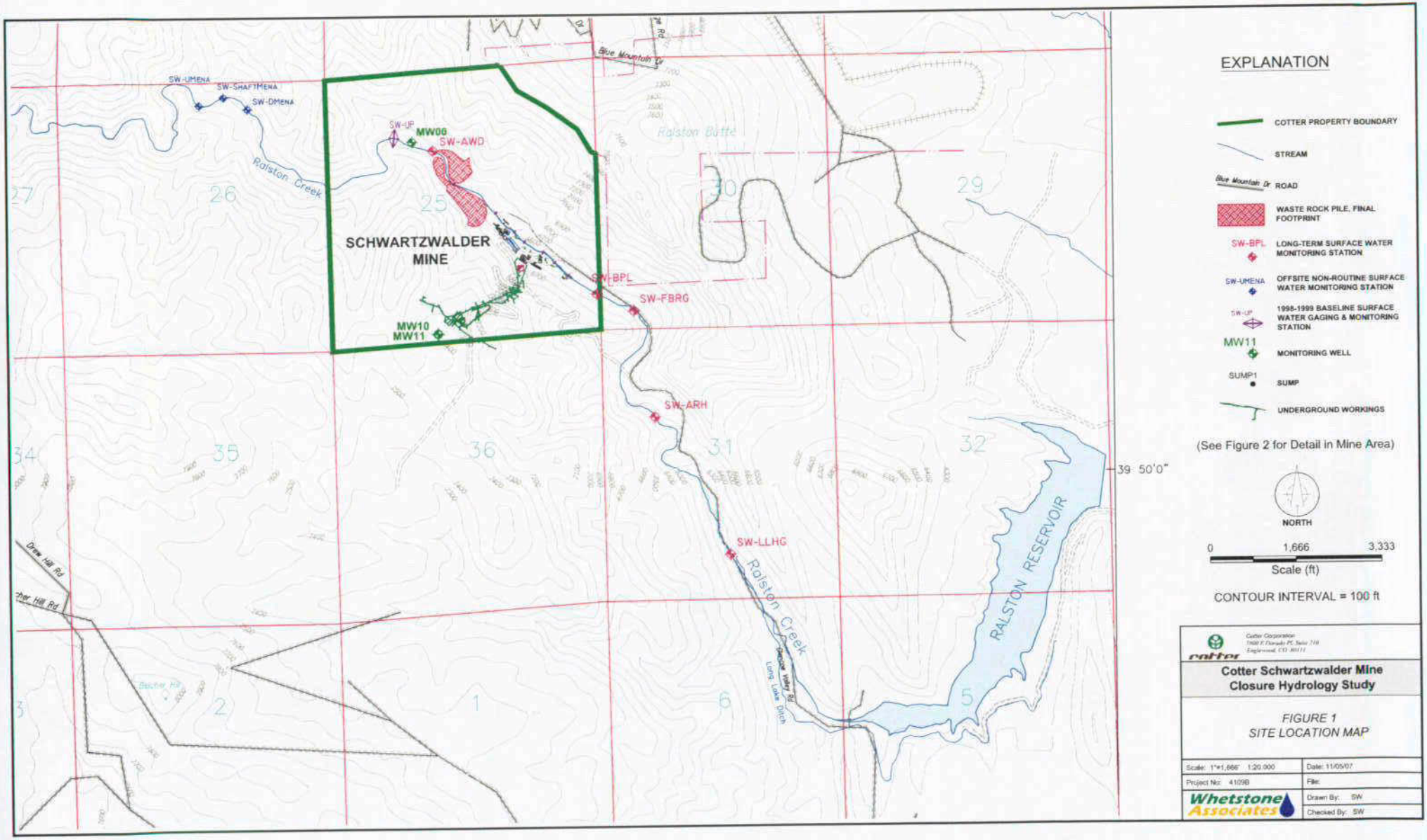
2. SITE DESCRIPTION

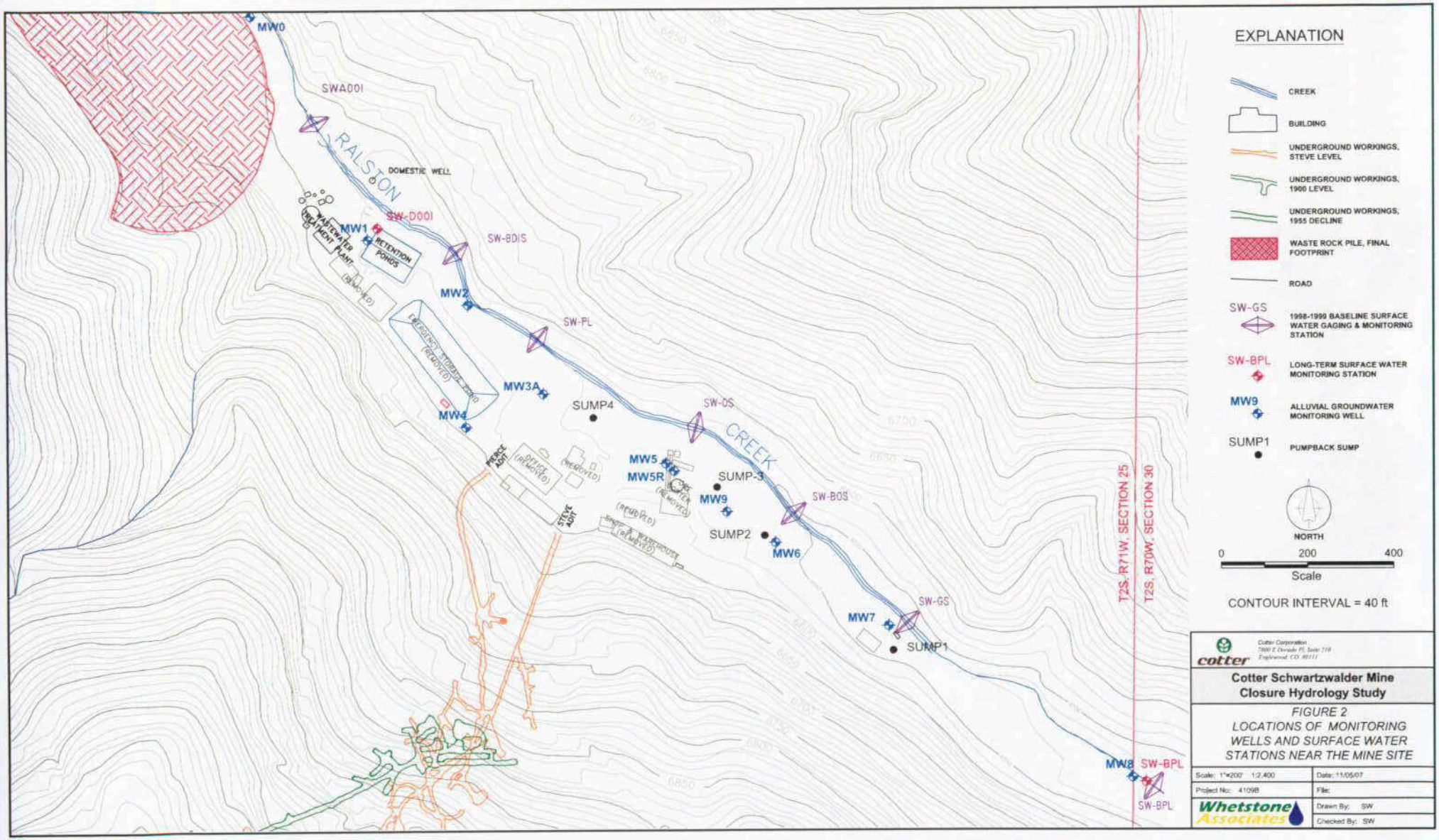
2.1 Location

The Schwartzwalder Mine is located in Ralston Creek Canyon, in northern Jefferson County, Colorado. The mine occupies the southeast quarter of Section 25, T2S, R71W (Figure 1). Cotter owns approximately 87% (558 acres) of Section 25. Fifty-seven (57) acres were permitted for mining under Colorado mining permit number 77-300.

The northeast corner of Section 25, along with adjacent sections to the north, northeast, and northwest, are rural residential properties associated with Blue Mountain Estates. The section west of the mine is used for summer cattle grazing, while the property south and east of the mine is owned by Jefferson County Open Space Parks. This area of Open Space is named White Ranch Park, in honor of Paul and Anna White who were the owners of vast holdings in the area, including Section 25 which their heirs sold to Commonwealth Edison Co. in 1982.

From Colorado State Highway 93, north of Golden Colorado, the site can be accessed by either Pine Ridge Road or West 56th Avenue. Where these roads intersect (one mile west of highway 93) a paved road enters the private property of 19 exclusive 35-acre home sites called Bear Tooth Ranch. The access road becomes bladed dirt, north of Bear Tooth Ranch, and the road enters Ralston Canyon and turns northwest upstream toward the mine. Approximately one-half mile of land along the road near Ralston Reservoir is owned by the Denver Water Board, and the next two miles of land are owned by Jefferson County Open Space Parks. The road then enters the mine property through a gate on the eastern boundary of mine property.


SCHWARTZWALDER MINE
SW-UMENA
SW-SHAFTMENA
SW-DMENA
SW-UP
MW00
SW-AWD
Ralston Creek
Ralston Butte
Blue Mountain Dr
SW-BPL
SW-FBRG
MW10
MW11
SW-ARH
SW-LLHG
Ralston Creek
Long Lake Ditch
RALSTON RESERVOIR
Drew Hill Rd
Becker Hill
39° 50'0"
EXPLANATION
COTTER PROPERTY BOUNDARY
STREAM
ROAD
WASTE ROCK PILE, FINAL FOOTPRINT
SW-BPL LONG-TERM SURFACE WATER MONITORING STATION
SW-UMENA OFFSITE NON-ROUTINE SURFACE WATER MONITORING STATION
SW-UP 1998-1999 BASELINE SURFACE WATER GAGING & MONITORING STATION
MW11 MONITORING WELL
SUMP1 SUMP
UNDERGROUND WORKINGS
(See Figure 2 for Detail in Mine Area)
NORTH
0 1,666 3,333
Scale (ft)
CONTOUR INTERVAL = 100 ft
Cotter Corporation
7600 E Orchard Rd, Suite 210
Englewood, CO 80111
Cotter Schwartzwalder Mine
Closure Hydrology Study
FIGURE 1
SITE LOCATION MAP
Scale: 1"=1,666' 1:20,000
Date: 11/05/07
Project No: 41098
File:
Whetstone Associates
Drawn By: SW
Checked By: SW



MW0
SWA001
RALSTON
DOMESTIC WELL
SW-D001
MW1
WASTEWATER TREATMENT PLANT
RETENTION PONDS
SW-BDIS
MW2
SW-PL
MW3A
MW4
SUMP4
SW-DS
CREEK
MW5
MW5R
SUMP-3
MW9
SW-BOS
SUMP2
MW6
MW7
SW-GS
SUMP1
MW8
SW-BPL
PIERCE ADIT
STEVE ADIT
T2S, R71W, SECTION 25
T2S, R70W, SECTION 30
EXPLANATION
CREEK
BUILDING
UNDERGROUND WORKINGS, STEVE LEVEL
UNDERGROUND WORKINGS, 1900 LEVEL
UNDERGROUND WORKINGS, 1955 DECLINE
WASTE ROCK PILE, FINAL FOOTPRINT
ROAD
SW-GS
1998-1999 BASELINE SURFACE WATER GAGING & MONITORING STATION
SW-BPL
LONG-TERM SURFACE WATER MONITORING STATION
MW9
ALLUVIAL GROUNDWATER MONITORING WELL
SUMP1
PUMPBACK SUMP
NORTH
0
200
400
Scale
CONTOUR INTERVAL = 40 ft
cotter
Cotter Corporation
Cotter Schwartzwalder Mine
Closure Hydrology Study
FIGURE 2
LOCATIONS OF MONITORING WELLS AND SURFACE WATER STATIONS NEAR THE MINE SITE
Scale: 1"=200' 1:2,400
Date: 11/05/07
Project No: 4109B
File:
Whetstone Associates
Drawn By: SW
Checked By: SW

Two other mines historically operated in Ralston Creek canyon. The Mena Mine is located about one mile upstream from the Schwartzwalder Mine where the West Rogers Fault crosses Ralston Creek. The Northstar Mine is located about one mile northwest of the Schwartzwalder Mine, in veins related to the East Rogers Fault System.

2.2 Terrain

Ralston Creek flows from northwest to southeast across Section 25, and occupies a narrow, steep-sided canyon, in the vicinity of the mine. Small intermittent tributaries of less than one mile in length enter Ralston Creek from both the north and south directions in the west half of Section 25. In the east half, short, usually dry gulches drain into Ralston Creek from the north (off the west side of Ralston Buttes) while a steep ridge parallels the creek on the south.

The mine portal is located on the west side of Ralston Creek Canyon, and numerous mine facilities were constructed on waste rock and fill from historical mining activities.

2.3 Climate

The Schwartzwalder Mine area has a semiarid climate characteristic of much of the central Rocky Mountain region. Precipitation records from 1978 to 2007 at Ralston Reservoir (located about 2 miles from the site and 560 feet lower in elevation) show a mean annual precipitation of 18.68 inches (Table 1). Approximately 40 percent of the precipitation falls during the spring, much of it as wet snow. Thunderstorms (June to August) account for an additional 30 percent of the annual precipitation. Fall and winter are drier seasons, accounting for 20 and 10 percent of the annual precipitation, respectively. Snowfall averages 68.8 inches per year, falling from late September through May.

Precipitation variation from the monthly and annual averages is shown in Table 2. With a standard deviation of 3.64 inches, precipitation ranged from 15.0 to 22.2 inches during 68% of all years. The lowest recorded precipitation was 11.9 inches in 2002 while the highest recorded precipitation was 26.4 inches in 1999.

Temperatures at the site are moderate. Extremely warm or cold weather is usually of short duration. Daily summer temperatures ranges from 53 to 88 °F, and winter temperatures range from 23 to 46 °F, on average.

Table 1. Monthly Climate Summary at Ralston Reservoir
May 1, 1978 – June 30, 2007

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average Max. Temperature (F)	46.0	46.1	52.3	59.4	69.7	79.7	88.0	83.5	75.3	63.0	51.7	44.9	63.3
Average Min. Temperature (F)	23.6	22.9	28.9	35.0	45.2	53.4	61.3	58.3	50.3	39.3	29.1	23.6	39.2
Average Total Precipitation (in.)	0.61	0.65	1.87	2.41	2.93	1.96	1.64	2.13	1.38	1.22	1.13	0.75	18.68
Average Total SnowFall (in.)	9.0	8.5	13.3	10.0	1.6	0.0	0.0	0.0	0.8	3.1	11.6	10.8	68.8
Average Snow Depth (in.)	1	1	1	1	0	0	0	0	0	0	1	2	1

Source: Western Regional Climate Center (WRCC), data download for station 056816 (Ralston Reservoir, Colorado)
Percent of possible observations for period of record: Max. Temp.: 17.1% Min. Temp.: 17% Precipitation: 99% Snowfall: 98.9% Snow Depth: 98.7%.

Table 2. Monthly Precipitation at Ralston Reservoir

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YR
1978	0.00 z	0.00 z	0.00 z	0.00 z	5.52	1.50	0.61	0.43	0.43	1.81	0.60	1.03	11.93
1979	0.68	0.39	2.09	1.83	4.61	3.31	0.43	3.25	0.34	1.26	2.31	1.34	21.84
1980	0.61	0.54	1.84	3.04	4.94	0.54	2.06	0.85	1.06	0.24	0.68	0.14	16.54
1981	0.08	0.57	2.77	1.22	4.11	0.44	1.74	1.20	0.49	1.27	0.40	0.96	15.25
1982	0.28	0.28	0.78	0.40	4.66	1.52	2.14	3.22	2.67	1.18	0.31	1.80	19.24
1983	0.06	0.15	5.47	1.94	5.28	3.94	2.17	1.50	0.51	0.27	3.32	0.73	25.34
1984	0.18	1.36 a	1.80	3.03	0.63	2.03	1.84	2.28	0.86	3.79	0.00	0.23	18.03
1985	0.61	1.05	0.95	1.86	2.09	1.79	1.54	0.15	1.70	0.34	2.11	0.68	14.87
1986	0.00 z	1.00	0.76	3.53	2.93	2.67	1.33	1.05	0.70	2.20	1.71	0.92	18.80
1987	0.92	1.68	1.82	1.88	4.01	5.17	0.58	2.15	0.60	1.30	1.24	1.81	23.16
1988	0.47	0.80	1.62	0.90	3.21	1.44	1.21	1.11	1.32	0.18	0.40	1.41	14.07
1989	1.16	0.92	0.55	1.53	2.02	2.93	1.86	2.21	2.70	0.57	0.58	1.16	18.19
1990	0.46	0.44	4.72	1.99	1.96	0.22	2.72	1.91	3.03	0.66	1.22	0.18	19.51
1991	0.80	0.12	0.35	2.19	3.93	3.36	2.82	2.49	0.99	0.77	2.99	0.02	20.83
1992	0.69	0.00	5.52	0.27	1.15	1.90	1.14	3.48	0.08	0.66	1.72	0.54	17.15
1993	0.14	0.50	2.12	1.87	1.38	1.81	0.85	0.61	2.10	1.54	1.40	0.33	14.65
1994	0.47	0.80	1.56	3.35	0.94	1.15	0.60	2.15	0.52	0.64	1.51	0.26	13.95
1995	0.46	0.96	1.20	4.86	6.55	3.85	0.70	0.52	1.85	0.23	0.88	0.09	22.15
1996	0.95	0.19 a	1.54	1.23	5.06	1.46	0.89	0.46	3.75	0.53	0.84	0.33	17.23
1997	0.52	1.30	0.33 b	4.31	1.10	2.91	1.80	3.22	1.43 a	2.65	1.17 b	0.92	21.66
1998	0.85	0.14	2.86	4.13	2.68 b	1.51 b	2.16 b	1.84 a	1.16 b	1.60	0.00 z	0.89 a	19.82
1999	0.60 b	0.25 d	0.50	5.67	3.84	2.51	3.47	4.88	2.23	1.05 a	0.55	0.87	26.42
2000	0.74	0.42	1.62	1.33	1.49 a	1.63	4.47 b	2.51	2.00 a	0.81 a	0.52	0.40	17.94
2001	0.55	0.67 a	1.54	2.18	3.32	1.19	2.35	3.50	2.41	0.40	0.89	0.40	19.40
2002	0.60	0.34	0.95	0.02	2.82	0.45	0.58	1.66 b	2.29	1.71 a	0.43	0.00 a	11.85
2003	0.06	1.57	4.43	3.30	1.44	1.54	0.61	1.38	0.25	0.18	0.37	0.65	15.78
2004	0.49	1.31	0.64	4.26	1.21	3.23	2.14	3.48	1.38	2.38	2.07	0.31	22.90
2005	1.34	0.09	0.93	3.98	1.43	2.03	0.54	3.85 b	0.39	2.27	0.55	0.20	17.60
2006	0.43	0.45	1.38	0.60	0.47	0.47	2.34	4.29	0.89	2.75	0.84	3.08	17.99
2007	1.89	0.65	1.60	3.31	3.05	0.38	0.64	2.29 g	0.03 p	0.00 z	0.00 z	0.00 z	11.52 z

Period of Record Statistics

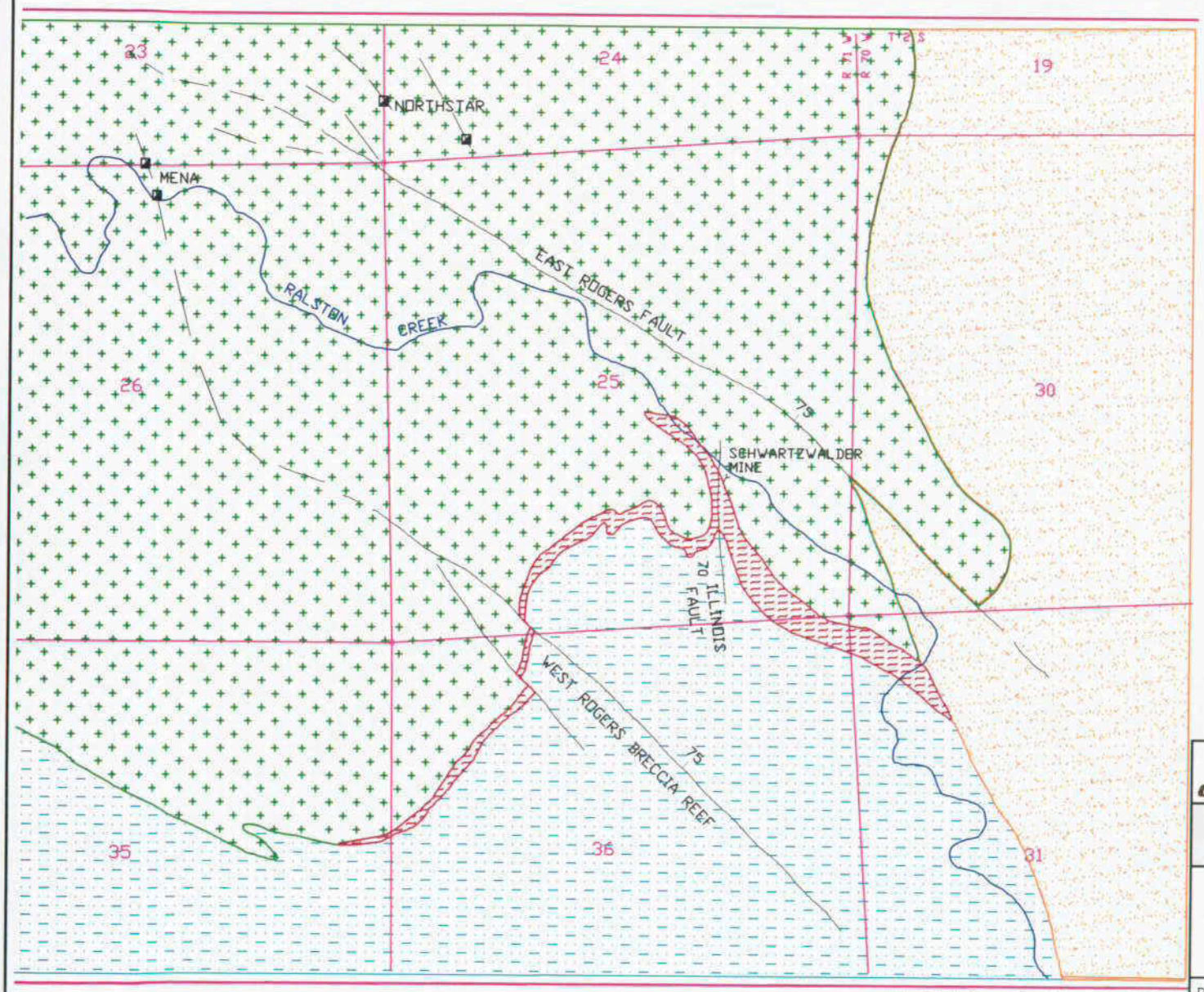
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
MEAN	0.61	0.65	1.87	2.41	2.93	1.96	1.61	2.13	1.38	1.22	1.13	0.75	18.60
S.D.	0.40	0.47	1.45	1.46	1.67	1.22	0.98	1.27	0.96	0.93	0.83	0.67	3.64
SKEW	1.18	0.62	1.40	0.32	0.33	0.64	0.88	0.30	0.64	0.93	1.07	1.60	0.33
MAX	1.89	1.68	5.52	5.67	6.55	5.17	4.47	4.88	3.75	3.79	3.32	3.08	26.42
MIN	0.06	0.00	0.33	0.02	0.47	0.22	0.43	0.15	0.08	0.18	0.00	0.00	11.85
# YRS	28	29	29	29	30	30	30	29	29	29	28	29	26

SOURCE: Western Regional Climate Center (WRCC), data download for station 056816 (Ralston Reservoir, Colorado), file last updated on Sept 17, 2007

NOTES: SD = Standard deviation
Provisional Data after 06/2007
a = 1 day missing, b = 2 days missing, c = 3 days, ..etc, z = 26 or more days missing, A = Accumulations present
Long-term means based on columns; thus, the monthly row may not sum (or average) to the long-term annual value.
MAXIMUM ALLOWABLE NUMBER OF MISSING DAYS : 5 (Individual Months not used for annual or monthly statistics if more than 5 days are missing.) Individual Years not used for annual statistics if any month in that year has more than 5 days missing.

2.4 Economic Geology

Uranium ore is hosted in a thin band of brittle garnet biotite gneiss and quartzite of the Schwartz Trend. The generalized geologic map of the site (Figure 3) shows that the deposit is generally bounded by a hornblende gneiss to the north and a mica schist to the south. The area is characterized by extensive vertical fracturing, dominated by the Illinois and the Rogers fault systems. Primary mineralization occurs in the brecciated Precambrian-age Schwartz Trend rocks. The deposit is essentially limited to Schwartz Trend rocks; veins truncate within 20-30 feet in the mica schist. Dominant ore minerals include pitchblende (uranium oxide) and coffinite (uranium sulfate).



Modified from Sheridan, et al,1968

EXPLANATION

- PHANEROZOIC SEDIMENTARY ROCK
- MICA SCHIST UNIT
- SCHWARTZ TREND
- HORNBLENDE GNEISS UNIT

NORTH

0 1,666 3,333

Scale (ft)

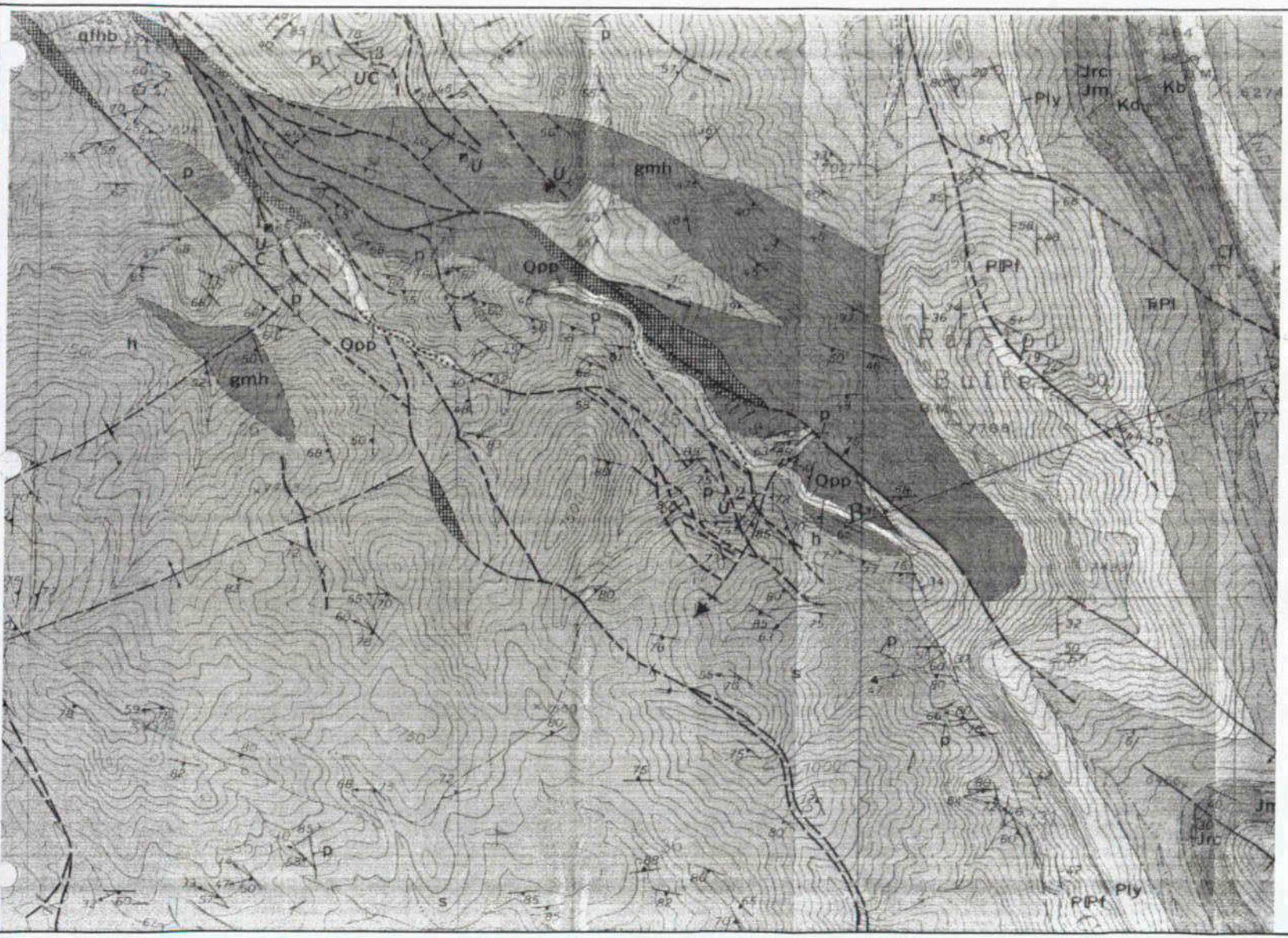
cotter

Cotter Corporation
7800 E.Dorado Pl. Suite 210
Englewood, CO 80111

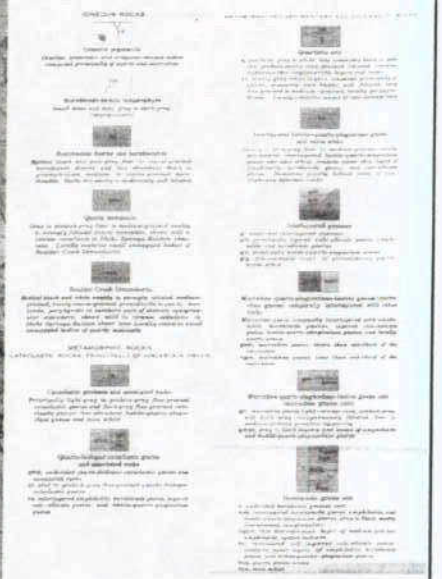
Cotter Schwartzwalder Mine
Closure Hydrology Study

FIGURE 3
GENERALIZED GEOLOGIC MAP OF SECTION 25

Date: 11/5/07	Scale: 1" = 1,666' 1:20,000
Whetstone Associates	Project/File:
	Drawn/Checked By: Cotter Corp



EXPLANATION



Source: Sheridan, et al., 1967.
USGS Professional Paper 520

NORTH

0 1200 2400
Scale
CONTOUR INTERVAL = 40 ft

cotter
Cotter Corporation
7800 E Dorado Pl, Suite 210
Englewood, CO 80111

Cotter Schwartzwalder Mine
Closure Hydrology Study

FIGURE 4
DETAILED GEOLOGIC MAP
of a portion of the
RALSTON CREEK 7 1/2' QUAD

Scale: 1"=1200' 1:14,400	Date: 10/31/07
Project No.: 41098	File
Whetstone Associates	Drawn By: SW
	Checked By: SW

2.5 Mine History

The Schwartzwalder Mine operated from 1953 to 2000. The deposit was discovered by Fred Schwartzwalder in 1949, and work progressed slowly on veins related to the Illinois Fault until 1953 when exploration and mining assistance was received from the Federal government. Production and exploration increased when Fred Schwartzwalder sold the mine to Denver-Golden Oil and Uranium Co. in 1956. Several adits were driven along the Illinois Fault System, including the Steve Level adit, located about 50 ft above creek level, and shaft sinking began in pursuit of deeper ore.

Cotter Corporation purchased the mine in 1966. The #1, #2, and #3 shafts were completed in 1958, 1970, and 1976, respectively. An exhaust borehole to the surface was drilled northwest of the other shafts in 1977. A water treatment plant was constructed in 1987. A spiral decline was developed from the 19 Level to the 22 Level during the 1988-1996 period.

Dewatering of the spiral decline ceased in September 1998, when the pumps were shut off at the bottom of the decline (approximately 2,200 feet), and the lower workings of the mine were allowed to refill to the 19 Level. Mining operations continued until May 2000, when the pumps were shut off on the 19 Level and 7 Level, and the mine was allowed to flood.

2.6 Mine Layout

The mine was accessed through the Steve Level, which occurs at approximately 6,602 feet elevation in North American Datum [NAD] 27 coordinates or 6,550 feet elevation in mine coordinates[1]. Two portals exist on the Steve Level, which provided for normal mine access (the Steve Portal) and emergency egress (the Pierce Adit).

Several older workings were developed above the Steve Level. The Charlie and Minnesota levels, which are 119 and 226 feet above the Steve Level, respectively, intercept the CV glory hole and represent the bulk of the upper workings (Figure 5). Additionally, the Upper Level and LBJ Level daylight on the hillside. The elevations of the upper levels are given in Table 3.

Table 3. Elevations of Upper Levels at the Schwartzwalder Mine

LEVEL	MINE ELEVATION	NAD27 ELEVATION
Upper	6,895	6,947
LBJ	6,835	6,887
Minnesota	6,776	6,828
CV	6,739	6,791
Charlie	6,669	6,721
Steve	6,550	6,602

Below the Steve Level, the levels are identified according their depth (in hundreds of feet). The most extensive workings are on the 19 Level, with significant development on the 7, 9, and 15 through 17 levels. The total mine depth is 2,222 feet from the Steve Level portal to the bottom of the spiral decline

The mine was well-ventilated through a series of vent shafts. The main vent shaft extends from the top of the hillside, at an elevation of 7,294 (NAD 27) to the 7 Level. The Jeffrey vent shaft extends from the

[1] The difference between mine coordinates and State Plane (NAD 27) is + 2,056,570.73 E, +727,267.71 N, and +51.23 in elevation.

surface near the Charlie level to the 11 Level. Areas that were not actively worked were typically bulkheaded, to prevent radon gas exposure.

During operations, the Schwartzwalder Mine was kept dry by pumping water from the lower levels of the mine. Water was collected in the 19 Level, pumped to the 7 level, and then pumped to the surface where it was sent through the water treatment plant before being discharged to Ralston Creek.

The water treatment plant also processed water collected from a series of four sumps in the alluvium and fill. These sumps pumped at a combined average of approximately 100 gpm. The mine operated under Colorado Mining Permit #77-300, Colorado Discharge Permit #CO-0001-244 and Radioactive Materials License number CO-369-03S.

3. SURFACE WATER FLOW

Ralston Creek is a small, intermittent stream which drains approximately 41 square miles of mountainous watershed. The creek is deeply incised into the surrounding mountains. The canyon is approximately 6,600 feet wide and 1,200 feet deep at the mine site, where the valley floor ranges from 60 to 300 feet wide. Near the mine, the original valley floor has been covered with waste rock fill to form a pad for mine facilities. Although the creek was rerouted to the north side of the canyon during mine development, it has since developed a series of natural riffles and pools where it flows past the mine site (Shepherd Miller, 1999).

3.1 Flow in Ralston Creek at Ralston Reservoir

Historical flow data are available for downstream gaging stations on Ralston Creek, for the period from 1957 to the present. The information was provided by the Denver Water Board, which measures flow and field parameters at the Long Lake ditch outlet from Ralston Creek (about 1.5 miles downstream from the Cotter property) and at the inlet to Ralston Reservoir. Data from the Ralston Creek and Long Lake Head Gate gaging stations were analyzed for the period from 1956 to January 2004[2] (Table 4). The flow records were processed[3] and evaluated to identify major trends in Ralston Creek.

The data indicate that the highest flows in Ralston Creek above Ralston Reservoir occur during the months of April, May, and June. Peak flows occur during the month of May, when the average flow rate is 32.4 cfs. By contrast, the average flow rate from August to February is 2.1 cfs. This relatively stable base flow during the summer, fall, and winter is indicative of steady groundwater flow to the creek. During the spring, runoff and snowmelt add to the groundwater base flow in Ralston Creek. The creek can be prone to flash flooding and significant erosion, due to the narrow channel and large recharge area.

Monthly average flow rates in Ralston Creek correlate well with monthly average precipitation, (Figure 6), but have a slightly larger time lag during winter months. Precipitation records for the Ralston Reservoir meteorological station, located about 2 miles east of the mine and 560 ft lower in elevation, are given in Section 2.3.

---

[2] Discontinuous records are available from 1953 to 1970. Flow records are fairly complete from 1970 to 2004.

[3] Flow records at Long Lake Feeder Ditch gaging station were added to the flow records for Ralston Creek above Ralston Reservoir gaging station to give the total flow in Ralston Creek. Where data were missing for the Long Lake Headgate flow, it was assumed to be zero.

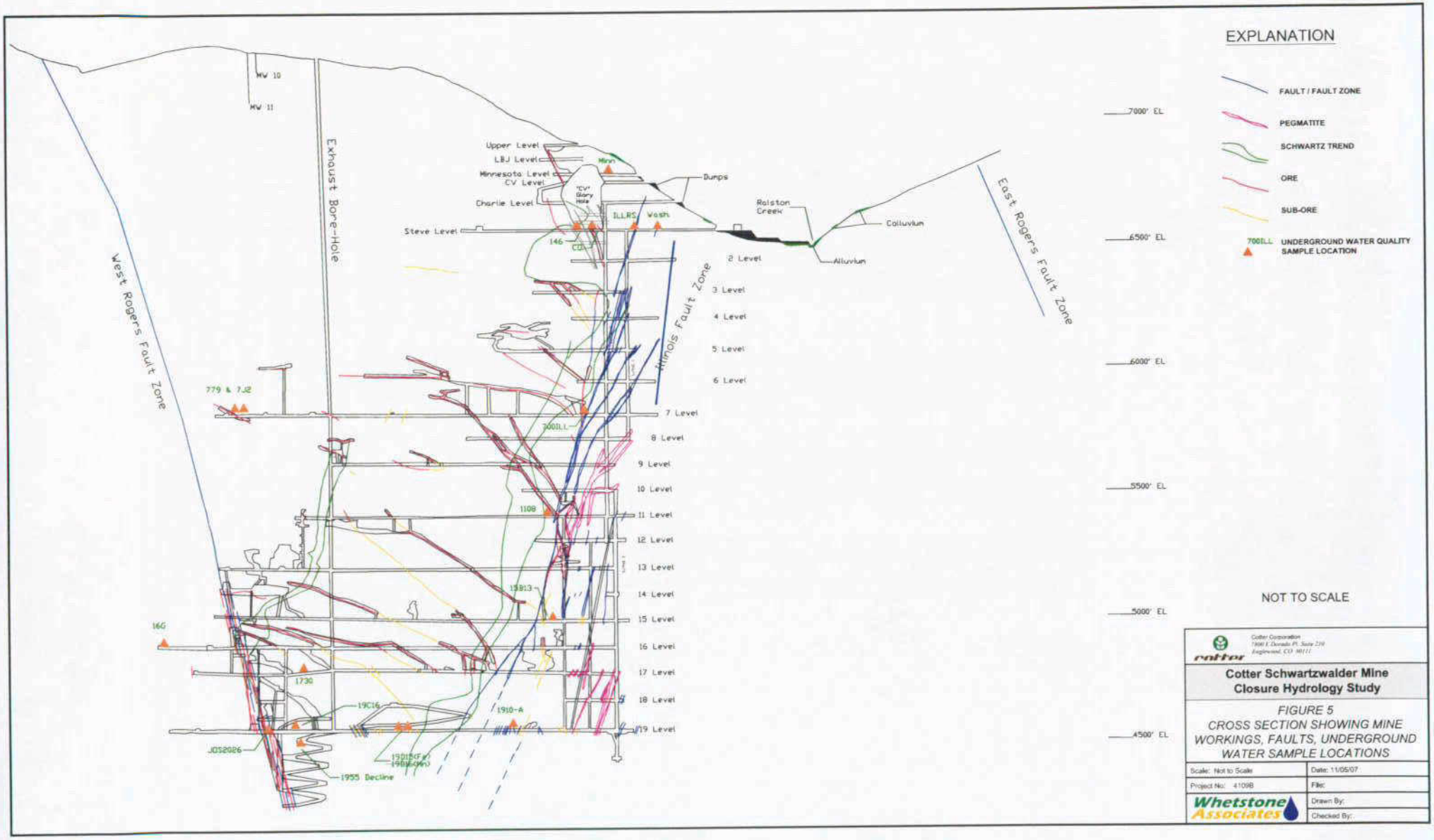

EXPLANATION
FAULT / FAULT ZONE
PEGMATITE
SCHWARTZ TREND
ORE
SUB-ORE
700ILL UNDERGROUND WATER QUALITY SAMPLE LOCATION
NOT TO SCALE
7000' EL
6500' EL
6000' EL
5500' EL
5000' EL
4500' EL
West Rogers Fault Zone
Exhaust Bore-Hole
Illinois Fault Zone
East Rogers Fault Zone
MW 10
MW 11
Upper Level
LBJ Level
Minnesota Level
CV Level
Charlie Level
Steve Level
Minn
Dumps
ILLRS
Wash
Ralston Creek
Colluvium
Alluvium
2 Level
3 Level
4 Level
5 Level
6 Level
7 Level
8 Level
9 Level
10 Level
11 Level
12 Level
13 Level
14 Level
15 Level
16 Level
17 Level
18 Level
19 Level
146
CO
779 & 7J2
700ILL
1108
15B13
16G
1730
19C16
1910-A
JOS2026
1955 Decline
Cotter Corporation
Cotter Schwartzwalder Mine
Closure Hydrology Study
FIGURE 5
CROSS SECTION SHOWING MINE WORKINGS, FAULTS, UNDERGROUND WATER SAMPLE LOCATIONS
Scale: Not to Scale
Date: 11/05/07
Project No: 4109B
File:
Drawn By:
Checked By:
Whetstone Associates

Table 4. Flow Rates in Ralston Creek vs. Monthly Mean Precipitation at Ralston Reservoir

Month	Mean Monthly Flow (cfs)	Average Minimum Flow (cfs)	Average Maximum Flow (cfs)	Number of Months (for which flow data were available)	Mean Monthly Precipitation (in)
Jan	1.6	1.3	1.8	35	0.61
Feb	1.7	1.2	2.2	35	0.65
Mar	4.1	2.3	9.1	38	1.87
Apr	14.1	4.1	32.4	44	2.41
May	32.4	13.3	57.6	47	2.93
Jun	16.1	4.0	34.5	45	1.96
Jul	3.8	1.4	16.0	40	1.64
Aug	2.9	1.1	6.9	39	2.13
Sep	2.4	1.1	7.1	37	1.38
Oct	2.2	1.5	6.1	37	1.22
Nov	2.5	1.4	5.8	36	1.13
Dec	1.8	1.4	2.2	35	0.75
Monthly Average	7.1	cfs			1.56 in.
Annual Average	5160.7	acre-ft			18.68 in

NOTES: Flow data obtained from Denver Water, period of record March 1957 through January 2004
Precipitation data from National Climatic Data Center, period of record May 1978 through July 2007

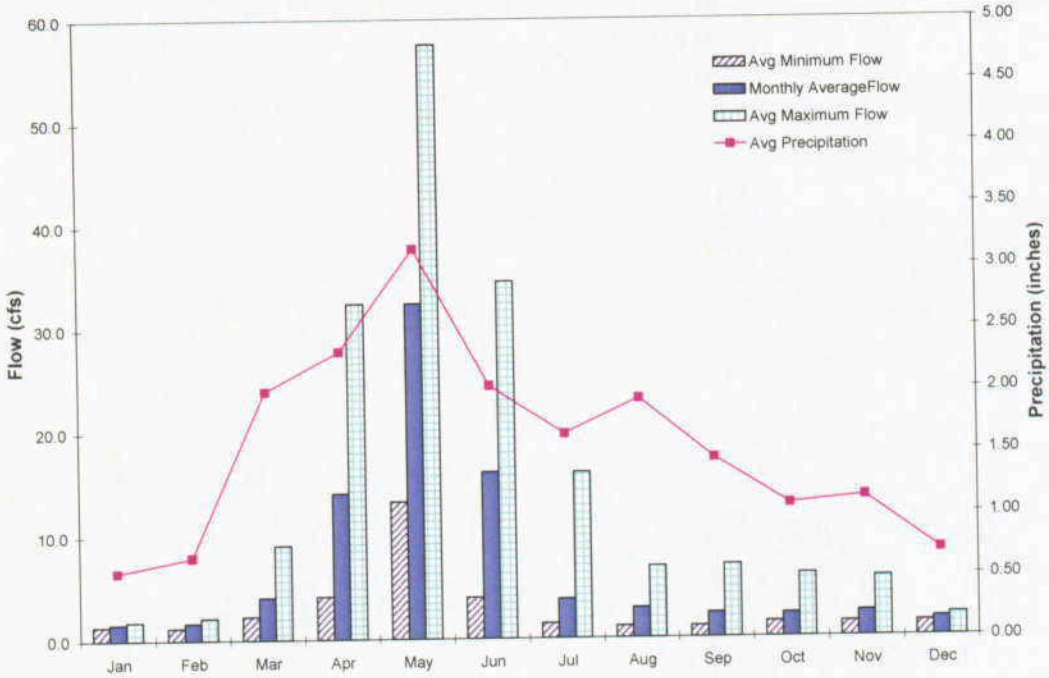


Figure 6. Average Flow Rates in Ralston Creek vs. Monthly Mean Precipitation

3.2 Flow in Ralston Creek at the Schwartzwalder Mine

A series of nine gaging stations were established in Ralston Creek near the mine site (Figure 2, Table 5) for baseline characterization during 1998-1999. The locations were selected to have straight, uniform stretches of channel with smooth banks and beds of a fairly permanent nature, and were located far from flow disturbances caused by turnouts. Semi-permanent staff gages were installed at each station[4], and flow was measured using a flow meter and wading rod on October 1998, May 1999, July 1999, and August 1999. These velocity-area measurements (Appendix A) were used to develop discharge rating curves for each station (Appendix A), from which staff gage readings of stream stage could be converted directly to flow rates.

[4] Stage recorders were installed by Cotter Corporation at nine of the ten surface water monitoring stations. Denver Water maintains and records flow at the tenth station, at the Long Lake Feeder Ditch.

Table 5. Stream Gaging Stations on Ralston Creek

STATION	NORTHING	EASTING	ELEVATION	DESCRIPTION	
SW-LLHG	726940.00	2065740.00	6155.00	Long Lake Head Gate	(Denver Water Board)
SW-BPL	732144.38	2063063.84	6508.97	Below Property Line	(near MW8)
SW-GS	732466.73	2062546.19	6533.43	Guard Shack	(near MW7)
SW-BOS	732696.77	2062307.12	6543.60[5]	Below Ore Sorter	(near MW6)
SW-OS	732902.10	2062102.41	6551.92	Ore Sorter	(upstream from Sump3)
SW-PL	733088.71	2061744.42	6563.94	Parking Lot	(near MW3A)
SW-BDIS	733336.16	2061476.31	6577.34	Below Discharge	
SW-A001	733673.75	2061141.35	6590.57	Above Discharge	(upstream of culvert)
SW-UC	734328.15	2060300.99	6618.08	Upper Culvert	(upstream of culvert)
SW-UP	735102.33	2059153.21	6660.82	Upgradient	(≈1,200' E of prop. Boundary)

Note: Coordinates given in State Plane feet, NAD 27.

Staff gages were read monthly from October 1998 to September 1999 for all nine stations near the mine. In addition, the staff gage at station SW-A001 was read six times between May 2001 and May 2003, and the staff gage at station SW-BPL was read nineteen times between May 2001 and September 2003.

The flows measured during 1998 – 1999 are summarized in Figure 7. Each measurement represents a snapshot in time, rather than a monthly average. The contemporaneous data are critical for determining gains or losses in Ralston Creek as it passes through the mine property. The instantaneous flow measurements are tabulated and shown graphically in Figure 8.

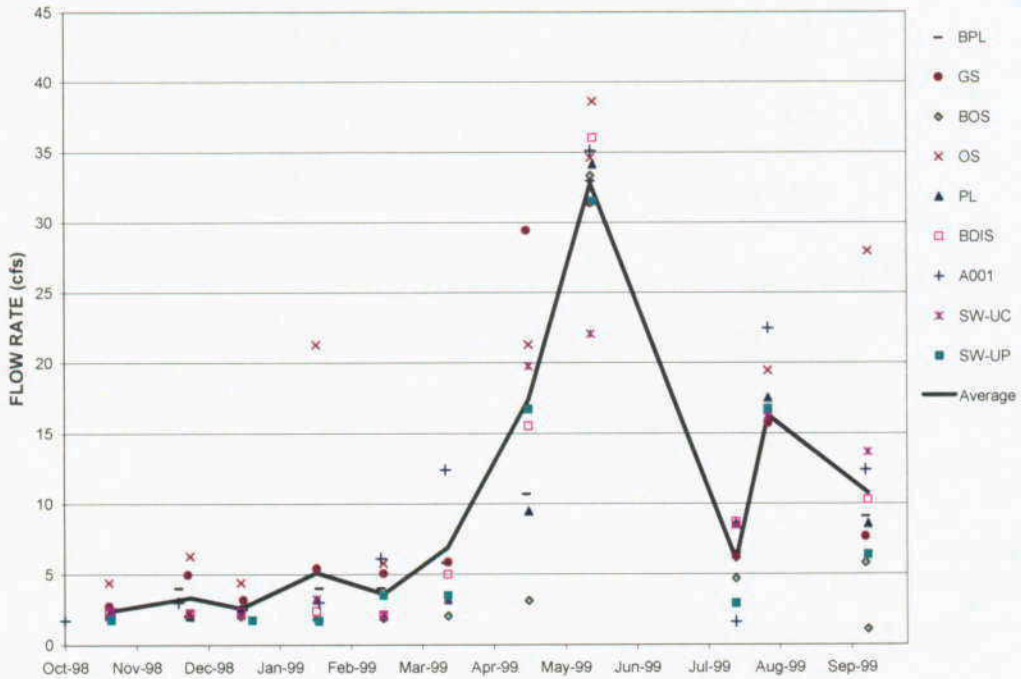
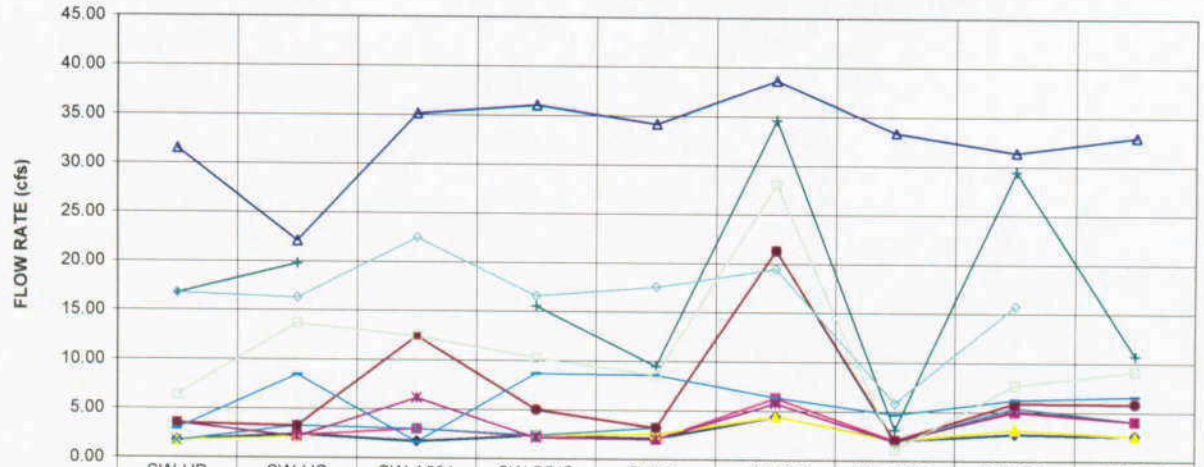


Figure 7. Flow Rates Measured in Ralston Creek near the Schwartzwalder Mine, by Month, 1998 - 1999

[5] Elevation is approximate (within 1 ft) for station SW-BOS



	SW-UP	SW-UC	SW-A001	SW-BDIS	SW-PL	SW-OS	SW-BOS	SW-GS	SW-BPL
Oct-98	1.74	2.33	1.70	2.34	2.08	4.37	2.03	2.71	2.54
Nov-98		2.23	2.96	2.22	1.98	6.26	2.01	4.95	3.99
Dec-98	1.70	2.09		2.32	2.53	4.37	1.99	3.16	2.47
Jan-99	1.64	3.20	2.96	2.34	3.18	21.27	1.83	5.40	3.99
Feb-99	3.47	2.09	6.10	2.09	1.98	5.75	1.87	5.04	3.99
Mar-99	3.47	3.20	12.38	4.97	3.18	21.27	2.01	5.85	5.80
Apr-99	16.70	19.72		15.51	9.45	34.59	3.10	29.40	10.67
May-99	31.47	22.04	35.09	36.00	34.14	38.58	33.32	31.36	32.95
Jul-99	2.89	8.42	1.59	8.66	8.55	6.32	4.66	6.21	6.53
Aug-99	16.70	16.24	22.44	16.56	17.50	19.41	5.81	15.70	
Sep-99	6.34	13.63	12.38	10.24	8.55	27.93	1.08	7.64	9.08

Figure 8. Flow Rates Measured in Ralston Creek near the Schwartzwalder Mine, by Station, 1998 – 1999

The following observations are made based on the flows measured at gaging stations near the mine and above Ralston Reservoir from October 1998 to September 1999:

- Flow in Ralston Creek is relatively constant (within the precision of the measurements) from above the mine (station SW-UC) to below the mine property (station SW-BPL), indicating that the measured reaches are neither gaining nor losing. No large catchments are tributary to Ralston Creek within this stretch. The discharge from the water treatment plant to the creek during the study period averaged 214 gpm (0.47 cfs), which is within the precision of the measurements. The added flow from the treatment plant discharge is not manifested as an increase in measured flows between stations SW-A001 and SW-BDIS.
- The rating curve developed for station SW-OS appears to slightly overestimate flows during low flow (4 – 5 cfs) and high flow (35 cfs) periods. The rating curve overestimates are even greater during intermediate flow periods (6 – 30 cfs) at station SW-OS. However, when evaluated in combination, the flow measurements and rating curves (Appendix A) from all nine stations provide a reasonably accurate assessment of flow in Ralston Creek near the mine site.
- The stream flow in Ralston Creek was below normal during the monitoring period. The daily flow data measured by Denver Water was less than the monthly average during 11 of the 12 gaging events (Table

6). Similarly, the monthly average flow measured by Denver Water from October 1998 to September 1999 was less than the long-term average for all months except May.

- Flows in Ralston Creek near the mine site are higher than flows measured 1.5 to 2 miles downstream (at the Long Lake Head Gate and Ralston Reservoir.) Ralston Creek must therefore contain losing reaches between the mine and Ralston Reservoir.
- The minimum flow in Ralston Creek at nine stations near the mine site occurred during the winter months, and was approximately 3.8 cfs (Table 7). This minimum flow represents base flow equivalent to 1.34 inches per year from the approximately 38 square miles of catchment, or approximately 7% of the average annual precipitation measured at Ralston Reservoir.
- The average flow in Ralston Creek at nine stations near the mine site was approximately 9.7 cfs. This average flow represents base flow equivalent to 3.48 inches per year from the approximately 38 square miles of catchment, or approximately 19% of the average annual precipitation measured at Ralston Reservoir.
- Peak flows in Ralston Creek near the mine site during the October 1998 – September 1999 monitoring period occurred in May, when the average flow at all nine stations was 32.7 cfs.

Peak flows for the 50- and 100-year recurrence interval storms were calculated in a hydrologic analysis of Ralston Creek, which was performed in 1983 as part of the waste rock stability report. The analysis determined that the discharge from the 50-year recurrence interval flood at the mine site is 4,960 cfs (McDermid, 1983a) and the discharge from the 100-year recurrence interval flood is 5,750 cfs (McDermid, 1983b). A 100-year peak flow of 119 cfs was used in the waste rock stability analysis.

Table 6. Stream Gaging Results for Ralston Creek Near Schwartzwalder Mine

STATION	10/20/98	11/19/98	12/17/98	1/19/99	2/15/99	3/15/99	4/19/99	5/17/99	7/19/99	8/2/99	9/13/99
SW-UP	1.74		1.70	1.64	3.47	3.47	16.70	31.47	2.89	16.70	6.34
SW-UC	2.33	2.23	2.09	3.20	2.09	3.20	19.72	22.04	8.42	16.24	13.63
SW-A001	1.70	2.96		2.96	6.10	12.38		35.09	1.59	22.44	12.38
SW-BDIS	2.34	2.22	2.32	2.34	2.09	4.97	15.51	36.00	8.66	16.56	10.24
SW-PL	2.08	1.98	2.53	3.18	1.98	3.18	9.45	34.14	8.55	17.50	8.55
SW-OS	4.37	6.26	4.37	21.27	5.75	21.27	34.59	38.58	6.32	19.41	27.93
SW-BOS	2.03	2.01	1.99	1.83	1.87	2.01	3.10	33.32	4.66	5.81	1.08
SW-GS	2.71	4.95	3.16	5.40	5.04	5.85	29.40	31.36	6.21	15.70	7.64
SW-BPL	2.54	3.99	2.47	3.99	3.99	5.80	10.67	32.95	6.53		9.08
AVERAGE	2.43	3.32	2.58	5.09	3.60	6.90	17.39	32.77	5.98	16.30	10.76
RALSTON CR. DAILY	1.00	1.00	1.00	2.00	1.00	2.00	5.00	25.00	2.00	5.00	3.00
RALSTON CR. MONTHLY	1.06	1.37	1.13	1.29	1.04	1.45	11.37	43.23	13.40	3.45	14.97
RALSTON CR. LONG-TERM AVERAGE	2.24	2.46	1.80	1.55	1.69	4.07	14.12	32.41	16.09	3.79	2.90

Table 7. Seasonal Distribution of Average Flows in Ralston Creek Measured at Nine Stations Near the Schwartzwalder Mine, October 1998 – September 1999

Season	Months	Flow Rate (cfs)
Fall	Sept-Oct-Nov	5.50
Winter	Dec-Jan-Feb	3.76
Spring	Mar-Apr-May	19.02
Summer	June-July-Aug	11.14

Flow rates in Ralston Creek have been affected by several project-related activities:

- *Sumps*. Four sumps were operated in the alluvium and fill adjacent to Ralston Creek. The sumps were designed to limit direct seepage of uranium-impacted water from the alluvium into the creek by collecting water from engineered French drains. The source of uranium in the alluvial sump water was not entirely known, although leaching from treatment pond sediments that were covered by construction of the ore sorter may be one potential source (Section 10.2). Water collected from the sumps was sent through the water treatment plant, and discharged into Ralston Creek at station SW-DIS001. As a result, the net affect of the sumps on flow rates in the creek was negligible.
- *Water Treatment Plant*. Until May 2002, flow rates in Ralston Creek were also affected by mine water which was pumped from the lower levels, treated, and discharged from the water treatment plant. Mine water pumping rates averaged about 200 gpm from 1995 to 1999 (Section 5.2.1). This contribution increased the net flow rate in Ralston Creek, although the increase was insufficient to be detected within the precision of the stream flow monitoring program. The change in flow from the treatment plant was not distinguishable in the flow rates measured in Ralston Creek.

Since pumping from the mine ceased in May 2000, and the mine sumps and water treatment plant were taken offline in June 2002, flows in Ralston Creek are no longer affected by pumping from bedrock or alluvium and return flow to surface water at the site.

4. GROUNDWATER

Groundwater occurs in two primary zones: bedrock and alluvium. Bedrock in the project area consists of amphibolite-grade metamorphic rocks. Alluvium is largely confined to stream deposits of limited thickness and extent along Ralston Creek, as shown in Figure 4.

4.1 Groundwater in Bedrock

Bedrock consists of three main lithologic units:

1) Lime-silicate-hornblende gneiss (LSHG);
2) Mica schist (MS); and
3) Garnet-biotite gneiss and quartzite rock of the Schwartz Trend.

The LSHG and MS rock types comprise the majority of the rock mass at the site. Bedrock north of the mine is composed of lime-silicate-hornblende gneiss. Bedrock south of the mine is predominantly mica schist. Uranium ore was hosted by Schwartz Trend rocks which form a thin band of brittle garnet-biotite gneiss and quartzite along the near vertical contact between the more extensive LSHG and MS units. A geologic map of the mine area is presented in Figure 3.

Pegmatite intrusive rocks comprise a fourth lithologic unit in the area, but represent a very small portion of the total rock mass. The pegmatites were significant to the mine's hydrology, however, in that they yielded large volumes of water to underground workings when initially drilled.

In general, LSGH, MS, and Schwartz Trend rocks have low primary permeability. Underground observation suggests that regional faults and associated fracture systems control the limited occurrence and flow of groundwater in bedrock. The primary structural features present at the mine include the West Rogers Fault, which strikes northwest and dips steeply to the northeast, and the Illinois Fault, which strikes north and dips steeply to the west (Figure 3). These two fault systems combined with high angle pegmatite dikes, steeply dipping regional foliation, and the high relief of the project area impart a strong vertical component to groundwater flow system.

4.1.1 Depth to Water and Groundwater Flow

Information about the depth to water and groundwater flow in bedrock is available from two monitoring wells, MW10 and MW11, which are located on the hillside above the mine (Figure 5, Figure 1).

Groundwater gradients in bedrock near the mine and on the slopes beside Ralston Creek, are dominantly vertical as demonstrated by water levels in MW10 and MW11. Monitoring well MW11 is completed in bedrock to a depth of 200 feet[6], where observed water level ranged from 82 to 122 feet below top of the casing (btoc). Shallow monitoring well, MW10, is located adjacent to MW11 and was installed to evaluate the vertical gradient in the area of the mine. MW10 is completed to a depth of 75 feet[7] and is dry for much of the year. In 1999, the depth to groundwater in MW10 was observed to be 67.2 ft btoc in May and 71.25 ft btoc in September. On the same dates, water levels in MW11 were measured to be 82.89 and 89.10 ft btoc (Table 8). Using the mid-point of the saturated screened intervals in the two wells as reference points, the downward vertical gradient near the mine is calculated to vary from 0.15 to 0.17 (Table 9).

Both wells exhibit marked seasonal variation in water levels. MW10 is commonly dry, as it was when measured most recently on November 2, 2007. MW11 has not been dry when measured, although its water level varies significantly with the seasons, as shown in Figure 9. Note that limited water level data are available for MW11 because the road leading from the mine site has been reclaimed, and access is now limited.

Table 8. Water Levels and Well Data for Bedrock Monitoring Wells MW10 and MW11

Date	Well	Depth to Water (ft. btoc)	Collar Elevation (ft. amsl)	Water Elevation (ft.amsl)	Top of Well Screen (ft.amsl)	Bottom of Well Screen (ft.amsl)	Mid-Point of Saturated Screen (ft.amsl)
5/27/99	MW10	67.20	7393.86	7326.66	7370.36	7320.36	7323.51
	MW11	82.89	7394.27	7311.38	7244.27	7194.27	7219.27
9/21/99	MW10	71.25	7393.86	7322.61	7370.36	7320.36	7321.49
	MW11	89.10	7394.27	7305.17	7244.27	7194.27	7219.27
11/09/07	MW10	>77.6	7393.86	<7316.26	7370.36	7320.36	N/A
	MW11	122.0	7394.27	7272.27	7244.27	7194.27	7219.27

[6] 200 ft is approximate total depth from ground surface when drilled in 1999. MW11 total depth was measured on 11/2/2007 at 189 ft below top of casing (btoc).

[7] 75 ft is approximate total depth from ground surface. MW10 total depth was measured on 11/2/2007 at 77.6 ft below top of casing (btoc).

Table 9. Calculation of Vertical Gradients in Shallow Bedrock

Date	Well	Elevation Head (H)	Mid-Point Elevation (y)	$y_1 - y_2$	H_1-H_2	Vertical Gradient $(H_1-H_2)/(y_1-y_2)$
5/27/99	MW10	7326.66	7323.51	104.24	15.28	0.15
	MW11	7311.38	7219.27			
9/21/99	MW10	7322.61	7321.49	102.22	17.44	0.17
	MW11	7305.17	7219.27			

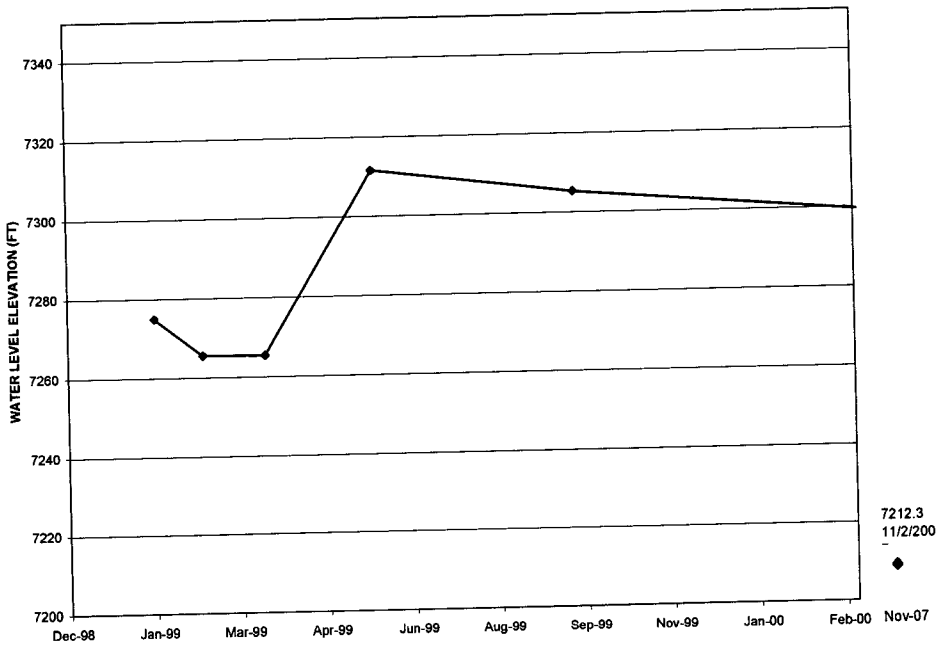


Figure 9. Seasonal Variation in Water Levels in Deep Bedrock Monitoring Well MW11

Based on the data from Monitoring wells MW10 and MW11 it can be concluded that:

1. The water table in bedrock is typically within about 100 feet of the ground surface.
2. Shallow bedrock groundwater levels fluctuate seasonally and the thickness of the unsaturated zone decreases to about 70 feet in the spring.
3. The hillside above the mine remains essentially saturated throughout the year. Therefore the hydraulic conductivity of the bedrock must be low.
4. Shallow groundwater flow in bedrock is predominately vertical. The high vertical gradient (15 to 17 percent) indicates that vertical hydraulic conductivity is low. The vertical hydraulic conductivity of bedrock, however, is probably greater than horizontal hydraulic conductivity because of steeply dipping foliation and near vertical orientation of major structural features.
5. The specific yield of bedrock is low. Water levels in MW11 rose approximately 50 feet during the spring of 1999. If it is assumed that recharge to the system by infiltration of meteoric water is about 3 inches during the spring, the drainable porosity of the rock is calculated to be 0.005, or

0.5% (infiltration/increase in water level). This value is at the low end of specific yield values for bedrock (Freeze and Cherry, 1979), and is consistent with low hydraulic conductivity.

4.1.2 Bedrock Permeability Tests

Permeability data for bedrock are available from 22 packer tests performed in seven underground boreholes. The packer tests were performed by Cotter personnel during the spring of 1999 according to methodology prepared by Adrian Brown Consultants (Appendix B). Data from the packer tests are contained in Appendix B. Results are summarized in Table 10.

Hydraulic conductivity values calculated from the packer tests ranged from 3.3×10^{-5} cm/sec to 9.9×10^{-8} cm/sec. The geometric mean hydraulic conductivity for all packer tests was calculated to be 4.7×10^{-7} cm/sec. The median hydraulic conductivity was calculated to be 2.7×10^{-7} cm/sec. Packer test results did not indicate significant variation in hydraulic conductivity between the major lithologic units (LSHG, GBG, and MS). In general, the permeability of unfractured bedrock was low (near 1×10^{-7} cm/sec). Four of 22 tests returned values in the 10^{-6} cm/sec range and 2 of the tests indicated permeabilities in the low 10^{-5} cm/sec range. Packer tests with hydraulic conductivities greater than 1×10^{-6} cm/sec are interpreted to result from fracture flow, with permeabilities in the low 10^{-5} cm/sec range best representing the hydraulic conductivity of transmissive fracture zones.

Packer tests completed in intrusive pegmatite rocks also indicated low permeability ($<1\times10^{-7}$ cm/sec). In contrast, the hydraulic conductivity of transmissive fracture zones is estimated to be on the order of 10^{-5} cm/sec. This range is consistent with published values for fractured metamorphic rocks (Freeze and Cherry 1979) and professional experience at other underground mines in metamorphic terrains (Crandon Project, Wisconsin; Monarch Mine, Venezuela; Midwest Project, Saskatchewan). These transmissive zones (faults, fractures and pegmatites) are of limited distribution and extent but provided the bulk of the flow to the underground workings during mine development and dewatering (Section 5.2.1). Most of the pegmatite coreholes were pressure-grouted in 1994 (Section 5.2.1), and the average bulk permeability of remaining fractured and unfractured bedrock was determined from mine inflow data to be 2.8×10^{-7} cm/sec (Section 0). The fact that the packer testing of pegmatite zones resulted in a very low permeability ($<1\times10^{-7}$ cm/sec) probably reflects the small number and limited aerial distribution of the packer tests rather than the actual range of permeabilities associated with the pegmatites.

Table 10. Summary of Packer Permeability Test Results

Borehole	Interval	Lithology	Hydraulic Conductivity (cm/sec)	Comments
19D-53	228.1 – 270.1	MS	2.6E-07	
19D-53	185.92 – 227.92	GBG - MS	<1.0E-7	No measurable flow during injection test
19D-53	142.7 – 184.7	GBG - MS	5.3E-07	
19D-53	101.75 – 143.75	GBG - MS	3.6E-07	
19D-53	58.9 – 100.9	MS	2.7E-07	
19C-16	185.75 – 227.75	LSHG	1.6E-06	
19C-16	228.4 – 270.4	LSHG	<1.0E-7	No measurable flow during injection test
19C-16	270.85 – 312.85	LSHG	<1.0E-7	No measurable flow during injection test
19C-16	143.7 – 185.7	LSHG	<1.0E-7	No measurable flow during injection test
19C-16	61.05 – 103.05	LSHG	<1.0E-7	No measurable flow during injection test
19K-18	49.7 – 91.7	PEG	<1.0E-7	No measurable flow during injection test
19K-18	92.55 – 134.55	PEG - MS	<1.0E-7	No measurable flow during injection test
19K-18	133.95 – 175.95	MS	<1.0E-7	No measurable flow during injection test
19K-18	20.1 – 62.1	PEG - MS	9.9E-08	
15B-13	168 – 725	LSHG	7.0E-06	
15B-13	105 – 168	LSHG	4.0E-07	
15B-13	171.2 – 725	LSHG	1.0E-05	
15B-13	142.7 – 184.7	LSHG	5.3E-07	
19D-16	178.1 – 675	GBG	3.3E-05	Leakage around packer, skewed results
19D-16	153.75 –174.75	GBG	6.0E-06	
19D-16	132 – 153	GBG	2.5E-07	
19D-16	160.3 – 181.3	GBG	3.7E-06	

Statistics

Count	22	
Maximum	3.3E-05	cm/sec
Minimum	9.9E-08	cm/sec
Average	2.9E-06	cm/sec
Geo. Mean	4.7E-07	cm/sec
Median	2.7E-07	cm/sec
Standard Dev.	7.2E-06	cm/sec

4.2 Groundwater in Alluvium

Groundwater is present in alluvium at depths ranging from near ground surface to over 30 feet. Alluvium in the vicinity of the mine is comprised of sand- to cobble-sized material and occurs as deposits of limited thickness and aerial extent adjacent to Ralston Creek. Alluvial groundwater has been studied in detail by monitoring wells installed at 10 locations, and by the collection of water level and water quality data over a period of 26 years. The locations of alluvial monitoring wells are shown in Figure 1 and Figure 2. Completion data for the monitoring wells are presented in Table 11 and well logs are provided in Appendix C. Hydrologic data are also available from four groundwater collection systems located in the alluvium. Groundwater collection systems are comprised of French drains and sumps which intercepted groundwater and pumped it to the water treatment facility. Sump locations are shown in Figure 10.

Table 11. Completion Data for Alluvial Monitoring Wells

Well ID	Completion Date	Total Depth (ft)	Depth to Bedrock (ft)	Well Construction	Screened Interval (ft)	Completion Depth to Water (ft)
MW00	11/4/98	27.3	25	4" PVC	16.9 – 26.9	10.25
MW1	11/12/81	25.5	23	2 1/2" PVC	17 – 22	7
MW2	11/12/81	15.4	21	2 1/2" PVC	8.4 – 13.4	10
MW3A	6/19/89	14	Not Penetrated	4" PVC	8.6 – 13.6	10.0
MW4	6/16/89	38.9	36.3	2" PVC	25.9 – 35.9	31.4
MW5R	1/19/99	20	17	4" PVC	9.5 – 19.5	15.5
MW6	6/20/89	15	13	2" PVC	5 – 15	40
MW7	6/20/89	11	8	2" PVC	5 – 10	3.5
MW8	12/8/90	12	10	4" PVC	7 – 12	Dry
MW9	1/19/99	19.2	16	6" PVC	9 – 19	10

4.2.1 Thickness and Extent of the Alluvium

Alluvium along Ralston Creek ranges from 5 to over 30 feet thick in the vicinity of the mine. In general, the alluvium is confined to the valley floor along Ralston Creek and pinches out at the eastern edge of Section 25, near the property boundary, where a natural constriction in the valley occurs (Figure 4). This "choke point" in the alluvium occurs where the valley narrows and its walls rise steeply from the creek bed. Bedrock is exposed along the width of the valley floor and groundwater previously flowing in the alluvium is forced to the surface where it enters Ralston Creek. Alluvium thickens again downstream from the choke point. Monitoring Well MW8 which is installed in the alluvium on the downstream side of the choke point has always been dry.

Alluvial monitoring well MW4 is also frequently dry as a result of its distal location on the southwestern fringe of the alluvial system.

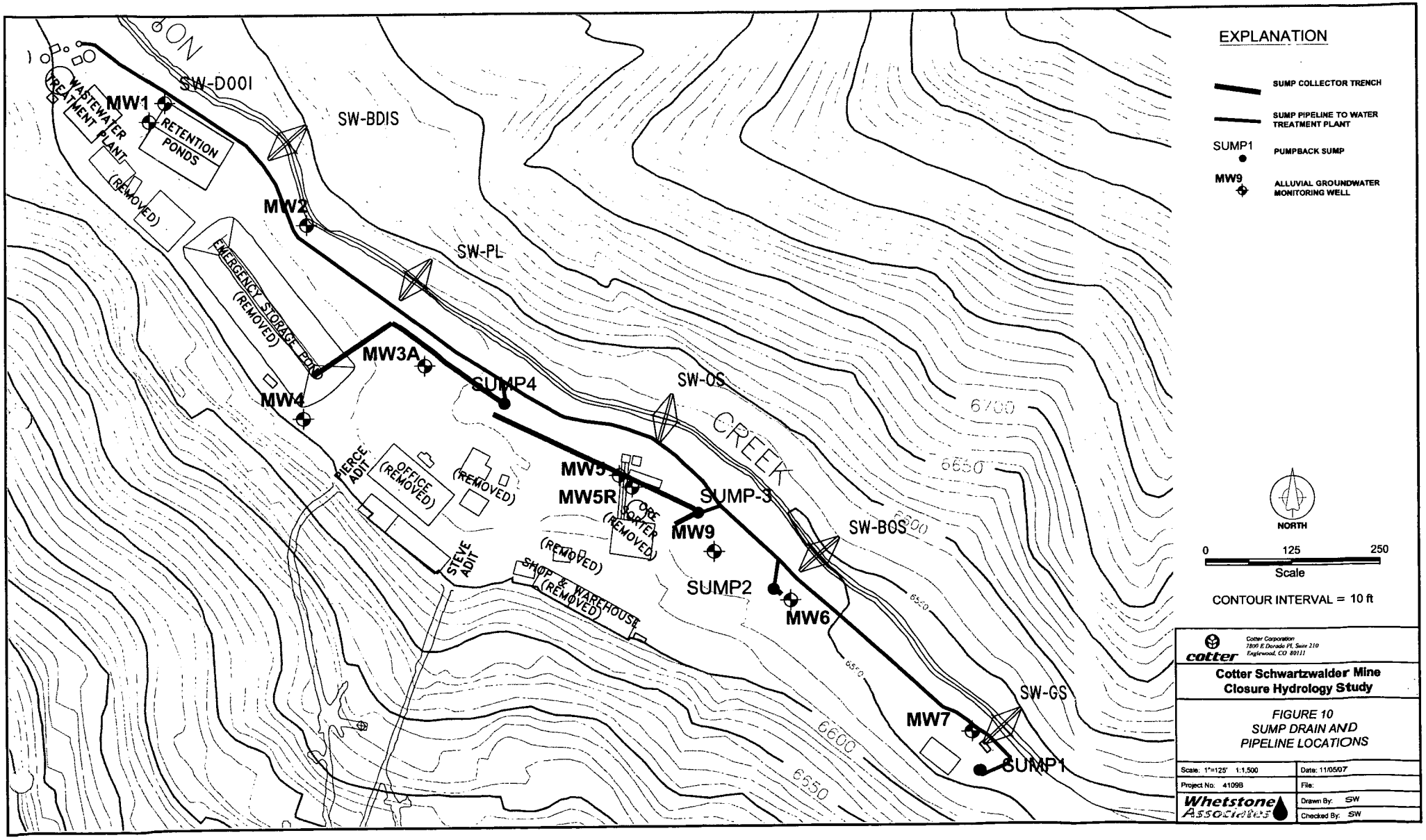
4.2.2 Alluvial Permeability Tests

Hydraulic conductivity data for alluvium are available from single well permeability tests (Geo-Hydro Consultants, 1982), laboratory permeability tests (Geo-Hydro Consultants, 1982), and a 72 hour pumping test performed in 1999 in monitoring well MW9 (Appendix D).

Geo-Hydro performed falling head (MW1) and rising head (MW2. MW3) permeability tests to characterize the hydraulic conductivity of alluvium adjacent to Ralston Creek. The results (Table 12) varied from 2.8 x 10^{-4} cm/sec to 1.7 x 10^{-2} cm/sec, with an average value of 1.1 x 10^{-2} cm/sec (28.6 ft/day) and a geometric mean of 3.96 x 10^{-3} cm/sec (11.2 ft/day). Laboratory testing indicated lower permeabilities than field testing, which is typical because the laboratory samples contained only the smaller grain size particles, rather than the complete distribution of particles in the sandy gravel.

Table 12. Summary of Single Well Permeability Tests in Alluvium

Monitoring Well	Installation Date	Total depth of PVC (ft)	Perforated Interval (ft)	Field Permeability Test Method	Hydraulic Conductivity (K) (cm/sec)	Hydraulic Conductivity (K) (ft/day)
MW1	11/12/1981	24.0	17.0 - 22.0	Falling Head	2.80E-04	0.79
MW2	11/12/1981	15.4	8.4 - 13.4	Constant Head	1.70E-02	48.19
MW3	11/13/1981	14.6	8.6 -13.6	Constant Head	1.30E-02	36.85
Mean					1.01E-02	28.6
Geometric Mean					3.96E-03	11.2


EXPLANATION
SUMP COLLECTOR TRENCH
SUMP PIPELINE TO WATER TREATMENT PLANT
SUMP1
PUMPBACK SUMP
MW9
ALLUVIAL GROUNDWATER MONITORING WELL
NORTH
0
125
250
Scale
CONTOUR INTERVAL = 10 ft
SW-D001
SW-BDIS
SW-PL
SW-OS
SW-BOS
SW-GS
CREEK
MW1
MW2
MW3A
MW4
MW5
MW5R
MW6
MW7
MW9
SUMP1
SUMP2
SUMP4
SUMP-3
WASTEWATER TREATMENT PLANT
RETENTION PONDS
(REMOVED)
EMERGENCY STORAGE POND
(REMOVED)
PIERCE ADIT
OFFICE (REMOVED)
(REMOVED)
STEVE ADIT
SHOP & WAREHOUSE (REMOVED)
(REMOVED)
ORE SORTER (REMOVED)
6700
6650
6600
6550
6500
Cotter Corporation
7800 E Dorado Pl, Suite 210
Englewood, CO 80111
cotter
Cotter Schwartzwalder Mine
Closure Hydrology Study
FIGURE 10
SUMP DRAIN AND
PIPELINE LOCATIONS
Scale: 1"=125' 1:1,500
Date: 11/05/07
Project No: 4109B
File:
Drawn By: SW
Checked By: SW
Whetstone Associates

A 72- hour pumping test with a 24-hour recovery period was performed in monitoring well MW9 during the spring of 1999. The objective of the test was to determine the permeability of the alluvium and to evaluate the hydraulic and chemical interaction between the alluvium and the creek. MW9 was pumped at a rate of 30 gpm and water levels were monitored in 7 observation wells and 4 sumps. Pumping from the sumps had been discontinued prior to the start of the test and water levels had recovered to 75% of the pre-pumping condition before starting the pumping test. Flow in Ralston Creek was also monitored during pumping. The methodology, results and analysis of the pumping test are presented in Appendix D. Significant conclusions from the pumping test include:

1. The average hydraulic conductivity of alluvium in the vicinity of MW9 is 6.4×10^{-3} cm/sec.
2. The specific yield of the alluvium as determined from observation well MW6 is 0.02
3. The distribution of hydraulic conductivity in the alluvium is heterogeneous. The observed resistance to flow was greater upstream of MW9 than it was downstream of the well.
4. The test did not appear to influence the chemistry of Ralston Creek or any of the wells or sumps adjacent to the stream.

4.2.3 Sump Pumping

Groundwater in the alluvium was intercepted and collected by four sumps, which were installed in 1990[8] and operated until June 2002. The locations of the sump drains are shown in Figure 10. Water drained into each sump by gravity and was pumped to the water treatment plant near the western end of the mine facilities. The water was treated and discharged into Ralston Creek, under Colorado Discharge Permit #CO-0001-244. The last Discharge Monitoring Report (DMR) with discharge indicated was submitted on June 29, 2002.

Sump pumping records provide an indication of the interconnection between Ralston Creek and the alluvium and fill material. Flow rates from the sumps were measured or estimated from 1995 to June 2002, when the pumps were shut off. Monthly average pumping rates for the four sumps combined ranged from 35 to 404 gpm, with an average of 104 gpm over the period of record (Table 13). A decline in sump pumping rates was observed from 2000 - 2002, which was most likely related to drought conditions.

Monthly average sump pumping rates clearly correlated with monthly average precipitation rates (Figure 12[9]). A slightly weaker correlation exists between monthly sump pumping rates and monthly average flow rate in Ralston Creek (Figure 13, Figure 14). Although flow rates in the creek peak in May, as did pumping rates from the sumps, the trend between creek flow and pumping rates differed during high flow (spring) months from the trend during low flow months.

---

[8] Sump #1 went online in August 1990, sump #2 in April 1990, sump #4 in October 1990, and sump #3 went online January1992.

[9] It should be noted that Figure 12 was generated using 26 years of precipitation data (May 1978 – November 2003), while the sump pumping records span only about five years. Some of the sump flow records contain only one or two flow measurements exist for a given month (Jan, Feb, Mar, Sept, Oct, Nov, Dec.) While a longer span of data might make the correlation stronger, the strong relationship between precipitation and sump flow (and the weaker relationship between stream flow and sump flow) is significant.

Table 13. Sump Pumping Rates

			Flow from Sumps (gpm)				
Month	From	To	Sump 1	Sump 2	Sump 3	Sump 4	Total Flow
Apr-95	4/12/1995	5/1/1995					223
May-95	5/1/1995	6/1/1995					404
Jun-95	6/1/1995	7/1/1995					266
Jul-95	7/1/1995	8/1/1995					259
Aug-95	8/1/1995	9/1/1995					194
Sep-95	9/1/1995	10/1/1995					185
May-96	5/22/1996	6/14/1996					174
Jun-96	6/14/1996	7/1/1996					156
Jul-96	7/1/1996	8/1/1996					118
Aug-96	8/1/1996	9/1/1996					89
Sep-96	9/1/1996	9/16/1996					92
Apr-97	4/1/1997	5/1/1997					137
May-97	5/1/1997	6/1/1997					268
Jun-97	6/1/1997	7/1/1997					254
Jul-97	7/1/1997	8/1/1997					119
Aug-97	8/1/1997	9/1/1997					89
Sep-97	9/1/1997	10/1/1997					114
Oct-97	10/1/1997	11/1/1997					108
Nov-97	11/1/1997	12/1/1997					92
Dec-97	12/1/1997	1/1/1998					78
Jan-98	1/1/1998	2/1/1998					73
Feb-98	2/1/1998	3/1/1998					71
Mar-98	3/1/1998	4/1/1998					107
Apr-98	4/1/1998	5/1/1998					189
May-98	5/1/1998	6/1/1998					211
Jun-98	6/1/1998	6/8/1998					170
Nov-99	11/17/1999	11/17/1999	4	5	12	38	59
Dec-99	12/14/1999	12/14/1999	6	4	12	39	61
Jan-00	1/27/2000	1/27/2000	8	3.5	11	44	66.5
Feb-00	2/1/2000	3/1/2000					60
Mar-00	3/1/2000	4/1/2000					60
Apr-00	4/1/2000	5/1/2000					65
May-00	5/1/2000	6/1/2000					65
Jun-00	6/1/2000	7/1/2000					59
Jul-00	7/1/2000	8/1/2000					58
Aug-00	8/1/2000	9/1/2000					35
Sep-00	9/1/2000	10/1/2000					57
Oct-00	10/1/2000	11/1/2000					46
Nov-00	11/1/2000	12/1/2000					53
Dec-00	12/1/2000	1/1/2001					48
Jan-01	1/1/2001	2/1/2001					48
Feb-01	2/1/2001	3/1/2001					55
Mar-01	3/1/2001	4/1/2001					60
Apr-01	4/1/2001	5/1/2001					65
May-01	5/1/2001	6/1/2001					65
Jun-01	6/1/2001	7/1/2001					60
Jul-01	7/1/2001	8/1/2001					60
Aug-01	8/1/2001	9/1/2001					35
Sep-01	9/1/2001	10/1/2001					55
Oct-01	10/1/2001	11/1/2001					45
Nov-01	11/1/2001	12/1/2001					50
Dec-01	12/1/2001	1/1/2002					45
Jan-02	1/1/2002	2/1/2002					55
Feb-02	2/1/2002	3/1/2002					55
Mar-02	3/1/2002	4/1/2002					60
Apr-02	4/1/2002	5/1/2002					65
May-02	5/1/2002	6/1/2002					65
Jun-02	6/1/2002	7/1/2002					55
Jul-02							0
						Min	35
						Max	404
						Average	104

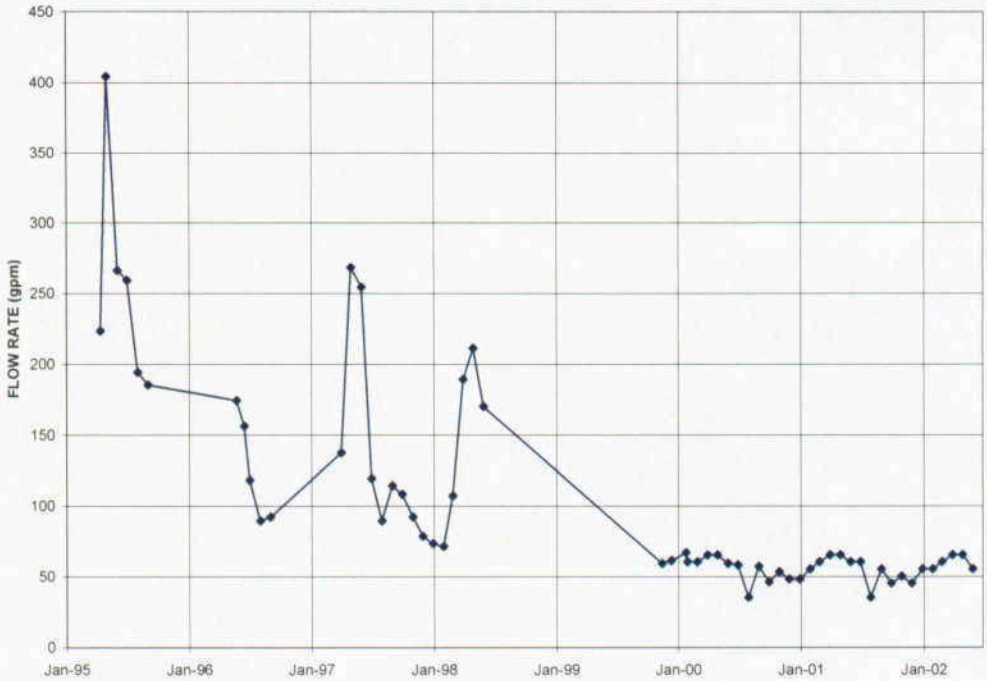


Figure 11. Sump Pumping Rates, 1995 - 2002

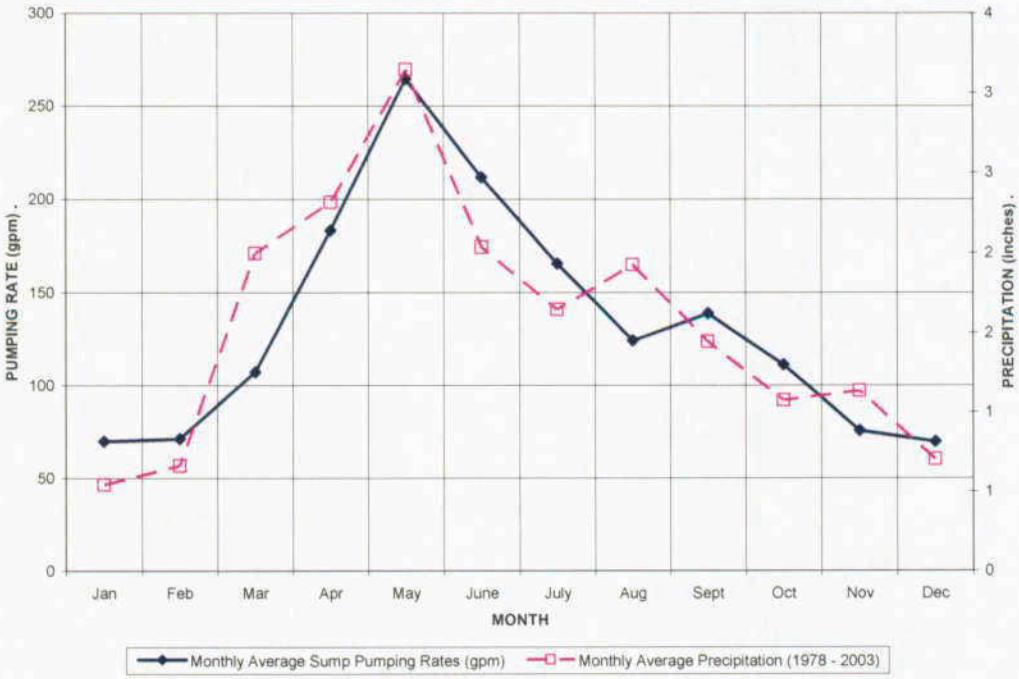


Figure 12. Monthly Average Sump Pumping Rates vs. Long-term Average Precipitation

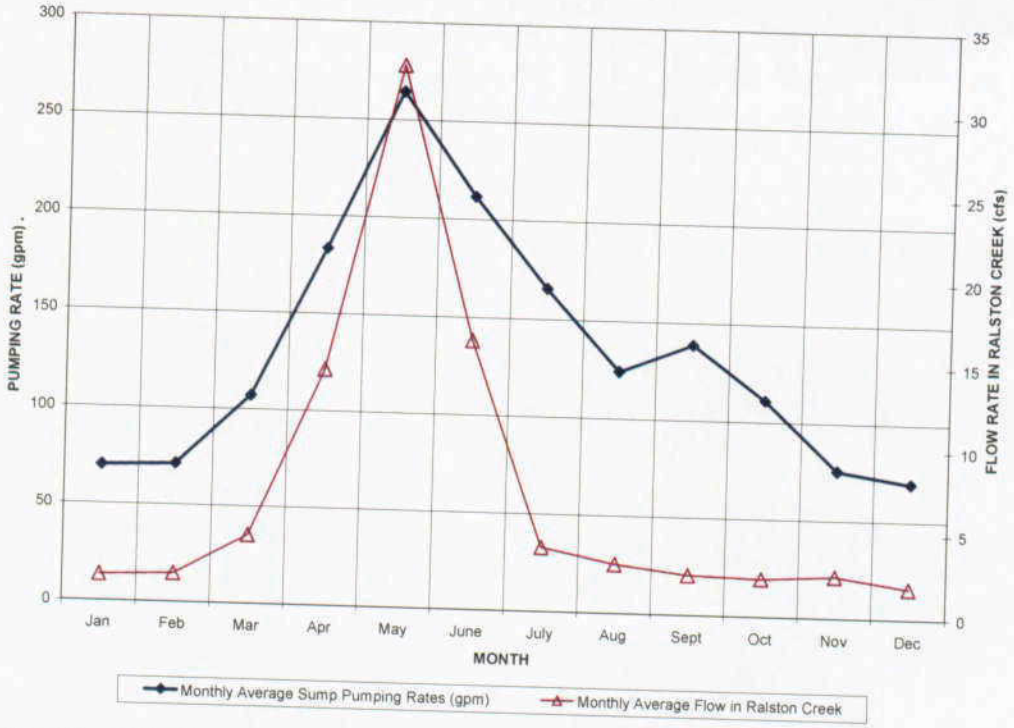


Figure 13. Monthly Average Sump Pumping Rates vs. Long-term Average Flow Rates in Ralston Creek

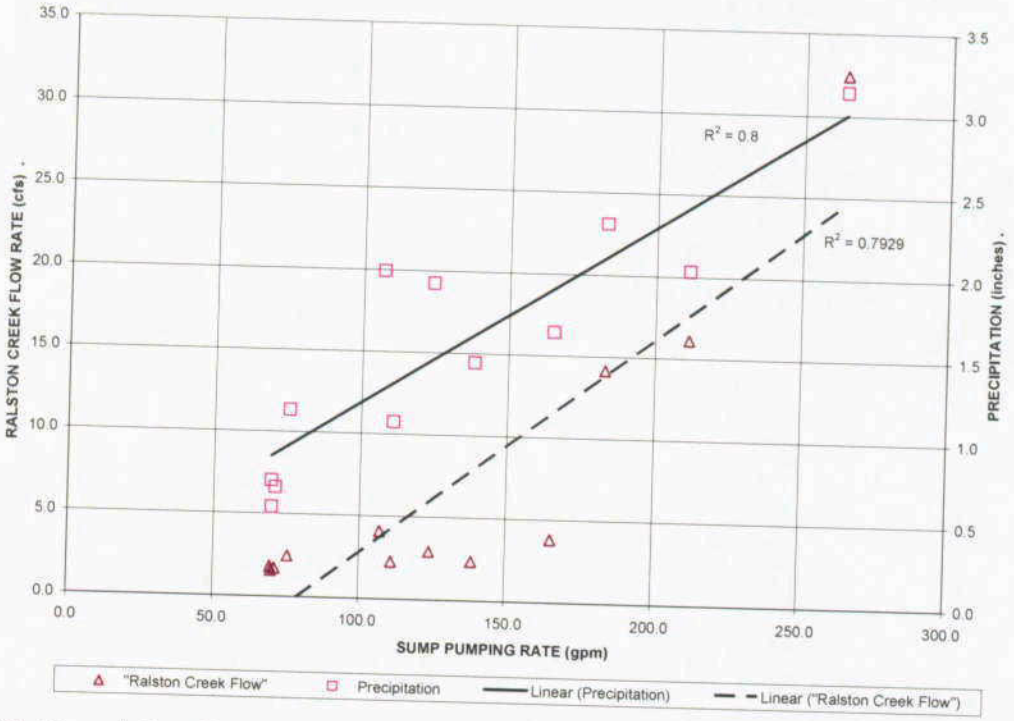


Figure 14. Correlation Between Monthly Average Sump Pumping Rates, Precipitation, and Flow Rates in Ralston Creek

4.3 Seeps

Numerous seeps exist on and below mine property, where groundwater surfaces at the contact of alluvium and the underlying, relatively impermeable hornblende gneiss unit. The natural seeps below mine property are located along the south side of the access road, along the road cut bank, where the alluvium thins and groundwater is forced to the surface. Numerous hydrophyllic grasses (phreatophytes) are associated with these seeps. Within the property boundary, seeps have been observed emanating from depressions or low points in the alluvium and fill.

Historically, a seep existed in the fill near the mine parking lot. The "parking lot seep" was removed when the emergency storage ponds were reclaimed and the area was regraded. Seeps also existed historically near MW9 and Sump 3. This seep, the "Sump 3 Seep", is still in existence as of fall 2007. Water quality in the seeps is discussed in Section 7.4.

5. MINE HYDROLOGY

5.1 Conceptual Hydrologic Model

The conceptual model for groundwater flow prior to mining is shown in Figure 15. Before 1953, groundwater in bedrock occurred in both local (shallow) and regional (deep) flow systems. Recharge to groundwater occurred by infiltration of precipitation and snowmelt in the upper portions of the watershed and either flowed in the shallow subsurface where it discharged into Ralston Creek, or entered the deeper regional system and flowed toward the east. Because the deep bedrock is relatively impermeable, most of the infiltrating precipitation flowed in the shallow, weathered bedrock (in the upper 50 ft or less below the water table) where permeabilities are somewhat higher. At depth, hydraulic gradients in bedrock were not significantly influenced by Ralston Creek, or other surface features.

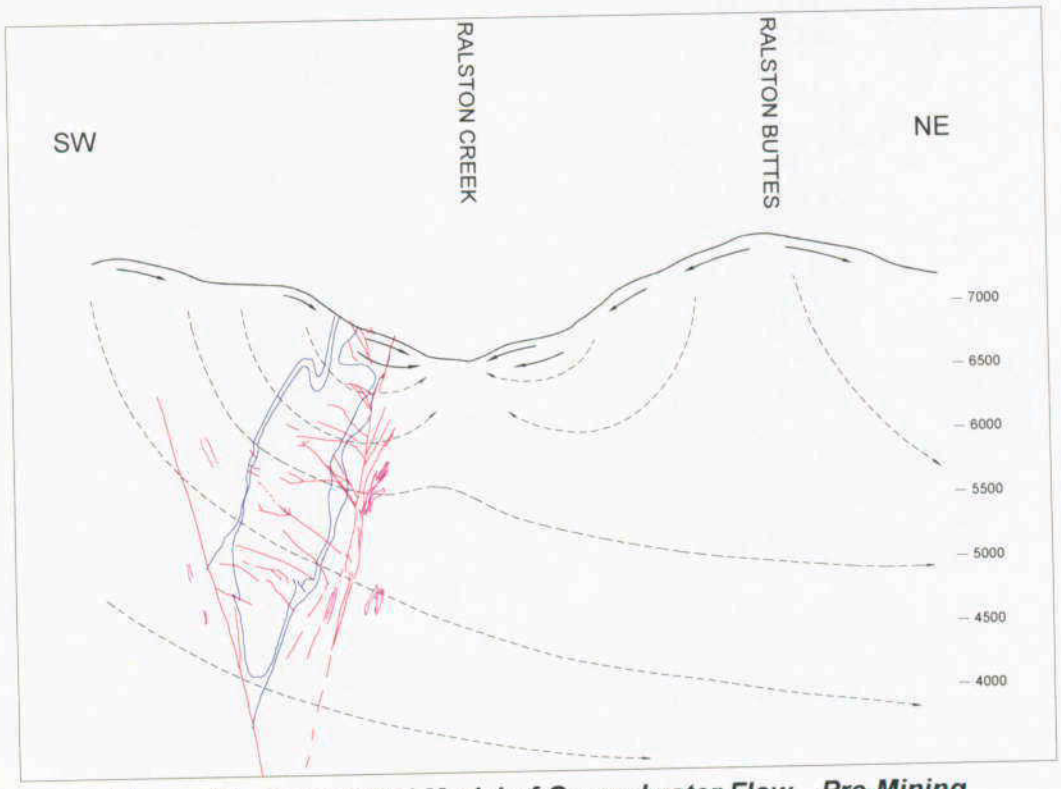


Figure 15. Conceptual Model of Groundwater Flow—Pre-Mining

After 1953, mining and dewatering operations altered the groundwater flow regime and created a zone of depression in the potentiometric surface around the mine. Groundwater within the zone of depression was captured by the mine and pumped to the surface where it was treated and discharged to Ralston Creek. The capture zone around the mine was limited in aerial extent (both vertically and horizontally) because of the relatively low permeability of the surrounding rock mass. A diagram of the groundwater flow system flow system during mining is shown in Figure 16.

