DOE–EM/GJ1632-2008

Environmental Management - Grand Junction Office

MOAB UTAH UMTRA Project

2007 Performance Assessment of the Ground Water Interim Action Well Field

Moab UMTRA Project

July 2008

U.S. Department of Energy

Office of Environmental Management

Work Performed by the Technical Assistance Contractor Under DOE Contract No. DE-AC30-07CC60012 for the U.S. Department of Energy Office of Environmental Management, Grand Junction, Colorado.

DOE-EM/GJ1632-2008

2007 Performance Assessment of the Ground Water Interim Action Well Field Moab, Utah

Moab UMTRA Project

July 2008

Work Performed by TAC under DOE Contract No. DE-AC30-07CC60012
for the U.S. Department of Energy, Office of Environmental Management, Grand Junction, Colorado.

2007 Performance Assessment for the Ground Water Interim Action Well Field

Moab UMTRA Project

Revision 0

Review and Approval

Ken Pill for 7/30/08

Liz Glowiak | Date

Project Hydrogeologist

Ken Pill 7/30/08

Ken Pill | Date

Ground Water Manager

Joseph D. Ritchey 7/30/08

Joseph D. Ritchey | Date

TAC Senior Program Manager

Donald R. Metzler 8-4-2008

Donald R. Metzler | Date

Federal Project Director

Contents

Tables

Figures

Appendices

Appendix A

Appendix B

Appendix C

Appendix D

Appendix E

Appendix F

Appendix G

Appendix H Attachments on CD **Email moabcomments@gjem.doe.gov for a copy**

1.0 Introduction

1.1 Site History and Background

The Moab UMTRA Project site near Moab, Utah, is a former uranium-ore processing facility located approximately three miles northwest of the city of Moab in Grand County, Utah. When processing operations ceased in 1984, the mill had accumulated an estimated 12 million cubic yards of uranium mill tailings in an unlined impoundment in the floodplain of the Colorado River. The tailings pile covers approximately 130 acres, is about 0.5 mile in diameter, averages 94 feet (ft) in height above ground surface, and is located about 750 ft west of the Colorado River (see Figure 1-1). In October 2001, the title of the property and responsibility for the remediation of the tailings pile and contaminated ground water beneath the site were transferred to the U.S. Department of Energy (DOE).

Ammonia and uranium contamination has leached from the tailings pile into naturally saline ground water. There are two plumes of ammonia associated with the site: a deep plume beneath the tailings pile and a shallower plume emanating from the toe of the tailings pile flowing towards the Colorado River. Ground water from the shallow plume discharges to the Colorado River and has affected surface-water quality in backwater riparian channels along the river. Degradation of surface-water quality may affect the habitat of endangered fish in the riparian channels.

DOE has been performing an interim action to evaluate two methods for treating contaminated ground water and protecting the endangered fish habitat in backwater riparian channels of the river adjacent to the site. One method is to extract contaminated ground water from remediation wells installed in the shallow plume and pump it to an evaporation pond and sprinkler system on top of the tailings pile. The other method is to pump diverted Colorado River water into a fresh-water storage pond, allow time for settlement of fines and then, after sediment filtration, inject the fresh water into a series of wells installed into the alluvium and/or an infiltration trench.

The Groundwater Interim Action Well Field contains four well Configurations, each in general consisting of 10 remediation wells (Configuration 1 also includes extraction well SMI-PW02), upgradient and downgradient observation wells, river bank well points, and surface-water sampling locations (see Figure 1-2). In addition, the well field also contains a fresh-water infiltration trench and a Baseline Area. The objectives of the Ground Water Interim Action are to:

- Protect aquatic species by reducing ammonia-contaminated ground water from discharging to backwater areas that may potentially be suitable habitat for threatened and endangered aquatic species; and
- Provide performance data for use in selecting and designing a final ground-water remedy.

A site conceptual model in Section 2 presents additional background information on the site.

1.2 Monitoring Requirements

The performance of the interim-action well field is monitored through collection and analysis of hydraulic and chemical data to: (1) optimize the extraction, fresh-water injection, and treatment system; (2) evaluate the effectiveness in reducing ammonia concentrations discharging to the surface water by either extraction of contaminated ground water or injection of fresh water into the aquifer; (3) minimize the upwelling of the salt-water interface in response to pumping the aquifer; and (4) develop and design a final ground-water remedy.

The remediation wells, observation wells, well points, and surface-water locations are sampled on a rotational monthly basis. At the chosen sampling locations, depth to water and field parameters, including temperature, pH, oxidation-reduction potential, conductivity, dissolved oxygen, and turbidity are recorded. Water samples are collected at various depths and locations to monitor the main constituents of concern (COCs): ammonia (as N), uranium, total dissolved solids (TDS), and manganese. All samples are also analyzed for bromide, chloride, and sulfate concentrations, and a few locations with historically high concentrations of metals are sampled and analyzed for selenium and copper. Water sampling was performed in accordance with the *Ground Water and Surface Water Sampling and Analysis Plan for U.S. Department of Energy Office of Legacy Management Sites* (DOE 2006c) and the *Environmental Procedures Catalog* (STO 6). EPA analytical methods and detection limits used for analyses of these samples are presented in Table 1-1.

Remediation wells are sampled through a sample port on the well discharge while the well is actively pumping. Observation wells and well points are sampled using low-flow methods through tubing placed at a specified depth within the well screen. Surface water is sampled by grab samples at specified locations.

Water levels are measured manually in extraction wells, observation wells, and well points. Continuous water-level measurements are collected from data loggers in select baseline area wells and observation wells.

Colorado River Flows are recorded at the U.S Geological Survey Cisco, Utah, gauging station (Station No. 09180500). River flows were converted to river stage elevations at the Moab Site using a regression analysis provided in Figure E-3 in Appendix E.

Table 1-1. EPA Analytical Methods and Detection Limits

Analyte	EPA Method	Detection Limit
Ammonia-N	350.3	0.1 mg/L
Chloride	9056	0.5 mg/L
Bromide	9056	0.5 mg/L
Sulfate	9056	0.5 mg/L
TDS	160.1	10 mg/L
Copper	SW-846 6010	25 µg/L
Selenium	SW-846 6020	0.1 µg/L
Manganese	SW-846 6010	5 µg/L
Uranium	SW-846 6020	0.1 µg/L

mg/L = milligrams per liter; µg/L = micrograms per liter

1.3 Performance Assessment Methods

Previous performance assessments of the ground-water extraction system are based on comparisons of operational hydraulic and water-chemistry data with baseline data at the Moab Site. In most instances, baseline data were collected at the well field before the wells were used for ground-water extraction (or injection) or before they were turned on for seasonal operation. In other instances, baseline information is derived from observations in a separate part of the well field called the Baseline Area, which is located north of both the well field configurations and the infiltration trench and about 400 ft south-southwest of the confluence of Moab Wash and the Colorado River (Figure 1–2). The Baseline Area is used as an analogue of ambient hydraulic and water-chemistry conditions that occur between the tailings pile and the river. While these assessment methods are used in this report, they are limited to the extent that the Baseline Area is outside the concentrated ammonia plume and river siltation has eliminated the river habitat in that area. Thus, the area may no longer be representative of baseline conditions for Configurations 1 and 4 that still have adjacent riparian habitat areas. Interpretation of the baseline data is qualitative and equivocal due to changing of river stage, pumping rates, location of nearby flood-irrigation plots, and presence or absence of riparian channels. Monitoring and interpretation of the baseline area is still performed, but interpretation is deemphasized compared to previous performance assessments (DOE 2007).

This performance assessment evaluates well field system performance by reviewing the volume pumped by the ground-water remediation system (Section 3) and ground-water levels and hydraulic control (Section 4). The extent of drawdown, contaminant capture, and remediation well specific capacity are important components of evaluating well-field efficiency. In addition, mass removal of ammonia and uranium, the primary contaminants in groundwater, is a useful metric of system performance. Contaminant distributions and temporal water chemistry are evaluated to determine the effect of the well field on downgradient water quality (Section 5). Infiltration trench performance is evaluated by interpreting the extent of hydraulic mounding and its influence on downgradient water quality (Section 6). Evaporation pond and sprinkler system performance is evaluated by reviewing the amount of water pumped and evaporated (Section 7). Conclusions on the effectiveness of the system are presented in Section 8.

Additional information and recommendations will be provided in a forthcoming Ground Water Interim Action Well Field Optimization Report to be issued in January 2009.

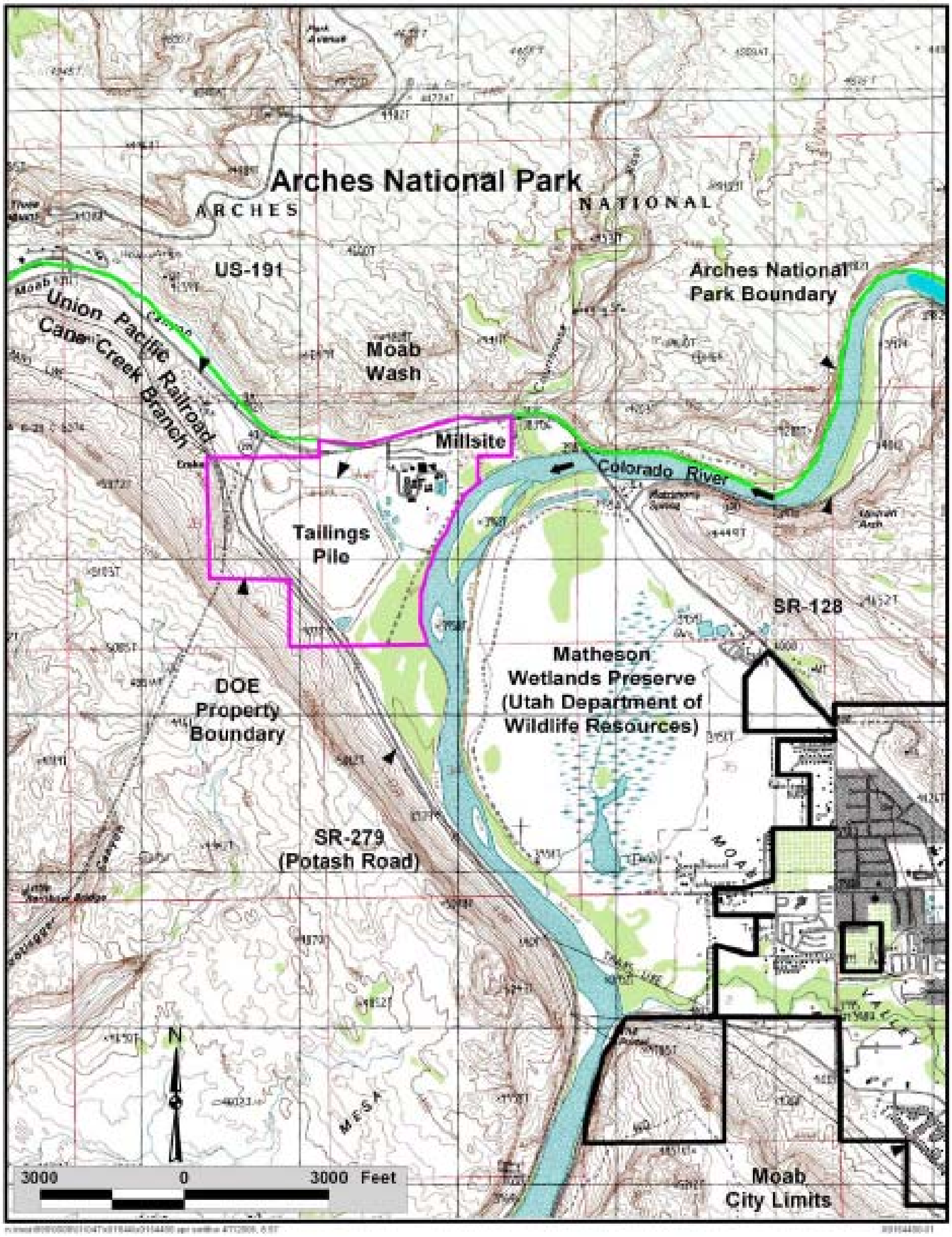


Figure 1–1. Location Map of the Moab Site and Surrounding Area

N:\MOA\999\0006\08\006\X02163\X0216300.mxd carverh 4/12/2007 12:13:36 PM

Figure 1–2. Map View of Interim Action Components and Sampling Locations in the Well Field

2.0 Conceptual Model of Ground Water Flow and Hydrochemistry

Discharge of ground water to the Colorado River at the Moab site is affected by river stage and density-dependent flow induced by the presence of very saline to briny water in the alluvium at the site. In addition, evidence for the presence of a hyporheic zone below the river, discussed in previous performance evaluations of the ground-water interim action (DOE 2005b, DOE 2005d, DOE 2006a), indicates that the chemistry of the ground water is significantly altered before it enters the river. A detailed conceptual model presented in preceding performance assessment reports (DOE 2006a and 2007d) is briefly summarized here.

2.1 Alluvial Ground Water System

The uppermost 10 ft of alluvium in the vicinity of the Ground Water Interim Action Well Field generally consists of sandy silt and silty sand deposits. These silt-bearing sediments are typically underlain by 5 to 6 ft of fine- to coarse-grained sand. From depths of approximately 15 and 29 ft below ground surface (bgs) (3952 to 3938 mean sea level [msl]), gravelly sands predominate, but thin clayey, gravelly sand units also may be present. Below 100 ft bgs (3867 ft msl), the alluvium consists of gravelly sands and sandy gravels. The water table in Ground Water Interim Action area is located at about 10 to 12 ft bgs (3957 to 3955 ft msl). Stratification within the alluvium causes hydraulic anisotropy, with the effective hydraulic conductivity in the vertical direction 10 to 100 times smaller than the horizontal hydraulic conductivity (DOE 2003d). The alluvium is underlain by the Paradox Salt Formation.

Natural ground water at the Moab site originates as recharge from atmospheric precipitation, infiltration of surface water flow across alluvium in the vicinity of Moab Wash, and infiltration through riverbanks during high river-stage conditions. A relatively minor amount of flow occurs through deep bedrock units into the site. The majority of the recharge water appears to enter the valley as subsurface discharge to the alluvium that dominates the unconsolidated deposits found throughout most of the valley. In general, flow in the alluvium at the Moab site is from the tailings pile southeast towards the river. The flow of ground water is influenced by changes in density associated with the level of salinity. A discussion of salinity is pertinent to understanding ground-water flow at the site as the presence of very saline or brine water indicates minimal ground-water flow in those areas as soluble salts would otherwise be flushed from the ground-water system.

Sampling of ground water in alluvium on both sides of the river indicates TDS concentrations range from as low as 700 milligrams per liter (mg/L) to more than 110,000 mg/L (DOE 2003d, Gardner and Solomon 2003, DOE 2006a, DOE 2007a). Brine in the deepest parts of the alluvium was derived from chemical dissolution of the underlying Paradox Salt Formation (Doelling et al. 2002). For purposes of characterization, water is typically characterized as being either mildly saline (TDS = 1,000 to 3,000 mg/L), moderately saline (TDS = 3,000 to 10,000 mg/L), very saline (TDS = 10,000 to 35,000 mg/L), or briny (TDS > 35,000 mg/L) (McCutcheon et al. 1993). The TDS concentrations in ground water are higher than those measured in the Colorado River water (500 to 1,000 mg/L), which is referred to as fresh water in this report.

Analysis of chloride/bromide (Cl/Br) ratios was performed to determine sources of salinity in the alluvial ground-water system. Cl/Br ratios in samples of shallow brine south of the Moab site were above 3,000 (DOE 2006a). In contrast, shallow ground water near the river and downgradient of the tailings pile exhibited ratios ranging from 300 to 1,000. The significantly different ratios indicate that the shallow briny water south of the site is derived from dissolution of Paradox Salt Formation. Shallow ground water at the plant site is north comprised a mixture of waters with origins including dissolution of shallower sandstone sediments, tailings seepage, and possibly some local recharge from infiltration of flows from Moab Wash (DOE 2007a).

On the west side of the Colorado River at the Moab site, moderately saline and very saline ground water are derived from the mixing of southeastward-moving shallow ground water with the deeper brine. However, some of the highly saline ground water close to the river is also attributed to seepage of high-TDS fluids from the base of the Moab tailings pile (DOE 2003d). TDS concentrations increase with depth in the vicinity of the Ground Water Interim Action Well Field (DOE 2006a). Analyses of salinity in ground water under the Moab site indicate that the brine surface is deepest in the western portion of the site and becomes shallower in the direction of the river (DOE 2003d).

2.2 Recharge and Discharge Relationships Between the Alluvial Aquifer and the Colorado River

Within Moab Valley, the Colorado River is a gaining watercourse, and ground-water discharge to the river occurs mostly along the banks of the river. The occurrence of highly saline water in shallow ground water near the Colorado River along both its west and east shores is due to the upwelling of brine (DOE 2006a).

Assessments of interim action Configurations 1 and 2 indicate that, under non-pumping conditions, brine is usually found in these areas at about 25 to 40 ft bgs (3942 to 3927 ft msl) (DOE 2004a, DOE 2005b, DOE 2005d, DOE 2006a), and extrapolation of the brine surface in these areas shows it intersecting the Colorado River close to its west bank (Figure 2–1). The Configuration 4 wells that were installed in 2006 show similar conditions, but with the brine surface at slightly shallower depths than Configurations 1 or 2. Figure 2–1 shows a conceptual model of ground water flow at the Moab site. Generally shallow, moderately saline water migrates faster than the deeper brine (DOE 2006a, DOE 2007a). In addition, the conceptual model suggests that ground-water salinity in the vicinity of the river is controlled by:

- The rate of ground-water flow. Slow velocities are associated with high TDS.
- The depth of the slightly saline brine interface increases with the depth to the Paradox Salt Formation.
- The depth of the slightly saline brine interface decreases with the presence of riparian channels.

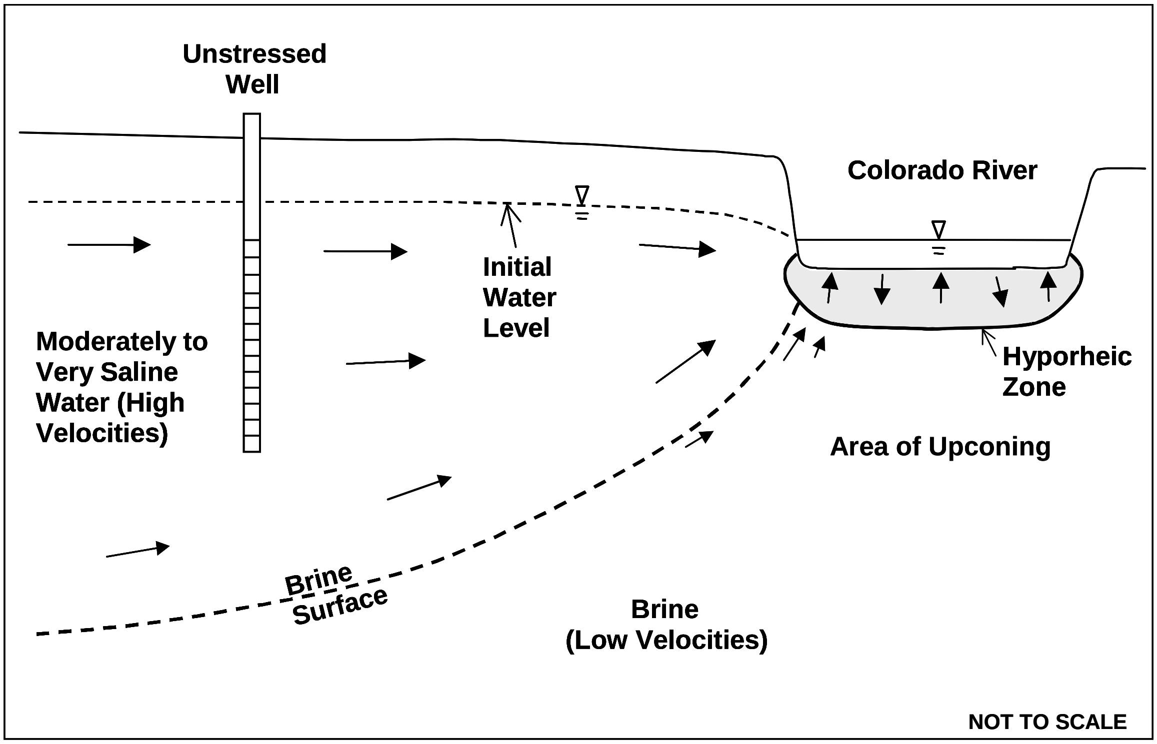


Figure 2–1. Conceptualization of Ground Water Flow Near the Colorado River Under Non-Pumping Conditions

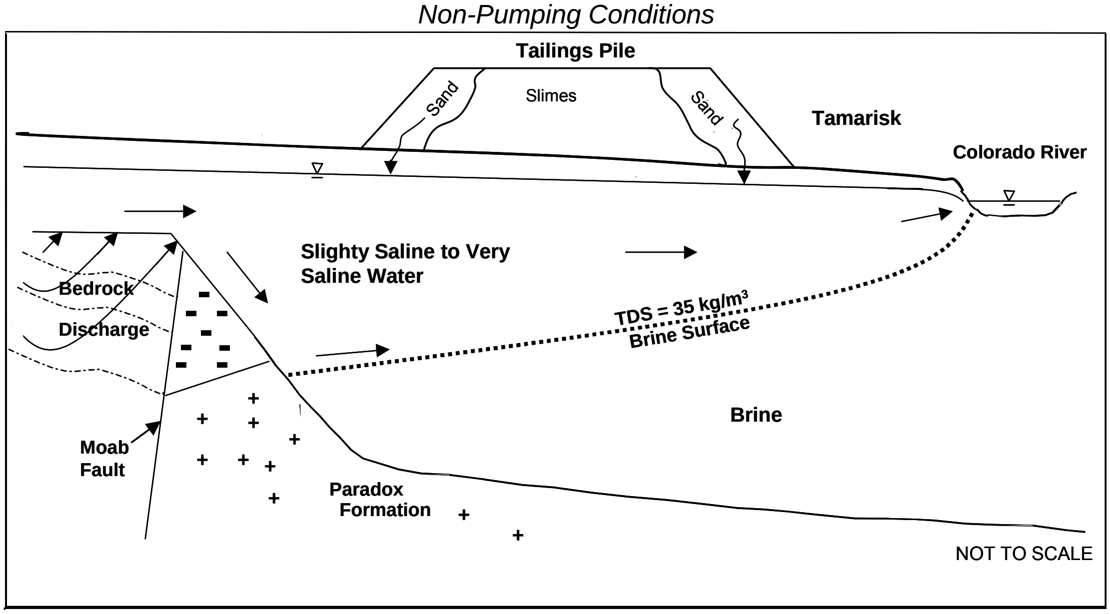


Figure 2–2. Conceptualization of Ground Water Flow at the Moab Site

Based on this information, the conceptual model shown was expanded (DOE 2007a) to illustrate how density-dependent ground-water flow occurs on both sides of the river, as shown in Figure 2–3. With this updated conceptualization, both the total distance and depth over which dissolution of Paradox Salt Formation sediments occurs south and east of the river can be quite different from what occurs on the west side at the river. As a result, the profile of the brine surface in the vicinity of the river can be asymmetric (DOE 2007a).

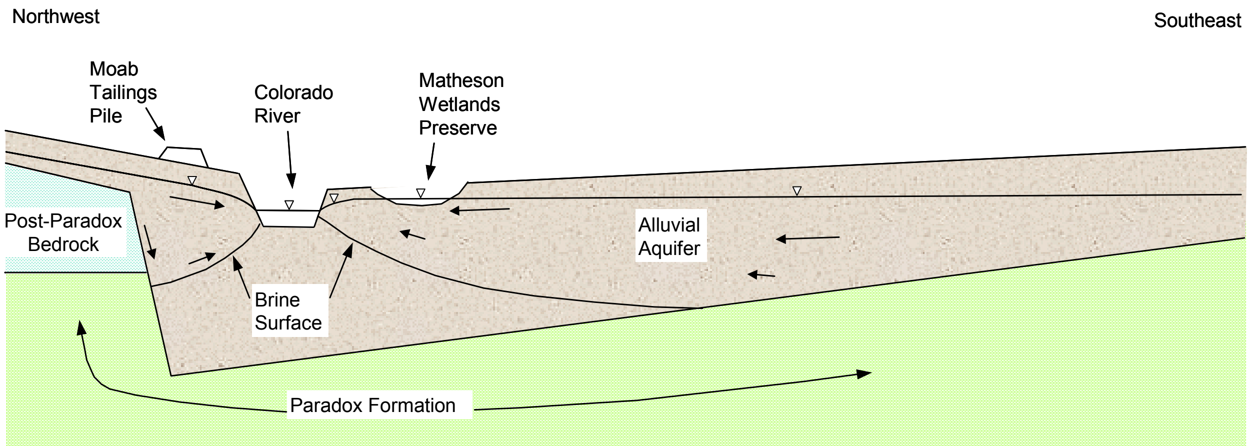


Figure 2–3. Conceptual Model of Density-Dependent Flow on Both Sides of the Colorado River (based partly on Figure 6 in Doelling et al. [2002])

During years in which high ammonia concentrations have been detected in surface water, they have typically been found in river-side riparian channels (backwaters) that are separated from the main river channel and are located close to a steep bank that separates the riverbed from the floodplain on which the Moab site sits (Figure 2–4a). These occurrences indicate that the contaminated ground water discharging to the river tends to converge on the side channels rather than migrating to the main channel where surface-water flows tend to be larger. However, because the river processes that helped create the backwaters vary with time, some side channels near the river's west bank have eventually filled in with sediment, and ground water under those conditions migrates farther east to discharge to the river's main channel (Figure 2–4b). Under these circumstances, the brine surface also migrates farther to the east, and the depth to brine near the steep bank increases. Such riverbed siltation appears to have occurred over the past several years adjacent to the Baseline Area and Configurations 2 and 3. If depths to the brine surface in these areas deepened as a result of sedimentation processes, the changes could be technically attributed to increases in distance from the river (i.e., proximity to the river).

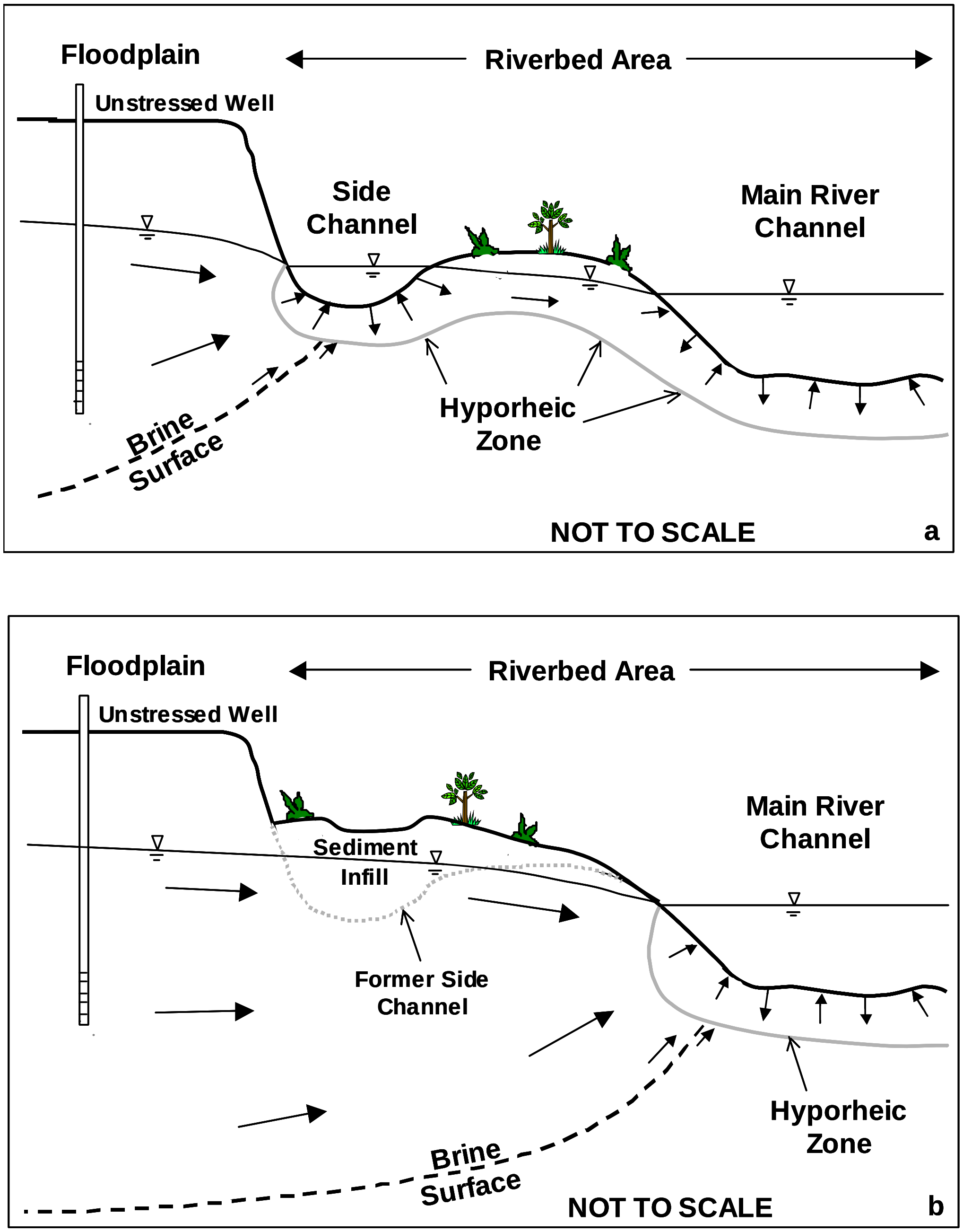


Figure 2–4. Conceptualization of Brine Surface Behavior in Response to River Sedimentation: (a) Before Sedimentation and (b) After Sedimentation

Surface water flow in the Colorado River is hydraulically connected to the alluvial system at the Moab site (DOE 2003d), and ground water levels fluctuate with river stage. A lag time of approximately one day is typically observed between river rise and increases in ground-water levels in wells located hundreds of feet from the river. However, the response time of ground water levels close to the river is relatively short, making it likely that river effects on water levels in the Ground Water Interim Action wells would be observed within periods of a few to tens of minutes.

During very high river flow constituent concentrations decrease in shallow ground water located close to the river or near riparian channels. Concentration decreases are attributed to infiltration of surface water from the river (DOE 2006a). Generally, under normal river flow conditions, changes in river elevation do not affect the elevation of the brine fresh-water interface inland west of the river. An exception to this may occur under higher river-stage conditions relative to low-flow conditions in drought years, where increasing salinity was observed with increase in river stage. It is hypothesized that, as the water table increases with increasing river stage, the vertical thickness of the water located above the brine surface essentially remains constant so that the net flow of ground water to the river is also constant (DOE 2006a).

Mixing river water with ambient ground water in the hyporheic zone facilitates the various biogeochemical processes that can cause attenuation of contaminant concentrations prior to their discharge to surface water (DOE 2006a). Microbially mediated processes are shown on Figure 2–5) (Dahm et al. 1998).

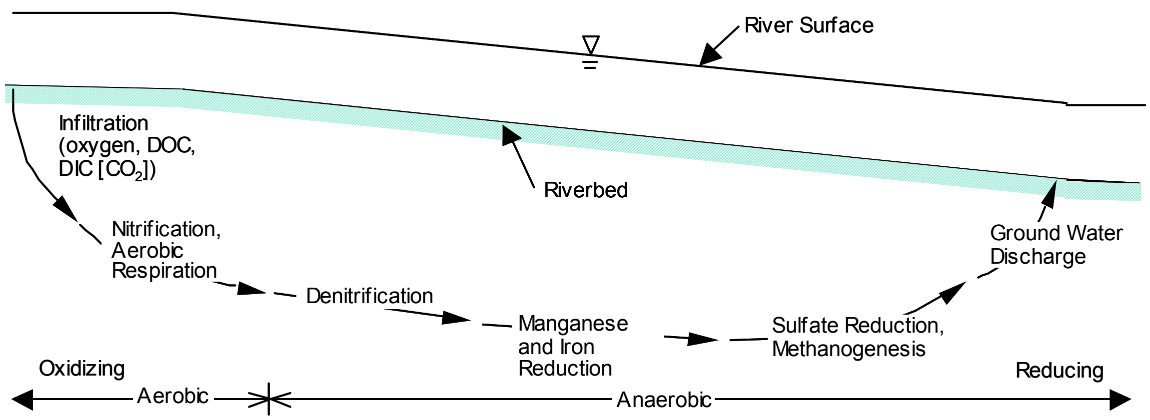


Figure 2–5. Microbially Mediated Processes in the Hyporheic Zone

For the range of oxidation-reduction potential (ORP) in the hyperoric zone, several types of bacterial metabolism, including nitrification and denitrification, can occur locally beneath the river. Tests for nitrifying bacteria indicate that ammonia in local ground water is converted to nitrate, which may in turn be subject to biodegradation downgradient in the hyporheic zone where mixing of river water and ground water produces an environment conducive to heterotrophic respiration (DOE 2006a). In addition, microcosm studies of site conditions indicate nitrogen/ammonia removal is likely to be the result of microbial nitrification, denitrification, and another microbially mediated reaction known as anammox (e.g., Ahn 2006). Conclusions of these studies suggest that several bacterially mediated nitrogen removal processes are possible in the hyperoric zone.

Assessment of ground-water biogeochemistry data from 2006 and early 2007 indicates that several different microbially mediated processes are occurring at all four configurations of the ground water interim action and the Baseline Area (DOE 2007d). Two autotrophic processes—nitrification and anammox—appear to significantly reduce dissolved concentrations of ammonia prior to ground water discharge to the Colorado River, thereby contributing to ammonia attenuation in the river.

Evaluation of biogeochemical data indicates that ground water from the extraction wells is anaerobic and chemically oxidizing. In contrast, water sampled from downgradient riverbed well points has relatively high dissolved-oxygen concentrations and negative ORP. The presence of oxygen in well-point water is attributed to the infiltration of river water to the hyporheic zone located below the riverbed, and the chemically reducing conditions implied by negative ORPs are attributed to the respiration of heterotrophic bacteria.

3.0 Ground Water Interim Action Well Field System Operations

This section provides information regarding the Groundwater Interim Action Well Field performance during the 2007 pumping season when Configurations 1, 2, 3, and 4 were actively extracting ground water. Also included in this section is a discussion regarding the total well-field ground-water extraction rate, evaporation pond storage volume, and sprinkler system discharge rate for the 2007 season.

Table 3-1 presents the average ground-water extraction rates and the total volume removed from each configuration. As shown, during 2007 the average extraction rate from the entire well field was 83 gpm, and more than 22 million gallons were removed and transported to the evaporation pond and sprinkler system.

Table 3-1. Total Volume and Average Ground Water Extraction Rate During 2007

Configuration	Total Avg Extraction Rate (gpm)	Total Ground Water Volume Extracted (gallons)
1	17.4	6,840,669
PW02	8.9	1,543,177
2	7.7	2,118,068
3	19.0	5,308,976
4	30.0	11,416,110
Total	**83.0**	**22,227,000**

The individual pumping rates and associated volume of ground water extracted by each well contained within Configurations 1, 2, 3, and 4 are presented in Appendices A, B, C, and D, respectively. Some of the monthly extracted ground water volumes presented are estimates. The data listed were generally based on flow rates recorded at meters installed at each extraction well head. These flow meters occasionally malfunctioned, which meant that some pumping rates had to be assumed using rates that were accurately captured prior to and after periods of malfunction. In addition, even when flow meter readings appeared to be accurate, they did not always fall on the last day of a month. Figure 3-1 provides a graphical summary of the volume of ground water extracted from each Configuration in 2007.

A major change in operation of the system during 2007 was winterization of the discharge line to the evaporation pond with a soil covering to provide insulation. This allowed Configuration 1 extraction wells to be operated during the 2007-2008 winter season. Other well field configurations were shut down for the winter in 2007-2008. Figure 3-1 shows that winter operation of the Configuration increased the volume of groundwater extracted while other well field configurations were shut down for the winter.

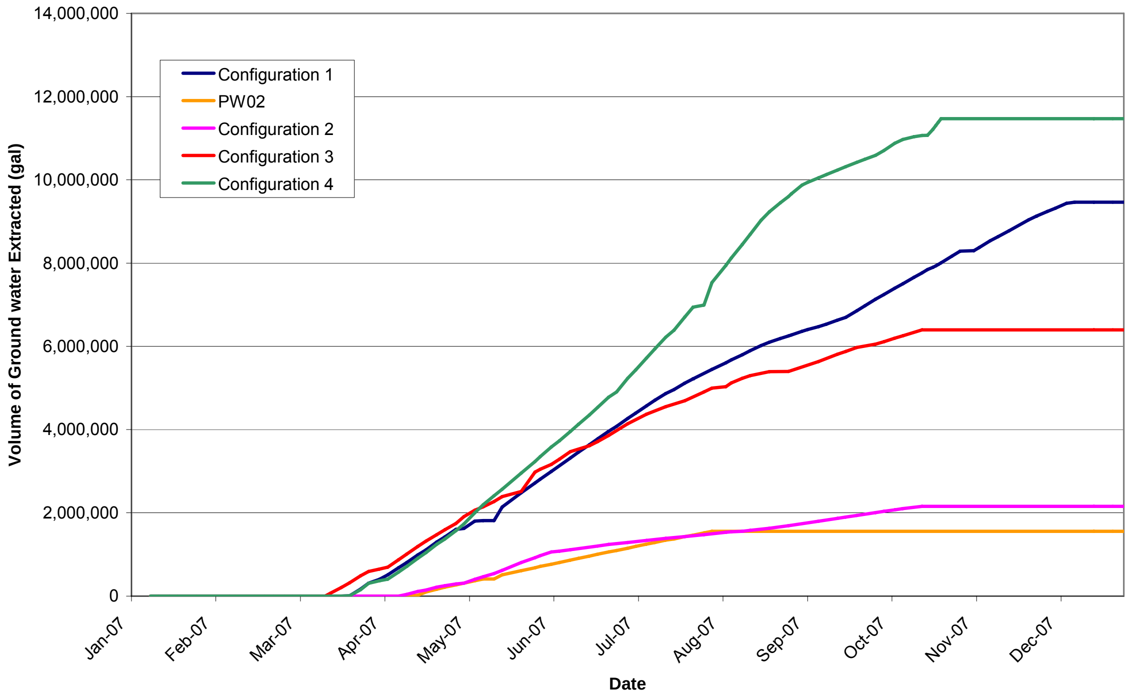


Figure 3-1. Volume of Extracted Ground Water from Each Configuration (Well SMI-PW02 presented separately) During 2007

3.1 Configuration 1 Pumping Rate and Ground Water Extracted Volume

Configuration 1 extraction wells (see Appendix A, Figure A-1 and Table A-1) 0470 through 0477 are screened from approximately 10 to 20 ft bgs (3956 and 3947 ft msl) , and wells 0478 and 0479 are screened from approximately 10 to 25 ft bgs (3957 and 3943 ft msl). Well completion intervals are shown on Figure 3-2. These extraction wells were restarted for the 2007 season on March 22, and were scheduled to operate throughout the winter in order to protect the riparian habitat channel area located on the shore of the river adjacent to this portion of the well field. They were temporarily shut down due to prolonged below-freezing air temperatures on December 12, and restarted after the first of the year in 2008. Well SMI-PW02 (which is considered a component of Configuration 1) was restarted on April 11 and shut down on August 3 due to electrical problems. Table A-2 (see Appendix A) provides information regarding activities associated with the 2007 operation of Configuration 1.

Monthly extraction volumes between March and December 2007 for each of the 10 wells comprising the Configuration 1 system and SMI-PW02 are listed in Table A-3 (see Appendix A). Configuration 1 wells extracted a combined volume of about 6.8 million gallons of ground water during 2007. Pumping from well SMI-PW02, which did not begin until April 2007, removed more than 1.5 million gallons of ground water during the time in which it was operating.

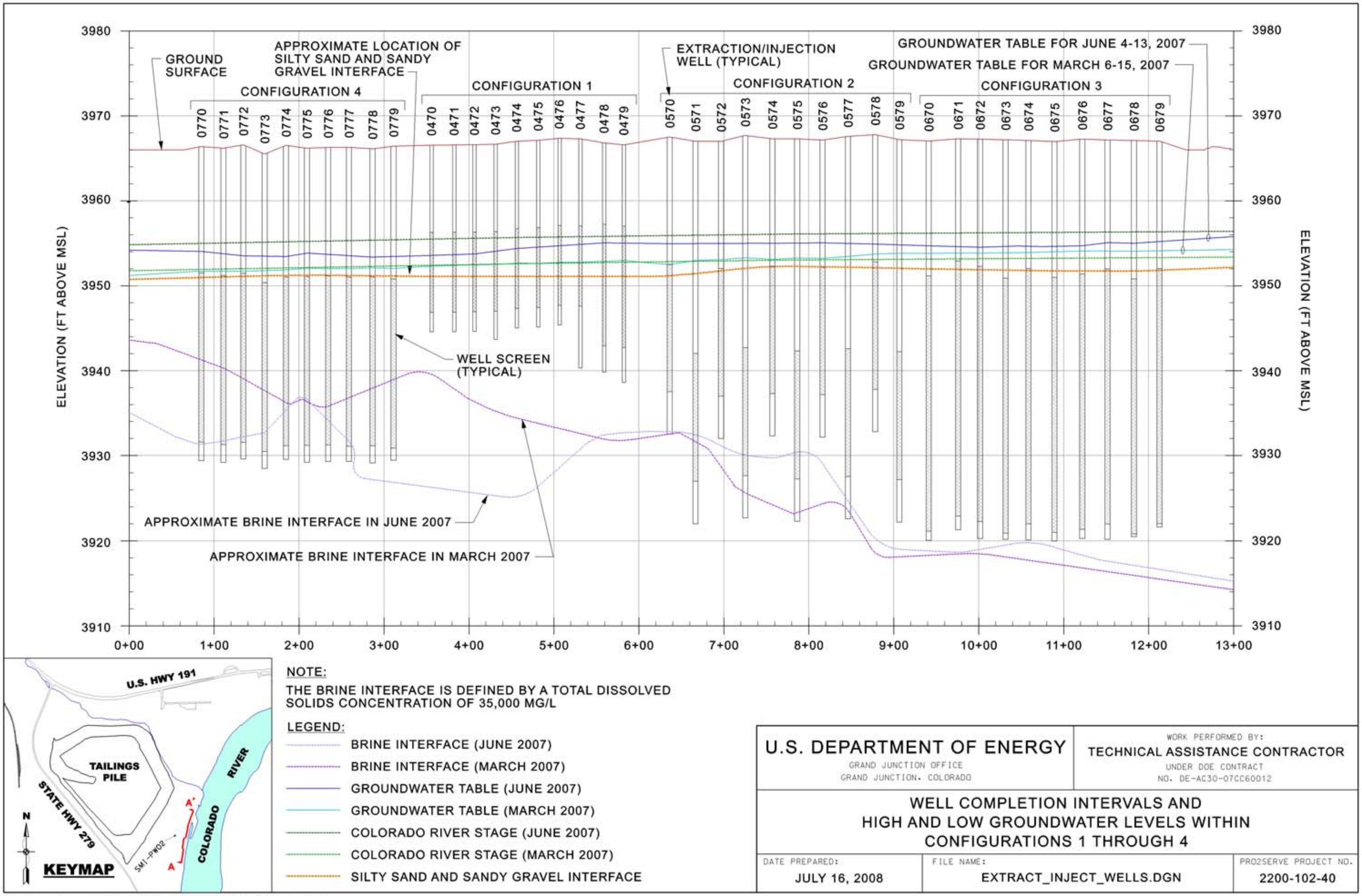


Figure 3-2. Well Completion Intervals and High and Low Ground Water Levels Within Configurations 1 through 4

In 2007, the estimated total ground water extraction volume attributed to Configuration 1 wells (6.8 million gallons) using well head meters is considerably less than the total volume of 9.5 million gallons indicated by a totalizer flow meter for the system (as shown in Figure 3-1). This discrepancy reflects the uncertainty associated with flow measurements at individual extraction wells.

Average monthly pumping rates at Configuration 1 wells were analyzed with the intent of characterizing individual well contributions to contaminant mass removal. Because, as previously mentioned, pumps were at times shut off or malfunctioned during the March to December 2007 period, the pumping-rate analysis was based solely on measured pumping rates when well-head meters were operating properly, rather than using cumulative pumping volumes provided by the meters. Monthly average pumping rates at each well and average rates for the March through December 2007 period illustrate how ground-water withdrawals from the system can vary both temporally and spatially.

