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Office of Legacy Management

Annual Ground Water Report April 2006 through March 2007 Tuba City, Arizona, Disposal Site

August 2007

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Office of Legacy Management

Work Performed Under DOE Contract No. DE–AC01–02GJ79491
for the U.S. Department of Energy Office of Legacy Management.
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Work Performed by S.M. Stoller Corporation under DOE Contract No. DE–AC01–02GJ79491
for the U.S. Department of Energy, Grand Junction, Colorado

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1.0 Introduction

1.1 Background Information

This report evaluates the performance of the ground water remediation system at the U.S. Department of Energy (DOE) Legacy Management site near Tuba City, Arizona, for the period April 2006 through March 2007. The site is located in Coconino County, Arizona, within the Navajo Nation and near Hopi Reservation land (Figure 1). Locally, ground water in an underlying sandstone aquifer is contaminated by several inorganic constituents, including nitrate, uranium, and sulfate, the primary site contaminants, as a result of former uranium-ore milling at the site. Surface remedial actions, consisting of encapsulating all solid waste within an on-site engineered disposal cell, occurred between 1988 and 1990. A remnant plume of ground water contamination extends off site to the south and southeast from the former mill area. DOE constructed a pump-and-treat remediation system, operational by mid-2002, to remove the contaminants from the aquifer and thus restore ground water quality. The progress of water quality restoration is evaluated and reported annually.

1.2 Ground Water Remediation System

The ground water remediation system currently comprises 37 extraction wells completed within the contaminated region of the aquifer. The extracted water is conveyed in underground piping to an on-site facility (treatment plant) where it is mechanically distilled following ion exchange pretreatment. An engineered solar evaporation pond receives the waste liquid (brine), and an infiltration trench located upgradient of the contaminant plume returns the treated water (distillate) to the aquifer to promote contaminant flushing. Six injection wells (wells 1003 through 1008) originally intended to create a hydraulic barrier at the downgradient limit of contamination remain unused for that purpose. Of the 37 extraction wells, eight wells (wells 1126 through 1133) were installed in summer 2004 to expand the capture zone of the original 25 wells (wells 1101 through 1125, installed in 1999). Wells 935, 942, 936, and 938, used formerly for monitoring purposes only, were converted to extraction use in summer 2004. Numerous other ground water monitor wells used to track water quality and water level trends are situated within and surrounding the network of extraction wells. The locations of extraction and monitor wells and the primary features of the site are depicted in Figure 2.

1.3 Ground Water Compliance Strategy

The ground water compliance strategy for the Tuba City site, as defined in the *Phase I Ground Water Compliance Action Plan for the Tuba City, Arizona, UMTRA Site* (DOE 1999), is to achieve applicable cleanup levels through active remediation of those portions of the aquifer affected by previous site activities. Cleanup levels for the aquifer comprise restoration "standards" (requirements of Title 40 *Code of Federal Regulations* Part 192 [40 CFR 192], "Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings") and restoration "goals" (cleanup levels requested by the Navajo Nation but not required by 40 CFR 192).

Ground water contaminants requiring active remediation at the site are molybdenum, nitrate, selenium, sulfate, and uranium (DOE 1999). Restoration standards (see Table 1) for these constituents, except sulfate, correspond to a maximum concentration limit in ground water established in Table 1 to Subpart A of 40 CFR 192. Sulfate is not regulated by 40 CFR 192. However, a restoration standard was adopted for this constituent because it is present in ground water at the site at concentrations that cause excess potential risk (DOE 1999). The Navajo Nation also requested that the distillate not exceed 20 milligrams per liter (mg/L) of sodium.

Table 1. Ground Water Remediation Goals
(source: DOE 1999)

Constituent/Property	Cleanup Level	Baseline Concentrations in Plume
Nitrate[a]	10 mg/L as N (44 mg/L as NO_3^-)	840–1,500 mg/L
Molybdenum[a]	0.10 mg/L	0.01–0.58 mg/L
Selenium[a]	0.01 mg/L	0.01–0.10 mg/L
Uranium[a]	30 pCi/L (0.044 mg/L) U-234 + U-238	0.3–0.6 mg/L
Sulfate[a]	250 mg/L	1,700–3,500 mg/L
TDS[b]	500 mg/L	3,500–10,000 mg/L
Chloride[b]	250 mg/L	20–440 mg/L
pH[b]	6.5–8.5	6.3–7.6
Corrosivity[b]	not corrosive	not applicable

[a]Restoration standard
[b]Restoration goal
pCi/L = picocuries per liter

1.4 Performance Monitoring and Reporting

The effectiveness of the remediation system in removing contaminants from the aquifer and progressing toward cleanup levels is evaluated yearly on the basis of ground water monitoring conducted in August and February of each year. During these events, samples are collected at monitor wells for water quality analysis, and water levels are measured. The data are then compared to baseline conditions determined between 1998 and March 2002 (DOE 2003) to evaluate the capture zone of the extraction system, plume movement within the aquifer, and concentration trends. The extraction wells are sampled during the August events. The February events also exclude monitoring of several distal wells and lower terrace wells that have no history of contamination.

Other monitoring data are collected during the routine operation of the treatment system to evaluate the efficiency of the treatment process and to measure the extracted mass and volume of contamination. These data include (1) continuous flow metering of each extraction well, (2) continuous flow metering of the bulk influent and all outflow streams, (3) weekly determination of bulk inflow and distillate composition through composite sampling, and (4) approximately monthly analysis of ground water composition at each extraction well.

1.5 Hydrogeologic Setting

The Tuba City site lies on the middle of three alluvial terraces formed during ancestral flow in Moenkopi Wash, located about 1.25 miles southeast of the site. Thin (≤ 20 feet [ft]) surficial deposits of coarse, semi-indurated, Quaternary alluvium and loose dune sand and silt are underlain by the regionally extensive Navajo Sandstone, a massively cross-bedded, friable, fine to very fine sandstone and siltstone. Escarpments that separate the terraces are formed by cliffs of the Navajo Sandstone. The regional dip of the bedrock is about one degree to the northeast.

At about 200 ft below ground, the massive eolian dune deposits typifying "classic" Navajo Sandstone become interbedded with fine-grained alluvium more typical of the deeper Kayenta Formation. This "intertonguing interval" is 400 to 450 ft thick. Occasional thin (≤ 2 ft), resistant limestone beds, relicts of former playa lakes, are interspersed throughout both the classic and intertonguing intervals. The Kayenta Formation consists primarily of 100 ft or more of less resistant, fine-bedded, red silt and fine sand, lacking the characteristic cross-beds of the Navajo Sandstone.

Ground water beneath the Tuba City site occurs in the regionally extensive “N” multiple-aquifer (Cooley et al. 1969), which in the site area comprises the classic and intertonguing intervals of the Navajo Sandstone. Because of the fine-grained nature of the Kayenta Formation locally, it is not water bearing and so is excluded from the “N” aquifer. Ground water saturation occurs from the ambient water table, about 50 to 60 ft below ground surface on the upper and middle terraces, to the upper contact of the Kayenta Formation, accounting for a saturated thickness on the order of 500 ft. Ground water flow beneath the site is southeast to Moenkopi Wash. There, regional aquifer discharge is expressed as a laterally extensive (miles) spring zone near the exposed base of the intertonguing interval. Local discharge of ground water from higher in the formation occurs in some areas, as evidenced by scattered bands of desert phreatophytes typically near the base of the escarpment between the middle and lower terraces. One such area is noted in Figure 2 as the “greasewood area,” where the depth to water is only about 20 ft. Figure A−1 in Appendix A depicts a conceptual model of the site hydrogeology.

1.5.1 Vertical Discretization of the N-Aquifer

In the absence of laterally continuous marker beds in the Navajo Sandstone, for this project the subsurface is discretized into 50-ft intervals, or “horizons,” each with a letter designation. These designations are convenient in evaluating the site hydrogeology and depth of contamination. The top of the middle terrace, nominally 5,050 ft in elevation, marks the top of the uppermost horizon (Horizon A).

Horizons A, B, C, and possibly D span the interval of “classic” Navajo Sandstone beneath the site. The depths of Horizons E through J include the regions of the intertonguing interval. Horizons K, L, and M include the lower intertonguing interval and possibly the upper portion of the Kayenta Formation. Because of surface topography, the uppermost horizon on the lower terrace progresses from Horizon C to D, north to south. The steep topography at Moenkopi Wash intersects Horizons E through G. Because contamination of the aquifer is limited in depth, ground water remediation at the site focuses primarily on the upper 250 ft of the bedrock aquifer (Horizons A through E).

The stratigraphic relationships to aquifer horizon are shown in Figure A−1. In Figure 2, color-coding identifies the corresponding horizon in which the mid-point of the screen of each well is located for project extraction wells (round symbols) and monitor wells (square symbols). Well screen depth in relation to aquifer horizon and elevation for all project wells is shown schematically in Figure A−2 of Appendix A. Table A−1 includes additional well completion information such as screen length and elevations.

2.0 Treatment & Extraction Systems

2.1 Bulk Treatment Parameters

During the current review period of April 2006 through March 2007, the treatment plant operated for about 342 of 365 total days, for a net on-stream factor of 94 percent. Power failures and scheduled maintenance requiring plant shutdown accounted for most of the downtime. About 44 million gallons of water were treated during this period, resulting in an average operating rate of 89 gallons per minute (gpm) and an effective rate (downtime included) of 84 gpm. The operating capacity of the treatment plant is about 120 gpm. This rate is not attained because of limited formation yield to the extraction system. Total ground water treatment as of April 1, 2007, was approximately 224 million gallons, equivalent to about 19 percent of the total estimated volume of uranium-contaminated ground water prior to remedial action (see Section 4.0 for discussion of contaminant removal rates).

Figure 3 shows the feed rate to the treatment plant and the corresponding concentration of nitrate and sulfate determined from weekly composite samples since the start of remediation. This figure indicates relatively stable concentrations of these constituents entering the treatment system at typical inflows. As seen in Figure 4, uranium concentration in the bulk feed shows a slight downward trend over the same period (concentration trends are discussed in Section 4.0). The masses of nitrate, sulfate, and uranium extracted during the current review period, estimated from the weekly monitoring of bulk inflow to the treatment plant, are respectively, 145,720 pounds (lbs); 366,500 lbs; and 79.3 lbs (Table 2).

Table 2. Treatment System Performance Summary

Contaminant	Typical Feed Concentration (mg/L)	Typical Distillate Concentration (mg/L)	Mass Removed During Review Period (lbs)
Nitrate (as NO_3)	350	7	147,720
Sulfate	1,000	20	366,500
Uranium	0.24	0.0035	79.3

2.2 Distillate Quality

Concentrations of nitrate, sulfate, and uranium in the distillate averaged about 7, 20, and 0.0035 mg/L, respectively, during the review period (Table 2 and Figure 5). Total dissolved solids (TDS) ranged between about 20 and 80 mg/L (40 mg/L average), and chloride concentrations were generally less than 2 mg/L with little variation. These results indicate highly effective contaminant removal and very high quality of water returned to the aquifer.

2.3 Treatment System Water Budget

About 88 percent of the total feed to the treatment system was returned to the aquifer at the infiltration trench over the past year. Treatment system wastewater sent to the evaporation pond comprised about 6 percent of the total inflow as brine and about 6 percent as loss for softener regeneration.

2.4 Extraction Wells

In Figure 2, the extraction wells labeled 1101 to 1125 are constructed of 6-inch-diameter Schedule 40 PVC solid casing and 6-inch, continuous V-wrap stainless steel screen (0.017-inch slot). A filter pack of 20−40 mesh silica sand completes the 2-inch annulus to 30 or 40 ft above the screen slots. Screen lengths are 150 ft, extending from the bottom half of Horizon B to the mid-depth of Horizon E, except for wells 1116, 1117, and 1118, which have 100-ft screens to near the base of Horizon D. Extraction wells 1126 to 1133 are constructed of 4-inch-diameter casing and screen. These wells have a 30-ft to 50-ft screen that is placed across most of Horizon B. These wells became operational in August 2005, as did former monitor wells 935, 936, 938, and 942 (4-inch wells). The extraction well pumps are generally positioned 10 to 15 ft above the bottom of the well. Pumps in wells 935, 936, 938, and 942 are at the bottom of the well because these wells are much shallower and so have much less potential drawdown.

The operational history of each extraction well for the evaluation period is included in Appendix A, Table A−2. Pumping is generally continuous at wells 1101 to 1125. Among these wells, steady pumping rates range between about 1 and 6 gpm, with an average rate of about 3.5 gpm. The contribution from wells 1101 to 1125 is about 96 percent of total production. Continuous pumping is not sustained at wells 1126 to 1133 because of low aquifer yield. The on-stream time for these wells is indicated to be less than 5 percent. During the remaining time, the pumps are off to allow water level recovery. Pumping is discontinuous at wells 935, 936, 938, and 942 primarily because they are shallow wells with short screen lengths.

There is some uncertainty that flow rates for the “new” extraction wells are accurately communicated to the treatment plant monitoring system. Some of these wells may be producing more water than presently registered at the treatment plant. This situation is currently under investigation.

3.0 Ground Water Capture Analysis

3.1 Extent of Ground Water Contamination

Figures 6a through 14a illustrate the concentrations of nitrate, sulfate, and uranium in ground water in the respective aquifer horizons before the start of remediation. Most of the information is from sample collection in March 2002, but data for some locations is from 1999. Figures 6b through 14b show contaminant distribution in August 2006 for the respective contaminant and aquifer horizon. Concentration data for wells 286 to 290 are from May 2007 sampling following their installation in March 2007.

Although each well location sampled for the respective period is shown, a concentration value is posted in Figures 6 through 14 only where the applicable remediation goal or standard was exceeded. In map view, the area of contamination in the various horizons does not appear significantly different from the baseline condition, indicating no lateral spreading of the contaminant plume (see also Section 4.1).

The depth of ground water contamination is generally limited to Horizons A, B, and C beneath the middle terrace. Contamination of Horizon D does not appear widespread or continuous in distribution (see Figures 7b, 10b, and 13b) and is generally of lesser magnitude in concentration. Contamination in Horizon E (see Figures 8b, 11b, and 14b) is limited to a single occurrence of nitrate in well 268 at concentrations of 70 to 80 mg/L as NO_3, which do not greatly exceed the restoration standard of 44 mg/L as NO_3. Contamination was not detected at well 268 prior to the start of remediation, but the nitrate concentration has lately increased to exceed the standard. In response to ground water extraction, the high amount of drawdown produced at this well may be accompanied by the downward movement of some slightly contaminated ground water from upper horizons. Vertical hydraulic gradients analyzed in previous annual site reports identified upward flow potentials from lower horizons to Horizon E in this area.

On the lower terrace, nitrate is present above the restoration standard at three locations, one fewer than the previous year. The maximum concentration of nitrate (89 mg/L as NO_3) among these locations does not greatly exceed the restoration standard of 44 mg/L as NO_3. In the past year, sulfate concentrations have decreased to levels below the restoration goal of 250 mg/L at all lower terrace locations (Figure 10b). Prior to 2005, uranium was present at several lower terrace wells in concentrations that exceeded the restoration standard of 0.044 mg/L. Since 2005, uranium concentrations have decreased to levels less than the restoration standard at all lower terrace locations.

Appendix B provides “plume” maps of the contaminant distributions for August 2006 (Figures B−1, B−2, and B−3). The contours shown in the figures were computer generated using the “natural neighbor” model to interpolate the posted concentration values. This method generates good contours from data sets containing areas of sparse and dense data and does not generate contours in areas beyond the data range. One outcome of this method is that contours do not extend far beneath the disposal cell, where no data are available. Analytical results for each contaminant requiring remediation are tabulated for August 2006, February 2007, and the baseline period in Appendix C.

3.2 Water Table Configuration

Figure 15 shows the estimated water table for the baseline period using water levels in Horizons A and B monitor wells for the middle terrace and Horizon C wells for the lower terrace. On the middle terrace, water levels from deeper wells are not representative of water table conditions because of pronounced vertical hydraulic gradients (see Section 3.5) and so are not appropriate for constructing a water table map. On the lower terrace, the water table occurs within Horizon C for the area of interest. The horizontal direction of ground water flow was predominantly south during the baseline period. A steeper hydraulic gradient corresponds to aquifer thinning at the escarpment (Figure 15).

Figure 16 shows a similarly constructed water table for August 2006. Comparison of Figures 15 and 16 indicates that operation of the extraction wells has significantly depressed the water table, with a significant drawdown cone centered on both the south and east bank of extraction wells. The water table underlying the escarpment and lower terrace appears unaffected by ground water extraction. Additional analysis of ground water flow directions, as influenced by ground water extraction, is provided in Sections 3.4 and 3.5. Also evident in Figure 16 is the development of an elongate ground water mound and increased hydraulic gradients along the north edge of the disposal cell caused by infiltrating distillate at the trench.

3.2.1 Infiltration Trench

The infiltration trench is constructed into bedrock along the north side of the site (see Figure 2 for trench location). Distillate enters the trench at its mid-point from where it can flow in either direction in perforated pipe embedded in a 3-ft-thick gravel pack. Through mid-2003, non-uniform infiltration caused greater than 20 ft of ground water mounding beneath the southwest section of the trench but only about 1 ft of mounding beneath the northeast section. The ground water mound progressively became more symmetrical after November 2003 when flow valves were installed, and all inflowing water was diverted to the northeast segment of the trench. In April 2005, the valves were again adjusted to redirect some flow back to the southwest section of the trench, which has resulted in comparatively greater mounding in that section. Water levels have risen at well 946 to historical maximums to within about 30 ft of ground surface (water level hydrographs for wells completed in the aquifer in the area of the trench are presented as Figure D−1 in Appendix D). Monitor wells 284 and 285 (see Figure 2 for location), screened across the contact of the terrace deposits and Navajo Sandstone immediately downgradient of the trench, remain dry, indicating that mounding has not over-topped the trench to saturate the alluvium, although the current water level at well 946 is very close to the bedrock/alluvium contact.

3.3 Water Level Drawdown

Figure 17 further illustrates the effect of ground water extraction and infiltration by showing the difference in water levels in Horizons A and B between the baseline period and August 2006. Figures 18 and 19 plot the water level differences between the same period for the deeper horizons. Positive values identify locations where the water level in August 2006 is less than the baseline value. Negative values, such as those at the wells surrounding the infiltration trench (Figure 17), indicate that water levels at the respective locations are presently higher than during the baseline period.

In the area of ground water extraction, the overall pattern of water level drawdown illustrated in Figures 17 through 19 reflects three-dimensional converging flow to the extraction wells. The greatest drawdown (30 to 40 ft) is observed at the Horizon E wells (wells 251 and 268) located within the extraction field. The intakes of these particular monitor wells are nearest to the interval of ground water extraction among all monitor wells for which baseline data are available (extraction wells are screened across Horizons C to E and centered in Horizon D). Drawdown is observed to decrease with vertical and horizontal distance from the extraction zone. Water level drawdown in response to ground water extraction does not imply capture of the water at an extraction well (see Sections 3.4 and 3.5 for capture analysis).

Well hydrographs in Appendix D provide an additional view of water level variation over time at selected monitor wells. The predominantly downward trend in ground water levels indicates an expanding capture zone and that the ground water setting has not attained the condition of steady-state flow since the start of ground water remediation.

3.4 Horizontal Capture

Figure 20 depicts the estimated zone of ground water capture in lateral extent in Horizons A and B, where the bulk of contamination resides. All ground water within the dashed blue line is predicted to ultimately flow to an extraction well. The prediction is based on slope analysis of the water table depicted in Figure 20 using a computerized grid-based contouring application (SURFER). The analysis calculates a vector representing the direction and relative magnitude of the slope for each grid cell. The capture line in Figure 20 is the flow divide that separates vectors that converge on the extraction wells from those that do not. Several conditions were imposed to obtain this result. First, because extraction well water levels are not monitored, the ground water level at each extraction well was assigned a uniform value of 4,990 ft. This value is consistent with the water table elevation observed at several monitor wells located within the extraction field. In addition, to mimic the regional water table gradient, prescribed water table elevations were assigned at several locations in a line upgradient of the site near well 901 and along Moenkopi Wash east and west of well 902.

This analysis indicates that the full width of the contaminant plume along the south edge of the disposal cell is captured, suggesting that flow of contaminated ground water from the site has been eliminated. However, ground water in the area encompassing extraction wells 1126−1129 apparently escapes capture. Evidence of ground water capture in this area may arise in following years with continued operation of these relatively new and lower productivity wells. In this area, contamination is indicated to be limited in vertical extent to Horizons A and B. Concentration values in this part of the plume range from about 150 to 1,370 mg/L nitrate as NO_3; <250 to 3,600 mg/L sulfate; and <0.044 to 0.076 mg/L uranium. Average concentrations are about 450 mg/L nitrate, 750 mg/L sulfate, and 0.065 mg/L uranium. The ranges in concentration for nitrate and sulfate are skewed by relatively high levels at wells 267 and 1126, which are located close together.

3.5 Vertical Capture

Hydrographs included in Appendix D for selected sets of co-located monitor wells illustrate that at a given location, the hydraulic head in the aquifer is a function of well-intake depth. This relationship clearly identifies vertical flow components throughout the entire monitored thickness of the aquifer, both before and since the start of ground water remediation. With few exceptions, the vertical potentials were downward during the baseline period. Since that time, the magnitude of downward flow in Horizons A, B, and C has increased, as exemplified by the greater vertical separation in the hydrographs for the respective locations of well pairs 265/266, 263/264, 908/912, and 909/932 since about mid-2002 (see Appendix D, Figures D−4 through D−7). In the main region of contamination, these increased gradients likely imply capture of ground water from the upper, most contaminated horizons of the aquifer (Horizons A, B, and C).

In the deeper horizons, vertical gradients are now generally upward to the extraction well intakes. For example, the vertical flow potentials have reversed to upward between Horizons M, I, and E at co-located wells 268/256/257 (Figure D−8; wells 256 and 257 were decommissioned in August 2005). A similar result between Horizons E, I, and possibly M is apparent at the location of wells 251/252/253 (see Figure D−9, the monitoring record is incomplete for well 253, a former Horizon M well that was decommissioned in 2001). A downward flow potential remains between Horizon I and M at wells 254/255 (Figure D−10; well 255 was decommissioned in August 2005); however, there is an upward gradient at that location between Horizon I (well 254; decommissioned in August 2005) and Horizon D (well 277). This apparent vertical flow divide at this location implies ground water capture possibly to Horizon I but not Horizon M.

Because the observed vertical influence of the extraction wells extends much deeper than the presumed depth of contamination (Horizons A, B, and C, and to a lesser extent Horizon D), it is likely that the remediation system captures the full vertical extent of the contaminant plume and prevents potential downward movement of the contaminants. Although ground water extraction has had no effect on downward flow between Horizons D and G at wells 915 and 916 (Figure D−11), this region of the aquifer is not contaminated. Downward flow potentials in lower terrace ground water also remain unaffected by ground water extraction (Figure D−12), but contamination there is minor and limited to the shallowest horizon. Also, there is no evidence of vertical or lateral spreading of contamination in the lower terrace ground water.

4.0 Remediation Progress

4.1 Contaminant Concentration Trends at Monitor Wells

Appendix E contains time-series graphs of nitrate, sulfate, and uranium concentrations in ground water at selected monitor wells located throughout the project area. In the main region of ground water contamination, obvious upward or downward trending is not apparent at the individual monitor wells (Figures E−1 to E−3). Toward the outer (south) margin of the plume, contaminant concentrations are relatively stable or slightly decreasing (see Figures E−4 through E−6). Horizons A, B, and C wells 271, 683, 684, 914, 921, and 929 are located beyond but near the downgradient or crossgradient extent of contamination. These “sentinel” wells remain uncontaminated, with the exception of minor but decreasing nitrate contamination at well 929, indicating no significant lateral expansion of the contaminant plume.

Breakthrough of clean water from the infiltration trench to the south side of the disposal cell is not yet apparent. Because the water table at well 940 has dropped below the base of the screen, a replacement well was installed 30 ft deeper in April 2007 (well 286). Similarly, a replacement well (well 287) was installed adjacent to well 941 in April 2007, where the water table is only slightly above the base of the screen. Well 942 was converted to an extraction well in 2005 but draws little water and so probably remains suited for monitoring breakthrough of treated water at that location. Porous media flow using Darcy’s Law predicts that under the observed water table gradient (Figure 16) and a hydraulic conductivity of 1 ft/day (from DOE 1998), the calculated travel time from the infiltration trench to well 940 is 17 years, which is greater than the cumulative remediation period to date.

Contaminant concentrations remain stable and below remediation standards in Horizons C and D wells 264, 266, 915, and 932 (Figures E−7 through E−8). These results indicate that no southward expansion of the plume is occurring at this depth in the aquifer. In these figures, elevated nitrate and sulfate concentrations at well 912 (Horizon C) are seen to decrease over time, which also indicates that contamination is not spreading in this downgradient direction (southwest).

In ground water beneath the lower terrace, uranium and sulfate concentrations have decreased to levels below the respective restoration objectives at all locations. The current extent of contamination is limited to nitrate at wells 930 (58 mg/L as NO_3), 903 (49 mg/L as NO_3), and co-located wells 691 and 1003 (53 and 89 mg/L as NO_3, respectively). Definitive trending at these locations is not recognized. Migration of this contamination apparently is not significant, as indicated by persistent background levels at nearby wells farther downgradient. Contaminant concentration plots for lower terrace monitor wells are included in Appendix E, Figures E−10 through E−12.

4.2 Contaminant Concentration Trends at Extraction Wells

Figures 21, 22, and 23 illustrate concentration trends at the extraction wells for nitrate, sulfate, and uranium, respectively. For each contaminant, the trend at most wells is of decreasing concentration as contaminant mass is removed from the aquifer. Appendix F contains individual concentration plots for each extraction well based on the monthly on-site sampling and analysis.

On the basis of those figures, Table 3 identifies that the extracted ground water is not below the remediation standard for all three primary contaminants at any extraction well. Although the extraction well samples are likely composites of ground water from several horizons of variable contamination, it is noted that the region of the aquifer east of the evaporation pond and encompassing well 1125 is approaching cleanup goals.

Table 3. Pumping Wells Where a Contaminant Concentration Is Below the Remediation Standard in the Extract, as of February 2007

Nitrate	Sulfate	Uranium
--	1107	--
--	1112	1112
--	1113	1113
--	1116	1116
--	1117	--
--	1123	1123
1125	1125	1125

4.3 Contaminant Inventory and Removal Rates

Table 4 lists the cumulative amounts of nitrate, sulfate, and uranium removed from the aquifer as of April 1, 2007. For comparison, Table 4 also provides the estimated quantities of contamination initially present in the aquifer and the amount of contaminant removed as a percent of the initial quantity. Calculation methods for these estimates are provided in Appendix G as Calculation Set 1.

By these estimates, at current mass recovery rates of between 1.6 to 4.3 percent per year, ground water restoration will require about 23 to 63 years to complete since the inception of active remediation in mid-2002 (see also Figures 24 and 25, which project current removal rates to future years), assuming total plume capture. The corresponding volume of ground water extracted at 23 years, assuming constant withdrawal of 85 gpm, is 1 billion gallons, or approximately one estimated pore volume of the contaminant plume.

Table 4. Summary of Cumulative Mass and Volume Recovery as of April 1, 2006

Contaminant	Initial Mass (lbs)[a]	Cumulative Mass Removed (lbs)	Cumulative Percent Mass Reduction	Initial Volume (gal)[a]	Volume Treated (gal)	Percent Plume Volume Reduction
Nitrate	9,500,000	757,445	8.0	1.2E+09	224,000,000	19
Sulfate	20,150,000	1,862,880	9.3	1.2E+09	224,000,000	19
Uranium	2,300	493	21.4	1.2E+09	224,000,000	19

[a]Source: see Appendix G

4.3.1 Aquifer Restoration Index

The restoration period is also estimated by an approach that is independent of mass and volume calculations. By this approach, an average concentration of a contaminant is computed for each sampling event from a selected group of monitor wells. The composition of the ground water plume is thus represented as a single concentration value for a given contaminant at a given time. A graph of the averages over time can then provide a measure of restoration progress. Figures 26 and 27 illustrate respectively how the geometric mean of the sulfate and uranium concentration for the individual sampling events varies since the baseline period. The selected monitor wells for this analysis are those located throughout the contaminant plume and sampled most regularly. Appendix G provides calculation information for this performance metric as Calculation Sets 3 and 4.

Despite the small increment of change and the relatively brief period of observation, the results presented in Figures 26 and 27 suggest a developing trend showing the effects of remediation in reducing the bulk concentration of uranium and sulfate (nitrate results not yet analyzed by this method). Linear projection of these data predicts a restoration time of 25 to 30 years since the inception of active remediation in mid-2002. This compares to an estimated 27 years to remove one pore volume of the initial contaminant plume (Table 4) at the current cumulative extraction rate of about 3.7 percent per year by volume.

5.0 Year in Review Summary

- On-stream extraction and treatment flow rates meet design objectives.
- Distillate quality meets or exceeds design objectives.
- Return flow to the aquifer as a percentage of extracted water meets design objectives.
- The current configuration and operation of the extraction system effectively captures the region of maximum ground water contamination.
- The current configuration and operation of the extraction system likely captures the full vertical extent of ground water contamination.
- Plume expansion is not significant on either the middle or lower terrace.
- Uranium and sulfate concentrations have decreased to levels less than the restoration standard at all lower terrace monitoring locations. Only minor nitrate contamination remains on the lower terrace.

- Bulk concentration trends indicate measurable progress in water quality restoration.
- Projected cleanup times range between about 25 and 60 years since mid-2002. These projections assume total plume capture, which currently is not achieved. Also, the projections do not forecast the potential flushing effects of trench water arriving to the extraction zone.
- Production from the extraction wells installed in 2004 is much less than expected, probably due to the low permeability of the formation; however, field observations indicate that production from these wells may be greater than is registered at the treatment plant.
- Sampling and analysis for gross alpha and gross beta activity, strontium, and isotopic uranium was discontinued with concurrence of all stakeholders.
- Five new monitor wells were installed. Two wells (wells 286 and 287) replace wells 940 and 941, which have gone dry or will do so soon; nested wells 288 and 290 are to monitor the arrival of treated water from the trench; and well 290 closes the plume boundary east of the eastern extraction wells.

6.0 Recommendations

- Reduce ground water monitoring (except that conducted for treatment plant operations) to one annual comprehensive event, possibly in March.
- Divert more flow of distillate to the northwest section of the infiltration trench.
- Consider implementing injection of distillate at the existing but unused injection wells if current trends of rising water levels at the infiltration trench continue.
- Use ground water modeling to predict the restoration time as the system is currently configured and operated and under assumed conditions of expanded ground water capture using additional extraction wells.

7.0 References

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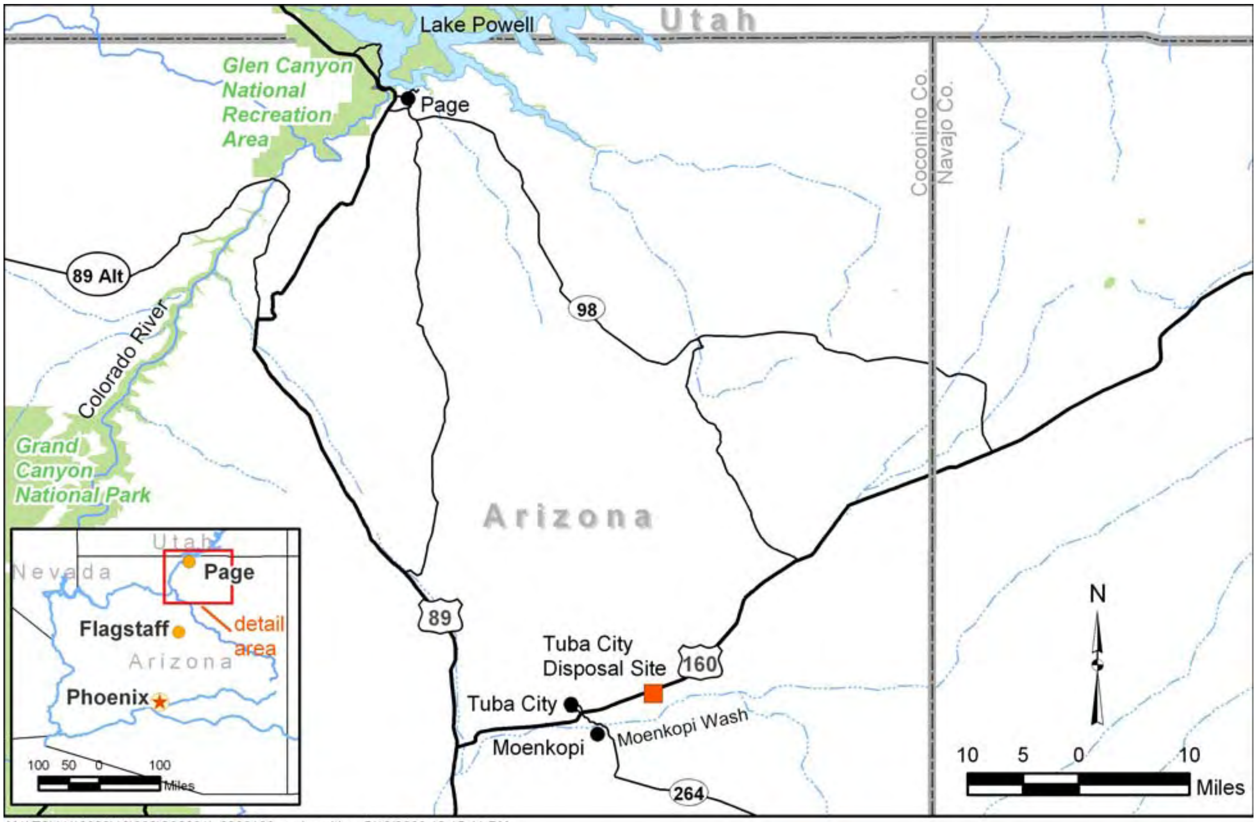

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Figure 1. Tuba City Site Location