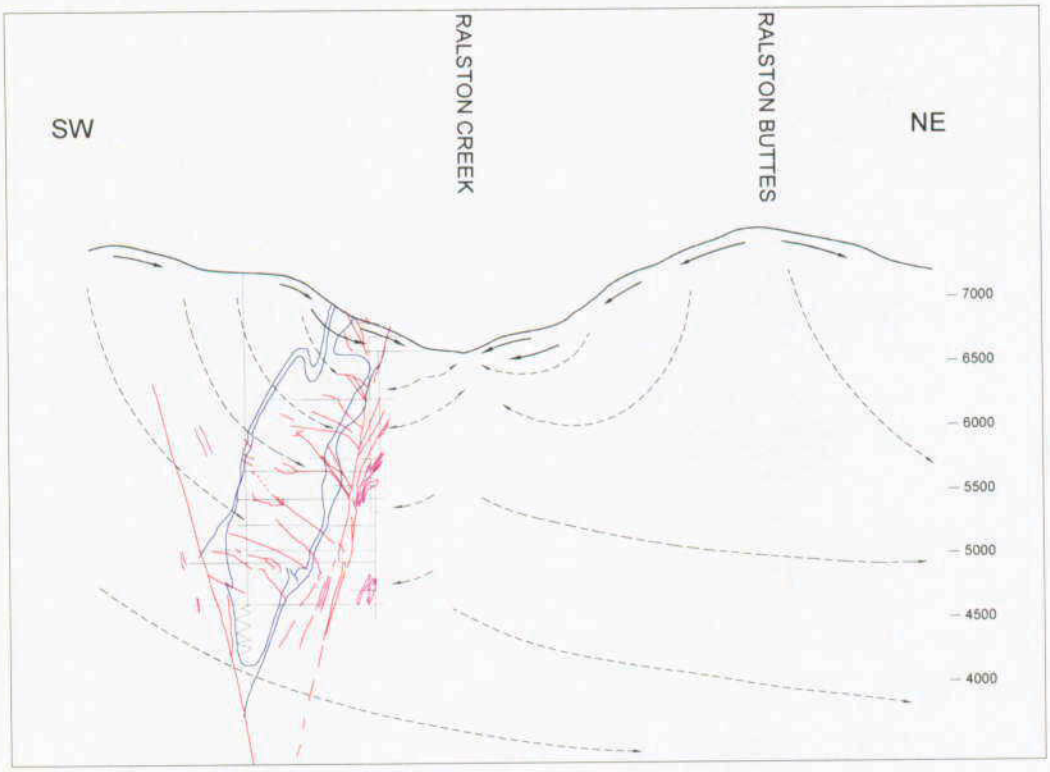


Figure 16. Conceptual Model of Groundwater Flow—During Mining

At the cessation of pumping, the underground workings began to flood and groundwater levels in bedrock began to rebound. Groundwater levels and water in the mine pool have risen until they are near the equilibrium static water level. At the steady state level, the post mining groundwater flow system will be similar to the pre-mining system, with very little flow in the low-permeability bedrock. The mine voids, however, will provide a permanent hydraulic connection throughout the rock mass in the mine area (Figure 17).

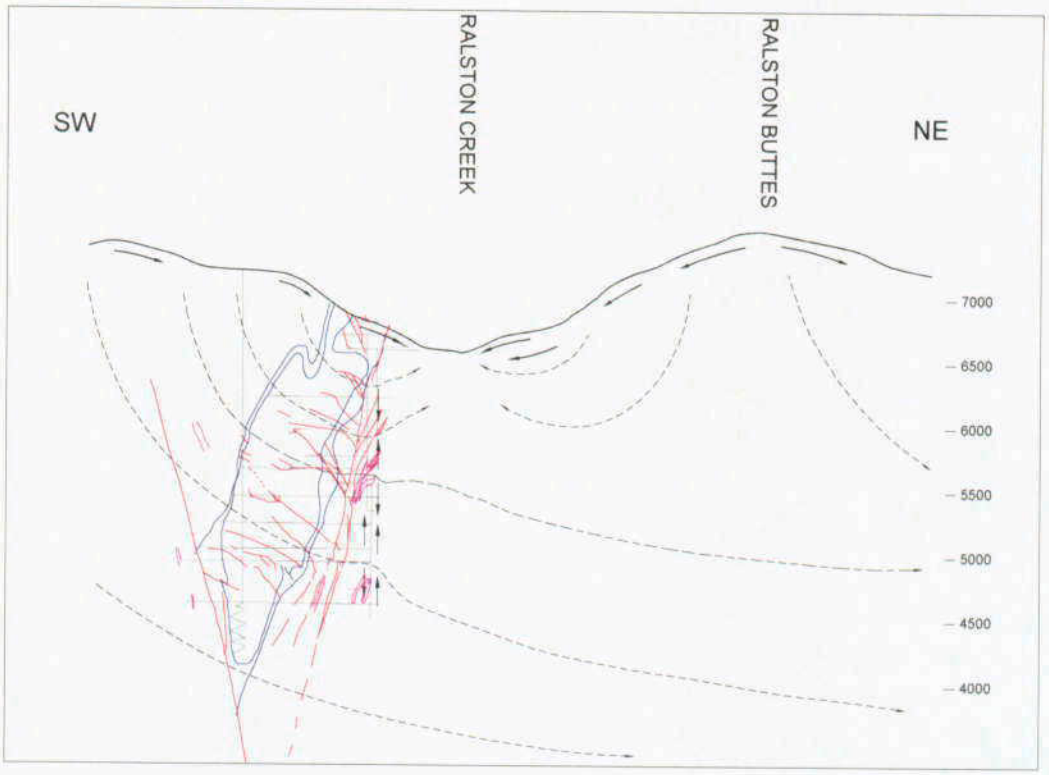


Figure 17. Conceptual Model of Groundwater Flow—Post-Mining

5.2 Mine Inflow

The first occurrence of groundwater in the Schwartzwalder Mine was recorded in 1959 when an inflow of 17 gpm was encountered in the No. 1 Shaft. After 1959, water was pumped from the mine as required to maintain dry working conditions, but because the treatment of discharged water was not required, no record of mine pumping was kept until 1973. Mine pumping records are available, however, from 1973 to 2000. Pumping from the lowest level of the mine was discontinued on May 19, 1998 and the spiral decline (between 2,200 and 1,900 feet) was allowed to flood. Pumping from the 19 Level was discontinued on May 24, 2000 and the mine has been filling with water since that time.

5.2.1 Pumping Records

Groundwater inflow to the mine between 1973 and 2000 varied from about 75 gpm to over 600 gpm depending on mine development and construction activities (Figure 18). Mine operations that affected the rate of groundwater inflow and pumpage included:

1. Deepening of shafts and mine expansion. Typically, higher inflows occurred during the initial shaft sinking and mine expansion, and decreased with time as water drained from storage in the bedrock. For example, mine inflow increased from about 200 gpm in 1975 to more than 600 gpm in 1976 during sinking of the #3 shaft. In the 2 years after the completion of the #3 shaft, pumping from the mine declined to a low of about 300 gpm.

2. Installation of drainage/dewatering boreholes. During the late 1970's and early 1980's drainage from dewatering boreholes completed on the 19 Level increased mine inflow from about 300 gpm to 600 gpm before declining to near 300 gpm again in 1981.
3. Plugging of productive boreholes that intersect permeable pegmatites or fractures. In 1994, boreholes that intersected pegmatite veins were grouted and mine inflow decreased from about 300 gpm to 150 gpm.

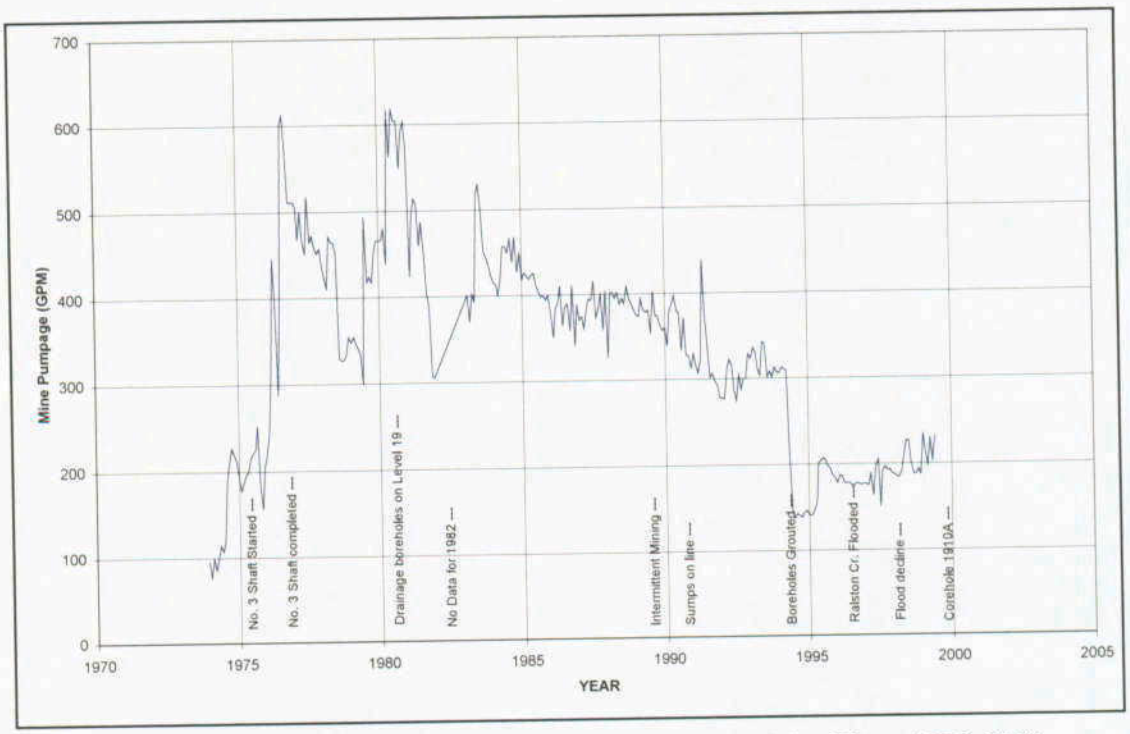


Figure 18. Groundwater Inflow to the Schwartzwalder Mine, 1973-1999

Much of the groundwater inflow to the mine from about 1988 through 1994 was derived from core holes drilled into pegmatite dikes in the hornblende-biotite-gneiss (HBGN) on the 1,800-2,000 levels of the mine. The water-producing boreholes were plugged and pressure-grouted in May 1994. This reduced inflow from about 310 gpm to about 140 gpm. Continued mining from 1994-1999 brought the average inflow rate up to about 190 gpm. The increased volume of the mine excavation after 1994 was partially responsible for the observed increase in inflow, but it is also likely that increased storage of water in the rock mass caused by the grouting of boreholes which previously drained the area contributed to the observed gradual increase in inflow. In other words, once the storage deficit had been met, inflow to the mine gradually increased. The increase in inflow, however, was lower than the pre-grouting flow rates. Mine pumping data are contained in Appendix E.

Under dewatered conditions, the inflow to the mine at its maximum extent (1995 – 1999) was 189 gpm. Given that the mine workings extend more than 2,000 feet below the pre-mining potentiometric surface, this rate of inflow is small and reflects the overall low permeability of the rock mass.

Mine pumping records between 1995 and 1999 indicate that inflow rates to the mine vary seasonally, with the lowest average inflow occurring in February and March (180 gpm) and the highest average inflow

occurring in June (209 gpm) (Figure 19). This pattern is consistent with the annual distribution of precipitation shown in Table 2 and Figure 6, but comparison of peak precipitation and infiltration indicates a lag time of approximately 1 month for precipitation to infiltrate into the mine. If it is assumed that inflow rates during February and March represent the infiltration to the mine during January and February when the ground is frozen and infiltration is essentially negligible, the average inflow to the mine by infiltration of precipitation to the upper levels can be calculated on a monthly basis for the referenced time period (Table 14).

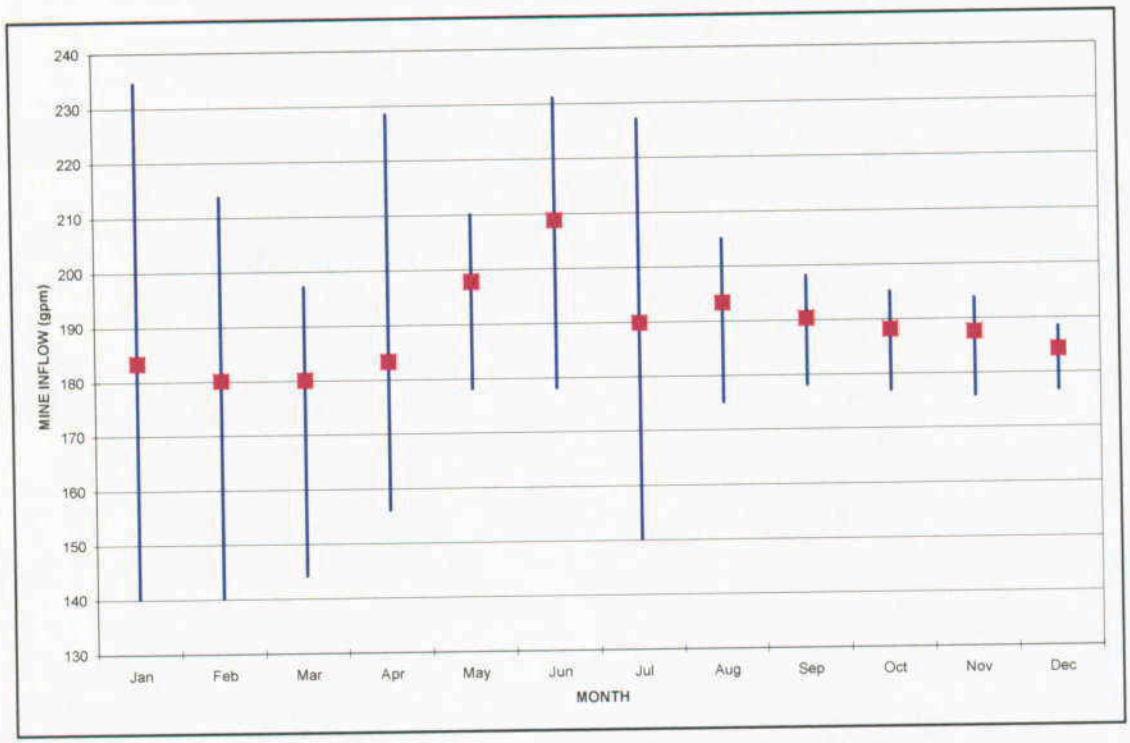


Figure 19. Average Groundwater Inflow by Month, 1995-1999

Table 14. Average Monthly Inflow to the Mine from Infiltration of Precipitation, 1995 - 1999

Month	Average Inflow (gpm)
January	3.3
February	0.0
March	0.0
April	3.2
May	17.7
June	28.7
July	9.7
August	13.2
September	10.2
October	8.0
November	7.4
December	4.1
Annual	**8.8**

5.2.2 Sources of Inflow

During mining, water inflow to the Schwartzwalder mine occurred from several sources including infiltration of groundwater through porous bedrock; infiltration of groundwater along faults, fractures, pegmatites and other permeable structures; and; recharge by precipitation and surface water through bedrock in the upper levels of the mine.

The slow infiltration of groundwater through unfractured bedrock was a minor component of the total mine inflow. Packer permeability tests indicate that the primary hydraulic conductivity of bedrock is on the order of 10^{-7} cm/sec or lower (Section 4.1.2). If it is assumed that inflow to the mine is analogous to a large well with a diameter of 500 feet and a depth of 2,200 feet, the steady state inflow from unfractured bedrock with a hydraulic conductivity of 1×10^{-7} cm/sec can be calculated using the large well methods described by Singh and Atkins (1985). Flow to the mine at its maximum extent can be approximated using the Theim equation for steady-state radial flow to a well:

$$Q = \frac{2\pi LKH}{\ln(R/r_h)}$$

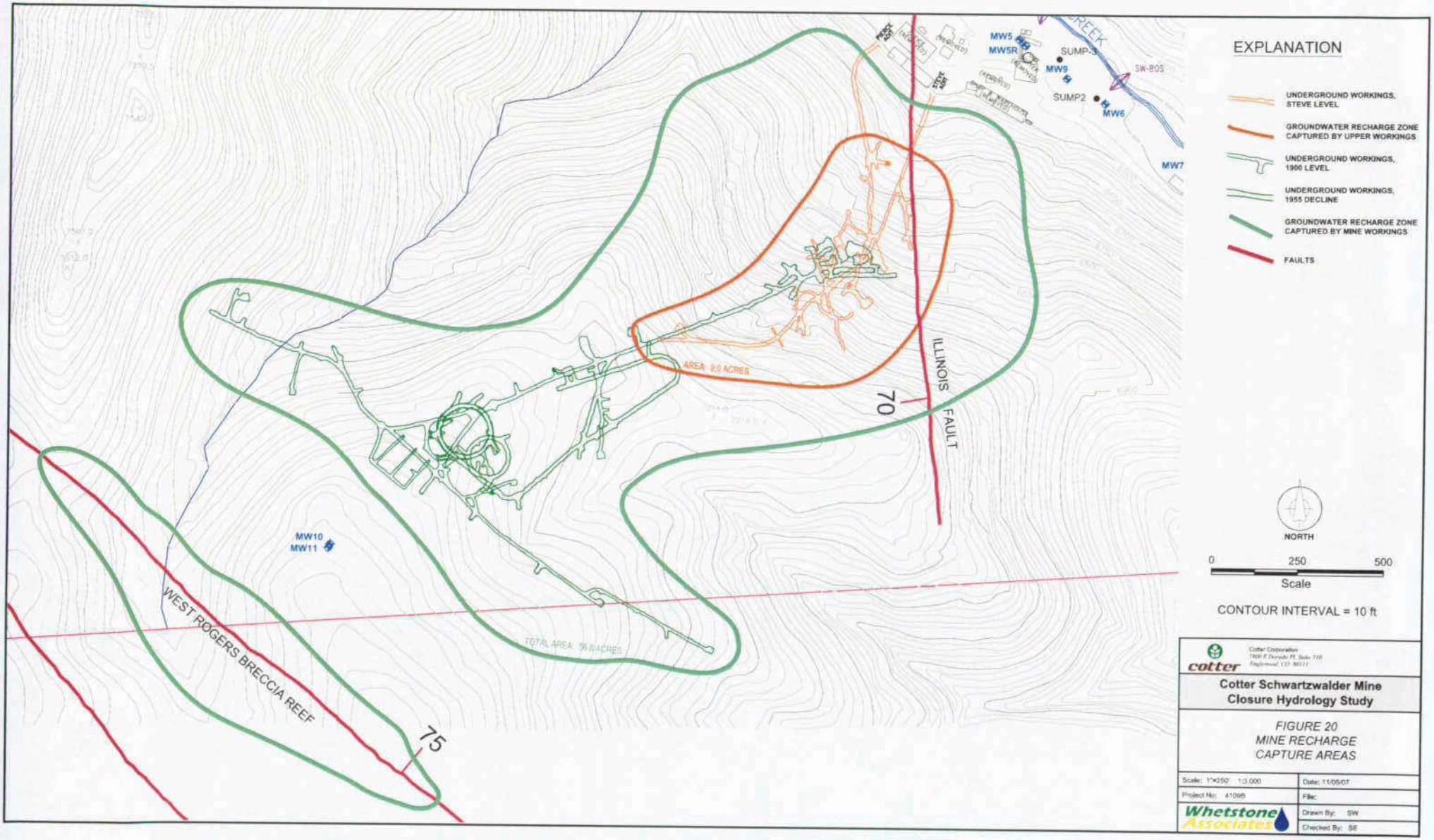
where:

Q = Volumetric inflow to the mine [L^3T^{-1}]
L = Length of the well screen [L]
K = Hydraulic conductivity [LT^{-1}]
H = Drawdown [L]
R = Radius of influence [L]
r_h = Radius of the well bore or mine workings [L]

The inflow to the mine from unfractured bedrock at full depth is calculated to be 64 gpm, or one third the total flow to the underground workings, based on the equation and assumptions stated above.

Recharge to groundwater by infiltration of precipitation at the site is estimated to be about three inches per year. This estimate is derived from baseflow calculations for Ralston Creek (Section 3.1), and water level fluctuations in Monitoring well MW11 (Section 4.1.1). Using the average annual infiltration rate of 8.8 gpm developed from mine pumping records, the direct recharge capture area for the entire mine in the fully dewatered condition is calculated to be about 56.8 acres.

The recharge area captured by the upper workings (Steve Level and above) is narrowly defined by topography and is estimated to be about nine acres (Figure 20). Based on this area and the 3-inch per year infiltration rate, the average annual inflow to the upper workings is estimated to be about 1.4 gpm or about 733,000 gallons per year.


EXPLANATION
UNDERGROUND WORKINGS, STEVE LEVEL
GROUNDWATER RECHARGE ZONE CAPTURED BY UPPER WORKINGS
UNDERGROUND WORKINGS, 1900 LEVEL
UNDERGROUND WORKINGS, 1955 DECLINE
GROUNDWATER RECHARGE ZONE CAPTURED BY MINE WORKINGS
FAULTS
NORTH
0
250
500
Scale
CONTOUR INTERVAL = 10 ft
MW5
MW5R
SUMP-3
MW9
SUMP2
MW6
MW7
SW-BOS
AREA: 9.0 ACRES
ILLINOIS FAULT
70
MW10
MW11
WEST ROGERS BRECCIA REEF
TOTAL AREA: 16.9 ACRES
75
cotter
Cotter Corporation
Cotter Schwartzwalder Mine
Closure Hydrology Study
FIGURE 20
MINE RECHARGE
CAPTURE AREAS
Scale: 1"=250' 1:3,000
Date: 11/05/07
Project No: 4109B
File:
Whetstone Associates
Drawn By: SW
Checked By: SE

The inflow history of the mine indicates that the majority of groundwater flows are associated with localized structural features including the West Rogers and Illinois Fault Zones and pegmatite dikes. Sinking of the Parker Winze, (now called the #1 Shaft) reportedly encountered very little water until about 250 feet deep. The #2 Shaft was completed to the 1,200 Level without major inflows before drifting and drilling on the 1,100 Level encountered significant water associated with pegmatites and the Illinois fault system (Cotter, 2000). The #3 Shaft encountered large inflows (600 gpm) on the 1,800 Level which were associated with pegmatites. Drilling on the 1,800 and 1,900 Levels near the #3 Shaft also found the pegmatites to be water bearing. Plugging of the boreholes on the 1,800 and 1,900 levels in 1994 reduced the short-term inflow to the mine from about 310 to 140 gpm. Significant groundwater was also encountered by drilling on the west end of the 1,600 level which penetrated the footwall of the West Rogers Fault. The deepest workings of the mine were dry except for minor water associated with the 21 Vein, a conjugate fracture in the hanging wall of the West Rogers Fault (Cotter, 2000).

5.2.3 Observed Rate of Mine Flooding

Water level measurements have been recorded in the mine shafts since the mine started flooding in May 2000 (Figure 21). The rates of water level rise have decreased over time, with rather distinct inflection points in the rate of refilling (Figure 22).

During the initial flooding of the 1,900 and 1,800 levels, the mine pool rose at an average rate of 5.7 feet per day (Table 15). Flooding of the 1,700 through mid-1,000 levels occurred at a slower rate with water levels rising at an average rate of 2.4 feet per day. The mine pool rose at a fairly consistent rate of 0.66 feet per day from June 2001 to June 2003, and 0.38 ft/day from September 2003 to October 2004. Rates slowed to 0.29 ft/day from October 2004 to July 2006, and 0.20 ft/day from June 2007 to July 2007 (Table 15, Figure 22). The rate of rise slowed further (to 0.018 ft/day) from September to October 2007.

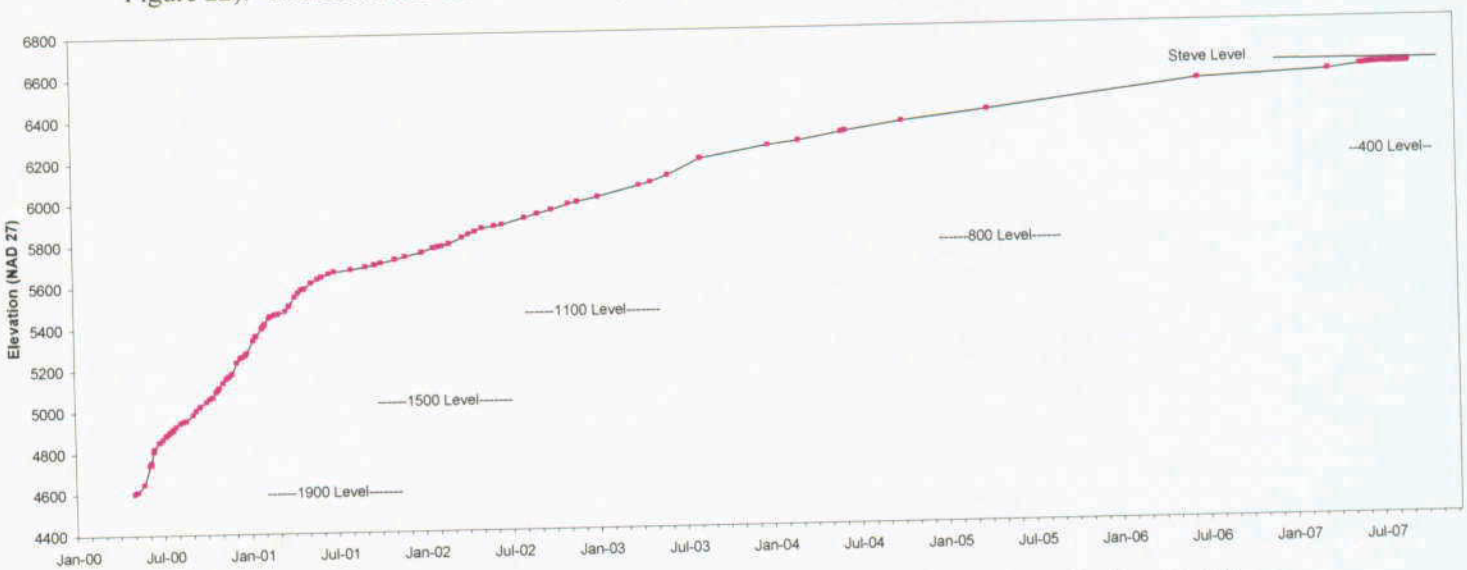
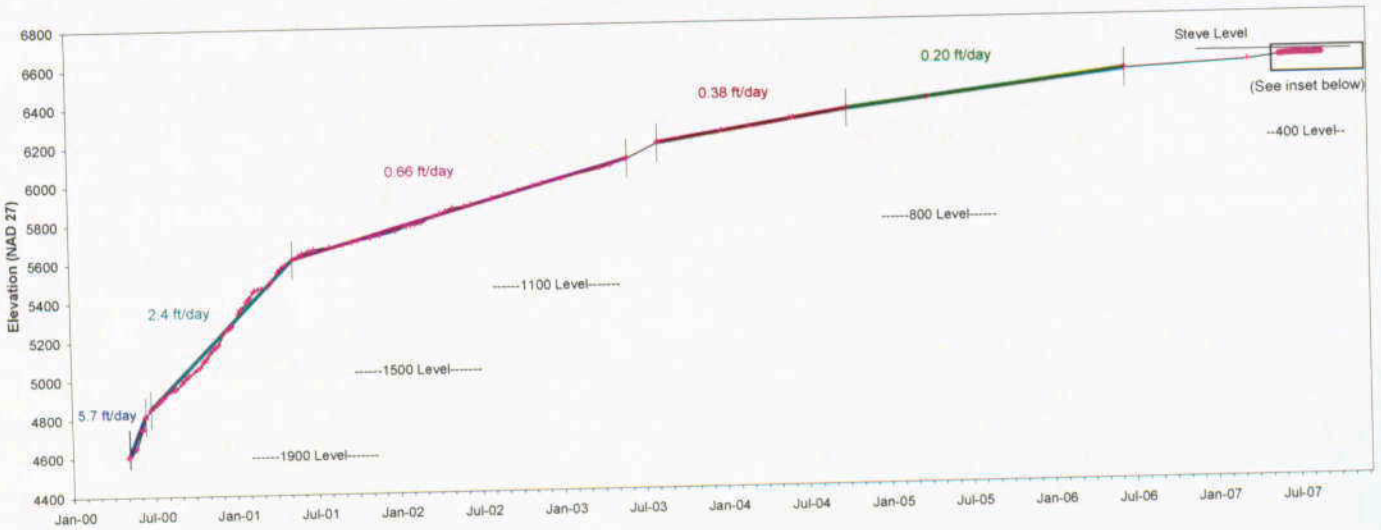


Figure 21. Observed Water Levels in the Schwartzwalder Mine During Refilling



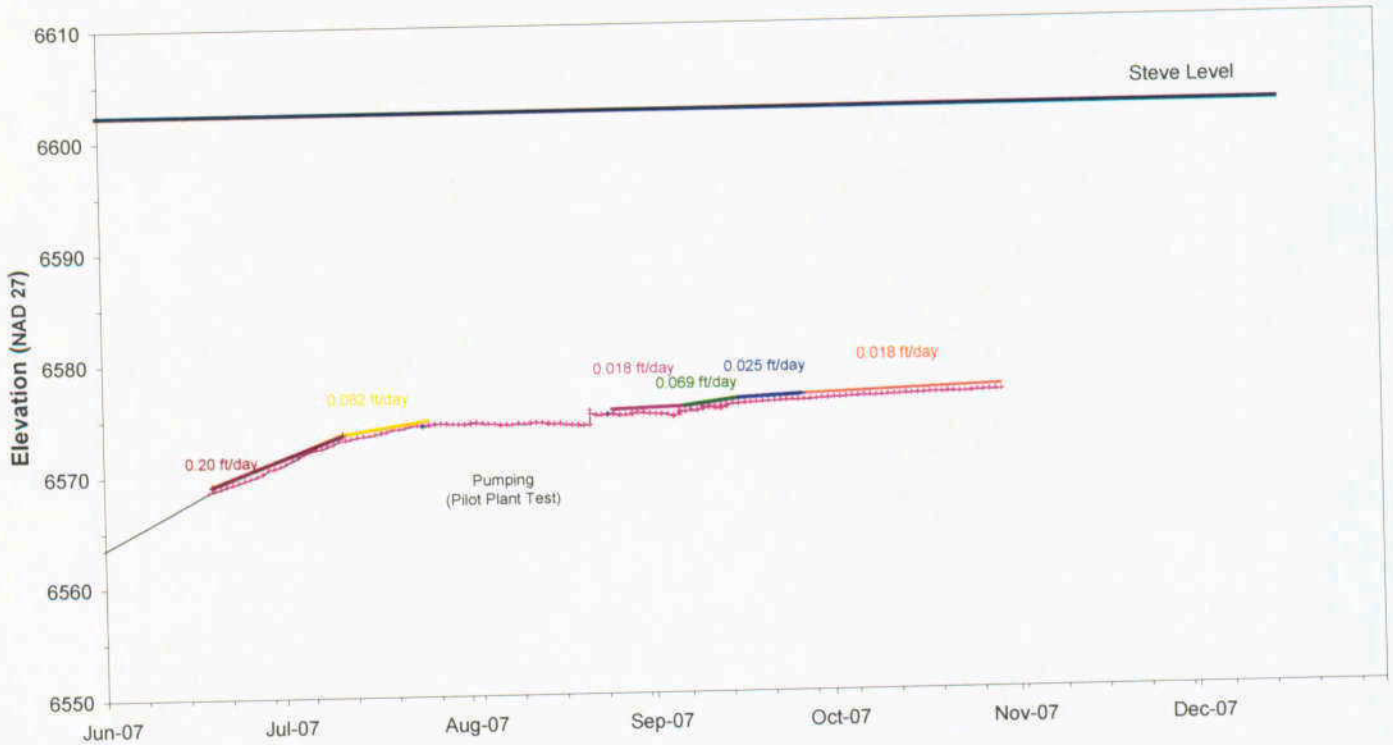


Figure 22. Rate of Water Level Rise During Mine Refilling

Table 15. Average Rate of Water Level Rise in Mine Shaft

Date	Water Elevation	Mine Level	Change in Elevation (ft)	Elapsed Days	Average Rate of Rise (ft/day)
5/30/00 7/6/00	4606.6 4816.6	Bottom of 1,900 Bottom of 1,700	210	37	5.7
7/6/00 6/4/01	4816.6 5609.1	Bottom of 1,700 Mid 1,000	793	333	2.4
6/4/01 6/24/03	5609.1 6101.0	Mid 1,000 Bottom of 500	491.9	750.11	0.66
9/1/03 10/29/04	6178.67 6338.9	Mid 400 Above 300	160.2	424.00	0.38
10/29/04 7/12/06	6338.9 6518.3	Above 300 Level 84 ft below Steve	179.4	621.00	0.29
6/18/07 7/10/07	6568.55 6573.04	33.8 ft below Steve 29.3 ft below Steve	4.49	22.01	0.20
7/10/07 7/24/07	6573.04 6574.22	29.3 ft below Steve 28.1 ft below Steve	1.18	14.33	0.082
7/24/07 8/24/07	6574.221 6574.943	*Pumping, 1 ft shift in transducer	0.72	30.83	0.023*
8/24/07 9/5/07	6574.943 6575.157	27.4 ft below Steve 27.1 ft below Steve	0.21	12.17	0.018
9/5/07 9/14/07	6575.157 6575.779	27.1 ft below Steve 26.5 ft below Steve	0.62	9.00	0.069
9/14/07 9/25/07	6575.779 6576.045	26.5 ft below Steve 26.3 ft below Steve	0.27	10.67	0.025
9/25/07 10/29/07	6576.045 6576.656	26.3 ft below Steve 25.6 ft below Steve	0.61	33.47	0.018

Water level and inflow data were also evaluated as functions of mine volume and elevation to determine how these variables affect the rate of mine flooding. Mine void volumes by level are shown graphically in Figure 23. Plots of the rate of water level rise and inflow against elevation and mine void volume are presented in Figure 24 and Figure 25. Flooding data are summarized in Table 16.

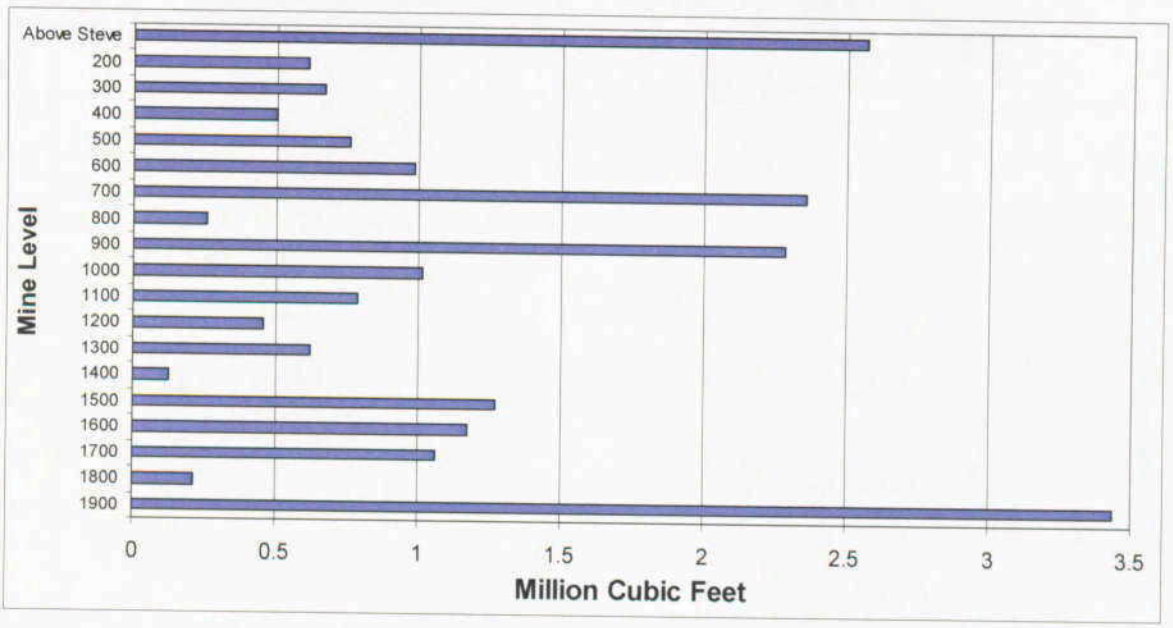


Figure 23. Volume of Mine Voids by Level

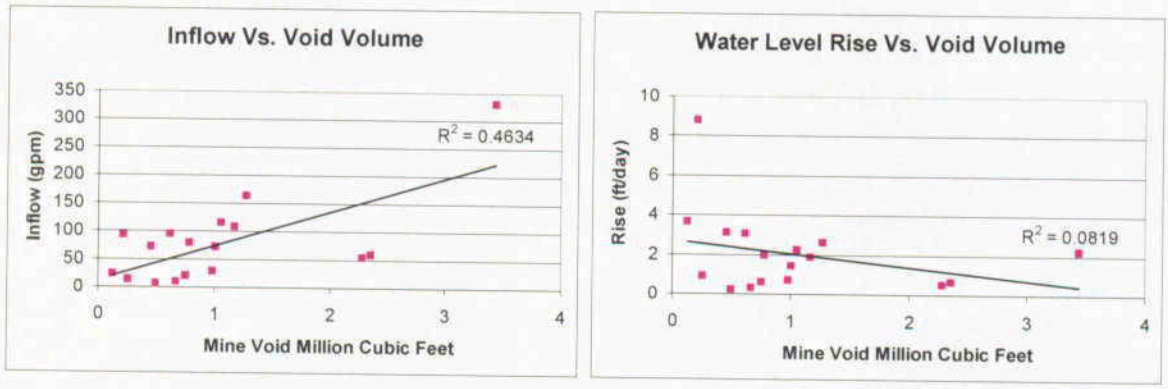


Figure 24. Void Volume vs. Inflow and Rate of Water Level Rise

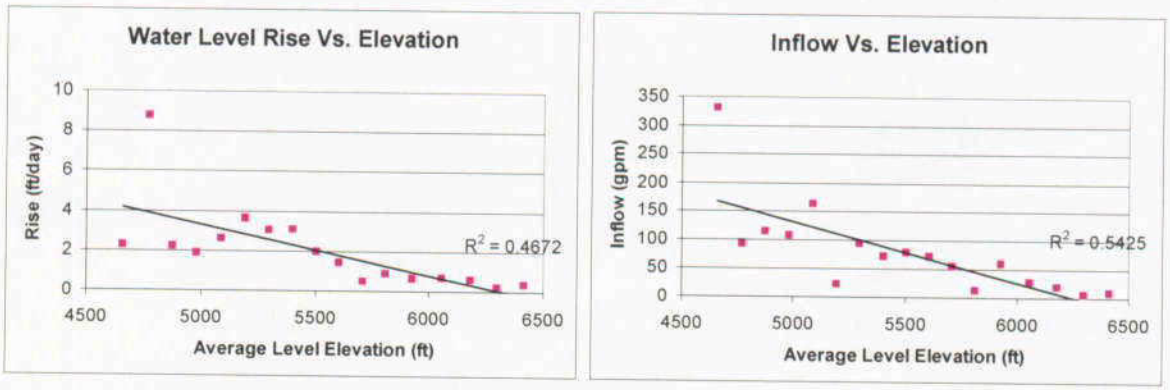


Figure 25. Average Level Elevation vs. Inflow and Rate of Water Level Rise

Table 16. Mine Void Volumes and Observed Inflow Rates During Refilling

Level	Bottom Elevation (ft)	Top Elevation (ft)	Void Volume (ft^3)	Rate of Water Level Rise (ft/day)	Days to Fill Level	Calculated Inflow Rate (gpm)
Above Steve	6602	6949	2,568,698	---	---	---
200	6479	6601	609,236	---	---	---
300	6352	6478	669,047	0.32	440.2	8.7
400	6245	6351	498,698	0.19	299.3	4.7
500	6118	6244	756,206	0.60	238.3	18.7
600	5993	6118	985,274	0.68	183.8	27.8
700	5861	5993	2,360,088	0.63	208.4	58.8
800	5764	5861	256,162	0.88	109.9	12.1
900	5660	5764	2,284,199	0.47	220.0	53.9
1000	5556	5660	1,013,990	1.40	74.3	70.8
1100	5453	5556	784,829	1.96	52.6	77.4
1200	5351	5453	458,321	3.06	33.3	71.4
1300	5246	5351	621,218	3.01	34.8	92.6
1400	5140	5246	125,914	3.60	29.4	22.2
1500	5035	5140	1,273,234	2.57	40.8	162.0
1600	4929	5035	1,174,644	1.85	57.2	106.7
1700	4824	4929	1,061,254	2.17	48.3	114.1
1800	4718	4824	213,873	8.72	12.2	91.3
1900	4598	4718	3,438,490	2.22	54.2	329.4

Notes: Inflow rates for each level were calculated as void volume divided by time to fill.
--- = mine has not filled to top of level

Based on the observed rate of mine flooding and plots comparing the rate of inflow and rise in water level to elevation and mine void volumes, the following conclusions can be made:

1. The plot of the water level in the mine versus time forms a smooth and predictable curve in spite of large variations in mine volume between levels (Figure 21).
2. The average rate of rise of the mine pool decreased over time from 5.7 ft/day during the initial filling of the 1,900 and 1,800 levels to about 0.7 ft/day during filling of the 900 to 600 levels and about 0.3 ft/day filling the 300 and 400 levels. Above the 300 level, the rate of rise of the mine pool decreased from 0.29 ft/day to less than 0.025 ft/day.
3. Changes in mine volume between levels does not appear to affect the rate of water level rise to a significant extent. The R^2 correlation between the rate of rise and void volume is weak (0.0819) with a negative slope
4. The volumetric rate of inflow has a moderate positive correlation with increasing mine volume (R^2 = 0.4634). In other words, the volumetric inflow (gpm) tends to increases or decrease with the volume of the mine workings. This relationship is probably a function of the increased "effective radius" of levels with extensive workings which intercept groundwater over a larger area.

5. The rate of rise of the mine pool decreases as the elevation of the mine pool increases. The R^2 correlation between rate at which the water level in the mine is rising and elevation has a negative slope and is 0.4672.
6. The rate of inflow decreases as the elevation of the mine pool increases. The R^2 correlation between inflow and the elevation of the mine pool has a negative slope and is 0.5425.

5.2.4 Projected Final Water Level

Although pre-mining static water levels were not measured prior to development of the Schwartwalder deposit in the 1950's, the expected level to which water will rise in the flooded mine can be calculated based on the observed inflow rates over time.

Two known conditions are used in the calculation: (1) dewatering mine inflow when the Schwartzwalder was advanced to its furthest depth (with pegmatite drillholes plugged) and (2) pumping rates during the pilot plant test in July and August, 2007 (with the pump set at 27 ft below the collar of the #2 shaft in the Steve Level. In both cases, the flow was accurately measured, and the pumping water level is known. The static water level is not known, and can be calculated iteratively using the Theim steady-state equation for Theim equation for steady-state radial flow to a well:

$$Q = \frac{2\pi LKH}{\ln(R/r_h)}$$

where:
- Q = Volumetric inflow to the mine [L^3T^{-1}]
- L = Length of the well screen [L]
- K = Hydraulic conductivity [LT^{-1}]
- H = Drawdown [L]
- R = Radius of influence [L]
- r_h = Radius of the well bore or mine workings [L]

Re-arranging to solve for hydraulic conductivity (K):

$$K = \frac{Q\ln(R/r_h)}{2\pi LH}$$

Or to solve for drawdown:

$$H = \frac{Q\ln(R/r_h)}{2\pi KL}$$

The iterative calculation involves first solving the Theim equation for the hydraulic conductivity that would produce the 180.1 gpm observed average inflow from bedrock when the mine was fully excavated[10]. Next, a second Theim equation is solved for drawdown that would produce the 1.2 gpm observed during the pilot plant pumping test, with the pump set at 27 ft below the Steve Level shaft opening. The equation is set up to allow any drawdown up to a maximum of 342 ft (the height of the hillside directly above the #2 shaft on the Steve Level, plus the depth of the pump below the collar). The calculated drawdown is then used to determine the saturated thickness (L) in both equations. The two equations are solved iteratively for K, H, and L.

[10] Average inflow at full depth was 188.9 gpm after the pegmatite coreholes were plugged and the initial storage deficit was met. Given 8.8 gpm average infiltration from surface, the yield from bedrock was approximately 180.1 gpm.

The calculation indicates that an overall bedrock permeability of 2.8×10^{-7} cm/sec would yield the inflows from bedrock observed at the full extent of mining (Table 17). This is higher than bedrock permeabilities measured from underground packer tests, but likely to represent the composite hydraulic conductivity of fractured and unfractured bedrock around the mine. Using this hydraulic conductivity value, the drawdown was calculated to be 14.6 ft below the static water level during the pilot plant pumping test, which indicates that the static water level is about 12 ft below the Steve Level or at an elevation of 6590 ft NAD 27. This simulation suggests that groundwater from deep bedrock will not discharge from the Steve Level adit, since the final static water level will be about 12 ft below the adit.

Table 17. Calculation of Final Static Water Level in the Flooded Mine

Case I. Fully Mined & Dewatered (1990 – 1995)	
Saturated Thickness (ft)	2,188
Hydraulic Conductivity (cm/sec)	2.8E-07
Drawdown (ft)	2188
Yield (ft^3/day)	34,672
Yield (gpm)	180.1
Target yield (gpm)	180.1
Case II. Refilling, Pilot Plant pumping test (July – Aug 2007)	
Saturated thickness (ft)	2,188
Static Water Level wrt datum	0
Saturated Thickness (ft)	2,188
Hydraulic Conductivity (cm/sec)	2.8E-07
Drawdown below static water level (ft)	14.6
Yield (ft^3/day)	231
Yield (gpm)	1.2
Target Yield (gpm)	1.2

This calculated final water level elevation is consistent with the slowing rate of water level rise over time (Figure 22). At the September 2007 rate of water level rise (0.025 ft/day), up to 560 days could be necessary for water level to reach the calculated static. Transient effects, such as infiltration during wet cycles, could accelerate this rise. Conversely, the rate of rise may slow as the water level in the mine approaches equilibrium, and it may take longer than April 2009 to reach this static level.

Downward seepage from the upper workings during particularly wet months could temporarily increase water levels in the mine above this calculated static water level. When the mine was fully dewatered at its maximum depth (from 1995 – 1999), the highest monthly infiltration from precipitation was estimated at 28 gpm during June, and 8.8 gpm on an annual average. However, now that the mine has substantially filled, the cone of depression in the saturated rock mass has a smaller capture area (Section 0, Figure 20), and infiltration through the upper workings in this area is believed to average less than 1.5 gpm. Flows from individual seeps in the upper workings (measured in 1999) were generally less than 0.25 gpm during a wet spring. Therefore, seasonal conditions are not expected to result in any significant transient head buildup above the static water level.

5.3 Evaluation of the Hydraulic Connection Between Ralston Creek and the Mine

Ralston Creek does not appear to be in strong hydraulic connection with the Schwartzwalder Mine based on stream flow rates, mine pumping rates, and isotopic comparison of mine water and surface water.

5.3.1 Evidence from Stream Flow Data

Stream flow data for Ralston Creek above the reservoir[11] indicate that the monthly average low flows in the creek are about 1.6 cfs (Section 3.1), and the creek is often dry above Ralston Reservoir. Near the mine, however, the creek has seldom (if ever) been dry, even while the mine was pumping at its maximum flow rate. Shutting off the mine pumps has had no detectable affect on flow rates in Ralston Creek.

5.3.2 Evidence from Mine Pumping Rates

Pumping rates from the underground mine were low, considering the depth of the mine and extent of workings. The highest inflows occurred as during the sinking of new shafts or rapid development of stopes. These activities led to increased water flow to the mine (Figure 18), which decreased over time as the storage in the rock mass was drained. If a strong and direct hydraulic connection with Ralston Creek existed, inflow to the mine would be lower than the observed inflow rates of 140 to 600 gpm (with an average of around 190 gpm).

5.3.3 Stable Isotopic Analysis of Mine Water and Ralston Creek

The potential for hydraulic connection between the mine and Ralston Creek was evaluated using the radioactive isotope of hydrogen, tritium (^3H), and stable isotopes of oxygen and hydrogen ($^{16}O/^{18}O$, $^1H/^2H$). A total of 6 water samples were collected for this analysis. One sample was collected from Ralston Creek near the mine. Five samples were collected from various locations in the underground mine. Sample locations and analytic results are summarized in Table 18.

Table 18. Summary of Isotopic Data for Water Samples

Sample	Date	Location	^3H (T.U.)	^{18}O ($\delta^{18}O$)	^2H (δD)
RC-980820	8/20/98	Ralston Creek near mine	12.4	-14.2	-108
779-DH	8/20/98	700 Level – pool	14.5	-16.0	-120
1730 Drift	8/20/98	1,700 Level – drift	14.3	-15.5	-114
19D-DH46	8/20/98	1,900 Level – DH19D-15(Fe)	6.0	-14.7	-110
19D-DH-Mn	8/20/98	1,900 Level – DH19D-16(Mn)	4.2	-14.6	-109
19-JOS-2026	8/20/98	1,900 Level – Johnson Ore Shoot	3.1	-14.5	-108

Analyses of oxygen and hydrogen isotope ratios in water samples can be compared to ratios observed in meteoric water to identify the probable source of underground water. Isotopic data are typically reported as $\delta^{18}O$ and δD which are defined as:

$$\delta\ ^{18}O = \frac{(^{18}O/^{16}O)_{sample} - (^{18}O/^{16}O)_{standard}}{(^{18}O/^{16}O)_{standard}} \times 1000$$

$$\delta\ D = \frac{(^{2}H/^{1}H)_{sample} - (^{2}H/^{1}H)_{standard}}{(^{2}H/^{1}H)_{standard}} \times 1000$$

[11] The flow is the sum of the flow at the gage above Ralston Reservoir and withdrawals at the Long Lake diversion, which takes water from Ralston Creek above the Stream gage.

and represent the relative difference in abundance of the isotope in the sample per mil (parts per thousand) compared to standard mean ocean water (SMOW).

The isotopic composition of water samples was evaluated using the standard format which plots $\delta^{18}O$ against δD and compares the resultant position against the meteoric water line (Figure 26). The meteoric water line is described by the equation $\delta D=8\delta^{18}O+10$ and represents isotopic fractionation by atmospheric processes (Drever 1988). Waters that differ significantly from the isotopic compositions observed for meteoric waters are generally interpreted to have had long residence times as groundwater.

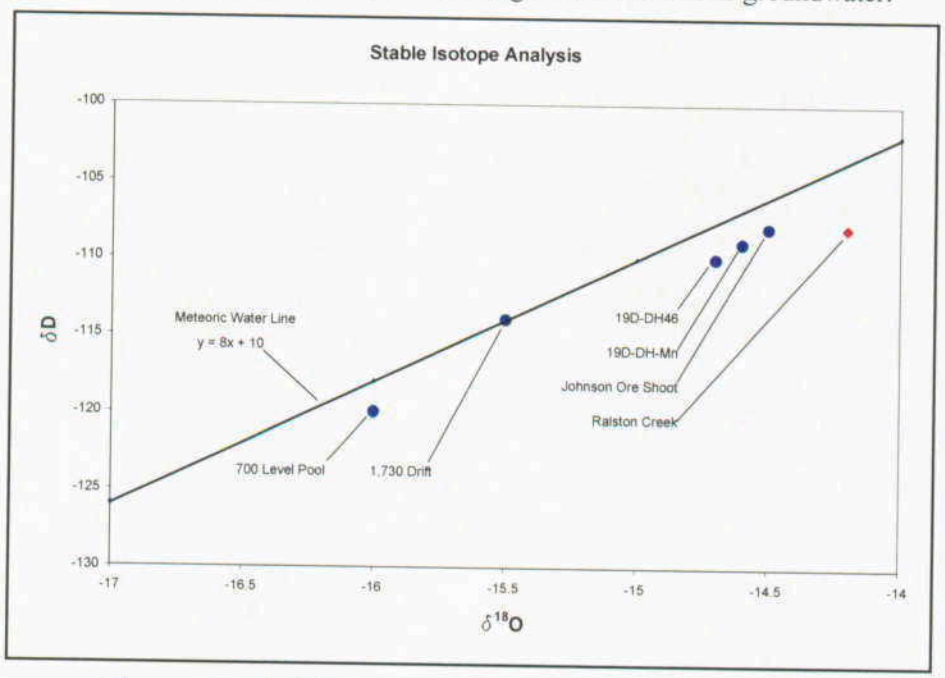


Figure 26. Stable Isotope Evaluation of Water Samples

All of the water samples plot close to the meteoric water line which indicates a meteoric origin for the infiltrating mine water. In general the isotopic composition of the water has been relatively unaffected by its transit through the rock mass suggesting that the water infiltrated quickly and moved to depth from surface recharge areas.

Mine water samples are isotopically lighter than water from Ralston Creek. This fractionation could occur from differences in elevation between source areas for the mine water and Ralston Creek, by evaporation of the lighter fractions from the stream, or by contact of Ralston Creek Water with atmospheric carbon monoxide and carbon dioxide (Drever, 1988). All of these mechanisms work to increase the isotopically heavier fraction in surface water. In general, the isotopic composition of precipitation at a given location is approximately constant, but it varies from season to season and from one rainstorm to another. An alternate explanation for the fractionation observed between mine water samples and Ralston Creek would be that water in the mine is derived from infiltration of meteoric water that fell during a different season than the water in the creek.

Although the stable isotope analyses indicate that mine water is of certain meteoric origin, isotopic differences between the mine water and water in Ralston Creek suggest that Ralston Creek is not the direct source of the underground water. In particular, the isotopic composition of water sampled from the 700 and 1,700 level are notably lighter than water in Ralston Creek. Samples collected from the 1900 level and the Johnson Ore Shoot are less definitive.

5.3.4 Tritium Dating of Mine Water

Tritium occurs naturally in the atmosphere, but by far, the most important source of tritium in meteoric water is from nuclear testing between 1952 and 1969. Pre-bomb tritium levels in rainwater averaged about 10 TU (Drever, 1988). During the 1960s, tritium levels in the atmosphere spiked above 10^3 TU before decaying to the current level of about 10 to 15 TU. Tritium has a half life of 12.3 years and is not formed in the subsurface.

Water that entered the groundwater system at any time during the last 50 years has approximately the same tritium concentration as meteoric water today because of equivalent rates of radioactive decay in the atmosphere and subsurface. Meteoric water that entered the groundwater system prior to 1952, had an initial tritium concentration of about 10 TU which will have decayed to less than 0.6 TU today. Groundwater that infiltrated after 1952 have tritium concentrations of about 10 to 15 TU. Groundwater with tritium concentrations between about 0.6 and 10 TU indicate mixtures of pre 1952 and post 1952 water, or result from subsurface ionic fractionation which is rare.

Results of the tritium analysis returned a value of 12.4 for Ralston Creek. This value is typical of precipitation, and suggests that the water in Ralston Creek was recent precipitation and/or groundwater baseflow with a residence time of less than 52 years.

Water samples from the 700 and 1,700 levels had tritium concentrations of 14.5 and 14.3 respectively. These values indicate that the water infiltrated from meteoric water less than 52 years ago. Tritium concentrations for water samples from the 1,900 level varied from 3.1 to 6.0 TU and indicate a mixture of old (pre 1952) and new (post 1952) water. Based on these results it is reasonable to conclude that the pre-mining groundwater at the 1,900 level was more than 52 years old and that vertical flow induced by pumping from the mine induced younger water to be drawn down to the 1,700 Level and below. During operation, the mine would have acted as a 2,000 foot deep well that increased the velocity of flow toward the mine and reduced the transit time of infiltrating meteoric water. Under the pre-mining condition, however, a much longer transit time would have been required.

In short, the tritium data do not definitively indicate the presence or lack of a hydraulic connection between Ralston Creek and the mine. Under dewatered conditions, the transit of meteoric derived water to workings above the 1,700 Level is documented to be less than 52 years. Transit of water to the deeper portions of the mine is more lengthy with a substantial component of the water infiltrating at the surface before 1952.

5.3.5 Summary

A strong direct hydraulic connection between Ralston Creek and the Schwartzwalder Mine is not indicated by the available evidence. However, a weak hydraulic connection may exist, so that while some water may have flowed from the creek into the mine during dewatering, flows from the creek to the mine were small and controlled by the inherent low permeability of the rock mass (2.8x10-7 cm/sec average bulk hydraulic conductivity). The low permeability of the bedrock limited flow from the creek into the mine, and dewatering the mine did not drain Ralston Creek.

6. SURFACE WATER QUALITY

The water quality in Ralston Creek is affected by natural runoff and groundwater inflow, upgradient abandoned mines, the fill materials in the valley at the Schwartzwalder mine, and previously by discharge from the Schwartzwalder water treatment plant. The magnitude of loading from these sources was evaluated by studies performed during 1998 and 1999, and by previous investigations.

6.1 Surface Water Quality Standards

6.1.1 Discharge Permit Limits

The discharge permit (#CO-0001-244) issued by the State of Colorado listed effluent limits for water discharged from the water treatment plant operated at the site. Those limits included specific metals, uranium (0.776 mg/L) and radium 226/228 (3 pCi/L), as shown in the following table.

Table 19. Discharge Permit Effluent Limitations

Effluent Parameter	Effluent Limitations Maximum Concentrations	
	30-Day Average	Daily Maximum
Flow, MGD	0.288	Report
COD, mg/l	100	200
Total Suspended Solids (TSS), mg/l	20	30
Potentially Dissolved Uranium, ug/l	776	1243
Radium 226 +228 (total), pCi/l	3	10
pH, s.u. (minimum-maximum)	NA	6.5-9 d/
Oil and Grease, mg/l	NA	10 d/
Total Recoverable Antimony, ug/l	6	Report
Boron, mg/l	0.75	Report
Total Recoverable Chromium, ug/l	11	16
Potentially Dissolved Copper, ug/l	5.4	7.7
Potentially Dissolved Silver, ug/l	0.027	0.73
Potentially Dissolved Zinc, ug/l	71	71
Weak Acid Dissociable Cyanide, ug/l	NA	5
Fluoride, mg/l	NA	2
Totak Recoverable Thallium, ug/l	0.5	NA
Whole Effluent Toxicity, Chronic Lethality		
Ceriodaphnia species	NA	IWC = 100%
Fathead Minnow (Pimephales promelas)	NA	IWC = 100%

The discharge permit applied to the single discharge point (Outfall 001), the pipe at which water from the treated water retention pond was released to Ralston Creek. In the 29 reporting periods leading up to the discharge permit renewal in 2005, CDPHE identified only four limit excursions: pH (1 event), thallium (1 event), silver (1 event), and ceriodaphnia WET test results (1 event). The Discharge Monitoring Reports have reported no discharge since the water treatment plant was shut down in June 2002.

6.1.2 Stream Standards

The Colorado Department of Public Health and Environment (CDPHE) Water Quality Control Commission (WQCC) has published in-stream water quality standards for this reach of Ralston Creek. Located in the Clear Creek Basin, Reach 17b includes the "mainstem of Ralston Creek from the source to the outlet of Arvada Reservoir, including Ralston Reservoir and Upper Long Lake" (5CCR 1002-38). Regulation Number 38 (5CCR 1002-38) lists the specific numeric standards for Stream Segment 17b, while Regulation Number 31 (5CCR 1002-31) gives the basic stream standards and methodologies applicable to all state waters.

The applicable water quality standards for cold water biota in Ralston Creek Stream Segment 17b are listed in Table 21. Acute and chronic standards for metals are based on dissolved concentrations, except where noted otherwise in Table 21. The numeric criteria for cadmium, chromium III, copper, lead, manganese, nickel, silver, uranium, and zinc are hardness dependent, and are calculated according to the following equations:

$$C_{(acute)} = WER \cdot e^{m_A \cdot \ln(H) + b_A} \cdot K_A$$

$$C_{(chronic)} = WER \cdot e^{m_C \cdot \ln(H) + b_C} \cdot K_C$$

where WER= Water effect ratio
m_A = Metal-specific constant for acute toxicity (e.g, m_A for uranium is 1.1021)
m_C = Metal-specific constant for chronic toxicity (e.g, m_C for uranium is 1.1021)
H = Hardness (mg/L as $CaCO_3$)
b_A = Metal-specific constant for acute toxicity (e.g, b_A for uranium is 2.7088)
b_C = Metal-specific constant for chronic toxicity (e.g, b_C for uranium is 2.2382)
K = Freshwater conversion factor

The numeric criteria shown in Table 21 have been calculated based on a hardness of 163, which is the low-flow average at station SW-BPL since sump shut-off in June 2002. The calculation assumes a water effect ratio (WER) of 1.0 unless otherwise noted.

The uranium standard of 40 pCi/L (0.059 mg/L) applies at a water supply intake. Elsewhere, the hardness-based aquatic toxicity standards apply. Using a hardness of 163 mg/L, the acute toxicity standard for uranium is 4.12 mg/L and the chronic toxicity standard is 2.57 mg/L.

The hardness value used in calculating numeric criteria is the average of the calculated hardness values for station SW-BPL during low flow months from June 2002 to February 2007. The use of average of hardness values during low-flow season is in accordance with the CDPHE WQCCs "Basic Standards and Methodologies for Surface Water," Document 5 CCR 1002-31, Table III, footnote (3). At Station SW-BPL, the low-flow season occurs between July and February. Hardness values were calculated from magnesium and calcium concentrations, and the calculated values were similar to laboratory-determined hardness values, when reported by the lab. Because values for many analytes, including calcium and magnesium, were different before and after the sump shut-off, only data from post sump shut-off were used to determine the mean hardness value used in the numeric criteria calculations. Calculated hardness values for these distinct periods are presented in Table 20.

Table 20. Determination of Hardness Values Used in Calculating Hardness-Based Aquatic Standards

Pre sump shut-off		Post sump shut-off		Post sump shut-off, low flow	
Date	Calculated Hardness, mg/L as CaCO3	Date	Calculated Hardness, mg/L as CaCO3	Date	Calculated Hardness, mg/L as CaCO4
10/20/98	149	6/25/02	194	12/31/02	352
11/19/98	153	12/31/02	352	1/31/03	305
12/17/98	121	1/31/03	305	2/27/03	222
1/19/99	123	2/27/03	222	7/29/03	258
2/15/99	160	3/26/03	112	7/31/03	146
12/21/00	108	4/29/03	46	9/26/03	165
1/29/01	172	5/22/03	49	10/31/03	138
2/28/01	119	6/23/03	88	11/25/03	112
3/27/01	89	7/29/03	258	12/16/03	123
4/18/01	69	7/31/03	146	1/23/04	123
5/29/01	68	9/26/03	165	2/25/04	93
6/19/01	115	10/31/03	138	7/29/04	86
7/11/01	110	11/25/03	112	8/30/04	76
8/24/01	153	12/16/03	123	9/29/04	90
9/17/01	121	1/23/04	123	7/31/05	221
10/24/01	137	2/25/04	93	8/30/05	214
11/27/01	128	3/30/04	103	11/30/05	138
12/18/01	126	4/28/04	69	12/31/05	103
1/22/02	166	5/31/04	117	2/27/06	123
2/26/02	202	6/29/04	106		
3/26/02	115	7/29/04	86		
4/24/02	111	8/30/04	76		
5/28/02	104	9/29/04	90		
		3/22/05	93		
		5/31/05	62		
		6/22/05	73		
		7/31/05	221		
		8/30/05	214		
		11/30/05	138		
		12/31/05	103		
		2/27/06	123		
		3/29/07	72		
Average:	**127**	Average:	**133**	Average:	**163**

Table 21. Water Quality Standards for Ralston Creek Stream Segment 17b

STREAM SEGMENT DESCRIPTION

REGION:	3
BASIN:	Clear Creek
STREAM SEGMENT:	17b. Mainstem of Ralston Creek from the source to the inlet of Arvada Reservoir, including Ralston Reservoir, and Upper Long Lake.
DESIGNATION:	UP
QUALIFIERS:	Water + Fish, Organics
CLASSIFICATIONS:	Aq Life Cold 2, Recreation 1a, Water Supply, Agriculture

NUMERIC STANDARDS

Basis of calculated standards:

pH =	7.06	s.u., low-flow average at SW-BPL, post sump shut-off
T =	1.25	°C, low-flow average at SW-BPL, post sump shut-off
Hardness =	163	mg/L, low-flow average at SW-BPL, post sump shut-off

	acute	chronic		
Physical and Biological				
D.O.*	6.0		mg/L	
D.O. (sp)*	7.0		mg/L	
pH*	6.5 - 9.0		S.U.	
F. Coli*	200/100mL		count	
E. Coli*	126/100mL		count	
Inorganic				
Ammonia*	22.8	5.77 (elsp)	mg/L as N	total
Chlorine*	0.019	0.011	mg/L	total residual
Cyanide*	0.005		mg/L	free
Sulfur*	0.002		mg/L	
Boron*	0.75		mg/L	
Nitrite*	0.05		mg/L	
Nitrate*	10		mg/L	
Chloride*	250		mg/L	
Sulfate (ws)*	250		mg/L	
Metals				
Aluminum	750	87	ug/L	total recoverable
Arsenic, *	50	---	ug/L	total recoverable
Cadmium(*	2.60(1) (tr)	0.61(2)	ug/L	dissolved
Chromium III*	50	---	ug/L	total recoverable
Chromium VI*	16	11	ug/L	dissolved
Copper*	21.3	13.6	ug/L	dissolved
Iron, dissolved (ws)*	---	300	ug/L	dissolved
Iron, total recoverable*	---	1000	ug/L	total recoverable
Lead*	109.5(3)	4.27(4)	ug/L	dissolved
Manganese*	3513	1941	ug/L	dissolved
Manganese (ws)*	---	50	ug/L	dissolved
Mercury, Total*	---	0	ug/L	total
Nickel*	707.9	78.6	ug/L	dissolved
Selenium*	0.0184	0.0046	ug/L	dissolved
Silver*	4.70(5)	0.74	ug/L	dissolved
Thallium	---	15.00	ug/L	dissolved
Uranium	4116	2571	ug/L	dissolved
Uranium, at the intake	40		pCi/L	dissolved
Uranium, at the intake	0.059		mg/L	dissolved
Zinc*	217.4(6)	188.5(7)	ug/L	dissolved
Radionuclides				
Americium 241	0.15		pCi/L	total
Cesium 134	80		pCi/L	dissolved
Plutonium 239 and 240	0.15		pCi/L	total
Radium 226 and 228	5		pCi/L	total
Strontium 90	8		pCi/L	total
Thorium 230 and 232	60		pCi/L	total
Tritium	20,000		pCi/L	dissolved

NOTES:

Standards from Colorado Administrative Code 5CCR 1002-31 and 5CCR 1002-38 (effective July 1, 2007)
Values in this table calculated using a water effect ratio (WER) of 1.0 unless otherwise noted
*Required by site-specific standards
(sp) - spawning standard
(elsp) - early life stages present
(ws) - water supply standard
(tr) - trout standard
(1) Cadmium KA = 1.136672 - (ln(hardness) x 0.041838) = 0.924
(2) Cadmium KC = 1.101672 - (ln(hardness) x 0.041839) = 0.889
(3) Lead KA = 1.46203 - (ln(hardness) x 0.145712) = 0.720
(4) Lead KC = 1.46203 - (ln(hardness) x 0.145712) = 0.720
(5) Silver KA = 0.5
(6) Zinc KA = 0.978
(7) Zinc KC = 0.986
Equation for Ammonia acute standard is based on "salmonids present:" = $0.275/(1+10^{7.204 - pH}) + 39.0/(1+10^{pH - 7.204})$
Equation for Ammonia chronic standard is based on elsp = $2.85 \times [0.0577/(1+10^{7.688 - pH}) + 39.0/(1+10^{pH - 7.688})]$ when T < 22.15

6.2 Previous Studies of Surface Water Quality

The USGS and others have performed several studies of water quality in Ralston Creek. Most of these studies were associated with the Schwartzwalder Mine discharge permit.

Yang[12] and Edwards[13] (1984) collected water samples and bed sediment samples from Ralston Creek and Reservoir during the winter of 1980 and spring of 1981 for uranium and radium analyses. They determined that the concentrations of uranium and radium in Ralston Creek, 400 feet upgradient of the Schwartzwalder mine, were 4.0 mg/L and 0.13 pCi/L, respectively.

R.G. Otto & Associates (1984) performed a detailed survey of surface and groundwater quality to assess the impact of runoff and seepage from the waste rock piles on the water quality in Ralston Creek. Surface water samples were collected upstream and downstream of the waste rock piles and groundwater samples were collected downslope of the disposal site from September 1983 through August 1984. The study concluded that the waste rock piles had no measurable impact on water quality in the stream, with the possible exception of stream uranium levels. The uranium data were inconclusive for determining impact, and the uranium levels in Ralston Creek downstream of the waste rock piles were well below the Colorado Basic Stream Standards.

6.3 Surface Water Sample Stations

6.3.1 Compliance Monitoring Stations

Monthly reporting of water quality in the treatment plant discharge water is required under Cotter's NPDES discharge permit. In addition, water quality has been monitored monthly (1990 to 2006) and quarterly (January 2007 to present) at the designated point of compliance in Ralston Creek (Station SW-BPL) and the results are submitted in an annual report to the Division of Reclamation, Mining and Geology (DRMG).

6.3.2 Additional Non-Routine Sampling

In addition to the compliance monitoring point in Ralston Creek (SW-BPL), five other stations have been monitored monthly from 1990 to 2002 and periodically (monthly to semi-annually) from June 2002 to September 2007. These stations are currently on a quarterly sampling schedule. The purpose of these samples was to understand upstream sources, further characterize the creek, and, at station SW-ARH, to evaluate the potential effects of an ore truck spill on the creek.

Two of the stations are located above the point of compliance. The uppermost station is located in Ralston Creek above the waste rock dumps (SW-AWD). The second is located above the former water treatment plant discharge location (SW-A001). Three of the stations are located downstream of the point of compliance: SW-ARH, SW-FBRG, and SW-LLHG, which is located on Ralston Creek at the Long Lake Head Gate, approximately 1.5 miles downstream from the Schwartzwalder Mine.

The period of record extends from approximately 1973 to the present[14]. The data set contains dissolved and total uranium and radium, as well as field parameters (temperature, pH, conductivity, and dissolved oxygen.) A longer suite of parameters is analyzed approximately annually at these stations, as discussed Section 6.5.

---

[12] Affiliated with the USGS at the time.

[13] Affiliated with the Colorado School of mines at the time

[14] The surface water quality data evaluated for this report ranges from 1998 (or 1990 for uranium) to September 2007.

Table 22. Compliance Monitoring Stations and Non-Routine Sampling Stations in Ralston Creek

STATION NAME	NORTHING	EASTING	ELEVATION	DESCRIPTION	FREQUENCY
SW-LLHG	726,873.63	2,065,661.22	6358.0	Long Lake Head Gate	Monthly
SW-ARH	729,590.23	2,064,210.64	6358.0	Above Red Hill	Variable
SW-FBRG	731,700.86	2,063,819.07	6460.0	First Bridge	Variable
SW-BPL	732,105.23	2,063,068.76	6509.0	Below Property Line	Monthly
SW-DIS001	733,406.0	2,061,299.0	6585.0	Discharge	Monthly
SW-A001	733,650.46	2,061,153.05	6590.57	Above Discharge Pt A001	Monthly
SW-AWD	734,870.0	2,059,850.0	6639.9	Above Waste Dump	Variable
SW-Abv Pl				Above Plant Site	Variable
D-MENA	735,830.0	2,056,360.0	6790.0	Downstream of Mena	Variable
SHFTMENA	735,960.0	2,055,850.0	6835.0	Mena Shaft	Variable
U-MENA	735,940.0	2,055,380.0	6815.0	Upstream of Mena	Variable

Note: Coordinates in NAD 27. Stations listed in order from downstream to upstream.

6.3.3 1998 – 1999 Baseline StudyData

Water quality in Ralston Creek was measured approximately monthly at 10 stations during the baseline data collection period from 1998-1999. The 10 stations are listed in order from downstream to upstream in Table 23. The analytical suite included constituents for which drinking water Maximum Contaminant Levels (MCLs) and Colorado instream water quality standards existed at the time.

Table 23. Surface Water Quality Sampling Stations From the 1998-1999 Baseline Hydrology Study

STATION	NORTHING	EASTING	ELEVATION	DESCRIPTION
SW-LLHG	726,873.63	2,065,661.22	6155.00	Long Lake Head Gate (1.5 miles downstream)
SW-BPL	732,105.23	2,063,068.76	6508.97	Below Property Line (near MW8)
SW-GS	732,466.73	2,062,546.19	6533.43	Guard Shack (near MW7)
SW-BOS	732,696.77	2,062,307.12	6543.60[15]	Below Ore Sorter (near MW6)
SW-OS	732,902.10	2,062,102.41	6551.92	Ore Sorter (upstream from Sump3)
SW-PL	733,088.71	2,061,744.42	6563.94	Parking Lot (near MW3A)
SW-BDIS	733,336.16	2,061,476.31	6577.34	Below Discharge
SW-A001	733,650.46	2,061,153.05	6590.57	Above Discharge (upstream of culvert)
SW-UC	734,328.15	2,060,300.99	6618.08	Upper Culvert (upstream of culvert)
SW-UP	735,102.33	2,059,153.21	6660.82	Upgradient (≈1,200' E of prop. Boundary)

[15] Elevation is approximate (within 1 ft) for station SW-BOS

6.4 Potential Loading Sources

6.4.1 Upgradient Sources

The water quality in Ralston Creek is affected by upgradient sources, including the Mena and Northstar Mines. Neither of these properties have been owned or operated by Cotter Corporation. The flow conditions and water quality from the Mena Mine were investigated in 1999.

The Mena Mine is located approximately 2 miles upstream of the Schwartzwalder Mine. The Mena Mine shaft is 50-90 feet deep. The mine consists of a north drift and a south drift, each of which extends 100-200 ft. The water level in the Mena mine has at times reached creek level, but is often 15-20 feet below the portal.

Water quality samples have been collected in the creek downstream and upstream of the mine, and in the mine shaft itself. These data indicate that total uranium increases very slightly from upstream to downstream, while dissolved uranium concentrations in the creek are unaffected by the mine. The concentrations of most other parameters in the creek, including total alkalinity, pH, conductivity, TDS, Ca, Mg, Cl, and NH_4, are apparently not significantly affected by the Mena mine. Slight decreases in sulfate and iron and increases in TSS are apparent. The sampling results are provided in Appendix F.

6.4.2 Alluvium and Fill

Four sumps were operated in the alluvium and fill adjacent to Ralston Creek (Figure 10). The sumps operated from 1990 to June 2002, and were designed to limit direct seepage of uranium-impacted water from the alluvium into the creek. During operation, the sumps were effective in reducing uranium loading to Ralston Creek because alluvial groundwater with higher concentrations of uranium and other dissolved solids was drawn into the sumps and prevented from interacting with water in the creek.

The effect of groundwater in the alluvium and valley fill on water quality in Ralston Creek was evident when the sumps were shut down. Two short-duration sump shutdown tests were conducted in 1998 and 1999, and the sumps were permanently shut down in June 2002. The sump shut down tests (Appendix G) indicated that water quality in Ralston Creek would be affected after the sumps were permanently shut down. The permanent shutdown of the sumps resulted in an initial flush of higher concentrations, which have generally decreased over time as described in Section 6.5.2.

6.4.3 Mineralized Bedrock

Naturally mineralized bedrock is an additional potential source of loading to Ralston Creek. In addition to potential contributions from upgradient mines listed in Section 6.4.1, Ralston Creek flows across the mineralized Illinios Fault zone upstream of the Schwartzwalder's Pierce and Steve Adits and other mineralized areas downstream of the mine property. Radiometric readings in the area drained by Ralston Creek are shown in the USGS map prepared by E.J. Young (1985) (Figure 27).

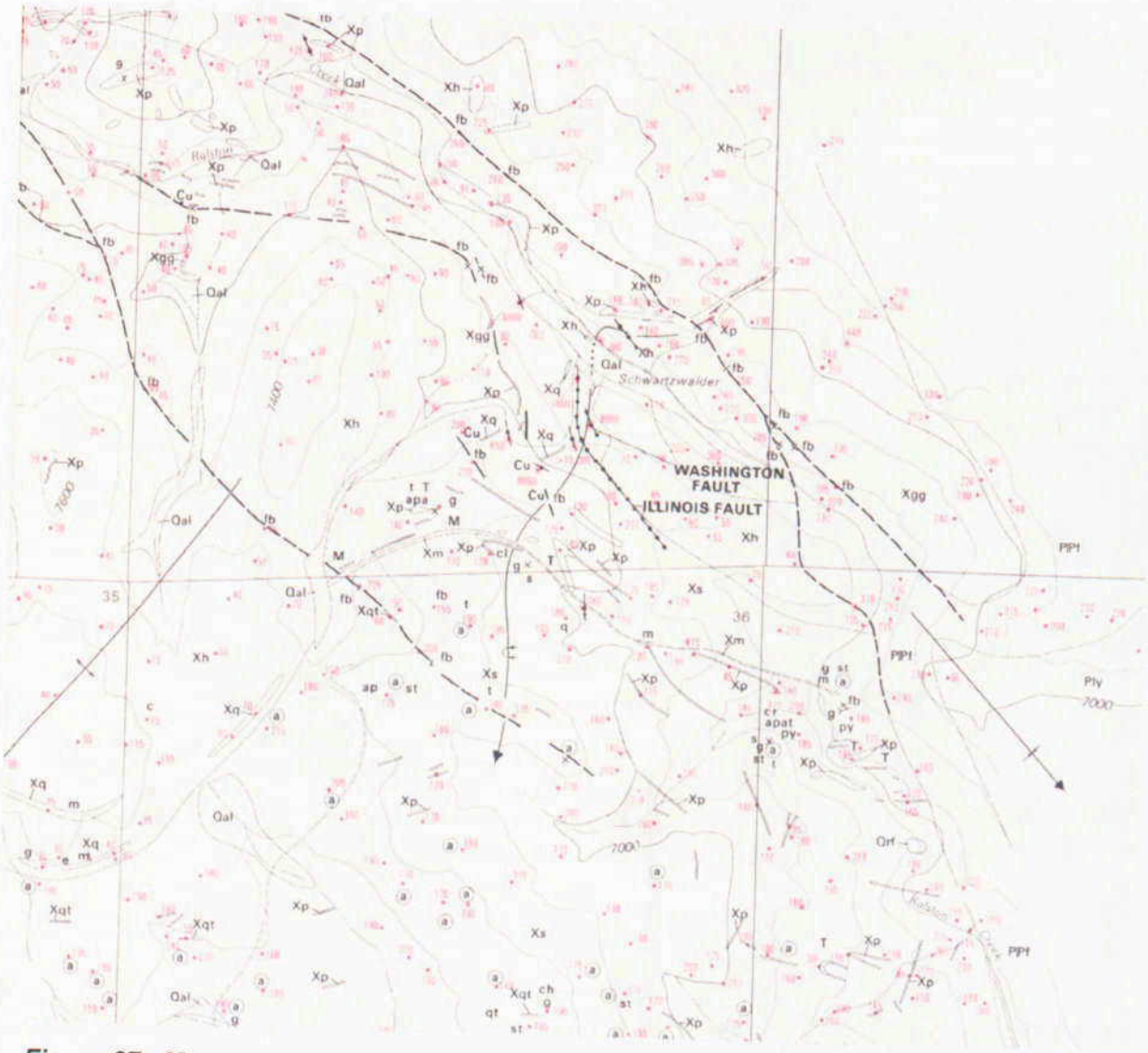


Figure 27. Map of Radiometric Readings (counts per second) in the Vicinity of Ralston Creek (Young, 1985)

6.5 Ralston Creek Water Quality

Water quality in Ralston Creek is affected by runoff from the drainage basin, groundwater inflow, upgradient abandoned mines, fill material in the valley at the Schwartzwalder Mine site, and, prior to June 2002, discharge from the mine's water treatment plant. The backgroundwater quality and the magnitude of these loading sources was evaluated during the 1998-1999 baseline hydrology study, in previous studies, and more recently with the latest water quality sampling results for the creek.

Water in Ralston Creek upstream of the Schwartzwalder Mine is a calcium-bicarbonate type water, with low levels of TDS (averaging 140 mg/L). Most metals are below detection at upstream monitoring stations SW-UP, SW-UC, SW-AWD, and SW-A001 (Table 24). Uranium at upstream stations SW-AWD and SW-A001 have never exceeded the water supply intake standard of 40 pCi/L or 0.059 mg/L (Figure 34) or the instream aquatic toxicity standards. Although water quality in Ralston Creek changes with distance downstream of Stations SW-AWD and SW-A001, as the creek flows across the mineralized zone and past the property, the applicable standards for uranium and trace metals have seldom been exceeded, as shown in the following table. Dissolved uranium has not exceeded the chronic or acute hardness-based aquatic toxicity standards in any of 98 samples analyzed. Total mercury exceeded chronic aquatic standards in one of 51 samples, dissolved iron in one of 60 samples, and total iron in one of 45 samples. Total aluminum exceeded the chronic aquatic toxicity standard in 9 of 52 samples, while the acute standard was exceeded only once.

Parameter	Units	Summary Statistics			Aquatic Standards (based on average hardness at SW-BPL)		Number of Exceedences	
		# of Samples	# of ND	% ND	Acute	Chronic	# of Acute	# of Chronic
pH	s.u.	16	0	0%	6.5 - 9.0	6.5 - 9.0	0	0
Nitrate Nitrogen	mg/L	10	3	30%	10	10	0	0
Ammonia, total	mg/L	10	3	30%	22.8	5.77	0	0
Sulfate	mg/L	71	0	0%	250	250	0	0
Chloride	mg/L	70	0	0%	250	250	0	0
Aluminum, total	mg/L	52	41	79%	0.75	0.087	1	9*
Arsenic, total	mg/L	54	54	100%	0.05	---	0	---
Boron, total	mg/L	3	3	100%	0.75	0.75	0	0
Cadmium, dissolved	mg/L	6	6	100%	0.0026	0.00061	0	0
Chromium, dissolved	mg/L	6	6	100%	0.016	0.011	0	0
Cyanide, total	mg/L	1	1	100%	0.005	0.005	0	0
Copper, dissolved	mg/L	75	63	84%	0.0213	0.0136	0	0
Iron, dissolved	mg/L	60	40	67%	---	0.3	---	1
Iron, total	mg/L	45	11	24%	---	1	---	1
Lead, dissolved	mg/L	8	8	100%	0.1095	0.00427	0	0
Lead, total	mg/L	54	54	100%	0.1095	0.00427	0	0
Manganese, dissolved	mg/L	72	62	86%	3.513	1.941	0	0
Manganese, total	mg/L	51	36	71%	3.513	1.941	0	0
Mercury, total	mg/L	51	50	98%	---	0	---	1
Nickel, dissolved	mg/L	8	8	100%	0.7079	0.0786	0	0
Selenium, dissolved	mg/L	8	8	100%	1.84E-05	0.0000046	0	0
Silver, dissolved	mg/L	9	9	100%	0.0047	0.00074	0	0
Thallium, dissolved	mg/L	77	77	100%	---	0.015	---	0
Zinc, dissolved	mg/L	10	8	80%	0.2174	0.1885	0	0
Uranium, dissolved	mg/L	98	0	0%	4.116	2.571	0	0
Uranium, suspended	mg/L	64	34	53%	4.116	2.571	0	0
Uranium, total	mg/L	2	0	0%	4.116	2.571	0	0
Radium-226, dissolved	pCi/L	65	14	22%	5	5	0	0
Radium-226, suspended	pCi/L	61	41	67%	5	5	0	0

* Aluminum standard based on total recoverable concentrations

6.5.1 Water Quality During Operation of the Sumps and WTP

While the sumps and water treatment plant were operating, the TDS in Ralston Creek increased to about 250 mg/L and the water changed to a calcium-magnesium-sodium-bicarbonate water as Ralston Creek passed the mine site (Figure 28). TDS concentrations varied seasonally (Figure 29), and were generally highest during the winter months and lowest during the spring months. Bicarbonate and sulfate were the dominant components of TDS in Ralston Creek adjacent to and below the mine site (Figure 29). Sulfate concentrations averaged 20 mg/L upstream of the mine and 68 mg/L downstream of the mine, and did not exceed the water quality standard of 250 mg/L in any of the samples analyzed.

The shift from a calcium-bicarbonate type water to a calcium-magnesium-sodium-bicarbonate type water was evident in the Piper diagram of average water quality at 14 stations (13 stations in Ralston Creek plus the treatment plant discharge.) Stations SW-UP, SW-UC, SW-AWD, and SW-A001 plot in a single cluster in the cation field of the Piper diagram (Figure 30), while stations SW-BDIS, SW-OS, SW-BOS, SW-GS, and SW-LLHG plot in separate cluster. The discharge water (Station SW-DIS001) had lower calcium and higher sodium than the upstream and downstream waters (Table 24).

Minor ions and trace metal concentrations remained essentially constant upstream and downstream of the mine, with the exception of uranium and molybdenum. Most trace metals were below detection at all sample stations. Uranium increased from about 0.003 mg/L upstream of the mine to about 0.006 mg/L near the downstream property boundary (Table 25), well below the drinking water intake standard of 0.059 mg/L (40 pCi/L) and the hardness-based aquatic toxicity standards. Molybdenum increased from below detection (<1 mg/L) above the mine to about 0.3 mg/L below the mine. No surface water standard has been established for molybdenum.

While the sumps and water treatment plant were operating, the increases in TDS, sulfate, magnesium, sodium, uranium, and molybdenum as Ralston Creek passed the mine site were due to treated discharge, which entered the creek at flow rates of 200 – 350 gpm (0.45 – 0.78 cfs). The discharge water contained sulfate concentrations of about 500 mg/L, sodium concentrations of about 150 mg/L, and magnesium concentrations of about 50 mg/L.

6.5.2 Water Quality After Turning off the Sumps and WTP

After the sumps were permanently shut down and the water treatment plant stopped discharging, the major ion concentrations in the creek near the mine site increased for several months, then decreased to about half the long-term average concentrations, then increased to about 50% above the long-term average (Figure 31) and again began to decline. Uranium concentrations followed the same trend as sulfate, bicarbonate, and TDS (Figure 32), indicating that the processes that generate TDS in the creek (initial sump flushing, seasonality, and possibly surface disturbance) also control uranium. The effect of seasonality on water quality in Ralston Creek became even more evident after the sumps and water treatment plant were shut down (Figure 29).

The initial increase in uranium and major ions after the sumps were shut down was due to a "first flush" phenomenon, as water in the sumps and alluvium came into contact with Ralston Creek for essentially the first time. The low concentrations in Spring 2003, 2005, 2006, and 2007 are the result of seasonal flushing and dilution. The second (July 2003) and third (July 2005) increases in concentration also could have resulted from regular seasonal variation in creek water quality, which was previously masked by discharge from the water treatment plant into the Ralston Creek. Uranium concentrations in 201 samples collected at Station SW-BPL from January 1990 to September 2007 indicate distinct seasonality, with concentrations at their lowest in the spring and highest in the winter.

Ralston Creek has been monitored for uranium at stations SW-AWD, SW-BPL, SW-ARH, and SW-LLHG regularly for nearly 18 years. The results are shown graphically in Figure 34 through Figure 36. The concentrations of uranium and other constituents in surface water from 1998 – 2007 were presented in

Table 24. Table 26 presents uranium data from 1990 – 2007. The highest uranium values were observed in January 2003, approximately six months after the sumps were shut down, when creek flows were at their lowest.

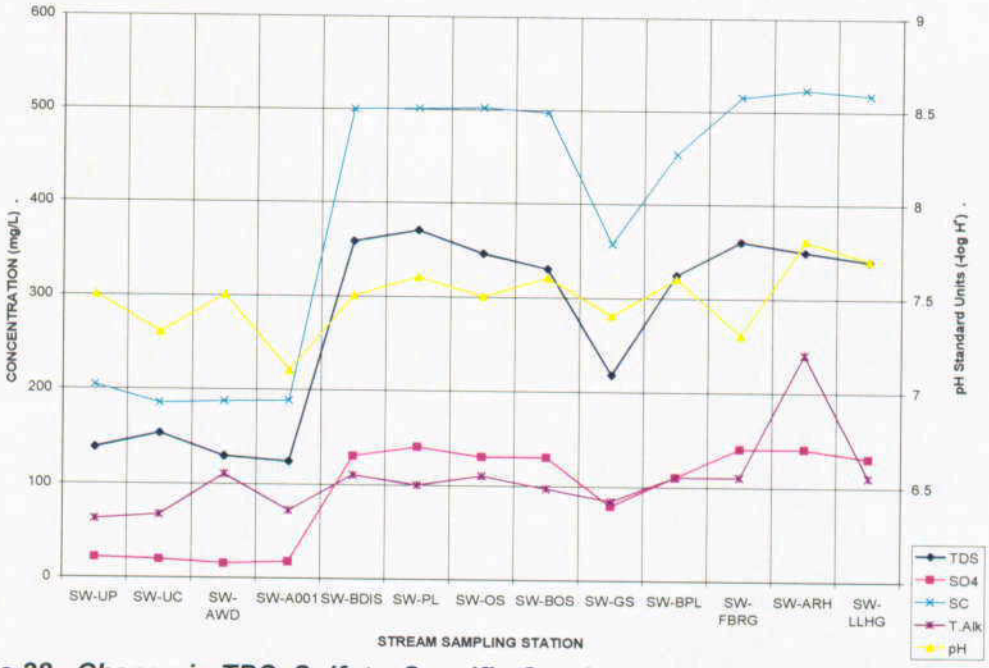


Figure 28. Change in TDS, Sulfate, Specific Conductance, Alkalinity, and pH in with Location in Ralston Creek, December 1998.