3.2 Configuration 2 Pumping Rate and Ground Water Extracted Volume

Configuration 2 remediation wells (see Appendix B, Figure B-1 and Table B-1) are designed to both inject fresh water and extract ground water. These wells were operated in extraction mode during 2007. Wells 0570, 0572, 0574, 0576, and 0578 are screened from 15 to 30 ft bgs (3952 to 3937 ft msl, and wells 0571, 0573, 0575, 0577, and 0579 are screened from 25 to 40 ft bgs (3942 to 3927 ft msl). Well completion intervals are shown on Figure 3-2. Wells were restarted for the 2007 pumping season on April 10, and all Configuration 2 ground-water extraction was suspended on October 17, 2007, for the remainder of the year. Table B-2 (see Appendix B) provides information regarding activities associated with the 2007 operation of Configuration 2.

Monthly extraction volumes between March and October 2007 for the Configuration 2 system are listed in Table B-3 (see Appendix B). Wells 0576 and 0579 were not extracting ground water throughout the entire timeframe Configuration 2 was operating.

Configuration 2 wells extracted a combined volume of about 2.1 million gallons of ground water during 2007. The combined volume was limited due to pump problems and low well efficiency. Efficiency problems with these wells have been documented previously, and redevelopment has failed to increase their ability to extract ground water (DOE 2005c, DOE 2005d).

3.3 Configuration 3 Pumping Rate and Ground Water Extracted Volume

Configuration 3 remediation wells 0670 through 0679 (see Appendix C, Figure C-1 and Table C-1), designed to both extract ground water and inject fresh water, exclusively extracted ground water during 2007. The well screens are placed between 3952 and 3921 ft msl. In general, the larger saturated thickness and larger slot size and sand pack designed to increase well efficiency provided higher sustainable flow rates and associated volumes of ground-water extraction compared to Configurations 1 and 2. Well completion intervals are shown on Figure 3-2. The Configuration 3 remediation wells started extracting ground water in a phased approach on March 13, 2007. By October 25, 2007 all wells were shut down for the winter. Starting at the beginning of October, a variety of pumping schedules were used (using various wells) in order to better manage the evaporation-pond level (see Appendix C, Table C-2).

Estimated monthly pumping rates and extraction volumes between March and October 2007 for each of the 10 wells comprising Configuration 3 are listed in Table C-3 (see Appendix C).

As indicated in Table C-3 (see Appendix C), the Configuration 3 wells individually extracted between approximately 194,000 (well 0672) and 1.1 million gallons (well 0671). Though the difference between these volumes might suggest problems with well efficiencies; this is not the case. In fact, none of the Configuration 3 wells were pumped at a sufficiently large rate that production was not limited by well efficiency but by the available evaporation-pond and sprinkler-system capacity. Differences for estimated pumped volumes for Configuration 3 wells are better explained by the discharge specified by the pump controls for individual wells. Other factors may include accuracy problems encountered with well-head flow meters during the early weeks of full system operation.

As opposed to Configuration 1, significant discrepancies were not observed between the total pumped volume recorded by a totalizer meter and the comparable quantity based on readings at individual well-head meters. The totalizer that measures the flow rate and volume for Configuration 3 also measures the volume and rate for Configuration 2. The totalizer meter indicated a total volume of extracted ground water for the 2007 pumping season of approximately 6.4 million gallons, whereas the sum of volumes at individual extraction wells was 6.1 million gallons.

3.4 Configuration 4 Pumping Rate and Ground Water Extracted Volume

Configuration 4 remediation wells 0770 through 0779 (also designed for both fresh-water injection and ground-water extraction) were installed in May 2006 with approximate screen intervals of 15 to 35 ft bgs (3951 to 3930 ft msl). Well completion intervals are shown on Figure 3-2. Similar to Configuration 3 wells, the Configuration 4 wells (see Appendix D, Figure D-1 and Table D-1) operated under ground-water extraction conditions during 2007 between March 22 and October 25. Starting in October, a variety of pumping schedules (see Appendix D, Table D-2) were utilized in order to manage the evaporation pond level.

Estimated monthly pumping rates and extraction volumes between March and October 2007 for each of the 10 wells comprising Configuration 4 are listed in Table D-3 (see Appendix D). A total of 11.4 million gallons of ground water was extracted from the Configuration 4 wells during the 2007 pumping season. Similar to the other configurations, these quantities were developed using only data collected when well-head meters were operating properly. As a result, the listed extraction volumes are considered sufficiently accurate to develop rough estimates of contaminant mass withdrawals on a per-well basis.

Similar to the Configuration 3 wells, none of the Configuration 4 wells were pumped at a sufficiently large rate that production was limited by available saturated thickness. Any differences in the volume of ground water extracted and average flow rates can be attributed to a required pumping schedule which was utilized to manage the volume of water stored in the evaporation pond. The total pumped volume (approximately 11.5 million gallons) recorded by a totalizer meter was similar to the volume measured at individual well-head meters.

4.0 Well Field System Performance

4.1 Ground Water Levels and Hydraulic Control

The Baseline Area is located upstream of the well-field configurations and the infiltration trench, just south of the confluence of the Moab Wash and the Colorado River (Figure 1-2). This area has been used as an analogue of hydraulic and water chemistry conditions in the alluvium that are unaffected by ground water pumping or injection. The types of aquifer materials encountered in the Baseline Area are generally the same as those observed in the vicinities of the interim action configurations. Observed phenomena in the Baseline Area, such as ground-water level variations in response to changing river flows, the presence or absence of riparian channels, concomitant changes in brine surface elevation, and hyporheic zone processes were useful for comparison with equivalent phenomena in the interim action areas. However, riparian habitat channels that have been silted in the Baseline Area limit the use of baseline data for comparison with water-level and water-quality data from Configurations 1 and 4, where there are riparian channels. Baseline data is still useful for comparison at the infiltration trench and Configurations 2 and 3.

4.1.1 Drawdown and Capture

Drawdown hydrographs were created by comparing ground-water elevations with water elevations from Baseline Area observation well 0406 and applicable pumping rates for the period of ground-water extraction. As part of this process, Baseline Area water-elevation data were adjusted so that both wells were assigned the same starting ground-water elevation prior to the time period when pumping began and after the pumping was suspended for the winter. Differences between the two curves are a qualitative estimate of drawdown in response to pumping. The drawdown hydrographs show that it becomes difficult to gage extraction/remediation and observation well drawdowns during months of high runoff in the river or a long period after start up. Thus, drawdowns were calculated based on the difference in matched water levels with Baseline Area observation well 406. This method is qualitative in that variation in hydraulic conductivity, distance from the river, and the presence or lack of riparian channels do not allow a rigorous comparison.

The peak mean daily flow in the Colorado River in 2007 was 14,900 cfs (on May 17), which represents a below average annual peak flow (23,400 cfs). During the month leading up to the peak and for a few months following it, little if any drawdown due to pumping could be discerned using the drawdown hydrographs.

Figure 4-1 is a temporal plot comparing the ground-water elevation measured in Baseline Area well 0406 and the Colorado River flows measured at the U.S. Geological Survey Cisco Gaging Station during 2007. As the plot exhibits, the ground water elevation fluctuations are in response to changes in the river flow.

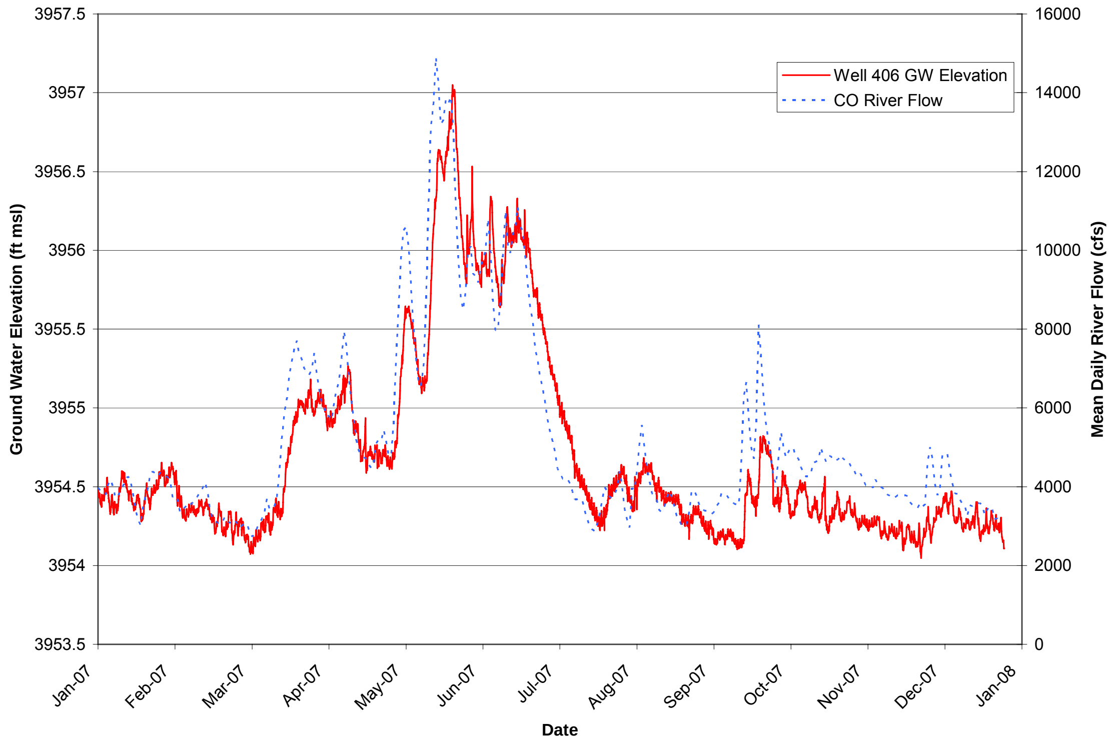


Figure 4-1. Hydrograph of Baseline Area Well 0406 Ground Water Elevation and the Colorado River Flow in 2007

Figure 4-2 presents an example plot of measured ground-water levels at observation well 0480 along with adjusted ground-water elevation fluctuations measured in Baseline Area well 0406 and Configuration 1 total pumping rates for 2007. Differences between the two curves represent the amount of drawdown caused by pumping at that location. Similar plots were generated for select observation wells in Configurations 1, 2, 3, and 4 and are contained in Appendices A, B, C, and D, respectively. These drawdown estimates provide the best available means to measure the capture zone in the vicinity of the extraction wells at each configuration and the effectiveness of capturing contaminants migrating towards the river.

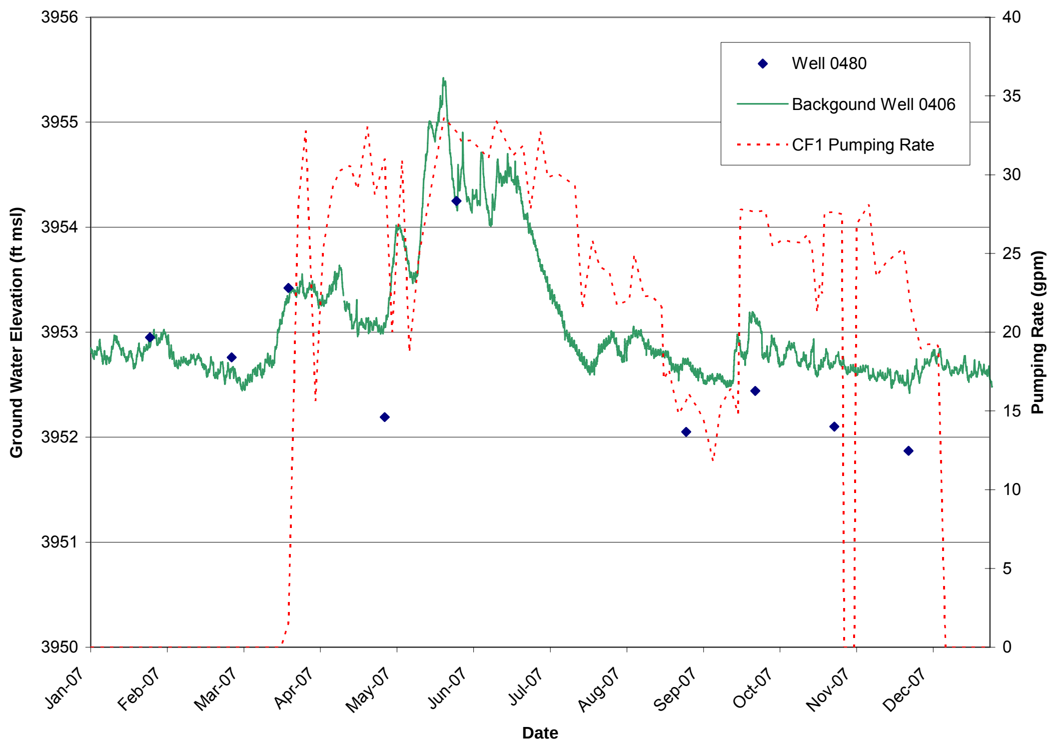


Figure 4-2. Ground Water Elevations at Observation Well 0480 and Baseline Area Well 0406 During 2007

The resulting computed drawdowns are presented in Table 4-1, along with drawdown measured during the 2006 pumping season for comparison purposes. As the results show, the drawdowns measured in 2007 are in general comparable to the drawdowns measured in 2006 at these locations. Such a response indicates that in 2007, the well field developed a similar capture zone to that generated during the 2006 pumping season.

Table 4-1. Computed Drawdowns Selected Observation Wells During 2007

Configuration	Well	Distance from Well Field Axis (ft)	2007 Drawdown (ft)	2006 Drawdown Range (ft)
1	0480	23	0.8	0.7 to 0.9
	0552	30	0.7	0.8
2	0587	20	0.4	0.4 to 0.5
	0601	25	0.3	0.5 to 0.7
3	0682	26	0.6	0.6 to 0.9
	0687	20	0.7	0.7 to 1.3
	0688	20	0.7	0.6 to 1.3
4	0780	20	1.1	0.5 to 0.9
	0787	30	0.4	0.2 to 0.8

The groundwater table in March and June 2007 for the Configurations 1 through 4 is shown in cross section in Figure 3-2. Pumping water levels in the well field changed by approximately 2 ft during high and low river stage. Figure 4-2 indicates that even at high river stage water levels in Configuration 1 wells are below the top of the well screen, thereby limiting available drawdown.

4.1.2 Remediation Well Specific Capacity

Specific capacity is a measure of a well's performance relative to formation hydraulic characteristics. Possible reasons for a low specific capacity of a well in an alluvial formation with high transmissivity are that the well is either too shallow, has an improper screen size, or is underdeveloped, silted, or encrusted.

Figure 4-3 is an example plot showing the discernible drawdowns at extraction well 0470 during 2007. As this figure shows, ground-water elevation data collected from extraction well 0470 drops below the background fluctuation elevation data (which represents the ground water elevation that would be measured in the well if ground water was not being extracted), especially during the months leading up to peak runoff in the river and in the months following the peak flow. During the peak runoff time frame, the ground water elevation is controlled by river stage and not the pumping rate.

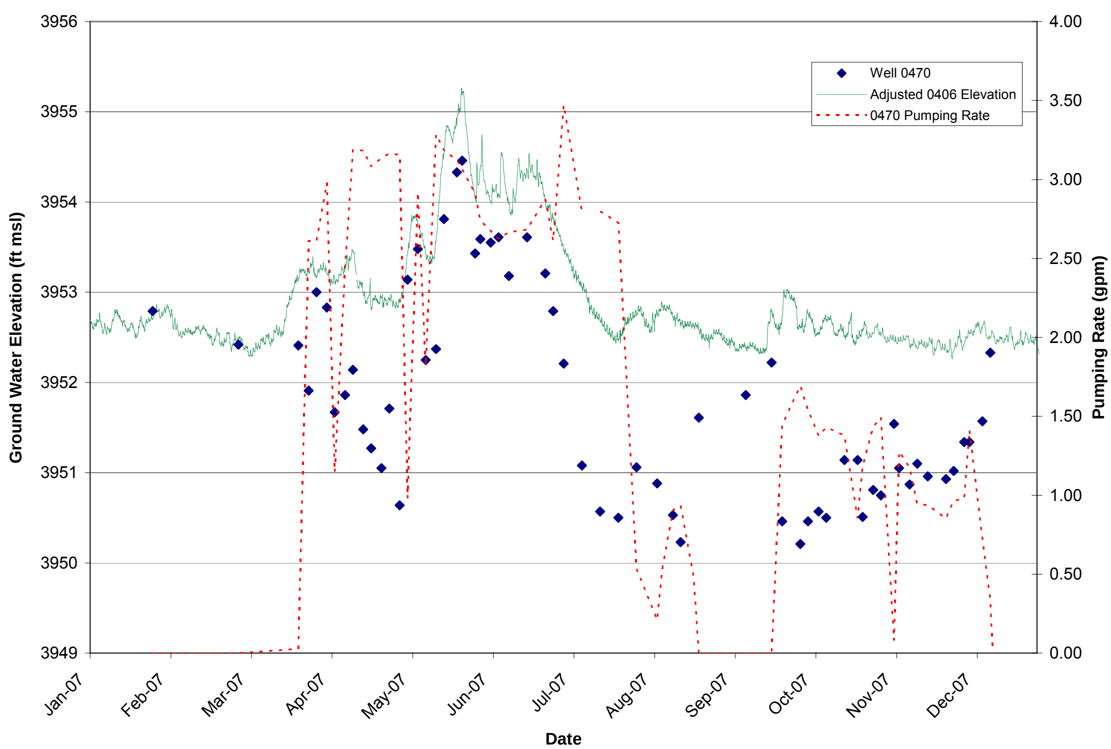


Figure 4-3. Well 0470 Ground Water Elevations and Pumping Rates Plotted with Background Well 0406 Fluctuations During 2007

The graphs contained in Appendices A, B, C, and D for select Configuration 1, 2, 3, and 4 extraction wells, respectively, were used to compute drawdowns and estimate the specific capacity during the 2007 pumping season. While this is not a rigorous method of calculating specific capacity because it does not account for well interference, it provides a qualitative evaluation of the relative performance of each configuration.

These wells, listed in Table 4-2, were selected based on calculated specific-capacity estimates in 2006 and represent the wells associated with the lowest and highest specific capacities in each of the four configurations. The 2007 results presented in Table 4-2 also include the range of the specific capacities calculated during 2006 for comparison purposes. As the data indicate, the specific capacities calculated in 2007 are comparable to the ranges measured in 2006.

Table 4-2. Computed Specific Capacities at Selected Extraction Wells During 2007

Configuration	Well	2007 Spec Cap (gpm/ft)	2006 Spec Cap Range (gpm/ft)
1	0470	1.8	0.4 to 1.8
	0478	0.7	
2	0572	0.1	0.02 to 0.22
	0577	0.2	
3	0674	1.5	1.4 to 5.1
	0678	7.0	
4	0770	5.6	1.6 to 4.9
	0778	1.6	

Spec Cap = specific capacity; gpm = gallons per minute; ft = feet; gpm/ft = gallons per minute per foot.

4.2 Contaminant Mass Removal

This section presents the estimated ammonia and uranium mass removed by Configurations 1, 2, 3, and 4 extraction/remediation wells during 2007. These estimates are based on the ground-water extraction rate and volumes recorded by flow meters located along the well-head discharge lines at each well. The masses of ammonia and uranium removed from ground water by the pumping of extraction/remediation wells during 2007 were estimated by multiplying the monthly extraction volumes by corresponding concentrations of ammonia (NH_3-N) and uranium (U) measured in each well.

The concentrations used in these calculations were drawn from analytical data presented in Appendices A, B, C, and D for Configurations 1, 2, 3, and 4, respectively, and Appendix H. In some instances, discharge samples were not collected each month the well was operating. In order to estimate the contaminant mass removed, concentrations from the previous and subsequent months were averaged to provide the approximate concentration.

Table 4-3 presents a summary of the ammonia and uranium mass removed during 2007 by each configuration. As shown, during the 2007 pumping season, a total of 45,579 kg of ammonia and 195.1 kg of uranium were removed by the well field.

Table 4-3. Total Volume and Average Ground Water Extraction Rate During 2007

Configuration	Total Ammonia Mass Removed (kg)	Total Uranium Mass Removed (kg)
1	8,532	51.4
PW02	4,730	15.3
2	5,590	19.9
3	8,871	45.0
4	17,856	63.5
Total	**45,579**	**195.1**

4.2.1 Configuration 1 Contaminant Mass Removal

The resulting monthly estimates of ammonia mass removed by Configuration 1 wells (0470 through 0479) are listed in Table A-4. During 2007, the largest mass quantities were associated with the three wells with the highest average flow rates, and the smallest amount of mass removed from ground water was observed at the well with the lowest average rate. The same trend is evident for ammonia during the 2005 and 2006 pumping seasons (DOE 2006a and DOE 2007d), The 10 Configuration 1 extraction wells removed an estimated total of 8,532 kg of ammonia during 2007, and another 4,730 kg of ammonia was removed from pumping well SMI-PW02.

Below average Colorado River spring runoff flows in 2007 did not dilute ammonia concentrations in Configuration 1 extraction wells except for the deeper wells 0478 and 0479 at the northern end of the configuration. This observation differs from interpretation of data collected during the 2005 and 2006 spring runoff seasons when lower ammonia concentrations were measured in the extraction wells during higher river stages. This response suggests that during the years in which below average flows are forecasted for the Colorado River, the ability of Configuration 1 to deliver average ammonia concentrations during the spring runoff period will not be impacted.

Estimated masses of uranium removed from ground water during 2007 by pumping of Configuration 1 extraction wells and well SMI-PW02 were developed using the same techniques applied to ammonia. The 10 Configuration 1 wells removed an estimated total of 51.4 kg of uranium from ground water during 2007. Pumping of well SMI-PW02 between April and August 2007 resulted in an estimated additional 15.3 kg of uranium mass removed.

4.2.2 Configuration 2 Contaminant Mass Removal

As shown in Table B-4 (see Appendix B), an estimated 5,509 kg of ammonia was removed from Configuration 2 remediation wells in 2007. Similar to previous years (as reported in the 2005 and 2006 Ground Water Interim Action Well Field Performance Assessments), significantly higher ammonia concentrations were measured in the Configuration 2 wells compared to Configuration 1 wells, which is a function of the deeper screened intervals for wells 0571, 0573, 0575, 0577, and 0579.

As shown in Table B-5 (see Appendix B), the Configuration 2 wells removed an estimated total of 19.9 kg of uranium from ground water during 2007. While the ammonia concentrations for Configuration 2 shallow wells were significantly lower compared to the deeper screened wells, the uranium concentrations measured from both sets of wells are comparable.

4.2.3 Configuration 3 Contaminant Mass Removal

The data presented in Table C-4 (see Appendix C) indicate that an estimated total of 8,870 kg of ammonia were extracted from ground water at Configuration 3 wells during the 2007 pumping season. This mass removal is similar to the mass removed by Configuration 1, but over a shorter time frame.

The ammonia concentrations (and associated mass removals) decreased significantly during August 2007 along the entire length of Configuration 3. One explanation for the decrease may be associated with the flood irrigation of the tree plot area and plot C5, which are located just upgradient of extraction wells 0670 through 0679.

Estimated mass withdrawals of uranium at Configuration 3 extraction wells (see Appendix C, Table C-5) indicate that a total of 45 kg of uranium was removed by this system between March and October 2007. This quantity represents a similar amount removed by Configuration 1. The data indicate Configuration 3 wells contained higher uranium concentrations compared to Configuration 1.

Similar to the ammonia concentrations, the uranium concentrations decreased significantly during August 2007 across Configuration 3.

4.2.4 Configuration 4 Contaminant Mass Removal

An estimated 17,856 kg of ammonia was extracted from ground water at Configuration 4 wells during the 2007 pumping season (Table D-4). This ammonia mass removed represents highest achieved by any of the configurations during the 2007 pumping season.

Ammonia concentrations decreased in May/June 2007 across the configuration and rebounded by the September/October 2007 timeframe. Such a temporal pattern suggests the Colorado River stage may have impacted the water chemistry in this vicinity of the well field. There is a riparian side channel that flowed consistently throughout 2007 just 60 ft off the line of Configuration 4 remediation wells which may have enhanced the hydraulic connection between surface water and groundwater. Infiltration of surface water from the channel probably diluted groundwater concentrations at higher river stage.

An estimated 63.5 kg of uranium was removed by this system between March and October 2007 (Table D-5), the highest mass removed by the well field. On average, Configuration 4 wells have the lowest uranium concentrations measured in the well field, but nearly two times the volume of water was removed from this location.

Uranium concentrations decreased during the May/June time frame following similar concentration trends in ammonia data.

5.0 Contaminant Distributions and Temporal Ground Water and Surface Water Chemistry

Section 5.1 describes the contaminant distributions observed in the well field during 2007 as determined by the sampling of the extraction and remediation wells throughout the well field. Section 5.2 focuses on the contaminant distribution and temporal water chemistry associated with Configuration 1. This area of the well field was chosen because of its larger network of observation wells and its proximity to established habitat areas. The temporal changes observed in Configuration 1 can also be applied to Configuration 4, which is located just to the south and also is upgradient of a habitat area. Section 5.3 provides a summary of changes observed in the surface water chemistry during 2007.

5.1 Extraction Well Contaminant Distributions

Extraction well contaminant concentrations for low and high river stages were plotted on a cross section to examine contaminant distributions as a function depth to the brine interface, well depth, and river stage. As shown on Figures 3-2, 5-1, and 5-2, during high river stage in June 2007, the brine interface upwelled only into Configuration 4 deep wells 0772 and 0776. This observation is limited by sampling of only one half the wells during this period. During low-river stage in March 2007, brine was present in all Configuration 4 wells and deep well 0571 in Configuration 2.

Interpretation of Figures 5-3 and 5-4 indicates that Configuration 4 wells and deeper wells in Configurations 1 and 2 pump significantly higher concentrations of ammonia under low river-stage conditions in March 2007 than under higher river-stage conditions in June 2007. Ammonia concentrations in Configuration 1 wells are generally lower compared to nearby Configurations 2 and 4. High concentrations of ammonia in deeper observation wells upgradient of Configuration 1 indicate that there is up to a 20 ft thickness of higher concentration ammonia plume beneath the screen interval and the brine interface in the vicinity of Configuration 1.

Riparian habitat channels adjacent to Configurations 1 and 4 were observed to contain surface water from mid-March through the end of July in 2007. The presence of proximate riparian habitat channels and high river stage at Configurations 1 and 4 are contributing factors to decreasing TDS and ammonia concentrations in the extractions wells at these configurations in the June period of operation. TDS and ammonia concentrations in Configurations 2 and 3 extraction wells are less affected by river stage as there were no riparian channels with surface water in 2007.

Review of Figures 5-5 and 5-6 suggests that uranium concentrations did not change significantly in extraction wells as a function of river stage in 2007. Uranium concentrations are the lowest in the Configuration 4 extraction wells.

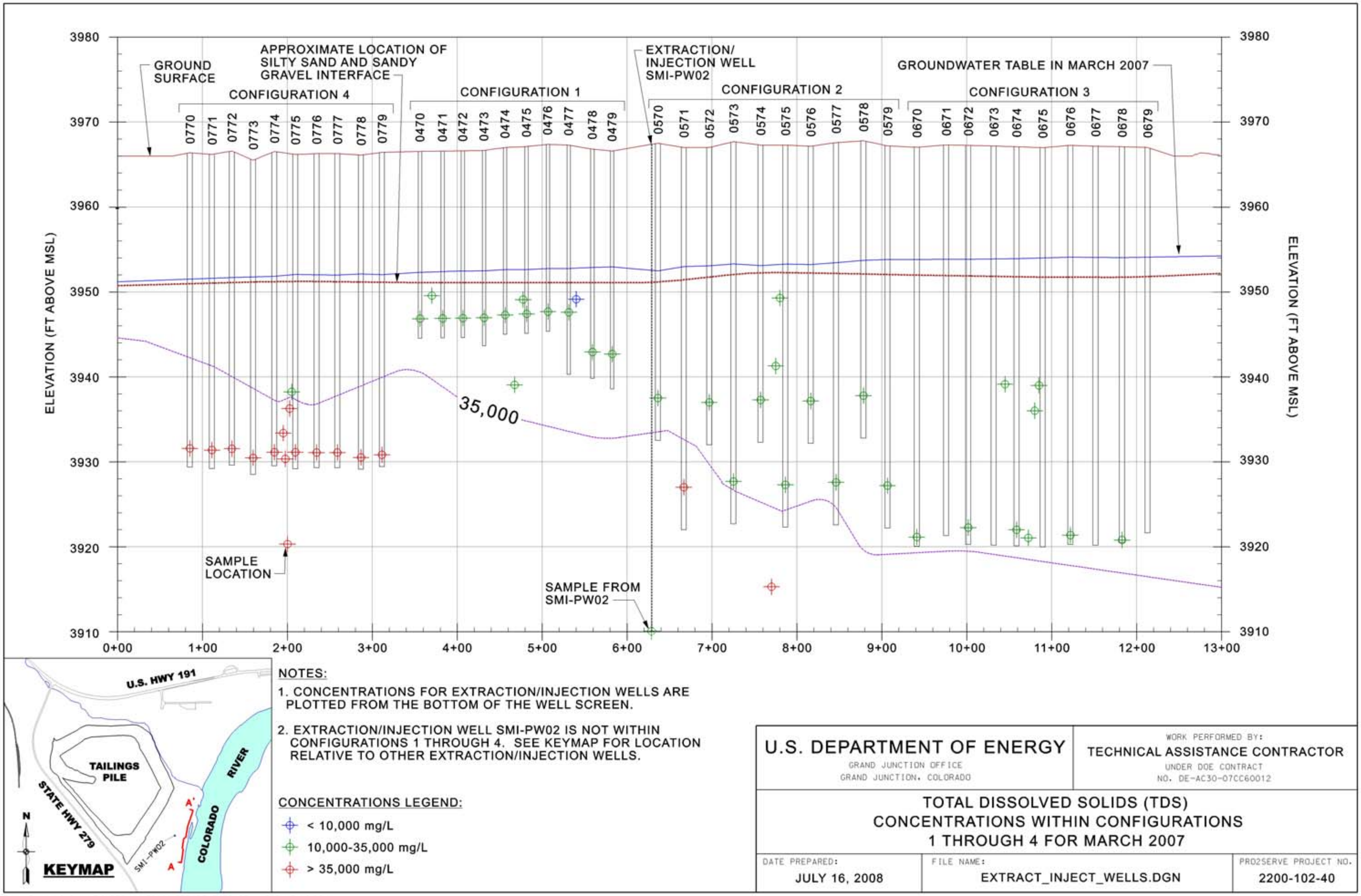


Figure 5-1 Total Dissolved Solids Concentrations within Configurations 1 through 4 for March 2007

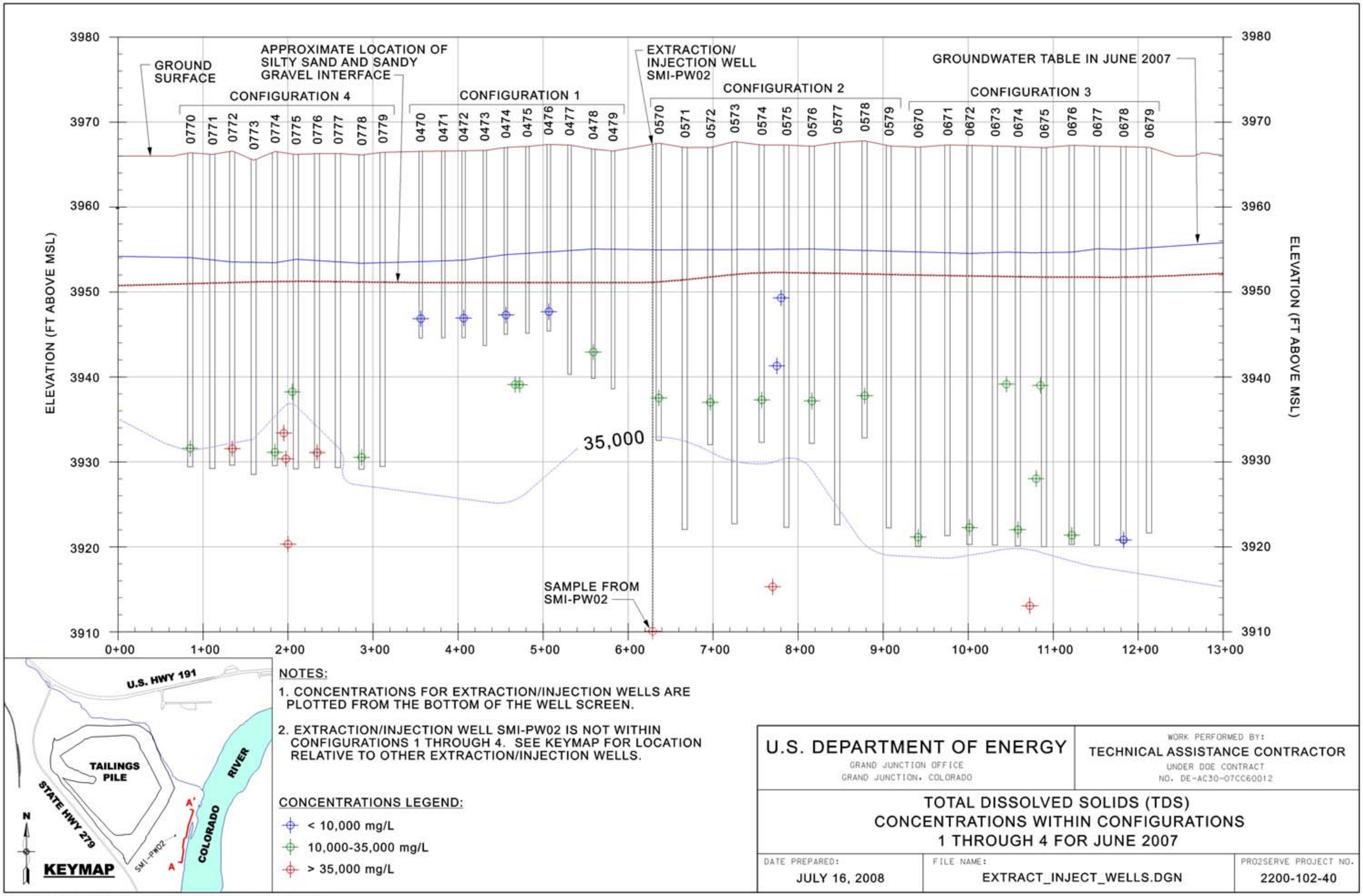


Figure 5-2 Total Dissolved Solids Concentrations within Configurations 1 through 4 for June 2007

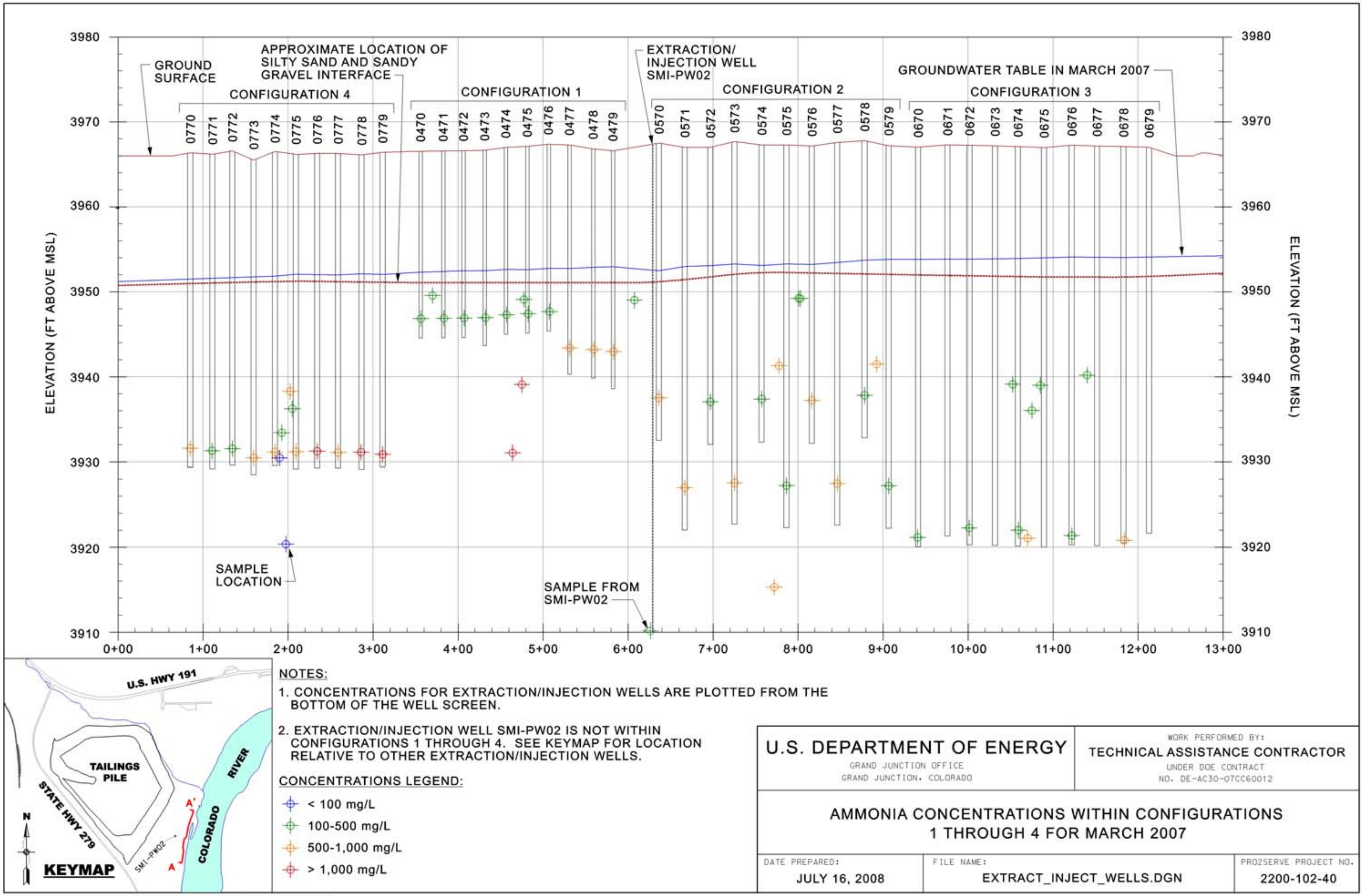


Figure 5-3 Ammonia Concentrations within Configurations 1 through 4 for March 2007

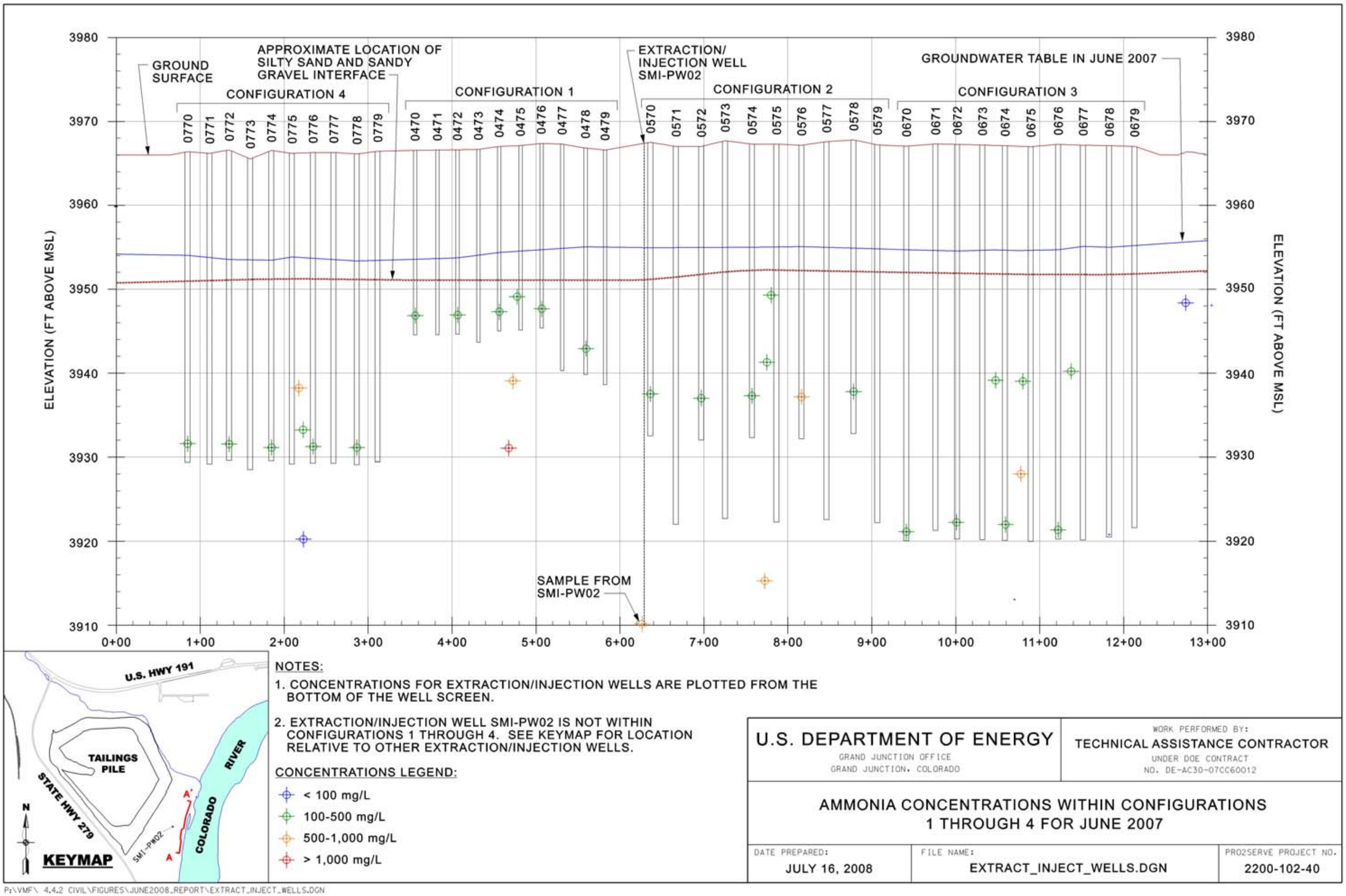


Figure 5-4 Ammonia Concentrations within Configurations 1 through 4 for June 2007

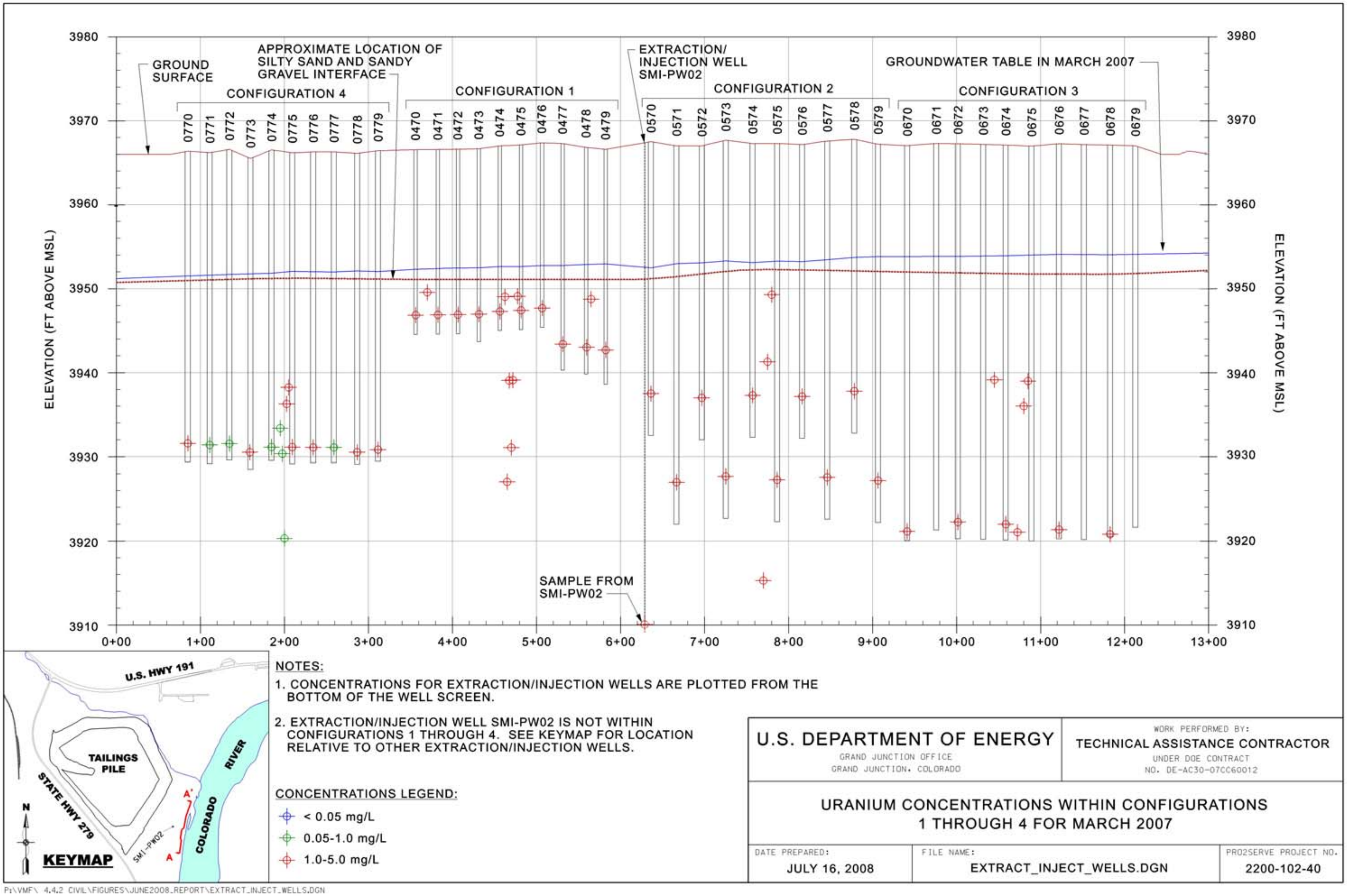


Figure 5-5 Uranium Concentrations within Configurations 1 through 4 for March 2007

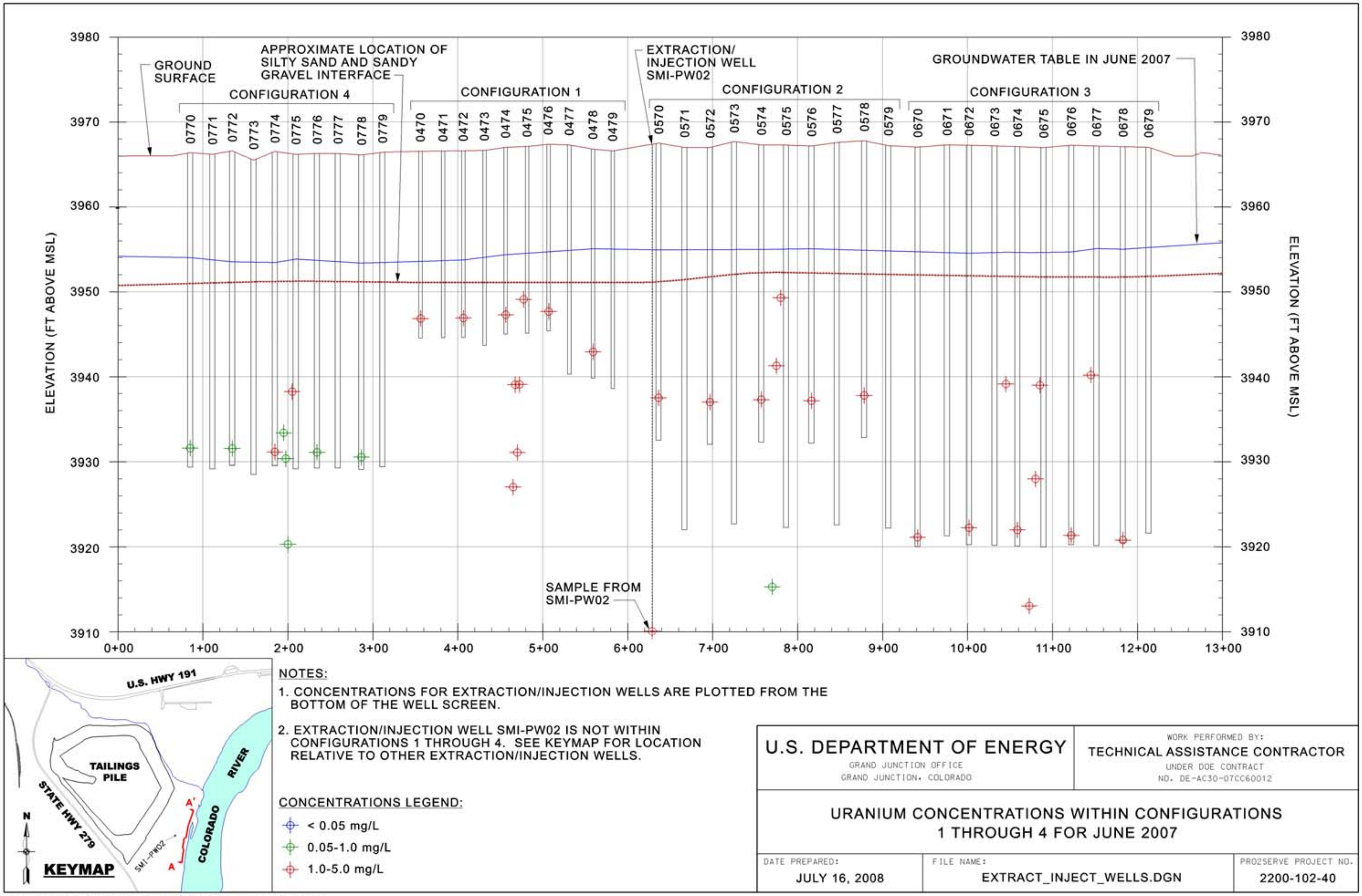


Figure 5-6 Uranium Concentrations within Configurations 1 through 4 for June 2007

5.2 Configuration 1 Temporal Ground Water Chemistry

This section evaluates temporal variations of water chemistry in samples collected from extraction wells, observation wells, riverbank well points, and surface water sample locations within Configuration 1 in 2007. The chemical data from Configuration 1 used to assess temporal variations are contained in Appendix H. The evaluation attempts to determine whether changes in ammonia, uranium, and TDS concentrations are significant and whether they are related to upgradient changes in water quality, pumping by the extraction well field, or changes in river stage. For evaluation purposes, a significant temporal variation is a factor of two change in concentration within the annual period. Otherwise the trend is incipient.