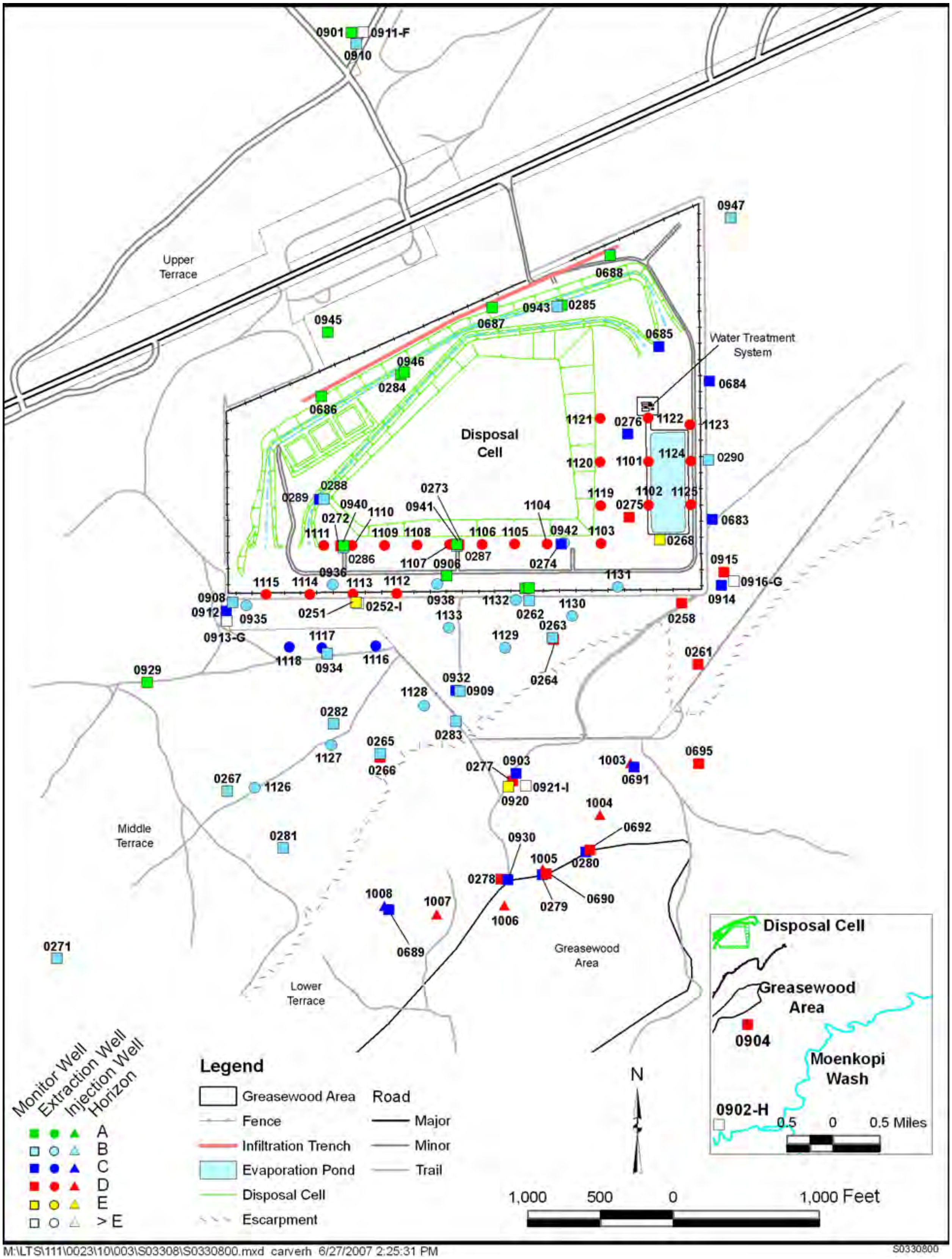

Figure 2. Tuba City Site Features and Well Locations

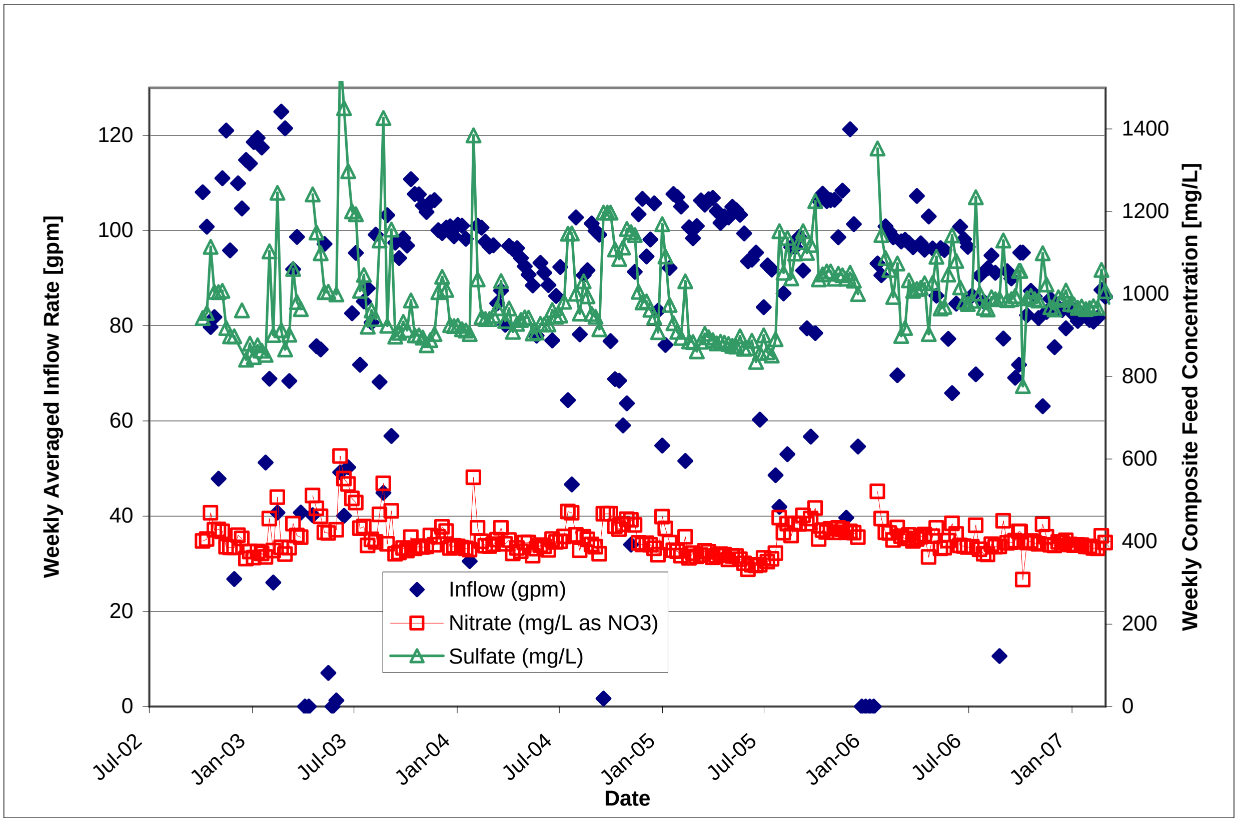

Figure 3. Treatment Plant Inflow Rate and Nitrate and Sulfate Concentration

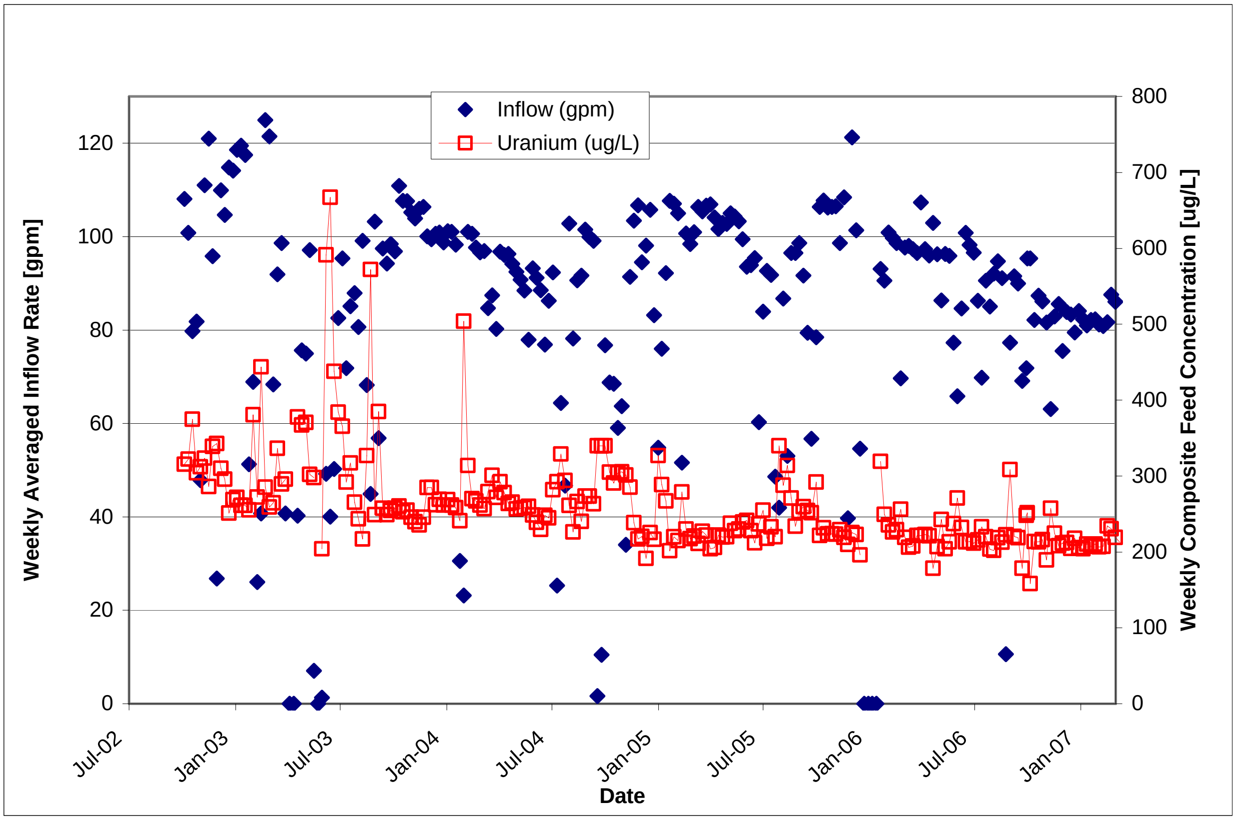

Figure 4. Treatment Plant Inflow Rate and Uranium Concentration

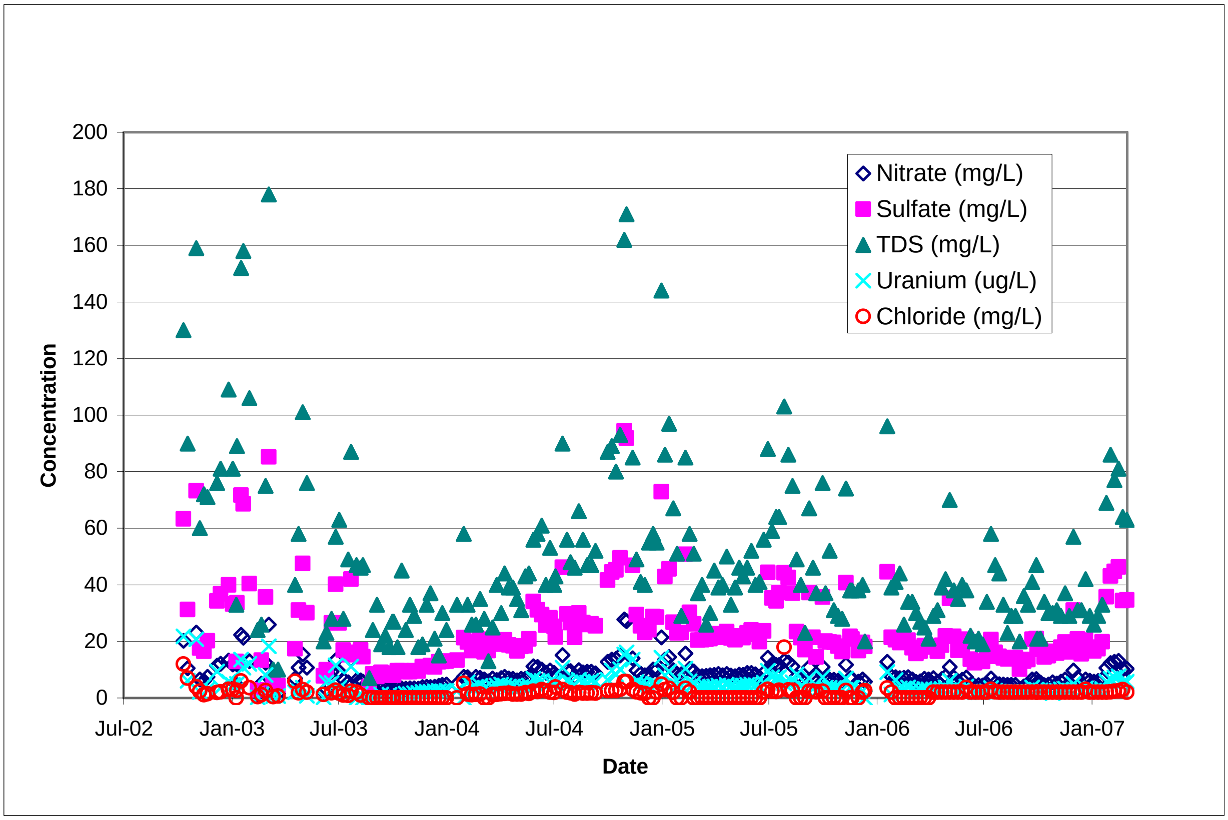

Figure 5. Treatment Plant Distillate Quality

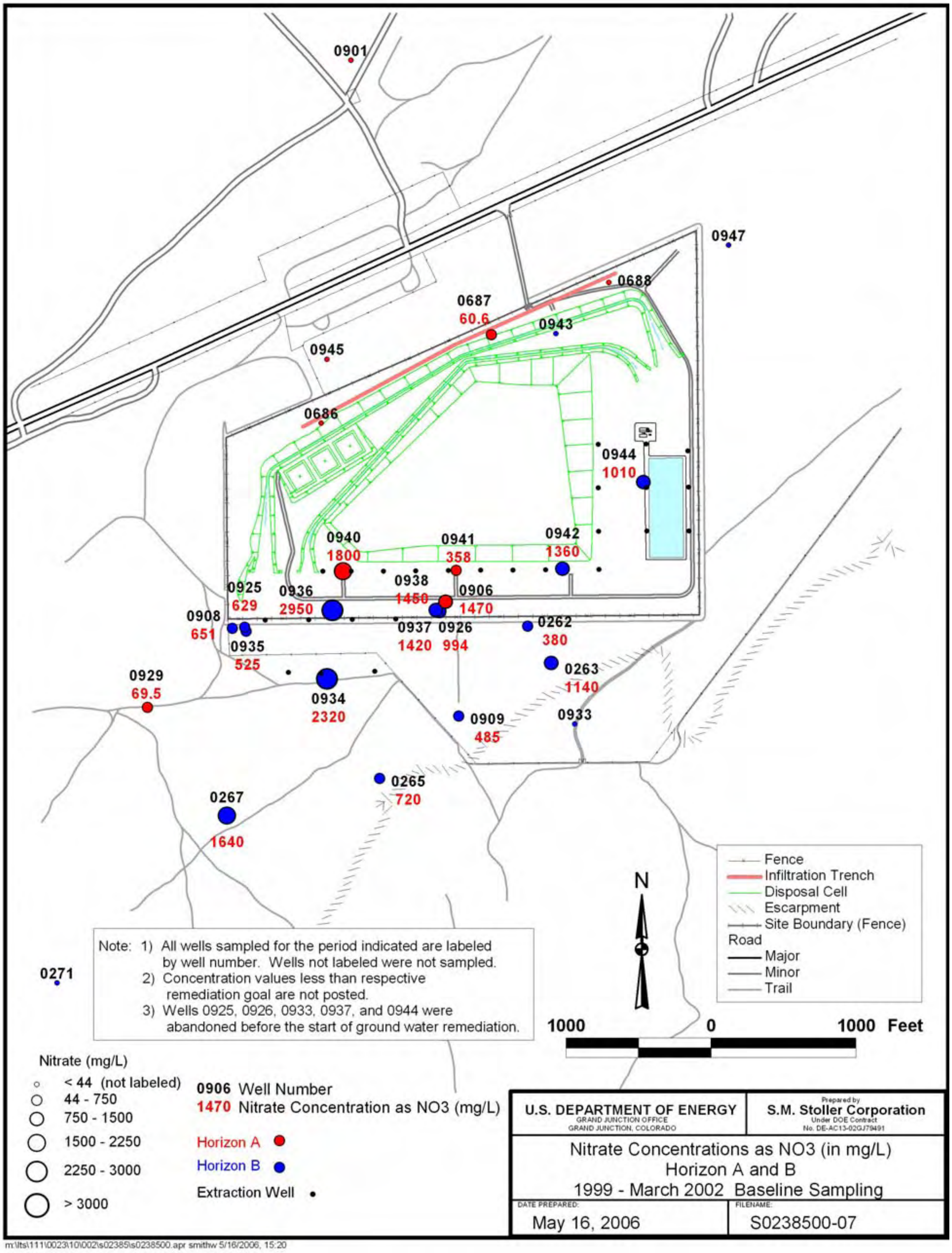

Figure 6a. Nitrate Concentrations in Ground Water, Horizons A and B, Baseline Period

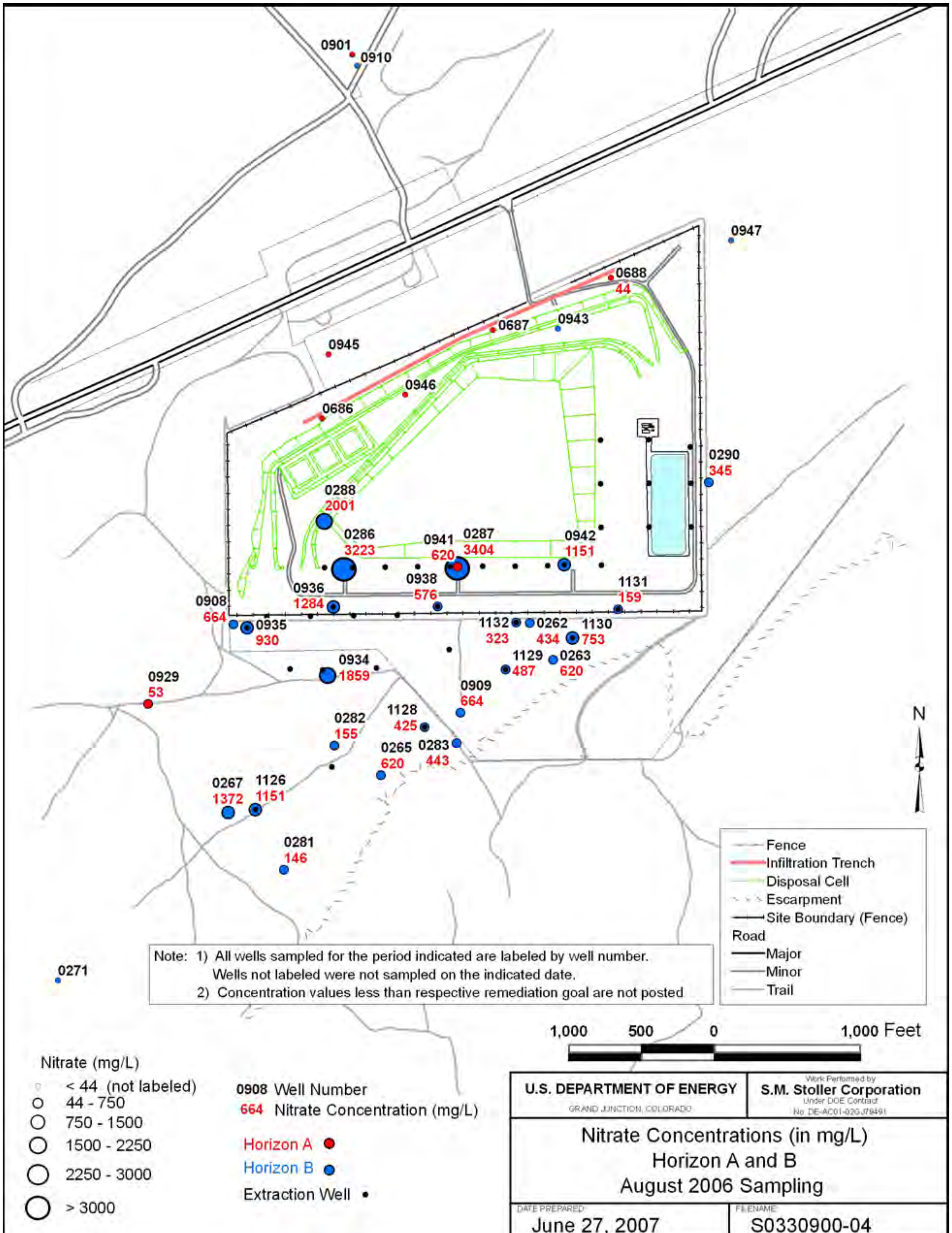

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Figure 6b. Nitrate Concentrations in Ground Water, Horizons A and B, August 2006

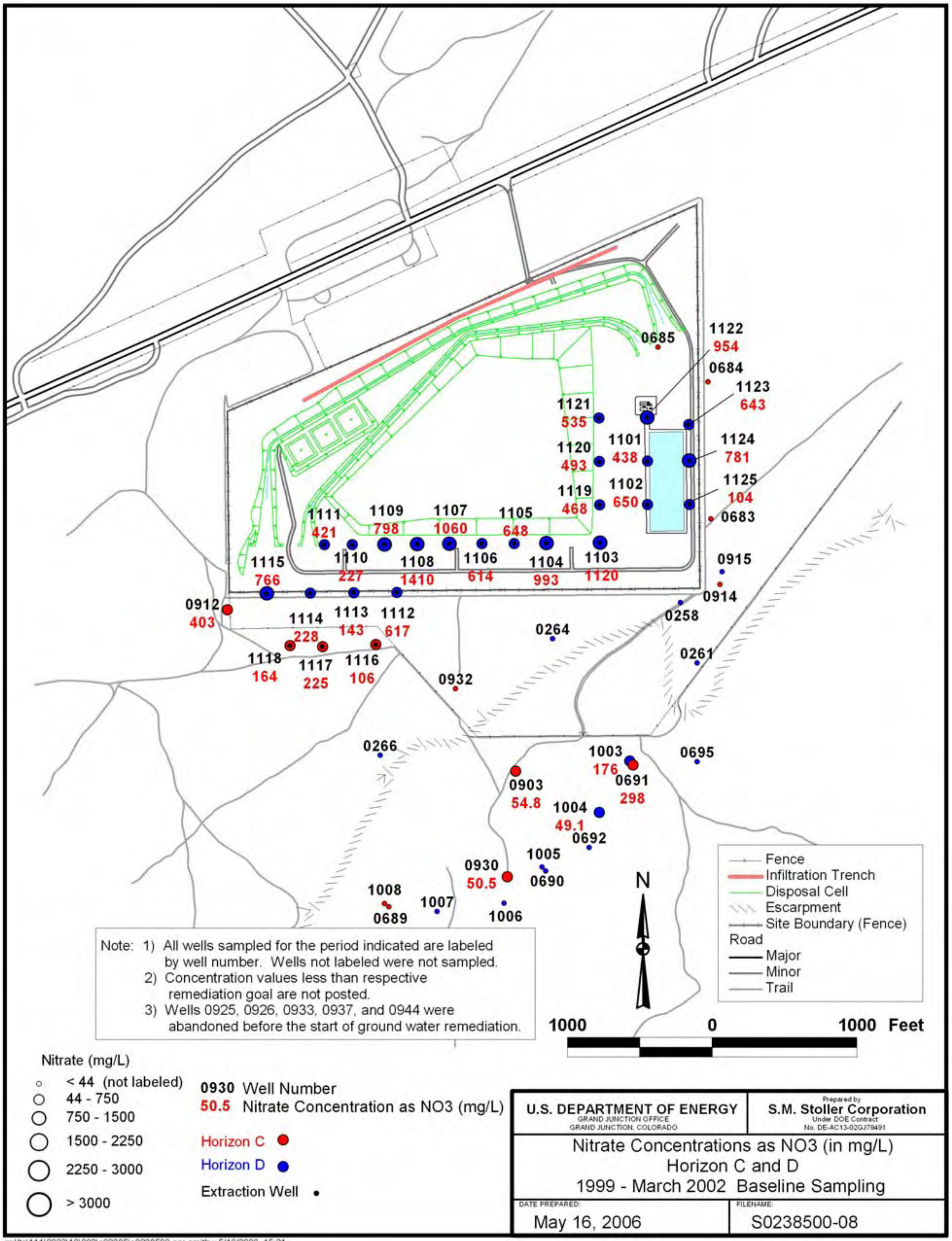

Figure 7a. Nitrate Concentrations in Ground Water, Horizons C and D, Baseline Period

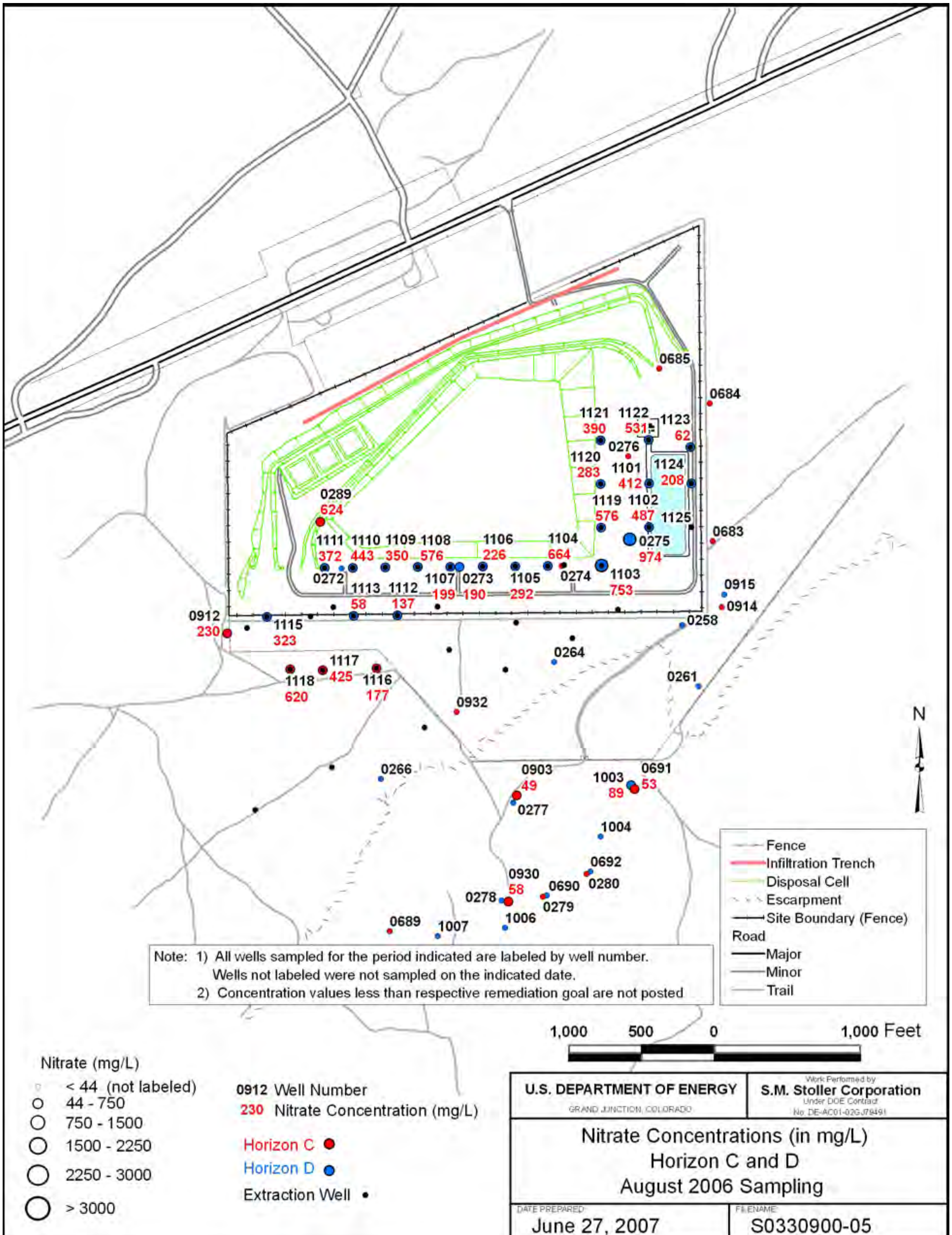

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Figure 7b. Nitrate Concentrations in Ground Water, Horizons C and D, August 2006

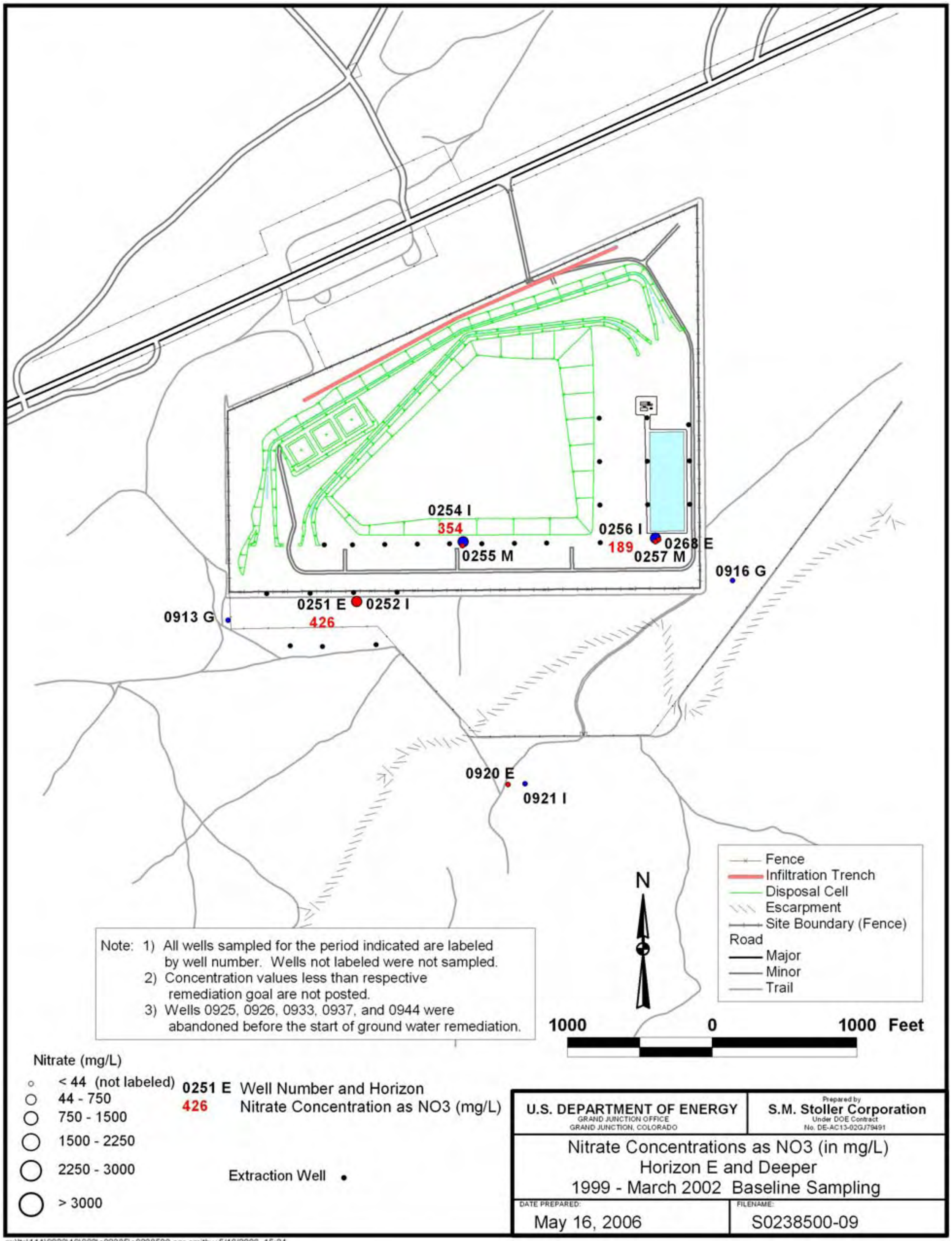

Figure 8a. Nitrate Concentrations in Ground Water, Horizons E and Deeper, Baseline Period

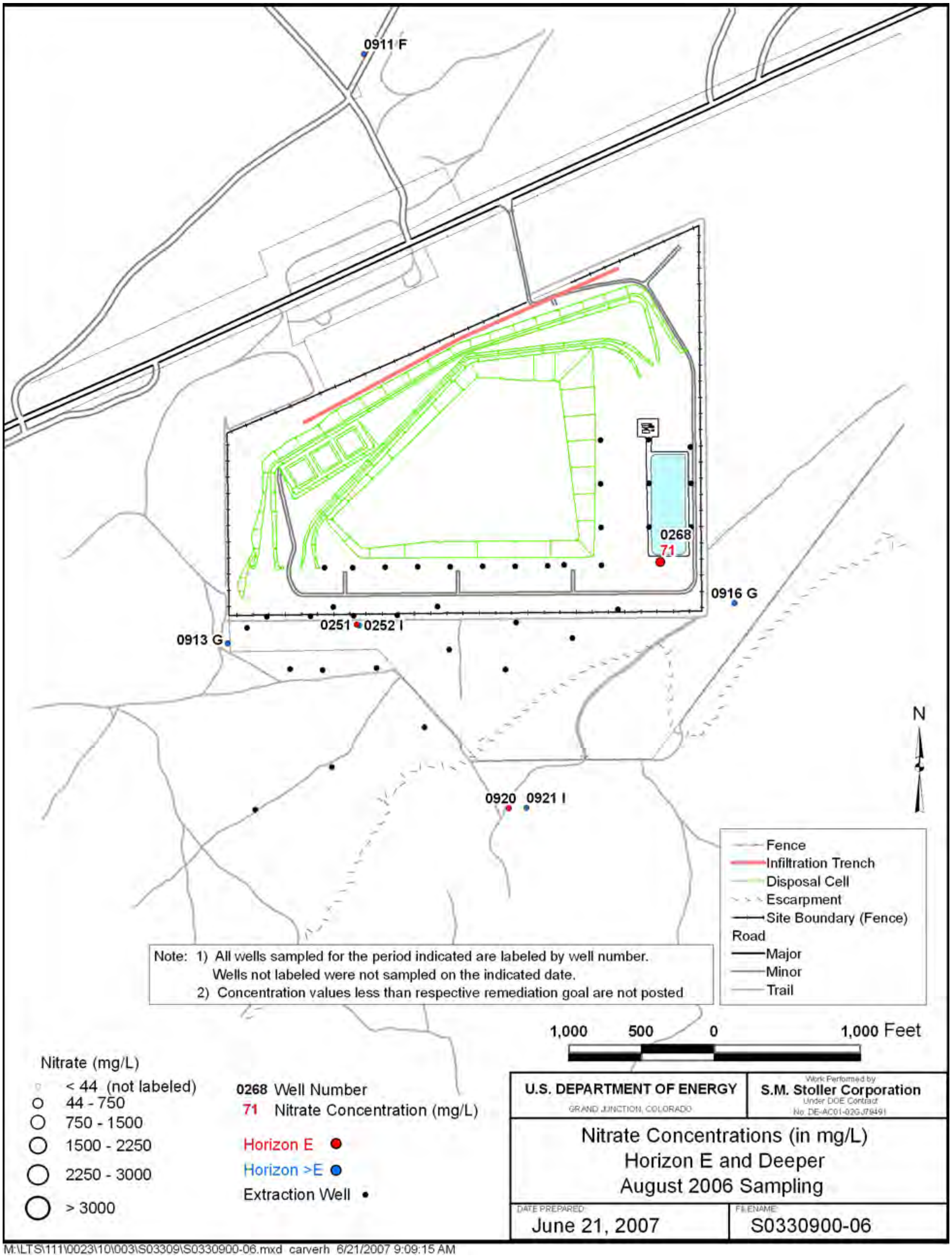

Figure 8b. Nitrate Concentrations in Ground Water, Horizons E and Deeper, August 2006

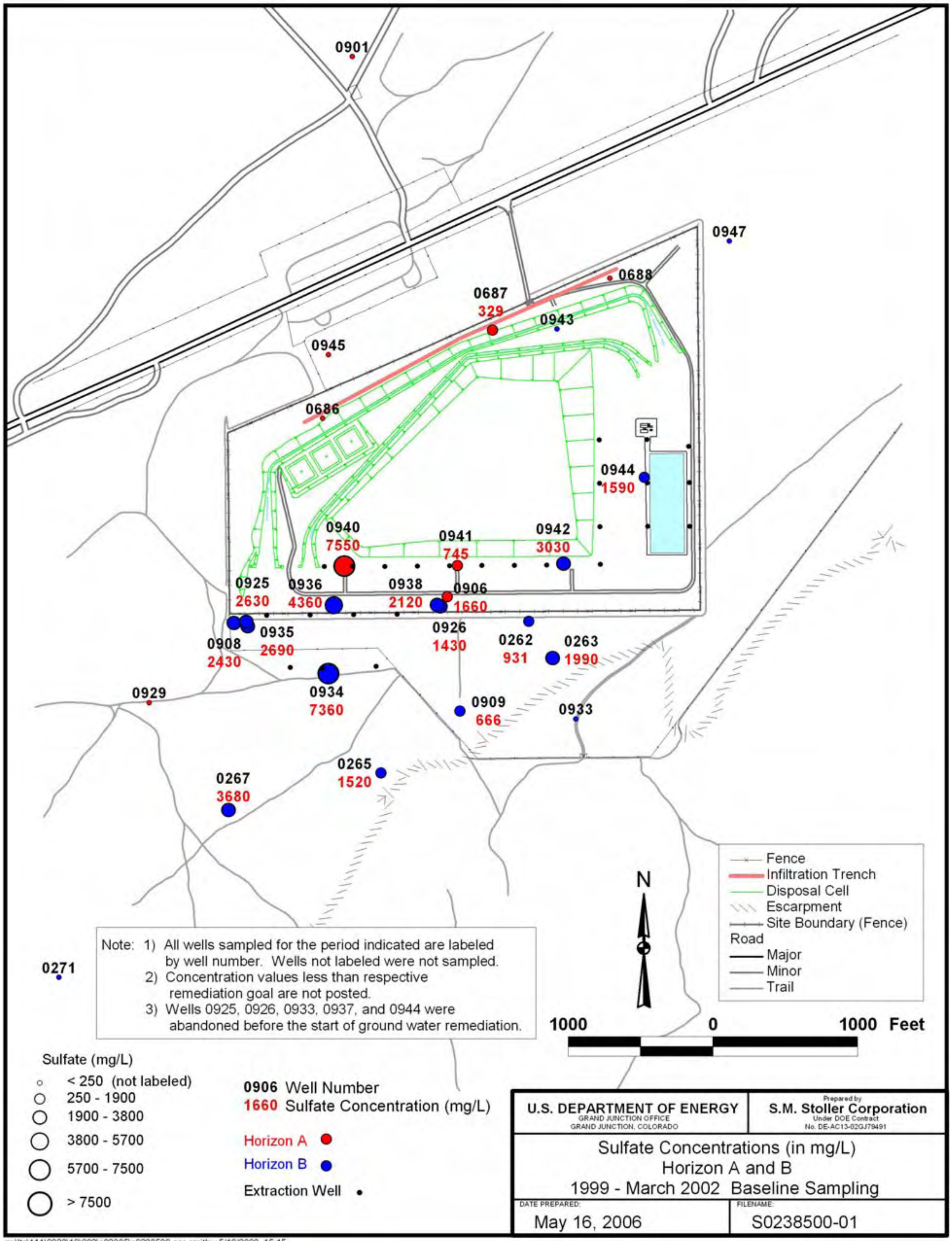

Figure 9a. Sulfate Concentrations in Ground Water, Horizons A and B, Baseline Period

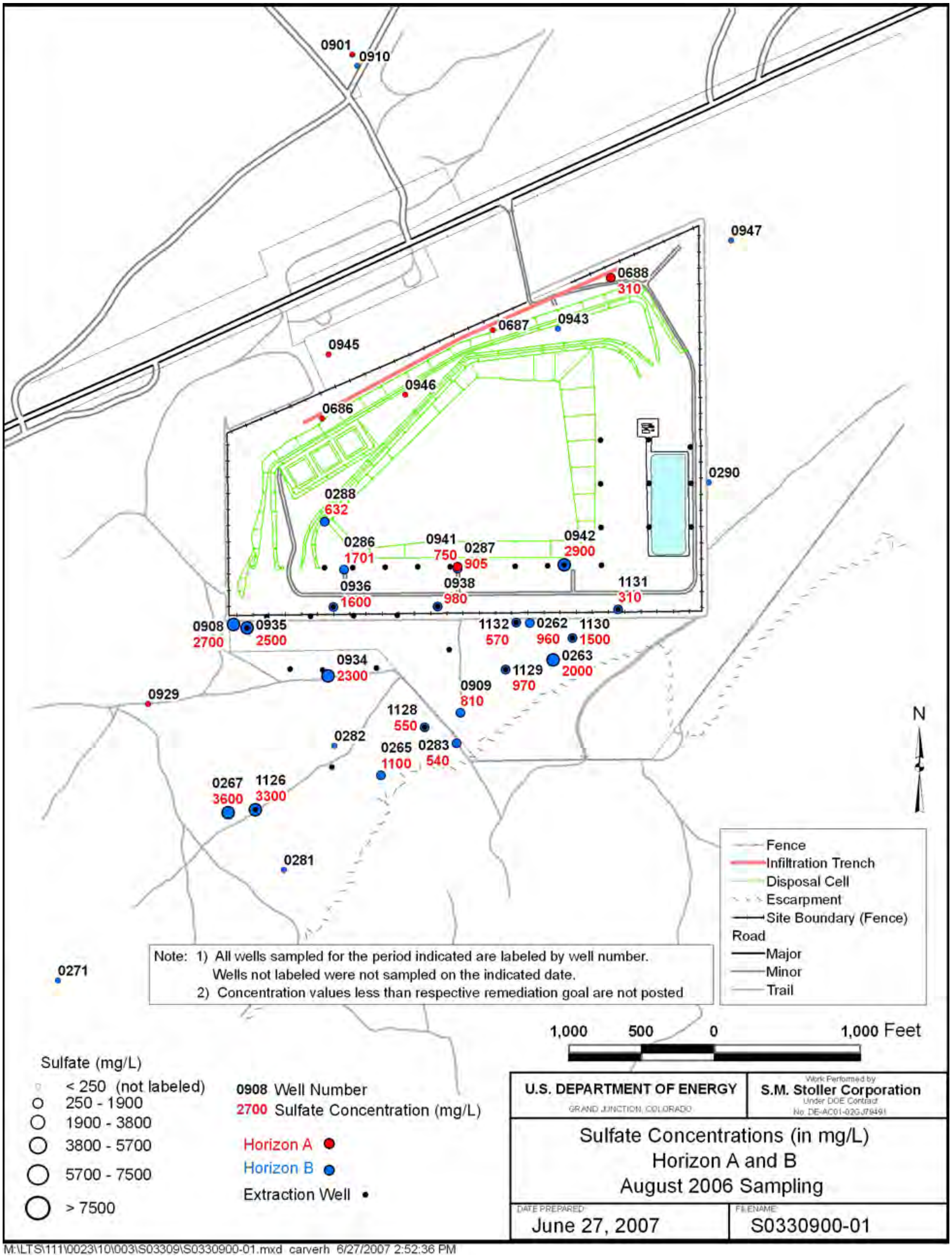

Figure 9b. Sulfate Concentrations in Ground Water, Horizons A and B, August 2006

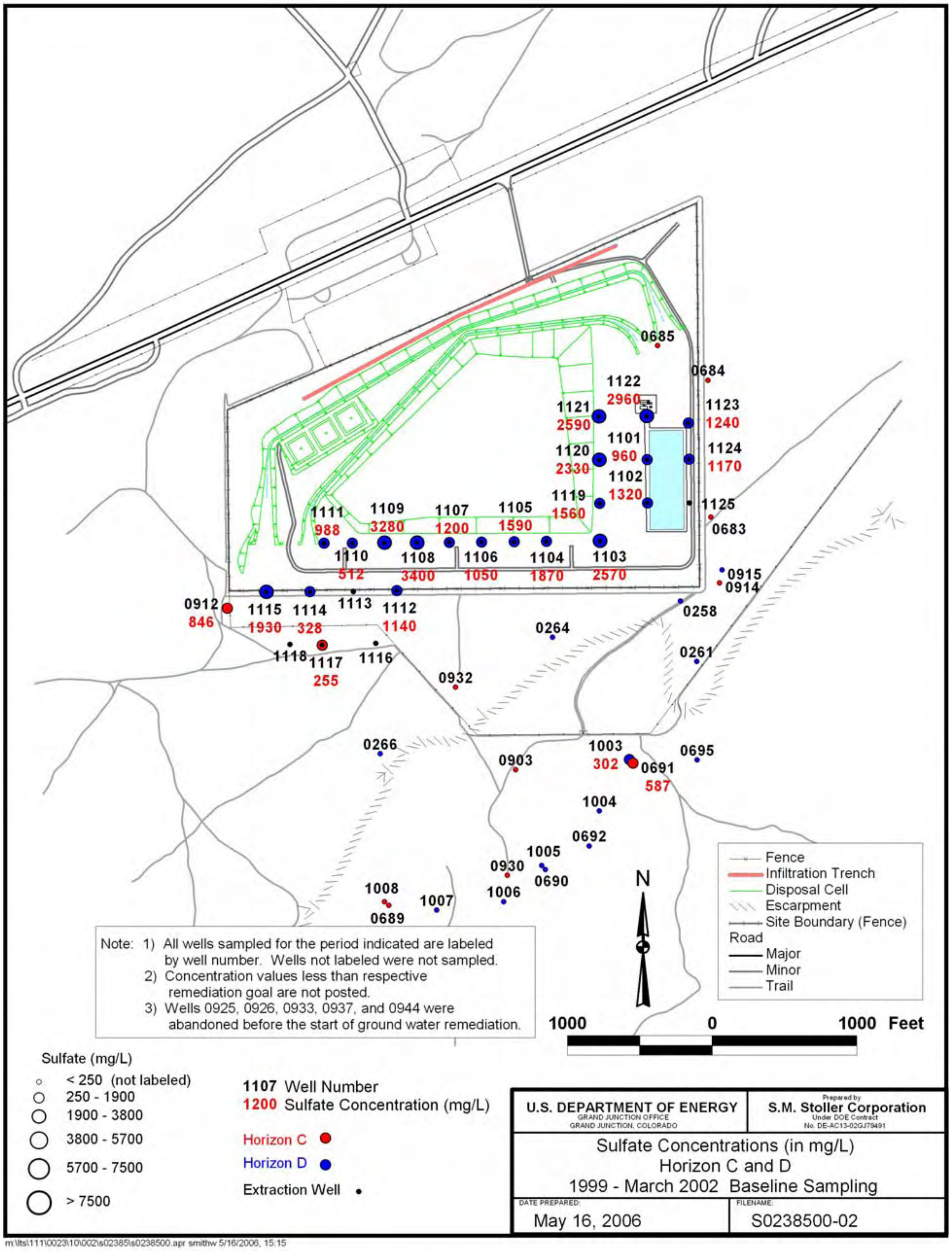

Figure 10a. Sulfate Concentrations in Ground Water, Horizons C and D, Baseline Period

