GJO−2003−490−TAC
GJO−GWSHP 13.2

UMTRA Ground Water Project

Semiannual Performance Report February 2003 through August 2003 for the Shiprock, New Mexico, UMTRA Project Site

September 2003

Prepared by
U.S. Department of Energy
Grand Junction Office
Grand Junction, Colorado

Work Performed Under DOE Contract Number DE−AC13−02GJ79491

This page intentionally left blank

Contents

Figures

Tables

Appendixes

1.0 Introduction

This report evaluates the performance of the ground water remediation system at the Uranium Mill Tailings Remedial Action (UMTRA) Project site in Shiprock, New Mexico, for the period of February 2003 through August 2003. This evaluation is based upon comparison of the site conditions in August 2003 to the baseline site conditions presented in the Shiprock Baseline Performance Report (DOE 2003). The baseline conditions were established using data collected primarily from March 2003. A detailed description of the site conditions is presented in the Site Observational Work Plan (SOWP) (DOE 2000), and the compliance strategy is presented in the Ground Water Compliance Action Plan (GCAP) (DOE 2002).

The Shiprock site is divided into two distinct areas, the floodplain and the terrace. An escarpment forms the boundary between the two areas. The terrace is further divided into terrace west and terrace east. Initially the remediation system (Figure 1) consisted of two floodplain ground water extraction wells, four terrace east ground water extraction wells, two interceptor drains (one installed in Bob Lee Wash and the other installed in Many Devils Wash), a lined evaporation pond, and a terrace drainage channel diversion structure. The terrace ground water extraction wells and interceptor drains became operational in late February 2003, and the floodplain extraction wells became operational in March 2003. Four additional extraction wells were installed on the terrace east portion of the site in July 2003; they were piped into the remediation system in early August 2003 in an attempt to increase the volume of ground water removed from the terrace.

1.1 Remediation System Performance Standards

This performance assessment is based on the analysis of water quality and water level data obtained from site monitoring wells in addition to ground water flow rates associated with the drains and seeps. Specific performance standards as established for the Shiprock floodplain ground water remediation system in the Baseline Performance Report (DOE 2003) are summarized as follows:

- Ground water flow directions in the vicinity of the extraction wells should be toward the extraction wells.
- Pumping on the floodplain should intercept contaminants of concern (COCs) that would otherwise discharge to the San Juan River.

Specific performance standards as established for the Shiprock terrace ground water remediation system in the Baseline Performance Report (DOE 2003) are summarized as follows:

- Terrace ground water surface elevations should decrease as water is removed from the terrace system.
- Ground water flow directions in the vicinity of the extraction wells should be toward the extraction wells.
- The volume of water discharging to the interceptor drains located in Bob Lee and Many Devils Washes should decrease over time as ground water levels on the terrace decline.

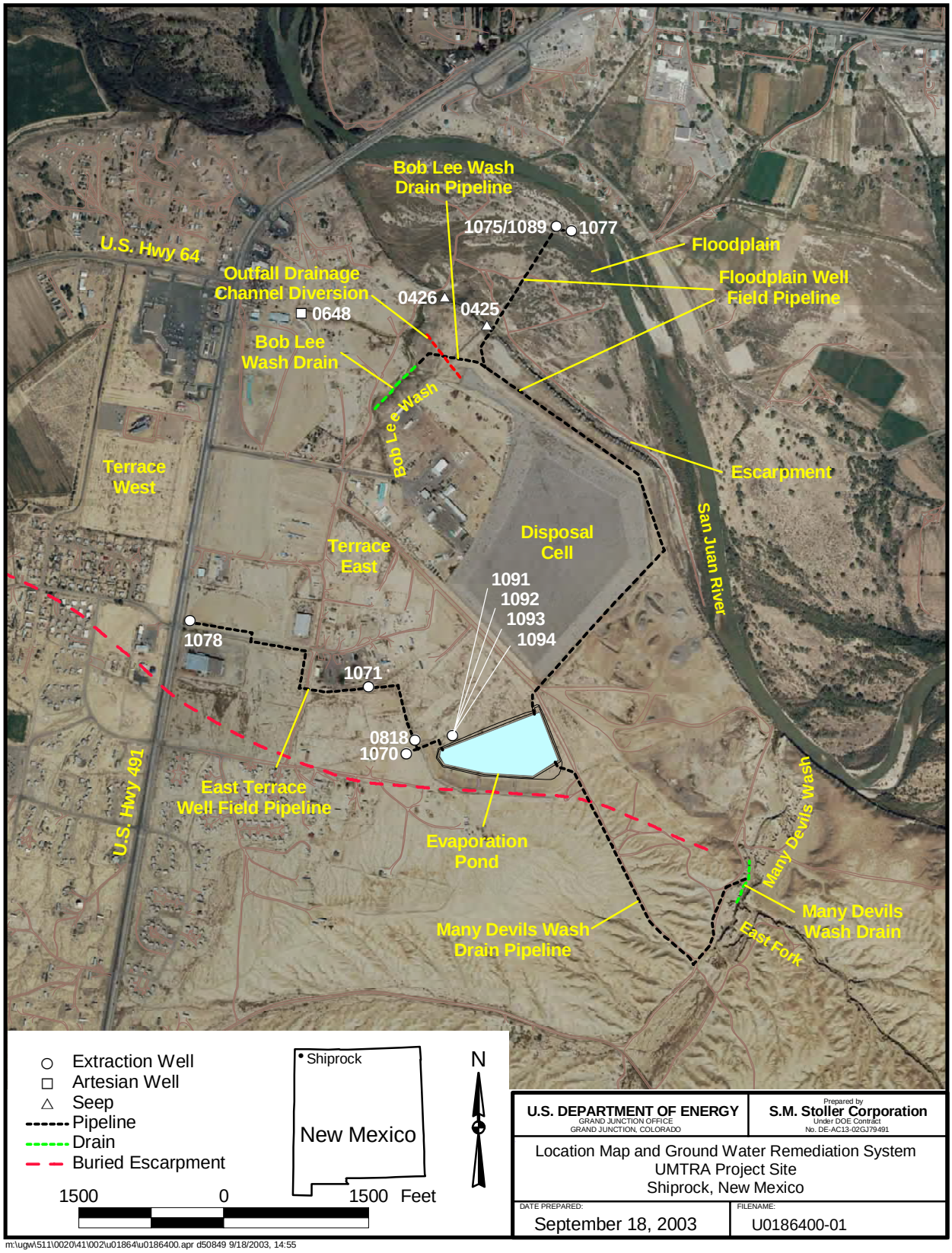


Figure 1. Location Map

- The flow rates of seeps located at the escarpment face (locations 0425 and 0426) should decrease over time as ground water levels on the terrace decline.

1.2 Contaminants of Concern and Remediation Goals

Ground water at the site is contaminated as a result of uranium milling activities between 1954 and 1968. The COCs for both the floodplain and terrace are ammonium, manganese, nitrate, selenium, strontium, sulfate, and uranium. Compliance standards for uranium and nitrate are their respective UMTRA standards of 0.044 and 44 milligrams per liter (mg/L). The cleanup objective for manganese is the maximum background concentration for the floodplain, which is currently 2.74 mg/L.

For sulfate, a secondary standard of 250 mg/L exists under the Safe Drinking Water Act. However, studies conducted by the Centers for Disease Control in conjunction with the U.S. Environmental Protection Agency (EPA) have shown that no adverse effects from sulfate ingestion occur at concentrations of up to 1,200 mg/L (EPA 1999). The report notes that other studies have shown that concentrations of sulfate exceeding 2,000 mg/L may have little to no adverse effect on humans and animals. Because of the presence of high background sulfate concentrations at the site in the floodplain (up to 1,920 mg/L) and the high sulfate concentration of water entering the floodplain from flowing artesian well 0648 (up to 2,340 mg/L), the proposed cleanup goal for floodplain sulfate is 2,000 mg/L.

Relatively high selenium concentrations in the floodplain make it unlikely that the UMTRA standard of 0.01 mg/L for this constituent can be met. An alternate concentration limit (ACL) is proposed for selenium of 0.05 mg/L, which is the maximum contaminant level established by EPA.

There are no cleanup standards or background concentrations established for ammonium and strontium.

1.3 Hydrogeological Setting

Sections 1.3.1 and 1.3.2 provide a summary of the floodplain and terrace ground water systems, respectively. A more detailed description is provided in the SOWP (DOE 2000).

1.3.1 Floodplain Ground Water System

The thick Mancos Shale of Cretaceous age forms the bedrock underlying the entire site. Floodplain ground water (floodplain alluvial aquifer) occurs in unconsolidated medium- to coarse-grained sand, gravel, and cobbles that were deposited in former channels of the San Juan River above the Mancos Shale. The floodplain aquifer is hydraulically connected to the San Juan River; the river contributes water to the floodplain in some areas, and receives ground water discharge in others. The floodplain aquifer also receives inflow from an artificial ground water system in the terrace area created during milling activities. The floodplain alluvium is up to 20 feet (ft) thick and overlies Mancos Shale, which is typically soft and weathered for the first several feet below the alluvium.

Most ground water contamination in the floodplain lies close to the escarpment east and north of the disposal cell. A plume extends northward from this contaminated area in an arc-shape as it

crosses the floodplain and reaches the San Juan River near the two floodplain extraction wells (1075/1089 and 1077, Figure 1). This plume configuration is best characterized by elevated concentrations of sulfate and uranium. Contamination does not occur along the escarpment base in the northwest part of the floodplain because relatively uncontaminated surface water from Bob Lee Wash discharges into the floodplain, recharging local ground water and then flowing to the north and west. Water that enters the floodplain from Bob Lee Wash consists mainly of deep nonpotable ground water from flowing (65 gallons per minute) artesian well 0648 that drains eastward into lower Bob Lee Wash. Background ground water quality in the floodplain aquifer has been defined by monitor wells installed in the floodplain about 1 mile upriver from the site.

1.3.2 Terrace Ground Water System

The terrace ground water system occurs partly in unconsolidated alluvium in the form of medium- to coarse-grained sand, gravel, and cobbles deposited in the floodplain of the ancestral San Juan River. Terrace alluvial material is Quaternary in age, typically 10 to 20 ft thick, and caps the Mancos Shale. Though less well mapped, some terrace ground water also occurs in weathered Mancos Shale underlying the alluvium. The Mancos Shale is exposed in the escarpment overlooking the present floodplain.

The terrace alluvial aquifer extends southwestward from the escarpment separating the terrace from the floodplain for up to 1 mile where it is abruptly bounded by a buried escarpment. Terrace alluvial material is exposed at the terrace/floodplain escarpment, but southwestward from there it is covered by an increasing thickness of silt, which was deposited by wind as loess. At the southwest edge of the terrace aquifer, along the base of the buried escarpment, up to 40 ft of loess overlies the alluvium. The alluvium in this latter area consists of coarse, ancestral San Juan River deposits.

Mancos Shale in the terrace area is weathered (fractured and soft) for up to several feet below its contact with alluvium. Ground water is known to occur in the weathered shale, and may flow through deeper portions of the shale that might be fractured.

2.0 Subsurface Conditions

This section summarizes hydraulic and water quality characteristics of the floodplain and terrace ground water systems in August 2003, approximately 6 months after startup of the treatment system. The response of the floodplain is evaluated in Section 2.1, and the terrace response is evaluated in Section 2.2.

2.1 Floodplain Subsurface Conditions

Metrics provided in the Baseline Performance Report (DOE 2003) and presented in Section 1.1 regarding the floodplain are designed to evaluate the effectiveness of the floodplain treatment system. An analysis of the horizontal hydraulic gradients and contaminant distributions in the floodplain are discussed in Sections 2.1.1 and 2.1.2, respectively.

2.1.1 Horizontal Hydraulic Gradients

The Baseline Performance Report contains a map of horizontal hydraulic gradients in the floodplain as determined from three-point analyses of March 2003 water level data. This figure, which represents conditions prior to the start-up of the floodplain extraction wells, is presented as Figure A−2 in Appendix A of this report. Figure A−3 (Appendix A) presents comparable horizontal gradients developed from a three-point analysis of water level data collected in August 2003.

Comparison of the two maps shows that the ground water flow direction in the vicinity of wells 0615, 0618, and 0619 have changed from the northeast to northwest (i.e., toward the extraction wells) between March 2003 and August 2003. This change in flow direction is likely attributed to the pumping of the floodplain extraction wells.

Appendix B contains graphs of floodplain ground water elevation fluctuations between January and August 2003 collected using data loggers installed in wells 0617, 0736, 0854, 0857, and 1008. With the exception of well 0617, each well is located approximately the same distance from the river (approximately 200 ft). This data may be used in subsequent reports to evaluate the performance of the floodplain extraction wells.

2.1.2 Contaminant Distributions

Ground water samples were collected from selected floodplain wells in August 2003. The resulting COC concentrations were compared to baseline concentrations measured in March 2003 during the last sampling effort prior to full operation of the treatment system. Table 1 lists both floodplain baseline and August 2003 concentrations for the COCs.

The data show that the majority of the contaminant concentrations have not significantly changed compared to the baseline concentrations. Of the wells that have changed significantly, it is believed that the concentration variations may be attributed to other factors (i.e., seasonal fluctuations) as opposed to ground water extraction.

Figure 2 through Figure 8 illustrate the spatial distribution of concentrations measured in August 2003 for ammonium, manganese, nitrate, selenium, strontium, sulfate, and uranium, respectively.

As previously mentioned, the site conceptual model suggests that pumping from the floodplain will not strongly affect COC concentrations. Consequently, concentrations measured in August 2003 were not expected to be significantly different from baseline concentrations. As a result, contouring of contaminant levels in August 2003 did not seem warranted at this time. Future performance reports may include contoured contaminant plume maps as pumping from the floodplain continues.

2.2 Terrace System

Metrics provided in the Baseline Performance Report (DOE 2003) and presented in Section 1.1 for the terrace are designed to evaluate the effectiveness of the terrace treatment system. Analyses of horizontal hydraulic gradients, water level trends, drain flow rates, and seep flow rates associated with the terrace are discussed in Sections 2.2.1, 2.2.2, 2.2.3, and 2.2.4, respectively.

Table 1. August 2003 COC Concentration Comparison to Baseline Data

Well	Ammonium			Manganese			Nitrate			Selenium			Strontium			Sulfate			Uranium		
	Baseline Concentration (mg/L)	August 2003 Concentration (mg/L)	Difference (%)	Baseline Concentration (mg/L)	August 2003 Concentration (mg/L)	Difference (%)	Baseline Concentration (mg/L)	August 2003 Concentration (mg/L)	Difference (%)	Baseline Concentration (mg/L)	August 2003 Concentration (mg/L)	Difference (%)	Baseline Concentration (mg/L)	August 2003 Concentration (mg/L)	Difference (%)	Baseline Concentration (mg/L)	August 2003 Concentration (mg/L)	Difference (%)	Baseline Concentration (mg/L)	August 2003 Concentration (mg/L)	Difference (%)
0608	389	391	0.5	7.8	6.98	-10.5	2,320	2,280	-1.7	0.0065	0.007	7.7	10.7	11.3	5.6	10,500	10,600	1.0	1.78	1.75	-1.7
0614	50.5	52.4	3.8	6.01	5.71	-5.0	4,240	3,920	-7.5	0.291	0.146	-49.8	13.1	12.2	-6.9	14,400	13,300	-7.6	2.43	2.2	-9.5
0615	51	36.6	-28.2	5.56	7.74	39.2	4,160	5,120	23.1	1.16	1.27	9.5	14.4	17	18.1	19,900	23,100	16.1	3.78	4.23	11.9
0618	776	76.4	-90.2	11.3	10.5	-7.1	1,230	999	-18.8	0.352	0.303	-13.9	11.2	10.6	-5.4	13,300	14,100	6.0	3.12	3.21	2.9
0619	2.9	0.012	-99.6	3.13	4.64	48.2	21.9	3.96	-81.9	0.213	0.158	-25.8	7.32	8.17	11.6	6,280	9,510	51.4	0.48	0.764	59.2
0734	0.004	dry	na	0.656	dry	na	7.43	dry	na	0.0086	dry	na	6.63	dry	na	4,940	dry	na	0.0735	dry	na
0735	14.8	15.3	3.4	3.47	1.51	-56.5	2,010	1,080	-46.3	0.159	0.057	-64.2	9.3	4.17	-55.2	6,980	3,700	-47.0	0.24	0.095	-60.4
0736	0.0921	dry	na	1.54	dry	na	0.0831	dry	na	0.0007	dry	na	6.79	dry	na	3,480	dry	na	0.146	dry	na
1008	28.6	20	-30.1	6.61	5.96	-9.8	172	354	105.8	0.169	0.124	-26.6	10.2	12.3	20.6	13,900	18,200	30.9	2.05	2.58	25.9

Notes: No ground water was present in wells 0734 and 0735 during the August 2003 sampling event.
na = not applicable