5.2.1 Extraction Wells

Extraction Wells SMI-PW02 and 0475

Extraction well SMI-PW02 was sampled twice after it was added to the ground-water extraction system in April 2007 (Figure A-4). SMI-PW02 continued to operate until early August when it had electrical problems and was shut off (Table A-2). During the active pumping timeframe, samples were collected directly from the discharge line of the dedicated submersible pump that has its intake set at a depth of approximately 55 ft bgs (well screened from 20 to 60 ft bgs [3906.6 to 3945.5 ft msl]).

Extraction well SMI-PW02 only was sampled twice in 2007 due to its short period of operation. Sampling results exhibited negligible changes in concentration from May to June. The ammonia concentration slightly increased from 800 to 820 mg/L, the uranium concentration increased from 2.6 to 2.7 mg/L, and the TDS concentration decreased from 47,000 to 42,000 mg/L (Figure A-4). Chemical concentrations for ammonia, uranium, and TDS measured during 2007 are the same order of magnitude as those recorded in 2006.

For further temporal analysis in this performance assessment, extraction well 0475 was chosen, due to its central location in the ammonia plume, to give a representation of the performance of the Configuration 1 extraction wells. Configuration 1 is adjacent to a riparian channel along the shore of the Colorado River that has the potential to receive ground water discharge. Because of the close proximity of the channel to the Configuration 1well field, contamination in shallow groundwater is diluted by inflow from the river during high river stage.

Configuration 1 extraction wells were sampled monthly during the full-scale operation of the system between March and December 2007. Prior to the start up of pumping, samples were collected from each of the 10 extraction wells in early March 2007. During system operation, samples were collected directly from the discharge of the dedicated submersible pump in each well. The pump intake depths at extraction wells 0470 through 0477 are located about 18 ft bgs (well screened from 10.3 to 19.7 ft bgs [3946.9 to 3956.3 ft msl]). In wells 0478 and 0479, pump intakes are located at a depth of approximately 21 ft bgs (well screened from 9.6-23.9 bgs [3942.9 to 3957.2 ft msl]).

The ammonia, TDS, and uranium concentrations in extraction well 0475 follow an incipient annual trend consisting of higher concentrations in the winter months and lower concentrations following periods of peak runoff (see Appendix A, Figure A-5). A pattern in Figure A-5 is the uniform decrease in analyte concentration in response to increased flow in the Colorado River. The lowest concentrations of TDS, ammonia, and uranium coincide with periods of high river flow. These observations show that the river water migrates into the ground-water system during periods of high-river flow.

The TDS concentration (Figure A-5) indicates that the brine interface was located below 18 ft bgs (3949 ft msl) along the middle axis of Configuration 1. All of the TDS samples collected from the extraction wells during pumping operations had TDS concentrations that were lower than their respective baseline (pre-pumping) concentrations in March. This is an indication that pumping of wells as shallow as those in Configuration 1 (wells screened from 10.3-19.7 ft bgs (3946.9- 3956.3 ft msl) does not produce upwelling resulting in an increase in TDS.

Because the highest extraction (pumping) rate corresponds with periods of peak river flow, it is difficult to determine whether the introduction of river water into the ground-water system or if the extraction of contaminated ground water is the main factor in the dilution of the contaminant concentrations observed in 2007.

5.2.2 Observation Wells

Configuration 1 observation wells located upgradient and downgradient of the well field axis were sampled on a monthly basis while the well field was operating between March and December 2007. The TDS and uranium concentration data are plotted with the Colorado River flow data and the ammonia data are plotted with the Configuration 1 extraction-rate data on Figures A-6, A-7, and A-8 in Appendix A.

Upgradient Wells 0480 and 0481

Figure A-6 presents analytical results of samples collected upgradient of Configuration 1 from well 0480 at a depth of 18 ft bgs (3949 ft msl) and well 0481 from a depth of 28 ft bgs (3939 ft msl). Both of these wells are approximately 25 ft from the well field axis. The chemical data from January through April showed relatively constant concentrations of constituents. However, while the TDS concentrations remained fairly uniform throughout 2007, the ammonia concentration plot shows variable and diverging trends during April through October.

The uranium concentration at 18 and 28 ft bgs fluctuated slightly throughout 2007 (Figure A-6). In well 0481, the concentration increased from 2.8 to 3.4 mg/L until the peak river flow in mid-May and then gradually decreased to 1.9 mg/L until December, when it began to increase. These incipient trends do not coincide with changes in river levels or Configuration 1 pumping rates.

In April, the ammonia concentration in well 0480 increased from 520 to 650 mg/l, then dropped to 520 mg/l again in May, and then increased once again to 640 mg/l in early June. During this timeframe, the ammonia concentration was steadily dropping in well 0481 from 580 to 490 mg/L (28 ft bgs).

Ammonia concentrations increased at the shallow upgradient wells (18 and 28 ft bgs) in August and then dropped in November; the ammonia concentrations in wells 0480 and 0481 diverged again in early December.

Irrigation of plot C3 took place during the operation of Configuration 1 in 2007. It is possible that the introduction of fresh river water may have slightly decreased concentrations in shallow groundwater in this region.

Downgradient Wells 0483 and 0484

Ground water sampling from downgradient cluster wells 0483 and 0484 provided water chemistry data from depths of 18 ft bgs (3949 ft msl) and 28 ft bgs (3939 ft msl), respectively. Both these wells are located less than 25 ft from the axis.

The ammonia, TDS, and uranium concentrations follow a similar trend in both wells in 2007 (Figure A-7). The ammonia concentrations (Figure A-7) significantly decreased from April to July (from 300 to 120 mg/L in samples from 0483 and from 950 to 680 mg/L from samples in well 0484). Another decrease was observed between September and November, when concentrations decreased from 470 to 330 mg/L and from 870 to 650 mg/L in samples collected from wells 0483 and 0484, respectively. This timeframe corresponds with increased extraction rates from the Configuration 1 remediation wells and high Colorado River flows. It is difficult to distinguish which of these factors was the main cause of the decrease of contaminant concentration.

Similar trends were observed in the time-concentration plots for TDS (Figure A-7) between April and July 2007; however, the concentration did not significantly change between September and November 2007. The TDS concentration in samples collected from 0483 decreased from 15,000 to 2,600 mg/L between April and July 2007, while samples from 0484 only decreased from 32,000 to 25,000 during the same timeframe. Such a response suggests the more shallow zone in the downgradient portion of Configuration 1 was more susceptible to changes in either the river stage or pumping rate. This plot also indicates that concentrations increase with depth, with the brine interface lying closely below 28 ft bgs during non-pumping Colorado River base-flow conditions and declining in elevation during pumping operations.

Uranium concentrations in samples collected from the more shallow zone (well 0483) decreased from 3 to 0.46 mg/L between April and July 2007, while concentrations in samples collected from 0484 did not significantly fluctuate over this same timeframe. Again, while the concentration did decrease between September and November 2007 in samples collected from 0483 (from 2.8 to 1.8 mg/L), the concentration did not significantly change (from 3.0 to 2.7 mg/L) in samples collected from well 0484.

These responses observed in the downgradient observation wells suggest the shallower zone in the downgradient portion of Configuration 1 was more susceptible to changes in either the river stage or pumping rate compared to the deeper zone (28 ft bgs), which coincides with the depth of the brine surface during certain times of the year. Analyte concentration changes observed in this portion of the well field also suggests the downgradient portion of the well field is more influenced by river stage and/or pumping rate changes compared to the upgradient areas of the well field.

Downgradient Wells 0559 and 0560

Ground water sampling from further downgradient cluster wells 0559 and 0560 provided water chemistry data from depths of 19 ft bgs (3948 ft msl) and 31 ft bgs (3936 ft msl), respectively. These wells are located along the edge of the river bank, approximately 65 ft from the axis.

Similar to the temporal changes observed in samples collected downgradient well 0483, the ammonia concentrations (Figure A-8) significantly decreased from April to July (from 220 to 29 mg/L in samples collected from well 0559. Sampling from well 0560 suggested the ammonia concentrations did not fluctuate as significantly during this same time period.

This timeframe corresponds with increased extraction rates from the Configuration 1 remediation wells and high Colorado River flows. It is difficult to distinguish which of these factors was the main cause of the decrease of contaminant concentration.

The TDS plot (Figure A-8) indicates concentrations increase with depth, with the brine interface lying between 19 and 31 ft bgs during non-pumping Colorado River base flow conditions (March 2007). TDS and uranium (Figure A-8) concentrations also sharply decreased during this same timeframe in 0559 (from 11,000 to 650 mg/L, and from 2.0 to 0.13 mg/L, respectively), while samples collected from well 0560 generally remain constant through 2007. This data indicates that the influence of riverbank storage on water chemistry in upper alluvial ground-water system does not extend to a depth of 31 ft bgs.

Downgradient Wells 0403 and 0407

Located approximately the same distance off the Configuration 1 extraction well axis are observation wells 0403 (located near the northern end of Configuration 1) and 0407 (located near the southern end). Ground water samples were collected from location 0403 from a depth of 18 ft bgs (3949 ft msl) and location 0407 from 17 ft bgs (3950 ft msl).

Despite the fact that these samples were collected from approximately the same elevation, the ammonia, TDS, and uranium concentrations are significantly different (Figure A-9). Prior to the start of pumping from Configuration 1 in 2007, the ammonia, TDS, and uranium concentrations were similar in February and March. However, once ground water extraction started, the concentrations measured in samples collected from well 0403 either stayed constant on gradually increased throughout the 2007. During this same timeframe the concentrations in samples collected from well 0407 significantly decreased. Between March and May 2007, ammonia concentrations decreased from 220 to less than 10 mg/L, TDS concentrations dropped from 12,000 to 1,100 mg/L, and uranium concentrations decreased from 2 to less than 0.2 mg/L.

This water chemistry variability caused by the Configuration 1 ground water extraction is a result of the alluvial aquifer's heterogeneity in this portion of the well field. The hydraulic conductivity in the southern portion of Configuration 1 is higher compared to the northern portion, and is more effective at drawing in river water and diluting nearshore ground water than is the northern portion.

5.2.3 Well Points 0562, 0563, and 0606

The Configuration 1 well points are divided into three clusters containing three well points each that are installed at different depths. The riverbank cluster of well points, 0562 (screened from 1.3 to 2.3 ft bgs [3952.5 to 3951.5 ft msl]), 0563 (screened from 4.6 to 5.6 ft bgs [3949.2 to 3948.2 ft msl]), and 0606 (screened from 9.3 to 10.3 ft bgs [3944.5 to 3943.5 ft msl]), was selected for the temporal analysis due to its close proximity to the interim-action well field. The TDS and uranium concentration data are plotted with the Colorado River flow data and the ammonia data are plotted with the Configuration 1 extraction rate data.

The well point chemical plots indicate that the ammonia, TDS, and uranium concentrations significantly increased from January through March 2007 (see Appendix A, Figure A-10) when Configuration 1 extraction wells not running. This timeframe is also when the Colorado River experienced some of the lowest flows during 2007.

Anomalously high TDS concentrations (10,800 and 11,000 mg/L) were measured in February and March samples from the shallowest well point 0562 (Figure A-10). These are anomalous compared to average well-point TDS concentrations (approximately 1,100 mg/L). The high TDS concentrations at a shallow depth may indicate that some mixing occurs in the shallow aquifer near the river bank.

The analyte concentrations decreased rapidly starting in mid-March-early April 2007. Ammonia concentrations (Figure A-9) in samples collected from well point 0562 decreased from 140 to less than 5 mg/L in July, and remained below 3 mg/L for the reminder of the year. Samples collected from well points 0563 and 0606 exhibited a similar trend during the same time frame, decreasing from 110 to 39 mg/L and 230 to 73 mg/L ammonia, respectively. Decreases in TDS and uranium concentrations at a similar scale also occurred during this time. The timing of the decrease coincides with the initiation of the Configuration 1 extraction wells and the increase in Colorado River flow.

5.3 Surface Water

Surface water locations (Figure 1-2) associated with the well field were sampled intermittently during 2007 when water was present. Table 5-1 presents a summary of the ammonia (as N), TDS, and uranium concentrations measured in samples collected from these locations.

Table 5-1. Summary of Ammonia (as N), TDS, and Uranium Surface Water Concentrations (mg/L) During 2007.

Location	n	Ammonia Conc Range (mg/L)	TDS Conc Range (mg/L)	Uranium Conc Range (mg/L)
0201	2	0.1 – 0.1	380 - 430	0.0022 - 0.0026
0216	9	0.049 – 20.8	330 - 4440	0.0022 – 0.418
0217	1	0.1	420	0.0028
0218	1	0.1	470	0.0029
0236	4	0.1 – 4.78	390 - 1100	0.0035 – 0.045
0239	10	0.043 – 0.99	420 - 930	0.0034 – 0.024
0240	5	0.03 – 0.14	410 - 750	0.0024 – 0.011
0243	11	0.1 – 1.07	400 - 850	0.0033 – 0.021
0245	9	0.03 – 2.8	432 - 1000	0.0041 – 0.072
0258	2	0.035 – 0.461	455 - 465	0.0032 – 0.0037
0259	11	0.067 – 0.82	410 - 970	0.0033 – 0.0171
0274	12	0.074 – 3.65	330 - 1040	0.0023 – 0.0412

Notes: n = number of samples collected, conc = concentration

Table 5-2 presents data for locations where the ammonia exceeded 2 times the detection limit during 2007 (background in 2007 was at or below the detection limit of 0.1 mg/L). The data provided in Table 5-2 show that ten samples exceeded the ambient water quality criteria (AWQC; EPA 1999) for ammonia (either acute, chronic or both) and that 70% these occurred in January-mid March a time of year when (most sensitive) young-of-year fish are not present.

Only one of these samples exceeded the acute water quality criteria, which is more pertinent for the Moab Site and use of back water habitat by aquatic species. This sample was collected during June 2007 off Configuration 2, at surface water location 0236. This location represents a river bed depression in the side channel that has historically contained elevated concentrations (DOE 2007d and DOE 2006a). This sample was collected at the base of the depression, and was not considered to be representative of the entire surface water body present in the channel at that time.

Compared with calendar year 2006; the number of samples which exceed ammonia water quality criteria increased, but were the same as 2005. However, the maximum concentration decreased each year from 170 mg/l (2005) to 76 mg/l (2006) to 20.8 mg/l in 2007, and may reflect positive impact of the operation of the Interim Action ground water remediation systems.

Table 5–2. Surface Locations with Ammonia Concentrations Exceeding Two Times Background During 2007

Location	Date	Ammonia Total as N (mg/L)	State/Federal AWQC—Acute Total as N (mg/L)	State/Federal AWQC—Chronic Total as N (mg/L)
0216	02/05/2007	20.8	23.0	4.73
0236	06/12/2007	4.78	3.20	0.76
0274	02/05/2007	3.65	8.40	2.43
0216	01/08/2007	2.9	10.1	2.80
0245	01/08/2007	2.8	8.40	2.43
0275	05/08/2007	2.8	4.71	1.52
0275	05/08/2007	2.7	5.72	0.97
0274	03/14/2007	1.2	2.65	0.92
0243	05/01/2007	1.07	3.20	1.09
0243	02/07/2007	0.992	3.20	1.09
0239	03/13/2007	0.99	N/A	N/A
0259	02/06/2007	0.82	3.88	0.615
0274	11/27/2007	0.77	N/A	N/A
0243	08/23/2007	0.6	3.88	1.03
0216	11/20/2007	0.59	17.0	3.61
0259	03/13/2007	0.57	6.95	2.10
0258	05/02/2007	0.461	3.20	1.09
0239	02/06/2007	0.433	1.77	0.386
0274	01/08/2007	0.43	3.88	1.29
0243	07/10/2007	0.4	N/A	N/A
0245	02/05/2007	0.389	3.20	0.67
0216	11/20/2007	0.38	5.72	1.11
0259	07/12/2007	0.32	N/A	N/A
0216	07/12/2007	0.27	12.1	1.96
0245	11/20/2007	0.27	5.72	1.96
0239	09/18/2007	0.26	2.65	0.92
0216	09/23/2007	0.25	4.71	1.52
0259	01/10/2007	0.25	23.0	4.73
0243	03/13/2007	0.21	3.20	0.76

N/A = Temperature and pH not available

TDS concentrations generally ranged from 400 to 1000 mg/L with the exception of the sample collected from location 0216, which had a TDS concentration of 4,400 mg/L. This elevated TDS concentration was detected in the sample collected in February 2007, when the ammonia was also elevated (providing further evidence of ground water discharging into this area when the Colorado River stage was low). Uranium concentrations, again with the exception of the same sample collected from 0216 during February, were all below 0.075 mg/L. As shown in Table 5-1, the highest measured concentration was 0.42 mg/L.

5.3.1 Configuration 1 Surface Water Location 0216

Surface water location 0216 showed a large increase in ammonia, TDS, and uranium concentration in February 2007. This increase is also observed in the extraction well 0475, upgradient observation wells, downgradient observation wells, and well points. When surface-water location 0216 was sampled in February, it consisted of a muddy channel containing small pockets of frozen water (see Appendix A, Figure A-11). It is likely that this water was composed of undiluted ground-water discharge in the side channel that was not connected to the river. Figure 5-7 compares the morphology of surface water location 0216 in January, February, and May 2007. In January, the sample location had analyte concentrations nearly four times less than what was observed in February. The spike in February was followed by concentrations that were slightly lower than the values seen in January (Figure A-11).

a.)  b.) 

c.) 

Figure 5-7. The morphology of the channel at surface water location 0216 changes depending on river flow. a.) In January, the backwater channel was barely open to the main river channel. b.) In February, the backwater channel consisted of isolated pockets of frozen water. Location 0216 showed an increase in analyte concentration during this month. c.) In May, the backwater channel is connected to the main river channel, thus diluting any possible contamination.

5.4 Summary

A number of factors affect the chemical concentration of the extraction wells, observation wells, well points, and surface water in the Configuration 1 portion of the interim-action well field (see Appendix A, Figures A-4 to A-11). Water chemistry results indicate that in the most shallow zone, the TDS, ammonia, and uranium concentrations generally decrease with high-river stage, and this trend was more pronounced in downgradient observation wells or in the vicinity of riparian habitat channels compared to the upgradient locations. Upgradient observation wells 0480 and 0481 had decreasing ammonia concentrations from April through October that did not correspond to high river stage. This decrease in concentration may be the result of flood irrigation in an upgradient vegetation plot. Surface water analyte concentrations in general did not fluctuate during 2007. Elevated concentrations were associated with either isolated pools during the winter months or were a function of the channel configuration.

6.0 Infiltration Trench Performance

The infiltration trench was installed in August and September 2006 and consists of a 160-ft perforated high density polyethylene pipe buried approximately 10 ft bgs (3957.5 ft above msl) north of Configuration 3 (Figure 1-2). The purpose of the infiltration trench is to inject fresh river water into the ground water to form a hydraulic barrier and to dilute the contaminant concentrations. Infiltration-trench flow is monitored at four individual ports with flow meters, and the hydrologic response is monitored by a series of four observation wells and three well points which are sampled throughout the year. Infiltration-trench performance is evaluated based on the magnitude and extent of ground water mounding and its effect on operational and downgradient water quality. Table F-1 (see Appendix F) shows the location of the observation wells and well points relative to the trench and their associated elevations. The location of the trench and the monitoring points are shown on Figure F-1 (see Appendix F). Additional data on the infiltration trench are presented in Appendix F.

6.1 Volume Injected

Fresh-water injection began on May 23, 2007, and continued until October 4, 2007 (see Appendix F, Table F-2). The trench was shut down for seven days in mid-July to replace a valve and again for eight days in late September to early October due to a leak in the fresh-water line.

The infiltrated water requires treatment by sedimentation and filtering to prevent clogging of the trench. Fresh water is diverted from the river and pumped into a fresh-water storage pond. Sediments reaching the pond from the river-pumping operation either settle or are filtered through a turbidity barrier between the inlet and outlet of the pond. Water from the pond is pumped into a sand-media filter, which filters out additional algae or sediment. In addition, a smaller filter is located at each of the four entry ports to further remove any remaining solid material from the freshwater prior to injection into the trench.

Injection flow varied from 3.3 to 95 gpm and a total of 3,663,309 gallons of fresh water was pumped into the infiltration trench during the 2007 calendar year. The surrounding observation wells and well points were sampled throughout the year prior to monitor start-up, operational, and shut-down phases of the infiltration trench.

6.2 Hydraulic Mounding

Observation wells 0730, 0731, and 0732 contain pressure transducers that collect water-elevation data during all phases of the infiltration trench. The hydrographs of observation wells 0730, 0731, 0732, and 0733 (see Appendix F, Figure F-2) show the response of the water levels to fresh-water injection. The elevation fluctuations measured in the observation wells propagated in response to changes in the injection rates and periods when the injection was temporarily suspended for repairs and river stage. To determine mounding, ground-water elevations in the transducer and hand-measured water-level data from the trench observation wells were compared with the ground-water elevation fluctuations of Baseline Area observation well 0406, approximately 300 ft north of the trench (see Appendix F, Figure F-3). This allows subtracting the effects of river stage on water levels. Tables 6-1 and 6-2 show the amount of fresh-water mounding that occurred in the four observation wells (upgradient and downgradient) that surround the infiltration trench.

The June 2007 mounding was calculated when the injection rate in the infiltration trench was 4.6 gpm. The mounding for wells 0730 through 0732 was calculated from the pressure transducer data, and the mounding for well 0733 was calculated from hand-measured water-level data (Table 6-1).

Under high river-stage conditions in June, mounding was observed in three of the four observation wells. Infiltration-trench operation was initiated May 23 and data in Table 6-1 present fresh-water mounding that occurred approximately two weeks later. Flood irrigation began in the vegetation plots just upgradient from observation wells in late May and may have affected the amount of freshwater mounding observed in the upgradient observation wells 0732 and 0733.

Table 6-1 Fresh-water Mounding in the Infiltration Trench Observation Wells in June 2007

Well No.	Date	Location to Trench	Ground water elevation (ft above msl)	Well 0406 Elevation (ft above msl)	Mounding (ft)
0730	06/04/07	< 5 ft Downgradient	3956.26	3955.75	0.51
0731	06/04/07	10 ft Downgradient	3955.77	3955.93	No Mounding
0732	06/04/07	10 ft Upgradient	3956.61	3955.80	0.81
0733	06/04/07	10 ft Upgradient	3956.38	3955.93	0.46

The July/August mounding was calculated during the maximum injection rate of 95 gpm. The mounding for wells 0730 through 0732 was calculated from the pressure-transducer data, and the mounding for well 0733 was calculated from hand-measured water-level data (Table 6-2). The data in July/August represent the mounding that occurs during maximum infiltration during low river flow.

Data from July/August show that fresh-water mounding occurred in both the upgradient and downgradient observation wells. Well 0732 displayed the most amount of fresh-water mounding (Table 6.2). Because this well is 10 ft upgradient from the infiltration trench, it is likely that the increased mounding is in part due to the flood-irrigated vegetation plot C5 directly upgradient from well 0732. The height of fresh-water mounding during the maximum injection rate is higher than the fresh-water mounding observed two weeks after the initiation of the infiltration trench during high river flow.

Table 6-2 Fresh-water Mounding in the Infiltration Trench Observation Wells in July/August 2007

Well No.	Date	Location to Trench	Ground water elevation (ft above msl)	Well 0406 Elevation (ft above msl)	Mounding (ft)
0730	7/30/07	< 5 ft Downgradient	3956.49	3954.45	2.04 ft
0731	7/30/07	10 ft Downgradient	3956.28	3954.26	2.02 ft
0732	7/29/07	10 ft Upgradient	3957.34	3954.45	2.88 ft
0733	8/24/07	10 ft Upgradient	3955.2	3954.28	0.92 ft

6.3 Influence on Water Chemistry

Pre-operational and operational analyte concentration cross-sections and chemical plots were created for the infiltration trench (Figures 6-1, 6-2, 6-3, and Appendix F, Figures F-4 and F-5). By analyzing the cross-sections and chemical hydrographs, it is possible to determine temporal chemical influences that result from the fresh-water injection.

6.3.1 Chemical Hydrographs

The ammonia, TDS, and uranium concentration of each observation well and well point were plotted against the infiltration rate (Figures F-4 and F-5). These chemical hydrographs allow comparison of fresh-water injection rates to contaminant concentrations in shallow ground water upgradient and downgradient of the infiltration trench. The following discussion is based on interpretation of Figures F-4 and F-5 in Appendix F.

Pre-operational plots from May 2007 demonstrate that the ammonia, TDS, and uranium concentrations increase with depth during non-pumping conditions. During operation of the infiltration trench, the ammonia, uranium, and TDS concentrations decreased significantly in samples collected from the observation wells and well points.

Ammonia concentrations varied throughout the observation wells and well points adjacent to the infiltration trench. The ammonia data from the upgradient and downgradient wells and well points indicate that the ammonia concentration declined significantly by June after the fresh-water infiltration had begun and then increased by October, after cessation of the infiltration-trench operation and flood irrigation. Downgradient well 0730 decreased in concentration from 27 mg/L of ammonia in June to 3 mg/L in August. The concentration began to slowly increase again by the end of October. The decrease in ammonia concentration that occurred in June also coincides with the peak spring runoff. Because ammonia concentrations remained low throughout the infiltration period, it is likely that the infiltration trench aided in the dilution of the ammonia concentration.

The TDS concentration follows the same general declining trend exhibited by upgradient and downgradient wells and the well points in response to operation of the infiltration trench. Analyte concentrations decreased significantly after the infiltration trench was initiated on May 23, 2007. For example, downgradient well 0730 had a TDS concentration of 6,500 mg/L on May 23, prior to the trench start up, and the concentration decreased to 860 mg/L by mid-August. The TDS concentration rebounded slightly in all of the wells in October, after the infiltration trench was winterized and shut-down. The one exception is well point 0726, where the TDS concentration continued to decrease through October.

Uranium concentrations also follow the decreasing trends exhibited on the TDS chemical hydrographs. The uranium concentration decreased in all of the wells in June after the initiation of the trench and decreased significantly by August after the maximum pumping rate of 95 gpm was implemented. For example, the uranium concentration in downgradient well 0730 decreased from 0.36 mg/L in June to 0.045 mg/L in August. Uranium concentrations rebounded slightly after the trench was winterized in October.

In 2006, there was evidence that the fresh-water injection into the infiltration trench led to mounding in some of the baseline area observation wells. Chemical plots from the baseline area observation wells indicate that similar ammonia, TDS, and uranium decreasing concentration trends were present in the infiltration trench shallow wells and the baseline shallow well (well 0405, 18 ft bgs [3948 ft msl]) in 2007 (see Appendix E, Figure E-2). The concentrations decrease after the onset of the infiltration-trench operation in mid-July and then remain low throughout the fresh-water injection timeframe.

Review of water quality data suggest that it takes approximately one month longer for the fresh-water injection to affect the Baseline Area (see Appendix E, Figure E-2). For example, after the initiation of the fresh-water injection in early May, the trench observation wells had a decrease in analyte concentration by early June, whereas the Baseline Area was not affected until mid-July. The same delayed response in water quality was observed in the shallow Baseline Area Well (0405) when the injection was suspended and the infiltration trench was shut down.

The chemical data of the deeper Baseline Area observation wells (0488 at 39 ft bgs [3928 ft msl] and 0493 at 54 ft bgs [3912 ft msl]) (see Appendix E, Figure E-2) indicate that the river flow may influence water quality at these depths. Concentrations of ammonia, TDS, and uranium increase when the river is near base flow conditions and decrease when the river stage increases. The TDS data indicates that the brine interface was located just below 54 ft bgs during base flow conditions.

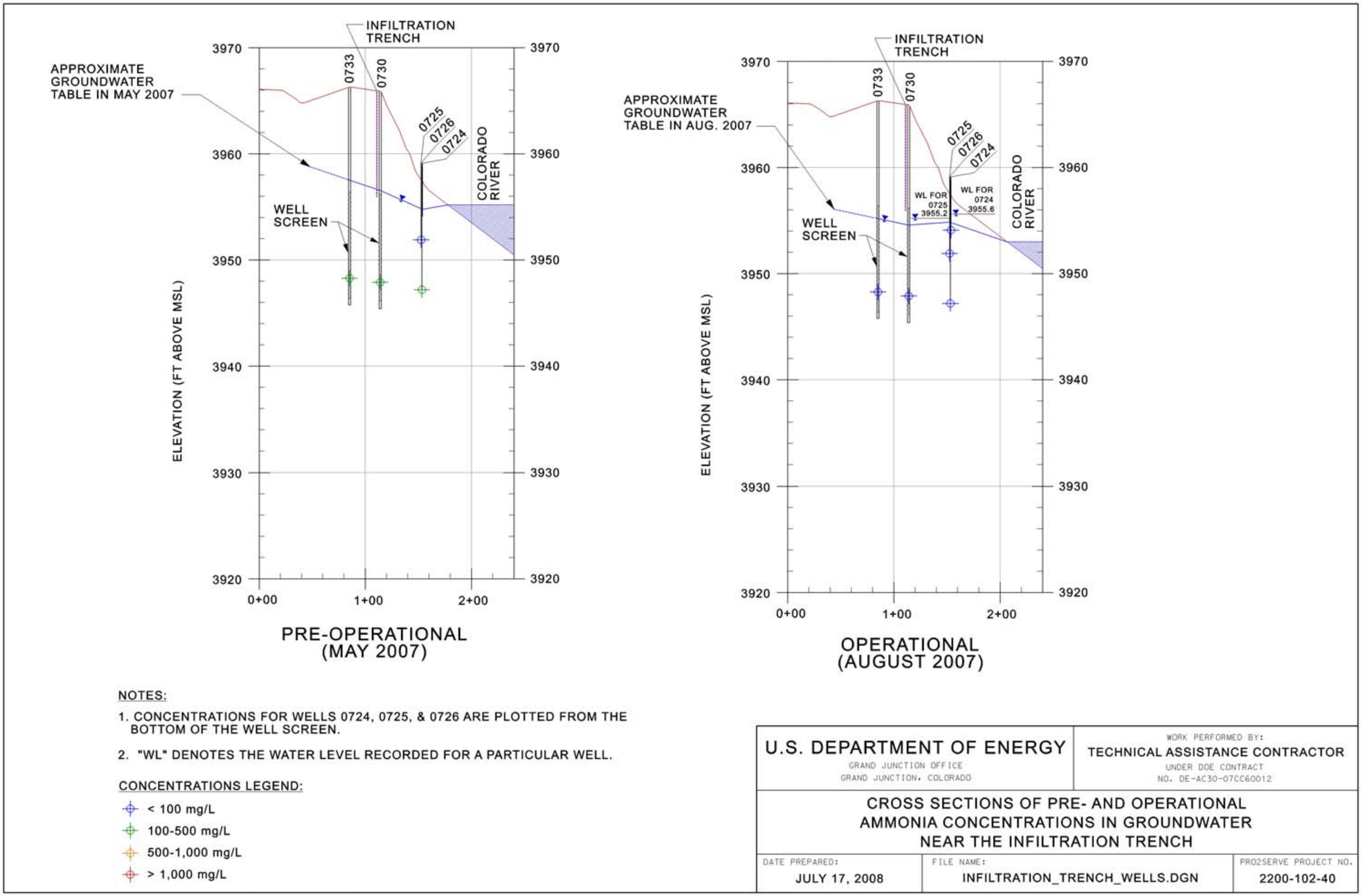
6.3.2 Infiltration Trench Hydrologic Cross-Sections and Contaminant Distributions

Pre-operational and post-operational analyte concentration cross-sections were created perpendicular to the infiltration trench (Figures 6-1, 6-2,and 6-3). The pre-operational plots from May 2007 demonstrate that the ammonia, TDS, and uranium concentrations increase with depth during non-pumping conditions. During operation of the infiltration trench, the ammonia, uranium, and TDS values decreased throughout the observation wells and well points.

6.4 Summary

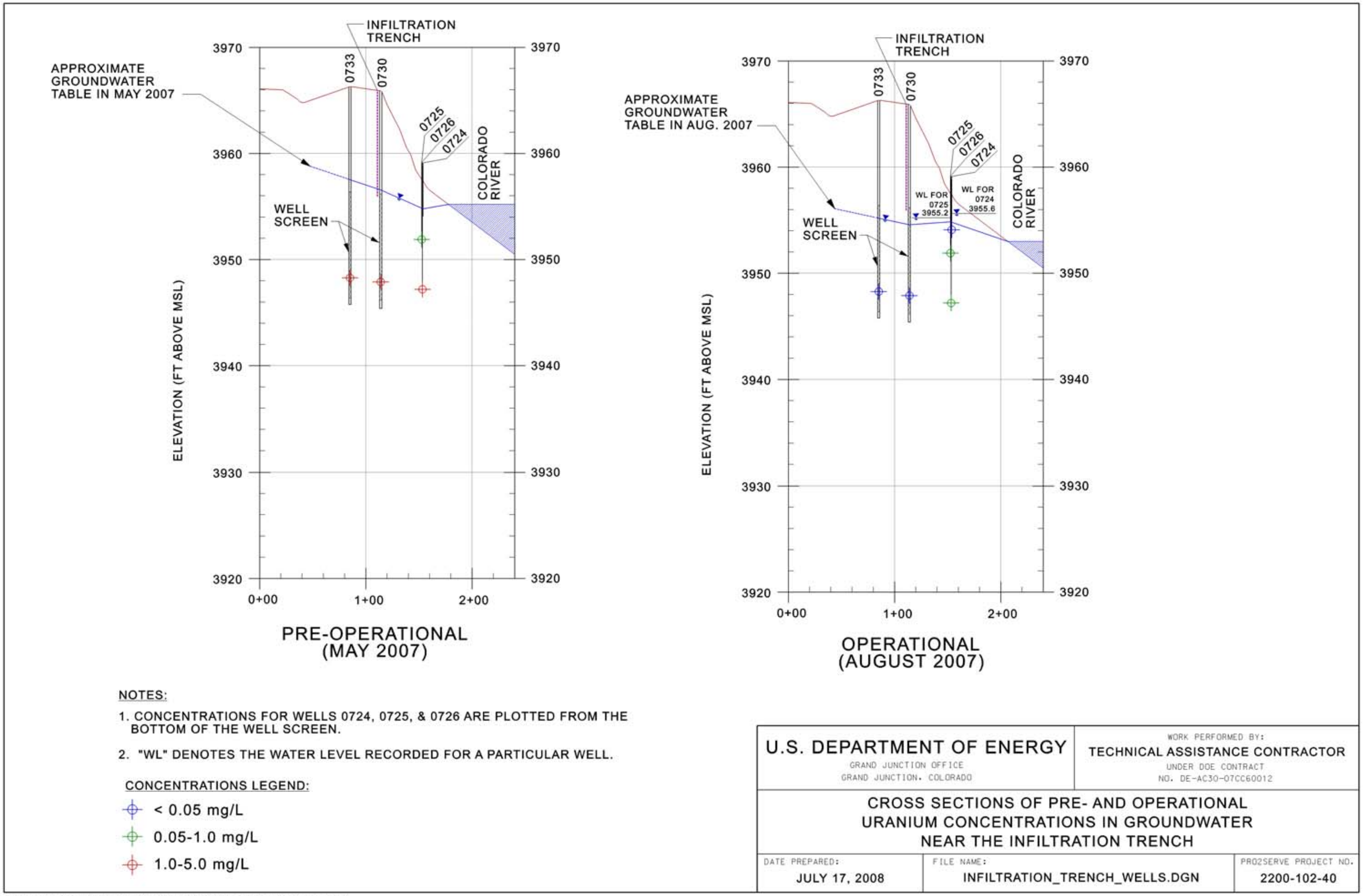
The infiltration of diverted river water into the trench resulted in fresh-water mounding of 0.51 to 0.81 ft during peak river flow in June and 0.92 to 2.04 ft during the maximum pumping rate in July/August. The observation well that recorded the greatest amount of mounding in both June and July was an upgradient observation well (0732) that may have been influenced by an adjacent flood-irrigated vegetation plot. In this case, it appears evident that flood irrigation may contribute to reducing chemical concentrations of ammonia and uranium entering the river.

The chemical hydrographs and cross-sections indicate that the infiltration trench and flood irrigation dilute contaminants within saline ground water in the alluvium. Contaminant concentrations decreased when the infiltration rate was increased and continued to decrease during low-flow river conditions when normally concentrations increase under baseline conditions. Although concentrations of contaminants rebound slightly after winter shutdown, a longer period of evaluation is necessary to determine the magnitude of rebound.



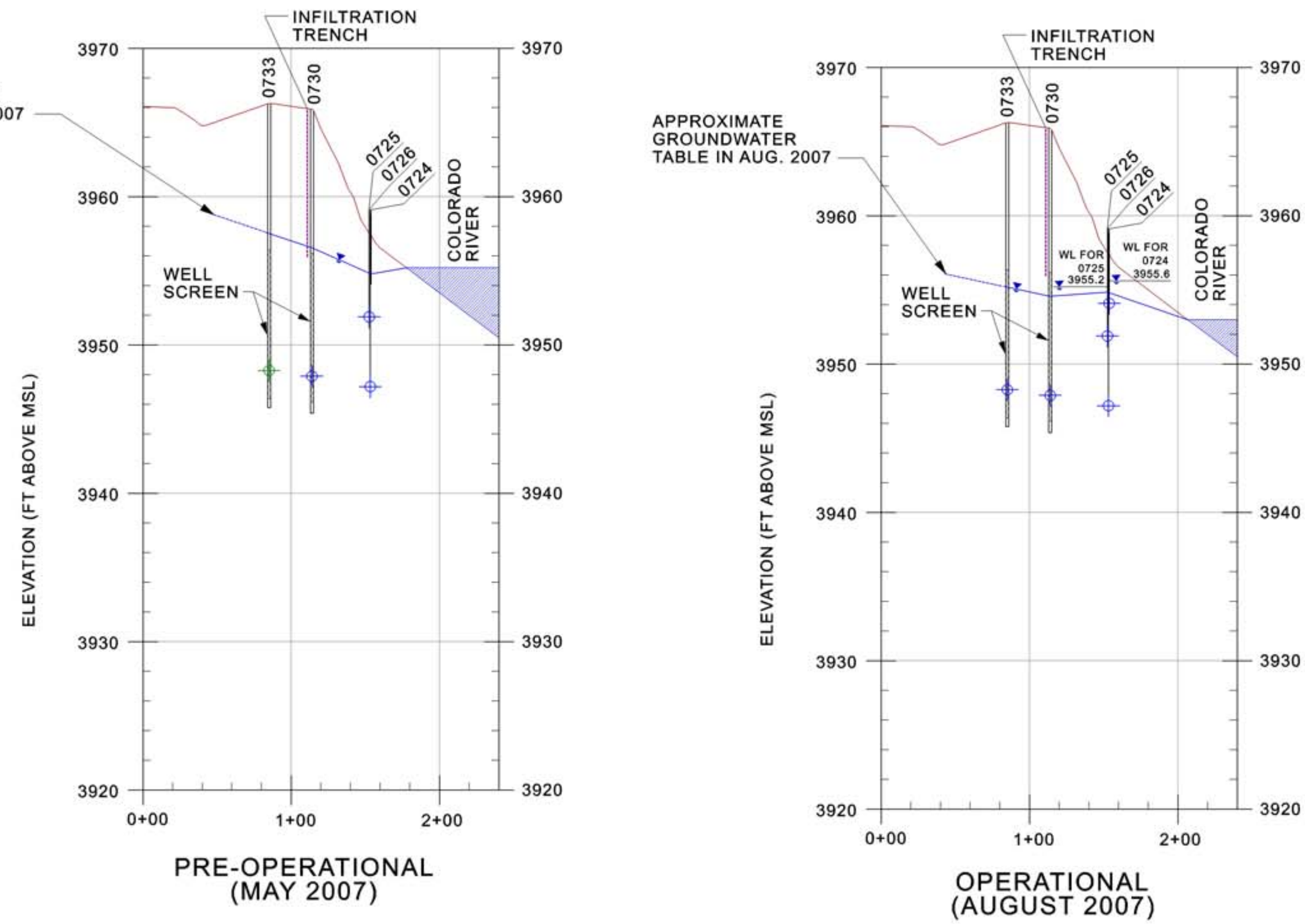
P:\VMF\ 4.4.2 CIVIL\FIGURES\JUNE2008_REPORT\INFILTRATION_TRENCH_WELLS.DGN

Figure 6-1 Cross-sections of Pre- and Operational Ammonia Concentrations in Groundwater near the Infiltration Trench



P:\VMF\ 4.4.2 CIVIL\FIGURES\JUNE2008_REPORT\INFILTRATION_TRENCH_WELLS.DGN

Figure 6-2 Cross-sections of Pre- and Operational Uranium Concentrations in Groundwater near the Infiltration Trench



NOTES:

1. CONCENTRATIONS FOR WELLS 0724, 0725, & 0726 ARE PLOTTED FROM THE BOTTOM OF THE WELL SCREEN.
2. "WL" DENOTES THE WATER LEVEL RECORDED FOR A PARTICULAR WELL.