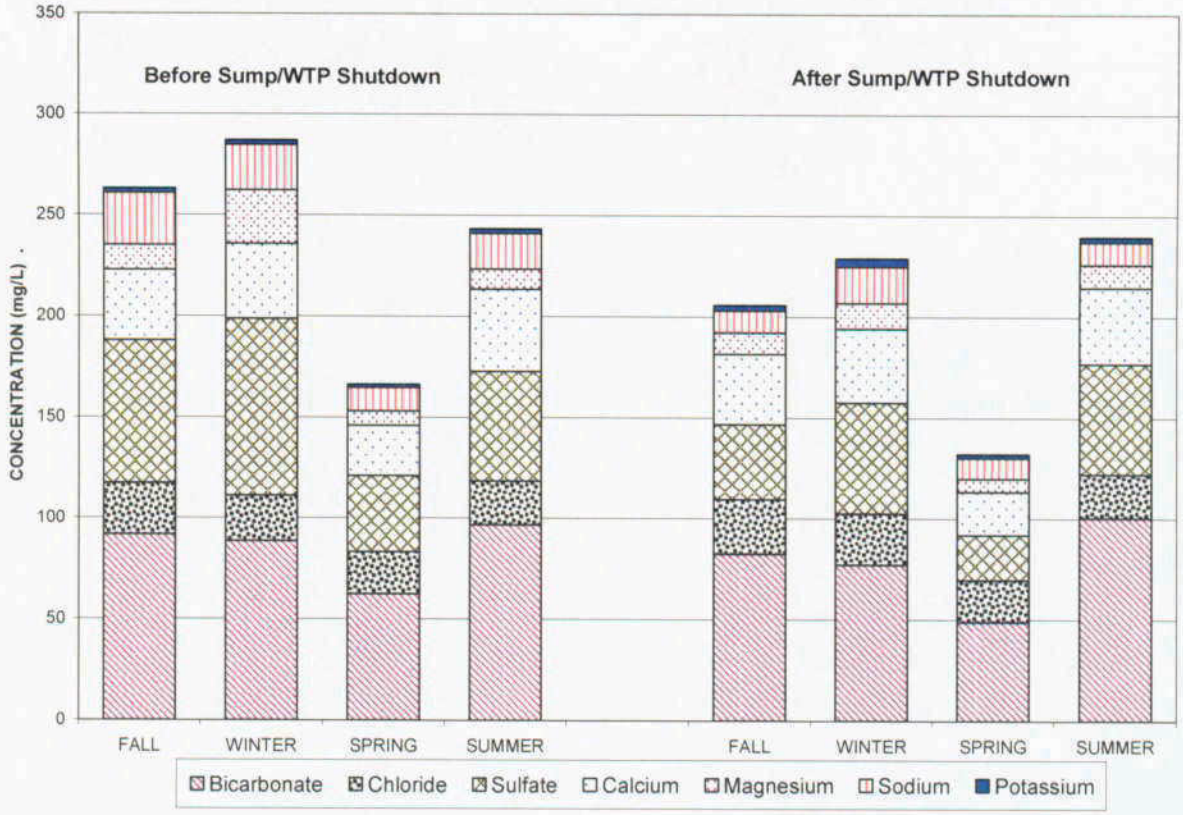


Figure 29. Seasonal Variation in TDS Components in Ralston Creek Water Downstream of Schwartzwalder Mine[16]

[16] Figure 29 is based on 18 samples from Station SW-BPL collected from 1998 – June 2002 and 36 samples collected from June 2002 – Sept 2007

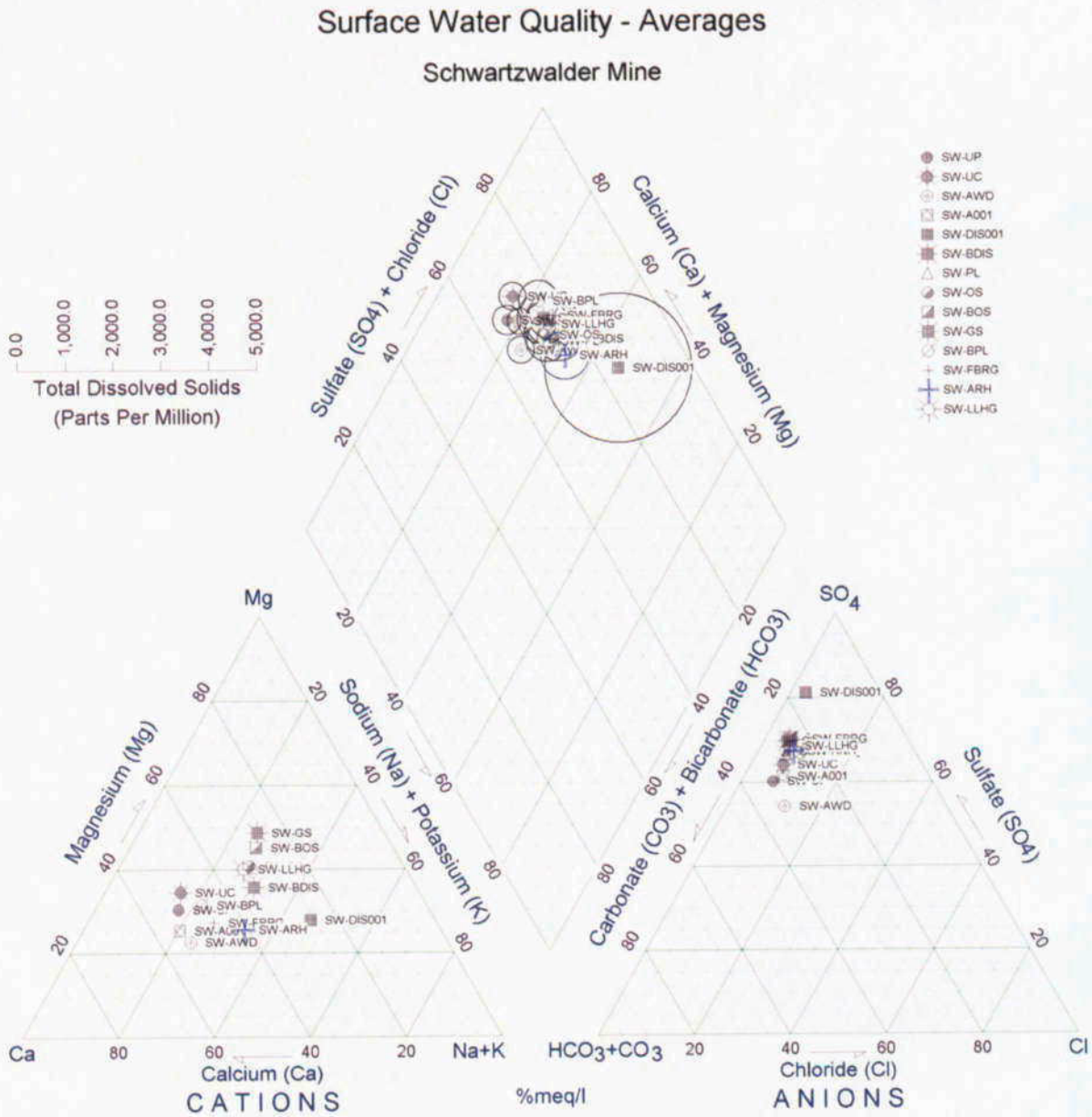


Figure 30. Piper Diagram Showing Major Ion Composition of Ralston Creek Samples, 1997 – 2003 (Averaged by Station)

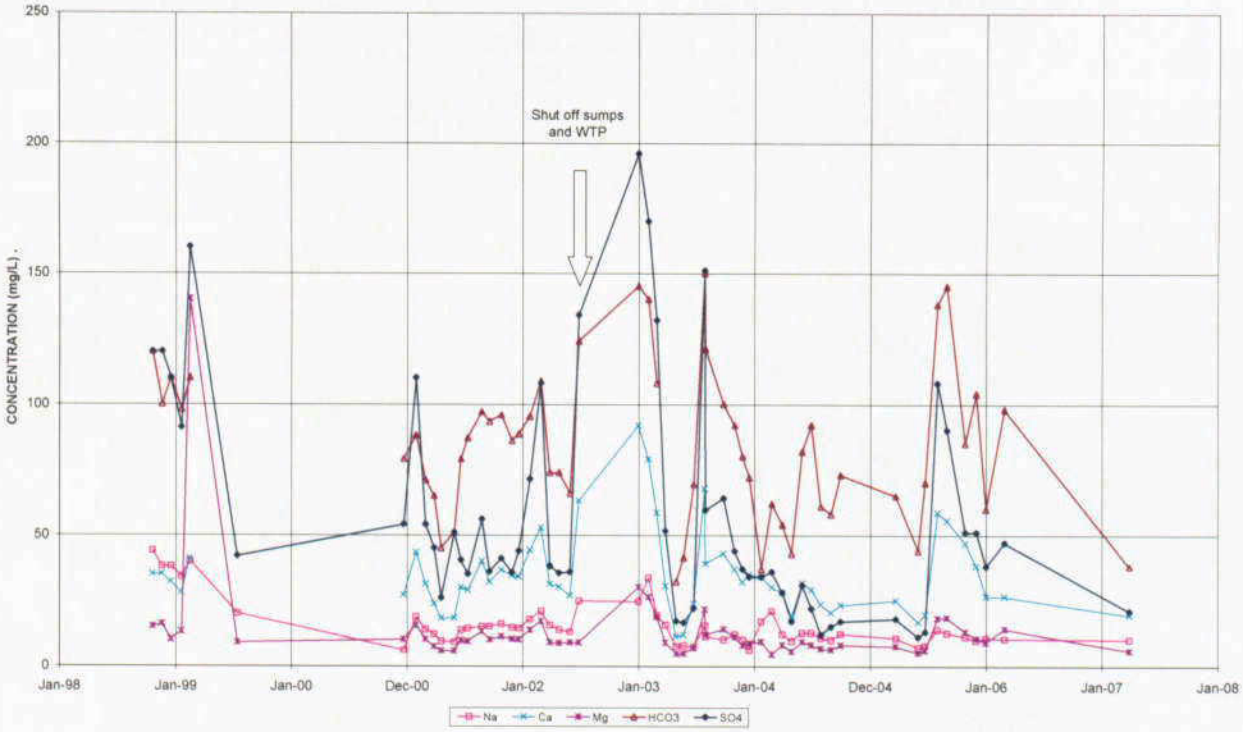


Figure 31. Trends in Major Ion Concentrations at Station SW-BPL, 1998 - 2007

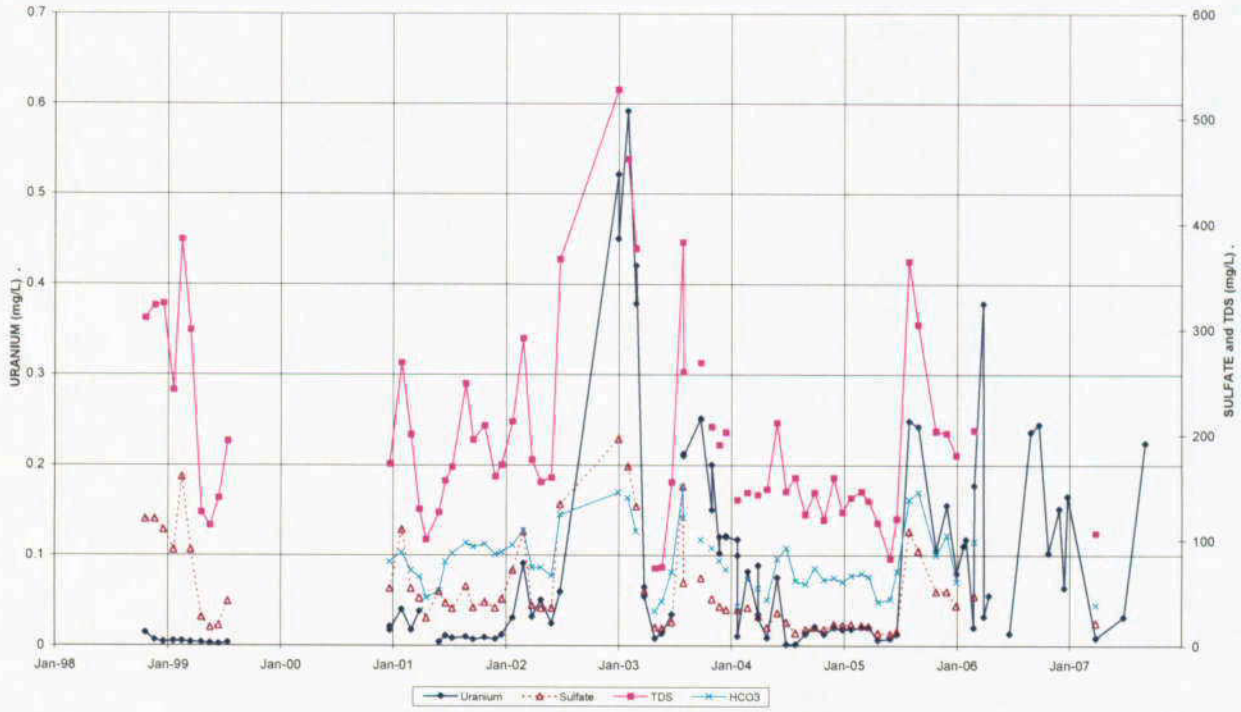


Figure 32. Correlation of Uranium, Sulfate, Bicarbonate, and TDS Concentrations at SW-BPL[17]

[17] Figure 32 is based on 98 samples analyzed for U, 71 samples for SO4, 56 samples for HCO_3, and 66 samples for TDS collected at Station SW-BPL on Ralston Creek from 1998 - 2007

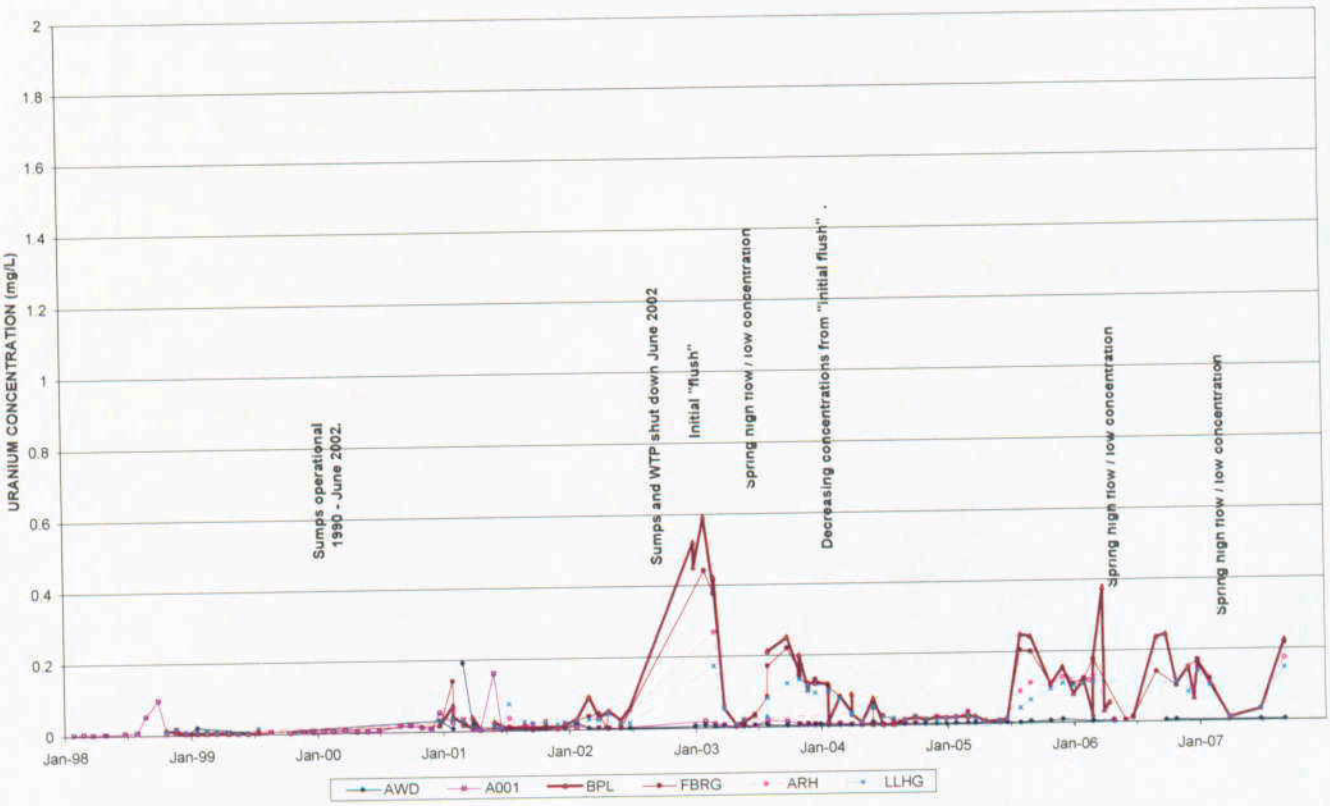
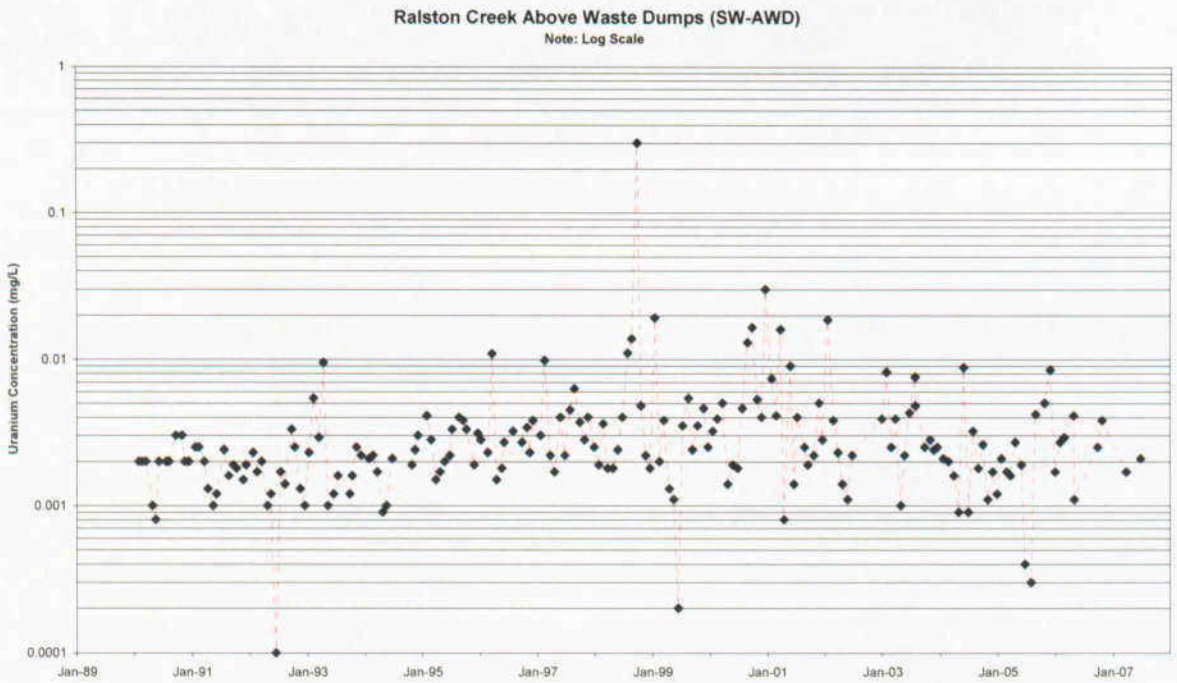


Figure 33. Trends in Uranium Concentrations at Stations SW-AWD, SW-A001, SW-BPL, SW-FBRG, SW-ARH, and SW-LLHG



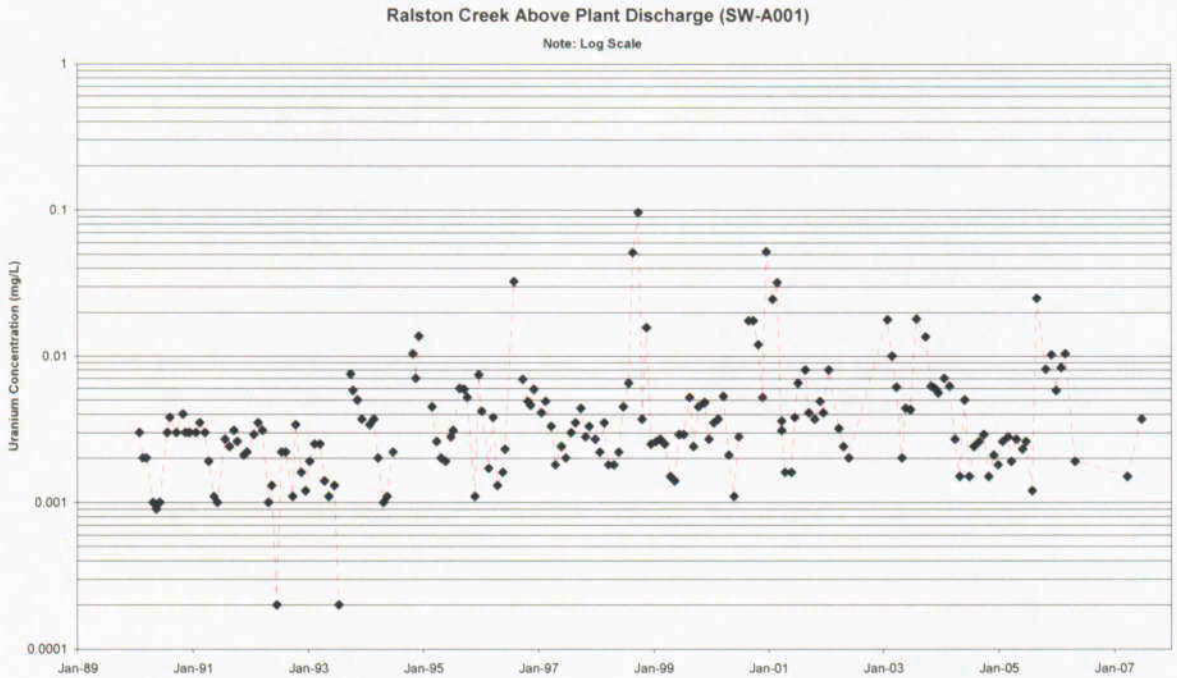
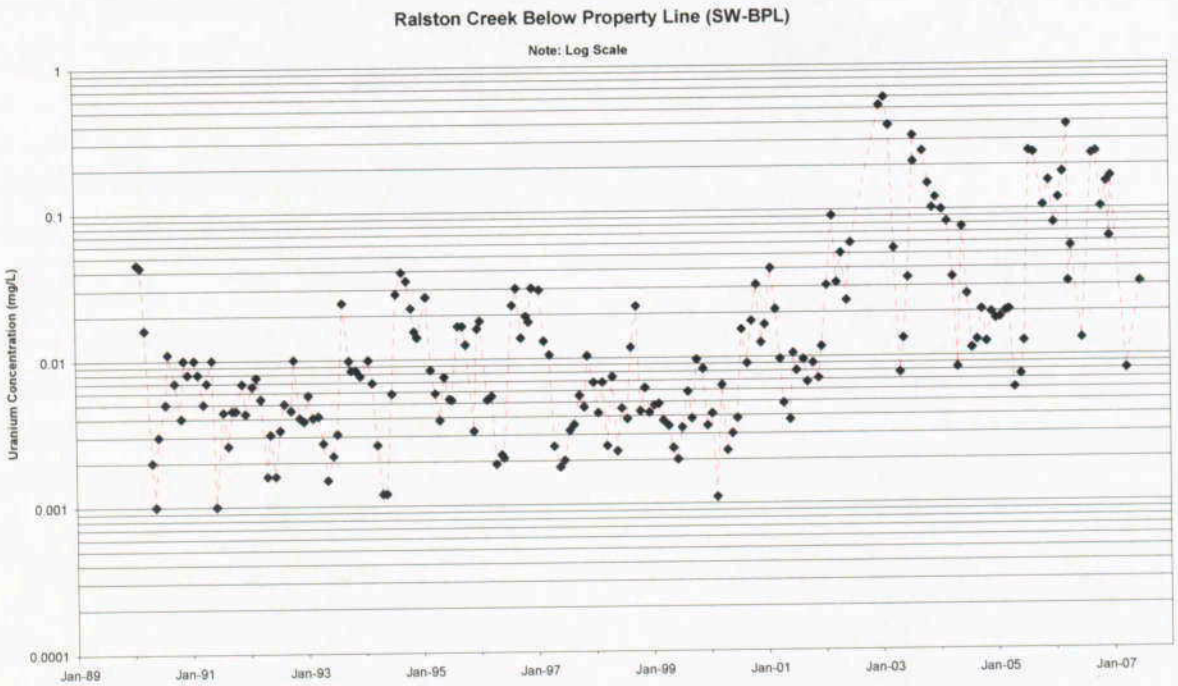


Figure 34. Uranium Concentrations in Ralston Creek at Upstream Stations SW-AWD and SW-A001, 1990 – 2007



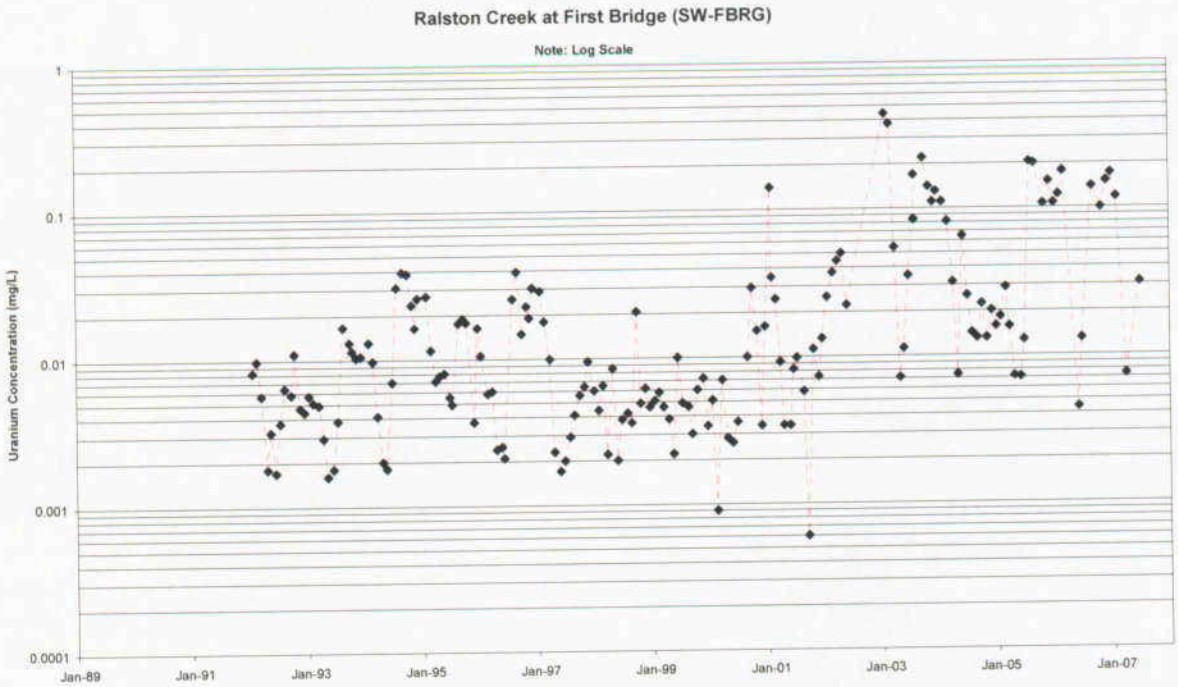
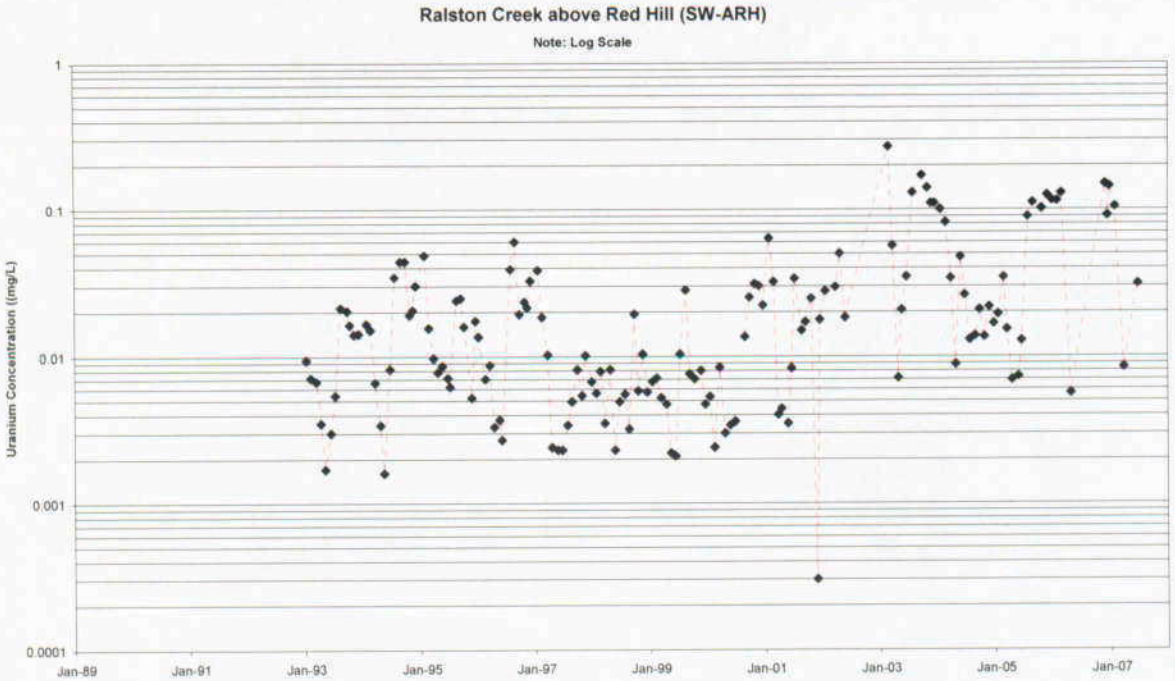


Figure 35. Uranium Concentrations in Ralston Creek at Downstream Stations SW-BPL and SW-FBRG, 1990 – 2007



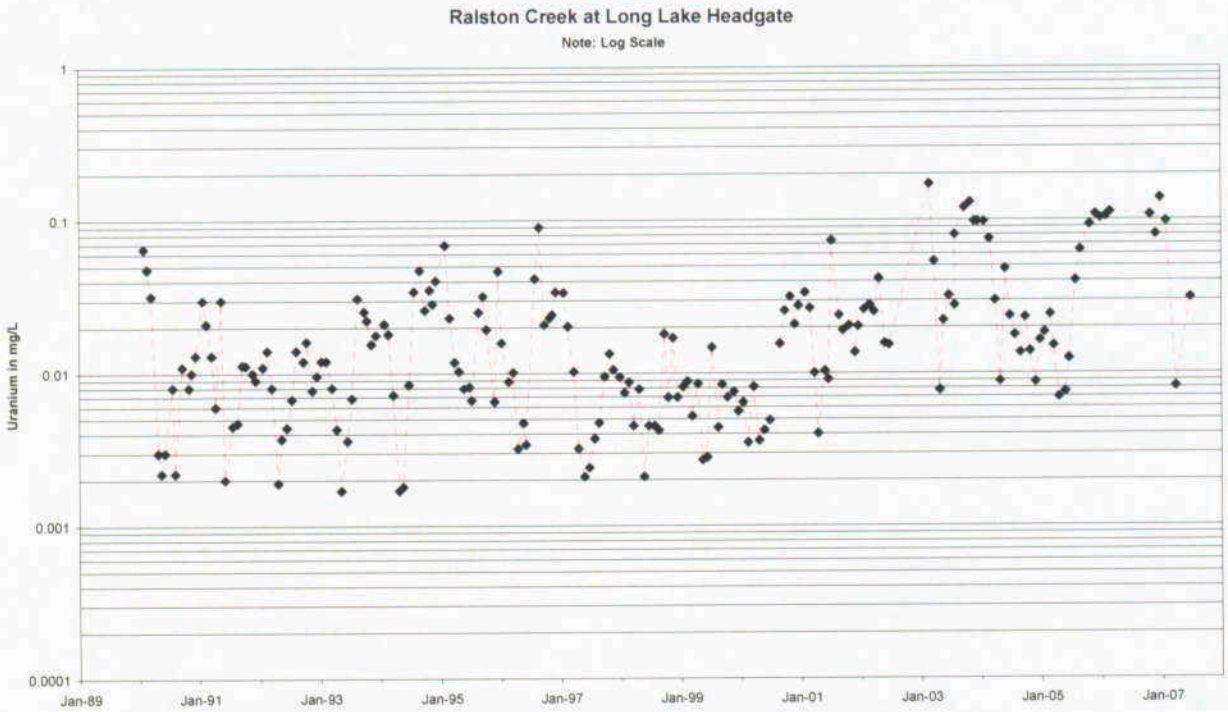


Figure 36. Uranium Concentrations in Ralston Creek at Downstream Stations SW-ARH and SW-LLHG, 1990 – 2007

TABLE 24. WATER QUALITY IN RALSTON CREEK
1998 - 2007
STATION SW-UP

	SW-UP 11/24/98	SW-UP 10/21/98	SW-UP 12/21/98	SW-UP 1/19/99	SW-UP 2/16/99	SW-UP 3/16/99	SW-UP 4/20/99	SW-UP 5/18/99	SW-UP 6/14/99	SW-UP 7/21/99	SW-UP 9/14/99	MIN	MAX	MEAN	MEDIAN	COUNT	ND	% ND
pH (std units)	8.0	7.8	7.5	7.4	7.7	7.7	7.7	7.1	7.4	7.8		7.1	8	7.6	7.7	10	0	0%
Conductivity (umhos)	500	206	204	185	221	184	193	114	141	194		114	500	214	194	10	0	0%
Total dissolved solids	400	127	138	80	131	135	133	101	115	131		80	400	149	131	10	0	0%
Total suspended solids	<1.	2	3	<1.	2	1	43	3	<10.	11.7		<1.	43	7.2	2.5	10	3	30%
Hardness, total	81	84	82	73								73	84	80.0	81.5	4	0	0%
Carbonate												n/a	n/a	n/a	n/a	0	0	n/a
Bicarbonate												n/a	n/a	n/a	n/a	0	0	n/a
Alkalinity, Dissolved							55	39	51	74		39	74	55	53	4	0	0%
Alkalinity, total	96	76	62	76	97	170	55	39				39	170	84	76	8	0	0%
Nitrate Nitrogen	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1		<0.5	<0.5	<0.1	<0.5	0.09	0.05	10	10	100%
Ammonia, total	0	0	0	0	0	0	0	<1.	<1.	<1.		0	1	0.2	0	10	3	30%
Calcium	23	24	23	20	23			13.9		23	24.3	13.9	24.3	21.8	23	8	0	0%
Sodium, dissolved	8	10	9	8	<5.			9.6		9.2	8.4	<5.	10	8.1	8.7	8	1	13%
Magnesium, dissolved	5.8	6.2	5.8	5.4	2.5			4.5		6	6.4	2.5	6.4	5.3	5.8	8	0	0%
Potassium, dissolved	1.3	1.7	1.4	1.3	0.7			1.1		1.5	1.4	0.7	1.7	1.30	1.35	8	0	0%
Sulfate	14	28	21	15	21	15	17	8.2	7.4	9.1		7.4	28	16	15	10	0	0%
Fluoride, total	0.3	0.3	0.3	0.3	0.3							0.3	0.3	0.3	0.3	5	0	0%
Chloride	11	14	12	11	13	13	14	10	11	13		10	14	12.2	12.5	10	0	0%
Phosphorous												n/a	n/a	n/a	n/a	0	0	n/a
Aluminum, dissolved	<0.5	<0.5	<0.5	<0.5				<0.1				<0.1	<0.5	0.21	0.25	5	5	100%
Aluminum, total												n/a	n/a	n/a	n/a	0	0	n/a
Antimony, dissolved	<0.008	<0.03	<0.003	<0.003	<0.003			<0.006		<0.006	<0.006	<0.003	<0.03	0.004063	0.003	8	8	100%
Antimony, total												n/a	n/a	n/a	n/a	0	0	n/a
Arsenic, dissolved	<0.003	<0.05						<0.005		<0.005	<0.005	<0.003	<0.05	0.00680	0.0025	5	5	100%
Arsenic, total			<0.003	<0.003	<0.003							<0.003	<0.003	0.0015	0.0015	3	3	100%
Barium, dissolved	0.04	0.03						<0.1		<0.1	<0.1	0.03	<0.1	0.044	0.05	5	3	60%
Barium, total			0.04	0.03	0.03							0.03	0.04	0.033333	0.03	3	0	0%
Beryllium, dissolved	<0.002	<0.001	<0.002	<0.002	<0.002			<0.001		<0.001	<0.001	<0.001	<0.002	0.00075	0.00075	8	8	100%
Boron, total								<0.05		<0.05	<0.05	<0.05	<0.05	0.025	0.025	3	3	100%
Cadmium, dissolved	<0.0002	<0.002	<0.0002	<0.001	<0.001			<0.001				<0.0002	<0.002	0.00045	0.0005	6	6	100%
Chromium, dissolved	<0.005	<0.005	<0.005	<0.005	<0.005			<0.005				<0.005	<0.005	0.0025	0.0025	6	6	100%
Cyanide, total											<0.01	<0.01	<0.01	0.0050	0.005	1	1	100%
Copper												n/a	n/a	n/a	n/a	0	0	n/a
Copper, dissolved	<0.02	<0.02	<0.02	<0.02				<0.005		<0.005	<0.005	<0.005	<0.02	0.007	0.01	7	7	100%
Copper, total												n/a	n/a	n/a	n/a	0	0	n/a
Iron, dissolved	<0.03	0.06	<0.03	<0.03				<0.1		0.1		<0.03	0.1	0.043	0.0325	6	4	67%
Iron, total												n/a	n/a	n/a	n/a	0	0	n/a
Iron, suspended												n/a	n/a	n/a	n/a	0	0	n/a
Iron, Ferrous (Fe2+)												n/a	n/a	n/a	n/a	0	0	n/a
Iron, Ferric (Fe3+)												n/a	n/a	n/a	n/a	0	0	n/a
Lead, dissolved	<0.002	<0.05						<0.005		<0.005	<0.005	<0.002	<0.05	0.0067	0.0025	5	5	100%
Lead, total			<0.002	<0.002	<0.002							<0.002	<0.002	0.00	0.001	3	3	100%
Manganese, dissolved	<0.01	<0.01	<0.01	<0.01				<0.01				<0.01	<0.01	0.005	0.005	5	5	100%
Manganese, total												n/a	n/a	n/a	n/a	0	0	n/a
Mercury, dissolved	<0.0002	<0.0002	0.0003	<0.0002	<0.0002							<0.0002	0.0003	0.0	0.0001	5	4	80%
Mercury, total												n/a	n/a	n/a	n/a	0	0	n/a
Molybdenum, dissolved	<0.01	<0.005	<0.01	<0.01	<0.01			0.017		<0.005	<0.005	<0.005	0.017	0.01	0.005	8	7	88%
Nickel, dissolved	<0.04	<0.02	<0.04	<0.04	<0.04			<0.01		<0.01	<0.01	<0.01	<0.04	0.01	0.015	8	8	100%
Selenium, dissolved	<0.005	<0.05	<0.005	<0.005	<0.005			<0.01		<0.01	<0.01	<0.005	<0.05	0.00625	0.00375	8	8	100%
Silver, dissolved	<0.001	<0.005	0.0004	<0.0002	<0.0002			<0.01				<0.0002	<0.01	0.0014	0.00045	6	5	83%
Silver, total												n/a	n/a	n/a	n/a	0	0	n/a
Thallium, dissolved	<0.001	<0.05	<0.001	<0.001	<0.001			<0.001		<0.001	<0.001	<0.001	<0.05	0.004	0.0005	8	8	100%
Vanadium, dissolved	<0.01	<0.005	<0.01	<0.01	<0.01			<0.01				<0.005	<0.01	0.005	0.005	6	6	100%
Thallium, total												n/a	n/a	n/a	n/a	0	0	n/a
Zinc, dissolved	<0.005	0.006	<0.005	<0.005				<0.01		<0.01	<0.01	<0.005	<0.01	0.004071	0.005	7	6	86%
Zinc, total												n/a	n/a	n/a	n/a	0	0	n/a
Uranium, dissolved	0.0028	0.0024	0.0036	0.002	0.0024	0.0022	0.0013	0.0014	0.0011	0.0028		0.0011	0.0036	0.0022	0.0023	10	0	0%
Uranium, suspended												n/a	n/a	n/a	n/a	0	0	n/a
Uranium, total												n/a	n/a	n/a	n/a	0	0	n/a
Thorium-228, dis. (pCi/L)		0						0.1				0	0.1	0.050	0.05	2	1	50%
Thorium-230, dis. (pCi/L)		0						0.1				0	0.1	0.05	0.05	2	1	50%
Thorium-232, dis. (pCi/L)		0						0				0	0	0.0000	0	2	2	100%
Radium-226, dis. (pCi/L)	0.2	0.2	0.4					0		0		0	0.4	0.1600	0.2	5	2	40%
Radium-226, susp. (pCi/L)												n/a	n/a	n/a	n/a	0	0	n/a
Radium-226, total (pCi/L)												n/a	n/a	n/a	n/a	0	0	n/a
Gross Alpha, dis. (pCi/L)	2.9	1.8	4.7					1.4		0.9		0.9	4.7	2.34	1.8	5	0	0%
Gross Beta, dis. (pCi/L)	0.9	1.2	0.8					<5.		<5.		0.8	<5.	1.58	1.2	5	2	40%

NOTES: Mean and median statistic calculated using one-half detection limit (1/2 D.L.)
ND = number of non-detects
Results are in mg/L unless otherwise noted

TABLE 24. WATER QUALITY IN RALSTON CREEK
1998 - 2007
STATION SW-AWD

	SW-AWD 11/19/98	SW-AWD 12/17/98	SW-AWD 1/19/99	SW-AWD 7/14/99	SW-AWD 12/21/00	SW-AWD 12/21/00	SW-AWD 1/29/01	SW-AWD 2/6/01	SW-AWD 2/28/01	SW-AWD 3/28/01	SW-AWD 3/28/01	SW-AWD 4/18/01	SW-AWD 5/29/01	SW-AWD 6/19/01	SW-AWD 7/11/01	SW-AWD 8/27/01	SW-AWD 9/17/01	SW-AWD 10/24/01	SW-AWD 11/27/01	SW-AWD 12/18/01	SW-AWD 1/22/02	SW-AWD 2/26/02	SW-AWD 3/26/02	SW-AWD 4/24/02	SW-AWD 5/28/02	SW-AWD 6/25/02	SW-AWD 12/31/02	SW-AWD 12/31/02	SW-AWD 1/30/03
pH (std units)	8.3	7.5	7.3	7.8		7.8					7.9																		
Conductivity (umhos)	192	187	186	182		257					252				126						134					202			
Total dissolved solids	128	129	90	126		118					116																		
Total suspended solids	1410	<1.	1	<10.		10					<10.																		
Hardness, total	78	76	71																										
Carbonate						<10.					<10.																		
Bicarbonate						83					70				80						83					132			
Alkalinity, Dissolved				100																	68					84			
Alkalinity, total	82	110	74			83					70				66														
Nitrate Nitrogen	0.5	<0.1	<0.1	<0.5																									
Ammonia, total	1	0	0	<1.																									
Calcium	22	21	20			22				21.6					23.3						31.2					32			
Sodium, dissolved	9	9	8			8				11.9					6.7						15.9					15.9			
Magnesium, dissolved	5.7	5.4	5.3			7.4				6.6					1.4						8.36					9.14			
Potassium, dissolved	1.4	1.3	1.3			1				1.5					12.6						2.02					1.98			
Sulfate	12	15	15	8.2		27				22.5	42				14.6						32					22.9			
Fluoride, total	0.3	0.3	0.3																										
Chloride	13	9	11	13		17				19.8	25				20.2						46.4					40.5			
Phosphorous																													
Aluminum, dissolved	<0.5	<0.5	<0.5		<0.2					<0.2					<0.1						<0.1					<0.2			
Aluminum, total															<0.1						<0.1					<0.2			
Antimony, dissolved	<0.008	<0.003	<0.003		<0.001					<0.001					<0.05						<0.001					<0.001			
Antimony, total															<0.05						<0.001					<0.001			
Arsenic, dissolved	<0.003														<0.05						<0.01					<0.01			
Arsenic, total		<0.003	<0.003																										
Barium, dissolved	0.03																												
Barium, total		0.03	0.03																										
Beryllium, dissolved	<0.002	<0.002	<0.002																										
Boron, total																													
Cadmium, dissolved	<0.0002	<0.0002	<0.001																										
Chromium, dissolved	<0.005	<0.005	<0.005																										
Cyanide, total					<0.005																								
Copper										0.006					<0.01						<0.01					<0.005			
Copper, dissolved	<0.02	<0.02	<0.02												<0.01						0.002					<0.005			
Copper, total															<0.03						<0.03					0.066			
Iron, dissolved	<0.03	<0.03	<0.03		<0.03					<0.03					0.07						<0.03					0.132			
Iron, total																													
Iron, suspended																													
Iron, Ferrous (Fe2+)																					<0.03					0.066			
Iron, Ferric (Fe3+)															<0.05														
Lead, dissolved	<0.002														<0.05						0.002					<0.005			
Lead, total		<0.002	<0.002												<0.01						<0.01					0.02			
Manganese, dissolved	<0.01	<0.01	<0.01		<0.01					<0.01					<0.01						<0.01					0.03			
Manganese, total															<0.001														
Mercury, dissolved	<0.0002	<0.0002	<0.0002												<0.001						0.0132					0.0001			
Mercury, total															<0.1						0.0005					<0.0005			
Molybdenum, dissolved	<0.01	<0.01	<0.01			<0.015					<0.005																		
Nickel, dissolved	<0.04	<0.04	<0.04																										
Selenium, dissolved	<0.005	<0.005	<0.005												<0.01														
Silver, dissolved	<0.001	<0.0002	<0.0002												<0.01						0.019					<0.001			
Silver, total															<0.001						<0.001					<0.001			
Thallium, dissolved	<0.001	<0.001	<0.001			<0.001				<0.001																			
Vanadium, dissolved	<0.01	<0.01	<0.01												<0.0001						<0.001					<0.001			
Thallium, total															0.02						0.017					<0.005			
Zinc, dissolved	<0.005	<0.005	<0.005																										
Zinc, total																													
Uranium, dissolved	0.0022	0.0018	0.0192	0.0035	0.03	0.03	0.0074		0.19	0.0075	0.016	0.0008	0.009	0.0014	0.004	0.0025	0.0019	0.0022	0.005	0.0028	0.0186	0.0038	0.0023	0.0014	0.0011	0.0022	0.0039	0.0056	0.0067
Uranium, suspended	0.0003	0.0001	0.0001	<0.002		0.002	0.002		0.0041		0.002	0	0.0005	0.0007	0.0003	<0.0003	<0.0003	<0.0003	0.0014	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003		<0.0003
Uranium, total								0.0055																					
Thorium-228, dis. (pCi/L)																													
Thorium-230, dis. (pCi/L)																													
Thorium-232, dis. (pCi/L)																													
Radium-226, dis. (pCi/L)	0.3	0.2				0.3	0.4		1.4		0.6	0.5	0.8	0.6	0.8	0.8	<0.2	0.5	0.6	0.5	0.4	0.4	<0.2	<0.2	<0.2	0.5	0.5		0.8
Radium-226, susp. (pCi/L)	0	0.1	0			0	0		0.1		0.1	0	0	<0.2	0.32	<0.2	<0.2	0.4	0.2	0.6	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2		<0.2
Radium-226, total (pCi/L)																													
Gross Alpha, dis. (pCi/L)	3.1	6.2																											
Gross Beta, dis. (pCi/L)	<0.3	2																											

NOTES: Mean and median statistic calculated using one-half detection limit (1/2 D.L.)
ND = number of non-detects
Results are in mg/L unless otherwise noted

TABLE 24. WATER QUALITY IN RALSTON CREEK
1998 - 2007
STATION SW-AWD

	SW-AWD 1/30/03	SW-AWD 2/27/03	SW-AWD 3/26/03	SW-AWD 3/26/03	SW-AWD 4/29/03	SW-AWD 5/22/03	SW-AWD 6/23/03	SW-AWD 7/29/03	SW-AWD 7/31/03	SW-AWD 9/26/03	SW-AWD 9/26/03	SW-AWD 10/31/03	SW-AWD 11/25/03	SW-AWD 12/16/03	SW-AWD 12/16/03	SW-AWD 12/31/03	SW-AWD 1/23/04	SW-AWD 2/25/04	SW-AWD 3/30/04	SW-AWD 4/28/04	SW-AWD 5/31/04	SW-AWD 5/31/04	SW-AWD 5/31/04	SW-AWD 6/29/04	SW-AWD 7/29/04	SW-AWD 8/30/04	SW-AWD 9/29/04	SW-AWD 10/29/04	SW-AWD 11/30/04	SW-AWD 12/28/04
pH (std units)																														
Conductivity (umhos)						114					170							137							162					112
Total dissolved solids																														
Total suspended solids																														
Hardness, total																									57					54
Carbonate															54															
Bicarbonate						39					70																			
Alkalinity, Dissolved																									47					44
Alkalinity, total						34					70				54															
Nitrate Nitrogen																														
Ammonia, total																									22.2					20.8
Calcium						14.6					27				27			25							10.5					
Sodium, dissolved						7.57					9				10			21							6.2					9.8
Magnesium, dissolved						4.21					7				6			3.2							1.3					
Potassium, dissolved						1.8					1.6				1.9			3.2							10					14
Sulfate						13.1					18				22															
Fluoride, total																									27					24
Chloride						16					24				32															
Phosphorous																									<0.2					<0.2
Aluminum, dissolved						<0.2				<0.2				<0.2				<0.2							0.4					<0.1
Aluminum, total						0.27				<0.2				<0.2				<0.2							<0.001					<0.001
Antimony, dissolved						<0.001				<0.001				<0.001				<0.001							<0.001					<0.05
Antimony, total						<0.001				<0.001				<0.001	<0.001			<0.001												
Arsenic, dissolved																									<0.01					<0.001
Arsenic, total						<0.01				<0.01				<0.01				<0.01												
Barium, dissolved																														
Barium, total																														
Beryllium, dissolved																														
Boron, total																														
Cadmium, dissolved																														
Chromium, dissolved																														
Cyanide, total																									<0.005					<0.005
Copper						<0.005				<0.005				<0.005				<0.005							<0.005					<0.01
Copper, dissolved						<0.005				<0.005				<0.005				<0.005							0.08					0.04
Copper, total						0.1					0.03				0.07										0.67					0.11
Iron, dissolved						0.304					0.03				0.03															
Iron, total																														
Iron, suspended																									0.59					0.07
Iron, Ferrous (Fe2+)																														
Iron, Ferric (Fe3+)						0.204																			<0.005					<0.05
Lead, dissolved						<0.005				<0.005				<0.005				<0.005							<0.01					<0.01
Lead, total						<0.01					<0.01				<0.01										0.03					<0.01
Manganese, dissolved						<0.01					<0.01				<0.01															
Manganese, total																									<0.0001					<0.001
Mercury, dissolved						<0.0001				<0.0001				0.0001				<0.0001							<0.005					<0.005
Mercury, total						<0.005					<0.005				0.005			<0.005												
Molybdenum, dissolved																														
Nickel, dissolved																														
Selenium, dissolved																									<0.001					<0.01
Silver, dissolved						<0.001				<0.001				<0.001				<0.001							<0.001					<0.001
Silver, total						<0.001				<0.001				<0.001				<0.001												
Thallium, dissolved																									<0.001					<0.1
Thallium, total						<0.001				<0.001				<0.001				<0.001												
Vanadium, dissolved																									0.006					<0.01
Zinc, dissolved						<0.005					<0.005				0.01															
Zinc, total																									0.0032	0.0018	0.0026	0.0011	0.0017	0.0012
Uranium, dissolved	0.0082	0.0025	0.0039	0.005	0.001	0.0022	0.0043	0.0076	0.0048	0.0025	0.0041	0.0028	0.0024	0.0025	0.0022	0.0056	0.0021	0.002	0.0016	0.0009	0.0088	0.00865	0.0099	0.0009	0.0008	0.0004	<0.0003	<0.0003	<0.0003	<0.0003
Uranium, suspended		<0.0003	<0.0003		<0.002	<0.0003	<0.002	<0.002	<0.002		<0.002	<0.002	<0.002		<0.002		<0.002	<0.002	<0.0003	<0.0003	0.0011			<0.0003						
Uranium, total																														
Thorium-228, dis. (pCi/L)																														
Thorium-230, dis. (pCi/L)																								0.9	<0.2	<0.2	<0.2	<0.2	0.3	0.3
Thorium-232, dis. (pCi/L)		0.5	0.3			0.2	0.4	0.2	0.1		0.3	0.3	0.1		0.2		0.1	0.2	<0.2	<0.2	<0.2			<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Radium-226, dis. (pCi/L)		<0.2	<0.2			<0.2	<0.1	<0.1	<0.1		<0.1	<0.1	<0.1		<0.1		<0.1	<0.1	<0.2	<0.2	<0.2									
Radium-226, susp. (pCi/L)																														
Radium-226, total (pCi/L)																														
Gross Alpha, dis. (pCi/L)																														
Gross Beta, dis. (pCi/L)																														

NOTES: Mean and median statistic calculated using one-half detection limit (1/2 D.L.)
ND = number of non-detects
Results are in mg/L unless otherwise noted

TABLE 24. WATER QUALITY IN RALSTON CREEK
1998 - 2007
STATION SW-AWD

	SW-AWD 1/25/05	SW-AWD 2/28/05	SW-AWD 3/22/05	SW-AWD 4/21/05	SW-AWD 5/31/05	SW-AWD 6/22/05	SW-AWD 7/31/05	SW-AWD 8/30/05	SW-AWD 10/26/05	SW-AWD 11/30/05	SW-AWD 2/25/06	SW-AWD 2/27/06	SW-AWD 4/28/06	SW-AWD 4/29/06	SW-AWD 4/29/06	SW-AWD 9/26/06	SW-AWD 10/26/06	SW-AWD 3/28/07	SW-AWD 6/27/07	SW-AWD 9/5/07	MIN	MAX	MEAN	MEDIAN	COUNT	ND	% ND
pH (std units)																			7.84		7.3	8.3	7.78	7.8	7	0	0%
Conductivity (umhos)																			235		182	257	213.0	192	7	0	0%
Total dissolved solids					100					150									162		90	202	133.9	128	17	0	0%
Total suspended solids																					<1.	1410	238.6	5	6	3	50%
Hardness, total																					71	78	75	76	3	0	0%
Carbonate																			76		<10.	<10.	5	5	2	2	100%
Bicarbonate					59					76											39	132	71.8	70	13	0	0%
Alkalinity, Dissolved																					100	100	100	100	1	0	0%
Alkalinity, total					49					62									62		34	110	66.2	67	16	0	0%
Nitrate Nitrogen																					0.1	0.5	0.2	0.15	4	3	75%
Ammonia, total																					0	1	0.38	0.25	4	1	25%
Calcium					15.5					28.1									24.6		14.6	32	23.4	22.2	17	0	0%
Sodium, dissolved					6.8					9.5									10.1		6.7	21	10.6	9.25	16	0	0%
Magnesium, dissolved					4.6					6.7									6.6		1.4	9.8	6.1	6.2	17	0	0%
Potassium, dissolved					1					1.2									1.5		1	12.6	2.288	1.5	16	0	0%
Sulfate					9					22									15		8.2	42	18.6	15	18	0	0%
Fluoride, total																					0.3	0.3	0.3	0.3	3	0	0%
Chloride					17					36									25		9	46.4	23.1	22.1	18	0	0%
Phosphorous																					n/a	n/a	n/a	n/a	0	0	n/a
Aluminum, dissolved					<0.2					<0.2	<0.2		<0.2	0.3	0.3	<0.2	<0.2		<0.2		<0.1	<0.5	0.133	0.1	23	21	91%
Aluminum, total					0.4					<0.1									<0.2		<0.1	0.4	0.148	0.1	12	9	75%
Antimony, dissolved					<0.001					<0.001	<0.001		<0.001	<0.001	<0.001	<0.001	<0.001		<0.001		<0.001	<0.001	0.00180	0.0005	23	23	100%
Antimony, total					<0.05					<0.05									<0.001		<0.001	<0.001	0.008	0.0005	13	13	100%
Arsenic, dissolved																			<0.001		<0.003	<0.003	0.0133	0.0133	2	2	100%
Arsenic, total					<0.001					<0.001									<0.1		<0.001	<0.001	0.0082	0.005	14	14	100%
Barium, dissolved																					0.03	0.03	0.03	0.03	1	0	0%
Barium, total																					0.03	0.03	0.030	0.03	2	0	0%
Beryllium, dissolved																					<0.002	0.002	0.001	0.001	3	3	100%
Boron, total																					n/a	n/a	n/a	n/a	0	0	n/a
Cadmium, dissolved																					<0.0002	<0.0002	0.00023	0.0001	3	3	100%
Chromium, dissolved																					<0.005	<0.005	0.0025	0.0025	3	3	100%
Cyanide, total																					n/a	n/a	n/a	n/a	0	0	n/a
Copper																					<0.005	<0.005	0.0025	0.0025	1	1	100%
Copper, dissolved					<0.005					<0.005	<0.001		0.003	0.003	0.003	0.003	0.003		<0.005		<0.001	<0.02	0.0039	0.00275	22	16	73%
Copper, total					<0.01					<0.01									<0.005		0.002	<0.01	0.003291667	0.0025	12	11	92%
Iron, dissolved					0.13					<0.03									<0.03		<0.03	0.13	0.0406875	0.015	16	9	56%
Iron, total					0.72					<0.03									0.06		<0.03	0.72	0.196	0.07	11	2	18%
Iron, suspended																					n/a	n/a	n/a	n/a	0	0	n/a
Iron, Ferrous (Fe2+)											<0.03		<0.03	0.18	0.19	<0.03	<0.03		<0.03		<0.03	0.19	0.063571429	0.015	7	5	71%
Iron, Ferric (Fe3+)					0.59					<0.03											<0.03	0.59	0.221	0.07	7	2	29%
Lead, dissolved																					<0.002	<0.002	0.013	0.013	2	2	100%
Lead, total					<0.05					<0.05									<0.005		0.002	<0.05	0.0087	0.0025	14	13	93%
Manganese, dissolved					0.01					<0.01	<0.01		0.01	<0.01	<0.01	<0.01	0.01		<0.01		<0.01	0.02	0.006363636	0.005	22	18	82%
Manganese, total					0.04					<0.01									<0.01		<0.01	0.04	0.0127	0.005	11	8	73%
Mercury, dissolved																					<0.0002	<0.0002	0.0002	0.0001	4	4	100%
Mercury, total					<0.001					<0.001									<0.0001		<0.0001	0.0132	0.0013	0.0001	12	9	75%
Molybdenum, dissolved					<0.005					<0.005	<0.005		<0.005	<0.005	<0.005	<0.005	<0.005		<0.005		<0.0005	<0.1	0.005032609	0.0025	23	21	91%
Nickel, dissolved																					<0.04	<0.04	0.02	0.02	3	3	100%
Selenium, dissolved																					<0.005	<0.005	0.003	0.0025	3	3	100%
Silver, dissolved																					<0.0002	<0.0002	0.001425	0.0003	4	4	100%
Silver, total					<0.01					<0.01									<0.001		<0.001	0.019	0.004	0.0005	12	11	92%
Thallium, dissolved					<0.001					<0.001	<0.001		<0.001	<0.001	<0.001	<0.001	<0.001		<0.001		<0.001	<0.001	0.0005	0.0005	23	23	100%
Vanadium, dissolved																					<0.01	<0.01	0.005	0.005	3	3	100%
Thallium, total					<0.1					<0.1									<0.001		<0.0001	<0.0001	0.0128375	0.0005	12	12	100%
Zinc, dissolved																					<0.005	0.02	0.0078	0.0025	6	4	67%
Zinc, total					<0.01					<0.01											<0.005	<0.01	0.0051	0.005	7	5	71%
Uranium, dissolved	0.0021	0.0017	0.0016	0.0027	0.0019	0.0021	0.0012	0.0042	0.005	0.0085	0.0015	0.0029	0.0041	0.0011		0.0025	0.0038	0.0017	0.0021	0.002	0.0008	0.19	0.0070	0.0025	77	0	0%
Uranium, suspended	0.0004	<0.0003	<0.0003	0.0008	0.0005	0.0004	<0.0003	<0.0003	<0.0003	<0.0003		<0.0003						0.0008	0.0003		0.	0.0041	0.0006	0.00015	61	40	66%
Uranium, total																		0.0025			0.0025	0.0055	0.004	0.004	2	0	0%
Thorium-228, dis. (pCi/L)																					n/a	n/a	n/a	n/a	0	0	n/a
Thorium-230, dis. (pCi/L)																					n/a	n/a	n/a	n/a	0	0	n/a
Thorium-232, dis. (pCi/L)																		<0.2	<0.2	0.7	<0.2	1.4	0.33	0.30	59	20	34%
Radium-226, dis. (pCi/L)	<0.2	<0.2	0.3	0.4	<0.2	0.4	<0.2	<0.2	<0.1	<0.2		0.6						<0.2	<0.2		0.	0.6	0.09779661	0.1	59	46	78%
Radium-226, susp. (pCi/L)	<0.2	<0.2	<0.1	<0.1	<0.2	<0.2	<0.2	<0.2	<0.1	<0.2		<0.1						<0.2			<0.2	<0.2	0.1	0.1	1	1	100%
Radium-226, total (pCi/L)																					3.1	6.2	4.65	4.65	2	0	0%
Gross Alpha, dis. (pCi/L)																					<0.3	2.	1.075	1.075	2	1	50%
Gross Beta, dis. (pCi/L)																											

NOTES: Mean and median statistic calculated using one-half detection limit (1/2 D.L.)
ND = number of non-detects
Results are in mg/L unless otherwise noted

TABLE 24. WATER QUALITY IN RALSTON CREEK
1998 - 2007
STATION SW-UC

	SW-UC 10/21/98	SW-UC 11/24/98	SW-UC 12/16/98	SW-UC 1/18/99	SW-UC 2/16/99	SW-UC 3/16/99	SW-UC 4/20/99	SW-UC 5/17/99	SW-UC 6/15/99	SW-UC 7/21/99	SW-UC 9/14/99	MIN	MAX	MEAN	MEDIAN	COUNT	ND	% ND
pH (std units)	7.7	8	7.3	7.2	7.9	7.6	7.5	7.3	7.3	7.5		7.2	8	7.53	7.5	10	0	0%
Conductivity (umhos)	206	598	185	192	212	185	164	115	143	195		115	598	219.5	188.5	10	0	0%
Total dissolved solids	130	388	153	119	120	137	113	101	108	131		101	388	150	125	10	0	0%
Total suspended solids	3	<1.	2	4	1	0	56.4	4	<10.	14.2		0	56.4	9.01	3.5	10	3	30%
Hardness, total	86	81	76	76								76	86	79.8	78.5	4	0	0%
Carbonate												0	0	n/a	n/a	0	0	n/a
Bicarbonate												0	0	n/a	n/a	0	0	n/a
Alkalinity, Dissolved							48	40	62	82		40	82	58	55	4	0	0%
Alkalinity, total	80	83	67	78	84	68	48	40				40	84	68.5	73	8	0	0%
Nitrate Nitrogen	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.5	<0.5	<0.5	<0.1	<0.5	0.105	0.05	11	11	100%
Ammonia, total	0	0	0	0	0	0	0	<1.	<1.	<1.		0	<1.	0.2	0	10	10	100%
Calcium	25	23	21	21	23			12.9		23.1	24.8	12.9	25	21.7	23	8	0	0%
Sodium, dissolved	10	8	8	9	<5.			6.4		8.8	7.8	<5.	10	7.6	8	8	1	13%
Magnesium, dissolved	6.1	5.7	5.5	5.5	3.9			3.6		6.2	6.2	3.6	6.2	5.3	5.6	8	0	0%
Potassium, dissolved	1.7	1.4	1.3	1.4	0.7			1.1		1.5	2.7	0.7	2.7	1.48	1.4	8	0	0%
Sulfate	17	13	19	18	14	16	16	8.6	6.6	12		6.6	19	14	15	10	0	0%
Fluoride, total	0.3	0.3	0.3	0.3	0.3							0.3	0.3	0.3	0.3	5	0	0%
Chloride	15	11	12	11	12	14	11	10	11	11		10	15	11.8	11	10	0	0%
Phosphorous												0	0	n/a	n/a	0	0	n/a
Aluminum, dissolved	<0.5	<0.5	<0.5	<0.5				0.2				0.2	<0.5	0.24	0.25	5	4	80%
Aluminum, total												0	0	n/a	n/a	0	0	n/a
Antimony, dissolved	<0.03	<0.008	<0.003	<0.003	<0.003			<0.006		<0.006	<0.006	<0.003	<0.03	0.0041	0.003	8	8	100%
Antimony, total												0	0	n/a	n/a	0	0	n/a
Arsenic, dissolved	<0.05	<0.003						<0.005		<0.005	<0.005	<0.003	<0.05	0.0068	0.0025	5	5	100%
Arsenic, total			<0.003	<0.003	<0.003							<0.003	<0.003	0.0015	0.0015	3	3	100%
Barium, dissolved	0.03	0.04						<0.1		<0.1	<0.1	0.03	<0.1	0.044	0.05	5	3	60%
Barium, total			0.03	0.04	0.04							0.03	0.04	0.037	0.04	3	0	0%
Beryllium, dissolved	<0.001	<0.002	<0.002	<0.002	<0.002			<0.001		<0.001	<0.001	<0.001	<0.002	0.0008	0.0008	8	8	100%
Boron, total								<0.05		<0.05	<0.05	<0.05	<0.05	0.025	0.025	3	3	100%
Cadmium, dissolved	<0.002	<0.0002	<0.0002	<0.0002	<0.001			<0.001				<0.0002	<0.002	0.0004	0.0003	6	6	100%
Chromium, dissolved	<0.005	<0.005	<0.005	<0.005	<0.005			<0.005				<0.005	<0.005	0.0025	0.0025	6	6	100%
Cyanide, total											<0.01	<0.01	<0.01	0.0050	0.005	1	1	100%
Copper												0	0	n/a	n/a	0	0	n/a
Copper, dissolved	<0.02	<0.02	<0.02	<0.02				<0.005		<0.005	<0.005	<0.005	<0.02	0.007	0.01	7	7	100%
Copper, total												0	0	n/a	n/a	0	0	n/a
Iron, dissolved	0.06	0.04	<0.03	<0.03				0.2		<0.1		<0.03	0.2	0.063	0.045	6	3	50%
Iron, total												0	0	n/a	n/a	0	0	n/a
Iron, suspended												0	0	n/a	n/a	0	0	n/a
Iron, Ferrous (Fe2+)												0	0	n/a	n/a	0	0	n/a
Iron, Ferric (Fe3+)												0	0	n/a	n/a	0	0	n/a
Lead, dissolved	<0.05	<0.002						<0.005		<0.005	<0.005	<0.002	<0.05	0.0067	0.0025	5	5	100%
Lead, total			<0.002	<0.002	<0.002							<0.002	<0.002	0.00	0.001	3	3	100%
Manganese, dissolved	<0.01	<0.01	<0.01	<0.01				<0.01				<0.01	<0.01	0.005	0.005	5	5	100%
Manganese, total												0	0	n/a	n/a	0	0	n/a
Mercury, dissolved	<0.0002	0.0005	<0.0002	<0.0002	<0.0002							<0.0002	0.0005	0.0	0.0001	5	4	80%
Mercury, total												0	0	n/a	n/a	0	0	n/a
Molybdenum, dissolved	<0.005	<0.01	<0.01	<0.01	<0.01			<0.005		<0.005	<0.005	<0.005	<0.01	0.0038	0.0038	8	8	n/a
Nickel, dissolved	<0.02	<0.04	<0.04	<0.04	<0.04			<0.01		<0.01	<0.01	<0.01	<0.04	0.013	0.015	8	8	100%
Selenium, dissolved	<0.05	<0.005	<0.005	<0.005	<0.005			<0.01		<0.01	<0.01	<0.005	<0.05	0.00625	0.00375	8	8	100%
Silver, dissolved	<0.005	<0.001	<0.0002	<0.0002	<0.0002			<0.01				<0.0002	<0.01	0.0014	0.0003	6	6	100%
Silver, total												0	0	n/a	n/a	0	0	n/a
Thallium, dissolved	<0.05	<0.001	<0.001	<0.001	<0.001			<0.001		<0.001	0.002	<0.001	<0.05	0.004	0.0005	8	7	88%
Vanadium, dissolved	<0.005	<0.01	<0.01	<0.01	<0.01			<0.01				<0.005	<0.01	0.005	0.005	6	6	100%
Thallium, total												0	0	n/a	n/a	0	0	n/a
Zinc, dissolved	0.005	<0.005	<0.005	<0.005				<0.01		<0.01	<0.01	<0.005	<0.01	0.0039	0.005	7	6	86%
Zinc, total												0	0	n/a	n/a	0	0	n/a
Uranium, dissolved	0.0025	0.0031	0.002	0.0029	0.0024	0.002	0.0014	0.0011	0.0014	0.0026		0.0011	0.0031	0.0021	0.0022	10	0	0%
Uranium, suspended												0	0	n/a	n/a	0	0	n/a
Uranium, total												0	0	n/a	n/a	0	0	n/a
Thorium-228, dis. (pCi/L)	0							0.1				0	0.1	0.05	0.05	2	1	50%
Thorium-230, dis. (pCi/L)	0							0.1				0	0.1	0.05	0.05	2	1	50%
Thorium-232, dis. (pCi/L)	0							0.1				0	0.1	0.05	0.05	2	1	50%
Radium-226, dis. (pCi/L)	0.2	0.2	0.3					0.2		0.2		0.2	0.3	0.22	0.2	5	0	0%
Radium-226, susp. (pCi/L)												0	0	n/a	n/a	0	0	n/a
Radium-226, total (pCi/L)												n/a	n/a	n/a	n/a	0	0	n/a
Gross Alpha, dis. (pCi/L)	2	3.3	43					1.3		1.5		1.3	43	10.22	2	5	0	0%
Gross Beta, dis. (pCi/L)	1.6	2.1	27					<5.		<5.		1.6	27	7.14	2.5	5	2	40%

NOTES: Mean and median statistic calculated using one-half detection limit (1/2 D.L.)
ND = number of non-detects

TABLE 24. WATER QUALITY IN RALSTON CREEK
1998 - 2007
STATION SW-A001

	SW-A001 1/27/1998	SW-A001 2/25/1998	SW-A001 3/23/1998	SW-A001 4/27/1998	SW-A001 5/1/98	SW-A001 6/24/98	SW-A001 7/29/98	SW-A001 8/24/98	SW-A001 9/28/98	SW-A001 10/21/98	SW-A001 11/19/98	SW-A001 12/17/98	SW-A001 1/19/99	SW-A001 2/15/99	SW-A001 3/15/99	SW-A001 4/19/99	SW-A001 5/17/99	SW-A001 6/14/99	SW-A001 7/14/99	SW-A001 8/19/99	SW-A001 9/13/99	SW-A001 10/15/99	SW-A001 11/23/99	SW-A001 12/20/99	SW-A001 1/19/00	SW-A001 2/17/00	SW-A001 3/22/00	SW-A001 4/25/00	SW-A001 5/26/00	SW-A001 6/28/00	SW-A001 8/29/00	SW-A001 9/27/00	SW-A001 10/30/00	SW-A001 11/27/00	SW-A001 12/21/00	SW-A001 1/29/01	SW-A001 2/6/01
pH (std units)										7.5	8.5	7.1	7.4	8.1	7.7	7.8	7.5	7.4	7.7																	
Conductivity (umhos)										207	192	188	186	196	182	165	117	142	185																	
Total dissolved solids										133	137	124	101	129	171	107	103	112	136																	
Total suspended solids										<1.	<1.	1	<1.	4	0		3	<10.	<10.																	
Hardness, total										87.	79.	76.	73.																							
Carbonate																																				
Bicarbonate																52	42	48	82																	
Alkalinity, Dissolved										75	78	72	72	73	65		42																			
Alkalinity, total										<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.5	<0.1		<0.5		<0.5															
Nitrate Nitrogen										0.	1.	0.	0.	0.	0.	<1.	<1.	<1.	<1.																	
Ammonia, total										24	23	21	20	23			12.5		21.6		24.8															
Calcium										10	9	9	9	<5.			6.4		8.4		11.5															
Sodium, dissolved										6.5	5.6	5.4	5.5	4.7			3.6		5.8		7.2															
Magnesium, dissolved										1.7	1.4	1.3	1.3	0.7			1.		1.5		1.6															
Potassium, dissolved										15	12	17	15	13	14	16	9.1	8.6	9.5																	
Sulfate										0.3	0.3	0.3	0.3	0.3																						
Fluoride, total										15	13	11	11	11	13	11	10	12	12																	
Chloride																																				
Phosphorous										<0.5	<0.5	<0.5	<0.5				0.4																			
Aluminum, dissolved																																				
Aluminum, total										<0.03	<0.008	<0.003	<0.003	<0.003			<0.006		<0.006		<0.008															
Antimony, dissolved																																				
Antimony, total										<0.05	<0.003						0.008		<0.005		<0.005															
Arsenic, dissolved												<0.003	<0.003	<0.003																						
Arsenic, total										0.03	0.03						<0.1		<0.1		<0.1															
Barium, dissolved												0.03	0.03	0.03																						
Barium, total										<0.001	<0.002	<0.002	<0.002	<0.002			0.002		<0.001		<0.001															
Beryllium, dissolved																	<0.05		<0.05		<0.05															
Boron, total										<0.002	<0.0002	<0.0002	<0.001	<0.0002			<0.001																			
Cadmium, dissolved										<0.005	<0.005	<0.005	<0.005	<0.005			<0.005																			
Chromium, dissolved																					<0.01															
Cyanide, total																																				
Copper										<0.02	<0.02	<0.02	<0.02				<0.005		<0.005		<0.005															
Copper, dissolved																																				
Copper, total										0.06	<0.03	<0.03	<0.03				0.3		<0.1																	
Iron, dissolved																																				
Iron, total																																				
Iron, suspended																																				
Iron, Ferrous (Fe2+)																																				
Iron, Ferric (Fe3+)										<0.05	<0.002						<0.005		<0.005		<0.005															
Lead, dissolved												<0.002	<0.002	<0.002																						
Lead, total										<0.01	0.01	<0.01	<0.01				0.01																			
Manganese, dissolved																																				
Manganese, total										<0.0002	<0.0002	<0.0002	<0.0002	<0.0002																						
Mercury, dissolved																																				
Mercury, total										<0.005	<0.01	<0.01	<0.01	<0.01			<0.005		<0.005		0.009															
Molybdenum, dissolved										<0.02	<0.04	<0.04	<0.04	<0.04			<0.01		<0.01		<0.01															
Nickel, dissolved										<0.05	<0.005	<0.005	<0.005	<0.005			<0.01		<0.01		<0.01															
Selenium, dissolved										<0.005	<0.001	<0.0002	<0.0002	<0.0002			<0.01																			
Silver, dissolved																																				
Silver, total										<0.05	<0.001	<0.001	<0.001	<0.001			<0.001		<0.001		<0.001															
Thallium, dissolved										<0.005	<0.01	<0.01	<0.01	<0.01			<0.01																			
Vanadium, dissolved																																				
Thallium, total										0.006	<0.005	<0.005	<0.005				<0.01		<0.01		<0.01															
Zinc, dissolved																																				
Zinc, total																																				
Uranium, dissolved	0.0022	0.0035	0.0016	0.0031	0.0022	0.0045	0.0065	0.0513	0.096	0.0037	0.0157	0.0025	0.0026	0.0027	0.0025	0.0015	0.0014	0.0029	0.0029	0.0052		0.0017	0.0046	0.0027	0.0035	0.0037	0.0053	0.0021	0.0022	0.0028	0.0175	0.0175	0.012	0.0052	0.052	0.0245	
Uranium, suspended	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002		0.0024	0.0001	0.0001	0.0001	0.0001	<0.002	<0.002	<0.002	<0.002	0.002		0.0012	1.7	0.002	0.002	0.012	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.032
Uranium, total										0							0.1																			
Thorium-228, dis. (pCi/L)										0.2							0.2																			
Thorium-230, dis. (pCi/L)										0.1							0																			
Thorium-232, dis. (pCi/L)										0.1	0.5	0.2				0.1	0.2	0.1	0.6	0.8		0.1	1.2	0.3	0.	0.1	0.	0.1	0.1	0.3	1.5	0.6	0.5	0.5	0.5	0.8	
Radium-226, dis. (pCi/L)	0	0	0	0	0.	0.1	0.5	0.1	0.3		0.1	0.	0.			0.	0.	0.		0.1		0.1	0.1	0.1	0.	0.1	0.	0.	0.1	0.	0.1	0.	0.	0.	0.1	0.	
Radium-226, susp. (pCi/L)	0	0	0	0	0.	0.	0.	0.	0.																											
Radium-226, total (pCi/L)										4.3	12	6.6					1.4		3.4																	
Gross Alpha, dis. (pCi/L)										3.8	5.8	2.3					<5.		<5.																	
Gross Beta, dis. (pCi/L)																																				

NOTES:

NOTES: Mean and median statistic calculated using one-half detection limit (1/2 D.L.)
ND = number of non-detects
Results are in mg/L unless otherwise noted

TABLE 24. WATER QUALITY IN RALSTON CREEK
1998 - 2007
STATION SW-A001

	SW-A001 2/14/01	SW-A001 2/28/01	SW-A001 3/27/01	SW-A001 4/18/01	SW-A001 5/29/01	SW-A001 6/19/01	SW-A001 7/11/01	SW-A001 8/27/01	SW-A001 9/17/01	SW-A001 10/24/01	SW-A001 11/27/01	SW-A001 12/18/01	SW-A001 1/22/02	SW-A001 3/26/02	SW-A001 4/24/02	SW-A001 5/28/02	SW-A001 1/30/03	SW-A001 2/27/03	SW-A001 3/26/03	SW-A001 3/26/03	SW-A001 4/29/03	SW-A001 5/22/03	SW-A001 6/23/03	SW-A001 7/31/03	SW-A001 9/26/03	SW-A001 10/31/03	SW-A001 11/25/03	SW-A001 12/16/03	SW-A001 1/23/04	SW-A001 1/23/04	SW-A001 2/25/04	SW-A001 3/30/04	SW-A001 4/28/04	SW-A001 5/31/04	SW-A001 6/29/04	SW-A001 7/29/04	SW-A001 8/30/04
pH (std units)																														118							
Conductivity (umhos)						108						138				139		186					155														
Total dissolved solids																																					
Total suspended solids																														34							
Hardness, total																																					
Carbonate						73						83.6				64		62.2					65.3														
Bicarbonate																														38							
Alkalinity, Dissolved						61						69				53		51					54														
Alkalinity, total																														27							
Nitrate Nitrogen																														21							
Ammonia, total						24.1						28.1				22.7		32.6					21.5							9.6							
Calcium						12.1						13.4				12.1		17					6.96							3.6							
Sodium, dissolved						7.						7.9				6.59		9.34					5.9							21							
Magnesium, dissolved						1.6						1.3				1.58		1.75					1.46														
Potassium, dissolved						18.2						23.8				18.7		68.5					15.7							24							
Sulfate																																					
Fluoride, total						19.6						25.8				29.9		23					20.8														
Chloride						<1.																							<0.2								
Phosphorous						<0.1						<0.1				<0.2		<0.2					<0.2						<0.2								
Aluminum, dissolved												<0.1				<0.2		<0.2					<0.2						<0.001								
Aluminum, total						<0.1						<0.05				<0.001		<0.001					<0.001						<0.001								
Antimony, dissolved						<0.001						<0.05				<0.001		<0.001					<0.001														
Antimony, total						<0.001																															
Arsenic, dissolved						<0.001						<0.001				<0.01		<0.01					<0.01						<0.01								
Arsenic, total																																					
Barium, dissolved																																					
Barium, total																																					
Beryllium, dissolved																																					
Boron, total																																					
Cadmium, dissolved																																					
Chromium, dissolved																																					
Cyanide, total																							<0.005						<0.005								
Copper						<0.005						<0.01				<0.005		<0.005					<0.005						<0.005								
Copper, dissolved						<0.005						<0.01				<0.005		<0.005					<0.005														
Copper, total						<0.03						<0.03				<0.03		<0.03					0.033														
Iron, dissolved						0.05						0.04				0.073		<0.03					0.187														
Iron, total												0.04																									
Iron, suspended																																					
Iron, Ferrous (Fe2+)																0.051		<0.03					0.154														
Iron, Ferric (Fe3+)																													<0.005								
Lead, dissolved						<0.005						<0.05				<0.005		<0.005					<0.005														
Lead, total						<0.005						<0.01				<0.01		<0.01					<0.01														
Manganese, dissolved						<0.01						<0.01				<0.01		<0.01					<0.01														
Manganese, total						<0.01																							<0.0001								
Mercury, dissolved						<0.0001						<0.001				<0.0001		<0.0001					<0.0001							<0.005							
Mercury, total						<0.0001						<0.1				<0.005		<0.005					<0.005														
Molybdenum, dissolved						0.0012																															
Nickel, dissolved																																					
Selenium, dissolved						<0.0001																	<0.001						<0.001								
Silver, dissolved						<0.0001						<0.01				<0.001		<0.001					<0.001						<0.001								
Silver, total						<0.001						<0.001				<0.001		<0.001																			
Thallium, dissolved																							<0.001						<0.001								
Vanadium, dissolved						<0.001						<0.001				<0.001		<0.001																			
Thallium, total						0.023																	<0.005														
Zinc, dissolved												<0.01				<0.005		<0.005																			
Zinc, total																														0.007	0.0062	0.0027	0.0015	0.005	0.0015	0.0024	0.0026
Uranium, dissolved		0.032	0.0031	0.0016	0.16	0.0038	0.0065	0.008	0.0041	0.0037	0.0049	0.0041	0.008	0.0032	0.0024	0.002	0.0178	0.01	0.007	0.0061	0.002	0.0044	0.0043	0.018	0.0136	0.0062	0.006	0.0056	0.0078								
Uranium, suspended		0.002	0.002	0.0003	0.0038	<0.0003	0.0004	<0.0003	<0.0003	<0.0003	0.0004	0.0002	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003		<0.002	<0.002	<0.0003	<0.002	<0.002	<0.002	<0.002	<0.002		<0.002	<0.002	<0.0003	0.0003	0.0006	<0.0003	0.0006	<0.0003
Uranium, total	0.0054																																				
Thorium-228, dis. (pCi/L)																																					
Thorium-230, dis. (pCi/L)																																					
Thorium-232, dis. (pCi/L)		1.1	0.9	0.7	0.8	1.4	0.6	0.9	0.4	0.5	<0.2	<0.2	0.	<0.2	0.4	<0.2	1.1	0.5	0.4		0.2	0.3	0.6	0.1	0.2	0.2	0.2	0.2		0.2	0.1	<0.2	<0.2	<0.2	0.4	<0.2	0.5
Radium-226, dis. (pCi/L)		0.	0.1	0.	0.1	<0.2	<0.6	0.2	<0.2	<0.2	<0.2	<0.2	0.7	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2		<0.1	0.1	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1		<0.1	<0.1	<0.2	<0.2	<0.2	0.4	<0.2	<0.2
Radium-226, susp. (pCi/L)																																					
Radium-226, total (pCi/L)																																					
Gross Alpha, dis. (pCi/L)																																					
Gross Beta, dis. (pCi/L)																																					

Mean and median statistic calculated using one-half detection limit (1/2 D.L.)
ND = number of non-detects
Results are in mg/L unless otherwise noted

NOTES: Mean and median statistic calcu
ND = number of non-detects
Results are in mg/L unless othe

TABLE 24. WATER QUALITY IN RALSTON CREEK
1998 - 2007
STATION SW-A001

	SW-A001 8/30/04	SW-A001 8/30/04	SW-A001 9/29/04	SW-A001 10/29/04	SW-A001 11/30/04	SW-A001 12/28/04	SW-A001 12/28/04	SW-A001 12/28/04	SW-A001 1/25/05	SW-A001 2/28/05	SW-A001 3/22/05	SW-A001 4/21/05	SW-A001 5/31/05	SW-A001 6/22/05	SW-A001 7/31/05	SW-A001 8/30/05	SW-A001 10/26/05	SW-A001 11/30/05	SW-A001 12/31/05	SW-A001 1/31/06	SW-A001 2/27/06	SW-A001 4/28/06	SW-A001 3/28/07	SW-A001 6/27/07	MIN	MAX	MEAN	MEDIAN	COUNT	ND	% ND
pH (std units)																									7.1	8.5	7.85	7.55	10	0	0%
Conductivity (umhos)																									117	207	176	186	10	0	0%
Total dissolved solids					138.							101.					150.								101	186	131	133	19	0	0%
Total suspended solids																									0	<10.	2.2	1	9	5	56%
Hardness, total																									73	87	78.8	77.5	4	0	0%
Carbonate																									n/a	n/a			0	0	n/a
Bicarbonate					59.							37.					85.								34	85	62.6	64	9	0	0%
Alkalinity, Dissolved																									42	82	56	50	4	0	0%
Alkalinity, total					48.							30.					70.								30	78	59.4	63	16	0	0%
Nitrate Nitrogen																									<0.1	<0.5	0.1	0.05	10	10	100%
Ammonia, total																									0	1	0.30	0.25	10	4	40%
Calcium					23.1							13.					26.1								12.5	32.6	23	23	17	0	0%
Sodium, dissolved																									<5.	21	10.60	9.5	14	1	7%
Magnesium, dissolved					11.4							6.8					12.2								3.6	12.2	7.1	6.59	17	0	0%
Potassium, dissolved																									0.7	3.6	1.56	1.48	14	0	0%
Sulfate					16.							10.					21.								8.6	68.5	18.0	15.7	19	0	0%
Fluoride, total																									0.3	0.3	0.3	0.3	5	0	0%
Chloride					25.							14.					28.								10	29.9	17.32	14	19	0	0%
Phosphorous																									<1.	<1.	0.5	0.5	1	1	100%
Aluminum, dissolved					<0.2							1.1					<0.2						0.2		<0.1	<1.1	0.227	0.1	15	12	80%
Aluminum, total					<0.1							1.4					<0.1								<0.1	<1.4	0.222	0.1	9	8	89%
Antimony, dissolved					<0.001							<0.001					<0.001					<0.001			<0.001	<0.05	0.0034	0.001	18	18	100%
Antimony, total					<0.05							<0.001					<0.001								<0.001	<0.05	0.006	0.0005	9	9	100%
Arsenic, dissolved																									<0.001	<0.05	0.0067	0.0025	6	5	83%
Arsenic, total					<0.001							<0.01					<0.01								<0.001	<0.01	0.0030	0.00325	12	12	100%
Barium, dissolved																									0.03	<0.1	0.042	0.05	5	3	60%
Barium, total																									0.03	0.03	0.030	0.03	3	0	0%
Beryllium, dissolved																									<0.001	0.002	0.0009	0.001	8	7	88%
Boron, total																									<0.05	<0.05	0.025	0.025	3	3	100%
Cadmium, dissolved																									<0.0002	<0.002	0.0004	0.0003	6	6	100%
Chromium, dissolved																									<0.005	<0.005	0.0025	0.0025	6	6	100%
Cyanide, total																									<0.01	<0.01	0.0050	0.005	1	1	100%
Copper					0.01							<0.005					<0.005						0.005		n/a	n/a			0	0	n/a
Copper, dissolved					<0.01							<0.005					<0.005								<0.005	<0.02	0.0050	0.0025	17	15	88%
Copper, total					0.05							0.44					<0.03								<0.005	<0.01	0.0030556	0.0025	9	9	100%
Iron, dissolved					0.16							0.92					<0.03								<0.03	0.44	0.0752	0.015	14	9	64%
Iron, total																									<0.03	0.92	0.1825	0.0815	8	2	25%
Iron, suspended																									0.04	0.04	0.04	0.04	1	0	0%
Iron, Ferrous (Fe2+)					<0.11							0.48					<0.03						0.15		0.15	0.15	0.15	0.15	1	0	0%
Iron, Ferric (Fe3+)																									<0.03	0.48	0.128	0.053	6	3	50%
Lead, dissolved					<0.05							0.008					<0.005								<0.002	<0.05	0.006	0.0025	6	6	100%
Lead, total					<0.01							0.02					<0.01						<0.01		<0.002	<0.05	0.0063	0.0025	12	11	92%
Manganese, dissolved					<0.01							0.04					<0.01								<0.01	0.02	0.0067857	0.005	14	11	79%
Manganese, total																									<0.01	<0.04	0.0094	0.005	8	7	88%
Mercury, dissolved					<0.001							<0.0001					<0.0001								<0.0001	<0.0002	9.167E-05	0.0001	6	6	100%
Mercury, total					<0.005							<0.005					<0.005						<0.005		<0.0001	<0.001	0.00015	0.00005	9	9	100%
Molybdenum, dissolved																									0.0012	<0.1	0.0060	0.0025	18	15	83%
Nickel, dissolved																									<0.01	<0.04	0.0131	0.015	8	8	100%
Selenium, dissolved																									<0.005	<0.05	0.006	0.00375	8	8	100%
Silver, dissolved					<0.01							<0.01					<0.01								<0.0001	<0.01	0.0012	0.0001	7	7	100%
Silver, total					<0.001							<0.001					<0.001						<0.001		<0.0001	<0.01	0.002	0.0005	9	9	100%
Thallium, dissolved																									<0.001	<0.05	0.0019	0.0005	18	18	100%
Vanadium, dissolved					<0.1							<0.001					<0.001								<0.005	<0.01	0.005	0.005	6	6	100%
Thallium, total																									<0.001	<0.1	0.006	0.0005	9	9	100%
Zinc, dissolved																									<0.005	0.023	0.0064	0.005	8	6	75%
Zinc, total					<0.01							0.006					<0.005								<0.005	<0.01	0.0037	0.0025	7	6	86%
Uranium, dissolved	0.00263	0.0027	0.0029	0.0015	0.0021	0.0018	0.00166	0.0019	0.0026	0.0028	0.0019	0.0027	0.0023	0.0026	0.0209	0.0249	0.0081	0.0102	0.0102	0.0083	0.0104	0.0019	0.0015	0.0037	0.0014	0.16	0.0094	0.0037	95	0	0%
Uranium, suspended			<0.0003	<0.0003	<0.0003	<0.0003			<0.0003	<0.0003	<0.0003	0.001	0.0004	0.0004	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003		0.001	<0.0002	<0.0001	<1.7	0.0205	0.001	87	20	23%
Uranium, total																							0.0025		0.0025	0.032	0.013	0.0054	3	0	0%
Thorium-228, dis. (pCi/L)																									0	0.1	0.05	0.05	2	0	0%
Thorium-230, dis. (pCi/L)																									0.2	0.2	0.2	0.2	2	0	0%
Thorium-232, dis. (pCi/L)			<0.2	<0.2	<0.2	0.4			<0.2	0.5	0.3	0.6	0.4	<0.2	<0.2	<0.2	0.3	0.3	<0.2	<0.2	<0.1		<0.2	1.5	0	0.1	0.05	0.05	2	0	0%
Radium-226, dis. (pCi/L)			<0.2	<0.2	<0.2	0.3			<0.2	<0.2	<0.1	<0.1	0.4	<0.2	<0.2	<0.2	<0.1	<0.2	<0.2	<0.2	<0.1		2.	<0.2	0	1.5	0.34	0.2	85	17	20%
Radium-226, susp. (pCi/L)																							2.		0	2	0.107	0.1071429	84	14	17%
Radium-226, total (pCi/L)																									2	2	2.000	2	1	0	0%
Gross Alpha, dis. (pCi/L)																									1.4	12	5.54	5.54	5	0	0%
Gross Beta, dis. (pCi/L)																									2.3	5.8	3.38	3.38	5	2	40%

lated using one-half detection limit (1/2 D.L.)

rwise noted

TABLE 24. WATER QUALITY IN RALSTON CREEK
1998 - 2007
STATION SW-DIS001

	DIS001 11/19/98	DIS001 12/17/98	DIS001 1/19/99	DIS001 3/15/99	DIS001 4/19/99	DIS001 5/17/99	DIS001 6/14/99	DIS001 7/14/99	DIS001 9/14/99	DIS001 3/28/01	DIS001 10/29/04	MIN	MAX	MEAN	MEDIAN	COUNT	ND	% ND
pH (std units)	8.7	7.8	7.8	7.9	8	7.9	8	8.1				7.8	8.7	8.0	7.95	8	0	0%
Conductivity (umhos)	1460	1400	1420	1410	1310	1180	138	1350				138	1460	1209	1375	8	0	0%
Total dissolved solids	1090	1060	1030	1050	927	866	870	953			445	445	1090	921	953	9	0	0%
Total suspended solids	4	1	3	0	14.5	0	<10.	<10.				<0.	<14.5	4.1	3.5	8	2	25%
Hardness, total	430	390	400									390	430	407	400	3	0	0%
Carbonate												n/a	n/a	n/a	n/a	0	0	n/a
Bicarbonate											146	146	146	146	146	1	0	0%
Alkalinity, Dissolved					180	170	180	210				<170.	<210.	185	180	4	0	0%
Alkalinity, total	190	230	210	190	180	170					119	119	230	184.1	190	7	0	0%
Nitrate Nitrogen	7.7	6.3	5.4	4.6	4.6	<0.1		2.9	2.9			<0.1	<7.7	4.31	4.6	8	1	13%
Ammonia, total	1	0	0	0	0	<1.	<1.	<1.				0	<1.	0.31	0.25	8	3	38%
Calcium	80	77	74			77.5		73.9	78.9	34.1	66.8	34.1	80	70.3	75.5	8	0	0%
Sodium, dissolved	150	160	160			132		160	165	13.5	27.2	13.5	165	121	155	8	0	0%
Magnesium, dissolved	56	49	52			42.9		47.6	54.8	11.8		11.8	56	44.9	49	7	0	0%
Potassium, dissolved	6.4	6.3	6.4			5.5		5.9	6.5	1.8		1.8	6.5	5.54	6.3	7	0	0%
Sulfate	560	510	520	510	440	420	430	470		63.2	176	63.2	560	410	455	10	0	0%
Fluoride, total	1.5	1.5	1.5									1.5	1.5	1.5	1.5	3	0	0%
Chloride	25	28	29	29	34	23	26	27		18.1	27	18.1	34	26.6	27	10	0	0%
Phosphorous												n/a	n/a	n/a	n/a	0	0	n/a
Aluminum, dissolved	<0.5	<0.5	<0.5			<0.1				<0.2	<0.2	0.1	0.5	0.16667	0.175	6	6	100%
Aluminum, total											<0.1	0.1	0.1	0.05	0.05	1	1	100%
Antimony, dissolved	0.018	0.014	0.018			0.01		0.013	0.021	<0.001	<0.001	<0.001	<0.021	0.0119	0.014	8	2	25%
Antimony, total											<0.05	0.05	0.05	0.025	0.025	1	1	100%
Arsenic, dissolved	<0.003					0.007		<0.005	<0.005			0.003	0.007	0.0034	0.0025	4	3	75%
Arsenic, total		<0.003	<0.003								<0.001	0.001	0.003	0.00117	0.0015	3	3	100%
Barium, dissolved	0.04					<0.1		<0.1	<0.1			0.04	0.1	0.0475	0.05	4	3	75%
Barium, total		0.04	0.04									0.04	0.04	0.04	0.04	2	0	0%
Beryllium, dissolved	<0.002	<0.002	<0.002			0.002		<0.001	<0.001			0.001	0.002	0.001	0.001	6	5	83%
Boron, total						0.25		0.31	0.29			0.25	0.31	0.28333	0.29	3	0	0%
Cadmium, dissolved	<0.0002	<0.0002	<0.001			<0.001						0.0002	0.001	0.0003	0.0003	4	4	100%
Chromium, dissolved	<0.005	<0.005	<0.005			<0.005						<0.005	<0.005	0.0025	0.0025	4	4	100%
Cyanide, total									<0.01			<0.01	<0.01	0.0	0.005	1	1	100%
Copper												n/a	n/a	n/a	n/a	0	0	n/a
Copper, dissolved	<0.02	0.1	<0.02			<0.005		<0.005	<0.005		<0.005	<0.005	0.1	0.01857	0.0025	7	6	86%
Copper, total										<0.005	<0.01	0.005	0.01	0.00375	0.00375	2	2	n/a
Iron, dissolved	<0.03	<0.03	<0.03			<0.1		<0.1		<0.03	<0.03	<0.03	<0.1	0.025	0.015	7	7	100%
Iron, total											0.15	0.15	0.15	0.15	0.15	1	0	n/a
Iron, suspended												n/a	n/a	n/a	n/a	0	0	n/a
Iron, Ferrous (Fe2+)												n/a	n/a	n/a	n/a	0	0	n/a
Iron, Ferric (Fe3+)												n/a	n/a	n/a	n/a	0	0	n/a
Lead, dissolved	<0.002					<0.005		<0.005	<0.005			<0.002	<0.005	0.0021	0.0025	4	4	100%
Lead, total		<0.002	0.003								<0.05	<0.002	0.05	0.00967	0.003	3	2	67%
Manganese, dissolved	0.01	<0.01	<0.01			<0.01				<0.01	0.12	0.01	0.12	0.0250	0.005	6	4	67%
Manganese, total											0.13	0.13	0.13	0.13	0.13	1	0	0%
Mercury, dissolved	<0.0002	<0.0002	<0.0002									<0.0002	<0.0002	0.0001	0.0001	3	3	100%
Mercury, total											<0.001	0.001	0.001	0.0005	0.0005	1	1	100%
Molybdenum, dissolved	1.05	0.9	0.85			0.314		0.744	0.613		0.061	0.061	1.05	0.6474	0.7440	7	0	0%
Nickel, dissolved	<0.04	<0.04	<0.04			<0.01		<0.01	<0.01			<0.01	<0.04	0.0125	0.0125	6	6	100%
Selenium, dissolved	<0.005	<0.005	<0.005			<0.01		<0.01	<0.01			<0.005	<0.01	0.0038	0.0038	6	6	100%
Silver, dissolved	<0.001	<0.0002	<0.0002			<0.01						<0.0002	<0.01	0.0014	0.0003	4	4	100%
Silver, total											<0.01	0.01	0.01	0.005	0.005	1	1	100%
Thallium, dissolved	<0.001	0.002	0.002			<0.001		<0.001	0.002		<0.001	<0.001	0.002	0.0011	0.0005	7	4	57%
Vanadium, dissolved	<0.01	<0.01	<0.01			<0.01						<0.01	<0.01	0.005	0.005	4	4	100%
Thallium, total										<0.001	<0.1	0.001	0.1	0.02525	0.02525	2	2	100%
Zinc, dissolved	<0.005	<0.005	<0.005			<0.01		<0.01	<0.01			<0.005	<0.01	0.0038	0.0038	6	6	100%
Zinc, total											0.06	0.06	0.06	0.06	0.06	1	0	0%
Uranium, dissolved	0.0113	0.0044	0.0056	0.0044	0.0053	0.0065	0.0091	0.0107		0.0036	0.0027	0.0027	0.0113	0.0064	0.0055	10	0	0%
Uranium, suspended	0.0004	0.0001	0.0002	0.0001	0.0001	<0.002	<0.002	<0.002			<0.0003	0.0001	0.002	0.0005	0.0002	9	4	44%
Uranium, total												n/a	n/a	n/a	n/a	0	0	n/a
Thorium-228, dis. (pCi/L)												n/a	n/a	n/a	n/a	0	0	#DIV/0!
Thorium-230, dis. (pCi/L)						0.2						0.2	0.2	0.2	0.2	1	0	0%
Thorium-232, dis. (pCi/L)						0						0	0	0	0	1	0	0%
Radium-226, dis. (pCi/L)	1.3	1			0.5	0.5	0.4	1			<0.2	0.2	1.3	0.69	0.5	7	1	14%
Radium-226, susp. (pCi/L)	0	0	0		0	0	0				<0.2	0	0.2	0.01429	0	7	1	14%
Radium-226, total (pCi/L)												n/a	n/a	n/a	n/a	0	0	n/a
Gross Alpha, dis. (pCi/L)	10	50				4.7		5.7				4.7	50	17.6	7.85	4	0	0%
Gross Beta, dis. (pCi/L)	6.4	33				<5.		5.3				<5.	33	11.8	5.85	4	1	25%

NOTES: Mean and median statistic calculated using one-half detection limit (1/2 D.L.)
ND = number of non-detects
Results are in mg/L unless otherwise noted

TABLE 24. WATER QUALITY IN RALSTON CREEK
1998 - 2007
STATION SW-BDIS

	SW-BDIS 10/20/98	SW-BDIS 11/24/98	SW-BDIS 12/16/98	SW-BDIS 1/18/99	SW-BDIS 2/16/99	SW-BDIS 3/16/99	SW-BDIS 4/20/99	SW-BDIS 5/18/99	SW-BDIS 6/15/99	SW-BDIS 7/21/99	SW-BDIS 9/14/99	MIN	MAX	MEAN	MEDIAN	COUNT	ND	% ND
pH (std units)	8	8.1	7.5	7.3	8.1	7.8	7.8	7.3	7.3	7.8		7.3	8.1	7.70	7.8	10	0	0%
Conductivity (umhos)	440	597	500	354	391	387	288	147	153	434		147	597	369	389	10	0	0%
Total dissolved solids	282	394	358	227	229	257	187	119	118	286		118	394	246	243	10	0	0%
Total suspended solids	3	<1.	<1.	4	2	1	42.3	4	<10.	131		<1.	131	19.3	3.5	10	3	30%
Hardness, total	140	180	150	110								110	180	145	145	4	0	0%
Carbonate												0	0	n/a	n/a	0	0	n/a
Bicarbonate												0	0	n/a	n/a	0	0	n/a
Alkalinity, Dissolved							64	40	51	100		40	100	63.8	57.5	4	0	0%
Alkalinity, total	110	120	110	84	92	82	64	40				40	120	87.8	88	8	0	0%
Nitrate Nitrogen	0.4	2.5	1.7	0.8	0.8	0.8	0.5	<0.1	<0.5	<0.5	0.8	<0.1	2.5	0.8	0.8	11	3	27%
Ammonia, total	0	0	0	0	0	0	0	<1.	<1.	<1.		0	<1.	0.15	0	10	10	100%
Calcium	34	40	35	28	29			12.5		33.9	34.1	12.5	40	30.8	34	8	0	0%
Sodium, dissolved	40	54	44	27	20			6.3		38.7	34.3	6.3	54	33.0	36.5	8	0	0%
Magnesium, dissolved	14	20	16	11	7.5			3.4		15	15.3	3.4	20	12.8	14.5	8	0	0%
Potassium, dissolved	2.6	2.9	2.5	1.9	2.1			1.1		2.9	2.3	1.1	2.9	2.288	2.4	8	0	0%
Sulfate	100	160	130	75	77	81	57	19	8.2	96		8.2	160	80.3	79	10	0	0%
Fluoride, total	0.5	0.6	0.6	0.4	0.5							0.4	0.6	0.5	0.5	5	0	0%
Chloride	18	16	15	13	12	16	11	10	11	14		10	18	13.60	13.5	10	0	0%
Phosphorous												0	0	n/a	n/a	0	0	n/a
Aluminum, dissolved	<0.5	<0.5	<0.5	<0.5				0.2				0.2	<0.5	0.240	0.25	5	4	80%
Aluminum, total												0	0	n/a	n/a	0	0	n/a
Antimony, dissolved	<0.03	<0.008	0.006	<0.003	0.004			<0.006		<0.006	<0.006	<0.003	<0.03	0.0049	0.0035	8	6	75%
Antimony, total												0	0	n/a	n/a	0	0	n/a
Arsenic, dissolved	<0.05	<0.003						<0.005		<0.005	<0.005	<0.003	<0.05	0.0068	0.0025	5	5	100%
Arsenic, total			<0.003	<0.003	<0.003							<0.003	<0.003	0.0015	0.0015	3	3	100%
Barium, dissolved	0.04	0.04						<0.1		<0.1	<0.1	0.04	<0.1	0.046	0.05	5	3	60%
Barium, total			0.03	0.03	0.04							0.03	0.04	0.033	0.03	3	0	0%
Beryllium, dissolved	<0.001	<0.002	<0.002	<0.002	<0.002			<0.001		<0.001	<0.001	<0.001	<0.002	0.00075	0.00075	8	8	100%
Boron, total								<0.05		0.08	0.06	<0.05	0.08	0.055	0.06	3	1	33%
Cadmium, dissolved	<0.002	<0.0002	<0.0002	<0.0002	<0.001			<0.001				<0.0002	<0.002	0.0004	0.0003	6	6	100%
Chromium, dissolved	<0.005	<0.005	<0.005	<0.005	<0.005			<0.005				<0.005	<0.005	0.0025	0.0025	6	6	100%
Cyanide, total											<0.01	<0.01	<0.01	0.0050	0.005	1	1	100%
Copper												0	0	n/a	n/a	0	0	n/a
Copper, dissolved	<0.02	<0.02	<0.02	<0.02				<0.005		<0.005	<0.005	<0.005	<0.02	0.0068	0.01	7	7	100%
Copper, total												0	0	n/a	n/a	0	0	n/a
Iron, dissolved	0.04	<0.03	0.03	<0.03				0.2		<0.1		<0.03	0.2	0.058	0.035	6	3	50%
Iron, total												0	0	n/a	n/a	0	0	n/a
Iron, suspended												0	0	n/a	n/a	0	0	n/a
Iron, Ferrous (Fe2+)												0	0	n/a	n/a	0	0	n/a
Iron, Ferric (Fe3+)												0	0	n/a	n/a	0	0	n/a
Lead, dissolved	<0.05	<0.002						<0.005		<0.005	<0.005	<0.002	<0.05	0.0067	0.0025	5	5	100%
Lead, total			<0.002	<0.002	<0.002							<0.002	<0.002	0.001	0.001	3	3	100%
Manganese, dissolved	<0.01	<0.01	<0.01	<0.01				<0.01				<0.01	<0.01	0.005	0.005	5	5	100%
Manganese, total												0	0	n/a	n/a	0	0	n/a
Mercury, dissolved	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002							<0.0002	<0.0002	0.0001	0.0001	5	5	100%
Mercury, total												0	0	n/a	n/a	0	0	n/a
Molybdenum, dissolved	0.173	0.35	0.22	0.11	0.14			<0.005		0.125	0.126	<0.005	0.35	0.156	0.133	8	1	13%
Nickel, dissolved	<0.02	<0.04	<0.04	<0.04	<0.04			<0.01		<0.01	<0.01	<0.01	<0.04	0.013	0.015	8	8	100%
Selenium, dissolved	<0.05	<0.005	<0.005	<0.005	<0.005			<0.01		<0.01	<0.01	<0.005	<0.05	0.006	0.004	8	8	100%
Silver, dissolved	<0.005	<0.001	<0.0002	<0.0002	<0.0002			<0.01				<0.0002	<0.01	0.001	0.000	6	6	100%
Silver, total												0	0	n/a	n/a	0	0	n/a
Thallium, dissolved	<0.05	<0.001	<0.001	<0.001	<0.001			<0.001		<0.001	<0.001	<0.001	<0.05	0.0036	0.0005	8	8	100%
Vanadium, dissolved	<0.005	<0.01	<0.01	<0.01	<0.01			<0.01				<0.005	<0.01	0.005	0.005	6	6	100%
Thallium, total												0	0	n/a	n/a	0	0	n/a
Zinc, dissolved	<0.005	<0.005	<0.005	<0.005				<0.01		<0.01	<0.01	<0.005	<0.01	0.0036	0.0025	7	7	100%
Zinc, total												0	0	n/a	n/a	0	0	n/a
Uranium, dissolved	0.0035	0.0034	0.0032	0.0033	0.0036	0.0029	0.0022	0.0019	0.001	0.0031		0.001	0.0036	0.0028	0.0032	10	0	0%
Uranium, suspended												0	0	n/a	n/a	0	0	n/a
Uranium, total												0	0	n/a	n/a	0	0	n/a
Thorium-228, dis. (pCi/L)	0							0				0	0	0	0	2	0	0%
Thorium-230, dis. (pCi/L)	0							0.3				0	0.3	0.15	0.15	2	0	0%
Thorium-232, dis. (pCi/L)	0							0				0	0	0	0	2	0	0%
Radium-226, dis. (pCi/L)	0.2	0.5	0.6	0.2				0.2		0.3		0.2	0.6	0.333	0.25	6	0	0%
Radium-226, susp. (pCi/L)												0	0	n/a	n/a	0	0	n/a
Radium-226, total (pCi/L)													n/a	n/a	n/a	0	0	n/a
Gross Alpha, dis. (pCi/L)	2.2	4.1	65	10				1.2		2.2		1.2	65	14.1	3.2	6	0	0%
Gross Beta, dis. (pCi/L)	2.6	4	43	2.1				<5.		<5.		2.1	43	9.45	2.55	6	2	33%

NOTES: Mean and median statistic calculated using one-half detection limit (1/2 D.L.)
ND = number of non-detects
Results are in mg/L unless otherwise noted