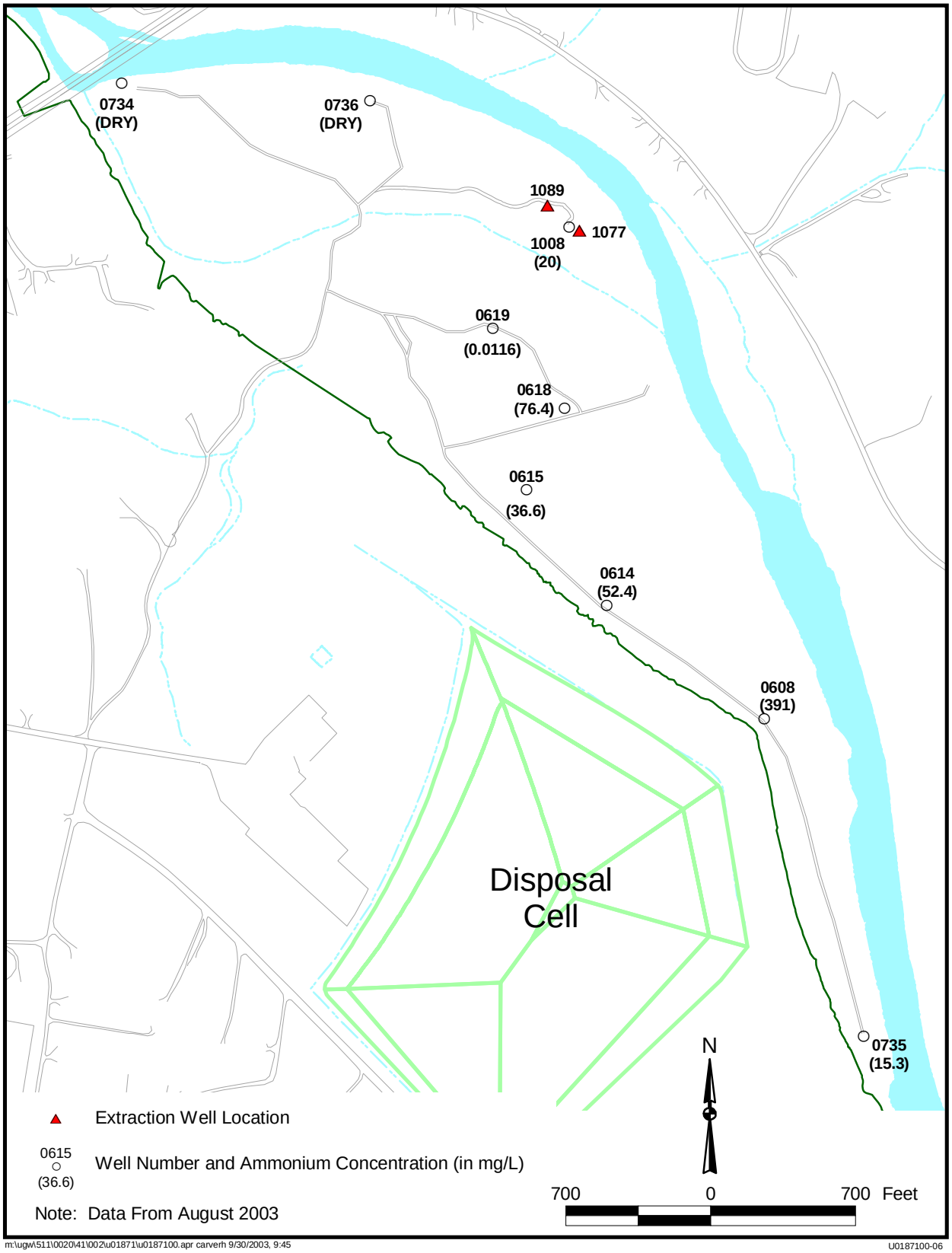


Figure 2. Floodplain Ammonium Ground Water Concentrations

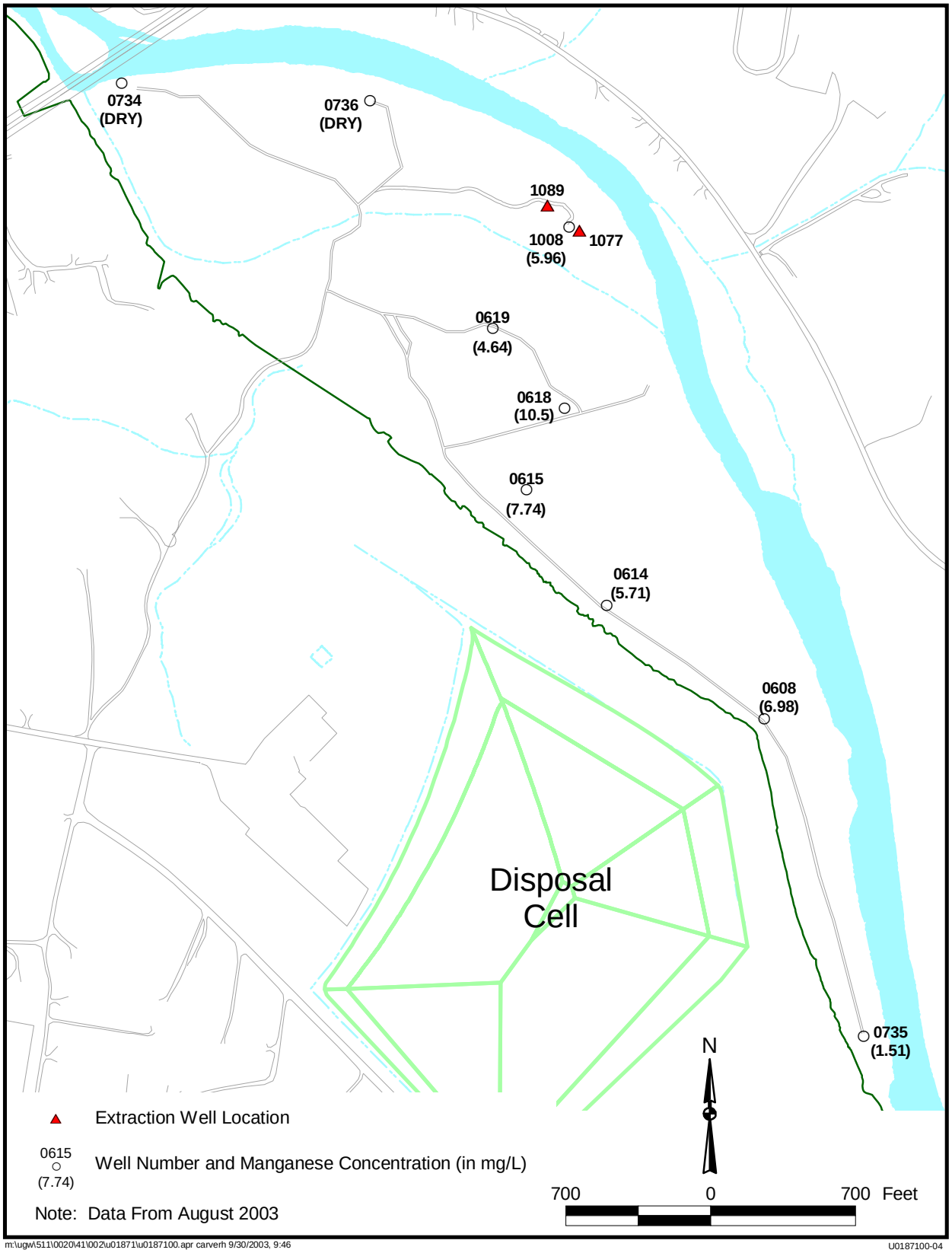


Figure 3. Floodplain Manganese Ground Water Concentrations

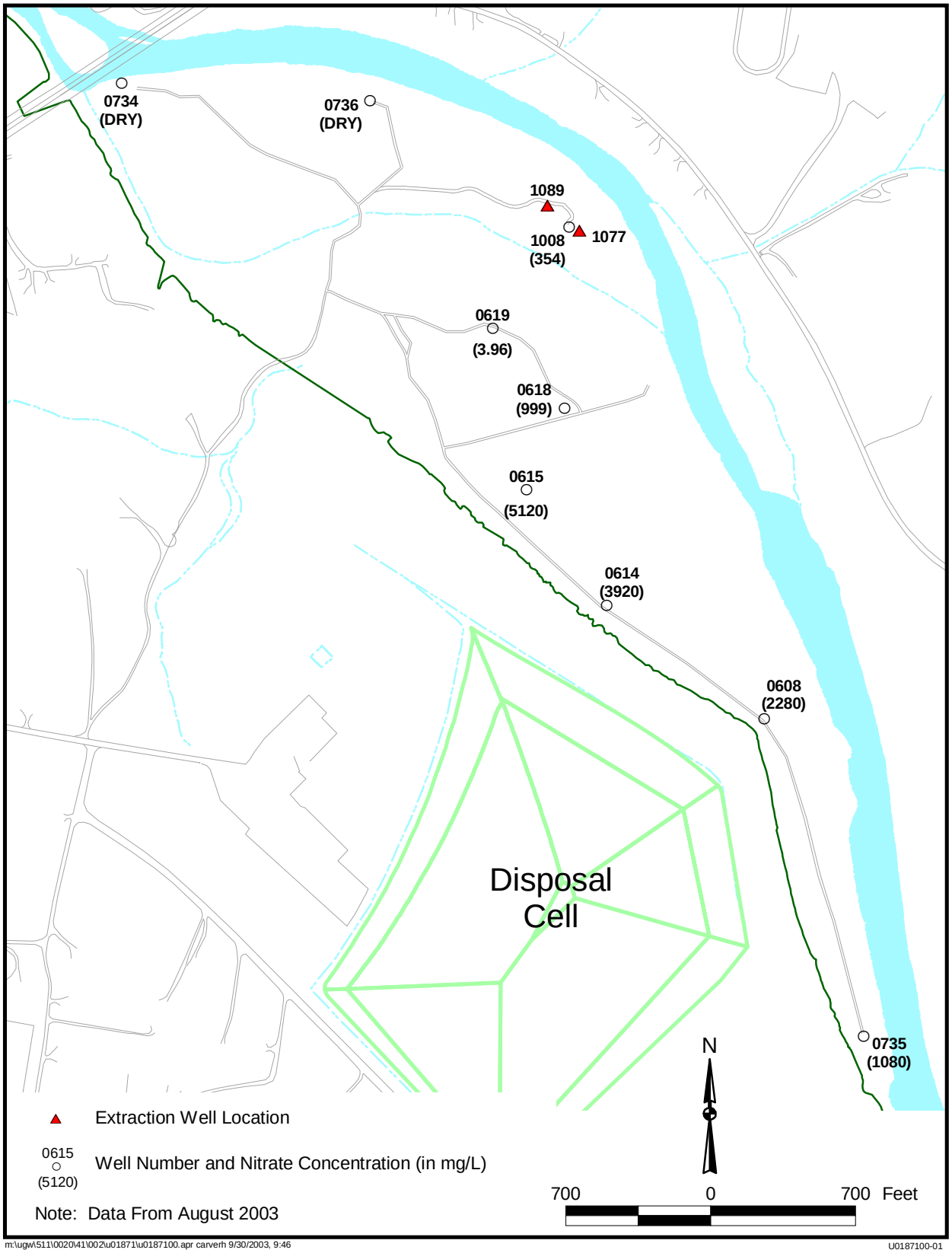


Figure 4. Floodplain Nitrate Ground Water Concentrations

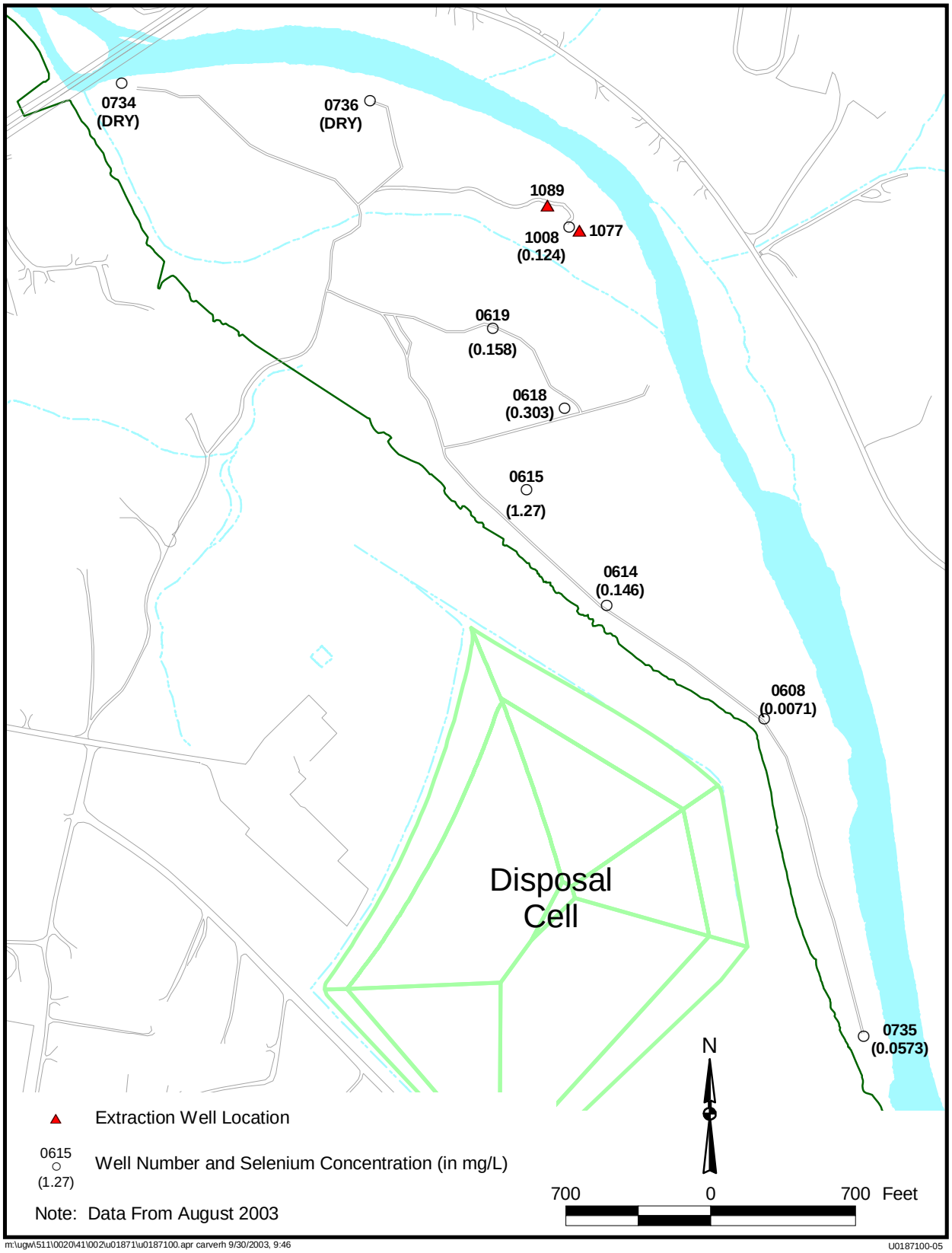


Figure 5. Floodplain Selenium Ground Water Concentrations

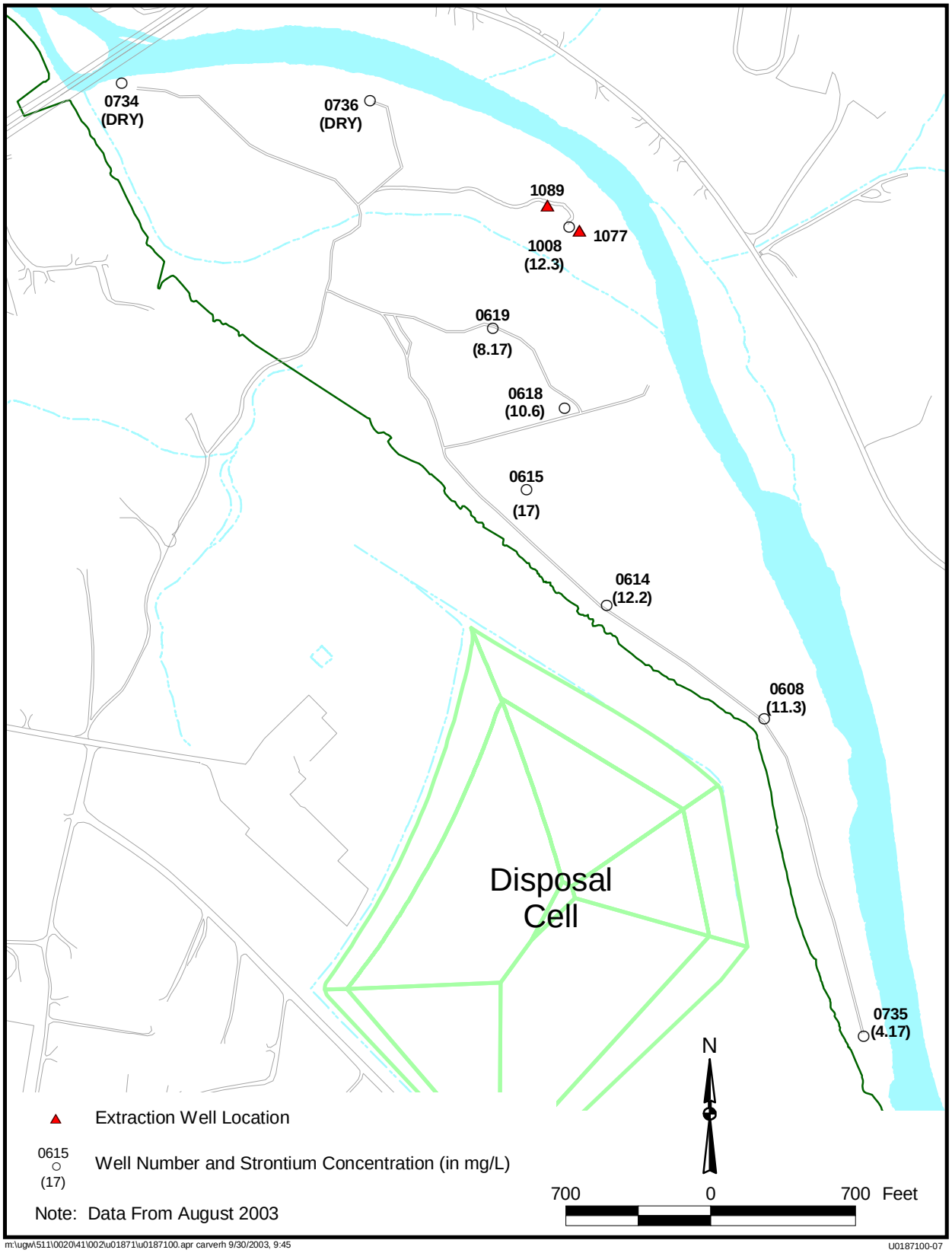


Figure 6. Floodplain Strontium Ground Water Concentrations

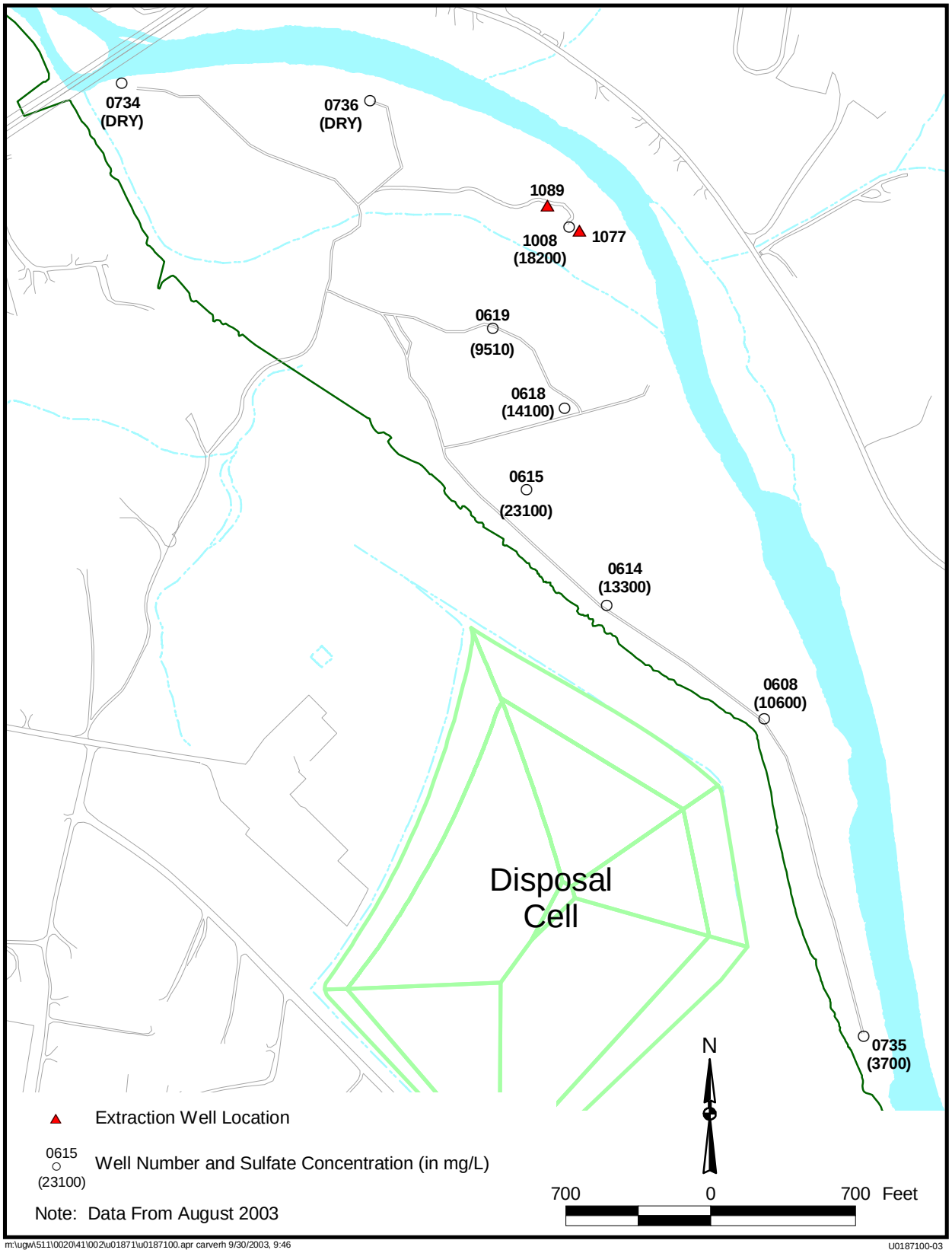


Figure 7. Floodplain Sulfate Ground Water Concentrations

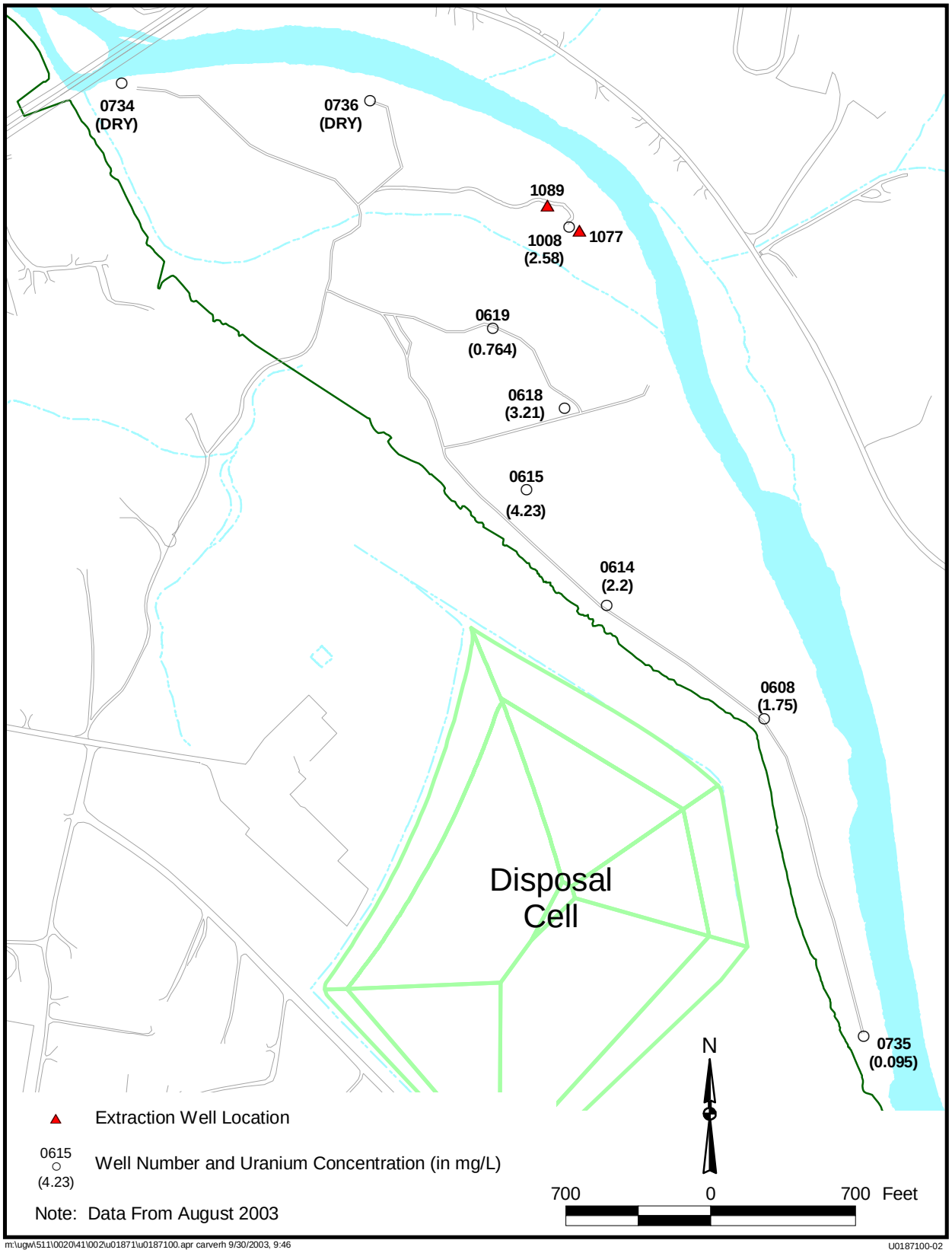


Figure 8. Floodplain Uranium Ground Water Concentrations

2.2.1 Horizontal Hydraulic Gradients

The Baseline Performance Report contains a map of horizontal hydraulic gradients in the terrace as determined from three-point analyses of March 2003 water level data. This figure, which represents the baseline condition prior to the start-up of the terrace extraction wells, is presented as Figure A−5 of Appendix A in this report. Figure A−6 (Appendix A) presents comparable horizontal gradients developed from three-point analysis of the water level data collected in August 2003.

Comparison of the two gradient maps shows that the flow directions during the two periods are generally the same, except in the vicinity of the terrace extraction wells. The ground water flow direction in the vicinity of well 0604 (which is located near extraction well 0818) has shifted from the northwest in March 2003 to the southeast in August 2003.

2.2.2 Water Level Trends

The August 2003 water level data were compared to terrace baseline ground water elevations presented in Table 1 of the Baseline Performance Report (DOE 2003). Table 2 summarizes the resulting changes in ground water levels and Figure 9 presents a map view of ground water elevation increases and decreases. In general, the ground water elevation appears to be decreasing in the vicinity of the terrace extraction wells and increasing in the terrace west area.

Water levels have also been monitored using pressure transducers that had been installed in selected wells on the terrace prior to treatment system startup. Appendix B contains plots of pressure transducer results in terrace east wells 0602, 0604, 0730, 0731, 0803, 0819, 0826, 0827, and 0830 and in terrace west wells 0835, 0836, 0837, 0841, 0843, 0846, and 1060. These graphs indicate that water levels in the terrace east area are generally declining, and water levels in much of the terrace west area fluctuate in response to irrigation practices in that area.

2.2.3 Drain Flow Rates

As discussed in the Baseline Performance Report, the flow rate of the pump removing water from the drains installed in Bob Lee and Many Devils Washes was expected to decrease as ground water levels in the terrace decline. The flow rate data collected over the first 6 months of drain collection (i.e., March through August 2003) indicate the pump in Bob Lee Wash initially was pumping approximately 7 gallons per minute (gpm), and that the water pump could not keep up with the water flowing into the drain. During May 2003, ponded water was no longer on the surface, indicating the pump at that time was removing water from the system as fast as the system recharged the drain. Over the 6-month evaluation period (March to August 2003), the flow rate decreased at a relatively constant rate. At the end of August 2003, approximately 3 gpm was being pumped from the drain.

The pump at the Many Devils Wash drain removed water at an average rate of about 0.14 gpm between March and August 2003.

Table 2. Comparison of Terrace August 2003 Water Level Data to Baseline Conditions

Well	Zone of Completion	Baseline Ground Water Elevation (ft msl)	Date of Baseline Measurement	August 2003 Ground Water Elevation (ft msl)	Difference in Elevation[a] (ft)
0727	Mancos	4,933.89	3/5/03	4,933.60	-0.29
0728*	Alluvium / Mancos	4,940.25	3/4/03	4,939.99	-0.26
0730	Alluvium / Mancos	4,946.26	3/5/03	4,945.60	-0.66
0812*	Alluvium / Mancos	4,944.62	3/5/03	4,944.59	-0.03
0813*	Alluvium / Mancos	4,941.03	3/4/03	4,940.99	-0.04
0814*	Alluvium / Mancos	4,936.27	3/5/03	4,936.12	-0.15
0815*	Alluvium / Mancos	4,927.78	3/4/03	4,927.77	-0.01
0817*	Mancos	4,938.68	3/4/03	4,938.40	-0.28
0819*	Mancos	4,935.68	3/4/03	4,935.63	-0.05
0826*	Alluvium / Mancos	4,933.02	3/4/03	4,933.23	0.21
0827	Alluvium / Mancos	4,920.12	3/5/03	4,920.21	0.09
0828*	Alluvium / Mancos	4,934.83	3/4/03	4,934.59	-0.24
0832*	Alluvium / Mancos	4,936.26	3/4/03	4,936.47	0.21
0835*	Alluvium	4,911.10	3/5/03	4,910.27	-0.83
0836*	Alluvium	4,878.25	3/4/03	4,879.13	0.88
0838*	Alluvium	4,911.73	3/4/03	4,911.20	-0.53
0839*	Alluvium / Mancos	4,917.32	3/5/03	4,916.98	-0.34
0841*	Alluvium	4,939.06	3/4/03	4,939.00	-0.06
0846*	Alluvium / Mancos	4,910.93	3/4/03	4,912.02	1.09
1007*	Alluvium / Mancos	4,917.91	3/3/03	4,917.43	-0.48
1057*	Alluvium	4,948.32	3/5/03	4,948.35	0.03
1059*	Mancos	4,947.64	3/4/03	4,947.60	-0.04
1060*	Alluvium / Mancos	4,932.64	3/4/03	4,935.94	3.30
1067*	Alluvium / Mancos	dry	3/5/03	dry	na
1068*	Alluvium / Mancos	4,920.71	3/5/03	4,920.49	-0.22
1069*	Alluvium / Mancos	4,920.15	3/5/03	dry	na
1073	Alluvium	4,941.99	9/17/02	4,941.52	-0.47
1079*	Alluvium	4,909.89	3/4/03	4,910.56	0.67

[a]August 2003 Water Level – Baseline Water Level
Notes: na = not applicable, water level not measured
* = designates a well included in the long-term monitoring plan

2.2.4 Seep Flow Rates

Rates of ground water discharge at seeps 0425 and 0426 were also measured in August 2003. The flow rate at seep 0425 was 0.34 gpm, which is lower than the rate measured in March 2003 (0.5 gpm). Between October 2002 and March 2003, the flow rate at seep 0425 ranged from 0.4 to 0.8 gpm. While the August 2003 rate was outside of this range, it is not considered to be indicative of a trend. Nor does it reflect the effects of pumping on the terrace. Rather, it is more likely the rate decreased in August 2003 due to recent drought conditions in the region.

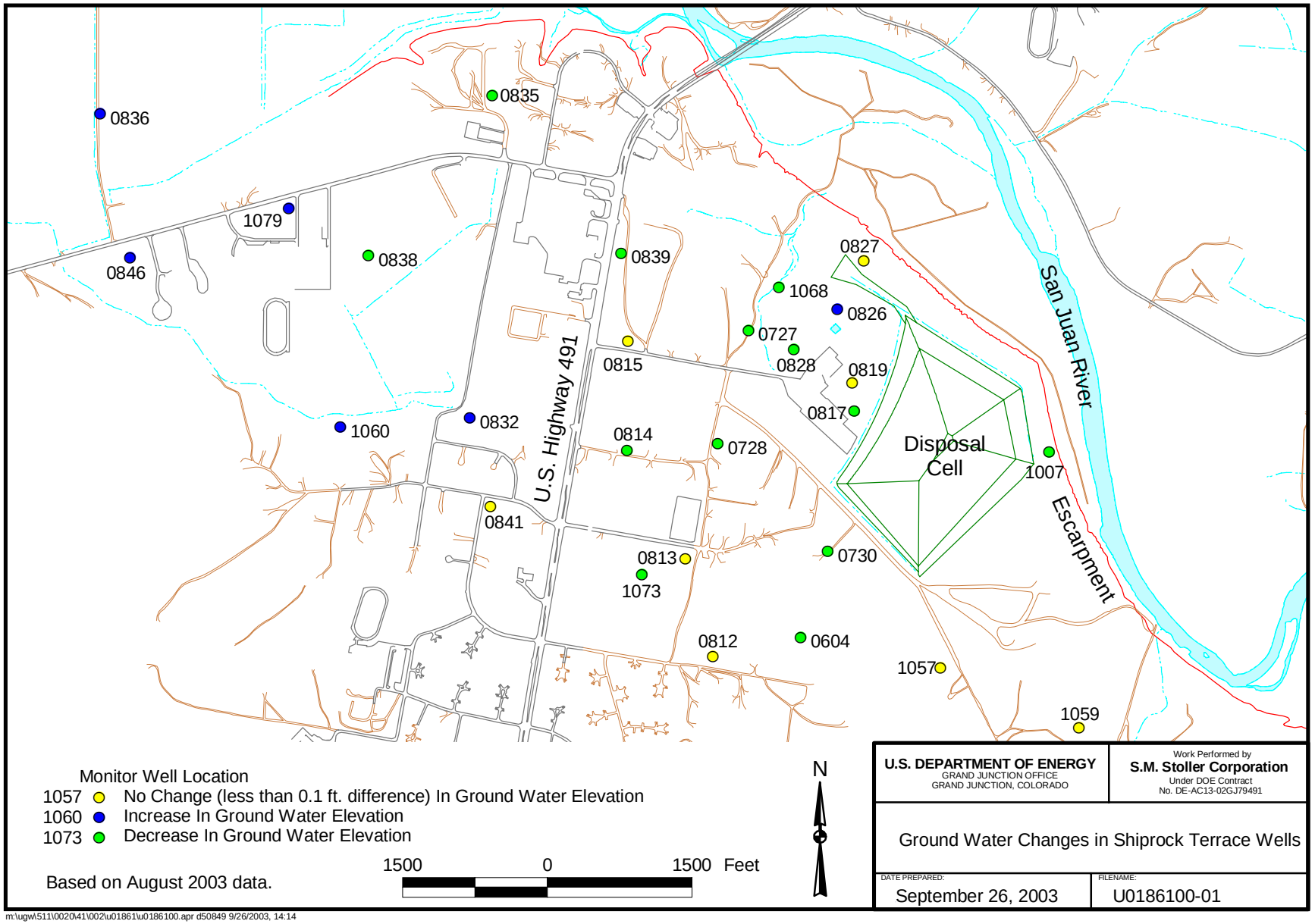


Figure 9. Terrace Ground Water Elevation Changes Between Baseline Conditions and August 2003

The flow measured at seep 0426 in August 2003 was 1.5 gpm, which is also lower than the rate measured in March 2003 (1.8 gpm). Between October 2002 and March 2003, the flow rate at seep 0426 ranged from 1.25 to 1.8 gpm, suggesting that flow at the seep has not changed significantly since initiation of the extraction system. Again, the observed decrease between March and August 2003 is likely the result of drought conditions.

3.0 Remediation System Performance

The following sections provide a brief description of the components of the floodplain and terrace ground water remediation systems, and summarize their performance between baseline conditions and August 2003.

3.1 Floodplain Remediation System

The objective of the floodplain ground water extraction system is to remove ground water from the parts of the COC plumes near the San Juan River. Pumping is focused at this location to lessen exposure risk to aquatic life. All ground water collected from the floodplain extraction wells is piped south to the terrace where it discharges into the evaporation pond. A more complete description of the floodplain extraction system is presented in the Baseline Performance Report (DOE 2003).

This system initially consisted of wells 1075 and 1077. These wells were drilled to approximately 20 ft below ground surface and had saturated alluvial thicknesses of 8 to 10 ft. After nearly 4 months of pumping, neither well was producing more than 3 gpm, far below the goal of 10 to 20 gpm per well. Both wells were re-developed a number of times in an attempt to increase the extraction rates. Ultimately, well 1075 was replaced with well 1089, which was installed just north of 1075 using alternative methods. Specifically, well 1089 was constructed using a slotted culvert placed in a trench excavated to bedrock. After installation of the culvert, the pump was removed from well 1075 and placed inside the new well.

3.1.1 Extraction Well Performance

Figure 10 presents measured pumping rates and cumulative volume of ground water pumped at the 1075/1089 location. These graphs clearly illustrate the effects of converting from well 1075 to well 1089. Prior to the conversion, well 1075 had an average pumping rate of approximately 1.6 gpm. After converting to well 1089, the average pumping rate increased to 5.2 gpm. By the end of August 2003, well 1075/1089 had removed more than 780,000 gallons of ground water from the floodplain ground water system.

Well 1077 has not performed as efficiently as well 1075/1089 (Figure 11). Between March 2003 and August 2003 the average pumping rate was 0.58 gpm, and only approximately 150,000 gallons of ground water had been pumped from this well at the end of the period. Appendix C lists measured flow rates and corresponding volumes of ground water removed from floodplain extraction wells 1075/1089 and 1077.

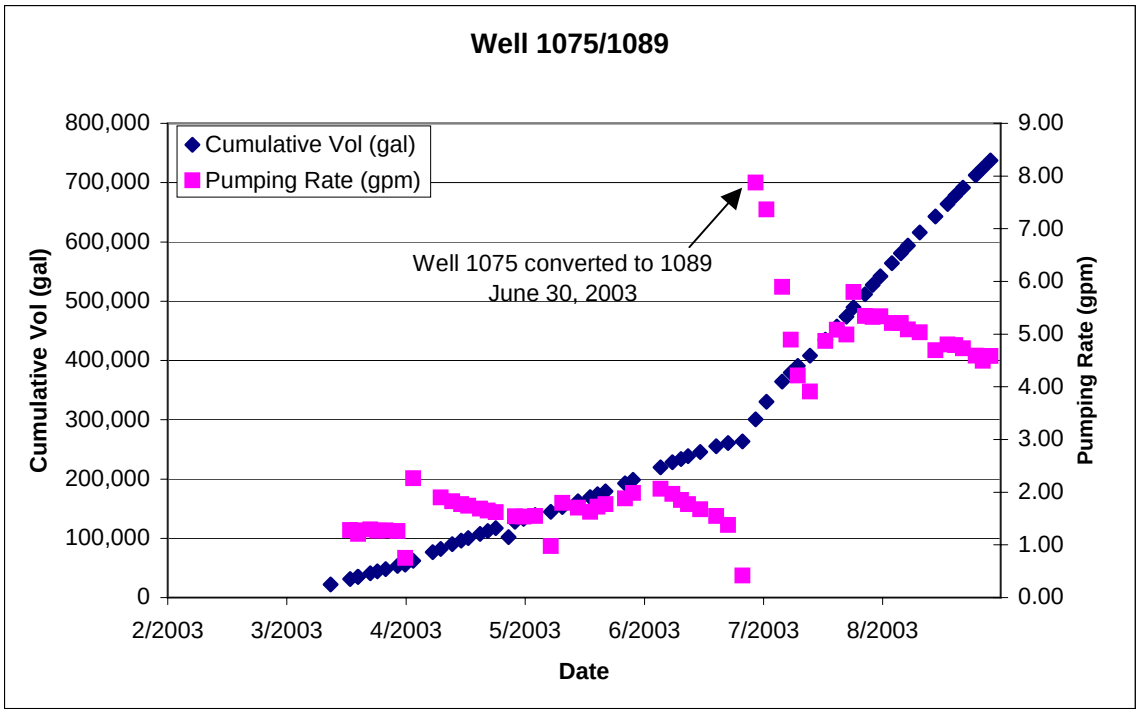


Figure 10. Well 1075/1089 Pumping Rate and Cumulative Ground Water Volume Extracted

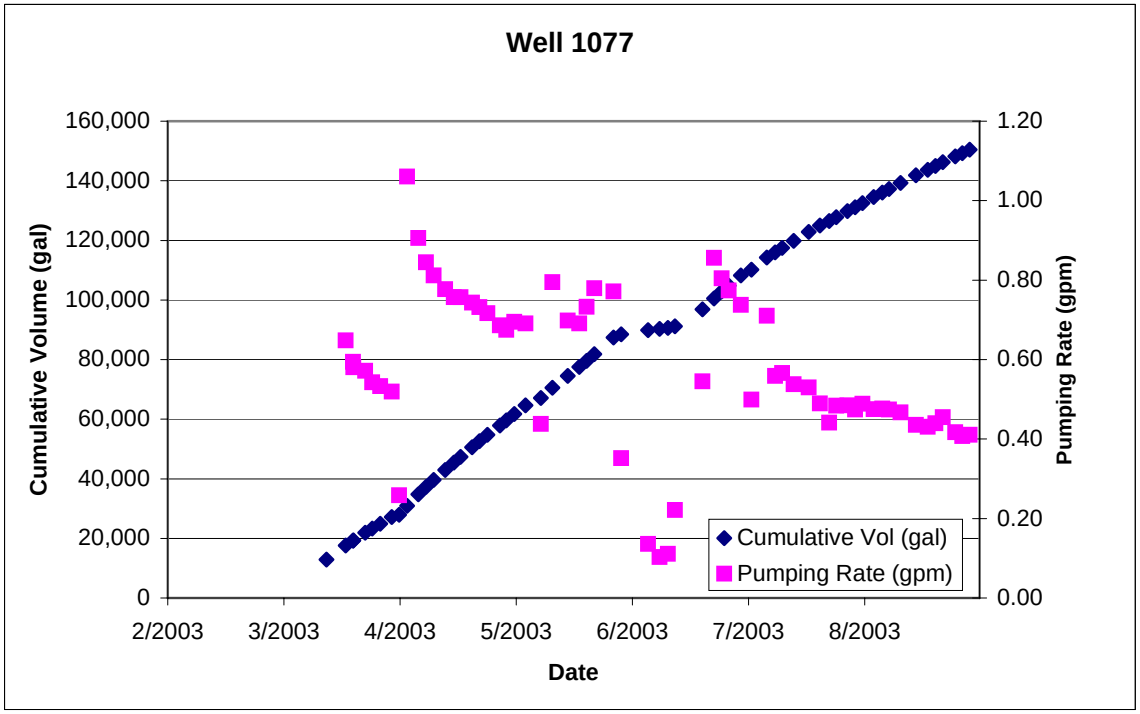


Figure 11. Well 1077 Pumping Rate and Cumulative Ground Water Volume Extracted

3.2 Terrace Remediation System

The terrace remediation system consists of four components: the terrace extraction wells, the terrace drains (Bob Lee and Many Devils Washes), the evaporation pond, and the terrace outfall drainage channel diversion (Figure 1).