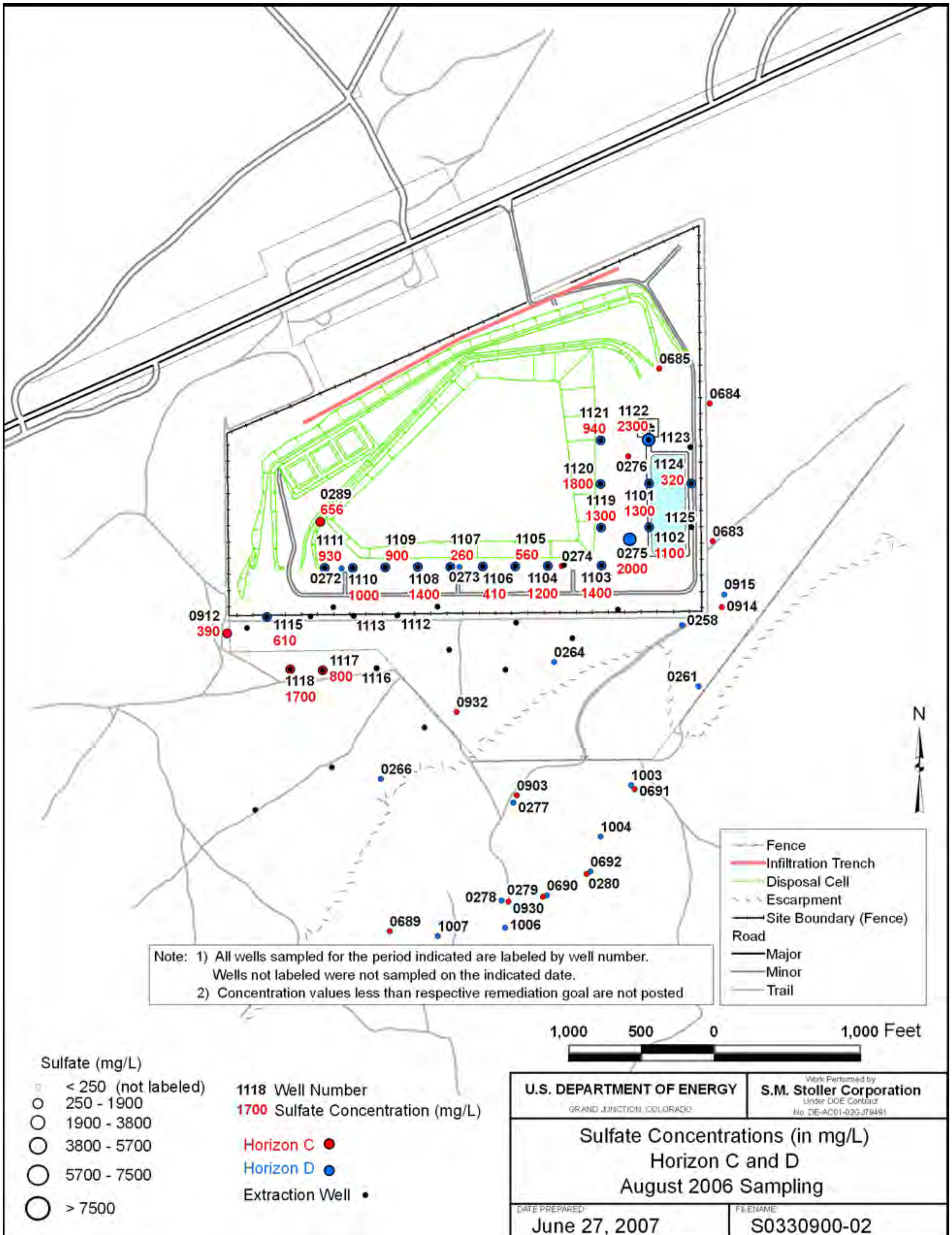

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Figure 10b. Sulfate Concentrations in Ground Water, Horizons C and D, August 2006

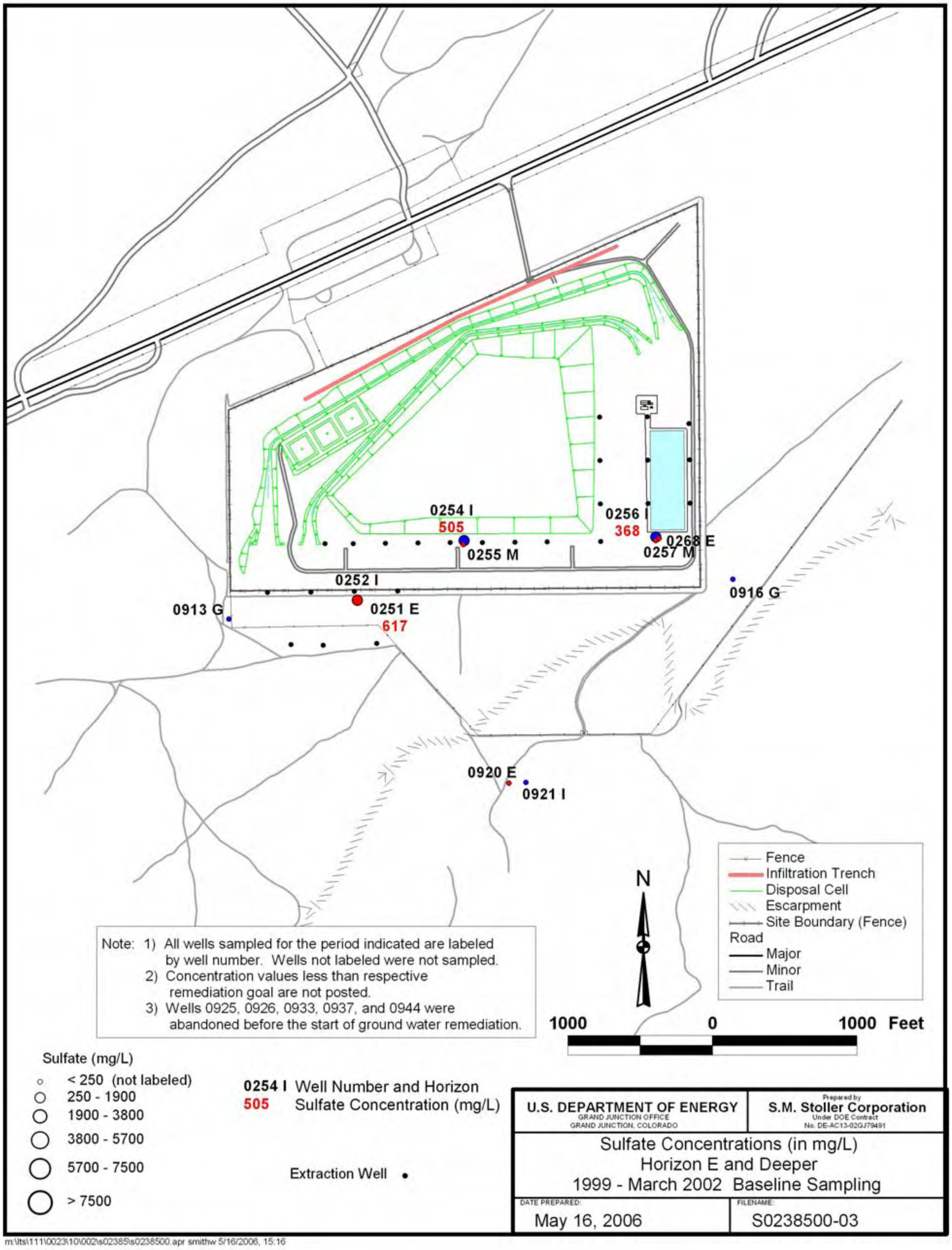

Figure 11a. Sulfate Concentrations in Ground Water, Horizons E and Deeper, Baseline Period

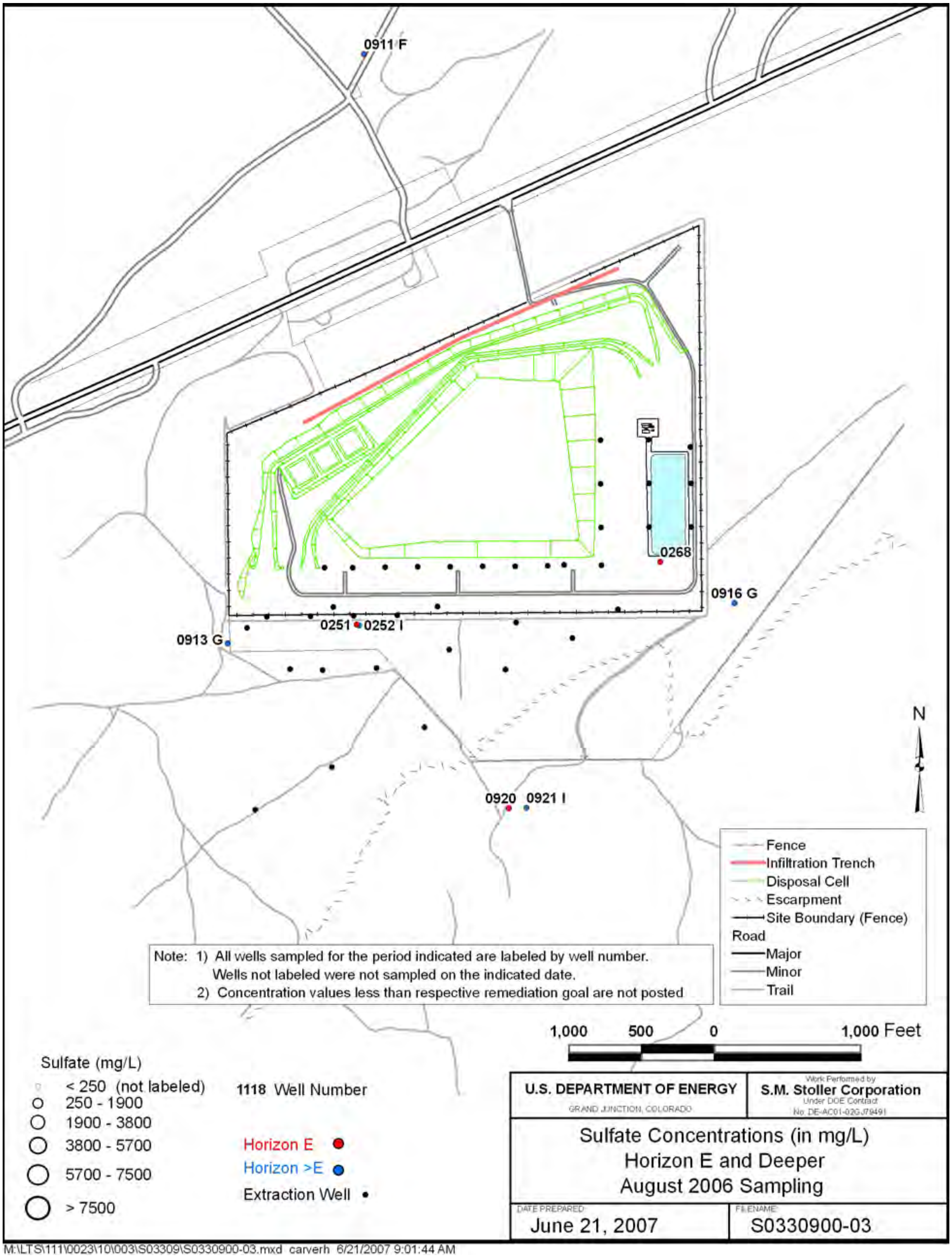

Figure 11b. Sulfate Concentrations in Ground Water, Horizons E and Deeper, August 2006

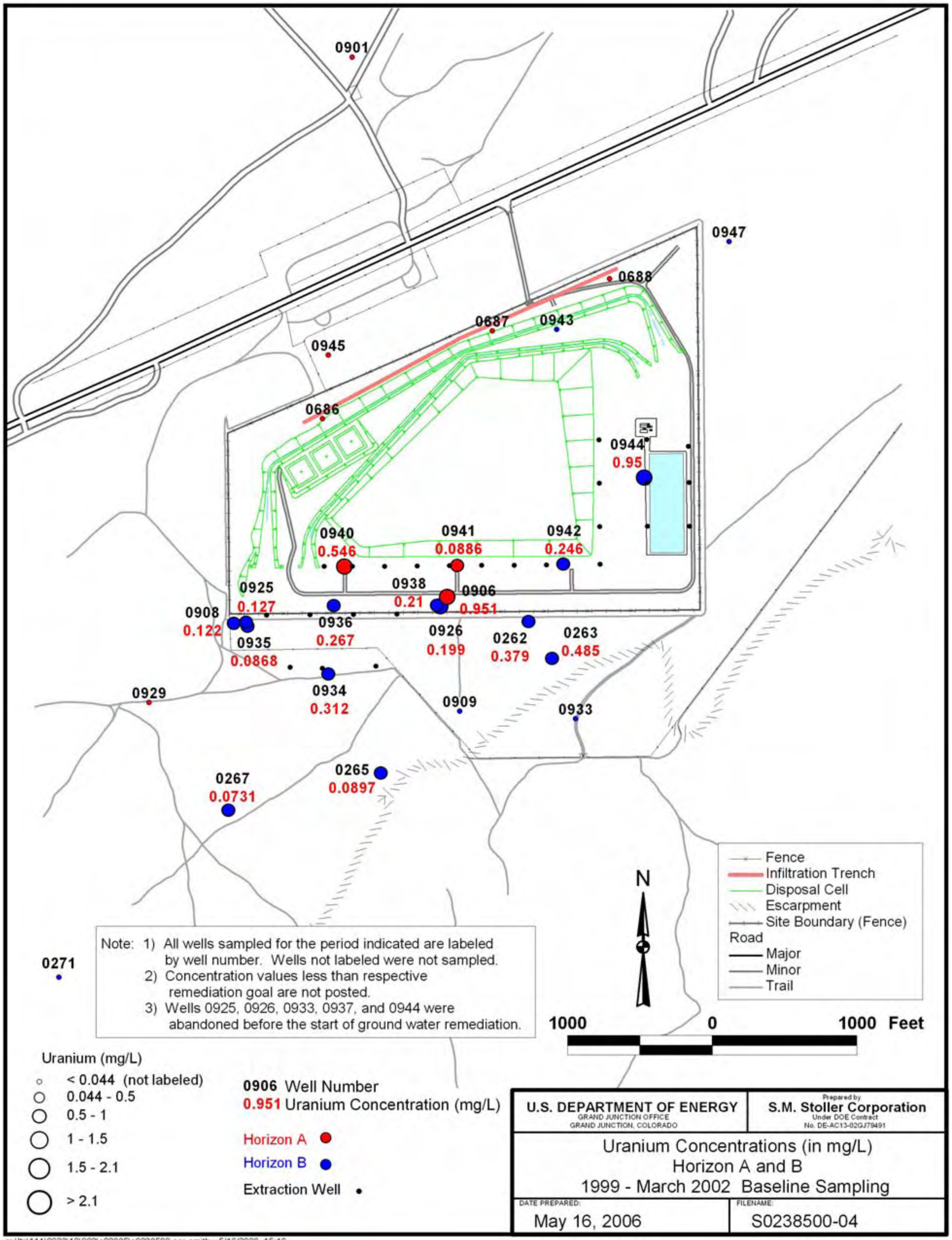

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Figure 12a. Uranium Concentrations in Ground Water, Horizons A and B, Baseline Period

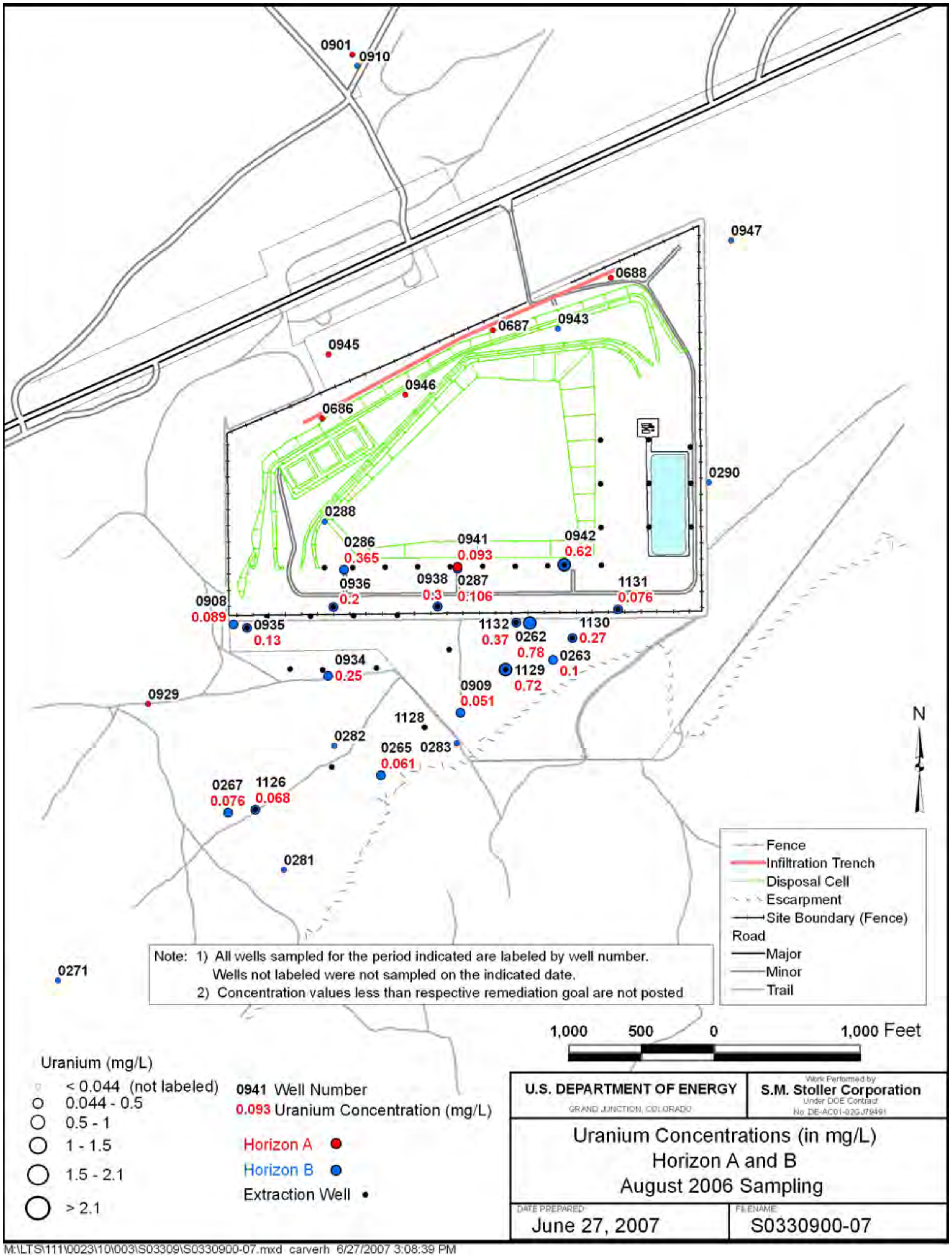

Figure 12b. Uranium Concentrations in Ground Water, Horizons A and B, August 2006

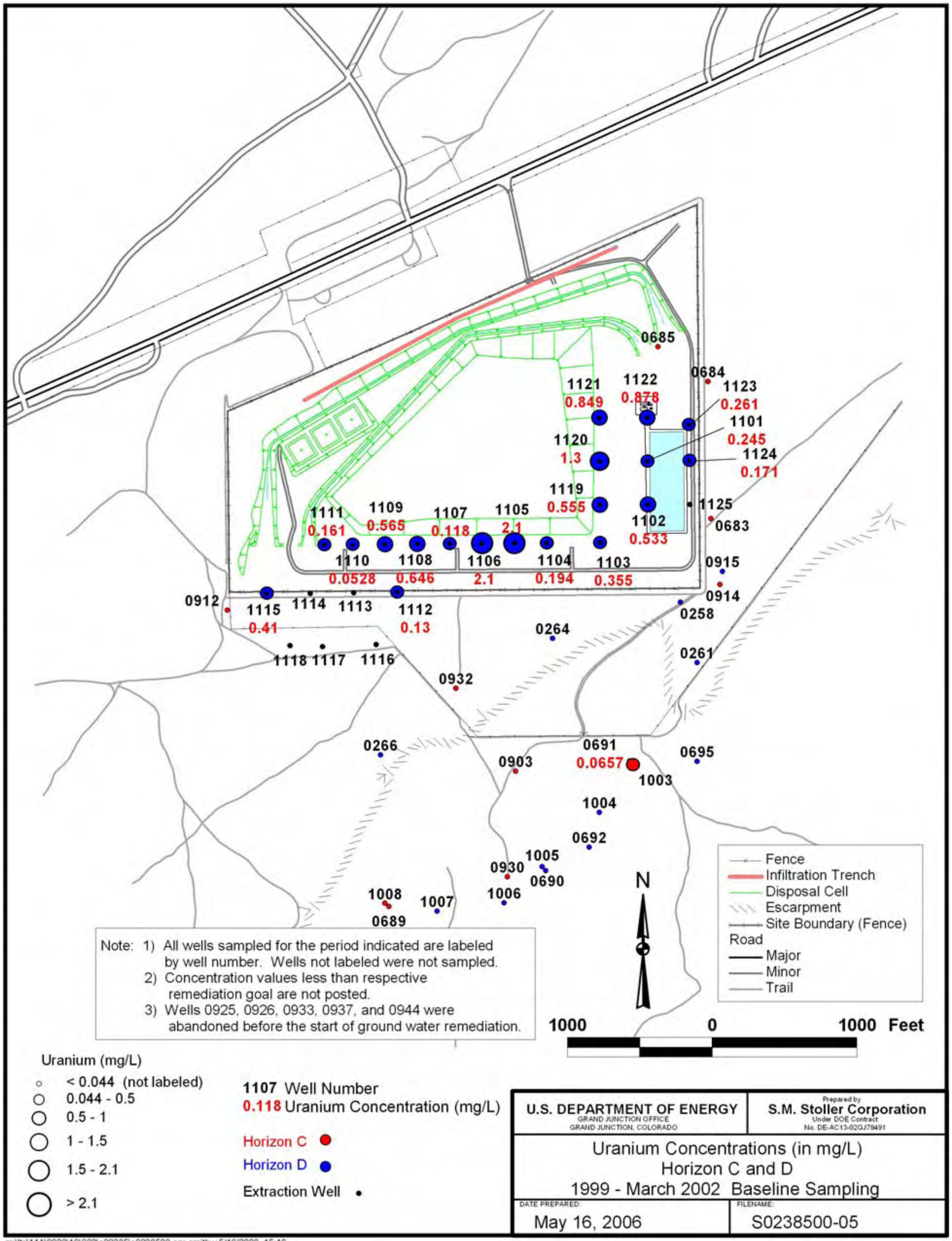

Figure 13a. Uranium Concentrations in Ground Water, Horizons C and D, Baseline

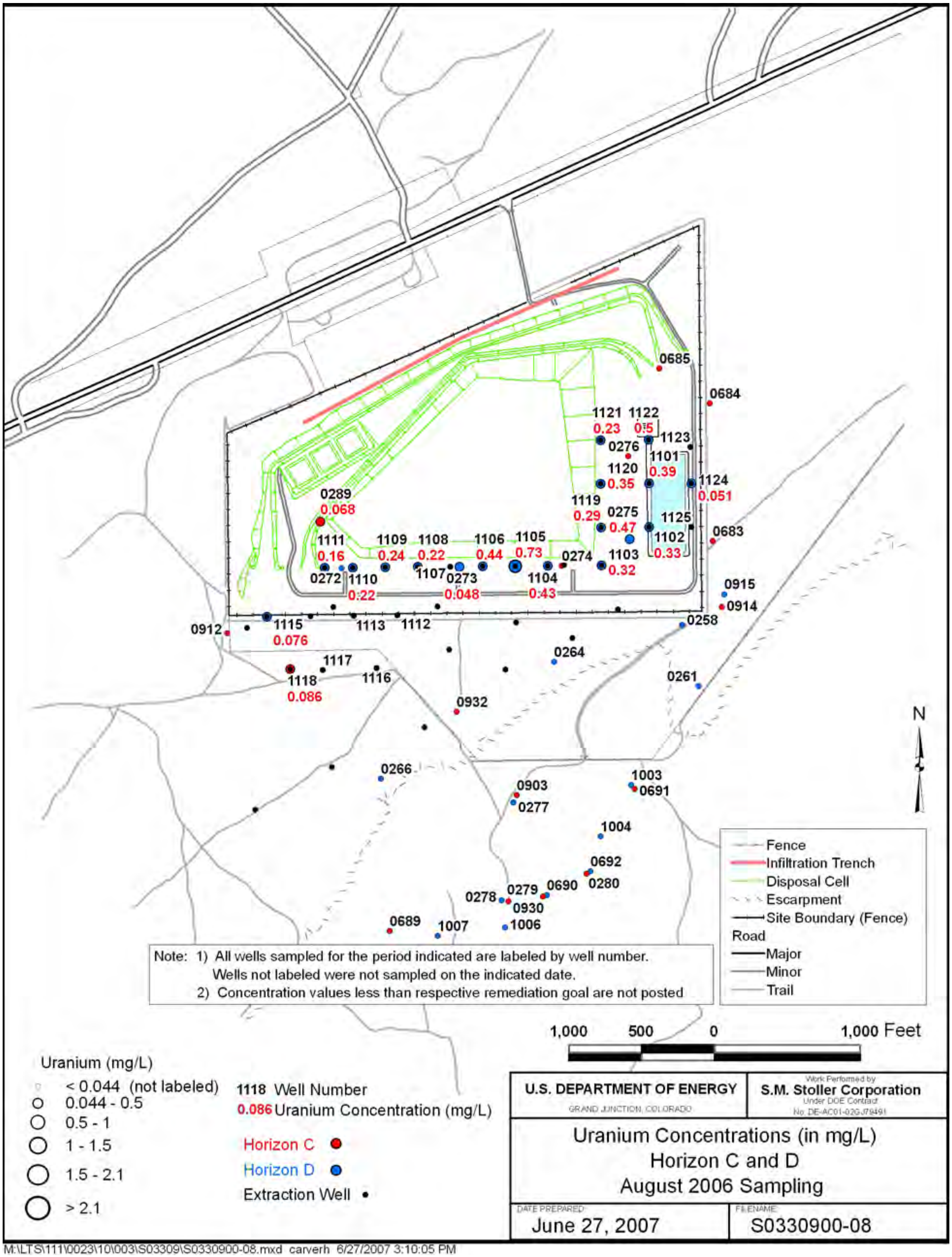

Figure 13b. Uranium Concentrations in Ground Water, Horizons C and D, August 2006

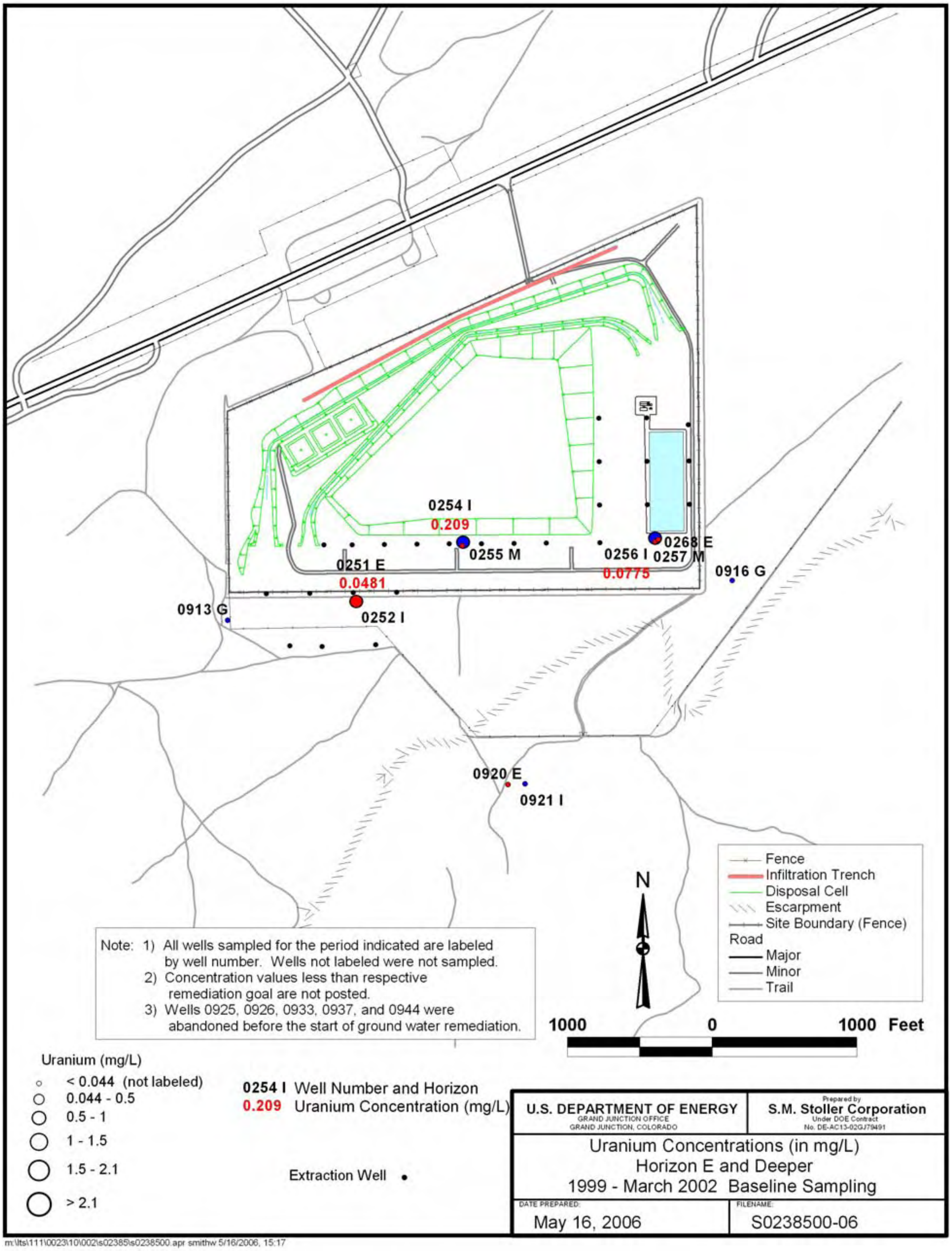

Figure 14a. Uranium Concentrations in Ground Water, Horizons E and Deeper, Baseline Period

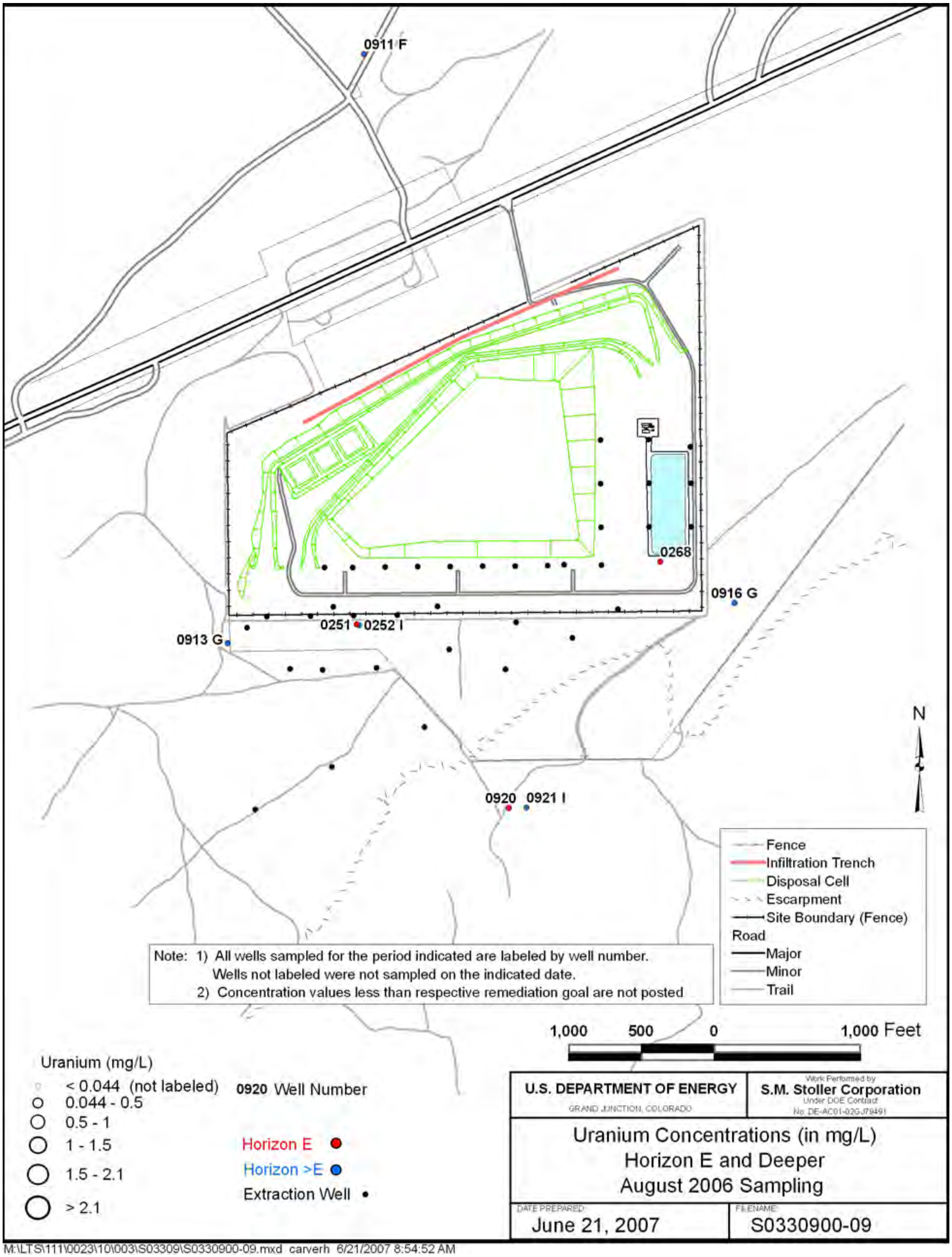

Figure 14b. Uranium Concentrations in Ground Water, Horizons E and Deeper, August 2006

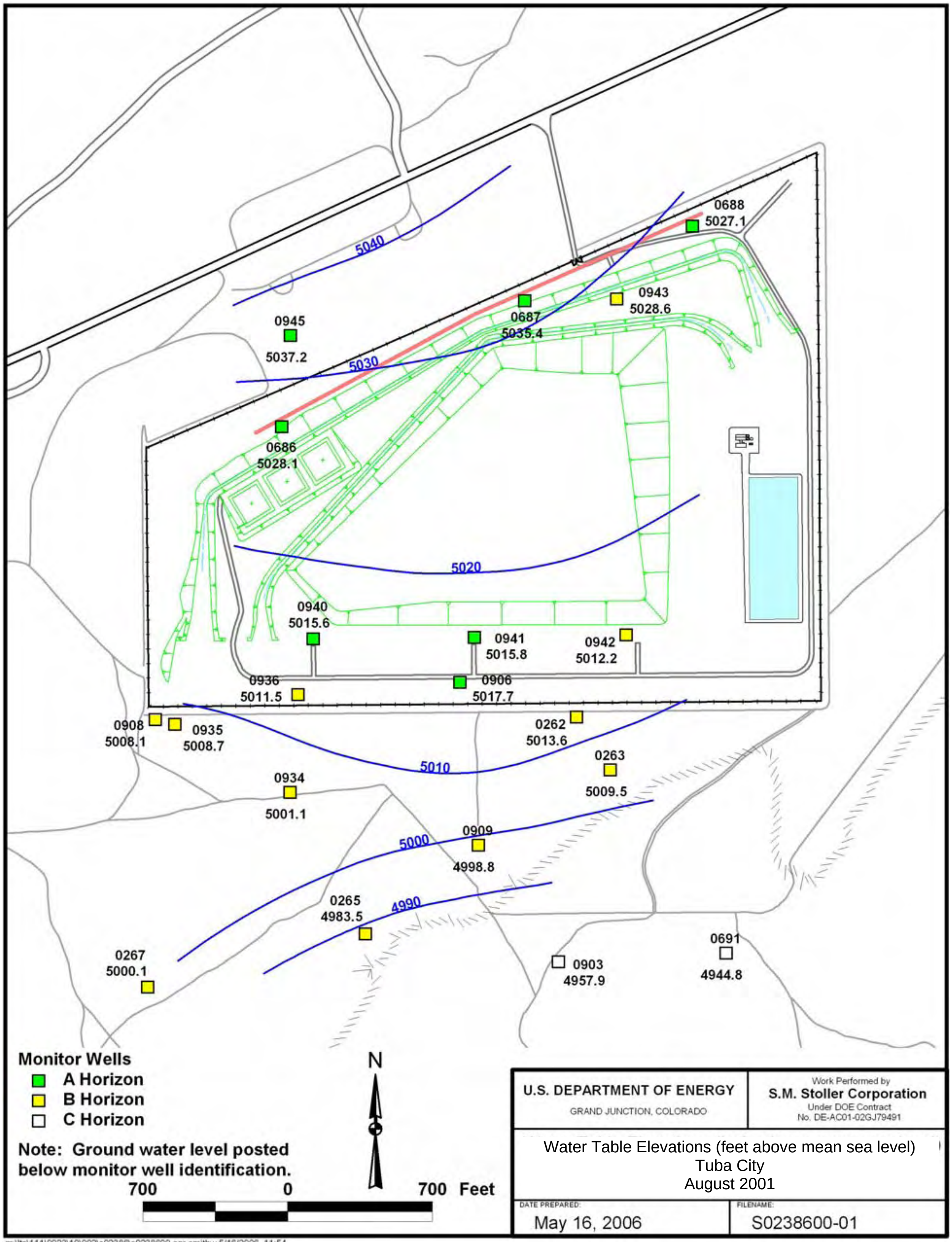

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Figure 15. Water Table Elevations (feet above mean sea level), Tuba City Site, August 2001