TABLE 24. WATER QUALITY IN RALSTON CREEK
1998 - 2007
STATION SW-PL

	SW-PL 10/20/98	SW-PL 11/24/98	SW-PL 12/16/98	SW-PL 1/18/99	SW-PL 2/16/99	SW-PL 3/16/99	SW-PL 4/20/99	SW-PL 5/18/99	SW-PL 6/15/99	SW-PL 7/21/99	SW-PL 9/14/99	MIN	MAX	MEAN	MEDIAN	COUNT	ND	% ND
pH (std units)	7.9	8.1	7.6	7.4	8.1	7.8	7.7	7.6	7.4	8		7.4	8.1	7.76	7.75	10	0	0%
Conductivity (umhos)	348	196	501	330	441	396	282	143	152	426		143	501	322	339	10	0	0%
Total dissolved solids	214	119	370	212	274	272	182	123	123	272		119	370	216.1	213	10	0	0%
Total suspended solids	3	<1.	1	3	1	1	55.5	9	16.7	17.3		<1.	55.5	10.8	3	10	1	10%
Hardness, total	120	180	150	110								110	180	140	135	4	0	0%
Carbonate												n/a	n/a	n/a	n/a	0	0	n/a
Bicarbonate												n/a	n/a	n/a	n/a	0	0	n/a
Alkalinity, Dissolved							58	92	59	100		58	100	77	75.5	4	0	0%
Alkalinity, total	97	120	100	82	96	76	58	92				58	120	90	94	8	0	0%
Nitrate Nitrogen	0.4	2.9	1.7	0.4	0.8	0.8	0.5	<0.1		<0.5	0.8	<0.1	2.9	0.9	0.65	10	2	20%
Ammonia, total	0	0	0	0	0	0	0	<1.	<1.	<1.		0	<1.	0.15	0	10	10	100%
Calcium	29	40	34	27	31			14		32.5	34	14	40	30.2	31.75	8	0	0%
Sodium, dissolved	28	55	45	25	22			9.3		36.7	34.1	9.3	55	31.9	31.1	8	0	0%
Magnesium, dissolved	11	20	16	10	11			4.4		14.2	15.2	4.4	20	12.7	12.6	8	0	0%
Potassium, dissolved	2.3	2.9	2.5	1.9	2.4			1.1		2.4	2.3	1.1	2.9	2	2.35	8	0	0%
Sulfate	65	170	140	70	96	91	56	18	9.9	93		9.9	170	80.9	80.5	10	0	0%
Fluoride, total	0.4	0.6	0.6	0.4	0.5							0.4	0.6	0.5	0.5	5	0	0%
Chloride	21	15	15	11	15	16	17	10	11	15		10	21	14.6	15	10	0	0%
Phosphorous												n/a	n/a	n/a	n/a	0	0	n/a
Aluminum, dissolved	<0.5	<0.5	<0.5	<0.5				0.2				0.2	<0.5	0.24	0.25	5	4	80%
Aluminum, total												n/a	n/a	n/a	n/a	0	0	n/a
Antimony, dissolved	<0.03	<0.008	0.006	<0.003	0.005			<0.006		<0.006	<0.006	<0.003	<0.03	0.0051	0.0035	8	6	75%
Antimony, total												n/a	n/a	n/a	n/a	0	0	n/a
Arsenic, dissolved	<0.05	<0.003						<0.005		<0.005	<0.005	<0.003	<0.05	0.0068	0.0025	5	5	100%
Arsenic, total			<0.003	<0.003	<0.003							<0.003	<0.003	0.0015	0.0015	3	3	100%
Barium, dissolved	0.03	0.03						<0.1		<0.1	<0.1	0.03	<0.1	0.042	0.05	5	3	60%
Barium, total			0.03	0.03	0.03							0.03	0.03	0.03	0.03	3	0	0%
Beryllium, dissolved	<0.001	<0.002	<0.002	<0.002	<0.002			<0.001		<0.001	<0.001	<0.001	<0.002	0.0008	0.00075	8	8	100%
Boron, total								<0.05		0.08	0.06	<0.05	<0.08	0.0550	0.06	3	1	33%
Cadmium, dissolved	<0.002	<0.0002	<0.0002	<0.0002	<0.001			<0.001				<0.0002	<0.002	0.000	0.0003	6	6	100%
Chromium, dissolved	<0.005	<0.005	<0.005	<0.005	<0.005			<0.005				<0.005	<0.005	0.003	0.0025	6	6	100%
Cyanide, total											<0.01	<0.01	<0.01	0.0050	0.005	1	1	100%
Copper												n/a	n/a	n/a	n/a	0	0	n/a
Copper, dissolved	<0.02	<0.02	<0.02	<0.02				<0.005		<0.005	<0.005	<0.005	<0.02	0.01	0.01	7	7	100%
Copper, total												n/a	n/a	n/a	n/a	0	0	n/a
Iron, dissolved	0.04	<0.03	<0.03	<0.03				0.1		<0.1		<0.03	0.1	0.039	0.0275	6	4	67%
Iron, total												n/a	n/a	n/a	n/a	0	0	n/a
Iron, suspended												n/a	n/a	n/a	n/a	0	0	n/a
Iron, Ferrous (Fe2+)												n/a	n/a	n/a	n/a	0	0	n/a
Iron, Ferric (Fe3+)												n/a	n/a	n/a	n/a	0	0	n/a
Lead, dissolved	<0.05	<0.002						<0.005		<0.005	<0.005	<0.002	<0.05	0.0067	0.0025	5	5	100%
Lead, total			<0.002	<0.002	<0.002							<0.002	<0.002	0.0010	0.001	3	3	100%
Manganese, dissolved	<0.01	<0.01	<0.01	<0.01				<0.01				<0.01	<0.01	0.005	0.005	5	5	100%
Manganese, total												n/a	n/a	n/a	n/a	0	0	n/a
Mercury, dissolved	<0.0002	0.0002	<0.0002	<0.0002	0.0003							<0.0002	0.0003	0.0002	0.0001	5	3	60%
Mercury, total												n/a	n/a	n/a	n/a	0	0	n/a
Molybdenum, dissolved	0.108	0.35	0.21	0.09	0.19			0.015		0.114	0.119	0.015	0.35	0.150	0.1165	8	0	0%
Nickel, dissolved	<0.02	<0.04	<0.04	<0.04	<0.04			<0.01		<0.01	<0.01	<0.01	<0.04	0.0131	0.0150	8	8	100%
Selenium, dissolved	<0.05	<0.005	<0.005	<0.005	<0.005			<0.01		<0.01	<0.01	<0.005	<0.05	0.0063	0.0038	8	8	100%
Silver, dissolved	<0.005	<0.001	<0.0002	<0.0002	<0.0002			<0.01				<0.0002	<0.01	0.0014	0.0003	6	6	100%
Silver, total												n/a	n/a	n/a	n/a	0	0	n/a
Thallium, dissolved	<0.05	<0.001	<0.001	<0.001	<0.001			<0.001		<0.001	<0.001	<0.001	<0.05	0.0036	0.0005	8	8	100%
Vanadium, dissolved	<0.005	<0.01	<0.01	<0.01	<0.01			<0.01				<0.005	<0.01	0.0046	0.005	6	6	100%
Thallium, total												n/a	n/a	n/a	n/a	0	0	n/a
Zinc, dissolved	<0.005	<0.005	<0.005	<0.005				<0.01		<0.01	<0.01	<0.005	<0.01	0.004	0.0025	7	7	100%
Zinc, total												n/a	n/a	n/a	n/a	0	0	n/a
Uranium, dissolved	0.0039	0.0035	0.0032	0.0031	0.0038	0.0029	0.0021	0.0014	0.0014	0.0036		0.0014	0.0039	0.003	0.00315	10	0	0%
Uranium, suspended												0	0	n/a	n/a	0	0	n/a
Uranium, total												0	0	n/a	n/a	0	0	n/a
Thorium-228, dis. (pCi/L)	0							0.1				0	0.1	0.05	0.05	2	1	50%
Thorium-230, dis. (pCi/L)	0							0.1				0	0.1	0.05	0.05	2	1	50%
Thorium-232, dis. (pCi/L)	0							0				0	0	0.000	0	2	2	100%
Radium-226, dis. (pCi/L)	0.2	0.4	0.6	0.3				0.1		0.2		0.1	0.6	0.3	0.25	6	0	0%
Radium-226, susp. (pCi/L)												n/a	n/a	n/a	n/a	0	0	n/a
Radium-226, total (pCi/L)												n/a	n/a	n/a	n/a	0	0	n/a
Gross Alpha, dis. (pCi/L)	2.4	5.7	19					1.1		2.2		1.1	19	6.08	2.4	5	0	0%
Gross Beta, dis. (pCi/L)	2.4	3.6	6					<5.		<5.		2.4	6	3.4	2.5	5	2	40%

NOTES: Mean and median statistic calculated using one-half detection limit (1/2 D.L.
ND = number of non-detects
Results are in mg/L unless otherwise noted

TABLE 24. WATER QUALITY IN RALSTON CREEK
1998 - 2007
STATION SW-OS

	SW-OS 10/20/98	SW-OS 11/24/98	SW-OS 12/16/98	SW-OS 1/18/99	SW-OS 2/16/99	SW-OS 4/20/99	SW-OS 5/17/99	SW-OS 5/18/99	SW-OS 6/14/99	SW-OS 6/15/99	SW-OS 7/21/99	SW-OS 9/14/99	MIN	MAX	MEAN	MEDIAN	COUNT	ND	% ND
pH (std units)	8	8.1	7.5	7.3	8.3	7.8	7.1	7.2	7.5	7.4	8		7.1	8.3	7.7	7.5	11	0	0%
Conductivity (umhos)	481	217	502	360	612	281	138	143	186	154	408		138	612	317	281	11	0	0%
Total dissolved solids	300	134	346	219	401	178	120	116	139	117	270		116	401	213	178	11	0	0%
Total suspended solids	4	1	<1.	<1.	<1.	232	4	4	10.7	10.3	24.5		<1.	232	26.5	4	11	3	27%
Hardness, total	150	180	150	120									120	180	150	150	4	0	0%
Carbonate													n/a	n/a	n/a	n/a	0	0	n/a
Bicarbonate													n/a	n/a	n/a	n/a	0	0	n/a
Alkalinity, Dissolved						64	42	43	60	100	100		<42.	<100.	68.17	62	6	0	0%
Alkalinity, total	110	120	110	84	120	64	42	43					<42.	<120.	86.6	97	8	0	0%
Nitrate Nitrogen	0.4	2.5	1.7	0.8	1.7	0.5	<0.1	<0.1			<0.5	<0.5	<0.1	2.5	0.8	0.45	10	4	40%
Ammonia, total	0	0	0	0	0	0	<1.	<1.	<1.	<1.	<1.		0	1	0.227	0	11	11	100%
Calcium	35	40	34	28	41		14.1	14.5			32.2	34.5	14.1	<41.	30.4	34	9	0	0%
Sodium, dissolved	44	54	44	28	45		9.1	9.3			34.2	33.7	9.1	54	33.5	34.2	9	0	0%
Magnesium, dissolved	15	20	16	11	15		4.4	4.5			13.6	15.1	4.4	20	12.7	15	9	0	0%
Potassium, dissolved	2.8	2.9	2.5	2	3		1.2	1.1			2.7	2.3	1.1	3	2	2.5	9	0	0%
Sulfate	110	170	130	77	160	55	17	18	21	6.2	85		6.2	170	77	77	11	0	0%
Fluoride, total	0.6	0.6	0.6	0.5	0.7								0.5	0.7	0.6	0.6	5	0	0%
Chloride	19	13	14	13	18	12	10	10	12	12	14		10	19	13.4	13	11	0	0%
Phosphorous													n/a	n/a	n/a	n/a	0	0	n/a
Aluminum, dissolved	<0.5	<0.5	<0.5	<0.5			0.3	0.3					0.3	<0.5	0.267	0.25	6	4	67%
Aluminum, total													n/a	n/a	n/a	n/a	0	0	n/a
Antimony, dissolved	<0.03	<0.008	0.005	<0.003	<0.003		<0.006	<0.006			<0.006	<0.006	<0.003	<0.03	0.0043	0.003	9	8	89%
Antimony, total													n/a	n/a	n/a	n/a	0	0	n/a
Arsenic, dissolved	<0.05	<0.003					<0.005	<0.005			<0.005	<0.005	<0.003	<0.05	0.006	0.0025	6	6	100%
Arsenic, total			<0.003	<0.003	<0.003								<0.003	<0.003	0.0015	0.0015	3	3	100%
Barium, dissolved	0.04	0.04					<0.1	<0.1			<0.1	<0.1	0.04	<0.1	0.047	0.05	6	4	67%
Barium, total			0.03	0.03	0.03								<0.03	<0.03	0.03	0.03	3	0	0%
Beryllium, dissolved	<0.001	<0.002	<0.002	<0.002	<0.002		<0.001	<0.001			<0.001	<0.001	<0.001	<0.002	0.0007	0.0005	9	9	100%
Boron, total							<0.05	<0.05			0.06	0.06	<0.05	0.06	0.0425	0.0425	4	2	50%
Cadmium, dissolved	<0.002	<0.0002	<0.0002	<0.0002	<0.001		<0.001	<0.001					<0.0002	<0.002	0.000	0.0005	7	7	100%
Chromium, dissolved	<0.005	<0.005	<0.005	<0.005	<0.005		<0.005	<0.005					<0.005	<0.005	0.003	0.0025	7	7	100%
Cyanide, total												<0.01	<0.01	<0.01	0.0050	0.005	1	1	100%
Copper													n/a	n/a	n/a	n/a	0	0	n/a
Copper, dissolved	<0.02	<0.02	<0.02	<0.02			<0.005	<0.005			<0.005	<0.005	<0.005	<0.02	0.01	0.00625	8	8	100%
Copper, total													n/a	n/a	n/a	n/a	0	0	n/a
Iron, dissolved	0.04	<0.03	<0.03	<0.03			0.2	0.2			<0.1		<0.03	0.2	0.076	0.04	7	4	57%
Iron, total													n/a	n/a	n/a	n/a	0	0	n/a
Iron, suspended													n/a	n/a	n/a	n/a	0	0	n/a
Iron, Ferrous (Fe2+)													n/a	n/a	n/a	n/a	0	0	n/a
Iron, Ferric (Fe3+)													n/a	n/a	n/a	n/a	0	0	n/a
Lead, dissolved	<0.05	<0.002					<0.005	<0.005			<0.005	<0.005	<0.002	<0.05	0.006	0.0025	6	6	100%
Lead, total			<0.002	<0.002	<0.002								<0.002	<0.002	0.0010	0.001	3	3	100%
Manganese, dissolved	<0.01	<0.01	<0.01	<0.01			<0.01	<0.01					<0.01	<0.01	0.005	0.005	6	6	100%
Manganese, total													n/a	n/a	n/a	n/a	0	0	n/a
Mercury, dissolved	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002								<0.0002	<0.0002	0.0001	0.0001	5	5	100%
Mercury, total													n/a	n/a	n/a	n/a	0	0	n/a
Molybdenum, dissolved	0.201	0.35	0.21	0.12	0.33		0.013	0.015			0.104	0.121	0.013	0.35	0.163	0.121	9	0	0%
Nickel, dissolved	<0.02	<0.04	<0.04	<0.04	<0.04		<0.01	<0.01			<0.01	<0.01	<0.01	<0.04	0.012	0.01	9	9	100%
Selenium, dissolved	<0.05	<0.005	<0.005	<0.005	<0.005		<0.01	<0.01			<0.01	<0.01	<0.005	<0.05	0.0061	0.005	9	9	100%
Silver, dissolved	<0.005	<0.001	<0.0002	<0.0002	<0.0002		<0.01	<0.01					<0.0002	<0.01	0.0019	0.0005	7	7	100%
Silver, total													n/a	n/a	n/a	n/a	0	0	n/a
Thallium, dissolved	<0.05	<0.001	<0.001	<0.001	<0.001		<0.001	<0.001			<0.001	<0.001	<0.001	<0.05	0.0032	0.0005	9	9	100%
Vanadium, dissolved	<0.005	<0.01	<0.01	<0.01	<0.01		<0.01	<0.01					<0.005	<0.01	0.0046	0.005	7	7	100%
Thallium, total													n/a	n/a	n/a	n/a	0	0	n/a
Zinc, dissolved	<0.005	<0.005	<0.005	<0.005			<0.01	<0.01			<0.01	<0.01	<0.005	<0.01	0.004	0.00375	8	8	100%
Zinc, total													n/a	n/a	n/a	n/a	0	0	n/a
Uranium, dissolved	0.0046	0.0049	0.0052	0.0036	0.0053	0.0052	0.0014	0.0015	0.0021	0.0019	0.003		0.0014	0.0053	0.004	0.0036	11	0	0%
Uranium, suspended													n/a	n/a	n/a	n/a	0	0	n/a
Uranium, total													n/a	n/a	n/a	n/a	0	0	n/a
Thorium-228, dis. (pCi/L)	0						0	0					0	0	0	0	3	0	0%
Thorium-230, dis. (pCi/L)	0.2						<0.1	0					0	0.2	0.083	0.05	3	1	33%
Thorium-232, dis. (pCi/L)	0.1						0	0.1					0	0.1	0.067	0.1	3	0	0%
Radium-226, dis. (pCi/L)	0.3	0.4	0.9	0.2			0.2	0.1			0.3		<0.1	<0.9	0.343	0.3	7	0	0%
Radium-226, susp. (pCi/L)													n/a	n/a	n/a	n/a	0	0	n/a
Radium-226, total (pCi/L)													n/a	n/a	n/a	n/a	0	0	n/a
Gross Alpha, dis. (pCi/L)	3.3	3.4	5.5	5.9			1.6	1.6			1.7		<1.6	5.9	3.3	3.3	7	0	0%
Gross Beta, dis. (pCi/L)	2.2	1.9	0.9	1.9			<5.	<5.			<5.		0.9	<5.	2.1	2.2	7	3	43%

NOTES: Mean and median statistic calculated using one-half detection limit (1/2 D.L.)
ND = number of non-detects
Results are in mg/L unless otherwise noted

TABLE 24. WATER QUALITY IN RALSTON CREEK
1998 - 2007
STATION SW-BOS

	SW-BOS 10/20/98	SW-BOS 11/23/98	SW-BOS 12/16/98	SW-BOS 1/18/99	SW-BOS 2/16/99	SW-BOS 3/16/99	SW-BOS 4/20/99	SW-BOS 5/17/99	SW-BOS 6/15/99	SW-BOS 7/21/99	SW-BOS 9/13/99	MIN	MAX	MEAN	MEDIAN	COUNT	ND	% ND
pH (std units)	8.7	8.1	7.6	7.4	8.4	7.7	7.8	7.2	7.7	7.7		7.2	8.7	7.8	7.7	10	0	0%
Conductivity (umhos)	477	467	497	356	808	391	276	139	192	388		139	808	399	390	10	0	0%
Total dissolved solids	306	309	330	221	534	316	180	117	138	252		117	534	270	279	10	0	0%
Total suspended solids	4	3	2	3	2	1	503	5	11.3	<10.		1	503	53.9	3.5	10	1	10%
Hardness, total	150	150	150	120								120	150	142.5	150	4	0	0%
Carbonate												n/a	n/a	n/a	n/a	0	0	n/a
Bicarbonate												n/a	n/a	n/a	n/a	0	0	n/a
Alkalinity, Dissolved							66	40	61	98		40	98	66.25	63.5	4	0	0%
Alkalinity, total	150	100	97	82	140	83	66	40				40	150	94.75	90	8	0	0%
Nitrate Nitrogen	0.4	1.8	1.7	0.8	2.5	0.4	0.5	<0.1	<0.5	<0.5	<0.5	<0.1	2.5	0.8	0.4	11	4	36%
Ammonia, total	0	0	0	0	0	0	0	<1.	<1.	<1.		0	<1.	0.15	0	10	10	100%
Calcium	35	34	33	28	48			13.8		31.1	32	13.8	48	31.9	32.5	8	0	0%
Sodium, dissolved	44	39	44	28	72			8.9		31.5	28.8	8.9	72	37.0	35.3	8	0	0%
Magnesium, dissolved	15	15	16	11	19			4.4		12.8	12.9	4.4	19	13.3	14.0	8	0	0%
Potassium, dissolved	2.8	2.4	2.5	2	3.6			1.2		2.3	2.1	1.2	3.6	2.4	2.4	8	0	0%
Sulfate	120	120	130	77	240	89	54	15	22	78		15	240	94.5	83.5	10	0	0%
Fluoride, total	0.6	0.5	0.5	0.4	0.9							0.4	0.9	0.6	0.5	5	0	0%
Chloride	20	13	14	13	20	15	13	10	11	15		10	20	14.4	13.5	10	0	0%
Phosphorous												n/a	n/a	n/a	n/a	0	0	n/a
Aluminum, dissolved	<0.5	<0.5	<0.5	<0.5				0.3				0.3	<0.5	0.260	0.25	5	4	80%
Aluminum, total												n/a	n/a	n/a	n/a	0	0	n/a
Antimony, dissolved	<0.03	<0.008	0.005	<0.003	<0.003			<0.006		<0.006	<0.006	<0.003	<0.03	0.0045	0.003	8	7	88%
Antimony, total												n/a	n/a	n/a	n/a	0	0	n/a
Arsenic, dissolved	<0.05	<0.003						<0.005		<0.005	<0.005	<0.003	<0.05	0.0068	0.0025	5	5	100%
Arsenic, total			<0.003	<0.003	<0.003							<0.003	<0.003	0.0015	0.0015	3	3	100%
Barium, dissolved	0.04	0.04						<0.1		<0.1	<0.1	0.04	<0.1	0.046	0.05	5	3	60%
Barium, total			0.03	0.03	0.04							0.03	0.04	0.033	0.03	3	0	0%
Beryllium, dissolved	<0.001	<0.002	<0.002	<0.002	<0.002			<0.001		<0.001	<0.001	<0.001	<0.002	0.0008	0.00075	8	8	100%
Boron, total								<0.05		0.07	0.05	<0.05	0.07	0.048	0.05	3	1	33%
Cadmium, dissolved	<0.002	<0.0002	<0.0002	<0.0002	<0.001			<0.001				<0.0002	<0.002	0.0004	0.0003	6	6	100%
Chromium, dissolved	<0.005	<0.005	<0.005	<0.005	<0.005			<0.005				<0.005	<0.005	0.0025	0.0025	6	6	100%
Cyanide, total											<0.01	<0.01	<0.01	0.0050	0.005	1	1	100%
Copper												n/a	n/a	n/a	n/a	0	0	n/a
Copper, dissolved	<0.02	<0.02	<0.02	<0.02				<0.005		<0.005	<0.005	<0.005	<0.02	0.0068	0.01	7	7	100%
Copper, total												n/a	n/a	n/a	n/a	0	0	n/a
Iron, dissolved	<0.03	<0.03	<0.03	0.03				0.2		<0.1		<0.03	0.2	0.054	0.0225	6	4	67%
Iron, total												n/a	n/a	n/a	n/a	0	0	n/a
Iron, suspended												n/a	n/a	n/a	n/a	0	0	n/a
Iron, Ferrous (Fe2+)												n/a	n/a	n/a	n/a	0	0	n/a
Iron, Ferric (Fe3+)												n/a	n/a	n/a	n/a	0	0	n/a
Lead, dissolved	<0.05	<0.002						<0.005		<0.005	<0.005	<0.002	<0.05	0.0067	0.0025	5	5	100%
Lead, total			<0.002	0.003	<0.002							<0.002	0.003	0.0017	0.001	3	2	67%
Manganese, dissolved	<0.01	<0.01	<0.01	<0.01				<0.01				<0.01	<0.01	0.005	0.005	5	5	100%
Manganese, total												n/a	n/a	n/a	n/a	0	0	n/a
Mercury, dissolved	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002							<0.0002	<0.0002	0.0001	0.0001	5	5	100%
Mercury, total												n/a	n/a	n/a	n/a	0	0	n/a
Molybdenum, dissolved	0.198	0.23	0.21	0.11	0.5			0.014		0.094	0.081	0.014	0.5	0.180	0.154	8	0	0%
Nickel, dissolved	<0.02	<0.04	<0.04	<0.04	<0.04			<0.01		<0.01	<0.01	<0.01	<0.04	0.0131	0.015	8	8	100%
Selenium, dissolved	<0.05	<0.005	<0.005	<0.005	<0.005			<0.01		<0.01	<0.01	<0.005	<0.05	0.006	0.00375	8	8	100%
Silver, dissolved	<0.005	<0.001	<0.0002	<0.0002	<0.0002			<0.01				<0.0002	<0.01	0.001	0.0003	6	6	100%
Silver, total												n/a	n/a	n/a	n/a	0	0	n/a
Thallium, dissolved	<0.05	<0.001	<0.001	<0.001	<0.001			<0.001		<0.001	0.002	<0.001	<0.05	0.0038	0.0005	8	7	88%
Vanadium, dissolved	<0.005	<0.01	<0.01	<0.01	<0.01			<0.01				<0.005	<0.01	0.005	0.005	6	6	100%
Thallium, total												n/a	n/a	n/a	n/a	0	0	n/a
Zinc, dissolved	<0.005	<0.005	<0.005	<0.005				<0.01		<0.01	<0.01	<0.005	<0.01	0.0036	0.0025	7	7	100%
Zinc, total												n/a	n/a	n/a	n/a	0	0	n/a
Uranium, dissolved	0.0059	0.0075	0.0119	0.0034	0.0052	0.0031	0.0047	0.0017		0.0029		0.0017	0.0119	0.0051	0.0047	9	0	0%
Uranium, suspended												n/a	n/a	n/a	n/a	0	0	n/a
Uranium, total												n/a	n/a	n/a	n/a	0	0	n/a
Thorium-228, dis. (pCi/L)	0							0.1				0	0.1	0.05	0.05	2	1	50%
Thorium-230, dis. (pCi/L)	0							0.1				0	0.1	0.05	0.05	2	1	50%
Thorium-232, dis. (pCi/L)	0							0				0	0	0	0	2	2	100%
Radium-226, dis. (pCi/L)	0.3	0.3	1.5	0.3				0.2		0.4		0.2	1.5	0.5	0.3	6	0	0%
Radium-226, susp. (pCi/L)												n/a	n/a	n/a	n/a	0	0	n/a
Radium-226, total (pCi/L)												n/a	n/a	n/a	n/a	0	0	n/a
Gross Alpha, dis. (pCi/L)	4.2	5.7	11	5.1				1.6		2.6		1.6	11	5.03	4.65	6	0	0%
Gross Beta, dis. (pCi/L)	4.6	2.9	11	0.8				<5.		<5.		0.8	11	4.05	2.7	6	2	33%

NOTES: Mean and median statistic calculated using one-half detection limit (1/2 D.L.)
ND = number of non-detects
Results are in mg/L unless otherwise noted

TABLE 24. WATER QUALITY IN RALSTON CREEK
1998 - 2007
STATION SW-GS

	SW-GS 10/20/98	SW-GS 11/23/98	SW-GS 12/17/98	SW-GS 1/18/99	SW-GS 2/16/99	SW-GS 3/16/99	SW-GS 4/19/99	SW-GS 7/21/99	SW-GS 9/13/99	MIN	MAX	MEAN	MEDIAN	COUNT	ND	% ND
pH (std units)	8	8.1	8	7.4	8.3	7.8	7.7	7.6		7.4	8.3	7.9	7.9	8	0	0%
Conductivity (umhos)	468	452	376	357	808	408	284	287		284	808	430	392	8	0	0%
Total dissolved solids	303	301	245	218	542	328	186	180		180	542	288	273	8	0	0%
Total suspended solids	4	5	1	3	<1.	1	43.4	<10.		<1.	43.4	7.9	3.5	8	2	25%
Hardness, total	150	140	120	110						110	150	130	130	4	0	0%
Carbonate										n/a	n/a	n/a	n/a	0	0	n/a
Bicarbonate										n/a	n/a	n/a	n/a	0	0	n/a
Alkalinity, Dissolved							70	87		70	87	78.5	78.5	2	0	0%
Alkalinity, total	120	120	140	84	130	82	70			70	140	107	120	7	0	0%
Nitrate Nitrogen	0.8	1.8	0.8	0.8	2.9	0.4	0.5	0.8	<0.5	0.4	2.9	1.0	0.8	9	1	11%
Ammonia, total	0	0	0	0	0	0	0	<1.		0	<1.	0.063	0	8	1	13%
Calcium	35	33	29	28	48			26.9	32	26.9	48	33.1	32	7	0	0%
Sodium, dissolved	44	38	29	28	69			19.3	27.8	19.3	69	36.4	29	7	0	0%
Magnesium, dissolved	15	15	11	11	20			9.5	12.5	9.5	20	13.4	12.5	7	0	0%
Potassium, dissolved	2.7	2.3	2	2	3.7			1.6	2.1	1.6	3.7	2.3	2.1	7	0	0%
Sulfate	120	110	79	79	240	89	54	41		41	240	102	84	8	0	0%
Fluoride, total	0.6	0.5	0.4	0.4	0.9					0.4	0.9	0.6	0.5	5	0	0%
Chloride	18	15	14	13	22	14	13	13		13	22	15.3	14	8	0	0%
Phosphorous										n/a	n/a	n/a	n/a	0	0	n/a
Aluminum, dissolved	<0.5	<0.5	<0.5	0.5						<0.5	<0.5	0.3125	0.25	4	4	100%
Aluminum, total										n/a	n/a	n/a	n/a	0	0	n/a
Antimony, dissolved	0.03	<0.008	<0.003	<0.003	0.011			<0.006	<0.006	<0.003	<0.03	0.0077	0.003	7	6	86%
Antimony, total										n/a	n/a	n/a	n/a	0	0	n/a
Arsenic, dissolved	0.05	<0.003						<0.005	<0.005	<0.003	<0.05	0.0141	0.0025	4	4	100%
Arsenic, total			<0.003	<0.003	<0.003					<0.003	<0.003	0.0015	0.0015	3	3	100%
Barium, dissolved	0.04	0.04						<0.1	<0.1	0.04	<0.1	0.045	0.045	4	2	50%
Barium, total			0.03	0.03	0.04					0.03	0.04	0.0333	0.03	3	0	0%
Beryllium, dissolved	0.001	<0.002	<0.002	<0.002	<0.002			<0.001	<0.001	<0.001	<0.002	0.0009	0.001	7	7	100%
Boron, total								<0.05	0.05	<0.05	0.05	0.0375	0.0375	2	1	50%
Cadmium, dissolved	0.002	<0.0002	<0.0002	<0.0002	<0.001					<0.0002	<0.002	0.001	0.0001	5	5	100%
Chromium, dissolved	0.005	<0.005	<0.005	<0.005	<0.005					<0.005	<0.005	0.003	0.0025	5	5	100%
Cyanide, total									<0.01	<0.01	<0.01	0.0050	0.005	1	1	100%
Copper										n/a	n/a	n/a	n/a	0	0	n/a
Copper, dissolved	<0.02	<0.02	<0.02	0.02				<0.005	<0.005	<0.005	<0.02	0.01	0.01	6	6	100%
Copper, total										n/a	n/a	n/a	n/a	0	0	n/a
Iron, dissolved	0.04	<0.03	<0.03	0.03				<0.1		<0.03	<0.1	0.030	0.03	5	4	80%
Iron, total										n/a	n/a	n/a	n/a	0	0	n/a
Iron, suspended										n/a	n/a	n/a	n/a	0	0	n/a
Iron, Ferrous (Fe2+)										n/a	n/a	n/a	n/a	0	0	n/a
Iron, Ferric (Fe3+)										n/a	n/a	n/a	n/a	0	0	n/a
Lead, dissolved	0.05	<0.002						<0.005	<0.005	<0.002	<0.05	0.0140	0.0025	4	4	100%
Lead, total			<0.002	<0.002	<0.002					<0.002	<0.002	0.001	0.001	3	3	100%
Manganese, dissolved	<0.01	<0.01	<0.01	0.01						<0.01	<0.01	0.006	0.005	4	4	100%
Manganese, total										n/a	n/a	n/a	n/a	0	0	n/a
Mercury, dissolved	0.0002	<0.0002	<0.0002	<0.0002	<0.0002					<0.0002	<0.0002	0.0001	0.0001	5	5	100%
Mercury, total										n/a	n/a	n/a	n/a	0	0	n/a
Molybdenum, dissolved	0.195	0.22	0.13	0.11	0.51			0.043	0.08	0.043	0.51	0.184	0.13	7	0	0%
Nickel, dissolved	0.02	<0.04	<0.04	<0.04	<0.04			<0.01	<0.01	<0.01	<0.04	0.016	0.02	7	7	100%
Selenium, dissolved	0.05	<0.005	<0.005	<0.005	<0.005			<0.01	<0.01	<0.005	<0.05	0.0100	0.0025	7	7	100%
Silver, dissolved	0.005	<0.001	<0.0002	<0.0002	<0.0002					<0.0002	<0.005	0.0012	0.0001	5	5	100%
Silver, total										n/a	n/a	n/a	n/a	0	0	n/a
Thallium, dissolved	0.05	<0.001	<0.001	<0.001	<0.001			<0.001	<0.001	<0.001	<0.05	0.007571	0.0005	7	7	100%
Vanadium, dissolved	0.005	<0.01	<0.01	<0.01	<0.01					<0.005	<0.01	0.0050	0.005	5	5	100%
Thallium, total										n/a	n/a	n/a	n/a	0	0	n/a
Zinc, dissolved	0.005	<0.005	<0.005	0.005				<0.01	<0.01	<0.005	<0.01	0.004	0.005	6	5	83%
Zinc, total										n/a	n/a	n/a	n/a	0	0	n/a
Uranium, dissolved	0.0076	0.0046	0.0062	0.0045	0.0051	0.0037	0.0038	0.0046		0.0037	0.0076	0.005	0.0046	8	0	0%
Uranium, suspended										n/a	n/a	n/a	n/a	0	0	n/a
Uranium, total										n/a	n/a	n/a	n/a	0	0	n/a
Thorium-228, dis. (pCi/L)	0									0	0	0	0	1	0	0%
Thorium-230, dis. (pCi/L)	0									0	0	0	0	1	0	0%
Thorium-232, dis. (pCi/L)	0									0	0	0	0	1	0	0%
Radium-226, dis. (pCi/L)	0.4	0.3	0.9	0.4				0.7		0.3	0.9	0.54	0.4	5	0	0%
Radium-226, susp. (pCi/L)										n/a	n/a	n/a	n/a	0	0	n/a
Radium-226, total (pCi/L)										n/a	n/a	n/a	n/a	0	0	n/a
Gross Alpha, dis. (pCi/L)	2.2	3.8	7.6					3.8		2.2	7.6	4.35	3.8	4	0	0%
Gross Beta, dis. (pCi/L)	2.2	2	1.5					<5.		1.5	<5.	2.05	2.1	4	1	25%

NOTES: Mean and median statistic calculated using one-half detection limit (1/2 D.L.)
ND = number of non-detects
Results are in mg/L unless otherwise noted

TABLE 24. WATER QUALITY IN RALSTON CREEK
1998 - 2007
STATION SW-BPL

	SW-BPL 10/20/98	SW-BPL 11/19/98	SW-BPL 12/17/98	SW-BPL 1/19/99	SW-BPL 2/15/99	SW-BPL 3/15/99	SW-BPL 4/19/99	SW-BPL 5/17/99	SW-BPL 6/14/99	SW-BPL 7/14/99	SW-BPL 9/13/99	SW-BPL 12/21/00	SW-BPL 12/21/00	SW-BPL 1/29/01	SW-BPL 1/29/01	SW-BPL 2/28/01	SW-BPL 2/28/01	SW-BPL 3/27/01	SW-BPL 3/27/01	SW-BPL 4/18/01	SW-BPL 4/18/01
pH (std units)	8.0	8.7	7.6	7.6	8.4	7.8	7.7	7.2	7.5	7.8			7.8		7.6		7.9		7.5		8.1
Conductivity (umhos)	479	478	453	406	599	412	196	141	184	282			328		462		318		256		204
Total dissolved solids	310	322	324	242	385	299	126	114	140	194			172		268		200		129		100
Total suspended solids	6	3	<1.	3	<1.	1	4	4	<10.	14.1			<10.		<10.		10		<10.		1
Hardness, total	150	150	120	120									<10.		<10.		<10.		<10.		<1.
Carbonate													79		88		71		65		45
Bicarbonate																					
Alkalinity, Dissolved							85	39	51	83			79		88		71		65		45
Alkalinity, total	120	100	110	98	110	85	85	39													
Nitrate Nitrogen	0.4	1.8	1.3	0.8	1.7	0.8	<0.1	3.8		<0.5	<0.5										
Ammonia, total	0	0	0	0	0	0	0	<1.	<1.	<1.											
Calcium	35	35	32	28	41								27	43.4		31.2		23.7		18.1	
Sodium, dissolved	44	38	38	34	40			9		20	26.9		6	18.6		13.8		12.1		9.4	
Magnesium, dissolved	15	16	10	13	14			4.3		8.9	12.3		10	15.4		10.1		7.3		5.7	
Potassium, dissolved	2.8	2.5	2.3	2.1	3			1.2		1.9	2.1		1.5	2.2		1.7		1.5		1.4	
Sulfate	120	120	110	91	160	91	27	17	19	42			54	106	110	52.4	54	30	45	20.7	26
Fluoride, total	0.6	0.5	0.5	0.5	0.7																
Chloride	19	15	14	13	15	14	12	10	12	14			22	23.7	26	14.4	19	19.4	27	16.3	19
Phosphorous																					
Aluminum, dissolved	<0.5	<0.5	<0.5	<0.5				0.3					<0.2	<0.2		<0.2		<0.2		<0.2	
Aluminum, total																					
Antimony, dissolved	<0.03	<0.008	0.003	<0.003	0.009			<0.006		<0.006	<0.006	<0.001		0.002		0.001		<0.001		<0.001	
Antimony, total																					
Arsenic, dissolved	<0.05	<0.003						0.005		<0.005	0.005										
Arsenic, total			<0.003	<0.003	<0.003																
Barium, dissolved	0.04	0.03						<0.1		<0.1	<0.1										
Barium, total			0.03	0.02	0.04																
Beryllium, dissolved	<0.001	<0.002	<0.002	<0.002	<0.002			0.002		<0.001	0.001										
Boron, total								<0.05		<0.05	<0.05										
Cadmium, dissolved	<0.002	<0.0002	<0.0002	<0.001	<0.0002			<0.001													
Chromium, dissolved	<0.005	<0.005	<0.005	<0.005	<0.005			<0.005													
Cyanide, total											<0.01										
Copper												<0.005		<0.005		<0.005		<0.005		<0.005	
Copper, dissolved	<0.02	<0.02	<0.02	<0.02				<0.005		<0.005	<0.005										
Copper, total																					
Iron, dissolved	<0.03	<0.03	<0.03	<0.03				0.2		<0.1		<0.03		<0.03		<0.03		<0.03		0.03	
Iron, total																					
Iron, suspended																					
Iron, Ferrous (Fe2+)																					
Iron, Ferric (Fe3+)																					
Lead, dissolved	<0.05	<0.002						<0.005		<0.005	<0.005										
Lead, total			<0.002	<0.002	<0.002																
Manganese, dissolved	<0.01	0.01	<0.01	<0.01				<0.01				<0.01		<0.01		<0.01		<0.01		<0.01	
Manganese, total																					
Mercury, dissolved	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002																
Mercury, total																					
Molybdenum, dissolved	0.204	0.22	0.17	0.13	0.33			0.009		0.057	0.076		<0.005		0.022		0.026		0.011		<0.002
Nickel, dissolved	<0.02	<0.04	<0.04	<0.04	<0.04			<0.01		<0.01	<0.01	-									
Selenium, dissolved	<0.05	<0.005	<0.005	<0.005	<0.005			<0.01		<0.01	<0.01										
Silver, dissolved	<0.005	<0.001	<0.0002	<0.0002	<0.0002			<0.01													
Silver, total																					
Thallium, dissolved	<0.05	<0.001	<0.001	<0.001	<0.001			<0.001		<0.001	<0.001	<0.001		<0.001		<0.001		<0.001		<0.001	
Vanadium, dissolved	<0.005	<0.01	<0.01	<0.01	<0.01			<0.01													
Thallium, total																					
Zinc, dissolved	<0.005	<0.005	<0.005	<0.005				<0.01		<0.01	<0.01										
Zinc, total																					
Uranium, dissolved	0.0142	0.0062	0.0042	0.0047	0.0048	0.0037	0.0034	0.0024	0.002	0.0033		0.021	0.0165	0.072	0.04	0.021	0.017	0.0096	0.038	0.0048	
Uranium, suspended		0.0003		0.0001	0.0001	0.0001	0.0003	<0.002	<0.002	<0.002			0.002				0.002		0.002		
Uranium, total																					
Thorium-228, dis. (pCi/L)	0							0.1													
Thorium-230, dis. (pCi/L)	0							0.1													
Thorium-232, dis. (pCi/L)	0							0													
Radium-226, dis. (pCi/L)	0.3	0.6	0.5				0.2	0.2	0	0.5			0.7		1.4		0.8		0.8		0.6
Radium-226, susp. (pCi/L)		0		0			0	0.1	0				0		0		0		0		0
Radium-226, total (pCi/L)																					
Gross Alpha, dis. (pCi/L)	9.4	7.1	5.1					2.1		3.1											
Gross Beta, dis. (pCi/L)	9	3.6	0.2					<5.		<5.											

	SW-BPL 5/29/01	SW-BPL 5/29/01	SW-BPL 6/19/01	SW-BPL 7/11/01	SW-BPL 8/24/01	SW-BPL 9/17/01	SW-BPL 10/24/01	SW-BPL 11/27/01	SW-BPL 12/18/01	SW-BPL 1/22/02	SW-BPL 2/26/02	SW-BPL 3/26/02	SW-BPL 4/24/02	SW-BPL 5/28/02	SW-BPL 6/25/02
pH (std units)															
Conductivity (umhos)	126		156	169	248	195	208	160	171	212	291	176	155	159	366
Total dissolved solids															
Total suspended solids															
Hardness, total															
Carbonate	51		79	87	97	93.3	95.8	86	88.5	95.2	109	73.8	73.8	65.9	124
Bicarbonate															
Alkalinity, Dissolved	43		65	71	80	77	79	71	73	78	90	61	61	54	102
Alkalinity, total															
Nitrate Nitrogen															
Ammonia, total	18.2		30	28.9	40	32	36.6	34.4	34	44.2	52.8	31.2	30.2	26.8	63.1
Calcium	9.1		13.6	14.2	15	15	16	14.6	14.3	17.8	20.8	15.5	13.7	12.9	24.8
Sodium, dissolved	5.6		9.7	9.3	13	10	11.1	10.2	10	13.6	17	8.94	8.7	8.91	8.91
Magnesium, dissolved	1.5		1.9	1.7	2.3	1.9	2.16	1.8	1.7	2.53	2.26	1.81	2.32	1.8	3.51
Potassium, dissolved	51		40.5	35.1	56	36	41.1	35.7	43.9	71.4	108	38.2	35.5	35.9	134
Sulfate															
Fluoride, total	21.8		21.5	17.3	30	27	36.5	31	27.9	41.6	34	32.2	28.9	29	35.6
Chloride	<1.		<1.												
Phosphorous	<0.01		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.2	<0.2	<0.2
Aluminum, dissolved			<0.1	<0.1	<0.1	<0.1	0.007	<0.1	<0.1	<0.1	0.07	<0.2	<0.2	<0.2	<0.2
Aluminum, total	<0.01		<0.001	<0.05	<0.05	<0.05	<0.001	<0.05	<0.05	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Antimony, dissolved	<0.05		<0.001	<0.05	<0.05	<0.05	<0.001	<0.05	<0.05	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Antimony, total	<0.05		<0.001	<0.05	<0.05	<0.05	<0.001	<0.05	<0.05	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic, dissolved	<0.001		<0.001	<0.001											
Arsenic, total	<0.001		<0.001	<0.001	<0.001	<0.001	<0.01	<0.001	<0.001	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Barium, dissolved															
Barium, total															
Beryllium, dissolved															
Boron, total															
Cadmium, dissolved															
Chromium, dissolved															
Cyanide, total															
Copper	<0.01		<0.005	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.007	<0.005	0.012	0.006
Copper, dissolved	<0.01		<0.005	<0.01	<0.01	<0.01	<0.001	<0.01	<0.01	0.002	<0.001	<0.005	<0.005	<0.005	<0.005
Copper, total	<0.03		<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Iron, dissolved							<0.03	0.04	<0.03	0.038	0.121	0.034	0.181	0.062	0.187
Iron, total	0.1		0.05	0.07	0.04	0.04		0.04	<0.03						
Iron, suspended										0.038	0.12	0.034	0.181	0.035	0.187
Iron, Ferrous (Fe2+)															
Iron, Ferric (Fe3+)	<0.05		<0.005	<0.05											
Lead, dissolved	<0.05		<0.005	<0.05	<0.05	<0.05	<0.001	<0.05	<0.05	<0.001	<0.001	<0.005	<0.005	<0.005	<0.005
Lead, total	<0.01		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.02	0.04
Manganese, dissolved	<0.01		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.02	0.06
Manganese, total	<0.001		<0.0001	<0.001											
Mercury, dissolved	<0.001		<0.001	<0.001	<0.001	<0.001	<0.0001	<0.001	<0.001	0.0043	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Mercury, total	<0.1		0.0156	<0.1	<0.1	<0.1	0.0226	<0.1	<0.1	0.0354	0.0341	0.008	0.01	0.006	0.027
Molybdenum, dissolved															
Nickel, dissolved															
Selenium, dissolved	<0.01		<0.0001	<0.01											
Silver, dissolved	<0.01		<0.0001	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.015	<0.001	<0.001	<0.001	<0.001	<0.001
Silver, total	<0.001		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Thallium, dissolved	<0.001		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Vanadium, dissolved	<0.01		0.015	0.02											
Thallium, total	0.04		<0.005	0.05	0.01	<0.01	<0.01	<0.01	<0.01	0.016	<0.005	<0.005	<0.005	0.031	0.022
Zinc, dissolved	0.0037	0.0249	0.0105	0.008	0.0095	0.0067	0.009	0.0071	0.0116	0.0304	0.0908	0.0317	0.0504	0.024	0.0591
Zinc, total		0.0017	<0.0003	0.0004	<0.0003	0.0005	0.61	0.0022	0.0002	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003
Uranium, dissolved															
Uranium, suspended															
Uranium, total															
Thorium-228, dis. (pCi/L)															
Thorium-230, dis. (pCi/L)															
Thorium-232, dis. (pCi/L)	0.4	0.9	1.4	1	1.5	1.3	0.8	<0.2	<0.2	1.1	0.7	<0.2	0.6	<0.2	1.5
Radium-226, dis. (pCi/L)		0.1	<0.2	0.1	<2.	0.4	0.7	<0.2	<0.2	<0.2	0.6	<0.2	2.3	<0.2	<0.2
Radium-226, susp. (pCi/L)															
Radium-226, total (pCi/L)															
Gross Alpha, dis. (pCi/L)															
Gross Beta, dis. (pCi/L)															

NOTES: Mean and median statistic calculated using one-half detection limit (1/2 D.L.)
ND = number of non-detects
Results are in mg/L unless otherwise noted

TABLE 24. WATER QUALITY IN RALSTON CREEK
1998 - 2007
STATION SW-BPL

	SW-BPL 12/31/02	SW-BPL 12/31/02	SW-BPL 1/31/03	SW-BPL 2/27/03	SW-BPL 2/27/03	SW-BPL 3/26/03	SW-BPL 3/26/03	SW-BPL 4/29/03	SW-BPL 5/22/03	SW-BPL 6/23/03	SW-BPL 7/29/03	SW-BPL 7/31/03	SW-BPL 7/31/03	SW-BPL 9/26/03	SW-BPL 9/26/03	SW-BPL 10/31/03	SW-BPL 10/31/03	SW-BPL 11/25/03	SW-BPL 11/25/03	SW-BPL 12/16/03	SW-BPL 12/16/03	SW-BPL 1/23/04	SW-BPL 1/23/04	SW-BPL 1/23/04	SW-BPL 2/25/04	SW-BPL 3/30/04	SW-BPL 3/30/04	SW-BPL 3/30/04	SW-BPL 4/28/04	SW-BPL 5/31/04	SW-BPL 6/29/04	SW-BPL 7/29/04	SW-BPL 8/30/04	SW-BPL 9/29/04	SW-BPL 10/29/04	SW-BPL 11/30/04
pH (std units)																																			
Conductivity (umhos)																																			
Total dissolved solids	527		461	376				73	74	155	382	259			268		207		190		202		138		145		143		148	211	146	159	124	145	119	159
Total suspended solids																																			
Hardness, total																																			
Carbonate																																			
Bicarbonate	145		140	108				32.3	41.5	69.5	150	121			100		92		80		72		37		62		54		43	82	92	61	58	73	62	64
Alkalinity, Dissolved																																			
Alkalinity, total	119		115	89				27	34	57	123	100			100		92		80		72		41		65		54		35	67	75	50	48	60	51	52
Nitrate Nitrogen																																			
Ammonia, total																																			
Calcium	91.7		78.9	58.5		30.5		11.1	11.9	23.9	67.6	39			43		37		32		35		34		30		28		18.7	31.7	29.2	23.5	20.4	23.2		
Sodium, dissolved	24.5		33.6	19.4		15.6		7.46	7.81	7.31	15.3	11.3			10		12		10		6		17		21		12		9.5	12.6	12.6	10.7	9.9	12.2		
Magnesium, dissolved	30		26.3	18.6		8.79		4.49	4.68	6.84	21.6	11.9			14		11		7.8		8.7		9.3		4.3		8		5.5	9.2	8	6.6	6.2	7.9	9.7	11.3
Potassium, dissolved	4.05		4.77	3.23		1.97		1.64	2.15	1.66	4.04	2.63			3.1		3.1		3.1		2.4		9.3		4.3		3.1		1.4	1.8	1.6	1.3	1.5	1.9		
Sulfate	196		170	132		51.6		17.1	16.5	22	151	59.4			64		44		37		34		34		36		28		17	31	22	12	15	17	15	20
Fluoride, total																																			
Chloride	35.6		34.7	24.2		23.1		15	13.5	20.9	21.2	18			26		27		28		31		22		22		26		22	25	27	27	23	29		26
Phosphorous																																			
Aluminum, dissolved	<0.2		<0.2	<0.2		<0.2		<0.2	<0.2	<0.2	<0.2	<0.2		<0.2		<0.2		<0.2		<0.2		<0.2					<0.2		<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Aluminum, total	<0.2		<0.2	<0.2		<0.2		0.38	0.33	<0.2	<0.2	<0.2		<0.2		<0.2		<0.2		<0.2		<0.2					<0.2		0.4	<0.2	<0.2	0.5	<0.2	<0.2	<0.1	<0.1
Antimony, dissolved	<0.001		<0.001	<0.001		<0.001		<0.001	<0.001	<0.001	<0.001	<0.001		<0.001		<0.001		<0.001		<0.001		<0.001					<0.001		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Antimony, total	<0.001		<0.001	<0.001		<0.001		<0.001	<0.001	<0.001	<0.001	<0.001		<0.001		<0.001		<0.001		<0.001		<0.001					<0.001		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.05	<0.05
Arsenic, dissolved																																			
Arsenic, total	<0.01		<0.01	<0.01		<0.01		<0.01	<0.01	<0.01	<0.01	<0.01		<0.01		<0.01		<0.01		<0.01		<0.01					<0.01		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.001	<0.001
Barium, dissolved																																			
Barium, total																																			
Beryllium, dissolved																																			
Boron, total																																			
Cadmium, dissolved																																			
Chromium, dissolved																																			
Cyanide, total																																			
Copper														<0.005		<0.005		<0.005		<0.005		<0.005					<0.005		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.008
Copper, dissolved	<0.005		0.006	<0.005		<0.005		<0.005	<0.005	<0.005	<0.005	<0.005		<0.005		<0.005		<0.005		<0.005		<0.005					<0.005		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.01	<0.01
Copper, total	<0.005		<0.005	<0.005		<0.005		<0.005	<0.005	<0.005	<0.005	<0.005			0.17		<0.03		0.05		<0.03								0.06	<0.03	<0.03	0.07	0.09	0.05	0.07	0.05
Iron, dissolved	<0.03		<0.03	<0.03		<0.03		0.122	0.071	<0.03	<0.03	0.036			0.17		<0.03		<0.03		<0.03								0.74	0.11	0.24	1.2	0.41	0.14	0.24	0.11
Iron, total	<0.03		<0.03	<0.03		<0.03		0.405	0.391	0.167	0.037	0.11																								
Iron, suspended																													0.68	0.11		1.13				<0.06
Iron, Ferrous (Fe2+)																																				
Iron, Ferric (Fe3+)	<0.03		<0.03	<0.03		<0.03		0.283	0.32	0.162	0.037	0.083																								
Lead, dissolved														<0.005		<0.005		<0.005		<0.005		<0.005					<0.005		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.05	<0.05
Lead, total	<0.005		<0.005	<0.005		<0.005		<0.005	<0.005	<0.005	<0.005	<0.005			<0.01		<0.01		<0.01		<0.01								<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Manganese, dissolved	0.04		<0.01	<0.01		<0.01		<0.01	<0.01	<0.01	0.01	<0.01			<0.01		0.02		<0.01		<0.01		<0.01						0.04	<0.01	0.02	0.06	0.01	<0.01	<0.01	<0.01
Manganese, total	<0.01		<0.01	<0.01		<0.01		<0.01	<0.01	<0.01	0.01	<0.01																								
Mercury, dissolved														<0.0001		<0.0001		<0.0001		<0.0001		<0.0001					<0.0001		<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.001	<0.001
Mercury, total	<0.0001		<0.0002	<0.0002		<0.0004		<0.0001	<0.0001	<0.0001	<0.0001	<0.0001			0.041		0.031		0.018		0.02		0.013		0.011		0.014		<0.005	0.009	0.009	<0.005	<0.005	<0.005	<0.005	<0.005
Molybdenum, dissolved	0.041		0.047	0.036		0.005		<0.005	<0.005	0.005	0.045	0.027																								
Nickel, dissolved																																			
Selenium, dissolved														<0.001		<0.001		<0.001		<0.001		<0.001					<0.001		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.01	<0.01
Silver, dissolved																																			
Silver, total	<0.001		<0.004	<0.004		<0.009		<0.001	<0.001	<0.001	<0.001	<0.001		<0.001		<0.001		<0.001		<0.001		<0.001					<0.001		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Thallium, dissolved	<0.001		<0.001	<0.001		<0.001		<0.001	<0.001	<0.001	<0.001	<0.001																								
Vanadium, dissolved														<0.001		<0.001		<0.001		<0.001		<0.001					<0.001		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.1	<0.1
Thallium, total	<0.001		<0.001	<0.001		<0.001		<0.001	<0.001	<0.001	<0.001	<0.001																								
Zinc, dissolved															<0.005		0.007		<0.005		<0.015								0.007	<0.005	<0.005	0.008	<0.005	<0.005	<0.01	<0.01
Zinc, total	0.01		0.013	0.01		0.012		<0.005	0.006	0.008	0.008	0.012																	0.0083	0.0754	0.0012	0.0012	0.0127	0.0205	0.0123	0.0196
Uranium, dissolved	0.521	0.45	0.591	0.378	0.42	0.0646	0.0542	0.0077	0.0131	0.0341		0.212	0.21	0.251	0.25	0.15	0.2	0.102	0.12	0.121	0.12	0.117	0.0993	0.0101	0.0819	0.0343	0.0884	0.0301	0.0007	0.0009	0.0262	0.0112	0.0008	<0.0003	0.0003	<0.0003
Uranium, suspended	<0.0003		<0.0003	<0.0003		<0.0003		<0.0003	<0.0003	<0.0003			<0.002		<0.002		<0.002		<0.002		<0.002		<0.002		<0.002		<0.002									
Uranium, total																																				
Thorium-228, dis. (pCi/L)																																				
Thorium-230, dis. (pCi/L)																													<0.2	1	0.6	0.4	0.5	<0.2	<0.2	0.3
Thorium-232, dis. (pCi/L)																							0.5		0.4		0.4		<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Radium-226, dis. (pCi/L)	0.7		1.3	0.7		0.5		0.4	0.3	0.3			0.9		1.0		1.0		0.4				<0.1		<0.1		<0.1									
Radium-226, susp. (pCi/L)	<0.2		<0.2	0.5		<0.2		<0.2	<0.2	<0.2			<0.1		<0.1		<0.1		<0.1																	
Radium-226, total (pCi/L)																																				
Gross Alpha, dis. (pCi/L)																																				
Gross Beta, dis. (pCi/L)																																				

NOTES: Mean and median statistic calculated using one-half detection limit (1/2 D.L.)
ND = number of non-detects
Results are in mg/L unless otherwise noted

TABLE 24. WATER QUALITY IN RALSTON CREEK
1998 - 2007
STATION SW-BPL

	SW-BPL 12/28/04	SW-BPL 1/25/05	SW-BPL 2/28/05	SW-BPL 3/22/05	SW-BPL 4/21/05	SW-BPL 5/31/05	SW-BPL 6/22/05	SW-BPL 7/31/05	SW-BPL 8/30/05	SW-BPL 10/26/05	SW-BPL 11/30/05	SW-BPL 12/31/05	SW-BPL 1/23/06	SW-BPL 1/31/06	SW-BPL 2/25/06	SW-BPL 2/27/06	SW-BPL 3/29/06	SW-BPL 3/30/06	SW-BPL 4/16/06	SW-BPL 4/28/06	SW-BPL 6/22/06	SW-BPL 8/30/06	SW-BPL 9/26/06	SW-BPL 10/26/06	SW-BPL 11/30/06	SW-BPL 12/16/06	SW-BPL 12/27/06	SW-BPL 3/29/07	SW-BPL 6/27/07	SW-BPL 9/5/07	MIN	MAX	MEAN	MEDIAN	COUNT	ND	% ND
pH (std units)																												7.11			7.11	8.7	7.8	7.75	16	0	0%
Conductivity (umhos)																												180			141	599	336	323	16	0	0%
Total dissolved solids	126	140	146	137	116	82	120	364	304	203	201	180				204												106			73	527	202	171.5	66	0	0%
Total suspended solids																															<1.	14.1	4.5	4	15	6	40%
Hardness, total																															120	150	135	135	4	0	0%
Carbonate																															<1.	<10.	4	5	5	5	100%
Bicarbonate																98												38			32.3	150	80	73.8	56	0	0%
Alkalinity, Dissolved	60	66	68	65	41	44	70	138	145	85	104	60																			39	85	65	67	4	0	0%
Alkalinity, total																												31			27	123	72	71	64	0	0%
Nitrate Nitrogen	49	54	56	53	34	40	58	113	119	70	85	55				80															<0.1	3.8	1.1	0.8	10	3	30%
Ammonia, total																															<0.	1	0.15	0	10	3	30%
Calcium				25		16.6	19.6	58.5	55.5		38.1	26.5	13.9		26	26.4												19.3			11.1	91.7	34	31.2	57	0	0%
Sodium, dissolved				10.6		7	7.7	13.7	12.5		9.7	10.7																10			6	44	15.9	13.6	57	0	0%
Magnesium, dissolved	10	12.3	14.6	7.4	6.4	4.9	5.8	18.2	18.4	12.9	10.5	8.9				14												5.7			4.3	30	10.7	9.7	65	0	0%
Potassium, dissolved				2.3		1	1.1	3.5	3		2	1.4																1.5			1	9.3	2.4	2.1	57	0	0%
Sulfate	19	20	19	18	12	11	13	108	90	51	51	38				47												21			11	196	53.8	38	71	0	0%
Fluoride, total																												22			0.5	0.7	0.6	0.5	5	0	0%
Chloride	24	24	24	28	16	16	18	18	23	26	27	25				24															10	41.6	23.2	23.4	70	0	0%
Phosphorous																															<1.	<1.	0.5	0.5	2	2	100%
Aluminum, dissolved	<0.2	<0.2	<0.2	<0.2	0.6	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2		<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2			<0.01	<0.6	0.110	0.1	74	72	97%
Aluminum, total	<0.1	<0.1	<0.1	<0.1	1	0.4	0.2	<0.1	<0.1	<0.1	<0.1	<0.1				<0.1				0.3								0.4			0.007	1	0.135	0.1	52	41	79%
Antimony, dissolved	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001			<0.001	<0.05	0.0029	0.0005	77	73	95%
Antimony, total	<0.05	<0.05	<0.05	<0.001	<0.05	<0.05	<0.05	<0.05	<0.05	<0.001	<0.05	<0.05				<0.05				<0.05								<0.001			<0.001	<0.05	0.010	0.0005	52	51	98%
Arsenic, dissolved																															<0.001	<0.05	0.0051	0.002	8	6	75%
Arsenic, total	<0.001	<0.001	<0.001	<0.01	<0.001	<0.001	<0.001	<0.001	<0.001	<0.01	<0.001	<0.001				<0.01												<0.1			<0.001	<0.1	0.0041	0.005	54	54	100%
Barium, dissolved																												0.037			0.03	<0.1	0.04283	0.045	6	3	50%
Barium, total																												0.098			0.02	0.098	0.047	0.035	4	0	0%
Beryllium, dissolved																															<0.001	0.002	0.001	0.001	8	6	75%
Boron, total																															<0.05	<0.05	0.025	0.025	3	3	100%
Cadmium, dissolved																															<0.0002	<0.002	0.0004	0.0003	6	6	100%
Chromium, dissolved																															<0.005	<0.005	0.0025	0.0025	6	6	100%
Cyanide, total																															<0.01	<0.01	0.0050	0.005	1	1	100%
Copper																															<0.005	<0.005	0.0025	0.0025	1	1	100%
Copper, dissolved	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.001	<0.001	<0.001	<0.001	0.005	0.001	<0.001		0.001	0.001	0.002	0.001	<0.001	<0.001	<0.001	<0.005			<0.001	<0.02	0.0033	0.0025	75	63	84%
Copper, total	<0.01	<0.01	<0.01	<0.005	<0.01	<0.01	<0.01	<0.01	<0.01	<0.005	<0.01	<0.01				0.001				0.001								<0.005			<0.001	<0.01	0.0033	0.0025	52	48	92%
Iron, dissolved	0.04	<0.03	<0.03	<0.03	0.41	0.12	0.06	0.03	0.06	<0.03	<0.03	<0.03				<0.03												0.06			<0.03	0.41	0.0414	0.015	60	40	67%
Iron, total	0.09	0.05	0.09	0.13	0.34	0.62	0.44	0.08	0.05	<0.03	<0.03	0.04				0.04				0.45								0.5			<0.03	1.2	0.18262	0.09	45	11	24%
Iron, suspended													<0.03	<0.03	<0.03		<0.03	<0.03	<0.03		0.07	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	0.06			<0.03	<0.1	0.0507	0.04	7	1	14%
Iron, Ferrous (Fe2+)																															0.03	0.07	0.02214	0.015	14	12	0.857
Iron, Ferric (Fe3+)	0.05	<0.05	0.07	0.1	<0.03	0.51	0.38	0.05	<0.03	<0.03	<0.03	<0.03				<0.03															<0.03	1.13	0.149	0.044	32	12	38%
Lead, dissolved																<0.005												<0.005			<0.002	<0.05	0.0108	0.0025	8	8	100%
Lead, total	<0.05	<0.05	<0.05	<0.005	<0.05	<0.05	<0.05	<0.05	<0.05	<0.005	<0.05	<0.05				<0.01	0.01	<0.01	<0.01		<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01			<0.001	<0.05	0.0098	0.0025	54	54	100%
Manganese, dissolved	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01				0.02								0.02			<0.01	0.04	0.0067	0.005	72	62	86%
Manganese, total	<0.01	<0.01	<0.01	<0.01	0.05	0.03	0.03	0.02	0.01	<0.01	<0.01	<0.01																			<0.01	0.06	0.0118	0.005	51	36	71%
Mercury, dissolved																<0.0001												<0.0001			<0.0001	<0.001	0.0002	0.0001	8	8	100%
Mercury, total	<0.001	<0.001	<0.001	<0.0001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.0001	<0.001	<0.001																			<0.0001	0.0043	0.0003	0.00005	51	50	98%
Molybdenum, dissolved	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.028	0.028	0.01	0.016	0.009	0.014	0.013	<0.005	0.021	0.048	0.005	0.007	<0.1	<0.005	0.028	0.032	0.01	0.016	0.008	0.018	<0.005			<0.002	0.33	0.0316	0.0140	79	27	34%
Nickel, dissolved																															<0.01	<0.04	0.0131	0.015	8	8	100%
Selenium, dissolved																															<0.005	<0.05	0.006	0.0038	8	8	100%
Silver, dissolved																<0.0005															<0.0001	<0.01	0.0020	0.0005	9	9	100%
Silver, total	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01																<0.001			<0.0001	0.015	0.003	0.0005	51	50	98%
Thallium, dissolved	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001			<0.001	<0.05	0.00082	0.0005	77	77	100%
Vanadium, dissolved																												<0.001			<0.005	<0.01	0.005	0.005	6	6	100%
Thallium, total	<0.1	<0.1	<0.1	<0.001	<0.1	<0.1	<0.1	<0.1	<0.1	<0.001	<0.1	<0.1				<0.001				<0.001											<0.001	<0.1	0.01192	0.0005	52	52	100%
Zinc, dissolved																												<0.005			<0.005	0.02	0.0065	0.005	10	8	80%
Zinc, total	<0.01	<0.01	<0.01	<0.005	<0.01	<0.01	<0.01	<0.01	<0.01	0.006	<0.01	<0.01				0.003															<0.003	<0.05	0.0081	0.005	49	30	61%
Uranium, dissolved	0.0177	0.0181	0.02	0.0204	0.006	0.0074	0.0124	0.248	0.242	0.105	0.155	0.0795	0.11	0.117	0.0197	0.177	0.378	0.0315	0.0551		0.0129	0.236	0.244	0.102	0.151	0.0636	0.165	0.008	0.0312	0.224	0.0012	0.591	0.0878	0.03135	98	0	0%
Uranium, suspended	<0.0003	<0.0003	<0.0003	0.0004	0.0024	0.0008	0.0006	<0.0003	0.0004	<0.0003	0.0003	0.0023				<0.0003				0.0081			0.247					0.001	0.0003		0.0001	0.61	0.0146	0.00035	64	34	53%
Uranium, total																												0.009			0.0081	0.009	0.00855	0.00855	2	0	0
Thorium-228, dis. (pCi/L)																															0	0.1	0.05	0.05	2	0	0%
Thorium-230, dis. (pCi/L)																															0	0.1	0.05	0.05	2	0	0%
Thorium-232, dis. (pCi/L)																															0	0	0	0	2	0	0%
Radium-226, dis. (pCi/L)	0.2	<0.2	<0.2	0.3	<0.2	<0.2	<0.2	0.4	0.5	0.6	1.2	0.5				0.8												<0.2	0.6	<0.2	0	1.5	0.55	0.5	65	14	22%
Radium-226, susp. (pCi/L)	0.3	<0.2	<0.2	<0.1	<0.2	<0.2	<0.2	0.4	<0.2	<0.1	<0.2	<0.2				<0.1												1.4	<0.2		0	2.3	0.19	0.1	61	41	67%
Radium-226, total (pCi/L)																												1.5			1.5	1.5	1.50	1.5	1	0	0%
Gross Alpha, dis. (pCi/L)																															2.1	9.4	5.36	5.1	5	0	0%
Gross Beta, dis. (pCi/L)																															<0.2	9	3.56	2.5	5	2	40%

NOTES: Mean and median statistic calculated using one-half detection limit (1/2 D.L.)
ND = number of non-detects
Results are in mg/L unless otherwise noted

TABLE 24. WATER QUALITY IN RALSTON CREEK
1998 - 2007
STATION SW-FBRG

	SW-FBRG 11/19/98	SW-FBRG 12/17/98	SW-FBRG 1/19/99	SW-FBRG 7/14/99	SW-FBRG 12/21/00	SW-FBRG 1/29/01	SW-FBRG 2/2/01	SW-FBRG 2/6/01	SW-FBRG 2/28/01	SW-FBRG 3/27/01	SW-FBRG 6/19/01	SW-FBRG 7/11/01	SW-FBRG 8/24/01	SW-FBRG 9/17/01	SW-FBRG 10/24/01	SW-FBRG 11/27/01	SW-FBRG 12/19/01	SW-FBRG 1/22/02	SW-FBRG 2/26/02	SW-FBRG 3/26/02	SW-FBRG 4/18/02	SW-FBRG 4/24/02	SW-FBRG 5/28/02	SW-FBRG 5/29/02	SW-FBRG 1/31/03	SW-FBRG 2/26/03	SW-FBRG 3/26/03	SW-FBRG 3/26/03
pH (std units)	8.2	7.3	7.7	7.5																								
Conductivity (umhos)	354	515	561	304										194								141			494			
Total dissolved solids	232	360	335	200																								
Total suspended solids	<1.	2	3	<10.																								
Hardness, total	120	150	170																									
Carbonate														94.6								74.4			126			
Bicarbonate																												
Alkalinity, Dissolved				98										78								61			104			
Alkalinity, total	100	110	120																									
Nitrate Nitrogen	0.9	1.7	1.7	<0.5																								
Ammonia, total	0	0	0	<1.										31.3								30.9			82.5			
Calcium	28	35	36											14.1								13.8			34.8			
Sodium, dissolved	26	46	52											9.8								8.88			27.2			
Magnesium, dissolved	12	16	19											1.4								2.82			4.42			
Potassium, dissolved	2	2.5	2.7											36.8								37.3			192			
Sulfate	72	140	150	43																								
Fluoride, total	0.4	0.6	0.6											26.7								28.1			33.9			
Chloride	11	14	17	14																								
Phosphorous														<0.1								<0.2			<0.2			
Aluminum, dissolved	<0.5	<0.5	<0.5											<0.1								<0.2			<0.2			
Aluminum, total														<0.05								<0.001			<0.001			
Antimony, dissolved	<0.008	0.005	<0.003											<0.05								<0.001			<0.001			
Antimony, total																												
Arsenic, dissolved	<0.003													<0.001								<0.01			<0.01			
Arsenic, total		<0.003	<0.003																									
Barium, dissolved	0.03																											
Barium, total		0.04	0.03																									
Beryllium, dissolved	<0.002	<0.002	<0.002																									
Boron, total																												
Cadmium, dissolved	<0.0002	<0.0002	<0.001																									
Chromium, dissolved	<0.005	<0.005	<0.005																									
Cyanide, total																												
Copper														<0.01								<0.005			0.008			
Copper, dissolved	<0.02	<0.02	<0.02											<0.01								<0.005			<0.005			
Copper, total														<0.03								<0.03			<0.03			
Iron, dissolved	<0.03	<0.03	<0.03																			<0.03			0.039			
Iron, total														0.04														
Iron, suspended																												
Iron, Ferrous (Fe2+)																						<0.03			<0.03			
Iron, Ferric (Fe3+)																												
Lead, dissolved	<0.002													<0.05								<0.005			<0.005			
Lead, total		0.006	<0.002											<0.01								<0.01			<0.01			
Manganese, dissolved	<0.01	<0.01	<0.01											<0.01								<0.01			<0.01			
Manganese, total																												
Mercury, dissolved	<0.0002	<0.0002	<0.0002											<0.001								<0.0001			<0.0002			
Mercury, total														<0.1								<0.011			0.04			
Molybdenum, dissolved	0.12	0.22	0.24																									
Nickel, dissolved	<0.04	<0.04	<0.04																									
Selenium, dissolved	<0.005	<0.005	<0.005																			<0.001			<0.004			
Silver, dissolved	<0.001	<0.0002	<0.0002											<0.01								<0.001			<0.001			
Silver, total														<0.001														
Thallium, dissolved	<0.001	<0.001	<0.001																									
Vanadium, dissolved	<0.01	<0.01	<0.01											<0.001								<0.001			<0.001			
Thallium, total																												
Zinc, dissolved	<0.005	<0.005	<0.005											<0.01								<0.005			0.045			
Zinc, total																												
Uranium, dissolved	0.0062	0.0046	0.0051	0.0049	0.016	0.14	0.0345		0.0245	0.0092	0.0082	0.0098	0.0058	0.0006	0.0112	0.0073	0.0132	0.0252	0.0368	0.0442	0.0034	0.0497	0.0222	0.0034	0.441	0.376	0.0543	0.0546
Uranium, suspended	0.0003	0.0001	0.0001	<0.002	0.002	0.0043			0.002	0.002	<0.0003	0.0003	<0.0003	<0.0003	<0.0003	0.0021		<0.0003	<0.0003	<0.0003	0.0011	<0.0003	<0.0003	0.0004	<0.0003	<0.0003	<0.0003	
Uranium, total								0.0335																				
Thorium-228, dis. (pCi/L)																												
Thorium-230, dis. (pCi/L)																												
Thorium-232, dis. (pCi/L)									1.2	1	1	1.4	1.2	1	0.8	0.6	0.9	0.7	0.6	<0.2	0.5	0.7	<0.2	0.5	1	1	0.4	
Radium-226, dis. (pCi/L)	0.4	0.5			1.1	2.3			0	0	<0.2	0.19	<0.2	<0.2	<0.2	0.2		0.6	0.8	<0.2	0	0.7	<0.2	0	<0.2	<0.2	<0.2	
Radium-226, susp. (pCi/L)	0	0	0		0.1	0.1																						
Radium-226, total (pCi/L)																												
Gross Alpha, dis. (pCi/L)	5.7	420																										
Gross Beta, dis. (pCi/L)	3.8	300																										

NOTES: Mean and median statistic calculated using one-half detection limit (1/2 D.L.)
ND = number of non-detects
Results are in mg/L unless otherwise noted

TABLE 24. WATER QUALITY IN RALSTON CREEK
1998 - 2007
STATION SW-FBRG

	SW-FBRG 4/29/03	SW-FBRG 5/22/03	SW-FBRG 6/23/03	SW-FBRG 7/29/03	SW-FBRG 7/31/03	SW-FBRG 7/31/03	SW-FBRG 9/26/03	SW-FBRG 10/31/03	SW-FBRG 10/31/03	SW-FBRG 11/25/03	SW-FBRG 12/16/03	SW-FBRG 1/23/04	SW-FBRG 2/25/04	SW-FBRG 3/30/04	SW-FBRG 4/28/04	SW-FBRG 5/31/04	SW-FBRG 5/31/04	SW-FBRG 5/31/04	SW-FBRG 6/29/04	SW-FBRG 7/29/04	SW-FBRG 8/30/04	SW-FBRG 9/29/04	SW-FBRG 10/29/04	SW-FBRG 11/30/04	SW-FBRG 12/28/04	SW-FBRG 1/25/05	SW-FBRG 2/28/05	SW-FBRG 3/22/05
pH (std units)																												
Conductivity (umhos)																							124					140
Total dissolved solids				366	261				215							196												
Total suspended solids																												
Hardness, total																												
Carbonate																							61					63
Bicarbonate				123	117				89							83												
Alkalinity, Dissolved																							50					52
Alkalinity, total				101	96				89							68												
Nitrate Nitrogen																							25.1					24.8
Ammonia, total																31.8							9.8					10.6
Calcium				61.1	36.7				19							12.6												7.3
Sodium, dissolved				14.6	11.4				15							9.3												2.3
Magnesium, dissolved				18	11.4				10							1.8							16					18
Potassium, dissolved				3.42	2.56				3.1							32												
Sulfate				138	60.2				48																			28
Fluoride, total																25												
Chloride				21	17.8				28														<0.2					<0.2
Phosphorous																<0.2							<0.1					<0.1
Aluminum, dissolved				<0.2	<0.2			<0.2								<0.2							<0.001					<0.001
Aluminum, total				<0.2	<0.2			<0.2								<0.001							<0.05					<0.001
Antimony, dissolved				<0.001	<0.001			<0.001								<0.001												
Antimony, total				<0.001	<0.001			<0.001															<0.001					<0.01
Arsenic, dissolved																<0.01												
Arsenic, total				<0.01	<0.01			<0.01																				
Barium, dissolved																												
Barium, total																												
Beryllium, dissolved																												
Boron, total																												
Cadmium, dissolved																												
Chromium, dissolved																												
Cyanide, total																							<0.005					<0.005
Copper				0.006	<0.005			<0.005								<0.005							0.01					<0.005
Copper, dissolved				<0.005	<0.005			<0.005								<0.005							0.06					<0.03
Copper, total				<0.03	0.041											<0.03							0.21					0.11
Iron, dissolved				0.162	0.117				<0.03							0.2												
Iron, total																												
Iron, suspended																												0.08
Iron, Ferrous (Fe2+)				0.162	0.041				<0.03							0.2												
Iron, Ferric (Fe3+)																							<0.05					<0.005
Lead, dissolved				<0.005	<0.005			<0.005								<0.005							<0.01					<0.01
Lead, total				0.05	<0.01				<0.01							<0.01							<0.01					<0.01
Manganese, dissolved				0.06	<0.01				0.02							<0.01												
Manganese, total																							<0.001					<0.0001
Mercury, dissolved				<0.0001	<0.0001			<0.0001								<0.0001							<0.005					<0.005
Mercury, total				0.028	0.027				0.027							0.009												
Molybdenum, dissolved																												
Nickel, dissolved																												
Selenium, dissolved																							<0.01					<0.01
Silver, dissolved				<0.001	<0.001			<0.001								<0.001							<0.001					<0.001
Silver, total				<0.001	<0.001			<0.001								<0.001												
Thallium, dissolved																							<0.1					<0.001
Vanadium, dissolved				<0.001	<0.001			<0.001								<0.001												
Thallium, total																							<0.01					<0.005
Zinc, dissolved				0.021	0.01				0.009							<0.005												
Zinc, total	0.0071	0.0112	0.035	0.0837	0.168	0.17	0.22	0.155	0.14	0.11	0.13	0.11	0.0809	0.0314	0.0074	0.0006	0.0597	0.058	0.0255	0.0142	0.0131	0.0223	0.0131	0.0201	0.0157	0.0182	0.0288	0.0156
Uranium, dissolved	<0.002	<0.002	<0.002	0.0023	<0.0003	<0.002	<0.002		<0.002	<0.002	<0.002	<0.002	<0.002	<0.0003	0.0007	0.0646			0.0018	0.0011	0.0007	<0.0003	<0.0003	0.0003	<0.0003	<0.0003	<0.0003	<0.0003
Uranium, suspended																												
Uranium, total																												
Thorium-228, dis. (pCi/L)																												
Thorium-230, dis. (pCi/L)																			<0.2	0.3	<0.2	0.5	<0.2	0.3	<0.2	<0.2	<0.2	0.3
Thorium-232, dis. (pCi/L)			0.4	1.9		0.9	0.8		0.8	0.6	0.5	0.5	0.3	<0.2	<0.2	<0.2			0.3	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	0
Radium-226, dis. (pCi/L)			<0.1	0.1		<0.1	<0.1		<0.1	<0.1	<0.1	<0.1	<0.1	<0.2	<0.2	0.8												
Radium-226, susp. (pCi/L)																												
Radium-226, total (pCi/L)																												
Gross Alpha, dis. (pCi/L)																												
Gross Beta, dis. (pCi/L)																												

NOTES: Mean and median statistic calculated using one-half detection limit (1/2 D.L.)
ND = number of non-detects
Results are in mg/L unless otherwise noted

TABLE 24. WATER QUALITY IN RALSTON CREEK
1998 - 2007
STATION SW-FBRG

	SW-FBRG 4/21/05	SW-FBRG 5/31/05	SW-FBRG 6/22/05	SW-FBRG 7/31/05	SW-FBRG 8/30/05	SW-FBRG 10/26/05	SW-FBRG 11/30/05	SW-FBRG 12/31/05	SW-FBRG 1/31/06	SW-FBRG 2/27/06	SW-FBRG 5/31/06	SW-FBRG 6/22/06	SW-FBRG 8/30/06	SW-FBRG 10/26/06	SW-FBRG 11/30/06	SW-FBRG 12/27/06	SW-FBRG 1/31/07	SW-FBRG 3/29/07	SW-FBRG 6/27/07	SW-FBRG 9/5/07	MIN	MAX	MEAN	MEDIAN	COUNT	ND	% ND
pH (std units)																			7.94		7.3	8.2	7.7	7.7	5	0	0%
Conductivity (umhos)																			266		266	561	400	354	5	0	0%
Total dissolved solids					294					210									176		124	494	246	213	16	0	0%
Total suspended solids																					<1.	<10.	2.6	2.5	4	2	50%
Hardness, total																					120	170	147	150	3	0	0%
Carbonate																					n/a	n/a	n/a	n/a	0	0	n/a
Bicarbonate					133					98									85		61	133	95.6	91.8	12	0	0%
Alkalinity, Dissolved																					98	98	98	98	1	0	0%
Alkalinity, total					111					80									70		50	120	86	89	15	0	0%
Nitrate Nitrogen																					<0.5	1.7	1.1	1.3	4	1	25%
Ammonia, total																					0	<1.	0.125	0.000	4	1	25%
Calcium					52.8					35.6									28.9		19	82.5	37.3	31.8	15	0	0%
Sodium, dissolved					12.2					15.6									10.7		9.8	52	19.9	14.1	15	0	0%
Magnesium, dissolved					17.2														8.1		7.3	27.2	13.4	11.4	13	0	0%
Potassium, dissolved					2.8														1.8		1.4	4.42	3	3	13	0	0%
Sulfate					89					50									23		16	192	72	49	16	0	0%
Fluoride, total																					0.4	0.6	0.5	0.6	3	0	0%
Chloride					28					24									23		11	33.9	22.6	24.0	15	0	0%
Phosphorous																					n/a	n/a	n/a	n/a	0	0	n/a
Aluminum, dissolved					<0.2					<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2		<0.2		<0.1	<0.5	0.12	0.10	22	22	100%
Aluminum, total					<0.1					<0.1									<0.2		<0.1	<0.2	0.079	0.100	12	12	100%
Antimony, dissolved					<0.001					<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001		<0.001		<0.001	<0.05	0.002	0.001	22	21	95%
Antimony, total					<0.05					<0.05									<0.001		<0.001	<0.05	0.009	0.001	12	12	100%
Arsenic, dissolved																					<0.003	<0.003	0.0015	0.0015	1	1	100%
Arsenic, total					<0.001					<0.01									<0.1		<0.001	<0.1	0.0068	0.0050	14	14	100%
Barium, dissolved																					0.03	0.03	0.03	0.03	1	0	0%
Barium, total																					0.03	0.04	0.035	0.035	2	0	0%
Beryllium, dissolved																					<0.002	<0.002	0.0010	0.0010	3	3	100%
Boron, total																					n/a	n/a	n/a	n/a	0	0	n/a
Cadmium, dissolved																					<0.0002	<0.001	0.000	0.000	3	3	100%
Chromium, dissolved																					<0.005	<0.005	0.003	0.003	3	3	100%
Cyanide, total																					n/a	n/a	n/a	n/a	0	0	n/a
Copper					<0.005					<0.001	<0.001	0.001	<0.001	0.001	<0.001	<0.001	<0.001		<0.005		n/a	n/a	n/a	n/a	0	0	n/a
Copper, dissolved					<0.01					<0.001									<0.005		<0.001	<0.02	0.00	0.00	22	18	82%
Copper, total					0.03					<0.03									<0.03		<0.001	<0.01	0.0	0.0	12	11	92%
Iron, dissolved					0.11					0.03									0.08		<0.03	0.06	0.021	0.015	14	11	79%
Iron, total																					<0.03	0.21	0.1	0.1	11	2	18%
Iron, suspended											0.19	0.07	<0.03	0.04	<0.03	<0.03	<0.03		<0.03		0.04	0.04	0.04	0.04	1	0	0%
Iron, Ferrous (Fe2+)					0.08					<0.03											0.03	0.19	0.05	0.02	8	5	63%
Iron, Ferric (Fe3+)																					<0.03	0.2	0.07	0.04	9	4	44%
Lead, dissolved					<0.05					<0.005									<0.005		<0.002	<0.002	0.001	0.001	1	1	100%
Lead, total					0.01					<0.01	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	<0.01		<0.01		<0.002	<0.05	0.0075	0.0025	14	13	93%
Manganese, dissolved					0.02					<0.01									<0.01		<0.01	0.05	0.008	0.005	22	19	86%
Manganese, total																					<0.01	0.06	0.012	0.005	12	9	75%
Mercury, dissolved					<0.001					<0.0001									<0.0001		<0.0002	<0.0002	0.0001	0.0001	3	3	100%
Mercury, total					0.026					0.021	<0.005	<0.005	0.018	0.012	0.015	0.018	0.014		<0.005		<0.0001	<0.001	0.0002	0.0001	12	12	100%
Molybdenum, dissolved																					<0.005	0.24	0.041	0.018	22	7	32%
Nickel, dissolved																					<0.04	<0.04	0.02	0.02	3	3	100%
Selenium, dissolved																					<0.005	<0.005	0.0025	0.0025	3	3	100%
Silver, dissolved					<0.01					<0.0005									<0.001		<0.0002	<0.001	0.0002	0.0001	3	3	100%
Silver, total					<0.001					<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001		<0.001		<0.0005	<0.01	0.002	0.001	12	12	100%
Thallium, dissolved																					<0.001	<0.001	0.0005	0.0005	22	22	100%
Vanadium, dissolved					<0.1					<0.001									<0.001		<0.01	<0.01	0.0050	0.0050	3	3	100%
Thallium, total																					<0.001	<0.1	0.0	0.0	12	12	100%
Zinc, dissolved					<0.01					0.003									<0.005		<0.005	<0.005	0.003	0.003	3	3	100%
Zinc, total																					<0.003	0.045	0.009	0.005	12	7	58%
Uranium, dissolved	0.0072	0.0071	0.0126	0.205	0.2	0.106	0.15	0.107	0.122	0.176	0.0044	0.0129	0.138	0.0995	0.15	0.17	0.117	0.0074	0.031	0.215	0.0006	0.441	0.070	0.029	75	0	0%
Uranium, suspended	0.0021	0.0006	0.0015	<0.0003	0.0004	<0.0003	0.0003	0.0008	0.0008	<0.0003					<0.0003			0.0024	0.0007		0.0001	0.0646	0.0018	0.0004	62	35	56%
Uranium, total																		0.0098			0.0098	0.0335	0.0217	0.0217	2	0	0%
Thorium-228, dis. (pCi/L)																					n/a	n/a	n/a	n/a	0	0	n/a
Thorium-230, dis. (pCi/L)																					n/a	n/a	n/a	n/a	0	0	n/a
Thorium-232, dis. (pCi/L)																		<0.2	<0.2	<0.6	<0.0003	2.3	0.54	0.50	58	20	34%
Radium-226, dis. (pCi/L)	<0.2	<0.2	<0.2	0.6	<0.2	0.6	0.6	<0.2	<0.0003	0.7					<0.2			0.6	<0.2		0	0.8	0.14	0.10	58	39	67%
Radium-226, susp. (pCi/L)	<0.2	<0.2	<0.2	<0.2	<0.2	<0.1	<0.2	<0.2	<0.2	<0.1								0.6			0.6	0.6	0.60	0.60	1	0	0%
Radium-226, total (pCi/L)																					5.7	420	213	213	2	0	0%
Gross Alpha, dis. (pCi/L)																					3.8	300	152	152	2	0	0%
Gross Beta, dis. (pCi/L)																											

NOTES: Mean and median statistic calculated using one-half detection limit (1/2 D.L.)
ND = number of non-detects
Results are in mg/L unless otherwise noted

TABLE 24. WATER QUALITY IN RALSTON CREEK
1998 - 2007
STATION SW-ARH

	SW-ARH 11/19/98	SW-ARH 12/17/98	SW-ARH 1/19/99	SW-ARH 7/14/99	SW-ARH 12/21/00	SW-ARH 1/29/01	SW-ARH 2/28/01	SW-ARH 3/27/01	SW-ARH 4/18/01	SW-ARH 5/29/01	SW-ARH 6/19/01	SW-ARH 7/11/01	SW-ARH 8/24/01	SW-ARH 9/17/01	SW-ARH 10/24/01	SW-ARH 11/27/01	SW-ARH 12/18/01	SW-ARH 1/22/02	SW-ARH 3/26/02	SW-ARH 4/24/02	SW-ARH 5/28/02	SW-ARH 2/26/03	SW-ARH 3/26/03	SW-ARH 3/26/03	SW-ARH 4/29/03	SW-ARH 5/22/03	SW-ARH 6/23/03	SW-ARH 7/31/03	SW-ARH 9/26/03	SW-ARH 10/31/03	SW-ARH 11/25/03	SW-ARH 12/16/03	SW-ARH 1/23/04	SW-ARH 5/22/03	SW-ARH 3/30/04	SW-ARH 4/28/04	SW-ARH 5/31/04
pH (std units)	8.5	7.8	7.6	7.9																																	139
Conductivity (umhos)	511	523	570	442											223				159					179													
Total dissolved solids	355	349	354	297																																	
Total suspended solids	2	3	<1.	<10.																																	
Hardness, total	160	160	160																																		43
Carbonate															100				54.9					67.7													
Bicarbonate																																					35
Alkalinity, Dissolved				100											82				47					56													
Alkalinity, total	97	240	110																																		
Nitrate Nitrogen	1.8	1.7	1.7	<0.5																																	17.7
Ammonia, total	0	0	0	<1.											38.2				28					32.8													8.9
Calcium	37	36	36												16.3				16.3					16													5.2
Sodium, dissolved	42	46	54												11.7				6.52					9.53													1.3
Magnesium, dissolved	18	16	18												2.3				1.97					2.14													17
Potassium, dissolved	2.5	2.5	2.8												44				42.1					59.1													
Sulfate	130	140	160	100																																	20
Fluoride, total	0.5	0.6	0.8												39				29.8					23.7													
Chloride	14	17	16	16																																	<0.2
Phosphorous															<0.1				<0.2					<0.2													0.4
Aluminum, dissolved	<0.5	<0.5	<0.5												<0.1				<0.2					<0.2													<0.001
Aluminum, total															<0.05				<0.001					<0.001													<0.001
Antimony, dissolved	<0.008	0.003	<0.003												<0.05				<0.001					<0.001													
Antimony, total																																					<0.01
Arsenic, dissolved	<0.003														<0.001				<0.01					<0.01													
Arsenic, total		<0.003	<0.003																																		
Barium, dissolved	0.04																																				
Barium, total		0.04	0.03																																		
Beryllium, dissolved	<0.002	<0.002	<0.002																																		
Boron, total																																					
Cadmium, dissolved	<0.0002	<0.0002	<0.001																																		
Chromium, dissolved	<0.005	<0.005	<0.005																																		
Cyanide, total																																					<0.005
Copper															0.01				0.012					<0.005													<0.005
Copper, dissolved	<0.02	<0.02	<0.02												0.01				<0.005					<0.005													0.05
Copper, total																																					0.78
Iron, dissolved	<0.03	<0.03	<0.03												<0.03				0.062					<0.03													
Iron, total																																					
Iron, suspended															<0.03				<0.03					<0.03													0.73
Iron, Ferrous (Fe2+)															<0.03				0.062					<0.03													
Iron, Ferric (Fe3+)																																					<0.005
Lead, dissolved	<0.002														<0.05				<0.005					<0.005													<0.01
Lead, total		0.002	<0.002												<0.01				<0.01					<0.01													0.04
Manganese, dissolved	<0.01	<0.01	<0.01												<0.01				<0.01					<0.01													
Manganese, total																																					<0.0001
Mercury, dissolved	<0.0002	<0.0002	<0.0002												<0.001				<0.0001					<0.0001													<0.005
Mercury, total															<0.1				0.012					0.007													
Molybdenum, dissolved	0.24	0.23	0.24																																		
Nickel, dissolved	<0.04	<0.04	<0.04																																		
Selenium, dissolved	<0.005	<0.005	<0.005																																		<0.001
Silver, dissolved	<0.001	<0.0002	<0.0002												<0.01				<0.001					<0.001													<0.001
Silver, total															<0.001				<0.001					<0.001													
Thallium, dissolved	<0.001	<0.001	<0.001																																		<0.001
Vanadium, dissolved	<0.01	<0.01	<0.01												<0.001				<0.001					<0.001													
Thallium, total																																					0.008
Zinc, dissolved	<0.005	<0.005	<0.005												0.01				0.008					0.007													
Zinc, total																									0.0564	0.0071	0.0205	0.0347	0.13	0.17	0.14	0.11	0.11	0.1	0.0815	0.0339	0.0088	0.0474
Uranium, dissolved	0.0103	0.0057	0.0067	0.0103	0.022	0.0635	0.032	0.004	0.0044	0.0035	0.0083	0.0336	0.0149	0.017	0.0245	0.0003	0.0176	0.0276	0.0294	0.0499	0.0182	0.268	0.0607		<0.002	<0.002	0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	0.0005	0.001	0.0008
Uranium, suspended	0.0003	0.0001	0.0001	<0.002	0.002	0.002	0.002	0.002	0.0004	0.0006	<0.0003	0.0035	0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003														
Uranium, total																																					
Thorium-228, dis. (pCi/L)																																					
Thorium-230, dis. (pCi/L)																											0.3	1.1	1	0.7	0.6	0.6	0.6	0.6	<0.2	<0.2	0.4
Thorium-232, dis. (pCi/L)																											<0.1	<0.1	<0.1	<0.1	0.1	0.1	0.1	0.1	<0.2	<0.2	<0.2
Radium-226, dis. (pCi/L)	0.8	0.7		1.5	1.2	1.6	1.3	0.9	0.9	0.6	0.6	1.9	2.3	1.2	1	0.7	0.7	0.7	0.6	0.7	0.6	0.9	0.6														
Radium-226, susp. (pCi/L)	0.1	0.1	0		0.1	0.2	0	0	0	0.1	<0.2	0.13	0.2	0.2	<0.2	0.2	<0.2	0	<0.2	<0.2	<0.2	<0.2	<0.2														
Radium-226, total (pCi/L)																																					
Gross Alpha, dis. (pCi/L)	9.2	31		7.7																																	
Gross Beta, dis. (pCi/L)	3.6	19		7.2																																	

NOTES: Mean and median statistic calculated using one-half detection limit (1/2 D.L.)
ND = number of non-detects
Results are in mg/L unless otherwise noted

TABLE 24. WATER QUALITY IN RALSTON CREEK
1998 - 2007
STATION SW-ARH

	SW-ARH 6/29/04	SW-ARH 7/29/04	SW-ARH 8/30/04	SW-ARH 9/29/04	SW-ARH 10/29/04	SW-ARH 11/30/04	SW-ARH 11/30/04	SW-ARH 12/28/04	SW-ARH 1/25/05	SW-ARH 2/28/05	SW-ARH 3/22/05	SW-ARH 4/21/05	SW-ARH 5/31/05	SW-ARH 6/22/05	SW-ARH 7/31/05	SW-ARH 8/30/05	SW-ARH 10/26/05	SW-ARH 11/30/05	SW-ARH 12/31/05	SW-ARH 1/31/06	SW-ARH 2/16/06	SW-ARH 2/27/06	SW-ARH 4/28/06	SW-ARH 11/30/06	SW-ARH 12/16/06	SW-ARH 12/27/06	SW-ARH 1/31/07	SW-ARH 3/29/07	SW-ARH 6/27/07	SW-ARH 9/5/07	MIN	MAX	MEAN	MEDIAN	COUNT	ND	% ND
pH (std units)																												7.24			7.24	8.5	7.81	7.8	5	0	0%
Conductivity (umhos)															302													184			184	570	446	511	5	0	0%
Total dissolved solids	141			149																								112			112	355	230	201	12	0	0%
Total suspended solids																															<1.	<10.	2.6	2.5	4	2	50%
Hardness, total																															160	160	160	160	3	0	0%
Carbonate																															n/a	n/a			0	0	n/a
Bicarbonate	76.2			76											120													41			41	120	72.35	71.85	8	0	0%
Alkalinity, Dissolved																															100	100	100	100	1	0	0%
Alkalinity, total	62.5			62											98					75								34			34	240	83.2	68.75	12	0	0%
Nitrate Nitrogen																															<0.5	1.8	1.4	1.7	4	1	25%
Ammonia, total																															0	<1.	0.13	0	4	1	25%
Calcium	29.4			28.5						28.3					45.3					32.8								19.6			17.7	45.3	31.5	32.8	13	0	0%
Sodium, dissolved	12.5			12.2											14.4					14								10.4			8.9	54	21.9	15.2	12	0	0%
Magnesium, dissolved	8.2			8						14.8					13.9					10.2								5.8			<5.2	<18.	11.2	10.2	13	0	0%
Potassium, dissolved	1.8			1.9											3.2					3.2								1.3			1.3	3.2	2.2	2.22	12	0	0%
Sulfate	23			18						31					83					47								22			17	160	65.4	45.5	14	0	0%
Fluoride, total										25					19					28								21			0.5	0.6	0.6	0.6	3	0	0%
Chloride	29			29																											14	39	23.3	22.35	14	0	0%
Phosphorous																															0	0			0	0	n/a
Aluminum, dissolved	<0.2			<0.2						<0.2					<0.2					<0.2	<0.2		<0.2	<0.2	<0.2	<0.2	<0.2	<0.2			<0.1	<0.5	0.121	0.1	19	19	100%
Aluminum, total	<0.2			<0.2						<0.1					<0.1					<0.1								0.4			<0.1	<0.4	0.140	0.1	10	8	80%
Antimony, dissolved	<0.001			<0.001						<0.001					<0.001					<0.001	<0.001		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001			<0.001	<0.05	0.0022	0.0005	19	18	95%
Antimony, total	<0.001			<0.001						<0.05					<0.05					<0.05								<0.001			<0.001	<0.05	0.010	0.0005	10	10	100%
Arsenic, dissolved																															<0.003	<0.003	0.0015	0.0015	1	1	100%
Arsenic, total	<0.01			<0.01						<0.001					<0.001					<0.001								<0.1			<0.001	<0.1	0.0067	0.0033	12	12	100%
Barium, dissolved																												0.039			0.039	0.04	0.0395	0.0395	2	0	0%
Barium, total																												0.218			0.03	0.218	0.096	0.04	3	0	0%
Beryllium, dissolved																															<0.002	<0.002	0.001	0.001	3	3	100%
Boron, total																															0	0			0	0	n/a
Cadmium, dissolved																															<0.0002	<0.001	0.0002	0.0001	3	3	100%
Chromium, dissolved																															<0.005	<0.005	0.0025	0.0025	3	3	100%
Cyanide, total																															0	0			0	0	n/a
Copper																															0	0			0	0	n/a
Copper, dissolved	<0.005			<0.005						<0.005					<0.005					<0.005	0.001		0.002	<0.001	0.001	<0.001	<0.001	<0.005			<0.001	<0.02	0.0041	0.0025	19	14	74%
Copper, total	<0.005			<0.005						<0.01					<0.01					<0.01								<0.005			<0.005	0.01	0.004	0.0025	10	9	90%
Iron, dissolved	<0.03			0.05						<0.03					0.09													0.06			<0.03	<0.09	0.0381	0.015	9	5	56%
Iron, total	0.32			0.13						0.06					0.2					<0.03								0.51			<0.03	0.78	0.211	0.096	10	3	30%
Iron, suspended																															0	0			0	0	n/a
Iron, Ferrous (Fe2+)																				<0.03	<0.03		0.05	<0.03	<0.03	<0.03	<0.03	0.08			<0.03	<0.06	0.022	0.015	11	9	82%
Iron, Ferric (Fe3+)	0.32									0.04					0.11					<0.03											<0.03	0.73	0.163	0.051	8	3	38%
Lead, dissolved																															<0.002	<0.002	0.001	0.001	1	1	100%
Lead, total	<0.005			<0.005						<0.05					<0.05					<0.05								<0.005			<0.002	<0.05	0.010	0.0025	12	11	92%
Manganese, dissolved	<0.01			<0.01						<0.01					0.01					0.01	<0.01		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01			<0.01	<0.01	0.006	0.005	19	17	89%
Manganese, total	0.03			<0.01						<0.01					0.02					0.02								0.02			<0.01	<0.04	0.0155	0.0125	10	5	50%
Mercury, dissolved																															<0.0002	<0.0002	0.0001	0.0001	3	3	100%
Mercury, total	<0.0001			<0.0001						<0.001					<0.001					<0.001								<0.0001			<0.0001	<0.001	0.00023	0.00005	10	10	100%
Molybdenum, dissolved	0.007			<0.005						0.005					0.023					0.015	0.018		<0.005	0.016	0.015	0.019	0.016	<0.005			0.005	0.24	0.049	0.015	19	5	26%
Nickel, dissolved																															<0.04	<0.04	0.02	0.02	3	3	100%
Selenium, dissolved																															<0.005	<0.005	0.003	0.0025	3	3	100%
Silver, dissolved																												<0.001			<0.0002	<0.001	0.0002	0.0001	3	3	100%
Silver, total	<0.001			<0.001						<0.01					<0.01					<0.01											<0.001	<0.01	0.002	0.0005	10	10	100%
Thallium, dissolved	<0.001			<0.001						<0.001					<0.001					<0.001	<0.001		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001			<0.001	<0.001	0.0005	0.0005	19	19	100%
Vanadium, dissolved																															<0.01	<0.01	0.005	0.005	3	3	100%
Thallium, total	<0.001			<0.001						<0.1					<0.1					<0.1								<0.001			<0.001	<0.1	0.01535	0.0005	10	10	100%
Zinc, dissolved																															<0.005	<0.005	0.0025	0.0025	3	3	100%
Zinc, total	0.006			<0.005						<0.01					<0.01					<0.01								0.005			0.005	0.01	0.0062	0.0055	10	4	40%
Uranium, dissolved	0.0259	0.0129	0.0137	0.0206	0.0135	0.0215	0.0192	0.02	0.0166	0.0192	0.0344	0.0151	0.0069	0.0073	0.0127	0.089	0.111	0.101	0.125	0.115	0.114	0.115	0.129	0.0056	0.149	0.0905	0.143	0.104	0.0084	0.031	0.172	0.0003	0.268	0.054	0.0268	68	0	0%
Uranium, suspended	0.0006	0.0011	0.0008	0.0003	<0.0003	<0.0003			<0.0003	<0.0003	<0.0003	<0.0003	0.0022	0.0007	0.0005	0.0005	0.0005	<0.0003	<0.0003	0.0004	<0.0003		<0.0003						0.0018	0.0003		0.0001	0.0035	0.0007	0.00045	58	31	53%
Uranium, total																													0.0102			0.0102	0.0102	0.010	0.0102	1	0	0
Thorium-228, dis. (pCi/L)																															0	0			0	0	n/a
Thorium-230, dis. (pCi/L)																															0	0			0	0	n/a
Thorium-232, dis. (pCi/L)																															0	0			0	0	n/a
Radium-226, dis. (pCi/L)	0.5	0.4	0.5	<0.2	0.5	0.3			0.3	<0.2	<0.2	0.3	<0.2	<0.2	<0.2	0.3	1.8	0.7	0.4	0.5	0.5		0.9						<0.2	0.8	0.7	0.2	2.3	0.7	0.6	56	9	16%
Radium-226, susp. (pCi/L)	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2			<0.2	<0.2	<0.2	<0.1	<0.2	<0.2	0.2	0.3	<0.2	<0.1	<0.2	<0.2	<0.2		<0.1						<0.2	<0.2		0	0.3	0.10	0.1	55	35	64%
Radium-226, total (pCi/L)																													<0.2			0.2	0.2	0.10	0.1	1	1	100%
Gross Alpha, dis. (pCi/L)																															7.7	31	15.97	9.2	3	0	0%
Gross Beta, dis. (pCi/L)																															3.6	19	9.93	7.2	3	0	0%