Extraction Wells

Three wells (1070, 1071, and 1078) were initially installed for the purposes of ground water extraction on the terrace. In addition, monitor well 0818 was converted to an additional pumping well. All of the wells, whose total depths range from 40 to 60 ft below ground surface, were located within the terrace east portion of the site. Saturated thickness in the wells ranged from 3 to 7 ft. Ground water extracted from these wells was collected in a pipeline and transported eastward to the evaporation pond.

After 5 months of pumping, and a number of efforts to increase the flow from the initial four extraction wells, additional wells were installed in an attempt to reach a total terrace extraction rate of 10 gpm. Wells 1091, 1092, 1093, and 1094 were installed in July 2003 just north of the west part of the evaporation pond (Figure 1).

Terrace Drain System

The terrace extraction system is also designed to collect seepage along Bob Lee and Many Devils Washes using subsurface interceptor drains. These drains, which consist of perforated pipe surrounded by drain rock and are lined with impermeable geomembrane and geotextile filter fabric, are offset from the centerline of each wash to minimize infiltration of surface water. All water collected by these drains is pumped through a pipeline to the evaporation pond.

Evaporation Pond

The selected method for treating ground water from the interceptor drains and extraction wells is solar evaporation. The contaminated ground water is pumped to a lined evaporation pond in the south part of the radon cover borrow pit area (Figure 1). This pond, with a surface area of approximately 11 acres, has a geosynthetic liner underlain by a compacted soil base.

Terrace Drainage Channel Diversion

During infrequent high-intensity rainfall events, surface water shed from the disposal cell has historically drained northwest to a rock-lined dissipation area, eventually reaching upper Bob Lee Wash. In some instances the water has become ponded in the rock-lined dissipation area, from whence it potentially recharged the aquifer and fed the escarpment seeps.

The outfall drainage channel diversion was installed to better drain surface water from the dissipation area and convey it northwest to the lower part of Bob Lee Wash. It is located such that it will not interfere with the interceptor drain in upper Bob Lee Wash.

A more detailed description of remediation system components are contained in the Baseline Performance Report (DOE 2003) and GCAP (DOE 2002). The following sections discuss the performance of the extraction wells (3.2.1), terrace drain system (3.2.2), and evaporation pond (3.2.3) between late February 2003 and August 2003. Performance of the outfall drainage channel is omitted because no method exists to measure flows in the channel.

3.2.1 Extraction Well Performance

The pumping rates and corresponding ground water volumes removed from wells 0818, 1070, 1071, and 1078 through August 2003 are presented in Figure 12 through Figure 15, respectively. Table 3 lists each well's average pumping rate and total ground water volume removed as of August 2003. The average pumping rates range from 0.1 (well 1071) to 1.25 gpm (well 818), and the total ground water volume removed from each well during this same time period ranged from 32,080 (well 1071) to 361,880 gallons (well 0818).

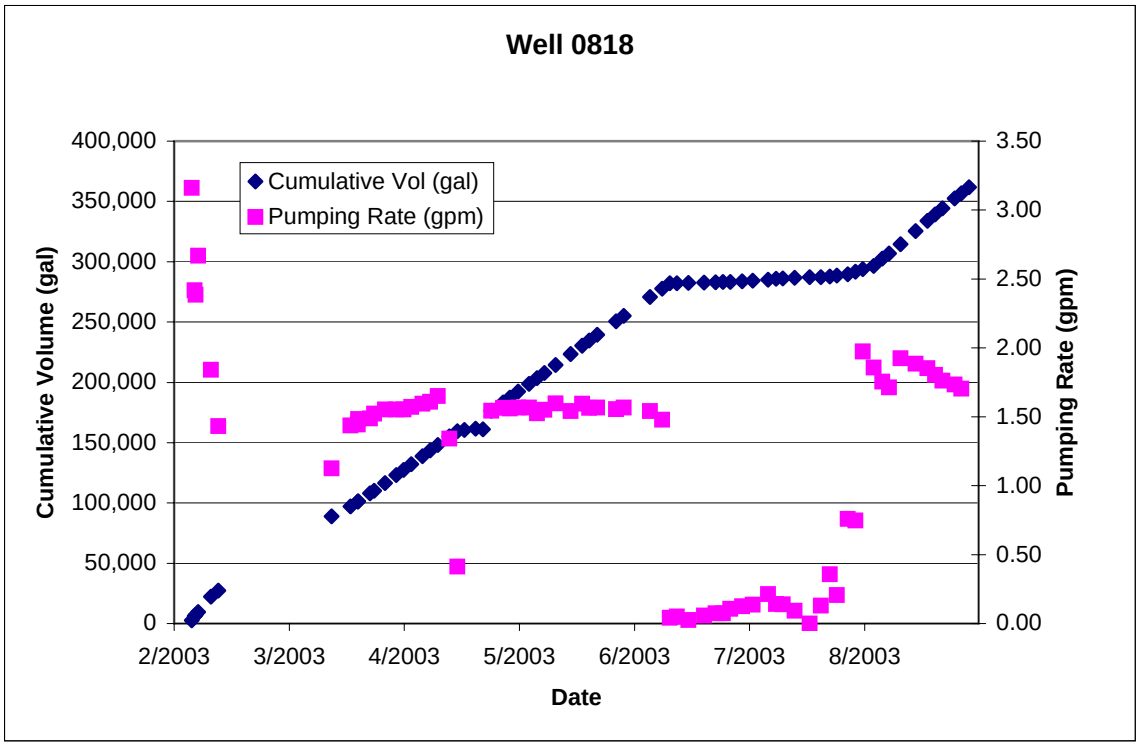


Figure 12. Well 0818 Pumping Rate and Cumulative Ground Water Volume Extracted

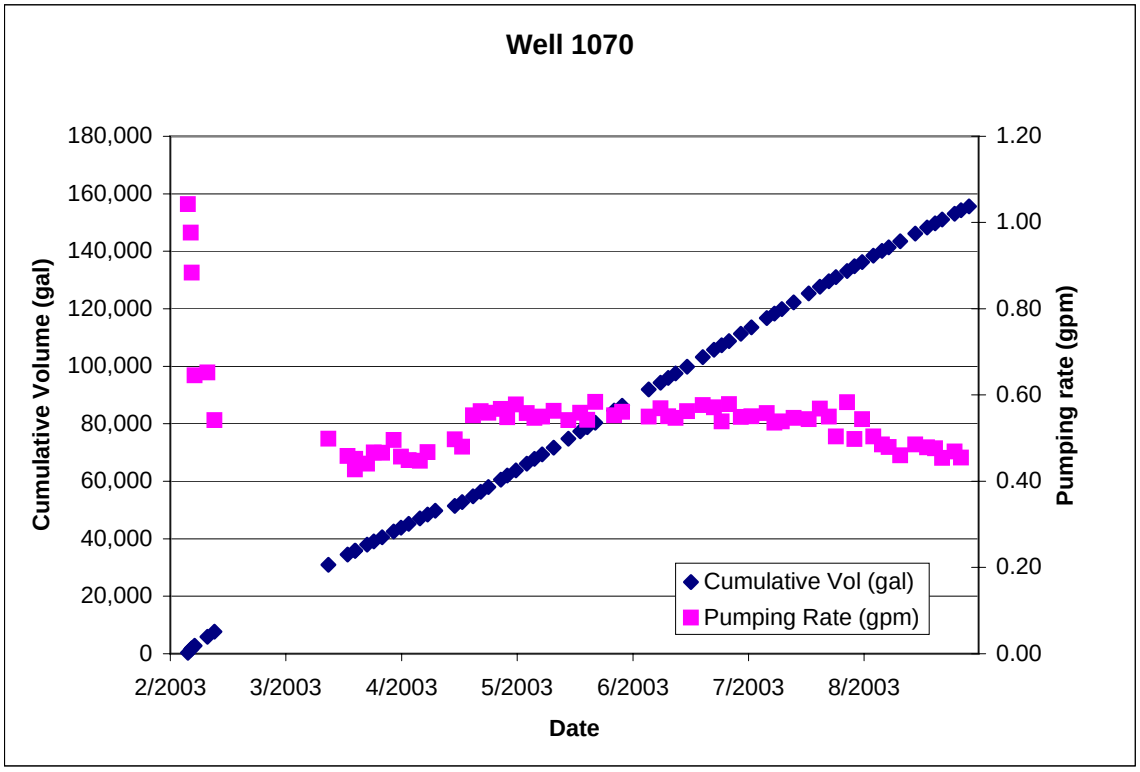


Figure 13. Well 1070 Pumping Rate and Cumulative Ground Water Volume Extracted

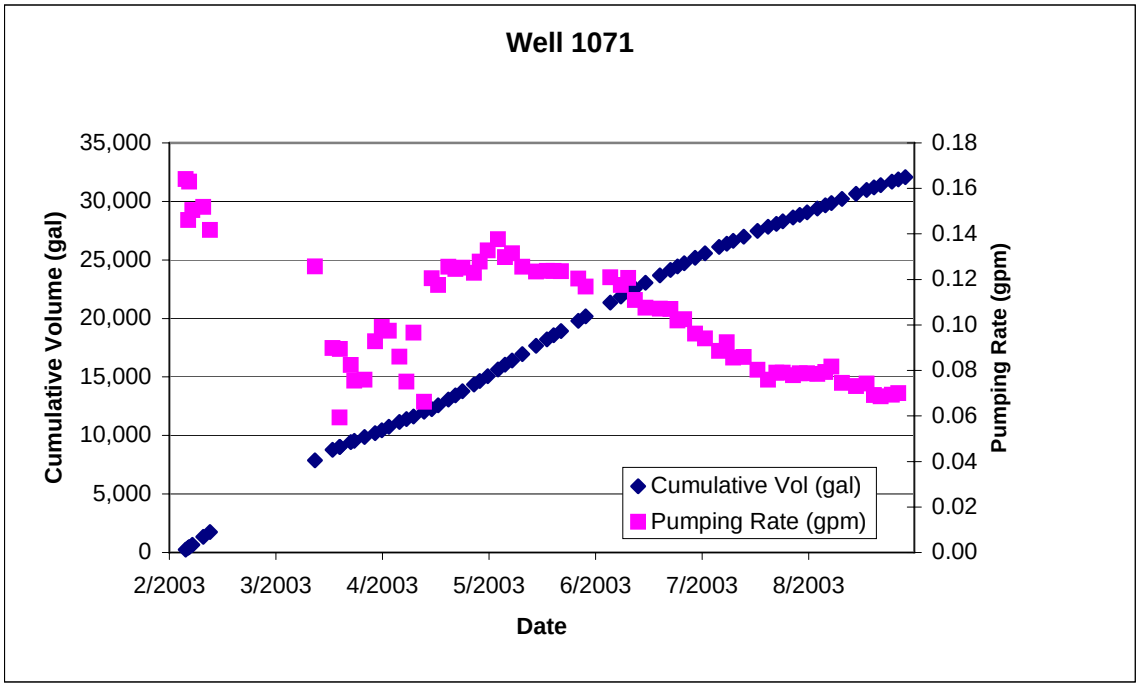


Figure 14. Well 1071 Pumping Rate and Cumulative Ground Water Volume Extracted

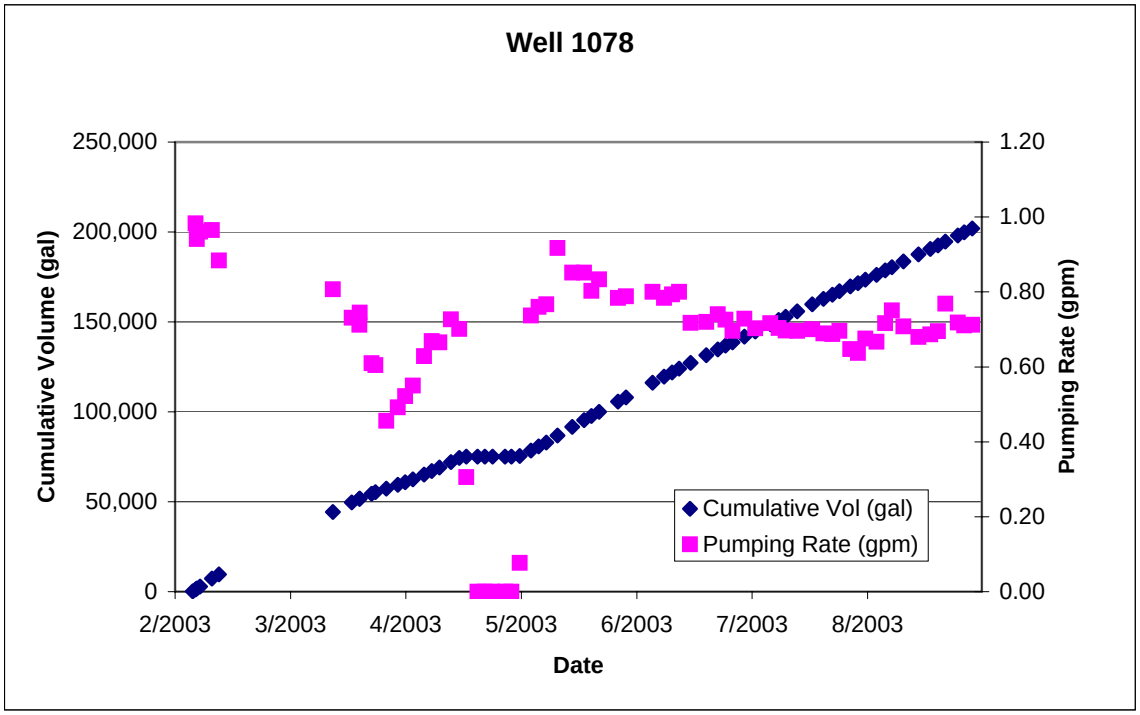


Figure 15. Well 1078 Pumping Rate and Cumulative Ground Water Volume Extracted

Table 3. Terrace Extraction Well Average Pumping Rate and Total Ground Water Volume Removed

Well	Average Pumping Rate, February 2003 through August 2003 (gpm)	Total Ground Water Volume Removed, August 2003 (gallons)
0818	1.25	361,880
1070	0.54	155,630
1071	0.10	32,080
1078	0.66	201,920
Total	**2.55**	**751,510**

Because wells 1091, 1092, 1093, and 1094 had been in operation less than 1 month by the end of August 2003, pumping rates and cumulative volumes pumped from these wells are not included in this performance report. Early data indicate that the extraction rates for these four wells range from 0.1 to 0.4 gpm. Appendix C lists measured pumping rates and corresponding volumes of ground water removed from all eight terrace ground water extraction wells.

3.2.2 Terrace Drain System Performance

Figure 16 presents extraction rates and cumulative flow volumes for the pump installed in the Bob Lee Wash drain. The data clearly indicate a uniform decline in drain flow since startup of the system in late February 2003. After starting at a flow rate of approximately 6.8 gpm, the flow rate by the end of August 2003 was 4.25 gpm. During the 6-month performance period (February to August 2003), the average flow rate was 4.76 gpm, with over 1.3 million gallons of water removed by the drain.

As previously discussed, inflow to the drain during its first few months of operation was greater than the ability of the pump installed in the drain to remove the water, as evidence by ponded water present on the surface near the base of the sump containing the pump. By early May 2003, the ponded water was gone, suggesting that the pump discharge was equal to the drain inflow.

During summer months the drain filter at Bob Lee Wash appeared to be affected by scaling that had likely reduced the ability of the ground water to enter the drain. Attempts were made to remove this material and increase the flow rate in July 2003.

The pumping rates and volumes of water removed from the drain installed in Many Devils Wash are presented in Figure 17. Ponded water was present along the wash bottom just east of the buried drain until late June 2003, at which time a supplemental french drain was installed to remove this water. The pumping rate from the drain between February 2003 and the end of August 2003 fluctuated and averaged only 0.14 gpm. No pumping occurred for 3 weeks in August 2003 due to pump mechanical problems. By the end of August 2003 the total volume removed by this drain was 52,800 gallons. Appendix C lists the measured pumping rates and corresponding volumes of ground water removed from the Bob Lee Wash and Many Devils Wash drains.

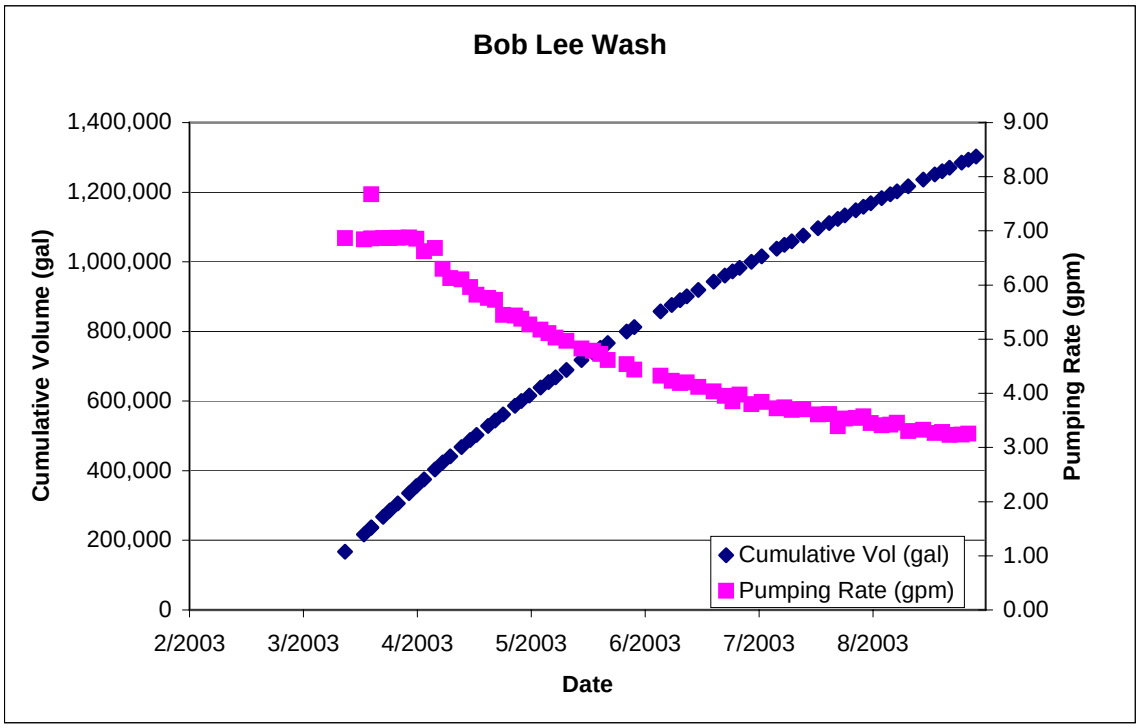


Figure 16. Bob Lee Wash Pumping Rate and Cumulative Ground Water Volume Extracted

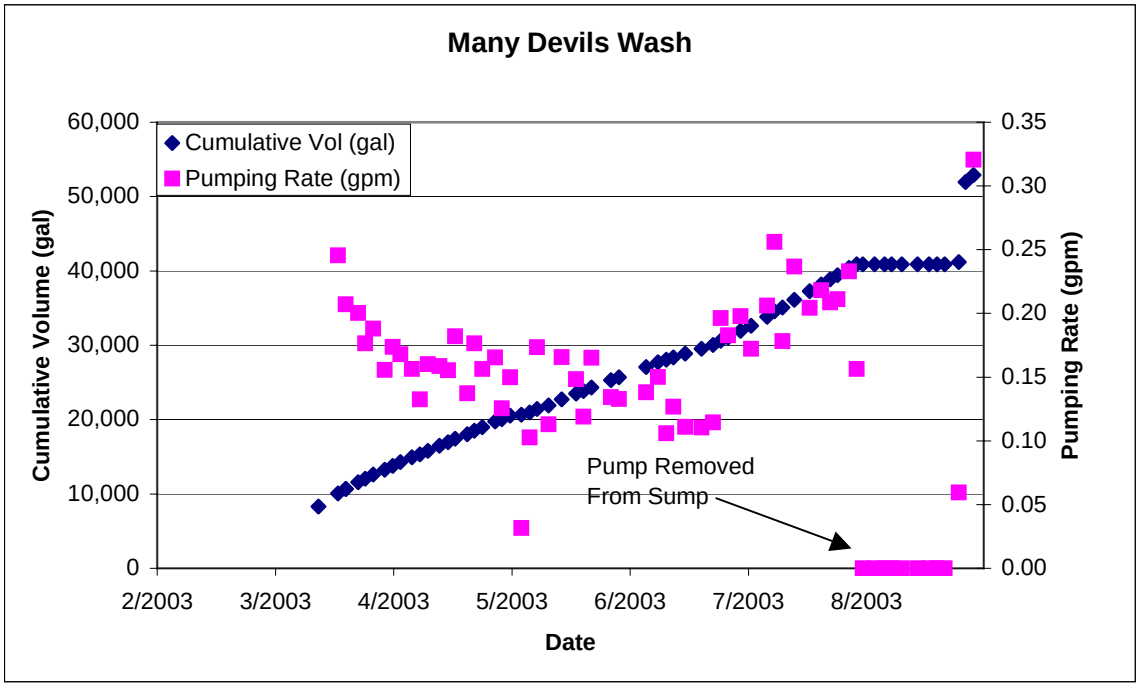


Figure 17. Many Devils Wash Pumping Rate and Cumulative Ground Water Volume Extracted

3.2.3 Evaporation Pond

The bottom of the evaporation pond was never completely covered during the first 6 months of remediation system operation. Relatively small volumes of water were stored in the pond due to limited pumpage from both the floodplain and the terrace. Figure 18 presents the total volume of water transported to the pond, and the relative contributions from the floodplain and terrace systems. This graph also shows the flow from Bob Lee Wash, which was the largest single contributor.

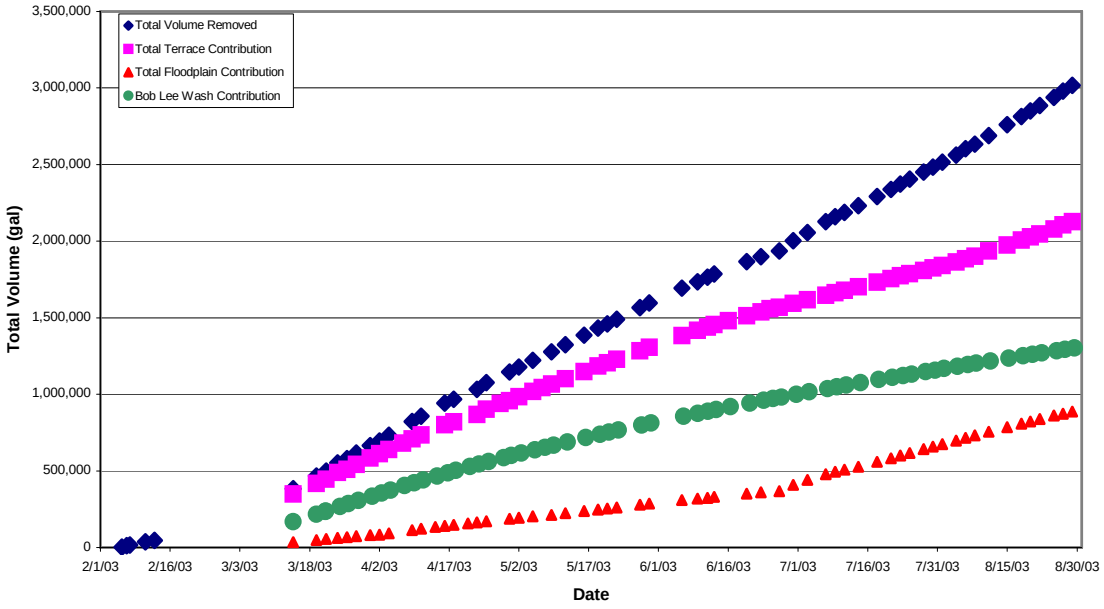


Figure 18. Total Ground Water Volume Transported to the Evaporation Pond

4.0 Performance Summary

No significant changes were expected at the Shiprock site during the initial 6 months of remedial system operation. Findings from the February through August 2003 performance evaluation of the floodplain remediation system at the site are as follows:

- Three-point analysis of August 2003 water level data in the vicinity of the two floodplain extraction wells indicates that ground water is locally flowing toward the wells in response to pumping.
- No significant reductions in COC concentrations are observed in the floodplain; however, the extraction wells removed some contamination that would have otherwise discharged to the San Juan River.

Findings from the February through August 2003 performance evaluation of the terrace remediation system are as follows:

- Three-point analysis of the August 2003 water level data indicates the extraction wells are inducing ground water flow towards them.
- The terrace east ground water elevations have been decreasing over the past 5 years, and the August 2003 data indicate the elevations have continued to decline during the previous 6 months. Ground water elevation data collected using data loggers confirm the decline. The terrace west water levels continue to fluctuate in response to irrigation practices in that portion of the site.
- Flow rate data collected from the pump installed in the Bob Lee Wash drain has exhibited a steady decline since start-up of the pumping system. When the system first became operational, ponded water was present around the base of the sump holding the pump.

Ponded water was no longer present after approximately 3 months, suggesting the volume of water removed from the system became equal to and eventually greater than the volume of ground water entering the drain.

- Flow rate data from the pump installed in the Many Devils Wash drain indicate that the flow rate has fluctuated slightly throughout the first 6 months of pumping, and has averaged 0.14 gpm.
- The flow rates measured in August 2003 from seeps 0425 and 0426 were not significantly different from historically measured rates.

5.0 Recommendations

On the basis of the preceding review, the following recommendations are provided as means to improve the performance of the Shiprock remediation system and to improve evaluation of the system:

- Increase the volume of ground water extracted from the floodplain to fill the evaporation pond. Well 1077 might be replaced with a new well in a similar manner to which well 1075 was replaced with well 1089.
- Evaluate the effects of well inefficiency on limited pumping rates for wells installed in the floodplain aquifer; devise methods to reduce well inefficiencies so that better capture of floodplain aquifer contaminants is achieved.
- Assess the potential for ground water flow and contaminant transport in Mancos Shale, both on the terrace and beneath the floodplain, to be affected by preferred flow paths associated with fractures, differential weathering, etc. Develop methods to improve contaminant recovery associated with such paths.
- Apply techniques to better understand the migration of contaminated Mancos Shale ground water to the floodplain aquifer, particularly along the escarpment separating the terrace from the floodplain (e.g., at seeps 0425 and 0426). Use associated findings to improve interception of floodplain contaminants via extraction wells, drain trenches, etc.
- Analyze flow rates and hydraulic head data associated with surface water collection at Bob Lee Wash, Many Devils Wash, and possibly constructed drain features along the escarpment to estimate hydraulic properties of the weathered and portions of the fractured Mancos Shale. Use relevant findings to more accurately predict attenuation of site ground water contamination and associated performance of remediation systems.
- Analyze pumping data from wells in alluvium in the southern part of the terrace ground water system to identify possible barrier boundary effects; if possible, revise ground water volume estimates for this area based on the pumping data, and use accordingly for performance evaluation in the terrace ground water system.
- Consider the installation of two to four additional extraction wells in the south part of the terrace east, in an arc between the highest-producing existing extraction wells 0818 and 1078. This spread, or optimization, of extraction wells should result in an increase of the volume of ground water extracted from the south part of terrace east.

6.0 References

Laase, A.D., J.E. Wilson, and D.W. Green, 2002. "Evaluation of Natural Flushing Using Three-Point and Partitioning Theory Analysis," in *Proceedings for the Third International Conference on Remediation of Chlorinated and Recalcitrant Compounds*, May.

U.S. Department of Energy (DOE), 2000. *Final Site Observational Work Plan for the Shiprock, New Mexico, UMTRA Project Site*, Rev. 2, GJO−2001−169−TAR, MAC-GWSHP 1.1, U.S. Department of Energy Grand Junction Office, Grand Junction, Colorado, November.

———, 2002. *Final Ground Water Compliance Action Plan for Remediation at the Shiprock, New Mexico, UMTRA Project Site*, GJO−2001−297−TAR, MAC-GWSHP 1.9, U.S. Department of Energy Grand Junction Office, Grand Junction, Colorado, July.

———, 2003. *Baseline Performance Report for the Shiprock, New Mexico, UMTRA Project Site*, GJO−2003−431−TAC, U.S. Department of Energy Grand Junction Office, Grand Junction, Colorado, September.

U.S. Environmental Protection Agency (EPA), 1999. *Health Effects from Exposure to High Levels of Sulfate in Drinking Water Study*, EPA 815-R-99-001, Office of Water, January.