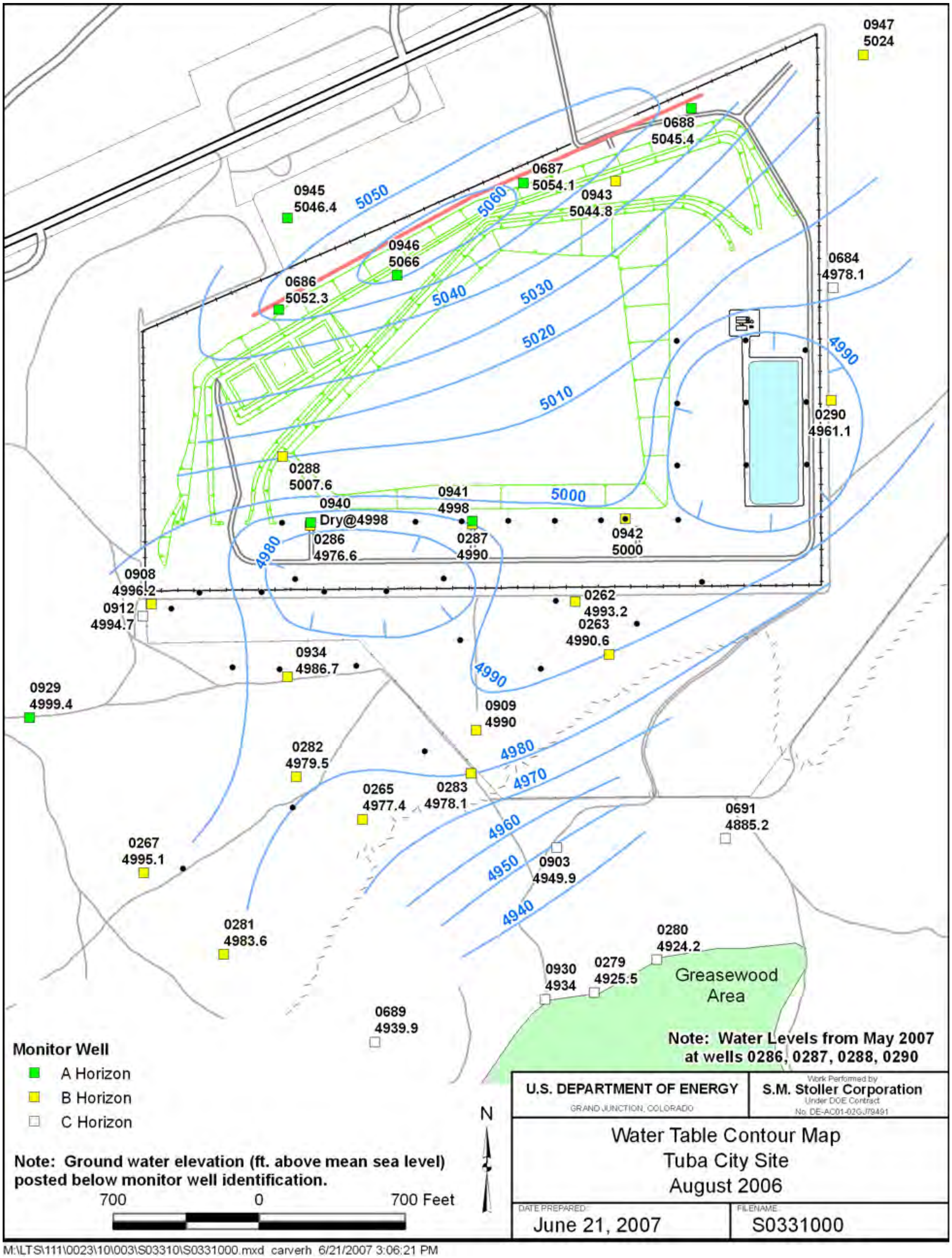

Figure 16. Water Table Contour Map, Tuba City Site, August 2006

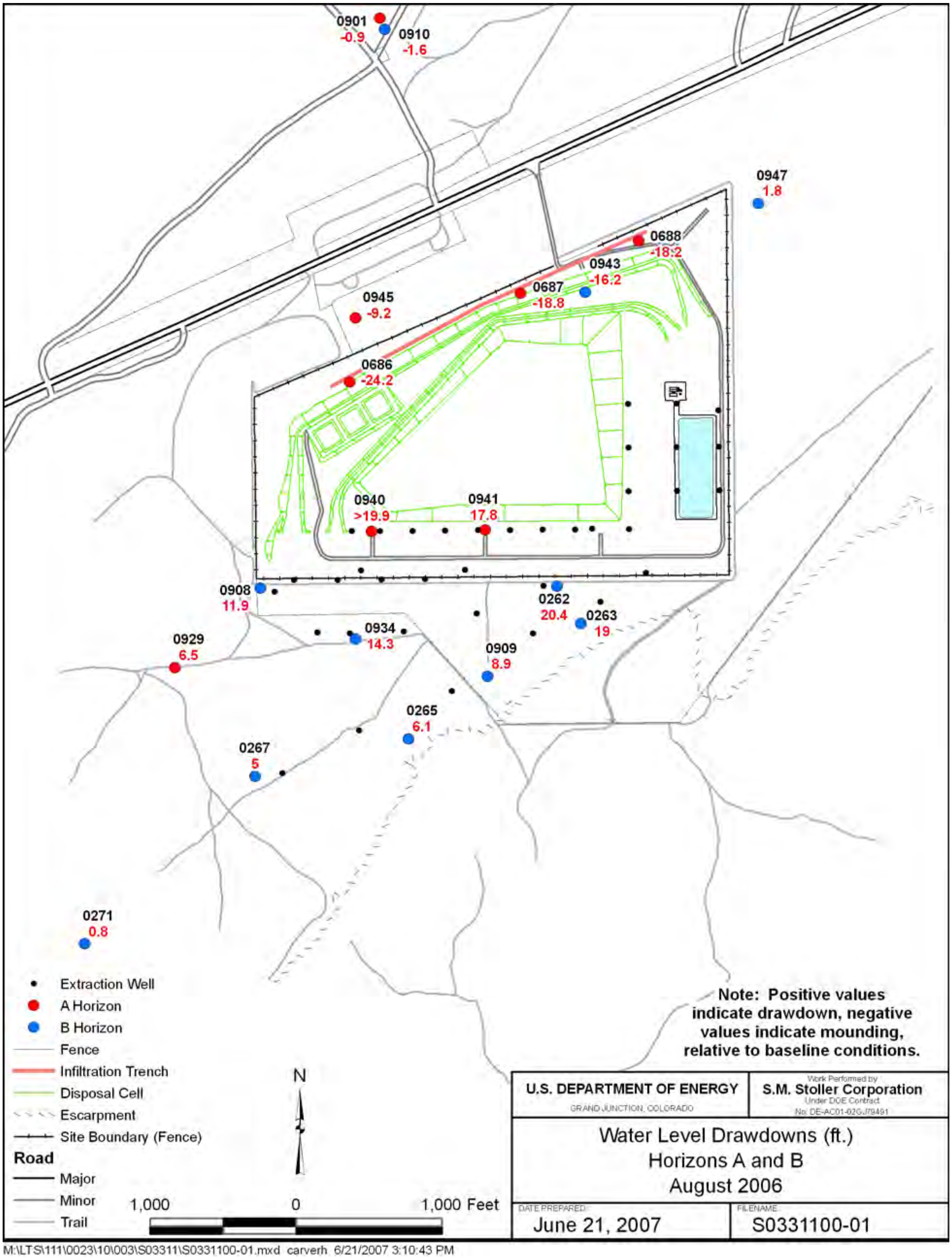

Figure 17. Water Level Drawdowns (feet), Horizons A and B, August 2005

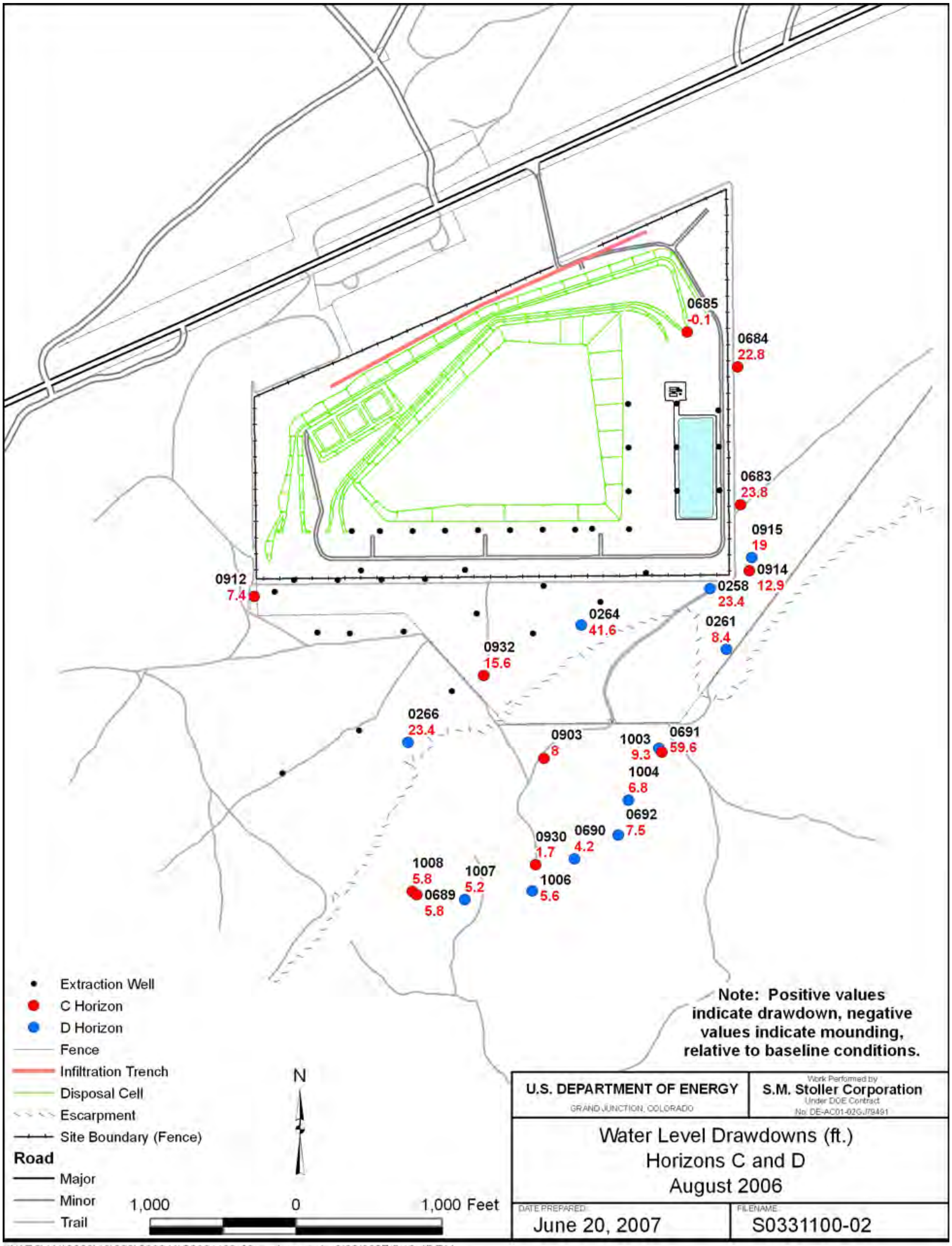

Figure 18. Water Level Drawdowns (feet), Horizons C and D, August 2006

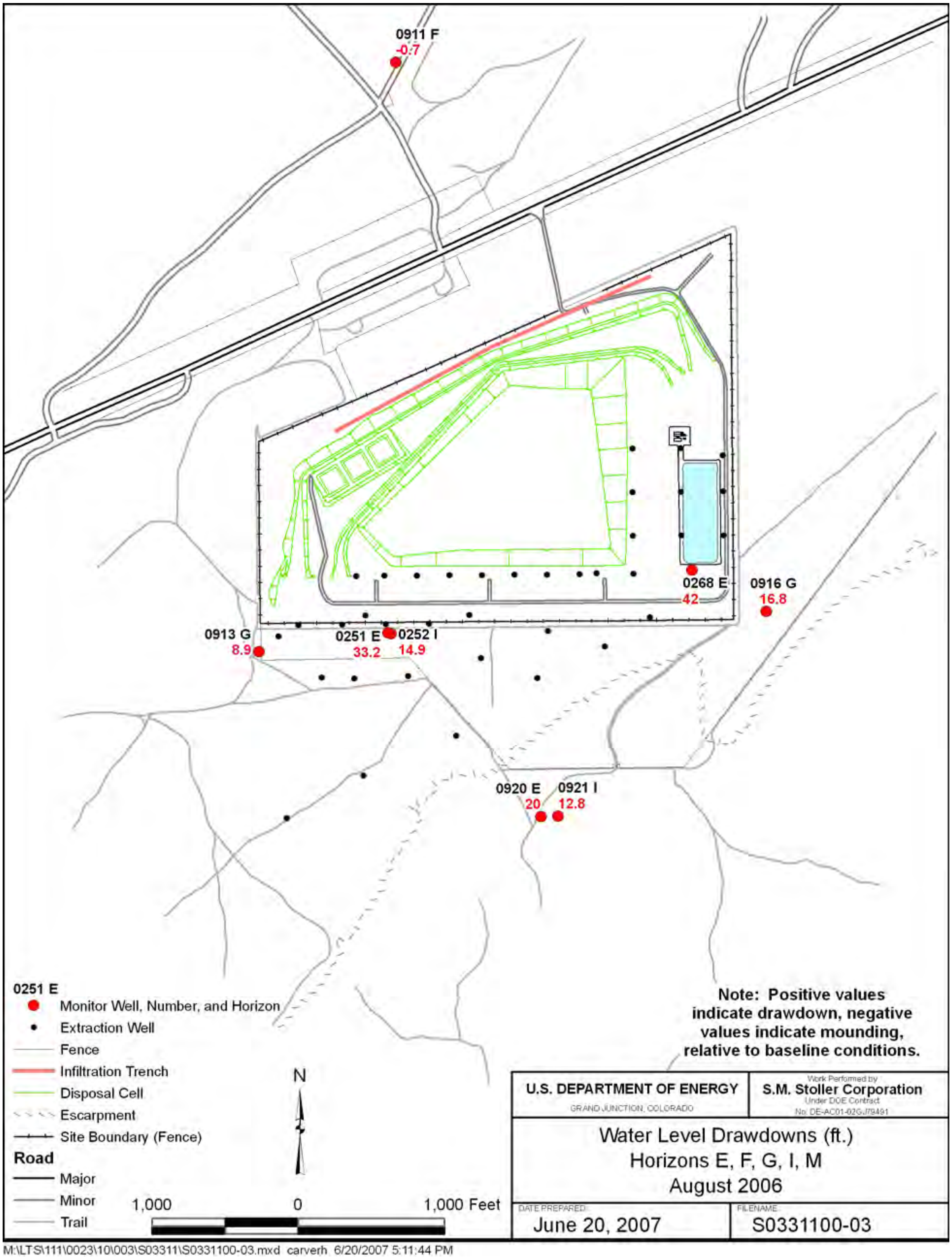

Figure 19. Water Level Drawdowns (feet), Horizons E, F, G, I, and M, August 2006

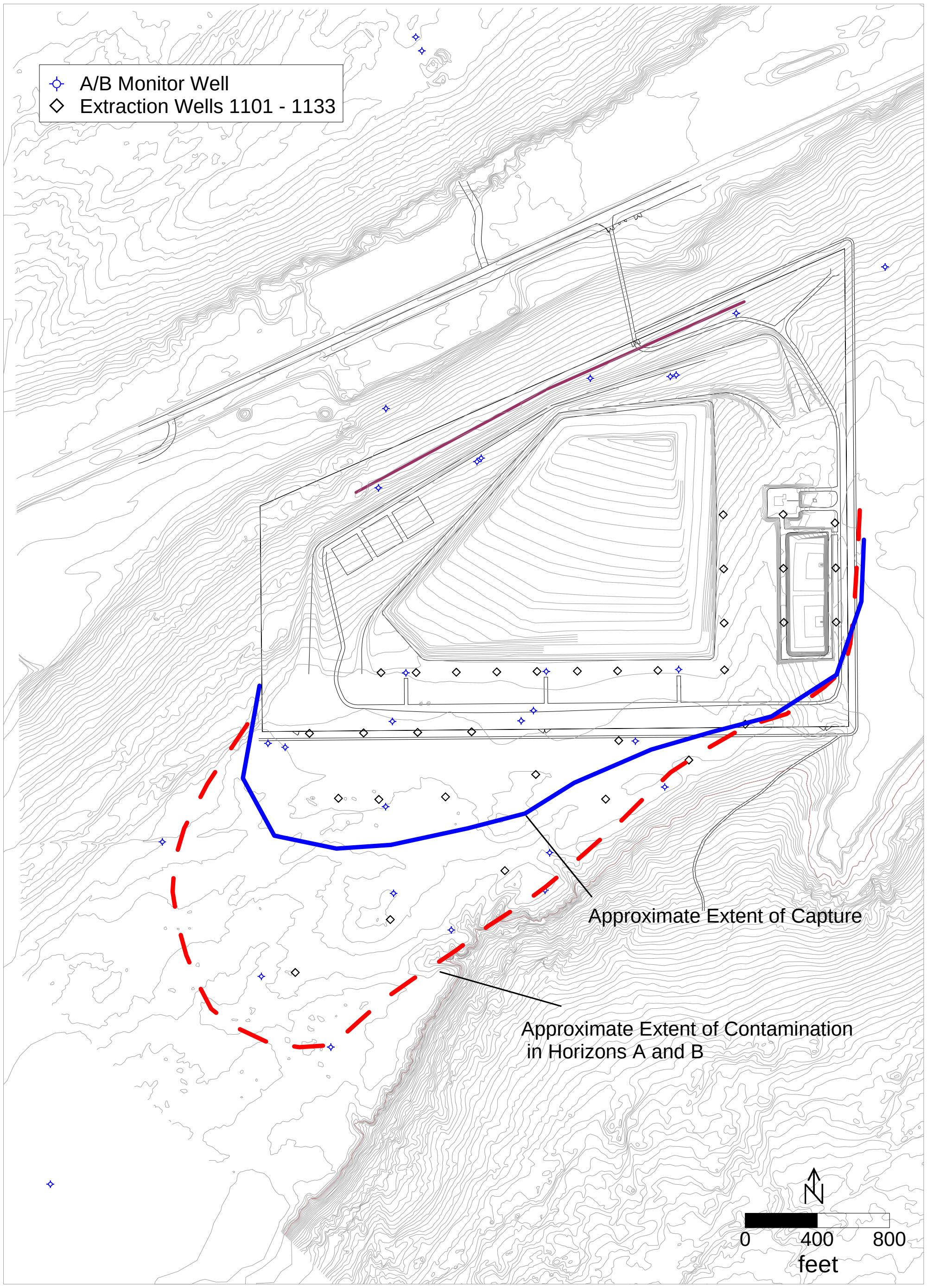

Figure 20. Extent of Ground Water Contamination and Extraction System Capture Zone: Horizons A and B

Tuba City Disposal Site (TUB01)

Nitrate as NO3 Concentration

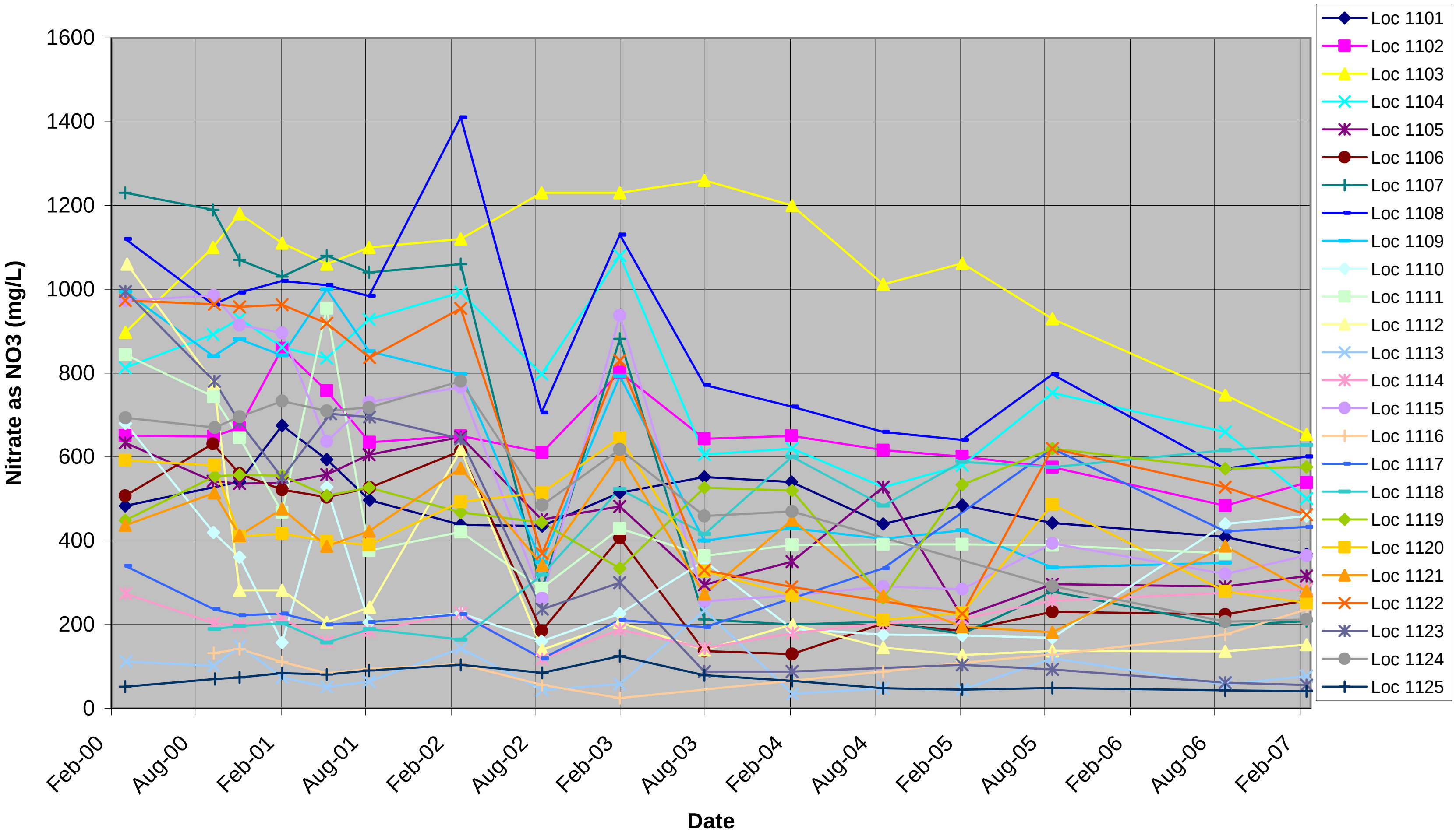

Figure 21. Nitrate Concentration Trends at Extraction Wells

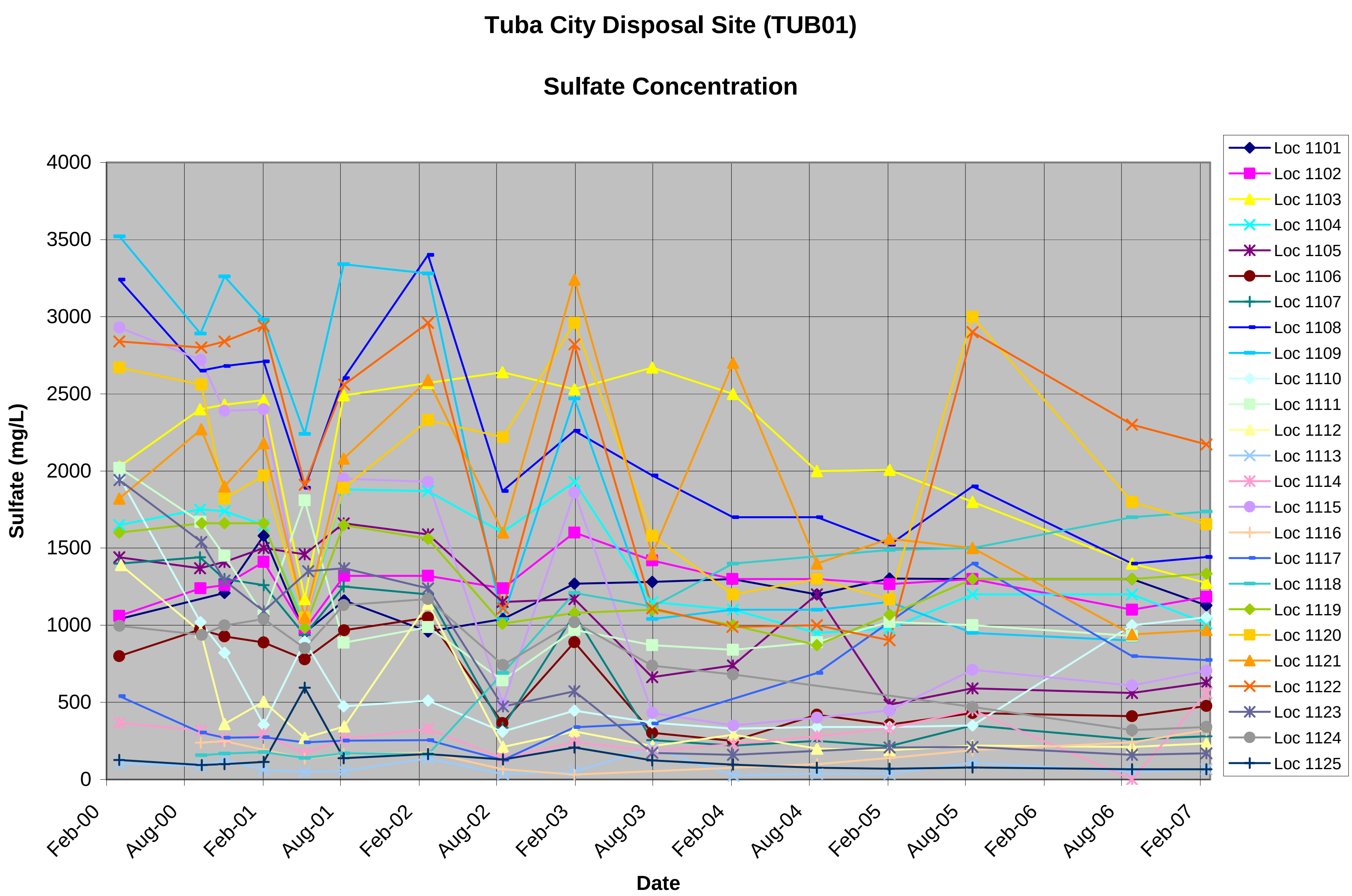

Figure 22. Sulfate Concentration Trends at Extraction Wells

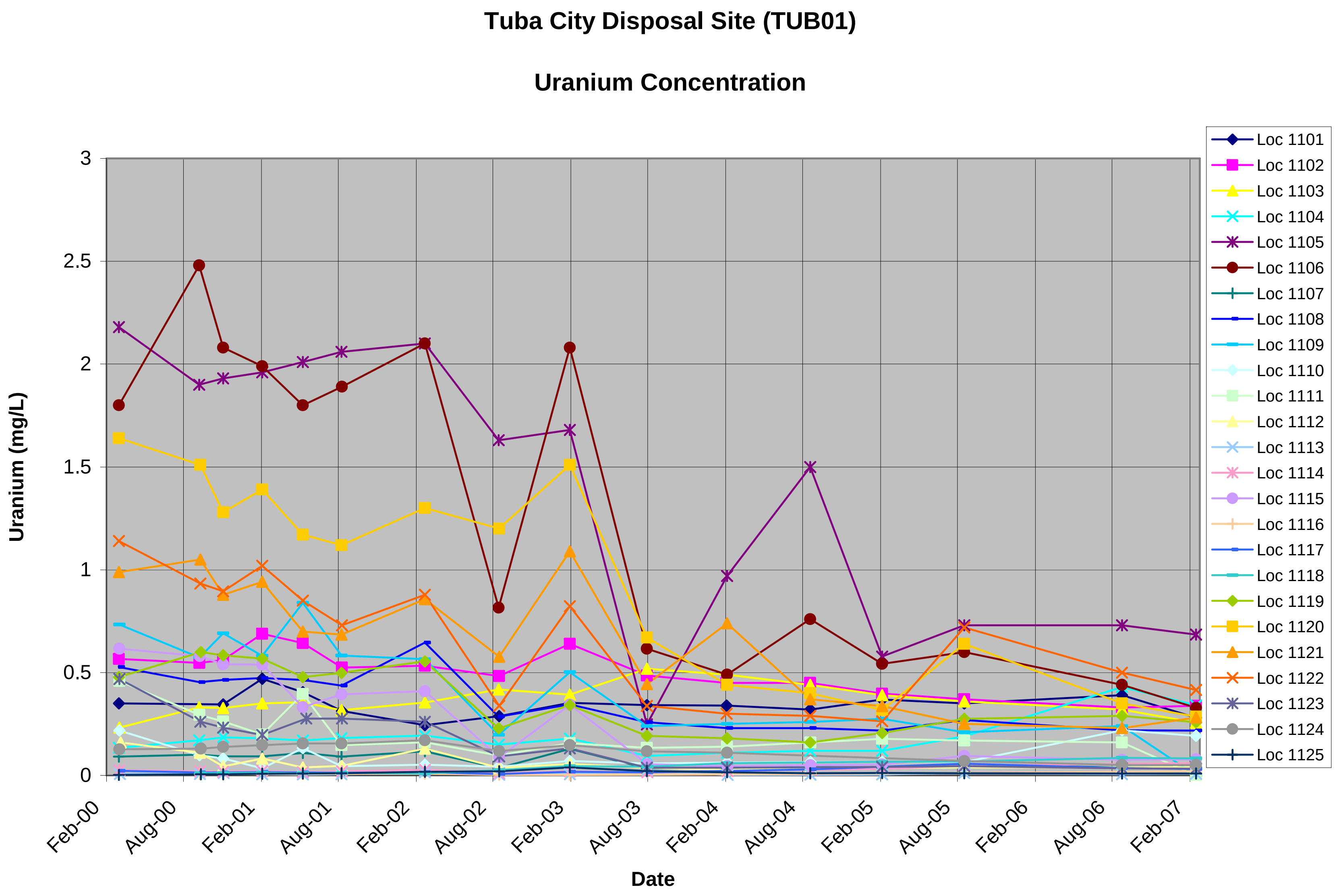

Figure 23. Uranium Concentration Trends at Extraction Wells

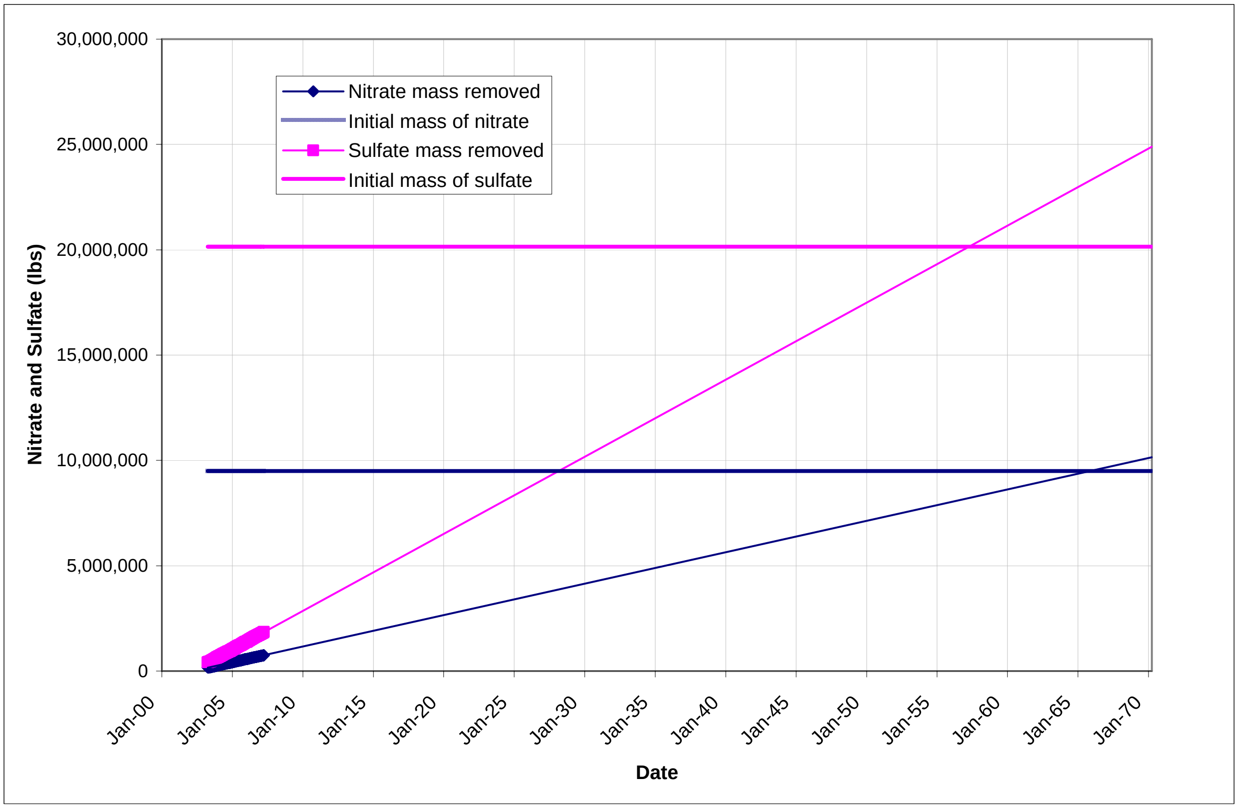

Figure 24. Nitrate and Sulfate Mass Removal Rate Projections

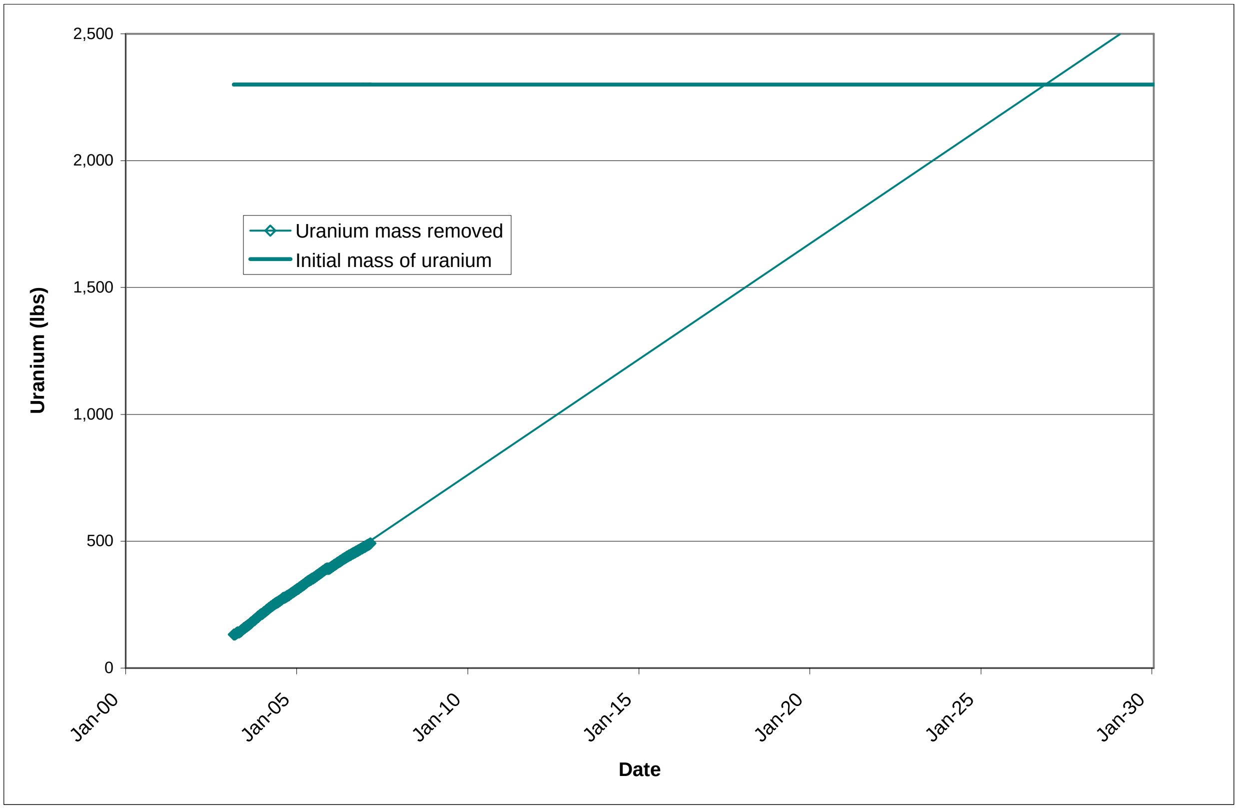

Figure 25. Uranium Mass Removal Rate Projection

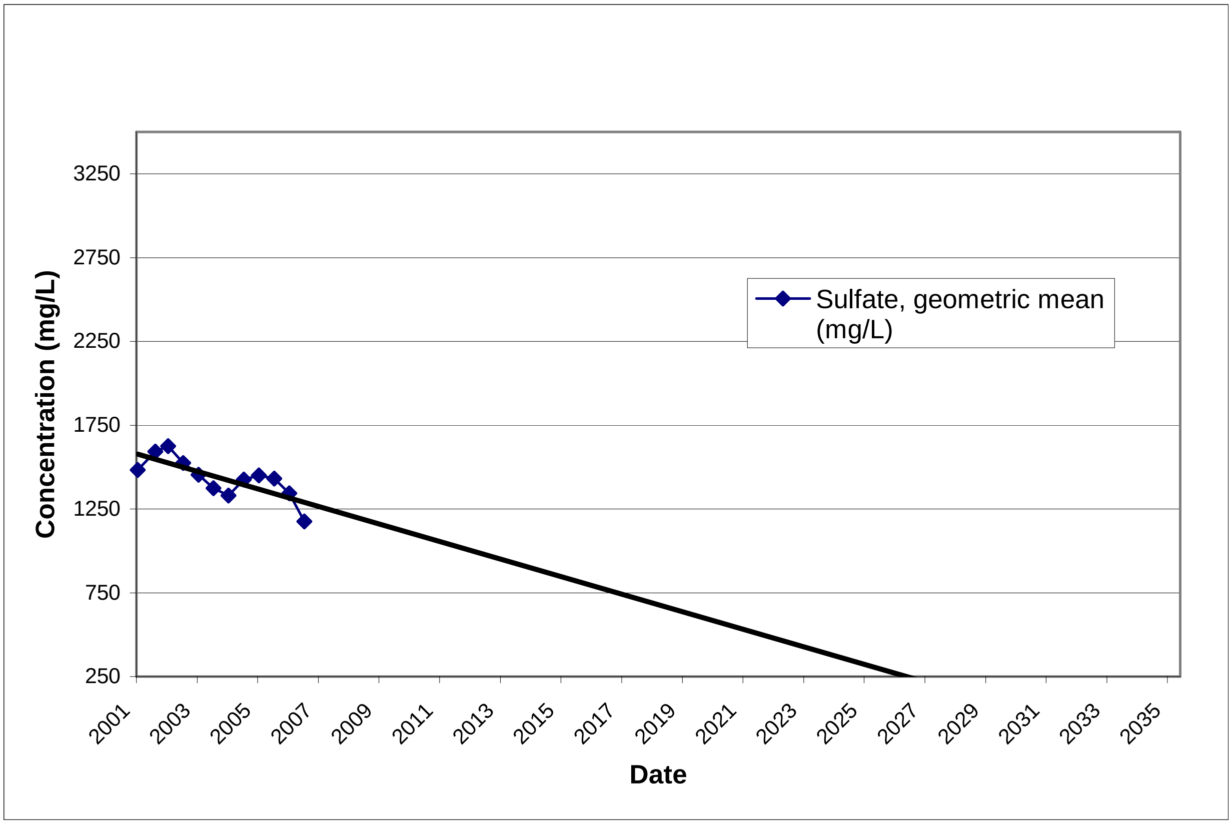

Figure 26. Bulk Restoration Trend for Sulfate

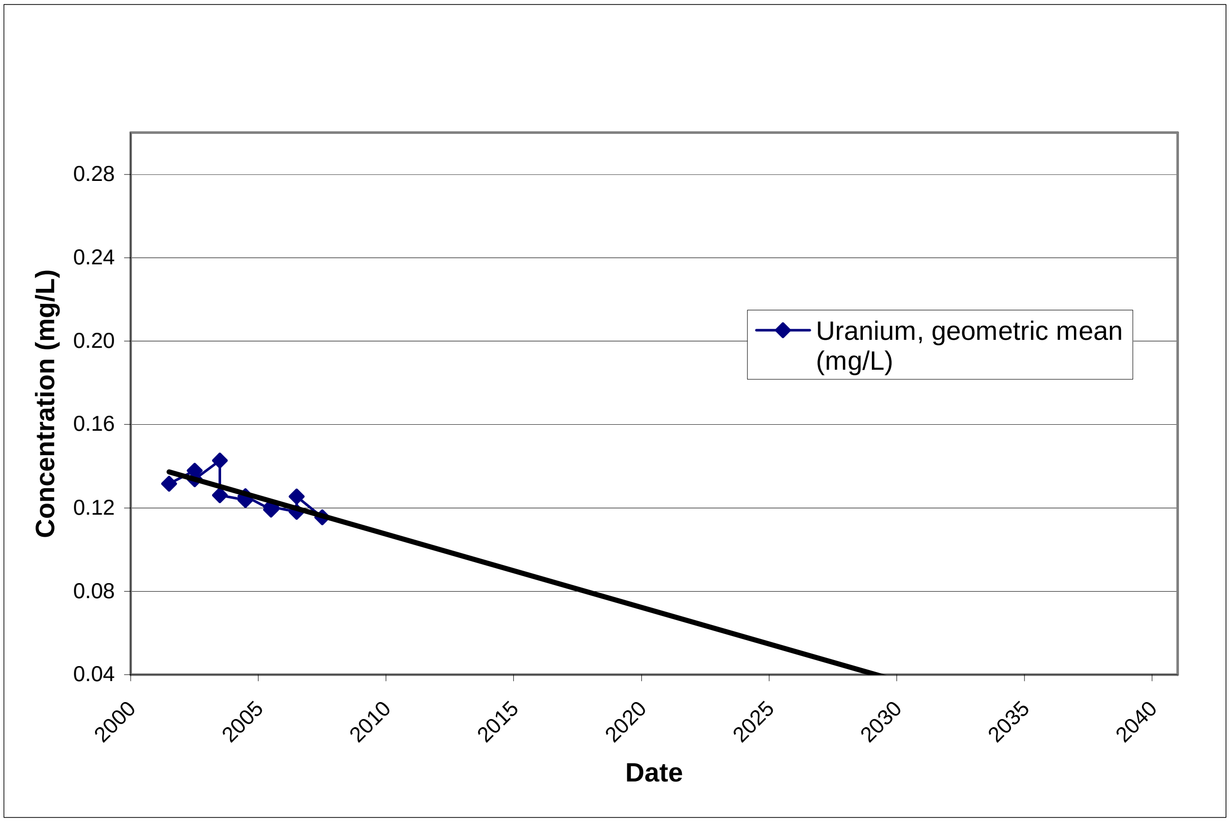

Figure 27. Bulk Restoration Trend for Uranium

Appendix A

Well Completion Information, Conceptual Site Model, and Extraction Well Operation Summary