NOTES: Mean and median statistic calculated using one-half detection limit (1/2 D.L.)
ND = number of non-detects
Results are in mg/L unless otherwise noted

TABLE 24. WATER QUALITY IN RALSTON CREEK
1998 - 2007
STATION SW-LLHG

	SW-LLHG 10/21/98	SW-LLHG 11/19/98	SW-LLHG 12/17/98	SW-LLHG 1/19/99	SW-LLHG 2/15/99	SW-LLHG 3/15/99	SW-LLHG 4/19/99	SW-LLHG 5/17/99	SW-LLHG 6/14/99	SW-LLHG 7/14/99	SW-LLHG 9/13/99	SW-LLHG 12/21/00	SW-LLHG 1/29/01	SW-LLHG 2/28/01	SW-LLHG 3/27/01	SW-LLHG 4/18/01	SW-LLHG 5/29/01	SW-LLHG 6/19/01	SW-LLHG 7/11/01	SW-LLHG 8/24/01	SW-LLHG 9/17/01	SW-LLHG 10/24/01	SW-LLHG 11/28/01	SW-LLHG 12/18/01	SW-LLHG 1/22/02	SW-LLHG 2/26/02	SW-LLHG 3/26/02	SW-LLHG 4/24/02	SW-LLHG 5/28/02
pH (std units)	7.8	8.3	7.7	7.7	8.5	7.8	7.7	7.3	7.6	8																238			
Conductivity (umhos)	469	482	517	570	601	420	308	143	177	444										224									
Total dissolved solids	303	302	339	352	382	319	197	112	132	308																			
Total suspended solids	2	2	1	1	1	1	36.9	5	<10.	<10.																			
Hardness, total	150	160	160	130																						125			
Carbonate																				98.8									
Bicarbonate																										103			
Alkalinity, Dissolved							70	38	47	100										81									
Alkalinity, total	98	100	110	110	230	88	70	38																					
Nitrate Nitrogen	0.8	1.8	1.7	1.7	1.7	0.8	0.5	<0.1		0.8	<0.5																		
Ammonia, total	0	0	0	0	0	0	0	<1.	<1.	<1.										39						41.6			
Calcium	35	36	36	24	42			14.2	17.3		33.5									16						19.3			
Sodium, dissolved	42	38	45	52	48			8.9	10.7		32.4									12						14.7			
Magnesium, dissolved	15	16	16	17	15			4.5	5.5		14.2									2.4						2.4			
Potassium, dissolved	2.7	2.5	2.5	2.7	2.9			1.2	1.1		2.3									51						68.2			
Sulfate	110	130	130	160	160	91	62	17	17	99																22.7			
Fluoride, total	0.5	0.5	0.6	0.6	0.6															28									
Chloride	18	16	16	14	15	16	13	9	13	16																<0.1			
Phosphorous								0.2												<0.1						0.068			
Aluminum, dissolved	<0.5	<0.5	<0.5	<0.5																<0.1						<0.001			
Aluminum, total								<0.006	<0.006		<0.006									<0.05						<0.001			
Antimony, dissolved	<0.03	<0.008	0.003	0.006	<0.003															<0.05									
Antimony, total								<0.005	<0.005		<0.005															<0.01			
Arsenic, dissolved	<0.05	<0.003																		<0.001									
Arsenic, total			<0.003	<0.003	<0.003																								
Barium, dissolved	0.04	0.03						<0.1	<0.1		<0.1																		
Barium, total			0.04	0.04	0.04																								
Beryllium, dissolved	<0.001	<0.002	<0.002	<0.002	<0.002			<0.001	<0.001		<0.001																		
Boron, total								<0.05	<0.05		0.06																		
Cadmium, dissolved	<0.002	<0.0002	<0.0002	<0.001	<0.0002			<0.001																					
Chromium, dissolved	<0.005	<0.005	<0.005	<0.005	<0.005			<0.005																					
Cyanide, total											<0.01																		
Copper																				<0.01						<0.01			
Copper, dissolved	<0.02	<0.02	<0.02	<0.02				<0.005	<0.005		<0.005									<0.01						0.002			
Copper, total																				<0.03						0.39			
Iron, dissolved	0.05	<0.03	<0.03	<0.03	<0.03			0.2	0.1											0.04						0.455			
Iron, total																													
Iron, suspended																										0.065			
Iron, Ferrous (Fe2+)																													
Iron, Ferric (Fe3+)								<0.005	<0.005		<0.005									<0.05						<0.001			
Lead, dissolved	<0.05	<0.002																		<0.01						0.07			
Lead, total			<0.002	0.002	<0.002															<0.01						<0.01			
Manganese, dissolved	<0.01	<0.01	<0.01	<0.01				<0.01																					
Manganese, total																				<0.001						<0.0001			
Mercury, dissolved	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002															<0.1						0.0281			
Mercury, total								0.014	0.018		0.09																		
Molybdenum, dissolved	0.186	0.21	0.21	0.25	0.31			<0.01	<0.01		<0.01																		
Nickel, dissolved	<0.02	<0.04	<0.04	<0.04	<0.04			<0.01	<0.01		<0.01																		
Selenium, dissolved	<0.05	<0.005	<0.005	<0.005	<0.005			<0.01												<0.01						<0.001			
Silver, dissolved	<0.005	<0.001	<0.0002	<0.0002	<0.0002															<0.001						<0.001			
Silver, total								<0.001	<0.001		<0.001																		
Thallium, dissolved	<0.05	<0.001	<0.001	<0.001	<0.001															<0.001						<0.001			
Vanadium, dissolved	<0.005	<0.01	<0.01	<0.01	<0.01			<0.01																					
Thallium, total									<0.01		<0.01									<0.01						<0.005			
Zinc, dissolved	0.006	<0.005	<0.005	0.005				<0.01																					
Zinc, total																													
Uranium, dissolved	0.0096	0.0169	0.0069	0.0081	0.0088	0.0052	0.0085	0.0027	0.0025	0.0147		0.0275	0.0336	0.0265	0.01	0.004	0.0103	0.0091	0.073	0.0238	0.019	0.0204	0.0136	0.0202	0.0259	0.0278	0.0252	0.0414	0.0156
Uranium, suspended		0.0001	0.0001	0.0001	0.0001	0.0001	0.0003	<0.002	<0.002	<0.002		0.002	0.002	0.002	0.002	0.0004	0.0007	<0.0003	0.0067	0.0003	<0.0003	<0.2	0.0039	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003
Uranium, total								0.1																					
Thorium-228, dis. (pCi/L)	0							0.4																					
Thorium-230, dis. (pCi/L)	0							0																					
Thorium-232, dis. (pCi/L)	0						0.3	0.5	0.1	3.9		1.6	1.6	1	1.2	0.6	0.9	1.1	1.6	2.4	1.3	0.8	0.9	0.8	0.7	1.1	<0.2	0.9	0.6
Radium-226, dis. (pCi/L)	0.4	0.9	0.5				0	0.1	0			0.1	0	0	0.1	0	0.1	<0.2	<0.06	<0.2	0.2	<0.2	0.3	<0.2	0	0.4	<0.2	<0.2	<0.2
Radium-226, susp. (pCi/L)		0	0.1	0																									
Radium-226, total (pCi/L)								3.1		30																			
Gross Alpha, dis. (pCi/L)	6	13	5.8					<5.		27																			
Gross Beta, dis. (pCi/L)	4.3	8.5	1.6																										

NOTES: Mean and median statistic calculated using one-half detection limit (1/2 D.L.).
ND = number of non-detects
Results are in mg/L unless otherwise noted

TABLE 24. WATER QUALITY IN RALSTON CREEK
1998 - 2007
STATION SW-LLHG

	SW-LLHG 6/25/02	SW-LLHG 2/26/03	SW-LLHG 2/26/03	SW-LLHG 3/26/03	SW-LLHG 3/26/03	SW-LLHG 4/29/03	SW-LLHG 5/22/03	SW-LLHG 6/23/03	SW-LLHG 7/29/03	SW-LLHG 7/31/03	SW-LLHG 9/26/03	SW-LLHG 10/31/03	SW-LLHG 11/25/03	SW-LLHG 11/25/03	SW-LLHG 12/16/03	SW-LLHG 1/23/04	SW-LLHG 2/25/04	SW-LLHG 3/30/04	SW-LLHG 3/30/04	SW-LLHG 4/28/04	SW-LLHG 5/31/04	SW-LLHG 5/31/04	SW-LLHG 6/29/04	SW-LLHG 7/29/04	SW-LLHG 8/30/04	SW-LLHG 9/29/04	SW-LLHG 10/29/04	SW-LLHG 11/30/04
pH (std units)																												
Conductivity (umhos)																												
Total dissolved solids						105								231					151						123			
Total suspended solids																												
Hardness, total																												
Carbonate																												
Bicarbonate						33.6								82					60						61			
Alkalinity, Dissolved																												
Alkalinity, total						28								82					60						50			
Nitrate Nitrogen																												
Ammonia, total																												
Calcium						15.1								33					26						20.2			
Sodium, dissolved						7.39								12					13						10.2			
Magnesium, dissolved						4.58								8.5					9						5.4			
Potassium, dissolved						1.48								2.9					3.3						1.7			
Sulfate						16.9								46					30						16			
Fluoride, total																												
Chloride						18.6								28					28						22			
Phosphorous																												
Aluminum, dissolved						<0.2							<0.2					<0.2							<0.2			
Aluminum, total						0.54							<0.2					<0.2							0.2			
Antimony, dissolved						<0.001							<0.001					<0.001							<0.001			
Antimony, total						<0.001							<0.001					<0.001							<0.001			
Arsenic, dissolved																												
Arsenic, total						<0.01							<0.01					<0.01							<0.01			
Barium, dissolved																												
Barium, total																												
Beryllium, dissolved																												
Boron, total																												
Cadmium, dissolved																												
Chromium, dissolved																												
Cyanide, total																												
Copper																												
Copper, dissolved						0.007							<0.005					<0.005							<0.005			
Copper, total						<0.005							<0.005					<0.005							<0.005			
Iron, dissolved						0.102								0.03											0.16			
Iron, total						0.61								<0.03											0.44			
Iron, suspended																												
Iron, Ferrous (Fe2+)																												
Iron, Ferric (Fe3+)						0.508																						
Lead, dissolved																												
Lead, total						<0.005							<0.005					<0.005							<0.005			
Manganese, dissolved						<0.01								<0.01											<0.01			
Manganese, total						0.02								0.02											0.02			
Mercury, dissolved																												
Mercury, total						<0.0001							<0.0001					<0.0001							<0.0001			
Molybdenum, dissolved						<0.005								0.026					0.008						<0.005			
Nickel, dissolved																												
Selenium, dissolved																												
Silver, dissolved																												
Silver, total						<0.001							<0.001					<0.001							<0.001			
Thallium, dissolved						<0.001							<0.001					<0.001							<0.001			
Vanadium, dissolved																												
Thallium, total						<0.001							<0.001					<0.001							<0.001			
Zinc, dissolved														<0.005											<0.005			
Zinc, total						0.014																						
Uranium, dissolved	0.0152	0.171	0.17	0.0548	0.0534	0.0077	0.022	0.032	0.0276	0.0796	0.12	0.13	0.0976	0.11	0.0926	0.097	0.0746	0.0298	0.0348	0.0088	0.0478	0.0521	0.049	0.0235	0.0177	0.0135	0.023	0.0138	0.0087
Uranium, suspended	<0.0003	<0.0003		<0.0003		<0.0003	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002		<0.002	<0.002	<0.002	<0.002		<0.002	0.0009	0.0009			0.0031	0.0017	0.0007	<0.0003	<0.0003	<0.0003
Uranium, total																												
Thorium-228, dis. (pCi/L)																												
Thorium-230, dis. (pCi/L)																												
Thorium-232, dis. (pCi/L)																												
Radium-226, dis. (pCi/L)	1.2	0.9		0.5		0.4		0.4	1.1	0.8	0.9	0.8		0.5	0.5	0.5	0.6		0.4	0.4	4.6			0.2	0.7	0.4	<0.2	<0.2	<0.2
Radium-226, susp. (pCi/L)	<0.2	<0.2		<0.2		<0.2		<0.1	0.1	<0.1	<0.1	<0.1		<0.1	<0.1	<0.1	<0.1		0.1	<0.2	<0.2			0.4	0.4	<0.2	<0.2	<0.2	<0.2
Radium-226, total (pCi/L)																												
Gross Alpha, dis. (pCi/L)																												
Gross Beta, dis. (pCi/L)																												

TABLE 24. WATER QUALITY IN RALSTON CREEK
1998 - 2007
STATION SW-LLHG

	SW-LLHG 12/28/04	SW-LLHG 1/25/05	SW-LLHG 2/28/05	SW-LLHG 3/22/05	SW-LLHG 4/21/05	SW-LLHG 5/31/05	SW-LLHG 6/22/05	SW-LLHG 7/31/05	SW-LLHG 7/31/05	SW-LLHG 8/30/05	SW-LLHG 10/26/05	SW-LLHG 11/30/05	SW-LLHG 12/31/05	SW-LLHG 1/31/06	SW-LLHG 2/27/06	SW-LLHG 10/26/06	SW-LLHG 11/30/06	SW-LLHG 12/27/06	SW-LLHG 1/31/07	SW-LLHG 3/29/07	SW-LLHG 6/27/07	SW-LLHG 9/5/07	MIN	MAX	MEAN	MEDIAN	COUNT	ND	% ND
pH (std units)																						8.06	7.3	8.5	7.86	7.8	11	0	0
Conductivity (umhos)																						453	143	601	417	453	11	0	0
Total dissolved solids		142					124						206									252	105	382	227	227.5	20	0	0
Total suspended solids																							1	36.9	6	2	10	2	20%
Hardness, total																							130	160	150	155	4	0	0
Carbonate																							n/a	n/a	n/a	n/a	0	0	n/a
Bicarbonate		69					76						101									142	33.6	142	84.8	79	10	0	0
Alkalinity, Dissolved																							38	100	63.8	58.5	4	0	0
Alkalinity, total		56					62						82									119	28	230	87.1	82	18	0	0
Nitrate Nitrogen																							<0.1	1.8	1.0	0.8	10	2	20%
Ammonia, total																							0	<1.	0.15	0	10	3	30%
Calcium		26.6					20						36.8									48.9	14.2	48.9	30.3	33.25	18	0	0
Sodium, dissolved		12.2					7.8						13.6									18.2	7.39	52	22.6	14.8	18	0	0
Magnesium, dissolved							5.9						11.3									14.9	4.5	17	11.1	12	17	0	0
Potassium, dissolved							1.1						1.8									3.3	1.1	3.3	2.25	2.4	17	0	0
Sulfate		22					14						55									68	14	160	68.2	58.5	20	0	0
Fluoride, total																							0.5	0.6	0.56	0.6	5	0	0
Chloride		25					17						31									32	9	32	19.9	17.5	20	0	0
Phosphorous																							n/a	n/a	n/a	n/a	0	0	n/a
Aluminum, dissolved		<0.2					<0.2						<0.2			<0.2	<0.2	<0.2	<0.2			<0.2	<0.1	<0.5	0.13	0.1	19	17	89%
Aluminum, total		<0.1					0.1						<0.1									<0.2	0.068	0.54	0.136	0.1	10	5	50%
Antimony, dissolved		<0.001					<0.001						<0.001			<0.001	<0.001	<0.001	<0.001			<0.001	<0.001	<0.05	0.003	0.0005	22	19	86%
Antimony, total		<0.05					<0.05						<0.05										<0.001	<0.05	0.011	0.0005	9	8	89%
Arsenic, dissolved																							<0.003	<0.05	0.0068	0.0025	5	5	100%
Arsenic, total		<0.001					<0.001						<0.001									<0.1	<0.001	<0.1	0.0063	0.0015	13	13	100%
Barium, dissolved																							0.03	<0.1	0.044	0.05	5	3	60%
Barium, total																							0.04	0.04	0.04	0.04	3	0	0%
Beryllium, dissolved																							<0.001	<0.002	0.0008	0.00075	8	8	100%
Boron, total																							<0.05	0.06	0.037	0.025	3	2	67%
Cadmium, dissolved																							<0.0002	<0.002	0.000	0.0003	6	6	100%
Chromium, dissolved																							<0.005	<0.005	0.003	0.0025	6	6	100%
Cyanide, total																							<0.01	<0.01	0.0050	0.005	1	1	100%
Copper																							n/a	n/a	n/a	n/a	0	0	n/a
Copper, dissolved		<0.005					<0.005						<0.005			0.001	<0.001	<0.001	<0.001			<0.005	<0.001	<0.02	0.00	0.0025	21	19	90%
Copper, total		<0.01					<0.01						<0.01									<0.005	0.002	<0.01	0.0	0.0025	10	9	90%
Iron, dissolved		<0.03					0.06						0.04									<0.03	<0.03	0.39	0.077	0.035	16	7	44%
Iron, total		0.04					0.36						0.06									0.2	0.03	0.61	0.2	0.2	9	1	11%
Iron, suspended																							n/a	n/a	n/a	n/a	0	0	n/a
Iron, Ferrous (Fe2+)																<0.03	<0.03	<0.03	<0.03			<0.03	0.03	0.03	0.02	0.015	5	5	100%
Iron, Ferric (Fe3+)		<0.04					0.31						<0.03										0.03	0.508	0.18	0.065	5	2	40%
Lead, dissolved																							<0.002	<0.05	0.0067	0.0025	5	5	100%
Lead, total		<0.05					<0.05						<0.05									<0.005	<0.001	<0.05	0.0090	0.0025	13	12	92%
Manganese, dissolved		<0.01					<0.01						<0.01			<0.01	<0.01	<0.01	<0.01			0.02	<0.01	0.07	0.009	0.005	18	16	89%
Manganese, total		<0.01					0.02						0.02									0.03	<0.01	0.03	0.01611	0.02	9	3	33%
Mercury, dissolved																							<0.0002	<0.0002	0.0001	0.0001	5	5	100%
Mercury, total		<0.001					<0.001						<0.001									<0.0001	<0.0001	<0.001	0.00023	0.00005	10	10	100%
Molybdenum, dissolved		<0.005					<0.005						0.015			0.01	0.009	0.018	0.015			0.023	<0.005	0.31	0.068	0.018	22	5	23%
Nickel, dissolved																							<0.01	<0.04	0.0131	0.015	8	8	100%
Selenium, dissolved																							<0.005	<0.05	0.0063	0.00375	8	8	100%
Silver, dissolved																							<0.0002	<0.01	0.0014	0.0003	6	6	100%
Silver, total		<0.01					<0.01						<0.01									<0.001	<0.001	<0.01	0.0023	0.0005	10	10	100%
Thallium, dissolved		<0.001					<0.001						<0.001			<0.001	<0.001	<0.001	<0.001			<0.001	<0.001	<0.05	0.0016	0.0005	22	22	100%
Vanadium, dissolved																							<0.005	<0.01	0.0046	0.005	6	6	100%
Thallium, total		<0.1					<0.1						<0.1										<0.001	<0.1	0.0	0.0005	9	9	100%
Zinc, dissolved																						0.008	<0.005	<0.01	0.004	0.005	7	5	71%
Zinc, total		<0.01					<0.01						<0.01										<0.005	0.014	0.0055	0.005	9	7	78%
Uranium, dissolved	0.0163	0.0184	0.024	0.015	0.0069	0.0075	0.0124	0.0402	0.0416	0.0632	0.0927	0.108	0.102	0.105	0.112	0.107	0.0798	0.138	0.0972	0.0081	0.031	0.145	0.0025	0.171	0.045	0.0259	79	0	0%
Uranium, suspended	<0.0003	<0.0003	<0.0003	<0.0003	0.0023	0.0007	0.0005	<0.0003		0.0004	<0.0003	<0.0003	0.0014	<0.0003	0.0009					0.0032	0.0005		<0.0001	<0.2	0.0024	0.0005	66	38	58%
Uranium, total																				0.0113			0.0113	0.0113	0.0113	0.0113	1	0	0%
Thorium-228, dis. (pCi/L)																							0	0.1	0.05	0.05	2	0	0%
Thorium-230, dis. (pCi/L)																							0	0.4	0.2	0.2	2	0	0%
Thorium-232, dis. (pCi/L)																							0	0	0.000	0	2	0	0%
Radium-226, dis. (pCi/L)	0.9	<0.2	<0.2	0.5	<0.2	<0.2	0.4	0.4		0.4	0.6	0.6	0.5	0.7	0.6					<0.2	0.7	0.6	0.1	4.6	0.8	0.6	64	9	14%
Radium-226, susp. (pCi/L)	<0.2	<0.2	<0.2	<0.1	<0.2	<0.2	<0.2	<0.2		0.2	<0.1	<0.2	0.4	<0.2	<0.1					<0.2	0.6		0	0.6	0.1	0.1	62	39	63%
Radium-226, total (pCi/L)																							0.2	0.2	0.1	0.1	1	1	100%
Gross Alpha, dis. (pCi/L)																							3.1	30	11.6	6	5	0	0%
Gross Beta, dis. (pCi/L)																							<1.6	27	8.8	4.3	5	1	20%

Table 25. Comparison of Water Quality with Location in Ralston Creek, November 1998

Parameter Name	SW-UP 11/24/98	SW-UC 11/24/98	SW-AWD 11/19/98	SW-A001 11/19/98	SW-BDIS 11/24/98	SW-PL 11/24/98	SW-OS 11/24/98	SW-BOS 11/23/98	SW-GS 11/23/98	SW-BPL 11/19/98	SW-FBRG 11/19/98	SW-ARH 11/19/98	SW-LLHG 11/19/98
pH	8	8	8.3	8.5	8.1	8.1	8.1	8.1	8	8.7	8.2	8.5	8.3
Conductivity	500	598	192	192	597	196	217	467	376	478	354	511	482
Total diss. solids	400	388	128	137	394	119	134	309	245	322	232	355	302
Total susp. solids	<1.	<1.	1410	<1.	<1.	<1.	1	3	1	3	<1.	2	2
Hardness, total	81	81	78	79	180	180	180	150	120	150	120	160	160
Bicarbonate (calc)	117	101	100	95	146	146	146	122	171	122	122	118	122
Alkalinity, total	96	83	82	78	120	120	120	100	140	100	100	97	100
Nitrate Nitrogen	<0.1	<0.1	0.5	<0.1	2.5	2.9	2.5	1.8	0.8	1.8	0.9	1.8	1.8
Calcium, diss.	23	23	22	23	40	40	40	34	29	35	28	37	36
Sodium, diss.	8	8	9	9	54	55	54	39	29	38	26	42	38
Magnesium, diss.	5.8	5.7	5.7	5.6	20	20	20	15	11	16	12	18	16
Potassium, diss.	1.3	1.4	1.4	1.4	2.9	2.9	2.9	2.4	2	2.5	2	2.5	2.5
Sulfate	14	13	12	12	160	170	170	120	79	120	72	130	130
Fluoride, total	0.3	0.3	0.3	0.3	0.6	0.6	0.6	0.5	0.5	0.5	0.4	0.5	0.5
Chloride	11	11	13	13	16	15	13	13	14	15	11	14	16
Aluminum, diss.	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Antimony, diss.	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008
Arsenic, diss.	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Barium, diss.	0.04	0.04	0.03	0.03	0.04	0.03	0.04	0.04	0.04	0.03	0.03	0.04	0.03
Beryllium, diss.	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Cadmium, diss.	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Chromium, diss.	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Copper, diss.	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Iron, diss.	<0.03	0.04	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Lead, diss.	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Manganese, diss.	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01
Mercury, diss.	<0.0002	0.0005	<0.0002	<0.0002	<0.0002	0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Molybdenum, diss.	<0.01	<0.01	<0.01	<0.01	0.35	0.35	0.35	0.23	0.22	0.22	0.12	0.24	0.21
Nickel, diss.	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04
Selenium, diss.	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Silver, diss.	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Thallium, diss.	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Vanadium, diss.	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc, diss.	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Uranium, diss.	0.0028	0.0031	0.0038	0.0157	0.0034	0.0035	0.0049	0.0075	0.0062	0.0062	0.0062	0.0103	0.0169
Radium-226, diss.	0.2	0.2	0.3	0.5	0.5	0.4	0.4	0.3	0.9	0.6	0.4	0.8	0.9
Gross Alpha, diss.	2.9	3.3	3.1	12	4.1	5.7	3.4	5.7	7.6	7.1	5.7	9.2	13
Gross Beta, diss.	0.9	2.1	<0.3	5.8	4	3.6	1.9	2.9	1.5	3.6	3.8	3.6	8.5

NOTES: Results in mg/L except gross alpha and gross beta (pCi/L), specific conductance (umhos/cm), and pH (standard units, $-\log H^+$).

Table 26. Uranium Concentrations in Ralston Creek, 1990 – 2007

SW-AWD		SW-A001		SW-DIS001		SW-BPL		SW-FBRG		SW-ARH		SW-LLHG	
Date	U (mg/L)	Date	U (mg/L)	Date	U (mg/L)	Date	U (mg/L)	Date	U (mg/L)	Date	U (mg/L)	Date	U (mg/L)
1/30/90	0.0020	1/30/90	0.0030	1/30/90	0.0050	1/30/90	0.0450	1/30/90		1/30/90		1/30/90	0.0650
2/20/90	0.0020	2/20/90	0.0020	2/20/90	0.0050	2/20/90	0.0430	2/20/90		2/20/90		2/20/90	0.0480
3/15/90	0.0020	3/15/90	0.0020	3/15/90	0.0020	3/15/90	0.0160	3/15/90		3/15/90		3/15/90	0.0320
4/26/90	0.0010	4/26/90	0.0010	4/26/90	0.0030	4/26/90	0.0020	4/26/90		4/26/90		4/26/90	0.0030
5/17/90	0.0008	5/17/90	0.0009	5/17/90	0.0030	5/17/90	0.0010	5/17/90		5/17/90		5/17/90	0.0022
6/7/90	0.0020	6/7/90	0.0010	6/7/90	0.0020	6/7/90	0.0030	6/7/90		6/7/90		6/7/90	0.0030
7/24/90	0.0020	7/24/90	0.0030	7/24/90	0.0010	7/24/90	0.0050	7/24/90		7/24/90		7/24/90	0.0080
8/9/90	0.0020	8/9/90	0.0038	8/9/90	0.0005	8/9/90	0.0110	8/9/90		8/9/90		8/9/90	0.0022
9/20/90	0.0030	9/20/90	0.0030	9/20/90	0.0010	9/20/90	0.0070	9/20/90		9/20/90		9/20/90	0.0110
10/30/90	0.0030	10/30/90	0.0040	10/30/90	0.0030	10/30/90	0.0040	10/30/90		10/30/90		10/30/90	0.0080
11/15/90	0.0020	11/15/90	0.0030	11/15/90	0.0020	11/15/90	0.0100	11/15/90		11/15/90		11/15/90	0.0100
12/11/90	0.0020	12/11/90	0.0030	12/11/90	0.0010	12/11/90	0.0080	12/11/90		12/11/90		12/11/90	0.0130
1/22/91	0.0025	1/22/91	0.0030	1/22/91	0.0026	1/22/91	0.0100	1/22/91		1/22/91		1/22/91	0.0300
2/14/91	0.0025	2/14/91	0.0035	2/14/91	0.0019	2/14/91	0.0080	2/14/91		2/14/91		2/14/91	0.0210
3/19/91	0.0020	3/19/91	0.0030	3/19/91	0.0018	3/19/91	0.0050	3/19/91		3/19/91		3/19/91	0.0130
4/11/91	0.0013	4/11/91	0.0019	4/11/91	0.0016	4/11/91	0.0070	4/11/91		4/11/91		4/11/91	0.0060
5/14/91	0.0010	5/14/91	0.0011	5/14/91	0.0020	5/14/91	0.0100	5/14/91		5/14/91		5/14/91	0.0300
6/5/91	0.0012	6/5/91	0.0010	6/5/91		6/5/91	0.0010	6/5/91		6/5/91		6/5/91	0.0020
7/23/91	0.0024	7/23/91	0.0027	7/23/91	0.0018	7/23/91	0.0044	7/23/91		7/23/91		7/23/91	0.0045
8/22/91	0.0016	8/22/91	0.0024	8/22/91	0.0009	8/22/91	0.0026	8/22/91		8/22/91		8/22/91	0.0047
9/19/91	0.0019	9/19/91	0.0031	9/19/91	0.0011	9/19/91	0.0045	9/19/91		9/19/91		9/19/91	0.0113
10/10/91	0.0018	10/10/91	0.0026	10/10/91	0.0010	10/10/91	0.0045	10/10/91		10/10/91		10/10/91	0.0112
11/21/91	0.0015	11/21/91	0.0021	11/21/91	0.0023	11/21/91	0.0069	11/21/91		11/21/91		11/21/91	0.0100
12/10/91	0.0019	12/10/91	0.0022	12/10/91	0.0030	12/10/91	0.0043	12/10/91		12/10/91		12/10/91	0.0090
1/23/92	0.0023	1/23/92	0.0029	1/23/92	0.0038	1/23/92	0.0066	1/23/92	0.0082	1/23/92	0.0094	1/23/92	0.0110
2/18/92	0.0017	2/18/92	0.0035	2/18/92	0.0038	2/18/92	0.0076	2/18/92	0.0098	2/18/92	0.0140	2/18/92	0.0140
3/17/92	0.0020	3/17/92	0.0031	3/17/92	0.0180	3/17/92	0.0054	3/17/92	0.0057	3/17/92	0.0069	3/17/92	0.0080
4/23/92	0.0010	4/23/92	0.0010	4/23/92	0.0064	4/23/92	0.0016	4/23/92	0.0018	4/23/92	0.0018	4/23/92	0.0019
5/14/92	0.0012	5/14/92	0.0013	5/14/92	0.0240	5/14/92	0.0031	5/14/92	0.0032	5/14/92	0.0034	5/14/92	0.0037
6/15/92	0.0001	6/15/92	0.0002	6/15/92	0.0020	6/15/92	0.0016	6/15/92	0.0017	6/15/92	0.0026	6/15/92	0.0044
7/15/92	0.0017	7/15/92	0.0022	7/15/92	0.0002	7/15/92	0.0033	7/15/92	0.0037	7/15/92	0.0057	7/15/92	0.0067
8/12/92	0.0014	8/12/92	0.0022	8/12/92	0.0018	8/12/92	0.0050	8/12/92	0.0064	8/12/92	0.0096	8/12/92	0.0140
9/24/92	0.0033	9/24/92	0.0011	9/24/92	0.0005	9/24/92	0.0045	9/24/92	0.0058	9/24/92	0.0085	9/24/92	0.0120
10/13/92	0.0025	10/13/92	0.0034	10/13/92	0.0093	10/13/92	0.0100	10/13/92	0.0110	10/13/92	0.0140	10/13/92	0.0160
11/17/92	0.0013	11/17/92	0.0016	11/17/92	0.0048	11/17/92	0.0040	11/17/92	0.0047	11/17/92	0.0062	11/17/92	0.0077
12/14/92	0.0010	12/14/92	0.0012	12/14/92	0.0044	12/14/92	0.0038	12/14/92	0.0044	12/14/92	0.0068	12/14/92	0.0096
1/11/93	0.0023	1/11/93	0.0019	1/11/93	0.0042	1/11/93	0.0057	1/11/93	0.0057	1/11/93	0.0094	1/11/93	0.0120
2/9/93	0.0054	2/9/93	0.0025	2/9/93	0.0033	2/9/93	0.0040	2/9/93	0.0051	2/9/93	0.0071	2/9/93	0.0120
3/16/93	0.0029	3/16/93	0.0025	3/16/93	0.0003	3/16/93	0.0041	3/16/93	0.0049	3/16/93	0.0067	3/16/93	0.0080
4/13/93	0.0095	4/13/93	0.0014	4/13/93	0.0100	4/13/93	0.0027	4/13/93	0.0029	4/13/93	0.0035	4/13/93	0.0043
5/10/93	0.0010	5/10/93	0.0011	5/10/93	0.0078	5/10/93	0.0015	5/10/93	0.0016	5/10/93	0.0017	5/10/93	0.0017
6/16/93	0.0012	6/16/93	0.0013	6/16/93	0.0015	6/16/93	0.0022	6/16/93	0.0018	6/16/93	0.0030	6/16/93	0.0036
7/13/93	0.0016	7/13/93	0.0002	7/13/93	0.0009	7/13/93	0.0031	7/13/93	0.0038	7/13/93	0.0054	7/13/93	0.0068
8/18/93		8/18/93		8/18/93	0.0008	8/18/93	0.0242	8/18/93	0.0166	8/18/93	0.0212	8/18/93	0.0310
9/27/93	0.0012	9/27/93	0.0075	9/27/93	0.0017	9/27/93	0.0098	9/27/93	0.0130	9/27/93	0.0202	9/27/93	0.0254
10/13/93	0.0016	10/13/93	0.0058	10/13/93	0.0022	10/13/93	0.0084	10/13/93	0.0114	10/13/93	0.0162	10/13/93	0.0222
11/9/93	0.0025	11/9/93	0.0050	11/9/93	0.0022	11/9/93	0.0084	11/9/93	0.0103	11/9/93	0.0140	11/9/93	0.0155
12/7/93	0.0022	12/7/93	0.0037	12/7/93	0.0025	12/7/93	0.0077	12/7/93	0.0105	12/7/93	0.0141	12/7/93	0.0177
1/27/94	0.0021	1/27/94	0.0034	1/27/94	0.0033	1/27/94	0.0099	1/27/94	0.0130	1/27/94	0.0165	1/27/94	0.0210
2/21/94	0.0022	2/21/94	0.0037	2/21/94	0.0014	2/21/94	0.0069	2/21/94	0.0097	2/21/94	0.0150	2/21/94	0.0180
3/21/94	0.0017	3/21/94	0.0020	3/21/94	0.0011	3/21/94	0.0026	3/21/94	0.0041	3/21/94	0.0066	3/21/94	0.0072
4/25/94	0.0009	4/25/94	0.0010	4/25/94	0.0009	4/25/94	0.0012	4/25/94	0.0020	4/25/94	0.0034	4/25/94	0.0017
5/18/94	0.0010	5/18/94	0.0011	5/18/94	0.0013	5/18/94	0.0012	5/18/94	0.0018	5/18/94	0.0016	5/18/94	0.0018
6/24/94	0.0021	6/24/94	0.0022	6/24/94	0.0135	6/24/94	0.0058	6/24/94	0.0070	6/24/94	0.0082	6/24/94	0.0084
7/25/94		7/25/94		7/25/94	0.0140	7/25/94	0.0277	7/25/94	0.0309	7/25/94	0.0344	7/25/94	0.0343
8/30/94		8/30/94		8/30/94	0.0320	8/30/94	0.0390	8/30/94	0.0390	8/30/94	0.0440	8/30/94	0.0470
9/30/94		9/30/94		9/30/94	0.0240	9/30/94	0.0340	9/30/94	0.0380	9/30/94	0.0440	9/30/94	0.0258
10/28/94	0.0019	10/28/94	0.0104	10/28/94	0.0164	10/28/94	0.0222	10/28/94	0.0234	10/28/94	0.0190	10/28/94	0.0351
11/16/94	0.0024	11/16/94	0.0070	11/16/94	0.0128	11/16/94	0.0154	11/16/94	0.0163	11/16/94	0.0204	11/16/94	0.0284
12/5/94	0.0030	12/5/94	0.0137	12/5/94	0.0126	12/5/94	0.0140	12/5/94	0.0260	12/5/94	0.0300	12/5/94	0.0403
1/31/95	0.0041	1/31/95		1/31/95	0.0112	1/31/95	0.0264	1/31/95	0.0268	1/31/95	0.0486	1/31/95	0.0685
2/27/95	0.0028	2/27/95	0.0045	2/27/95	0.0018	2/27/95	0.0084	2/27/95	0.0115	2/27/95	0.0155	2/27/95	0.0230
3/29/95	0.0015	3/29/95	0.0026	3/29/95	0.0025	3/29/95	0.0058	3/29/95	0.0071	3/29/95	0.0097	3/29/95	0.0118
4/25/95	0.0017	4/25/95	0.0020	4/25/95	0.0027	4/25/95	0.0038	4/25/95	0.0077	4/25/95	0.0078	4/25/95	0.0103
5/25/95	0.0020	5/25/95	0.0019	5/25/95	0.0167	5/25/95	0.0075	5/25/95	0.0080	5/25/95	0.0086	5/25/95	0.0079
6/27/95	0.0022	6/27/95	0.0028	6/27/95	0.0022	6/27/95	0.0053	6/27/95	0.0055	6/27/95	0.0071	6/27/95	0.0081
7/11/95	0.0033	7/11/95	0.0031	7/11/95	0.0224	7/11/95	0.0052	7/11/95	0.0049	7/11/95	0.0062	7/11/95	0.0066
8/22/95	0.0040	8/22/95	0.0060	8/22/95	0.0032	8/22/95	0.0166	8/22/95	0.0175	8/22/95	0.0238	8/22/95	0.0250
9/19/95	0.0038	9/19/95	0.0059	9/19/95	0.0234	9/19/95	0.0166	9/19/95	0.0188	9/19/95	0.0246	9/19/95	0.0319
10/9/95	0.0033	10/9/95	0.0052	10/9/95	0.0210	10/9/95	0.0124	10/9/95	0.0177	10/9/95	0.0158	10/9/95	0.0193

Table 26. Uranium Concentrations in Ralston Creek, 1990 – 2007 (Part 2)

SW-	AWD	SW-	A001	SW-	DIS001	SW-	BPL	SW-	FBRG	SW-	ARH	SW-	LLHG
Date	U (mg/L)	Date	U (mg/L)	Date	U (mg/L)	Date	U (mg/L)	Date	U (mg/L)	Date	U (mg/L)	Date	U (mg/L)
11/27/95	0.0019	11/27/95	0.0011	11/27/95	0.0017	11/27/95	0.0032	11/27/95	0.0037	11/27/95	0.0052	11/27/95	0.0065
12/21/95	0.0031	12/21/95	0.0074	12/21/95	0.0134	12/21/95	0.0159	12/21/95	0.0162	12/21/95	0.0173	12/21/95	0.0464
1/9/96	0.0028	1/9/96	0.0042	1/9/96	0.0126	1/9/96	0.0180	1/9/96	0.0105	1/9/96	0.0135	1/9/96	0.0157
2/22/96	0.0023	2/22/96	0.0017	2/22/96	0.0057	2/22/96	0.0052	2/22/96	0.0058	2/22/96	0.007	2/22/96	0.0088
3/21/96	0.0109	3/21/96	0.0038	3/21/96	0.0057	3/21/96	0.0055	3/21/96	0.0060	3/21/96	0.0087	3/21/96	0.0101
4/18/96	0.0015	4/18/96	0.0013	4/18/96	0.0041	4/18/96	0.0019	4/18/96	0.0024	4/18/96	0.0033	4/18/96	0.0032
5/21/96	0.0018	5/21/96	0.0016	5/21/96	0.0033	5/21/96	0.0022	5/21/96	0.0025	5/21/96	0.0037	5/21/96	0.0047
6/5/96	0.0027	6/5/96	0.0023	6/5/96	0.0043	6/5/96	0.0021	6/5/96	0.0021	6/5/96	0.0027	6/5/96	0.0034
7/31/96	0.0032	7/31/96	0.0325	7/31/96	0.0038	7/31/96	0.0230	7/31/96	0.0255	7/31/96	0.039	7/31/96	0.0415
8/27/96		8/27/96		8/27/96	0.0075	8/27/96	0.0300	8/27/96	0.0388	8/27/96	0.06	8/27/96	0.0894
9/26/96	0.0027	9/26/96	0.0069	9/26/96	0.0144	9/26/96	0.0137	9/26/96	0.0147	9/26/96	0.0192	9/26/96	0.0207
10/28/96	0.0034	10/28/96	0.0049	10/28/96	0.0431	10/28/96	0.0193	10/28/96	0.0227	10/28/96	0.0232	10/28/96	0.0229
11/14/96	0.0023	11/14/96	0.0046	11/14/96	0.0147	11/14/96	0.0176	11/14/96	0.0189	11/14/96	0.0213	11/14/96	0.0240
12/5/96	0.0038	12/5/96	0.0059	12/5/96	0.0445	12/5/96	0.0300	12/5/96	0.0302	12/5/96	0.0326	12/5/96	0.0340
1/22/97	0.0030	1/22/97	0.0041	1/22/97	0.0228	1/22/97	0.0291	1/22/97	0.0287	1/22/97	0.0383	1/22/97	0.0336
2/17/97	0.0098	2/17/97	0.0049	2/17/97	0.0215	2/17/97	0.0130	2/17/97	0.0178	2/17/97	0.0183	2/17/97	0.0202
3/25/97	0.0022	3/25/97	0.0033	3/25/97	0.0188	3/25/97	0.0105	3/25/97	0.0099	3/25/97	0.0102	3/25/97	0.0102
4/21/97	0.0017	4/21/97	0.0018	4/21/97	0.0130	4/21/97	0.0025	4/21/97	0.0023	4/21/97	0.0024	4/21/97	0.0032
5/28/97	0.0040	5/28/97	0.0024	5/28/97	0.0176	5/28/97	0.0018	5/28/97	0.0017	5/28/97	0.0023	5/28/97	0.0021
6/26/97	0.0022	6/26/97	0.0020	6/26/97	0.0128	6/26/97	0.0020	6/26/97	0.0020	6/26/97	0.0023	6/26/97	0.0024
7/30/97	0.0045	7/30/97	0.0030	7/30/97	0.0050	7/30/97	0.0032	7/30/97	0.0029	7/30/97	0.0034	7/30/97	0.0037
8/26/97	0.0063	8/26/97	0.0035	8/26/97	0.0068	8/26/97	0.0035	8/26/97	0.0041	8/26/97	0.0049	8/26/97	0.0047
9/29/97	0.0037	9/29/97	0.0044	9/29/97	0.0072	9/29/97	0.0055	9/29/97	0.0056	9/29/97	0.0081	9/29/97	0.0095
10/29/97	0.0028	10/29/97	0.0028	10/29/97	0.0110	10/29/97	0.0046	10/29/97	0.0064	10/29/97	0.0054	10/29/97	0.0133
11/20/97	0.0040	11/20/97	0.0033	11/20/97	0.0466	11/20/97	0.0103	11/20/97	0.0095	11/20/97	0.0101	11/20/97	0.0105
12/29/97	0.0025	12/29/97	0.0027	12/29/97	0.0027	12/29/97	0.0068	12/29/97	0.0060	12/29/97	0.0067	12/29/97	0.0094
1/27/98	0.0019	1/27/98	0.0022	1/27/98	0.0073	1/27/98	0.0042	1/27/98	0.0044	1/27/98	0.0056	1/27/98	0.0074
2/24/98	0.0036	2/24/98	0.0035	2/24/98	0.0177	2/24/98	0.0068	2/24/98	0.0065	2/24/98	0.0079	2/24/98	0.0087
3/23/98	0.0018	3/23/98	0.0018	3/23/98	0.0081	3/23/98	0.0025	3/23/98	0.0022	3/23/98	0.0035	3/23/98	0.0045
4/27/98	0.0018	4/27/98	0.0018	4/27/98	0.0196	4/27/98	0.0074	4/27/98	0.0085	4/27/98	0.0081	4/27/98	0.0078
5/27/98	0.0024	5/27/98	0.0022	5/27/98	0.0269	5/27/98	0.0023	5/27/98	0.0020	5/27/98	0.0023	5/27/98	0.0021
6/24/98	0.0040	6/24/98	0.0045	6/24/98	0.0272	6/24/98	0.0045	6/24/98	0.0038	6/24/98	0.0049	6/24/98	0.0045
7/29/98	0.0110	7/29/98	0.0065	7/29/98	0.0160	7/29/98	0.0038	7/29/98	0.0042	7/29/98	0.0055	7/29/98	0.0045
8/24/98	0.0138	8/24/98	0.0513	8/24/98	0.0258	8/24/98	0.0117	8/24/98	0.0036	8/24/98	0.0032	8/24/98	0.0042
9/28/98	0.3000	9/28/98	0.0960	9/28/98	0.0614	9/28/98	0.0224	9/28/98	0.0206	9/28/98	0.0192	9/28/98	0.0180
10/21/98	0.0048	10/21/98	0.0037	10/27/98	0.0064	10/20/98	0.0043	10/20/98	0.0049	10/20/98	0.0058	10/20/98	0.0069
11/19/98	0.0022	11/19/98	0.0157	11/19/98	0.0113	11/19/98	0.0062	11/19/98	0.0062	11/19/98	0.0103	11/19/98	0.0169
12/17/98	0.0018	12/17/98	0.0025	12/17/98	0.0044	12/17/98	0.0042	12/17/98	0.0046	12/17/98	0.0057	12/17/98	0.0069
1/19/99	0.0192	1/19/99	0.0026	1/19/99	0.0056	1/19/99	0.0047	1/19/99	0.0051	1/19/99	0.0067	1/19/99	0.0081
2/15/99	0.0020	2/15/99	0.0027	2/15/99	0.0042	2/15/99	0.0048	2/15/99	0.0058	2/15/99	0.0071	2/15/99	0.0088
3/15/99	0.0038	3/15/99	0.0025	3/15/99	0.0044	3/15/99	0.0037	3/15/99	0.0046	3/15/99	0.0052	3/15/99	0.0052
4/19/99	0.0013	4/19/99	0.0015	4/19/99	0.0053	4/19/99	0.0034	4/19/99	0.0038	4/19/99	0.0047	4/19/99	0.0085
5/17/99	0.0011	5/17/99	0.0014	5/17/99	0.0065	5/17/99	0.0024	5/17/99	0.0022	5/17/99	0.0022	5/17/99	0.0027
6/14/99	0.0002	6/14/99	0.0029	6/14/99	0.0091	6/14/99	0.0020	6/14/99	0.0100	6/14/99	0.0021	6/14/99	0.0028
7/14/99	0.0035	7/14/99	0.0029	7/14/99	0.0107	7/14/99	0.0033	7/14/99	0.0049	7/14/99	0.0103	7/14/99	0.0147
8/19/99	0.0054	8/19/99	0.0052	8/19/99	0.0070	8/19/99	0.0058	8/19/99	0.0046	8/19/99	0.0280	8/19/99	0.0044
9/13/99	0.0024	9/13/99	0.0024	9/13/99	0.0095	9/13/99	0.0038	9/13/99	0.0030	9/13/99	0.0076	9/13/99	0.0084
10/15/99	0.0035	10/15/99	0.0045	10/15/99	0.0061	10/15/99	0.0096	10/15/99	0.0060	10/15/99	0.0070	10/15/99	0.0069
11/23/99	0.0046	11/23/99	0.0048	11/23/99	0.0097	11/23/99	0.0083	11/23/99	0.0072	11/23/99	0.0080	11/23/99	0.0075
12/20/99	0.0025	12/20/99	0.0027	12/20/99	0.0047	12/20/99	0.0034	12/20/99	0.0034	12/20/99	0.0047	12/20/99	0.0056
1/19/00	0.0032	1/19/00	0.0035	1/19/00	0.0061	1/19/00	0.0041	1/19/00	0.0051	1/19/00	0.0053	1/19/00	0.0064
2/17/00	0.0039	2/17/00	0.0037	2/17/00	0.0014	2/17/00	0.0011	2/17/00	0.0009	2/17/00	0.0024	2/17/00	0.0035
3/22/00	0.0050	3/22/00	0.0053	3/22/00	0.0105	3/22/00	0.0064	3/22/00	0.0070	3/22/00	0.0084	3/22/00	0.0081
4/25/00	0.0014	4/25/00	0.0021	4/25/00	0.0188	4/25/00	0.0023	4/25/00	0.0028	4/25/00	0.0030	4/25/00	0.0036
5/26/00	0.0019	5/26/00	0.0011	5/26/00	0.0094	5/26/00	0.0030	5/26/00	0.0026	5/26/00	0.0034	5/26/00	0.0042
6/28/00	0.0018	6/28/00	0.0028	6/28/00	0.0015	6/28/00	0.0038	6/28/00	0.0036	6/28/00	0.0036	6/28/00	0.0049
7/27/00	0.0046	7/27/00		7/27/00	0.0046	7/27/00	0.0153	7/27/00		7/27/00		7/27/00	
8/29/00	0.0130	8/29/00	0.0175	8/29/00	<0.0002	8/29/00	0.0090	8/29/00	0.0100	8/29/00	0.0135	8/29/00	0.0155
9/27/00	0.0165	9/27/00	0.0175	9/27/00	0.0100	9/27/00	0.0175	9/27/00	0.0295	9/27/00	0.0250	9/27/00	0.0255
10/30/00	0.0053	10/30/00	0.0120	10/30/00	0.0095	10/30/00	0.0310	10/30/00	0.0150	10/30/00	0.0310	10/30/00	0.0316
11/27/00	0.0040	11/27/00	0.0052	11/27/00	0.0036	11/27/00	0.0124	11/27/00	0.0034	11/27/00	0.0300	11/27/00	0.0208
12/21/00	0.0300	12/21/00	0.0520	12/21/00	0.0600	12/21/00	0.0165	12/21/00	0.0160	12/21/00	0.0220	12/21/00	0.0275
1/29/01	0.0074	1/29/01	0.0245	1/29/01	0.0185	1/29/01	0.0400	1/29/01	0.1400	1/29/01	0.0635	1/29/01	0.0336
2/28/01	0.0041	2/28/01	0.032	2/28/01	0.0026	2/28/01	0.0210	2/2/01	0.0345	2/28/01	0.0320	2/28/01	0.0265
3/28/01	0.0160	3/27/01	0.0031	3/27/01	0.014	3/27/01	0.0096	2/28/01	0.0245	3/27/01	0.0040	3/27/01	0.0100
4/18/01	0.0008	3/28/01	0.0036	4/18/01	0.0021	4/18/01	0.0048	3/27/01	0.0092	4/18/01	0.0044	4/18/01	0.004
5/29/01	0.0090	4/18/01	0.0016	5/29/01	0.0085	5/29/01	0.0037	4/18/01	0.0034	5/29/01	0.0035	5/29/01	0.0103
6/19/01	0.0014	5/29/01	0.0016	6/19/01	0.0063	6/19/01	0.0105	5/29/01	0.0034	6/19/01	0.0083	6/19/01	0.0091
7/11/01	0.0040	6/19/01	0.0038	7/11/01	0.0135	7/11/01	0.0080	6/19/01	0.0082	7/11/01	0.0336	7/11/01	0.073

Table 26. Uranium Concentrations in Ralston Creek, 1990 – 2007 (Part 3)

SW-	AWD	SW-	A001	SW-	DIS001	SW-	BPL	SW-	FBRG	SW-	ARH	SW-	LLHG
Date	U (mg/L)	Date	U (mg/L)	Date	U (mg/L)	Date	U (mg/L)	Date	U (mg/L)	Date	U (mg/L)	Date	U (mg/L)
8/27/01	0.0025	7/11/01	0.0065	8/27/01	0.0051	8/24/01	0.0095	7/11/01	0.0098	8/24/01	0.0149	8/24/01	0.0238
9/17/01	0.0019	8/27/01	0.0080	9/17/01	0.0012	9/17/01	0.0067	8/24/01	0.0058	9/17/01	0.017	9/17/01	0.019
10/24/01	0.0022	9/17/01	0.0041	10/24/01	0.0008	10/24/01	0.009	9/17/01	0.0006	10/24/01	0.0245	10/24/01	0.0204
11/27/01	0.0050	10/24/01	0.0037	11/27/01	0.0208	11/27/01	0.0071	10/24/01	0.0112	11/27/01	0.0003	11/28/01	0.0136
12/18/01	0.0028	11/27/01	0.0049	12/18/01	0.0036	12/18/01	0.0116	11/27/01	0.0073	12/18/01	0.0176	12/18/01	0.0202
1/22/02	0.0186	12/18/01	0.0041	1/22/02	0.0036	1/22/02	0.0304	12/19/01	0.0132	1/22/02	0.0276	1/22/02	0.0259
2/26/02	0.0038	1/22/02	0.008	2/26/02	0.0187	2/26/02	0.0908	1/22/02	0.0252	3/26/02	0.0294	2/26/02	0.0278
3/26/02	0.0023	3/26/02	0.0032	3/26/02	0.0074	3/26/02	0.0317	2/26/02	0.0368	4/24/02	0.0499	3/26/02	0.0252
4/24/02	0.0014	4/24/02	0.0024	4/24/02	0.0037	4/24/02	0.0504	3/26/02	0.0442	5/28/02	0.0182	4/24/02	0.0414
5/28/02	0.0011	5/28/02	0.002	5/28/02	0.0024	5/28/02	0.024	4/24/02	0.0497	2/26/03	0.268	5/28/02	0.0156
6/25/02	0.0022	1/30/03	0.0178	6/29/02	0.0021	6/25/02	0.0591	5/28/02	0.0222	3/26/03	0.0564	6/25/02	0.0152
12/31/02	0.0039	2/27/03	0.01	No	Discharge	12/31/02	0.521	1/31/03	0.441	4/29/03	0.0071	2/26/03	0.171
1/30/03	0.0082	3/26/03	0.0061	"	"	1/31/03	0.591	2/26/03	0.376	5/22/03	0.0205	3/26/03	0.0534
2/27/03	0.0025	4/29/03	0.0020	"	"	2/27/03	0.378	3/26/03	0.0543	6/23/03	0.0347	4/29/03	0.0077
3/26/03	0.0039	5/22/03	0.0044	"	"	3/26/03	0.0542	4/29/03	0.0071	7/31/03	0.13	5/22/03	0.022
4/29/03	0.0010	6/23/03	0.0043	"	"	4/29/03	0.0077	5/22/03	0.0112	9/26/03	0.17	6/23/03	0.032
5/22/03	0.0022	7/31/03	0.018	"	"	5/22/03	0.0131	6/23/03	0.0350	10/31/03	0.14	7/29/03	0.0276
6/23/03	0.0043	9/26/03	0.0136	"	"	6/23/03	0.0341	7/29/03	0.0837	11/25/03	0.11	7/31/03	0.0796
7/29/03	0.0076	10/31/03	0.0062	"	"	7/29/03	0.32	7/31/03	0.168	12/16/03	0.11	9/26/03	0.12
7/31/03	0.0048	11/25/03	0.006	"	"	7/31/03	0.212	9/26/03	0.22	1/23/04	0.10	10/31/03	0.13
9/26/03	0.0025	12/16/03	0.0056	"	"	9/26/03	0.25	10/31/03	0.14	2/25/04	0.0815	11/25/03	0.0976
10/31/03	0.0028	1/23/04	0.0070	"	"	10/31/03	0.15	11/25/03	0.11	3/30/04	0.0339	12/16/03	0.0976
11/25/03	0.0024	2/25/04	0.0062	"	"	11/25/03	0.102	12/16/03	0.13	4/28/04	0.0088	1/23/04	0.097
12/16/03	0.0025	3/30/04	0.0027	"	"	12/16/03	0.12	1/23/04	0.11	5/31/04	0.0474	2/25/04	0.0746
1/23/04	0.0021	4/28/04	0.0015	"	"	1/23/04	0.0993	2/25/04	0.0809	6/26/04	0.0259	3/30/04	0.0298
2/25/04	0.0020	5/31/04	0.0050	"	"	2/25/04	0.0819	3/30/04	0.0314	7/29/04	0.0129	4/28/04	0.0088
3/30/04	0.0016	6/29/04	0.0015	"	"	3/30/04	0.0343	4/28/04	0.0074	8/30/04	0.0137	5/31/04	0.0478
4/28/04	0.0009	7/29/04	0.0024	"	"	4/28/04	0.0083	5/31/04	0.0646	9/29/04	0.0206	6/29/04	0.0235
5/31/04	0.0088	8/30/04	0.0026	"	"	5/31/04	0.0754	6/29/04	0.0255	10/29/04	0.0135	7/29/04	0.0177
6/29/04	0.0009	9/29/04	0.0029	"	"	6/29/04	0.0262	7/29/04	0.0142	11/30/04	0.0215	8/30/04	0.0135
7/29/04	0.0032	10/29/04	0.0015	"	"	7/29/04	0.0112	8/30/04	0.0131	12/28/04	0.0166	9/29/04	0.0230
8/30/04	0.0018	11/30/04	0.0021	"	"	8/30/04	0.0127	9/29/04	0.0223	1/25/05	0.0192	10/29/04	0.0138
9/29/04	0.0026	12/28/04	0.0018	"	"	9/29/04	0.0205	10/29/04	0.0131	2/28/05	0.0344	11/30/04	0.0087
10/29/04	0.0011	1/25/05	0.0026	"	"	10/29/04	0.0123	11/30/04	0.0201	3/22/05	0.0151	12/28/04	0.0163
11/30/04	0.0017	2/28/05	0.0028	"	"	11/30/04	0.0196	12/28/04	0.0157	4/21/05	0.0069	1/25/05	0.0184
12/28/04	0.0012	3/22/05	0.0019	"	"	12/28/04	0.0177	1/25/05	0.0182	5/31/05	0.0073	2/28/05	0.0240
1/25/2005	0.0021	4/21/05	0.0027	"	"	1/25/2005	0.0181	2/28/05	0.0288	6/22/05	0.0127	3/22/05	0.0150
2/28/05	0.0017	5/31/05	0.0023	"	"	2/28/05	0.0200	3/22/05	0.0156	7/31/05	0.089	4/21/05	0.0069
3/22/05	0.0016	6/22/05	0.0026	"	"	3/22/05	0.0204	4/21/05	0.0072	8/30/05	0.111	5/31/05	0.0075
4/21/05	0.0027	7/31/05	0.0012	"	"	4/21/05	0.006	5/31/05	0.0071	10/26/05	0.101	6/22/05	0.0124
5/31/05	0.0019	8/30/05	0.0249	"	"	5/31/05	0.0074	6/22/05	0.0126	11/30/05	0.125	7/31/05	0.0402
6/22/05	0.0004	10/26/05	0.0081	"	"	6/22/05	0.0124	7/31/05	0.205	12/31/05	0.115	8/30/05	0.0632
7/31/05	0.0003	11/30/05	0.0102	"	"	7/31/05	0.248	8/30/05	0.200	1/31/06	0.114	10/26/05	0.0927
8/30/05	0.0042	12/31/05	0.0058	"	"	8/30/05	0.242	10/26/05	0.106	2/27/06	0.129	11/30/05	0.108
10/26/05	0.0050	1/31/06	0.0083	"	"	10/26/05	0.105	11/30/05	0.150	4/28/06	0.0056	12/31/05	0.102
11/30/05	0.0085	2/27/06	0.0104	"	"	11/30/05	0.155	12/31/05	0.107	11/30/06	0.149	1/31/06	0.105
12/31/05	0.0017	4/28/06	0.0019	"	"	12/31/05	0.0795	1/31/06	0.122	12/16/06	0.0905	2/27/06	0.112
1/31/06	0.0027	3/28/07	0.0015	"	"	1/31/06	0.118	2/27/06	0.176	12/27/06	0.143	10/26/06	0.107
2/27/06	0.0029	6/27/07	0.0037	"	"	2/27/06	0.177	5/31/06	0.0044	1/31/07	0.104	11/30/06	0.0798
4/28/06	0.0041	9/5/07	0.0123	"	"	3/29/06	0.378	6/22/06	0.0129	3/29/07	0.0084	12/27/06	0.138
4/29/06	0.0011			"	"	3/30/06	0.0315	8/30/06	0.138	6/27/07	0.031	1/31/07	0.0972
9/26/06	0.0025			"	"	4/16/06	0.0551	10/26/06	0.0995	9/5/07	0.172	3/29/07	0.0081
10/26/06	0.0038			"	"	6/22/06	0.0129	11/30/06	0.15			6/27/07	0.031
3/28/07	0.0017			"	"	8/30/06	0.236	12/27/06	0.17			9/5/07	0.145
6/27/07	0.0021			"	"	9/26/06	0.244	1/31/07	0.117				
9/5/07	0.002			"	"	10/26/06	0.102	3/29/07	0.0074				
				"	"	11/30/06	0.151	6/27/07	0.031				
				"	"	12/16/06	0.0636	9/5/07	0.215				
				"	"	12/27/06	0.165						
				"	"	3/29/07	0.008						
				"	"	6/27/07	0.0312						
				"	"	9/5/07	0.224						

7. GROUNDWATER QUALITY

Groundwater quality data are available from 9 monitoring wells in alluvium, 4 sumps in alluvium, 2 monitoring wells in bedrock, 21 sampling sites in the underground mine prior to flooding, and from a range of depths in the underground #3 shaft during mine flooding. Monitoring locations and the number of samples collected[18] from each station for the closure hydrology study are summarized in Table 27.

Table 27. Location and Frequency of Groundwater Quality Samples Compiled and Evaluated for the Mine Closure Hydrology Study

Alluvial Wells	Description	Number Of Samples	Comments
MW00	Alluvium, upgradient of mining activities	56	Constructed in 1999
MW0	Alluvium, below southeast toe of waste rock pile	53	
MW1	Alluvium, northwest of treated water discharge pond	58	Poorly installed, high turbidity
MW2	Alluvium, downgradient of treatment plant	50	Influenced by Ralston Creek
MW3A	Alluvium, southeast of former untreated water storage pond	6	Usually dry prior to 2003
MW4	Alluvium, southern corner of former untreated water storage pond	6	Little water, often dry
MW5	Alluvium near former ore and waste containment bins	0	Out of service since 1999
MW5R	Alluvium near former ore and waste containment bins	8	Replacement well for MW05
MW6	Alluvium down gradient of mine and office/shop	62	
MW7	Alluvium near former ore sorter	63	
MW8	Alluvium, downgradient of former mining facilities	0	Dry
MW9	Alluvium near former ore and waste containment bins	46	Used as pumping well for multi-day test.
Sumps			
#1 Sump	Southeast of Guard Shack, near former core storage building	84	Went online August 1990
#2 Sump	190 feet southeast of former ore sorter, inside flood control wall	39	Went online April 1990
#3 Sump	65 feet southeast of former ore sorter	40	Went online January1992
#4 Sump	Midway between former ore sorter and emergency storage pond	85	Went online October 1990
Bedrock Wells			
MW10	Completed in mica schist southwest of mine workings	0	data quality impaired by poor completion
MW11	Completed in mica schist southwest of mine workings	10	Deep bedrock well
Mine Water (Collected Underground During Operations)			
MINN	Minnesota level, near Glory Hole	1	Upper workings (Minnesota Level)
Wash	Steve level: seeps from Washington chutes	1	Upper workings (Steve Level)
CO	Steve level: Colorado drift bulkhead	1	Upper workings (Steve Level)
ILLRS	Steve level: seeps from boards in Illinois raise	1	Upper workings (Steve Level)
146	Steve level: pond behind air regulator	1	Upper workings (Steve Level)
2Adit	Pool behind berm	1	Adjacent workings (Steve elevation)
2A	Rt heading in decline, below intersection	1	Adjacent workings (Steve elevation)
700ILL	Fracture (along Illinois Fault)	6	700 Level
779	Pool (composite sample from pool)	5	700 Level
7J2	Corehole, intermittent flow (drip/low flow)	2	700 Level
1108	Bulkhead (composite)	5	1100 Level
15B	Bulkhead (composite)	1	1500 Level
15B13	Corehole at drill station 15B	4	1500 Level
16G	Corehole flowing through muck (Fe ppt)	5	1600 Level
1730	Leyner hole	5	1700 Level
19D15(Fe)	Corehole at drill station 19D, Fe staining	5	1900 Level
19D16(Mn)	Corehole at drill station 19D, Mn staining	5	1900 Level
19C16	Corehole at drill station 16C	4	1900 Level
JOS2026	Stope water (Johnson Ore Shoot)	5	2000 Level
1955 Decline	Standing water	4	1955 Level
Mine Water (Collected Underground After Operations)			
Steve Adit	Steve level: seeps from boards in Illinois raise	1	Upper workings (Steve Level)
Mine Water (Collected in Shaft During Reflooding)			
# 3 & #2 shaft	Samples collected from the reflooded mine workings	114	various depths and levels

[18] The table reports the only number of samples collected and evaluated for the mine closure hydrology study.

7.1 Groundwater Quality Standards and Point of Compliance

CPDHE has developed numeric standards that apply to classified groundwater. The majority of the numeric standards are the maximum contaminant levels (MCLs) for public drinking water supplies, as established by the National Primary Drinking Water Regulations. The remainder are derived from the Colorado Basic Water Standards for Ground Water (5CCR 2002-41, amended November 8, 2004, effective March 22, 2005). These human health levels are set to protect the public from acute poisoning and from long-term "chronic" effects. The numeric standards listed in column 1 of Table 28 are applicable to groundwater classified "Domestic Use-Quality".

The classification system consists of five (5) categories or classes based on existing and potential future uses and actual water quality data. Groundwater may be assigned more than one class because it may have more than one existing or potential use. The classes are:

1. Domestic Use - Quality
2. Agricultural Use – Quality
3. Surface Water Quality Protection
4. Potentially Usable Quality
5. Limited Use and Quality

The point of compliance was set by DRMS and was accepted by the Water Quality Control Commission (WQCC). These organizations typically recognize that mining activities occur within groundwater bodies and that water quality within the disturbed area will obviously change. Points of compliance are established outside the disturbance area to protect the water body while allowing the mining activity.

A point of compliance well was originally drilled at the property boundary for the alluvial groundwater. However, downgradient well MW8 is always dry and has never been sampled. The alluvium pinches out, and groundwater in the alluvium is forced into Ralston Creek. The creek is essentially the point of compliance for groundwater in the alluvium, and is monitored routinely at station SW-BPL (below the property line).

Table 28. Groundwater Quality Standards

Parameter	Groundwater Standards for Drinking Water and Human Health	Agricultural Standards for Groundwater
Total Coliform	K[a] 1 org/100 mL	
Color (color units)	15 (s)	
Phenol (mg/L)	0.300 (s)	
Chlorophenol (mg/L)	0.0002 (s)	
Corrosivity	Non-corrosive (s)	
pH	6.5-8.5 (s)	6.5-8.5
Temperature (°C)	---	
Conductivity (µmhos/cm)	---	
Alkalinity (mg $CaCO_3$/l)	---	
Bicarbonate (mg $CaCO_3$/l)	---	
Boron (mg/L)	---	0.75
Calcium (mg/L)	---	
Chloride (mg/L)	250 (s)	
Fluoride (mg/L)	4	2
Nitrogen, ammonia (mg/L)	---	
Nitrogen, nitrate (mg/L)	10	
Nitrogen, nitrite (mg/L)	1	10
Nitrogen, nitrate + nitrite (mg/L)	10	100
Phosphorus, total (mg/L)	---	
Potassium (mg/L)	---	
Sodium (mg/L)	---	
Sulfate (mg/L)	250 (s)	
TDS (mg/L)	500 (s)	
Aluminum (mg/L)	---	5
Antimony (mg/L)	0.006	
Arsenic (mg/L)	0.05	0.1
Asbestos (fibers/liter)	7,000,000	
Barium (mg/L)	2	
Beryllium (mg/L)	0.004	0.1
Cadmium (mg/L)	0.005	.01
Chromium, total (mg/L)	0.1	0.1
Cobalt (mg/L)	---	0.05
Copper (mg/L)	1.0 (s)	0.2
Cyanide [free] (mg/L)	0.20	
Iron (mg/L)	0.3 (s)	5
Lead (mg/L)	0.05	0.1
Lithium (mg/L)	---	2.5
Magnesium (mg/L)	---	
Manganese (mg/L)	0.05 (s)	0.2
Mercury (mg/L)	0.002	0.01
Molybdenum (mg/L)	---	
Nickel (mg/L)	0.1	0.2
Selenium (mg/L)	0.05	0.02
Silver	0.05	
Thallium	0.002	
Uranium (mg/L)	---	
Vanadium (mg/L)	---	0.1
Zinc (mg/L)	5.0 (s)	2.0
Gross Alpha (pCi/l)	15	
Gross Beta (pCi/l)	4 mrem/yr (8 pCi/L)	
Radium-226 and –228 (pCi/L)	5 pCi/L	
Americium (total) (pCi/L)	0.15	
Cesium 134 (pCi/L)	80	
Plutonium 239/240 (total) (pCi/l)	0.15	
Strontium 90 (total) (pCi/L)	8	
Thorium 230/232 (total) (pCi/L)	60	
Tritium (pCi/L)	20,000	

NOTES: Standards from Colorado Administrative Code 5CCR 1002-41 and 5CCR 1002-48
--- = no established State standard
s = secondary standard
Gross beta standard of 4 mrem/yr exposure is converted to 8 pCi/L concentration by assuming a 2-liter per day intake of water for an 80-kg human, and that the beta activity is due to Sr-90.

7.2 Alluvial Water Quality

Water quality data are available for 9 monitoring wells completed in alluvium adjacent to Ralston Creek (Figure 2). Six of the wells (MW0, MW01, MW02, MW04, MW06, and MW07) were sampled and analyzed for uranium, radium, and field parameters (temperature, pH, and conductivity) for approximately 9 years, prior to the start of the 1998 – 1999 baseline hydrologic study. Three additional wells (MW9, MW5R, and MW00) were constructed in the alluvium in 1999 as part of the mine closure baseline hydrology study. These wells have been routinely monitored to the present, and several are slated for abandonment (in accordance with Colorado water well regulations) as part of mine closure.

Water quality for the alluvial monitoring wells is provided in Table 29. The water is a calcium-bicarbonate to calcium-sulfate-bicarbonate type water, with low dissolved solids and near neutral pH. TDS averages 170 mg/L in upgradient well MW00, and increases to about 340 mg/L in the vicinity of the mine. Trace metals are below detection in alluvial groundwater, with the exception of molybdenum and uranium.

The observed fluctuations in uranium concentrations in alluvial monitoring wells (Figure 38) may have resulted from surface disturbance related to reclamation activities. A trend of increasing concentrations in alluvial groundwater related to mine refilling is not apparent because (1) concentration trends do not coincide with mine refill trends (Section 5.2.3), (2) the highest concentrations in alluvial groundwater were observed in 2002 – 2003 when water levels in the mine were 400 – 600 feet below the creek level, and (3) groundwater in the mine and in the alluvium have distinct geochemical signatures. Nor are seasonal trends observed in surface water apparent in the alluvial groundwater. Surface water in Ralston Creek exhibits low concentrations during spring (high flow) months and higher concentrations during winter (low flow) months. Although more water flows through the alluvium in the spring, the higher water levels may liberate oxidized salts from above the normal water level in the alluvium and fill.

The point of compliance well drilled near the property boundary (MW8) was intended to monitor water quality in the alluvium as it exits the site. However, monitoring well MW8 is always dry and has never been sampled. As described in Section 4.2.1 and shown in Figure 4, the alluvium pinches out at the eastern edge of Section 25, near the property boundary, where a natural constriction in the valley occurs. Bedrock is exposed along the width of the valley floor and groundwater previously flowing in the alluvium is forced to the surface where it enters Ralston Creek. The point of compliance for groundwater in the alluvium is surface water station SW-BPL (below the property line).

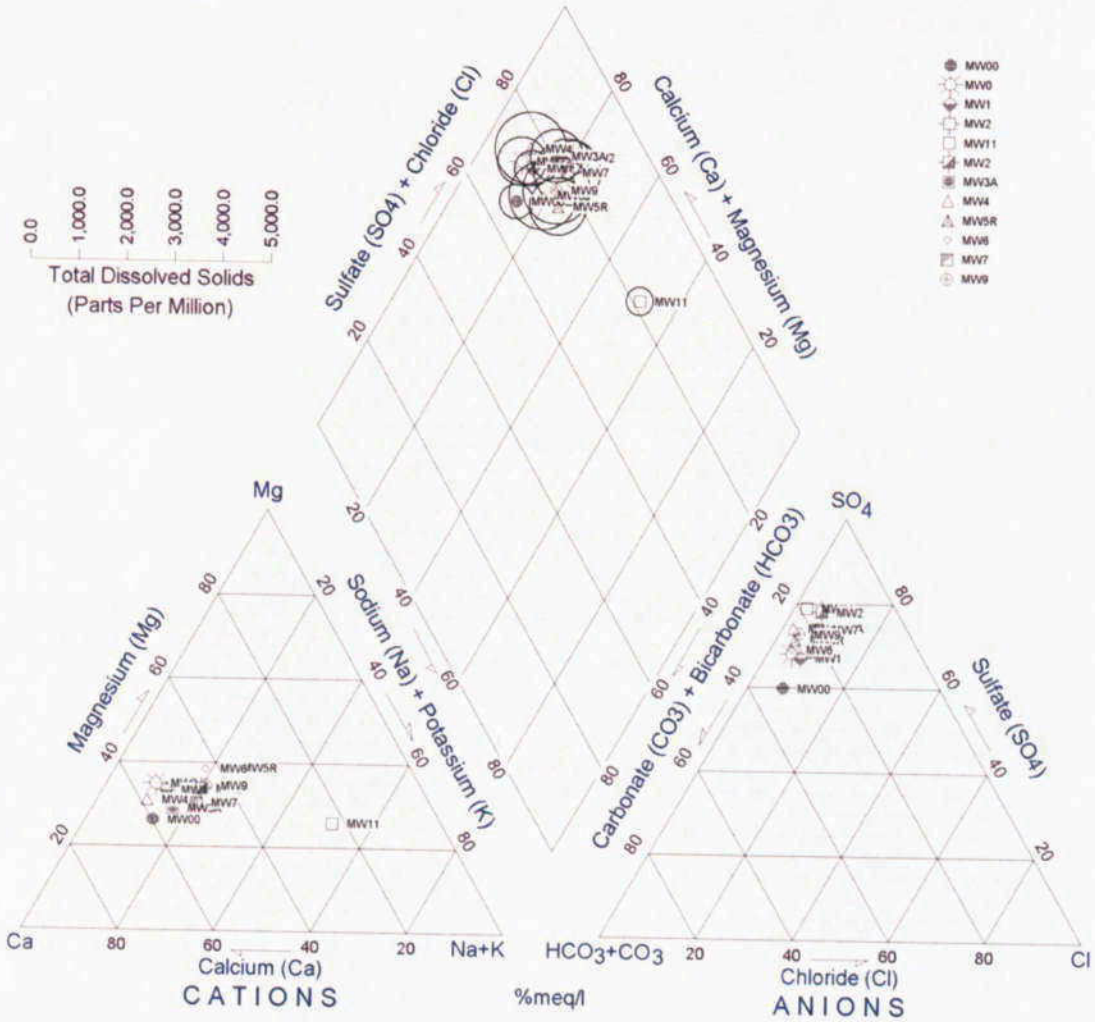


Figure 37. Piper Diagram Showing Major Ion Composition of Groundwater Samples (Averaged by Well)

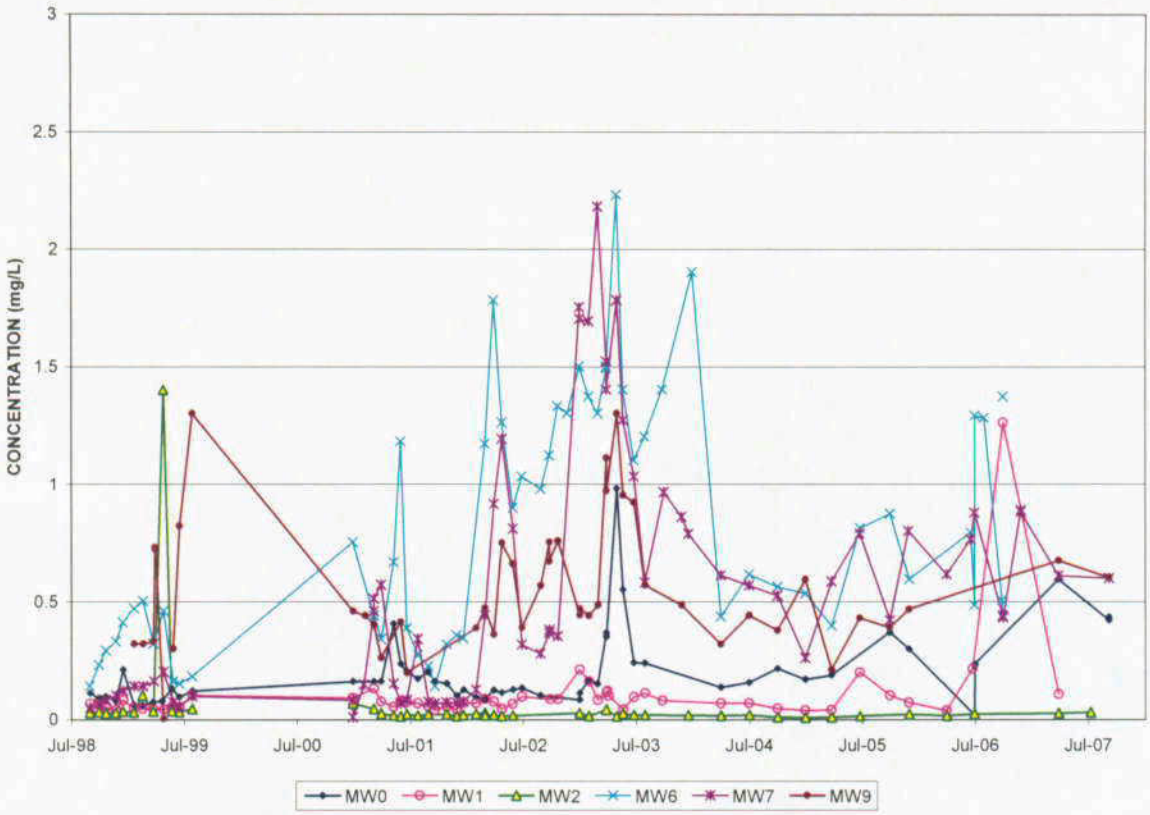


Figure 38. Uranium Concentrations in Alluvial Monitoring Wells Over Time

TABLE 32. WATER QUALITY IN ALLUVIAL MONITORING WELLS
1998 - 2007
MONITORING WELL MW00

	MW00 12/21/98	MW00 1/20/99	MW00 1/21/99	MW00 2/17/99	MW00 3/24/99	MW00 4/21/99	MW5 5/19/99	MW00 6/16/99	MW00 7/27/99	MW00 9/15/99	MW00 12/28/00	MW00 12/28/00	MW00 1/30/01	MW00 3/5/01	MW00 3/28/01	MW00 5/7/01	MW00 5/31/01	MW00 6/20/01	MW00 7/25/01	MW00 8/28/01	MW00 9/18/01	MW00 10/27/01	MW00 11/28/01	MW00 12/20/01	MW00 1/29/02	MW00 2/27/02	MW00 3/28/02	MW00 4/29/02	MW00 5/29/02	MW00 6/27/02	MW00 8/27/02	MW00 9/27/02
pH (std units)	6.9	7.1	7	7.4	7.6		7.6	7.3	7.9		7.6																					
Conductivity (umhos)	222	231	221	232	226		277	305	270		273									177							170					
Total dissolved solids	189	133	130	151	163		179	192	172		128																					
Total suspended solids	71.3	91.2	<1.	51.8	2		3	<10.	<10.		<10.																					
Hardness, total	88	96	92																													
Carbonate											<10.																					
Bicarbonate											82									107							90.3					
Alkalinity, dissolved							110	150	130																							
Alkalinity, total	85	96	86	98	89		110				82									88							74					
Nitrate Nitrogen	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	1	<0.5	<0.5	<0.5																						
Ammonia, total	0	0	0	0	0	0	<1.	<1.	<1.																							
Calcium, dissolved	24	26	24	25							22									32							32.7					
Calcium, total							36.5		32.8	46.4																						
Magnesium, dissolved	7.1	7.9	7.6	12			11.6		10.5	15.6	9.9									10							9.99					
Sodium, dissolved	10	10	9	<5.			8.8		8.9	11.3	5									12							11.3					
Potassium, dissolved	1.6	1.7	1.6	1.6			1.6		1.8	2.8	1.2									1.9							1.65					
Sulfate	19	18	18	19	19		16	16	12		25									17							27.1					
Fluoride, total	0.2	0.2	0.2	0.2																												
Chloride	11	10	11	12	10		7	5	11		19									25							29					
Aluminum, dissolved	<0.5	<0.5	<0.5				<0.1			0.3										<0.1							<0.2					
Aluminum, total												<0.2								<0.1							<0.2					
Antimony, dissolved	<0.003	<0.003	<0.003	<0.003			<0.006		<0.006	<0.006										<0.05							<0.001					
Antimony, total												<0.001								<0.05							<0.001					
Arsenic, dissolved				<0.003			<0.005		<0.005	<0.005																						
Arsenic, total	<0.003	<0.003	<0.003																	<0.001							<0.01					
Barium, dissolved				0.04			<0.1			<0.1																						
Barium, total	0.04	0.05	0.04																													
Beryllium, dissolved	<0.002	<0.002	<0.002	<0.002			<0.001			<0.001																						
Beryllium, total																																
Boron, total										<0.05																						
Cadmium, dissolved	<0.001	<0.0002	<0.0002	<0.0002			<0.001			<0.001																						
Cadmium, total																																
Chromium, dissolved	<0.005	<0.005	<0.005	<0.005			<0.005			<0.005																						
Chromium, total										<0.01																						
Cyanide, total																																
Copper																				<0.01							<0.011					
Copper, dissolved	<0.02	<0.02	<0.02				<0.005		<0.005	0.018		<0.005								<0.01							<0.005					
Copper, total																				<0.03							<0.03					
Iron, dissolved	<0.03	<0.03	<0.03				<0.1			0.2																						
Iron, total												<0.03								<0.03							<0.03					
Iron, suspended																																
Iron, Ferrous (Fe2+)																											<0.03					
Iron, Ferric (Fe3+)																																
Lead, dissolved				<0.002			<0.005		<0.005	<0.005										<0.05							<0.005					
Lead, total	<0.002	<0.002	0.004																													
Manganese, diss.	0.01	<0.01	<0.01				<0.01			<0.01										<0.01							<0.01					
Manganese, total												<0.01								<0.01							<0.01					
Mercury, dissolved	<0.0002	<0.0002	<0.0002	<0.0002																												
Mercury, total																				<0.001							<0.0001					
Molybdenum, diss.	<0.01	<0.01	<0.01	<0.01			<0.005		<0.005	<0.005	0.024									<0.1							<0.005					
Molybdenum, total																																
Nickel, dissolved	<0.04	<0.04	<0.04	<0.04			<0.01			0.01																						
Nickel, total																																
Phosphorous																																
Selenium, dissolved	<0.005	<0.005	<0.005	<0.005			<0.01		<0.01	<0.01																						
Selenium, total																																
Silver, dissolved	<0.0002	<0.0002	<0.0002	<0.0002			<0.01			<0.01										<0.01							<0.001					
Silver, total																				<0.001							<0.001					
Thallium, dissolved	<0.001	<0.001	<0.001	<0.001			<0.001		<0.001	<0.001																						
Vanadium, dissolved	<0.01	<0.01	<0.01	<0.01			<0.01			<0.01		<0.001								<0.001							<0.001					
Thallium, total																																
Vanadium, total																																
Zinc, dissolved	0.006	0.007	<0.005				<0.01		<0.01	<0.01										<0.01							<0.005					
Zinc, total																																
Uranium, dissolved	0.0028	0.0037	0.0059	0.0018	0.0091	0.0025	0.006	0.0089	0.0045		0.0055		0.0033	0.0033	0.0019	0.0032	0.0029	0.0075	0.0038	0.0033	0.0031	0.0034	0.0019	0.0028	0.002	0.0022	0.0021	0.0017	0.0019	0.0052	0.0039	0.0056
Uranium, suspended			0.0001								0.002	1.7																				
Uranium, total																																
Thorium-228, dis. (pCi/L)							0					0.0034																				
Thorium-230, dis. (pCi/L)							0.1																									
Thorium-232, dis. (pCi/L)							0																									
Radium-226, dis. (pCi/L)	0.6						0.2		0.3		0.6									0.7							<0.2					
Radium-226, susp. (pCi/L)			0								0.1																					
Radium-226, total (pCi/L)																																
Gross Alpha, dis. (pCi/L)	4.7						3.3		3																							
Gross Beta, dis. (pCi/L)	1.1						<5.		<5.																							

NOTES: Mean and median statistic calculated using one-half the detection limit (1/2 D.L.) < = not detected at detection limit shown ND, %ND = number and percent of non detects
Results in mg/L unless otherwise noted.