CONCENTRATIONS LEGEND:

- < 10,000 mg/L
- 10,000-35,000 mg/L
- > 35,000 mg/L

U.S. DEPARTMENT OF ENERGY GRAND JUNCTION OFFICE GRAND JUNCTION, COLORADO		WORK PERFORMED BY: TECHNICAL ASSISTANCE CONTRACTOR UNDER DOE CONTRACT NO. DE-AC30-07CC60012
CROSS SECTIONS OF PRE- AND OPERATIONAL TDS CONCENTRATIONS IN GROUNDWATER NEAR THE INFILTRATION TRENCH		
DATE PREPARED: JULY 17, 2008	FILE NAME: INFILTRATION_TRENCH_WELLS.DGN	PRO2SERVE PROJECT NO. 2200-102-40

P:\VMF\ 4.4.2 CIVIL\FIGURES\JUNE2008_REPORT\INFILTRATION_TRENCH_WELLS.DGN

Figure 6-3 Cross-sections of Pre- and Operational TDS Concentrations in Groundwater near the Infiltration Trench

7.0 Evaporation Pond and Sprinkler System Performance

The main components of the interim-action treatment system include the remediation wells in Configurations 1, 2, 3, and 4, the infiltration trench, the evaporation pond on the tailings pile, and the sprinkler system also on the tailings pile (Figure 7-1). Ground water extracted at the well field is pumped up the southeast side of the tailings pile to the evaporation pond, which is the source of water for the sprinkler system.

During the 2007 high evaporation-potential months (May through September), the sprinkler system was operated each week on a seven-day work schedule. An increasing rate of decline in the pond level was seen immediately after the sprinkler system was started in late March, when the pond was nearly at capacity. Although most of the decrease in pond depth reflected discharge to the sprinkler system, some of the decrease is due to evaporation from the pond surface.

7.1 Well Field and Sprinkler System Pumping Rates and Volumes

Table G-1 (see Appendix G) summarizes important dates associated with operation of the interim-action treatment system during 2006. By the end of March, all ground water extraction wells at Configurations 1, 2, 3, and 4 were operating to maximize the amount of ground water removed along with reducing ammonia and uranium mass. The sprinkler system was brought online on March 12, 2007 (after a number of system checks in February), once the potential for overnight below-freezing temperatures was considered minimal, and was operated through November 18. Starting in mid-August, the volume of ground water extracted from the well field was reduced in order to slowly lower the level of the pond in preparation of operating Configuration 1 wells throughout the winter. By the time the sprinkler system was shut down and winterized, the pond level was approximately 3 ft.

Figure 7-2 shows a graphical record of well field delivery rates to the evaporation pond, delivery rates from the evaporation pond to the sprinkler system, and pond levels during 2007. The delivery rates to the sprinkler system shown in Figure 7-2 were based on flow volumes recorded at meters on sprinkler delivery lines.

N:\MOA\999\0006\08\006\X02170\X0217000.mxd carverh 4/10/2007 3:02:59 PM

Figure 7–1. Treatment System Components

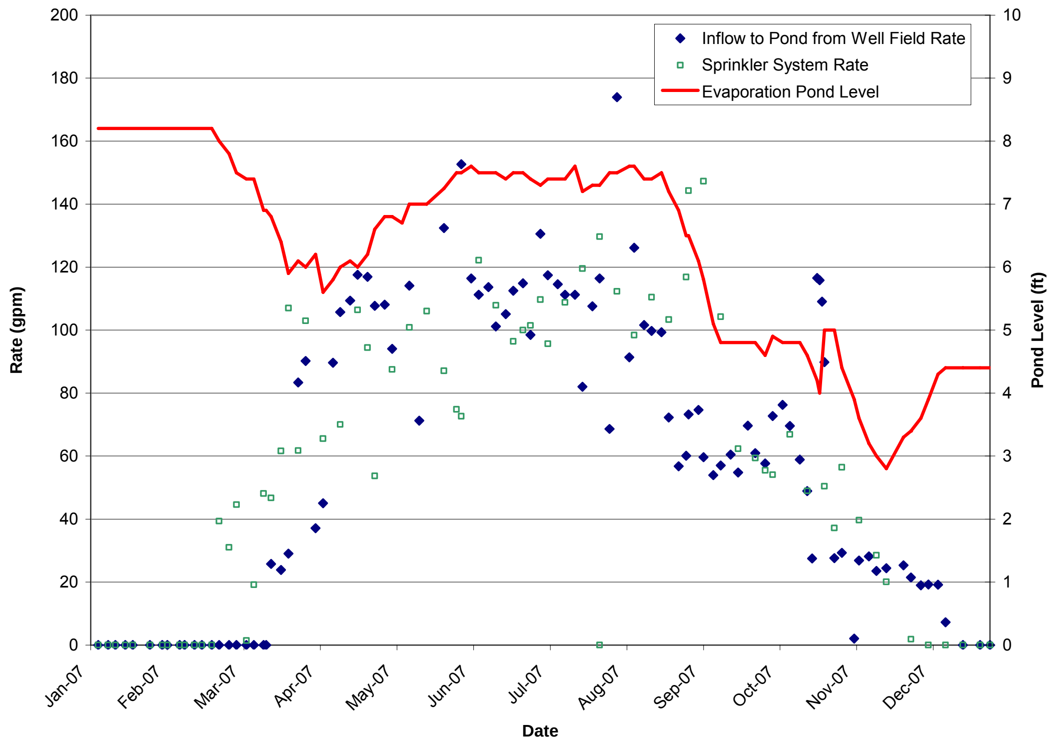


Figure 7–2. Rates of Water Delivery to the Evaporation Pond and the Sprinkler System and Pond Depths During 2007

As indicated in the figure, the pond level stabilized at a depth of about 7.5 ft from June through August 2007. During this period, the delivery rate from the well field remained relatively constant, averaging approximately 110 gpm, and the sprinkler system was operated such that the average rate of delivery from the pond to the sprinkler system was approximately 89 gpm. These data make it possible to estimate the evaporation rate from the pond at the time. A summary of the monthly water volumes delivered to the evaporation pond and the sprinkler system during 2007 is presented in Table G-2 (see Appendix G).

As the data indicate, the well field delivered approximately 31.2 million gallons of ground water to the evaporation pond, and approximately 32.2 million gallons were distributed through the sprinkler system. Based on the design drawings for the evaporation pond, a change of the level from 8.2 to 4.4 ft (from the January of 2007 through the end of December 2007) is equivalent to a loss of 2.5 million gallons. Based on this value, the sprinkler system would have distributed 2.5 million gallons more than the well field provided to the pond, assuming no evaporation took place. The flow meter data shows a difference of only 1.0 million gallons between the two systems, which may be indicative of losses due to evaporation.

7.2 Evaporation Pond Concentration Trends

During the 2007 pumping season, samples were collected during the time frame when the interim-action well field was actively extracting ground water (March through December). Samples were collected of the ground water discharging into the evaporation pond and from the recirculation pump.

The inlet sample (0547) is representative of the extracted ground water transported to the pond from the entire well field, and the sample collected off the recirculation pump (0548) is representative of the water stored in the pond.

Time versus TDS, ammonia, and uranium concentration plots generated from data collected during 2007 are presented in Figure 7-3. Each was plotted with the evaporation-pond level data collected during the same time frame.

Water chemistry data indicate TDS concentrations in samples collected from both locations tend to fluctuate in the same manner, with the pond TDS consistently higher compared to the inlet concentration throughout the year. Concentrations remained constant (between 19,000 and 26,000 mg/L for both the inlet and pond) between April and September, at which time they both decreased to 10,000 and 20,000 mg/L for the inlet and pond, respectively.

Ammonia concentrations did not follow the same trend as TDS. Ammonia concentrations apparently declined in June, rebounded in September/October, and then decreased again near the end of the year. Inlet and pond ammonia concentrations ranged from 340 and 550 mg/L during 2007.

Uranium concentrations never varied more than 0.5 mg/L between the two locations and closely followed the trends exhibited by the ammonia concentrations in 2007.

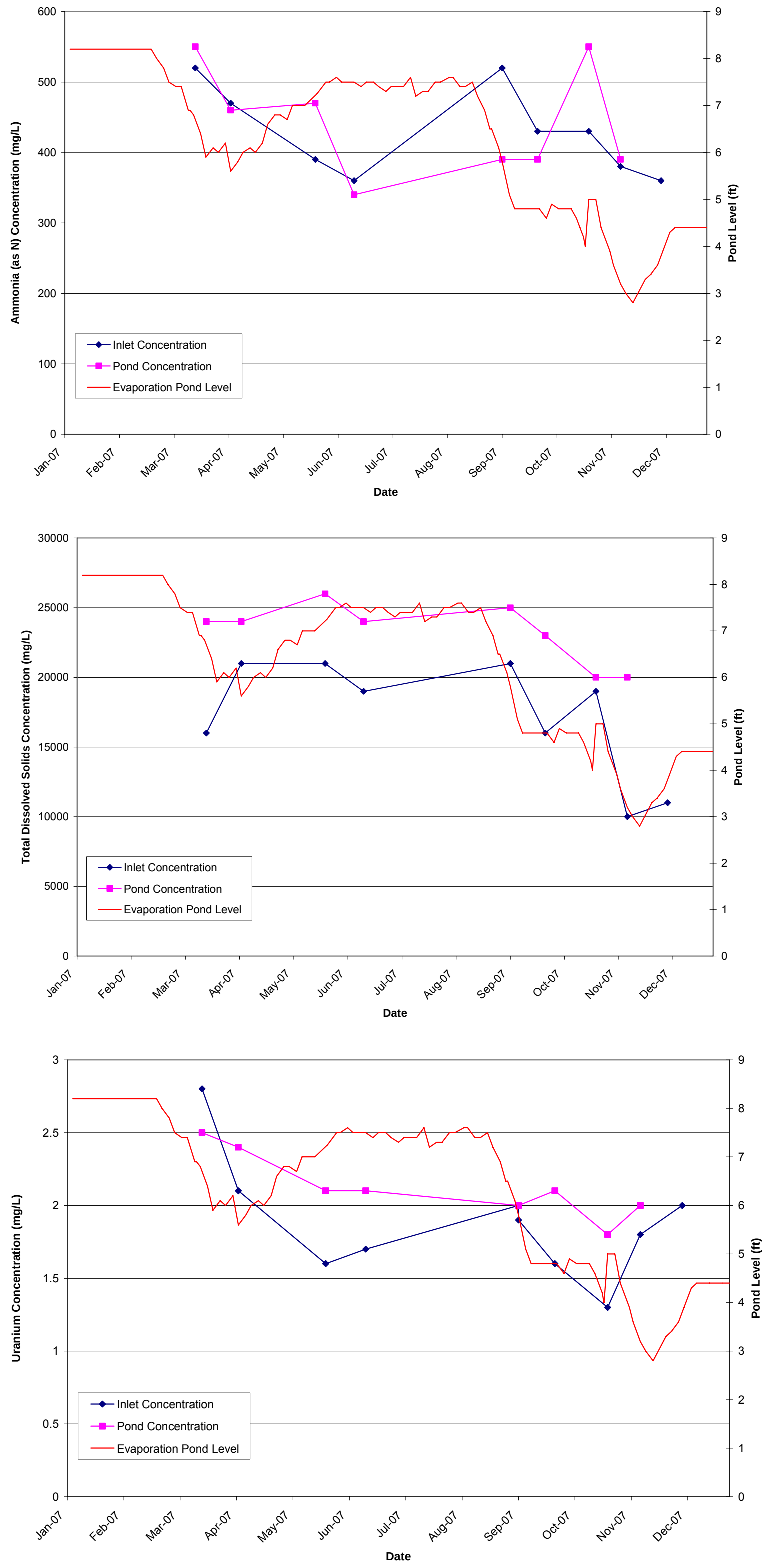


Figure 7-3. Measured Concentrations of Ammonia, TDS, and Uranium at 0547 (Pond Inlet) and 0548 (Pond Storage) During 2007

8.0 Conclusions

During the 2007 pumping season, Configurations 1, 2, 3, and 4 were actively extracting ground water, and the infiltration trench was injecting fresh water. The extracted water was transported to the evaporation pond and sprinklers for treatment. Conclusions from evaluation of performance of each of the components of the ground water interim-action system are provided in the following sections followed by some general conclusions.

Some overall performance observations and conclusions are provided below:

- The conceptual site model regarding location and response of the brine interface to pumping and river flow remains valid.
- The conceptual model of the distribution of ammonia and uranium with respect to the brine interface remains valid. Uranium concentrations are highest in shallow ground water and decrease with depth. Ammonia concentrations increase from the water table to the interface, reach a maximum just below the interface, and decrease with depth from there.
- The data collected during the 2007 pumping season generally follows the site conceptual model for the interim-action well field. While local variations within individual configurations regarding the depth to the brine surface occur across the entire well field, the depth to the brine surface decreases towards the southern end.
- Water chemistry data indicate that during ground-water extraction all configurations (not including SMI-PW02) exhibited a decrease in contaminant concentrations between low and high river stage.
- The Configuration 4 remediation wells are the most efficient based on specific capacity calculations, while Configuration 2 wells are the least efficient. The highest producing (based on volume of ground water extracted and average extraction rate) remediation wells for 2006 were in Configuration 4, with Configuration 2 remediation wells producing the lowest.
- Configuration 3 and 4 remediation wells and well SMI-PW02 were the most efficient in ammonia and uranium mass removal during 2006. The bottom of the screened interval at these wells is relatively deep, and the wells are less affected by an influx of river water during pumping than the wells at Configurations 1 and 2.
- When calculating the ratio of the volume of ground water extracted to the mass of ammonia removed from the aquifer, well SMI-PW02 and Configurations 2 and 3 remediation wells were significantly more efficient compared to Configurations 1 and 4. Configuration 3 was nearly twice as efficient for uranium mass removal compared to the other configurations. Configuration 4 was the least efficient at uranium mass removal based on this method. This is partly due to higher ammonia and uranium concentrations present near Configurations 2 and 3 as compared to Configuration 4.
- Analytical data collected from the riverbed well points exhibited randomness associated with processes typical of a hyporheic zone.

- Surface water sampling indicated ammonia concentrations ranged from below detection to 20.8 mg/L in 2007. Ten of the 108 samples exceeded the ambient water quality criteria (AWQC; EPA 1999) for ammonia (either acute, chronic or both), and 70% these occurred in January-mid March a time of year when (most sensitive) young-of-year fish are not present.

8.1 Ground-Water Remediation Wells

Configuration 1

- Configuration 1 extraction wells 0470 through 0479 extracted approximately 6.8 million gallons of ground water with an average pumping rate of 17.4 gpm during 2007. Well SMI-PW02 extracted 1.5 million gallons of ground water from its location closer to the tailings pile at an average rate of 8.9 gpm, but was shut off due to electrical problems in August. Average pumping rates decreased for Configuration 1 and SMI-PW02 compared to 2006 rates of 26.4 million gallons and 23.3 gpm, respectively.
- Based on drawdown and extraction-rate data collected during 2007, Configuration 1 extraction wells 0470 through 0479 operated with a range of specific capacities of 0.7 to 1.8 gpm/ft, which is within the range provided for the 2006 values for this parameter. Because all the wells are pumping at the same time and there is well interference, the evaluation is qualitative, but can be used as a rough comparison of available capacity relative to previous years. The conclusion is that although the wells have a low specific capacity due to lack of available drawdown caused by shallow well completion intervals, they are not decreasing in efficiency with time.
- The 10 Configuration 1 extraction wells removed an estimated total of 8,532 kg of ammonia as ammonia during 2007, and another 4,730 kg of ammonia was removed from pumping well SMI-PW02 during the 2007 pumping season. The 10 Configuration 1 wells removed an estimated total of 51.4 kg of uranium from the ground water during 2007. Pumping of well SMI-PW02 between April and August 2007 resulted in an estimated additional 15.3 kg of uranium mass removed. For comparison an estimated 8,913 kg of ammonia was extracted from wells 0470 through 0479 and another 18,626 kg from well SMI-PW02 during 2006. In addition, 64.6 and 66.7 kg of uranium were removed from extraction wells 0470 through 0479 and SMI-PW02, respectively, during 2006. Well SMI-PW02 removed less mass of contamination in 2007 during its shorter period of operation.
- The alluvial aquifer at the southern portion of Configuration 1 has a higher hydraulic conductivity and is more effective at drawing in river water and diluting nearshore ground water than is the northern portion. These local variations in hydraulic conductivity illustrate the heterogeneous nature of the aquifer.
- Constituent concentrations in extracted ground water in the northern portion of the configuration tend to be higher and more uniform (particularly for uranium) than in the southern portion.

- Water chemistry results from wells 0470 through 0479 indicate TDS, ammonia, and uranium concentrations followed the same pattern (i.e., all increase or decrease at the same time) throughout the year. In addition, analyte concentrations decreased during extraction in response to increases in the Colorado River stage during the spring runoff in June. This is probably due to the presence of river infiltration from proximate riparian habitat channels. Well SMI-PW02 is located approximately 200 ft farther west of the riverbank, and analyte concentrations were not significantly impacted by changes in the river stage.
- Surface water concentrations in the river adjacent to Configuration 1 are normally fairly low. Concentrations tend to peak during base flow river conditions.

Configuration 2

- Configuration 2 was switched from fresh-water injection to ground water-extraction during March 2006 and was operated in extraction mode for the entire 2007 period.
- Configuration 2 remediation wells 0570 through 0579 (with the exception of 0574 and 0578) extracted approximately 2.1 million gallons of ground water with an average pumping rate of only 7.7 gpm during 2007. These values are equal to those in 2006 indicating the same low level of performance. Configuration 2 extracts at the lowest rate of all the well field configurations.
- Based on drawdown and extraction rate data, during 2007 Configuration 2 remediation wells operated with average specific capacities ranging from 0.1 to 0.2, indicating these wells are considerably less efficient compared to Configurations 1, 3, and 4. The average specific capacities are within the range of those measured in 2006.
- An estimated 5,509 kg of ammonia and 19.9 kg of uranium were removed by the Configuration 2 wells in 2007. This is slightly more than the 4,705 kg of ammonia and 16.2 kg of uranium were removed by the active Configuration 2 remediation wells in 2006.
- Analyte concentrations in the shallow zone aquifer appear to decrease during ground-water extraction at high-river stage, most likely due to the influx of river water.

Configuration 3

- Configuration 3 remediation wells 0670 through 0679 extracted 5.3 million gallons at an average pumping rate of 19 gpm in 2007. This is significantly less than the 13.3 million gallons of ground water extracted during 2006 at an average pumping rate of 35.3 gpm. The decrease in 2007 provided available evaporation pond capacity for the discharge of Configuration 1 wells during the 2007/2008 winter.
- Based on drawdown and extraction rate data during 2007, Configuration 3 remediation wells operated with average specific capacities ranging from 1.5 to 7 gpm/ft, indicating these wells were more efficient compared to Configurations 1 and 2. Average specific capacities were in the same range as in 2006.
- An estimated 8,871 kg of ammonia and 45 kg of uranium were removed by the Configuration 3 remediation wells in 2007. For comparison, 25,903 kg of ammonia and 148 kg of uranium were removed by the Configuration 3 remediation wells in 2006. The decrease is mostly due to the reduced pumping rate in 2007.
- Analytical results for samples collected from the northern portion of Configuration 3 near the end of the 2007 pumping season suggest infiltration trench fresh-water injection decreased analyte concentrations in that area.

- Irrigation of adjacent vegetation plot C5 in 2007 apparently resulted in higher uranium concentrations in the northern half of Configuration 3. Similar observations were made during the 2006 pumping season.
- Remediation well analyte concentrations decrease with an increase in the Colorado River stage contrary to what was reported in 2006.

Configuration 4

- Configuration 4 remediation wells 0770 through 0779 were installed in May 2006 and only became fully extraction operational in September 2006. They were fully operational for the 2007 season. In 2007, Configuration 4 wells extracted 11.4 million gallons at an average rate of 30 gpm, which is the highest average extraction rate of all configurations. For comparison, during the shortened pumping season in 2006, Configuration 4 remediation wells extracted approximately 2.8 million gallons of ground water with an average pumping rate of 21.1 gpm.
- Drawdown and extraction rate data during 2007 showed that Configuration 4 remediation wells operated with average specific capacities ranging from 1.5 to 5.6 gpm/ft, indicating these wells are more efficient compared to Configurations 1 and 2 and slightly more than Configuration 3. The average specific capacity of these wells is similar to those measured in 2006.
- During the 2007 pumping season, an estimated 17,856 kg of ammonia and 63.5 kg of uranium were removed by Configuration 4. This is a significant increase over the 5,676 kg of ammonia and 18.5 kg of uranium removed from the groundwater in the vicinity of Configuration 4 in 2006.
- Remediation-well analyte concentrations decreased with an increase in the Colorado River stage comparable to in the trend Configuration 1 extraction wells. It is surmised that this is due to the presence of river infiltration from proximate riparian habitat channels.
- Brine entered the Configuration 4 well field during pumping at low river stage.

8.2 Infiltration Trench

- The infiltration trench began infiltrating fresh water in late 2006 and operated in 2007 from May 23 to October 4. Injection flow varied from 3.3 to 52.7 gpm and a total of 3,663,309 gallons of fresh water was pumped through the infiltration trench during 2007. This is a significant increase over the shorter 2006 period where a total of 2.2 million gallons of fresh water were injected with an average injection rate of 21.1 gpm. Ground-water elevation data collected from nearby downgradient observation wells indicated fresh-water injection generated approximately 2 ft of mounding at distances between 5 and 10 ft from the trench. Data from July/August show that fresh-water mounding occurred in both the upgradient and downgradient observation wells. Well 0732 displayed up to 2.88 ft at a distance of 10 ft upgradient from the infiltration trench. It is likely that the increased mounding is due to the flood-irrigated vegetation plot C5 directly upgradient from well 0732.
- The amount of fresh-water mounding during the maximum injection rate is higher than the fresh-water mounding observed two weeks after the initiation of the infiltration trench during high river flow.

- Chemical hydrographs and cross-sections indicate that the infiltration trench and flood irrigation dilute contaminants within saline ground water in the alluvium. Contaminant concentrations decreased when the infiltration rate was increased and continued to decrease during low-flow river conditions when normally concentrations increase under baseline conditions. Although concentrations of contaminants rebound slightly after winter shutdown, a longer period of evaluation is necessary to determine the magnitude of rebound.

8.3 Evaporation Pond and Sprinkler System

- The sprinkler system was brought online on March 12, 2007 and was operated through November 18. Starting in mid-August, the volume of ground water extracted from the well field was reduced in order to slowly lower the level of the pond in preparation of operating Configuration 1 wells throughout the winter. By the time the sprinkler system was shut down and winterized, the pond level was approximately 3 ft.
- The well field delivered approximately 31.2 million gallons of ground water to the evaporation pond, and approximately 32.2 million gallons were distributed through the sprinkler system. Based on the design drawings for the evaporation pond, a change of the level from 8.2 to 4.4 ft (from January of 2007 through the end of December 2007) is equivalent to a loss of 2.5 million gallons. Based on this value, the sprinkler system would have distributed 2.5 million gallons more than the well field provided to the pond, assuming no evaporation took place. The flow meter data shows a difference of only 1.0 million gallons between the two systems, which may be indicative of loss due to evaporation.

9.0 References

Ahn, Y.H., 2006. Sustainable Nitrogen Elimination Biotechnologies: A Review. *Process Biochemistry* 41, p. 1709-1721

Anderson, R.T., and D.R. Lovley, 2002. Microbial Redox Interactions with Uranium: An Environmental Perspective, Chapter 7 in *Interactions of Microorganisms with Radionuclides*, M.J. Keith-Roach and F.R. Livens, Editors, Elsevier Science Ltd.

Blanchard, P. J. 1990. *Ground-Water Conditions in the Grand County Area, Utah, with Emphasis on the Mill Creek-Spanish Valley Area*. State of Utah Department of Natural Resources, Division of Water Rights. Technical Publication No. 100.

Dahm, C.N., N.B. Grimm, P. Marmonier, H.M. Valett, and P. Vervier, 1998. Nutrient Dynamics at the Interface Between Surface Waters and Ground Waters, *Freshwater Biology*, v. 40, p. 423-451.

Davis, S.N., D.O. Whittemore, and J. Fabryka-Martin, 1998. Uses of Chloride/Bromide Ratios in Studies of Potable Water, *Ground Water* 36(2), p. 338-350.

Doelling, H.H., M.L. Ross, and W.E. Mulvey, 2002. *Geologic Map of the Moab 7.5' Quadrangle, Grand County, Utah,* Utah Geological Survey.

DOE (U.S. Department of Energy), 2002. *Characterization of Ground Water Brine Zones at the Moab Project Site (Phase I),* Report GJO-2002-333-TAR, prepared for U.S. Department of Energy Grand Junction Office under Contract Number DE-AC13-96GJ87335.

DOE (U.S. Department of Energy), 2003a. *Moab Predicted Ground Water Elevations Based on Historical Colorado River Flows*, Calculation No. Moab-2003-X0060200-00.

DOE (U.S. Department of Energy), 2003b. *Extraction Well Calculations – Interim Action Design*, Calculation No. Moab 04-2003-01-02-00-00.

DOE (U.S. Department of Energy), 2003c. *Moab Project Site Ground Water Interim Action Remediation Construction Specifications*, prepared by the U.S. Department of Energy, Grand Junction, Colorado, December.

DOE (U.S. Department of Energy), 2003d. *Site Observational Work Plan for the Moab, Utah, Site*, GJO-2003-424-TAC, prepared by the U.S. Department of Energy, Grand Junction, Colorado, December.

DOE (U.S. Department of Energy), 2004a. *Evaluation of September 2003 Preliminary Performance Data for the Interim Action*, Calculation No. Moab 02-2004-01-03-00, U.S. Department of Energy, Grand Junction, Colorado, February.

DOE (U.S. Department of Energy), 2004b. *Interim Expansion Work Plan for the Moab, Utah, Site*, DOE-EM/GJ626-2004, U.S. Department of Energy, Grand Junction, Colorado, April.

DOE (U.S. Department of Energy), 2005a. *Operations, Maintenance, and Performance Monitoring Plan for the Interim Action Ground Water Treatment System, Moab, Utah, Site*, DOE-EM/GJ813-2005, U.S. Department of Energy, Grand Junction, Colorado, March.

DOE (U.S. Department of Energy), 2005b. *Fall 2004 Performance Assessment of Interim Action Pumping at the Moab, Utah, Project Site*, U.S. Department of Energy, Grand Junction, Colorado, DOE-EM/GJ769-2004.

DOE (U.S. Department of Energy), 2005c. *Performance of the Ground Water Interim Action Injection System at the Configuration 2 Well Field*, Calculation No. Moab-04-2005-03-00, U.S. Department of Energy, Grand Junction, Colorado.

DOE (U.S. Department of Energy), 2005d. *Performance of the Ground Water Interim Action Injection System at the Configuration 2 Well Field, October 2004-October 2005*, Calculation No. 001-12-2005-2-03-00, U.S. Department of Energy, Grand Junction, Colorado.

DOE (U.S. Department of Energy), 2006a. *Fall 2005 Performance Assessment of the Ground Water Interim Action Well Fields at the Moab, Utah, Project Site*, U.S. Department of Energy, Grand Junction, Colorado, DOE-EM/GJ1190-2006.

DOE (U.S. Department of Energy), 2006b. *Operations, Maintenance, and Performance Monitoring Plan for the Interim Action Ground Water Treatment System, Moab, Utah, Site*, DOE-EM/GJ1220-2006, U.S. Department of Energy, Grand Junction, Colorado, June (revision 3 February 2007).

DOE (U.S. Department of Energy), 2006c. *Sampling and Analysis Plan for U.S. Department of Energy Office of Legacy Management Sites*, DOE-LM/GJ1197-2006, U.S. Department of Energy, Grand Junction, Colorado.

DOE (U.S. Department of Energy), 2007a. *Fall 2006 Assessment of Matheson Wetlands Hydrogeology and Ground Water Chemistry*, U.S. Department of Energy, Grand Junction, Colorado, DOE-EM/GJ1441-2007.

DOE (U.S. Department of Energy), 2007b. *November 2006 Validation Data Package for Performance Assessment of the Monthly Sampling for the Ground Water Interim Action, Moab, Utah*, U.S. Department of Energy, Grand Junction, Colorado, DOE-EM/GJ1439-2007.

DOE (U.S. Department of Energy), 2007c. *Biota Monitoring Report*

DOE (U.S. Department of Energy), 2007d. *2006 Performance Assessment of the Ground Water Interim Action Well Field* U.S. Department of Energy, Grand Junction, Colorado, DOE-EM/GJ1478-2007, June 2007.

Domenico, P.A., and F.W. Schwartz, 1998. *Physical and Chemical Hydrogeology*, John Wiley and Sons, Inc.

Duff, J.H., and F.J. Triska, 2000. Nitrogen Biogeochemistry and Surface-Subsurface Exchange in Streams, in *Streams and Ground Waters*, J.B. Jones and P.J. Mulholland, eds., Academic Press.

Eisinger, C., and M. Lowe, 1999. *A Summary of the Ground-Water Resources and Geohydrology of Grand County, Utah*, Utah Geological Society, Circular 99.

EPA (U.S. Environmental Protection Agency), 1993. *Nitrogen Control*, EPA/625/R-93/010.

EPA (U.S. Environmental Protection Agency), 1999. *Update of Ambient Water Quality Criteria for Ammonia*, EPA-822-R-99-014.

Freethey, G.W., and G.E. Cordy, 1991. *Geohydrology of Mesozoic Rocks in the Upper Colorado River Basin in Arizona, Colorado, New Mexico, Utah, and Wyoming, Excluding the San Juan Basin*. U.S. Geological Survey Professional Paper 1411-C.

Gardner, P.M., and D.K. Solomon, 2003. *Investigation of the Hydrologic Connection Between the Moab Mill Tailings and the Matheson Wetlands Preserve*, Department of Geology and Geophysics, University of Utah.

Heath, R.C., 1989. *Basic Ground-Water Hydrology*. U.S. Geological Survey, Water-Supply Paper 2220.

Hem, J.D., 1985. *Study and Interpretation of the Chemical Characteristics of Natural Water,* U.S. Geological Survey, Water Supply Paper 2254.

McCutcheon, S.C., J.L. Martin, and T.O. Barnwell, Jr., 1993. Water Quality, in D.H. Maidment (ed), *Handbook of Hydrology*, p. 11.1-11.73. McGraw-Hill.

Phillips, F.M., J. Hogan, S.K. Mills, and J.M. Hendricks, 2002. *Environmental Tracers for Assessing Water and Salt Balances in Arid-Region River Basins*, Dubai International Conference on Water Resources and Integrated Management in the Third Millenium, Dubai, United Arab Emirates, February.

(SMI) Shepherd Miller, Inc., 2001. *Site Hydrogeologic and Geochemical Characterization and Alternatives Assessment for the Moab Mill Tailings Site, Moab, Utah*, April.

Tufenkji, N., J.N. Ryan, and M. Elimelech, 2002. Bank Filtration, *Environmental Science and Technology*, 36(21), p. 423a – 428a.

Yim, C.S., and M.F.N. Mohsen, 1992. Simulation of Tidal Effects on Contaminant Transport in Porous Media. *Ground Water* 30(1), p. 78-86.

Appendix A Figures and Tables

Table A-1. Summary of Well and Well Point Construction in Configuration 1

Well	Well Type/Relative Depth	Diameter (inches)	Ground Surface Elevation (ft above msl)	Screen Interval (ft bgs)	Total Depth (ft bgs)
0470	Extraction	4	3,966.56	10.3–19.7	21.3
0471	Extraction	4	3,966.59	10.3–19.7	21.3
0472	Extraction	4	3,966.62	10.3–19.7	21.3
0473	Extraction	4	3,966.67	10.3–19.7	21.3
0474	Extraction	4	3,967.02	10.3–19.7	21.3
0475	Extraction	4	3,967.13	10.3–19.7	21.3
0476	Extraction	4	3,967.38	10.3–19.7	21.3
0477	Extraction	4	3,967.30	10.3–19.7	21.3
0478	Extraction	4	3,966.82	9.6–23.9	25.5
0479	Extraction	4	3,966.60	9.3–23.6	25.2
SMI-PW02	Extraction	4	3,965.60	20–60	60.3
0403	Observation / Shallow	1	3,966.90	13.3–18.2	18.4
0407	Observation / Shallow	1	3,967.20	13.3–18.3	18.5
0480	Observation / Shallow	4	3,966.94	15.5–19.8	20.3
0481	Observation / Intermediate	4	3,967.01	25.4–29.7	31.3
0482	Observation / Deep	4	3,967.03	55.4–59.7	61.3
0483	Observation / Shallow	4	3,967.00	15.5–19.8	20.3
0484	Observation / Intermediate	4	3,967.19	25.5–29.8	30.3
0485	Observation / Deep	4	3,966.99	55.6–59.9	60.4
0551	Observation / Shallow	1	3,966.65	10.3–20.3	20.6
0552	Observation / Shallow	1	3,966.33	10.2–20.2	20.4
0553	Observation / Shallow	1	3,966.87	10.6–20.5	20.8
0554	Observation / Shallow	1	3,967.63	10.4–20.4	20.6
0555	Observation / Shallow	1	3,967.32	10.2–20.1	20.4
0556	Observation / Shallow	1	3,966.69	10.2–20.1	20.4
0557	Observation / Intermediate	6	3,967.01	35.0–45.0	45.9
0558	Observation / Intermediate	6	3,966.85	35.0–45.0	45.1
0559	Observation / Shallow	1	3,967.84	10.5–20.5	20.7
0560	Observation / Intermediate	6	3,966.95	30.0–40.0	40.4
0561	Observation / Deep	6	3,966.46	45.2–55.2	55.3
0596	Observation / Shallow	1	3,966.91	15.3–25.3	25.5
0562	Well point / Shallow	1	3,953.82	1.3−2.3	2.3
0563	Well point / Intermediate	1	3,953.82	4.6−5.6	5.6
0606	Well point / Deep	1	3,953.79	9.3−10.3	10.3
0611	Well point / Shallow	1	3,954.57	2.2−3.2	3.2
0612	Well point / Intermediate	1	3,954.57	4.3−5.3	5.3
0608	Well point / Deep	1	3,954.57	8.9−9.9	9.9
0564	Well point / Shallow	1	3,953.50	1.2−2.2	2.2
0565	Well point / Intermediate	1	3,953.50	4.0−5.0	5.0
0607	Well point / Deep	1	3,952.99	9.6−10.6	10.6

Table A-2. Chronology of Configuration 1 Activities in 2007

Date	River Flow (daily mean cfs)	Activity	Samples Collected
Jan 3, 8, 2007	3,850, 3,710	Monthly Sampling	8 observation wells (0480, 0481, 0484, 0557, 0558, 0559, 0560), 3 well points (0562, 0563, 0606), 2 surface water locations (0216, 0245)
Feb 5, 6, 2007	3,470 to 3,570	Biogeochemical Sampling	8 well points (0562, 0563, 0565, 0606, 0608, 0611, 0612), 2 surface water locations (0216, 0245)
Feb 13, 15, 2007	4,110, 3,440	Quarterly Sampling	16 observation wells (0403, 0407, 0480, 0481, 0482, 0483, 0484, 0485, 0552, 0555, 0557, 0558, 0559, 0560, 0561, 0596)
March 14-16, 2007	3,750 to 5,220	Monthly Sampling	11 extraction wells, sampled from one depth, measured field params from one other depth (0470-0479, SMI-PW02), 10 observation wells (0403, 0407, 0480, 0481, 0483, 0484, 0557, 0558, 0559, 0560), 3 well points (0562, 0563, 0606), 1 surface water location (0245), and 2 surface treatment water locations (0547, 0548)
March 22, 2007	7,490	Started Extraction for 2007	N/A
April 3-5, 2007	5,790 to 5,700	Monthly Sampling	5 extraction wells (0470, 0472, 0474, 0476, 0478), 8 observation wells (0480, 0481, 0483, 0484, 0557, 0558, 0559, 0560), 3 well points (0562, 0563, 0606), 2 surface water locations (0216, 0245), 2 surface treatment water locations (0547, 0548)
April 11, 2007	7,570	Started pumping from SMI-PW02	N/A
April 30-May 1, 2007	5,610 to 7,280	Biogeochemical Sampling	9 well points (0562, 0563, 0564, 0565, 0606, 0607, 0608, 0611, 612), 2 surface water locations (0216, 0245)
May 10, 14, 23, 2007	6,680, 11,000, 13,900	Quarterly Sampling	11 extraction wells (0470-0479, SMI-PW02), 16 observation wells (0403, 0407, 0480, 0481, 0482, 0483, 0484, 0485, 0552, 0555, 0557, 0558, 0559, 0560, 0561, 0596), 2 surface treatment water locations (0547, 0548)
June 7, 12, 14, 19, 2007	10,800, 8,700, 11,000, 11,100	Monthly Sampling	6 extraction wells (0470, 0472, 0474, 0476, 0478, SMI-PW02), 8 observation wells (0480, 0481, 0483, 0484, 0557, 0558, 0559, 0560), 1 surface water location (0216), the well points were inaccessible due to high river flow, 2 surface treatment water locations (0547, 0548)
July 2-3, 11-12, 2007	5,400 to 5,150, 3,880 to 3,680	Monthly Sampling	5 extraction wells (0470, 0472, 0474, 0476, 0478), 8 observation wells (0480, 0481, 0483, 0484, 0557, 0558, 0559, 0560), 2 well points (0562, 0563)

Date	River Flow (daily mean cfs)	Activity	Samples Collected
Aug 3, 2007	2,960	SMI-PW02 stopped operating for 2007 (equipment problems)	N/A
Aug 20-22, 30, Sept 5, 2007	3,720 to 3,260, 3,750, 3,300	Quarterly Sampling	10 extraction wells (0470-0479), 16 observation wells (0403, 0407, 0480, 0481, 0482, 0483, 0484, 0485, 0552, 0555, 0557, 0558, 0559, 0560, 0561, 0596), 9 well points (0562, 0563, 0564, 0565, 0606, 0607, 0608, 0611, 0612), 1 surface water location (216), 2 surface treatment water locations (0547, 0548)
Aug 21, 2007	3,510	Even numbered wells off for pond level control	N/A
Sept 20, 2007	5,570	Even numbered wells back on	N/A
Sept 12, 19, 20, 26, 2007	3,690, 6,650, 6,210, 6,210	Monthly Sampling	5 extraction wells (0471, 0473, 0475, 0477, 0479), 8 observation wells (0480, 0481, 0483, 0484, 0557, 0558, 0559, 0560), 1 surface water location (216), 2 surface treatment water locations (0547, 0548), the well points were inaccessible due to high river flow
Oct 18, 22, 24, 25, 2007	4,680, 4,770, 4,670	Monthly Sampling	10 extraction wells (0470-0479), 10 observation wells (0403, 0407, 0480, 0481, 0483, 0484, 0557, 0558, 0559, 0560), 3 well points (0562, 0563, 0606), 2 surface water locations (0216, 0245), 2 surface treatment water locations (0547, 0548)
Nov 2, 5, 7, 20, 27, 2007	4,310, 4,180, 4,040, 3,780, 3,460	Quarterly Sampling	5 extraction wells (0471, 0473, 0475, 0477, 0479), 16 observation wells (0403, 0407, 0480, 0481, 0482, 0483, 0484, 0485, 0552, 0555, 0557, 0558, 0559, 0560, 0561, 0596), 9 well points (0562, 0563, 0564, 0565, 0606, 0607, 0608, 0611, 0612), 2 surface water locations (0216, 0245), 2 surface treatment water locations (0547, 0548)
Nov 1, 2007	4,490	System shut down for line repair	N/A
Nov 6, 2007	4,040	System re-started	N/A
Dec 3- 5, 2007	4,690 to 3,780	Monthly Sampling	4 extraction wells (0470, 0472, 0474, 0476), 10 observation wells (0403, 0407, 0480, 0481, 0483, 0484, 0557, 0558, 0559, 0560), 1 surface treatment water location (0547)
Dec 11, 2007	4,090	Wells shut down due to cold air temperatures	N/A

Table A-2. Chronology of Configuration 1 Activities in 2007 (continued)

Table A-3. Monthly Average Pumping Rates and Extraction Volumes at Configuration 1 Wells in 2007

Month	Well 0470		Well 0471		Well 0472		Well 0473		Well 0474	
	Vol (gal)	Q (gpm)	Vol (gal)	Q (gpm)	Vol (gal)	Q (gpm)	Vol (gal)	Q (gpm)	Vol (gal)	Q (gpm)
Mar 2007	28,525	2.61	22,534	2.08	18,974	1.73	21,527	1.97	9,474	0.87
Apr 2007	131,415	2.83	94,740	2.01	92,997	2.00	101,184	2.17	38,654	0.83
May 2007	121,972	2.67	110,667	2.43	86,123	1.89	77,438	1.73	32,399	0.72
June 2007	109,246	2.69	106,804	2.64	87,109	2.14	89,133	2.19	30,740	0.86
July 2007	109,374	2.47	120,115	2.73	96,441	2.12	102,416	2.23	78,409	1.73
Aug 2007	16,362	0.51	106,683	2.40	65,697	1.75	91,227	2.03	50,893	1.34
Sept 2007	8,365	0.48	88,000	2.44	12,741	0.73	84,709	2.34	11,376	0.65
Oct 2007	69,507	1.36	140,984	2.81	94,810	1.86	110,287	2.17	98,809	1.97
Nov 2007	39,615	0.97	109,642	2.54	82,351	1.90	83,374	1.95	77,999	1.78
Dec 2007	17,831	0.70	29,626	1.18	40,664	1.66	25,990	1.02	40,204	1.59
Annual Avg / Total	**652,212**	**1.73**	**929,795**	**2.33**	**677,907**	**1.78**	**787,285**	**1.98**	**468,957**	**1.23**

Month	Well 0475		Well 0476		Well 0477		Well 0478		Well 0479	
	Vol (gal)	Q (gpm)	Vol (gal)	Q (gpm)	Vol (gal)	Q (gpm)	Vol (gal)	Q (gpm)	Vol (gal)	Q (gpm)
Mar 2007	22,664	2.08	22,083	2.02	14,958	1.37	26,004	2.36	18,278	1.68
Apr 2007	106,902	2.29	101,882	2.19	68,904	1.48	106,064	2.27	72,765	1.58
May 2007	121,145	2.59	89,880	1.97	60,884	1.39	112,646	2.35	71,758	1.69
June 2007	96,295	2.37	83,681	2.07	61,593	1.51	162,505	3.56	95,378	2.05
July 2007	100,063	2.21	84,801	1.88	61,857	1.36	73,369	1.41	87,049	1.66
Aug 2007	96,819	2.15	56,029	1.50	66,252	1.44	6,819	0.24	102,821	2.01
Sept 2007	85,794	2.37	11,990	0.69	83,452	1.81	10,577	0.46	45,827	2.24
Oct 2007	114,795	2.27	102,254	2.02	79,692	1.78	4,780	0.05	113,011	2.23
Nov 2007	92,751	2.14	80,618	1.88	46,782	1.15	0	0.00	80,210	1.85
Dec 2007	67,635	1.52	29,955	1.20	3,890	0.09	0	0.00	18,352	0.73
Annual Avg / Total	**904,863**	**2.20**	**663,173**	**1.74**	**548,264**	**1.34**	**502,764**	**1.27**	**705,449**	**1.77**

Month	Well SMI-PW02	
	Vol (gal)	Q (gpm)
Apr 2007	205,132	10.75
May 2007	498,594	9.81
June 2007	381,517	9.41
July 2007	418,360	9.38
Aug 2007	39,574	5.30
Avg / Total	**1,543,177**	**8.93**

Notes: Q = pumping rate; gpm = gallons per minute; Vol = volume; gal = gallons

Table A-4. Estimated Ammonia Mass Withdrawals at Configuration 1 Extraction Wells and Well SMI-PW02 During 2007

Month	Well 0470[a]		Well 0471[b]		Well 0472[a]		Well 0473[b]		Well 0474[a]	
	NH_3-N Conc (mg/L)	Mass Removed (kg)	NH_3-N Conc (mg/L)	Mass Removed (kg)	NH_3-N Conc (mg/L)	Mass Removed (kg)	NH_3-N Conc (mg/L)	Mass Removed (kg)	NH_3-N Conc (mg/L)	Mass Removed (kg)
Mar 2007	470	50.7	420	36	300	22	260	21	390	14
Apr 2007	490	243.4	365	131	410	144	245	94	360	53
May 2007	240	110.7	310	130	210	68	230	67	310	38
June 2007	260	107.4	330	133	300	99	225	76	300	35
July 2007	460	190.2	330	150	350	128	225	87	310	92
Aug 2007	270	16.7	350	141	200	50	220	76	280	54
Sept 2007	290	9.2	390	130	260	13	210	67	305	13
Oct 2007	310	81.4	380	203	320	115	260	108	330	123
Nov 2007	365	54.7	590	245	385	120	330	104	340	100
Dec 2007	420	28.3	590	66	450	69	330	32	350	53
Total		**893**		**1,363**		**826**		**733**		**575**

Month	Well 0475[b]		Well 0476[a]		Well 0477[b]		Well 0478[a]		Well 0479[b]	
	NH_3-N Conc (mg/L)	Mass Removed (kg)	NH_3-N Conc (mg/L)	Mass Removed (kg)	NH_3-N Conc (mg/L)	Mass Removed (kg)	NH_3-N Conc (mg/L)	Mass Removed (kg)	NH_3-N Conc (mg/L)	Mass Removed (kg)
Mar 2007	340	29	350	29	490	28	570	56	670	46
Apr 2007	345	139	270	104	405	105	480	192	502.5	138
May 2007	350	160	290	99	320	74	420	179	335	91
June 2007	310	113	240	76	285	66	310	190	320	115
July 2007	310	117	240	77	285	67	310	86	320	105
Aug 2007	270	99	300	64	250	63	540	14	305	119
Sept 2007	380	123	290	13	290	91	540	22	430	74
Oct 2007	310	135	280	108	350	105	540	10	310	132
Nov 2007	330	116	275	84	300	53	270	0	310	94
Dec 2007	330	84	270	31	300	4	0	0	310	22
Total		**1,116**		**684**		**657**		**749**		**937**

Notes: [a]Used average concentrations for September and November due to the sampling schedule.
[b]Used average concentrations for April, June, July, and December due to the sampling schedule.