End of current text

Appendix A

Three-Point Analyses of Floodplain and Terrace Ground Water Elevation Data

This page intentionally left blank

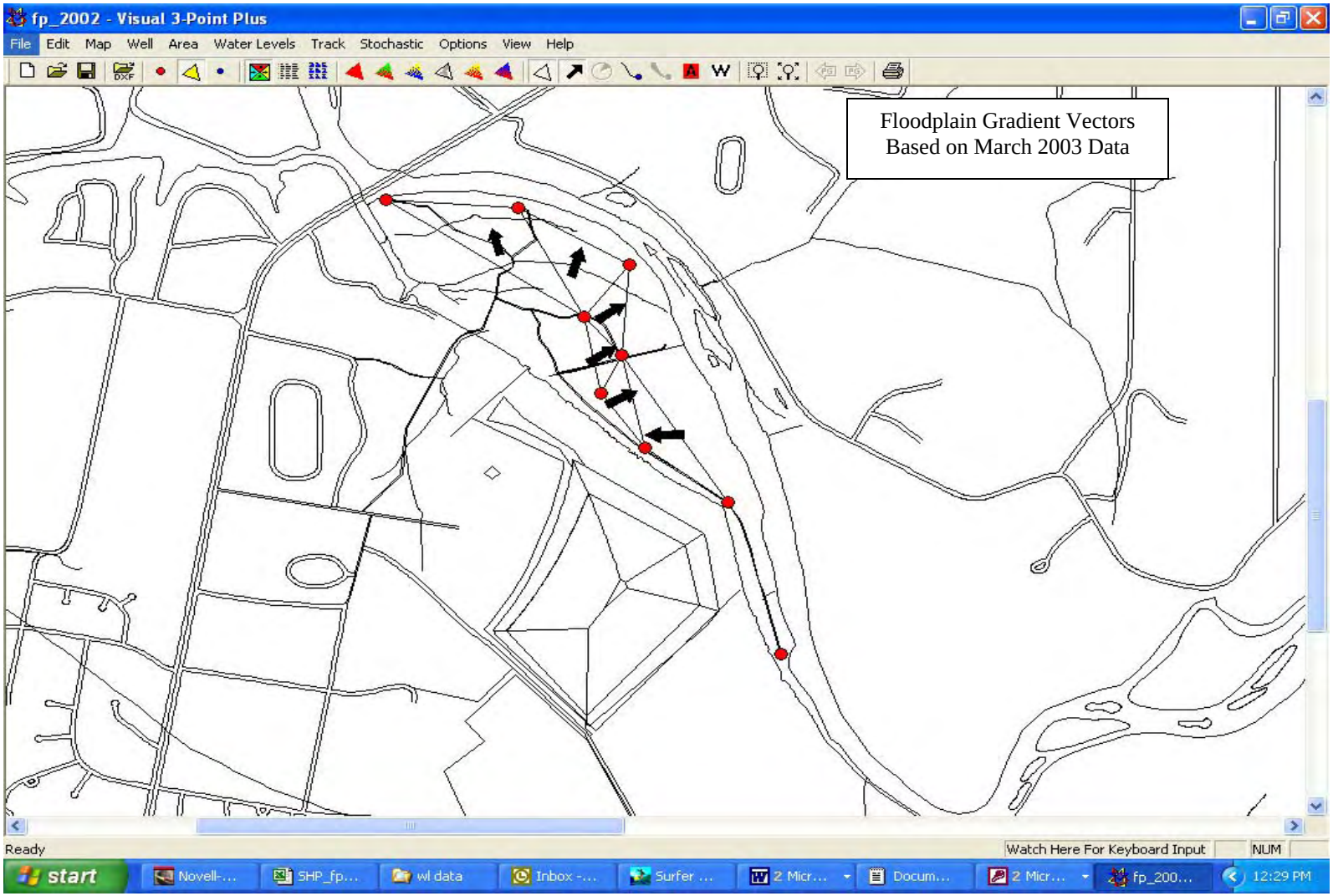

fp_2002 - Visual 3-Point Plus
File Edit Map Well Area Water Levels Track Stochastic Options View Help
Floodplain Gradient Vectors
Based on March 2003 Data
Ready
Watch Here For Keyboard Input
NUM
start
Novell-...
SHP_fp...
wl data
Inbox -...
Surfer ...
2 Micr...
Docum...
2 Micr...
fp_200...
12:29 PM

Figure A−1

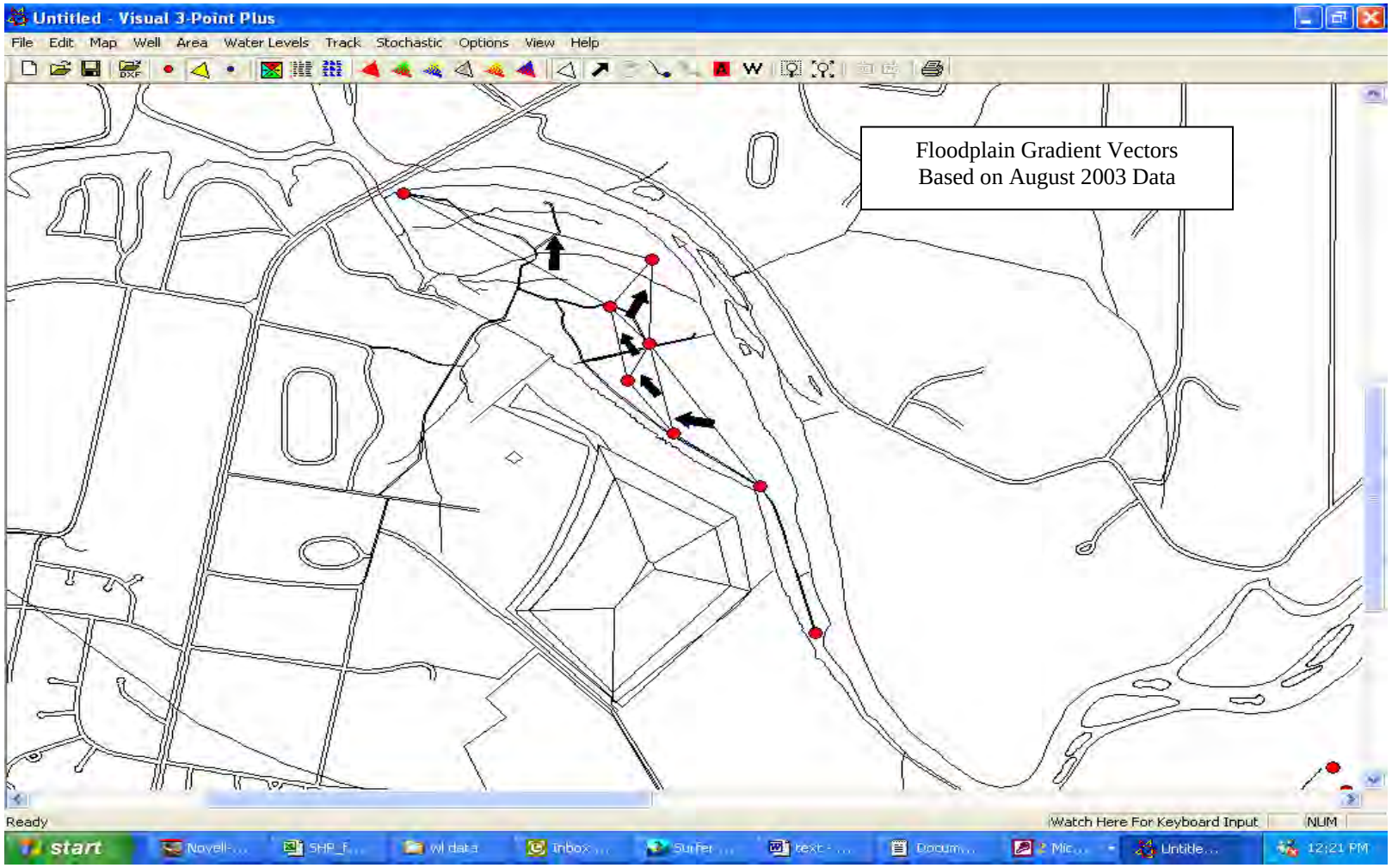

Untitled - Visual 3-Point Plus
File Edit Map Well Area Water Levels Track Stochastic Options View Help
Floodplain Gradient Vectors
Based on August 2003 Data
Ready
Watch Here For Keyboard Input
NUM
start
12:21 PM

Figure A−2

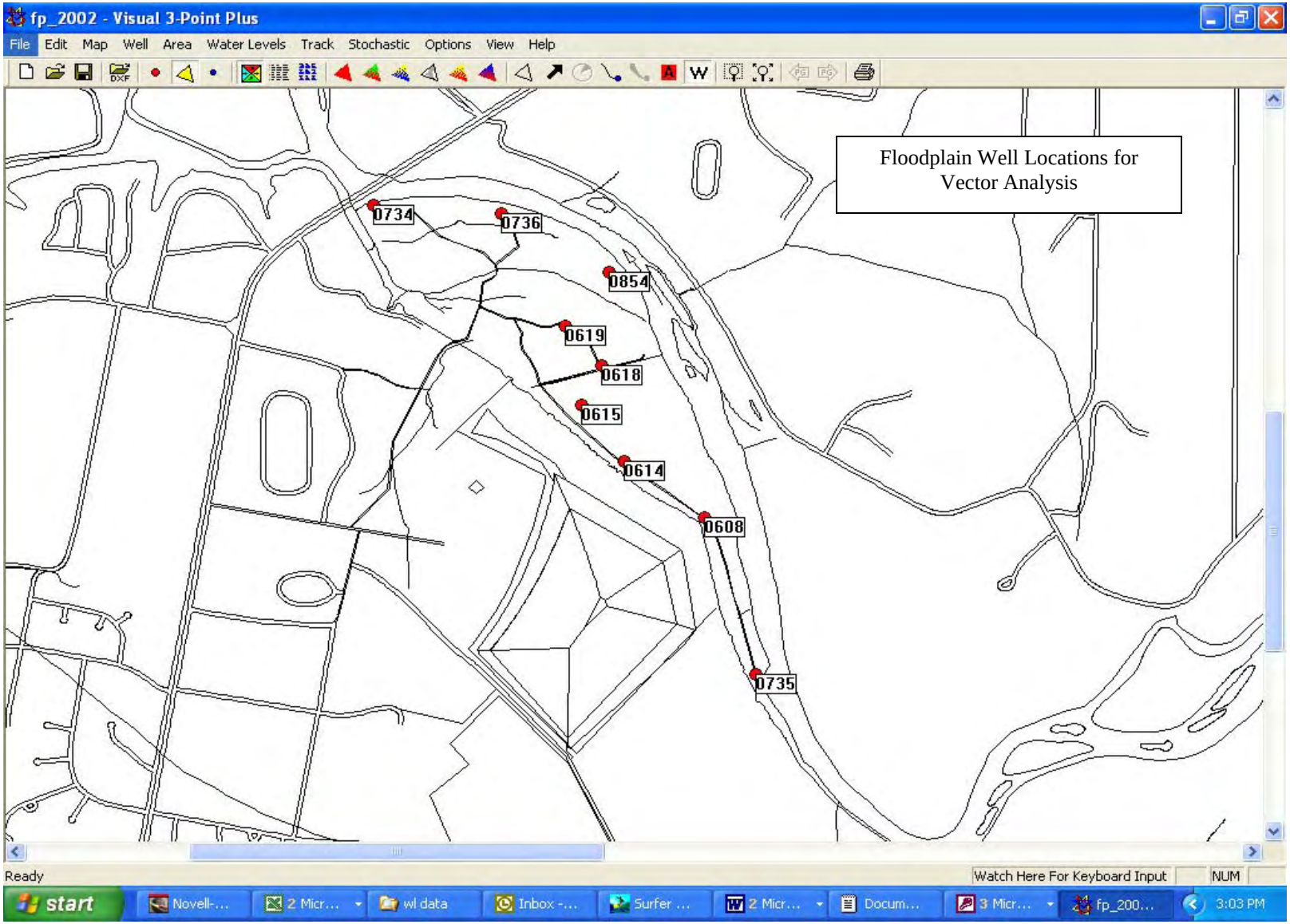

fp_2002 - Visual 3-Point Plus
File Edit Map Well Area Water Levels Track Stochastic Options View Help
Floodplain Well Locations for Vector Analysis
0734
0736
0854
0619
0618
0615
0614
0608
0735
Ready
Watch Here For Keyboard Input
NUM
start
Novell-...
2 Micr...
wl data
Inbox -...
Surfer ...
2 Micr...
Docum...
3 Micr...
fp_200...
3:03 PM

Figure A−3

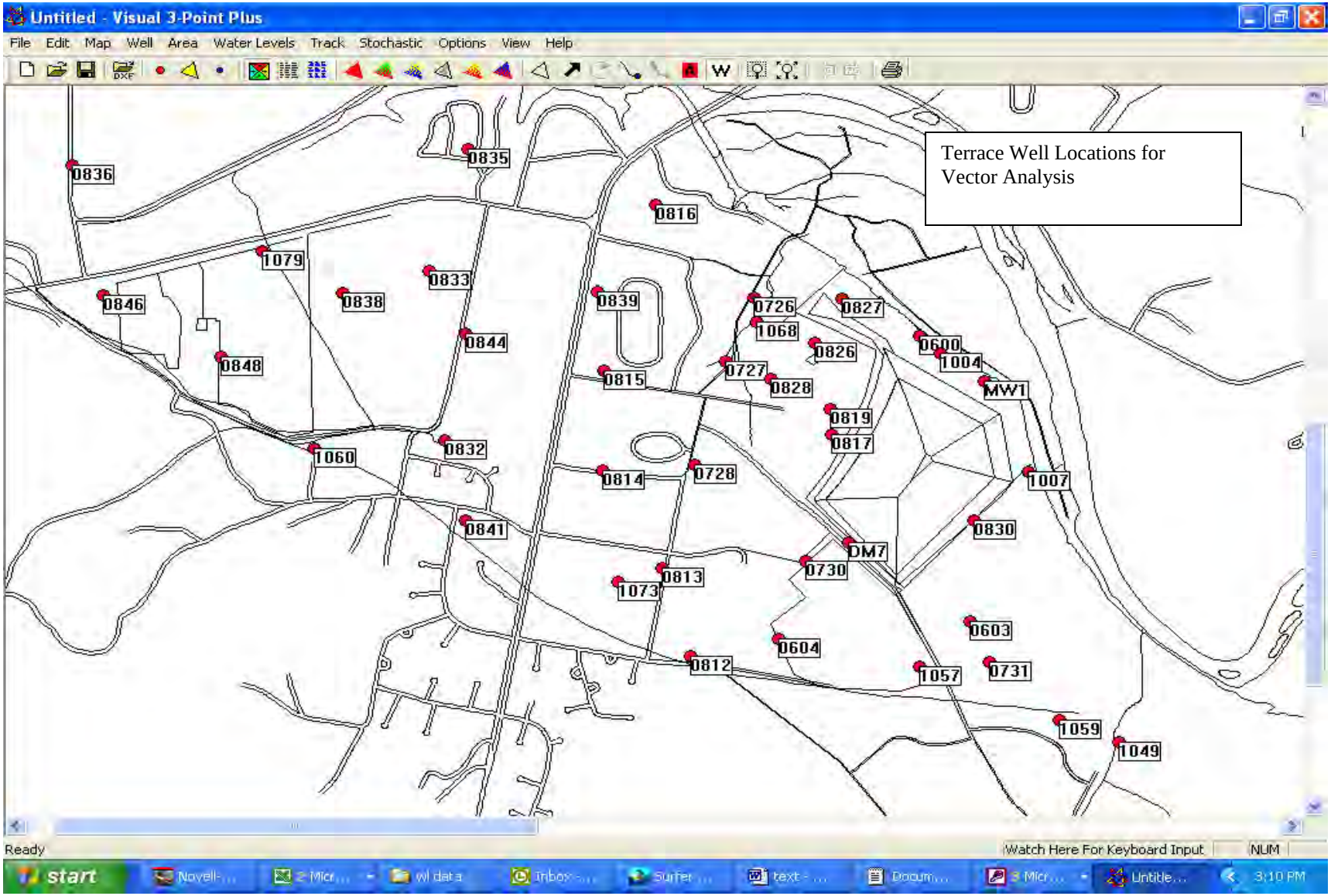

Untitled - Visual 3-Point Plus
File Edit Map Well Area Water Levels Track Stochastic Options View Help
Terrace Well Locations for Vector Analysis
0836
0835
0816
1079
0833
0846
0838
0839
0726
0827
1068
0844
0826
0600
1004
0848
0727
0828
MW1
0815
0819
0817
0832
1060
0814
0728
1007
0841
0830
DM7
0730
0813
1073
0603
0604
0812
1057
0731
1059
1049
Ready
Watch Here For Keyboard Input
NUM
start
3:10 PM

Figure A−4

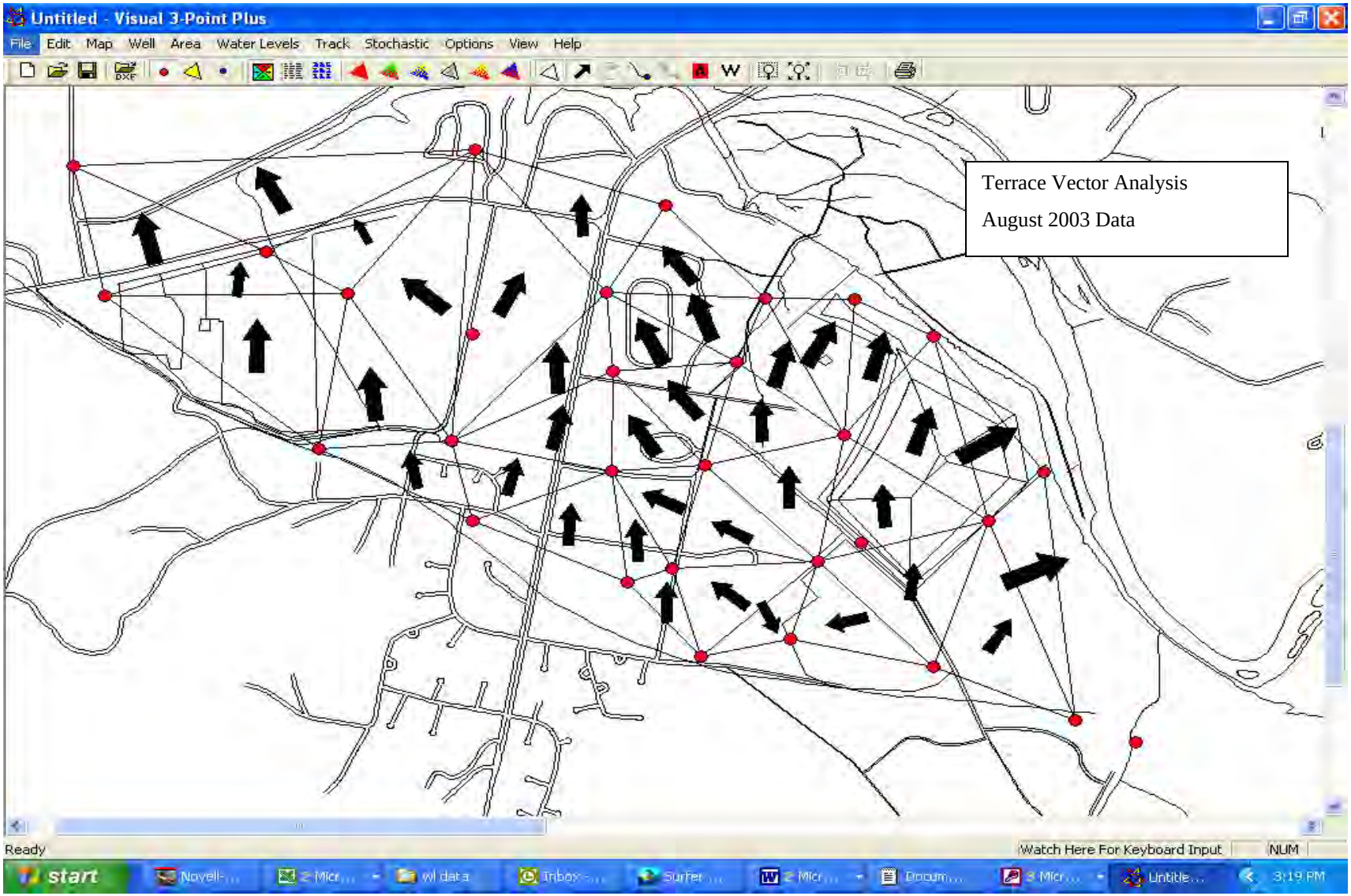

Untitled - Visual 3-Point Plus
File Edit Map Well Area Water Levels Track Stochastic Options View Help
Terrace Vector Analysis
August 2003 Data
Ready
Watch Here For Keyboard Input
NUM
start
3:19 PM

Figure A−5

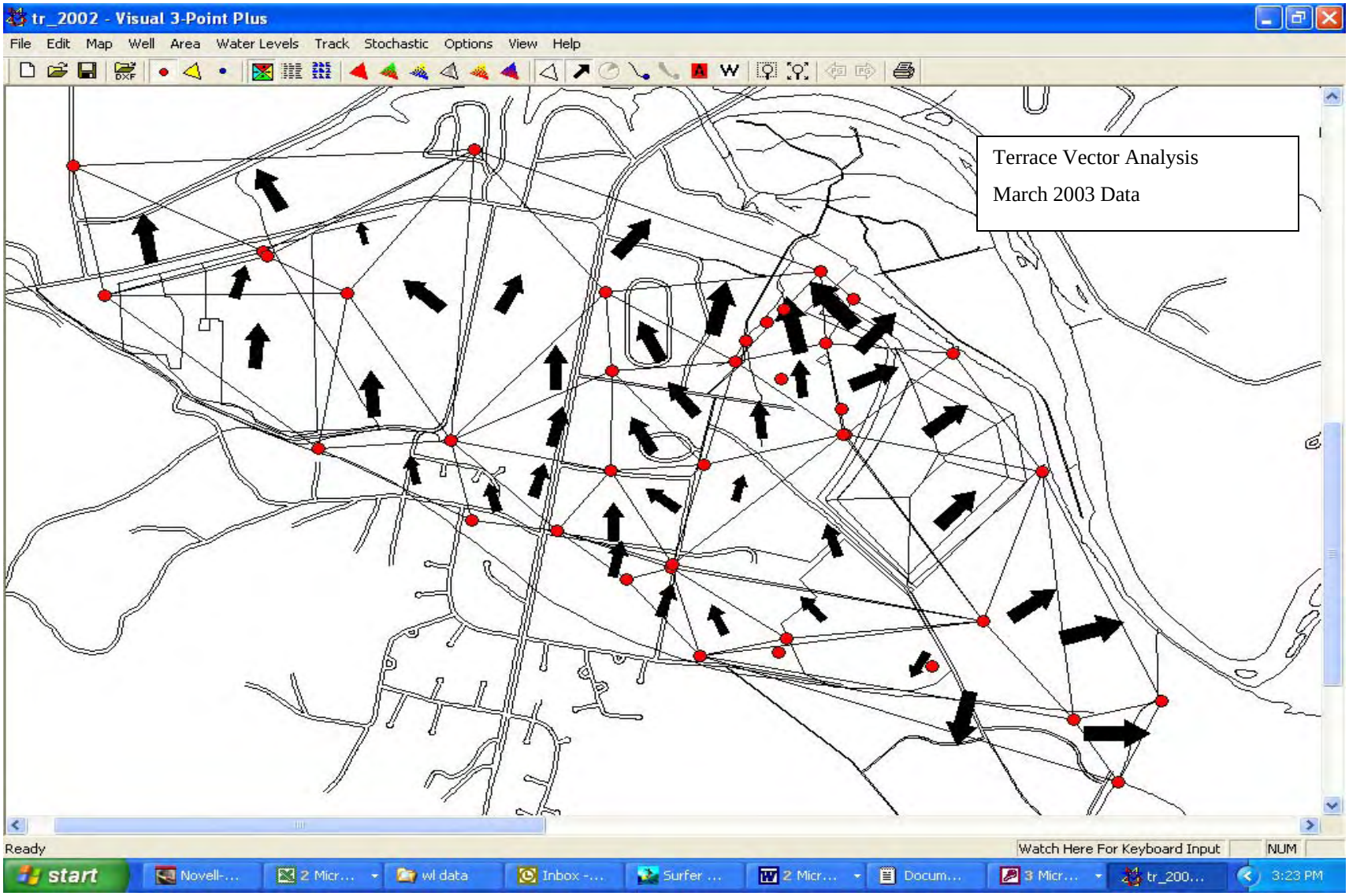

tr_2002 - Visual 3-Point Plus
File Edit Map Well Area Water Levels Track Stochastic Options View Help
Terrace Vector Analysis
March 2003 Data
Ready
Watch Here For Keyboard Input
NUM
start
Novell-...
2 Micr...
wl data
Inbox -...
Surfer ...
2 Micr...
Docum...
3 Micr...
tr_200...
3:23 PM

Figure A−4

Appendix B

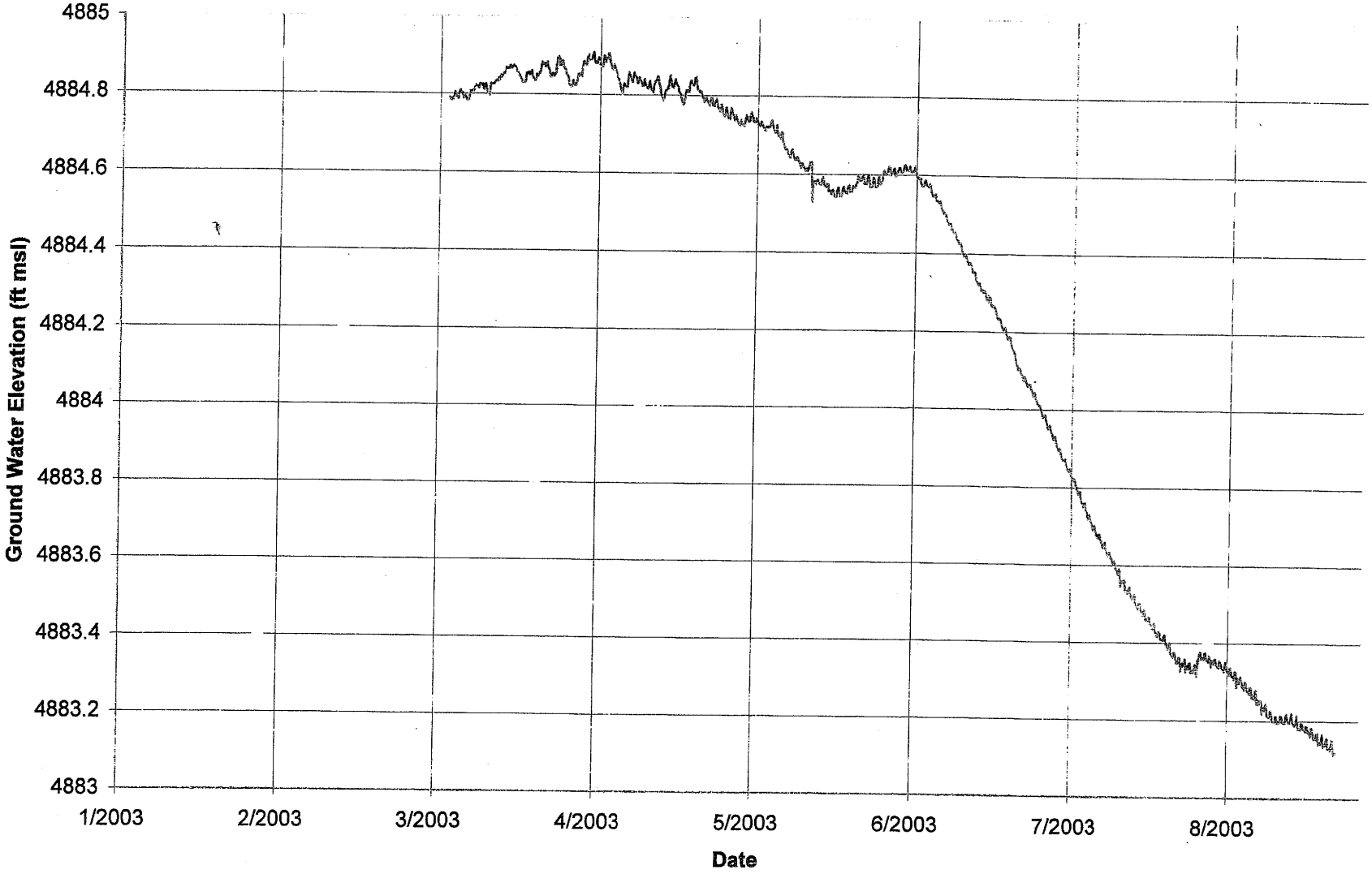
Shiprock Data Logger Ground Water Elevation Data