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Table A−1. Well Completion Information

WELL	TYPE	Horizon	TOP OF SCREEN ELEV	MID SCREEN ELEV	BOTTOM OF SCREEN ELEV	TOP OF SCREEN DEPTH	MID SCREEN DEPTH	BOTTOM OF SCREEN DEPTH	SCREEN LENGTH	SUMP LENGTH	WELL DEPTH
0284	MW	A	5079.8	5074.8	5069.8	16.5	21.5	26.5	10.0	1.5	28.0
0285	MW	A	5090.8	5088.3	5085.8	3.0	5.5	8.0	5.0	0.1	8.1
0686	MW	A	5045.5	5025.5	5005.5	60.0	80.0	100.0	40.0	0.3	100.3
0687	MW	A	5047.6	5027.6	5007.6	60.0	80.0	100.0	40.0	0.3	100.3
0688	MW	A	5044.1	5024.1	5004.1	60.0	80.0	100.0	40.0	0.3	100.3
0901	MW	A	5045.8	5035.8	5025.8	58.0	68.0	78.0	20.0	2.0	80.0
0906	MW	A	5016.9	5006.9	4996.9	44.0	54.0	64.0	20.0	2.0	66.0
0907	MW	A	5010.7	5000.7	4990.7	66.5	76.5	86.5	20.0		
0928	MW	A	5022.1	5009.6	4997.1	30.0	42.5	55.0	25.0	3.0	58.0
0929	MW	A	5010.4	4990.4	4970.4	48.2	68.2	88.2	40.0		
0940	MW	A	5017.9	5010.4	5002.9	45.0	52.5	60.0	15.0	3.0	68.0
0941	MW	A	5018.0	5008.0	4998.0	45.0	55.0	65.0	20.0	3.0	68.0
0945	MW	A	5028.1	5018.1	5008.1	110.0	120.0	130.0	20.0	3.0	133.0
0946	MW	A	5057.6	5047.6	5037.6	40.0	50.0	60.0	20.0	3.3	63.3
0262	MW	B	4999.2	4979.2	4959.2	60.0	80.0	100.0	40.0	0.3	100.3
0263	MW	B	5000.2	4980.2	4960.2	60.0	80.0	100.0	40.0	0.3	100.3
0265	MW	B	4991.1	4971.1	4951.1	60.0	80.0	100.0	40.0	0.3	100.3
0267	MW	B	4990.8	4970.8	4950.8	60.0	80.0	100.0	40.0	0.3	100.3
0271	MW	B	4984.0	4964.0	4944.0	60.0	80.0	100.0	40.0	0.3	100.3
0281	MW	B	4977.8	4972.8	4967.8	70.5	75.5	80.5	10.0	1.5	82.0
0282	MW	B	4983.3	4978.3	4973.3	74.1	79.1	84.1	10.0	1.5	85.6
0283	MW	B	4984.8	4979.8	4974.8	70.5	75.5	80.5	10.0	1.5	82.0
0286	MW	B	4968.84	4963.8	4958.84	93.2	98.2	103.2	10.0	0.4	103.6
0287	MW	B	4962.29	4957.3	4952.29	100.7	105.7	110.7	10.0	0.4	111.1
0288	MW	B	4965.86	4960.9	4955.86	104.0	109.0	114.0	10.0	0.5	114.5
0290	MW	B	4964.33	4959.3	4954.33	102.7	107.7	112.7	10.0	0.4	113.1
0905	MW	B	5006.0	4998.5	4991.0	63.0	70.5	78.0	15.0	2.0	80.0
0908	MW	B	5005.3	4997.8	4990.3	52.0	59.5	67.0	15.0	2.0	69.0
0909	MW	B	4990.8	4983.3	4975.8	65.0	72.5	80.0	15.0	2.0	82.0
0910	MW	B	5007.6	4957.6	4907.6	97.0	147.0	197.0	100.0	1.0	198.0
0918	MW	B	4986.2	4983.7	4981.2	61.0	63.5	66.0	5.0	2.0	68.0
0925	EXT	B	5005.8	4985.8	4965.8	53.0	73.0	93.0	40.0	0.5	93.5
0926	EXT	B	5018.3	4993.3	4968.3	42.2	67.2	92.2	50.0	3.0	95.2
0933	MW	B	4993.3	4992.3	4991.3	23.0	24.0	25.0	2.0		
0934	MW	B	5013.0	4990.5	4968.0	45.0	67.5	90.0	45.0	3.0	93.0
0935	MW	B	5008.8	4988.8	4968.8	50.0	70.0	90.0	40.0	3.0	93.0
0936	MW	B	5017.9	4997.9	4977.9	42.0	62.0	82.0	40.0	3.0	85.0
0937	MW	B	5020.2	4992.7	4965.2	40.0	67.5	95.0	55.0	3.0	98.0
0938	MW	B	5020.4	4992.9	4965.4	40.0	67.5	95.0	55.0	3.0	98.0
0939	EXT	B	5021.1	4993.6	4966.1	40.0	67.5	95.0	55.0	3.0	98.0
0942	MW	B	5009.5	4999.5	4989.5	54.0	64.0	74.0	20.0	3.0	77.0
0943	MW	B	4994.1	4984.1	4974.1	101.0	111.0	121.0	20.0	3.0	124.0
0944	MW	B	4979.9	4969.9	4959.9	85.0	95.0	105.0	20.0	2.0	107.0
0947	MW	B	4990.0	4980.0	4970.0	105.0	115.0	125.0	20.0	3.3	128.3
1126	EXT	B	4991.9	4971.9	4951.9	60.0	80.0	100.0	40.0	3.3	103.3
1127	EXT	B	4984.2	4964.2	4944.2	72.7	92.7	112.7	40.0	3.3	116.0
1128	EXT	B	4982.3	4962.3	4942.3	72.7	92.7	112.7	40.0	3.3	116.0
1129	EXT	B	4990.9	4975.9	4960.9	68.2	83.2	98.2	30.0	3.3	101.5
1130	EXT	B	4987.3	4962.3	4937.3	71.7	96.7	121.7	50.0	3.3	125.0
1131	EXT	B	4998.1	4978.1	4958.1	59.7	79.7	99.7	40.0	3.3	103.0
1132	EXT	B	5009.1	4984.1	4959.1	49.7	74.7	99.7	50.0	3.3	103.0
1133	EXT	B	4999.4	4979.4	4959.4	59.7	79.7	99.7	40.0	3.3	103.0
0274	MW	C	4913.6	4903.6	4893.6	149.0	159.0	169.0	20.0	1.5	170.5
0276	MW	C	4910.0	4900.0	4890.0	154.5	164.5	174.5	20.0	1.5	176.0
0279	MW	C	4922.1	4917.1	4912.1	26.5	31.5	36.5	10.0	1.5	38.0
0280	MW	C	4922.6	4917.6	4912.6	26.5	31.5	36.5	10.0	1.5	38.0
0683	MW	C	4973.2	4948.2	4923.2	95.0	120.0	145.0	50.0	3.0	148.0
0684	MW	C	4943.1	4917.4	4891.8	124.2	149.9	175.5	51.3	2.5	178.0
0685	MW	C	4975.6	4949.7	4923.8	93.7	119.6	145.5	51.8	2.5	148.0
0689	MW	C	4923.9	4903.9	4883.9	55.0	75.0	95.0	40.0	0.3	95.3
0691	MW	C	4921.9	4901.9	4881.9	55.0	75.0	95.0	40.0	0.3	95.3
0903	MW	C	4953.5	4943.5	4933.5	28.0	38.0	48.0	20.0	2.0	50.0
0912	MW	C	4934.7	4914.7	4894.7	123.0	143.0	163.0	40.0	2.0	165.0
0914	MW	C	4930.3	4921.8	4913.3	137.2	145.7	154.2	17.0	2.0	156.2
0917	MW	C	4917.8	4907.8	4897.8	128.0	138.0	148.0	20.0	2.0	150.0
0930	MW	C	4933.0	4918.0	4903.0	20.0	35.0	50.0	30.0	3.0	53.0
0932	MW	C	4942.3	4932.3	4922.3	112.5	122.5	132.5	20.0	2.7	135.2
1008	INJ	C	4926.8	4901.6	4876.4	55.6	80.8	106.0	50.4	2.5	108.5
1116	EXT	C	4964.1	4912.5	4861.0	92.4	143.9	195.5	103.1	2.5	198.0
1117	EXT	C	4965.3	4913.7	4862.1	92.3	143.9	195.5	103.2	2.5	198.0

Table A−1 (continued). Well Completion Information

WELL	TYPE	Horizon	TOP OF SCREEN ELEV	MID SCREEN ELEV	BOTTOM OF SCREEN ELEV	TOP OF SCREEN DEPTH	MID SCREEN DEPTH	BOTTOM OF SCREEN DEPTH	SCREEN LENGTH	SUMP LENGTH	WELL DEPTH
1118	EXT	C	4967.9	4915.1	4862.3	89.9	142.7	195.5	105.6	2.5	198.0
0258	MW	D	4894.0	4874.0	4854.0	159.0	179.0	199.0	40.0	0.3	199.3
0261	MW	D	4907.0	4887.0	4867.0	160.0	180.0	200.0	40.0	0.3	200.3
0264	MW	D	4899.6	4879.6	4859.6	160.0	180.0	200.0	40.0	0.3	200.3
0266	MW	D	4890.6	4870.6	4850.6	160.0	180.0	200.0	40.0	0.3	200.3
0272	MW	D	4902.8	4892.8	4882.8	159.1	169.1	179.1	20.0	1.5	180.6
0273	MW	D	4909.4	4899.4	4889.4	153.0	163.0	173.0	20.0	1.5	174.5
0275	MW	D	4903.0	4893.0	4883.0	158.2	168.2	178.2	20.0	1.5	179.7
0277	MW	D	4884.0	4879.0	4874.0	95.7	100.7	105.7	10.0	1.5	107.2
0278	MW	D	4862.9	4857.9	4852.9	90.5	95.5	100.5	10.0	1.5	102.0
0690	MW	D	4893.3	4873.3	4853.3	55.0	75.0	95.0	40.0	0.3	95.3
0692	MW	D	4895.6	4875.6	4855.6	55.0	75.0	95.0	40.0	0.3	95.3
0695	MW	D	4919.3	4899.3	4879.3	55.0	75.0	95.0	40.0	0.3	95.3
0904	MW	D	4873.8	4868.8	4863.8	28.0	33.0	38.0	10.0	2.0	40.0
0915	MW	D	4897.8	4892.8	4887.8	170.0	175.0	180.0	10.0	2.0	182.0
1003	INJ	D	4923.4	4898.4	4873.4	55.5	80.5	105.5	50.0	2.5	108.0
1004	INJ	D	4918.1	4893.1	4868.1	45.5	70.5	95.5	50.0	2.5	98.0
1005	INJ	D	4904.7	4879.7	4854.7	45.5	70.5	95.5	50.0	2.5	98.0
1006	INJ	D	4903.7	4878.7	4853.7	45.7	70.7	95.7	50.0	2.5	98.2
1007	INJ	D	4915.6	4890.5	4865.4	45.8	70.9	96.0	50.2	2.5	98.5
1101	EXT	D	4974.2	4896.5	4818.9	96.1	173.8	251.5	155.4	2.5	254.0
1102	EXT	D	4968.8	4893.8	4818.8	101.5	176.5	251.5	150.0	2.5	254.0
1103	EXT	D	4962.3	4887.3	4812.3	100.0	175.0	250.0	150.0	2.5	252.5
1104	EXT	D	4972.3	4894.8	4817.3	90.0	167.5	245.0	155.0	3.0	248.0
1105	EXT	D	4972.1	4894.6	4817.1	90.0	167.5	245.0	155.0	3.0	248.0
1106	EXT	D	4966.0	4888.7	4811.4	96.5	173.8	251.1	154.6	2.9	254.0
1107	EXT	D	4971.2	4894.0	4816.8	91.1	168.3	245.5	154.4	2.5	248.0
1108	EXT	D	4966.1	4891.1	4816.1	96.3	171.3	246.3	150.0	2.5	248.8
1109	EXT	D	4972.1	4894.7	4817.3	90.3	167.7	245.1	154.8	2.9	248.0
1110	EXT	D	4966.8	4891.8	4816.8	95.5	170.5	245.5	150.0	2.5	248.0
1111	EXT	D	4971.9	4894.7	4817.5	90.7	167.9	245.1	154.4	2.5	247.6
1112	EXT	D	4969.1	4891.6	4814.1	90.5	168.0	245.5	155.0	2.5	248.0
1113	EXT	D	4968.7	4891.2	4813.7	90.5	168.0	245.5	155.0	2.5	248.0
1114	EXT	D	4968.5	4891.0	4813.6	90.6	168.0	245.5	154.9	2.5	248.0
1115	EXT	D	4968.6	4891.2	4813.7	90.5	168.0	245.5	155.0	2.5	248.0
1119	EXT	D	4968.7	4893.7	4818.7	95.3	170.3	245.3	150.0	2.5	247.8
1120	EXT	D	4971.0	4896.0	4821.0	95.5	170.5	245.5	150.0	2.5	248.0
1121	EXT	D	4972.0	4897.0	4822.0	97.5	172.5	247.5	150.0	2.5	250.0
1122	EXT	D	4973.4	4896.3	4819.2	96.9	174.0	251.1	154.2	2.9	254.0
1123	EXT	D	4976.2	4899.2	4822.2	91.0	168.0	245.0	154.0	3.0	248.0
1124	EXT	D	4978.7	4899.9	4821.1	87.9	166.7	245.5	157.6	2.5	248.0
1125	EXT	D	4972.8	4897.8	4822.8	95.5	170.5	245.5	150.0	2.5	248.0
0251	MW	E	4858.9	4808.9	4758.9	200.0	250.0	300.0	100.0	0.3	300.3
0268	MW	E	4864.5	4814.5	4764.5	200.0	250.0	300.0	100.0	0.3	300.3
0920	MW	E	4866.0	4846.0	4826.0	114.4	134.4	154.4	40.0	2.0	156.4
0948	EXDS	E	4893.9	4803.9	4713.9	221.5	311.5	401.5	180.0	5.0	406.5
0911	MW	F	4795.2	4775.2	4755.2	309.4	329.4	349.4	40.0	2.0	351.4
0913	MW	G	4729.2	4709.2	4689.2	328.7	348.7	368.7	40.0	2.0	370.7
0916	MW	G	4721.7	4716.7	4711.7	345.7	350.7	355.7	10.0	2.0	357.7
0919	MW	G	4707.9	4702.9	4697.9	337.7	342.7	347.7	10.0	2.0	349.7
0902	MW	H	4673.7	4668.7	4663.7	63.0	68.0	73.0	10.0	2.0	75.0
0252	MW	I	4658.9	4608.9	4558.9	400.0	450.0	500.0	100.0	0.4	500.4
0254	MW	I	4662.7	4612.7	4562.7	400.0	450.0	500.0	100.0	0.4	500.4
0256	MW	I	4664.0	4614.0	4564.0	400.0	450.0	500.0	100.0	0.4	500.4
0921	MW	I	4663.7	4643.7	4623.7	313.2	333.2	353.2	40.0	2.0	355.2
0253	MW	M	4458.8	4408.8	4358.8	600.0	650.0	700.0	100.0	0.4	700.4
0255	MW	M	4462.3	4412.3	4362.3	600.0	650.0	700.0	100.0	0.4	700.4
0257	MW	M	4463.4	4413.4	4363.4	600.0	650.0	700.0	100.0	0.4	700.4
0968	EXDS		5000.4	4699.9	4399.4	106.0	406.5	707.0	601.0	0.0	707.0
0970	EXDS		5007.7	4705.2	4402.7	100.0	402.5	705.0	605.0	0.0	705.0
0971	EXDS		4985.3	4693.8	4402.3	117.0	408.5	700.0	583.0	0.0	700.0
0972	EXDS		5039.7	4724.7	4409.7	100.0	415.0	730.0	630.0	0.0	730.0

Table A−1 (continued). Well Completion Information

WELL	TYPE	Horizon	TOP OF CASING ELEV		GROUND ELEV		WELL DIAMETER	BORING STARTED	DECOMMISSION DATE	STATE PLANE EAST	STATE PLANE NORTH
0284	MW	A	5098.72		5096.3		2	16-Aug-04		730525	1873562
0285	MW	A	5096.47		5093.8		2	16-Aug-04		731629	1874042
0686	MW	A	5107.97		5105.5		2	28-Mar-00		729978	1873416
0687	MW	A	5109.82		5107.6		2	29-Mar-00		731152	1874024
0688	MW	A	5106.98		5104.1		2	29-Mar-00		731961	1874385
0901	MW	A	5105.46		5103.8		2	16-Oct-84		730185	1875918
0906	MW	A	5062.10		5060.9		2	19-Nov-84		730838	1872181
0907	MW	A	5079.17		5077.2		2	30-Nov-84	19-Apr-88	731252	1872920
0928	MW	A	5053.99		5052.1		4	20-Oct-95	24-May-00	729401	1870814
0929	MW	A	5060.82		5058.6		4			728780	1871453
0940	MW	A	5064.77		5062.9		4	01-Nov-95		730130	1872391
0941	MW	A	5065.97		5063.0		4	10-Nov-95		730908	1872398
0945	MW	A	5140.49		5138.1		4	11-Oct-95		730019	1873857
0946	MW	A	5100.50		5097.6		4	02-Nov-95		730547	1873582
0262	MW	B	5061.99		5059.2		2	03-Apr-00		731402	1872012
0263	MW	B	5063.10		5060.2		2	04-Apr-00		731565	1871757
0265	MW	B	5053.88		5051.1		2	16-Apr-00		730382	1870964
0267	MW	B	5053.40		5050.8		2	14-Apr-00		729329	1870707
0271	MW	B	5046.72		5044.0		2	29-Apr-00		728160	1869555
0281	MW	B	5051.00		5048.3		2	11-Aug-04		729714	1870315
0282	MW	B	5060.04		5057.4		2	10-Aug-04		730062	1871168
0283	MW	B	5057.97		5055.3		2	03-Aug-04		730901	1871185
0286	MW	B	5063.99		5062.0		2	13-Mar-07		730128	1872377
0287	MW	B	5065.65		5063.0		2	15-Mar-07		730908	1872386
0288	MW	B	5072.54		5069.9		2	18-Mar-07		729995	1872709
0290	MW	B	5068.91		5067.0		2	17-Mar-07		732633	1872979
0905	MW	B	5072.80		5069.0		2	14-Nov-84	24-May-00	732933	1873200
0908	MW	B	5058.14		5057.3		2	17-Nov-84		729366	1871999
0909	MW	B	5057.17		5055.8		2	18-Nov-84		730927	1871393
0910	MW	B	5106.70		5104.6		4	26-Jul-85		730219	1875840
0918	MW	B	5049.63		5047.2		4	15-Aug-85		727294	1868724
0925	EXT	B	5060.87		5058.8		6	21-Oct-95	24-May-00	729452	1872006
0926	EXT	B	5062.85		5060.5		6	25-Oct-95	17-May-00	730790	1872126
0933	MW	B	5018.03		5016.3		4	18-Oct-95	24-May-00	731727	1871341
0934	MW	B	5059.73		5058.0		4	02-Nov-95		730018	1871649
0935	MW	B	5061.50		5058.8		4	28-Oct-95	*	729461	1871978
0936	MW	B	5062.30		5059.9		6	26-Oct-95	*	730055	1872121
0937	MW	B	5062.80		5060.2		4	09-Nov-95	24-May-00	730790	1872116
0938	MW	B	5063.64		5060.4		4	26-Oct-95	*	730769	1872124
0939	EXT	B	5063.23		5061.1		6	23-Oct-95	16-May-00	731403	1872132
0942	MW	B	5066.45		5063.5		4	03-Nov-95	*	731642	1872409
0943	MW	B	5098.05		5095.1		4	13-Oct-95		731596	1874034
0944	MW	B	5067.00		5064.9		4	04-Nov-95	28-Jul-99	732199	1873007
0947	MW	B	5097.01		5095.0		4	03-Nov-95		732786	1874642
1126	EXT	B	*5051.9*	**	*5051.9*	**	4	09-Sep-04		729517	1870728
1127	EXT	B	*5056.9*	**	*5056.9*	**	4	11-Sep-04		730044	1871022
1128	EXT	B	*5055.0*	**	*5055.0*	**	4	12-Sep-04		730679	1871294
1129	EXT	B	*5059.1*	**	*5059.1*	**	4	30-Aug-04		731237	1871690
1130	EXT	B	*5059.0*	**	*5059.0*	**	4	29-Jul-04		731699	1871907
1131	EXT	B	*5057.8*	**	*5057.8*	**	4	08-Sep-04		732011	1872106
1132	EXT	B	*5058.8*	**	*5058.8*	**	4	31-Aug-04		731310	1872015
1133	EXT	B	*5059.1*	**	*5059.1*	**	4	02-Sep-04		730850	1871827
0274	MW	C	5064.42		5062.6		2	30-Aug-04		731623	1872403
0276	MW	C	5067.55		5064.5		2	01-Sep-04		732081	1873158
0279	MW	C	4951.04		4948.6		2	15-Aug-04		731494	1870132
0280	MW	C	4951.52		4949.1		2	15-Aug-04		731794	1870289
0683	MW	C	5070.64		5068.2		6	31-Aug-99		732661	1872574
0684	MW	C	5070.05		5067.3		6	20-Aug-99		732642	1873521
0685	MW	C	5072.44		5069.3		6	19-Aug-99		732295	1873760
0689	MW	C	4981.63		4978.9		2	31-Mar-00		730439	1869893
0691	MW	C	4979.41		4976.9		2	30-Mar-00		732124	1870872
0903	MW	C	4983.33		4981.5		2	30-Oct-84		731314	1870829
0912	MW	C	5059.97		5057.7		4	12-Aug-85		729324	1871942
0914	MW	C	5070.10		5067.5		4	16-Aug-85		732723	1872119
0917	MW	C	5048.02		5045.8		4	14-Aug-85		727255	1868642
0930	MW	C	4954.96		4953.0		4	23-Oct-95		731257	1870099
0932	MW	C	5057.32		5054.8		4	29-Oct-95		730900	1871401
1008	INJ	C	4980.52		4982.3		6	23-Jul-99		730410	1869916
1116	EXT	C	5053.74		5056.5		6	08-Aug-99		730350	1871702
1117	EXT	C	5054.95		5057.6		6	11-Aug-99		729981	1871688

Table A−1 (continued). Well Completion Information

WELL	TYPE	Horizon	TOP OF CASING ELEV	GROUND ELEV	WELL DIAMETER	BORING STARTED	DECOMMISSION DATE	STATE PLANE EAST	STATE PLANE NORTH
1118	EXT	C	5055.11	5057.8	6	12-Aug-99		729756	1871695
0258	MW	D	5055.56	5053.0	2	13-Apr-00		732452	1871996
0261	MW	D	5069.69	5067.0	2	01-Apr-00		732565	1871578
0264	MW	D	5062.19	5059.6	2	03-Apr-00		731569	1871746
0266	MW	D	5053.32	5050.6	2	15-Apr-00		730380	1870941
0272	MW	D	5064.24	5061.9	2	28-Aug-04		730112	1872389
0273	MW	D	5064.74	5062.4	2	29-Aug-04		730922	1872397
0275	MW	D	5062.64	5061.2	2	01-Sep-04		732092	1872586
0277	MW	D	4982.35	4979.7	2	12-Aug-04		731290	1870777
0278	MW	D	4956.09	4953.4	2	14-Aug-04		731210	1870104
0690	MW	D	4950.87	4948.3	2	30-Mar-00		731521	1870140
0692	MW	D	4953.31	4950.6	2	05-Apr-00		731821	1870303
0695	MW	D	4976.83	4974.3	2	06-Apr-00		732566	1870896
0904	MW	D	4904.11	4901.8	2	07-Nov-84		731808	1868036
0915	MW	D	5070.84	5067.8	4	24-Aug-85		732740	1872209
1003	INJ	D	4976.58	4978.9	6	26-Jul-99		732101	1870898
1004	INJ	D	4961.55	4963.6	6	27-Jul-99		731892	1870544
1005	INJ	D	4947.83	4950.2	6	25-Jul-99		731496	1870168
1006	INJ	D	4947.08	4949.5	6	24-Jul-99		731233	1869918
1007	INJ	D	4958.56	4961.4	6	23-Jul-99		730770	1869861
1101	EXT	D	5067.29	5070.4	6	24-Aug-99		732223	1872970
1102	EXT	D	5066.76	5070.3	6	24-Aug-99		732225	1872670
1103	EXT	D	5059.56	5062.3	6	30-Jul-99		731896	1872407
1104	EXT	D	5059.57	5062.3	6	01-Aug-99		731527	1872404
1105	EXT	D	5059.33	5062.1	6	02-Aug-99		731304	1872401
1106	EXT	D	5059.73	5062.5	6	03-Aug-99		731081	1872400
1107	EXT	D	5059.51	5062.3	6	03-Aug-99		730858	1872398
1108	EXT	D	5059.62	5062.4	6	03-Aug-99		730634	1872396
1109	EXT	D	5059.64	5062.4	6	04-Aug-99		730410	1872394
1110	EXT	D	5059.47	5062.3	6	07-Aug-99		730187	1872392
1111	EXT	D	5059.87	5062.6	6	06-Aug-99		729993	1872392
1112	EXT	D	5057.08	5059.6	6	17-Aug-99		730494	1872064
1113	EXT	D	5058.54	5059.2	6	17-Aug-99		730196	1872061
1114	EXT	D	5056.25	5059.1	6	11-Aug-99		729896	1872057
1115	EXT	D	5056.36	5059.2	6	07-Aug-99		729596	1872055
1119	EXT	D	5061.19	5064.0	6	31-Jul-99		731894	1872667
1120	EXT	D	5063.60	5066.5	6	28-Jul-99		731891	1872967
1121	EXT	D	5066.61	5069.5	6	28-Jul-99		731889	1873267
1122	EXT	D	5067.31	5070.3	6	26-Aug-99		732221	1873269
1123	EXT	D	5064.54	5067.2	6	02-Sep-99		732508	1873222
1124	EXT	D	5063.86	5066.6	6	23-Aug-99		732512	1872972
1125	EXT	D	5065.47	5068.3	6	25-Aug-99		732515	1872671
0251	MW	E	5061.25	5058.9	2	28-Apr-00		730215	1871999
0268	MW	E	5067.24	5064.5	2	15-May-00		732301	1872430
0920	MW	E	4982.97	4980.4	4	30-Jul-85		731262	1870737
0948	EXDS	E	5117.80	5115.4	4	17-Oct-95		733915	1875516
0911	MW	F	5106.96	5104.6	4	18-Jul-85		730265	1875920
0913	MW	G	5060.16	5057.9	4	02-Aug-85		729327	1871871
0916	MW	G	5070.00	5067.4	4	22-Aug-85		732811	1872146
0919	MW	G	5048.56	5045.6	4	26-Aug-85		727353	1868654
0902	MW	H	4737.42	4736.7	2	02-Dec-84		730179	1862292
0252	MW	I	5061.30	5058.9	4	26-Apr-00		730232	1871993
0254	MW	I	5065.38	5062.7	4	03-May-00		730951	1872411
0256	MW	I	5066.58	5064.0	4	13-May-00		732277	1872437
0921	MW	I	4979.08	4976.9	4	22-Jul-85		731379	1870742
0253	MW	M	5061.11	5058.8	4	18-Apr-00	11-Apr-01	730213	1871974
0255	MW	M	5064.89	5062.3	4	01-May-00		730947	1872387
0257	MW	M	5066.40	5063.4	4	11-May-00		732278	1872414
0968	EXDS		5107.00	5106.4	10			730180	1875689
0970	EXDS		5109.53	5107.7	10			730653	1876567
0971	EXDS		5104.00	5102.3	10			731590	1878306
0972	EXDS		5141.07	5139.7	10			728031	1877986

ALL DIMENSIONS IN FEET EXCEPT WELL DIAMETER IN INCHES
ALL DEPTHS ARE RELATIVE TO GROUND SURFACE
* CONVERTED TO EXT 8/05
MW MONITOR WELL
EXT GROUND WATER REMEDIATION EXTRACTION WELL
INJ GROUND WATER REMEDIATION INJECTION WELL
EXDS OTHER SUPPLY WELL
** APPROXIMATE

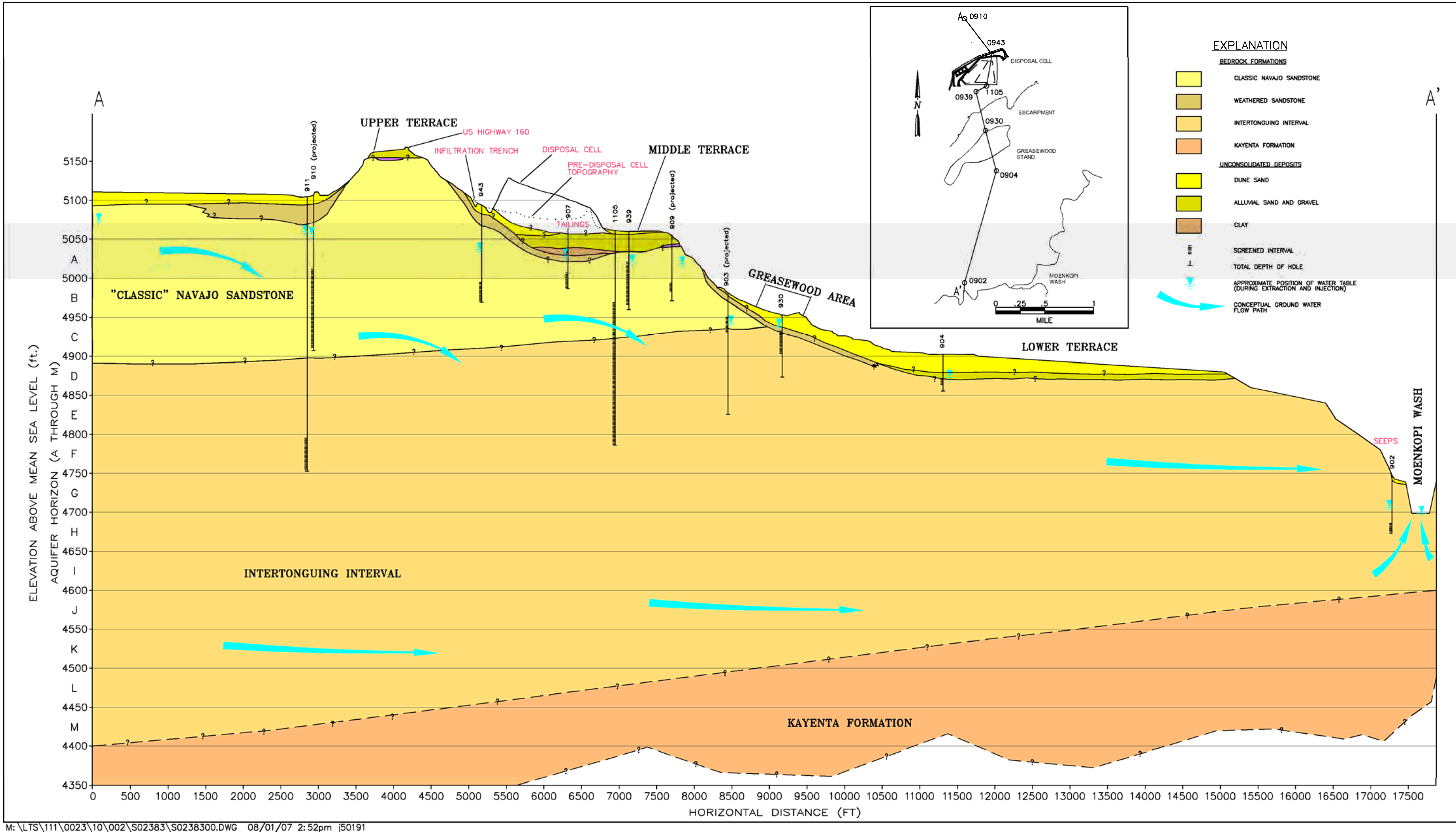

Figure A–1. Conceptual Model of the Site Hydrogeology

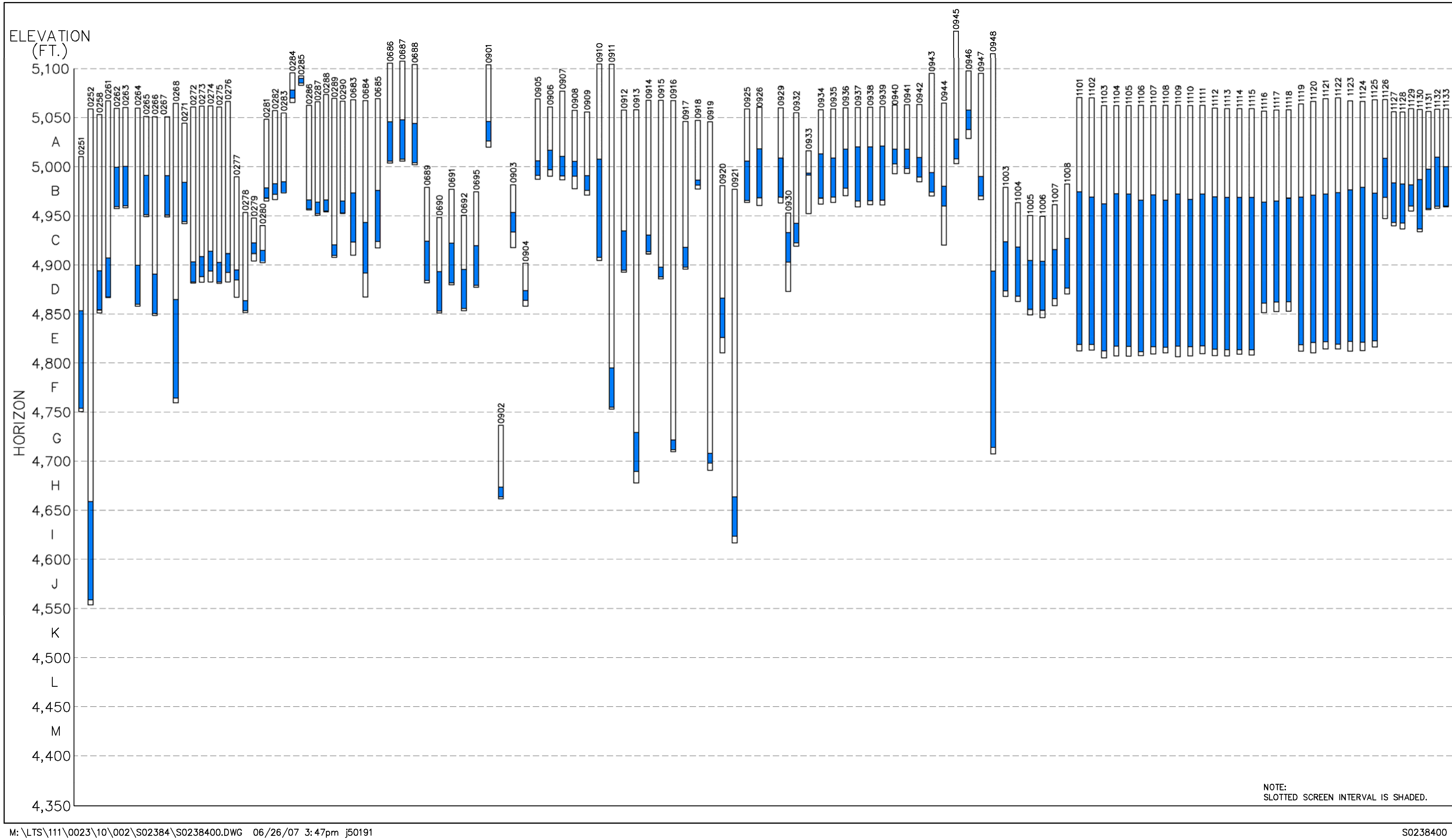

Figure A−2. Well Completions Schematic

Table A− 2. Extraction Well Operation Summary—April 2006 through March 2007

Apr-06						
Plant Time On	28.39	days				
Well	Pumping Time	OST	Gallons	Q1 gpm	Q2 gpm	Q3 gpm
935	0.00	0%	0	0.0	0.0	0.0
936	0.00	0%	0	0.0	0.0	0.0
938	0.00	0%	0	0.0	0.0	0.0
942	1.34	5%	13,524	7.0	0.3	0.3
1101	28.25	100%	260,210	6.4	6.4	6.0
1102	28.24	99%	146,495	3.6	3.6	3.4
1103	28.19	99%	243,290	6.0	6.0	5.6
1104	28.21	99%	155,632	3.8	3.8	3.6
1105	10.71	38%	223,767	14.5	5.5	5.2
1106	28.26	100%	74,851	1.8	1.8	1.7
1107	28.16	99%	149,558	3.7	3.7	3.5
1108	28.26	100%	185,533	4.6	4.5	4.3
1109	28.26	100%	115,032	2.8	2.8	2.7
1110	28.26	100%	55,575	1.4	1.4	1.3
1111	28.24	99%	156,872	3.9	3.8	3.6
1112	28.26	100%	76,495	1.9	1.9	1.8
1113	28.26	100%	40,789	1.0	1.0	0.9
1114	28.26	100%	149,543	3.7	3.7	3.5
1115	28.26	100%	218,880	5.4	5.4	5.1
1116	28.26	100%	154,852	3.8	3.8	3.6
1117	28.38	100%	218,202	5.3	5.3	5.1
1118	28.26	100%	127,778	3.1	3.1	3.0
1119	28.24	99%	120,975	3.0	3.0	2.8
1120	28.26	100%	187,220	4.6	4.6	4.3
1121	28.22	99%	172,764	4.3	4.2	4.0
1122	28.26	100%	67,072	1.6	1.6	1.6
1123	25.22	89%	11,540	0.3	0.3	0.3
1124	28.26	100%	186,070	4.6	4.6	4.3
1125	15.40	54%	68,565	3.1	1.7	1.6
1126	0.00	0%	0	0.0	0.0	0.0
1127	0.28	1%	88	0.2	0.0	0.0
1128	0.65	2%	4,575	4.9	0.1	0.1
1129	0.48	2%	3,588	5.2	0.1	0.1
1130	1.05	4%	8,699	5.8	0.2	0.2
1131	0.00	0%	0	0.0	0.0	0.0
1132	0.73	3%	5,842	5.5	0.1	0.1
1133	0.70	2%	5,653	5.6	0.1	0.1
total gallons			3,609,528			
operating q gpm			88.3			
days/month			30			
os factor			95%			
avg monthly q gpm			84			
avg well q gpm				3.6	2.4	2.3