Month	Well SMI-PW02	
	NH_3-N Conc (mg/L)	Mass Removed (kg)
Apr 2007	800	620
May 2006	800	1,508
June 2006	820	1,183
July 2006	820	1,297
Aug 2006	820	123
Total		**4,730**

Note: Applied May concentration to April, and June concentration to July and August.

Table A-5. Estimated Uranium Mass Withdrawals at Configuration 1 Extraction Wells and Well SMI-PW02 During 2007

Month	Well 0470[a]		Well 0471[b]		Well 0472[a]		Well 0473[b]		Well 0474[a]	
	U Conc (mg/L)	Mass Removed (kg)	U Conc (mg/L)	Mass Removed (kg)	U Conc (mg/L)	Mass Removed (kg)	U Conc (mg/L)	Mass Removed (kg)	U Conc (mg/L)	Mass Removed (kg)
Mar 2007	3.5	0.4	3.7	0.3	3.4	0.2	3	0.2	3.4	0.1
Apr 2007	2.5	1.2	2.5	0.9	2.3	0.8	2.05	0.8	2.7	0.4
May 2007	1.3	0.6	1.3	0.5	0.9	0.3	1.1	0.3	1.4	0.2
June 2007	1.4	0.6	1.35	0.5	1.5	0.5	1	0.3	1.9	0.2
July 2007	2.3	1.0	1.35	0.6	1.8	0.7	1	0.4	1.5	0.4
Aug 2007	1.1	0.1	1.4	0.6	0.9	0.2	1	0.3	1.3	0.3
Sept 2007	1.35	0.0	1.3	0.4	1.15	0.1	1.1	0.4	1.4	0.1
Oct 2007	1.6	0.4	1.7	0.9	1.4	0.5	1.2	0.5	1.5	0.6
Nov 2007	1.85	0.3	1.9	0.8	1.55	0.5	1.3	0.4	1.7	0.5
Dec 2007	2.1	0.1	1.9	0.2	1.7	0.3	1.3	0.1	1.9	0.3
Total		**4.7**		**5.8**		**4.0**		**3.8**		**3.0**

Month	Well 0475[b]		Well 0476[a]		Well 0477[b]		Well 0478[a]		Well 0479[b]	
	U Conc (mg/L)	Mass Removed (kg)	U Conc (mg/L)	Mass Removed (kg)	U Conc (mg/L)	Mass Removed (kg)	U Conc (mg/L)	Mass Removed (kg)	U Conc (mg/L)	Mass Removed (kg)
Mar 2007	3.3	0.3	3.3	0.3	3.7	0.2	3.5	0.3	3.5	0.2
Apr 2007	2.7	1.1	2.7	1.0	3.2	0.8	2.8	1.1	3.5	0.9
May 2007	2.0	0.9	2.3	0.8	2.7	0.6	2.8	1.2	3.4	0.9
June 2007	1.9	0.7	1.7	0.5	2.5	0.6	2.6	1.6	2.8	1.0
July 2007	1.9	0.7	1.6	0.5	2.5	0.6	2.7	0.7	2.8	0.9
Aug 2007	1.8	0.7	2.2	0.5	2.3	0.6	2.5	0.1	2.2	0.9
Sept 2007	2.1	0.7	2.3	0.1	2.2	0.7	2.3	0.1	2.2	0.4
Oct 2007	1.7	0.7	2.4	0.9	2.6	0.8	2.0	0.0	2.3	1.0
Nov 2007	1.8	0.6	2.4	0.7	2.5	0.4	0.0	0.0	2.0	0.6
Dec 2007	1.8	0.5	2.4	0.3	2.5	0.0	0.0	0.0	2.0	0.1
Total		**6.8**		**5.6**		**5.4**		**5.2**		**7.0**

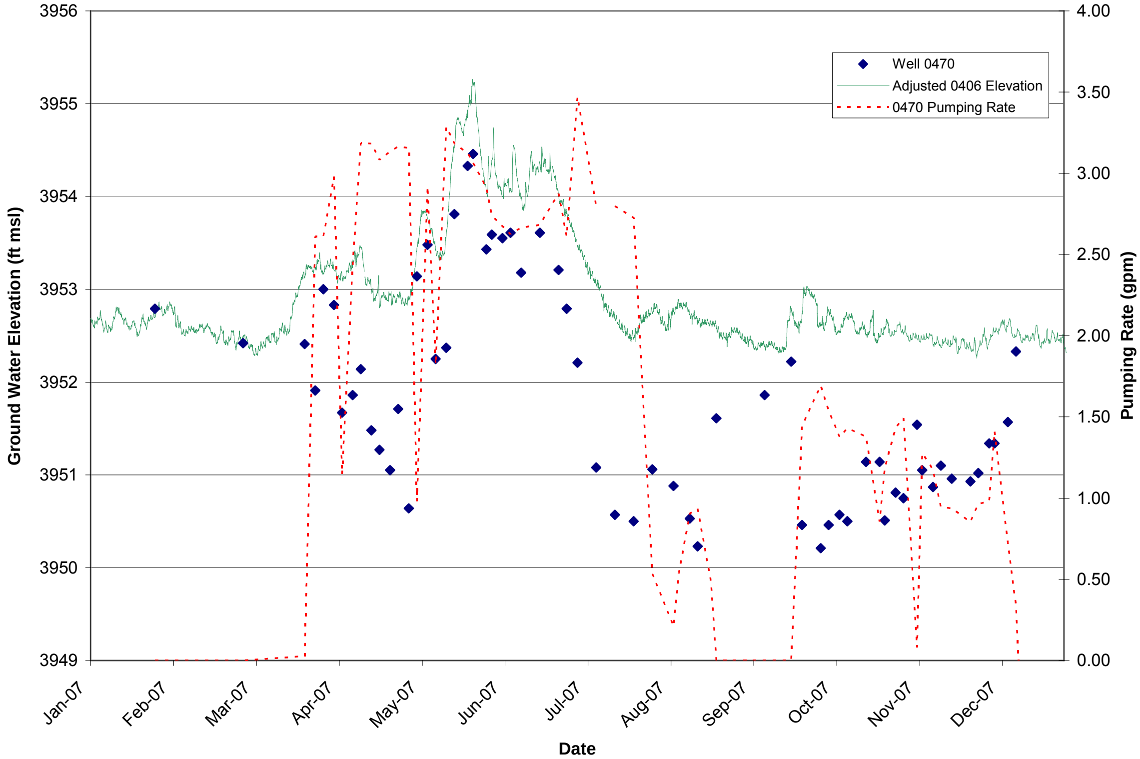
Notes: [a]Used average concentrations for September and November due to the sampling schedule.
[b]Used average concentrations for April, June, July, and December due to the sampling schedule.

Month	Well SMI-PW02	
	U Conc (mg/L)	Mass Removed (kg)
Apr 2007	2.4	1.9
May 2007	2.6	4.9
June 2007	2.7	3.9
July 2007	2.7	4.3
Aug 2007	2.7	0.4
Total		**15.3**

Note: Applied May concentration to April, and June concentration to July and August.

N:\MOA\999\0006\08\006\X02164\x0216400.apr carverh 4/10/2007, 12:58 X0216400

Figure A-1. Map View of Configuration 1 Wells and Sampling Locations



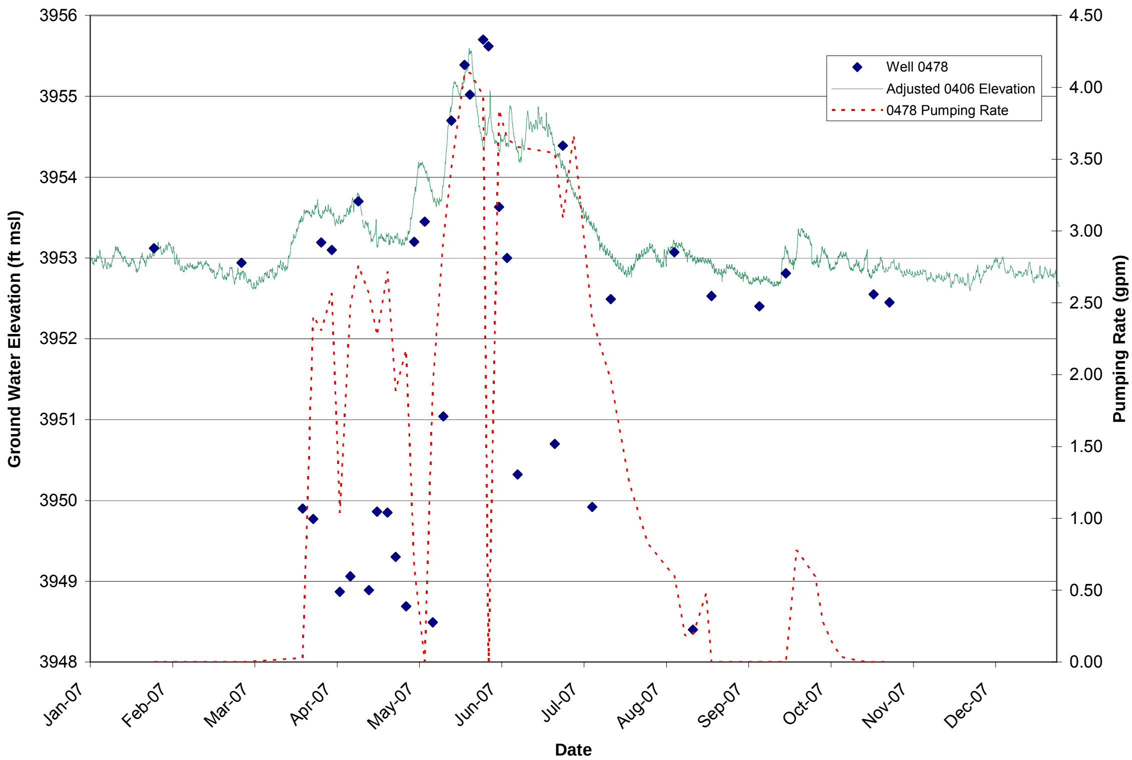


Figure A-2. Ground Water Elevations at Configuration 1 Extraction Wells 0470 and 0478 and Baseline Area Well 0406 During 2007

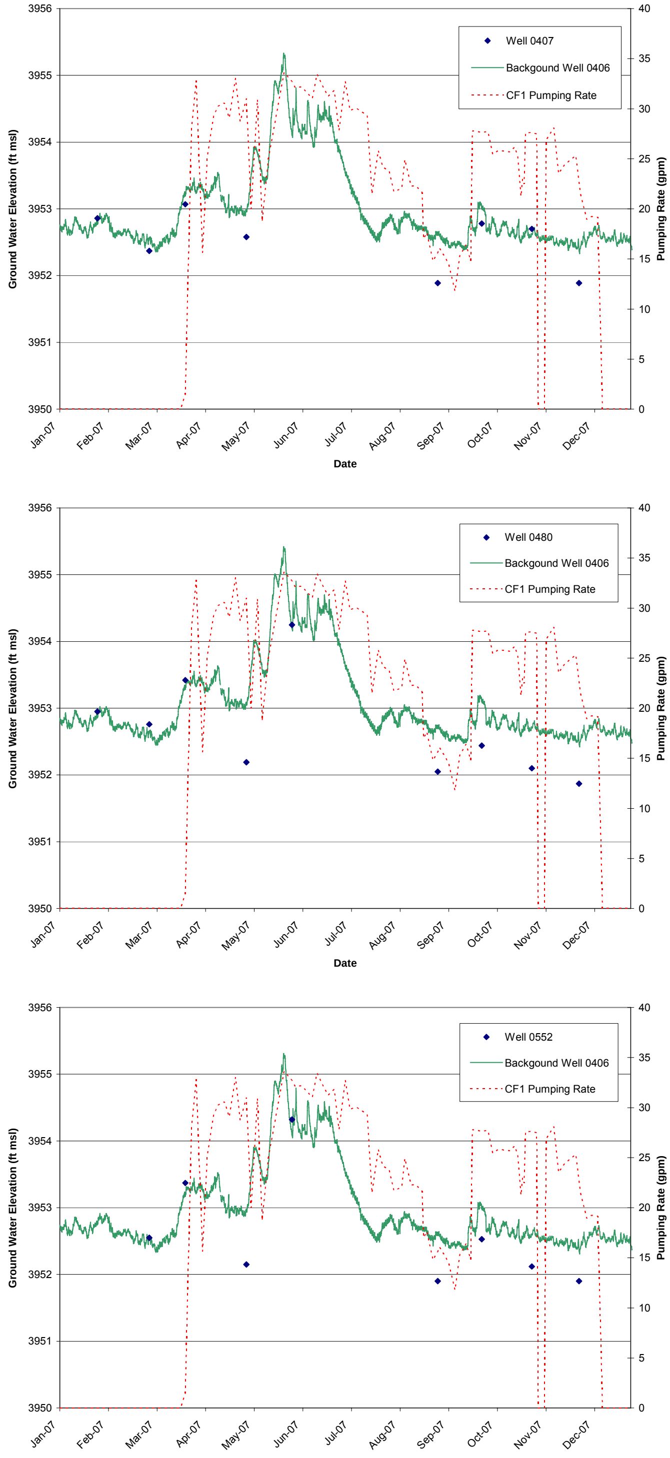


Figure A-3. Ground Water Elevations at Configuration 1 Observation Wells 0407, 0480, and 0552 and Baseline Area Well 0406 During 2007

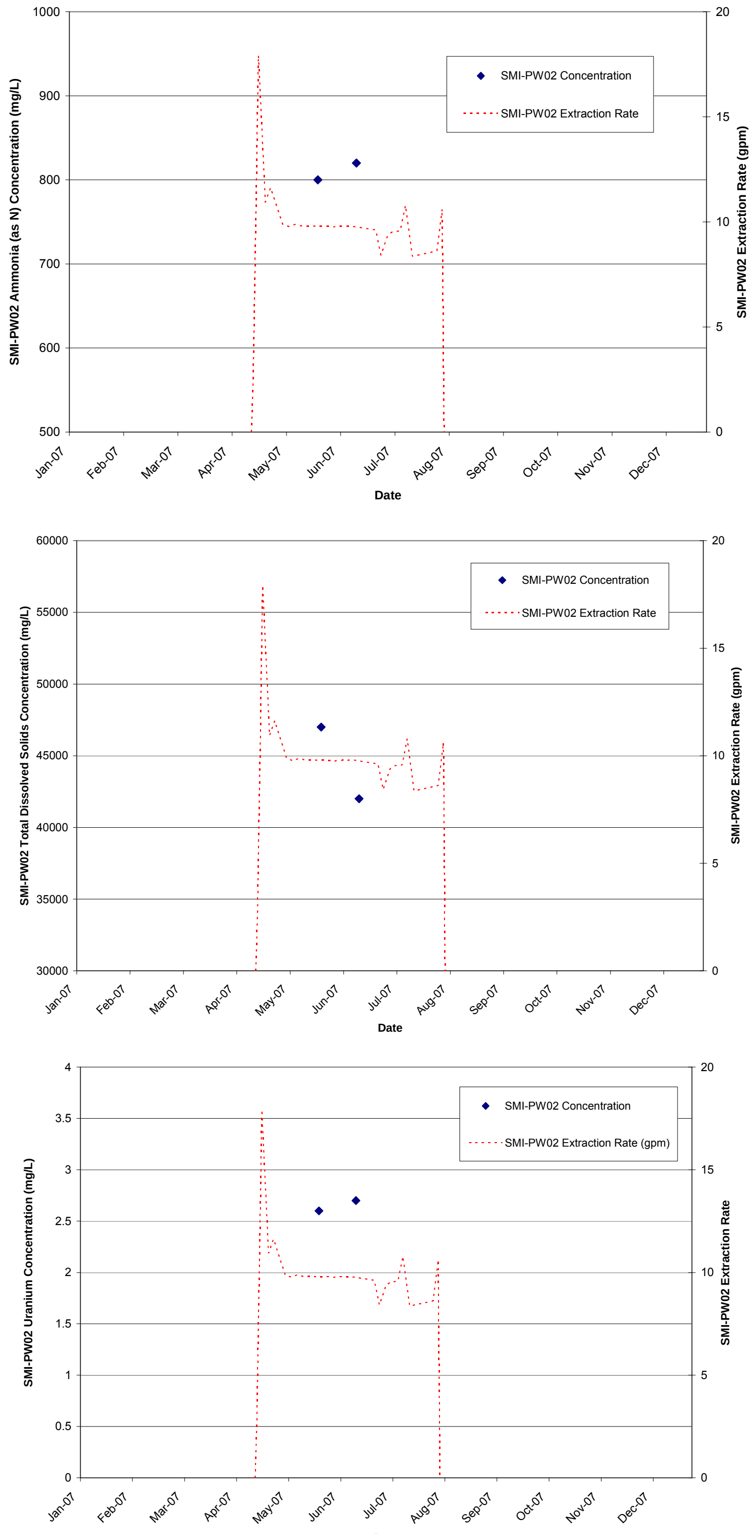
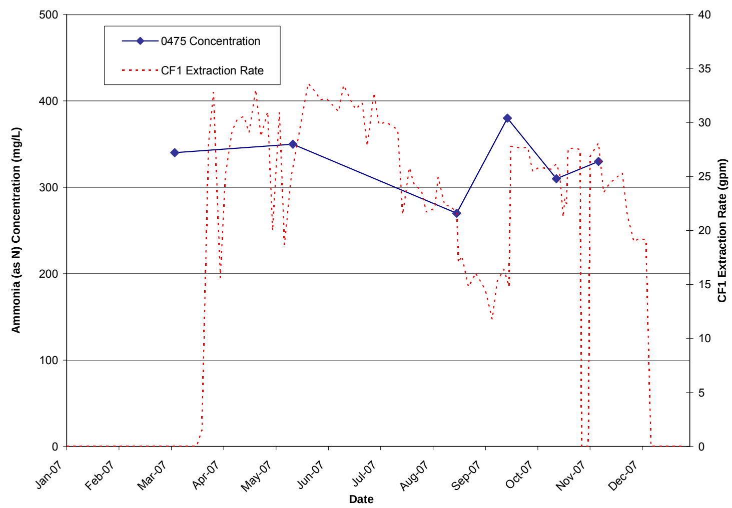
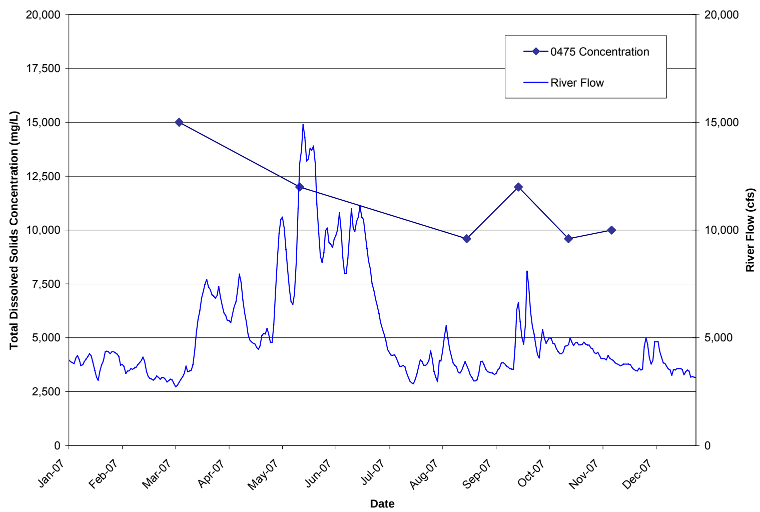


Figure A-4. Chemical Hydrographs of Ammonia, TDS, and Uranium for Configuration 1 Extraction Well SMI-PW02





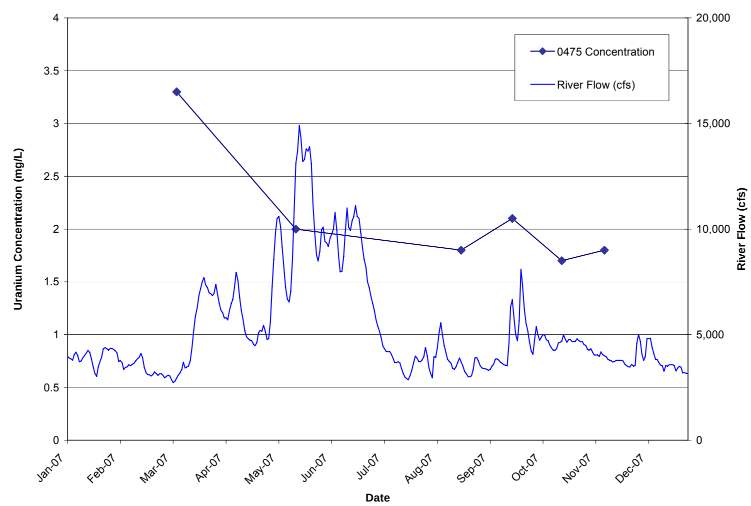


Figure A-5. Chemical Hydrographs of Ammonia, TDS and Uranium for Configuration 1 Extraction Well 0475

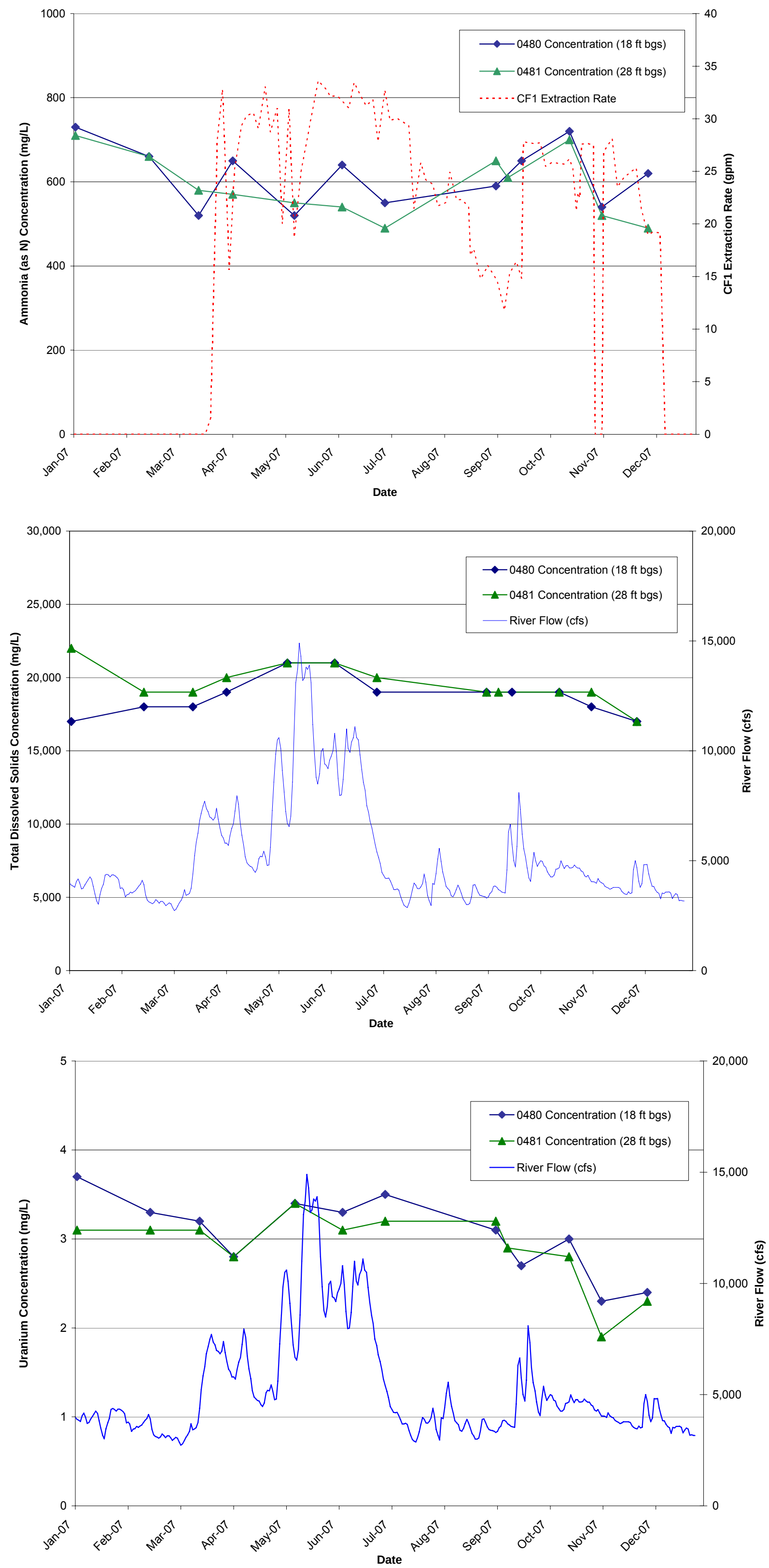


Figure A-6. Chemical Hydrographs of Ammonia, TDS, and Uranium for Configuration 1 Upgradient Observation Wells 0480 and 0481

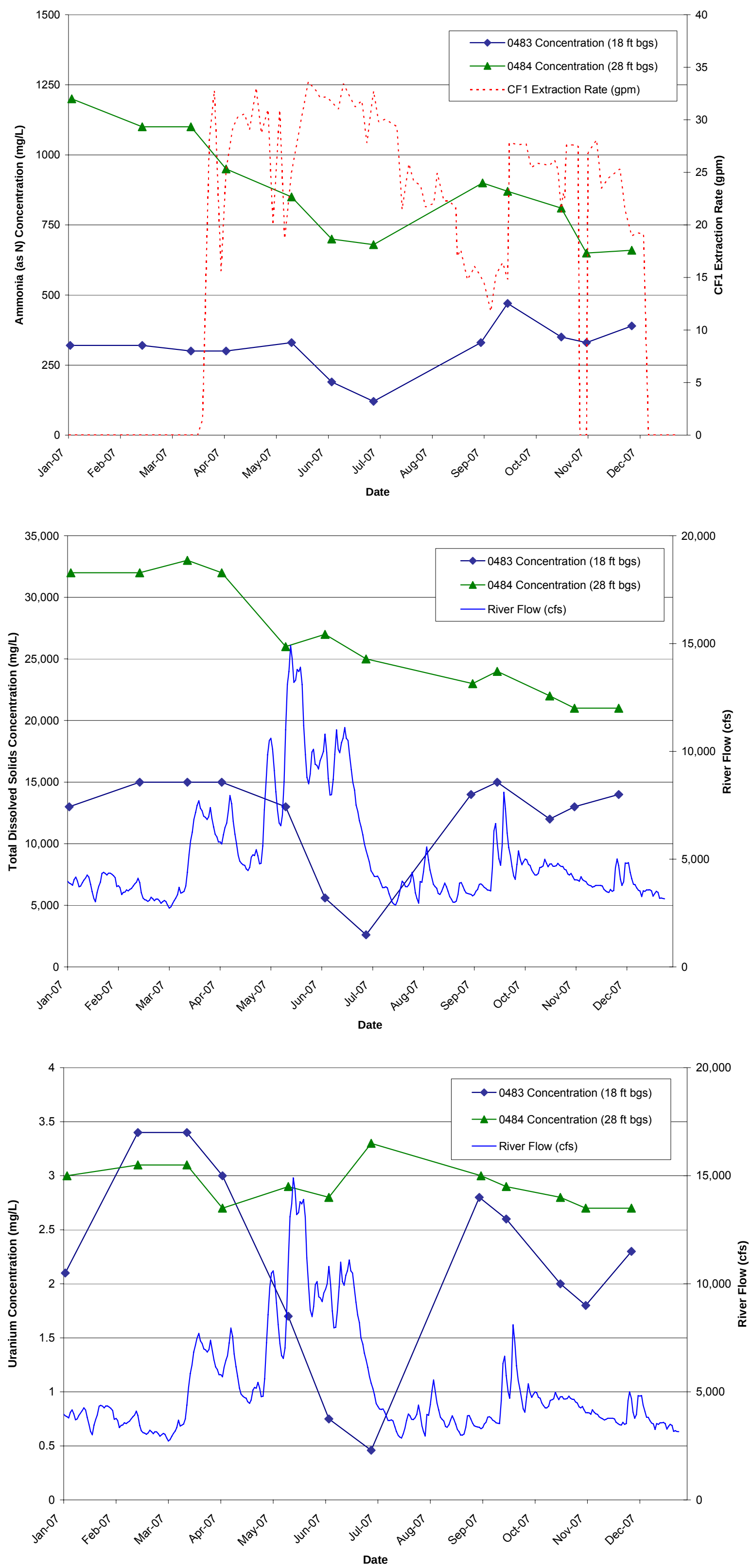


Figure A-7. Chemical Hydrographs of Ammonia, TDS, and, Uranium for Configuration 1 Downgradient Observation Wells 0483 and 0484

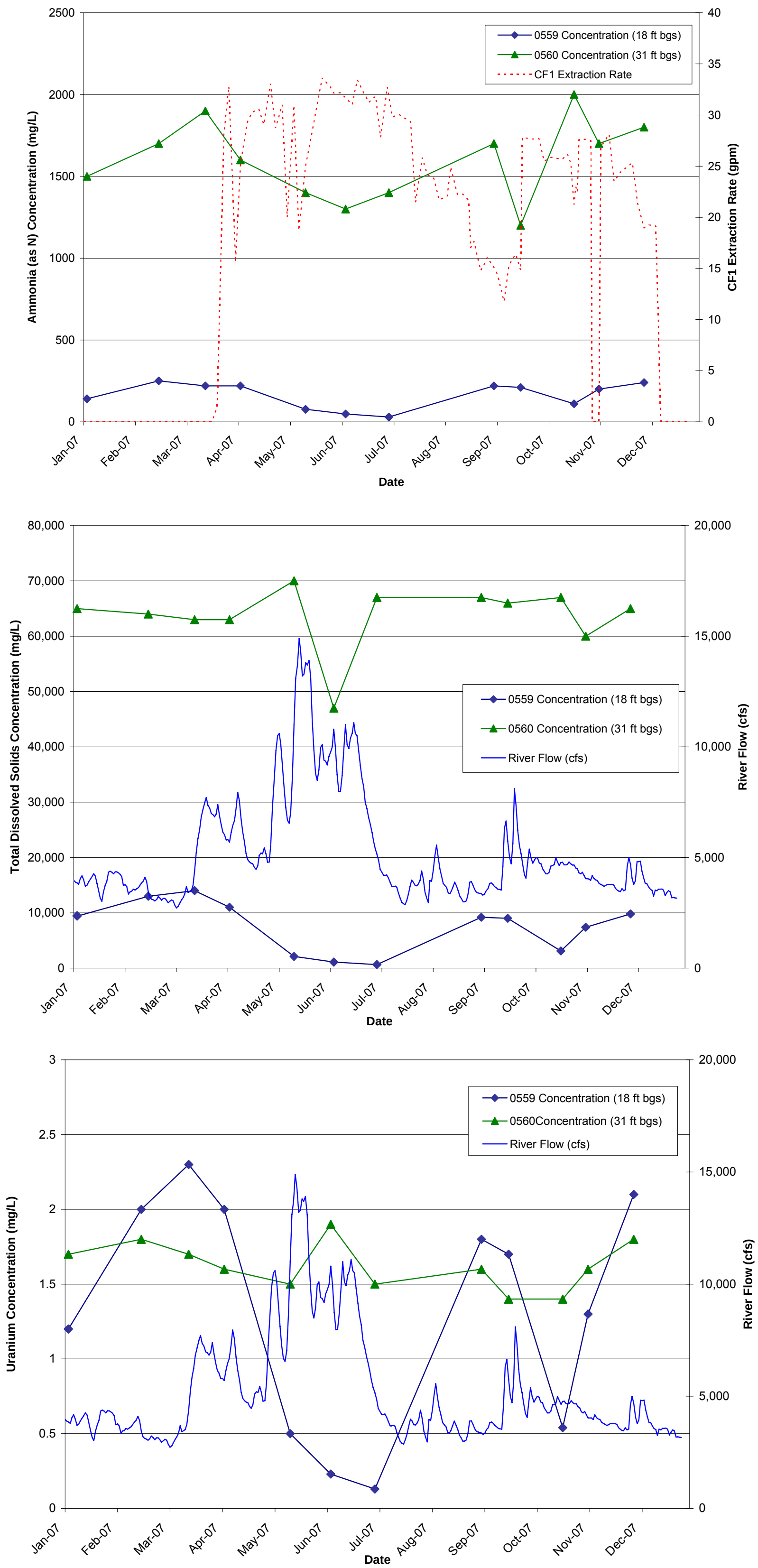


Figure A-8. Chemical Hydrographs of Ammonia, TDS, and, Uranium for Configuration 1 Downgradient Wells 0559 and 0560

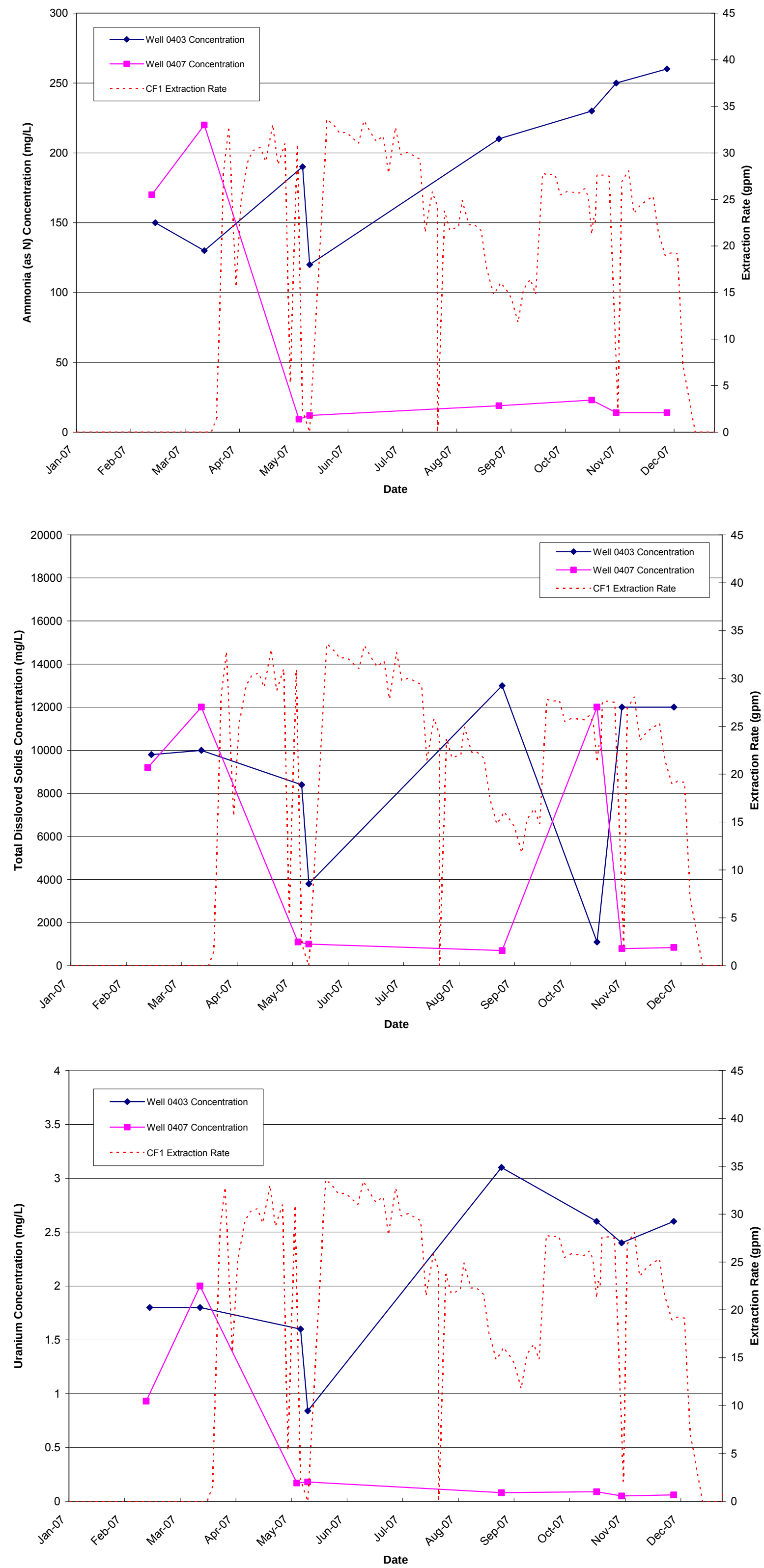


Figure A-9. Chemical Hydrographs of Ammonia, TDS, and Uranium for Configuration 1 Downgradient Observation Wells 0403 and 0407

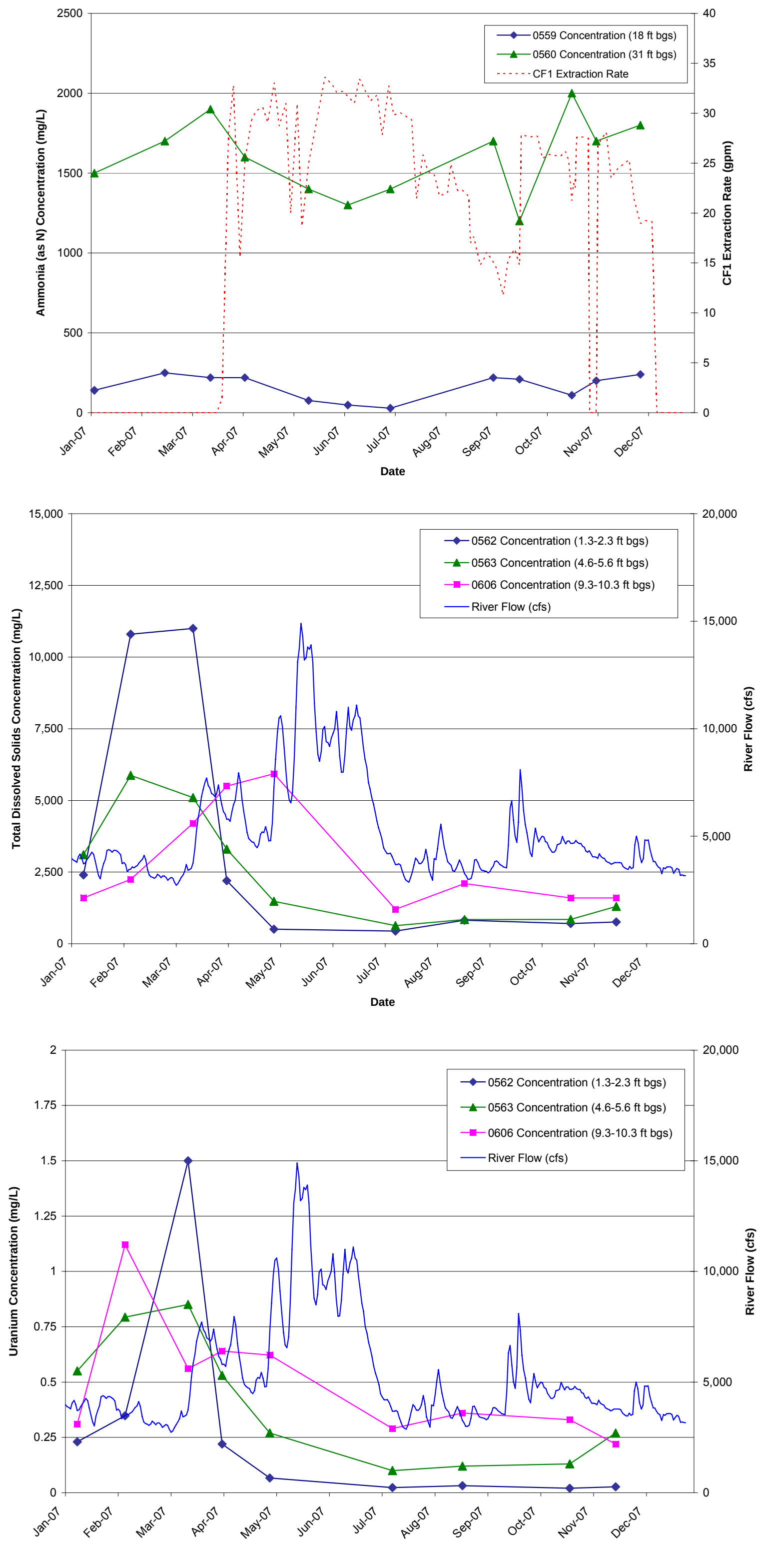


Figure A-10. Chemical Hydrographs of Ammonia, TDS, and, Uranium for Configuration 1 River Bank Well Points 0562, 0563, and 0606