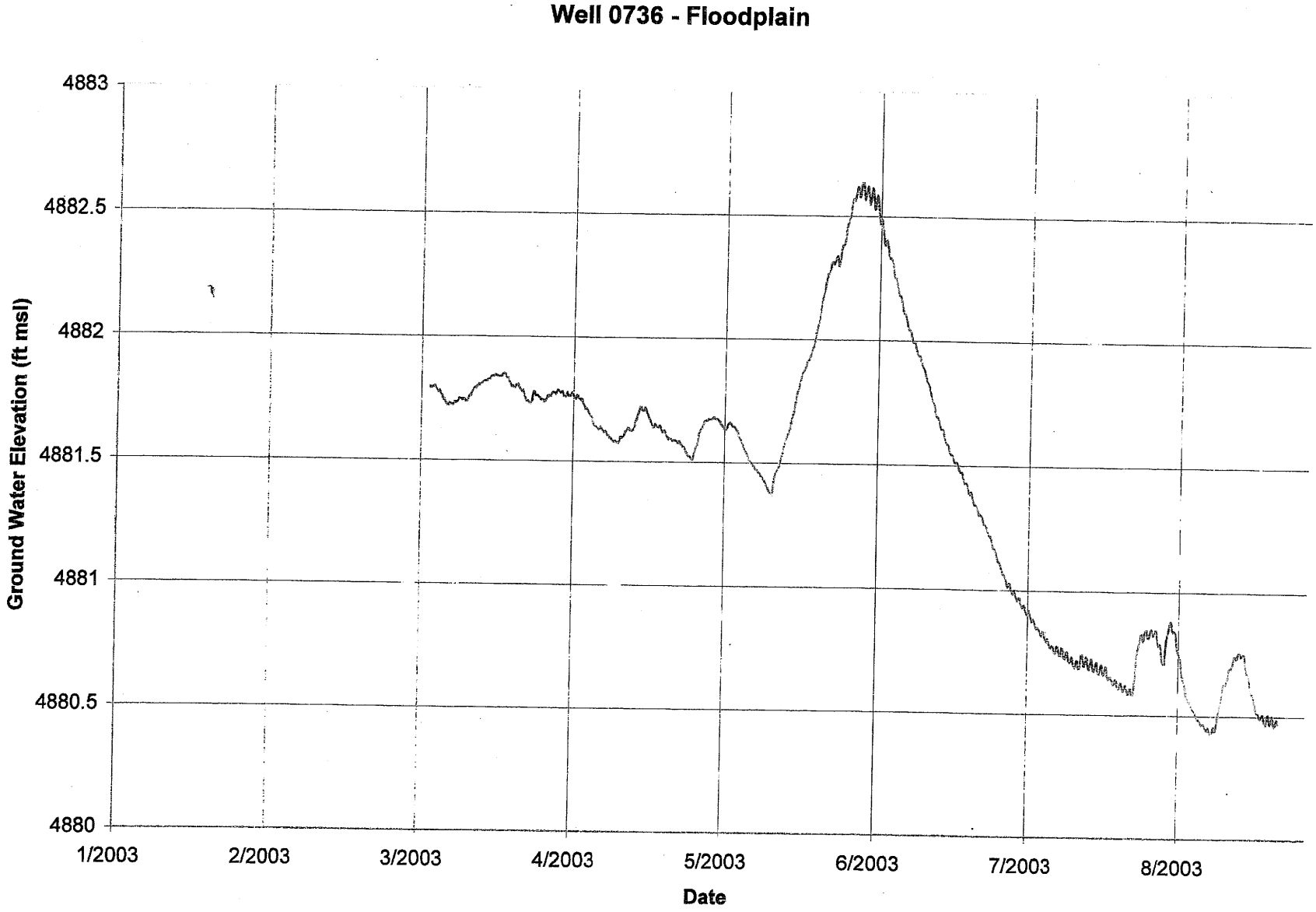
This page intentionally left blank

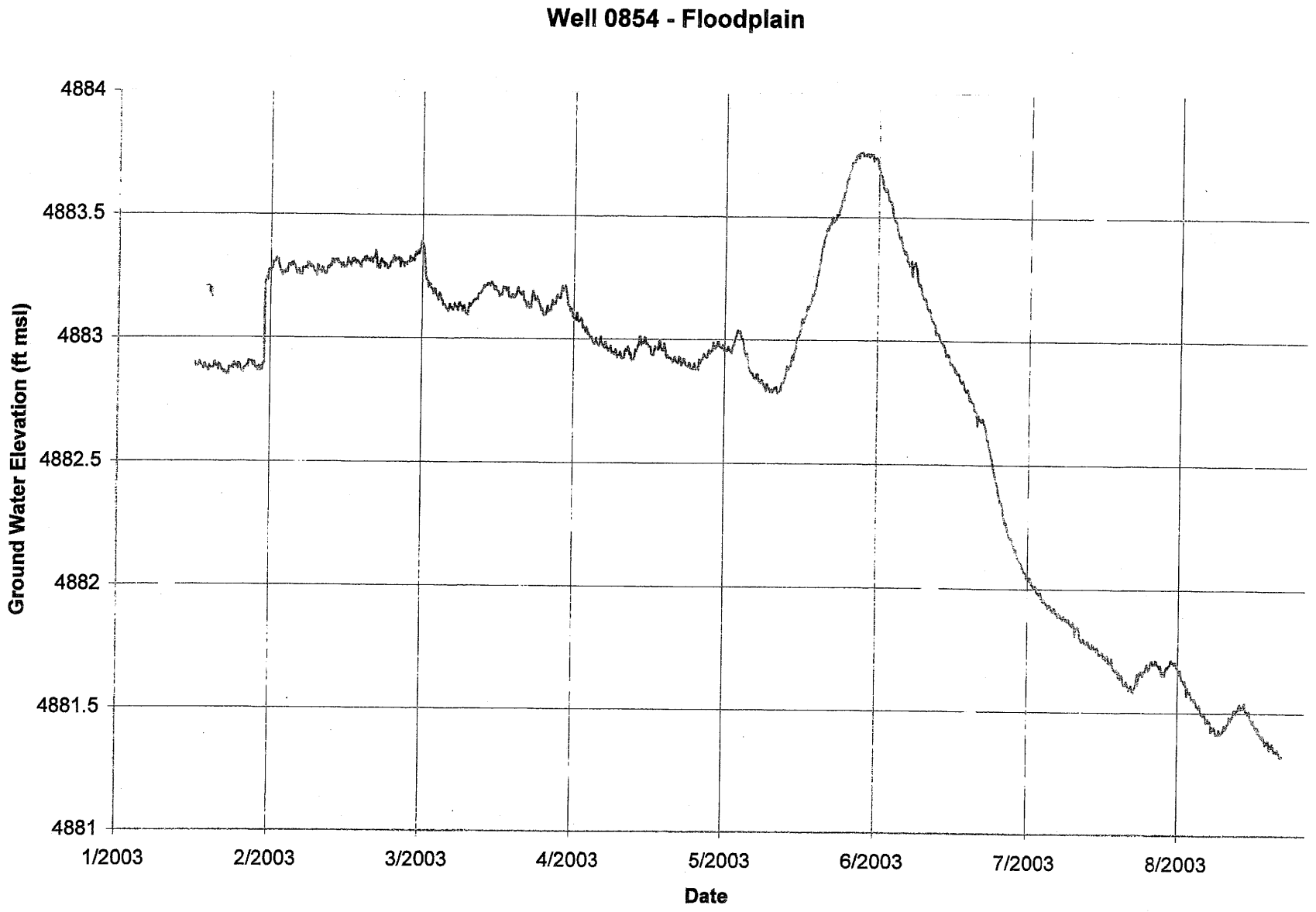
Floodplain Ground Water Elevation Data

(January through August 2003)

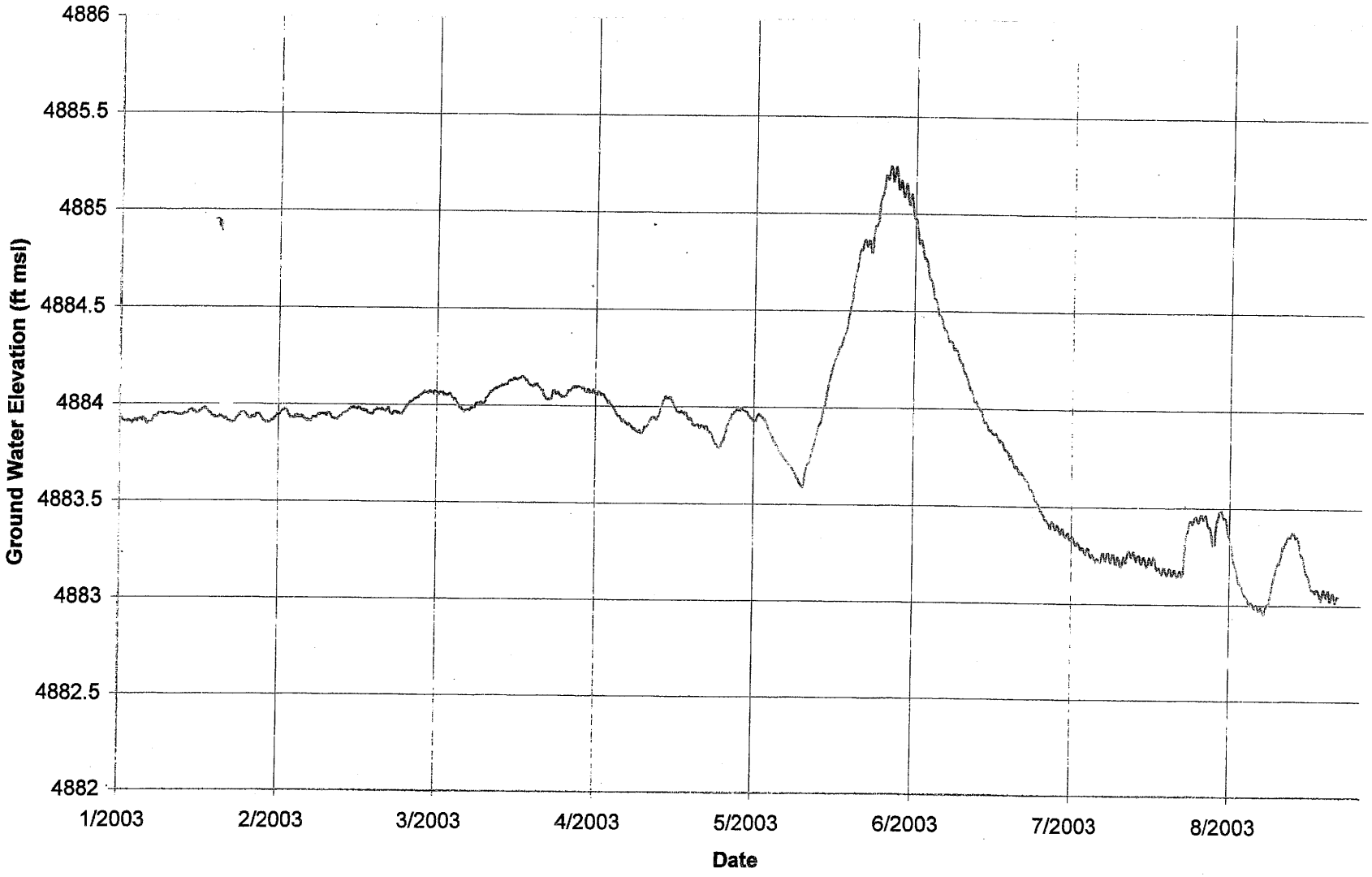
Well 0617 - Floodplain

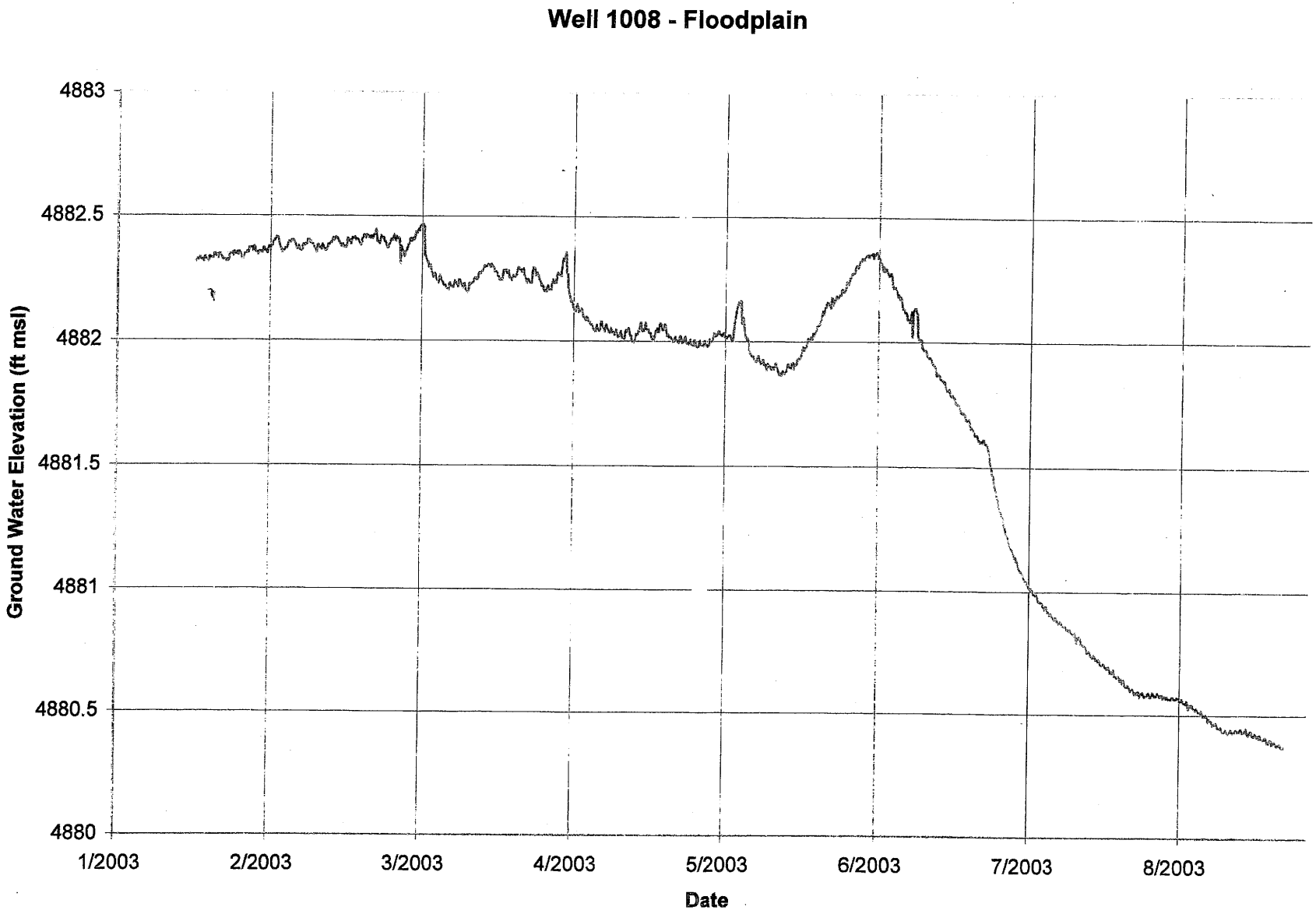



Well 0736 - Floodplain
Ground Water Elevation (ft msl)
4883
4882.5
4882
4881.5
4881
4880.5
4880
1/2003
2/2003
3/2003
4/2003
5/2003
6/2003
7/2003
8/2003
Date


Well 0854 - Floodplain
Ground Water Elevation (ft msl)
4884
4883.5
4883
4882.5
4882
4881.5
4881
1/2003
2/2003
3/2003
4/2003
5/2003
6/2003
7/2003
8/2003
Date

Well 0857 - Floodplain

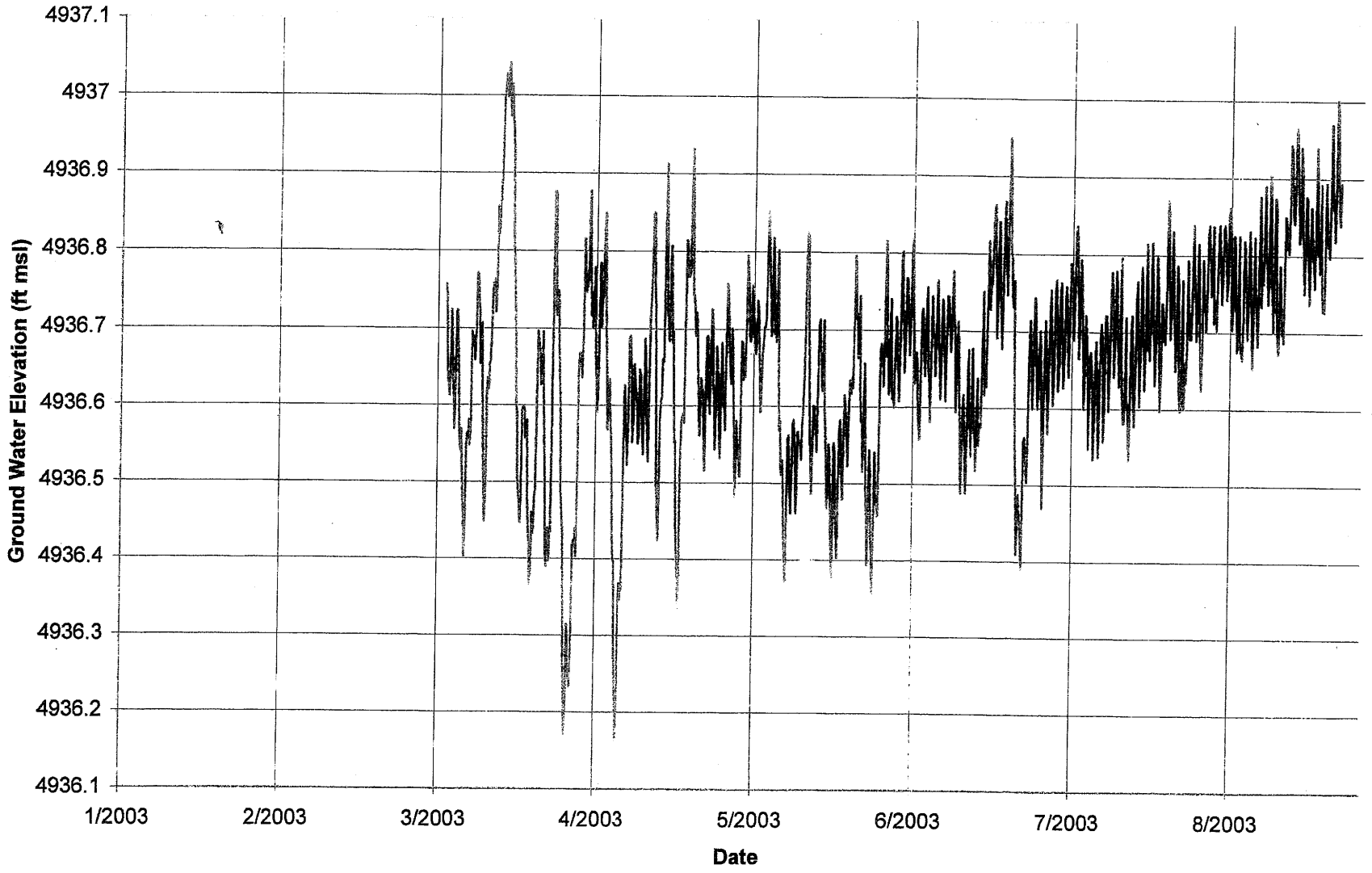



Well 1008 - Floodplain
Ground Water Elevation (ft msl)
4883
4882.5
4882
4881.5
4881
4880.5
4880
1/2003
2/2003
3/2003
4/2003
5/2003
6/2003
7/2003
8/2003
Date

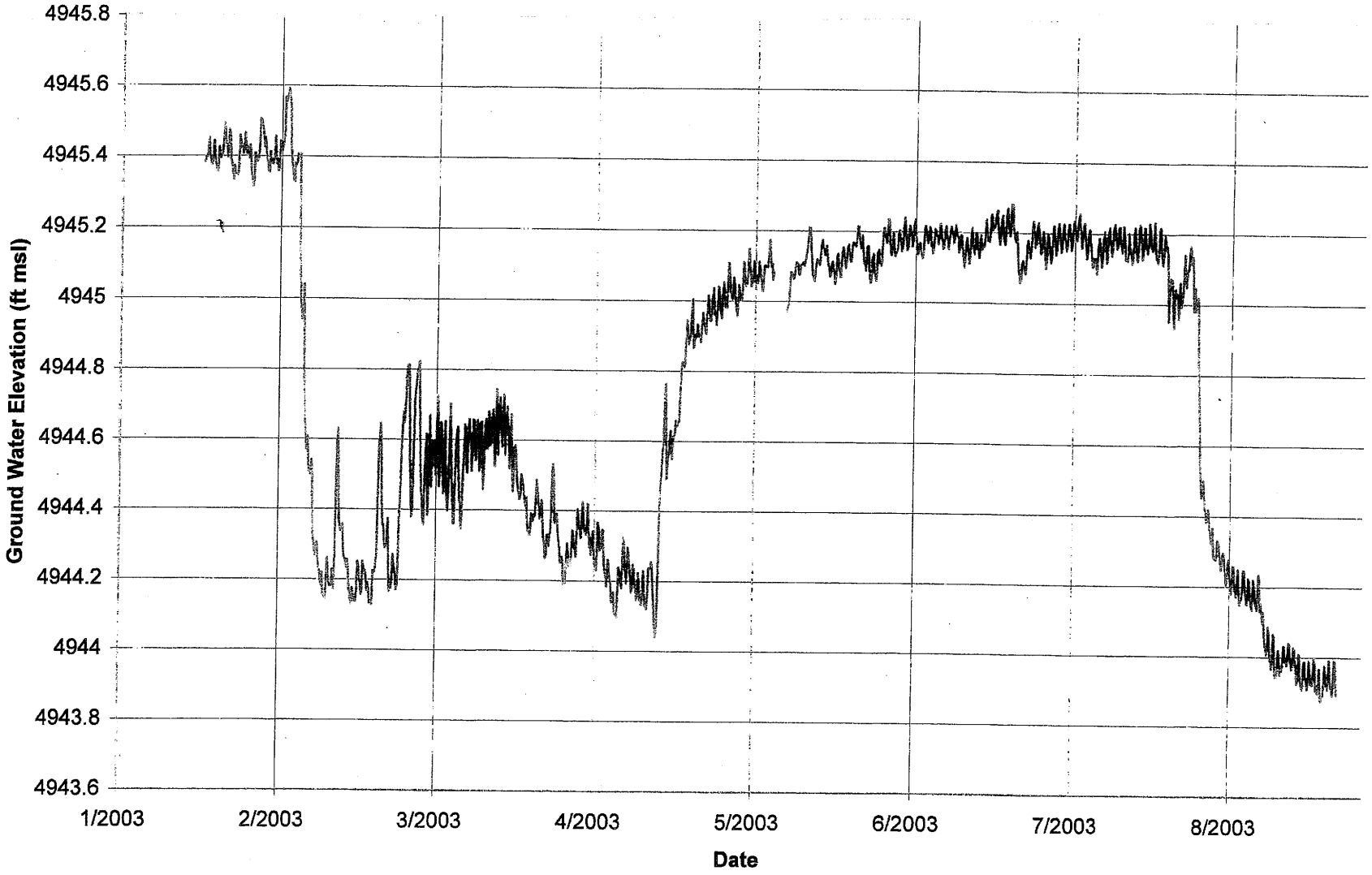
Terrace East Ground Water Elevation Data

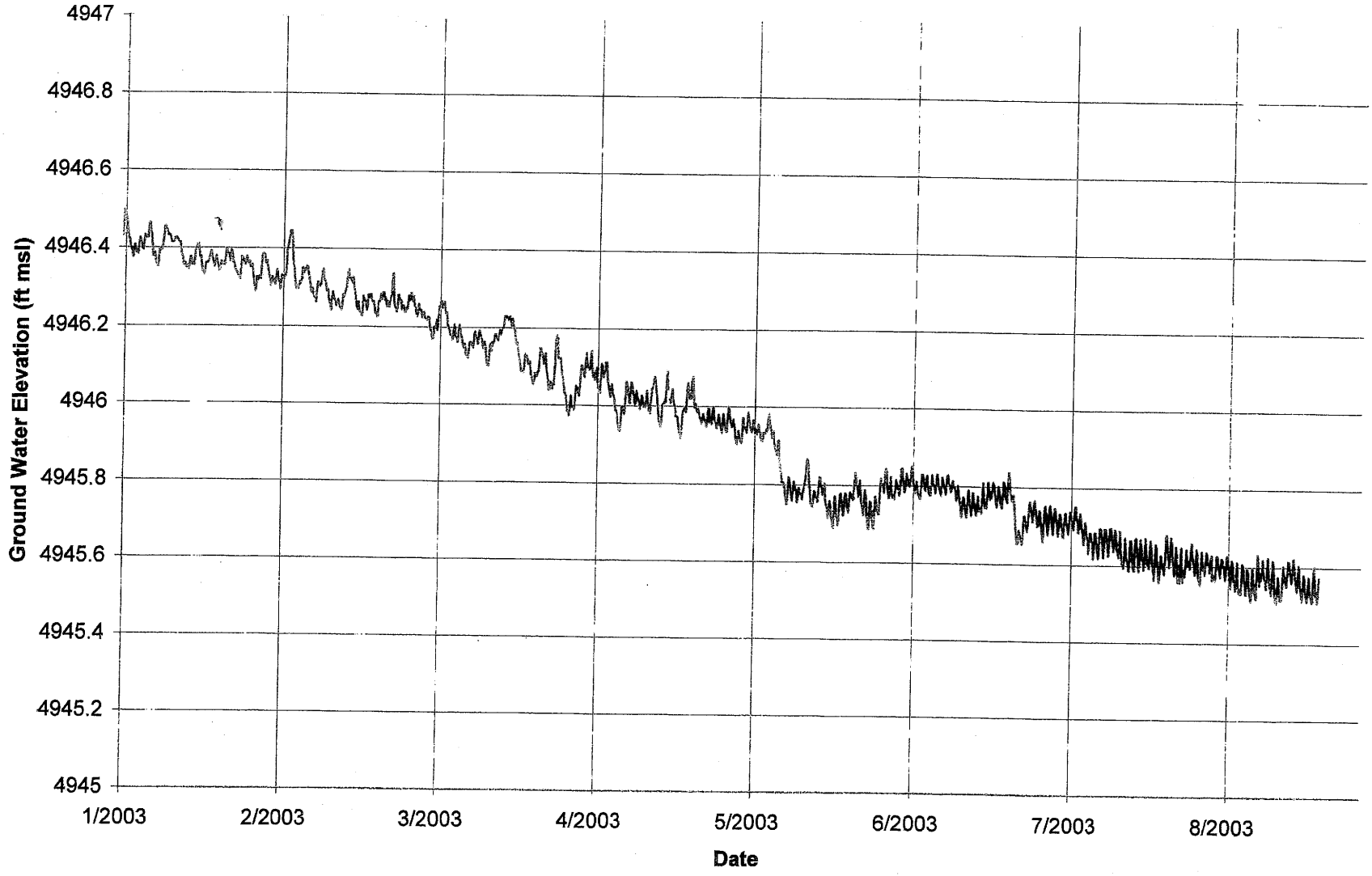
(January through August 2003)

Well 0602 - Terrace East (NECA Yard, NW of Disposal Cell)