May-06						
Plant Time On	28.00	days				
Well	Pumping Time	OST	Gallons	Q1 gpm	Q2 gpm	Q3 gpm
935	0.00	0%	0	0.0	0.0	0.0
936	0.00	0%	0	0.0	0.0	0.0
938	0.00	0%	0	0.0	0.0	0.0
942	1.33	5%	13,398	7.0	0.3	0.3
1101	27.99	100%	259,068	6.4	6.4	5.8
1102	27.90	100%	141,436	3.5	3.5	3.2
1103	27.88	100%	239,698	6.0	5.9	5.4
1104	27.97	100%	157,848	3.9	3.9	3.5
1105	10.73	38%	222,046	14.4	5.5	5.0
1106	27.99	100%	74,904	1.9	1.9	1.7
1107	26.13	93%	140,005	3.7	3.5	3.1
1108	27.98	100%	188,734	4.7	4.7	4.2
1109	27.99	100%	116,476	2.9	2.9	2.6
1110	26.60	95%	49,551	1.3	1.2	1.1
1111	27.98	100%	156,574	3.9	3.9	3.5
1112	24.93	89%	68,289	1.9	1.7	1.5
1113	24.93	89%	35,560	1.0	0.9	0.8
1114	27.38	98%	154,648	3.9	3.8	3.5
1115	27.99	100%	216,363	5.4	5.4	4.8
1116	24.93	89%	135,597	3.8	3.4	3.0
1117	26.90	96%	212,718	5.5	5.3	4.8
1118	27.99	100%	124,432	3.1	3.1	2.8
1119	27.97	100%	120,378	3.0	3.0	2.7
1120	27.99	100%	186,296	4.6	4.6	4.2
1121	27.95	100%	174,235	4.3	4.3	3.9
1122	27.99	100%	68,634	1.7	1.7	1.5
1123	22.36	80%	10,281	0.3	0.3	0.2
1124	27.99	100%	185,406	4.6	4.6	4.2
1125	6.37	23%	28,554	3.1	0.7	0.6
1126	0.00	0%	0	0.0	0.0	0.0
1127	0.23	1%	73	0.2	0.0	0.0
1128	0.57	2%	3,963	4.9	0.1	0.1
1129	0.41	1%	3,031	5.2	0.1	0.1
1130	0.84	3%	6,871	5.7	0.2	0.2
1131	0.00	0%	0	0.0	0.0	0.0
1132	0.62	2%	4,974	5.6	0.1	0.1
1133	0.60	2%	4,805	5.6	0.1	0.1
total gallons			3,504,843			
operating q gpm			86.9			
days/month			31			
os factor			90%			
avg monthly q gpm			79			
avg well q gpm				3.6	2.3	2.1

Table A−2 (continued). Extraction Well Operation Summary—April 2006 through March 2007

Jun-06						
Plant Time On	28.57	days				
Well	Pumping Time	OST	Gallons	Q1 gpm	Q2 gpm	Q3 gpm
935	0.00	0%	0	0.0	0.0	0.0
936	0.00	0%	0	0.0	0.0	0.0
938	0.00	0%	0	0.0	0.0	0.0
942	1.48	5%	14,632	6.9	0.4	0.3
1101	28.24	99%	253,452	6.2	6.2	5.9
1102	28.20	99%	146,058	3.6	3.6	3.4
1103	28.15	99%	240,450	5.9	5.8	5.6
1104	28.20	99%	160,660	4.0	3.9	3.7
1105	10.60	37%	222,334	14.6	5.4	5.1
1106	28.25	99%	74,958	1.8	1.8	1.7
1107	28.16	99%	152,542	3.8	3.7	3.5
1108	28.25	99%	192,996	4.7	4.7	4.5
1109	28.25	99%	116,674	2.9	2.8	2.7
1110	28.25	99%	51,323	1.3	1.2	1.2
1111	28.24	99%	157,283	3.9	3.8	3.6
1112	28.51	100%	77,505	1.9	1.9	1.8
1113	28.50	100%	45,011	1.1	1.1	1.0
1114	28.25	99%	152,265	3.7	3.7	3.5
1115	28.51	100%	216,604	5.3	5.3	5.0
1116	28.51	100%	154,297	3.8	3.8	3.6
1117	28.50	100%	218,768	5.3	5.3	5.1
1118	28.50	100%	123,296	3.0	3.0	2.9
1119	28.23	99%	120,820	3.0	2.9	2.8
1120	28.55	100%	188,919	4.6	4.6	4.4
1121	28.19	99%	177,424	4.4	4.3	4.1
1122	28.25	99%	70,959	1.7	1.7	1.6
1123	24.99	87%	11,557	0.3	0.3	0.3
1124	28.26	99%	185,423	4.6	4.5	4.3
1125	2.53	9%	11,688	3.2	0.3	0.3
1126	0.00	0%	0	0.0	0.0	0.0
1127	0.27	1%	74	0.2	0.0	0.0
1128	0.60	2%	4,283	4.9	0.1	0.1
1129	0.45	2%	3,323	5.1	0.1	0.1
1130	0.92	3%	7,475	5.7	0.2	0.2
1131	0.00	0%	0	0.0	0.0	0.0
1132	0.70	2%	5,565	5.6	0.1	0.1
1133	0.66	2%	5,415	5.7	0.1	0.1
total gallons			3,564,033			
operating q gpm			86.6			
days/month			30			
os factor			95%			
avg monthly q gpm			83			
avg well q gpm				3.6	2.3	2.2

Jul-06						
Plant Time On	28.07	days				
Well	Pumping Time	OST	Gallons	Q1 gpm	Q2 gpm	Q3 gpm
935	1.58	6%	14,562	6.4	0.4	0.3
936	0.58	2%	85	0.1	0.0	0.0
938	0.05	0%	76	1.0	0.0	0.0
942	1.31	5%	13,206	7.0	0.3	0.3
1101	27.99	100%	256,447	6.4	6.3	5.7
1102	27.71	99%	142,269	3.6	3.5	3.2
1103	27.82	99%	236,562	5.9	5.9	5.3
1104	6.97	25%	39,018	3.9	1.0	0.9
1105	21.72	77%	180,207	5.8	4.5	4.0
1106	26.27	94%	73,824	2.0	1.8	1.7
1107	25.44	91%	140,248	3.8	3.5	3.1
1108	26.27	94%	183,702	4.9	4.5	4.1
1109	26.27	94%	110,431	2.9	2.7	2.5
1110	26.21	93%	47,309	1.3	1.2	1.1
1111	26.26	94%	146,294	3.9	3.6	3.3
1112	24.32	87%	68,243	1.9	1.7	1.5
1113	23.75	85%	46,531	1.4	1.2	1.0
1114	27.44	98%	151,678	3.8	3.8	3.4
1115	28.02	100%	214,031	5.3	5.3	4.8
1116	27.31	97%	149,401	3.8	3.7	3.3
1117	27.48	98%	211,629	5.3	5.2	4.7
1118	28.01	100%	120,526	3.0	3.0	2.7
1119	27.95	100%	120,454	3.0	3.0	2.7
1120	28.01	100%	189,071	4.7	4.7	4.2
1121	27.89	99%	178,775	4.5	4.4	4.0
1122	28.01	100%	70,564	1.7	1.7	1.6
1123	18.72	67%	9,407	0.3	0.2	0.2
1124	27.96	100%	185,814	4.6	4.6	4.2
1125	0.92	3%	4,192	3.2	0.1	0.1
1126	0.04	0%	564	10.4	0.0	0.0
1127	0.16	1%	69	0.3	0.0	0.0
1128	0.51	2%	3,735	5.1	0.1	0.1
1129	0.38	1%	2,803	5.2	0.1	0.1
1130	0.70	2%	5,598	5.6	0.1	0.1
1131	0.00	0%	0	0.0	0.0	0.0
1132	0.64	2%	5,074	5.5	0.1	0.1
1133	0.56	2%	4,409	5.5	0.1	0.1
total gallons			3,326,811			
operating q gpm			82.3			
days/month			31			
os factor			91%			
avg monthly q gpm			75			
avg well q gpm				3.9	2.2	2.0

Table A−2 (continued). Extraction Well Operation Summary—April 2006 through March 2007

Aug-06						
Plant Time On	22.90	days				
Well	Pumping Time	OST	Gallons	Q1 gpm	Q2 gpm	Q3 gpm
935	1.97	9%	18,151	6.4	0.6	0.4
936	0.56	2%	169	0.2	0.0	0.0
938	0.05	0%	85	1.3	0.0	0.0
942	1.14	5%	11,442	7.0	0.3	0.3
1101	22.88	100%	204,917	6.2	6.2	4.6
1102	22.62	99%	119,720	3.7	3.6	2.7
1103	22.68	99%	189,269	5.8	5.7	4.2
1104	21.88	96%	119,705	3.8	3.6	2.7
1105	22.85	100%	166,270	5.1	5.0	3.7
1106	22.89	100%	64,211	1.9	1.9	1.4
1107	22.89	100%	126,538	3.8	3.8	2.8
1108	22.88	100%	160,823	4.9	4.9	3.6
1109	22.88	100%	95,469	2.9	2.9	2.1
1110	22.88	100%	39,547	1.2	1.2	0.9
1111	22.88	100%	127,461	3.9	3.9	2.9
1112	22.88	100%	68,179	2.1	2.1	1.5
1113	22.09	96%	46,928	1.5	1.4	1.1
1114	12.56	55%	66,439	3.7	2.0	1.5
1115	22.89	100%	174,599	5.3	5.3	3.9
1116	22.89	100%	124,727	3.8	3.8	2.8
1117	22.56	99%	176,494	5.4	5.4	4.0
1118	22.88	100%	97,286	3.0	3.0	2.2
1119	22.88	100%	98,785	3.0	3.0	2.2
1120	22.88	100%	157,925	4.8	4.8	3.5
1121	22.84	100%	147,597	4.5	4.5	3.3
1122	22.89	100%	58,751	1.8	1.8	1.3
1123	15.68	68%	10,414	0.5	0.3	0.2
1124	22.89	100%	153,167	4.6	4.6	3.4
1125	14.59	64%	63,768	3.0	1.9	1.4
1126	0.14	1%	0	0.0	0.0	0.0
1127	0.01	0%	5	0.4	0.0	0.0
1128	0.46	2%	3,362	5.0	0.1	0.1
1129	0.36	2%	2,588	5.0	0.1	0.1
1130	0.68	3%	5,454	5.6	0.2	0.1
1131	0.00	0%	7	1.2	0.0	0.0
1132	0.63	3%	4,966	5.5	0.2	0.1
1133	0.06	0%	457	5.7	0.0	0.0
total gallons			2,905,674			
operating q gpm			88.1			
days/month			31			
os factor			74%			
avg monthly q gpm			65			
avg well q gpm				3.6	2.4	1.8

Sep-06						
Plant Time On	27.59	days				
Well	Pumping Time	OST	Gallons	Q1 gpm	Q2 gpm	Q3 gpm
935	2.35	9%	21,542	6.4	0.5	0.5
936	2.15	8%	106	0.0	0.0	0.0
938	0.06	0%	90	1.0	0.0	0.0
942	1.53	6%	15,414	7.0	0.4	0.4
1101	27.47	100%	242,942	6.1	6.1	5.6
1102	27.44	99%	143,400	3.6	3.6	3.3
1103	27.27	99%	235,462	6.0	5.9	5.5
1104	27.48	100%	150,343	3.8	3.8	3.5
1105	27.43	99%	194,219	4.9	4.9	4.5
1106	27.48	100%	76,863	1.9	1.9	1.8
1107	27.42	99%	151,806	3.8	3.8	3.5
1108	27.48	100%	192,549	4.9	4.8	4.5
1109	27.48	100%	112,720	2.8	2.8	2.6
1110	27.48	100%	48,617	1.2	1.2	1.1
1111	27.58	100%	154,944	3.9	3.9	3.6
1112	27.48	100%	77,210	2.0	1.9	1.8
1113	27.48	100%	63,861	1.6	1.6	1.5
1114	0.00	0%	0	0.0	0.0	0.0
1115	27.43	99%	209,669	5.3	5.3	4.9
1116	27.48	100%	154,306	3.9	3.9	3.6
1117	27.48	100%	215,426	5.4	5.4	5.0
1118	27.39	99%	119,374	3.0	3.0	2.8
1119	27.45	100%	126,020	3.2	3.2	2.9
1120	27.48	100%	202,723	5.1	5.1	4.7
1121	27.43	99%	174,295	4.4	4.4	4.0
1122	21.56	78%	64,263	2.1	1.6	1.5
1123	20.51	74%	11,642	0.4	0.3	0.3
1124	27.48	100%	181,210	4.6	4.6	4.2
1125	26.98	98%	117,934	3.0	3.0	2.7
1126	0.00	0%	0	0.0	0.0	0.0
1127	0.00	0%	0	0.0	0.0	0.0
1128	0.37	1%	2,546	4.8	0.1	0.1
1129	0.25	1%	1,696	4.6	0.0	0.0
1130	0.53	2%	4,194	5.5	0.1	0.1
1131	0.12	0%	176	1.0	0.0	0.0
1132	0.46	2%	3,477	5.2	0.1	0.1
1133	0.00	0%	0	0.0	0.0	0.0
total gallons			3,471,038			
operating q gpm			87.4			
days/month			30			
os factor			92%			
avg monthly q gpm			80			
avg well q gpm				3.3	2.4	2.2

Table A−2 (continued). Extraction Well Operation Summary—April 2006 through March 2007

Oct-06						
Plant Time On	30.34	days				
Well	Pumping Time	OST	Gallons	Q1 gpm	Q2 gpm	Q3 gpm
935	2.49	8%	22,765	6.3	0.5	0.5
936	8.33	27%	108,454	9.0	2.5	2.4
938	0.05	0%	78	1.2	0.0	0.0
942	1.75	6%	15,720	6.2	0.4	0.4
1101	30.33	100%	265,552	6.1	6.1	5.9
1102	30.33	100%	158,270	3.6	3.6	3.5
1103	30.26	100%	256,573	5.9	5.9	5.7
1104	30.34	100%	166,030	3.8	3.8	3.7
1105	30.29	100%	205,361	4.7	4.7	4.6
1106	30.33	100%	78,408	1.8	1.8	1.8
1107	30.34	100%	164,997	3.8	3.8	3.7
1108	30.33	100%	209,142	4.8	4.8	4.7
1109	30.34	100%	119,174	2.7	2.7	2.7
1110	30.34	100%	51,617	1.2	1.2	1.2
1111	30.33	100%	167,236	3.8	3.8	3.7
1112	30.34	100%	79,242	1.8	1.8	1.8
1113	30.33	100%	66,405	1.5	1.5	1.5
1114	0.00	0%	0	0.0	0.0	0.0
1115	30.33	100%	223,629	5.1	5.1	5.0
1116	30.33	100%	168,689	3.9	3.9	3.8
1117	30.33	100%	235,123	5.4	5.4	5.3
1118	30.34	100%	129,422	3.0	3.0	2.9
1119	30.33	100%	129,416	3.0	3.0	2.9
1120	30.34	100%	221,151	5.1	5.1	5.0
1121	30.31	100%	192,083	4.4	4.4	4.3
1122	30.33	100%	81,715	1.9	1.9	1.8
1123	23.40	77%	12,073	0.4	0.3	0.3
1124	30.34	100%	191,636	4.4	4.4	4.3
1125	30.18	99%	127,756	2.9	2.9	2.9
1126	0.00	0%	0	0.0	0.0	0.0
1127	0.00	0%	0	0.0	0.0	0.0
1128	0.55	2%	3,638	4.6	0.1	0.1
1129	0.44	1%	2,871	4.5	0.1	0.1
1130	0.81	3%	6,220	5.3	0.1	0.1
1131	0.28	1%	408	1.0	0.0	0.0
1132	0.77	3%	5,720	5.2	0.1	0.1
1133	0.00	0%	0	0.0	0.0	0.0
total gallons			3,866,571			
operating q gpm			88.5			
days/month			31			
os factor			98%			
avg monthly q gpm			87			
avg well q gpm				3.5	2.4	2.3

Nov-06						
Plant Time On	27.84	days				
Well	Pumping Time	OST	Gallons	Q1 gpm	Q2 gpm	Q3 gpm
935	2.23	8%	20,107	6.3	0.5	0.5
936	7.01	25%	90,345	9.0	2.3	2.1
938	0.08	0%	179	1.5	0.0	0.0
942	1.68	6%	14,364	5.9	0.4	0.3
1101	25.97	93%	230,562	6.2	5.8	5.3
1102	25.75	92%	135,331	3.6	3.4	3.1
1103	25.87	93%	219,124	5.9	5.5	5.1
1104	26.30	94%	143,936	3.8	3.6	3.3
1105	25.91	93%	185,425	5.0	4.6	4.3
1106	25.97	93%	68,089	1.8	1.7	1.6
1107	25.97	93%	145,585	3.9	3.6	3.4
1108	25.98	93%	185,908	5.0	4.6	4.3
1109	15.70	56%	65,027	2.9	1.6	1.5
1110	25.97	93%	44,290	1.2	1.1	1.0
1111	1.02	4%	5,591	3.8	0.1	0.1
1112	25.93	93%	78,735	2.1	2.0	1.8
1113	25.93	93%	56,627	1.5	1.4	1.3
1114	26.75	96%	148,169	3.8	3.7	3.4
1115	25.97	93%	183,714	4.9	4.6	4.3
1116	25.97	93%	140,174	3.7	3.5	3.2
1117	25.97	93%	195,320	5.2	4.9	4.5
1118	25.97	93%	105,645	2.8	2.6	2.4
1119	25.97	93%	109,919	2.9	2.7	2.5
1120	25.97	93%	190,030	5.1	4.7	4.4
1121	25.95	93%	166,375	4.5	4.2	3.9
1122	25.97	93%	74,112	2.0	1.8	1.7
1123	8.16	29%	4,867	0.4	0.1	0.1
1124	25.97	93%	173,011	4.6	4.3	4.0
1125	24.58	88%	104,483	3.0	2.6	2.4
1126	0.00	0%	0	0.0	0.0	0.0
1127	0.00	0%	0	0.0	0.0	0.0
1128	0.50	2%	3,324	4.6	0.1	0.1
1129	0.40	1%	2,688	4.7	0.1	0.1
1130	0.75	3%	5,756	5.3	0.1	0.1
1131	0.29	1%	414	1.0	0.0	0.0
1132	0.71	3%	5,331	5.2	0.1	0.1
1133	0.00	0%	0	0.0	0.0	0.0
total gallons			3,302,558			
operating q gpm			82.4			
days/month			30			
os factor			93%			
avg monthly q gpm			76			
avg well q gpm				3.6	2.2	2.1

Table A−2 (continued). Extraction Well Operation Summary—April 2006 through March 2007

Dec-06						
Plant Time On	30.54	days		gpm	gpm	gpm
Well	Pumping Time	OST	Gallons	Q1 gpm	Q2 gpm	Q3 gpm
935	2.40	8%	21,491	6.2	0.5	0.5
936	8.19	27%	105,580	9.0	2.4	2.4
938	0.09	0%	366	2.9	0.0	0.0
942	1.49	5%	18,642	8.7	0.4	0.4
1101	30.53	100%	265,562	6.0	6.0	5.9
1102	29.88	98%	177,936	4.1	4.0	4.0
1103	30.50	100%	252,483	5.7	5.7	5.7
1104	30.50	100%	166,896	3.8	3.8	3.7
1105	30.50	100%	204,672	4.7	4.7	4.6
1106	30.54	100%	73,275	1.7	1.7	1.6
1107	30.54	100%	168,339	3.8	3.8	3.8
1108	30.53	100%	218,513	5.0	5.0	4.9
1109	0.00	0%	0	0.0	0.0	0.0
1110	30.53	100%	49,320	1.1	1.1	1.1
1111	0.00	0%	0	0.0	0.0	0.0
1112	30.53	100%	88,031	2.0	2.0	2.0
1113	30.52	100%	66,012	1.5	1.5	1.5
1114	30.99	101%	168,052	3.8	3.8	3.8
1115	30.53	100%	206,965	4.7	4.7	4.6
1116	30.53	100%	164,055	3.7	3.7	3.7
1117	30.53	100%	227,916	5.2	5.2	5.1
1118	30.54	100%	123,316	2.8	2.8	2.8
1119	30.53	100%	123,383	2.8	2.8	2.8
1120	30.53	100%	219,250	5.0	5.0	4.9
1121	30.52	100%	193,157	4.4	4.4	4.3
1122	30.53	100%	78,490	1.8	1.8	1.8
1123	14.63	48%	8,592	0.4	0.2	0.2
1124	30.53	100%	192,856	4.4	4.4	4.3
1125	26.34	86%	111,684	2.9	2.5	2.5
1126	0.00	0%	0	0.0	0.0	0.0
1127	0.00	0%	0	0.0	0.0	0.0
1128	0.51	2%	3,329	4.5	0.1	0.1
1129	0.43	1%	2,721	4.4	0.1	0.1
1130	0.74	2%	5,397	5.1	0.1	0.1
1131	0.31	1%	450	1.0	0.0	0.0
1132	0.77	3%	5,655	5.1	0.1	0.1
1133	0.00	0%	0	0.0	0.0	0.0
total gallons			3,712,383			
operating q gpm			84.4			
days/month			31			
os factor			99%			
avg monthly q gpm			83			
avg well q gpm				3.5	2.3	2.2

Jan-07						
Plant Time On	30.88	days		gpm	gpm	gpm
Well	Pumping Time	OST	Gallons	Q1 gpm	Q2 gpm	Q3 gpm
935	2.35	8%	21,012	6.2	0.5	0.5
936	8.48	27%	110,391	9.0	2.5	2.5
938	0.08	0%	120	1.0	0.0	0.0
942	1.51	5%	16,209	7.4	0.4	0.4
1101	30.88	100%	274,490	6.2	6.2	6.1
1102	30.32	98%	158,294	3.6	3.6	3.5
1103	30.88	100%	245,447	5.5	5.5	5.5
1104	30.88	100%	168,948	3.8	3.8	3.8
1105	30.88	100%	204,372	4.6	4.6	4.6
1106	30.88	100%	70,764	1.6	1.6	1.6
1107	30.88	100%	169,412	3.8	3.8	3.8
1108	30.88	100%	220,324	5.0	5.0	4.9
1109	0.00	0%	0	0.0	0.0	0.0
1110	30.88	100%	48,192	1.1	1.1	1.1
1111	0.00	0%	0	0.0	0.0	0.0
1112	30.88	100%	87,768	2.0	2.0	2.0
1113	30.88	100%	66,928	1.5	1.5	1.5
1114	31.00	100%	167,007	3.7	3.8	3.7
1115	30.88	100%	202,331	4.6	4.6	4.5
1116	30.88	100%	165,574	3.7	3.7	3.7
1117	30.88	100%	229,706	5.2	5.2	5.1
1118	30.88	100%	122,910	2.8	2.8	2.8
1119	30.88	100%	121,340	2.7	2.7	2.7
1120	30.88	100%	219,976	4.9	4.9	4.9
1121	30.88	100%	195,182	4.4	4.4	4.4
1122	30.88	100%	75,786	1.7	1.7	1.7
1123	15.10	49%	8,625	0.4	0.2	0.2
1124	30.88	100%	189,848	4.3	4.3	4.3
1125	26.54	86%	116,003	3.0	2.6	2.6
1126	0.00	0%	0	0.0	0.0	0.0
1127	0.00	0%	0	0.0	0.0	0.0
1128	0.49	2%	3,172	4.5	0.1	0.1
1129	0.43	1%	2,682	4.4	0.1	0.1
1130	0.70	2%	5,048	5.0	0.1	0.1
1131	0.33	1%	468	1.0	0.0	0.0
1132	0.77	2%	5,546	5.0	0.1	0.1
1133	0.00	0%	0	0.0	0.0	0.0
total gallons			3,693,873			
operating q gpm			83.1			
days/month			31			
os factor			100%			
avg monthly q gpm			83			
avg well q gpm				3.3	2.2	2.2

Table A−2 (continued). Extraction Well Operation Summary—April 2006 through March 2007

Feb-07							
Plant Time On	27.95	days					
Well	Pumping Time	OST	Gallons	Q1 gpm	Q2 gpm	Q3 gpm	
935	2.09	7%	18,551	6.2	0.5	0.5	
936	7.68	27%	99,933	9.0	2.5	2.5	
938	0.06	0%	90	1.0	0.0	0.0	
942	1.33	5%	14,353	7.5	0.4	0.4	
1101	27.95	100%	253,517	6.3	6.3	6.3	
1102	27.93	100%	145,506	3.6	3.6	3.6	
1103	27.95	100%	216,018	5.4	5.4	5.4	
1104	27.92	100%	152,760	3.8	3.8	3.8	
1105	27.86	100%	182,725	4.6	4.5	4.5	
1106	27.95	100%	62,954	1.6	1.6	1.6	
1107	27.95	100%	151,564	3.8	3.8	3.8	
1108	27.95	100%	195,276	4.9	4.9	4.8	
1109	14.50	52%	57,027	2.7	1.4	1.4	
1110	27.95	100%	43,248	1.1	1.1	1.1	
1111	14.41	52%	81,436	3.9	2.0	2.0	
1112	27.86	100%	75,717	1.9	1.9	1.9	
1113	27.87	100%	56,774	1.4	1.4	1.4	
1114	28.00	100%	147,151	3.6	3.7	3.6	
1115	27.95	100%	177,097	4.4	4.4	4.4	
1116	27.95	100%	149,102	3.7	3.7	3.7	
1117	27.97	100%	206,539	5.1	5.1	5.1	
1118	27.95	100%	108,863	2.7	2.7	2.7	
1119	27.95	100%	105,415	2.6	2.6	2.6	
1120	27.95	100%	198,956	4.9	4.9	4.9	
1121	27.95	100%	176,630	4.4	4.4	4.4	
1122	27.95	100%	66,607	1.7	1.7	1.7	
1123	17.10	61%	9,031	0.4	0.2	0.2	
1124	27.95	100%	168,728	4.2	4.2	4.2	
1125	25.23	90%	110,266	3.0	2.7	2.7	
1126	0.00	0%	0	0.0	0.0	0.0	
1127	0.00	0%	0	0.0	0.0	0.0	
1128	0.44	2%	2,786	4.4	0.1	0.1	
1129	0.39	1%	2,426	4.3	0.1	0.1	
1130	0.62	2%	4,396	4.9	0.1	0.1	
1131	0.25	1%	366	1.0	0.0	0.0	
1132	0.68	2%	4,977	5.1	0.1	0.1	
1133	0.00	0%	0	0.0	0.0	0.0	
total gallons			3,446,787				
operating q gpm			85.6				
days/month			28				
os factor			100%				
avg monthly q gpm			85				
avg well q gpm				3.5	2.3	2.3	

Mar-07						
Plant Time On	31.00	days				
Well	Pumping Time	OST	Gallons	Q1 gpm	Q2 gpm	Q3 gpm
935	2.24	7%	19,884	6.2	0.4	0.4
936	8.51	27%	110,838	9.0	2.5	2.5
938	0.00	0%	0	0.0	0.0	0.0
942	1.53	5%	15,414	7.0	0.3	0.3
1101	31.00	100%	275,709	6.2	6.2	6.2
1102	31.00	100%	161,484	3.6	3.6	3.6
1103	31.00	100%	235,393	5.3	5.3	5.3
1104	30.94	100%	169,290	3.8	3.8	3.8
1105	30.97	100%	201,667	4.5	4.5	4.5
1106	31.00	100%	65,915	1.5	1.5	1.5
1107	31.00	100%	164,813	3.7	3.7	3.7
1108	31.00	100%	210,713	4.7	4.7	4.7
1109	31.00	100%	117,482	2.6	2.6	2.6
1110	31.00	100%	48,443	1.1	1.1	1.1
1111	31.00	100%	174,742	3.9	3.9	3.9
1112	31.00	100%	78,773	1.8	1.8	1.8
1113	31.00	100%	57,234	1.3	1.3	1.3
1114	31.00	100%	156,693	3.5	3.5	3.5
1115	31.00	100%	189,089	4.2	4.2	4.2
1116	31.00	100%	163,443	3.7	3.7	3.7
1117	31.00	100%	227,096	5.1	5.1	5.1
1118	31.00	100%	117,801	2.6	2.6	2.6
1119	31.00	100%	112,393	2.5	2.5	2.5
1120	31.00	100%	219,937	4.9	4.9	4.9
1121	31.00	100%	195,839	4.4	4.4	4.4
1122	31.00	100%	73,173	1.6	1.6	1.6
1123	20.73	67%	10,640	0.4	0.2	0.2
1124	31.00	100%	185,544	4.2	4.2	4.2
1125	28.96	93%	126,604	3.0	2.8	2.8
1126	0.00	0%	0	0.0	0.0	0.0
1127	0.00	0%	0	0.0	0.0	0.0
1128	0.48	2%	3,004	4.4	0.1	0.1
1129	0.43	1%	2,630	4.3	0.1	0.1
1130	0.67	2%	4,747	4.9	0.1	0.1
1131	0.24	1%	348	1.0	0.0	0.0
1132	0.75	2%	5,443	5.0	0.1	0.1
1133	0.00	0%	0	0.0	0.0	0.0
total gallons			3,902,217			
operating q gpm			87.4			
days/month			31			
os factor			100%			
avg monthly q gpm			87			
avg well q gpm				3.4	2.4	2.4

SUMMARY		KEY
Total days on for 12-month period	342	total time on = number of days in month that pumps are operating
Total days in period	365	total time = number of days in month of pump on-cycle; excludes off-cycle time
Net onstream factor calc	94%	ost (on stream time) = total time on / total time
Total gals out	42,306,316	Q1 = instantaneous pumping rate
Avg operating Q gpm	86	Q2 = effective pumping rate on-cycle plus off-cycle time
Net Q gpm	80	Q3 = monthly pumping rate including downtime

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Appendix B

Nitrate, Sulfate, and Uranium Plume Maps

(See text for an explanation of contouring methods and well-selection criteria)

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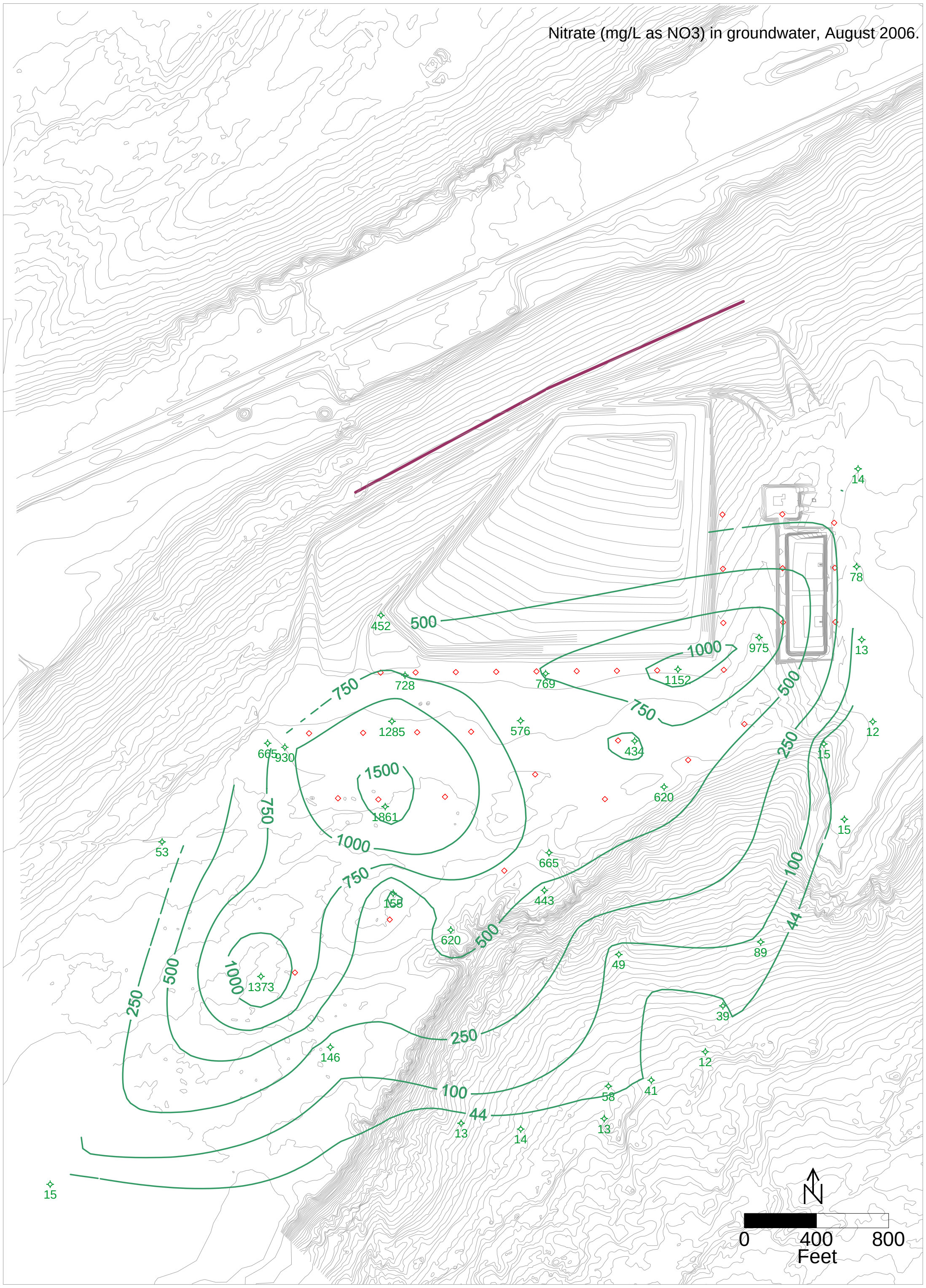