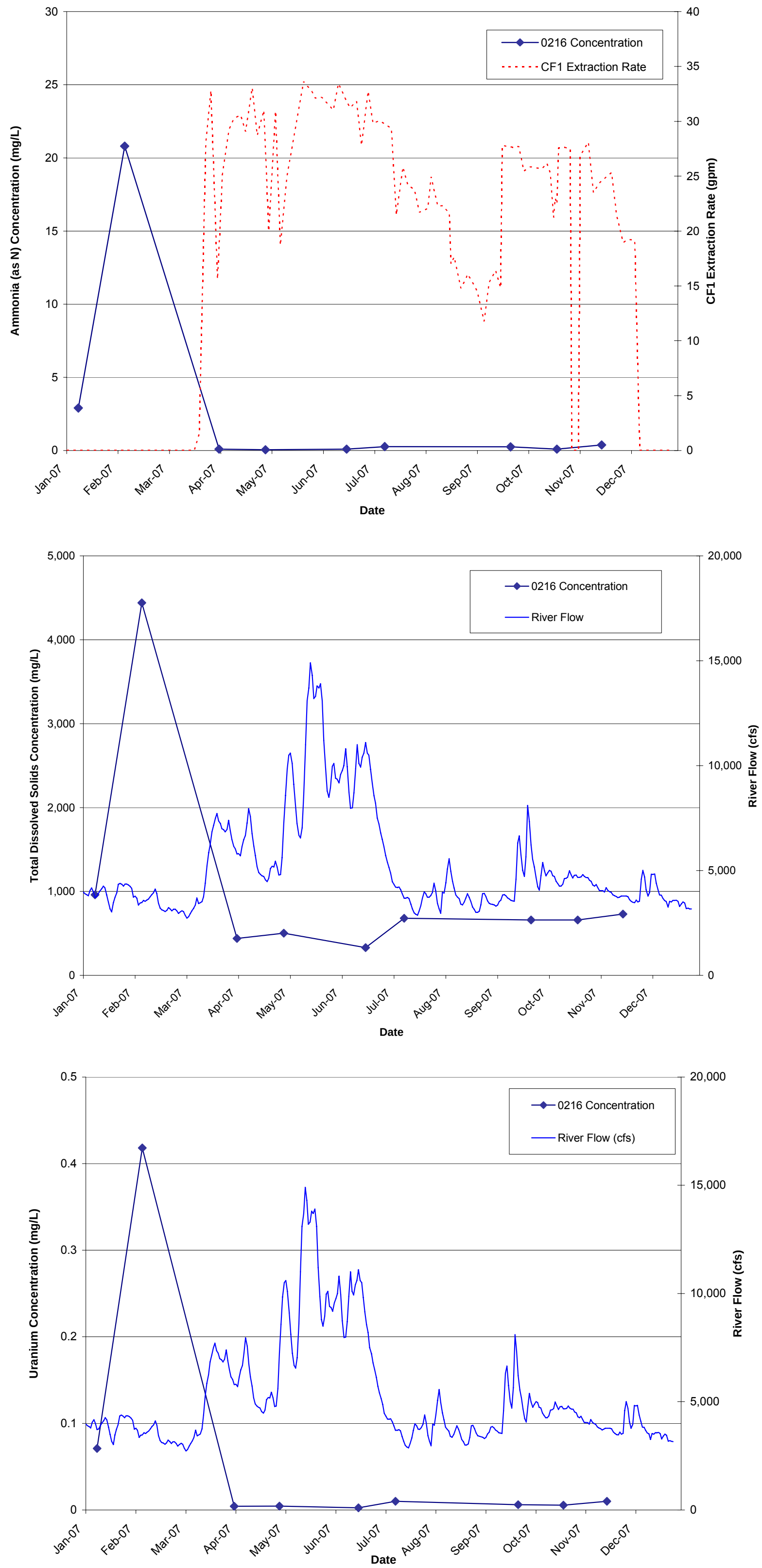


Figure A-11. Chemical Hydrographs of Ammonia, TDS, and Uranium for Configuration 1 Surface Water Location 0216

Appendix B Figures and Tables

Table B-1. Summary of Well and Well Point Construction in Configuration 2

Well	Well Type/Relative Depth	Diameter (inches)	Ground Surface Elevation (ft above msl)	Screen Interval (ft bgs)	Total Depth (ft bgs)
0570	Remediation / Shallow	6	3,967.52	15.0–30.0	31.3
0571	Remediation / Deep	6	3,967.01	25.0–40.0	41.3
0572	Remediation / Shallow	6	3,967.01	15.0–30.0	31.3
0573	Remediation / Deep	6	3,967.70	25.0–40.0	41.3
0574	Remediation / Shallow	6	3,967.30	15.0–30.0	31.3
0575	Remediation / Deep	6	3,967.30	25.0–40.0	41.3
0576	Remediation / Shallow	6	3,967.17	15.0–30.0	31.3
0577	Remediation / Deep	6	3,967.59	25.0–40.0	41.3
0578	Remediation / Shallow	6	3,967.80	15.0–30.0	31.3
0579	Remediation / Deep	6	3,967.21	25.0–40.0	41.3
0401	Observation / Shallow	1	3,967.70	13.0–17.9	18.9
0402	Observation / Shallow	1	3,967.70	13.4–18.3	18.5
0408	Observation / Shallow	1	3,967.80	23.0–27.9	28.0
0580	Observation / Shallow	1	3,967.52	10.2–20.2	20.4
0581	Observation / Shallow	1	3,967.01	10.3–20.3	20.5
0582	Observation / Shallow	1	3,967.67	9.8–19.7	20.0
0583	Observation / Shallow	1	3,967.53	8.9–18.8	19.1
0584	Observation / Shallow	1	3,967.17	10.3–20.2	20.5
0585	Observation / Shallow	1	3,967.59	10.4–20.3	20.6
0586	Observation / Shallow	1	3,967.21	10.0–19.9	20.2
0587	Observation / Shallow	1	3,967.30	10.0–19.6	20.2
0588	Observation / Intermediate	6	3,967.22	24.8–34.8	35.0
0589	Observation / Deep	6	3,966.98	42.7–52.7	53.0
0600	Observation / Shallow	1	3,966.88	19.5–29.5	29.7
0601	Observation / Shallow	1	3,967.09	19.5–29.5	29.7
0602	Observation / Shallow	1	3,967.57	9.5–19.5	19.7
0590	Well Point / Shallow	1	3,953.82	1.0–2.0	2.0
0591	Well Point / Intermediate	1	3,953.82	3.9–4.9	4.9
0603	Well Point / Deep	1	3,953.82	9.2–10.2	10.2
0613	Well Point / Shallow	1	3,955.59	1.2–2.2	2.2
0614	Well Point / Intermediate	1	3,955.59	5.1–5.1	6.1
0604	Well Point / Deep	1	3,955.59	7.3–8.3	8.3
0615	Well Point / Shallow	1	3,954.96	1.4–2.4	2.4
0616	Well Point / Intermediate	1	3,954.96	5.3–6.3	6.3
0605	Well Point / Deep	1	3,954.96	9.4–10.4	10.4

Table B-2. Chronology of Configuration 2 Activities in 2007

Date	River Flow (daily mean cfs)	Activity	Samples Collected
Jan 3, 4, 9, 2007	3,850 to 3,790, 3,750	Monthly Sampling	6 observation wells (0408, 0583, 0584, 0587, 0588, 0589), 3 well points (0590, 0591, 0603), 2 surface water locations (0236, 0259)
Feb 6, 7, 2007	3,570 to 3,530	Biogeochemical Sampling	7 well points (0590, 0591, 0603, 0604, 0605, 0615, 0616), 1 surface water location (0259)
Feb 19, 2007	3,040	Quarterly Sampling	12 observation wells (0401, 0408, 0581, 0582, 0583, 0584, 0585, 0586, 0587, 0588, 0589, 0600)
March 7, 13, 15, 16, 2007	3,080, 3,510 to 5,220	Monthly Sampling	10 remediation wells, params at one depth and sampled at another depth (0570-0579), 6 observation wells (0408, 0583, 0584, 0587, 0588, 0589), 3 well points (0590, 0591, 0603), 1 surface water location (0239)
April 3, 9, 2007	5,790, 7,260	Monthly Sampling	6 observation wells (0408, 0583, 0584, 0587, 0588, 0589), 3 well points (0590, 0591, 0603), 3 surface water locations (0240, 0236, 0239)
April 10, 2007	7,950	Started ground water extraction for 2007	N/A
April 30, May 1, 2007	5,610 to 7,280	Biogeochemical Sampling	4 well points (0604, 0605, 0615, 0616), 2 surface water locations (0239, 0240)
May 8, 9, 2007	8,120 to 7,240	Quarterly Sampling	9 remediation wells (0570-0576, 0578, 0579), 12 observation wells (0401, 0408, 0581, 0582, 0583, 0584, 0585, 0586, 0587, 0588, 0589, 0600), 1 surface water location (0236)
June 5, 12, 2007	9,760, 8,700	Monthly Sampling	5 remediation wells (0570, 0572, 0574, 0576, 0578), 6 observation wells (0408, 0583, 0584, 0587, 0588, 0589), 3 well points (0590, 0591, 0603), 3 surface water locations (0236, 0239, 0240)
July 11, 12, 2007	3,880 to 3,680	Monthly Sampling	5 remediation wells (0570, 0572, 0574, 0576, 0578), 6 observation wells (0408, 0583, 0584, 0587, 0588, 0589), 3 well points (0590, 0591, 0603), 1 surface water location (0240)
Aug 21, 28, 30, 2007	3,510, 3,890, 3,750	Quarterly Sampling	9 remediation wells (0570-0575, 0577-0579), 12 observation wells (0401, 0408, 0581, 0582, 0583, 0584, 0585, 0586, 0587, 0588, 0589, 0600), 8 well points (0590, 0591, 0603, 0604, 0605, 0614, 0615, 0616), and 1 surface water location (0239)
Sept 18, 19, 20, 2007	6,310 to 5,010	Monthly Sampling	9 remediation wells (0570-0578), 6 observation wells (0408, 0583, 0584, 0587, 0588, 0589), 3 well points (0590, 0591, 0603), 2 surface water locations (0239, 0240)
Oct 15, 16, 24, 2007	4,340 to 4,610, 4,670	Monthly Sampling	6 remediation wells (0570-0574, 0577), 6 observation wells (0408, 0583, 0584, 0587, 0588, 0589), 3 well points (0590, 0591, 0603), 1 surface water location (0239)

Date	River Flow (daily mean cfs)	Activity	Samples Collected
Oct 17, 2007	4, 630	Shut down for winter	N/A
Oct 31, Nov 1, 5, 19, 2007	4,530 to 4,490, 4,180, 3,780	Quarterly Sampling	12 observation wells (0401, 0408, 0581, 0582, 0583, 0584, 0585, 0586, 0587, 0588, 0589, 0600), 7 well points (0590, 0591, 0603, 0604, 0605, 0615, 0616), 1 surface water location (0239)
Dec 4, 2007	4,070	Monthly Sampling	4 observation wells (0408, 0583, 0587, 0589)

Table B-2. Chronology of Configuration 2 Activities in 2007 (continued)

Table B-3. Monthly Average Pumping Rates and Extraction Volumes at Configuration 2 Wells in 2007

Month	Well 0570		Well 0571		Well 0572		Well 0573		Well 0574	
	Vol (gal)	Q (gpm)	Vol (gal)	Q (gpm)	Vol (gal)	Q (gpm)	Vol (gal)	Q (gpm)	Vol (gal)	Q (gpm)
Apr 2007	7,676	0.29	24,198	0.92	15,768	0.61	47,271	1.81	13,718	0.53
May 2007	25,685	0.57	83,415	1.83	42,790	0.93	80,003	1.74	22,369	0.48
June 2007	17,980	0.49	27,204	0.74	29,915	0.82	29,808	0.82	12,145	0.33
July 2007	9,808	0.19	22,210	0.44	36,608	0.73	19,958	0.40	5,052	0.10
Aug 2007	4,889	0.10	33,572	0.72	26,567	0.62	27,884	0.58	10,677	0.23
Sept 2007	15,941	0.41	37,133	1.11	18,160	0.51	36,567	1.03	9,797	0.24
Oct 2007	7,235	0.23	35,179	0.84	18,755	0.48	33,445	0.78	6,547	0.15
Annual Avg / Total	**89,214**	**0.33**	**262,911**	**0.94**	**188,563**	**0.67**	**274,936**	**1.02**	**80,305**	**0.29**

Month	Well 0575		Well 0576		Well 0577		Well 0578		Well 0579	
	Vol (gal)	Q (gpm)	Vol (gal)	Q (gpm)	Vol (gal)	Q (gpm)	Vol (gal)	Q (gpm)	Vol (gal)	Q (gpm)
Apr 2007	57,822	2.22	16,933	0.65	60,449	2.25	10,133	0.41	0	0.00
May 2007	79,123	1.73	27,218	0.61	0	0.00	25,139	0.54	290,268	6.32
June 2007	13,418	0.39	3,890	0.11	88,485	2.51	333	0.01	43,679	1.26
July 2007	5	0.00	19	0.00	145,702	2.89	461	0.01	20	0.00
Aug 2007	961	0.02	31	0.00	108,070	2.34	621	0.01	662	0.01
Sept 2007	27,274	0.76	149	0.01	99,455	2.76	462	0.02	1,396	0.04
Oct 2007	25,631	0.60	2	0.00	92,524	2.23	346	0.01	1,458	0.03
Annual Avg / Total	**204,234**	**0.82**	**48,242**	**0.20**	**594,685**	**2.14**	**37,495**	**0.14**	**337,483**	**1.10**

Notes: Q = pumping rate; gpm = gallons per minute; Vol = volume; gal = gallons

Table B-4. Estimated Ammonia Mass Withdrawals at Configuration 2 Extraction Wells During 2007

Month	Well 0570[a]		Well 0571[b]		Well 0572[a]		Well 0573[b]		Well 0574[a]	
	NH_3-N Conc (mg/L)	Mass Removed (kg)	NH_3-N Conc (mg/L)	Mass Removed (kg)	NH_3-N Conc (mg/L)	Mass Removed (kg)	NH_3-N Conc (mg/L)	Mass Removed (kg)	NH_3-N Conc (mg/L)	Mass Removed (kg)
Apr 2007	570	17	880	80	390	23	640	114	450	23
May 2007	580	56	900	284	590	95	750	227	390	33
June 2007	460	31	900	93	330	37	750	85	270	12
July 2007	660	24	1300	109	410	57	860	65	410	8
Aug 2007	440	8	1300	165	490	49	860	91	520	21
Sept 2007	700	42	1100	154	510	35	810	112	150	6
Oct 2007	300	8	980	130	620	44	990	125	460	11
Total		**187**		**1016**		**341**		**818**		**114**

Month	Well 0575[b]		Well 0576[a]		Well 0577[b]		Well 0578[a]		Well 0579[b]	
	NH_3-N Conc (mg/L)	Mass Removed (kg)	NH_3-N Conc (mg/L)	Mass Removed (kg)	NH_3-N Conc (mg/L)	Mass Removed (kg)	NH_3-N Conc (mg/L)	Mass Removed (kg)	NH_3-N Conc (mg/L)	Mass Removed (kg)
Apr 2007	440	96	510	33	680	155	350	13	380	0
May 2007	710	212	440	45	680	0	370	35	560	614
June 2007	710	36	520	8	710	237	350	0	560	92
July 2007	735	0	220	0	740	408	250	0	560	0
Aug 2007	760	3	255	0	740	302	360	1	560	1
Sept 2007	760	78	290	0	820	308	380	1	560	3
Oct 2007	920	89	290	0	730	255	380	0	560	3
Total		**515**		**86**		**1666**		**51**		**714**

Notes: [a]Used average concentrations for August and October due to the sampling schedule.
[b]Used average concentrations for June and July due to the sampling schedule.

Table B-5. Estimated Uranium Mass Withdrawals at Configuration 2 Extraction Wells During 2007

Month	Well 0570[a]		Well 0571[b]		Well 0572[a]		Well 0573[b]		Well 0574[a]	
	U Conc (mg/L)	Mass Removed (kg)	U Conc (mg/L	Mass Removed (kg)	U Conc (mg/L	Mass Removed (kg)	U Conc (mg/L)	Mass Removed (kg)	U Conc (mg/L	Mass Removed (kg)
Apr 2007	1.9	0.1	2.2	0.2	3.2	0.2	2.9	0.5	2.4	0.1
May 2007	2.5	0.2	1.9	0.6	2.6	0.4	2.3	0.7	2.6	0.2
June 2007	2.4	0.2	1.9	0.2	3.2	0.4	2.3	0.3	2.5	0.1
July 2007	2.7	0.1	1.5	0.1	3.2	0.4	2.6	0.2	3.0	0.1
Aug 2007	2.6	0.0	1.5	0.2	2.6	0.3	2.6	0.3	2.9	0.1
Sept 2007	2.4	0.1	1.7	0.2	2.5	0.2	2.4	0.3	1.2	0.0
Oct 2007	2.8	0.1	1.9	0.3	2.5	0.2	2.3	0.3	2.8	0.1
Total		**0.8**		**1.8**		**2.0**		**2.6**		**0.7**

Month	Well 0575[b]		Well 0576[a]		Well 0577[b]		Well 0578[a]		Well 0579[b]	
	U Conc (mg/L	Mass Removed (kg)	U Conc (mg/L	Mass Removed (kg)	U Conc (mg/L	Mass Removed (kg)	U Conc (mg/L)	Mass Removed (kg)	U Conc (mg/L	Mass Removed (kg)
Apr 2007	2.7	0.6	2.8	0.2	3.2	0.7	3.5	0.1	2.6	0.0
May 2007	2.3	0.7	3.2	0.3	3.2	0.0	3.2	0.3	2.4	2.6
June 2007	2.3	0.1	3.1	0.0	2.9	1.0	2.9	0.0	2.4	0.4
July 2007	2.3	0.0	2.4	0.0	2.6	1.4	4.3	0.0	2.4	0.0
Aug 2007	2.4	0.0	2.3	0.0	2.6	1.1	3.2	0.0	2.4	0.0
Sept 2007	2.4	0.2	2.1	0.0	2.4	0.9	2.5	0.0	2.4	0.0
Oct 2007	2.3	0.2	2.1	0.0	2.4	0.8	2.5	0.0	2.4	0.0
Total		**1.9**		**0.6**		**5.9**		**0.5**		**3.1**

Notes: [a]Used average concentrations for August and October due to the sampling schedule.
[b]Used average concentrations for June and July due to the sampling schedule.

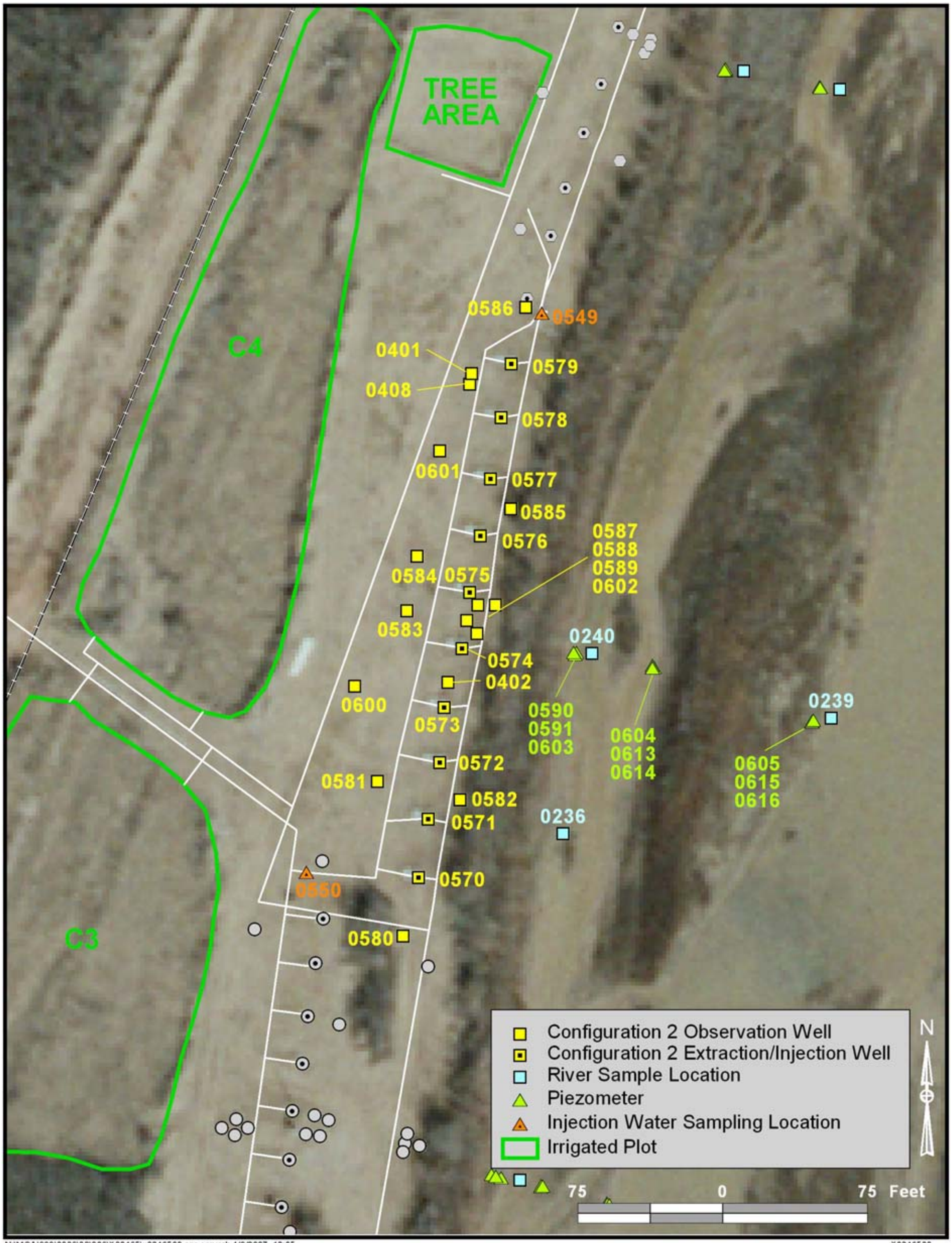
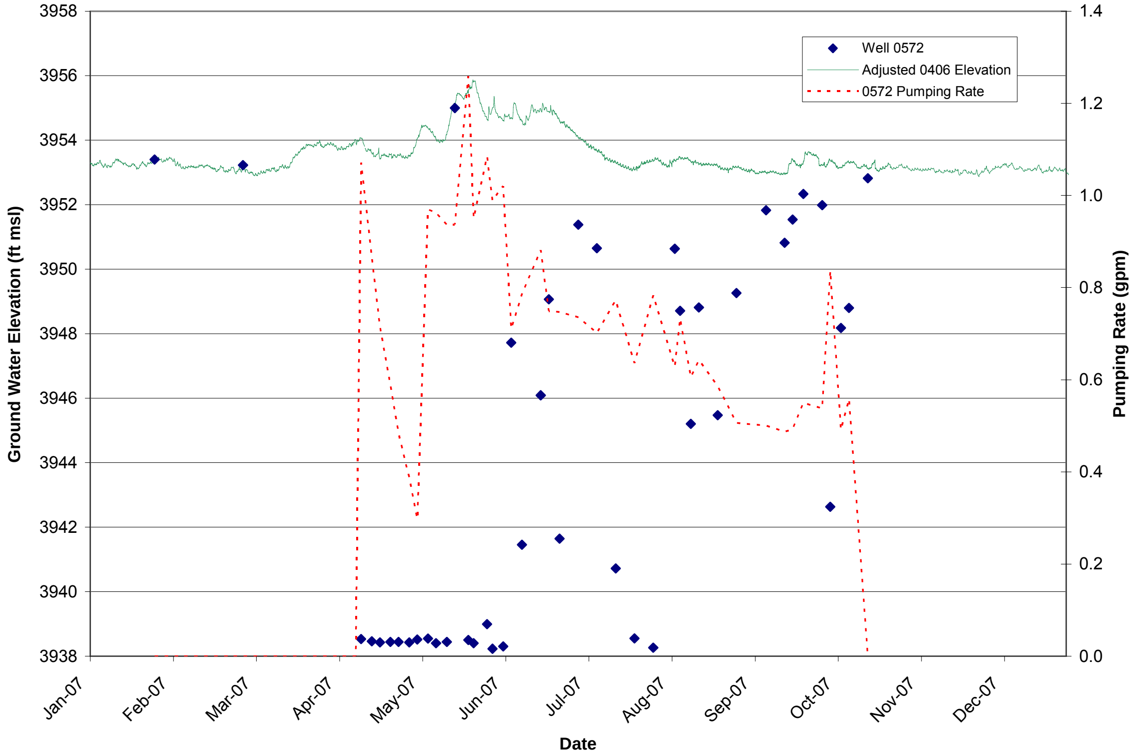


Figure B-1. Map View of Configuration 2 Wells and Sampling Locations



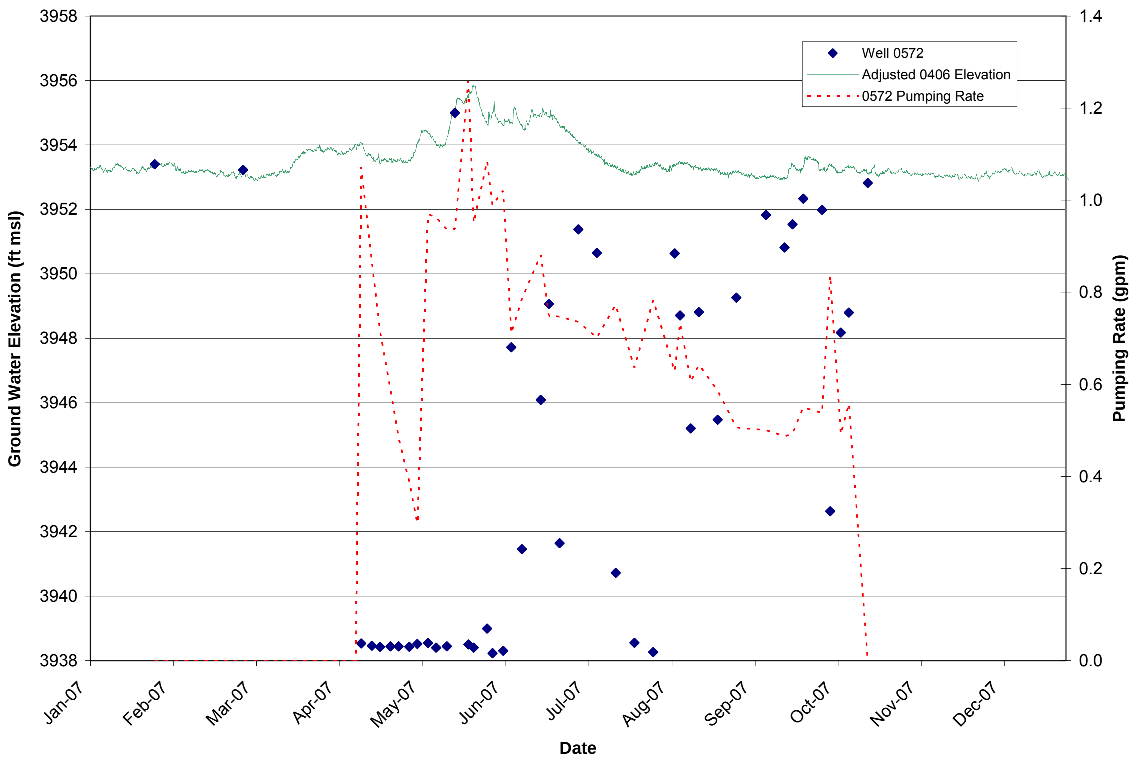
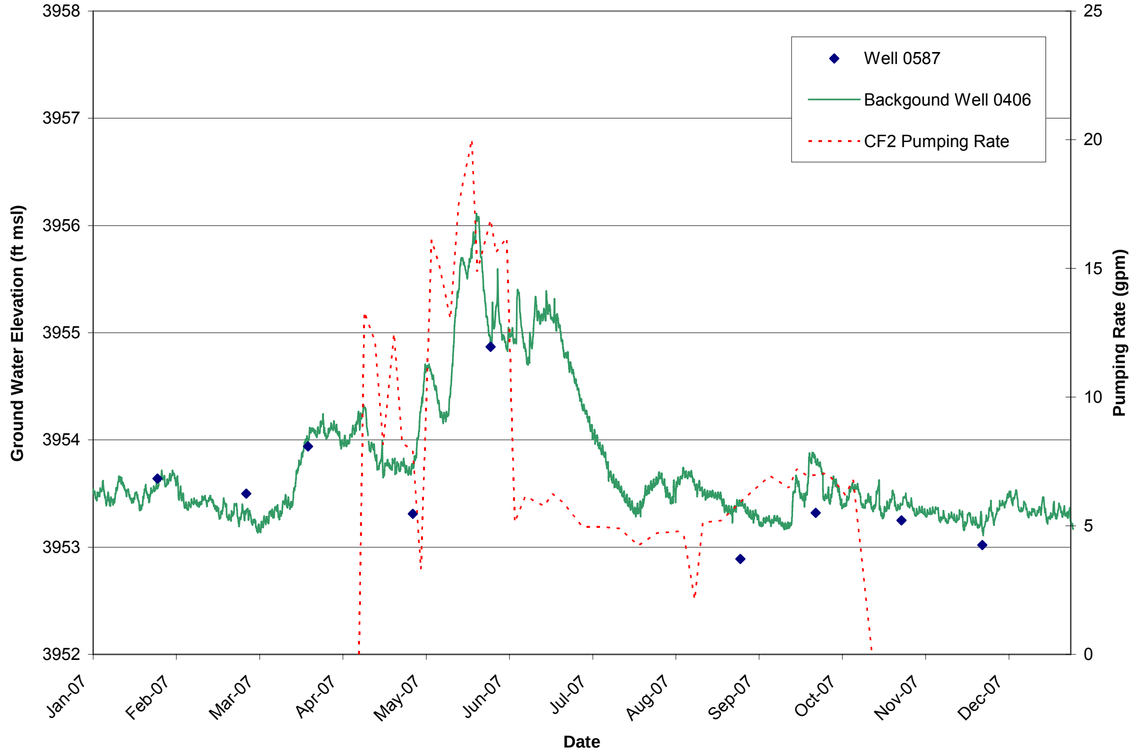


Figure B-2. Ground Water Elevations at Configuration 2 Extraction Wells 0572 and 0577 and Background Well 0406 During 2007



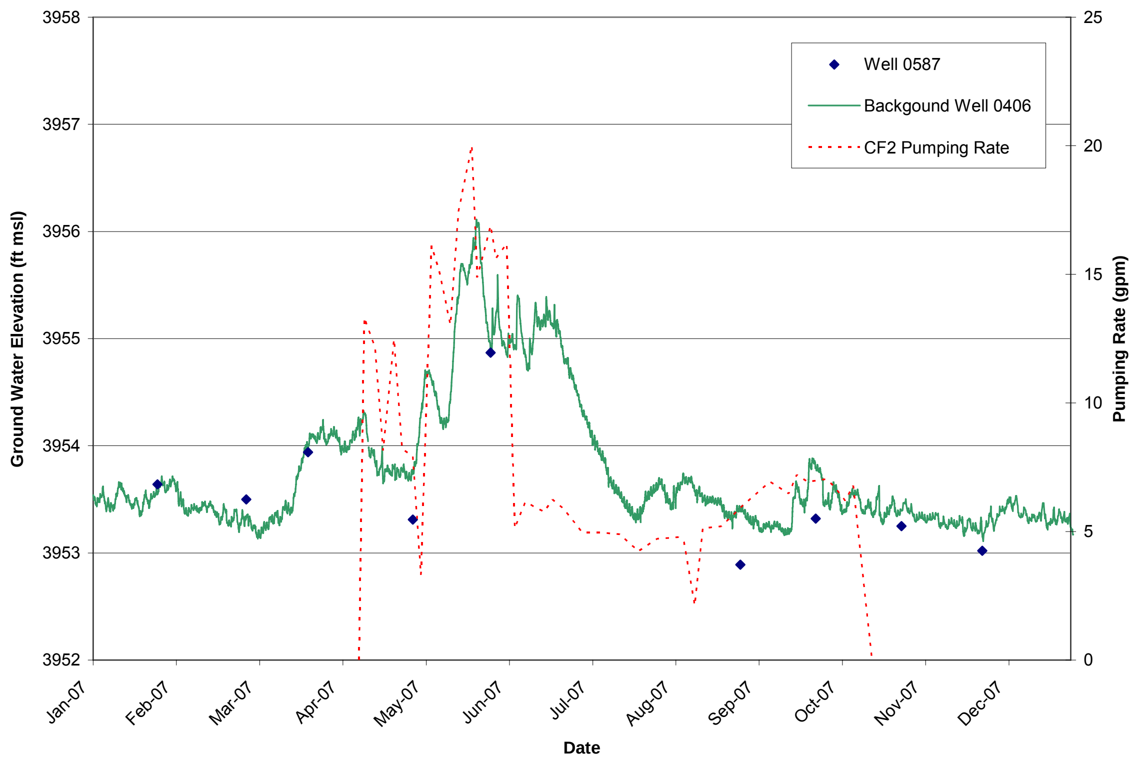


Figure B-3. Ground Water Elevations at Configuration 2 Observation Wells 0587 and 601 and Background Well 0406 During 2007

Appendix C Figures and Tables

Table C-1. Summary of Well and Well Point Construction in Configuration 3

Well	Well Type/Relative Depth	Diameter (inches)	Ground Surface Elevation (ft above msl)	Screen Interval (ft bgs)	Total Depth (ft bgs)
0670	Remediation / Deep	6	3,967.05	15.9–45.9	46.3
0671	Remediation / Deep	6	3,967.31	14.4–44.4	44.8
0672	Remediation / Deep	6	3,967.27	15.0–45.0	45.4
0673	Remediation / Deep	6	3,967.19	16.3–46.3	46.7
0674	Remediation / Deep	6	3,967.11	15.1–45.1	45.5
0675	Remediation / Deep	6	3,966.99	16.0–46.0	46.4
0676	Remediation / Deep	6	3,967.27	15.9–45.9	46.3
0677	Remediation / Deep	6	3,967.17	15.2–45.2	45.6
0678	Remediation / Deep	6	3,967.11	16.3–46.3	46.6
0679	Remediation / Deep	6	3,967.03	15.0–45.0	45.4
0404	Observation / Shallow	1	3,967.70	13.0–17.9	18.9
0680	Observation / Shallow	1	3,967.75	9.9–19.8	20.0
0681	Observation / Shallow	1	3,967.65	10.2–20.2	20.4
0682	Observation / Shallow	1	3,968.25	19.6–29.5	29.7
0683	Observation / Shallow	1	3,968.76	21.2–31.2	31.4
0684	Observation / Shallow	1	3,968.48	11.3–21.3	21.5
0685	Observation / Shallow	1	3,967.11	20.0–30.0	30.2
0686	Observation / Shallow	1	3,967.08	10.0–20.0	20.2
0687	Observation / Shallow	1	3,966.74	20.0–30.0	30.2
0688	Observation / Intermediate	6	3,966.57	30.6–40.6	41.0
0689	Observation / Deep	6	3,966.62	46.0–56.0	56.4
0690	Well point / Shallow	1	3,957.15	3.3–4.3	4.3
0691	Well point / Intermediate	1	3,957.15	6.5–7.5	7.5
0692	Well point / Deep	1	3,957.15	9.7–10.1	10.1
0693	Well point / Shallow	1	3,955.36	2.0–3.0	3.0
0694	Well point / Intermediate	1	3,955.36	4.3–5.3	5.3
0695	Well point / Deep	1	3,955.36	9.3–10.3	10.3
0696	Well point / Shallow	1	3,954.50	1.3–2.3	2.3
0697	Well point / Intermediate	1	3,954.50	4.3–5.3	5.3
0698	Well point / Deep	1	3,954.50	9.9–10.3	10.3

Table C-2. Chronology of Configuration 3 Activities in 2007

Date	River Flow (daily mean cfs)	Activity	Samples Collected
Jan 9, 10, 2007	3,750 to 3,900	Monthly Sampling	5 observation wells (0682, 0683, 0687, 0688, 0689), 3 well points (0690, 0691, 0692), 1 surface water location 0259)
Feb 7, 2007	3,530	Biogeochemical Sampling	9 well points (0690-0698), 1 surface water location (0259)
Feb 20, 21, 2007	3,100	Quarterly Sampling	11 observation wells (0404, 0680, 0681, 0682, 0683, 0684, 0685, 0686, 0687, 0688, 0689)
March 3, 2007	2,860	Monthly Sampling	5 remediation wells, params at two depths, sampled at one depth (0670, 0672, 0674, 0676, 0678), 5 observation wells (0682, 0683, 0687, 0688, 0689), 3 well points (0690-0692), 1 surface water location (0258)
March 13, 2007	3,510	Started ground water extraction for 2007 from even-numbered wells	N/A
March 22, 2007	7,710	Started ground water extraction for 2007 from odd-numbered wells	N/A
April 2, 4, 9, 2007	6,030, 5,800, 7,260	Monthly Sampling	5 remediation wells (0670, 0672, 0674, 0676, 0678), 5 observation wells (0682, 0683, 0687, 0688, 0689), 3 well points (0690-0692), 1 surface water location (0258)
March 21, 2007	7,490	Begin extraction on all remediation wells	N/A
May 1, 2, 2007	7,280 to 8,570	Biogeochemical Sampling	8 well points (0691-0698), 2 surface water locations (0258, 0259)
May 8, 9, 2007	8,120 to 7,240	Quarterly Sampling	10 remediation wells (0670-0679), 11 observation wells (0404, 0680, 0681, 0682, 0683, 0684, 0685, 0686, 0687, 0688, 0689)
June 4, 5, 11, 2007	9,570 to 9,760, 7,990	Monthly Sampling	5 remediation wells (0670, 0672, 0674, 0676, 0678), 5 observation wells (0682, 0683, 0687, 0688, 0689),1 surface water location (0258), 3 well points (0690, 0691, 0692)
July 9, 11, 12, 2007	4,210, 3,880, 3,680	Monthly Sampling	5 remediation wells (0670, 0672, 0674, 0676, 0678), 5 observation wells (0682, 0683, 0687, 0688, 0689), 1 surface water location (0259), 3 well points (0690, 0691, 0692)

Table C-2. Chronology of Configuration 3 Activities in 2007 (continued)

Date	River Flow (daily mean cfs)	Activity	Samples Collected
Aug 21, 2008	3,510	Even-numbered wells shut down to control pond level	N/A
Aug 21, 28, 29, 2007	3,510, 3,890 to 3,910	Quarterly Sampling	10 remediation wells (0670-0679), 11 observation wells (0404, 0680, 0681, 0682, 0683, 0684, 0685, 0686, 0687, 0688, 0689), 9 well points (0690-0698), 1 surface water location (0259)
Sept 18, 19, 2007	6,310 to 6.650	Monthly Sampling	5 remediation wells (0671, 0673, 0675, 0677, 0679), 5 observation wells (0682, 0683, 0687, 0688, 0689), 1 surface water location (0259), 3 well points (0690, 0692, 0691)
Sept 21, 2007	5,010	Even-numbered wells restarted	N/A
Oct 2, 2007	4,760	Even-numbered wells shut down to control pond level	N/A
Oct 15, 16, 24, 2007	4,340 to 4,610, 4,670	Monthly Sampling	5 remediation wells (0671, 0673, 0675, 0677, 0679), 5 observation wells (0682, 0683, 0687, 0688, 0689), 9 well points (0690-0698), 1 surface water location (0259)
Oct 17, 2007	4,630	All wells shut down	N/A
Oct 20, 2007	4,800	All wells restarted	N/A
Oct 25, 2007	4,670	All wells shut down for 2007 season	N/A
Oct 31, Nov 13, 14, 2007	4,530, 3,960 to 3,840	Quarterly Sampling	11 observation wells (0404, 0680, 0681, 0682, 0683, 0684, 0685, 0686, 0687, 0688, 0689), 8 well points (0691-0698), 1 surface water location (0259)
Dec 4, 5, 2007	4,070 to 3,780	Monthly Sampling	4 observation wells (0682, 0687, 0688, 0689)

Table C–3. Monthly Average Pumping Rates and Extraction Volumes at Configuration 3 Wells in 2007

Month	Well 0670		Well 0671		Well 0672		Well 0673		Well 0674	
	Vol (gal)	Q (gpm)	Vol (gal)	Q (gpm)	Vol (gal)	Q (gpm)	Vol (gal)	Q (gpm)	Vol (gal)	Q (gpm)
Mar 2007	77,982	2.88	32,637	1.07	83,831	3.05	27,106	0.83	94,497	3.45
Apr 2007	44,883	1.08	202,643	4.43	19,229	0.44	84,061	1.80	28,293	0.63
May 2007	77,717	1.63	204,546	4.53	25,313	0.57	113,290	2.48	37,270	0.82
June 2007	35,497	1.14	193,754	4.74	21,354	0.69	53,949	1.69	38,705	1.00
July 2007	16,181	0.38	217,082	4.79	2,607	0.06	65,434	1.67	17,769	0.43
Aug 2007	25,535	0.54	117,214	2.34	9,260	0.27	102,206	3.05	31,844	1.05
Sept 2007	7,146	0.31	74,340	1.89	1,775	0.08	75,500	1.96	12,258	0.53
Oct 2007	18,987	0.55	43,136	1.13	30,765	0.65	19,676	0.54	72,437	1.71
Annual Avg / Total	303,928	1.06	1,085,352	3.11	194,134	0.73	541,222	1.75	333,073	1.20

Month	Well 0675		Well 0676		Well 0677		Well 0678		Well 0679	
	Vol (gal)	Q (gpm)	Vol (gal)	Q (gpm)	Vol (gal)	Q (gpm)	Vol (gal)	Q (gpm)	Vol (gal)	Q (gpm)
Mar 2007	7,399	0.22	102,685	3.74	10,188	0.39	113,163	4.11	30,040	0.98
Apr 2007	66,771	1.41	179,265	3.81	60,808	1.31	210,176	4.47	136,759	2.91
May 2007	23,003	0.49	166,063	3.68	62,356	1.47	203,249	4.50	123,379	2.73
June 2007	69,924	1.87	163,775	4.01	56,742	1.64	187,282	4.61	119,108	2.91
July 2007	56,422	1.40	180,158	3.94	28,011	0.70	203,046	4.45	105,394	2.71
Aug 2007	81	0.00	123,102	3.29	5,384	0.26	57,710	1.45	20,182	0.28
Sept 2007	117,112	3.32	4,974	0.21	113,530	3.04	19,286	0.83	136,146	3.78
Oct 2007	126,305	2.29	28,382	0.81	96,914	1.87	8,001	0.14	156,584	3.19
Annual Avg / Total	467,017	1.37	948,404	2.94	433,933	1.34	1,001,913	3.07	827,592	2.44

Notes: Q = pumping rate; gpm = gallons per minute; Vol = volume; gal = gallons

Table C-4. Estimated Ammonia Mass Withdrawals at Configuration 3 Extraction Wells During 2007

Month	Well 0670[a]		Well 0671[b]		Well 0672[a]		Well 0673[b]		Well 0674[a]	
	NH_3-N Conc (mg/L)	Mass Removed (kg)	NH_3-N Conc (mg/L)	Mass Removed (kg)	NH_3-N Conc (mg/L)	Mass Removed (kg)	NH_3-N Conc (mg/L)	Mass Removed (kg)	NH_3-N Conc (mg/L)	Mass Removed (kg)
Mar 2007	430	127	360	44	290	92	320	33	350	125
Apr 2007	580	98	550	421	520	38	520	165	520	56
May 2007	530	156	540	418	710	68	610	261	570	80
June 2007	375	50	357.5	262	340	27	395	81	450	66
July 2007	320	20	295	242	270	3	270	67	270	18
Aug 2007	84	8	80	35	100	4	83	32	78	9
Sept 2007	500	14	530	149	590	4	650	186	585	27
Oct 2007	350	25	370	60	640	74	640	48	295	81
Total		**497**		**1632**		**310**		**872**		**462**

Month	Well 0675[b]		Well 0676[a]		Well 0677[b]		Well 0678[a]		Well 0679[b]	
	NH_3-N Conc (mg/L)	Mass Removed (kg)	NH_3-N Conc (mg/L)	Mass Removed (kg)	NH_3-N Conc (mg/L)	Mass Removed (kg)	NH_3-N Conc (mg/L)	Mass Removed (kg)	NH_3-N Conc (mg/L)	Mass Removed (kg)
Mar 2007	375	10	400	155	567.5	22	735	314	735	83
Apr 2007	460	116	400	271	540	124	680	540	680	352
May 2007	450	39	470	295	690	163	370	284	545	254
June 2007	395	104	340	210	255	55	170	120	170	77
July 2007	310	66	350	238	221	23	92	71	92	37
Aug 2007	82	0	130	60	76	2	76	17	93	7
Sept 2007	520	230	435	8	350	150	255	19	160	82
Oct 2007	450	215	410	44	370	136	265	8	160	95
Total		**781**		**1,283**		**674**		**1,373**		**986**

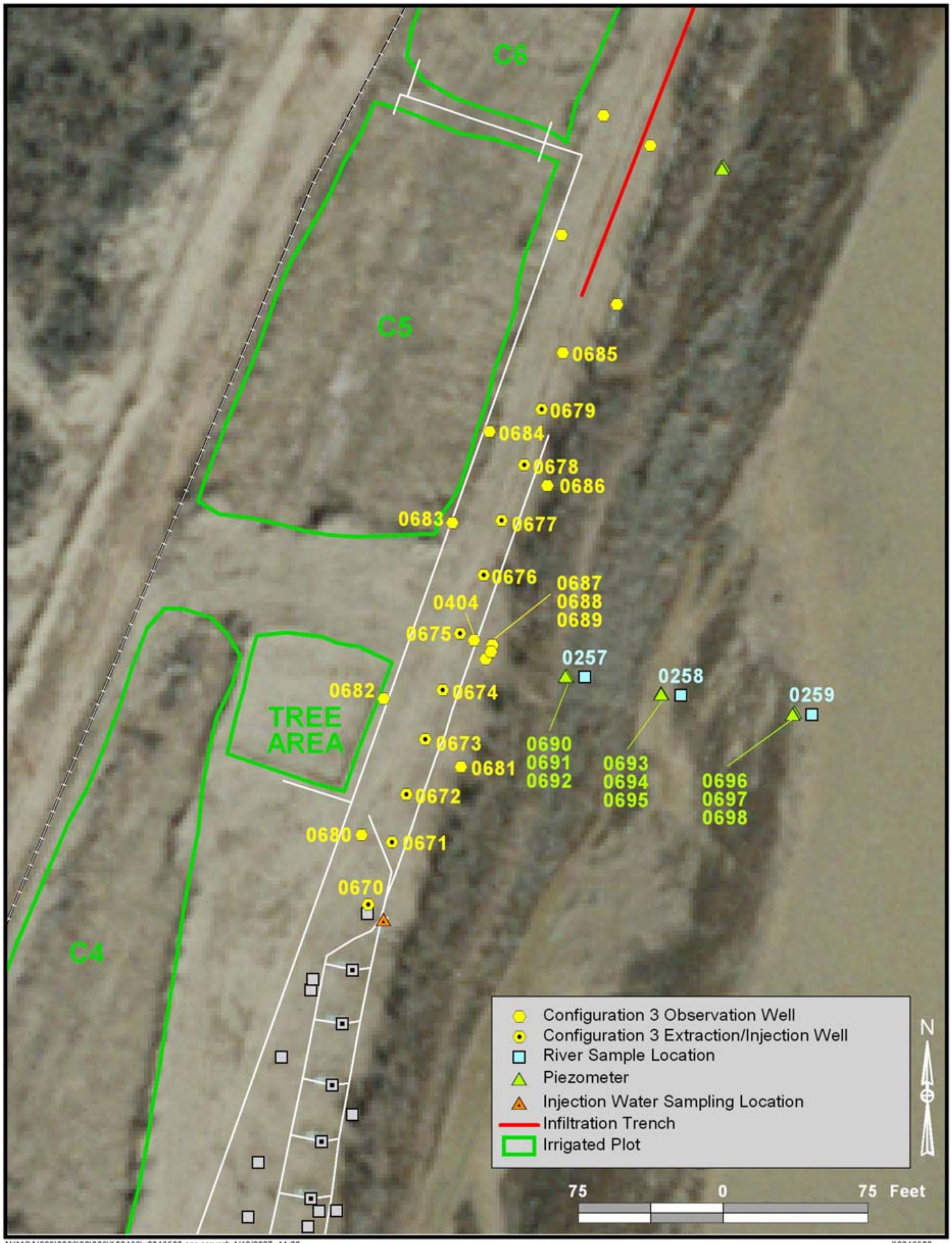
Notes: [a]Used average concentrations for September and October due to the sampling schedule.
[b]Used average concentrations for June and July due to the sampling schedule.