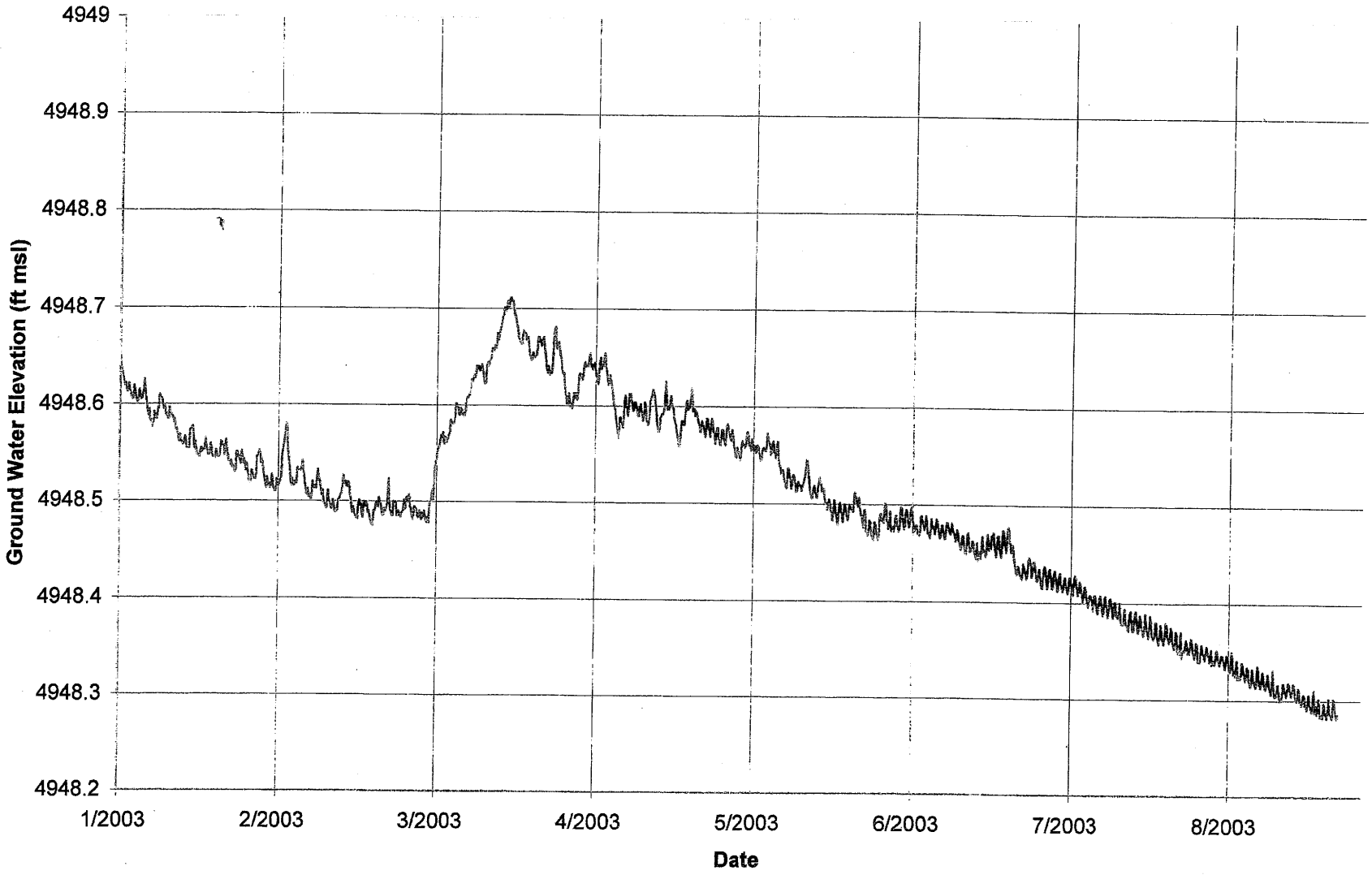


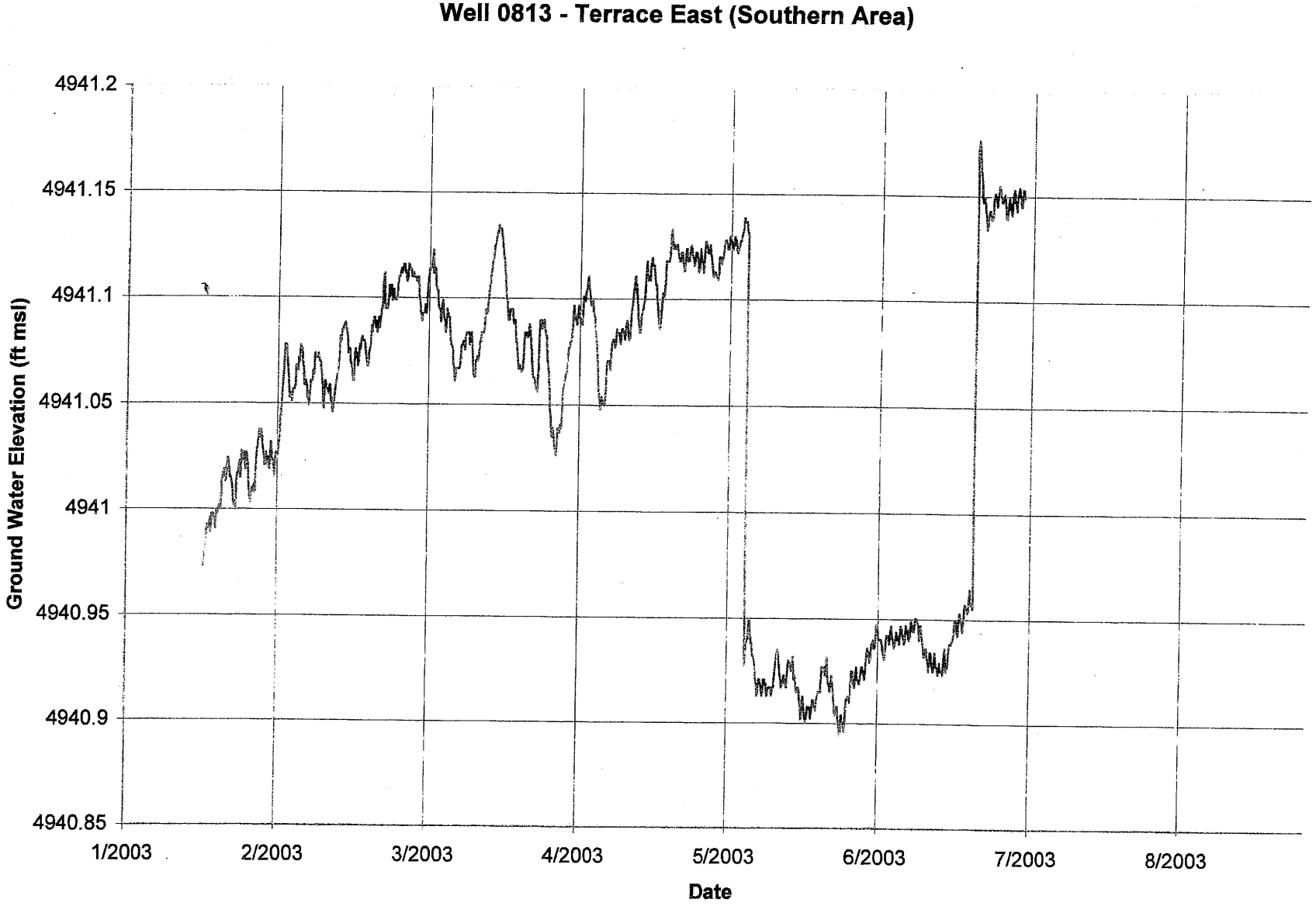
Well 0604 - Terrace East (Off Extraction Well 0818)



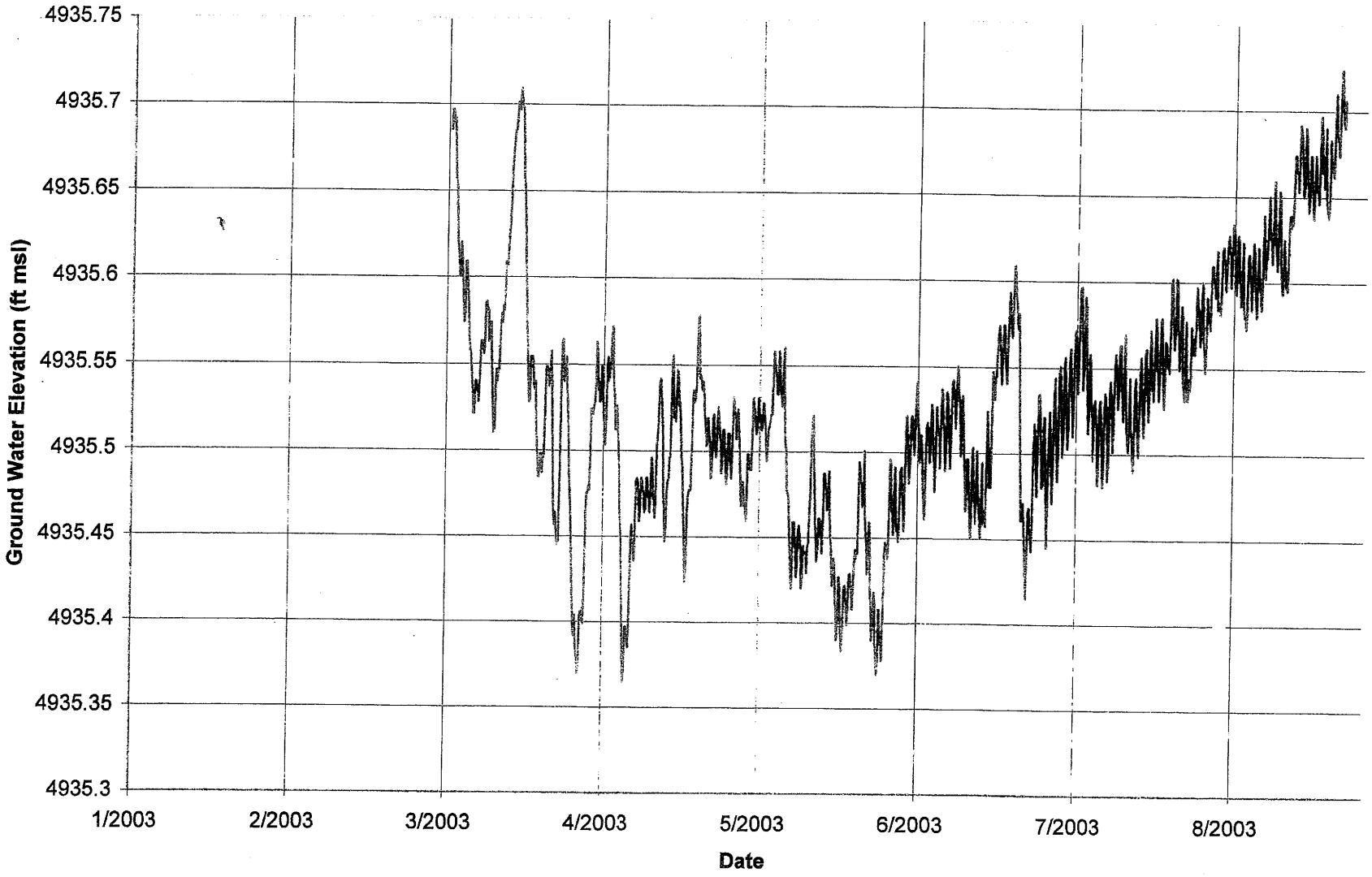

Well 0730 - Terrace East (SW of Disposal Cell)
Ground Water Elevation (ft msl)
4947
4946.8
4946.6
4946.4
4946.2
4946
4945.8
4945.6
4945.4
4945.2
4945
1/2003
2/2003
3/2003
4/2003
5/2003
6/2003
7/2003
8/2003
Date

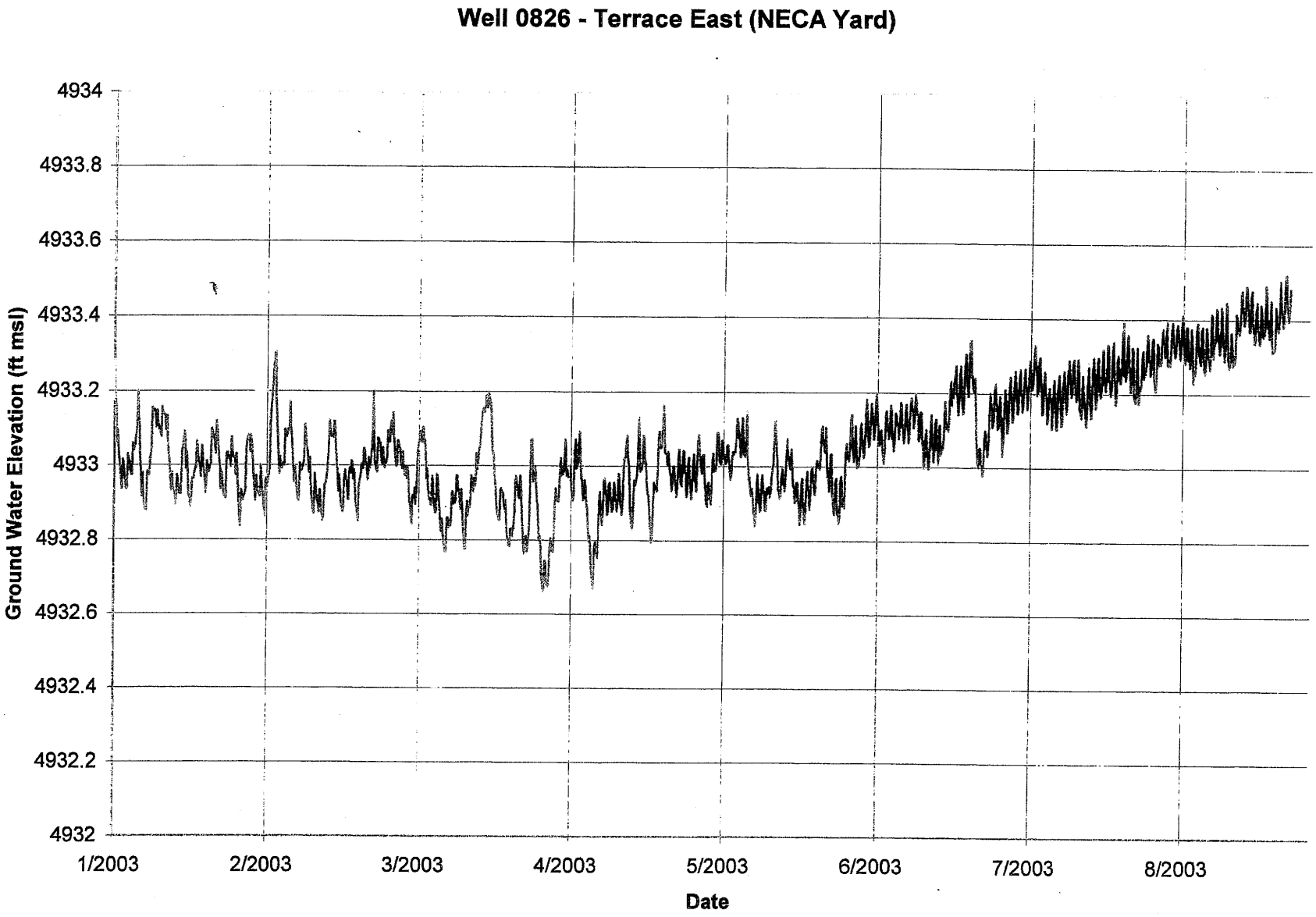
Well 0731 - Terrace East (East of the Evaporation Pond)



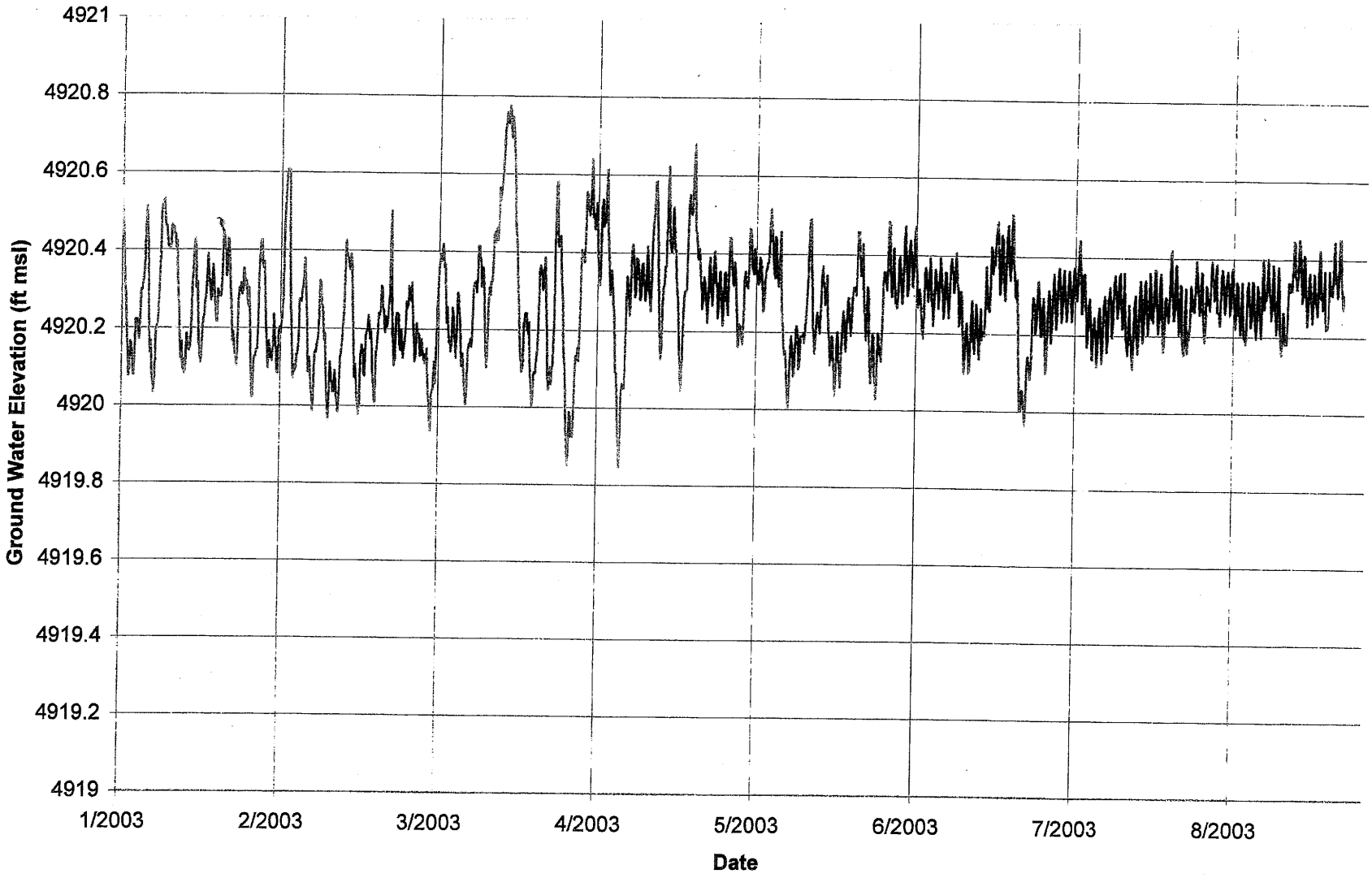

Well 0813 - Terrace East (Southern Area)
Ground Water Elevation (ft msl)
4941.2
4941.15
4941.1
4941.05
4941
4940.95
4940.9
4940.85
1/2003
2/2003
3/2003
4/2003
5/2003
6/2003
7/2003
8/2003
Date

Well 0819 - Terrace East (NECA Yard, NW of Disposal Cell)

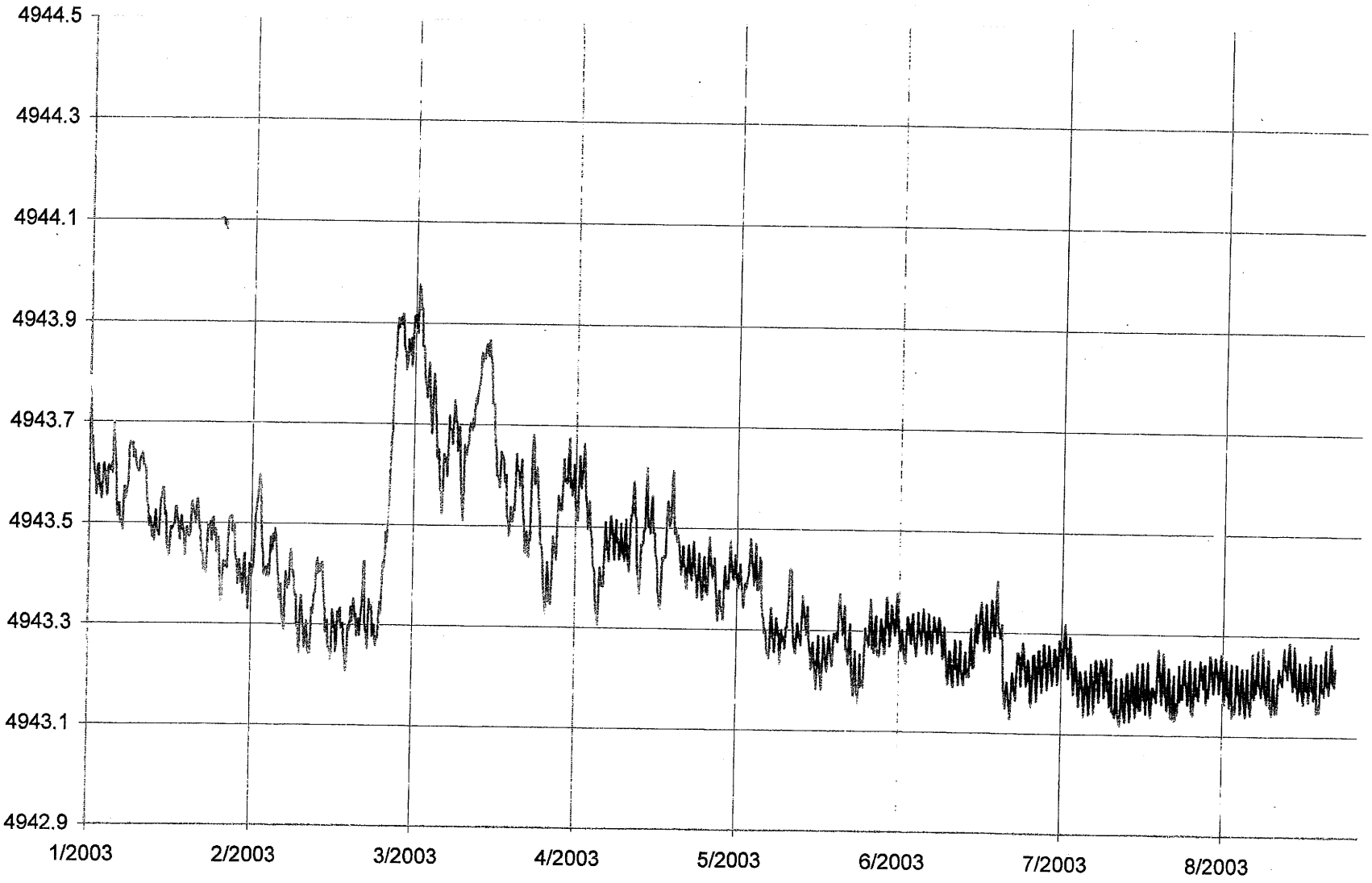



Well 0826 - Terrace East (NECA Yard)
Ground Water Elevation (ft msl)
4934
4933.8
4933.6
4933.4
4933.2
4933
4932.8
4932.6
4932.4
4932.2
4932
1/2003
2/2003
3/2003
4/2003
5/2003
6/2003
7/2003
8/2003
Date

Well 0827 - Terrace East (Off NW Corner of Disposal Cell)



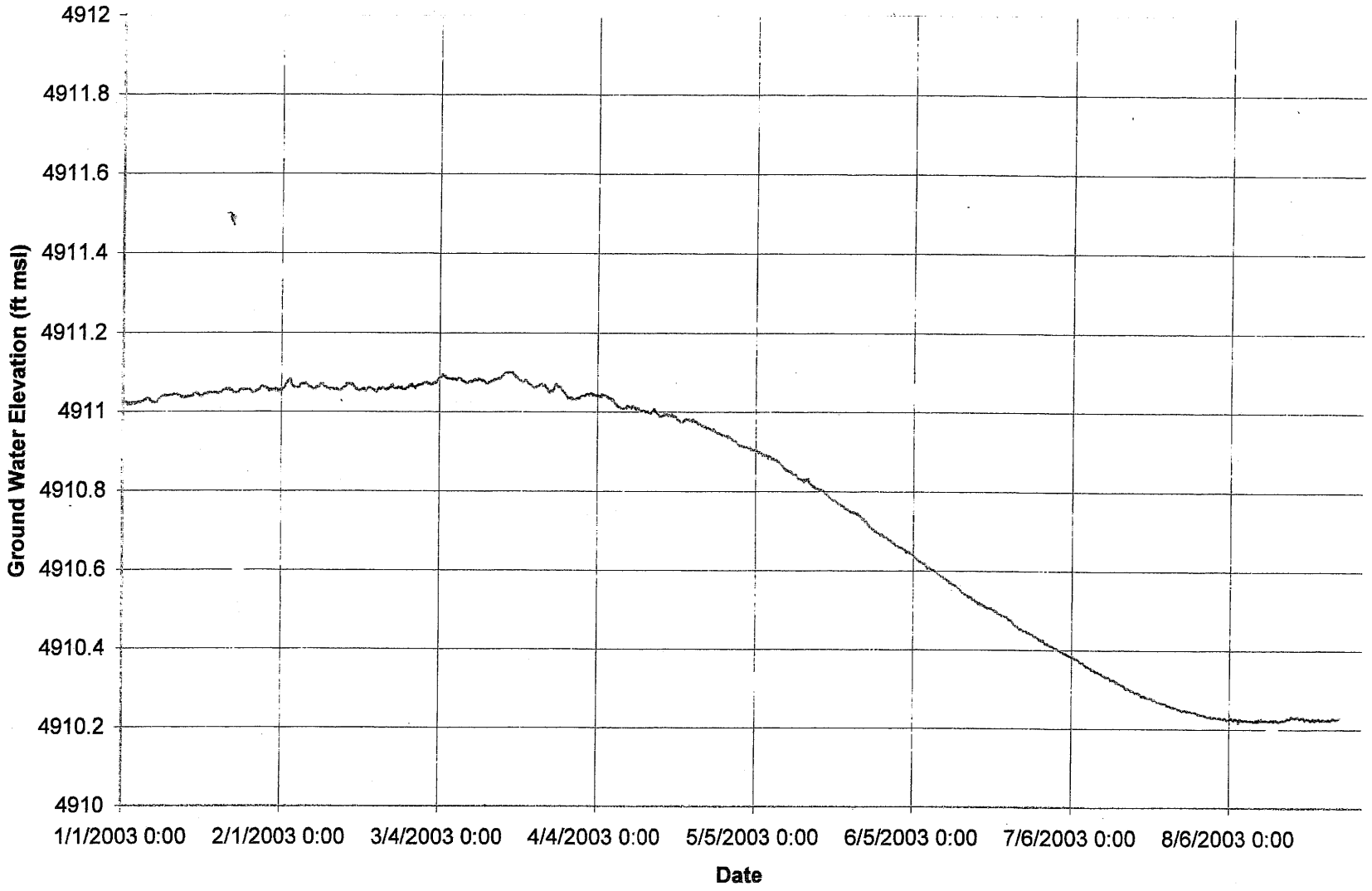
Well 0830 - Terrace East (SE of Disposal Cell)



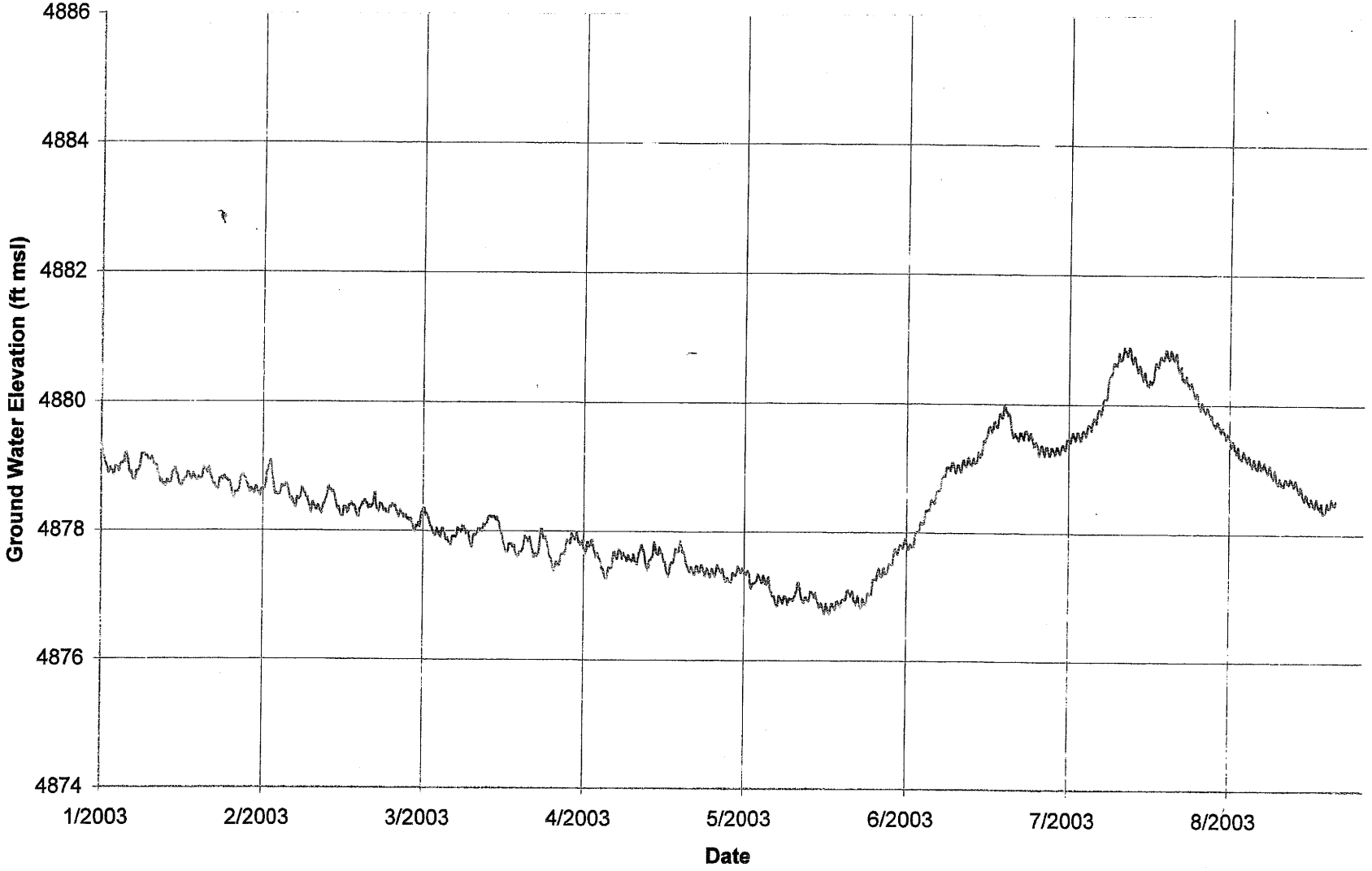
Terrace West Ground Water Elevation Data

(January through August 2003)