TABLE 32. WATER QUALITY IN ALLUVIAL MONITORING WELLS
1998 - 2007
MONITORING WELL MW00

	MW00 10/28/02	MW00 11/22/02	MW00 12/31/02	MW00 12/31/02	MW00 1/30/03	MW00 2/27/03	MW00 3/27/03	MW00 3/27/03	MW00 4/30/03	MW00 5/21/03	MW00 6/24/03	MW00 7/30/03	MW00 9/24/03	MW00 3/31/04	MW00 9/30/04	MW00 12/29/04	MW00 3/23/05	MW00 6/23/05	MW00 9/28/05	MW00 11/29/05	MW00 3/26/06	MW00 6/23/06	MW00 9/30/06	MW00 3/28/07	MW00 6/28/07	MIN	MAX	MEAN	MEDIAN	COUNT	ND	% ND
pH (std units)																									7.29	6.9	7.9	7.37	7.3	10	0	0%
Conductivity (umhos)																									319	221	319	258	232	10	0	0%
Total dissolved solids		221									214						146			140					194	128	221	168.7	170	16	0	0%
Total suspended solids																										<1.	91.2	26.1	5	9	4	44%
Hardness, total																										88	96	92	92	3	0	0%
Carbonate																										<10.	<10.	5		1	1	100%
Bicarbonate		132									128						79			95					139	79	139	106.5	101	8	0	0%
Alkalinity, dissolved																										110	150	130	140	3	0	0%
Alkalinity, total		109									105						64			78					114	64	114	91.286	88	14	0	0%
Nitrate Nitrogen																										<0.1	<1.	0.21	0.05	10	9	90%
Ammonia, total																										0	1	0.167	0	9	9	100%
Calcium, dissolved		48.4									34.6						27.3			27.2					35.8	22	48.4	29.9	27.25	12	0	0%
Calcium, total																										32.8	46.4	38.6	39.6	3	0	0%
Magnesium, dissolved		15.5									10.7						8.5			7.9					11.1	7.1	15.6	10.4	9.995	15	0	0%
Sodium, dissolved		16.3									7.94						9.9			8.6					10.2	<5.	16.3	9.4	9.95	15	1	7%
Potassium, dissolved		2.5									1.75						2.2			1.6					1.7	1.2	2.8	1.8	1.7	15	0	0%
Sulfate		47									25.3						15			19					18	12	47	20.7	19	16	0	0%
Fluoride, total																										0.2	0.2	0.2	0.2	4	0	0%
Chloride		26.3									15.2						28			24					18	5	29	16.344	15.2	16	0	0%
Aluminum, dissolved		<0.2									<0.2						<0.2			<0.2	<0.2	<0.2	<0.2		<0.2	<0.1	<0.5	0.137	0.1	15	14	93%
Aluminum, total		0.7									<0.2						0.1			<0.1					<0.2	<0.1	0.7	0.1625	0.1	8	6	75%
Antimony, dissolved		<0.001									<0.001						<0.001			<0.001	<0.001	<0.001	<0.001		<0.001	<0.001	<0.05	0.0026	0.0005	17	17	100%
Antimony, total		<0.001									<0.001						<0.001			<0.05					<0.001	<0.001	<0.05	0.0066	0.0005	8	8	100%
Arsenic, dissolved																										<0.003	<0.005	0.0023	0.0025	4	4	100%
Arsenic, total		<0.01									<0.01						<0.01			<0.001					<0.1	<0.001	<0.1	0.0076	0.00325	10	10	100%
Barium, dissolved																									0.053	0.04	0.1	0.048	0.05	4	2	50%
Barium, total																									0.058	0.04	0.058	0.047	0.045	4	0	0%
Beryllium, dissolved																										<0.001	<0.002	0.00083	0.001	6	6	100%
Beryllium, total																										0	0			0	0	n/a
Boron, total																										<0.05	<0.05	0.025	0.025	1	1	100%
Cadmium, dissolved																										<0.0002	<0.001	0.0003	0.0001	6	6	100%
Cadmium, total																										0	0			0	0	n/a
Chromium, dissolved																										<0.005	<0.005	0.0025	0.0025	6	6	100%
Chromium, total																										0	0			0	0	n/a
Cyanide, total																										<0.01	<0.01	0.005	0.005	1	1	100%
Copper																										0	0			0	0	n/a
Copper, dissolved		0.009									<0.005						<0.005			<0.005	0.002	0.002	0.003		<0.005	<0.002	<0.02	0.00541	0.00275	17	12	71%
Copper, total		0.007									<0.005						<0.005			<0.01					<0.005	<0.005	<0.01	0.0039	0.0025	7	6	86%
Iron, dissolved		<0.03									<0.03						<0.03			<0.03					<0.03	<0.03	0.2	0.0333	0.015	12	11	92%
Iron, total																	0.08			<0.03					0.04	<0.03	<0.08	0.0375	0.0275	4	2	50%
Iron, suspended		0.79									0.035															<0.03	0.79	0.214	0.025	4	2	50%
Iron, Ferrous (Fe2+)																					<0.03	0.04	<0.03		<0.03	0.03	0.04	0.02125	0.015	4	3	75%
Iron, Ferric (Fe3+)		0.79									0.035						0.07			<0.03						<0.03	0.79	0.185	0.035	5	2	40%
Lead, dissolved																										<0.002	<0.005	0.0021	0.0025	4	4	100%
Lead, total		<0.005									<0.005						<0.005			<0.05					<0.005	<0.002	<0.05	0.00685	0.0025	10	9	90%
Manganese, diss.		<0.01									<0.01						<0.01			<0.01	<0.01	<0.01	<0.01		<0.01	<0.01	0.01	0.0053	0.005	15	14	93%
Manganese, total		0.05									<0.01						<0.01			<0.01					<0.01	<0.01	0.05	0.010625	0.005	8	7	88%
Mercury, dissolved																										<0.0002	<0.0002	0.0001	0.0001	4	4	100%
Mercury, total		<0.0001									<0.0001						<0.0001			<0.001					<0.0001	<0.0001	<0.001	0.0002	0.00005	7	7	100%
Molybdenum, diss.		<0.005									<0.005						<0.005			<0.005	0.079	0.007	0.058		<0.005	<0.005	<0.1	0.0145	0.005	18	14	78%
Molybdenum, total																										0	0			0	0	n/a
Nickel, dissolved																										0.01	<0.04	0.01583	0.02	6	5	83%
Nickel, total																										0	0			0	0	n/a
Phosphorous																										0	0			0	0	n/a
Selenium, dissolved																										<0.005	<0.01	0.0036	0.0025	7	7	100%
Selenium, total																										0	0			0	0	n/a
Silver, dissolved																										<0.0002	<0.01	0.0017	0.0001	6	6	100%
Silver, total		<0.001									<0.001						<0.01			<0.01					<0.001	<0.001	<0.01	0.0024	0.0005	7	7	100%
Thallium, dissolved		<0.001									<0.001						<0.001			<0.001	<0.001	<0.001	<0.001		<0.001	<0.001	<0.001	0.0005	0.0005	17	17	100%
Vanadium, dissolved																										<0.001	<0.01	0.0044	0.005	7	7	100%
Thallium, total		<0.001									<0.001						<0.001			<0.1					<0.001	<0.001	<0.1	0.00757	0.0005	7	7	100%
Vanadium, total																										0	0			0	0	n/a
Zinc, dissolved																										<0.005	<0.01	0.00508	0.005	6	4	67%
Zinc, total		0.012									0.007						<0.005			<0.01					<0.005	<0.005	0.012	0.0052	0.005	7	5	71%
Uranium, dissolved	0.0146	0.0686	0.0046	0.0031	0.0019	0.0013	0.002	0.0013	0.0056	0.0084	0.0066	0.0068	0.0176	0.0018	0.0012	0.0009	0.0013	0.447	0.0023	0.0038	0.462	0.189	1.18	0.0045	0.0054	0.0009	1.18	0.0465	0.00335	55	0	0%
Uranium, suspended																		0.0035							<0.0002	0.0001	1.7	0.3411	0.002	5	1	20%
Uranium, total																									0.0036	0.0036	0.0036	0.0036	0.0036	1	0	0%
Thorium-228, dis. (pCi/L)																										0	0.0034	0.0017	0.0034	2	1	50%
Thorium-230, dis. (pCi/L)																										0.1	0.1	0.1		1	0	0%
Thorium-232, dis. (pCi/L)																										0	0	0		1	1	100%
Radium-226, dis. (pCi/L)		1.4									0.4						<0.2			<0.2					0.6	<0.2	1.4	0.46	0.5	11	3	27%
Radium-226, susp. (pCi/L)																									<0.2	0	0.2	0.067	0.1	3	2	67%
Radium-226, total (pCi/L)																										0	0			0	0	n/a
Gross Alpha, dis. (pCi/L)																										3	4.7	3.667	3.85	3	0	0%
Gross Beta, dis. (pCi/L)																										1.1	<5.	2.033	1.8	3	2	67%

TABLE 32. WATER QUALITY IN ALLUVIAL MONITORING WELLS
1998 - 2007
MONITORING WELL MW0

	MW0 8/31/98	MW0 9/29/98	MW0 10/21/98	MW0 11/23/98	MW0 12/16/98	MW0 1/20/99	MW0 2/17/99	MW0 3/24/99	MW0 4/21/99	MW0 5/24/99	MW0 6/16/99	MW0 7/28/99	MW0 9/15/99	MW0 12/28/00	MW0 3/5/01	MW0 3/28/01	MW0 5/7/01	MW0 5/31/01	MW0 6/20/01	MW0 7/25/01	MW0 8/27/01	MW0 9/18/01	MW0 10/27/01	MW0 11/28/01	MW0 12/20/01	MW0 1/29/02	MW0 2/27/02	MW0 3/28/02	MW0 4/23/02	MW0 5/29/02	MW0 6/27/02	MW0 8/27/02
pH (std units)	7.4	7.4	7.2	7.7	7.2	6.9	7.3	7.5		7.2	7.1	7.1																				
Conductivity (umhos)	374	363	358	343	334	310	298	293		406	256	355										280							240			
Total dissolved solids	276	215	234	241	222	176	189	181		286	176	248																				
Total suspended solids	2	5	<1.	<1.	2	<1.	<1.	7		0	45.1	<10.																				
Hardness, total	160	170	160	150	150	140																										
Carbonate																						135							135			
Bicarbonate										87	89	92																	80			
Alkalinity, Dissolved										87												111										
Alkalinity, total	120	220	120	120	120	98	97	79		1	0.5	0.5	1.7																			
Nitrate Nitrogen	0.7	0.4	<0.1	0.5	<0.1	0.4	<0.1	0.4	<0.1	<1.	<1.	<1.																				
Ammonia, total		0	0	0	0	0	0	0	0													50							48.6			
Calcium, dissolved	43	45	42	41	39	36	43																									
Calcium, total										51.4		43.2	83									18							16.8			
Magnesium, dissolved	14	14	13	13	12	11	96			17.1		14.7	31.4									12							11.1			
Sodium, dissolved	8	12	10	10	9	9	<5.			10		10	14.1									2.5							2.6			
Potassium, dissolved	2.1	3	2.9	2.6	2.6	2.3	2.3			2.8		2.7	3.8									71							78.2			
Sulfate	83	60	73	65	65	54	52	52		110	45	75																				
Fluoride, total	0.2	0.3	0.3	0.3	0.3	0.3	0.3															25							29.9			
Chloride	10	13	13	11	9	10	10	10		8	11	10										<0.1							<0.1			
Aluminum, dissolved	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5				<0.1												<0.1							<0.2			
Aluminum, total																						<0.05							<0.001			
Antimony, dissolved		<0.03	<0.03	<0.008	<0.003	<0.003	<0.003			<0.006		<0.006	<0.006									<0.05							<0.001			
Antimony, total	<0.03																															
Arsenic, dissolved	<0.005	<0.05	<0.05	<0.003			<0.003			<0.005		<0.005	<0.005									<0.001							<0.01			
Arsenic, total	<0.05				<0.003	<0.003																										
Barium, dissolved	<0.5	0.06	0.06	0.05			0.04			<0.1																						
Barium, total	0.06				0.05	0.05																										
Beryllium, dissolved		<0.001	<0.001	<0.002	<0.002	<0.002	<0.002			<0.001																						
Beryllium, total	<0.001																															
Boron, total																																
Cadmium, dissolved		<0.002	<0.002	<0.0002	<0.0002	<0.0002	<0.0002			<0.001																						
Cadmium, total	<0.003																															
Chromium, dissolved		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005			<0.005																						
Chromium, total	<0.005												<0.01																			
Cyanide, total																																
Copper																						<0.01							<0.005			
Copper, dissolved	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02				<0.005		<0.005	<0.005									<0.01							<0.005			
Copper, total																						<0.03							<0.03			
Iron, dissolved	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03				<0.1																			<0.03			
Iron, total																						<0.03										
Iron, suspended																																
Iron, Ferrous (Fe2+)																													<0.03			
Iron, Ferric (Fe3+)																																
Lead, dissolved	0.0013	<0.05	<0.05	<0.002			<0.002			<0.005		<0.005	<0.005									<0.05							<0.005			
Lead, total	<0.02				<0.002	<0.002																<0.01							<0.01			
Manganese, diss.	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01				<0.01												<0.01							<0.01			
Manganese, total																																
Mercury, dissolved		<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002															<0.001							<0.0001			
Mercury, total	<0.0002																					<0.1							0.019			
Molybdenum, diss.		0.024	0.028	0.02	0.02	0.02	0.02			0.035		0.034	0.036																			
Molybdenum, total	0.03																															
Nickel, dissolved		<0.02	<0.02	<0.04	<0.04	<0.04	<0.04			<0.01			<0.01																			
Nickel, total	<0.02																															
Phosphorous																																
Selenium, dissolved		<0.05	<0.05	<0.005	<0.005	<0.005	<0.005			<0.01		<0.01	<0.01																			
Selenium, total	<0.05																															
Silver, dissolved		<0.005	<0.005	<0.001	<0.0002	<0.0002	<0.0002			<0.01												<0.01							<0.001			
Silver, total	<0.005																					<0.001							<0.001			
Thallium, dissolved		<0.05	<0.05	<0.001	<0.001	<0.001	<0.001			<0.001		<0.001	<0.001																			
Vanadium, dissolved		<0.005	<0.005	<0.01	<0.01	<0.01	<0.01			<0.01												<0.001							<0.001			
Thallium, total	<0.03																															
Vanadium, total	<0.005																															
Zinc, dissolved	0.008	0.008	0.006	<0.005	<0.005	0.008				<0.01		<0.01	<0.01									<0.01							<0.005			
Zinc, total																																
Uranium, dissolved	0.11	0.0895	0.096	0.076	0.21	0.062	0.0585	0.0735	0.0765	0.13	0.0945	0.12		0.16	0.16	0.16	0.405	0.235	0.203	0.172	0.199	0.16	0.152	0.0992	0.125	0.0932	0.0845	0.123	0.112	0.126	0.132	0.101
Uranium, suspended																																
Uranium, total																																
Thorium-228, dis. (pCi/L)	0.2	0	0							0																						
Thorium-230, dis. (pCi/L)	0.2	0.1	0							0																						
Thorium-232, dis. (pCi/L)	0.2	0	0							0												0.5							1			
Radium-226, dis. (pCi/L)	1.7	0.5	0.3	0.6	0.3					0.4		0.5																				
Radium-226, susp. (pCi/L)																																
Radium-226, total (pCi/L)																																
Gross Alpha, dis. (pCi/L)	140	120	44	43	46					57		57																				
Gross Beta, dis. (pCi/L)	29	32	36	35	39					60		48																				

NOTES: Mean and median statistic calculated using one-half the detection limit (1/2 D.L.)
Results in mg/L unless otherwise notec

< = not detected at detection limit shown

ND, %ND = number and percent of non detects

TABLE 32. WATER QUALITY IN ALLUVIAL MONITORING WELLS
1998 - 2007
MONITORING WELL MW0

	MW0 12/31/02	MW0 12/31/02	MW0 1/30/03	MW0 2/27/03	MW0 3/27/03	MW0 3/27/03	MW0 4/30/03	MW0 5/21/03	MW0 6/24/03	MW0 7/30/03	MW0 3/31/04	MW0 6/30/04	MW0 9/30/04	MW0 12/29/04	MW0 3/23/05	MW0 9/28/05	MW0 11/29/05	MW0 6/29/06	MW0 6/30/06	MW0 6/30/06	MW0 3/28/07	MW0 9/6/07	MW0 9/6/07	MIN	MAX	MEAN	MEDIAN	COUNT	ND	% ND
pH (std units)																						7.03	6.98	6.9	7.7	7.23	7.2	13	0	0%
Conductivity (umhos)																						535	536	256	536	367.8	355	13	0	0%
Total dissolved solids			437							640		280										376	378	176	640	281.9	244.5	18	0	0%
Total suspended solids																								0	45.1	6.191	2	11	6	55%
Hardness, total																								140	170	155	155	6	0	0%
Carbonate																								0	0			0	0	n/a
Bicarbonate			108							121		108										145	145	108	145	128.1	135	7	0	0%
Alkalinity, Dissolved																								69	92	82.7	87	3	0	0%
Alkalinity, total			89							99		88.2										119	119	79	220	110.4	105	16	0	0%
Nitrate Nitrogen																								<0.1	1.7	0.48	0.4	13	4	31%
Ammonia, total																								0	<1.	0.136	0	11	11	100%
Calcium, dissolved			78.4							71.4		54.4										57.8	59.6	36	78.4	50.7	46.8	14	0	0%
Calcium, total																								43.2	83	59.2	51.4	3	0	0%
Magnesium, dissolved			26.1							23.8		18.8										20.7	21.5	11	96	22.5	17.1	17	0	0%
Sodium, dissolved			24.2							11		11.8										12.4	13	5	24.2	11.2	11	17	1	6%
Potassium, dissolved			3.96							2.69		2.5										3.2	3.3	2.1	3.96	2.81	2.69	17	0	0%
Sulfate			191							179		99										131	131	45	191	89.7	74	18	0	0%
Fluoride, total																								0.2	0.3	0.286	0.3	7	0	0%
Chloride			32.7							17.2		24										24	24	8	32.7	16.2	12	18	0	0%
Aluminum, dissolved			<0.2							<0.2		<0.2						<0.2	<0.2	<0.2		<0.2	<0.2	<0.1	<0.5	0.144	0.1	17	17	100%
Aluminum, total			<0.2							<0.2		<0.2										<0.2	<0.2	<0.1	<0.2	0.093	0.1	7	7	100%
Antimony, dissolved			<0.001							<0.001		<0.001						<0.001	<0.001	<0.001		<0.001	<0.001	<0.001	<0.05	0.004	0.0015	19	19	100%
Antimony, total			<0.001							<0.001		<0.001												<0.001	<0.05	0.0070	0.0005	6	6	100%
Arsenic, dissolved																								<0.003	<0.05	0.0079	0.0025	8	8	100%
Arsenic, total			<0.01							<0.01		<0.01										<0.1	<0.1	<0.001	<0.1	0.015	0.005	10	10	100%
Barium, dissolved																						0.072	0.065	0.04	0.5	0.081	0.06	8	2	25%
Barium, total																						0.068	0.063	0.05	0.068	0.058	0.06	5	0	0%
Beryllium, dissolved																								<0.001	<0.002	0.001	0.001	7	7	100%
Beryllium, total																								<0.001	<0.001	0.0005	0.0005	1	1	100%
Boron, total																								0	0			0	0	n/a
Cadmium, dissolved																								<0.0002	<0.002	0.0004	0.0001	7	7	100%
Cadmium, total																								<0.003	<0.003	0.0015	0.0015	1	1	100%
Chromium, dissolved																								<0.005	<0.005	0.0025	0.0025	7	7	100%
Chromium, total																								<0.005	<0.005	0.0025	0.0025	1	1	100%
Cyanide, total																								<0.01	<0.01	0.005	0.005	1	1	100%
Copper																								0	0			0	0	n/a
Copper, dissolved			0.01							<0.005		<0.005						<0.001	0.003	0.003		<0.005	<0.005	<0.001	<0.02	0.005	0.003	19	16	84%
Copper, total			<0.005							<0.005		<0.005										<0.005	<0.005	<0.005	<0.01	0.0029	0.0025	7	7	100%
Iron, dissolved			<0.03							<0.03		<0.03										0.16	0.1	<0.03	<0.16	0.034	0.015	14	12	86%
Iron, total			0.047							0.094		0.08										0.15	0.09	<0.03	0.15	0.079	0.085	6	1	17%
Iron, suspended																								<0.03	<0.03	0.015	0.015	1	1	100%
Iron, Ferrous (Fe2+)																		<0.03	<0.03	<0.03		0.16	0.1	0.03	0.16	0.061	0.015	5	3	60%
Iron, Ferric (Fe3+)			0.047							0.094		0.08												<0.03	0.094	0.059	0.0635	4	1	25%
Lead, dissolved																								0.0013	<0.05	0.0076	0.0025	8	7	88%
Lead, total			<0.005							<0.005		<0.005										<0.005	<0.005	<0.002	<0.05	0.0052	0.0025	10	10	100%
Manganese, diss.			<0.01							<0.01		<0.01						<0.01	<0.01	<0.01		<0.01	<0.01	<0.01	<0.01	0.005	0.005	17	17	100%
Manganese, total			<0.01							<0.01		<0.01										<0.01	<0.01	<0.01	<0.01	0.005	0.005	7	7	100%
Mercury, dissolved																								<0.0002	<0.0002	0.0001	0.0001	6	6	100%
Mercury, total			<0.0002							<0.0001		<0.0001										<0.0001	<0.0001	<0.0001	<0.001	0.0001	0.00005	8	8	100%
Molybdenum, diss.			0.015							0.021		0.023						0.006	0.021	0.021		0.024	0.024	0.006	<0.1	0.024	0.021	19	1	5%
Molybdenum, total																								0.03	0.03	0.03	0.03	1	0	0%
Nickel, dissolved																								<0.01	<0.04	0.014	0.015	8	8	100%
Nickel, total																								<0.02	<0.02	0.01	0.01	1	1	100%
Phosphorous																								<0.	<0.			0	0	n/a
Selenium, dissolved																								<0.005	<0.05	0.008	0.005	9	9	100%
Selenium, total																								<0.05	<0.05	0.025	0.025	1	1	100%
Silver, dissolved																								<0.0002	<0.01	0.0015	0.0005	7	7	100%
Silver, total			<0.004							<0.001		<0.001										<0.001	<0.001	<0.001	<0.01	0.002	0.0005	8	8	100%
Thallium, dissolved			<0.001							<0.001		<0.001						<0.001	<0.001	<0.001		<0.001	<0.001	<0.001	<0.05	0.0031	0.0005	19	19	100%
Vanadium, dissolved																								<0.005	<0.01	0.004	0.005	7	7	100%
Thallium, total			<0.001							<0.001		<0.001												<0.001	<0.03	0.0029	0.0005	6	6	100%
Vanadium, total																								<0.005	<0.005	0.0025	0.0025	1	1	100%
Zinc, dissolved																								<0.005	<0.01	0.006	0.005	9	5	56%
Zinc, total			0.007							0.005		<0.005										<0.005	<0.005	<0.005	<0.01	0.004	0.0025	7	5	71%
Uranium, dissolved	0.0824	0.11	0.166	0.15	0.367	0.35	0.98	0.55	0.24	0.238	0.135	0.155	0.214	0.168	0.187	0.369	0.298	0.0183	0.228	0.233	0.594	0.42	0.434	0.0183	0.98	0.202	0.1575	54	0	0%
Uranium, suspended																						0.0008	0.0004	0.0004	0.0008	0.0006	0.0006	2	0	0%
Uranium, total																						0.456	0.43	0.43	0.456	0.443	0.443	2	0	0%
Thorium-228, dis. (pCi/L)																								0	0.2	0.050	0	4	3	75%
Thorium-230, dis. (pCi/L)																								0	0.2	0.075	0.05	4	2	50%
Thorium-232, dis. (pCi/L)																								0	0.2	0.050	0	4	3	75%
Radium-226, dis. (pCi/L)			1.4							0.5		0.5										<0.2	<0.2	0.2	1.7	0.60	0.5	14	2	14%
Radium-226, susp. (pCi/L)																						<0.2	<0.2	0.2	0.2	0.1	0.1	2	2	100%
Radium-226, total (pCi/L)																								0	0			0	0	n/a
Gross Alpha, dis. (pCi/L)																								43	140	72.4	57	7	0	0%
Gross Beta, dis. (pCi/L)																								29	60	39.9	36	7	0	0%

TABLE 32. WATER QUALITY IN ALLUVIAL MONITORING WELLS
1998 - 2007
MONITORING WELL MW1

	MW1 8/31/98	MW1 9/29/98	MW1 10/22/98	MW1 11/23/98	MW1 12/16/98	MW1 1/20/99	MW1 2/17/99	MW1 3/24/99	MW1 4/27/99	MW1 5/24/99	MW1 6/15/99	MW1 7/28/99	MW1 9/15/99
pH (std units)	7.2	8.3	7.1	7.5	7.2	6.9	7.3	7.5	7.4	7.2	7.2	7.2	
Conductivity (umhos)	303	286	271	264	245	238	233	224	296	296	332	309	
Total dissolved solids	223	158	170	193	152	126	151	132	187	211	226	207	
Total suspended solids	293	174	128	33.9	41.8	216	175	4	30.3	3	<10.	46.3	
Hardness, total	130	120	110	110	100	96							
Carbonate													
Bicarbonate									66	70	85	91	
Alkalinity, Dissolved													
Alkalinity, total	120	97	93	95	120	81	83	85	66	70			
Nitrate Nitrogen	0.7	0.4	0.4	0.9	<0.1	0.4	0.4	0.4	0.8	1	0.5	0.5	<0.5
Ammonia, total		0	0	0	0	0	0	0	0	<1.	<1.	<1.	
Calcium, dissolved	35	33	30	31	27	26	34						
Calcium, total										35.2		36.5	59.1
Magnesium, dissolved	10	10	9.6	9.2	8.4	7.9	75			11.5		12.2	21.6
Sodium, dissolved	8	10	10	9	8	9	5			8.6		10	12
Potassium, dissolved	2.2	2.5	2.3	2.1	1.9	1.7	1.8			2.3		2.3	3.1
Sulfate	48	37	36	39	36	32	39	27	65	69	63	52	
Fluoride, total	0.2	0.3	0.3	0.2	0.3	0.3	0.3						
Chloride	9	13	13	12	13	10	9	11	11	9	10	11	
Aluminum, dissolved	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5				<0.1			
Aluminum, total													
Antimony, dissolved		<0.03	<0.03	<0.008	<0.003	<0.003	<0.003			<0.006		<0.006	<0.006
Antimony, total	<0.03												
Arsenic, dissolved	<0.005	<0.05	<0.05	<0.003			<0.003			<0.005		<0.005	<0.005
Arsenic, total	<0.05				<0.003	<0.003							
Barium, dissolved	<0.5	0.05	0.05	0.05			0.03			<0.1			
Barium, total	0.05				0.04	0.05							
Beryllium, dissolved		<0.001	<0.001	<0.002	<0.002	<0.002	<0.002			<0.001			
Beryllium, total	<0.001												
Boron, total													
Cadmium, dissolved		<0.002	<0.002	<0.0002	<0.0002	<0.0002	<0.0002			<0.001			
Cadmium, total	<0.003												
Chromium, dissolved		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005			<0.005			
Chromium, total	<0.005												<0.01
Cyanide, total													
Copper													
Copper, dissolved	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02				<0.005		<0.005	<0.005
Copper, total													
Iron, dissolved	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03				<0.1			
Iron, total													
Iron, suspended													
Iron, Ferrous (Fe2+)													
Iron, Ferric (Fe3+)													
Lead, dissolved	<0.0003	<0.05	<0.05	<0.002			0.004			<0.005		<0.005	<0.005
Lead, total	<0.02				<0.002	0.005							
Manganese, diss.	<0.01	0.01	<0.01	<0.01	<0.01	<0.01				<0.01			
Manganese, total													
Mercury, dissolved		<0.0002	0.0003	0.0002	<0.0002	<0.0002	0.0008						
Mercury, total	<0.0002												
Molybdenum, diss.		0.006	0.008	0.01	<0.01	<0.01	<0.01			0.019		0.013	0.014
Molybdenum, total	0.012												
Nickel, dissolved		<0.02	<0.02	<0.04	<0.04	<0.04	<0.04			<0.01			<0.01
Nickel, total	<0.02												
Phosphorous													
Selenium, dissolved		<0.05	<0.05	<0.005	<0.005	<0.005	<0.005			<0.01		<0.01	<0.01
Selenium, total	<0.05												
Silver, dissolved		<0.005	<0.005	<0.001	<0.0002	<0.0002	<0.0002			<0.01			
Silver, total	<0.005												
Thallium, dissolved		<0.05	<0.05	<0.001	<0.001	<0.001	<0.001			<0.001		<0.001	0.001
Vanadium, dissolved		<0.005	<0.005	<0.01	<0.01	<0.01	<0.01			<0.01			
Thallium, total	<0.03												
Vanadium, total	<0.005												
Zinc, dissolved	0.006	0.006	0.008	<0.005	0.007	0.008				<0.01		<0.01	<0.01
Zinc, total													
Uranium, dissolved	0.0648	0.0622	0.05	0.0392	0.0804	0.049	0.044	0.042	0.041	0.052	0.0525	0.1	
Uranium, suspended													
Uranium, total													
Thorium-228, dis. (pCi/L)	0	0	0							0			
Thorium-230, dis. (pCi/L)	0.4	0.2	0.1							0			
Thorium-232, dis. (pCi/L)	0	0	0							0			
Radium-226, dis. (pCi/L)	1.2	0.5	0.3	0.5	1				0.3	0.1		0.3	
Radium-226, susp. (pCi/L)													
Radium-226, total (pCi/L)													
Gross Alpha, dis. (pCi/L)	92	81	31	29	45					28		35	
Gross Beta, dis. (pCi/L)	25	13	26	18	35					32		34	

	MW1 12/28/00	MW1 3/5/01	MW1 3/28/01	MW1 5/7/01	MW1 5/31/01	MW1 6/20/01	MW1 7/25/01	MW1 8/27/01	MW1 9/18/01	MW1 10/27/01	MW1 11/28/01	MW1 12/20/01	MW1 1/29/02	MW1 2/27/02	MW1 3/28/02	MW1 4/23/02	MW1 5/28/02	MW1 6/27/02
pH (std units)																		
Conductivity (umhos)											153							315
Total dissolved solids																		
Total suspended solids																		
Hardness, total																		
Carbonate											80.5							95.2
Bicarbonate																		
Alkalinity, Dissolved											66							78
Alkalinity, total																		
Nitrate Nitrogen																		
Ammonia, total											31.9							56.6
Calcium, dissolved																		
Calcium, total											9.3							16.7
Magnesium, dissolved											12.8							18.7
Sodium, dissolved											1.8							2.56
Potassium, dissolved											28.4							121
Sulfate																		
Fluoride, total											28.3							34.8
Chloride											<0.1							<0.2
Aluminum, dissolved											0.3							<0.2
Aluminum, total											<0.05							<0.001
Antimony, dissolved											<0.05							<0.001
Antimony, total																		
Arsenic, dissolved											<0.001							<0.01
Arsenic, total																		
Barium, dissolved																		
Barium, total																		
Beryllium, dissolved																		
Beryllium, total																		
Boron, total																		
Cadmium, dissolved																		
Cadmium, total																		
Chromium, dissolved																		
Chromium, total																		
Cyanide, total																		
Copper											<0.01							<0.005
Copper, dissolved											<0.01							<0.005
Copper, total																		
Iron, dissolved											0.86							0.199
Iron, total																		
Iron, suspended											<0.03							<0.03
Iron, Ferrous (Fe2+)											0.86							0.199
Iron, Ferric (Fe3+)																		
Lead, dissolved											<0.05							<0.005
Lead, total											<0.01							<0.01
Manganese, diss.											<0.01							<0.01
Manganese, total																		
Mercury, dissolved											<0.001							<0.0001
Mercury, total											<0.1							<0.005
Molybdenum, diss.																		
Molybdenum, total																		
Nickel, dissolved																		
Nickel, total																		
Phosphorous																		
Selenium, dissolved																		
Selenium, total																		
Silver, dissolved											<0.01							<0.001
Silver, total											<0.001							<0.001
Thallium, dissolved																		
Vanadium, dissolved											<0.001							<0.001
Thallium, total																		
Vanadium, total																		
Zinc, dissolved											<0.01							0.006
Zinc, total																		
Uranium, dissolved	0.09	0.13	0.0744	0.0523	0.0774	0.0726	0.067	0.055	0.039	0.0536	0.0409	0.0687	0.0682	0.0854	0.0731	0.0444	0.065	0.0943
Uranium, suspended																		
Uranium, total																		
Thorium-228, dis. (pCi/L)																		
Thorium-230, dis. (pCi/L)																		
Thorium-232, dis. (pCi/L)																		
Radium-226, dis. (pCi/L)	1.3		0.7						0.6		<0.2				0.5			0.3
Radium-226, susp. (pCi/L)																		
Radium-226, total (pCi/L)																		
Gross Alpha, dis. (pCi/L)																		
Gross Beta, dis. (pCi/L)																		

NOTES: Mean and median statistic calculated using one-half the detection limit (1/2 D.L.)
Results in mg/L unless otherwise notec

< = not detected at detection limit shown

ND, %ND = number and percent of non detects

TABLE 32. WATER QUALITY IN ALLUVIAL MONITORING WELLS
1998 - 2007
MONITORING WELL MW1

	MW1 9/27/02	MW1 10/22/02	MW1 12/31/02	MW1 1/30/03	MW1 2/27/03	MW1 3/27/03	MW1 3/31/03	MW1 4/3/03	MW1 5/21/03	MW1 6/24/03	MW1 7/30/03	MW1 9/24/03	MW1 3/31/04	MW1 6/30/04	MW1 9/30/04	MW1 12/29/04	MW1 3/23/05	MW1 6/23/05	MW1 9/28/05	MW1 11/29/05	MW1 3/31/06	MW1 6/23/06	MW1 9/30/06	MW1 3/28/07	MIN	MAX	MEAN (calc using 1/2 DL)	MEDIAN	COUNT	ND	% ND
pH (std units)																								7.32	6.9	8.3	7.33	7.2	13	0	0%
Conductivity (umhos)																								372	224	372	282.2	286	13	0	0%
Total dissolved solids			335		212																			234	126	335	199.1	193	17	0	0%
Total suspended solids																									3	293	95.9	44.1	12	1	8%
Hardness, total																									96	130	111	110	6	0	0%
Carbonate																									0	0			0	0	n/a
Bicarbonate			97.6		67.7																			63	63	97.6	80.8	80.5	5	0	0%
Alkalinity, Dissolved																									66	91	78.0	77.5	4	0	0%
Alkalinity, total			80		56																			52	52	120	82.8	81	15	0	0%
Nitrate Nitrogen																									<0.1	1	0.52	0.4	13	2	15%
Ammonia, total																									0	<1.	0.136	0	11	11	100%
Calcium, dissolved			63.2		35.4																			43.6	26	63.2	37.2	33.5	12	0	0%
Calcium, total																									35.2	59.1	43.6	36.5	3	0	0%
Magnesium, dissolved			19.1		10.6																			14.2	7.9	75	16.4	10.6	15	0	0%
Sodium, dissolved			17.6		15.9																			12	5	18.7	11.1	10	15	0	0%
Potassium, dissolved			2.9		2.01																			2	1.7	3.1	2.23	2.2	15	0	0%
Sulfate			130		74.5																			95	27	130	58.3	48	17	0	0%
Fluoride, total																									0.2	0.3	0.271	0.3	7	0	0%
Chloride			33.7		22.8																			23	9	34.8	16.1	12	17	0	0%
Aluminum, dissolved			<0.1		<0.2																<0.2	<0.2	<0.2	<0.2	<0.1	<0.5	0.150	0.1	15	15	100%
Aluminum, total			0.29		0.28																			<0.2	<0.2	0.3	0.214	0.28	5	2	40%
Antimony, dissolved			<0.001		<0.001																<0.001	<0.001	<0.001	<0.001	<0.001	<0.05	0.004	0.0015	17	17	100%
Antimony, total			<0.001		<0.001																			<0.001	<0.001	<0.05	0.0070	0.0005	6	6	100%
Arsenic, dissolved																									<0.003	<0.05	0.0079	0.0025	8	8	100%
Arsenic, total			<0.01		<0.01																			<0.1	<0.001	<0.1	0.012	0.005	8	8	100%
Barium, dissolved																								0.047	0.03	<0.5	0.075	0.05	7	2	29%
Barium, total																								0.05	0.04	0.05	0.048	0.05	4	0	0%
Beryllium, dissolved																									<0.001	<0.002	0.001	0.001	7	7	100%
Beryllium, total																									<0.001	<0.001	0.0005	0.0005	1	1	100%
Boron, total																									0	0			0	0	n/a
Cadmium, dissolved																									<0.0002	<0.002	0.0004	0.0001	7	7	100%
Cadmium, total																									<0.003	<0.003	0.0015	0.0015	1	1	100%
Chromium, dissolved																									<0.005	<0.005	0.0025	0.0025	7	7	100%
Chromium, total																									<0.005	<0.005	0.0025	0.0025	1	1	100%
Cyanide, total																									<0.01	<0.01	0.005	0.005	1	1	100%
Copper																									0	0			0	0	n/a
Copper, dissolved			<0.005		<0.005																0.003	0.002	0.002	<0.005	<0.002	<0.02	0.005	0.0025	17	14	82%
Copper, total			<0.005		<0.005																			<0.005	<0.005	<0.01	0.0030	0.0025	5	5	100%
Iron, dissolved																								<0.03	<0.03	<0.1	0.019	0.015	8	8	100%
Iron, total			0.9		1.1																			<0.03	0.03	1.1	0.615	0.86	5	1	20%
Iron, suspended																									0	0			0	0	n/a
Iron, Ferrous (Fe2+)			<0.03		<0.03																<0.03	0.05	<0.03	<0.03	<0.03	<0.05	0.019375	0.015	8	7	88%
Iron, Ferric (Fe3+)			0.9		1.1																				0.199	1.1	0.765	0.88	4	0	0%
Lead, dissolved																									<0.0003	<0.05	0.0078	0.0025	8	7	88%
Lead, total			<0.005		<0.005																			<0.005	<0.002	<0.05	0.0064	0.0025	8	7	88%
Manganese, diss.			<0.01		<0.01																<0.01	<0.01	<0.01	<0.01	<0.01	0.01	0.005	0.005	15	14	93%
Manganese, total			0.01		0.01																			<0.01	<0.01	0.01	0.007	0.005	5	3	60%
Mercury, dissolved																									<0.0002	<0.0008	0.0003	0.00015	6	3	50%
Mercury, total			0.0005		<0.0001																			<0.0001	<0.0001	<0.001	0.0002	0.000075	6	5	83%
Molybdenum, diss.			0.005		0.007																0.014	0.008	0.068	0.012	<0.005	0.1	0.015	0.008	17	5	29%
Molybdenum, total																									0.012	0.012	0.01	0.012	1	0	0%
Nickel, dissolved																									<0.01	<0.04	0.014	0.015	8	8	100%
Nickel, total																									<0.02	<0.02	0.01	0.01	1	1	100%
Phosphorous																									<0.	<0.			0	0	n/a
Selenium, dissolved																									<0.005	<0.05	0.008	0.005	9	9	100%
Selenium, total																									<0.05	<0.05	0.025	0.025	1	1	100%
Silver, dissolved																									<0.0002	<0.01	0.0015	0.0005	7	7	100%
Silver, total			0.009		<0.001																			<0.001	<0.001	<0.01	0.003	0.0015	6	5	83%
Thallium, dissolved			<0.001		<0.001																<0.001	<0.001	<0.001	<0.001	<0.001	<0.05	0.0034	0.0005	17	16	94%
Vanadium, dissolved																									<0.005	<0.01	0.004	0.005	7	7	100%
Thallium, total			<0.001		<0.001																			<0.001	<0.001	<0.03	0.0029	0.0005	6	6	100%
Vanadium, total																									<0.005	<0.005	0.0025	0.0025	1	1	100%
Zinc, dissolved																									<0.005	<0.01	0.006	0.006	9	4	44%
Zinc, total			0.019		0.011																			0.008	0.006	0.019	0.010	0.008	5	1	20%
Uranium, dissolved	0.0847	0.0846	0.21	0.16	0.0809	0.114	0.12	0.0985	0.0415	0.093	0.11	0.0782	0.0673	0.0683	0.045	0.0373	0.0383	0.198	0.0998	0.0699	0.0373	0.212	1.26	0.105	0.0373	1.26	0.101	0.0693	54	0	0%
Uranium, suspended																								0.0005	0.0005	0.0005	0.0005	0.0005	1	0	0%
Uranium, total																								0.106	0.106	0.106	0.106	0.106	1	0	0%
Thorium-228, dis. (pCi/L)																									0	0	0.000	0	4	4	100%
Thorium-230, dis. (pCi/L)																									0	0.4	0.175	0.15	4	1	25%
Thorium-232, dis. (pCi/L)																									0	0	0.000	0	4	4	100%
Radium-226, dis. (pCi/L)		0.4	0.5		0.3	<0.2				0.2			<0.2	0.9	<0.2	<0.2	0.9	0.5	0.4	<0.2				<0.2	0.1	1.3	0.44	0.35	28	7	25%
Radium-226, susp. (pCi/L)																								0.6	0.6	0.6	0.6	0.6	1	0	0%
Radium-226, total (pCi/L)																								0.6	0.6	0.6	0.6	0.6	1	0	0%
Gross Alpha, dis. (pCi/L)																									28	92	48.7	35	7	0	0%
Gross Beta, dis. (pCi/L)																									13	35	26.1	26	7	0	0%

TABLE 32. WATER QUALITY IN ALLUVIAL MONITORING WELLS
1998 - 2007
MONITORING WELL MW2

	MW2 8/31/98	MW2 9/29/98	MW2 10/22/98	MW2 11/23/98	MW2 12/16/98	MW2 1/20/99	MW2 2/17/99	MW2 3/24/99	MW2 4/26/99	MW2 5/24/99	MW2 6/16/99	MW2 7/28/99	MW2 9/15/99	MW2 12/28/00
pH (std units)	7.4	7.6	7.3	7.7	7.2	7.2	7.4	7.5	7.5	7.3	7.4	7.2		3.2
Conductivity (umhos)	269	286	281	279	283	260	263	264	336	191	217	290		560
Total dissolved solids	198	153	176	190	1170	132	171	141	217	135	140	189		189
Total suspended solids	98.1	11.4	21.6	1	27.4	10.4	12.2	11.7	2	1	30.6	<10.		10
Hardness, total	97	110	100	110	100	92								
Carbonate														<10.
Bicarbonate														<10.
Alkalinity, Dissolved									65	55	64	87		
Alkalinity, total	110	89	86	120	78	450	85	79	65	55				<10.
Nitrate Nitrogen	<0.1	0.4	0.4	0.9	<0.1	0.4	0.4	0.4	0.8	<0.1	0.5	0.5	<0.5	
Ammonia, total		0	0	0	0	0	0	0	0	<1.	<1.	<1.		
Calcium, dissolved	27	29	28	29	27	25	36							22
Calcium, total										19.9		30.8	35.3	
Magnesium, dissolved	7.2	8.2	7.9	8	7.9	7.2	69			6.5		9.2	11.4	9.2
Sodium, dissolved	14	18	18	16	16	15	5			11		17.1	17.2	<5.
Potassium, dissolved	1.9	2.2	1.9	1.7	1.9	1.5	1.4			1.4		2.1	2.3	0.9
Sulfate	37	39	42	45	52	40	43	44	77	22	23	42		39
Fluoride, total	0.3	0.3	0.3	0.3	0.3	0.3	0.3							
Chloride	11	15	14	12	11	10	12	11	12	10	13	13		20
Aluminum, dissolved	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5				<0.1				
Aluminum, total														
Antimony, dissolved		<0.03	<0.03	<0.008	<0.003	<0.003	<0.003			<0.006		<0.006	<0.006	
Antimony, total	<0.03													
Arsenic, dissolved	<0.005	<0.05	<0.05	<0.003			<0.003			<0.005		<0.005	<0.005	
Arsenic, total	<0.05				<0.003	<0.003								
Barium, dissolved	<0.5	0.04	0.04	0.04			0.03			<0.1				
Barium, total	0.04				0.04	0.04								
Beryllium, dissolved		<0.001	<0.001	<0.002	<0.002	<0.002	<0.002			<0.001				
Beryllium, total	<0.001													
Boron, total														
Cadmium, dissolved		<0.002	<0.002	<0.0002	<0.0002	<0.0002	<0.0002			<0.001				
Cadmium, total	<0.003													
Chromium, dissolved		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005			<0.005				
Chromium, total	<0.005													
Cyanide, total													<0.01	
Copper														
Copper, dissolved	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02				<0.005		<0.005	<0.005	
Copper, total														
Iron, dissolved	<0.03	<0.03	0.2	<0.03	<0.03	<0.03				<0.1				
Iron, total														
Iron, suspended														
Iron, Ferrous (Fe2+)														
Iron, Ferric (Fe3+)														
Lead, dissolved	<0.0004	<0.05	<0.05	<0.002			<0.002			0.035		<0.005	<0.005	
Lead, total	<0.02				0.002	<0.002								
Manganese, diss.	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01				<0.01				
Manganese, total														
Mercury, dissolved		<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002							
Mercury, total	<0.0002													
Molybdenum, diss.		0.023	0.024	0.02	0.03	0.03	0.03			0.038		0.027	0.023	0.009
Molybdenum, total	0.026													
Nickel, dissolved		<0.02	<0.02	<0.04	<0.04	<0.04	<0.04			<0.01			<0.01	
Nickel, total	<0.02													
Phosphorous														
Selenium, dissolved		<0.05	<0.05	<0.005	<0.005	<0.005	<0.005			<0.01		<0.01	<0.01	
Selenium, total	<0.05													
Silver, dissolved		<0.005	<0.005	<0.001	<0.0002	<0.0002	<0.0002			<0.01				
Silver, total	<0.005													
Thallium, dissolved		<0.05	<0.05	<0.001	<0.001	<0.001	<0.001			<0.001		<0.001	<0.001	
Vanadium, dissolved		<0.005	<0.005	<0.01	<0.01	<0.01	<0.01			<0.01				
Thallium, total	<0.03													
Vanadium, total	<0.005													
Zinc, dissolved	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005				<0.01		<0.01	<0.01	
Zinc, total														
Uranium, dissolved	0.0262	0.03	0.0248	0.0275	0.033	0.0298	0.1	0.0334	1.4	0.034	0.031	0.044		0.066
Uranium, suspended														0.002
Uranium, total														
Thorium-228, dis. (pCi/L)	0	0	0							0				
Thorium-230, dis. (pCi/L)	0.2	0.1	0.1							0				
Thorium-232, dis. (pCi/L)	0	0	0							0				
Radium-226, dis. (pCi/L)	0.8	0.2	0.2	0.2	0.4				0.2	0.2		0.2		1
Radium-226, susp. (pCi/L)														0.1
Radium-226, total (pCi/L)														
Gross Alpha, dis. (pCi/L)	36	48	14	17	19					18		17		
Gross Beta, dis. (pCi/L)	8.8	6.8	14	12	17					19		16		

	MW2 12/28/00	MW2 3/5/01	MW2 3/28/01	MW2 5/7/01	MW2 5/31/01	MW2 6/20/01	MW2 7/25/01	MW2 8/27/01	MW2 10/27/01	MW2 11/28/01	MW2 12/19/01	MW2 1/29/02	MW2 2/27/02	MW2 2/28/02	MW2 3/28/02
pH (std units)															
Conductivity (umhos)											160				
Total dissolved solids															
Total suspended solids															
Hardness, total											85.4				
Carbonate															
Bicarbonate											70				
Alkalinity, Dissolved															
Alkalinity, total															
Nitrate Nitrogen											31.3				
Ammonia, total															
Calcium, dissolved															
Calcium, total											9.3				
Magnesium, dissolved											14.2				
Sodium, dissolved											1.4				
Potassium, dissolved											33.6				
Sulfate															
Fluoride, total											26				
Chloride	<0.2										<0.1				
Aluminum, dissolved											<0.1				
Aluminum, total											<0.05				
Antimony, dissolved	<0.001										<0.05				
Antimony, total															
Arsenic, dissolved											<0.001				
Arsenic, total															
Barium, dissolved															
Barium, total															
Beryllium, dissolved															
Beryllium, total															
Boron, total															
Cadmium, dissolved															
Cadmium, total															
Chromium, dissolved															
Chromium, total															
Cyanide, total	<0.005														
Copper											<0.01				
Copper, dissolved											<0.01				
Copper, total	<0.03														
Iron, dissolved											2.04				
Iron, total															
Iron, suspended											<0.03				
Iron, Ferrous (Fe2+)											2.04				
Iron, Ferric (Fe3+)															
Lead, dissolved											<0.05				
Lead, total											<0.01				
Manganese, diss.	<0.01										<0.01				
Manganese, total															
Mercury, dissolved											<0.001				
Mercury, total											<0.1				
Molybdenum, diss.															
Molybdenum, total															
Nickel, dissolved															
Nickel, total															
Phosphorous															
Selenium, dissolved															
Selenium, total															
Silver, dissolved											<0.01				
Silver, total											<0.001				
Thallium, dissolved	<0.001														
Vanadium, dissolved											<0.001				
Thallium, total															
Vanadium, total															
Zinc, dissolved											<0.01				
Zinc, total	0.0668	0.044	0.0242	0.016	0.0118	0.0225	0.016	0.021	0.0203	0.0141	0.0173	0.0218	0.0263	0.0154	0.0184
Uranium, dissolved															
Uranium, suspended															
Uranium, total															
Thorium-228, dis. (pCi/L)															
Thorium-230, dis. (pCi/L)															
Thorium-232, dis. (pCi/L)			0.9			0.6					<0.5				0.3
Radium-226, dis. (pCi/L)															
Radium-226, susp. (pCi/L)															
Radium-226, total (pCi/L)															
Gross Alpha, dis. (pCi/L)															
Gross Beta, dis. (pCi/L)															

NOTES: Mean and median statistic calculated using one-half the detection limit (1/2 D.L.)
Results in mg/L unless otherwise notec

< = not detected at detection limit shown

ND, %ND = number and percent of non detects

TABLE 32. WATER QUALITY IN ALLUVIAL MONITORING WELLS
1998 - 2007
MONITORING WELL MW2

	MW2 4/23/02	MW2 5/29/02	MW2 12/31/02	MW2 1/30/03	MW2 3/27/03	MW2 4/30/03	MW2 5/21/03	MW2 6/24/03	MW2 7/30/03	MW2 12/17/03	MW2 3/31/04	MW2 6/30/04	MW2 9/30/04	MW2 12/29/04	MW2 3/23/05	MW2 6/23/05	MW2 11/29/05	MW2 3/31/06	MW2 6/29/06	MW2 3/28/07	MW2 7/9/07	MIN	MAX	MEAN (calc using 1/2 DL)	MEDIAN	COUNT	ND	% ND
pH (std units)																				7.33		3.2	7.7	7.09	7.365	14	0	0%
Conductivity (umhos)																				238		191	560	286.9	274	14	0	0%
Total dissolved solids							107													142		107	1170	225.8	165.5	16	0	0%
Total suspended solids																						1	98.1	18.646	11.4	13	1	8%
Hardness, total																						92	110	101.5	100	6	0	0%
Carbonate																						<10.	<10.			1	1	100%
Bicarbonate							55.5													60		<10.	85.4	51.5	57.75	4	1	25%
Alkalinity, Dissolved																						55	87	67.8	64.5	4	0	0%
Alkalinity, total							46													50		<10.	450	99.1	78.5	14	1	7%
Nitrate Nitrogen																						<0.1	0.9	0.39	0.4	13	4	31%
Ammonia, total																						0	<1.	0.136	0	11	11	100%
Calcium, dissolved							16													26.5		16	36	27.0	27	11	0	0%
Calcium, total																						19.9	35.3	28.7	30.8	3	0	0%
Magnesium, dissolved							5.94													7.6		5.94	69	12.5	7.95	14	0	0%
Sodium, dissolved							9.1													11.3		<5.	18	13.2	14.6	14	1	7%
Potassium, dissolved							2.19													1.6		0.9	2.3	1.74	1.8	14	0	0%
Sulfate							22.6													29		22	77	39.4	39.5	16	0	0%
Fluoride, total																						0.3	0.3	0.300	0.3	7	0	0%
Chloride							11.8													23		10	26	14.1	12	16	0	0%
Aluminum, dissolved							<0.2			<0.2								<0.2	<0.2	<0.2		<0.1	<0.5	0.157	0.1	14	14	100%
Aluminum, total							0.32			<0.2										<0.2		<0.1	0.32	0.1425	0.1	4	3	75%
Antimony, dissolved							<0.001			<0.001								<0.001	<0.001	<0.001		<0.001	<0.05	0.005	0.0015	16	16	100%
Antimony, total							<0.001			<0.001										<0.001		<0.001	<0.05	0.0083	0.0005	5	5	100%
Arsenic, dissolved																						<0.003	<0.05	0.0079	0.0025	8	8	100%
Arsenic, total							<0.01			<0.01										<0.1		<0.001	<0.1	0.013	0.005	7	7	100%
Barium, dissolved																				0.024		0.024	<0.5	0.068	0.04	7	2	29%
Barium, total																				0.027		0.027	0.04	0.03675	0.04	4	0	0%
Beryllium, dissolved																						<0.001	<0.002	0.001	0.001	7	7	100%
Beryllium, total																						<0.001	<0.001	0.0005	0.0005	1	1	100%
Boron, total																						0	0			0	0	n/a
Cadmium, dissolved																						<0.0002	<0.002	0.0004	0.0001	7	7	100%
Cadmium, total																						<0.003	<0.003	0.0015	0.0015	1	1	100%
Chromium, dissolved																						<0.005	<0.005	0.0025	0.0025	7	7	100%
Chromium, total																						<0.005	<0.005	0.0025	0.0025	1	1	100%
Cyanide, total																						<0.01	<0.01	0.005	0.005	1	1	100%
Copper																						<0.005	<0.005	0.0025	0.0025	1	1	100%
Copper, dissolved							<0.005			<0.005								0.001	0.001	<0.005		<0.001	<0.02	0.005467	0.0025	15	13	87%
Copper, total							<0.005			<0.005										<0.005		<0.005	<0.01	0.003125	0.0025	4	4	100%
Iron, dissolved																				<0.03		<0.03	0.2	0.039	0.015	9	8	89%
Iron, total							1.1													0.48		0.48	2.04	1.206667	1.1	3	0	0%
Iron, suspended																						0	0			0	0	n/a
Iron, Ferrous (Fe2+)							<0.03											<0.03	<0.03	<0.03		<0.03	<0.03	0.015	0.015	5	5	100%
Iron, Ferric (Fe3+)							1.1															1.1	2.04	1.57	1.57	2	0	0%
Lead, dissolved																						<0.0004	<0.05	0.012	0.0025	8	7	88%
Lead, total							<0.005			<0.005										<0.005		0.002	0.05	0.007	0.0025	7	6	86%
Manganese, diss.							0.03											<0.01	<0.01	<0.01		<0.01	0.03	0.007	0.005	13	12	92%
Manganese, total							0.03													<0.01		<0.01	0.03	0.013333	0.005	3	2	67%
Mercury, dissolved																						<0.0002	<0.0002	0.0001	0.0001	6	6	100%
Mercury, total							<0.0001			<0.0001										<0.0001		<0.0001	<0.001	0.0002	0.00005	5	5	100%
Molybdenum, diss.							0.013											0.006	0.007	0.009		0.006	<0.1	0.023	0.023	15	1	7%
Molybdenum, total																						0.026	0.026	0.026	0.026	1	0	0%
Nickel, dissolved																						<0.01	<0.04	0.014	0.015	8	8	100%
Nickel, total																						<0.02	<0.02	0.01	0.01	1	1	100%
Phosphorous																						<0.	<0.			0	0	n/a
Selenium, dissolved																						<0.005	<0.05	0.008	0.005	9	9	100%
Selenium, total																						<0.05	<0.05	0.025	0.025	1	1	100%
Silver, dissolved																						<0.0002	<0.01	0.0015	0.0005	7	7	100%
Silver, total							<0.001			<0.001										<0.001		<0.001	<0.01	0.0018	0.0005	5	5	100%
Thallium, dissolved							<0.001			<0.001								<0.001	<0.001	<0.001		<0.001	<0.05	0.0036	0.0005	16	16	100%
Vanadium, dissolved																						<0.005	<0.01	0.004	0.005	7	7	100%
Thallium, total							<0.001			<0.001										<0.001		<0.001	<0.03	0.0034	0.0005	5	5	100%
Vanadium, total																						<0.005	<0.005	0.0025	0.0025	1	1	100%
Zinc, dissolved																						<0.005	<0.01	0.0033	0.0025	9	9	100%
Zinc, total							<0.01													<0.005		<0.005	<0.01	0.004167	0.005	3	3	100%
Uranium, dissolved	0.0128	0.0156	0.026	0.0137	0.04	0.0115	0.0231	0.0175	0.018	0.0164	0.0149	0.0173	0.0081	0.0065	0.0086	0.0132	0.021	0.015	0.0221	0.0245	0.0282	0.0065	1.4	0.063	0.0218	49	0	0%
Uranium, suspended																				0.0007		0.0007	0.002	0.00135	0.00135	2	0	0%
Uranium, total																				0.0252		0.0252	0.0252	0.0252	0.0252	1	0	0%
Thorium-228, dis. (pCi/L)																						0	0	0	0	4	4	100%
Thorium-230, dis. (pCi/L)																						0	0.2	0.1	0.1	4	1	25%
Thorium-232, dis. (pCi/L)																						0	0	0	0	4	4	100%
Radium-226, dis. (pCi/L)					<0.2		0.6		0.3		<0.2	0.7	<0.2	0.2	0.2	<0.2	0.8			<0.2		<0.2	1	0.36	0.2	24	6	25%
Radium-226, susp. (pCi/L)																				0.6		0.1	0.6	0.35	0.35	2	0	0%
Radium-226, total (pCi/L)																				0.6		0.6	0.6	0.6	0.6	1	0	0%
Gross Alpha, dis. (pCi/L)																						14	48	24.1	18	7	0	0%
Gross Beta, dis. (pCi/L)																						6.8	19	13.4	14	7	0	0%

TABLE 32. WATER QUALITY IN ALLUVIAL MONITORING WELLS
1998 - 2007
MONITORING WELL MW3A

	MW3A 3/31/03	MW3A 4/30/03	MW3A 5/21/03	MW3A 3/28/07	MW3A 6/28/07	MW3A 9/6/07	MIN	MAX	MEAN (calc using 1/2 DL)	MEDIAN	COUNT	ND	% ND
pH (std units)					7.56		7.56	7.56	7.56	7.56	1	0	0%
Conductivity (umhos)					490		490	490	490	490	1	0	0%
Total dissolved solids	332				322		322	332	327	327	2	0	0%
Total suspended solids							n/a	n/a	n/a	n/a	0	0	n/a
Hardness, total							n/a	n/a	n/a	n/a	0	0	n/a
Carbonate							n/a	n/a	n/a	n/a	0	0	n/a
Bicarbonate	97.6				137		97.6	137	117.3	117.3	2	0	0%
Alkalinity, Dissolved							n/a	n/a	n/a	n/a	0	0	n/a
Alkalinity, total	80				112		80	112	96.0	96	2	0	0%
Nitrate Nitrogen							n/a	n/a	n/a	n/a	0	0	n/a
Ammonia, total							n/a	n/a	n/a	n/a	0	0	n/a
Calcium, dissolved	55.3				57.5		55.3	57.5	56.4	56.4	2	0	0%
Calcium, total							n/a	n/a	n/a	n/a	0	0	n/a
Magnesium, dissolved	18				19		18	19	18.500	18.5	2	0	0%
Sodium, dissolved	16.3				12.5		12.5	16.3	14.4	14.4	2	0	0%
Potassium, dissolved	5.27				3		3	5.27	4.1	4.135	2	0	0%
Sulfate	113				98		98	113	105.50	105.5	2	0	0%
Fluoride, total							n/a	n/a	n/a	n/a	0	0	n/a
Chloride	22				22		22	22	22.000	22	2	0	0%
Aluminum, dissolved	<0.2				<0.2		<0.2	<0.2	0.100	0.1	2	2	100%
Aluminum, total	<0.2				<0.2		<0.2	<0.2	0.1	0.1	2	2	100%
Antimony, dissolved	<0.001				<0.001		<0.001	<0.001	0.001	0.0005	2	2	100%
Antimony, total	<0.001				<0.001		<0.001	<0.001	0.0005	0.0005	2	2	100%
Arsenic, dissolved							n/a	n/a	n/a	n/a	0	0	n/a
Arsenic, total	<0.01				<0.1		<0.01	<0.1	0.0275	0.0275	2	2	100%
Barium, dissolved					0.051		0.051	0.051	0.051	0.051	1	0	0%
Barium, total					0.049		0.049	0.049	0.049	0.049	1	0	0%
Beryllium, dissolved							n/a	n/a	n/a	n/a	0	0	n/a
Beryllium, total							n/a	n/a	n/a	n/a	0	0	n/a
Boron, total							n/a	n/a	n/a	n/a	0	0	n/a
Cadmium, dissolved							n/a	n/a	n/a	n/a	0	0	n/a
Cadmium, total							n/a	n/a	n/a	n/a	0	0	n/a
Chromium, dissolved							n/a	n/a	n/a	n/a	0	0	n/a
Chromium, total							n/a	n/a	n/a	n/a	0	0	n/a
Cyanide, total							n/a	n/a	n/a	n/a	0	0	n/a
Copper							<0.005	<0.005	0.0025	0.0025	2	2	100%
Copper, dissolved	<0.005				<0.005		<0.005	<0.005	0.0025	0.0025	2	2	100%
Copper, total	<0.005				<0.005		<0.03	<0.03	0.015	0.015	2	2	100%
Iron, dissolved	<0.03				<0.03		<0.03	<0.03	0.015	0.015	2	2	100%
Iron, total	<0.03				<0.03		n/a	n/a	n/a	n/a	0	0	n/a
Iron, suspended							<0.03	<0.03		0.015	1	1	100%
Iron, Ferrous (Fe2+)					<0.03		<0.03	<0.03	0.015	0.015	1	1	100%
Iron, Ferric (Fe3+)	<0.03						n/a	n/a	n/a	n/a	0	0	n/a
Lead, dissolved							<0.005	<0.005	0.0025	0.0025	2	2	100%
Lead, total	<0.005				<0.005		<0.01	<0.01	0.005	0.005	2	2	100%
Manganese, diss.	<0.01				<0.01		<0.01	<0.01	0.005	0.005	2	2	100%
Manganese, total	<0.01				<0.01		n/a	n/a	n/a	n/a	0	0	n/a
Mercury, dissolved							<0.0001	<0.0001	0.000	0.00005	2	2	100%
Mercury, total	<0.0001				<0.0001		0.015	0.021	0.018	0.018	2	0	0%
Molybdenum, diss.	0.021				0.015		n/a	n/a	n/a	n/a	0	0	n/a
Molybdenum, total							n/a	n/a	n/a	n/a	0	0	n/a
Nickel, dissolved							n/a	n/a	n/a	n/a	0	0	n/a
Nickel, total							n/a	n/a	n/a	n/a	0	0	n/a
Phosphorous							n/a	n/a	n/a	n/a	0	0	n/a
Selenium, dissolved							n/a	n/a	n/a	n/a	0	0	n/a
Selenium, total							n/a	n/a	n/a	n/a	0	0	n/a
Silver, dissolved							<0.001	<0.001	0.0005	0.0005	2	2	100%
Silver, total	<0.001				<0.001		<0.001	<0.001	0.001	0.0005	2	2	100%
Thallium, dissolved	<0.001				<0.001		n/a	n/a	n/a	n/a	0	0	n/a
Vanadium, dissolved							<0.001	<0.001	0.0005	0.0005	2	2	100%
Thallium, total	<0.001				<0.001		n/a	n/a	n/a	n/a	0	0	n/a
Vanadium, total							n/a	n/a	n/a	n/a	0	0	n/a
Zinc, dissolved							<0.005	0.015	0.0088	0.00875	2	1	50%
Zinc, total	<0.005				0.015		0.0509	0.226	0.16	0.1685	6	0	0%
Uranium, dissolved	0.154	0.19	0.14	0.0509	0.226	0.183	<0.0002	0.15	0.075	0.07505	2	1	50%
Uranium, suspended	0.15				<0.0002		0.219	0.219	0.219	0.219	1	0	0%
Uranium, total					0.219		n/a	n/a	n/a	n/a	0	0	n/a
Thorium-228, dis. (pCi/L)							n/a	n/a	n/a	n/a	0	0	n/a
Thorium-230, dis. (pCi/L)							n/a	n/a	n/a	n/a	0	0	n/a
Thorium-232, dis. (pCi/L)							0.8	0.8	0.8	0.8	1	0	0%
Radium-226, dis. (pCi/L)					0.8		<0.2	0.8	0.45	0.45	2	1	50%
Radium-226, susp. (pCi/L)	0.8				<0.2		n/a	n/a	n/a	n/a	0	0	n/a
Radium-226, total (pCi/L)							n/a	n/a	n/a	n/a	0	0	n/a
Gross Alpha, dis. (pCi/L)							n/a	n/a	n/a	n/a	0	0	n/a
Gross Beta, dis. (pCi/L)													

NOTES: Mean and median statistic calculated using one-half the detection limit (1/2 D.L.)

< = not detected at detection limit shown

ND, %ND = number and percent of non detects

Results in mg/L unless otherwise noted.

TABLE 32. WATER QUALITY IN ALLUVIAL MONITORING WELLS
1998 - 2007
MONITORING WELL MW4

	MW4 8/31/98	MW4 9/29/98	MW4 10/22/98	MW4 11/23/98	MW4 12/16/98	MW4 1/20/99	MIN	MAX	MEAN (calc using 1/2 DL)	MEDIAN	COUNT	ND	% ND
pH (std units)	7.7	7.6	7.2	7.9	7	7.2	7	7.9	7.43	7.4	6	0	0%
Conductivity (umhos)	676	688	654	611	598	550	550	688	629.5	632.5	6	0	0%
Total dissolved solids	515	459	465	433	432	353	353	515	442.8	446	6	0	0%
Total suspended solids	196	123	254	155	117	17.7	17.7	254	143.783	139	6	0	0%
Hardness, total	320	330	320	300	290	260	260	330	303.3333	310	6	0	0%
Carbonate							n/a	n/a	n/a	n/a	0	0	n/a
Bicarbonate							n/a	n/a	n/a	n/a	0	0	n/a
Alkalinity, Dissolved							n/a	n/a	n/a	n/a	0	0	n/a
Alkalinity, total	130	140	140	150	130	140	130	150	138.3	140	6	0	0%
Nitrate Nitrogen	2.9	3.1	3.3	3.2	2.5	2.1	2.1	3.3	2.85	3	6	0	0%
Ammonia, total		0	0	0	0	0	0	<0.	0.000	0	5	5	100%
Calcium, dissolved	85	87	84	78	75	67	67	87	79.3	81	6	0	0%
Calcium, total							n/a	n/a	n/a	n/a	0	0	n/a
Magnesium, dissolved	27	28	27	25	24	22	22	28	25.500	26	6	0	0%
Sodium, dissolved	14	16	14	14	13	13	13	16	14.0	14	6	0	0%
Potassium, dissolved	3.1	3.7	3.5	3.4	3.4	3.2	3.1	3.7	3.4	3.4	6	0	0%
Sulfate	210	210	190	170	180	150	150	210	185.00	185	6	0	0%
Fluoride, total	0.3	0.3	0.3	0.3	0.4	0.3	0.3	0.4	0.3	0.3	6	0	0%
Chloride	9	10	11	11	11	10	9	11	10.333	10.5	6	0	0%
Aluminum, dissolved	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.250	0.25	6	6	100%
Aluminum, total							n/a	n/a	n/a	n/a	0	0	n/a
Antimony, dissolved		<0.03	<0.03	<0.008	0.003	<0.003	<0.003	<0.03	0.008	0.004	5	4	80%
Antimony, total	<0.03						<0.03	<0.03	0.015	0.015	1	1	100%
Arsenic, dissolved	<0.005	<0.05	<0.05	<0.003			<0.003	<0.05	0.0135	0.01375	4	4	100%
Arsenic, total	<0.05				<0.003	<0.003	<0.003	<0.05	0.009333	0.0015	3	3	100%
Barium, dissolved	<0.5	0.04	0.04	0.04			0.04	<0.5	0.093	0.04	4	1	25%
Barium, total	0.04				0.03	0.04	0.03	0.04	0.036667	0.04	3	0	0%
Beryllium, dissolved		<0.001	<0.001	<0.002	<0.002	<0.002	<0.001	<0.002	0.001	0.001	5	5	100%
Beryllium, total	<0.001						<0.001	<0.001	0.0005	0.0005	1	1	100%
Boron, total							n/a	n/a	n/a	n/a	0	0	n/a
Cadmium, dissolved		<0.002	<0.002	<0.0002	<0.0002	<0.0002	<0.0002	<0.002	0.0005	0.0001	5	5	100%
Cadmium, total	<0.003						<0.003	<0.003	0.0015	0.0015	1	1	100%
Chromium, dissolved		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.0025	0.0025	5	5	100%
Chromium, total	<0.005						<0.005	<0.005	0.0025	0.0025	1	1	100%
Cyanide, total							n/a	n/a	n/a	n/a	0	0	n/a
Copper							n/a	n/a	n/a	n/a	0	0	n/a
Copper, dissolved	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.01	0.01	6	6	100%
Copper, total							n/a	n/a	n/a	n/a	0	0	n/a
Iron, dissolved	<0.03	<0.03	<0.03	<0.03	0.03	<0.03	<0.03	0.03	0.018	0.015	6	5	83%
Iron, total							n/a	n/a	n/a	n/a	0	0	n/a
Iron, suspended							n/a	n/a	n/a	n/a	0	0	n/a
Iron, Ferrous (Fe2+)							n/a	n/a	n/a	n/a	0	0	n/a
Iron, Ferric (Fe3+)							n/a	n/a	n/a	n/a	0	0	n/a
Lead, dissolved	<0.0002	<0.05	<0.05	<0.002			<0.0002	<0.05	0.0128	0.013	4	4	100%
Lead, total	<0.02				<0.002	<0.002	<0.002	<0.02	0.004	0.001	3	3	100%
Manganese, diss.	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.01	0.005833	0.005	6	5	83%
Manganese, total							n/a	n/a	n/a	n/a	0	0	n/a
Mercury, dissolved		<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	0.0001	0.0001	5	5	100%
Mercury, total	<0.0002						<0.0002	<0.0002	0.000	0.0001	1	1	100%
Molybdenum, diss.		0.031	0.029	0.03	0.15	0.03	0.029	0.15	0.054	0.03	5	0	0%
Molybdenum, total	0.033						0.033	0.033	0.033	0.033	1	0	0%
Nickel, dissolved		<0.02	<0.02	<0.04	<0.04	<0.04	<0.02	<0.04	0.016	0.02	5	5	100%
Nickel, total	<0.02						<0.02	<0.02	0.010	0.01	1	1	100%
Phosphorous							n/a	n/a	n/a	n/a	0	0	n/a
Selenium, dissolved		<0.05	<0.05	<0.005	<0.005	<0.005	<0.005	<0.05	0.0115	0.0025	5	5	100%
Selenium, total	<0.05						<0.05	<0.05	0.0250	0.025	1	1	100%
Silver, dissolved		<0.005	<0.005	<0.001	0.0006	<0.0002	<0.0002	<0.005	0.00124	0.0006	5	4	80%
Silver, total	<0.005						<0.005	<0.005	0.0025	0.0025	1	1	100%
Thallium, dissolved		<0.05	<0.05	<0.001	<0.001	<0.001	<0.001	<0.05	0.010	0.0005	5	5	100%
Vanadium, dissolved		<0.005	<0.005	<0.01	<0.01	<0.01	<0.005	<0.01	0.004	0.005	5	5	100%
Thallium, total	<0.03						<0.03	<0.03	0.015	0.015	1	1	100%
Vanadium, total	<0.005						<0.005	<0.005	0.0025	0.0025	1	1	100%
Zinc, dissolved	<0.005	<0.005	0.006	<0.005	<0.005	<0.005	<0.005	0.006	0.003083	0.0025	6	5	83%
Zinc, total							n/a	n/a	n/a	n/a	0	0	n/a
Uranium, dissolved	0.3	0.031	0.28	0.29	0.29	0.2	0.031	0.3	0.231833	0.285	6	0	0%
Uranium, suspended							n/a	n/a	n/a	n/a	0	0	n/a
Uranium, total							n/a	n/a	n/a	n/a	0	0	n/a
Thorium-228, dis. (pCi/L)	0	0.1	0				0	0.1	0.033333	0	3	2	67%
Thorium-230, dis. (pCi/L)	0.4	0.3	0				0	0.4	0.233333	0.3	3	1	33%
Thorium-232, dis. (pCi/L)	0	0	0				0	0	0	0	0	3	n/a
Radium-226, dis. (pCi/L)	1.2	0.2	0.2	0.5	0.5		0.2	1.2	0.52	0.5	5	0	0%
Radium-226, susp. (pCi/L)							n/a	n/a	n/a	n/a	0	0	n/a
Radium-226, total (pCi/L)							n/a	n/a	n/a	n/a	0	0	n/a
Gross Alpha, dis. (pCi/L)	400	420	170	160	150		150	420	260	170	5	0	0%
Gross Beta, dis. (pCi/L)	93	63	140	120	130		63	140	109.2	120	5	0	0%

NOTES: Mean and median statistic calculated using one-half the detection limit (1/2 D.L.)

< = not detected at detection limit shown

ND, %ND = number and percent of non detects

Results in mg/L unless otherwise noted.

TABLE 32. WATER QUALITY IN ALLUVIAL MONITORING WELLS
1998 - 2007
MONITORING WELL MW5R

	MW5R 1/20/99	MW5R 2/19/99	MW5R 3/25/99	MW5R 4/26/99	MW5R 5/27/99	MW5R 6/17/99	MW5R 7/28/99	MW5R 9/16/99	MIN	MAX	MEAN	MEDIAN	COUNT	ND	% ND
pH (std units)	7.4	7.7	8	8	7.6	7.6	9.6		7.4	9.6	7.99	7.7	7	0	0%
Conductivity (umhos)	539	541	507	581	369	616	600		369	616	536.1	541	7	0	0%
Total dissolved solids	326	347	330	390	232	419	410		232	419	350.6	347	7	0	0%
Total suspended solids	<1.	<1.	0	<1.	<10.	<10.	47.9		0	47.9	8.486	0.5	7	6	86%
Hardness, total	180								180	180	180	180	1	0	0%
Carbonate									n/a	n/a		n/a	0	0	n/a
Bicarbonate									n/a	n/a		n/a	0	0	n/a
Alkalinity, Dissolved				100	140	100	53		53	140	98.25	100	4	0	0%
Alkalinity, total	120	110	120	100					100	120	112.5	115	4	0	0%
Nitrate Nitrogen	1.7	1.4	0.8	3.6	0.5	2	3		0.5	3.6	1.86	1.7	7	0	0%
Ammonia, total	0	0	0	0	<1.	<1.	<1.		0	<1.	0.214	0	7	7	100%
Calcium, dissolved	45	53							45	53	49.0	49	2	0	0%
Calcium, total					33.4		52.1	44	33.4	52.1	43.1667	44	3	0	0%
Magnesium, dissolved	16	110			12.3		13.5	17.7	12.3	110	33.9	16	5	0	0%
Sodium, dissolved	41	30			29.8		45.7	33.3	29.8	45.7	36.0	33.3	5	0	0%
Potassium, dissolved	2.4	2.3			1.8		15.3	2.7	1.8	15.3	4.9	2.4	5	0	0%
Sulfate	140	140	120	150	48	190	230		48	230	145.43	140	7	0	0%
Fluoride, total	0.5								0.5	0.5	0.5	0.5	1	0	0%
Chloride	14	16	16	13	9	15	16		9	16	14.143	15	7	0	0%
Aluminum, dissolved	<0.5				<0.1				<0.1	<0.5	0.150	0.15	2	2	100%
Aluminum, total									n/a	n/a	n/a	n/a	0	0	n/a
Antimony, dissolved	<0.003				<0.006		<0.006	<0.006	<0.003	<0.006	0.003	0.003	4	4	100%
Antimony, total									n/a	n/a	n/a	n/a	0	0	n/a
Arsenic, dissolved					<0.005		<0.005	<0.005	<0.005	<0.005	0.0025	0.0025	3	3	100%
Arsenic, total	<0.003								<0.003	<0.003	0.0015	0.0015	1	1	100%
Barium, dissolved					<0.1				<0.1	<0.1	0.050	0.05	1	1	100%
Barium, total	0.04								0.04	0.04	0.04	0.04	1	0	0%
Beryllium, dissolved	<0.002				<0.001				<0.001	<0.002	0.001	0.00075	2	2	100%
Beryllium, total									n/a	n/a	n/a	n/a	0	0	n/a
Boron, total									n/a	n/a	n/a	n/a	0	0	n/a
Cadmium, dissolved	<0.0002				<0.001				<0.0002	<0.001	0.0003	0.0003	2	2	100%
Cadmium, total									n/a	n/a	n/a	n/a	0	0	n/a
Chromium, dissolved	<0.005				<0.005				<0.005	<0.005	0.0025	0.0025	2	2	100%
Chromium, total									n/a	n/a	n/a	n/a	0	0	n/a
Cyanide, total								<0.01	<0.01	<0.01	0.005	0.005	1	1	100%
Copper									n/a	n/a	n/a	n/a	0	0	n/a
Copper, dissolved	<0.02				<0.005		<0.005	<0.005	<0.005	<0.02	0.00438	0.0025	4	4	100%
Copper, total									n/a	n/a	n/a	n/a	0	0	n/a
Iron, dissolved	0.04				<0.1				0.04	<0.1	0.045	0.045	2	1	50%
Iron, total									n/a	n/a	n/a	n/a	0	0	n/a
Iron, suspended									n/a	n/a	n/a	n/a	0	0	n/a
Iron, Ferrous (Fe2+)									n/a	n/a	n/a	n/a	0	0	n/a
Iron, Ferric (Fe3+)									n/a	n/a	n/a	n/a	0	0	n/a
Lead, dissolved					<0.005		<0.005	<0.005	<0.005	<0.005	0.0025	0.0025	3	3	100%
Lead, total	<0.002								<0.002	<0.002	0.001	0.001	1	1	100%
Manganese, diss.	<0.01				<0.01				<0.01	<0.01	0.005	0.005	2	2	100%
Manganese, total									n/a	n/a	n/a	n/a	0	0	n/a
Mercury, dissolved	<0.0002								<0.0002	<0.0002	0.0001	0.0001	1	1	100%
Mercury, total									n/a	n/a	n/a	n/a	0	0	n/a
Molybdenum, diss.	0.11				0.13		1.11	0.096	<0.096	1.11	0.3615	0.12	4	0	0%
Molybdenum, total									n/a	n/a	n/a	n/a	0	0	n/a
Nickel, dissolved	<0.04				<0.01			<0.01	<0.01	<0.04	0.01	0.005	3	3	100%
Nickel, total									n/a	n/a	n/a	n/a	0	0	n/a
Phosphorous									n/a	n/a	n/a	n/a	0	0	n/a
Selenium, dissolved	<0.005				<0.01		<0.01	<0.01	<0.005	<0.01	0.00438	0.005	4	4	100%
Selenium, total									n/a	n/a	n/a	n/a	0	0	n/a
Silver, dissolved	<0.0002				<0.01				<0.0002	<0.01	0.00255	0.00255	2	2	100%
Silver, total									n/a	n/a	n/a	n/a	0	0	n/a
Thallium, dissolved	<0.001				<0.001		<0.001	<0.001	<0.001	<0.001	0.001	0.0005	4	4	100%
Vanadium, dissolved	<0.01				<0.01				<0.01	<0.01	0.005	0.005	2	2	100%
Thallium, total									n/a	n/a	n/a	n/a	0	0	n/a
Vanadium, total									n/a	n/a	n/a	n/a	0	0	n/a
Zinc, dissolved	<0.005				<0.01		<0.01	<0.01	<0.005	<0.01	0.00438	0.005	4	4	100%
Zinc, total									n/a	n/a	n/a	n/a	0	0	n/a
Uranium, dissolved	0.081	0.093	0.077	0.19	0.11	0.58	0.16		0.077	0.58	0.18443	0.11	7	0	0%
Uranium, suspended									n/a	n/a	n/a	n/a	0	0	n/a
Uranium, total									n/a	n/a	n/a	n/a	0	0	n/a
Thorium-228, dis. (pCi/L)					0				0	0	0	0	1	1	100%
Thorium-230, dis. (pCi/L)					0				0	0	0	0	1	1	100%
Thorium-232, dis. (pCi/L)									n/a	n/a	n/a	n/a	0	0	n/a
Radium-226, dis. (pCi/L)					0				0	0	0.00	0	1	1	100%
Radium-226, susp. (pCi/L)					0.4		11.4		0.4	11.4	5.9	5.9	2	0	0%
Radium-226, total (pCi/L)									n/a	n/a	n/a	n/a	0	0	n/a
Gross Alpha, dis. (pCi/L)					56		120		56	120	88	88	2	0	0%
Gross Beta, dis. (pCi/L)					55		99		<55.	99	77	77	2	0	0%

NOTES: Mean and median statistic calculated using one-half the detection limit (1/2 D.L.)
Results in mg/L unless otherwise notec

< = not detected at detection limit shown

ND, %ND = number and percent of non detects

TABLE 32. WATER QUALITY IN ALLUVIAL MONITORING WELLS
1998 - 2007
MONITORING WELL MW6

	MW6 8/31/98	MW6 9/29/98	MW6 10/22/98	MW6 11/23/98	MW6 12/16/98	MW6 1/21/99	MW6 2/19/99	MW6 3/25/99	MW6 4/26/99	MW6 5/27/99	MW6 6/17/99	MW6 7/28/99	MW6 9/16/99	MW6 12/28/00	MW6 3/5/01	MW6 3/28/01	MW6 5/7/01	MW6 5/31/01	MW6 6/20/01	MW6 7/25/01	MW6 8/28/01	MW6 9/18/01	MW6 10/27/01	MW6 11/27/01	MW6 12/19/01	MW6 2/27/02	MW6 3/28/02	MW6 4/23/02	MW6 5/29/02	MW6 6/27/02	MW6 8/27/02	MW6 9/24/02	MW6 10/22/02	MW6 11/22/02
pH (std units)	7.2	7.4	7.1	7.7	7	7.1	7.4	7.9	7.4	9.4	7.5	7.2																						
Conductivity (umhos)	311	496	478	474	511	559	544	466	933	238	257	467														350						387		471
Total dissolved solids	214	298	314	320	367	371	356	301	685	155	160	317																						
Total suspended solids	7	3	9	1	3	6	5	0	59.3	<10.	<10.	<10.																						
Hardness, total	110	180	160	160	170	180																												
Carbonate																										112						212		222
Bicarbonate																																		
Alkalinity, Dissolved									110	36	74	110														92						174		182
Alkalinity, total	110	110	110	130	100	100	120	100	110																									
Nitrate Nitrogen	0.7	0.4	0.8	1.4	1.3	1.3	0.9	0.8	1.8	<0.1	<0.5	<0.5																						
Ammonia, total		0	0	0	0	0	0	0	0	<1.	<1.	<1.														62.5						78.4		90.3
Calcium, dissolved	27	44	40	40	41	42	47																											
Calcium, total										22.7		41.8	39.9													26.5						28.1		31.2
Magnesium, dissolved	10	16	15	15	16	17	170			9.4		16	18													23						27.7		34.4
Sodium, dissolved	20	34	<10.	34	39	47	36			12.6		33.7	28.4													3.29						4.26		5.43
Potassium, dissolved	3.1	3.8	2.9	2.7	2.6	2.5	2.5			2.9		3.9	3.8													147						140		164
Sulfate	52	130	120	120	140	160	150	110	370	30	33	110																						
Fluoride, total	0.4	0.4	0.5	0.4	0.4	0.5																				30						27		29.4
Chloride	14	18	17	12	15	14	15	15	16	11	13	15														<0.1						<0.2		<0.2
Aluminum, dissolved	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5				<0.1																2.16						3.46		3.81
Aluminum, total																										0.001						<0.001		<0.001
Antimony, dissolved		<0.03	<0.03	<0.008	<0.003	<0.003				<0.006		<0.006	<0.006													<0.001						0.001		0.002
Antimony, total	<0.03																																	
Arsenic, dissolved	<0.005	<0.05	<0.05	<0.003						<0.005		<0.005	<0.005													<0.01						<0.01		<0.01
Arsenic, total	<0.05				<0.003	<0.003																												
Barium, dissolved	<0.5	0.03	0.03	0.03						<0.1																								
Barium, total	0.02				0.05	0.03																												
Beryllium, dissolved		<0.001	<0.001	<0.002	<0.002	<0.002				<0.001																								
Beryllium, total	<0.001																																	
Boron, total																																		
Cadmium, dissolved		<0.002	<0.002	<0.0002	<0.0002	<0.0002				<0.001																								
Cadmium, total	<0.003																																	
Chromium, dissolved		<0.005	<0.005	<0.005	<0.005	<0.005				<0.005																								
Chromium, total	<0.005																																	
Cyanide, total													<0.01																					
Copper																										<0.01						0.024		0.009
Copper, dissolved	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02				<0.005		<0.005	<0.005													0.007						0.013		0.017
Copper, total																										<0.03						<0.03		<0.03
Iron, dissolved	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03				<0.1																2.93						6.01		7.2
Iron, total																																		
Iron, suspended																																		
Iron, Ferrous (Fe2+)																										2.9						6.01		7.2
Iron, Ferric (Fe3+)																																		
Lead, dissolved	<0.0001	<0.05	<0.05	<0.002						<0.005		<0.005	<0.005													0.005						0.009		0.008
Lead, total	<0.02				0.003	<0.002																				<0.01						0.01		<0.01
Manganese, diss.	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01				<0.01																0.2						0.28		0.27
Manganese, total																																		
Mercury, dissolved		<0.0002	<0.0002	<0.0002	<0.0002	<0.0002																				<0.0001						<0.0001		0.0001
Mercury, total	<0.0002																									0.127						0.101		0.107
Molybdenum, diss.		0.098	0.127	0.13	0.08	0.19				0.164		0.108	0.119																					
Molybdenum, total	0.112																																	
Nickel, dissolved		<0.02	<0.02	<0.04	<0.04	<0.04				<0.01			<0.01																					
Nickel, total	<0.02																																	
Phosphorous																																		
Selenium, dissolved		<0.05	<0.05	<0.005	<0.005	<0.005				<0.01		<0.01	<0.01																					
Selenium, total	<0.05																																	
Silver, dissolved		<0.005	<0.005	<0.001	<0.0002	<0.0002				<0.01																<0.001						<0.001		<0.001
Silver, total	<0.005																									<0.001						<0.001		<0.001
Thallium, dissolved		<0.05	<0.05	<0.001	<0.001	<0.001				<0.001		<0.001	<0.001																					
Vanadium, dissolved		<0.005	<0.005	<0.01	<0.01	<0.01				<0.01																<0.001						<0.001		<0.001
Thallium, total	<0.03																																	
Vanadium, total	<0.005																																	
Zinc, dissolved	0.007	0.008	0.008	0.006	0.007	0.008				0.01		0.01	<0.01													0.031						0.069		0.07
Zinc, total																																		
Uranium, dissolved	0.14	0.23	0.29	0.33	0.41	0.47	0.5	0.32	0.46	0.16	0.15	0.18		0.75	0.44	0.34	0.666	1.18	0.387	0.271	0.224	0.14	0.318	0.356	0.344	1.17	1.78	1.26	0.895	1.03	0.976	1.12	1.33	1.3
Uranium, suspended																																		
Uranium, total																																		
Thorium-228, dis. (pCi/L)	0	0	0							0																								
Thorium-230, dis. (pCi/L)	0.2	0.4	0							0.1																								
Thorium-232, dis. (pCi/L)	0	0	0							0																								
Radium-226, dis. (pCi/L)	0.6	0.3	0.4	0.3	7.2					0.2		1.3														0.9						1.4		1.7
Radium-226, susp. (pCi/L)																																		
Radium-226, total (pCi/L)																																		
Gross Alpha, dis. (pCi/L)	170	120	150	170	220					74		93																						
Gross Beta, dis. (pCi/L)	27	110	130	130	210					86		87																						

NOTES: Mean and median statistic calculated using one-half the detection limit (1/2 D.L.)
Results in mg/L unless otherwise notec

< = not detected at detection limit shown

ND, %ND = number and percent of non detects

TABLE 32. WATER QUALITY IN ALLUVIAL MONITORING WELLS
1998 - 2007
MONITORING WELL MW6

	MW6 12/31/02	MW6 1/30/03	MW6 2/28/03	MW6 3/27/03	MW6 3/27/03	MW6 4/30/03	MW6 5/21/03	MW6 6/24/03	MW6 7/30/03	MW6 9/24/03	MW6 12/31/03	MW6 3/31/04	MW6 6/30/04	MW6 9/30/04	MW6 12/29/04	MW6 3/23/05	MW6 6/23/05	MW6 9/28/05	MW6 11/29/05	MW6 6/17/06	MW6 6/29/06	MW6 6/30/06	MW6 7/30/06	MW6 9/26/06	MW6 9/28/06	MW6 9/29/06	MW6 9/30/06	MIN	MAX	MEAN	MEDIAN	COUNT	ND	% ND
pH (std units)																												7	9.4	7.53	7.4	12	0	0%
Conductivity (umhos)																												238	933	477.8	476	12	0	0%
Total dissolved solids						1090								292		291		386										155	1090	375.0	320	19	0	0%
Total suspended solids																												0	59.3	9.025	5	12	4	33%
Hardness, total																												110	180	160	165	6	0	0%
Carbonate																												0	0			0	0	n/a
Bicarbonate						160								142		124		165										112	222	162.429	160	7	0	0%
Alkalinity, Dissolved																												36	110	82.5	92	4	0	0%
Alkalinity, total						131								116		102		135										92	182	120.1	110	16	0	0%
Nitrate Nitrogen																												<0.1	1.8	0.83	0.8	12	3	25%
Ammonia, total																												0	<1.	0.136	0	11	11	n/a
Calcium, dissolved						164								66.5		57.9		67.5										27	164	62.0	52.45	14	0	0%
Calcium, total																												22.7	41.8	34.8	39.9	3	0	0%
Magnesium, dissolved						80.9								22.8		19.3		22.9										9.4	170	31.4	18	17	0	0%
Sodium, dissolved						23.7								16.2		13.9		17.6										<10.	47	26.2	27.7	17	1	6%
Potassium, dissolved						8.61								4.4		3.9		4.1										2.5	8.61	3.8	3.8	17	0	0%
Sulfate						575								115		89		148										30	575	152.68	130	19	0	0%
Fluoride, total																												0.4	0.5	0.4	0.4	6	0	0%
Chloride						23.9								26		29		20										11	30	18.963	16	19	0	0%
Aluminum, dissolved						<0.2						<0.2		<0.2		<0.2		<0.2		<0.2	<0.2	<0.2	<0.2	<0.2	<0.2		<0.2	<0.1	<0.5	0.136	0.1	22	22	n/a
Aluminum, total						<0.2						0.4		<0.2		<0.1		1.2								<0.1		<0.1	3.81	1.26	0.4	9	4	44%
Antimony, dissolved						<0.001						<0.001		<0.001		<0.001		<0.001		<0.001	<0.001	0.001	0.001	<0.001	0.001		<0.001	<0.001	<0.03	0.002	0.001	23	19	83%
Antimony, total						<0.001						<0.001		<0.001		<0.001		<0.05								<0.05		<0.001	<0.05	0.00705	0.00075	10	8	80%
Arsenic, dissolved																												<0.003	<0.05	0.0088	0.0025	7	7	100%
Arsenic, total						<0.01						<0.01		<0.01		<0.01		<0.001										<0.001	<0.05	0.0058	0.005	11	11	100%
Barium, dissolved																												0.03	<0.5	0.078	0.03	5	2	40%
Barium, total																												0.02	0.05	0.0333	0.03	3	0	0%
Beryllium, dissolved																												<0.001	<0.002	0.001	0.00075	6	6	100%
Beryllium, total																												<0.001	<0.001	0.0005	0.0005	1	1	100%
Boron, total																												0	0			0	0	n/a
Cadmium, dissolved																												<0.0002	<0.002	0.0005	0.0003	6	6	100%
Cadmium, total																												<0.003	<0.003	0.0015	0.0015	1	1	100%
Chromium, dissolved																												<0.005	<0.005	0.0025	0.0025	6	6	100%
Chromium, total																												<0.005	<0.005	0.0025	0.0025	1	1	100%
Cyanide, total																												<0.01	<0.01	0.005	0.005	1	1	100%
Copper																												0	0			0	0	n/a
Copper, dissolved						<0.005						<0.005		<0.005		<0.005		<0.005		0.001	<0.001	0.001	0.001	<0.005	0.001		0.004	<0.001	0.024	0.0054	0.0025	24	17	71%
Copper, total						<0.005						<0.005		<0.005		<0.005		<0.01								<0.001		<0.001	0.017	0.0058	0.0025	9	6	67%
Iron, dissolved						<0.03								<0.03		<0.03		<0.03										<0.03	<0.1	0.018	0.015	14	14	100%
Iron, total						0.054								0.2		0.13		2.44								<0.03		0.03	7.2	2.37	1.32	8	1	13%
Iron, suspended																												0	0			0	0	n/a
Iron, Ferrous (Fe2+)																				<0.03	<0.03	<0.03	<0.03	<0.03	<0.03		<0.03	0.03	0.03	0.015	0.015	7	7	100%
Iron, Ferric (Fe3+)						0.054								<0.2		0.12		2.43										0.054	7.2	2.69	2.43	7	1	14%
Lead, dissolved																												<0.0001	<0.05	0.0084	0.0025	7	7	100%
Lead, total						<0.005						<0.005		<0.005		<0.005		<0.05										<0.002	<0.05	0.00645	0.003	11	7	64%
Manganese, diss.						<0.01								<0.01		<0.01		<0.01		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01		<0.01	<0.01	0.01	0.0052	0.005	21	20	95%
Manganese, total						<0.01								0.02		<0.01		0.12								<0.01		<0.01	0.28	0.113	0.07	8	3	38%
Mercury, dissolved																												<0.0002	<0.0002	0.0001	0.0001	5	5	100%
Mercury, total						<0.0001						<0.0001		<0.0001		<0.0001		<0.001										<0.0001	<0.001	0.00011	0.00005	9	8	89%
Molybdenum, diss.						0.071								0.052		0.039		0.049		0.076	0.035	0.113	0.111	0.1	0.047		0.084	0.035	0.19	0.09673	0.1005	22	0	0%
Molybdenum, total																										<0.1		0.1	0.112	0.081	0.081	2	1	50%
Nickel, dissolved																												<0.01	<0.04	0.0129	0.01	7	7	100%
Nickel, total																												<0.02	<0.02	0.01	0.01	1	1	100%
Phosphorous																												0	0			0	0	n/a
Selenium, dissolved																												<0.005	<0.05	0.0091	0.005	8	8	100%
Selenium, total																												<0.05	<0.05	0.025	0.025	1	1	100%
Silver, dissolved																												<0.0002	<0.01	0.0018	0.0015	6	6	100%
Silver, total						<0.001						<0.001		<0.001		<0.01		<0.01										<0.001	<0.01	0.00172	0.0005	9	9	100%
Thallium, dissolved						<0.001						<0.001		<0.001		<0.001		<0.001		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001		<0.001	<0.001	<0.05	0.003	0.0005	23	23	100%
Vanadium, dissolved																										<0.001		<0.005	<0.01	0.0042	0.005	6	6	100%
Thallium, total						<0.001						<0.001		<0.001		<0.001		<0.1										<0.001	<0.1	0.0069	0.0005	10	10	100%
Vanadium, total																												<0.005	<0.005	0.0025	0.0025	1	1	100%
Zinc, dissolved						0.112								0.025		0.017		0.04										0.006	0.01	0.0077	0.008	9	1	11%
Zinc, total																												0.017	0.112	0.052	0.04	7	0	0%
Uranium, dissolved	1.5	1.37	1.3	1.49	1.5	2.23	1.4	1.1	1.2	1.4	1.9	0.434	0.614	0.562	0.532	0.396	0.81	0.87	0.593	0.791	0.484	1.29	1.28	0.504	0.44		1.37	0.14	2.23	0.8013	0.614	59	0	0%
Uranium, suspended																												0	0			0	0	n/a
Uranium, total																										1.09		1.09	1.09	1.09	1.09	1	0	0%
Thorium-228, dis. (pCi/L)																												0	0	0	0	4	4	100%
Thorium-230, dis. (pCi/L)																												0	0.4	0.175	0.15	4	1	25%
Thorium-232, dis. (pCi/L)																												0	0	0.00	0	4	4	100%
Radium-226, dis. (pCi/L)						3.4								2		0.2		1										0.2	7.2	1.49	0.95	14	0	0%
Radium-226, susp. (pCi/L)																												0	0			0	0	n/a
Radium-226, total (pCi/L)																												0	0			0	0	n/a
Gross Alpha, dis. (pCi/L)																												74	220	142.4	150	7	0	0%
Gross Beta, dis. (pCi/L)																												27	210	111.4	110	7	0	0%

TABLE 32. WATER QUALITY IN ALLUVIAL MONITORING WELLS
1998 - 2007
MONITORING WELL MW7

	MW7 8/31/98	MW7 9/29/98	MW7 10/22/98	MW7 11/23/98	MW7 12/16/98	MW7 1/21/99	MW7 2/19/99	MW7 3/26/99	MW7 4/26/99	MW7 5/27/99	MW7 6/17/99	MW7 7/28/99	MW7 9/15/99	MW7 12/28/00	MW7 12/28/00	MW7 2/1/01	MW7 3/5/01	MW7 3/5/01	MW7 3/28/01	MW7 5/7/01	MW7 5/31/01	MW7 6/20/01	MW7 7/25/01	MW7 8/28/01	MW7 9/18/01	MW7 10/25/01	MW7 11/28/01	MW7 12/19/01	MW7 1/29/02	MW7 2/27/02	MW7 3/28/02	MW7 4/23/02	MW7 5/29/02	MW7 6/27/02	MW7 8/27/02	MW7 9/24/02	MW7 9/24/02	MW7 10/22/02
pH (std units)	7.6	7.4	7.3	7.7	7.1	7.1	7.4	7.8	8.2	7.4	7.7	7.3			7.5			7.8																				
Conductivity (umhos)	312	442	470	473	505	548	556	525	631	306	276	419			453			560																				
Total dissolved solids	207	256	314	321	363	354	350	335	402	195	162	272			264			348			202	183	222	242	253	232	172	175	212	349	407	726	686	384	442	451		557
Total suspended solids	206	125	69.3	315	86.6	161	40	1	2	<10.	<10.	43.5			17.5			<10.																				
Hardness, total	100	150	160	160	170	180																																
Carbonate															<10.			<10.																				
Bicarbonate															84			87			81	99	108	115	110	101	90.9	90.9	91.5	96	125	137	135	139	150	157		152
Alkalinity, Dissolved									95	87	87	120																										
Alkalinity, total	110	98	84	110	110	410	100	100	95						84			87			67	81	89	95	253	83	75	72	75	81	103	113	111	114	123	129		125
Nitrate Nitrogen	0.7	0.4	0.8	0.9	1.3	1.7	1.4	1.3	0.9	<0.1	<0.5	<0.5	<0.5																									
Ammonia, total		0	0	0	0	0	0	0	0	<1.	<1.	<1.																										
Calcium, dissolved	27	40	41	40	43	45	51								35	42.4	47.9				28.2	31.2	34.3	39	40	30.6	33.1	30.6	41.8	59	69.6	123	104	63.6	62	77.9		77.7
Calcium, total										23.9		38.3	36.1																									
Magnesium, dissolved	8.1	13	13	13	15	16	75			8.5		13.1	13.3		17	16.6	18.8				10.7	11.8	13.7	13	14	11.1	11.6	11.6	13.9	21.4	24.8	44.8	40.2	23	21.8	27.3		26.3
Sodium, dissolved	24	32	36	36	37	43	38			27.4		30.9	29.5		5	22	29.1				17.5	18.5	19.4	20	21	17.7	16.8	16	17.8	24.3	28.2	42.1	44.6	27	35.9	44.2		44
Potassium, dissolved	2.7	3.4	3	2.6	2.7	2.6	2.6			2.3		3.1	3.2		1.6	2.3	2.7				2.3	2.6	2.7	2.8	2.9	2.1	2.1	2.1	2.3	2.42	3.37	5.2	4.67	3.87	3.62	4.18		4.43
Sulfate	43	98	110	110	140	150	140	130	160	39	29	88			110	114	121	130			54.4	41.9	52.5	51	67	43	40.8	41.6	70.6	140	162	348	311	141	147	202		223
Fluoride, total	0.5	0.5	0.5	0.4	4.5	0.4																																
Chloride	14	20	17	19	18	15	19	18	36	15	14	16			22	23.4	31.1	32			20.8	24.6	26.3	30	28	35	29.9	28	33.2	34.5	33.5	52.8	71.2	37.9	33.3	32.6		51.9
Aluminum, dissolved	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5				<0.1				<0.2		<0.2	<0.2				<0.1	<0.1	<0.1	<0.1	<0.1	<0.01	<0.1	<0.1	<0.1	<0.1	<0.2	<0.1	<0.2	<0.2	<0.2	<0.2		<0.2
Aluminum, total																					<0.1	<0.1	0.015	0.39	<0.1	<0.01	<0.1	<0.1	0.019	0.023	<0.2	<0.2	<0.2	<0.2	1.76	1.21		<0.1
Antimony, dissolved		<0.03	<0.03	<0.008	<0.003	<0.003				<0.006		<0.006	<0.006	<0.001		0.001	0.001				<0.05	<0.001	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.001	<0.001	<0.001	0.001	0.001	0.001	0.001	<0.001		<0.001
Antimony, total	<0.03																				<0.05	0.001	0.0017	<0.05	<0.05	<0.05	<0.05	<0.05	<0.001	<0.001	<0.001	<0.001	0.001	0.001	<0.001	<0.001		<0.001
Arsenic, dissolved	<0.005	<0.05	<0.05	<0.003						<0.005		<0.005	<0.005								<0.001	<0.001	<0.001															
Arsenic, total	<0.05				<0.003	<0.003															<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01		<0.01
Barium, dissolved	<0.5	0.05	0.05	0.04						<0.1																												
Barium, total	0.03				<0.02	0.05																																
Beryllium, dissolved		<0.001	<0.001	<0.002	<0.002	<0.002				<0.001																												
Beryllium, total	<0.001																																					
Boron, total																																						
Cadmium, dissolved		<0.002	<0.002	<0.0002	<0.0002	<0.0002				<0.001																												
Cadmium, total	<0.003																																					
Chromium, dissolved		<0.005	<0.005	<0.005	<0.005	<0.005				<0.005																												
Chromium, total	<0.005																																					
Cyanide, total													<0.01																									
Copper														<0.005		<0.005	<0.005																					
Copper, dissolved	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02				<0.005		<0.005	<0.005								<0.01	<0.005	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	0.015	<0.005	<0.005	<0.005	0.009	0.008		0.007
Copper, total																					<0.01	<0.005	0.0017	<0.01	<0.01	<0.01	<0.01	<0.01	<0.001	<0.001	<0.005	<0.005	0.012	<0.005	0.062	0.037		0.008
Iron, dissolved	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03				<0.1				<0.03		<0.03	<0.03				<0.03	<0.03	<0.03	<0.03	<0.03	<0.03			<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03		<0.03
Iron, total																											0.04	0.1	<0.03	<0.03	<0.03	<0.03	<0.03	0.057	2.85	2.33		<0.03
Iron, suspended																					<0.03	<0.03	0.0923	0.77	<0.03	0.27												
Iron, Ferrous (Fe2+)																											0.04	0.1										
Iron, Ferric (Fe3+)																											<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	0.057	2.85	2.33		<0.03
Lead, dissolved	<0.0004	<0.05	<0.05	<0.002						<0.005		<0.005	<0.005								<0.05	<0.005																
Lead, total	<0.02				<0.002	0.003															<0.05	<0.005			<0.05	<0.05	<0.05	<0.05	<0.001	<0.001	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005		<0.005
Manganese, diss.	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01				<0.01				<0.01		<0.01	<0.01				<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01		<0.01
Manganese, total																					<0.01	<0.01	0.0073	0.09	<0.01	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.16	0.17		<0.01
Mercury, dissolved		<0.0002	<0.0002	0.0016	<0.0002	<0.0002															<0.001	<0.0001	<0.001															
Mercury, total	<0.0002																				<0.001	<0.0001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.0007	<0.0001		<0.0001
Molybdenum, diss.		0.095	0.085	0.08	<0.01	0.09				0.194		0.12	0.12		0.06			0.146			<0.1	0.0817	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.0467	0.0586	0.091	0.082	0.083	0.076	0.071	0.055		0.046
Molybdenum, total	0.119																																					
Nickel, dissolved		<0.02	<0.02	<0.04	<0.04	<0.04				<0.01			<0.01																									
Nickel, total	<0.02																																					
Phosphorous																					<1.	<1.																
Selenium, dissolved		<0.05	<0.05	<0.005	<0.005	<0.005				<0.01		<0.01	<0.01																									
Selenium, total	<0.05																																					
Silver, dissolved		<0.005	<0.005	<0.001	<0.0002	<0.0002				<0.01											<0.01	<0.0001																
Silver, total	<0.005																				<0.01	<0.0001	<0.01		<0.01	<0.01	<0.01	<0.01	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001		<0.001
Thallium, dissolved		<0.05	<0.05	<0.001	<0.001	<0.001				<0.001		<0.001	<0.001	<0.001		<0.001	<0.001				<0.001	<0.001	<0.05	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001		<0.001
Vanadium, dissolved		<0.005	<0.005	<0.01	<0.01	<0.01				<0.01																												
Thallium, total	<0.03																				<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001		<0.001
Vanadium, total	<0.005																																					
Zinc, dissolved	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005				<0.01		<0.01	<0.01								0.07	0.092	0.087															
Zinc, total																					<0.01	<0.013	0.095	<0.01	<0.01	0.07	<0.01	<0.01	<0.05	<0.005	<0.005	0.008	0.032	<0.005	0.026	0.02		0.038
Uranium, dissolved	0.049	0.063	0.0805	0.1	0.12	0.14	0.14	0.16	0.2	0.0705	0.0505	0.0955		0.0799	0.0076	0.146	0.458	0.51	0.57	0.15	0.0674	0.0807	0.34	0.073	0.066	0.0715	0.0678	0.0742	0.124	0.44	0.912	1.19	0.807	0.316	0.278	0.365	0.38	0.352
Uranium, suspended															0.0058			0.002																				
Uranium, total														0.079																								
Thorium-228, dis. (pCi/L)	0	0	0							0																												
Thorium-230, dis. (pCi/L)	0.3	0.6	0.2							0																												
Thorium-232, dis. (pCi/L)	0	0	0							0																												
Radium-226, dis. (pCi/L)	0.7	0.5	0.4	0.5	3.2					0.2		0.6			1.4			0.4			1.8	2.6	4.8	0.9	0.8	<0.2	<0.2	<0.2	1.1	0.8	<0.2	1.7	0.9	0.8	1.2	1		0.9
Radium-226, susp. (pCi/L)																																						
Radium-226, total (pCi/L)															0.5			0.1																				
Gross Alpha, dis. (pCi/L)	62	36	42	44	72					35		38																										
Gross Beta, dis. (pCi/L)	12	38	40	40	60					36		35																										

NOTES: Mean and median statistic calculated using one-half the detection limit (1/2 D.L.) < = not detected at detection limit shown ND, %ND = number and percent of non detects
Results in mg/L unless otherwise notec