Table C-5. Estimated Uranium Mass Withdrawals at Configuration 3 Extraction Wells During 2007

Month	Well 0670[a]		Well 0671[b]		Well 0672[a]		Well 0673[b]		Well 0674[a]	
	U Conc (mg/L)	Mass Removed (kg)	U Conc (mg/L)	Mass Removed (kg)	U Conc (mg/L)	Mass Removed (kg)	U Conc (mg/L)	Mass Removed (kg)	U Conc (mg/L)	Mass Removed (kg)
Mar 2007	2.4	0.7	3.2	0.4	3.9	1.2	3.4	0.3	2.8	1.0
Apr 2007	2.5	0.4	2.5	1.9	2.4	0.2	2.5	0.8	2.6	0.3
May 2007	2.4	0.7	2.4	1.9	2.7	0.3	2.5	1.1	2.6	0.4
June 2007	2.2	0.3	2.2	1.6	2.1	0.2	2.6	0.5	3.0	0.4
July 2007	1.8	0.1	1.6	1.3	1.4	0.0	1.5	0.4	1.5	0.1
Aug 2007	0.4	0.0	0.3	0.1	0.5	0.0	0.3	0.1	0.3	0.0
Sept 2007	2.0	0.1	2.1	0.6	2.4	0.0	2.6	0.7	2.3	0.1
Oct 2007	1.5	0.1	1.6	0.3	2.6	0.3	2.4	0.2	2.3	0.6
Total		**2.4**		**8.0**		**2.2**		**4.1**		**3.0**

Month	Well 0675[b]		Well 0676[a]		Well 0677[b]		Well 0678[a]		Well 0679[b]	
	U Conc (mg/L)	Mass Removed (kg)	U Conc (mg/L)	Mass Removed (kg)	U Conc (mg/L)	Mass Removed (kg)	U Conc (mg/L)	Mass Removed (kg)	U Conc (mg/L)	Mass Removed (kg)
Mar 2007	2.6	0.1	2.3	0.9	2.6	0.1	2.8	1.2	2.8	0.3
Apr 2007	2.4	0.6	2.2	1.5	2.4	0.6	2.6	2.1	2.6	1.3
May 2007	2.6	0.2	2.5	1.6	2.9	0.7	2.5	1.9	2.8	1.3
June 2007	2.7	0.7	2.3	1.4	1.8	0.4	1.2	0.8	1.2	0.5
July 2007	1.8	0.4	2.1	1.4	1.3	0.1	0.5	0.4	0.5	0.2
Aug 2007	0.3	0.0	0.5	0.2	0.3	0.0	0.3	0.1	0.4	0.0
Sept 2007	2.0	0.9	1.8	0.0	1.5	0.6	1.0	0.1	0.6	0.3
Oct 2007	2.2	1.1	1.9	0.2	1.6	0.6	1.1	0.0	0.6	0.3
Total		**3.9**		**7.3**		**3.1**		**6.6**		**4.4**

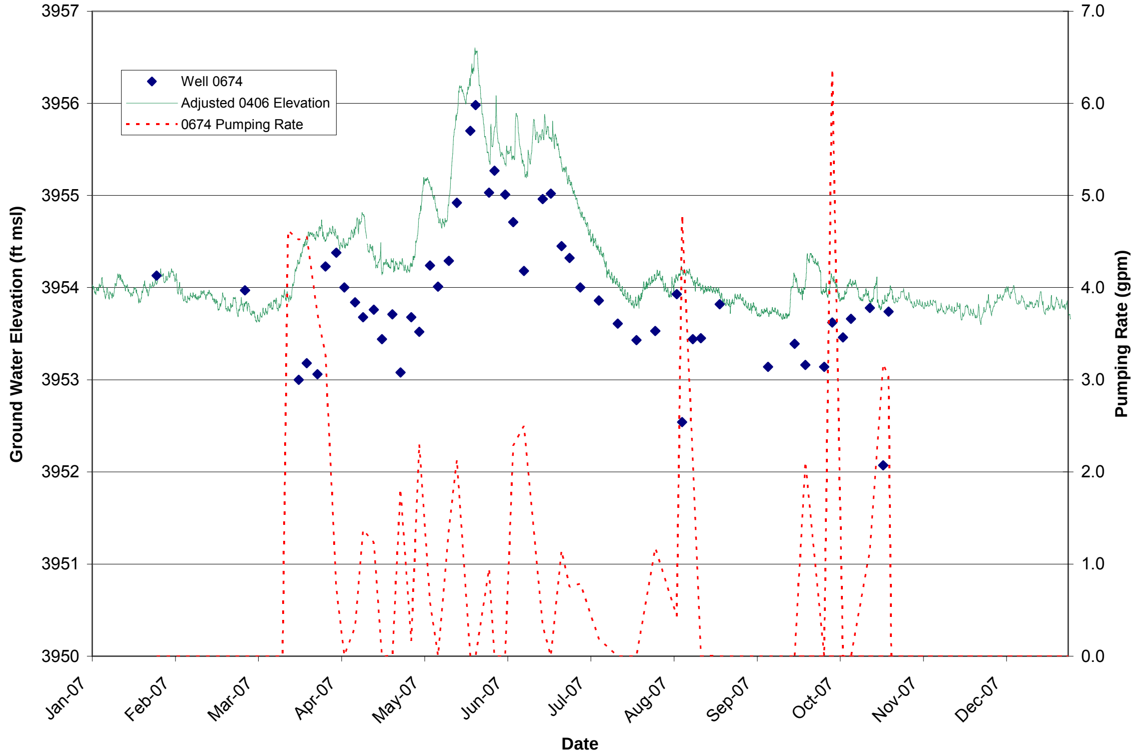
Notes: [a]Used average concentrations for September and October due to the sampling schedule.
[b]Used average concentrations for June and July due to the sampling schedule.



N:\MOA\999\0006\08\006\X02166\x0216600.apr carverh 4/10/2007, 14:22

X0216600

Figure C-1. Map View of Configuration 3 Wells and Sampling Locations



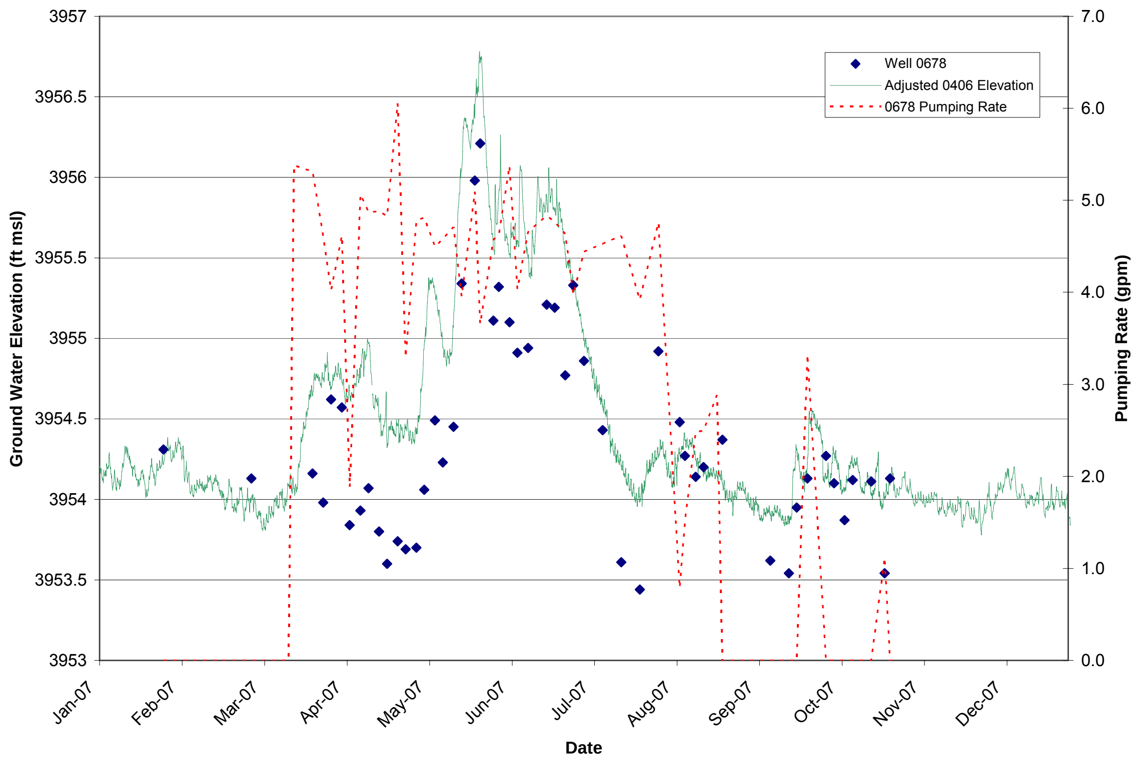


Figure C-2. Ground Water Elevations at Configuration 3 Extraction Wells 0674 and 0678 and Background Well 0406 During 2007

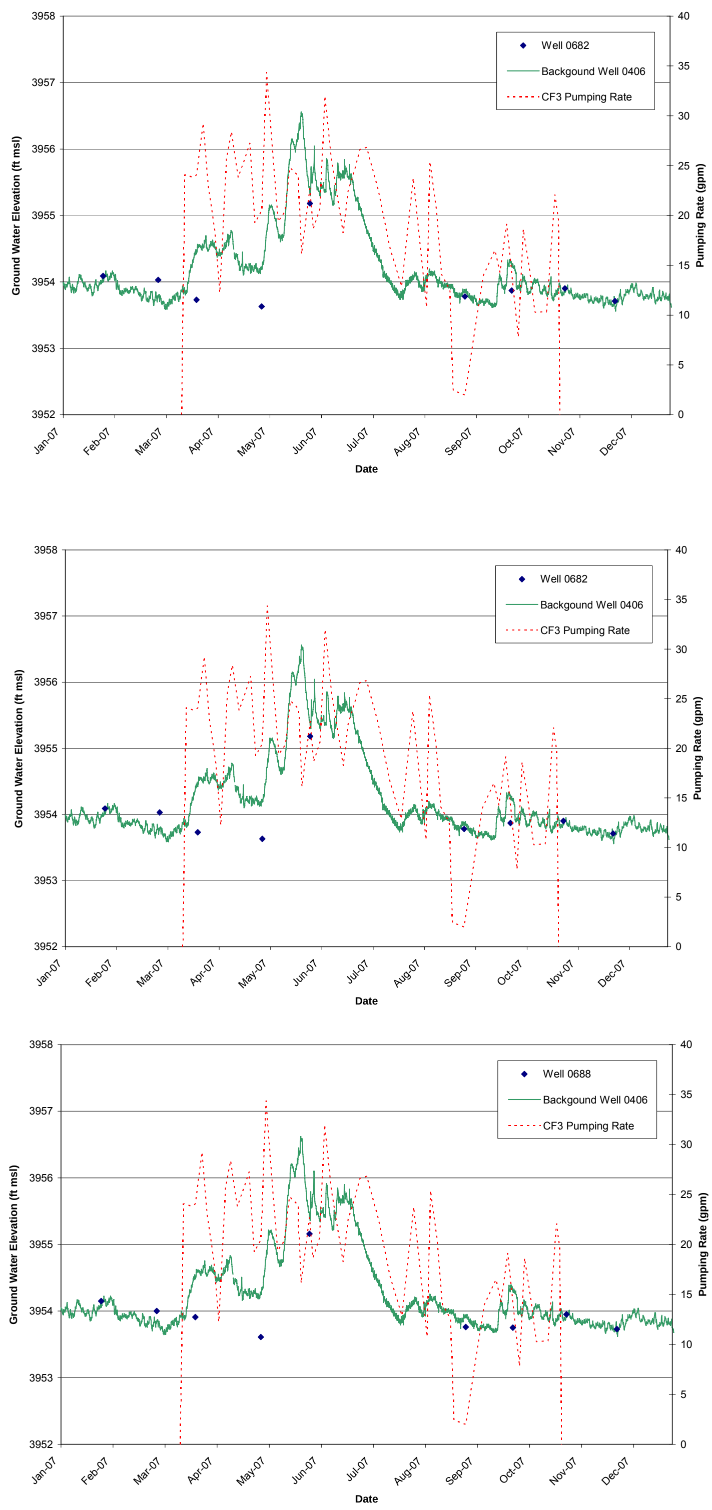


Figure C-3. Ground Water Elevations at Configuration 3 Observation Wells 0682, 0687, and 688 and Background Well 0406 During 2007

Appendix D Figures and Tables

Table D-1. Summary of Well and Well Point Construction in the Configuration 4

Well	Well Type/Relative Depth	Diameter (inches)	Ground Surface Elevation (ft above msl)	Screen Interval (ft bgs)	Total Depth (ft bgs)
0770	Remediation / Deep	6	3,968.86	14.9–34.8	35.2
0771	Remediation / Deep	6	3,969.04	15.0–34.9	35.3
0772	Remediation / Deep	6	3,969.21	15.2–35.1	35.5
0773	Remediation / Deep	6	3,969.15	15.2–35.1	35.5
0774	Remediation / Deep	6	3,968.77	15.5–35.4	35.8
0775	Remediation / Deep	6	3,969.18	15.1–35.0	35.4
0776	Remediation / Deep	6	3,968.97	15.2–35.1	35.5
0777	Remediation / Deep	6	3,968.76	15.3–35.2	35.6
0778	Remediation / Deep	6	3,968.93	15.1–35.0	35.4
0779	Remediation / Deep	6	3,968.34	15.7–35.6	36.0
0780	Observation / Shallow	6	3,968.45	20.3–30.1	30.5
0781	Observation / Deep	6	3,968.56	44.8–54.5	55.0
0782	Observation / Deep	6	3,968.46	31.0–40.8	41.2
0783	Observation / Shallow	2	3,968.82	8.6–18.6	19.1
0784	Observation / Shallow	2	3,968.73	9.4–19.4	19.9
0785	Observation / Shallow	2	3,968.24	9.6–19.6	19.9
0786	Observation / Shallow	6	3,968.14	20.5–30.3	30.7
0787	Observation / Deep	6	3,968.43	35.4–45.2	45.7
0790	Well Point / Shallow	1	3,953.91	2.0–3.0	3.0
0791	Well Point / Intermediate	1	3,953.91	4.3–5.3	5.3
0792	Well Point / Deep	1	3,953.91	9.3–10.3	10.3
0793	Well Point / Shallow	1	3,952.69	2.0–3.0	3.0
0794	Well Point / Intermediate	1	3,952.69	4.3–5.3	5.3
0795	Well Point / Deep	1	3,952.69	9.3–10.3	10.3

Table D-2. Chronology of Configuration 4 Activities in 2007

Date	River Flow (daily mean cfs)	Activity	Samples Collected
Jan 2, 8, 2007	3,890 and 3,710	Monthly Sampling	5 observation wells (0780, 0781, 0782, 0786, 0787), 3 well points (0790, 0791, 0792), 1 surface water location (0274)
Feb 7, 2007	3,530	Biogeochemical Sampling	5 well points (0790, 0791, 0792, 0793, 0795), 1 surface water location (0274)
Feb 12, 2007	3,930	Quarterly Sampling	5 observation wells (0780, 0781, 0782, 0786, 0787)
March 5, 14, 15, 2007	2,790, 3,750, 4,390	Monthly Sampling	9 remediation wells, params at two depths, sampled at one depth (0670-0679), 5 observation wells (0780, 0781, 0782, 0786, 0787), 3 well points (0790-0792), 1 surface water location (0274)
March 22, 2007	7,490	Started extraction for 2007	N/A
April 3, 4, 2007	5,790, 5,800	Monthly Sampling	4 remediation wells (0770, 0772, 0774, 0778), 5 observation wells (0780, 0781, 0782, 0786, 0787), 3 well points (0790-0792), 1 surface water location (0274)
April 30, May 1, 2007	5,610, 7,280	Biogeochemical Sampling	5 well points (0790-0793, 0795), 1 surface water location (0274)
May 7, 8, 2007	9,110, 8,120	Quarterly Sampling	9 remediation wells (0770-0779), 8 observation wells (0780-0787)
June 12, 13, 19, 2007	8,700, 9,860, 11,100	Monthly Sampling	5 remediation wells (0770, 0772, 0774, 0776, 0778), 5 observation wells (0786, 0787, 0780, 0781, 0782), 1 surface water location (0274), the well points were inaccessible due to high river flow
July 2, 11, 2007	5,400, 3,880	Monthly Sampling	5 remediation wells (0770, 0772, 0774, 0776, 0778), 5 observation wells (0786, 0787, 0780, 0781, 0782), 3 well points (0790-0792), 1 surface water location (0274)
Aug 20, Sept, 4, 5, 2007	3,720, 3,360, 3,300	Quarterly Sampling	9 remediation wells (0770-0779), 8 observation wells (0780-0787), 5 well points (0790-0793, 0795), 1 surface water location (0274)
Aug 21, 2007	3,510	Even-numbered wells shut down to control pond level	N/A
Sept 11, 12, 2007	3,790, 3,690	Monthly Sampling	5 remediation wells (0771, 0773, 0775, 0777, 0779), 5 observation wells (0786, 0787, 0780, 0781, 0782), 3 well points (0790-0792), 1 surface water location (0274)
Oct 2, 2007	4,760	Even-numbered wells restarted	N/A

Table D-2. Chronology of Configuration 4 Activities in 2007 (continued)

Date	River Flow (daily mean cfs)	Activity	Samples Collected
Oct 10, 2007	4,710	Even-numbered wells shut down to control pond level	N/A
Oct 17, 2007	4,630	All wells shut down	N/A
Oct 17, 23, 2007	4,630, 4,780	Monthly Sampling	3 remediation wells (0771, 0775, 0777), 6 observation wells (0786, 0787, 0780, 0781, 0782), 3 well points (0790-0792), 1 surface water location (0274)
Oct 20, 2007	4,800	Restarted system with exception of 773 and 779	N/A
Oct 25, 2007	4,670	Shut down for 2007 season	N/A
Nov 7, 26, 27, 2007	4,040, 3,480, 3,460	Quarterly Sampling	8 observation wells (0780-0787), 5 well points (0790-0793, 0795), 1 surface water location (0274)
Dec 4, 2007	4,070	Monthly Sampling	3 observation wells (0771, 0775, 0777)

Table D-3. Monthly Average Pumping Rates and Extraction Volumes at Configuration 4 Wells in 2007

Month	Well 0770		Well 0771		Well 0772		Well 0773		Well 0774	
	Vol (gal)	Q (gpm)	Vol (gal)	Q (gpm)	Vol (gal)	Q (gpm)	Vol (gal)	Q (gpm)	Vol (gal)	Q (gpm)
Mar 2007	40,166	3.73	33,112	3.08	31,330	2.85	30,370	2.82	45,320	4.19
Apr 2007	91,519	1.90	161,750	3.13	95,369	1.81	432,999	8.22	213,437	4.16
May 2007	43,394	1.28	168,301	3.64	113,413	2.46	599,549	12.98	214,077	4.64
June 2007	31,916	1.39	150,621	3.72	101,693	2.49	522,229	12.96	187,461	4.65
July 2007	418,069	7.13	482,302	8.28	107,063	2.12	672,454	12.90	226,197	4.39
Aug 2007	295,869	6.63	625,020	11.10	44,700	1.25	627,690	10.67	91,013	2.61
Sept 2007	0	0.00	30,644	2.11	9,949	1.16	45,102	3.22	12,537	1.46
Oct 2007	83,736	2.20	130,520	3.34	88,748	2.34	4	0.00	84,420	2.16
Annual Avg / Total	**1,004,669**	**3.03**	**1,782,270**	**4.80**	**592,265**	**2.06**	**2,930,397**	**7.97**	**1,074,462**	**3.53**

Month	Well 0775		Well 0776		Well 0777		Well 0778		Well 0779	
	Vol (gal)	Q (gpm)	Vol (gal)	Q (gpm)	Vol (gal)	Q (gpm)	Vol (gal)	Q (gpm)	Vol (gal)	Q (gpm)
Mar 2007	33,449	3.15	13,802	1.32	172	0.02	8,958	0.94	33,917	3.69
Apr 2007	185,838	3.63	132,517	2.56	2,007	0.04	72,651	0.96	102,328	2.00
May 2007	178,688	3.87	77,843	1.70	13,168	0.26	122,348	2.67	128,290	2.74
June 2007	156,204	3.85	184,237	3.77	181,819	3.84	70,651	1.73	71,937	1.78
July 2007	176,914	3.47	172,952	3.38	314,800	5.66	83,871	1.62	95,015	1.81
Aug 2007	255,823	3.53	72,000	2.07	398,103	5.68	48,678	1.38	139,185	2.03
Sept 2007	59,356	4.03	16,500	1.92	79,687	5.23	7,835	0.91	1,695	0.08
Oct 2007	86,072	1.83	49,059	1.37	106,870	2.75	91,491	2.54	5,317	0.26
Annual Avg / Total	**1,132,344**	**3.42**	**718,910**	**2.26**	**1,096,626**	**2.93**	**506,483**	**1.59**	**577,684**	**1.80**

Notes: Q = pumping rate; gpm = gallons per minute; Vol = volume; gal = gallons

Table D-4. Estimated Ammonia Mass Withdrawals at Configuration 4 Extraction Wells During 2007

Month	Well 0770[a]		Well 0771[b]		Well 0772[a]		Well 0773[b]		Well 0774[a]	
	NH_3-N Conc (mg/L)	Mass Removed (kg)	NH_3-N Conc (mg/L)	Mass Removed (kg)	NH_3-N Conc (mg/L)	Mass Removed (kg)	NH_3-N Conc (mg/L)	Mass Removed (kg)	NH_3-N Conc (mg/L)	Mass Removed (kg)
Mar 2007	680	103	270	34	280	33	530	61	700	120
Apr 2007	890	308	765	468	640	231	720	1178	800	645
May 2007	320	52	300	191	180	77	260	589	270	218
June 2007	230	28	180	102	130	50	185	365	240	170
July 2007	350	553	270	492	190	77	290	737	390	333
Aug 2007	260	291	230	543	91	15	280	664	320	110
Sept 2007	370	0	380	44	360	14	340	58	500	24
Oct 2007	400	127	410	202	360	121	340	0	615	196
Total		**1,462**		**2,077**		**618**		**3,653**		**1,817**

Month	Well 0775[b]		Well 0776[a]		Well 0777[b]		Well 0778[a]		Well 0779[b]	
	NH_3-N Conc (mg/L)	Mass Removed (kg)	NH_3-N Conc (mg/L)	Mass Removed (kg)	NH_3-N Conc (mg/L)	Mass Removed (kg)	NH_3-N Conc (mg/L)	Mass Removed (kg)	NH_3-N Conc (mg/L)	Mass Removed (kg)
Mar 2007	940	119	1900	99	650	0	1400	47	1700	218
Apr 2007	800	562	800	401	450	3	890	244	850	329
May 2007	440	297	350	103	320	16	480	222	580	281
June 2007	265	156	290	202	285	196	280	75	270	73
July 2007	445	298	500	327	490	583	480	152	470	169
Aug 2007	600	580	460	125	420	632	430	79	820	431
Sept 2007	660	148	575	36	490	148	640	19	790	5
Oct 2007	890	290	690	128	490	198	640	221	790	16
Total		**2,450**		**1,421**		**1,776**		**1,060**		**1,523**

Notes: [a]Used average concentrations for September due to the sampling schedule.
[b]Used average concentrations for April, June, and July due to the sampling schedule.

Table D-5. Estimated Uranium Mass Withdrawals at Configuration 4 Extraction Wells During 2007

Month	Well 0770[a]		Well 0771[b]		Well 0772[a]		Well 0773[b]		Well 0774[a]	
	U Conc (mg/L)	Mass Removed (kg)	U Conc (mg/L)	Mass Removed (kg)	U Conc (mg/L)	Mass Removed (kg)	U Conc (mg/L)	Mass Removed (kg)	U Conc (mg/L)	Mass Removed (kg)
Mar 2007	1.4	0.2	0.6	0.1	0.8	0.1	1.0	0.1	0.9	0.1
Apr 2007	2.2	0.8	2.2	1.3	2.2	0.8	2.4	3.8	2.5	2.0
May 2007	1.1	0.2	1.1	0.7	0.8	0.3	1.2	2.7	1.3	1.1
June 2007	0.9	0.1	0.8	0.5	0.8	0.3	1.2	2.3	1.6	1.1
July 2007	1.2	1.9	1.3	2.4	1.4	0.6	1.9	4.8	2.4	2.1
Aug 2007	1.0	1.1	0.9	2.0	0.9	0.1	1.3	3.1	1.7	0.6
Sept 2007	1.0	0.0	1.2	0.1	1.5	0.1	1.8	0.3	2.3	0.1
Oct 2007	4.0	1.3	0.4	0.2	0.4	0.1	0.4	0.0	0.5	0.2
Total		**5.5**		**7.3**		**2.4**		**17.2**		**7.3**

Month	Well 0775[b]		Well 0776[a]		Well 0777[b]		Well 0778[a]		Well 0779[b]	
	U Conc (mg/L)	Mass Removed (kg)	U Conc (mg/L)	Mass Removed (kg)	U Conc (mg/L)	Mass Removed (kg)	U Conc (mg/L)	Mass Removed (kg)	U Conc (mg/L)	Mass Removed (kg)
Mar 2007	1.1	0.1	1.5	0.1	0.9	0.0	2.0	0.1	1.4	0.2
Apr 2007	2.0	1.4	2.0	1.0	2.0	0.0	2.2	0.6	2.0	0.8
May 2007	2.2	1.5	0.8	0.2	1.1	0.1	1.2	0.6	1.2	0.6
June 2007	1.2	0.7	0.7	0.5	0.8	0.6	1.0	0.3	9.0	2.4
July 2007	2.0	1.3	1.5	1.0	1.6	1.8	1.6	0.5	1.1	0.4
Aug 2007	2.5	2.4	1.0	0.3	1.1	1.7	1.2	0.2	1.0	0.5
Sept 2007	2.7	0.6	2.0	0.1	1.3	0.4	1.3	0.0	1.2	0.0
Oct 2007	0.9	0.3	0.7	0.1	0.5	0.2	0.5	0.2	0.5	0.0
Total		**8.3**		**3.3**		**4.7**		**2.4**		**4.9**

Notes: [a]Used average concentrations for September due to the sampling schedule.
[b]Used average concentrations for April, June, and July due to the sampling schedule.

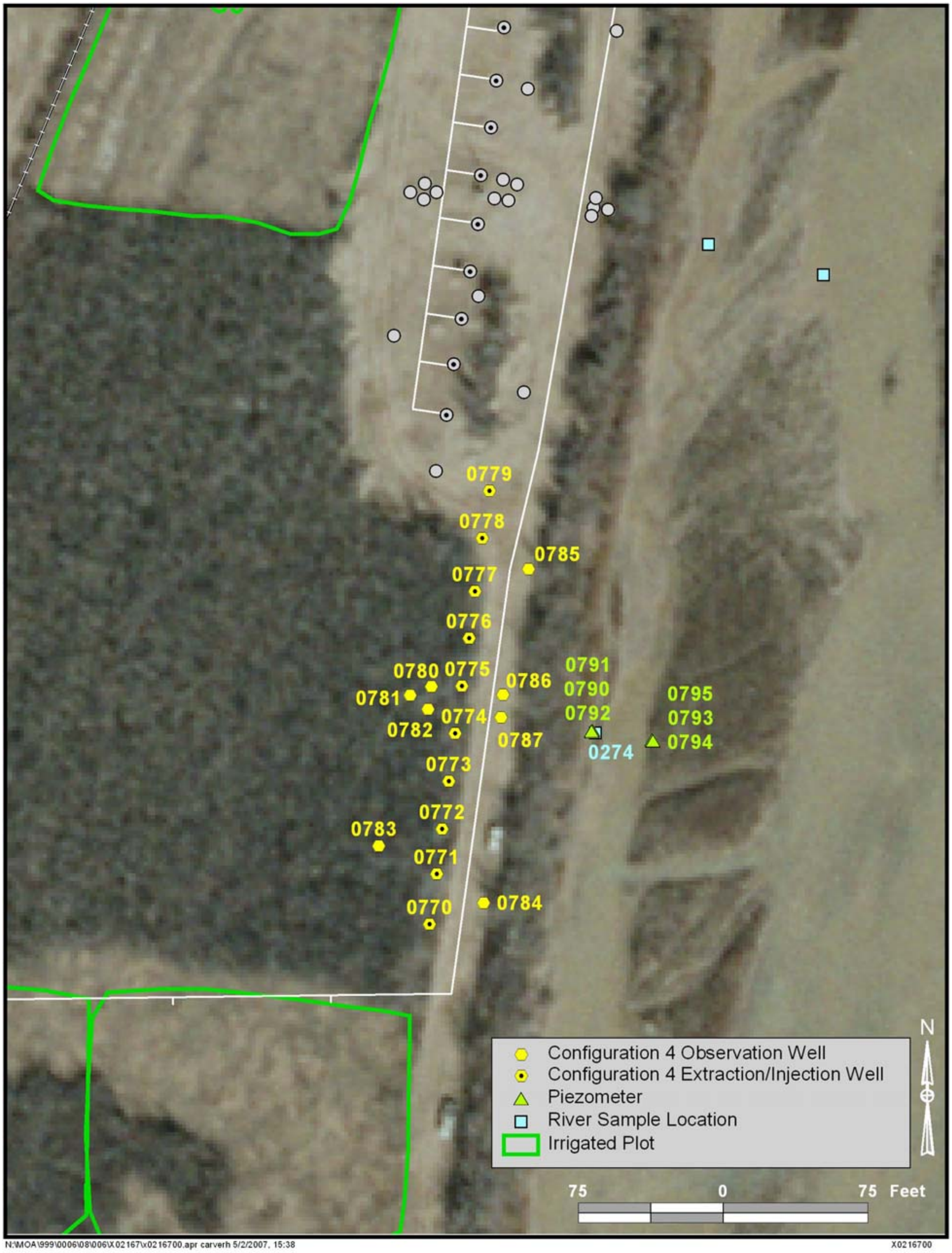
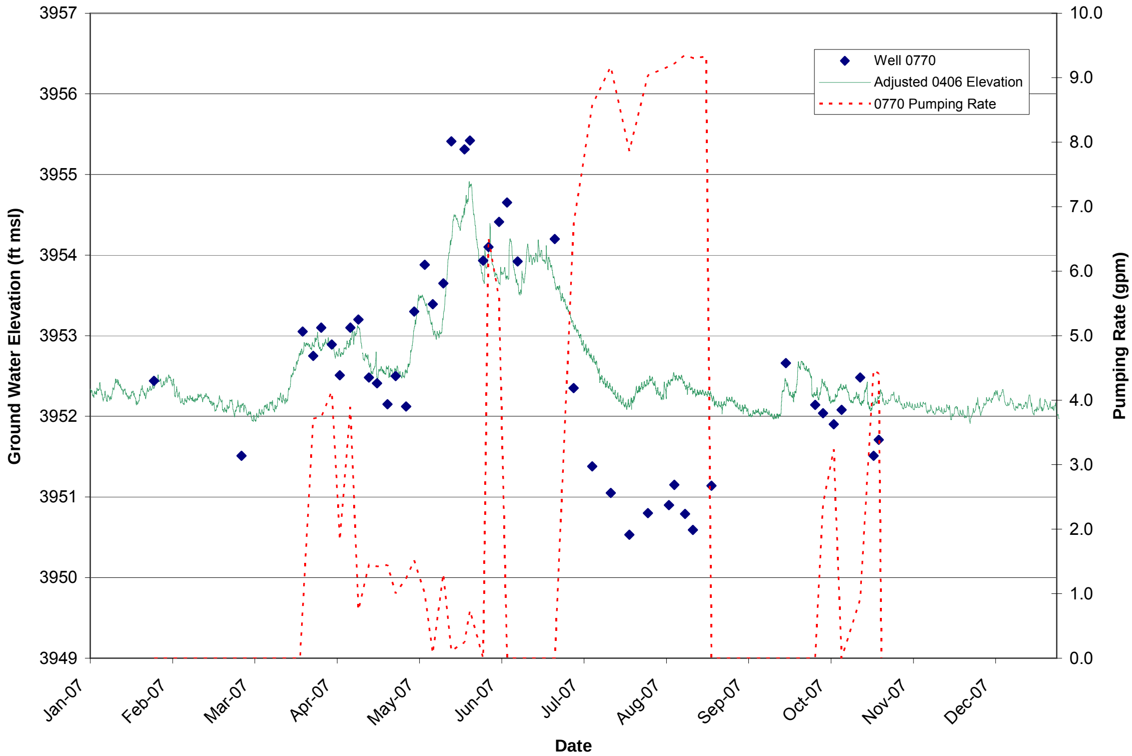


Figure D-1. Map View of Configuration 4 Wells and Sampling Locations



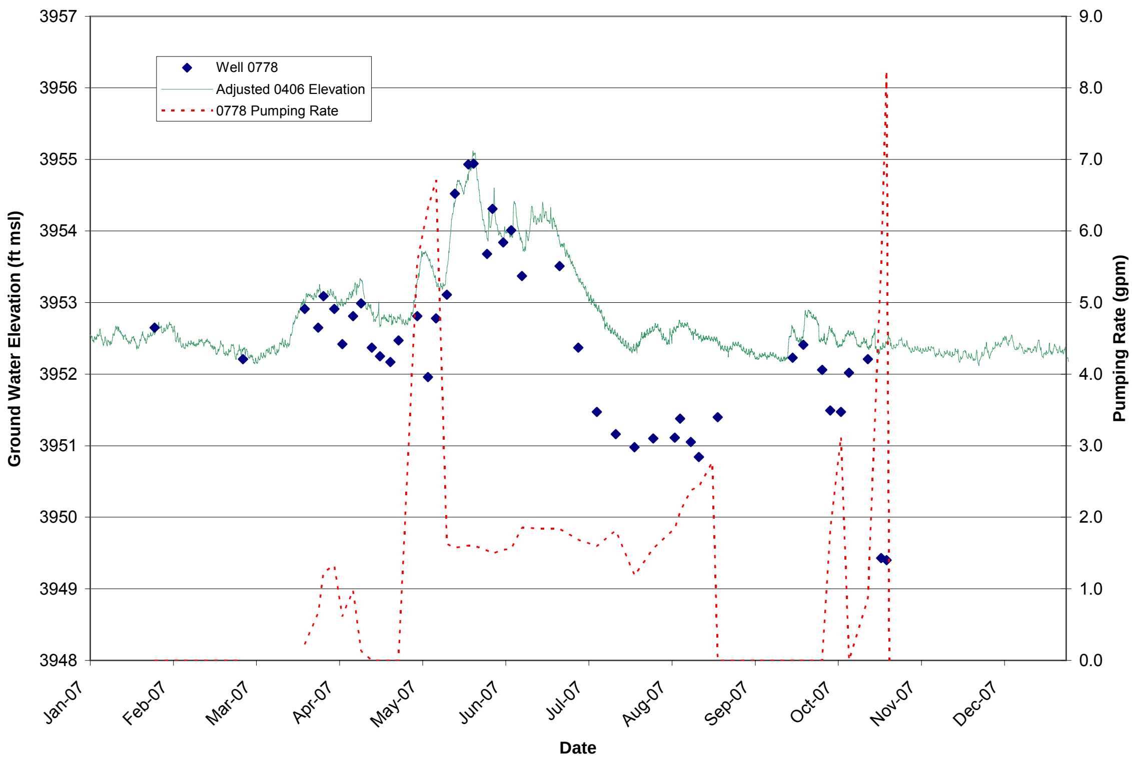
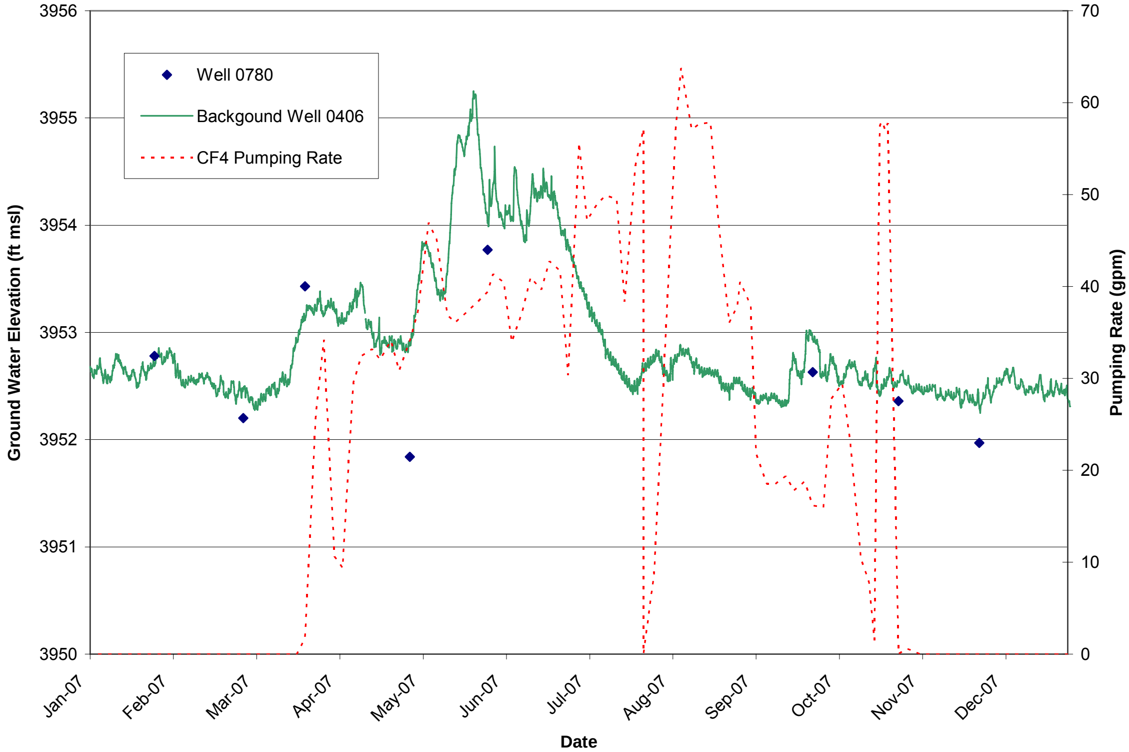


Figure D-2. Ground Water Elevations at Configuration 4 Extraction Wells 0770 and 0778 and Background Well 0406 During 2007



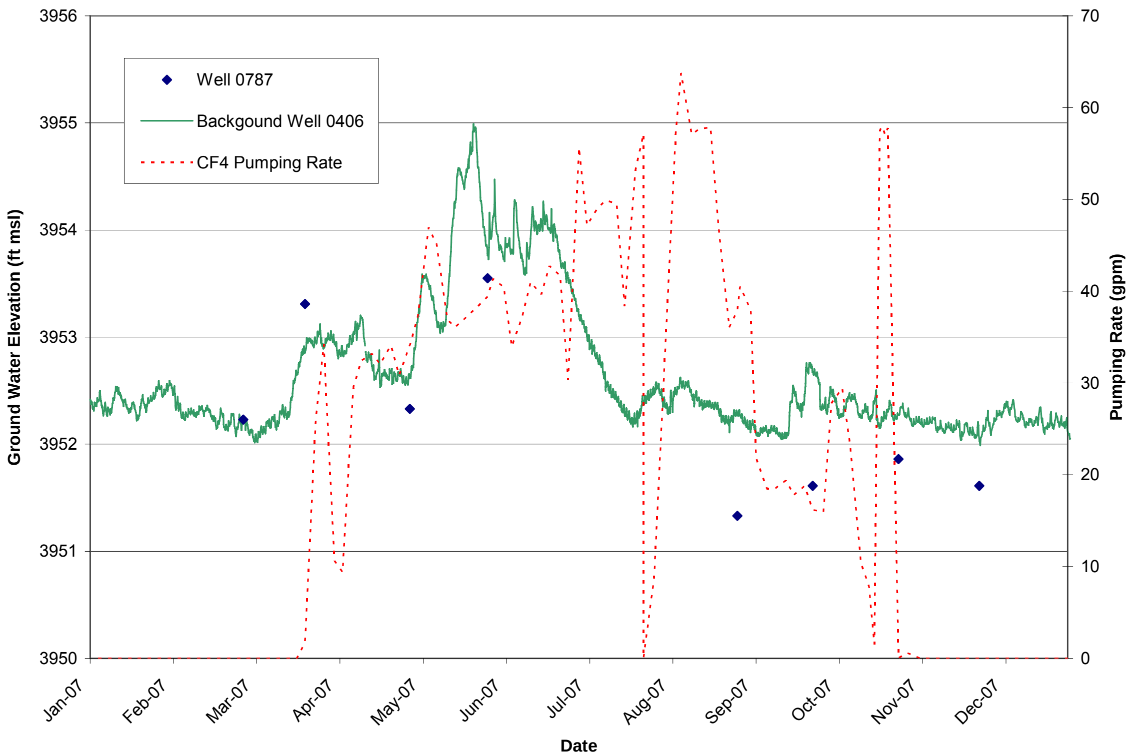


Figure D-3. Ground Water Elevations at Configuration 4 Observation Wells 0780 and 787 and Background Well 0406 During 2007