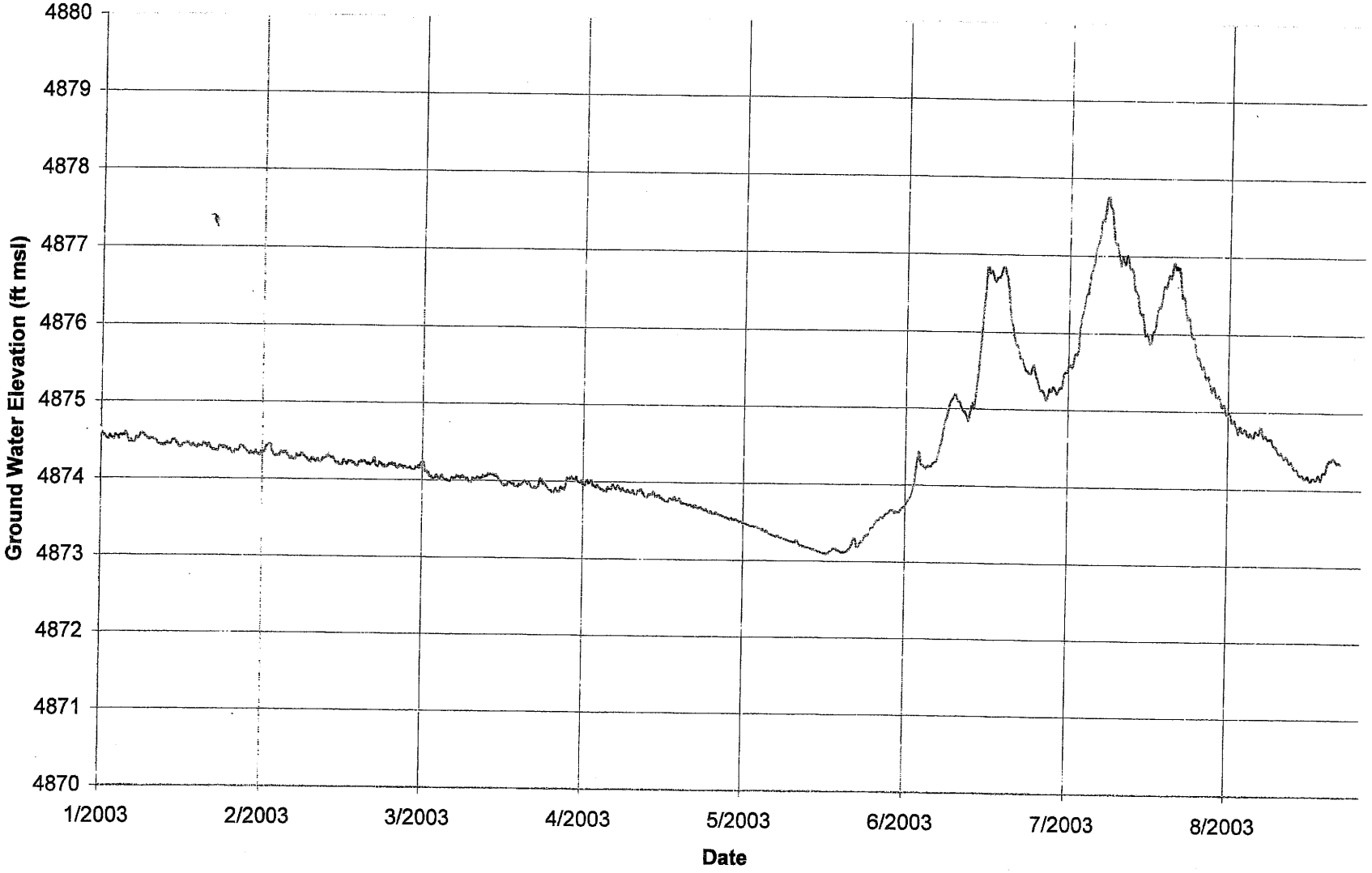
Well 0835 - Terrace West

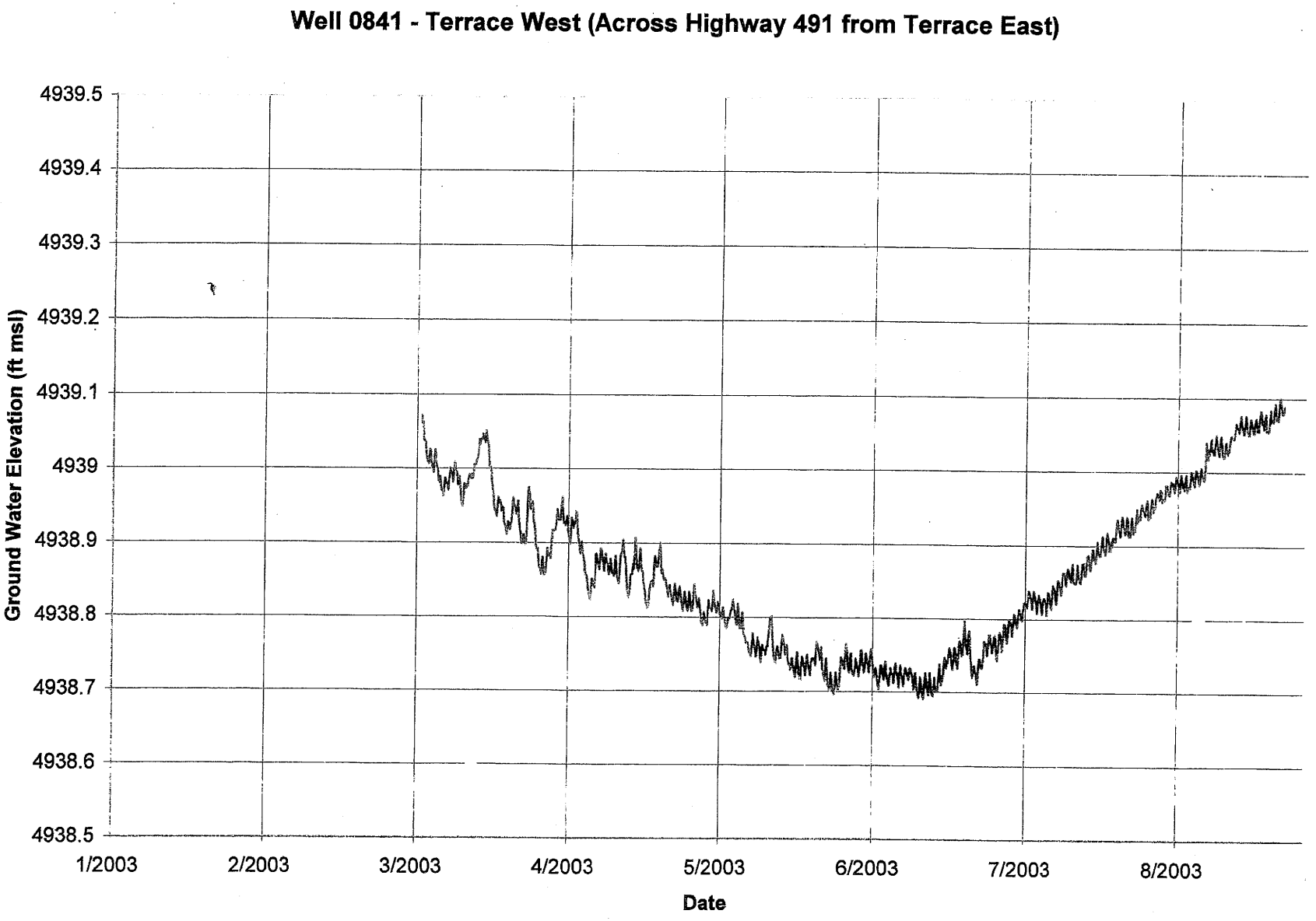


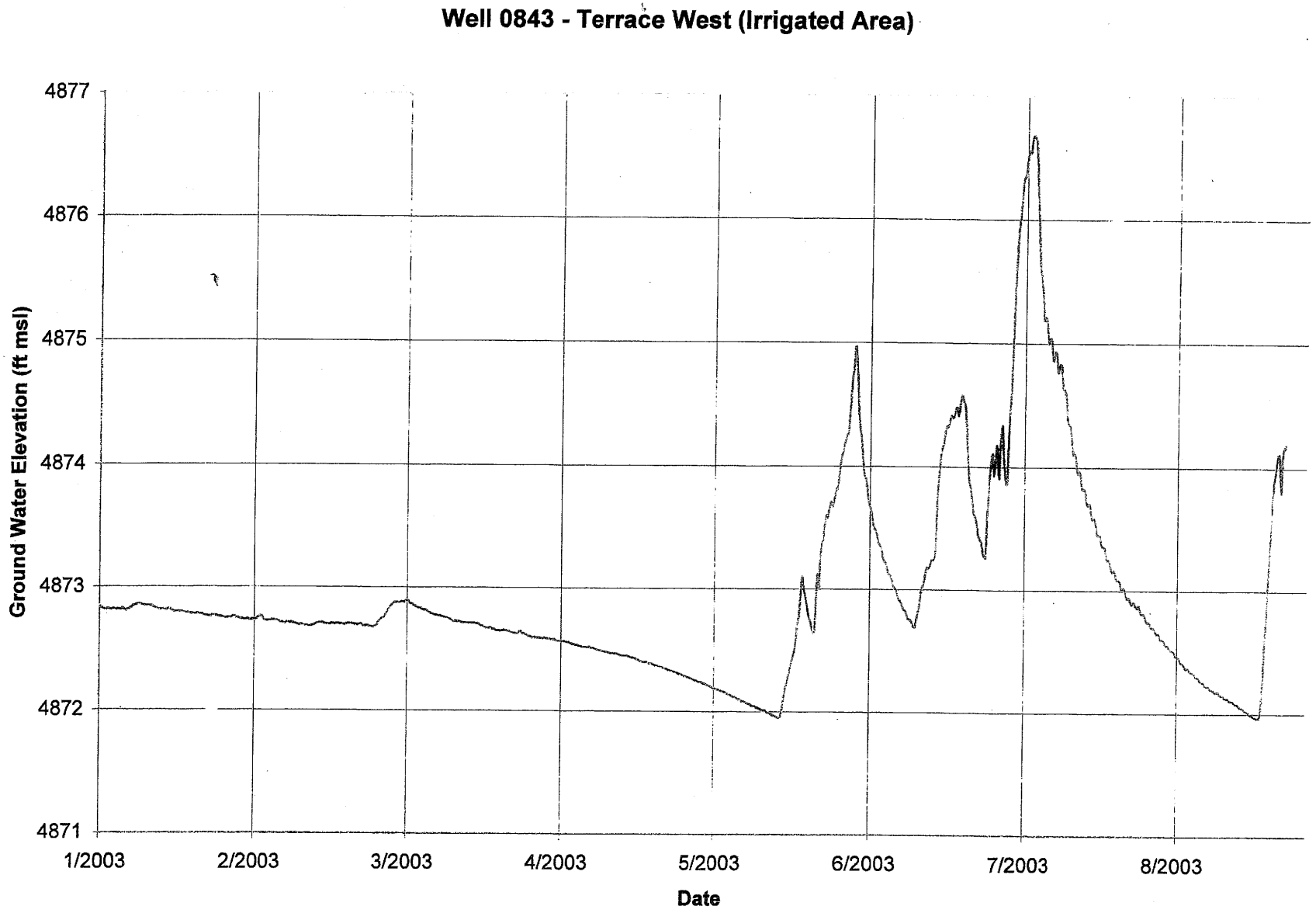
Well 0836 - Terrace West (Irrigated Area)



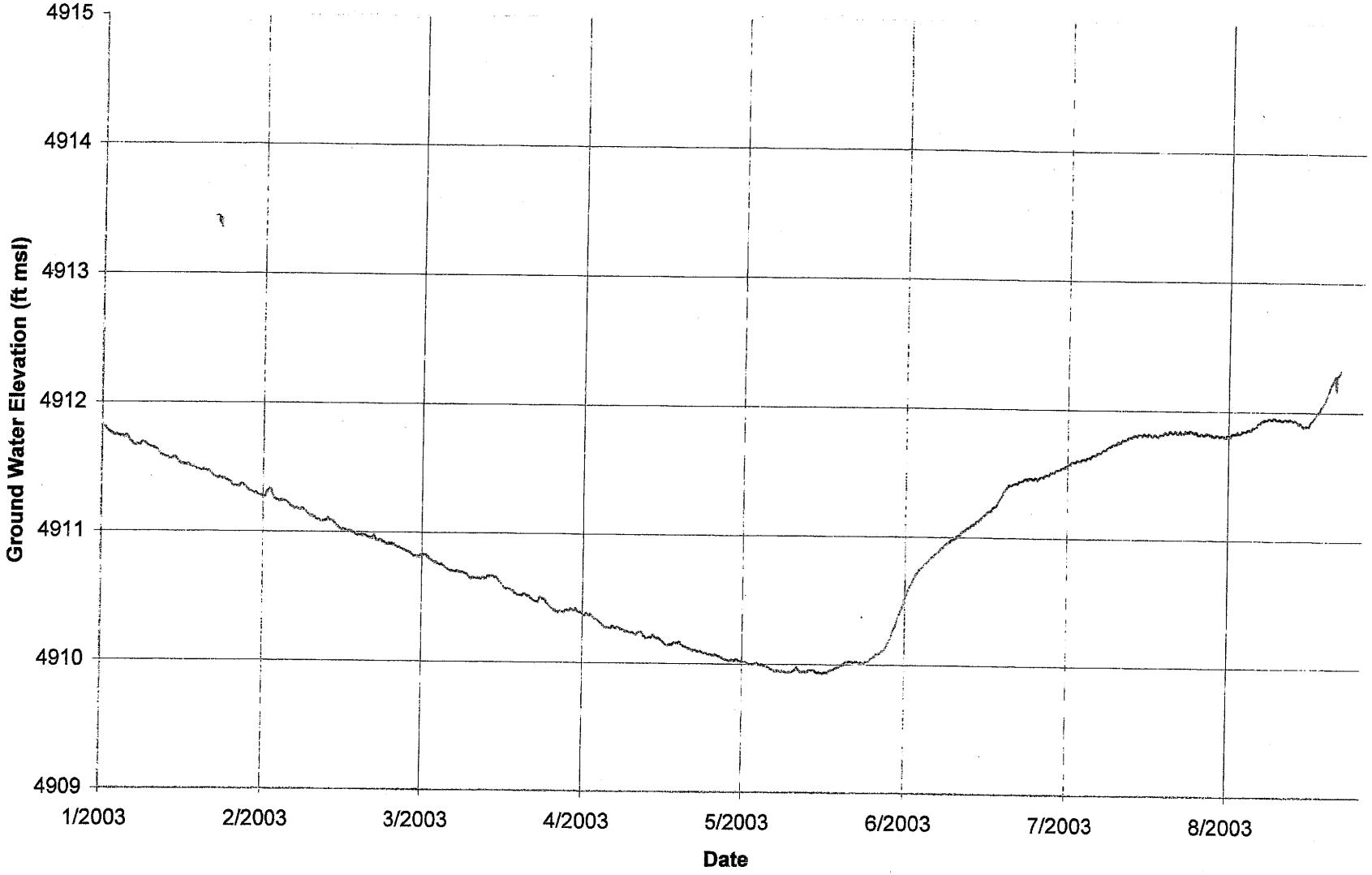
Well 0837 - Terrace West (Irrigated Area)



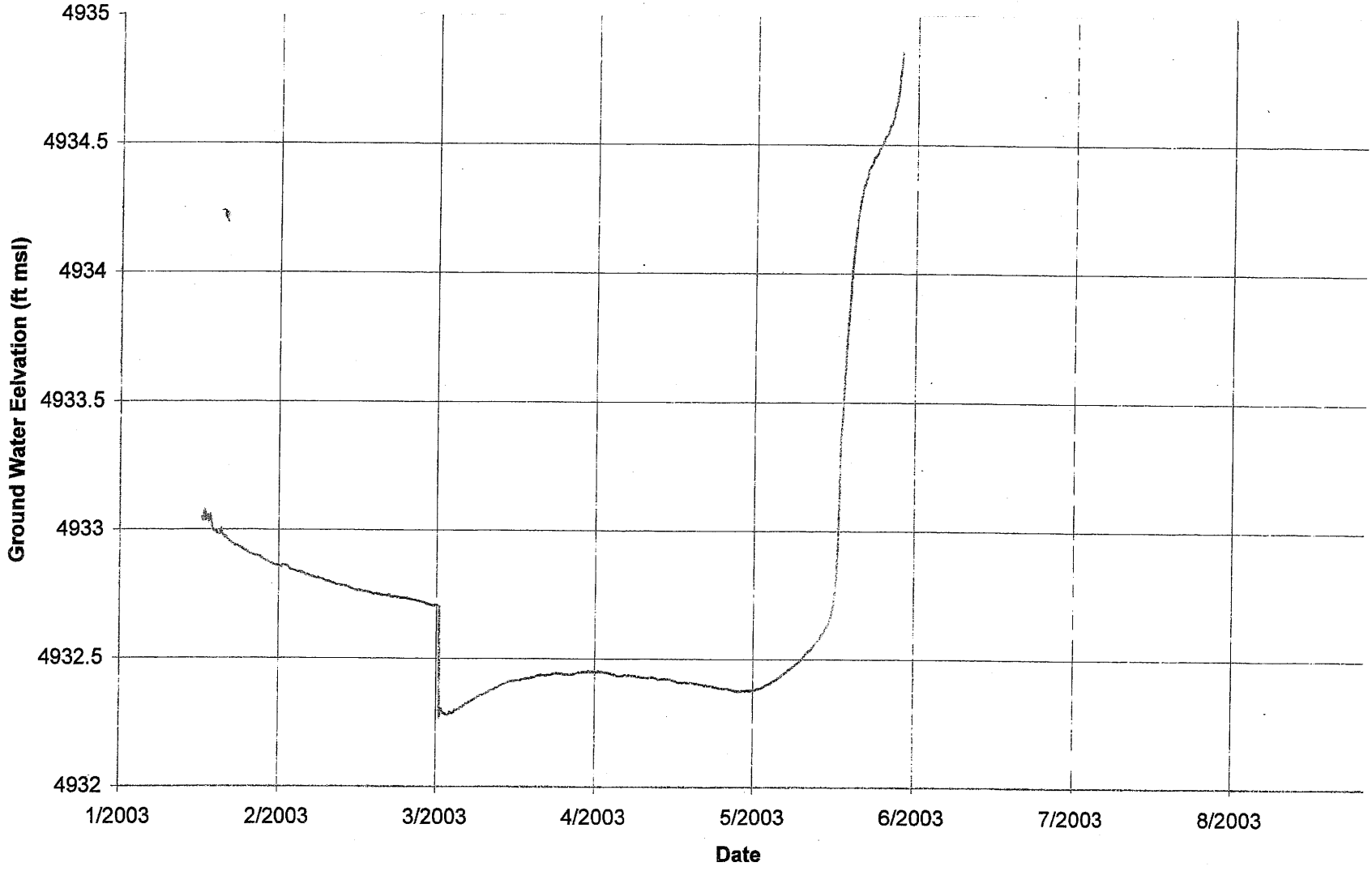

Well 0841 - Terrace West (Across Highway 491 from Terrace East)
Ground Water Elevation (ft msl)
4939.5
4939.4
4939.3
4939.2
4939.1
4939
4938.9
4938.8
4938.7
4938.6
4938.5
1/2003
2/2003
3/2003
4/2003
5/2003
6/2003
7/2003
8/2003
Date


Well 0843 - Terrace West (Irrigated Area)
Ground Water Elevation (ft msl)
4877
4876
4875
4874
4873
4872
4871
1/2003
2/2003
3/2003
4/2003
5/2003
6/2003
7/2003
8/2003
Date

Well 0846 - Terrace West (Just South of Hwy 64)



Well 1060 - Terrace West



Appendix C

Floodplain and Terrace Ground Water Extraction Well Data (February through August 2003)

This page intentionally left blank

Shiprock Terrace Well Field Pumping Rates

well	date/time	cum flow (gal)	end hr meter date/time	assumed cum flow (gal)	delta vol (gal)	delta t (min)	avg gpm
818	2/5/2003 14:40	2,565	2/5/2003 14:40	2,565			
	2/6/2003 9:20	6,106	**2/6/2003 9:20**	6,106	3541	1120	3.16
	2/6/2003 15:52	7,054	2/6/2003 15:52	7,054	948	392	2.42
	2/7/2003 8:33	9,441	**2/7/2003 8:33**	9,441	2388	1001	2.39
	2/10/2003 16:37	22,260	2/10/2003 16:37	22,260	12819	4804	2.67
	2/12/2003 14:25	27,320	2/12/2003 14:25	27,320	5060	2748	1.84
	3/14/2003 11:40	89,032	3/14/2003 11:40	89,032	61712	43035	1.43
	3/19/2003 11:37	97,136	3/19/2003 11:37	97,136	8104	7197	1.13
	3/21/2003 9:40	101,105	3/21/2003 9:40	101,105	3969	2763	1.44
	3/21/2003 12:11	101,323	3/21/2003 12:11	101,323	218	151	1.44
	3/24/2003 14:56	107,978	3/24/2003 14:56	107,978	6655	4485	1.48
	3/25/2003 16:34	110,266	3/25/2003 16:34	110,266	2288	1538	1.49
	3/28/2003 12:46	116,496	3/28/2003 12:46	116,496	6230	4092	1.52
	3/31/2003 12:56	123,219	3/31/2003 12:56	123,219	6723	4330	1.55
	4/2/2003 11:10	127,531	4/2/2003 11:10	127,531	4312	2774	1.55
	4/4/2003 12:23	132,122	4/4/2003 12:23	132,122	4591	2953	1.55
	4/7/2003 11:27	138,830	4/7/2003 11:27	138,830	6708	4264	1.57
	4/9/2003 11:50	143,465	4/9/2003 11:50	143,465	4635	2903	1.60
	4/11/2003 12:01	148,120	4/11/2003 12:01	148,120	4655	2891	1.61
	4/14/2003 11:48	155,235	4/14/2003 11:48	155,235	7115	4307	1.65
	4/16/2003 15:23	159,392	4/16/2003 15:23	159,392	4157	3095	1.34
	4/18/2003 12:00	160,500	4/18/2003 12:00	160,500	1108	2677	0.41
	4/21/2003 10:12	161765 (?)	4/21/2003 10:12	161,765			
	4/23/2003 9:10	161,117	4/23/2003 9:10	161,117			
	4/25/2003 10:15	161,117	4/25/2003 13:00	176,431			
	4/28/2003 16:13	161,117	4/28/2003 17:02	183,474	7043	4562	1.54
	4/30/2003 8:54	161,117	4/30/2003 10:15	187,346	3872	2473	1.57
	5/2/2003 14:30	161,117	5/2/2003 15:20	192,316	4970	3185	1.56
	5/5/2003 12:50	161,117	5/5/2003 12:50	198,852	6536	4170	1.57
	5/7/2003 14:40	161,117	5/7/2003 14:40	203,541	4689	2990	1.57
	5/9/2003 13:40	161,117	5/9/2003 13:40	207,844	4302	2820	1.53
	5/12/2003 11:45	161,117	5/12/2003 12:40	214,453	6610	4260	1.55
	5/16/2003 8:55	161,117	5/16/2003 10:35	223,455	9002	5635	1.60
	5/19/2003 12:15	161,117	5/19/2003 13:00	230,343	6888	4465	1.54
	5/21/2003 8:15	161,117	5/21/2003 9:50	234,638	4295	2690	1.60
	5/23/2003 10:36	161,117	5/23/2003 11:17	239,285	4647	2967	1.57
	5/28/2003 9:16	161,117	5/28/2003 10:00	250,448	11164	7123	1.57
	5/30/2003 12:08	161,117	5/30/2003 12:29	255,159	4711	3029	1.56
	6/6/2003 12:40	161,117	6/6/2003 9:40	270,696	15537	9911	1.57
	6/9/2003 10:00	161,117	6/9/2003 13:30	277,717	7020	4550	1.54
	6/11/2003 13:57	161,223	6/11/2003 15:30	282,158	4441	3000	1.48
	6/13/2003 11:20	161,264	6/13/2003 11:30	282,269	111	2640	0.04
	6/16/2003 12:30	161,254	6/16/2003 13:00	282,491	223	4410	0.05
	6/20/2003 15:24	161,265	6/20/2003 15:37	282,643	151	5917	0.03
	6/23/2003 15:08	161,254	6/23/2003 15:27	282,893	250	4310	0.06
	6/25/2003 14:06	161,254	6/25/2003 15:48	283,105	212	2901	0.07
	6/27/2003 12:40	161,254	6/27/2003 13:30	283,315	423	5643	0.07
	6/30/2003 15:28	161,254	6/30/2003 15:32	283,785	470	4442	0.11
	7/3/2003 10:38	161,426	7/3/2003 11:05	284,295	510	4053	0.13
	7/7/2003 10:55	161,426	7/7/2003 11:40	285,086	790	5795	0.14
	7/9/2003 12:20	161,615	7/9/2003 14:50	285,742	657	3070	0.21
	7/11/2003 10:07	161,726	7/11/2003 10:21	286,114	372	2611	0.14
	7/14/2003 12:00	161,727	7/14/2003 12:30	286,731	616	4449	0.14
	7/18/2003 10:11	161,728	7/18/2003 10:44	287,251	521	5654	0.09
	7/21/2003 9:00	161,728	7/21/2003 9:28	287,251	0	4244	0.00
	7/23/2003 16:00	161,891	7/23/2003 18:35	287,697	445	3427	0.13
	7/25/2003 14:25	163,561	7/25/2003 14:45	288,645	948	2650	0.36
	7/28/2003 11:16		7/28/2003 11:36	289,495	850	4131	0.21
	7/30/2003 9:47	165,140	7/30/2003 12:00	291,700	2205	2904	0.76
	8/1/2003 10:40	172,317	8/1/2003 11:10	293,817	2117	2830	0.75
	8/4/2003 8:37	180,604	8/4/03 8:57	296,426	2609	4187	1.97
	8/6/2003 15:22	186,706	8/6/03 15:47	302,528	6102	3290	1.86
	8/8/2003 9:16	191,118	8/8/03 9:25	306,940	4412	2498	1.75
			8/11/2003 10:35	314,478			1.71
			8/15/03 9:24	325,433			1.93
			8/18/2003 11:21	333,803			1.89
			8/20/03 12:32	339,269			1.85
			8/22/2003 10:49	344,278			1.80
			8/25/2003 16:07	352,459			1.76
			8/27/2003 9:45	356,792			1.73
			8/29/2003 11:30	361,880			1.70
						avg	**1.25**

Shiprock Terrace Well Field Pumping Rates

well	date/time	cum flow (gal)	delta vol (gal)	delta t (min)	avg gpm
1070	2/5/2003 14:45	323			
	2/6/2003 9:10	1,475	1152.1	1105	1.04
	2/6/2003 15:45	1,860	385.7	395	0.98
	2/7/2003 8:33	2,751	890.6	1008	0.88
	2/10/2003 16:44	5,857	3105.6	4811	0.65
	2/12/2003 14:12	7,635	1778.9	2728	0.65
	3/14/2003 11:45	30,950	23314.5	43053	0.54
	3/19/2003 11:45	34,543	3593.1	7200	0.50
	3/21/2003 9:55	35,813	1270.4	2770	0.46
	3/21/2003 12:26	35,878	64.6	151	0.43
	3/24/2003 15:10	37,905	2027.3	4484	0.45
	3/26/2003 9:17	39,019	1113.4	2527	0.44
	3/28/2003 12:54	40,465	1446.5	3097	0.47
	3/31/2003 13:00	42,482	2016.5	4326	0.47
	4/2/2003 11:27	43,864	1381.8	2787	0.50
	4/4/2003 12:30	45,209	1345.6	2943	0.46
	4/7/2003 11:55	47,134	1924.6	4285	0.45
	4/9/2003 12:10	48,429	1295.4	2895	0.45
	4/11/2003 12:05	49,773	1344	2875	0.47
	4/14/2003 11:52				
	4/16/2003 15:02	51,398			
	4/18/2003 12:15	52,747	1349.3	2713	0.50
	4/21/2003 9:56	54,755	2008	4181	0.48
	4/23/2003 8:56	56,314	1558.7	2820	0.55
	4/25/2003 10:15	57,978	1664.4	2959	0.56
	4/28/2003 16:09	60,590	2611.3	4674	0.56
	4/30/2003 8:50	61,975	1385.7	2441	0.57
	5/2/2003 15:00	63,758	1782.5	3250	0.55
	5/5/2003 11:48	66,144	2386	4128	0.58
	5/7/2003 13:09	67,796	1652.1	2961	0.56
	5/9/2003 13:20	69,377	1581.2	2891	0.55
	5/12/2003 12:15	71,717	2339.6	4255	0.55
	5/16/2003 8:45	74,841	3124.4	5550	0.56
	5/19/2003 12:44	77,312	2470.3	4559	0.54
	5/21/2003 8:20	78,773	1461.9	2616	0.56
	5/23/2003 10:31	80,406	1633	3011	0.54
	5/28/2003 9:16	84,569	4162.1	7125	0.58
	5/30/2003 11:19	86,229	1660.5	3003	0.55
	6/6/2003 11:54	91,906	5677.2	10115	0.56
	6/9/2003 13:15	94,328	2421.3	4401	0.55
	6/11/2003 13:54	95,989	1661.5	2919	0.57
	6/13/2003 11:35	97,499	1509.5	2741	0.55
	6/16/2003 12:50	99,903	2404.5	4395	0.55
	6/20/2003 15:29	103,231	3328	5919	0.56
	6/23/2003 15:03	105,706	2475	4294	0.58
	6/25/2003 13:54	107,312	1606	2811	0.57
	6/27/2003 13:15	108,751	3045	5652	0.54
	6/30/2003 15:34	111,332	2581	4459	0.58
	7/3/2003 10:50	113,549	2217	4036	0.55
	7/7/2003 11:30	116,743	3194	5800	0.55
	7/9/2003 9:55	118,298	1555	2785	0.56
	7/11/2003 10:12	119,851	1553	2897	0.54
	7/14/2003 12:22	122,247	2396	4450	0.54
	7/18/2003 10:30	125,337	3090	5648	0.55
	7/21/2003 9:18	127,647	2310	4248	0.54
	7/23/2003 18:20	129,593	1946	3422	0.57
	7/25/2003 14:34	131,052	1459	2654	0.55
	7/28/2003 11:22	133,132	2080	4128	0.50
	7/30/2003 9:44	134,754	1622	2782	0.58
	8/1/2003 10:57	136,225	1471	2953	0.50
	8/4/2003 8:50	138,506	2281	4193	0.54
	8/6/2003 15:26	140,157	1651	3276	0.50
	8/8/2003 9:19	141,377	1220	2513	0.49
	8/11/2003 10:55	143,494	2117	4416	0.48
	8/15/03 9:30	146,104	2610	5675	0.46
	8/18/2003 11:35	148,262	2158	4445	0.49
	8/20/03 13:47	149,704	1442	3012	0.48
	8/22/2003 11:15	151,003	1299	2728	0.48
	8/25/2003 16:12	153,101	2098	4617	0.45
	8/27/2003 9:40	154,267	1166	2488	0.47
	8/29/2003 11:40	155,632	1365	3000	0.46
				avg	**0.54**