Table B−1. Nitrate (mg/L as NO_3) Plume Map

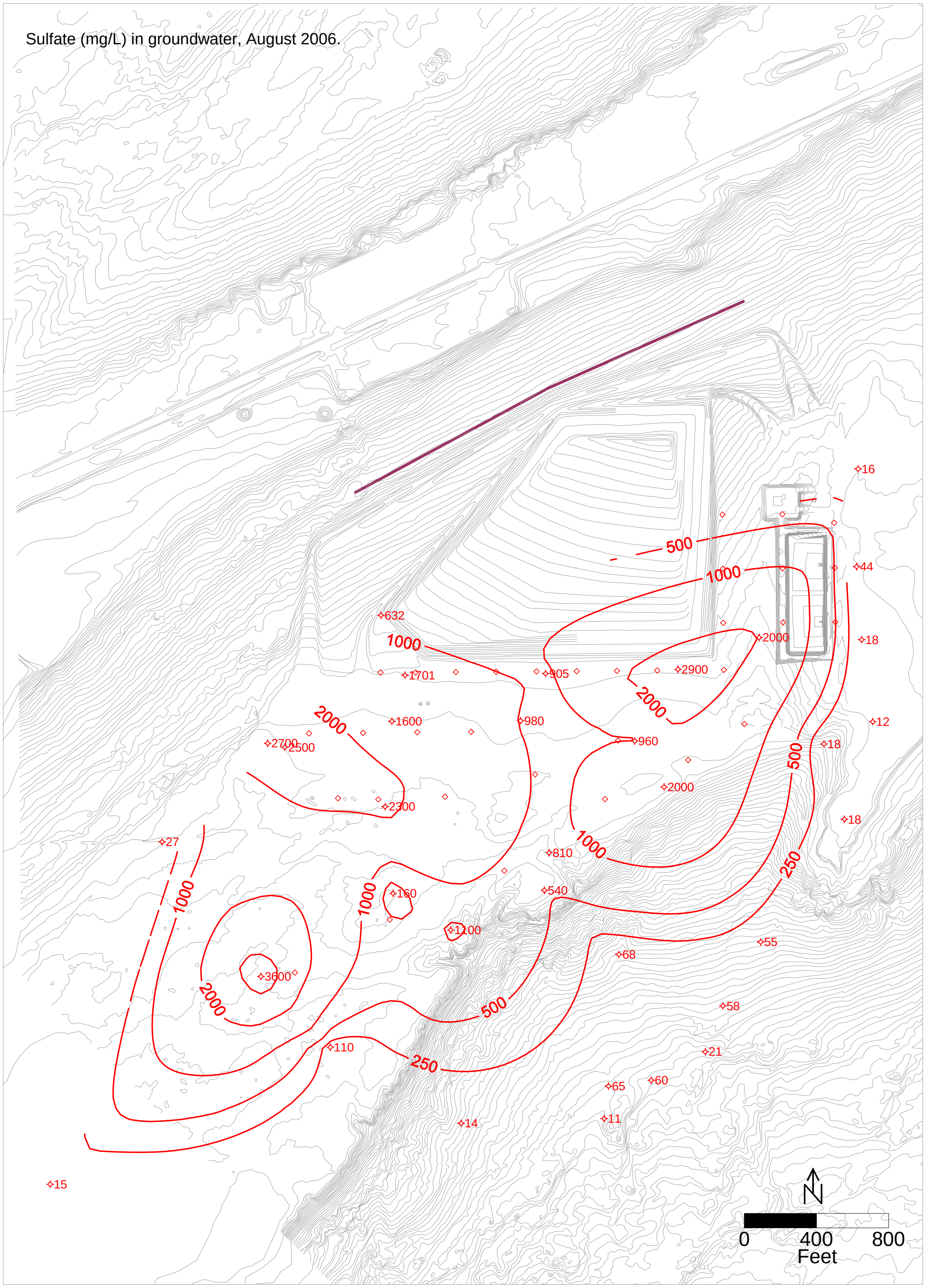

Table B−2. Sulfate (mg/L) Plume Map

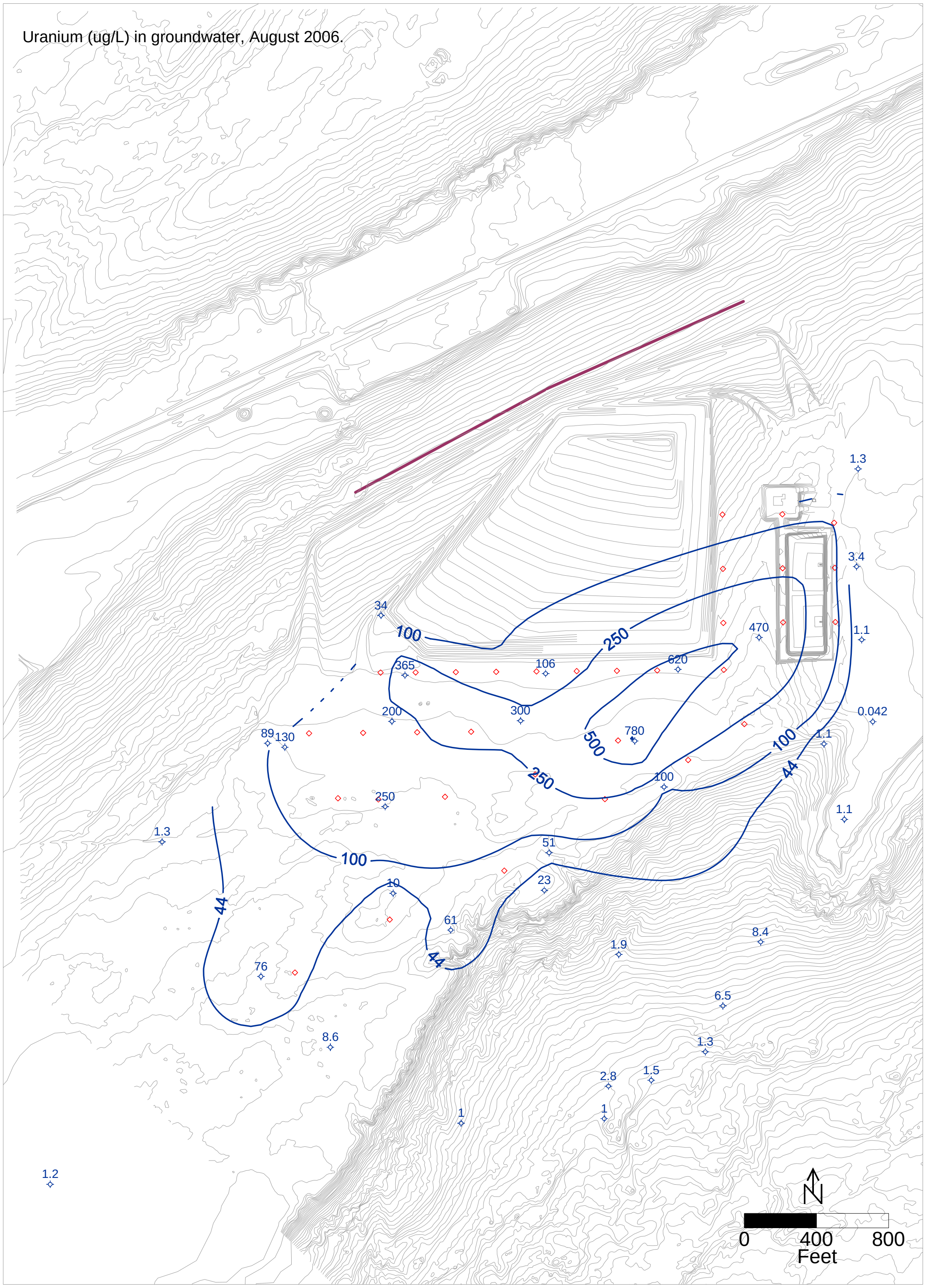

Table B−3. Uranium (µg/L) Plume Map

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Appendix C

Ground Water Sample Results for Contaminants of Concern: August 2006, February 2007, and the Baseline Period

Table C−1. Baseline, August 2006, and February 2007 Molybdenum Concentrations

Well Number	Horizon	Baseline Molybdenum Concentration (mg/L)	Year Sampled, Baseline	Aug 2006 Molybdenum Concentration (mg/L)	Feb 2007 Molybdenum Concentration (mg/L)
0686	A	0.0015U	2002	0.00086BU	NS
0687	A	0.0113	2002	0.0041	NS
0688	A	0.0015U	2002	0.0033	NS
0901	A	0.00078	2001	0.0007BU	NS
0906	A	0.0137	2002	NS	NS
0929	A	0.0015U	2002	0.00047BU	0.00047BU
0940	A	0.0015U	2002	NS	NS
0941	A	0.0284	2002	0.024N	0.017
0945	A	0.0015U	2002	0.0006BU	NS
0946	A			0.0023U	NS
0262	B	0.432	2001	0.81	0.89
0263	B	0.192	2001	0.015	0.015
0265	B	0.00046	2001	0.0005BU	0.00034BU
0267	B	0.0015U	2002	0.00048BU	0.00039BU
0271	B	0.0015U	2002	0.00059BU	NS
0281	B			0.001U	0.00079BU
0282	B			0.0014U	0.001U
0283	B			0.0045	0.0047
0908	B	0.0015U	2002	0.0017	0.00045BU
0909	B	0.0015U	2002	0.00035B	0.00042BU
0910	B			0.00051BU	NS
0934	B	0.0015U	2002	0.00087B	0.00039BU
0935	B	0.0015U	2002	0.00026U	0.00037BU
0936	B	0.0015U	2002	0.00056BU	NS
0938	B	0.001U	1999	0.033	0.046
0942	B	0.021	2002	0.014	0.014
0943	B	0.0015U	2002	0.00077BU	NS
0947	B	0.0015U	2002	0.0005BU	NS
1126	B			0.00026U	NS
1128	B			0.00026U	NS
1129	B			0.67	NS
1130	B			0.065	NS
1131	B			0.0012U	NS
1132	B			0.25	NS
0274	C			0.0016U	0.00048BU
0276	C			0.00073BU	0.00054BU
0279	C			0.00065BU	NS
0280	C			0.00062BU	NS
0683	C	0.0015U	2002	0.00058BU	NS
0684	C	0.0015U	2002	0.00055BU	NS
0685	C	0.0015U	2002	0.00049BU	NS
0689	C	0.0015U	2002	0.00056BU	NS
0691	C	0.0015U	2002	0.0006BU	0.0005BU
0903	C	0.0015U	2002	0.00048BU	NS
0912	C	0.0003U	2001	0.0003B	NS
0914	C	0.00081	2001	0.00074BU	NS

Table C−1 (continued). Baseline, August 2006, and February 2007 Molybdenum Concentrations

Well Number	Horizon	Baseline Molybdenum Concentration (mg/L)	Year Sampled, Baseline	Aug 2006 Molybdenum Concentration (mg/L)	Feb 2007 Molybdenum Concentration (mg/L)
0917	C	0.0013	2001	NS	NS
0930	C	0.0015U	2002	0.00039BU	0.0004BU
0932	C	0.0018U	2002	0.00051BU	0.00051BU
1008	C	0.0004U	2000	NS	NS
1116	C	0.0015U	2002	0.0003BU	NS
1117	C	0.0015U	2002	0.00027BU	NS
1118	C	0.0015U	2002	0.00047BU	NS
0258	D	0.00063	2000	0.00077BU	0.0006BU
0261	D	0.0026	2001	0.00079BU	NS
0264	D	0.0031	2001	0.00086BU	0.00054BU
0266	D	0.00058	2001	0.00056BU	0.00049BU
0272	D			0.00051BU	0.00043BU
0273	D			0.028	0.02
0275	D			0.021	0.00054BU
0277	D			0.00073BU	NS
0278	D			0.00058BU	NS
0690	D	0.0015U	2002	0.00055BU	NS
0692	D	0.0015U	2002	0.00066BU	NS
0695	D	0.0015U	2002	NS	NS
0904	D	0.00077	2001	0.00059BU	NS
0915	D	0.00054	2001	0.00056BU	NS
1003	D	0.0004U	2000	0.00042BU	NS
1004	D	0.0004U	2000	0.00043BU	NS
1005	D	0.0004U	2000	NS	NS
1006	D	0.0004U	2000	0.00037B	NS
1007	D	0.0004U	2000	0.00053BU	NS
1101	D	0.0015U	2002	0.00032B	NS
1102	D	0.0015U	2002	0.00032B	NS
1103	D	0.0015U	2002	0.0027	NS
1104	D	0.0916	2002	0.037	NS
1105	D	2.96	2002	0.55	NS
1106	D	1.26	2002	0.24	0.26
1107	D	0.16	2002	0.022	NS
1108	D	0.0015U	2002	0.0007BU	NS
1109	D	0.0015U	2002	0.00028BU	NS
1110	D	0.0015U	2002	0.00028BU	NS
1111	D	0.0015U	2002	0.00026U	NS
1112	D	0.0015U	2002	0.0014U	NS
1113	D	0.0015U	2002	0.00044BU	NS
1114	D	0.0027	2002	NS	NS
1115	D	0.0015U	2002	0.00034BU	NS
1119	D	0.0053	2002	0.0028	NS
1120	D	0.0815	2002	0.039	0.028
1121	D	0.105	2002	0.058	NS
1122	D	0.0015U	2002	0.00038BU	NS
1123	D	0.0015U	2002	0.00039BU	NS

Table C−1 (continued). Baseline, August 2006, and February 2007 Molybdenum Concentrations

Well Number	Horizon	Baseline Molybdenum Concentration (mg/L)	Year Sampled, Baseline	Aug 2006 Molybdenum Concentration (mg/L)	Feb 2007 Molybdenum Concentration (mg/L)
1124	D	0.0015U	2002	0.00032BU	NS
1125	D	0.0015U	2002	0.00035BU	NS
0251	E	0.0015U	2002	0.00064BU	0.00057BU
0268	E	0.0015U	2002	0.00053BU	0.00041BU
0920	E	0.0003U	2001	0.00047BU	NS
0911	F			0.00035BU	NS
0913	G	0.0003U	2001	0.00035BU	NS
0916	G	0.00096	2001	0.0013U	NS
0252	I	0.0015U	2002	0.00055BU	0.0005BU
0921	I	0.0003U	2001	0.00039BU	NS

Table C−2. Baseline, August 2006, and February 2007 Nitrate Concentrations

Well Number	Horizon	Baseline Nitrate Concentration (mg/L as NO_3)	Year Sampled, Baseline	Aug 2006 Nitrate Concentration (mg/L as NO_3)	Feb 2007 Nitrate Concentration (mg/L as NO_3)
0686	A	32.2	2002	8	NS
0687	A	60.6	2002	12	NS
0688	A	35.1	2002	44	NS
0901	A	13	2001	14	NS
0906	A	1470	2002	NS	NS
0929	A	69.5	2002	53	49
0940	A	1800	2002	NS	NS
0941	A	358	2002	620	620
0945	A	12.7	2002	11	NS
0946	A			15	NS
0262	B	380	2001	430	487
0263	B	1140	2001	620	664
0265	B	720	2001	620	531
0267	B	1640	2002	1370	1370
0271	B	15.6	2002	15	NS
0281	B			150	170
0282	B			150	150
0283	B			443	531
0908	B	651	2002	664	753
0909	B	485	2002	664	708
0910	B			10	NS
0934	B	2320	2002	1860	1900
0935	B	525	2002	930	930
0936	B	2950	2002	1280	NS
0938	B	1450	1999	576	576
0942	B	1360	2002	1150	1200
0943	B	22.1	2002	29	NS
0947	B	12.5	2002	12	NS
1126	B			1150	NS
1128	B			420	NS
1129	B			487	NS
1130	B			753	NS
1131	B			160	NS
1132	B			320	NS
1133	B			NS	NS
0274	C			15	15
0276	C			10	14
0279	C			41	NS
0280	C			12	NS
0683	C	14.1	2002	10	NS
0684	C	13.9	2002	14	NS
0685	C	14.3	2002	14	NS
0689	C	14.3	2002	13	NS
0691	C	298	2002	53	62
0903	C	54.8	2002	49	NS
0912	C	403	2001	230	NS

Table C−2 (continued). Baseline, August 2006, and February 2007 Nitrate Concentrations

Well Number	Horizon	Baseline Nitrate Concentration (mg/L as NO_3)	Year Sampled, Baseline	Aug 2006 Nitrate Concentration (mg/L as NO_3)	Feb 2007 Nitrate Concentration (mg/L as NO_3)
0914	C	13	2001	12	NS
0917	C	15.7	2001	NS	NS
0930	C	50.9	2002	58	62
0932	C	25.3	2002	27	29
1008	C	15.7	2000	NS	NS
1116	C	106	2002	180	NS
1117	C	225	2002	420	NS
1118	C	164	2002	620	NS
0258	D	15	2000	15	15
0261	D	14	2001	15	NS
0264	D	24.3	2001	39	41
0266	D	14	2001	14	14
0272	D			15	15
0273	D			190	140
0275	D			974	1060
0277	D			14	NS
0278	D			10	NS
0690	D	12.5	2002	12	NS
0692	D	12.5	2002	13	NS
0695	D	25.4	2002	NS	NS
0904	D	5.13	2001	4	NS
0915	D	14.1	2001	14	NS
1003	D	176	2000	89	NS
1004	D	49.1	2000	39	NS
1005	D	14.5	2000	NS	NS
1006	D	14.1	2000	10	NS
1007	D	15.3	2000	14	NS
1101	D	438	2002	410	NS
1102	D	650	2002	487	NS
1103	D	1120	2002	753	NS
1104	D	993	2002	664	NS
1105	D	648	2002	290	NS
1106	D	614	2002	230	260
1107	D	1060	2002	200	NS
1108	D	1410	2002	576	NS
1109	D	798	2002	350	NS
1110	D	227	2002	443	NS
1111	D	421	2002	370	NS
1112	D	617	2002	140	NS
1113	D	143	2002	58	NS
1114	D	228	2002	NS	NS
1115	D	766	2002	320	NS
1119	D	468	2002	576	NS
1120	D	493	2002	280	270
1121	D	573	2002	390	NS
1122	D	954	2002	531	NS
1123	D	643	2002	62	NS

Table C−2 (continued). Baseline, August 2006, and February 2007 Nitrate Concentrations

Well Number	Horizon	Baseline Nitrate Concentration (mg/L as NO_3)	Year Sampled, Baseline	Aug 2006 Nitrate Concentration (mg/L as NO_3)	Feb 2007 Nitrate Concentration (mg/L as NO_3)
1124	D	781	2002	210	NS
1125	D	104	2002	43	NS
0251	E	426	2002	17	17
0268	E	15.4	2002	71	89
0920	E	14.8	2001	15	NS
0911	F			14	NS
0913	G	12.4	2001	12	NS
0916	G	11.6	2001	10	NS
0252	I	15.3	2002	11	10
0921	I	11	2001	11	NS

Table C−3. Baseline, August 2006, and February 2007 Selenium Concentrations

Well Number	Horizon	Baseline Selenium Concentration (mg/L)	Year Sampled, Baseline	Aug 2006 Selenium Concentration (mg/L)	Feb 2007 Selenium Concentration (mg/L)
0686	A	0.0088	2002	0.00015	NS
0687	A	0.0145	2002	0.00036	NS
0688	A	0.0033	2002	0.022	NS
0901	A	0.0024	2001	0.0023	NS
0906	A	0.0335	2002	NS	NS
0929	A	0.0028	2002	0.0028	0.0025
0940	A	0.105	2002	NS	NS
0941	A	0.0348	2002	0.058	0.059
0945	A	0.0035	2002	0.0023	NS
0946	A			0.0021	NS
0262	B	0.0621	2001	0.064	0.073
0263	B	0.0632	2001	0.027	0.026
0265	B	0.0071	2001	0.0057	0.0065
0267	B	0.0532	2002	0.043	0.043
0271	B	0.0016	2002	0.0009	NS
0281	B			0.0019	0.0023
0282	B			0.0015	0.0022
0283	B			0.0094	0.016
0908	B	0.0163	2002	0.021	0.024
0909	B	0.0224	2002	0.052	0.052
0910	B			0.00096	NS
0934	B	0.0116	2002	0.01	0.013
0935	B	0.0195	2002	0.023	0.025
0936	B	0.0869	2002	0.026	NS
0938	B	0.0432	1999	0.032	0.035
0942	B	0.0348	2002	0.048	0.045
0943	B	0.0021	2002	0.0021	NS
0947	B	0.0019	2002	0.0012	NS
1126	B			0.048	NS
1128	B			0.0075	NS
1129	B			0.057	NS
1130	B			0.028	NS
1131	B			0.0023	NS
1132	B			0.036	NS
0274	C			0.0009	0.0017
0276	C			0.00099	0.0019
0279	C			0.0021	NS
0280	C			0.0019	NS
0683	C	0.0022	2002	0.0017	NS
0684	C	0.0019	2002	0.0011	NS
0685	C	0.0017	2002	0.0013	NS
0689	C	0.0014	2002	0.00078	NS
0691	C	0.0046	2002	0.0015	0.0023
0903	C	0.0023	2002	0.002	NS
0912	C	0.0137	2001	0.0062	NS
0914	C	0.0016	2001	0.00067	NS

Table C−3 (continued). Baseline, August 2006, and February 2007 Selenium Concentrations

Well Number	Horizon	Baseline Selenium Concentration (mg/L)	Year Sampled, Baseline	Aug 2006 Selenium Concentration (mg/L)	Feb 2007 Selenium Concentration (mg/L)
0917	C	0.0017	2001	NS	NS
0930	C	0.002	2002	0.0017	0.0021
0932	C	0.0019	2002	0.0011	0.0018
1008	C	0.0015	2000	NS	NS
1116	C	0.0018	2002	0.0025	NS
1117	C	0.0028	2002	0.012	NS
1118	C	0.0028	2002	0.019	NS
0258	D	0.0018	2000	0.0015	0.0019
0261	D	0.0021	2001	0.0012	NS
0264	D	0.0018	2001	0.001	0.0019
0266	D	0.0013	2001	0.00065	0.0013
0272	D			0.00071	0.0013
0273	D			0.015	0.013
0275	D			0.018	0.022
0277	D			0.00087	NS
0278	D			0.00069	NS
0690	D	0.0014	2002	0.00075	NS
0692	D	0.0022	2002	0.0016	NS
0695	D	0.0019	2002	NS	NS
0904	D	0.0131	2001	0.015	NS
0915	D	0.0019	2001	0.0012	NS
1003	D	0.003	2000	0.0017	NS
1004	D	0.0021	2000	0.0013	NS
1005	D	0.0014	2000	NS	NS
1006	D	0.0013	2000	0.00075	NS
1007	D	0.0013	2000	0.00078	NS
1101	D	0.0188	2002	0.027	NS
1102	D	0.0121	2002	0.017	NS
1103	D	0.0613	2002	0.022	NS
1104	D	0.0344	2002	0.028	NS
1105	D	0.0871	2002	0.021	NS
1106	D	0.0925	2002	0.018	0.03
1107	D	0.0903	2002	0.013	NS
1108	D	0.0704	2002	0.026	NS
1109	D	0.0372	2002	0.014	NS
1110	D	0.0081	2002	0.017	NS
1111	D	0.0172	2002	0.014	NS
1112	D	0.0154	2002	0.0038	NS
1113	D	0.0025	2002	0.0011	NS
1114	D	0.0035	2002	NS	NS
1115	D	0.0362	2002	0.011	NS
1119	D	0.029	2002	0.025	NS
1120	D	0.0563	2002	0.025	0.024
1121	D	0.0455	2002	0.018	NS
1122	D	0.0558	2002	0.035	NS
1123	D	0.0449	2002	0.0036	NS
1124	D	0.0186	2002	0.0061	NS

Table C−3 (continued). Baseline, August 2006, and February 2007 Selenium Concentrations

Well Number	Horizon	Baseline Selenium Concentration (mg/L)	Year Sampled, Baseline	Aug 2006 Selenium Concentration (mg/L)	Feb 2007 Selenium Concentration (mg/L)
1125	D	0.0025	2002	0.0022	NS
0251	E	0.0035	2002	0.00055	0.0011
0268	E	0.0018	2002	0.0018	0.002
0920	E	0.0014	2001	0.00077	NS
0911	F			0.00061	NS
0913	G	0.00063	2001	0.00054	NS
0916	G	0.001	2001	0.00059	NS
0252	I	0.00092	2002	0.00039	0.0009
0921	I	0.00091	2001	0.00053	NS

Table C−4. Baseline, August 2006, and February 2007 Sulfate Concentrations

Well Number	Horizon	Baseline Sulfate Concentration (mg/L)	Year Sampled, Baseline	Aug 2006 Sulfate Concentration (mg/L)	Feb 2007 Sulfate Concentration (mg/L)
0686	A	98.6	2002	25	NS
0687	A	329	2002	33	NS
0688	A	40	2002	310	NS
0901	A	26.2	2001	32	NS
0906	A	1660	2002	NS	NS
0929	A	28.1	2002	27	23
0940	A	7550	2002	NS	NS
0941	A	745	2002	750	780
0945	A	32.1	2002	24	NS
0946	A			51	NS
0262	B	931	2001	960	1000
0263	B	1990	2001	2000	2100
0265	B	1520	2001	1100	990
0267	B	3680	2002	3600	3400
0271	B	16.4	2002	15	NS
0281	B			110	120
0282	B			160	130
0283	B			540	730
0908	B	2430	2002	2700	2900
0909	B	666	2002	810	870
0910	B			15	NS
0934	B	7360	2002	2300	2600
0935	B	2690	2002	2500	2600
0936	B	4360	2002	1600	NS
0938	B	2120	1999	980	990
0942	B	3030	2002	2900	3100
0943	B	29	2002	97	NS
0947	B	18.7	2002	17	NS
1126	B			3300	NS
1128	B			550	NS
1129	B			970	NS
1130	B			1500	NS
1131	B			310	NS
1132	B			570	NS
1133	B			NS	NS
0274	C			15	15
0276	C			16	17
0279	C			60	NS
0280	C			21	NS
0683	C	21.6	2002	18	NS
0684	C	18	2002	16	NS
0685	C	26.2	2002	19	NS
0689	C	13.7	2002	14	NS
0691	C	587	2002	91	100
0903	C	76.5	2002	68	NS
0912	C	846	2001	390	NS

Table C−4 (continued). Baseline, August 2006, and February 2007 Sulfate Concentrations

Well Number	Horizon	Baseline Sulfate Concentration (mg/L)	Year Sampled, Baseline	Aug 2006 Sulfate Concentration (mg/L)	Feb 2007 Sulfate Concentration (mg/L)
0914	C	15.6	2001	12	NS
0917	C	13.9	2001	NS	NS
0930	C	59.8	2002	65	59
0932	C	30.2	2002	27	37
1008	C	13	2000	NS	NS
1116	C	176	2002	240	NS
1117	C	255	2002	800	NS
1118	C	163	2002	1700	NS
0258	D	17.4	2000	18	18
0261	D	18.2	2001	18	NS
0264	D	37.7	2001	62	58
0266	D	10.9	2001	11	11
0272	D			11	11
0273	D			230	140
0275	D			2000	2200
0277	D			18	NS
0278	D			12	NS
0690	D	13.8	2002	12	NS
0692	D	20.8	2002	18	NS
0695	D	50.4	2002	NS	NS
0904	D	96.5	2001	100	NS
0915	D	17.8	2001	17	NS
1003	D	302	2000	55	NS
1004	D	66.2	2000	58	NS
1005	D	12.7	2000	NS	NS
1006	D	12.2	2000	11	NS
1007	D	11.7	2000	13	NS
1101	D	960	2002	1300	NS
1102	D	1320	2002	1100	NS
1103	D	2570	2002	1400	NS
1104	D	1870	2002	1200	NS
1105	D	1590	2002	560	NS
1106	D	1050	2002	410	490
1107	D	1200	2002	260	NS
1108	D	3400	2002	1400	NS
1109	D	3280	2002	900	NS
1110	D	512	2002	1000	NS
1111	D	988	2002	930	NS
1112	D	1140	2002	210	NS
1113	D	136	2002	49	NS
1114	D	328	2002	NS	NS
1115	D	1930	2002	610	NS
1119	D	1560	2002	1300	NS
1120	D	2330	2002	1800	1700
1121	D	2590	2002	940	NS
1122	D	2960	2002	2300	NS

Table C−4 (continued). Baseline, August 2006, and February 2007 Sulfate Concentrations

Well Number	Horizon	Baseline Sulfate Concentration (mg/L)	Year Sampled, Baseline	Aug 2006 Sulfate Concentration (mg/L)	Feb 2007 Sulfate Concentration (mg/L)
1123	D	1240	2002	160	NS
1124	D	1170	2002	320	NS
1125	D	165	2002	66	NS
0251	E	617	2002	14	14
0268	E	17.4	2002	130	140
0920	E	12.7	2001	12	NS
0911	F			9	NS
0913	G	8.43	2001	7.7	NS
0916	G	13.5	2001	10	NS
0252	I	19.2	2002	6.5	6.7
0921	I	8.52	2001	7.6	NS

Table C−5. Baseline, August 2006, and February 2007 Uranium Concentrations

Well Number	Horizon	Baseline Uranium Concentration (mg/L)	Year Sampled, Baseline	Aug 2006 Uranium Concentration (mg/L)	Feb 2007 Uranium Concentration (mg/L)
0686	A	0.0021	2002	0.000058BU	NS
0687	A	0.0208	2002	0.00041	NS
0688	A	0.002	2002	0.0062	NS
0901	A	0.0026	2001	0.0028	NS
0906	A	0.951	2002	NS	NS
0929	A	0.0012	2002	0.0013	0.0013
0940	A	0.546	2002	NS	NS
0941	A	0.0886	2002	0.093N	0.078
0945	A	0.0031	2002	0.0022	NS
0946	A			0.00017U	NS
0262	B	0.379	2001	0.78	0.93
0263	B	0.485	2001	0.1	0.098
0265	B	0.0897	2001	0.061	0.053
0267	B	0.0731	2002	0.077	0.061
0271	B	0.0014	2002	0.0012	NS
0281	B			0.0086	0.008
0282	B			0.01	0.0073
0283	B			0.023	0.03
0908	B	0.122	2002	0.089	0.092
0909	B	0.0389	2002	0.051	0.047
0910	B			0.001	NS
0934	B	0.312	2002	0.25	0.21
0935	B	0.0868	2002	0.13	0.11
0936	B	0.267	2002	0.2	NS
0938	B	0.21	1999	0.3	0.31
0942	B	0.246	2002	0.62	0.46
0943	B	0.0049	2002	0.022	NS
0947	B	0.0024	2002	0.001	NS
1126	B			0.068	NS
1128	B			0.034	NS
1129	B			0.72	NS
1130	B			0.27	NS
1131	B			0.076	NS
1132	B			0.37	NS
0274	C			0.0015	0.0012
0276	C			0.0014	0.0013
0279	C			0.0015	NS
0280	C			0.0013	NS
0683	C	0.0012	2002	0.0011	NS
0684	C	0.0019	2002	0.0013	NS
0685	C	0.0012	2002	0.0011	NS
0689	C	0.0011	2002	0.001	NS
0691	C	0.0657	2002	0.013	0.014
0903	C	0.0022	2002	0.0019	NS
0912	C	0.0342	2001	0.021	NS
0914	C	0.0013	2001	0.000042BU	NS

Table C−5 (continued). Baseline, August 2006, and February 2007 Uranium Concentrations

Well Number	Horizon	Baseline Uranium Concentration (mg/L)	Year Sampled, Baseline	Aug 2006 Uranium Concentration (mg/L)	Feb 2007 Uranium Concentration (mg/L)
0917	C	0.0013	2001	NS	NS
0930	C	0.0023	2002	0.0028	0.0025
0932	C	0.0016	2002	0.0015	0.0013
1008	C	0.001	2000	NS	NS
1116	C	0.0081	2002	0.017	NS
1117	C	0.0151	2002	0.036	NS
1118	C	0.0098	2002	0.086	NS
0258	D	0.0018	2000	0.0011	0.0011
0261	D	0.0018	2001	0.0011	NS
0264	D	0.0033	2001	0.0031	0.0028
0266	D	0.0019	2001	0.0015	0.0014
0272	D			0.0013	0.0012
0273	D			0.048	0.033
0275	D			0.47	0.46
0277	D			0.0024	NS
0278	D			0.0011	NS
0690	D	0.0018	2002	0.0015	NS
0692	D	0.0015	2002	0.0015	NS
0695	D	0.002	2002	NS	NS
0904	D	0.0044	2001	0.0051	NS
0915	D	0.0017	2001	0.00004BU	NS
1003	D	0.0205	2000	0.0084	NS
1004	D	0.0053	2000	0.0065	NS
1005	D	0.0013	2000	NS	NS
1006	D	0.0014	2000	0.001	NS
1007	D	0.0012	2000	0.0011	NS
1101	D	0.245	2002	0.39	NS
1102	D	0.533	2002	0.33	NS
1103	D	0.355	2002	0.32	NS
1104	D	0.194	2002	0.43	NS
1105	D	2.1	2002	0.73	NS
1106	D	2.1	2002	0.44	0.45
1107	D	0.118	2002	0.039	NS
1108	D	0.646	2002	0.22	NS
1109	D	0.565	2002	0.24	NS
1110	D	0.0528	2002	0.22	NS
1111	D	0.161	2002	0.16	NS
1112	D	0.13	2002	0.039	NS
1113	D	0.0149	2002	0.0061	NS
1114	D	0.0277	2002	NS	NS
1115	D	0.41	2002	0.076	NS
1119	D	0.555	2002	0.29	NS
1120	D	1.3	2002	0.35	0.28
1121	D	0.857	2002	0.23	NS
1122	D	0.878	2002	0.5	NS
1123	D	0.261	2002	0.035	NS
1124	D	0.171	2002	0.051	NS

Table C−5 (continued). Baseline, August 2006, and February 2007 Uranium Concentrations

Well Number	Horizon	Baseline Uranium Concentration (mg/L)	Year Sampled, Baseline	Aug 2006 Uranium Concentration (mg/L)	Feb 2007 Uranium Concentration (mg/L)
1125	D	0.0176	2002	0.01	NS
0251	E	0.0481	2002	0.0016	0.0018
0268	E	0.0014	2002	0.021	0.022
0920	E	0.0017	2001	0.0011	NS
0911	F			0.0011	NS
0913	G	0.0016	2001	0.0011	NS
0916	G	0.0014	2001	0.000044BU	NS
0252	I	0.0024	2002	0.0016	0.0017
0921	I	0.0047	2001	0.0046	NS

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Appendix D

Monitor Well Water Level Hydrographs

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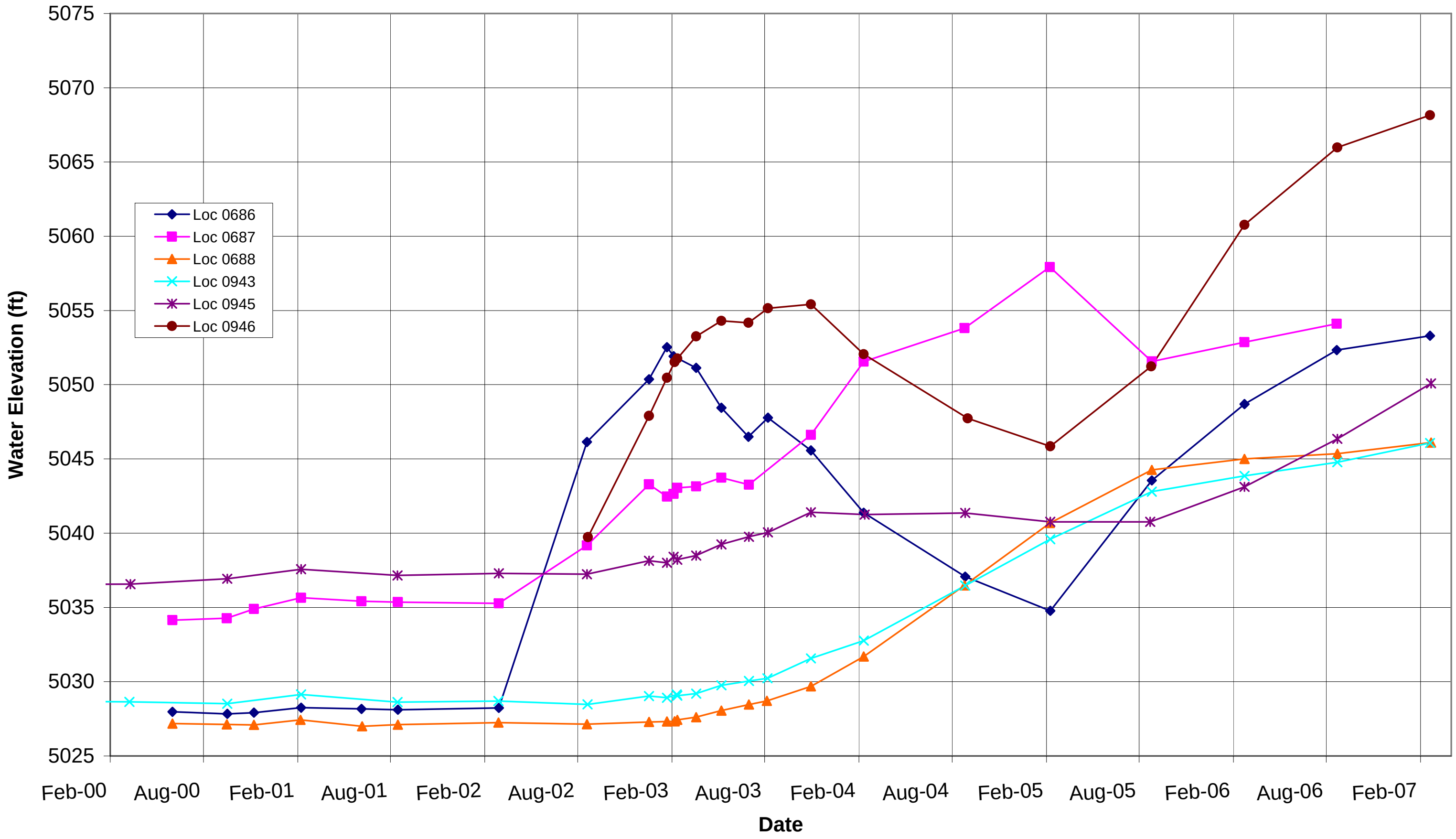