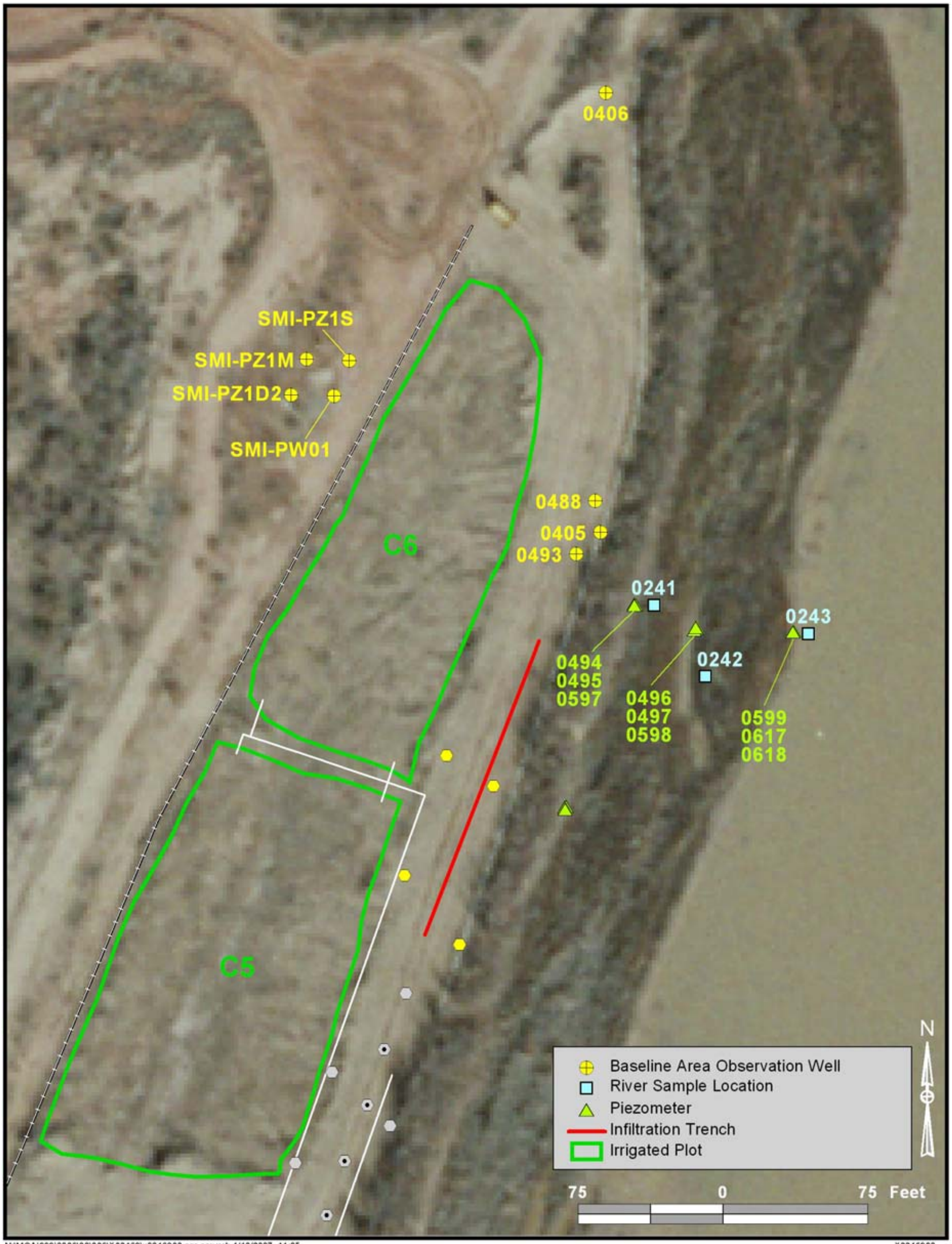
Appendix E Figures and Tables

Table E-1. Summary of Well and Well Point Construction in the Baseline Area

Well	Well Type/Relative Depth	Diameter (inches)	Ground Surface Elevation (ft above msl)	Screen Interval (ft bgs)	Total Depth (ft bgs)
0405	Observation / Shallow	1	3,966.40	15.1 - 20.0	20.3
0406	Observation / Shallow	1	3,967.90	13.1 – 18.0	18.3
0488	Observation / Intermediate	6	3,966.82	25.0 - 40.0	40.3
0493	Observation / Deep	6	3,966.08	45.0 - 55.0	55.3
SMI-PW01	Observation / Deep	4	3,966.40	20.1 – 60.1	60.2
SMI-PZ1S	Observation / Shallow	2	3,966.70	13.9 – 18.9	19.1
SMI-PZ1M	Observation / Intermediate	2	3,966.30	55.5 – 60.5	60.8
SMI-PZ1D2	Observation / Deep	2	3,966.40	69.8 – 74.8	75.0
0494	Well Point / Shallow	1	3,957.41	2.4 – 3.4	3.4
0495	Well Point / Intermediate	1	3,957.41	4.6 – 5.6	5.6
0597	Well Point / Deep	1	3,957.41	9.3 – 10.3	10.3
0496	Well Point / Shallow	1	3,955.62	2.2 – 3.2	3.2
0497	Well Point / Intermediate	1	3,955.62	4.0 – 4.9	4.9
0598	Well Point / Deep	1	3,955.62	9.1 – 10.1	10.1
0617	Well Point / Shallow	1	3,954.24	1.7 – 2.7	2.7
0618	Well Point / Intermediate	1	3,954.24	5.3 – 6.3	6.3
0599	Well Point / Deep	1	3,954.24	9.4 – 10.4	10.4

Table E-2. Chronology of Baseline Area Activities in 2007

Date	River Flow (daily mean cfs)	Activity	Samples Collected
Jan 11, 2007	4,020	Monthly Sampling	3 observation wells (0405, 0488, 0493), 3 well points (0496, 0598), 1 surface water location (0243)
Feb 8, 2007	3,590	Biogeochemical Sampling	7 well points (0495, 0496, 0597, 0598, 0599, 0617, 0618), 1 surface water location (0243)
Feb 21-22, 2007	3,230 to 3,160	Quarterly Sampling	7 observation wells (0405, 0488, 0493, SMI-PZ1M, SMI-PZ1D, SMI-PZ1S, SMI-PW01)
March 13, 16, 2007	3,510, 5,220	Monthly Sampling	3 observation wells (0405, 0488, 0493), 2 well points (0496, 0598), 1 surface water location (0243)
April 2, 10, 2007	6,030, 7,950	Monthly Sampling	3 observation wells (0405, 0488, 0493), 2 well points (0496, 0598), 1 surface water location (0243)
May 1, 3, 2007	7,280, 9,840	Biogeochemical Sampling	8 well points (0495, 0496, 0497, 0597, 0598, 0599, 0617, 0618), 1 surface water location (0243)
May 17, 22, 2007	14,900, 13,700	Quarterly Sampling	7 observation wells (0405, 0488, 0493, SMI-PZ1M, SMI-PZ1D, SMI-PZ1S, SMI-PW01)
June 4, 11, 2007	9,570, 7,990	Monthly Sampling	3 observation wells (0405, 0488, 0493), 3 well points (0496, 0497, 0598), 1 surface water location (0243)
July 9-10, 2007	4,210 to 4,070	Monthly Sampling	2 observation wells (0405, 0488), 2 well points (0496, 0598), 1 surface water location (0243)
Aug 23-24, 2007	3,150 to 3,000	Quarterly Sampling	7 observation wells (0405, 0488, 0493, SMI-PZ1M, SMI-PZ1D, SMI-PZ1S, SMI-PW01), 7 well points (0495, 0496, 0597, 0598, 0617, 0618, 0619), 1 surface water location (0243)
Sept 25-26, 2007	7,330 to 6,210	Monthly Sampling	3 observation wells (0405, 0488, 0493), 2 well points (0496, 0598), one surface water location (0243)
Oct 15, 25, 2007	4,340, 4.670	Monthly Sampling	3 observation wells (0405, 0488, 0493), 2 well points (0496, 0598), 1 surface water location (0243)
Oct 30, Nov 11, 2007	4,660, 3,990	Quarterly Sampling	7 observation wells (0405, 0488, 0493, SMI-PZ1M, SMI-PZ1D, SMI-PZ1S, SMI-PW01), 7 well points (0495, 0496, 0597, 0598, 0617, 0618, 0619), 1 surface water location (0243)
Dec 5, 2007	3,780	Monthly Sampling	3 observation wells (0405, 0488, 0493)



N:\MOA\999\0006\08\006\X02169\x0216900.apr carverh 4/10/2007, 14:05 X0216900

Figure E-1. Map View of Baseline Area Wells and Sampling Locations

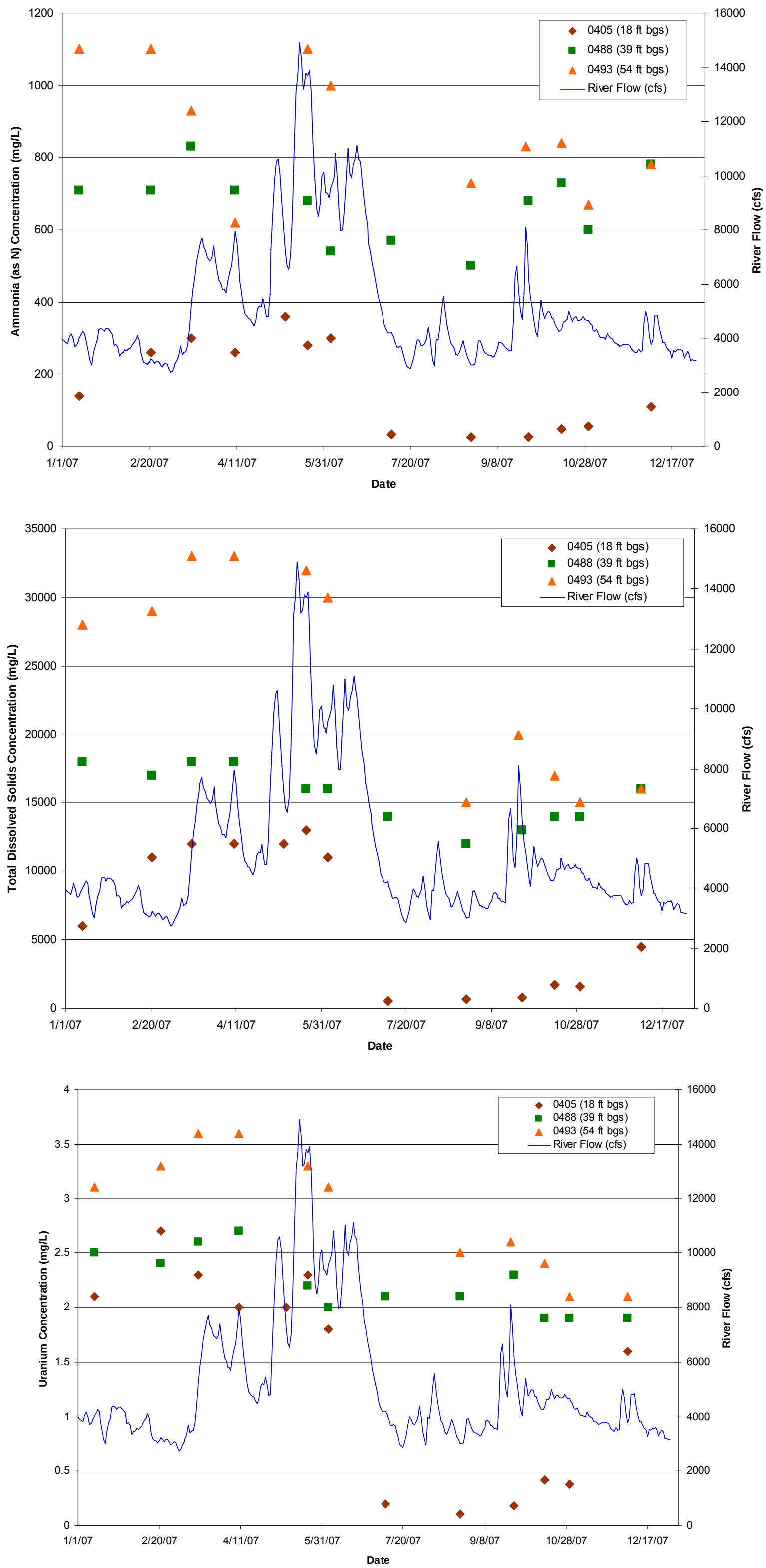


Figure E-2. Chemical Hydrographs for Observation Wells 0405, 0488, and 0493

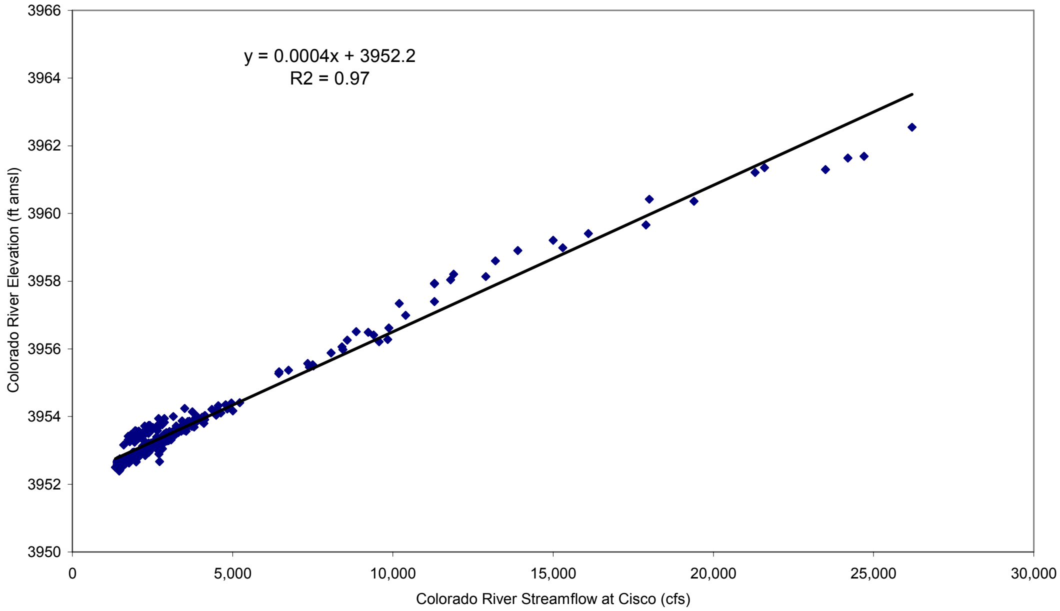


Figure E-3 Linear Regression of River Flow to Surface Water Stage in the Colorado River at the Moab Site (From DOE 2003d)

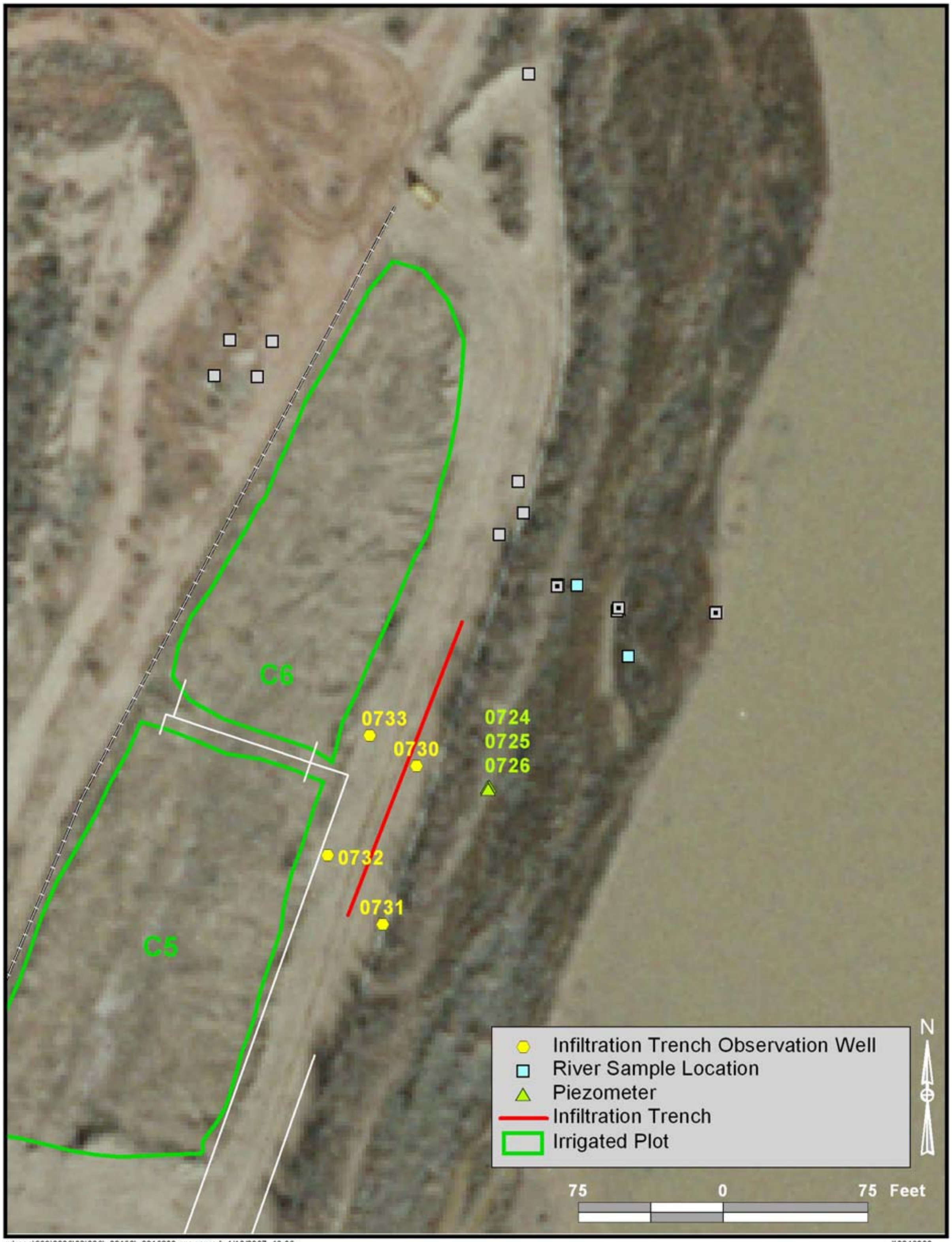
Appendix F Figures and Tables

Table F-1. Summary of the Infiltration Trench Well and Well Point Construction

Well	Well Type/Relative Depth	Distance from trench (ft)	Ground Surface Elevation (ft above msl)	Screen Interval (ft above msl)
0730	Observation / Shallow	< 5	3965.90	3957.3 - 3947.3
0731	Observation / Shallow	10	3966.95	3957.1 - 3956.55
0732	Observation / Shallow	10	3967.02	3957.42 - 3956.42
0733	Observation / Shallow	10	3966.31	3945.81 - 3936.01
0724	Well Point / Shallow	~ 50	3957.50	3955.1 - 3954.1
0725	Well Point / Intermediate	~ 50	3957.50	3952.9 - 3951.9
0726	Well Point / Deep	~ 50	3957.50	3948 - 3947

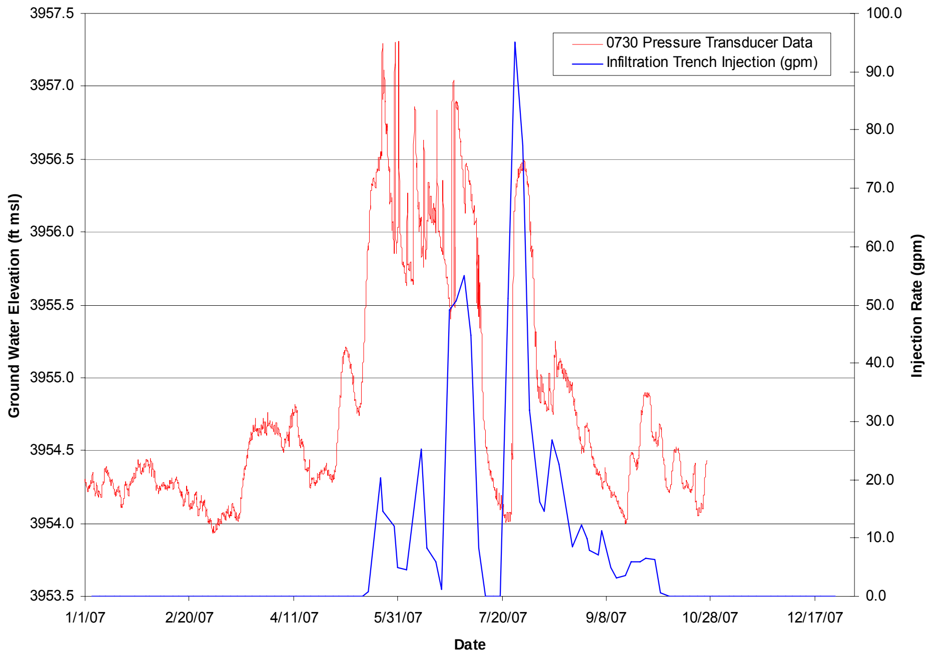
Table F-2. Chronology of Infiltration Trench Activities in 2007

Date	River Flow (daily mean cfs)	Activity	Samples Collected/Comments
Jan, 11, 2007	4,020	Monthly Sampling	1 well point (0724)
Feb 8-9, 2007	3,590 to 3,640	Biogeochemical Sampling	2 well points (0725, 0726)
April 2, 2007	6,030	Monthly Sampling	2 well points (0725, 0726)
May 2, 2007	8,570	Biogeochemical Sampling	2 well points (0725, 0726)
May 22-23, 2007	13,700 to 13,900	Quarterly Sampling	4 observation wells (0730-0733)
May 23, 2007	13,900	System start-up at	Injection Trench started at 0930
June 4, 11, 2007	9,570, 7,990	Monthly Sampling	4 observation wells (0730-0733), 3 well points (0724-0726)
July 10, 2007	4,070	Monthly Sampling	3 well points (0724-0726)
July 12-19, 2007		System shut down for repairs	Valve replaced
Aug 23-24, 27, 2007	3,150 to 3,000, 3,360	Quarterly Sampling	4 observation wells (0730-0733), 3 well points (0724-0726)
Sept 18, 24, 2007	6,310, 8,100	Monthly Sampling	4 observation wells (0730-0733), 2 well points (0725, 0726)
September 27-October 4, 2007	4,220-5,540	System shut-down for repairs	Repaired a leak in the freshwater line off of CF3
October 4, 2007	4,990	System shut-down for winter	N/A
Oct 15, 25, 2007	4,340, 4,670	Monthly Sampling	4 observation wells (0730-0733), 3 well points (0724-0726)
Oct 30, Nov 13, 2007	4,660, 3,960	Quarterly Sampling	4 observation wells (0730-0733), 2 well points (0725, 0726)



n:\moa\999\0006\08\006\x02168\x0216800.apr carverh 4/10/2007, 13:36 X0216800

Figure F-1. Map View of Infiltration Trench and Sampling Locations



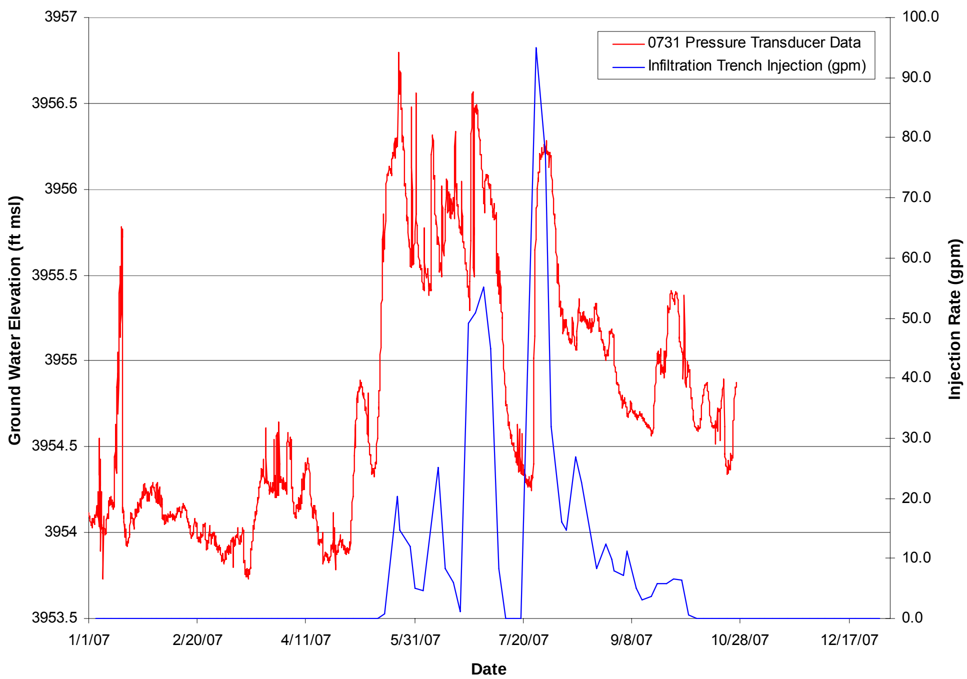
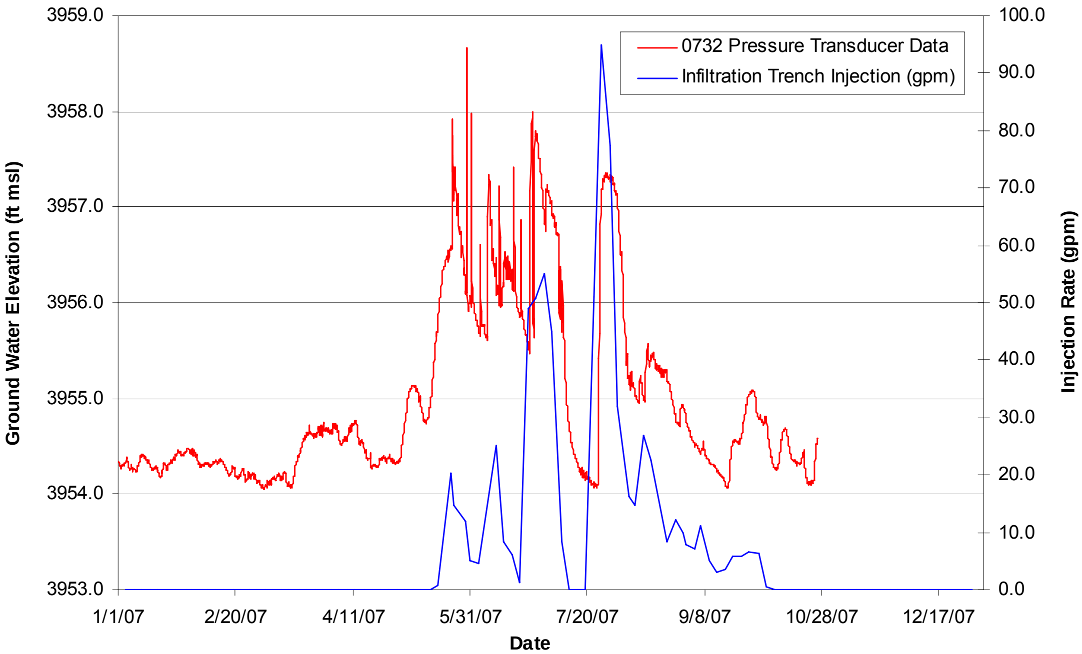


Figure F-2 Groundwater Elevation Determined From Pressure Transducers and Hand-measured Data of Wells 0730, 0731, 0732, and 0733 (continued on the next page) Versus the Infiltration Trench Injection Rate.



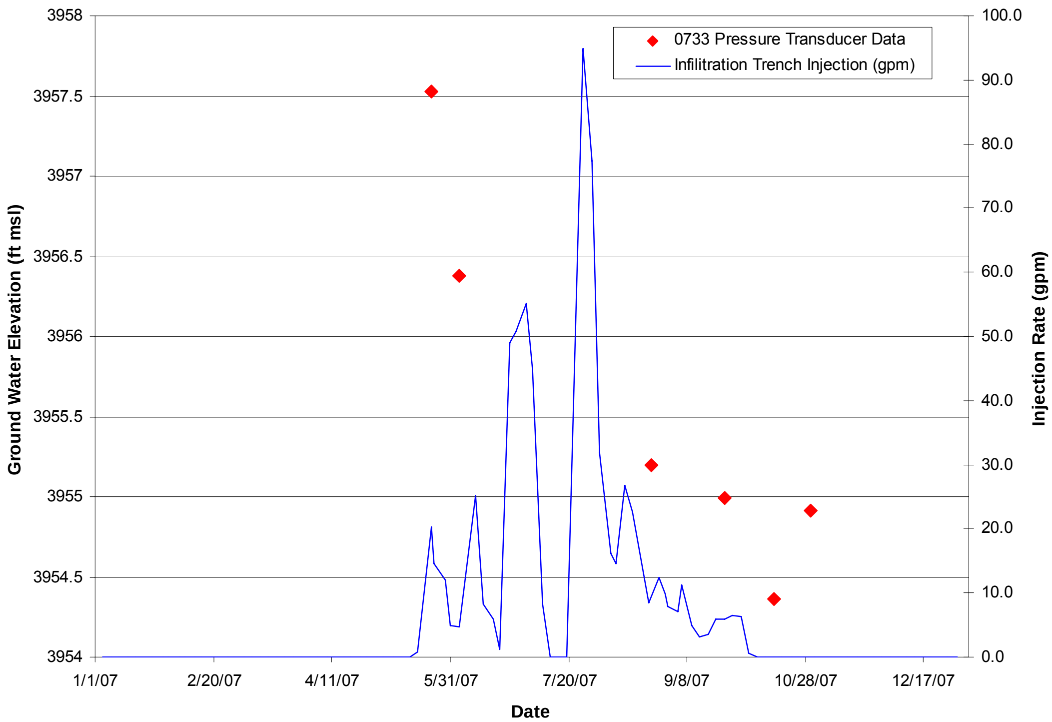
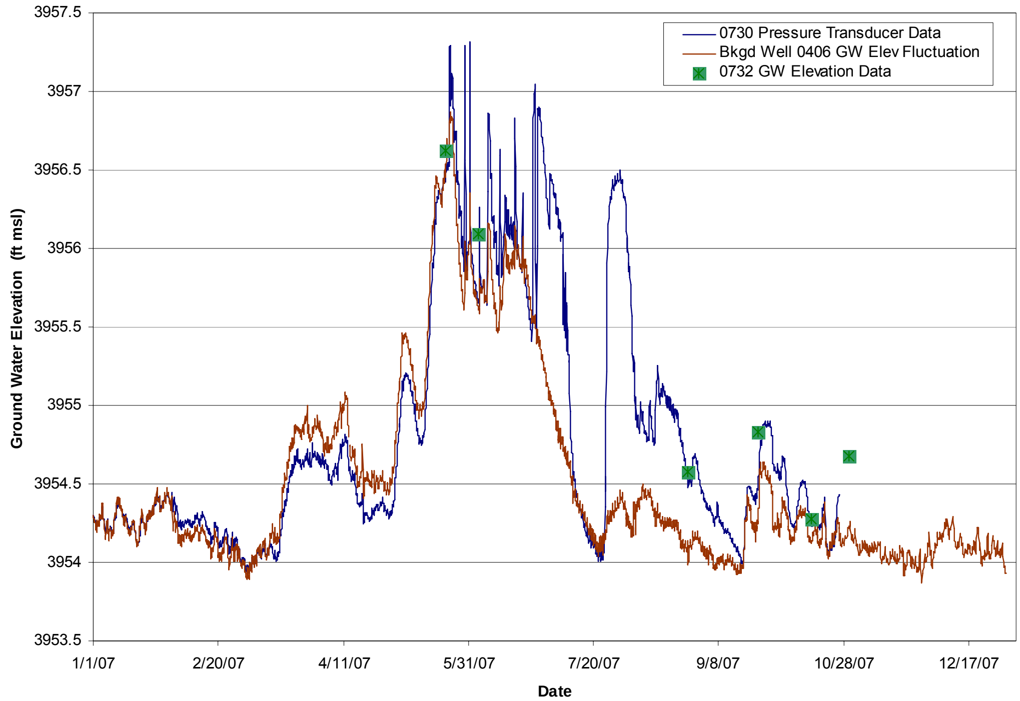


Figure F-2. Groundwater Elevation Determined From Pressure Transducers and Hand-measured Data of Wells 0730, 0731, 0732, and 0733 (continued from previous page) Versus the Infiltration Trench Injection Rate.



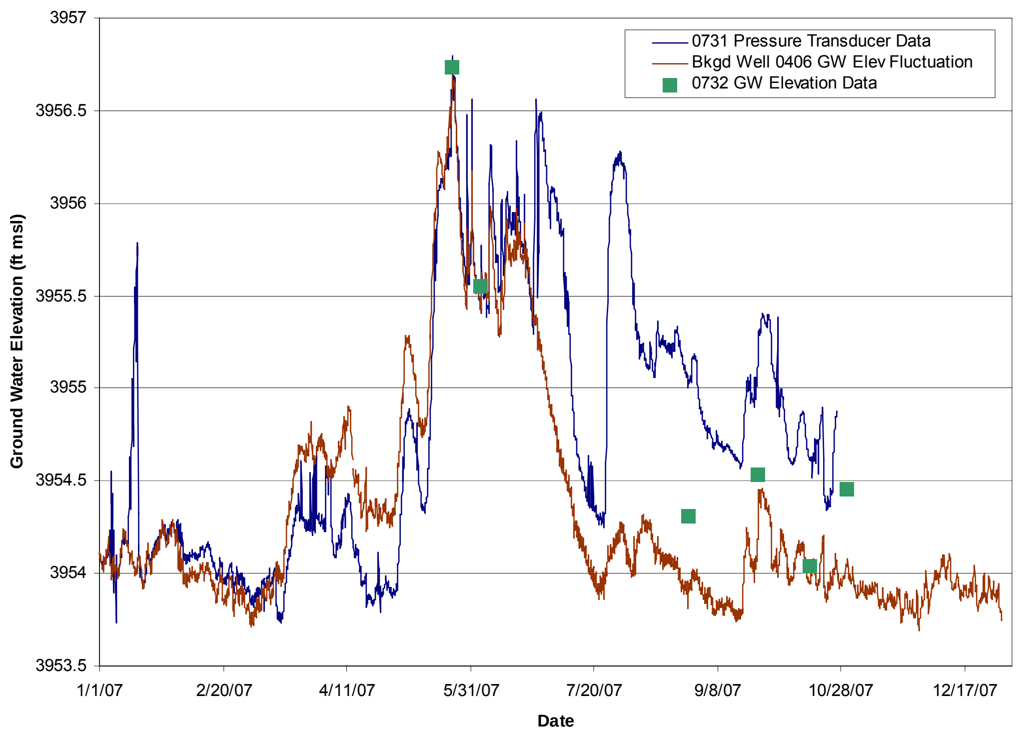
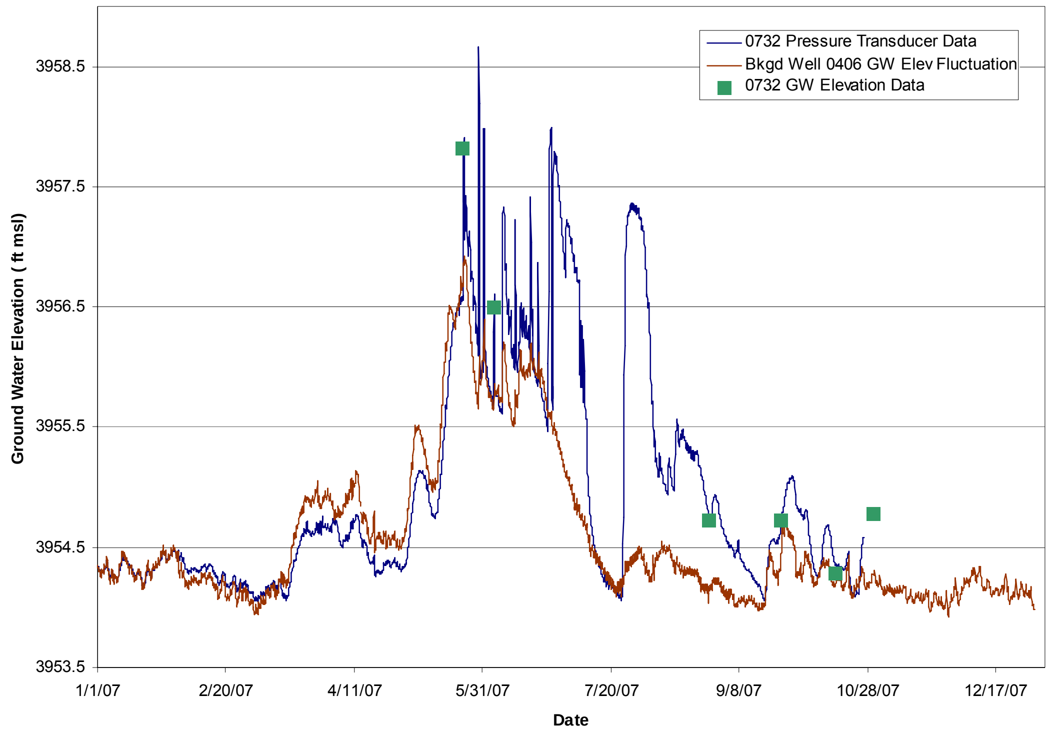
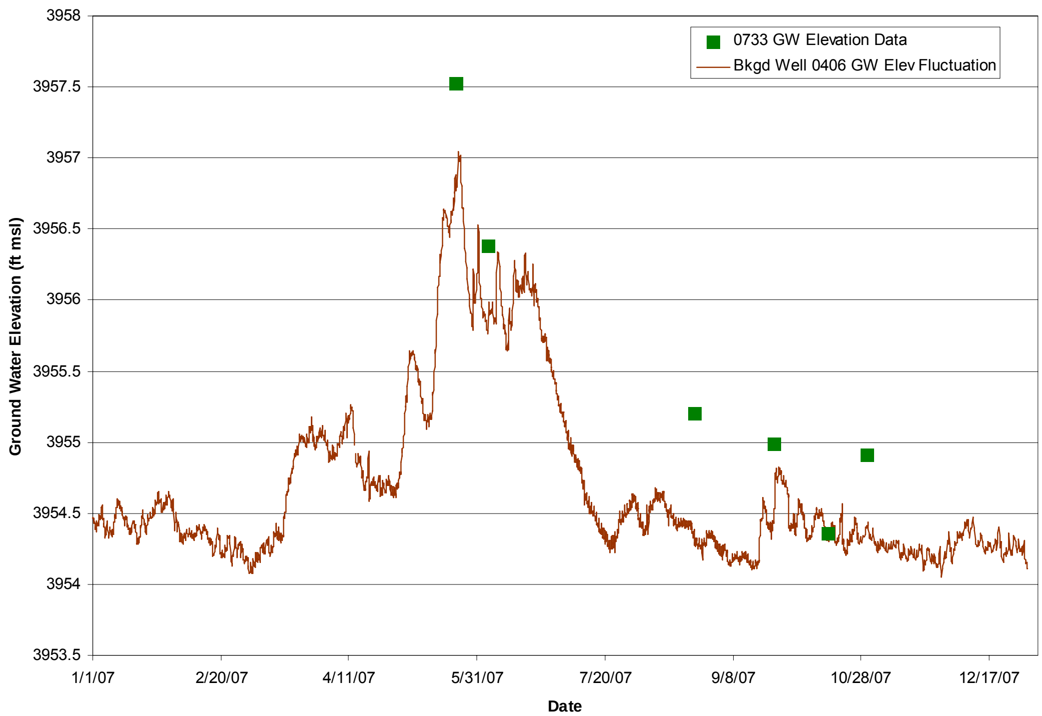


Figure F-3. Ground Water Elevations at Wells 0730, 0731, 0732, 0733 (continued on next page) Versus the Ground Water Elevation of Baseline Area Well 0406.





F-3. Ground Water Elevations at Wells 0730, 0731, 0732, 0733 (continued from previous page) Versus the Ground Water Elevation of Baseline Area Well 0406.

Figure F-4 Chemical Hydrographs for Ammonia, TDS, and Uranium for Infiltration Trench Observation Wells 0730, 0731, 0732, 0733

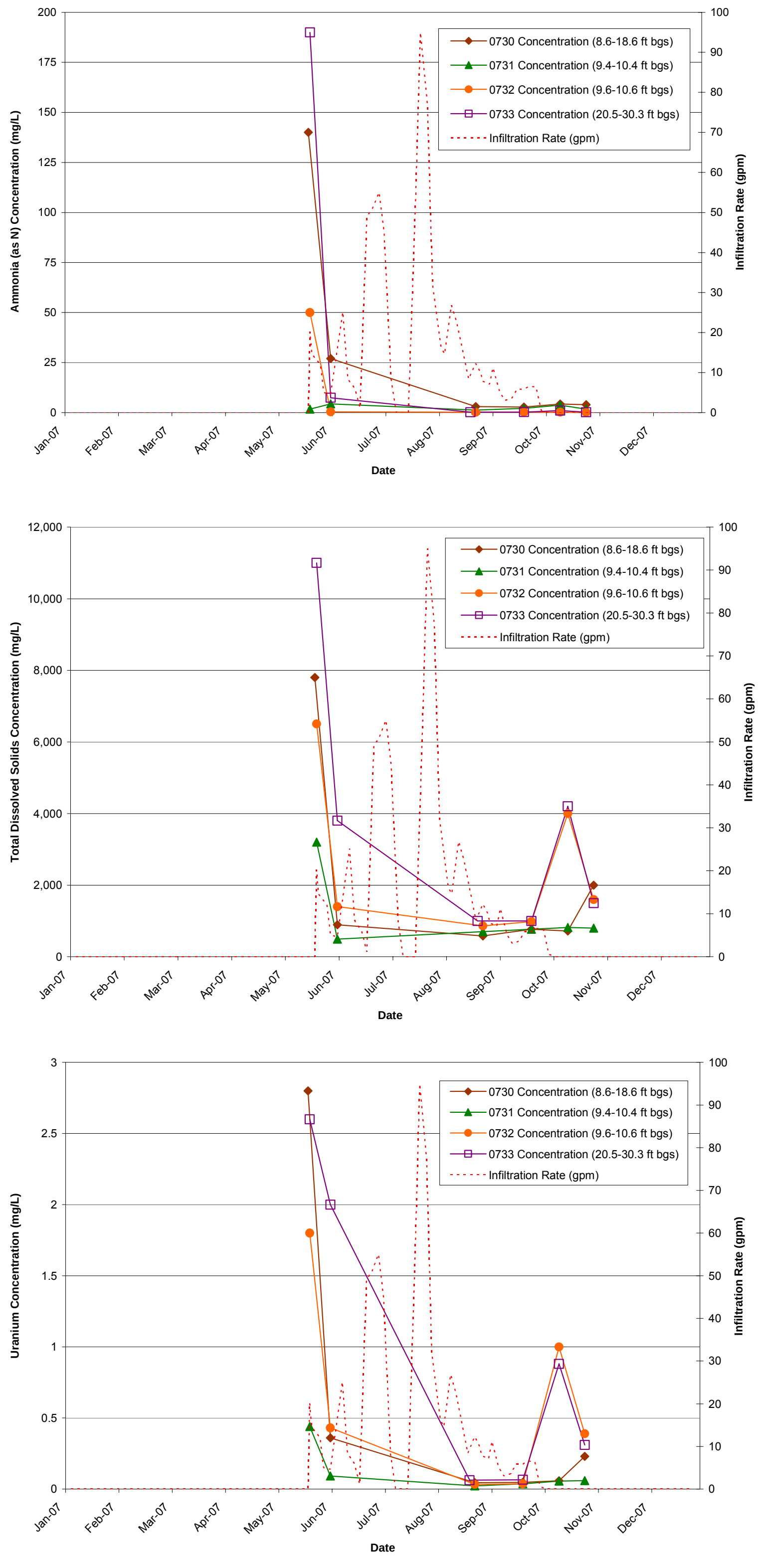


Figure F-5 Chemical Hydrographs for Ammonia, TDS, and Uranium for Infiltration Trench Well Points 0730, 0731, 0732, 0733.

Appendix G Figures and Tables

Table G-1. Important Dates, Evaporation Pond Levels, and Activities Associated with the Interim Action Treatment System During 2007

Date	Pond Level (ft)	Activity
January 1, 2007	8.2	Start of 2007
February 22, 2007	8.0	Started trouble shooting sprinkler system
March 12, 2007	6.9	Sprinkler system fully operational
March 13, 2007	6.9	CF3 even-numbered wells ground water extraction started
March 22, 2007	5.9	CF3 odd-numbered wells, CF4, and CF1 started extracting ground water.
April 11, 2007	6.0	Started ground water extraction form PW02
April 12, 2007	6.0	CF2 ground water extraction started
April 16, 2007	6.1	Started site irrigation for 2007
May 24, 2007	7.3	Started fresh water injection at the Infiltration Trench for 2007
August 7, 2007	7.6	PW02 stopped operating for 2007
August 21, 2007	7.5	Shut down even-numbered wells in CF1, CF3, and CF4 to start lowering pond level
September 20, 2007	4.8	Restarted CF1 and CF3 even-numbered wells
October 2, 2007	4.6	CF4 even-numbered wells restarted, CF3 even numbered wells shut down
October 4, 2007	4.9	Adjusted all CF3 and CF4 operating wells to ~3 gpm, infiltration trench fresh water injection shut down for 2007
October 10, 2007	4.8	Shut down CF4 even-numbered wells
October 17, 2007	4.6	Shut down all CF2, CF3, and CF4 wells
October 20, 2007	4.0	CF3 and CF4 wells restarted
October 25, 2007	5.0	Shut down all CF3 and CF4 wells for 2007, last day of site irrigation
November 18, 2007	2.8	Last day of sprinkler system operation
December 20, 2007	4.4	CF1 wells temporarily shut down

CF1 = Configuration 1; CF2 = Configuration 2; CF3 = Configuration 3; CF4 = Configuration 4

Table G-2. Summary of Monthly Water Deliveries to the Evaporation Pond and the Sprinkler System for 2007

Month	Volume pumped to pond (gals)	Volume pumped to sprinkler system (gals)
Jan 2007	0	0
Feb 2007	0	343,980
Mar 2007	1,203,750	2,383,830
Apr 2007	4,279,885	3,212,482
May 2007	5,407,851	4,593,925
June 2007	4,423,322	4,308,326
July 2007	4,924,726	4,675,555
Aug 2007	4,361,609	5,648,616
Sept 2007	2,403,410	3,546,362
Oct 2007	2,937,669	2,444,210
Nov 2007	973,378	1,073,342
Dec 2007	334,092	0
Total	**31,249,692**	**32,230,628**

gals = gallons