Shiprock Terrace Well Field Pumping Rates

well	date/time	cum flow (gal)	delta vol (gal)	delta t (min)	avg gpm
1071	2/5/2003 16:23	239			
	2/6/2003 9:35	408	169.3	1032	0.16
	2/6/2003 16:10	466	57.7	395	0.15
	2/7/2003 12:25	664	198.1	1215	0.16
	2/10/2003 16:33	1,351	687.3	4568	0.15
	2/12/2003 13:47	1,764	412.3	2714	0.15
	3/14/2003 11:30	7,865	6101.7	43063	0.14
	3/19/2003 11:00	8,767	901.8	7170	0.13
	3/21/2003 9:50	9,020	252.7	2810	0.09
	3/21/2003 13:02	9,031	11.4	192	0.06
	3/24/2003 15:32	9,431	399.6	4470	0.09
	3/25/2003 16:21	9,553	122.6	1489	0.08
	3/28/2003 12:28	9,862	308.47	4087	0.08
	3/31/2003 12:38	10,191	328.73	4330	0.08
	4/2/2003 11:43	10,453	262.2	2825	0.09
	4/4/2003 12:04	10,740	287.7	2901	0.10
	4/7/2003 11:13	11,157	416.2	4269	0.10
	4/9/2003 12:04	11,409	252.1	2931	0.09
	4/11/2003 11:40	11,623	214.4	2856	0.08
	4/14/2003 11:24	12,039	415.9	4304	0.10
	4/16/2003 16:30	***12,250***	211	3186	0.07
	4/18/2003 12:07	12,565	315.4	2617	0.12
	4/21/2003 10:30	13,062	496.5	4223	0.12
	4/23/2003 9:15	13,414	352.1	2805	0.13
	4/25/2003 10:27	13,782	367.6	2952	0.12
	4/28/2003 16:18	14,366	584.5	4671	0.13
	4/30/2003 8:59	14,666	300	2441	0.12
	5/2/2003 13:55	15,072	406.2	3176	0.13
	5/5/2003 12:27	15,634	561.9	4232	0.13
	5/7/2003 13:20	16,038	403.8	2933	0.14
	5/9/2003 12:25	16,405	366.8	2825	0.13
	5/12/2003 11:21	16,964	559.5	4256	0.13
	5/16/2003 9:05	17,671	706.3	5624	0.13
	5/19/2003 11:50	18,225	554	4485	0.12
	5/21/2003 8:23	18,555	330.6	2673	0.12
	5/23/2003 10:17	18,926	370.6	2994	0.12
	5/28/2003 9:23	19,809	883.3	7146	0.12
	5/30/2003 11:11	20,169	359.8	2988	0.12
	6/6/2003 11:48	21,351	1182	10117	0.12
	6/9/2003 12:10	21,876	525.4	4342	0.12
	6/11/2003 14:01	22,228	351.7	2991	0.12
	6/13/2003 11:05	22,554	326.2	2704	0.12
	6/16/2003 12:11	23,041	486.8	4386	0.11
	6/20/2003 15:17	23,681	640	5946	0.11
	6/23/2003 14:57	24,142	460.5	4300	0.11
	6/25/2003 14:23	24,446	304.5	2846	0.11
	6/27/2003 12:15	24,712	570.5	5598	0.10
	6/30/2003 15:23	25,174	462.4	4508	0.10
	7/3/2003 10:22	25,561	386.6	4019	0.10
	7/7/2003 10:30	26,104	543	5768	0.09
	7/9/2003 14:35	26,381	277	3125	0.09
	7/11/2003 10:03	26,622	241	2608	0.09
	7/14/2003 11:46	27,001	379	4423	0.09
	7/18/2003 9:49	27,486	485	5643	0.09
	7/21/2003 8:39	27,827	341	4250	0.08
	7/23/2003 18:25	28,090	263	3466	0.08
	7/25/2003 14:15	28,298	208	2630	0.08
	7/28/2003 11:14	28,625	327	4139	0.08
	7/30/2003 10:16	28,845	220	2822	0.08
	8/1/2003 10:57	29,075	230	2921	0.08
	8/4/2003 8:50	29,405	330	4193	0.08
	8/6/2003 15:35	29,663	258	3285	0.08
	8/8/2003 9:10	29,861	198	2495	0.08
	8/11/2003 10:15	30,219	358	4385	0.08
	8/15/03 9:19	30,644	425	5704	0.07
	8/18/2003 11:11	30,968	324	4432	0.07
	8/20/03 13:00	31,190	222	2989	0.07
	8/22/2003 10:33	31,379	189	2733	0.07
	8/25/2003 16:04	31,698	319	4651	0.07
	8/27/2003 9:55	31,872	174	2511	0.07
	8/29/2003 11:10	32,079	207	2955	0.07
				avg	**0.10**

Shiprock Terrace Well Field Pumping Rates

well	date/time	cum flow (gal)	delta vol (gal)	delta t (min)	avg gpm
1078	2/5/2003 15:38	262			
	2/6/2003 9:40	1,326	1063.5	1082	0.98
	2/6/2003 16:20	1,702	376.4	400	0.94
	2/7/2003 12:45	2,879	1176.6	1225	0.96
	2/10/2003 16:28	7,265	4385.8	4543	0.97
	2/12/2003 13:05	9,630	2365.7	2677	0.88
	3/14/2003 11:15	44,391	34760.7	43090	0.81
	3/19/2003 10:46	49,633	5242	7171	0.73
	3/21/2003 9:35	51,635	2001.5	2809	0.71
	3/21/2003 11:42	51,729	94.6	127	0.74
	3/24/2003 14:28	54,463	2734	4486	0.61
	3/25/2003 15:48	55,382	918.9	1520	0.60
	3/28/2003 11:50	57,243	1861	4082	0.46
	3/31/2003 12:00	59,374	2131.4	4330	0.49
	4/2/2003 10:56	60,845	1470.1	2816	0.52
	4/4/2003 11:52	62,459	1614.1	2936	0.55
	4/7/2003 10:56	65,138	2679.6	4264	0.63
	4/9/2003 11:37	67,091	1952.3	2921	0.67
	4/11/2003 11:25	68,999	1908.7	2868	0.67
	4/14/2003 11:13	72,131	3131.5	4308	0.73
	4/16/2003 16:02	74,353	2222.3	3169	0.70
	4/18/2003 11:55	75,157	804	2633	0.31
	4/21/2003 11:15	75,157	0	4280	0.00
	4/23/2003 9:19	75,157	0	2764	0.00
	4/25/2003 10:48	75,157	0	2969	0.00
	4/28/2003 16:24	75,157	0	4656	0.00
	4/30/2003 9:06	75,157	0	2442	0.00
	5/2/2003 13:30	75,397	240.4	3144	0.08
	5/5/2003 12:02	78,516	3119	4232	0.74
	5/7/2003 13:25	80,768	2251.6	2963	0.76
	5/9/2003 12:10	82,920	2152.4	2805	0.77
	5/12/2003 11:00	86,818	3898	4250	0.92
	5/16/2003 9:20	91,638	4819.1	5660	0.85
	5/19/2003 11:43	95,437	3799.7	4463	0.85
	5/21/2003 10:40	97,699	2262.2	2817	0.80
	5/23/2003 10:03	100,069	2369.6	2843	0.83
	5/28/2003 9:27	105,689	5620	7164	0.78
	5/30/2003 11:01	108,033	2343.7	2974	0.79
	6/6/2003 11:27	116,120	8087.7	10106	0.80
	6/9/2003 11:45	119,521	3400.6	4338	0.78
	6/11/2003 14:06	121,918	2397	3021	0.79
	6/13/2003 10:40	124,058	2140	2674	0.80
	6/16/2003 11:56	127,210	3152	4396	0.72
	6/20/2003 15:11	131,496	4286	5955	0.72
	6/23/2003 14:47	134,676	3180	4296	0.74
	6/25/2003 14:35	136,759	2083	2868	0.73
	6/27/2003 11:40	138,555	3879	5573	0.70
	6/30/2003 15:14	141,859	3304	4534	0.73
	7/3/2003 10:10	144,681	2822	4016	0.70
	7/7/2003 10:15	148,813	4132	5765	0.72
	7/9/2003 14:35	151,024	2211	3140	0.70
	7/11/2003 9:51	152,833	1809	2596	0.70
	7/14/2003 11:30	155,909	3076	4419	0.70
	7/18/2003 9:30	159,861	3952	5640	0.70
	7/21/2003 8:24	162,794	2933	4254	0.69
	7/23/2003 18:10	165,177	2383	3466	0.69
	7/25/2003 13:58	167,007	1830	2628	0.70
	7/28/2003 11:00	169,687	2680	4142	0.65
	7/30/2003 10:26	171,500	1813	2846	0.64
	8/1/2003 10:10	173,435	1935	2864	0.68
	8/4/2003 8:10	176,238	2803	4200	0.67
	8/6/2003 14:52	178,589	2351	3282	0.72
	8/8/2003 9:02	180,489	1900	2530	0.75
	8/11/2003 9:50	183,580	3091	4368	0.71
	8/15/03 9:13	187,472	3892	5723	0.68
	8/18/2003 10:54	190,506	3034	4421	0.69
	8/20/03 11:35	192,536	2030	2921	0.69
	8/22/2003 10:20	194,692	2156	2805	0.77
	8/25/2003 16:00	198,038	3346	4660	0.72
	8/27/2003 10:00	199,829	1791	2520	0.71
	8/29/2003 10:50	201,917	2088	2930	0.71
				avg	**0.66**

Shiprock Terrace Well Field Pumping Rates

well	date/time	cum flow (gal)	delta vol (gal)	delta t (min)	avg gpm
1091					
	8/7/2003 17:00	0			
	8/11/2003 17:00	1,769	1768.8	5760	0.31
	8/18/2003 10:00	3,711	1942.2	9660	0.20
	8/20/03 9:05	4,676	965	2825	0.34
	8/22/2003 8:20	5,556	880	2835	0.31
	8/25/2003 15:21	6,886	1330	4741	0.28
	8/27/2003 9:10	7,618	732	2509	0.29
	8/29/2003 9:02	8,440	822	2872	0.29
			avg	**0.29**	

Shiprock Terrace Well Field Pumping Rates

well	date/time	cum flow (gal)	delta vol (gal)	delta t (min)	avg gpm
1092					
	8/8/2003 7:30	0			
	8/11/2003 17:00	701	701	4890	0.14
	8/18/2003 10:10	1,805	1104	9670	0.11
	8/20/03 8:55	2,489	684	2805	0.24
	8/22/2003 8:15	3,131	642	2840	0.23
	8/25/2003 15:19	4,167	1036	4744	0.22
	8/27/2003 9:10	4,730	563	2511	0.22
	8/29/2003 9:00	5,368	638	2870	0.22
				avg	**0.20**

Shiprock Terrace Well Field Pumping Rates

well	date/time	cum flow (gal)	delta vol (gal)	delta t (min)	avg gpm
1093					
	8/8/2003 7:30	0			
	8/11/2003 17:00	1,953	1953	4890	0.40
	8/18/2003 9:45	4,569	2616	9645	0.27
	8/20/03 8:50	5,335	766	2825	0.27
	8/22/2003 9:00	5,352	17	2890	0.01
	8/25/2003 15:23	5,449	97	4703	0.02
	8/27/2003 9:05	5,449	0	2502	0.00
	8/29/2003 10:00	5,449	0	2935	0.00
				avg	**0.14**

Shiprock Terrace Well Field Pumping Rates

well	date/time	cum flow (gal)	delta vol (gal)	delta t (min)	avg gpm
1094	8/8/2003 7:30	0			
	8/11/2003 17:00	548	547.9	4890	0.11
	8/18/2003 9:30	1,190	642.1	9630	0.07
	8/20/03 8:47	1,326	136	2837	0.05
	8/22/2003 9:20	1,348	22	2913	0.01
	8/25/2003 15:23				
	8/27/2003 9:05	1,628	1628	2502	
	8/29/2003 10:00	1,863	235	2935	0.08
				avg	**0.06**

Shiprock Wash Drain Pumping Rates

location	date/time	cum flow (gal)	delta vol (gal)	delta t (min)	avg gpm
bob lee	3/14/2003 10:20	167,705			
	3/19/2003 10:00	217,002	49297	7180	6.87
	3/21/2003 9:00	236,297	19295	2820	6.84
	3/21/2003 10:20	236,911	614	80	7.68
	3/24/2003 13:20	267,796	30885	4500	6.86
	3/26/2003 8:08	285,430	17634	2568	6.87
	3/28/2003 10:33	306,210	20780	3025	6.87
	3/31/2003 10:28	335,860	29650	4315	6.87
	4/2/2003 10:20	355,621	19761	2872	6.88
	4/4/2003 10:20	375,359	19738	2880	6.85
	4/7/2003 9:32	403,670	28311	4272	6.63
	4/9/2003 10:37	423,349	19679	2945	6.68
	4/11/2003 10:24	441,407	18058	2867	6.30
	4/14/2003 10:11	467,802	26395	4307	6.13
	4/16/2003 16:44	487,788	19986	3273	6.11
	4/18/2003 10:25	502,706	14918	2501	5.96
	4/21/2003 11:34	528,252	25546	4389	5.82
	4/23/2003 10:00	544,308	16056	2786	5.76
	4/25/2003 12:48	561,769	17461	3048	5.73
	4/28/2003 16:34	586,549	24780	4546	5.45
	4/30/2003 9:15	599,816	13267	2441	5.44
	5/2/2003 12:22	616,302	16486	3067	5.38
	5/5/2003 10:25	638,447	22145	4203	5.27
	5/7/2003 14:15	654,542	16095	3110	5.18
	5/9/2003 11:00	668,267	13725	2685	5.11
	5/12/2003 9:40	689,581	21314	4240	5.03
	5/16/2003 9:30	718,154	28573	5750	4.97
	5/19/2003 10:38	739,336	21182	4388	4.83
	5/21/2003 8:55	752,630	13294	2777	4.79
	5/23/2003 9:14	766,333	13703	2899	4.73
	5/28/2003 9:36	799,678	33345	7222	4.62
	5/30/2003 9:59	812,861	13183	2903	4.54
	6/6/2003 10:03	857,616	44755	10084	4.44
	6/9/2003 10:30	876,411	18795	4347	4.32
	6/11/2003 14:19	889,562	13151	3109	4.23
	6/13/2003 9:40	900,462	10900	2601	4.19
	6/16/2003 10:50	918,902	18440	4390	4.20
	6/20/2003 14:41	943,592	24690	5991	4.12
	6/23/2003 14:15	960,929	17337	4294	4.04
	6/25/2003 14:48	972,450	11521	2913	3.96
	6/27/2003 10:47	982,333	21404	5552	3.86
	6/30/2003 14:45	1,000,472	18139	4558	3.98
	7/3/2003 9:15	1,015,636	15164	3990	3.80
	7/7/2003 9:10	1,037,756	22120	5755	3.84
	7/9/2003 9:05	1,048,455	10699	2875	3.72
	7/11/2003 9:18	1,059,281	10826	2893	3.74
	7/14/2003 10:18	1,075,447	16166	4380	3.69
	7/18/2003 8:30	1,096,398	20951	5652	3.71
	7/21/2003 7:20	1,111,742	15344	4250	3.61
	7/23/2003 14:27	1,123,709	11967	3307	3.62
	7/25/2003 12:05	1,132,993	9284	2738	3.39
	7/28/2003 10:40	1,147,960	14967	4235	3.53
	7/30/2003 10:54	1,158,217	10257	2894	3.54
	8/1/2003 9:00	1,168,111	9894	2766	3.58
	8/4/2003 7:30	1,182,709	14598	4230	3.45
	8/6/2003 13:55	1,193,845	11136	3265	3.41
	8/8/2003 8:41	1,202,622	8777	2566	3.42
	8/11/2003 8:30	1,217,517	14895	4309	3.46
	8/15/03 8:46	1,236,589	19072	5776	3.30
	8/18/2003 10:20	1,251,287	14698	4414	3.33
	8/20/03 10:25	1,260,712	9425	2885	3.27
	8/22/2003 9:30	1,270,001	9289	2825	3.29
	8/25/2003 15:33	1,285,129	15128	4683	3.23
	8/27/2003 10:25	1,293,456	8327	2572	3.24
	8/29/2003 10:10	1,302,781	9325	2865	3.25
				avg	**4.76**

Shiprock Wash Sump Pumping Rates

location	date/time	cum flow (gal)	delta vol (gal)	delta t (min)	avg gpm
many devils	3/14/2003 9:30	8,315			
	3/19/2003 9:00	10,076	1760.6	7170	0.25
	3/21/2003 8:40	10,668	592.3	2860	0.21
	3/21/2003 10:02	10,695	26.7	82	0.33
	3/24/2003 13:06	11,597	901.9	4504	0.20
	3/26/2003 9:02	12,062	465	2636	0.18
	3/28/2003 10:00	12,614	552.8	2938	0.19
	3/31/2003 8:40	13,274	659.7	4240	0.16
	4/2/2003 9:55	13,788	513.5	2955	0.17
	4/4/2003 9:44	14,270	482.1	2869	0.17
	4/7/2003 8:50	14,937	666.9	4266	0.16
	4/9/2003 10:00	15,328	391.4	2950	0.13
	4/11/2003 10:05	15,790	462.1	2885	0.16
	4/14/2003 9:45	16,472	681.9	4300	0.16
	4/16/2003 14:42	16,966	494.1	3177	0.16
	4/18/2003 10:05	17,440	474	2603	0.18
	4/21/2003 12:31	18,053	613.3	4466	0.14
	4/23/2003 8:46	18,522	468.7	2655	0.18
	4/25/2003 10:00	18,984	462.3	2954	0.16
	4/28/2003 15:31	19,754	769.2	4651	0.17
	4/30/2003 8:36	20,063	309.6	2465	0.13
	5/2/2003 12:05	20,526	463.1	3089	0.15
	5/5/2003 9:55	20,659	132.4	4190	0.03
	5/7/2003 12:56	20,973	314.4	3061	0.10
	5/9/2003 10:45	21,450	477	2749	0.17
	5/12/2003 9:14	21,928	478.2	4229	0.11
	5/15/2003 17:25	22,726	797.5	4811	0.17
	5/19/2003 10:20	23,517	791.2	5335	0.15
	5/21/2003 8:06	23,844	326.8	2746	0.12
	5/23/2003 8:58	24,328	484.6	2932	0.17
	5/28/2003 9:04	25,296	967.6	7206	0.13
	5/30/2003 9:45	**25,684**	388.1	2921	0.13
	6/6/2003 9:50	27,076	1391.6	10085	0.14
	6/9/2003 10:15	27,728	652.7	4345	0.15
	6/11/2003 13:40	28,055	326.7	3085	0.11
	6/13/2003 9:10	28,386	330.9	2610	0.13
	6/16/2003 10:25	28,874	487.6	4395	0.11
	6/20/2003 14:30	29,537	663.5	6005	0.11
	6/23/2003 14:05	30,028	491.4	4295	0.11
	6/25/2003 13:41	30,589	560.6	2856	0.20
	6/27/2003 10:30	31,042	1013.6	5545	0.18
	6/30/2003 14:34	31,945	902.6	4564	0.20
	7/3/2003 8:55	32,630	685.4	3981	0.17
	7/7/2003 10:55	33,841	1211.4	5880	0.21
	7/9/2003 8:35	34,543	701.6	2740	0.26
	7/11/2003 9:05	35,062	519	2910	0.18
	7/14/2003 10:00	36,098	1036	4375	0.24
	7/18/2003 8:08	37,253	1155	5648	0.20
	7/21/2003 6:59	38,180	927	4251	0.22
	7/23/2003 14:30	38,875	695	3331	0.21
	7/25/2003 11:40	39,447	572	2710	0.21
	7/28/2003 9:50	40,428	981	4210	0.23
	7/30/2003 9:32	40,876	448	2862	0.16
	8/1/2003 0:00	40,876	0	2308	0.00
	8/4/2003 0:00	40,876	0	4320	0.00
	8/6/2003 13:45	40,876	0	3705	0.00
	8/8/2003 8:20	40,876	0	2555	0.00
	8/11/2003 0:00	40,876	0	3820	0.00
	8/15/2003 0:00	40,876	0	5760	0.00
	8/18/2003 0:00	40,876	0	4320	0.00
	8/20/2003 0:00	40,876	0	2880	0.00
	8/22/2003 0:00	40,876	0	2880	0.00
	8/25/2003 15:09	41,187	311	5229	0.06
	8/27/2003 8:30	51,955	10768	2481	
	8/29/2003 8:45	52,883	928	2895	0.32
				avg	**0.14**

Shiprock Floodplain Well Field Pumping Rates

well	date/time	cum flow (gal)	delta vol (gal)	delta t (min)	avg gpm
1075/1089	3/14/2003 10:50	22,220			
	3/19/2003 10:20	31,414	9194.5	7170	1.28
	3/21/2003 9:00	34,982	3567.9	2800	1.27
	3/21/2003 10:38	35,100	118.5	98	1.21
	3/24/2003 13:38	40,920	5820	4500	1.29
	3/26/2003 8:23	44,176	3256	2565	1.27
	3/28/2003 10:50	48,029	3852.7	3027	1.27
	3/31/2003 10:53	53,481	5452	4323	1.26
	4/2/2003 10:37	55,638	2156.7	2864	0.75
	4/4/2003 11:04	62,226	6588.1	2907	2.27
	4/7/2003 10:00				
	4/9/2003 11:00	*76,759*			
	4/11/2003 11:04	*82,246*	5486.9	2884	1.90
	4/14/2003 10:28	90,071	7825.1	4284	1.83
	4/16/2003 16:56	95,864	5792.9	3268	1.77
	4/18/2003 10:45	100,236	4372	2509	1.74
	4/21/2003 12:01	107,650	7414	4396	1.69
	4/23/2003 10:15	112,230	4580	2774	1.65
	4/25/2003 12:06	117,076	4846	2991	1.62
	4/28/2003 16:48	101,973			
	4/30/2003 9:34	127,962	10886	7048	1.54
	5/2/2003 13:00	132,696	4734	3086	1.53
	5/5/2003 11:08	139,206	6510	4208	1.55
	5/7/2003 14:15				
	5/9/2003 11:35	144,874	5668	5787	0.98
	5/12/2003 10:23	152,508	7634	4248	1.80
	5/16/2003 10:00	162,286	9778	5737	1.70
	5/19/2003 11:30	169,465	7179	4410	1.63
	5/21/2003 9:10	174,189	4724	2740	1.72
	5/23/2003 9:30	179,336	5147	2900	1.77
	5/28/2003 9:49	192,939	13603	7219	1.88
	5/30/2003 10:10	198,698	5759	2901	1.99
	6/6/2003 10:15	219,511	20813	10085	2.06
	6/9/2003 11:10	228,114	8603	4375	1.97
	6/11/2003 14:20	233,795	5681	3070	1.85
	6/13/2003 10:01	238,442	4647	2621	1.77
	6/16/2003 11:40	245,844	7402	4419	1.68
	6/20/2003 15:02	255,067	9223	5962	1.55
	6/23/2003 14:27	260,985	5918	4285	1.38
	6/25/2003 0:00				
	6/27/2003 7:30	263,230	2245	5343	0.42
	6/30/2003 14:56	300,782	37552	4766	7.88
		well upgraded, now called 1089			
	7/3/2003 9:50	330,360	29578	4014	7.37
	7/7/2003 9:50	364,308	33948	5760	5.89
	7/9/2003 13:01	379,343	15035	3071	4.90
	7/11/2003 9:36	390,623	11280	2675	4.22
	7/14/2003 11:00	407,836	17213	4404	3.91
	7/18/2003 9:10	435,341	27505	5650	4.87
	7/21/2003 8:10	456,987	21646	4260	5.08
	7/23/2003 17:20	474,111	17124	3430	4.99
	7/25/2003 13:30	489,479	15368	2650	5.80
	7/28/2003 10:40	511,649	22170	4150	5.34
	7/30/2003 11:05	527,126	15477	2905	5.33
	8/1/2003 9:49	542,102	14976	2804	5.34
	8/4/2003 7:55	564,006	21904	4206	5.21
	8/6/2003 14:15	580,995	16989	3260	5.21
	8/8/2003 8:51	593,999	13004	2556	5.09
	8/11/2003 8:58	615,770	21771	4327	5.03
	8/15/03 9:01	642,810	27040	5763	4.69
	8/18/2003 10:45	664,065	21255	4424	4.80
	8/20/03 10:47	677,882	13817	2882	4.79
	8/22/2003 10:05	691,314	13432	2838	4.73
	8/25/2003 15:45	712,698	21384	4660	4.59
	8/27/2003 10:50	724,315	11617	2585	4.49
	8/29/2003 10:25	737,397	13082	2855	4.58
				avg	**5.17**

Shiprock Floodplain Well Field Pumping Rates

well	date/time	cum flow (gal)	delta vol (gal)	delta t (min)	avg gpm
1077	3/14/2003 10:45	12,925			
	3/19/2003 10:25	17,578	4653.4	7180	0.65
	3/21/2003 9:10	19,245	1666.6	2805	0.59
	3/21/2003 11:03	19,310	65.6	113	0.58
	3/24/2003 14:05	21,886	2575.8	4502	0.57
	3/26/2003 8:44	23,276	1390.1	2559	0.54
	3/28/2003 11:04	24,886	1610.1	3020	0.53
	3/31/2003 11:03	27,129	2242.7	4319	0.52
	4/2/2003 10:45	27,869	740.2	2862	0.26
	4/4/2003 11:20	30,960	3091	2915	1.06
	4/7/2003 10:13	34,814	3853.6	4253	0.91
	4/9/2003 11:10	37,294	2480.5	2937	0.84
	4/11/2003 10:47	39,613	2318.7	2857	0.81
	4/14/2003 10:40	42,963	3350.3	4313	0.78
	4/16/2003 17:00	45,432	2468.7	3260	0.76
	4/18/2003 10:58	47,338	1906.3	2518	0.76
	4/21/2003 11:56	50,591	3252.7	4378	0.74
	4/23/2003 10:17	52,627	2036	2781	0.73
	4/25/2003 12:27	54,784	2157.2	3010	0.72
	4/28/2003 16:54	57,932	3147.7	4587	0.69
	4/30/2003 9:40	59,583	1650.6	2446	0.67
	5/2/2003 12:32	61,703	2120.6	3052	0.69
	5/5/2003 10:52	64,619	2915.4	4220	0.69
	5/7/2003 14:15				
	5/9/2003 11:11	67,152	2533.2	5779	0.44
	5/12/2003 10:00	70,529	3377.7	4249	0.79
	5/16/2003 10:10	74,557	4028	5770	0.70
	5/19/2003 11:00	77,578	3020.2	4370	0.69
	5/21/2003 9:15	79,612	2034.2	2775	0.73
	5/23/2003 9:42	81,878	2266.1	2907	0.78
	5/28/2003 9:45	87,434	5555.6	7203	0.77
	5/30/2003 10:48	88,469	1035.8	2943	0.35
	6/6/2003 11:16	89,842	1372.5	10108	0.14
	6/9/2003 10:42	90,282	440.5	4286	0.10
	6/11/2003 14:32	90,628	345.7	3110	0.11
	6/13/2003 10:20	91,210	582	2628	0.22
	6/16/2003 11:11				
	6/20/2003 15:02	96,857	5647	10362	0.54
	6/23/2003 14:36	100,533	3676	4294	0.86
	6/25/2003 15:05	102,874	2341	2909	0.80
	6/27/2003 11:11	104,834	4301	5555	0.77
	6/30/2003 15:02	108,190	3356	4551	0.74
	7/3/2003 9:35	110,184	1994	3993	0.50
	7/7/2003 9:30	114,272	4088	5755	0.71
	7/9/2003 13:35	116,018	1746	3125	0.56
	7/11/2003 9:40	117,515	1497	2645	0.57
	7/14/2003 10:40	119,873	2358	4380	0.54
	7/18/2003 8:48	122,868	2995	5648	0.53
	7/21/2003 7:45	124,953	2085	4257	0.49
	7/23/2003 17:30	126,481	1528	3465	0.44
	7/25/2003 13:40	127,764	1283	2650	0.48
	7/28/2003 10:45	129,773	2009	4145	0.48
	7/30/2003 11:07	131,150	1377	2902	0.47
	8/1/2003 9:20	132,506	1356	2773	0.49
	8/4/2003 7:45	134,514	2008	4225	0.48
	8/6/2003 14:20	136,075	1561	3275	0.48
	8/8/2003 8:55	137,287	1212	2555	0.47
	8/11/2003 8:55	139,304	2017	4320	0.47
	8/15/03 9:01	141,818	2514	5766	0.44
	8/18/2003 10:31	143,718	1900	4410	0.43
	8/20/03 10:56	144,996	1278	2905	0.44
	8/22/2003 9:49	146,275	1279	2813	0.45
	8/25/2003 15:49	148,227	1952	4680	0.42
	8/27/2003 10:55	149,281	1054	2586	0.41
	8/29/2003 10:20	150,449	1168	2845	0.41
				avg	**0.58**