TABLE 32. WATER QUALITY IN ALLUVIAL MONITORING WELLS
1998 - 2007
MONITORING WELL MW7

	MW7 12/31/02	MW7 12/31/02	MW7 1/30/03	MW7 2/28/03	MW7 3/27/03	MW7 3/27/03	MW7 4/30/03	MW7 5/21/03	MW7 6/24/03	MW7 7/30/03	MW7 9/29/03	MW7 11/26/03	MW7 12/17/03	MW7 3/31/04	MW7 6/30/04	MW7 9/30/04	MW7 12/29/04	MW7 3/23/05	MW7 6/23/05	MW7 9/28/05	MW7 11/28/05	MW7 3/31/06	MW7 6/17/06	MW7 6/29/06	MW7 9/28/06	MW7 9/30/06	MW7 11/26/06	MW7 11/26/06	MW7 3/28/07	MW7 9/6/07	MIN	MAX	MEAN (calc using 1/2 DL)	MEDIAN	COUNT	ND	% ND
pH (std units)																																7.1	8.2	7.54	7.45	14	0	0%
Conductivity (umhos)																																276	631	462.6	471.5	14	0	0%
Total dissolved solids	1050		745	1080	685		658	635	579	635					426	327	236	382	576	402	398											162	1080	409.8	352	46	0	0%
Total suspended solids																																1	315	77.3	41.75	14	3	21%
Hardness, total																																100	180	153.3	160	6	0	0%
Carbonate																																<10.	<10.	<5.	5	2	2	100%
Bicarbonate	160		179	172	143		79.3	134	109	166					142	151	104	138	159	165	140											79.3	179	126.2	134.5	34	0	0%
Alkalinity, Dissolved																																87	120	97.3	91	4	0	0%
Alkalinity, total	131		147	141	117		65	110	90	136					117	124	86	113	130	135	115											65	410	114.7	110	43	0	0%
Nitrate Nitrogen																																<0.1	1.7	0.78	0.8	13	4	31%
Ammonia, total																																0	<1.	0.136	0	11	11	100%
Calcium, dissolved	158		110	164	106		105	106	103	77.8					71.6	71		73	98	74.9	66.6											27	164	66.8	62	41	0	0%
Calcium, total																	45.9															23.9	45.9	36.1	37.2	4	0	0%
Magnesium, dissolved	61.5		43.6	63.9	36.7		49.3	37	38.3	29.1					24.3	25.5		28.4	36.3	26.7	23.4											8.1	75	25.1	21.6	44	0	0%
Sodium, dissolved	50.6		48.9	58.3	40.8		29.1	22.8	18.4	17.2					16.9	18.4	13.2	16.9	17.6	16.3	12.2											5	58.3	27.6	24.3	45	0	0%
Potassium, dissolved	5.5		6.14	8.63	7.01		7.27	6.85	6.73	5.98					5.2	5.3		5.1	5.1	5.1	4.1											1.6	8.63	3.9	3.285	44	0	0%
Sulfate	449		308	516	293		423	294	292	199					141	142	66	153	263	169	147											29	516	160.5	140	48	0	0%
Fluoride, total																																0.4	4.5	1.1	0.5	6	0	0%
Chloride	78.6		51.7	63.2	32.3		20.7	18.4	24.2	20.7					25	26	25	30	17	22	25											14	78.6	29.4	25.5	48	0	0%
Aluminum, dissolved	<0.2		<0.2	<0.2	<0.2		<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2			<0.01	<0.5	0.105	0.1	53	53	100%
Aluminum, total	<0.1		<0.2	<0.2	<0.2		<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.1	<0.1	<0.1	0.8	<0.1											<0.01	1.76	0.18	0.1	36	29	81%
Antimony, dissolved	<0.001		0.001	0.001	<0.001		0.001	0.001	0.001	0.001	0.001	0.001	<0.001	<0.001	0.001	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	<0.001	0.001	<0.001	0.001	0.001				<0.001	<0.05	0.005	0.001	54	34	63%
Antimony, total	<0.001		0.001	<0.001	<0.001		0.001	0.001	0.001	0.001	0.001	<0.001	0.001	<0.001	0.001	0.001	<0.05	<0.001	<0.05	<0.05	<0.05											<0.001	<0.05	0.00771	0.001	37	24	65%
Arsenic, dissolved																																<0.001	<0.05	0.0063	0.0025	10	10	100%
Arsenic, total	<0.01		<0.01	<0.01	<0.01		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.001	<0.01	<0.001	<0.001	<0.001											<0.001	<0.05	0.0039	0.005	39	39	100%
Barium, dissolved																																0.04	<0.5	0.088	0.05	5	2	40%
Barium, total																																<0.02	0.05	0.03	0.03	3	1	33%
Beryllium, dissolved																																<0.001	<0.002	0.001	0.00075	6	6	100%
Beryllium, total																																<0.001	<0.001	0.0005	0.0005	1	1	100%
Boron, total																																0	0			0	0	n/a
Cadmium, dissolved																																<0.0002	<0.002	0.0005	0.0003	6	6	100%
Cadmium, total																																<0.003	<0.003	0.0015	0.0015	1	1	100%
Chromium, dissolved																																<0.005	<0.005	0.0025	0.0025	6	6	100%
Chromium, total																																<0.005	<0.005	0.0025	0.0025	1	1	100%
Cyanide, total																																<0.01	<0.01	0.005	0.005	1	1	100%
Copper																																<0.005	<0.005	0.0025	0.0025	3	3	100%
Copper, dissolved	0.005		0.015	0.009	0.007		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.001	0.001	<0.001	0.001	0.002	0.002	0.002			<0.001	<0.02	0.0048	0.0025	52	37	71%
Copper, total	<0.005		<0.005	<0.005	<0.005		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.01	<0.01	<0.01										<0.001	0.062	0.0060	0.0025	36	31	86%
Iron, dissolved	<0.03		<0.03	<0.03	<0.03		<0.03	<0.03	0.032	<0.03					<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03										<0.03	<0.1	0.016	0.015	40	39	98%
Iron, total	0.087		0.048	0.047	0.04		0.03	<0.03	0.073	<0.03					<0.03	0.03	<0.03	<0.03	0.12	1.26	<0.03										<0.03	2.85	0.28	0.03	26	12	46%
Iron, suspended																						<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03			<0.03	0.77	0.196	0.05365	6	3	50%
Iron, Ferrous (Fe2+)																															0.03	0.1	0.02722	0.015	9	7	78%
Iron, Ferric (Fe3+)	0.087		0.048	0.047	0.04		0.03	<0.03	0.041	<0.03					<0.03	<0.03	<0.03	<0.03	0.1	1.25	<0.03										<0.03	2.85	0.27	0.015	26	15	58%
Lead, dissolved																															<0.0004	<0.05	0.0096	0.0025	9	9	100%
Lead, total	<0.005		<0.005	<0.005	<0.005		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.05	<0.005	<0.05	<0.05	<0.05										<0.001	<0.05	0.00804	0.0025	37	36	97%
Manganese, diss.	<0.01		<0.01	<0.01	<0.01		<0.01	<0.01	<0.01	<0.01					<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01			<0.01	0.01	0.0051	0.005	49	48	98%
Manganese, total	<0.01		<0.01	<0.01	<0.01		<0.01	<0.01	<0.01	<0.01					<0.01	<0.01	<0.01	<0.01	<0.01	0.06	<0.01										0.0073	0.17	0.020	0.005	32	26	81%
Mercury, dissolved																															<0.0001	0.0016	0.00038	0.0001	8	7	88%
Mercury, total	<0.0001		<0.0002	<0.0001	<0.0001		<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.001	<0.001	<0.001										<0.0001	<0.001	0.00019	0.00005	37	36	97%
Molybdenum, diss.	0.062		0.071	0.071	0.09		0.088	0.093	0.085	0.073					0.072	0.063	0.05	0.051	0.054	0.043	0.057	0.076	0.071	0.06	0.05	0.022	0.081	0.082			<0.01	0.194	0.07145	0.071	49	8	16%
Molybdenum, total																															0.119	0.119	0.119	0.119	1	0	0%
Nickel, dissolved																															<0.01	<0.04	0.0129	0.01	7	7	100%
Nickel, total																															<0.02	<0.02	0.01	0.01	1	1	100%
Phosphorous																															<1.	<1.	<0.5	0.5	2	2	100%
Selenium, dissolved																															<0.005	<0.05	0.0091	0.005	8	8	100%
Selenium, total																															<0.05	<0.05	0.025	0.025	1	1	100%
Silver, dissolved																															<0.0001	<0.01	0.0020	0.0015	8	8	100%
Silver, total	<0.001		<0.004	<0.001	<0.001		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001										<0.0001	<0.01	0.00196	0.0005	36	36	100%
Thallium, dissolved	<0.001		<0.001	<0.001	<0.001		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001			<0.001	<0.05	0.002	0.0005	54	54	100%
Vanadium, dissolved																															<0.006	<0.01	0.0042	0.005	6	6	100%
Thallium, total	<0.001		<0.001	<0.001	<0.001		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.05	<0.001	<0.1	<0.1	<0.1										<0.001	<0.1	0.00557	0.0005	37	37	100%
Vanadium, total																															<0.005	<0.005	0.0025	0.0025	1	1	100%
Zinc, dissolved																															<0.005	0.092	0.0233	0.00375	12	9	75%
Zinc, total	0.016		0.013	0.018	0.009		0.014	0.009	0.015	0.009					0.007	0.008	<0.005	0.009	<0.01	<0.01	<0.01										<0.005	0.095	0.016	0.0085	32	14	44%
Uranium, dissolved	1.75	1.7	1.69	2.18	1.52	1.4	1.78	1.27	1.03	0.579	0.963	0.857	0.785	0.61	0.566	0.524	0.258	0.584	0.786	0.42	0.797	0.614	0.762	0.875	0.439	0.43	0.885	0.88	0.608	0.597	0.0076	2.18	0.56	0.44	67	0	0%
Uranium, suspended																															0.002	0.0058	0.0039	0.0039	2	0	0%
Uranium, total																															0.079	0.079	0.079	0.079	1	0	0%
Thorium-228, dis. (pCi/L)																															0	0	0	0	4	4	100%
Thorium-230, dis. (pCi/L)																															0	0.6	0.275	0.25	4	1	25%
Thorium-232, dis. (pCi/L)																															0	0	0.00	0	4	4	100%
Radium-226, dis. (pCi/L)	1.5		1.6	2	1.2		0.9	1.9	1.1	0.9					0.7	0.6	0.6	1.1	0.9	0.9	1										<0.2	4.8	1.09	0.9	41	4	10%
Radium-226, susp. (pCi/L)																															<0.	0			0	0	n/a
Radium-226, total (pCi/L)																															0.1	0.5	0.3	0.3	2	0	0%
Gross Alpha, dis. (pCi/L)																															35	72	47.0	42	7	0	0%
Gross Beta, dis. (pCi/L)																															12	60	37.3	38	7	0	0%

TABLE 32. WATER QUALITY IN ALLUVIAL MONITORING WELLS
1998 - 2007
MONITORING WELL MW9

	MW9 1/21/99	MW9 2/19/99	MW9 3/24/99	MW9 3/29/99	MW9 3/30/99	MW9 3/31/99	MW9 4/26/99	MW9 5/1/99	MW9 5/27/99	MW9 6/17/99	MW9 7/28/99	MW9 9/16/99	MW9 9/16/99	MW9 12/28/00	MW9 2/5/01	MW9 3/5/01	MW9 3/28/01	MW9 5/31/01	MW9 6/20/01	MW9 1/29/02	MW9 2/27/02	MW9 3/28/02	MW9 4/23/02	MW9 5/28/02	MW9 6/27/02	MW9 8/27/02	MW9 9/24/02	MW9 9/24/02	MW9 10/22/02	MW9 12/31/02
pH (std units)	7.0	7.4	7.6	7.7	7.7	7.7	8.1		7.5	7.5	7.5																			
Conductivity (umhos)	546	546	534	594	680	665	865		368	539	783																			
Total dissolved solids	354	364	337	404	475	472	629		251	374	567									242						422			413	
Total suspended solids	<1.	1	2	0	0	0	<1.		<10.	<10.	<10.																			
Hardness, total	190																													
Carbonate																														
Bicarbonate																				108						168			187	
Alkalinity, Dissolved							97		78	98	13																			
Alkalinity, total	110	130	94	130	130	130	97													89						138			153	
Nitrate Nitrogen	1.7	1.4	0.8	2.5	2.5	2.5	2.7		1	1	2																			
Ammonia, total	0	0	0	0	0	0	0		<1.	<1.	<1.																			
Calcium, dissolved	47	59																		48.5						69.3			72.6	
Calcium, total				59.2	70.8			69.3	34.8		91.6	52.1	33.1																	
Magnesium, dissolved	17	110		21.2	26.3			26	12.2		31.1	19.5	10.5							13.9						22.8			23.6	
Sodium, dissolved	40	34		37.9	37.4			36.6	23.5		33.9	28.9	9.1							17.9						23.7			30	
Potassium, dissolved	3.1	3.1		3.4	3.7			3.4	2.9		6.2	4	1.6							2.79						3.24			4.48	
Sulfate	150	25	140	160	200	200	330		83	160	270									71.8						133			140	
Fluoride, total	0.5																													
Chloride	14	16	16	15	15	14	11		11	11	10									31.4						26.4			31.3	
Aluminum, dissolved	<0.5			<0.1	<0.1			<0.1	<0.1				<0.1							<0.1						<0.2			<0.2	
Aluminum, total																				0.041						0.38			<0.1	
Antimony, dissolved	<0.003			<0.006	<0.006			<0.006	<0.006		<0.006	<0.006	<0.006							<0.001						<0.001			<0.001	
Antimony, total																				<0.001						<0.001			<0.001	
Arsenic, dissolved				0.005	<0.005			<0.005	<0.005		<0.005	<0.005	<0.005																	
Arsenic, total	<0.003																			<0.01						<0.01			<0.01	
Barium, dissolved				<0.1	<0.1			<0.1	<0.1				<0.1																	
Barium, total	0.05																													
Beryllium, dissolved	<0.002			<0.001	0.001			0.002	<0.001				<0.001																	
Beryllium, total																														
Boron, total				0.06	<0.05			<0.05					<0.05																	
Cadmium, dissolved	<0.0002			<0.001	<0.001			<0.001	<0.001				<0.001																	
Cadmium, total																														
Chromium, dissolved	<0.005			<0.005	<0.005			<0.005	<0.005				<0.005																	
Chromium, total																														
Cyanide, total													<0.01																	
Copper																														
Copper, dissolved	<0.02			<0.005	<0.005			<0.005	<0.005		<0.005	<0.005	<0.005							<0.01						0.016			0.006	
Copper, total																				0.002						<0.005			0.006	
Iron, dissolved	<0.03			<0.1	<0.1			<0.1	<0.1				<0.1							<0.03						<0.03			<0.03	
Iron, total																				<0.03						<0.03			<0.03	
Iron, suspended																														
Iron, Ferrous (Fe2+)																														
Iron, Ferric (Fe3+)																				<0.03						<0.03			<0.03	
Lead, dissolved				<0.005	<0.005			<0.005	<0.005		<0.005	<0.005	<0.005																	
Lead, total	0.002																			<0.001						<0.005			<0.005	
Manganese, diss.	<0.01			<0.01	<0.01			<0.01	<0.01				<0.01							<0.01						<0.01			<0.01	
Manganese, total																				<0.01						<0.01			<0.01	
Mercury, dissolved	<0.0002																													
Mercury, total																				<0.0001						<0.0001			<0.0001	
Molybdenum, diss.	0.11			0.122	0.114			0.094	0.184		0.243	0.144	<0.005							0.0711						0.06			0.056	
Molybdenum, total																														
Nickel, dissolved	<0.04			<0.01	<0.01			<0.01	<0.01			<0.01	<0.01																	
Nickel, total																														
Phosphorous																														
Selenium, dissolved	<0.005			<0.01	<0.01			<0.01	<0.01		<0.01	<0.01	<0.01																	
Selenium, total																														
Silver, dissolved	<0.0002			<0.01	<0.01			<0.01	<0.01				<0.01																	
Silver, total																				<0.001						<0.001			<0.001	
Thallium, dissolved	<0.001			<0.001	<0.001			<0.001	<0.001		<0.001	<0.001	<0.001							<0.001						<0.001			<0.001	
Vanadium, dissolved	<0.01			<0.01	<0.01			<0.01	<0.01				<0.01																	
Thallium, total																				<0.001						<0.001			<0.001	
Vanadium, total																														
Zinc, dissolved	0.005			0.04	0.01			0.01	0.07		<0.01	<0.01	<0.01																	
Zinc, total																				0.01						<0.005			0.025	
Uranium, dissolved	0.32	0.32	0.33	0.73	0.72	0.72	0.0016		0.3	0.82	1.3			0.46	0.44	0.4	0.26	0.414	0.197	0.387	0.472	0.359	0.748	0.66	0.389	0.567	0.751	0.67	0.758	0.442
Uranium, suspended						0.0036																								
Uranium, total																														
Thorium-228, dis. (pCi/L)									0																					
Thorium-230, dis. (pCi/L)									0																					
Thorium-232, dis. (pCi/L)									0																					
Radium-226, dis. (pCi/L)									0.4		1.7									0.9						1.8			<0.2	
Radium-226, susp. (pCi/L)																														
Radium-226, total (pCi/L)																														
Gross Alpha, dis. (pCi/L)									130		560																			
Gross Beta, dis. (pCi/L)									140		550																			

NOTES: Mean and median statistic calculated using one-half the detection limit (1/2 D.L.) < = not detected at detection limit shown ND, %ND = number and percent of non detects
Results in mg/L unless otherwise notec

TABLE 32. WATER QUALITY IN ALLUVIAL MONITORING WELLS
1998 - 2007
MONITORING WELL MW9

	MW9 12/31/02	MW9 1/30/03	MW9 2/28/03	MW9 3/27/03	MW9 3/27/03	MW9 4/30/03	MW9 5/21/03	MW9 6/24/03	MW9 7/30/03	MW9 11/26/03	MW9 3/31/04	MW9 6/30/04	MW9 9/30/04	MW9 12/29/04	MW9 3/23/05	MW9 6/23/05	MW9 9/28/05	MW9 11/29/05	MW9 3/28/07	MW9 9/6/07	MIN	MAX	MEAN (calc using 1/2 DL)	MEDIAN	COUNT	ND	% ND
pH (std units)																				7.26	7.0	8.1	7.54	7.5	11	0	0%
Conductivity (umhos)																				533	368	865	604.8	546	11	0	0%
Total dissolved solids														352		334				366	242	629	397.3	370	16	0	0%
Total suspended solids																					0	<10.	1.900	0.75	10	8	80%
Hardness, total																					190	190	190	190	1	0	0%
Carbonate																					0	0			0	0	n/a
Bicarbonate														120		115				153	108	187	141.8	136.5	6	0	0%
Alkalinity, Dissolved																					13	98	71.5	87.5	4	0	0%
Alkalinity, total														98		94				126	89	153	116.8	126	13	0	0%
Nitrate Nitrogen																					0.8	2.7	1.81	1.85	10	0	0%
Ammonia, total																					0	<1.	0.150	0	10	10	100%
Calcium, dissolved																59.8				56.4	47	72.6	58.9	59	7	0	0%
Calcium, total														64.7							33.1	91.6	59.45	61.95	8	0	0%
Magnesium, dissolved																20.3				19	10.5	110	26.7	20.75	14	0	0%
Sodium, dissolved														17.9		13.5				15.1	9.1	40	26.6	28.9	15	0	0%
Potassium, dissolved																3.1				4	1.6	6.2	3.5	3.32	14	0	0%
Sulfate														132		131				112	25	330	152.4	140	16	0	0%
Fluoride, total																					0.5	0.5	0.5	0.5	1	0	0%
Chloride														26		15				27	10	31.4	18.1	15	16	0	0%
Aluminum, dissolved										<0.2	<0.2			<0.2		<0.2				<0.2	<0.1	<0.5	0.089	0.1	14	14	100%
Aluminum, total										<0.2	<0.2			<0.1		<0.1				<0.2	0.041	0.38	0.11	0.075	8	6	75%
Antimony, dissolved										<0.001	<0.001			<0.001		<0.001				<0.001	<0.001	<0.006	0.002	0.001	16	16	100%
Antimony, total										<0.001	<0.001			<0.05		<0.05					<0.001	<0.05	0.0075	0.0005	7	7	100%
Arsenic, dissolved																					<0.005	0.005	0.0029	0.0025	7	6	86%
Arsenic, total										<0.01	<0.01			<0.001		<0.001				<0.1	<0.001	<0.1	0.0086	0.005	9	9	100%
Barium, dissolved																				0.049	<0.049	<0.1	0.050	0.05	6	5	83%
Barium, total																				0.048	0.048	0.05	0.0490	0.049	2	0	0%
Beryllium, dissolved																					<0.001	0.002	0.001	0.00075	6	4	67%
Beryllium, total																					0	0			0	0	n/a
Boron, total																					<0.05	0.06	0.034	0.025	4	3	75%
Cadmium, dissolved																					<0.0002	<0.001	0.0004	0.0005	6	6	100%
Cadmium, total																					0	0			0	0	n/a
Chromium, dissolved																					<0.005	<0.005	0.0025	0.0025	6	6	100%
Chromium, total																					0	0			0	0	n/a
Cyanide, total																					<0.01	<0.01	0.005	0.005	1	1	100%
Copper																					0	0			0	0	n/a
Copper, dissolved										<0.005	<0.005			<0.005		<0.005				<0.005	<0.005	<0.02	0.004	0.0025	16	14	88%
Copper, total										<0.005	<0.005			<0.005		<0.01				<0.005	0.002	0.01	0.0032	0.0025	8	6	75%
Iron, dissolved														<0.03		<0.03				0.09	<0.03	<0.1	0.036	0.0325	12	11	92%
Iron, total														0.03		<0.03				0.08	<0.03	<0.08	0.03	0.015	6	4	67%
Iron, suspended																					0	0			0	0	n/a
Iron, Ferrous (Fe2+)																				0.09	0.09	0.09	0.09	0.09	1	0	0%
Iron, Ferric (Fe3+)														<0.03		<0.03					<0.03	<0.03	0.02	0.015	5	5	100%
Lead, dissolved																					<0.005	<0.005	0.0025	0.0025	7	7	100%
Lead, total										<0.005	<0.005			<0.05		<0.05				<0.005	<0.001	<0.05	0.0072	0.0025	9	8	89%
Manganese, diss.														<0.01		<0.01				<0.01	<0.01	<0.01	0.0050	0.005	12	12	100%
Manganese, total														<0.01		<0.01				<0.01	<0.01	<0.01	0.005	0.005	6	6	100%
Mercury, dissolved																					<0.0002	<0.0002	0.0001	0.0001	1	1	100%
Mercury, total										<0.0001	<0.0001			<0.0001		<0.001				<0.0001	<0.0001	<0.001	0.00011	0.00005	8	8	100%
Molybdenum, diss.														0.053		0.052				0.048	<0.005	0.243	0.097	0.08255	14	1	7%
Molybdenum, total																					0	0			0	0	n/a
Nickel, dissolved																					<0.01	<0.04	0.0071	0.005	7	7	100%
Nickel, total																					0	0			0	0	n/a
Phosphorous																					0	0			0	0	n/a
Selenium, dissolved																					<0.005	<0.01	0.0047	0.005	8	8	100%
Selenium, total																					0	0			0	0	n/a
Silver, dissolved																					<0.0002	<0.01	0.0042	0.005	6	6	100%
Silver, total										<0.001	<0.001			<0.01		<0.01				<0.001	<0.001	<0.01	0.00163	0.0005	8	8	100%
Thallium, dissolved										<0.001	<0.001			<0.001		<0.001				<0.001	<0.001	<0.001	0.001	0.0005	16	16	100%
Vanadium, dissolved																					<0.01	<0.01	0.0050	0.005	6	6	100%
Thallium, total										<0.001	<0.001			<0.05		<0.1					<0.001	<0.1	0.01107	0.0005	7	7	100%
Vanadium, total																					0	0			0	0	n/a
Zinc, dissolved																					0.005	0.07	0.0188	0.0075	8	3	38%
Zinc, total														0.008		<0.01				0.006	<0.005	0.025	0.009	0.007	6	2	33%
Uranium, dissolved	0.47	0.44	0.484	1.11	0.97	1.3	0.95	0.92	0.57	0.484	0.319	0.441	0.377	0.593	0.21	0.43	0.39	0.467	0.674	0.601	0.0016	1.3	0.556	0.47	47	0	0%
Uranium, suspended																				0.0004	0.0004	0.0036	0.002	0.002	2	0	0%
Uranium, total																				0.635	0.635	0.635	0.635	0.635	1	0	0%
Thorium-228, dis. (pCi/L)																					0	0		0	1	1	100%
Thorium-230, dis. (pCi/L)																					0	0	0	0	1	1	100%
Thorium-232, dis. (pCi/L)																					0	0	0	0	1	1	100%
Radium-226, dis. (pCi/L)														0.8		0.2				0.4	<0.2	1.8	0.79	0.6	8	1	13%
Radium-226, susp. (pCi/L)																				<0.2	<0.2	0.2	0.10	0.1	1	1	100%
Radium-226, total (pCi/L)																					0	0			0	0	n/a
Gross Alpha, dis. (pCi/L)																					130	560	345.0	345	2	0	0%
Gross Beta, dis. (pCi/L)																					140	550	345.0	345	2	0	0%

7.3 Sump Water Quality

Water in the alluvium was intercepted by four collector trenches and sumps (Figure 10) that operated from 1990 to June 2002 (Section 4.2.3). During operations, water in the sumps contained moderate levels of TDS (300 – 935 mg/L) and few dissolved metals, with the exception of zinc, molybdenum, and uranium (Table 30). Sulfate, bicarbonate, calcium, sodium, and magnesium were the primary components of TDS in the sump water.

Compared to samples from alluvial monitoring wells, the sump water generally contained 50 – 100% more dissolved solids, and higher concentrations of molybdenum, uranium, and zinc. Water quality in the sumps was nearly indistinguishable from water quality in well MW6, which had a slightly lower TDS and comparable concentrations of molybdenum, uranium, and zinc.

Water quality in the sumps has generally improved since the sumps were shut down. TDS concentrations in Sump decreased from 935 mg/L in May 2003 to 417 in March 2005, while zinc concentrations declined from 0.232 mg/L to 0.045 mg/L over the same period.

Uranium in water samples collected from the sumps since 1998 are shown in Table 31. The trends of uranium concentrations in the sumps is somewhat similar to the trends in Ralston Creek (Section 6.5.2), although the sumps are much less affected by seasonality. After the sumps were turned off in June 2002, uranium concentrations in Sump 1 increased due to a "first flush" of water through the alluvium. Concentrations in the sumps have generally declined since that initial flush (Figure 39). Average annual uranium concentrations in Sump 1 declined from 1.38 mg/L in 2003 to 0.89 mg/L in 2004 and 0.74 mg/L in 2007.

The sumps are slated for removal, in accordance with the Mine Reclamation Plan.

7.4 Seep Water Quality

Although numerous seeps exist below mine property along the access road where groundwater surfaces at the contact between the alluvium and underlying bedrock, long-term monitoring of these natural seeps has not been conducted. On mine property, seeps were somewhat limited while the sumps were in operation. Two historical seeps on mine property included the "Parking Lot Seep" and the "Sump 3 Seep".

Water quality was monitored in the "Parking Lot Seep" from January 1998 to August 2001. Uranium concentrations were very consistent, and averaged 0.026 mg/L with minor variation throughout the monitoring period (Table 31). The seep was removed in 2001 when the emergency storage ponds were reclaimed and the area was regraded.

The "Sump 3 Seep" existed near MW9 and Sump 3. Here, water emanated from a low point in the fill during the wet season. Since the sumps were shut down, water levels have risen in the alluvium and fill. The seep is still in existence, and was sampled for uranium on August 8, 2007. The sample, labeled as SchwartSpring, had a dissolved uranium concentration of 0.301 mg/L, which is about half the concentration measured at Sump 1 in fall (September) 2007 (0.675 mg/L) and 60% higher than the concentration measured in Sump 3 in spring (May) 2007 (0.185 mg/L). These results indicate that the water emanating from the Sump 3 Seep is not identical to the water in the nearby sump, although it may be related to the French Drain system previously installed at Sump 3.

Table 30. Water Quality in the Sumps

Parameter	Sump 1 11/15/99	Sump 1 5/21/03	Sump 1 12/16/03	Sump 1 3/22/05	Sump 2 11/15/99	Sump 3 11/15/99	Sump 4 11/15/99	Sump 4 11/25/03	Sump 4 3/22/05	Sump 4 12/16/06
Conductivity (µMhos)	671				535	752	463			
Total diss. solids (mg/L)	410	935	424	417	340	510	300	236	252	
Total susp. solids (mg/L)	<4.				<4.	<4.	<4.			
Hardness, total (mg/L)	227				201	336	188			
Bicarbonate (mg/L)		171	130	144				96	102	
Alkalinity, total (mg/L)	102	141	130	118	100	114	96	96	84	
Nitrate Nitrogen (mg/L)	0.5				0.7	1.5	0.9			
Ammonia, total (mg/L)	0.29				<0.02	<0.02	<0.02			
Calcium, diss. (mg/L)		146	78	79.3				44		
Calcium, total (mg/L)	55.4				49	84.5	48.6		43.1	
Sodium, diss. (mg/L)	54.8	26.1	20	17.3	39.1	39.8	27.5	8	12.3	
Potassium, diss. (mg/L)	4.6	9.29	26	6.1	3.3	3.6	<3.	3.9	3.3	
Sulfate (mg/L)	150	451	150	174	139	268	110	37	59	
Fluoride (mg/L)	0.6				0.6	0.6	0.4			
Chloride (mg/L)	52	21.2	36	34	15.3	16	12.3	32		
Aluminum, diss. (mg/L)	<0.03	<0.2	<0.2	<0.2	0.04	<0.03	<0.03	<0.2	<0.2	<0.2
Aluminum, total (mg/L)		<0.2	<0.2	0.4				<0.2	<0.1	
Antimony, diss. (mg/L)	<0.005	0.001	<0.001	0.001	0.006	<0.005	<0.005	<0.001	<0.001	<0.001
Antimony, total (mg/L)		0.001	0.001	0.002				<0.001	<0.001	
Arsenic, diss. (mg/L)	<0.005				<0.005	<0.005	<0.005			
Arsenic, total (mg/L)		<0.01	<0.01	<0.01				<0.01	<0.01	
Barium, diss. (mg/L)	0.042				0.037	0.038	0.046			
Beryllium, diss. (mg/L)	<0.001				<0.001	<0.001	<0.001			
Boron, total (mg/L)	0.07				0.07	0.07	<0.05			
Cadmium, diss. (mg/L)	<0.001				<0.001	<0.001	<0.001			
Chromium, diss. (mg/L)	<0.005				<0.005	<0.005	<0.005			
Cyanide, total (mg/L)	<0.01				<0.01	<0.01	<0.01			
Copper, diss. (mg/L)	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.001
Copper, total (mg/L)		<0.005	<0.005	<0.005				<0.005	<0.005	
Iron, diss. (mg/L)	<0.03	<0.03	0.05	<0.03	0.06	<0.03	<0.03	0.14	<0.03	
Iron, total (mg/L)		0.045	0.05	1.31				<0.03	0.47	
Iron, Ferrous (Fe2+)										<0.03
Iron, Ferric (Fe3+) (mg/L)		0.045		1.3					0.46	
Lead, diss. (mg/L)	<0.005				<0.005	<0.005	<0.005			
Lead, total (mg/L)		<0.005	<0.005	<0.005				<0.005	<0.005	
Magnesium, diss. (mg/L)	21.5	56.4	26	31	19.1	30.3	16.2	12	13.6	
Manganese, diss. (mg/L)	0.09	0.02	<0.01	<0.01	<0.01	0.32	<0.01	<0.01	0.02	<0.01
Manganese, total (mg/L)		0.02	0.02	0.05				<0.01	0.02	
Mercury, diss. (mg/L)	<0.0002				<0.0002	<0.0002	<0.0002			
Mercury, total (mg/L)		<0.0001	<0.0001	<0.0001				<0.0001	<0.0001	
Molybdenum, diss. (mg/L)	0.119	0.067	0.057	0.081	0.12	0.073	0.059	0.024	0.015	0.015
Nickel, diss. (mg/L)	<0.01				<0.01	<0.01	<0.01			
Selenium, diss. (mg/L)	<0.01				<0.01	<0.01	<0.01			
Silver, diss. (mg/L)	<0.0002				<0.0002	<0.0002	<0.0002			
Silver, total (mg/L)		<0.001	<0.001	<0.01				<0.001	<0.01	
Thallium, diss. (mg/L)	<0.01	<0.001	<0.001	<0.001	<0.01	<0.01	<0.01	<0.001	<0.001	<0.001
Vanadium, diss. (mg/L)	<0.01				<0.01	<0.01	<0.01			
Thallium, total (mg/L)		<0.001	<0.001	<0.001				<0.001	<0.001	
Zinc, diss. (mg/L)	0.03				0.03	0.02	<0.01			
Zinc, total (mg/L)		0.232	0.066	0.045				0.013	0.01	
Uranium, diss. (mg/L)		1.62	0.74	0.873				0.11	0.0962	0.0988
Uranium, suspended (mg/L)				0.004					0.0005	
Radium-226, diss. (pCi/L)		14.9	6.3	4.8				0.7	0.3	
Radium-226, susp. (pCi/L)				0.5					<0.1	

Note: See Table 31 for additional uranium analyses for water samples collected from the sumps, 1990 – 2007

Table 31. Uranium Concentrations in Sumps and Seep, 1998 - 2007

Sump 1		Sump 2		Sump 3		Sump 4		Parking Lot Seep	
1/28/98	0.2100	1/28/98	0.3100	1/28/98	0.2900	1/28/98	0.0920	1/28/98	0.0197
2/24/98	0.4200	2/24/98	0.3500	2/24/98	0.3600	2/24/98	0.0980	2/24/98	0.0202
3/26/98	0.8400	3/26/98	0.6000	3/26/98	0.8300	3/26/98	0.2900	3/26/98	
4/29/98	3.4000	4/29/98	2.8000	4/29/98	2.1000	4/29/98	1.2000	4/29/98	
5/28/98	0.4700	5/28/98	1.2000	5/28/98	1.1000	5/28/98	0.2700	5/28/98	
6/29/98	0.1700	6/29/98	0.3500	6/29/98	0.5000	6/29/98	0.1600	6/29/98	0.0244
7/30/98	0.2200	7/30/98	0.2900	7/30/98	0.6000	7/30/98	0.2100	7/30/98	0.0263
8/31/98	0.1400	8/31/98	0.2200	8/31/98	0.4000	8/31/98	0.1500	8/31/98	0.0210
9/30/98	0.1800	9/30/98	0.2900	9/30/98	0.3600	9/30/98	0.1400	9/30/98	0.1200
10/28/98	0.2600	10/28/98	0.3100	10/28/98	0.3400	10/28/98	0.1200	10/28/98	0.0275
11/25/98	0.2300	11/25/98	0.3500	11/25/98	0.4500	11/25/98	0.1100	11/25/98	0.0281
12/17/98	0.2400	12/17/98	0.3400	12/17/98	0.3700	12/17/98	0.1100	12/17/98	0.0257
1/26/99	0.3100	1/26/99	0.3800	1/26/99	0.3400	1/26/99	0.1100	1/26/99	0.0244
2/25/99	0.0360	2/25/99	0.3900	2/25/99	0.0332	2/25/99	0.1000	2/25/99	0.0255
3/24/99	0.3300	3/24/99	0.3400	3/24/99	0.3000	3/24/99	0.1200	3/24/99	0.0169
4/29/99	0.0058	4/29/99	1.1000	4/29/99	0.9000	4/29/99	0.2900	4/29/99	
5/28/99	0.2800	5/28/99	0.3300	5/28/99	0.0006	5/28/99	0.1800	5/28/99	
6/23/99	0.2000	6/23/99	0.2800	6/23/99	0.4000	6/23/99	0.2100	6/23/99	0.0160
7/27/99	0.3000	7/27/99	0.3200	7/27/99	0.3900	7/27/99	0.1400	7/27/99	0.0260
8/31/99	0.3700	8/31/99	1.1000	8/31/99	0.8200	8/31/99	0.2600	8/31/99	0.0380
9/29/99	0.7500	9/29/99	0.4600	9/29/99	0.4800	9/29/99	0.2100	9/29/99	0.0380
10/29/99	0.3500	10/29/99	0.4400	10/29/99	0.4700	10/29/99	0.1400	10/29/99	0.0316
11/30/99	0.3300	11/30/99	0.3600	11/30/99	0.4300	11/30/99	0.1200	11/30/99	0.0317
12/22/99	0.3500	12/22/99	0.3900	12/22/99	0.4500	12/22/99	0.0344	12/22/99	<0.0002
1/27/00	0.5400	1/27/00	0.4300	1/27/00	0.4700	1/27/00	0.1400	1/27/00	0.0300
2/24/00	0.3700	2/24/00	0.3000	2/24/00	0.3200	2/24/00	0.1000	2/24/00	0.0239
3/29/00	0.4500	3/29/00	0.0340	3/29/00	0.3700	3/29/00	0.1200	3/29/00	0.0228
6/29/00	0.2700	6/29/00	0.0040	6/29/00	0.3200	6/29/00	0.1200	5/31/00	
9/29/00	0.4800	6/29/00	0.0040	8/31/00	0.0042	9/29/00	0.1400	6/29/00	0.0265
11/7/00	0.4900	9/29/00	0.2600	9/29/00	0.3500	11/7/00	0.1300	7/27/00	
12/19/00	0.4500	11/7/00	0.4100	11/28/00	0.2500	12/19/00	0.1400	8/31/00	
3/1/01	0.8200	12/19/00	0.4500	12/19/00	0.2600	3/1/01	0.1000	9/29/00	0.0225
3/28/01	0.6800	3/1/01	0.2900	1/30/01	0.2700	3/28/01	0.1100	11/7/00	0.0220
5/3/01	0.4870	3/28/01	0.2400	3/1/01	0.2200	5/3/01	0.0441	12/19/00	0.0250
5/29/01	0.5390	5/3/01	0.1790	3/28/01	0.1100	5/29/01	0.2050	3/1/01	0.0230
6/21/01	0.3080	5/29/01	1.1300	5/3/01	0.0800	6/21/01	0.1540	3/28/01	0.0220
7/11/01	0.3550	6/21/01	0.2250	5/29/01	0.2100	7/11/01	0.1420	5/3/01	0.0321
8/23/01	0.2890	7/11/01	0.2060	6/20/01	0.1540	8/23/01	0.2080	5/29/01	0.0068
9/17/01	0.3270	8/23/01	0.1410	7/11/01	0.1660	9/17/01	0.0640	6/21/01	0.0115
10/24/01	0.2420	9/5/07	26.8	3/28/07	0.1850	10/24/01	0.0695	7/11/01	0.0120
12/18/01	0.2610					12/18/01	0.0719	8/23/01	0.0193
1/22/02	0.3600					1/22/02	0.0597	Removed	
2/26/02	1.01					2/26/02	0.0886	"	
5/29/02	0.9820					3/28/02	0.2330	"	
6/25/02	0.4900					4/24/02	0.2530	"	
9/24/02	1.4000					5/29/02	0.1570	"	
9/24/02	1.5200					6/25/02	0.0853	"	
12/31/02	2.1300					8/27/02	0.0802	"	
12/31/02	2.7000					9/24/02	0.1600	"	
1/30/03	1.6200					9/24/02	0.1660	"	
2/26/03	2.1500					10/31/02	0.1190	"	
3/26/03	1.9600					11/22/02	0.1010	"	
3/26/03	2.1000					12/31/02	0.3230	"	
4/29/03	2.0000					12/31/02	0.3600	"	
5/21/03	1.6200					1/30/03	0.2670	"	
6/23/03	1.2000					2/27/03	0.2140	"	
7/29/03	0.6500					2/27/03	0.2300	"	
9/26/03	1.2000					3/27/03	0.2350	"	
11/25/03	0.8000					3/26/03	0.1100	"	
12/16/03	0.7250					4/29/03	0.2000	"	
2/25/04	0.6100					5/21/03	0.1500	"	
3/30/04	0.7170					6/23/03	0.2000	"	
4/28/04	0.9740					7/29/03	0.6700	"	
7/28/04	0.7990					9/26/03	0.1700	"	
8/30/04	1.0000					11/25/03	0.1030	"	
10/1/04	0.5720					3/30/04	0.0795	"	
10/29/04	0.7650					4/28/04	0.1210	"	
11/30/04	1.0600					5/15/04	0.103	"	
12/29/04	0.5450					7/28/04	0.1180	"	
1/25/05	0.9010					8/30/04	0.1170	"	
2/28/05	0.8240					9/30/04	0.0782	"	
3/22/05	0.8730					10/29/04	0.0655	"	
4/21/05	1.2000					11/30/04	0.0796	"	
5/31/05	0.8560					12/29/04	0.1140	"	
6/22/05	0.7680					1/25/05	0.1230	"	
8/30/05	0.7240					2/28/05	0.0873	"	
9/30/05	0.8240					3/22/05	0.0962	"	
10/26/05	1.1000					4/21/05	0.0898	"	
11/30/05	0.8620					5/31/05	0.1510	"	
12/31/05	0.5790					6/22/05	0.1740	"	
1/31/06	0.5680					8/30/05	0.1100	"	
2/27/06	0.4910					9/28/05	0.1910	"	
9/6/07	0.675					10/26/05	0.2090	"	
						11/30/05	0.1140	"	
						12/31/05	0.0722	"	
						12/16/06	0.0988		

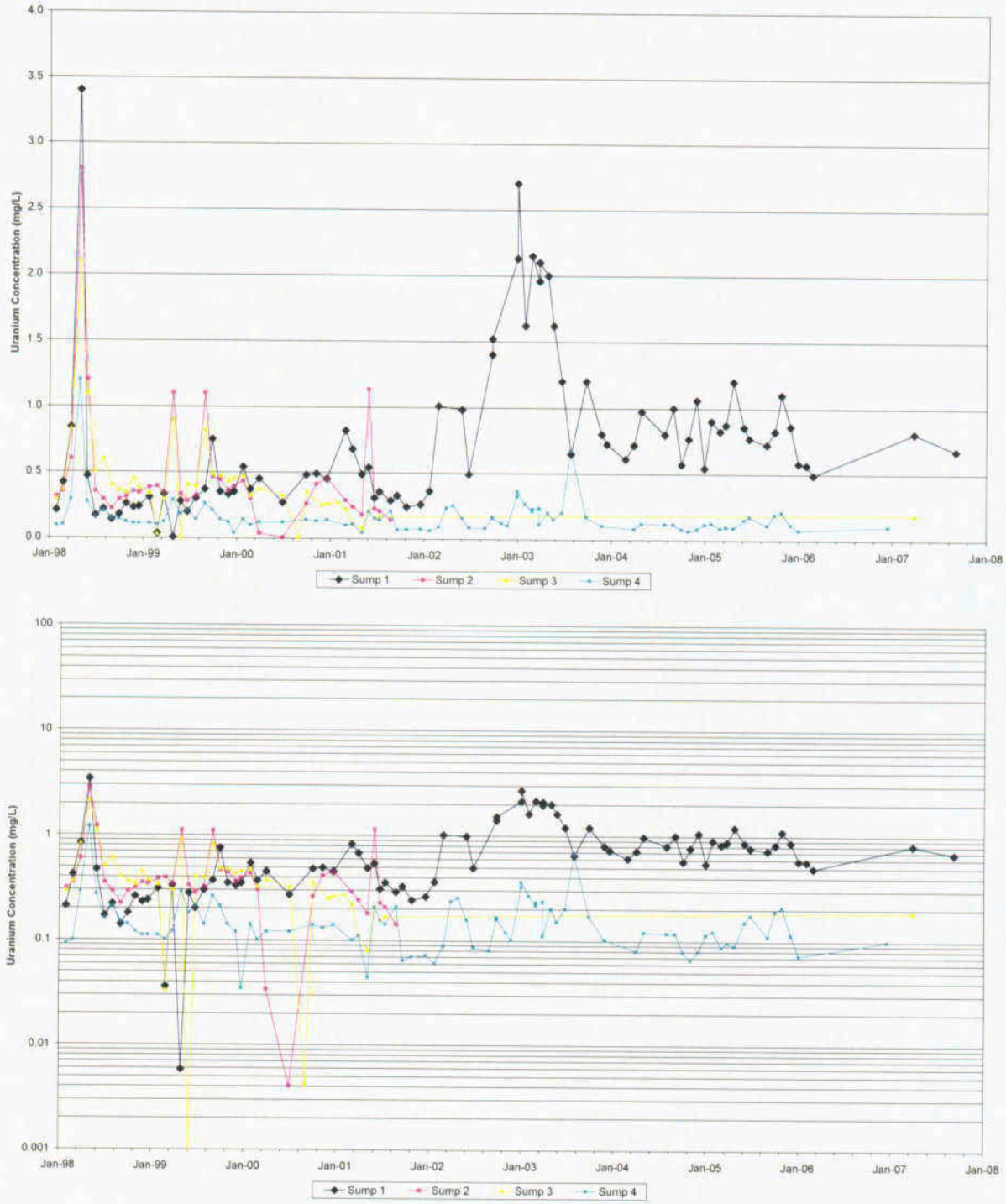


Figure 39. Uranium Concentrations in Sumps, 1990 – 2007
Shown in (a) arithmetic scale and (b) logarithmic scale

7.5 Shallow Bedrock Water Quality

Two monitoring wells were installed in the shallow bedrock on the hillside above the mine, MW10 and MW11 (Section 4.1.1). Both wells are located far above the mine (Figure 5), in bedrock undisturbed by mining, and represent background bedrock water quality. MW10 could not be sampled, due to poor completion. MW11 was sampled ten times between February 1999 and July 2001. Results indicate that groundwater in the shallow bedrock is calcium-bicarbonate[19] type water with low to moderate dissolved solids and near-neutral to slightly basic pH (Table 32). Dissolved uranium averaged 0.29 mg/L with a median value of 0.033 mg/L. Molybdenum was below detection.

Table 32. Water Quality in Shallow Bedrock

	MW11 2/17/99	MW11 3/25/99	MW11 4/21/99	MW11 5/25/99	MW11 1/2/01	MW11 1/2/01	MIN	MAX	MEAN	MEDIAN	COUNT	ND	% ND
pH		8.2	7.4	7.9		7.3	7.3	8.2	7.70	7.65	4	0	0%
Conductivity		259	234	348		197	197	348	259.5	246.5	4	0	0%
Total diss. solids		199	164	340		121	121	340	206.0	181.5	4	0	0%
Total susp.solids		35.1	120	50.7		64.7	35.1	120	67.625	57.7	4	0	0%
Carbonate						<10.	10	10	5	5	1	1	100%
Bicarbonate						51	51	51	51.0	51	1	0	0%
Alkalinity, Diss.			69	100			69	100	84.5	84.5	2	0	0%
Alkalinity, total		110	69			51	51	110	76.7	69	3	0	0%
Nitrate Nitrogen		0.4	<0.1	1			<0.1	1	0.48	0.4	3	1	33%
Ammonia, total		0	0	<1.			0	<1.	0.167	0	3	3	100%
Calcium, diss.						5.5	5.5	5.5	5.5	5.5	1	0	0%
Magnesium, diss.						3.8	3.8	3.8	3.8	3.8	1	0	0%
Sodium, diss.						14	14	14	14.0	14	1	0	0%
Potassium, diss.						0.4	0.4	0.4	0.40	0.4	1	0	0%
Sulfate		36	37	88		50	36	88	52.8	43.5	4	0	0%
Fluoride, total	0.2						0.2	0.2	0.200	0.2	1	0	0%
Chloride		5	5	5		5	5	5	5.0	5	4	0	0%
Aluminum, diss.					0.4		<0.4	<0.4	0.400	0.4	1	0	0%
Antimony, diss.	<0.003				<0.001		<0.001	<0.003	0.001	0.001	2	2	100%
Arsenic, diss.	<0.003						<0.003	<0.003	0.0015	0.0015	1	1	100%
Barium, diss.	<0.02						<0.02	<0.02	0.010	0.01	1	1	100%
Beryllium, diss.	<0.002						<0.002	<0.002	0.001	0.001	1	1	100%
Cadmium, diss.	<0.0002						<0.0002	<0.0002	0.0001	0.0001	1	1	100%
Chromium, diss.	<0.005						<0.005	<0.005	0.0025	0.0025	1	1	100%
Copper					0.005		0.005	0.005	0.005	0.005	1	0	0%
Iron, diss.					0.2		<0.2	<0.2	0.200	0.2	1	0	0%
Lead, diss.	<0.002						<0.002	<0.002	0.0010	0.001	1	1	100%
Manganese, diss.					<0.01		<0.01	0.01	0.005	0.005	1	1	100%
Mercury, diss.	<0.0002						<0.0002	<0.0002	0.0001	0.0001	1	1	100%
Molybdenum, diss	<0.01					<0.005	<0.005	<0.01	0.004	0.00375	2	2	100%
Nickel, diss.	<0.04						<0.04	<0.04	0.020	0.02	1	1	100%
Selenium, diss.	<0.005						<0.005	<0.005	0.003	0.0025	1	1	100%
Silver, diss.	<0.0002						<0.0002	<0.0002	0.0001	0.0001	1	1	100%
Thallium, diss.	<0.001				<0.001		<0.001	<0.001	0.0005	0.0005	2	2	100%
Vanadium, diss.	<0.01						<0.01	<0.01	0.005	0.005	1	1	100%
Radium-226, diss.						1.8	1.8	1.8	1.80	1.8	1	0	0%
Radium-226, susp.						1	1	1	1	1	1	0	0%
Uranium, susp.						0.004	0.004	0.004	0.004	0.004	1	0	0%
Uranium, total					0.0017		0.0017	0.0017	0.0017	0.0017	1	0	0%
	2/17/99	3/25/99	4/21/99	5/25/99	1/2/01	1/2/01							
Uranium, diss.		0.019	0.0625	0.047	2.63	0.008							
	2/5/01	3/5/01	5/31/01	6/20/01	7/25/01								
	0.007	0.057	0.0013	0.0101	0.055		0.0013	2.63	0.290	0.033	10	0	0%

Notes: All results in mg/L except conductivity (µmhos/cm) and pH (standard units).
Mean and median statistic calculated using one half the detection limit (1/2 D.L.)

[19] At pH less than 8, bicarbonate can be calculated from total alkalinity using the relationship HCO_3 = T.Alk/0.8202 (Hem, 1985).

7.6 Underground Mine Water Quality

The chemistry of groundwater entering the mine is known from samples collected from seeps, drips, and flows occurring from coreholes, faults, and bulkheads in the underground workings (Figure 5). These samples are affected to varying degrees by chemical loading from contact with wall rocks and minerals exposed to oxidizing conditions within the mine and are not necessarily representative of the background quality of bedrock groundwater[20]. They do, however, provide insight to the variability of water quality from different underground levels, rock types, and structures within the mine. The number of samples collected at each location within the underground workings is listed in Table 27. Sampling locations are described in Table 33. Locations above the Steve level are grouped as "shallow mine" while those at or below the 700 level are included in "deep mine"analysis. Samples collected after the water level in the mine had submerged many of the deep mine locations are discussed separately as "reflooded mine water."

Quarterly samples were collected from most underground stations during 1998 and 1999. Sampling stations located in the Minnesota and Steve levels were generally dry except in the spring, and therefore, only one sample was collected from each of the upper stations (WASH, CO, ILLRS, 146, and MINN) in May 1999.

Seasonal variation in flow rate is evident in the lack of water at sample stations in the upper levels during the summer, fall, and winter months. The rates of groundwater inflow to the mine (Section 5.2.1) also show a seasonal variation. However, no significant seasonal variation in flow or chemistry at the deeper underground sampling stations is evident.

[20] Samples from coreholes drilled into virgin rock may be considered representative of bedrock water quality peripheral to the mine. These samples include: 7J2, 15B13, 19D15(Fe), 19D15(Mn), and 19D16.

Table 33. Locations of Underground Water Quality Samples

Station Name	Mine Level	Northing	Easting	Elevation	Description
MINN	Minnesota Level	732,148.0	2,061,436.0	6832.0	Minnesota level, near Glory Hole
Wash	Steve Level	732,406.0	2,061,624.0	6608.0	Steve level: seeps from Washington chutes
CO	Steve Level	732,144.0	2,061,443.0	6600.0	Steve level: Colorado drift bulkhead
ILLRS	Steve Level	732,280.0	2,061,551.0	6609.0	Steve level: seeps from boards in Illinois raise
Steve Adit	Steve Level	732,280.0	2,061,551.0	6609.0	Steve level: seeps from boards in Illinois raise (assumed location)
146	Steve Level	732,078.0	2,061,399.0	6601.0	Steve level: pond behind air regulator
2Adit	n/a	733,353.0	2,061,111.0	6601.0	Pool behind berm
2A	n/a	733,368.0	2,061,001.0	6573.0	Rt heading in decline, below intersection
700ILL	700	732,435.0	2,061,323.0	5871.0	Fracture (along Illinois Fault)
779	700	731,980.0	2,059,953.0	5866.0	Pool (composite sample from pool)
7J2	700	731,974.7	2,059,926.7	5887.6	Corehole, intermittent flow (drip/low flow)
1108	1100	732,283.0	2,061,263.0	5459.0	Bulkhead (composite)
15B	1500	732,223.0	2,061,001.0	5040.0	Bulkhead (composite)
15B13	1500	732,252.2	2,060,996.2	5043.6	Corehole at drill station 15B
16G	1600	732,038.0	2,059,681.0	4950.0	Corehole flowing through muck (Fe ppt)
1730	1700	731,698.0	2,060,108.0	4851.0	Leyner hole
19D15(Fe)	1900	731,629.3	2,060,770.7	4613.5	Corehole at drill station 19D, Fe staining
19D16(Mn)	1900	731,628.7	2,060,771.7	4613.0	Corehole at drill station 19D, Mn staining
19C16	1900	731,742.7	2,060,370.7	4607.4	Corehole at drill station 16C
1955 Decline	1955	731,548.0	2,060,588.0	4605.0	Standing water
JOS2026	2000	731,615.0	2,060,206.0	4612.0	Stope water (Johnson Ore Shoot)
RMW	n/a	n/a	n/a	n/a	Raw mine water
RMW&S	n/a	n/a	n/a	n/a	Raw mine water plus sumps
UGM	n/a	n/a	n/a	n/a	Bottle roll on underground low-grade muck

Note: Northing and easting given in State Plane coordinates, elevation is NAD 27

7.6.1 Deep Mine Water

The chemistry of water in the underground mine varied with location during operation. Water flowing into the mine along discrete structures (e.g., the Johnson Ore Shoot, the Illinois Fault, or the West Rogers Fault) and at different levels was observed to have different chemical characteristics (Table 34). In general, water seeping into the deeper levels of the mine was a well-buffered magnesium-calcium-sulfate, calcium-sodium-sulfate, or sodium-sulfate type (Figure 40) with moderate to high dissolved solids (507 to 6,990 mg/L) and alkaline pH (7.5 to 9). Concentrations of sulfate (460 mg/L median concentration) gross alpha radiation (3,000 pCi/L median concentration), and gross beta radiation (450 pCi/L median concentration) in deep mine water generally exceeded their respective groundwater standards of 250 mg/L, 15 pCi/L, and 8 pCi/L. The trace metal content of the water was variable with some locations showing elevated uranium (up to 180 mg/L) and molybdenum (up to 4 mg/L) concentrations. The highest uranium and molybdenum concentrations were observed on the 700 level and were associated with standing pools (779) or fractures along the Illinois fault (700Ill). Water from the deeper workings also displayed sporadic concentrations of nitrate (40 mg/L maximum), antimony (0.151 mg/L maximum), iron (1.3 mg/L maximum), and manganese (0.34 mg/L maximum) which exceeded groundwater standards.

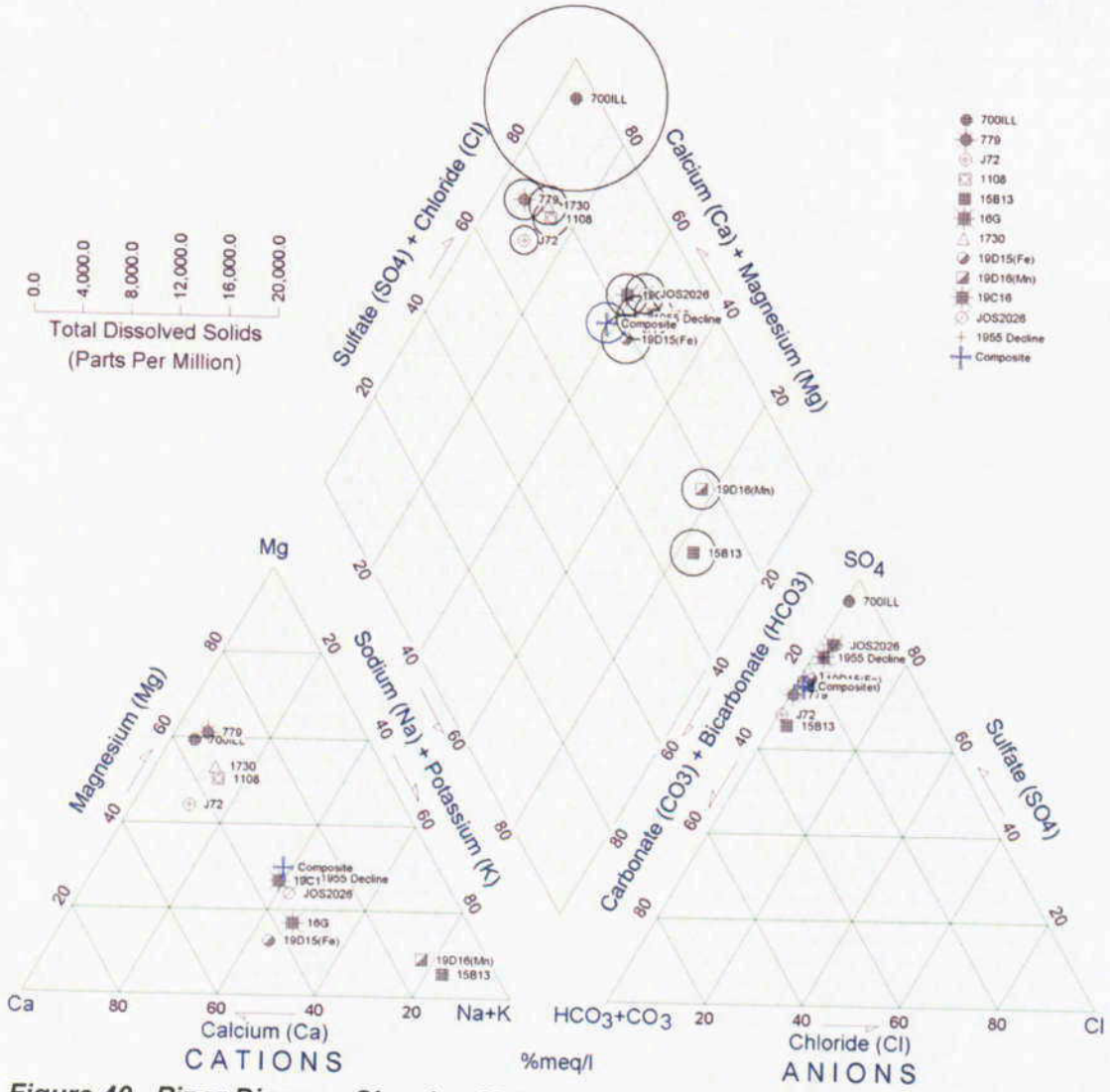


Figure 40. Piper Diagram Showing Major Ion Composition of Deep Mine Water Samples (Averaged by Location)

TABLE 34. WATER QUALITY AT UNDERGROUND SAMPLING STATIONS IN THE LOWER MINE LEVELS

Parameter	7001LL 9/9/98	7001LL 11/12/98	7001LL 12/15/98	7001LL 3/24/99	7001LL 6/17/99	7001LL 6/23/99	779 8/20/98	779 8/31/98	779 12/16/98	779 3/23/99	779 6/23/99
pH (Std. Units)	8.1	8.3	8	7.8		8.2	7.9	8.1	7.5	7.9	8
Conductivity, specific (uS/cm)	5390	5150	4390	3820		5540	1010	1000	990	946	1760
Total dissolved solids (mg/L)	6810	5960	5120	3920		6990	772	756	767	692	1500
Total suspended solids (mg/L)	3310	30.8	20.9	13.6		<10.	14.9	1	3	15	<10.
Alkalinity, Dissolved (mg/L						360					520
Alkalinity, total (mg/L	300	330	270	220			240	340	350	300	
Hardness, total (mg/L)	3700	3700	3300				530	470	1000		
Ammonia, total (mg/L		0	0	0	<1.				0	0	<1.
Nitrate Nitrogen (mg/L)	36	25	6.7	0.8	40		2.9	2.2	<0.1	<0.1	<0.5
Calcium, dissolved (mg/L)	450	640	520		560		95	85	100		150
Sodium, dissolved (mg/L)	78	67	60		66		20	18	18		29
Potassium, dissolved (mg/L)	26	26	24		28		6.5	5.9	6		9.1
Sulfate (mg/L)	4100	3800	3200	2600		4300	250	250	270	250	620
Chloride (mg/L)	23	50	26	28		23	8	7	6	5	6
Fluoride, total (mg/L)	1.6	0.6	0.5					0.2	0.2		
Aluminum, dissolved (mg/L)	<0.5	<0.5	<0.5				<0.5	<0.5	<0.5		
Antimony, dissolved (mg/L)		0.022	0.015						0.151		
Antimony, total (mg/L)	<0.03						0.18	0.16			
Arsenic, dissolved (mg/L)	<0.001	<0.003					0.016	0.018			
Arsenic, total (mg/L)	<0.5		0.006				0.06	0.05	0.028		
Barium, dissolved (mg/L)	<0.5	0.02					<0.5	<0.5			
Barium, total (mg/L)	<0.1		<0.02				0.07	0.07	0.05		
Beryllium, dissolved (mg/L		0.01	0.006						<0.002		
Beryllium, total (mg/L	0.01						0.002	0.002			
Boron, total (mg/L)											
Cadmium, dissolved (mg/L		0.0023	<0.0004						<0.0002		
Cadmium, total (mg/L)	<0.02						<0.003	<0.003			
Chromium, dissolved (mg/L		<0.005	<0.005						<0.005		
Chromium, total (mg/L)	<0.05						<0.005	<0.005			
Copper, dissolved (mg/L)	<0.02	<0.02	<0.02		0.05		0.03	0.02	<0.02		0.04
Iron, dissolved (mg/L)	<0.03	<0.03	<0.03				<0.03	<0.03	0.03		
Lead, dissolved (mg/L)	<0.001	<0.002					0.0013	0.0019			
Lead, total (mg/L)	<0.3		<0.002				0.04	0.04	0.004		
Magnesium, dissolved (mg/L)	610	510	490		690		70	62	180		180
Manganese, dissolved (mg/L)	<0.01	<0.01	<0.01		0.01		0.34	0.23	0.09		<0.01
Mercury, dissolved (mg/L)		<0.0002	<0.0002						<0.0002		
Mercury, total (mg/L)	<0.0002						<0.0002	<0.0002			
Molybdenum, dissolved (mg/L)		2.08	1.13						4		
Molybdenum, total (mg/L)	3.05						3.15	3.07			
Nickel, dissolved (mg/L)		<0.04	<0.04						0.07		
Nickel, total (mg/L)	<0.2						0.08	0.07			
Selenium, dissolved (mg/L)		<0.005	<0.005						<0.005		
Selenium, total (mg/L)	<0.5						<0.05	<0.05			
Silver, dissolved (mg/L)		<0.001	<0.0004						<0.0002		
Silver, total (mg/L)	0.15						0.025	0.023			
Thallium, dissolved (mg/L)		0.003	0.001						<0.001		
Thallium, total (mg/L)	<0.5						<0.03	<0.03			
Vanadium, dissolved (mg/L)		<0.01	<0.01						<0.01		
Vanadium, total (mg/L)	<0.05						<0.005	<0.005			
Zinc, dissolved (mg/L)	0.238	0.329	0.309				0.327	0.244	0.017		
Uranium, dissolved (pCi/L)	150	110	83	49	180		20	60	14	14	27
Thorium-228, dissolved (pCi/L)	0.1						0.5	0			
Thorium-230, dissolved (pCi/L)	1.5						9	0.7			
Thorium-232, dissolved (pCi/L)	0						0.6	0			
Radium-226, dissolved (pCi/L)	12.4	18.7	13.9				453	341	440		
Gross Alpha, dissolved (pCi/L	90000	22000	42000					24000	8900		
Gross Beta, dissolved (pCi/L)	34000	53000	46000					1800	7900		

Parameter	7J2 8/20/98	7J2 8/31/98	1108 9/9/98	1108 11/11/98	1108 12/15/98	1108 3/22/99	1108 6/21/99
pH (Std. Units)	8.1	8.2	8.5	9	8.2	8.1	8.4
Conductivity, specific (uS/cm)	944	851	1290	1110	1050	1000	1230
Total dissolved solids (mg/L)	668	604	1020	848	753	706	922
Total suspended solids (mg/L)	79.7	<2.	<1.	2	6	6	<10.
Alkalinity, Dissolved (mg/L	260	350					300
Alkalinity, total (mg/L			260	310	300	290	
Hardness, total (mg/L)	3300	400	630	550	520		
Ammonia, total (mg/L				0	0	0	<1.
Nitrate Nitrogen (mg/L)	<0.1	<0.1	2.9	3.3	1.3	0.8	8.5
Calcium, dissolved (mg/L)	90	83	99	97	91		100
Sodium, dissolved (mg/L)	24	22	48	40	37		43
Potassium, dissolved (mg/L)	5.1	4.6	6.1	5.3	5		5.8
Sulfate (mg/L)	260	210	470	350	310	270	390
Chloride (mg/L)	5	5	10	10	10	10	12
Fluoride, total (mg/L)		0.2	0.4	0.4	0.4		
Aluminum, dissolved (mg/L)	<0.5	<0.5	<0.5	<0.5	<0.5		
Antimony, dissolved (mg/L)				<0.008	<0.006		
Antimony, total (mg/L)	<0.03	<0.03	<0.3				
Arsenic, dissolved (mg/L)	<0.005	<0.001	<0.001	<0.003			
Arsenic, total (mg/L)	<0.05	<0.05	<0.05		<0.001		
Barium, dissolved (mg/L)	<0.5	<0.5	<0.5	<0.02			
Barium, total (mg/L)	0.04	0.04	<0.02		<0.02		
Beryllium, dissolved (mg/L				<0.002	<0.002		
Beryllium, total (mg/L	<0.001	<0.001	0.001				
Boron, total (mg/L)				<0.0002	<0.0004		
Cadmium, dissolved (mg/L							
Cadmium, total (mg/L)	<0.003	<0.003	<0.002				
Chromium, dissolved (mg/L				<0.005	<0.005		
Chromium, total (mg/L)	<0.005	<0.005	<0.005				
Copper, dissolved (mg/L)	<0.02	<0.02	<0.02	<0.02	<0.02		0.04
Iron, dissolved (mg/L)	<0.03	<0.03	0.03	<0.03	<0.03		
Lead, dissolved (mg/L)	<0.0008	<0.0004	0.0034	<0.002			
Lead, total (mg/L)	<0.02	<0.02	<0.05		<0.002		
Magnesium, dissolved (mg/L)	59	46	92	76	71		96
Manganese, dissolved (mg/L)	<0.01	<0.01	0.02	<0.01	<0.01		0.02
Mercury, dissolved (mg/L)				<0.0002	<0.0002		
Mercury, total (mg/L)	<0.0002	<0.0002	<0.0002				
Molybdenum, dissolved (mg/L)				0.09	0.09		
Molybdenum, total (mg/L)	0.029	0.022	0.132				
Nickel, dissolved (mg/L)				<0.04	<0.04		
Nickel, total (mg/L)	<0.02	<0.02	<0.02				
Selenium, dissolved (mg/L)				<0.005	<0.005		
Selenium, total (mg/L)	<0.05	<0.05	<0.05				
Silver, dissolved (mg/L)				<0.001	<0.0004		
Silver, total (mg/L)	<0.005	<0.005	0.009				
Thallium, dissolved (mg/L)				<0.001	<0.001		
Thallium, total (mg/L)	<0.03	<0.03	<0.05				
Vanadium, dissolved (mg/L)				<0.01	<0.01		
Vanadium, total (mg/L)	<0.005	<0.005	<0.005				
Zinc, dissolved (mg/L)	0.016	0.016	0.044	0.045	0.033		
Uranium, dissolved (pCi/L)	0.4	0.36	8.8	5.2	4	3.2	7.1
Thorium-228, dissolved (pCi/L)	0.2	0	0	0			
Thorium-230, dissolved (pCi/L)	58.6	0.4	0.1	0			
Thorium-232, dissolved (pCi/L)	0.6	0	0	0			
Radium-226, dissolved (pCi/L)	48.3	4.5	20.4	18.4	17.1		
Gross Alpha, dissolved (pCi/L		650	10000	3100	2000		
Gross Beta, dissolved (pCi/L)		130	180	2600	2000		

Parameter	15B 9/9/98	15B13 11/12/98	15B13 12/15/98	15B13 3/22/99	15B13 6/23/99
pH (Std. Units)	8	9	7.8	8.1	8.1
Conductivity, specific (uS/cm)	1430	1430	1400	1440	1450
Total dissolved solids (mg/L)	987	864	946	944	966
Total suspended solids (mg/L)	<1	4	8	6	<10.
Alkalinity, Dissolved (mg/L					370
Alkalinity, total (mg/L	290	940	380	590	
Hardness, total (mg/L)	160	120	110		
Ammonia, total (mg/L		1	0	0	<1.
Nitrate Nitrogen (mg/L)	<0.1	0.4	<0.1	<0.1	<0.5
Calcium, dissolved (mg/L)	39	33	30		30
Sodium, dissolved (mg/L)	270	280	290		280
Potassium, dissolved (mg/L)	5.8	6.2	6.1		6.5
Sulfate (mg/L)	390	340	350	350	350
Chloride (mg/L)	30	50	26	25	24
Fluoride, total (mg/L)	4.3	5.3	5.4		
Aluminum, dissolved (mg/L)	<0.5	<0.5	<0.5		
Antimony, dissolved (mg/L)		<0.008	<0.006		
Antimony, total (mg/L)	<0.03	0.014			
Arsenic, dissolved (mg/L)	0.004				
Arsenic, total (mg/L)	<0.05		0.016		
Barium, dissolved (mg/L)	<0.5	<0.02			
Barium, total (mg/L)	<0.02		<0.02		
Beryllium, dissolved (mg/L		<0.002	<0.002		
Beryllium, total (mg/L	<0.001				
Boron, total (mg/L)		<0.0002	<0.0004		
Cadmium, dissolved (mg/L	<0.002				
Cadmium, total (mg/L)		<0.005	<0.005		
Chromium, dissolved (mg/L	<0.005				
Chromium, total (mg/L)	<0.02	<0.02	<0.02		0.02
Copper, dissolved (mg/L)	<0.03	<0.03	<0.03		
Iron, dissolved (mg/L)	<0.001	<0.002			
Lead, dissolved (mg/L)	<0.05		<0.002		
Lead, total (mg/L)	14	9.8	7.5		8.4
Magnesium, dissolved (mg/L)	<0.01	0.02	0.02		<0.01
Manganese, dissolved (mg/L)		<0.0002	<0.0002		
Mercury, dissolved (mg/L)	<0.0002				
Mercury, total (mg/L)		0.03	0.02		
Molybdenum, dissolved (mg/L)	0.028				
Molybdenum, total (mg/L)		<0.04	<0.04		
Nickel, dissolved (mg/L)	<0.02				
Nickel, total (mg/L)		<0.005	<0.005		
Selenium, dissolved (mg/L)	<0.05				
Selenium, total (mg/L)		<0.001	<0.0004		
Silver, dissolved (mg/L)	<0.005				
Silver, total (mg/L)		<0.001	<0.001		
Thallium, dissolved (mg/L)	<0.05				
Thallium, total (mg/L)		<0.01	<0.01		
Vanadium, dissolved (mg/L)	<0.005				
Vanadium, total (mg/L)	0.009	0.005	<0.005		
Zinc, dissolved (mg/L)	0.56	0.59	0.0118	0.0047	0.0112
Uranium, dissolved (pCi/L)	0	0	0.1		
Thorium-228, dissolved (pCi/L)	0.1	0.3	0.1		
Thorium-230, dissolved (pCi/L)	0	0	0		
Thorium-232, dissolved (pCi/L)	14.6	3	2	4.1	
Radium-226, dissolved (pCi/L)	700	38	22	41	
Gross Alpha, dissolved (pCi/L	160	2.7	15	39	
Gross Beta, dissolved (pCi/L)					

Parameter	16G 9/9/98	16G 11/11/98	16G 12/14/98	16G 3/23/99	16G 6/23/99
pH (Std. Units)	8.3	8.9	8	8.3	7.9
Conductivity, specific (uS/cm)	1350	1380	1400	1520	1560
Total dissolved solids (mg/L)	1040	1060	1040	1150	1210
Total suspended solids (mg/L)	4	5	37.1	0	<10.
Alkalinity, Dissolved (mg/L					140
Alkalinity, total (mg/L	190	160	180	170	
Hardness, total (mg/L)	400	420	420		
Ammonia, total (mg/L		0	0	0	<1.
Nitrate Nitrogen (mg/L)	<0.1	0.4	<0.1	<0.1	<0.5
Calcium, dissolved (mg/L)	110	120	120		84
Sodium, dissolved (mg/L)	150	150	150		180
Potassium, dissolved (mg/L)	3.9	3.9	4		4.3
Sulfate (mg/L)	550	560	590	640	660
Chloride (mg/L)	28	24	24	27	29
Fluoride, total (mg/L)	0.8	0.8	0.9		
Aluminum, dissolved (mg/L)	<0.5	<0.5	<0.5		
Antimony, dissolved (mg/L)		<0.008	<0.006		
Antimony, total (mg/L)	<0.03				
Arsenic, dissolved (mg/L)	0.002	<0.003			
Arsenic, total (mg/L)	<0.05		0.005		
Barium, dissolved (mg/L)	<0.5	0.03			
Barium, total (mg/L)	0.03		0.03		
Beryllium, dissolved (mg/L		<0.002	<0.002		
Beryllium, total (mg/L	<0.001				
Boron, total (mg/L)		<0.0002	<0.0004		
Cadmium, dissolved (mg/L	<0.002				
Cadmium, total (mg/L)		<0.005	<0.005		
Chromium, dissolved (mg/L	<0.005				
Chromium, total (mg/L)	<0.02	<0.02	<0.02		0.02
Copper, dissolved (mg/L)	<0.03	<0.03	0.03		
Iron, dissolved (mg/L)	<0.0002	<0.002			
Lead, dissolved (mg/L)	<0.05		<0.002		
Lead, total (mg/L)	30	30	30		32
Magnesium, dissolved (mg/L)	0.02	0.03	0.03		0.04
Manganese, dissolved (mg/L)		<0.0002	<0.0002		
Mercury, dissolved (mg/L)	<0.0002				
Mercury, total (mg/L)		0.02	0.02		
Molybdenum, dissolved (mg/L)	0.014				
Molybdenum, total (mg/L)		<0.04	<0.04		
Nickel, dissolved (mg/L)	<0.02				
Nickel, total (mg/L)		<0.005	<0.005		
Selenium, dissolved (mg/L)	<0.05				
Selenium, total (mg/L)		<0.001	<0.0004		
Silver, dissolved (mg/L)	<0.005				
Silver, total (mg/L)		<0.001	<0.001		
Thallium, dissolved (mg/L)	<0.05				
Thallium, total (mg/L)		<0.01	<0.01		
Vanadium, dissolved (mg/L)	<0.005				
Vanadium, total (mg/L)	<0.005	<0.005	<0.005		
Zinc, dissolved (mg/L)	0.025	0.018	0.046	0.029	0.035
Uranium, dissolved (pCi/L)	0	0.1			
Thorium-228, dissolved (pCi/L)	0.3	0.1			
Thorium-230, dissolved (pCi/L)	0	0			
Thorium-232, dissolved (pCi/L)	3	2	4.1		
Radium-226, dissolved (pCi/L)	38	22	41		
Gross Alpha, dissolved (pCi/L	2.7	15	39		
Gross Beta, dissolved (pCi/L)					

Parameter	1730 8/20/98	1730 9/2/98	1730 12/14/98	1730 3/23/99	1730 6/23/99
pH (Std. Units)	8.2	8.2	8	7.9	8.3
Conductivity, specific (uS/cm)	1170	1150	1300	1680	1410
Total dissolved solids (mg/L)	876	898	1000	1360	1130
Total suspended solids (mg/L)	6	<1.	5	3	<10.
Alkalinity, Dissolved (mg/L					310
Alkalinity, total (mg/L	280	270	320	280	
Hardness, total (mg/L)	600	590	710		
Ammonia, total (mg/L			0	2	<1.
Nitrate Nitrogen (mg/L)	3.2	2.9	17	23	20
Calcium, dissolved (mg/L)	92	91	110		120
Sodium, dissolved (mg/L)	36	36	37		39
Potassium, dissolved (mg/L)	6.5	8	8.2		9.1
Sulfate (mg/L)	380	380	440	640	470
Chloride (mg/L)	5	6	5	8	6
Fluoride, total (mg/L)		0.2	0.2		
Aluminum, dissolved (mg/L)	<0.5	<0.5	<0.5		
Antimony, dissolved (mg/L)			0.068		
Antimony, total (mg/L)	0.04	<0.03			
Arsenic, dissolved (mg/L)	0.016	0.019			
Arsenic, total (mg/L)	<0.05	<0.05	0.022		
Barium, dissolved (mg/L)	<0.5	<0.5			
Barium, total (mg/L)	0.04	0.04	0.04		
Beryllium, dissolved (mg/L			<0.002		
Beryllium, total (mg/L	0.001	<0.001			
Boron, total (mg/L)			<0.0004		
Cadmium, dissolved (mg/L	<0.003	<0.003			
Cadmium, total (mg/L)			<0.005		
Chromium, dissolved (mg/L	<0.005	<0.005			
Chromium, total (mg/L)	<0.02	<0.02	<0.02		<0.02
Copper, dissolved (mg/L)	<0.03	<0.03	<0.03		
Iron, dissolved (mg/L)	0.0012	<0.0005			
Lead, dissolved (mg/L)	<0.02	<0.02	<0.002		
Lead, total (mg/L)	91	83	100		110
Magnesium, dissolved (mg/L)	0.01	0.01	0.02		0.03
Manganese, dissolved (mg/L)			<0.0002		
Mercury, dissolved (mg/L)	<0.0002	<0.0002			
Mercury, total (mg/L)			2.22		
Molybdenum, dissolved (mg/L)	1.57	1.52			
Molybdenum, total (mg/L)			<0.04		
Nickel, dissolved (mg/L)	0.02	<0.02			
Nickel, total (mg/L)			<0.005		
Selenium, dissolved (mg/L)	<0.05	<0.05			
Selenium, total (mg/L)			<0.0004		
Silver, dissolved (mg/L)	0.013	0.011			
Silver, total (mg/L)			0.002		
Thallium, dissolved (mg/L)	<0.03	<0.03			
Thallium, total (mg/L)			<0.01		
Vanadium, dissolved (mg/L)	<0.005	<0.005			
Vanadium, total (mg/L)	0.021	0.021	0.022		
Zinc, dissolved (mg/L)	9.8	9.5	12	24	15
Uranium, dissolved (pCi/L)	0.8	0			
Thorium-228, dissolved (pCi/L)	0.6	0.7			
Thorium-230, dissolved (pCi/L)	0.6	0			
Thorium-232, dissolved (pCi/L)	53.7	50.7	60.8		
Radium-226, dissolved (pCi/L)		13000	5800		
Gross Alpha, dissolved (pCi/L		1700	6300		
Gross Beta, dissolved (pCi/L)					

Parameter	19D15(Fe) 8/20/98	19D15(Fe) 9/2/98
pH (Std. Units)	7.9	8.6
Conductivity, specific (uS/cm)	1460	1450
Total dissolved solids (mg/L)	1010	1050
Total suspended solids (mg/L)	142	1
Alkalinity, Dissolved (mg/L		
Alkalinity, total (mg/L	300	320
Hardness, total (mg/L)	320	320
Ammonia, total (mg/L		
Nitrate Nitrogen (mg/L)	<0.1	0.7
Calcium, dissolved (mg/L)	83	82
Sodium, dissolved (mg/L)	220	210
Potassium, dissolved (mg/L)	9.9	9.3
Sulfate (mg/L)	440	440
Chloride (mg/L)	26	25
Fluoride, total (mg/L)		0.8
Aluminum, dissolved (mg/L)	<0.5	<0.5
Antimony, dissolved (mg/L)	<0.03	<0.03
Antimony, total (mg/L)	0.007	<0.005
Arsenic, dissolved (mg/L)	<0.05	<0.05
Arsenic, total (mg/L)	<0.5	<0.5
Barium, dissolved (mg/L)	0.03	0.03
Barium, total (mg/L)		
Beryllium, dissolved (mg/L	<0.001	<0.001
Beryllium, total (mg/L		
Boron, total (mg/L)		
Cadmium, dissolved (mg/L	<0.003	<0.003
Cadmium, total (mg/L)		
Chromium, dissolved (mg/L	<0.005	<0.005
Chromium, total (mg/L)	<0.02	<0.02
Copper, dissolved (mg/L)	1.3	0.04
Iron, dissolved (mg/L)	0.0018	<0.001
Lead, dissolved (mg/L)	<0.02	<0.02
Lead, total (mg/L)	29	29
Magnesium, dissolved (mg/L)	0.08	0.06
Manganese, dissolved (mg/L)		
Mercury, dissolved (mg/L)	<0.0002	<0.0002
Mercury, total (mg/L)		
Molybdenum, dissolved (mg/L)	0.048	0.051
Molybdenum, total (mg/L)		
Nickel, dissolved (mg/L)	<0.02	<0.02
Nickel, total (mg/L)		
Selenium, dissolved (mg/L)	<0.05	<0.05
Selenium, total (mg/L)		
Silver, dissolved (mg/L)	0.006	0.008
Silver, total (mg/L)		
Thallium, dissolved (mg/L)	<0.03	<0.03
Thallium, total (mg/L)		
Vanadium, dissolved (mg/L)	<0.005	<0.005
Vanadium, total (mg/L)	0.043	<0.005
Zinc, dissolved (mg/L)	5	5.6
Uranium, dissolved (pCi/L)	0.4	0
Thorium-228, dissolved (pCi/L)	0.9	0.6
Thorium-230, dissolved (pCi/L)	0.5	0
Thorium-232, dissolved (pCi/L)	1.6	7.7
Radium-226, dissolved (pCi/L)		6800
Gross Alpha, dissolved (pCi/L		180
Gross Beta, dissolved (pCi/L)		

NOTES: Original lab data for Station JOS2026 on 12/14/98 reported TDS as 12 mg/L. Value was converted to 1,200 mg/L based on ratio of TDS to SC in 4 other sample
Mean and median statistic calculated using one half detection limit (1/2 D.L

TABLE 34. WATER QUALITY AT UNDERGROUND SAMPLING STATIONS IN THE LOWER MINE LEVELS

Parameter	19D15(Fe) 12/14/98	19D15(Fe) 3/23/99	19D15(Fe) 6/21/99	19D16(Mn) 8/20/98	19D16(Mn) 9/2/98	19D16(Mn) 12/14/98	19D16(Mn) 3/23/99	19D16(Mn) 6/21/99	19C16 11/11/98	19C16 12/14/98	19C16 3/22/99	19C16 6/21/99	JOS2026 8/20/98	JOS2026 9/2/98	JOS2026 12/14/98	JOS2026 3/22/99	JOS2026 6/21/99	1955 Decline 11/11/98	1955 Decline 12/14/98	1955 Decline 3/23/99	1955 Decline 6/21/99	MIN	MAX	MEAN	MEDIAN	COUNT	ND	%ND
pH (Std. Units)	7.9	7.9	8.3	8.1	8.2	8	8	8.1	8.5	7.7	7.7	7.8	8	8.4	7.9	8.1	8.4	8.4	7.8	7.8	8.3	7.5	9	8.13	8.10	55	0	0%
Conductivity, specific (uS/cm)	1880	1470	1460	1460	1540	815	1590	1590	1450	1430	1420	1430	1740	1730	1520	1660	1670	1930	1770	1020	807	807	5540	1688	1440	55	0	0%
Total dissolved solids (mg/L)	1440	1040	1020	1080	1090	522	1070	1080	1110	1120	1090	1100	1410	1430	1200	1280	1300	1560	1420	692	507	507	6990	1453	1050	55	0	0%
Total suspended solids (mg/L)	31.9	6	<10.	28.6	<1.	3	10	<10.	9	12	6	<10.	3	3	57.4	185	<10.	38.9	19.1	33.6	<10.	0	3310	76.9	5	55	16	29%
Alkalinity, Dissolved (mg/L			330					330				210					170				230	140	520	298	310	13	0	0%
Alkalinity, total (mg/L	370	330		300	310	250	330		260	220	210		150	150	160	170		260	240	230		150	940	289	280	42	0	0%
Hardness, total (mg/L)	540			250	240	53			490	490			580	540	460			640	600			53	3700	823	520	33	0	0%
Ammonia, total (mg/L	0	0	<1.			0	0	<1.	0	0	0	<1.	1		0	0	<1.	5	0	0	<1	0	5	0.3625	0	40	11	28%
Nitrate Nitrogen (mg/L)	<0.1	<0.1	<0.5	<0.1	0.7	<0.1	<0.1	<0.5	0.4	<0.1	0.4	<0.5	2.9	1.4	0.8	1.3	0.5	20	13	3.3	2	<0.1	40	4.49	0.5	55	23	42%
Calcium, dissolved (mg/L)	140		470	70	67	13		1.4	110	110		110	130	120	120		130	140	130		8.7	1.4	640	140	100	44	0	0%
Sodium, dissolved (mg/L)	240		210	260	270	160		260	140	140		140	180	180	170		180	190	180		110	18	290	134	145	44	0	0%
Potassium, dissolved (mg/L)	12		11	8.5	7.8	9		9.2	4.5	4.5		4.6	5	4.6	4.5		4.9	8.4	7.9		3.7	3.7	28	8	6	44	0	0%
Sulfate (mg/L)	690	440	440	450	450	190	460	460	590	590	540	550	790	800	680	730	720	780	720	280	180	180	4300	753	460	55	0	0%
Chloride (mg/L)	29	17	26	27	32	9	27	27	24	24	24	22	34	34	28	28	27	29	29	14	11	5	50	21	24	55	0	0%
Fluoride, total (mg/L)	1.2				2.4	1.7			0.4	0.3				0.7	0.8			0.6	0.6			0.2	5.4	1.2	0.6	27	0	0%
Aluminum, dissolved (mg/L	<0.5			<0.5	<0.5	<0.5			<0.5	<0.5			<0.5	<0.5	<0.5			<0.5	<0.5			<0.5	<0.5	0.25	0.25	33	33	100%
Antimony, dissolved (mg/L	<0.006					<0.006			<0.008	<0.006					<0.006			0.047	0.074			<0.006	0.151	0.0244	0.004	17	11	65%
Antimony, total (mg/L				<0.03	<0.03								<0.03	<0.03								0.014	<0.3	0.043	0.015	17	13	76%
Arsenic, dissolved (mg/L				0.005	0.006				<0.003				<0.005	<0.005				<0.003				<0.001	0.019	0.005	0.0025	21	12	57%
Arsenic, total (mg/L	0.009			<0.05	<0.05	0.036				0.004			<0.05	<0.05	0.004				0.006			<0.001	<0.5	0.030	0.025	27	15	56%
Barium, dissolved (mg/L				<0.5	<0.5				0.03				<0.5	<0.5				0.04				<0.02	<0.5	0.188	0.25	22	18	82%
Barium, total (mg/L)	0.03			0.04	0.03	0.04				0.03			0.03	0.03	0.03				0.05			<0.02	<0.1	0.034	0.03	27	6	22%
Beryllium, dissolved (mg/L	<0.002					<0.002			<0.002	<0.002					<0.002			<0.002	<0.002			<0.002	0.01	0.0018	0.001	17	15	88%
Beryllium, total (mg/L				<0.001	<0.001								<0.001	<0.001								<0.001	0.01	0.001	0.0005	16	11	69%
Boron, total (mg/L)																						n/a	n/a	n/a	n/a	0	0	n/a
Cadmium, dissolved (mg/L	<0.0004					<0.0004			<0.0002	<0.0004					<0.0004			<0.0002	<0.0004			<0.0002	0.0023	0.0003	0.0002	17	16	94%
Cadmium, total (mg/L				<0.003	<0.003								<0.003	<0.003								<0.002	<0.02	0.002	0.0015	16	16	100%
Chromium, dissolved (mg/L	<0.005					<0.005			<0.005	<0.005					<0.005			<0.005	<0.005			<0.005	<0.005	0.0025	0.0025	17	17	100%
Chromium, total (mg/L				<0.005	<0.005								<0.005	<0.005								<0.005	<0.05	0.004	0.0025	16	16	100%
Copper, dissolved (mg/L)	<0.02		0.02	<0.02	<0.02	<0.02		0.02	<0.02	<0.02		<0.02	<0.02	<0.02	<0.02		<0.02	<0.02	<0.02		0.03	<0.02	0.05	0.014	0.01	44	34	77%
Iron, dissolved (mg/L)	<0.03			<0.03	<0.03	<0.03			<0.03	<0.03			0.03	0.03	<0.03			<0.03	<0.03			<0.03	1.3	0.057	0.015	33	26	79%
Lead, dissolved (mg/L)				0.0018	<0.0002				<0.002				<0.0005	<0.0004				<0.002				<0.0002	0.0034	0.001	0.001	22	16	73%
Lead, total (mg/L)	<0.002			<0.02	<0.02	<0.002				<0.002			<0.02	<0.02	0.004				0.002			<0.002	<0.3	0.016	0.01	27	22	81%
Magnesium, dissolved (mg/L)	49		30	17	17	5		19	52	51		52	63	58	40		53	69	67		26	5	690	102	53	44	0	0%
Manganese, dissolved (mg/L)	0.02		0.04	<0.01	<0.01	<0.01		<0.01	0.04	0.04		0.02	0.1	0.09	0.15		0.11	0.3	0.32		<0.01	<0.01	0.34	0.054	0.02	44	15	34%
Mercury, dissolved (mg/L)	<0.0002					0.0007			<0.0002	<0.0002					<0.0002			<0.0002	<0.0002			<0.0002	0.0007	0.00014	0.0001	17	16	94%
Mercury, total (mg/L)				<0.0002	<0.0002								<0.0002	<0.0002								<0.0002	<0.0002	0.0001	0.0001	16	16	100%
Molybdenum, dissolved (mg/L)	0.07					0.1			0.11	0.12					0.05			2.99	3.07			0.02	4	0.95	0.10	17	0	0%
Molybdenum, total (mg/L)				0.024	0.022								0.384	0.346								0.014	3.15	0.8	0.1	16	0	0%
Nickel, dissolved (mg/L)	<0.04					<0.04			<0.04	<0.04					<0.04			<0.04	<0.04			<0.04	0.07	0.0229	0.02	17	16	94%
Nickel, total (mg/L)				<0.02	<0.02								<0.02	<0.02								<0.02	<0.2	0.024	0.01	16	13	81%
Selenium, dissolved (mg/L)	<0.005					<0.005			<0.005	<0.005					<0.005			<0.005	<0.005			<0.005	<0.005	0.0025	0.0025	17	17	100%
Selenium, total (mg/L)				<0.05	<0.05								<0.05	<0.05								<0.05	<0.5	0.039	0.025	16	16	100%
Silver, dissolved (mg/L)	<0.0004					<0.0004			<0.001	<0.0004					<0.0004			<0.001	<0.0004			<0.0002	<0.001	0.0003	0.0002	17	17	100%
Silver, total (mg/L)				<0.005	<0.005								0.006	0.006								<0.005	0.15	0.017	0.006	16	6	38%
Thallium, dissolved (mg/L	<0.001					<0.001			<0.001	<0.001					<0.001							<0.001	0.003	0.0008	0.0005	15	12	80%
Thallium, total (mg/L)				<0.03	<0.03								<0.03	<0.03				0.007	0.006			<0.006	<0.5	0.029	0.015	18	16	89%
Vanadium, dissolved (mg/L)	<0.01					<0.01			<0.01	<0.01					<0.01							<0.01	<0.01	0.005	0.005	15	15	100%
Vanadium, total (mg/L)				<0.005	<0.005								<0.005	<0.005				<0.01	<0.01			<0.005	<0.05	0.004	0.0025	18	18	100%
Zinc, dissolved (mg/L)	0.011			0.024	0.006	<0.005			<0.005	<0.005			0.093	0.064	0.029			0.09	0.08			<0.005	0.329	0.065	0.021	33	8	24%
Uranium, dissolved (pCi/L)	5.3	3.3	3.5	2	2.4	1.2	1.4	1.5	0.28	0.34	0.49	0.72	4.9	2.2	0.37	1.7	2.7	1	8.7	2.7	1.4	0.0047	180	16	3	55	0	0%
Thorium-228, dissolved (pCi/L)				0.7	0				0.1				0.6	0				0				0	0.8	0.2	0.0	20	0	0%
Thorium-230, dissolved (pCi/L)				2	0.4				0				0.6	0.6				0				0	58.6	3.9	0.6	20	0	0%
Thorium-232, dissolved (pCi/L)				0.6	0				0				0.5	0.1				0				0	0.6	0.2	0.0	20	0	0%
Radium-226, dissolved (pCi/L)	20.7			6	2.9	0.9			9.8	14			93.1	66.1	38.7			275	281			0.9	453	73	17	33	0	0%
Gross Alpha, dissolved (pCi/L)	3000				2700	620			210	260				5700	310			6800	5700			22	90000	9437	3000	27	0	0%
Gross Beta, dissolved (pCi/L)	3000				84	600			160	200				450	220			4800	5000			2.7	53000	6328	450	27	0	0%

NOTES: Original lab data for Station JOS2026 on 12/14/98 reported TDS as 12 mg/L. Value was converted to 1,200 mg/L based on ratio of TDS to SC in 4 other sample
Mean and median statistic calculated using one half detection limit (1/2 D.L.

7.6.2 Shallow Mine Water

Infiltration to the upper levels of the mine occurred seasonally in the spring and after periods of heavy rain. During the majority of the year, however, the upper workings were dry. Samples of seasonal inflow to the upper levels were collected at five stations in May, 1999. Sampling stations were located on the Steve and Minnesota levels and are shown in Figure 5 and summarized in Table 35.

Table 35. Flow Rates at Underground Sampling Stations in the Upper Mine Levels

STATION	NORTHING	EASTING	ELEVATION	DESCRIPTION	MAY 1999 FLOW (GPM)
Wash	732,406	2,061,624	6,608	Steve Level: seeps from Washington chutes	0.05
ILLRS	732,280	2,061,551	6,609	Steve Level: seeps from boards in Illinois raise	0.15
CO	732,144	2,061,443	6,600	Steve Level: Colorado drift bulkhead	0.8
146	732,078	2,061,399	6,601	Steve Level: pond behind air regulator	0.5
MINN	732,148	2,061,436	6,832	Minnesota Level, near Glory Hole	

The flow estimates listed in Table 35 are based on field notes and verbal descriptions made by mine geologist Dick White, who described the samples and flows as follows:

- WASH - The flow was captured from seeps and drips entering the mine from the Washington chutes on the Steve Level. The water was captured from most (but not all) of the drips, collected on plastic sheeting, and funneled into a one-gallon sample bottle. It took 20 – 30 minutes to collect one gallon, which equates to a flow rate of 0.03 to 0.05 gpm.
- ILLRS - The flow seeped out from boards in the Illinois raise on the Steve Level. The water from the largest drip was collected on plastic sheeting, and it took 10 – 15 minutes to collect one gallon. This equates to a flow rate of 0.067 to 0.1 gpm for the largest drip. The estimated flow rate for all of the drips at this location is 0.15 gpm.
- CO - The sample was collected from the Colorado drift bulkhead on the Steve Level. The flow was approximately four times the volume seen in the WASH and ILLRS samples, combined. The flow rate was estimated at 0.8 gpm.
- 146 - This sample was a composite sample from pools on the Steve Level. It represents the composite water quality from a number of random drips that could not be sampled individually. The estimated flow rate for all these random drips is 0.5 gpm.
- MINN - Water entering the Minnesota Level near the glory hole was sampled on May 15, 1999. The flow rate was not measured.

The combined inflow rate of 1.5 gpm to the upper workings listed in Table 35 excludes unmeasured flow near the glory hole and represents a snapshot in time of seasonal inflow in response to spring runoff. The average annual inflow to the mine workings above the Steve Level is estimated to be about 1.4 gpm (Section 0).

Water seeping into the upper levels of the mine is impacted by acid rock drainage and is a poor quality magnesium-calcium-sulfate water with acidic to moderately alkaline pH (2.7 to 8.2), and high concentrations of total dissolved solids (1,230 to 11,000 mg/L) mostly in the form of sulfate (790 to 7,200 mg/L). Water samples from the upper workings were also analyzed for a limited suite of metals including

copper (0.04 to 19 mg/L), manganese (0.57 to 27 mg/L), and uranium (29 to 150 mg/L). Water quality analyses for samples collected from the Minnesota and Steve Levels are plotted in Figure 41 and summarized in Table 36.

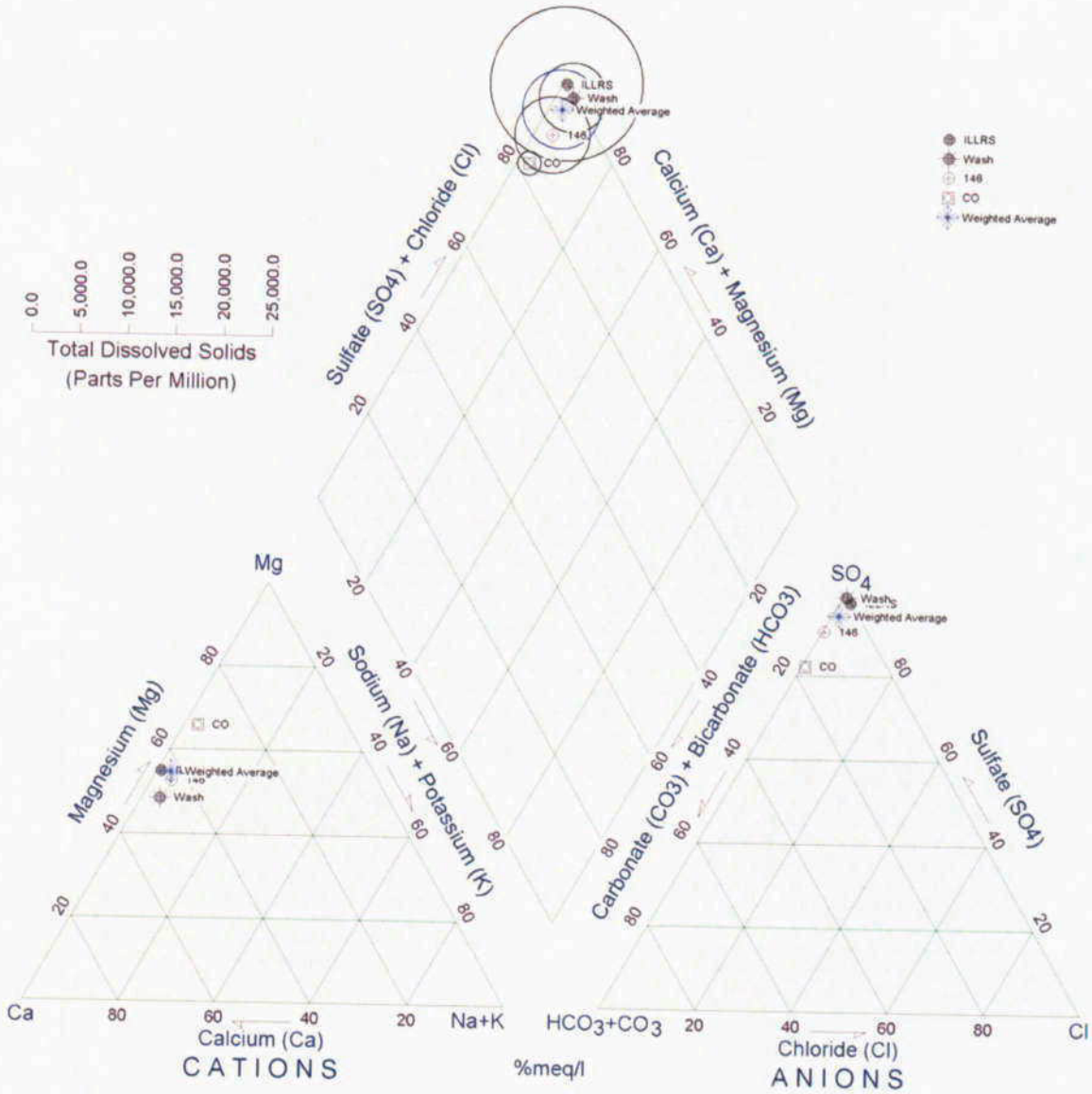


Figure 41. Piper Diagram Showing Major Ion Composition of Upper Mine Water Samples

Table 36. Water Quality at Underground Sampling Stations in the Upper Mine Levels

	May 6, 1999 Sampling Results						
PARAMETER	**MINN**	**WASH**	**ILLRS**	**CO**	**146**	**2Adit**	**2A**
pH (lab) (s.u.)	---	3.8	2.7	7.9	8.2	8.1	7.8
Conductivity, specific (µS/cm)	---	3740	7190	1430	4120	416	669
Total dissolved solids	---	4,200	11,000	1,230	4,650	223	442
Total suspended solids	---	30.4	10.3	37.4	<2.5	2	13.6
Alkalinity, Dissolved	---	<10	<10	170	300	200	210
Alkalinity, total	---	<1	<1	170	300	200	210
Ammonia, total	<0.5	<0.5	<0.5	<0.5	<0.5	0	2
Nitrate Nitrogen	2.9	2.9	8.3	4.2	28	1.3	1.3
Calcium, dissolved	<1	390	360	110	380	---	---
Sodium, dissolved	<5	28	8	7	29	---	---
Potassium, dissolved	2.9	14	<0.3	7.4	21	---	---
Sulfate	---	2,900	7,200	790	2,900	38	150
Chloride	---	19	130	5	9	5	5
Copper, dissolved	0.02	0.67	19	0.04	0.61	---	---
Magnesium, dissolved	15	240	270	140	280	---	---
Manganese, dissolved	<0.01	25	27	0.57	0.92	---	---
Uranium, dissolved (pCi/L)	0.0338	52	150	29	130	0.21	0.15
Gross Alpha Particles, diss. (pCi/L)	14	---	---	---	---	---	---
Gross Beta Particles, diss. (pCi/L)	21	---	---	---	---	---	---
Thorium-228, dissolved (pCi/L)	0	---	---	---	---	---	---
Thorium-230, dissolved (pCi/L)	0	---	---	---	---	---	---
Thorium-232, dissolved (pCi/L)	0	---	---	---	---	---	---
Radium-226, dissolved (pCi/L)	2.3	---	---	---	---	---	---
Field Temperature	10.3	4.1	6.6	7.7	9.3	---	---
Field pH	7.84	3.97	3.02	8.34	8.47	---	---
Field Conductivity	241	3,960	7,720	1,880	4,230	---	---

Note: --- indicates the sample was not analyzed for this parameter.
Results given in mg/L unless otherwise noted.

7.6.3 Water Quality in the Reflooded Mine

Water quality samples in and above the 1900 level of the flooded mine have been collected since June 2000. A total of 115 samples were collected from the # 2 and #3 shafts as of June 2007. Mine water samples were collected using a thief sampler to obtain water samples at discrete depths within the mine during flooding. Samples were collected on an approximately monthly basis between June 2000 and July 2001, and on a quarterly basis from July 2001 to May 2003. Additional samples were also collected from the #2 shaft in April 2005 and April and July of 2007.

Water quality analyses for the flooded mine show that the mine water is a strongly-buffered calcium-magnesium-sodium-sulfate water (Figure 42) with near neutral pH (median value = 7.17), and high concentrations of total dissolved solids (about 3,000 mg/L). Major contributors to TDS include sulfate (520 to 2,060 mg/L), bicarbonate (270 to 482 as $CaCO_3$), calcium (71 to 413 mg/L), sodium (140 to 225 mg/L) and magnesium (37 to 271 mg/L).

Several metals in mine water samples occur at concentrations above Colorado groundwater standards including antimony, manganese, thallium, and occasionally iron, lead and mercury. Concentrations of TDS,

sulfate, and radium-226 are also elevated above Colorado groundwater standards. Molybdenum concentrations are notably elevated in mine water, however, no standard exists for this element. Comparison of metals concentrations in mine to groundwater standards is presented for reference only as the standards may not apply to mine water. Summary statistics for mine water are presented in Table 37. Complete analytical results are presented in Appendix F.

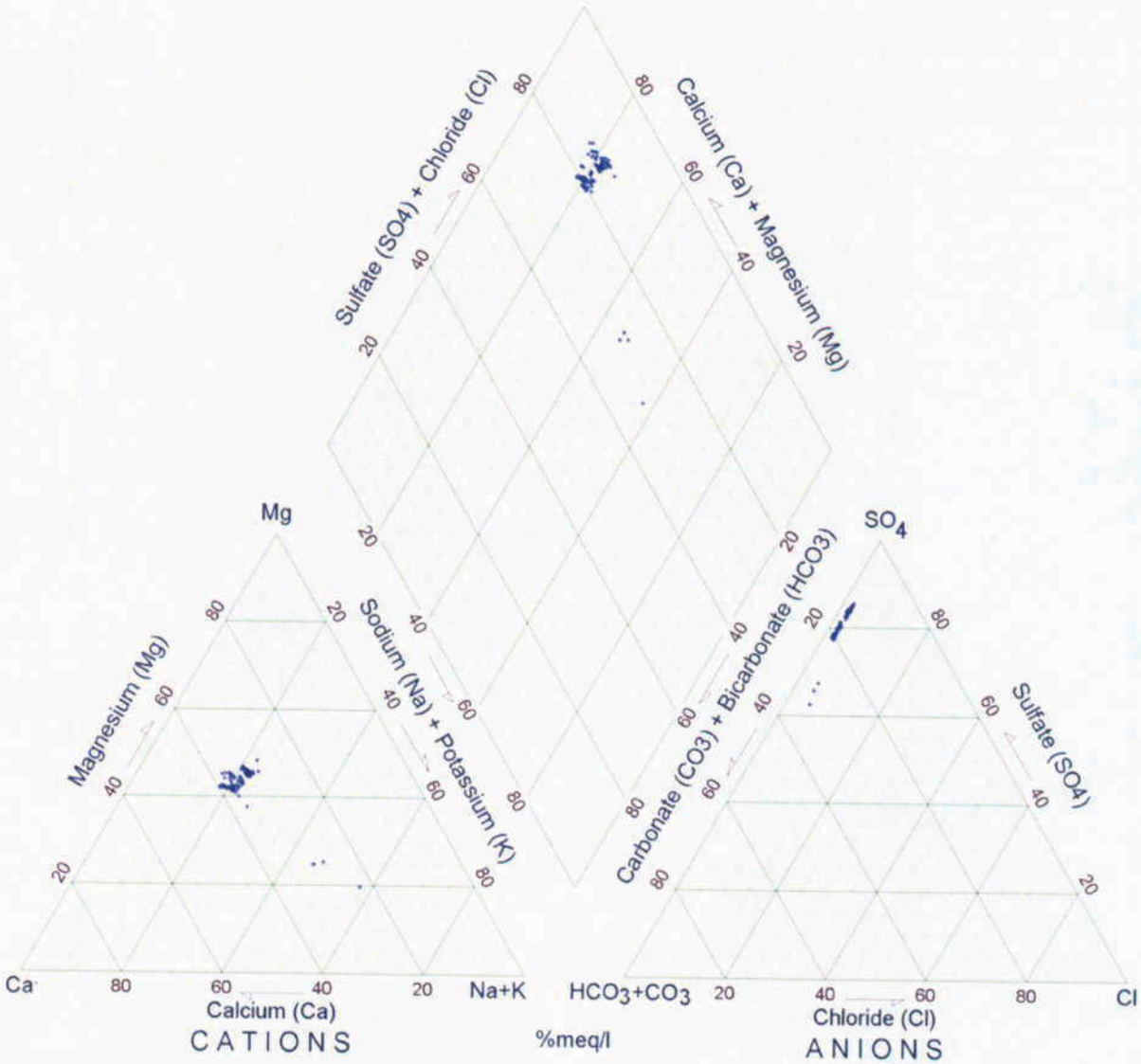


Figure 42. Piper Diagram Showing Major Ion Composition of Water in Reflooded Mine

Table 37 Summary Statistics for Water Samples Collected from Flooded Mine

Analyte	Number of Samples	Number of Non-Detects	Percent Non-Detects	Maximum	Minimum	Mean	Median	Standard Deviation
General Parameters								
Temp (C)	111	0	0%	20.5	11.5	17.2	17.2	1.2
pH (s.u).	113	0	0%	8.15	6.56	7.19	7.17	0.26
ORP (mV)	88	0	0%	517	83	193	194	56
E.C. (us/cm)	113	0	0%	4250	1509	3319	3460	796
TDS	114	0	0%	**3420**	**1110**	**2917**	**2940**	362
HCO3 (mg $CaCO_3$/L)	114	0	0%	482	270	374	340	68
SO4	114	0	0%	**2060**	**520**	**1725**	**1765**	236
Ca	114	0	0%	413	71	299	290	58
Na	114	0	0%	225	140	197	201	16
Cl	114	0	0%	35.8	24.8	31.2	32.0	2.2
K	114	0	0%	22.7	8.3	17.2	17.0	3.2
Mg	114	0	0%	271	37	224	229	38
P	50	49	98%	0.50	0.05	0.15	0.05	0.19
Dissolved Metals								
Ag	51	50	98%	0.02	0.00005	0.0034	0.0050	0.0037
Al	100	44	44%	2.2	0.05	0.15	0.1	0.26
As	51	37	73%	0.01	0.0005	0.0036	0.0050	0.0021
Cu	100	27	27%	0.059	0.001	0.010	0.007	0.010
Fe	98	78	80%	0.15	0.02	0.02	0.02	0.02
Hg	51	39	76%	**0.0035**	0.00005	0.00036	0.00010	0.00057
Mn	88	0	0%	**5.59**	0.01	**2.05**	**1.5**	1.03
Mo	114	0	0%	3.40	0.60	1.85	1.70	0.52
Pb	51	47	92%	0.0018	0.0001	0.0003	0.0001	0.0004
Sb	100	13	13%	**0.032**	0.0025	**0.014**	**0.007**	0.011
Tl	96	5	5%	**0.22**	0.0005	**0.0249**	**0.024**	0.0206
U[1]	114	0	0%	61.00	3.90	41.14	42.90	11.86
U[2]	22	0	0%	32.4	4	18.0	16.8	8.4
Zn	47	0	0%	1.41	0.05	0.383	0.38	0.183
Ra 226 (pCi/L)	50	0	0%	**219**	**128**	**178**	**180**	20
Total Metals								
Ag	52	44	85%	0.009	0.00005	0.0023	0.0005	0.0024
Al	51	48	94%	0.37	0.05	0.09	0.05	0.07
As	52	39	75%	**0.05**	0.0005	0.0058	0.0050	0.0092
Cu	52	15	29%	0.016	0.0025	0.008	0.008	0.003
Fe	44	0	0%	**3.42**	0.05	**0.62**	0.21	0.93
Hg	52	33	63%	0.0018	0.0001	0.0004	0.0002	0.0004
Mn	46	0	0%	**6.86**	**1.39**	**2.63**	**2.38**	1.01
Mo	11	0	0%	1.80	1.20	1.39	1.30	0.21
Pb	52	39	75%	**0.05**[3]	0.001	0.018	0.005	0.020
Sb	52	13	25%	**0.029**	0.001	**0.020**	**0.025**	0.009
Tl	48	1	2%	**0.033**	0.001	**0.024**	**0.025**	0.006
U[1]	11	0	0%	37.59	30.06	34.29	34.37	1.99
Zn	48	0	0%	1.36	0.041	0.366	0.3385	0.229

All concentrations in mg/L unless otherwise noted.
Mean and median statistic calculated using one-half the detection limit (1/2 D.L.)
Bolded values are above Colorado groundwater standards for reference. The standards may not apply to mine water.
[1] Cotter Laboratory (considered to be the most reliable uranium analyses)
[2] Sintrex Labratory

7.6.3.1 Evaluation of Mine Water Mine Water Quality with Depth

Water quality samples were collected at various discrete depths within the #3 and #2 shafts for each sampling round up until May 2003 when the elevation of the mine pool was at 6,016.8 feet. As part of this analysis, profiles of temperature, pH, redox potential and electrical conductivity were plotted for 3 sampling rounds during mine flooding (Figure 43 - Figure 45). The results of the evaluation indicate that redox conditions in the mine were moderately oxidizing at depths of several hundred feet below the surface of the pool. Eh values ranged from 83 and 517 mV. Profiles of pH showed slight variation and were near neutral. Electrical conductivity and temperature profiles displayed greater fluctuation than pH, and may have been affected by currents on levels intersecting permeable structures.

Field parameters for temperature, pH, conductivity and ORP were also measured in the shaft on November 12, 2007. The water level in the mine was at 6,576.9 feet elevation. The results from the 2007 sampling round indicated that the pH of mine water was near neutral and that temperature and electrical conductivity varied only slightly in the upper 40 feet of the water column (Figure 46). ORP values (52.8 to 22.8 mV) in the mine pool had decreased since 2003 and showed a decreasing trend with depth.

7.6.3.2 Evaluation of Chemical Trends in Mine Water as a Function of Time

Chemical trends in mine water were evaluated as a function of time by plotting concentrations for the various constituents against the date sampled (Figure 49 and Figure 51). Observations from this analysis are summarized as follows:

1. Redox conditions have decreased with time from a high of near 300 mV during flooding to 22.8 mV in late 2007.
2. Prior to the November 2007 profile, redox conditions in the mine water fluctuated between 100 and 300 mV Eh with a possible weak increasing trend ($R^2 = 0.0760$).
3. The mine water pH has remained relatively stable through time, fluctuating near 7 with no distinct trend toward acidification or increasing pH.
4. Bicarbonate alkalinity increased rapidly during the early flooding of the mine (280 to about 410 mg $CaCO_3$/L). The rate of increase has been slower since May 2001, with concentrations increasing from about 410 to 482 mg $CaCO_3$/L.
5. After an initial rapid increase during the first two months of flooding, TDS concentrations have been stable to slightly rising to the current level of 3,300 mg/L.
6. Sulfate concentrations have been slowly increasing since April 2002 from about 1,600 mg/L to 2,020 mg/L in 2007.
7. Sodium and chloride concentrations have had weak decreasing trends since 2003.
8. Calcium concentrations increased rapidly during the early flooding of the mine to about 280 mg/L by the fall of 2000 and them increased at a much slower rate to about 400 mg/L by June 2007.
9. Magnesium concentrations increased rapidly during the early flooding of the mine to about 230 mg/L and have been stable since about August 2000.
10. Potassium concentrations increased slowly from about 10 mg/L to 20 mg/L from July 2000 to May 2003. They have been stable near 20 mg/L since this time.
11. Manganese (1 to about 5.59 mg/L) concentrations have increased with time in mine water.
12. Molybdenum concentrations increased from about 1 mg/L at the start of mine flooding to a peak of about 2.6 mg/L in mid-2001. Since 2001, molybdenum concentrations have been steadily decreasing to near 1.6 mg/l in 2007.
13. Uranium concentrations increased from about 4 mg/L at the start of mine flooding to a peak of about 59.5 mg/L in October 2002. Since October 3003, uranium concentrations have been steadily decreasing to near 45 mg/l by 2007.
14. Dissolved iron concentrations have been stable at a very low level during flooding. Total iron has shown elevated concentrations (3.42 mg/L maximum) since January 2003.

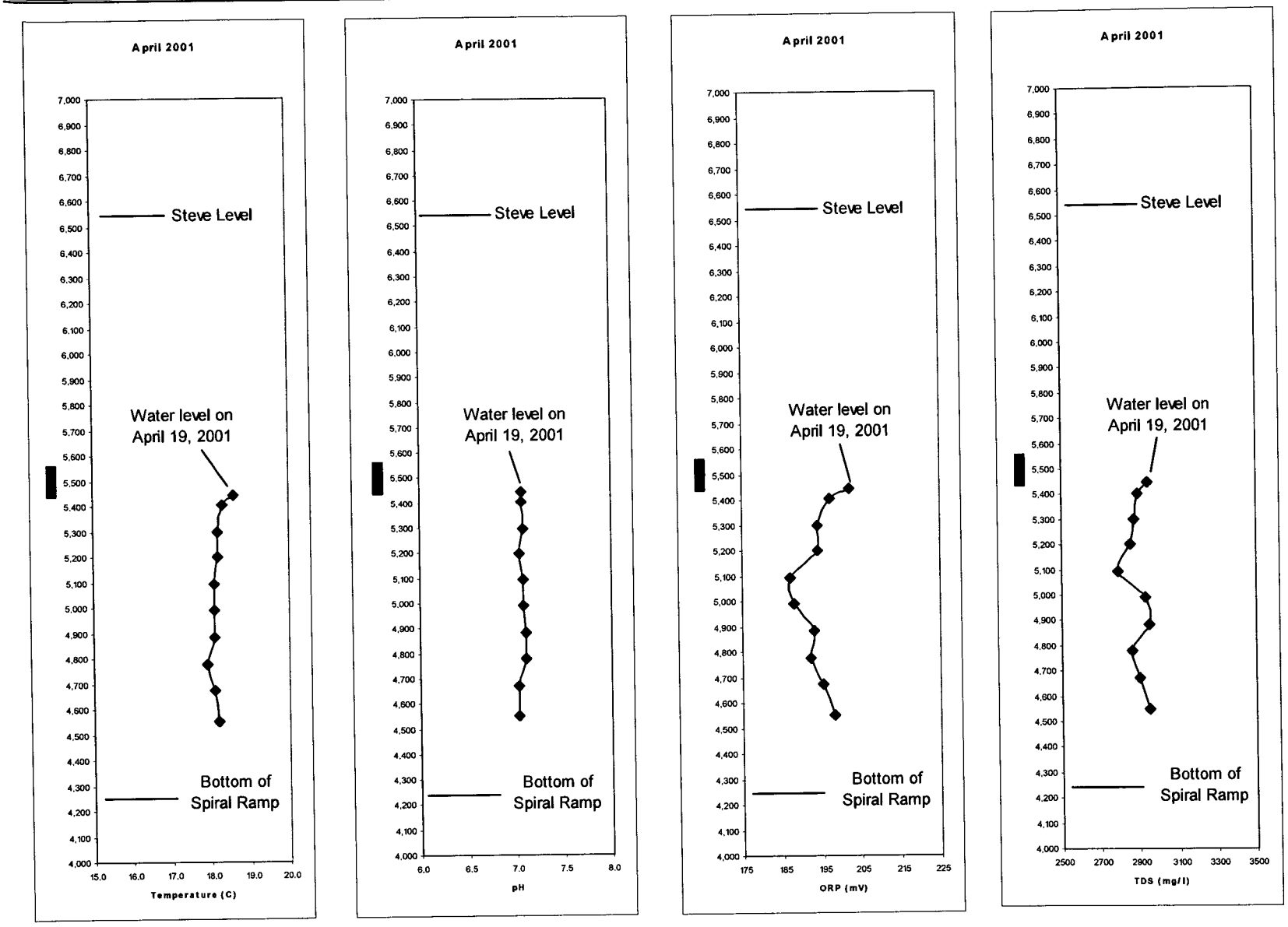


Figure 43. Depth Profile for General Parameters in Flooded Mine Workings April 19, 2001

(Note: Elevations shown in Mine Grid [NAD27 minus 53 ft].)

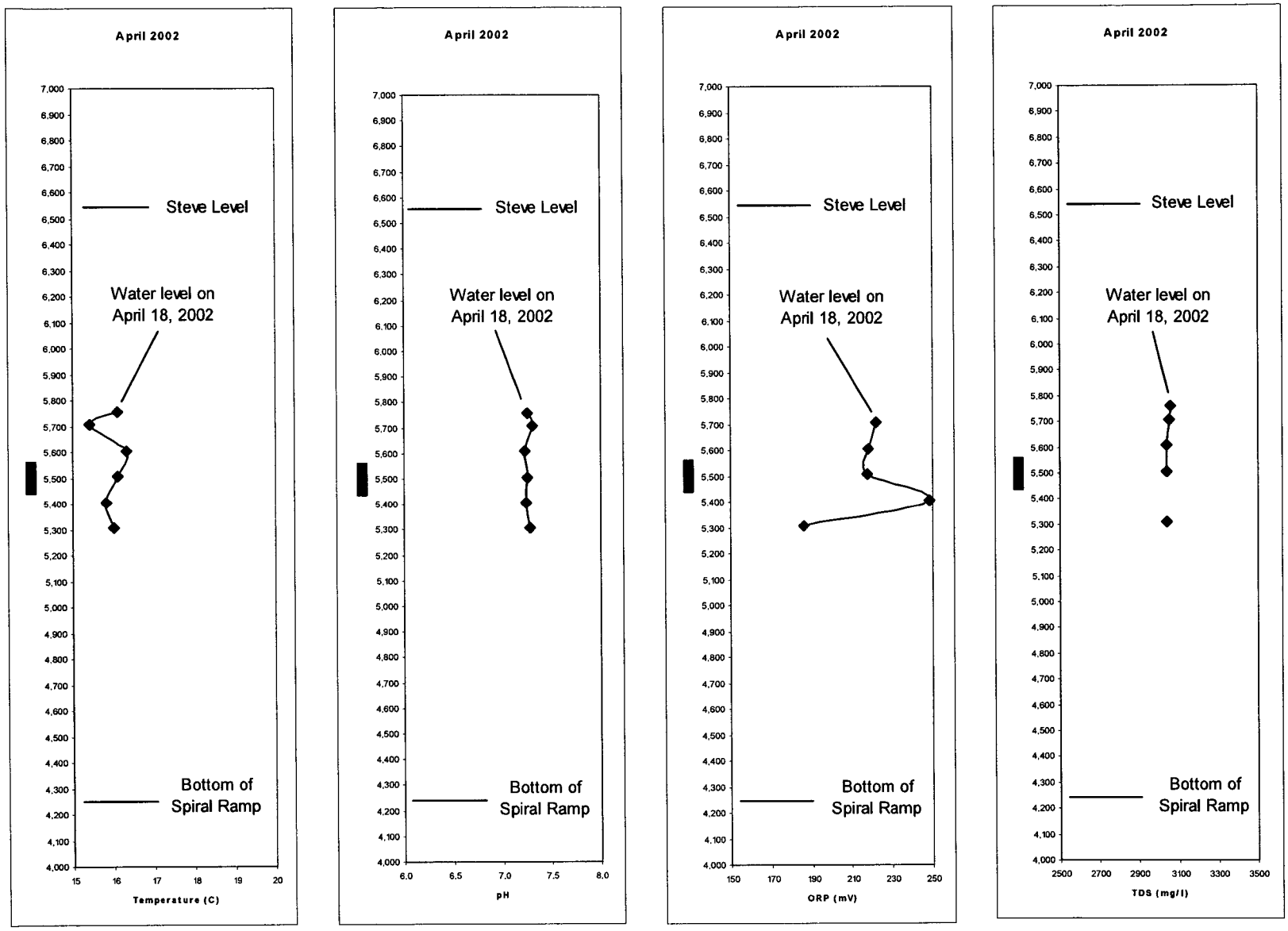


Figure 44. Depth Profile for General Parameters in Flooded Mine Workings April 18, 2002

(Note: Elevations shown in Mine Grid [NAD27 minus 53 ft].)

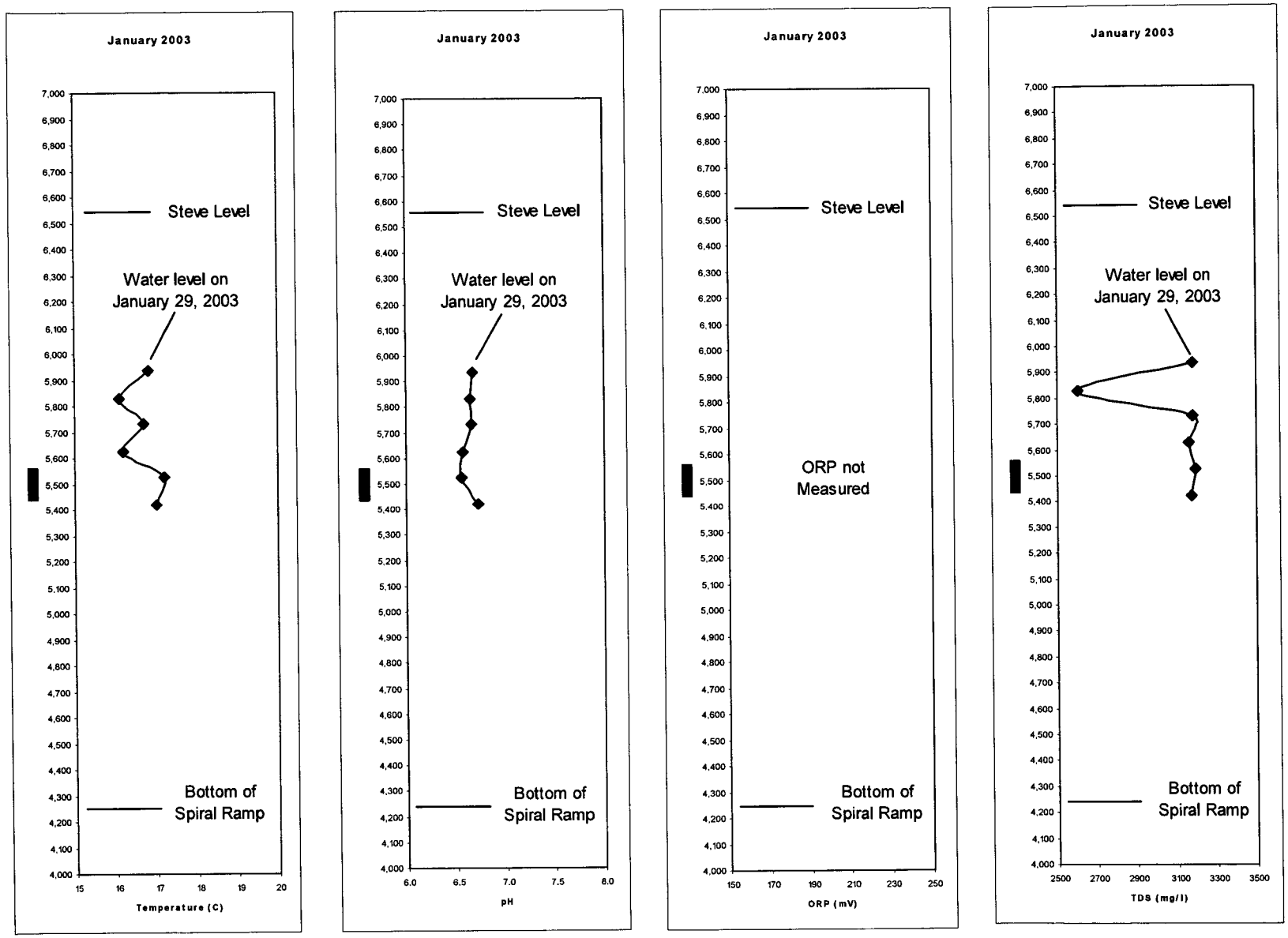


Figure 45. Depth Profile for General Parameters in Flooded Mine Workings January 29, 2003

(Note: Elevations shown in Mine Grid [NAD27 minus 53 ft].)

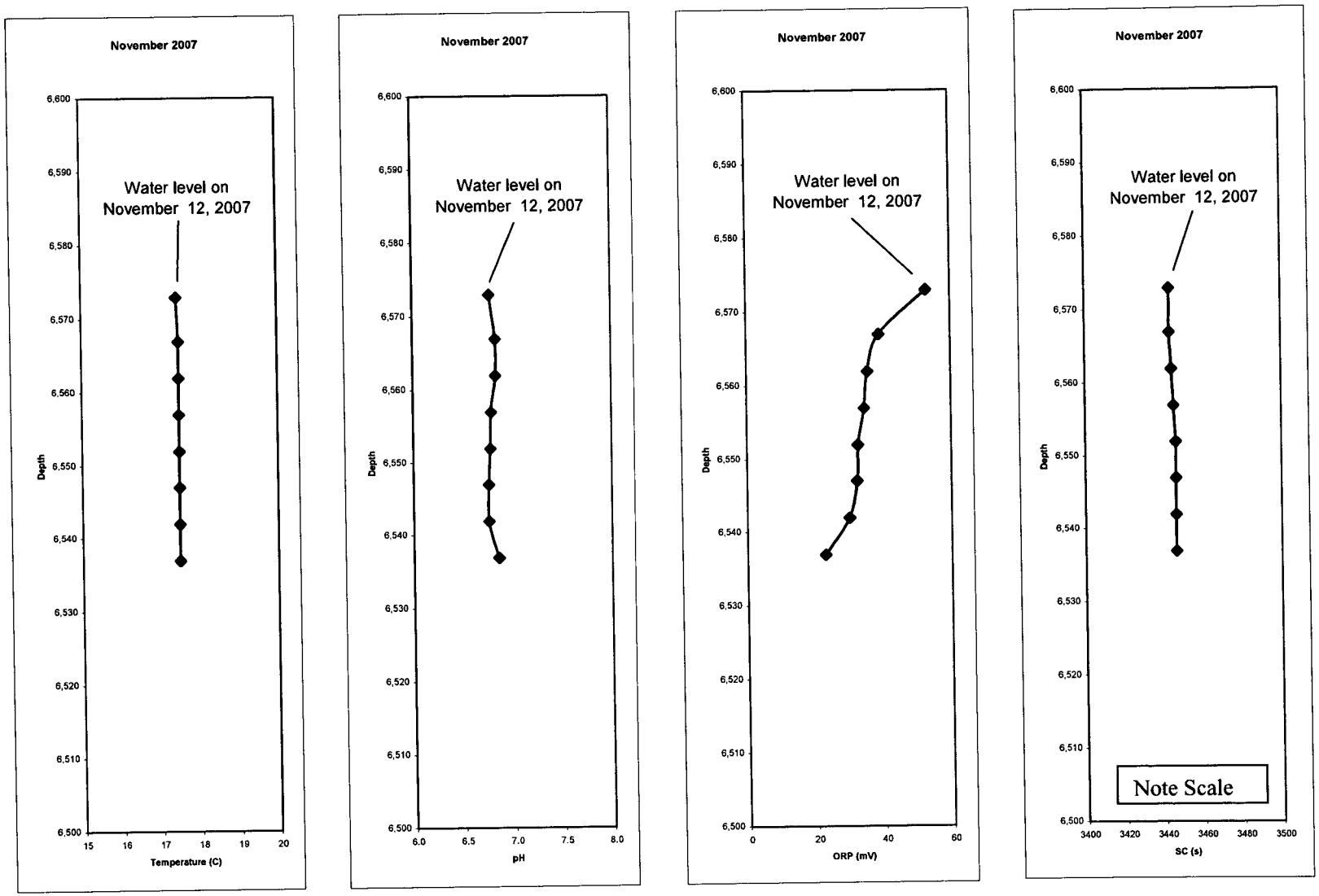


Figure 46. Depth Profile for General Parameters in Upper 40 ft of Flooded Mine Workings, Nov 12, 2007

(Note: Elevations shown in Mine Grid [NAD27 minus 53 ft].)

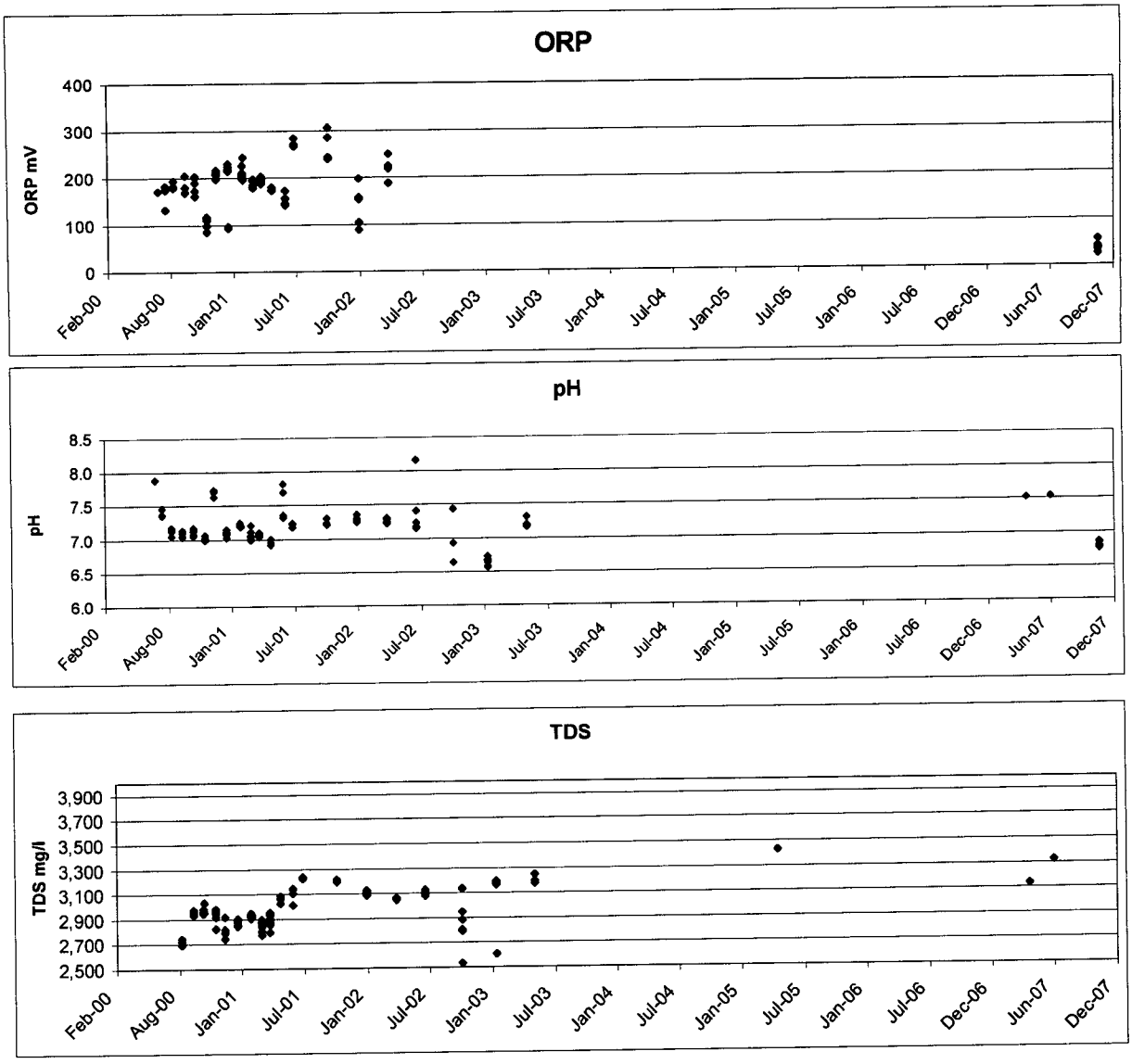


Figure 47. Time Concentration Plots for General Parameters (pH, ORP, TDS) in Mine Water

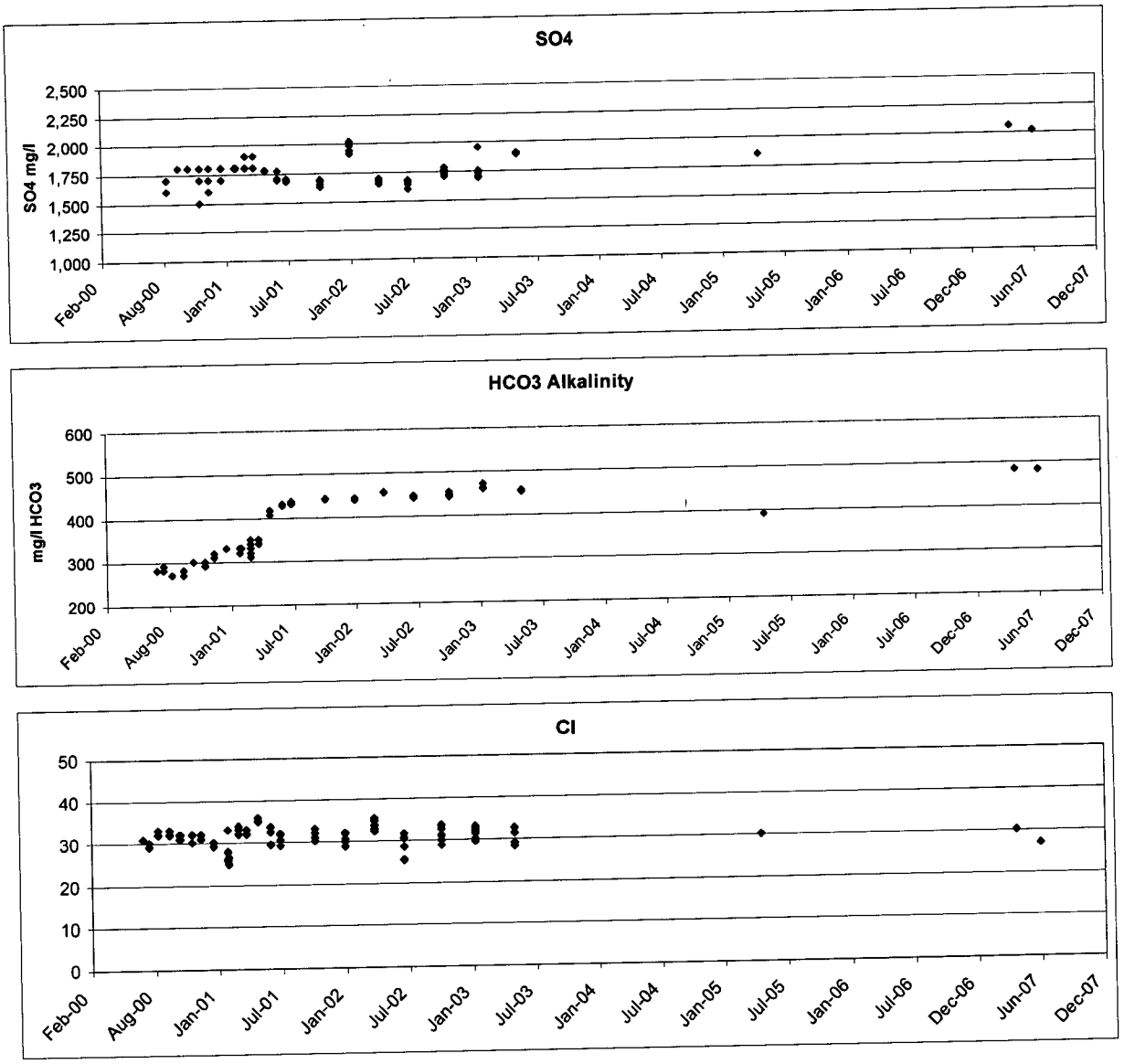


Figure 48. Time Concentration Plots for Major Anions (SO_4, HCO_3, and Cl) in Mine Water

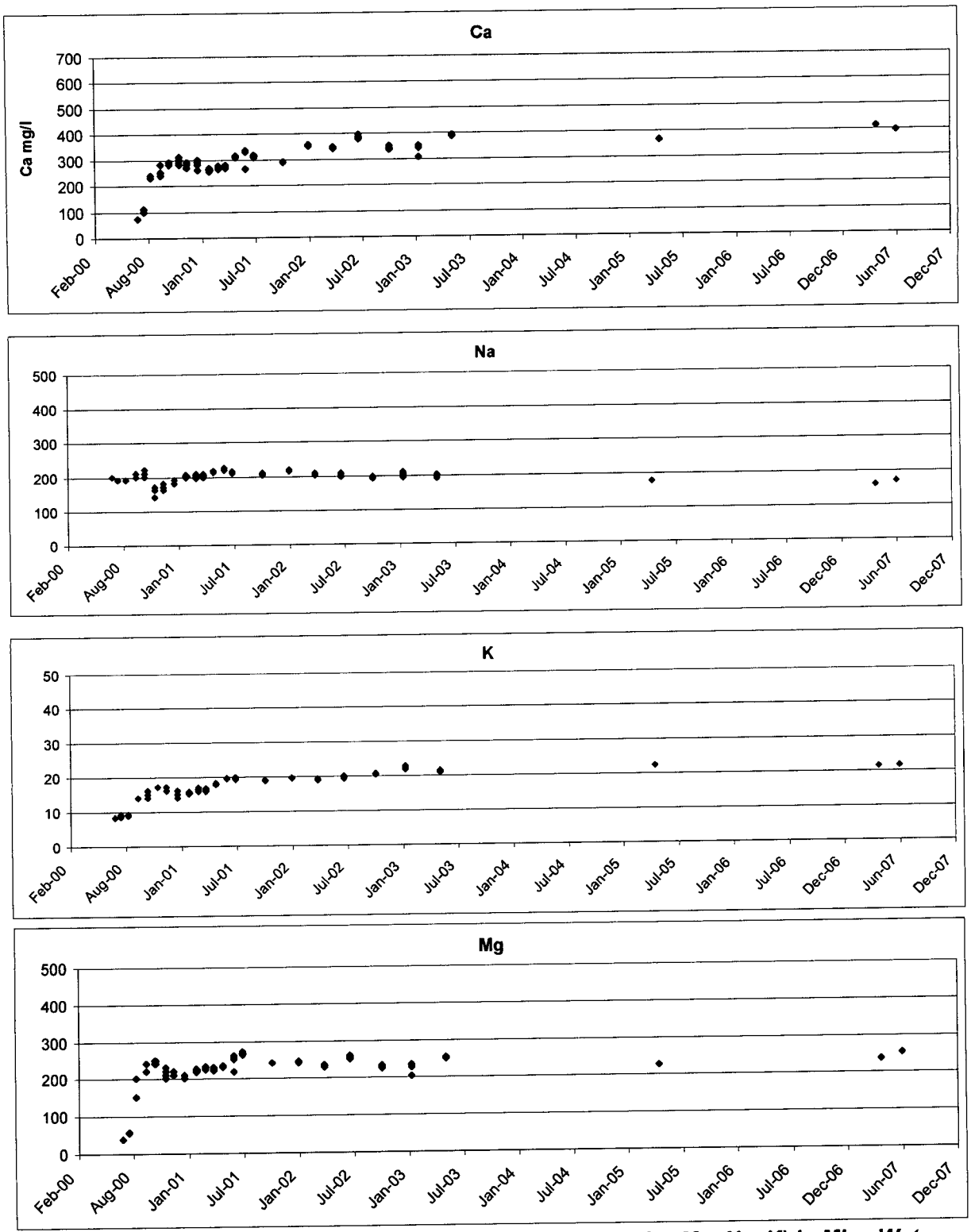


Figure 49. Time Concentration Plots for Major Cations (Ca, Mg, Na, K) in Mine Water

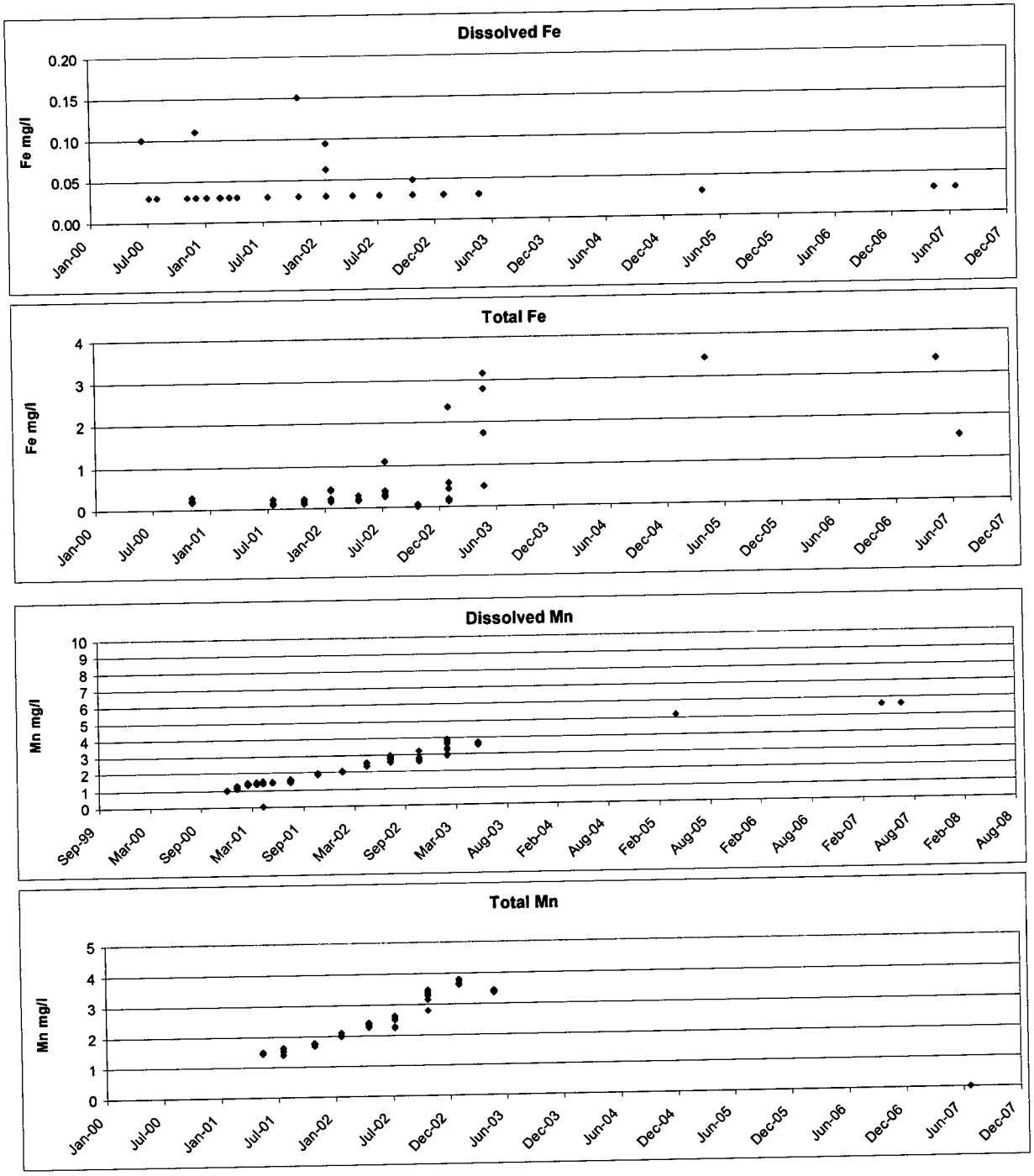


Figure 50. Time Concentration Plots for Metals (Fe, Mn) in Mine Water

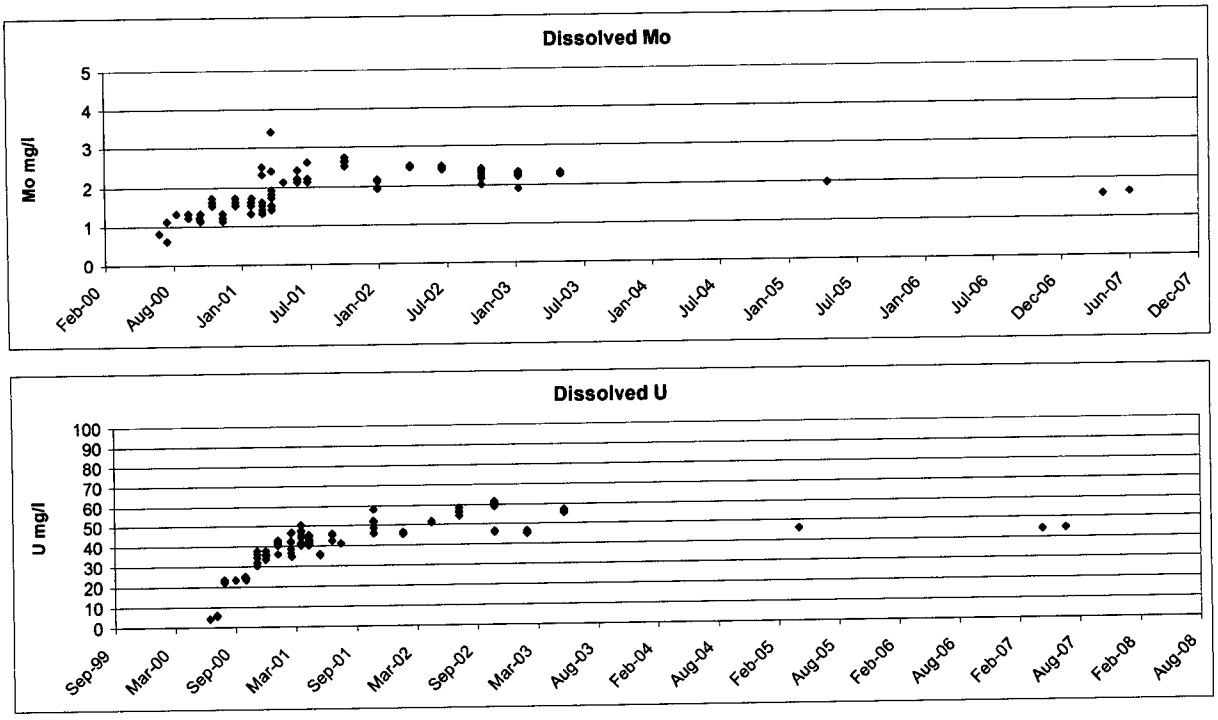


Figure 51. Time Concentration Plots for Trace Metals (U, Mo) in Mine Water

7.6.3.3 *Concentration Correlation Plots*

Concentration correlation plots of molybdenum and uranium versus iron and molybdenum and uranium versus manganese were prepared to determine if a relationship exists between these metals. Plots of uranium and molybdenum versus iron did not indicate a relationship (i.e. they essentially plotted as a flat line). Plots of uranium and molybdenum versus manganese however indicated a moderate correlation with R^2 values of 0.3408 and 0.4765 respectively.

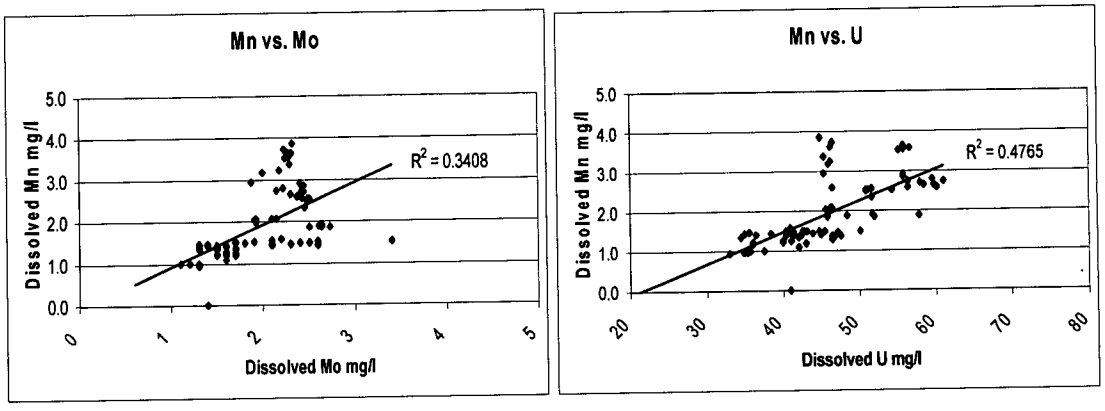


Figure 52. Concentration Plots of Manganese vs. Uranium and Molybdenum

8. CHARACTERIZATION OF WASTE ROCK AND FILL

Material placed in the north and south waste rock piles and used as fill is comprised of lime-silicate-hornblende gneiss, garnet-biotite gneiss, mica schist, and smaller amounts of quartzite, pegmatite, and vein material derived from the underground mine and ore-sorter reject rock. In total, the two piles contain have combined footprint of about 6.3 acres (Figure 1). The east pile is larger (about 4.0 acres) than the west pile (about 2.3 acres), and both were capped with 3 ft of rock cover, then topped with surface soils and vegetated using the seed mix specified by DMG (DRMG).

Prior to the construction of mine facilities, waste rock from the mine was placed as fill material in the valley adjacent to Ralston Creek. The fill material covers an area of approximately seven (7) acres. The composition of the fill is similar to the waste rock piles. During reclamation, additional fill was mined from the Black Forest Mine (east of the Schwartzwalder) and used for cover and fill material in the valley. Rock from the Black Forest Mine is a hornblende gneiss (LSHG) unit, assumed to have the same chemical composition as other LSHG samples that have been analyzed from the site.

Geochemical characterization data for waste rock are available from several sources including whole rock analysis of major elemental composition and trace metals, acid–base accounting tests, acid consumption tests, and a bottle roll leaching test. In addition to laboratory testing, water quality data from sumps completed in fill material and the observed chemistry of Ralston Creek above and below the waste piles can be used to evaluate the long-term leaching characteristics of waste and fill material. Portions of the waste piles and fill have been in place for up to 30 years and provide a large scale test of the leaching behavior of waste rock. Sources of waste rock geochemical characterization data are summarized in Table 38.

Table 38. Summary of Geochemical Characterization Data for Waste Rock and Fill

Test Type	Number of Tests	Sample Type	Sample Source
Whole Rock Analysis		Rock	Underground workings
Acid-Base Accounting	11	Rock	East and West waste rock piles
Bottle Roll	1	Rock	Underground workings
Acid Consumption		Rock	East and West waste rock piles
Sump Water Analysis	248 (1)	Water	Groundwater in Fill Material
Seep Water Analysis	33	Water	Groundwater Seep from Fill Material
Surface Water Analysis	173 (2)	Water	Ralston Creek water above and below waste rock piles

NOTES: (1) Approximate total number of analyses evaluated from the sumps, Jan 1990 – Sept 2007
(2) Number of analyses available from SW-AWD and SW-A001, Jan 1990 – Sept 2007

8.1 Whole Rock Analysis

Whole rock analyses of the elemental chemistry of rock materials at the Schwartzwalder Mine are available from studies by Wallace (1983) and Wallace and Karlson (1985). Average mineral and chemical analyses for the evaluated rock types are summarized in (Table 39).

Table 39. Average Mineral and Chemical Analyses of Schwartzwalder Rocks

	Lime-Silicate-Hornblende Gneiss	Schwartzwalder Trend Quartzite	Schwartzwalder Trend Garnet-Biotite-Gneiss	Mica Schist	Vein Material
Minerals (%)					
Calcite	15	nd	nd	nd	nd
Pyrite	nd	5	4	nd	nd
Major Components (%)					
SiO2	43	94	54	61	
MgO	4	0.5	3	2	
CaO	12	0.6	1.5	1.3	
Total Iron	11	2	19	13	
Total Carbon	2	0.3	1.4	0.4	5.4
Total Sulfur	0.1	0.3	1.4	0.01	0.7
Metals (ppm)					
Arsenic	18	25	14	2	73
Cadmium	nd	nd	2	nd	2
Copper	68	26	9	20	357
Molybdenum	11	6	15	4	1933
Nickel	59	5	40	3	47
Lead	9	nd	6	30	2267
Uranium	9	14	18	4	5100
Vanadium	20	11	19	78	313
Zinc	8	15	142	112	273

As expected, results of the whole rock analyses indicate that metals, including molybdenum, lead, and uranium are enriched in the ore/vein material above normal crustal abundances (Rose et al., 1979). Copper, vanadium and zinc are also enriched in ore but not to the extent observed for molybdenum, lead, and uranium. Metal concentrations in host rock and waste lithologies are much lower than in the vein material, and although they are weakly elevated, they approach normal crustal abundances for igneous and metamorphic rocks (Rose et al., 1979).

8.2 Acid-Base Accounting

Acid-base accounting (ABA) tests were used to evaluate the potential for waste rock and fill material to generate acid rock drainage. Eleven samples of waste rock were submitted for ABA testing including six samples from the west waste rock pile and five samples from the east pile. The samples were collected from five separate pits and most of the rock had been exposed to surface weathering conditions for at least ten years.

Acid-base accounting provides a theoretical estimate of the net acid-producing potential of rock materials by comparing the total acid generating potential (AGP) to total acid neutralizing potential (ANP). Test results are generally evaluated by calculating the net neutralizing potential (NNP = ANP-AGP) or by the ratio of ANP to AGP (ANP/AGP). Samples with NNPs greater than 20 and ANP/AGP ratios greater than 3 are considered to have low potential to produce acid. Samples with NNP values between 0 and 20 and ANP/AGP ratios between 3 and 1 are indeterminate. Samples with negative NNP values and ANP/AGP ratios below 1 are potentially acid generating (EPA, 1994).

The results of the ABA tests indicate that waste rock from the Schwartzwalder Mine is strongly neutralizing with an average net neutralizing (NNP) capacity of 149 t $CaCO^3$/kt and an ANP/AGP ratio of 10 (Table 40). The NNP of the tested samples varied from 86 to 206 t $CaCO^3$/kt. The observed range of t $CaCO^3$/kt ratios was 2.3 to 28.5. Only one of the samples tested had an ANP/AGP ratio less than 3. Its net neutralizing potential, however, was 89 t $CaCO^3$/kt which is more than four time greater than the recommended guidance of 20 t $CaCO^3$/kt for material with low potential to produce acidic drainage. In

light of theses results, waste rock in the east and west piles, and the fill material adjacent to Ralston Creek are considered to have very low potential to generate acidic drainage.

Table 40. Summary of Acid-Base Accounting Results

Sample Location	Depth (ft)	Years Exposed to Weathering	ANP t $CaCO^3$/kt	AGP t $CaCO^3$/kt	NNP t $CaCO^3$/kt	ANP/AGP
North Waste Rock Pile						
South End, Central Bench	1.5	<1*	214	8	206	28.5
South End, Central Bench	6	10-17	175	23	152	7.5
South End, Central Bench	11	10-17	179	14	165	12.7
North End, Central Bench	1.7	<1*	188	8	180	22.7
North End, Central Bench	6	10-17	123	38	86	3.3
North End, Central Bench	11.5	10-17	160	22	138	7.4
South Waste Rock Pile						
North End, Top	1.5	15-17	186	29	158	6.5
North End, Top	6	15-17	162	38	124	4.3
North End, Top	10.5	15-17	174	33	141	5.3
South End, Top	1	13-18	229	28	201	8.2
South End, Toe	2.5	13-15	157	68	89	2.3
Average			**177**	**28**	**149**	**10**

* = moved in six months prior to ABA testing

8.3 Acid Consumption Tests

An evaluation of the potential for acid-leach reprocessing of the waste rock piles was performed in 1986 by CSMRI, the Colorado School of Mines Research Institute (Chlumsky, 1986). Results of the study indicated that the acid consumption per ton of waste rock was between 400 and 420 pounds of sulfuric acid. This neutralizing potential is equivalent to about 160 t $CaCO^3$/kt assuming 40% solution of sulfuric acid, and is in good agreement with the results of the acid base accounting tests which indicate high neutralizing potential.

9. IMPACT ANALYSIS

9.1 Waste Rock Piles

The two waste rock piles associated with the mine are located in the Ralston Creek valley, upstream (west) of the mine. The footprint of the East and West piles near the end of mining (2000) are shown Figure 1. The quantity and character of the waste rock was discussed in Section 8. Issues related to the closure of the waste rock piles include stability of the piles and water quality in Ralston Creek adjacent to the piles.

The stability of the waste rock piles has been investigated (McDermid, 1983a, 1983b) and hydraulic control structures have been designed to protect the piles from the 100-year flood event (Shepherd Miller, 1999). These control structures include an energy dissipater located in the ephemeral drainage near the east waste rock pile and rip rap on the side slopes. In addition, the mine reclamation permit requires recontouring the waste rock piles to 2H:1V.

Based on the analyses performed by McDermid (1983a, 1983b) and Shepherd Miller (1999), the approval of CDMG, and the reclamation activities performed to date, the waste rock piles are considered stable and are expected to remain so in the future, even through a 100-year flood event.

Portions of the waste rock piles have been in place for over 30 years. During much of that time, water quality in Ralston Creek has been monitored regularly at upstream station SW-AWD and at downstream stations SW-A001 and SW-BPL. The long-term sampling results (Section 6.5) indicate that the waste rock piles have little effect on the water quality in Ralston Creek. No change in major ion chemistry or dissolved metals is evident (Table 24). The average TDS *decreases* between stations SW-AWD and SW-A001, while changes in uranium concentrations are negligible (Figure 53). Mean and median uranium levels increase from 0.007 and 0.0025 mg/L at station SW-AWD to 0.0094 and 0.0037 mg/L at station SW-A001, respectively. Although the 0.0012 mg/L difference in mean concentration represents a 34% increase, the difference is only 0.13% of the acute toxicity limit[21], 0.21% of the chronic toxicity limit, and 4.1% of the water supply intake limit. In summary, water quality changes are negligible as Ralston Creek passes the waste rock piles, based on approximately 173 samples collected from 1990 to 2007.

The chemical evaluations performed on the exposed waste rock (Table 40) indicate that the material is not acid generating, but instead is strongly neutralizing. The rock contains relatively limited quantities of metals which could be leached into the groundwater or surface water. Additionally, the long-term water quality data indicate that the waste rock piles are not affecting water quality in Ralston Creek.

[21] Acute toxicity limit is 1.80 mg/L uranium and chronic toxicity limit is 1.125 mg/L uranium based on an average hardness of 77 mg/L for Stations SW-AWD and SW-A001.

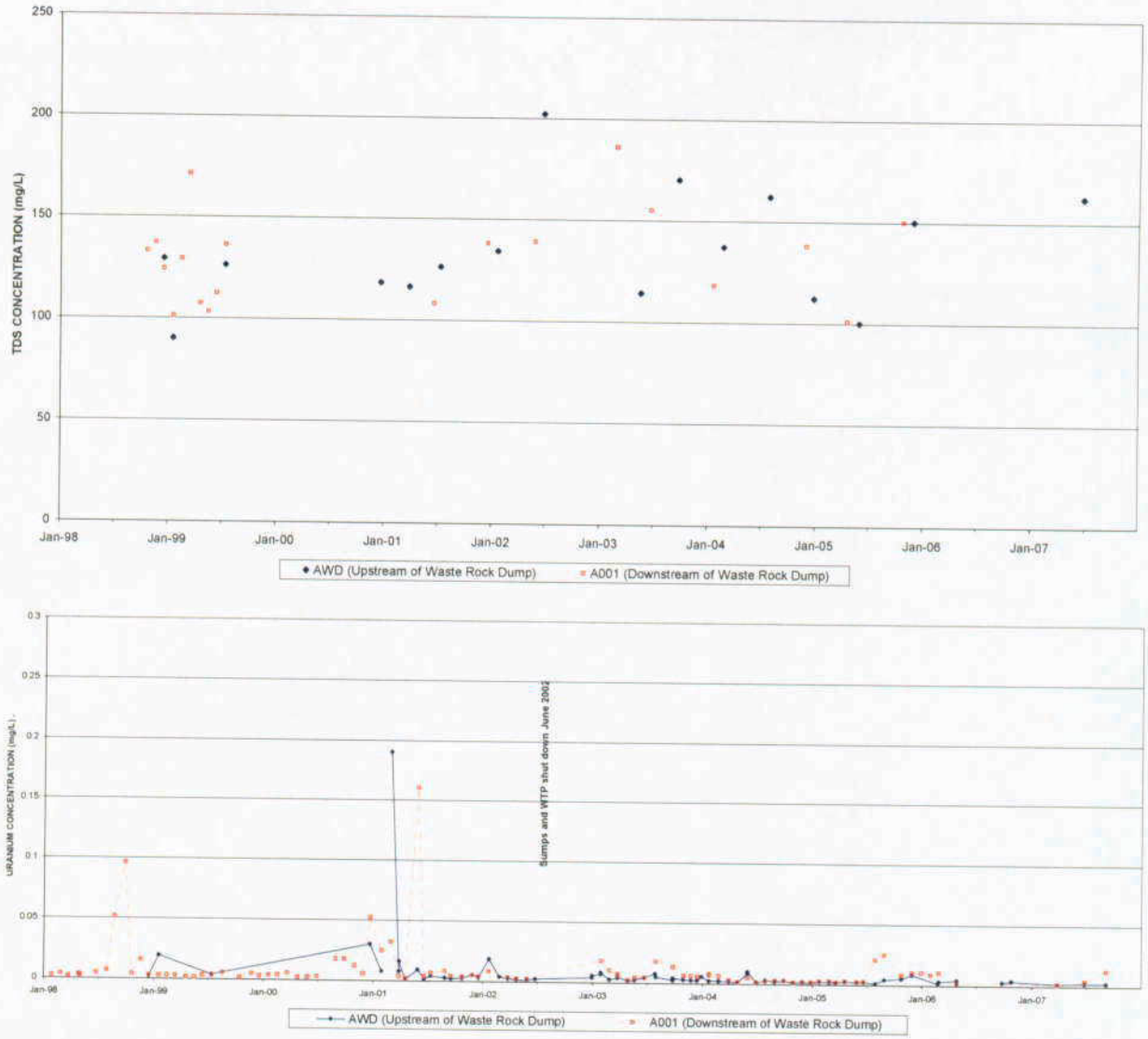


Figure 53. Comparison of TDS and Uranium Concentrations in Ralston Creek, Upstream and Downstream of Waste Rock Dumps

9.2 Alluvium and Fill

Interaction with groundwater in the alluvium and fill has affected the water quality in Ralston Creek since the sumps were shut down in June, 2002 (Section 6.4.2). The four collector trenches and pumpback sumps were installed in the alluvium and fill during 1990 and 1991, and operated until June, 2002. Much of the fill has been in place since the 1960s, when Ralston Creek was re-routed to the north side of the canyon and mine facilities were constructed on the artificial fill.

Areas of contamination in and above the fill have been excavated and removed, in accordance with the Mine Reclamation Plan (Section 10.2). The remaining fill material is not slated for removal.

Based on the existing conditions, water quality in Ralston Creek is expected to continue to show distinct seasonal variation in uranium concentrations. High creek flows in the spring will result in low uranium concentrations, well below the water supply intake standard (40 pCi/L, 0.059 mg/L) and the acute (4.12 mg/L) and chronic (2.57 mg/L) aquatic toxicity standards (calculated in Section 6.1.2). Low creek flows in the winter and late summer will result in increased uranium concentrations, which may sometimes exceed the water supply intake standard but are unlikely to ever exceed the aquatic toxicity standards.

The source of the increased uranium and TDS in Ralston Creek is believed to be from diffuse sources in the fill material. Geochemical modeling of water under oxidizing conditions has not indicated a limiting control for uranium solubility. Rather, uranium concentrations are controlled by reaction kinetics, the velocity of groundwater flow within the alluvium and fill, and seasonal fluctuations in water levels. Seasonal fluctuations in water levels expose uraniferous fill to oxidizing conditions during low water periods. Infiltrating water which contacts these reactive surfaces solubilizes the stored uranium salts and transports uranium into the groundwater system. Groundwater in the alluvium and fill interacts with surface water in Ralston Creek, resulting in elevated uranium concentrations in the creek during certain times of the year.

Uranium concentrations are not expected to exceed the concentrations observed within the first six months of turning off the sumps. At that time, the reactive surfaces had been exposed for over a decade while the sumps were in operation. The "first flush" of uranium removed from the sump drains, fill, and alluvium is expected to be the "worst case" condition. However, uranium concentrations during low flow period are not expected to fall below about 0.2 mg/L, the observed concentrations during low flow (Fall 2003) after the initial flush.

9.3 Mine Refilling

Water levels in the mine have risen from 2,200 feet to about 26 feet below the Steve Level in 7 ½ years, and are predicted to reach a maximum elevation of about 12 feet below the Steve Level portal after April 2009 (Section 5.2.4). Mine water is not predicted to discharge from the Steve Level portal into Ralston Creek.

Based on the observed rate of mine flooding through September 2007, a time frame was estimated for the mine pool to reach steady-state elevation (Section 5.2.4). Assuming that water levels in the mine continue to rise at a linear rate of 0.025 ft/day, the earliest time at which the mine pool would reach static would be April, 2009. It is likely, however, that the rate of rise will follow a traditional groundwater recovery curve and will continue to slow as the elevation of the mine pool increases.

9.4 Mine Water Chemistry

Equilibrium based geochemical modeling of mine water was performed to identify mineral controls and processes affecting water quality in the mine. The geochemical modeling program PHREEQCi v. 2.14.2 (Charlton and Parkhurst, 2007) was used for this analysis along with the MINTEQ.v4 database which contains an expanded compilation of thermodynamic data for metals. PHREEQCi is public domain software developed by United States Geological Survey, and is widely used and accepted by regulatory agencies to model mine water chemistry.

9.4.1 Geochemical Modeling Approach

Water entering the mine originates from two broad sources with variable water quality including:

1. Groundwater which enters the mine at a level equal to, or below, the mine pool; and,
2. Infiltration of meteoric water into the upper portions of the mine.

Although numerous water quality samples were collected from the deeper portions of the mine prior to flooding, the actual chemistry of the groundwater before it enters the mine is not well known. Samples from the deep mine are probably the best approximation of background groundwater geochemistry[22] but some samples were subject to chemical loading by the dissolution of soluble minerals and salts from wall rocks that had been exposed to oxidizing conditions in the workings during operation. Comparison of the "average" deep mine water quality in 1999[23] with the water from the partially flooded mine indicates continued loading during filling and at least a three-fold increase in total dissolved solids, predominantly in the form sulfate, calcium, magnesium, and sodium between 1999 and 2003. Uranium, manganese, and molybdenum also increased during that time by factors of ten, five, and three respectively. However, more recent data from 2005 and 2007 suggests a possible reversal of some of these trends. Although sulfate and manganese continued to increase, calcium and magnesium remained relatively constant and sodium, molybdenum and uranium appear to have begun a decreasing trend. Average water quality data for samples collected from the lower workings have acceptable cation-anion balances for geochemical modeling and are summarized in Table 41.

Water from the upper workings is impacted by acid rock drainage and is of much poorer quality than water entering the lower workings. Water from the upper levels has widely varying pH (2.7 to 8.2) high total dissolved solids (1,230 to 11,000 mg/L), and elevated concentrations of uranium (29 to 150 mg/L) manganese (0.57 to 27 mg/L) and copper (0.04 to 19 mg/L). Molybdenum and other metals were not analyzed for samples collected from the upper workings, but at low pH, most metals exhibit increased solubility and are expected to be present at elevated concentrations. Although water quality analyses from the upper workings provide valuable information that can be used in the geochemical model, they are incomplete with regard to major ion composition and have percent errors in cation-anion balance of up to about 50 %. For this reason, weighted averages and individual compositions of samples collected from the upper workings and should be used with caution. Water quality data for the upper workings is summarized in Table 42.

9.4.1.1 Mass Balance Mixing Model

A mass balance mixing model was prepared to evaluate whether conservative constituents could be identified in the mine water that could be used to confirm percentage inflows from deep groundwater and the upper workings. Results of the analysis did not identify any constituents that could be used to calculate mixing percentages for the upper and lower inflow sources. For many parameters, concentrations in the flooded mine were lower than reported in either the deep mine water or water from the upper workings (i.e. no combination would provide the correct chemistry). In other cases, the calculated mixing fractions were heavily weighted toward the chemistry of the upper workings and indicated that they provided the majority of inflow to the mine. This condition is known to be incorrect. Based on the inability of the mass balance model to provide reasonable results, the chemistry of the mine water is shown to be controlled by dynamic processes which include precipitation and dissolution of minerals from solution.

[22] Samples from coreholes drilled into virgin rock may be considered representative of bedrock water quality peripheral to the mine. These samples include: 7J2, 15B13, 19D15(Fe), 19D15(Mn), and 19D16.

[23] "Average" deep mine water composition from sample RMW (raw mine water) collected 11/15/99 and from 1955 Decline collected 3/23/99, a pooling location for deep mine water during operation.

Table 41. Average Water Quality for Samples Collected from Deep Mine Workings

		779	7J2	1108	15B13/15B	16G	1730	19D15(Fe)	19D16(Mn)	19C16	Composite Average
General Parameters											
pH	s.u.	7.9	8.2	8.4	8.2	8.3	8.1	8.1	8.1	7.9	8.1
TDS	mg/L	897	636	850	941	1100	1053	1112	968	1105	963
Alkalinity	mg/L CaCO3	520	305	300	370	140	310	330	330	210	313
Major Ions											
Ca	mg/L	108	87	97	33	109	103	194	38	110	97
Cl	mg/L	6.4	5.0	10.4	31.0	26.4	6.0	24.6	24.4	23.5	17.5
F	mg/L	0.2	0.2	0.4	5.0	0.8	0.2	1.0	2.1	0.4	1.1
K	mg/L	6.9	4.9	5.6	6.2	4.0	8.0	10.6	8.6	4.5	6.6
Mg	mg/L	123	53	84	10	31	96	34	15	52	55
Na	mg/L	21	23	42	280	158	37	220	238	140	129
SO4	mg/L	328	235	358	356	600	462	490	402	568	422
NH3	Mg/L N	0.5	0.0	0.5	1.0	0.5	1.5	0.5	0.5	0.5	0.6
NO3	Mg/L N	0.5	0.1	3.4	0.2	0.2	13.2	0.2	0.2	0.4	2.0
Dissolved Metals											
Al	mg/L	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Sb	mg/L	0.151	0.000	0.004	0.004	0.004	0.068	0.003	0.003	0.004	0.027
As	mg/L	0.017	0.002	0.001	0.004	0.003	0.018	0.006	0.006	0.002	0.006
Ba	mg/L	0.25	0.25	0.13	0.13	0.27	0.25	0.25	0.25	0.03	0.20
Be	mg/L	0.001	0.000	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Cd	mg/L	0.0001	0.0000	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0001
Cr	mg/L	0.0025	0.0000	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0022
Cu	mg/L	0.028	0.010	0.020	0.015	0.013	0.010	0.010	0.013	0.010	0.014
Fe	mg/L	0.030	0.015	0.030	0.015	0.020	0.015	0.040	0.015	0.015	0.022
Pb	mg/L	0.0016	0.0003	0.0027	0.0008	0.0006	0.0009	0.0014	0.0010	0.0010	0.0011
Mn	mg/L	0.168	0.005	0.015	0.015	0.030	0.018	0.050	0.005	0.033	0.038
Hg	mg/L	0.0001	0.0000	0.0001	0.0001	0.0001	0.0001	0.0001	0.0007	0.0001	0.0002
Mo	mg/L	4.000	0.000	0.090	0.025	0.020	2.220	0.070	0.100	0.115	0.738
Ni	mg/L	0.07	0.00	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Se	mg/L	0.0025	0.0000	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0022
Ag	mg/L	0.0001	0.0000	0.0004	0.0004	0.0004	0.0002	0.0002	0.0004	0.0004	0.0003
Tl	mg/L	0.0005	0.0000	0.0050	0.0005	0.0005	0.0020	0.0005	0.0005	0.0005	0.0011
V	mg/L	0.0050	0.0000	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050	0.0044
Zn	mg/L	0.20	0.02	0.04	0.01	0.00	0.02	0.01	0.01	0.00	0.03
U	mg/L	27.00	0.38	5.66	0.24	0.03	14.06	4.54	1.70	0.46	6.01

Table 42. Weighted Average Water Quality for the Upper Mine Workings

PARAMETER	Unit	ILLRS	Wash	146	CO	Weighted Average
General Parameters						
pH	Su	2.7	3.8	8.2	7.9	*
Alkalinity (dis)	mg CaCO3/l	< 10	< 10	300	170	*
Alkalinity (tot)	mg CaCO3/l	< 1	< 1	300	170	*
E.C.	us/cm	7,190	3,740	4,120	1,430	4004
TSS	mg/L	10.3	30.4	< 2.5	37.4	18.9
TDS	mg/L	11,000	4,200	4,650	1,230	5119
Major Ions						
SO4	mg/L	7,200	2,900	2,900	790	3,321
Ca	mg/L	360	390	380	110	293
Cl	mg/L	130	19	9	5	39
Mg	mg/L	270	240	280	140	229
K	mg/L	< 0.3	14	21	7.4	11
Na	mg/L	8	28	29	7	16.8
Nutrients						
NO3	mg N/l	8.3	2.9	28	4.2	12.4
NH4	mg N/l	< 0.5	< 0.5	< 0.5	< 0.5	0.25
Dissolved Metals						
Cu	mg/L	19	0.67	0.61	0.04	5.04
Mn	mg/L	27	25	0.92	0.57	10.46
U	mg/L	150	52	130	29	94
Estimated % Contribution to Upper Level Flows		**25%**	**13%**	**31%**	**31%**	**100%**

* Weighted averages for pH and alkalinity are not considered to be meaningful for this data set

9.4.1.2 *Evaluation of Precipitation and Dissolution Reactions Controlling Mine Water Chemistry*

Equilibrium based geochemical modeling was performed to evaluate chemical processes occurring within the flooded mine. The modeling approach included speciation of the average water quality from the upper and lower mine workings to evaluate the mineralogical controls on solute concentrations during the initial flooding, and speciation of the mine water from 2007 to evaluate the processes that will control the long-term chemistry of the flooded mine. Speciation was also modeled using the most recent pH and Eh measurements, as each of these parameters has recently decreased. A decreasing trend may be expected for Eh, as groundwater flowing in from deep bedrock is no longer exposed to oxygen in the mine voids. In contrast, pH is likely to remain circum-neutral in the flooded mine because the water is well buffered (394 mg/L alkalinity) and the flow from low-pH seeps in the upper workings is small (Table 35).

9.4.1.2.1 Upper Mine Water Speciation

The speciation run for the average water quality of the upper mine workings indicated a charge imbalance of – 46.77 %. The calculations were performed for oxidizing conditions (Eh = 592 mV) and all solid phases (minerals) for copper, uranium and molybdenum were strongly undersaturated in solution (the input concentrations for molybdenum were estimated from the observed ratio of U to Mo in samples from the flooded mine as data for the upper mine water were not available). Gypsum was the only oversaturated mineral that was likely to precipitate with a saturation index of 0.12 (Appendix H).

9.4.1.2.2 Deep Mine Water Speciation

The speciation run for the average deep groundwater quality had a charge balance error of –0.65 %. The calculations were performed for oxidizing conditions at an Eh of 178 mV which is similar to values observed in the flooded mine. As expected, the results indicated near equilibrium conditions for many minerals in solution including calcite and gypsum (Table 43). This suggests that the major ion composition (Ca, SO_4, HCO_3) of the deep mine water is controlled by precipitation and dissolution reactions involving carbonate minerals and gypsum. Ferrihydrite, a mineral that commonly limits iron concentrations in oxidized waters was also calculated as being oversaturated in solution. This result, however, is a statistical artifact of the high detection limit for iron (<0.03 mg/L) that was used to calculate the input value. All uranium and molybdenum minerals evaluated by the model were undersaturated in the deep mine water.

Table 43. Controlling Mineral Phases in Deep Mine Water

Mineral	Composition	Saturation Index[1]
Calcite	$CaCO_3$	0.87
Alunite	$KAl_3(SO_4)_2(OH)_6$	-0.35
Chrome Hydroxide (am)	$Cr(OH)_3$	0.46
Ferrihydrite	$Fe(OH)_3$	1.71
Gypsum	$CaSO4 \bullet 2H_2O$	0.78
$MgCr_2O_4$	$MgCr_2O_4$	-0.34
Magnesite	$MgCO_3$	0.31
Jarosite_K	$KFe_3(SO_4)_2(OH)_6$	0.36
Otavite	$CdCO_3$	-0.89
Rhodochrosite	$MnCO_3$	-0.74

[1] Positive values are oversaturated; negative values are undersaturated

9.4.1.2.3 Reflooded Mine Water Speciation

Speciation runs were performed for four samples collected from the flooded mine. The modeled samples included, water from a depth of 221 feet collected on May 21, 2001, water from a depth of 465 feet collected on April 18, 2002, water from a depth of 291 feet collected on May 20, 2003, and water from just below the surface on June 27, 2007. The modeled water chemistries had acceptable charge balance errors ranging from –2.46% to 2.52 %. The model calculations for the 2001, 2002, and 2003 samples were performed for oxidizing conditions at an Eh of 178 mV similar to values observed in the flooded mine during that period. The calculations for 2007 were performed using an Eh of 23 mV as was observed during measurements in November 2007. Results of the analysis indicate that calcite and gypsum are near equilibrium for all of the samples and that they are the probable mineral controls of calcium, sulfate and bicarbonate in solution. Amorphous aluminum hydroxide, magnesite, and rhodocrosite were also calculated to be near equilibrium. CO_2 gas is oversaturated in the mine water as compared to equilibrium with atmospheric pressure (atmospheric equilibrium for CO_2 gas occurs at saturation indices between –3.2 and –3.5). Ferrihydrite saturation ranges from near equilibrium to oversaturated, but the model results are impacted by the relatively high detection limit for iron (<0.03 mg/L) that was used to calculate the input value. The precipitation of ferrihydrite typically limits iron concentrations in oxidized waters at neutral pH, and is the most probable control limiting iron concentrations in mine water. All of the uranium and molybdenum minerals evaluated by the model were undersaturated in solution. Saturation Indices for the probable controlling phases are presented in Table 44.

Table 44. Controlling Mineral Phases in Flooded Mine Water

Mineral	Composition	Saturation Index May 21, 2001	Saturation Index April 18, 2002	Saturation Index May 20, 2003	Saturation Index June 27, 2007
Calcite	$CaCO_3$	0.16	0.52	0.46	0.77
CO_2 gas	CO_2	-1.47	-1.75	-1.67	-1.99
$Al(OH)_3$ (am)	$Al(OH)_3$	-0.80	-0.53	-0.52	-0.94
Ferrihydrite	$Fe(OH)_3$	1.16	-0.22	-0.33	-1.01
Gypsum	$CaSO4 \bullet 2H_2O$	-0.02	0.00	0.07	-0.18
Magnesite	$MgCO_3$	-0.26	0.04	-0.03	-0.06
Rhodochrosite	$MnCO_3$	-0.37	0.14	0.22	0.85

[1] Positive values are oversaturated; negative values are undersaturated

9.4.1.2.4 Modified Reflooded Mine Water Speciation

Eh appears to show a recent decreasing trend in the flooded mine water, based on a limited depth profile conducted in the #2 Shaft on November 12, 2007. Eh values were only one-half to one-quarter the value of previous (2003) measurements. The pH was near neutral (6.85), but slightly lower than in June 2007 (7.53). To analyze the effect that decreased Eh or pH might have on future mine water chemistry, mine water concentrations from the June 2007 laboratory analysis were modeled with lower pH and Eh values. Of particular interest in these speciation models was the increase of the saturation index of the potential uranium concentration-limiting species uraninite (UO_2) from undersaturated to oversaturated. June 2007 water quality data was initially speciated using a pH value of 7.53, as measured on the sample date. The same data was speciated again, changing only the pH. A value of 6.85 was selected because it reflects the most recently measured pH in November 2007. With this slightly acidic pH, uraninite showed slight oversaturation (SI = 0.26). It was also found that uraninite moves from undersaturation to oversaturation as Eh decreases from 23 to -25. A decrease of this magnitude in the mine water seems possible given the reduction in measured Eh from near 300 at the most oxidizing to the current measurement of 23. It is possible that the decrease in Eh has occurred because the groundwater inflow from bedrock is no longer exposed to oxygen in the mine voids. While the observed decrease in pH in the upper 40 ft of the shaft could result from the increasing relative contribution of acidic, oxidized water from the upper mine workings and the slowing influx of deep mine groundwater, the flooded mine water is well buffered (394 mg/L alkalinity) and pH is likely to remain circum-neutral in the flooded mine. Saturation indices for uraninite and other phases of interest are presented in Table 45.

Table 45. Effect of pH and Eh on Controlling Mineral Phases

Mineral	Composition	Saturation Index June 27, 2007	Saturation Index lower pH	Saturation Index lower Eh
pH	--	7.53	6.85	7.53
Eh	--	23	23	-25
Charge Balance	--	-2.46	-2.45	-2.46
$Al(OH)_3$ (am)	$Al(OH)_3$	-0.94	-.051	-0.91
Barite	$BaSO_4$	0.64	.064	0.64
Calcite	$CaCO_3$	0.77	0.1	0.74
$CaMO_4$	$CaMO_4$	0.23	0.23	0.23
Cerrusite	$Pb(CO_3)$	-0.35	-0.65	-0.36
CO_2 gas	CO_2	-1.99	-1.3	-1.96
Ferrihydrite	$Fe(OH)_3$	-1.01	-3.05	-1.91
Gypsum	$CaSO_4 \bullet 2H_2O$	-0.18	-0.18	-0.18
Magnesite	$MgCO_3$	-0.06	-0.73	-0.09
Rhodochrosite	$MnCO_3$	0.85	0.17	0.82
Uraninite	UO_2	-1.7	0.26	0.01

[1] Positive values are oversaturated; negative values are undersaturated

The geochemical modeling results suggest that the trend of decreasing uranium and molybdenum concentrations in the flooded mine water are related decreasing Eh. The pH is circum-neutral and the flooded mine water is well buffered (394 mg/L alkalinity). With the exception of iron and manganese, the observed concentrations of trace metals in the flooded mine water have been stable over time.

10. MINE CLOSURE AND RECLAMATION

10.1 Mine Reclamation Plan

The Reclamation Plan for the Schwartzwalder Mine was prepared in 1977 and revised in 1983 (Cotter, 1983). The Reclamation Plan includes the following tasks:

- Removal of mine buildings and facilities, including concrete slabs;
- Recontouring and reclaiming the parking lot, including removal of surface depressions;
- Recontouring and revegetating the waste rock piles;
- Seeding and revegetation of roads;
- Sealing off access to the portal and flooded underground workings.

These activities are being performed under the approved mine reclamation plan.

10.2 Closure Activities Performed to Date

10.2.1 Mine Reclamation

Cotter has performed numerous closure and reclamation activities at the mine site over the last decade and a half. The ore sorter was dismantled and removed from site. Uranium-contaminated soils associated with a historic pond were removed. Waste rock piles were consolidated, recontoured, and revegetated. A summary of reclamation is provided in Table 46.

Table 46. Summary of Reclamation Activities

Reclamation Area	Area Description	Completion Status
DMG 01	Exhaust Borehole	95% Complete (1)
DMG 02	Upper / Schwartz Level	100% Complete
DMG 03	Minnesota Level	In Progress
DMG 04	CV / Charley / Intakes	In Progress
DMG 05	Surface Shop / #1 Warehouse	100% Complete
DMG 06	Core Shed / Guard Shack	100% Complete
DMG 07	Atlantic / Montana Adit	100% Complete
DMG 08	Main Office Area	100% Complete
DMG 09	Fuel Depot / Schwartz Adits	100% Complete
DMG 10	East Boneyard	100% Complete
DMG 11	West Boneyard	100% Complete
DMG 12	West Waste Dump	100% Complete
DMG 13	East Waste Dump	100% Complete
DMG 14	Barrow Pit	100% Complete
DMG 15	Mine Rescue Training Area	100% Complete
DMG 16	Roadways North of EBH	100% Complete
DMG 17	Trash Trenches / Roadways	100% Complete
General	Fill Material Borrow Area	In Progress
GV 01	Transfer Pad / Dozer Pad	100% Complete
GV 02	The Point and West Spur Rd.	100% Complete
GV 03	Service Entrance Rd.	100% Complete
GV 04	Lake Hill Rd.	100% Complete
GV 05	Old Road Bed Cleanup	100% Complete
GV 06	Open Space Trail / Lot#13	100% Complete.
RML 01	Ore Sorter Decommissioning	100% Complete
RML 02	Wastewater Plant Removal	In Progress
RML 03	Drying Trenches Cleanup	90% Complete (2)

Notes: DMG = Division of Minerals and Geology areas.
RML = Radioactive Materials License areas.
GV = Glencoe Valley areas (offsite)
(1) Needs monument set
(2) Needs backfilling

10.2.2 Technologies Research

Cotter has investigated several technologies and treatment strategies related to underground mine water. Although the most current information indicates that mine water will not discharge from the Steve Level Adit, two of the earlier technologies research projects focused on the treatment of mine water in the event of a discharge from the Stevel Level adit into Ralston Creek. These reports, by Shepard Miller and WRT, are summarized below.

Shepard Miller conducted pilot studies in 2001 and 2002 to test the feasibility of using in situ bioremediation for removal of uranium and molybdenum from the Schwartzwalder Mine refill water. Four 30-gallon reaction barrels (Barrels A, B, C, and D) were filled with 33.7 pounds of wall rock collected from the underground workings and crushed to +¼-mesh. The barrels were filled to 25 gallons (total volume) using a fully mixed aliquot of the approximately 300 gallons of groundwater that had been collected from the mine and stored in clean, 30-gallon plastic barrels. Additional amendments were then added to the following barrels:

- **Barrel A:** 136 ml of a mixture of sugars, short-chain organic acids and alcohol, plus phosphate (hence forth referrer to as nutrient solution) to provide a total organic carbon (TOC) loading of 100 mg/L.

- **Barrel B:** 310 ml of the nutrient solution to provide about 650 mg/L TOC
- **Barrels C:** 310 ml of nutrient mixture (~650 mg/L) plus a small inoculum (300 ml) of anoxic soil/sediment, with active anaerobic microbial communities.
- **Barrels D:** No added nutrients, this system served as a qualitative abiotic control.

Conductivity in Systems A through B rose sharply, when compared to the feed water, after the nutrient solution was added. Solution pH declines in Systems A through C upon the addition of nutrient solution as would be expected with the addition organic acids. The pH in these barrels began to rise after week 1 primarily as a result of alkalinity produced from anaerobic respiration. The Eh dropped from an initial +187 mV to and average of –206 mV by week 2 in systems to which nutrients were added, then rose again in these systems until week 4 to an average value of –64 mV after which it again declined to an average of –195 mV. Uranium levels in all systems dropped by week 2, with the greatest decreases seen in Systems A, B, and C, which dropped from an initial U concentration of 45 mg/L to 31, 33, and 35 mg/L respectively. At least part of the initial decline might be attributed to sorption of the uranyl ion to the walls of plastic barrels. After week 2 the uranium levels in all the systems with the exception of the feed water increased slightly, and from that point each of the test systems operated independently.

Overall the results from the pilot scale study designed to test the feasibility of using bioremediation as a means of removing uranium and molybdenum from Schwartzwalder Mine refill water were ambiguous.

WRT completed a pilot study designed to assess the effectiveness of a proprietary Z-92™ and Z-88® uranium and radium removal technology for radionuclide and metals removal from mine water. The pilot study was conducted over a 24 day period in July and August, 2007. The testing revealed satisfactory removal of uranium from the water to very high loading levels and to discharge levels below the discharge permit. However, the Z-92™ however was not effective at removal of other metal contaminants during the testing.

Ultimately, the hydrology of the refilling mine did not appear to warrant the application of the treatment technologies that were investigated. Since mine water is not currently discharging from the Steve Level Adit, and since hydrologic calculations indicate that such discharge is unlikely, modification of the Mine Closure and Reclamation Plan to include these treatment technologies was not warranted.

10.3 Closure and Mitigation Strategies

10.3.1 Waste Rock Piles

No additional closure strategies are recommended for the two waste rock piles, beyond those contained in the existing mine reclamation plan. Reclamation of the East and West waste rock piles was completed in the summer of 2003. Both waste rock piles were capped with 3 ft of rock cover, then topped with surface soils and vegetated using the seed mix specified by DMG (DRMG). By summer 2007, the vegetation was very well established.

As described in Section 9.1, the waste rock piles were designed to meet the stability requirements for a 100-year flood event. Portions of the pile have been in place for over 30 years, and chemical evaluations performed on the exposed waste rock indicate that the material is not acid generating, but instead is strongly neutralizing.

Water quality has been measured in Ralston Creek upstream and downstream of the waste rock piles for decades. The long-term sampling results indicate that the waste rock piles have little effect on the water quality in Ralston Creek. Average uranium concentrations increase by 0.0012 mg/L, which is only 0.13%

of the acute toxicity limit[24] and 0.21% of the chronic toxicity limit. No change in major ion chemistry or dissolved metals is evident, and the average TDS decreases slightly as Ralston Creek flows past the waste rock piles (Section 9.1).

10.3.2 Alluvium and Fill

The mine closure plan calls for regrading and reseeding of the alluvium and fill. Surface depressions will be filled, and the alluvium will be sloped and seeded to eliminate ponding and facilitate natural runoff. Areas of contamination in and above the fill have been excavated and removed, in accordance with the Mine Reclamation Plan. The remaining fill material is not slated for removal.

Both natural and anthropogenic sources of uranium and TDS loading to Ralston Creek have been identified (Section 6.4). The fill material is believed to be a diffuse (non-point) source of uranium and TDS loading, as described in Section 9.2. However, the effect of alluvium and fill on water quality in Ralston Creek can be difficult to differentiate from natural changes in water quality that occur at the creek passes the naturally mineralized zone. A conductivity survey in the creek or a resistivity survey in the alluvium could assist in determining areas of fill that may be contributing to TDS and metals loading in Ralston Creek. Such surveys are best performed during winter (low flow) conditions.

If a specific zone of chemical loading were identified in the fill, the reclamation strategy could include (1) engineered regrading to limit infiltration, (2) encapsulation through targeted grouting, or (3) targeted source removal. These strategies would not be cost effective, and could have severe unintended environmental consequences if applied to the entire fill area. It is likely that regrading to remove localized depressions will be adequate to reduce infiltration and chemical loading to Ralston Creek.

Regrading the alluvium and fill materials may also address the Sump 3 Seep that exists near MW9 and Sump 3, where water emanates from a low point in the fill.

10.3.3 Underground Mine

Closure of the Schwartzwalder Mine, according to the approved Mine Reclamation Plan (Cotter, 1983), involved limited removal of equipment, turning off the pumps and allowing the mine to flood, and sealing (or bulkheading) the portals and other access points to the underground mine. The pumps were turned off in May 2000, and the mine was allowed to flood.

The rates of water level rise in the underground mine have decreased over time. During the initial flooding of the 1,900 and 1,800 levels, the mine pool rose at an average rate of 5.7 feet per day. Flooding of the 1,700 through mid-1,000 levels slowed to an average rise of 2.4 feet per day. The rise of the mine pool slowed further to 0.66 feet per day from June 2001 to June 2003, 0.38 ft/day from September 2003 to October 2004, and 0.29 ft/day from October 2004 to July 2006. Most recently, the rate of rise slowed to 0.018 ft/day from September to October 2007.

The expected final water level was calculated iteratively using the Theim steady-state equation radial flow. The results indicate The calculation yields an overall bedrock permeability of 2.8×10^{-7} cm/sec and a final static water level of about 12 ft below the Steve Level (about 6,590 ft NAD 27). The calculation suggests that groundwater from deep bedrock will not discharge from the Steve Level adit, since the final static water level will be about 12 ft below the adit.

The chemistry of underground mine water has been monitored since the start of flooding. The pH of groundwater in the flooded mine has remained relatively stable through time, fluctuating near 7 with no distinct trend toward acidification or increasing pH. Redox conditions initially fluctuated between 100 and

[24] Acute toxicity limit is 1.80 mg/L uranium and chronic toxicity limit is 1.125 mg/L uranium based on an average hardness of 77 mg/L for Stations SW-AWD and SW-A001.

300 mV Eh, and decreased to around 25 in 2007. The trend of decreasing Eh may have occurred because the groundwater flowing in from bedrock is no longer exposed to oxygen in the mine voids, and the lower Eh is more representative of background conditions in bedrock.

Water in the underground mine is a calcium-magnesium-sodium type water, with near-neutral pH and high levels of dissolved solids (3,300 mg/L). Water quality changed rapidly during initial filling, and has been relatively stable for the past 4 years (Section 7.6.3). After an initial rapid increase during the first two months of flooding, TDS concentrations have been stable to slightly rising to the current level of 3,300 mg/L. Bicarbonate alkalinity has increased slowly since May 2001, with concentrations increasing from about 410 to 482 mg $CaCO_3$/L. Similarly, Sulfate concentrations have been slowly increasing from about 1,900 mg/l in May 20003 to 2,020 mg/L in 2007. Calcium and magnesium concentrations increased rapidly during the early flooding of the mine, then increased at much slower rates to about 400 mg/L and 250 mg/L, respectively, by June 2007. Sodium and chloride concentrations have had weak decreasing trends since 2003.

The geochemical modeling suggest that the observed trends of decreasing uranium and molybdenum concentrations in the flooded mine water are related to declining Eh. The pH is circum-neutral and the flooded mine water is well buffered (394 mg/L alkalinity). With the exception of iron and manganese, the observed concentrations of trace metals in the flooded mine water have been stable over time.

Trace metals concentrations have also been fairly stable in the flooded mine water, with the exception of manganese (which has increased from 1 to about 5.59 mg/L over time). Dissolved iron concentrations have been stable at a very low level during flooding. Total iron has shown elevated concentrations (3.42 mg/L maximum) since January 2003. Molybdenum concentrations increased from about 1 mg/L at the start of mine flooding to a peak of about 2.6 mg/L in mid-2001. Since 2001, molybdenum concentrations have been steadily decreasing to near 1.6 mg/l in 2007. Uranium concentrations increased from about 4 mg/L at the start of mine flooding to a peak of about 59.5 mg/L in October 2002. Since October 3003, uranium concentrations have been steadily decreasing to near 45 mg/l by 2007.

Hydrologic calculations indicate that water from the underground mine will not discharge at the surface. However, bulkheading the Steve and Pierce Adits is a prudent mitigative strategy for the underground mine, to prevent potential exposure to enriched mine water. Plugging and abandonment of old coreholes drilled from at or near creek level into the deposit is also recommended, although locating such coreholes can be difficult.

11. CONCLUSIONS

The Schwartzwalder underground uranium mine was operated by Cotter Corporation from 1966 to May 2000, when the mine was shut down and allowed to flood.

Groundwater inflows to the Schwartzwalder Mine during operations were very low, considering the depth and extent of excavation. At its fullest extent, with pegmatite coreholes plugged, inflow to the 2,200-ft deep mine averaged 190 gpm. The low permeability of the surrounding rock mass limited groundwater flow into the mine during operations, and now limits flow through the flooded mine.

Water levels in the mine have risen from 2,200 feet to about 26 feet below the Steve Level in 7 ½ years, and are predicted to reach a maximum elevation of about 12 feet below the Steve Level portal after April 2009. Mine water is not predicted to discharge from the Steve Level portal into Ralston Creek. The chemistry of groundwater in the flooded mine increased during initial flooding, but has been relatively stable since 2003 in response to chemical equilibrium with calcite and gypsum. Underground mine water has near-neutral pH and high levels of dissolved solids (3,300 mg/L). Uranium concentrations increased from about 4 mg/L at the start of mine flooding to a peak of about 59.5 mg/L in October 2002. Since October 3003, uranium concentrations have been steadily decreasing to near 45 mg/l by 2007. Although

this water is not predicted to discharge from the portal, bulkheading the Steve Portal and Pierce Adit is a prudent mitigation option.

Water quality data and geochemical modeling results point to a potential trend of decreasing uranium and molybdenum concentrations in the flooded mine water as Eh declines. The pH is circum-neutral and the flooded mine water is well buffered (394 mg/L alkalinity). With the exception of iron and manganese, the observed concentrations of trace metals in the flooded mine water are low and have been stable over time

The waste rocks dumps have had no discernable effect on water quality in Ralston Creek. Water quality at stations upgradient and downgradient of the reclaimed waste rock dumps shows negligible increases in uranium, and slight decreases in TDS.

The alluvium and fill have affected water quality in Ralston. However, uranium concentrations in alluvial monitoring wells and in Ralston Creek have generally been declining since the initial flush following the shutdown of the pumpback sumps in 2002. Further, uranium concentrations in the creek have not exceeded the applicable aquatic toxicity standards. Localized zones of fill have been remediated by source removal in the areas of the former Ore Sorter and the former Emergency Storage Pond. Regrading of the alluvium and fill in accordance with the Mine Reclamation Plan will provide drainage and infiltration control that may further reduce loading. If necessary, additional mitigation options include localized source removal, or localized encapsulation. If employed, such mitigation measures should be staged to produce as little disturbance as possible.

November 16, 2007
Prepared and submitted by:

Whetstone Associates, Inc.

Susan Wyman, P.E., P.G.
Principal Hydrologist / Civil Engineer

Scott Effner, P.G.
Principal Hydrogeologist / Geochemist

12. REFERENCES

CDHPE, 2001a. Colorado Department of Public Health And Environment, Water Quality Control Commission, Regulation No. 31, The Basic Standards And Methodologies For Surface Water, (5 CCR 1002-31), Effective October 30, 2001. 169 pp.

CDHPE, 2001b. Colorado Department of Public Health And Environment, Water Quality Control Commission, Regulation No. 41, The Basic Standards For Groundwater, Amended December 30, 2001. 65 pp.

CDHPE, 2002, Colorado Department Of Health, Water Quality Control Commission, Regulation No. 38, Classifications And Numeric Standards South Platte River Basin, Laramie River Basin, Republican River Basin, Smoky Hill River Basin, effective January 30, 2002. 60 pp.

CDHPE, 2004. Colorado Department of Public Health And Environment, Water Quality Control Commission, Regulation No. 42, Site-Specific Water Quality Classifications And Standards For Groundwater, Amended February 2, 2004. 137 pp.

Chlumsky, 1986. Preliminary Results of Leach Investigation on Schwartzwalder Mine Ore Sorter Reject, letter from Gregory F. Chlumsky, CSMRI (Colorado School of Mines Research Institute) to Steve Taylor, Cotter Corporation, May 19, 1986.

Cotter Corporation, 1983. Mine Reclamation Plan, Exhibit E to the Plan of Operations.

Cotter Corporation, 2000. Electronic transmittal: Spreadsheet files and description of mine inflow rates, 1973 – 2000.

Freeze, R. and Cherry, J., 1979. Groundwater, p. 61, Published by Prentice Hall.

Geo-Hydro Consulting, Inc., 1982. Geotechnical and Hydrological Study for the Proposed Water Treatment System, Cotter Corporation Schwartzwalder Mine, Golden Colorado, Job number 1030-001, January 1982.

Hem, John D., 1985. Study and Interpretation of the Chemical Characteristics of Natural Water, Third Edition, U.S. Geological Survey Water Supply Paper 2254. 263 pp.

HydroGeoLogic, Inc., 1999. MINTEQA2/PRODEFA2, A Geochemical Assessment Model for Environmental Systems: User Manual Supplement for Version 4.0. Prepared for U.S. EPA.

Lindsay, W.L., 1979. Chemical Equilibria in Soils. John Wiley and Sons New York

McDermid Engineering Associates, Inc. and Geo-Hydro Consulting, Inc., 1983a. Schwartzwalder Mine Waste Rock Pile Stability, February, 1983.

McDermid Engineering Associates, Inc. and Geo-Hydro Consulting, Inc., 1983b. Responses to State of Colorado Mined Land Reclamation Division Comments on Waste Pile Related Portions of Permit Amendment Application, July, 1983.

Meima, J.A. and Comans R.J., 1999. The Leaching of Trace Elements from Municipal Solid Waste Incinerator Bottom Ash at Different Stages of Weathering. Applied Geochemistry, 14, p. 159-171.

Otto, R.G., and Associates (1984). Effects of Runoff or Seepage from the Schwartzwalder Mine Waste Rock Piles on the Water Quality of Ralston Creek, Jefferson County, Colorado, prepared for Cotter Corporation, December 1984.

Parkhurst, D.L. and Appelo C.J., 2001. Users Guide to PHREEQCi (Version 2.8) – A Computer Program for Speciation, Batch-Reaction, One-Dimensional Transport, and Inverse Geochemical Calculations.

Rose, A., Hawkes, H., and Webb, J., 1979. Geochemistry in Mineral Exploration, Published by Academic Press, Orlando Florida.

Shepherd Miller, Inc. 1999. Revised Schwartzwalder Mine Surface Hydrology Study, prepared for Cotter Corporation, November 19, 1999. 24 pp plus attachments.

Sheridan, Douglas M., Maxwell, Charles H., and Albee, Arden L., 1967. Geology and Uranium Deposits of the Ralston Buttes District, Jefferson County, Colorado, U.S. Geological Survey Professional Paper 520, 121 pp plus plates.

Singh R.N., and Atkins, A.S., 1984. Application of Analytical Solutions to Simulate Some Mine Inflow Problems in Underground Coal Mining, International Journal of Mine Water, vol 3(4), pp. 1-27.

Theim, G., 1906. *Hydrologische methode*. Leipzip, Gebhardt, 56 pp.

Wallace, Alan R., 1983. Analytical Data from Host Rocks and Ores, Schwartzwalder Uranium Deposit, Front Range, Colorado, United States Department of Interior, Geological Survey, Open-File Report 83-364.

Yang, I.C., and Edwards, K.W., 1984. Releases of Radium and Uranium into Ralston Creek and Reservoir, Colorado, from Uranium Mining, in Geochemical Behavior of Radioactive Waste, pp. 271-285.