Figure D−1. Monitor Wells at Infiltration Trench

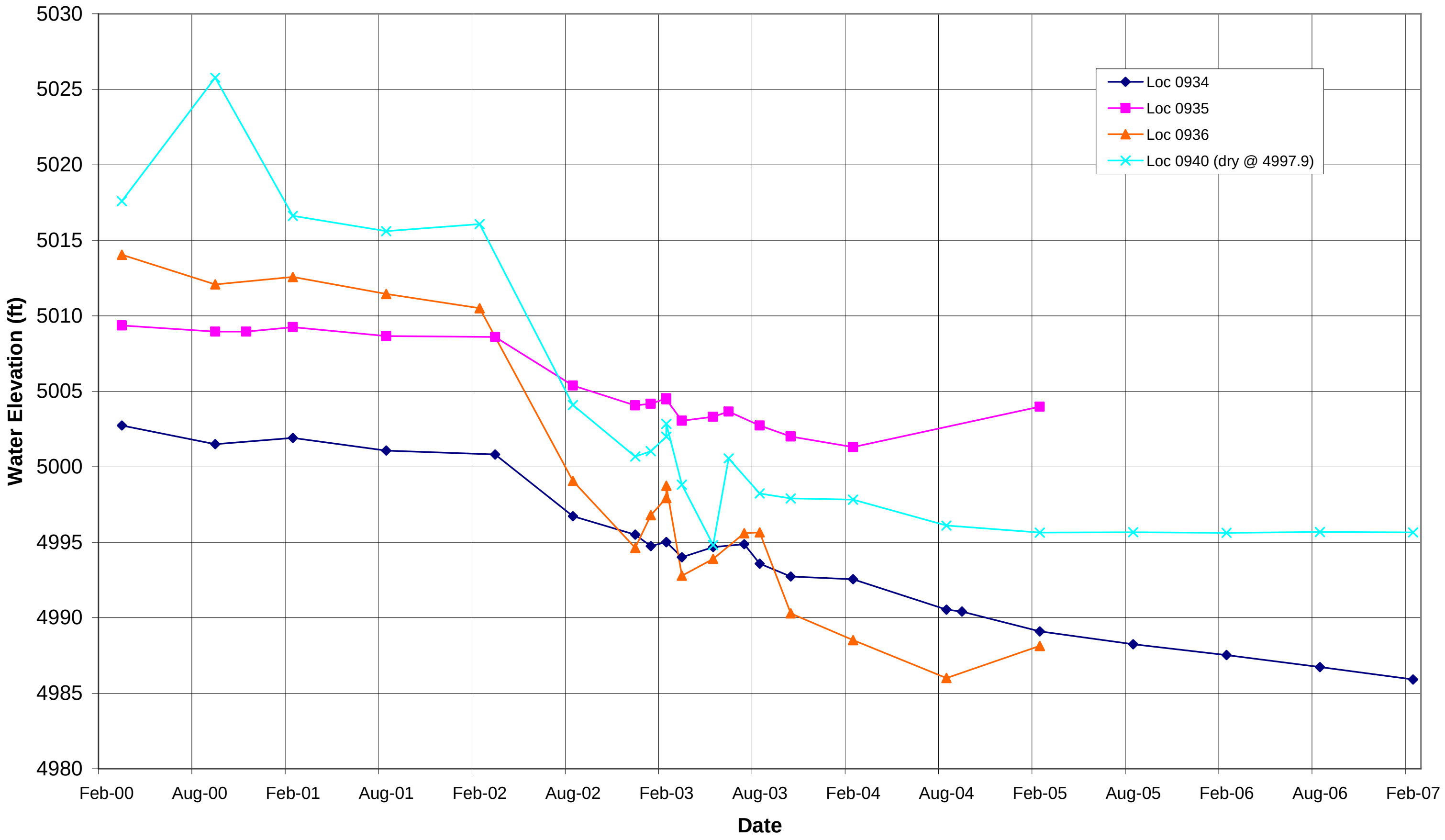

Figure D−2. Selected Horizon A and B Monitor Wells

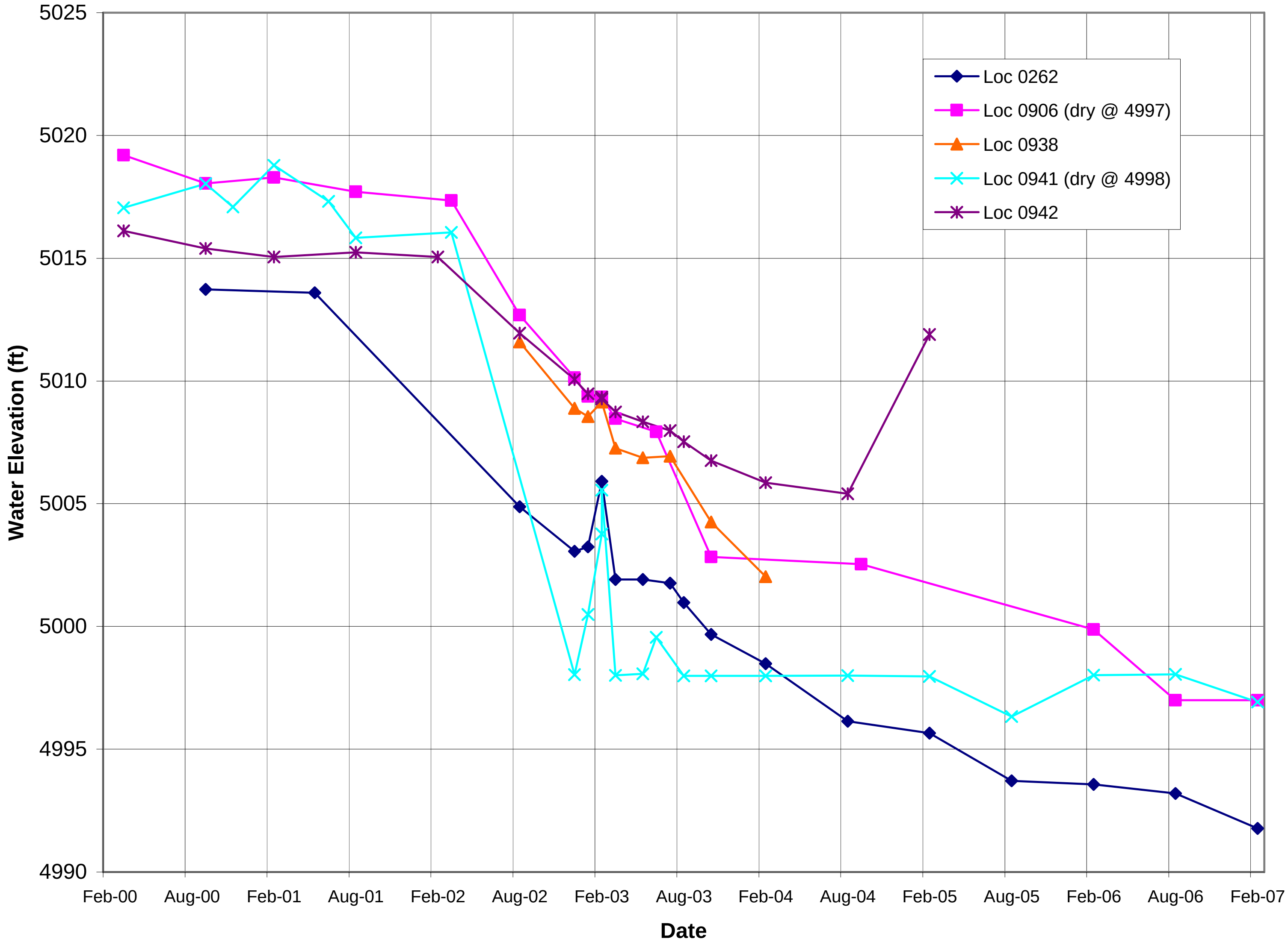

Figure D−3. Selected Horizon A and B Monitor Wells

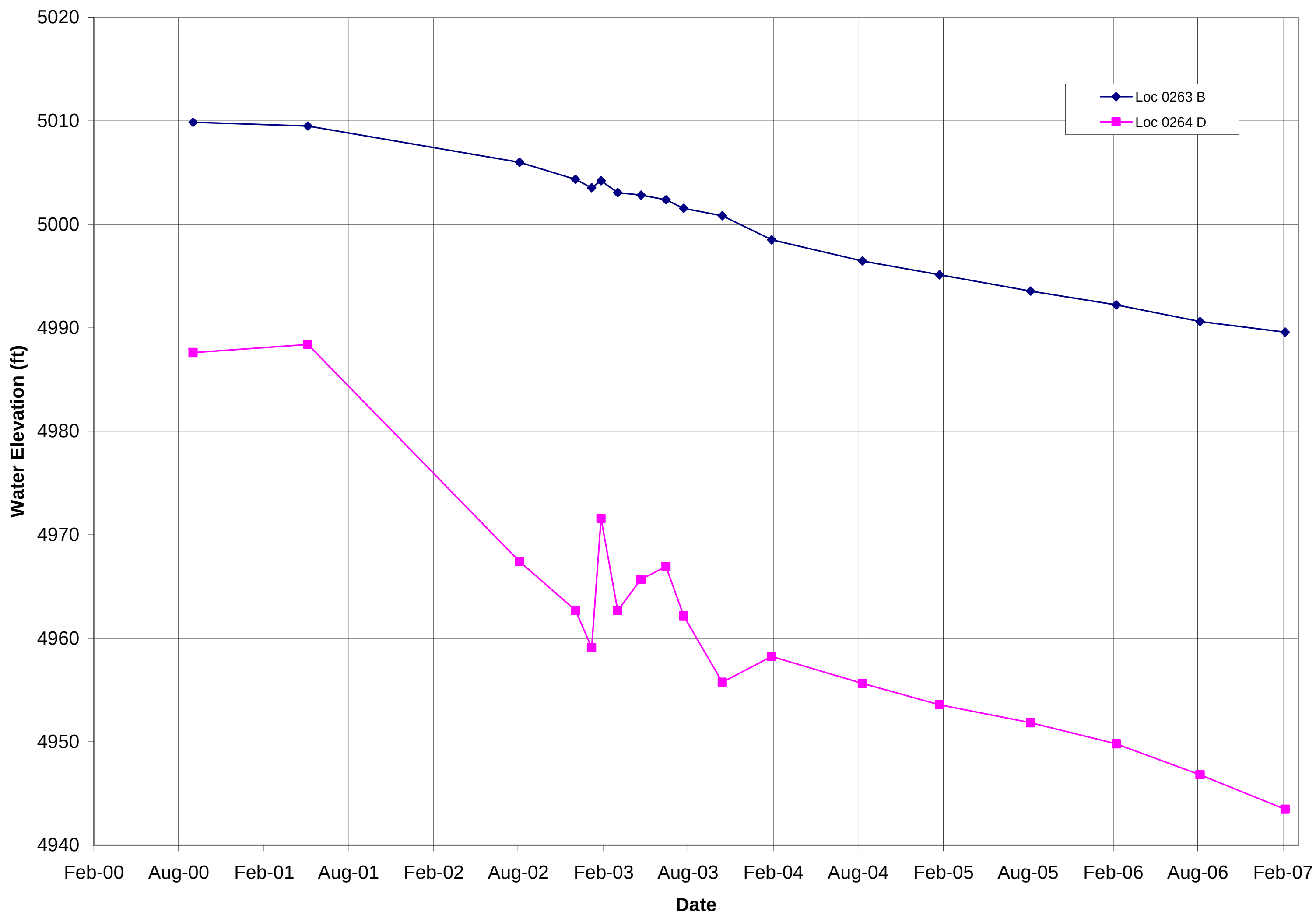

Figure D−4. Middle Terrace Well Pair

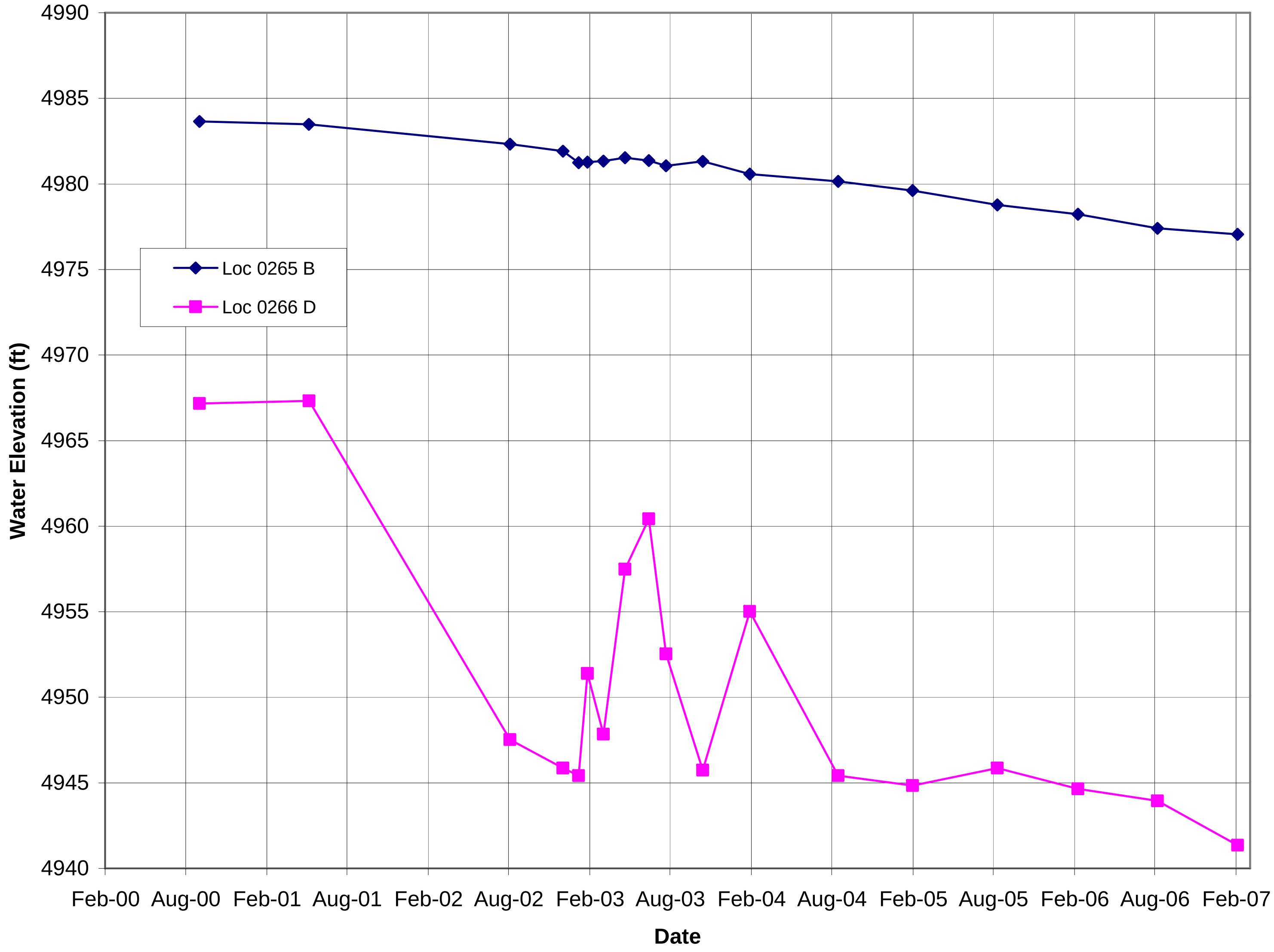

Figure D−5. Middle Terrace Well Pair

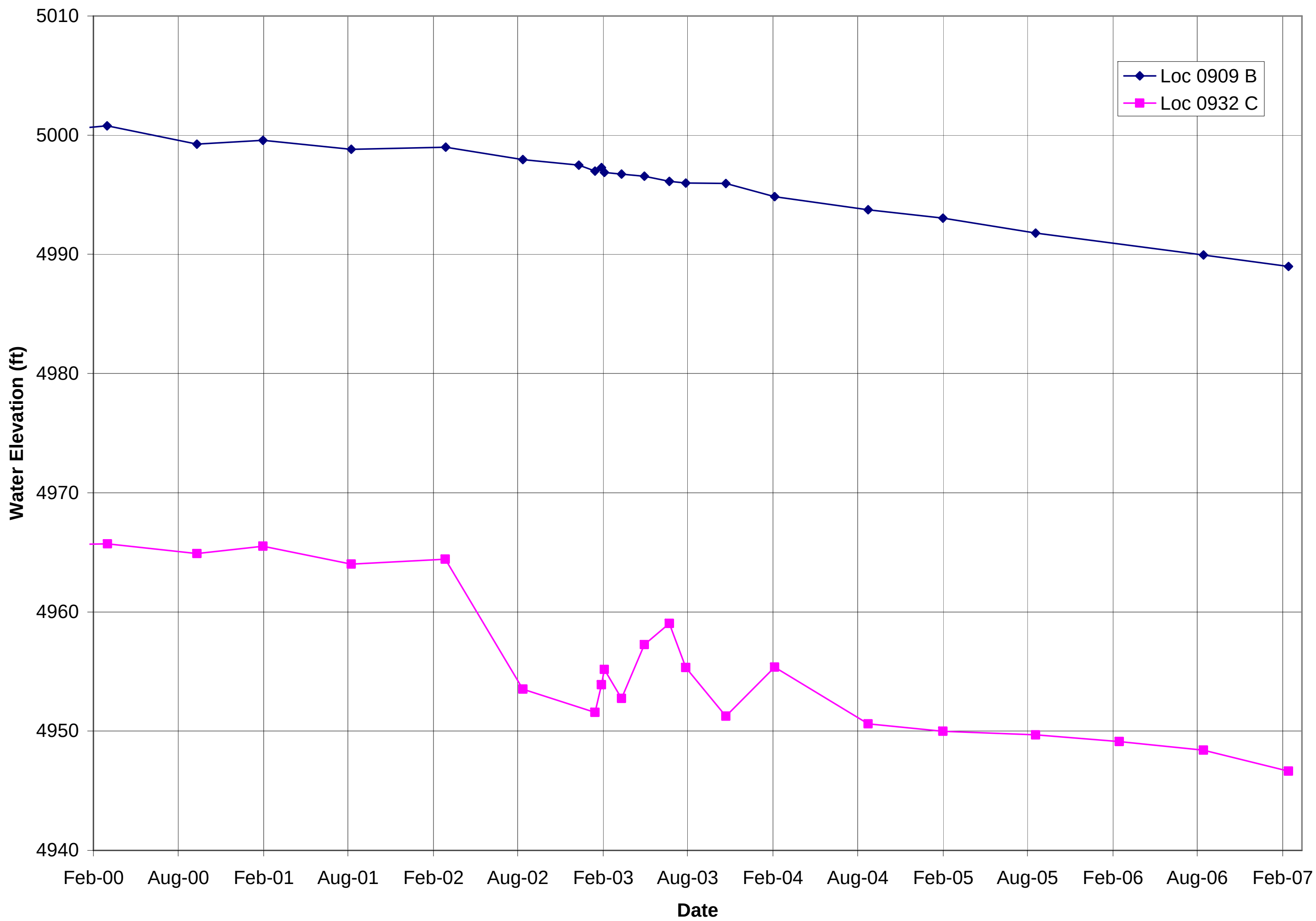

Figure D–6. Middle Terrace Well Pair

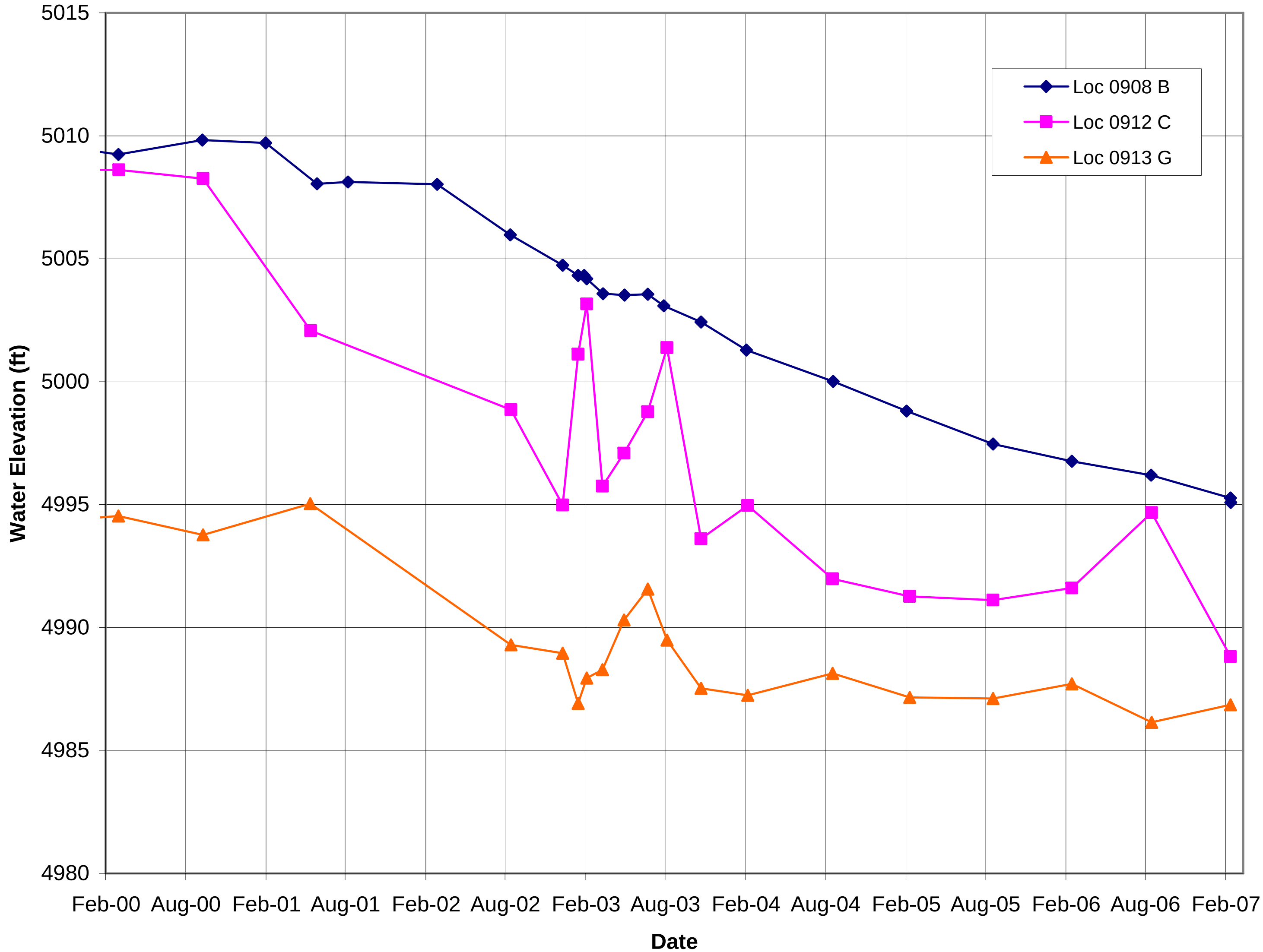

Figure D−7. Middle Terrace Well Pair

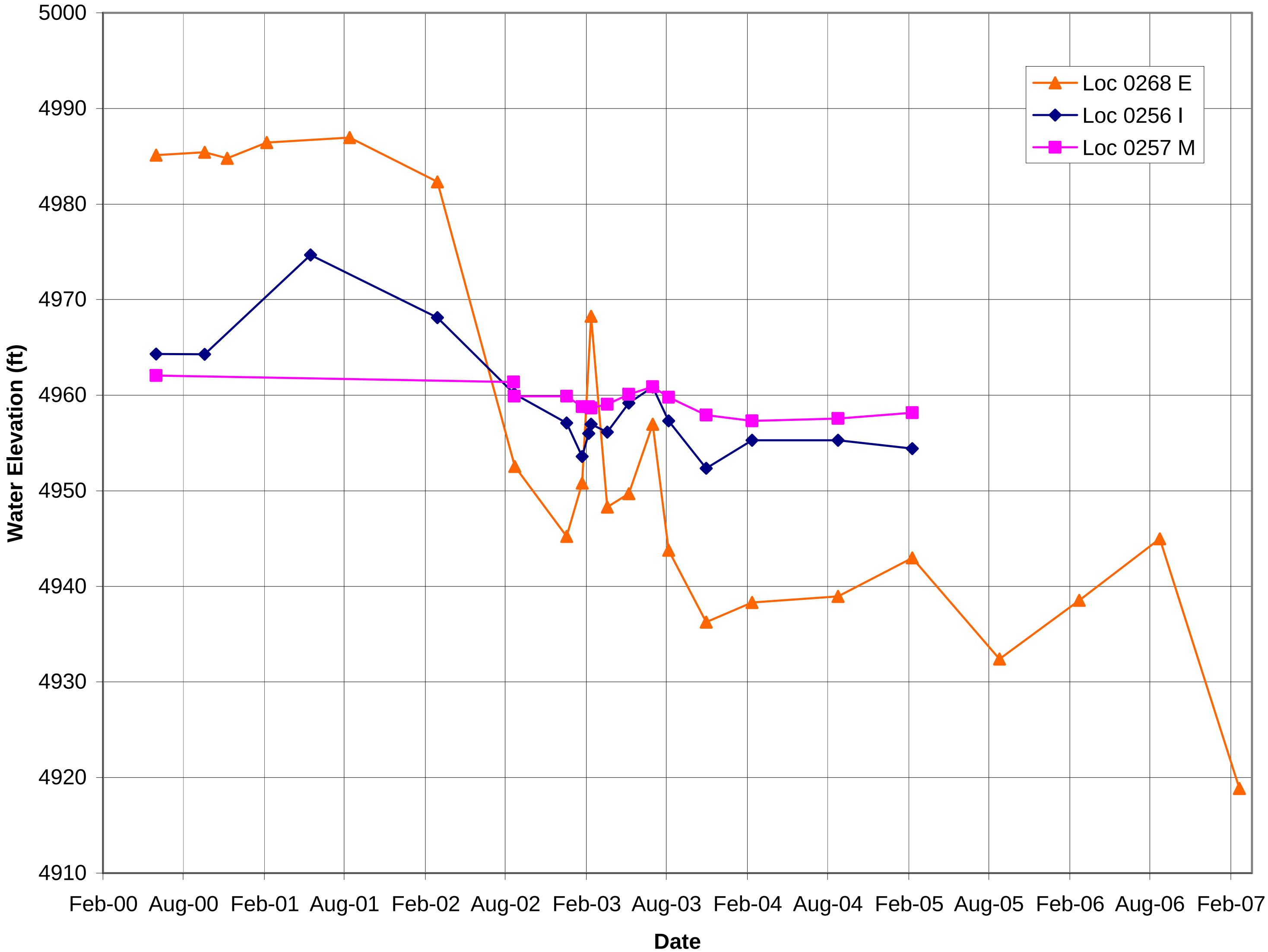

Figure D−8. Middle Terrace Well Cluster

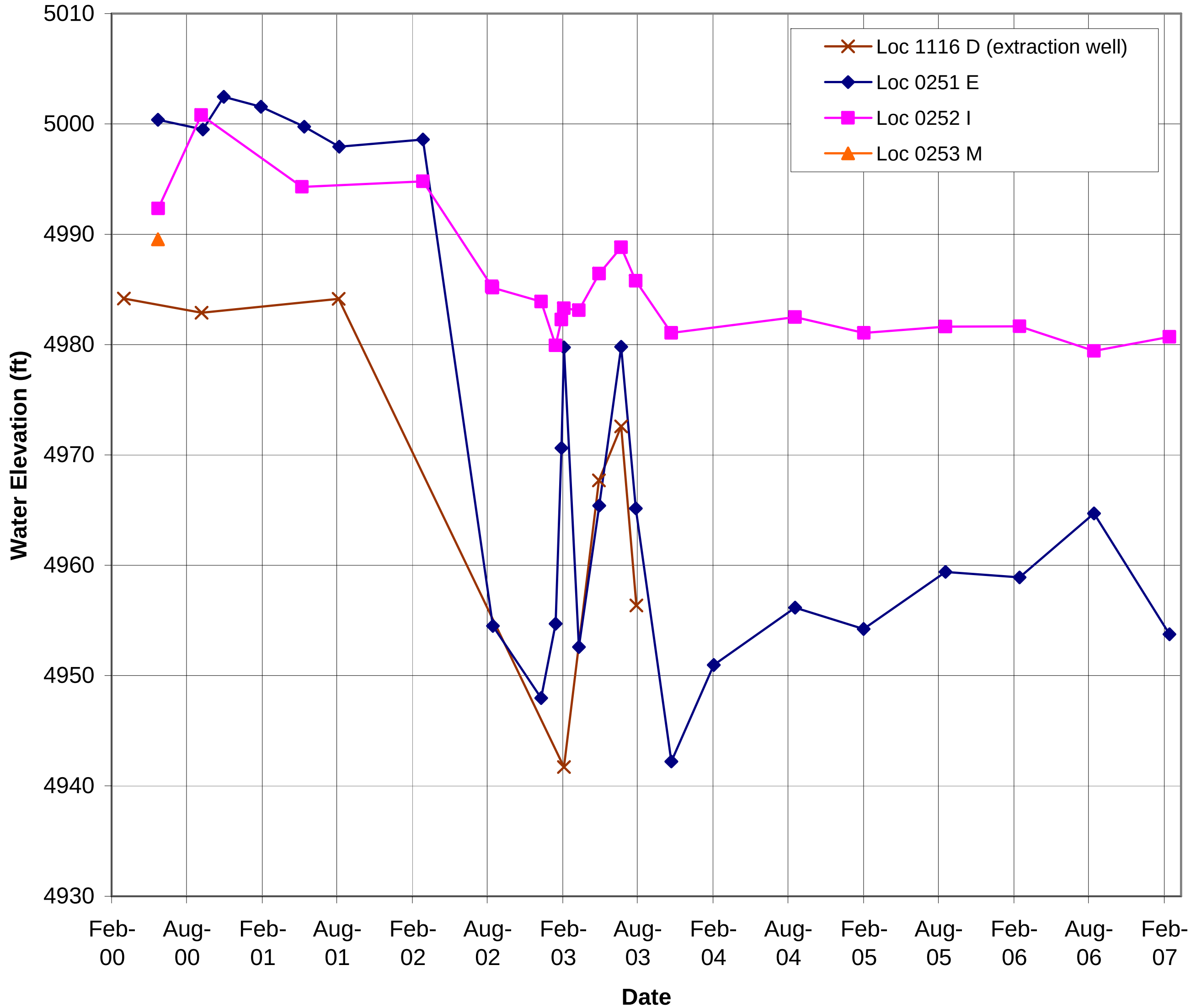

Figure D−9. Middle Terrace Well Cluster

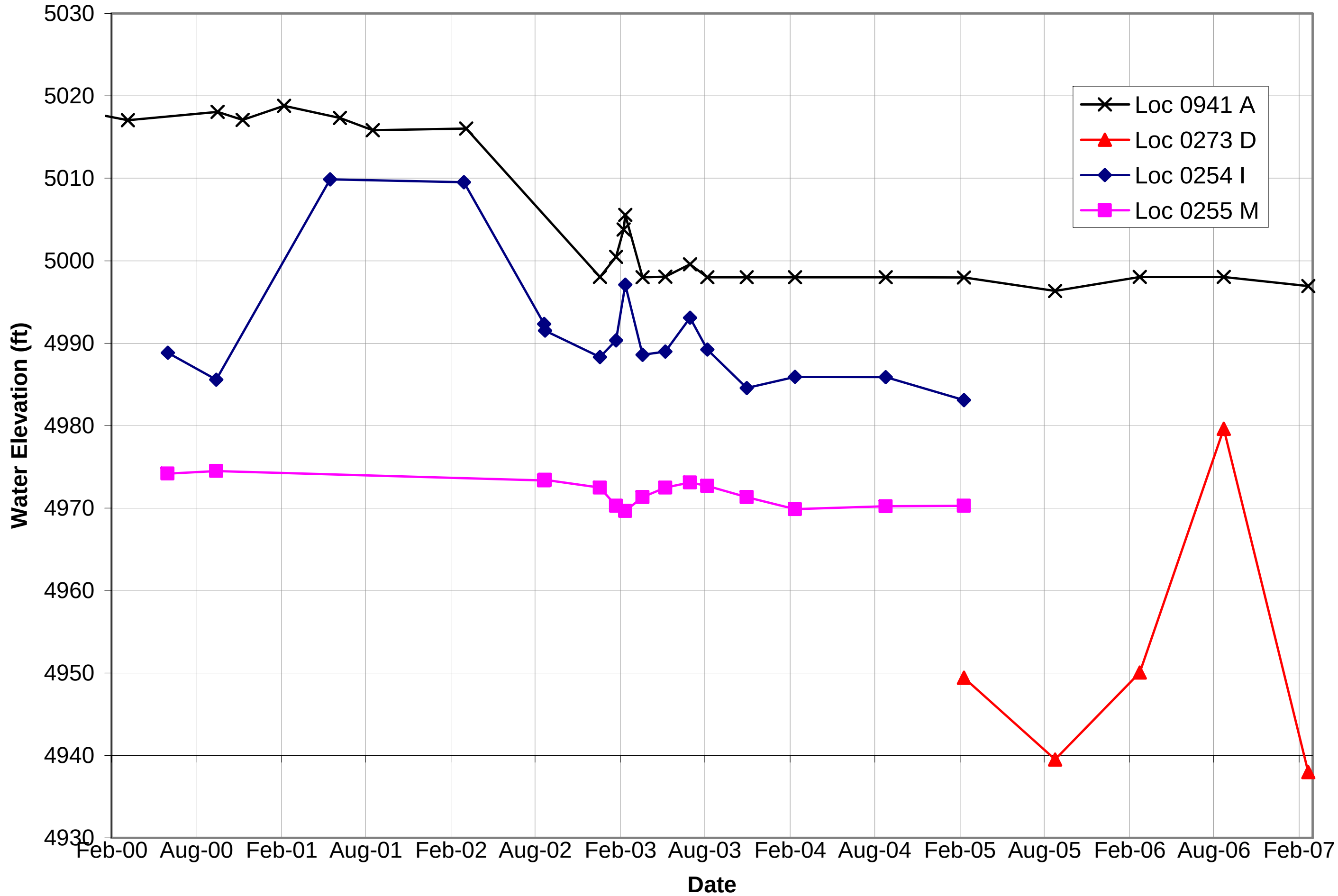

Figure D−10. Middle Terrace Well Cluster

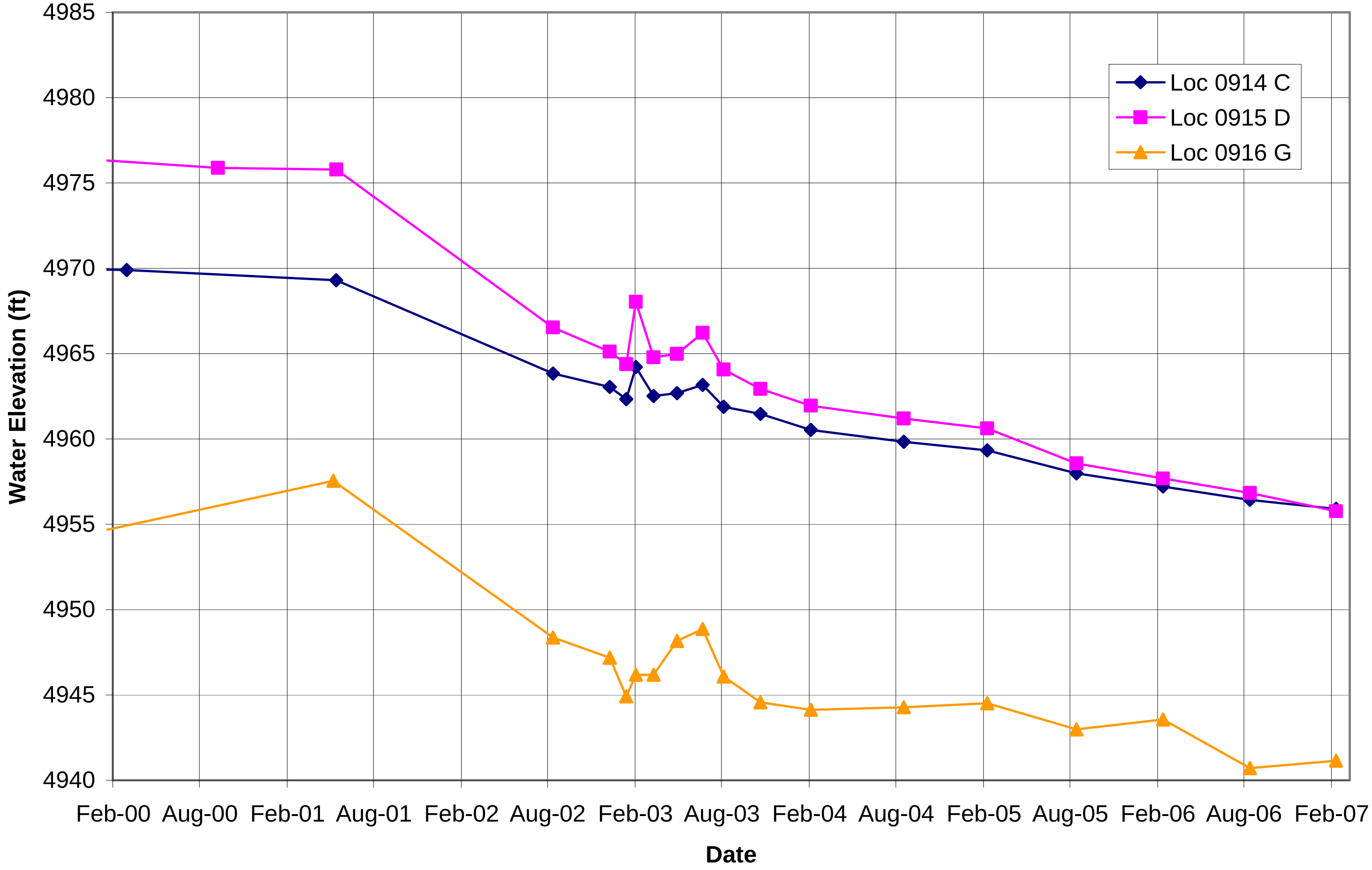

Figure D−11. Middle Terrace Well Cluster

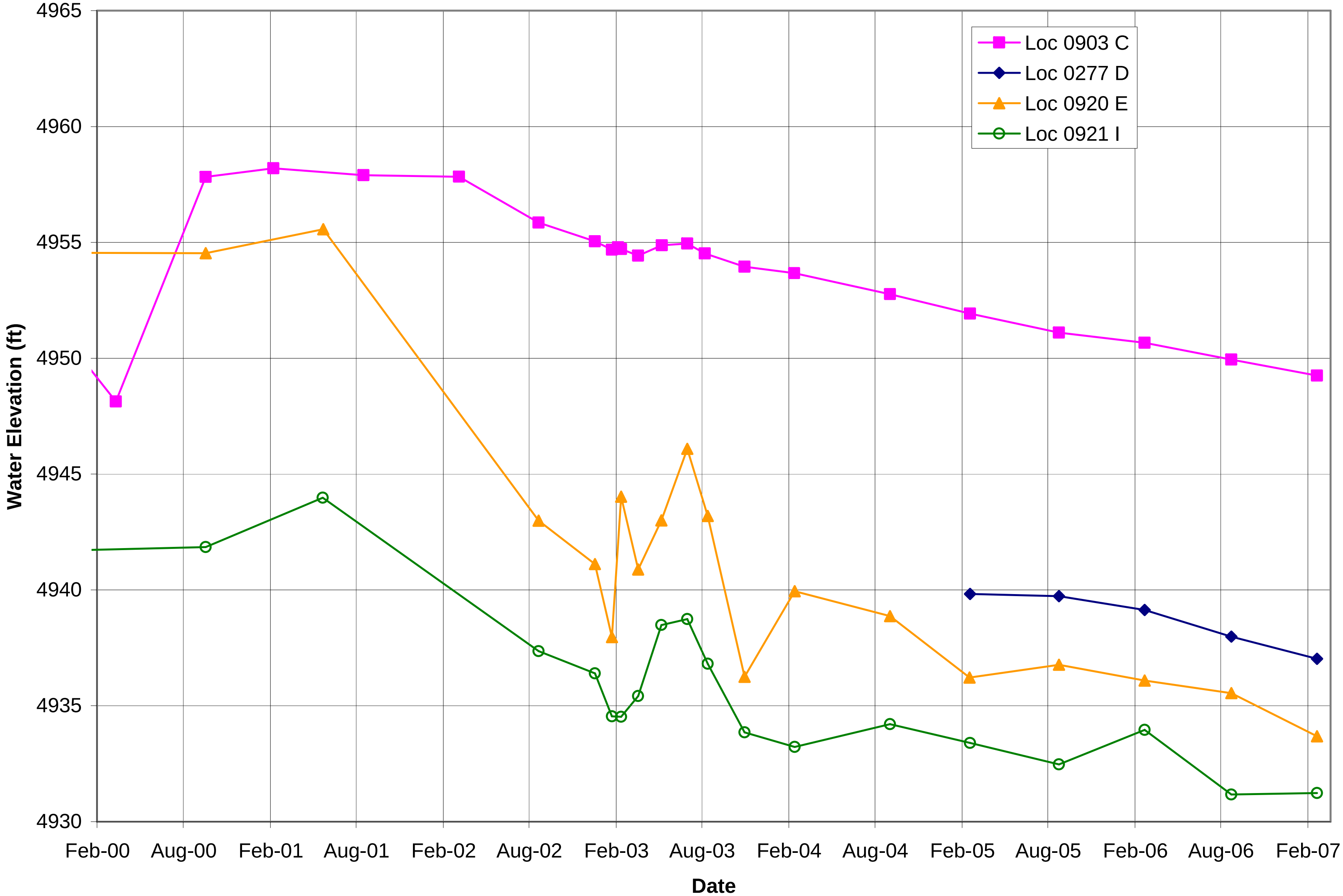

Figure D−12. Lower Terrace Well Cluster

Appendix E

Contaminant Concentration Trends at Monitor Wells

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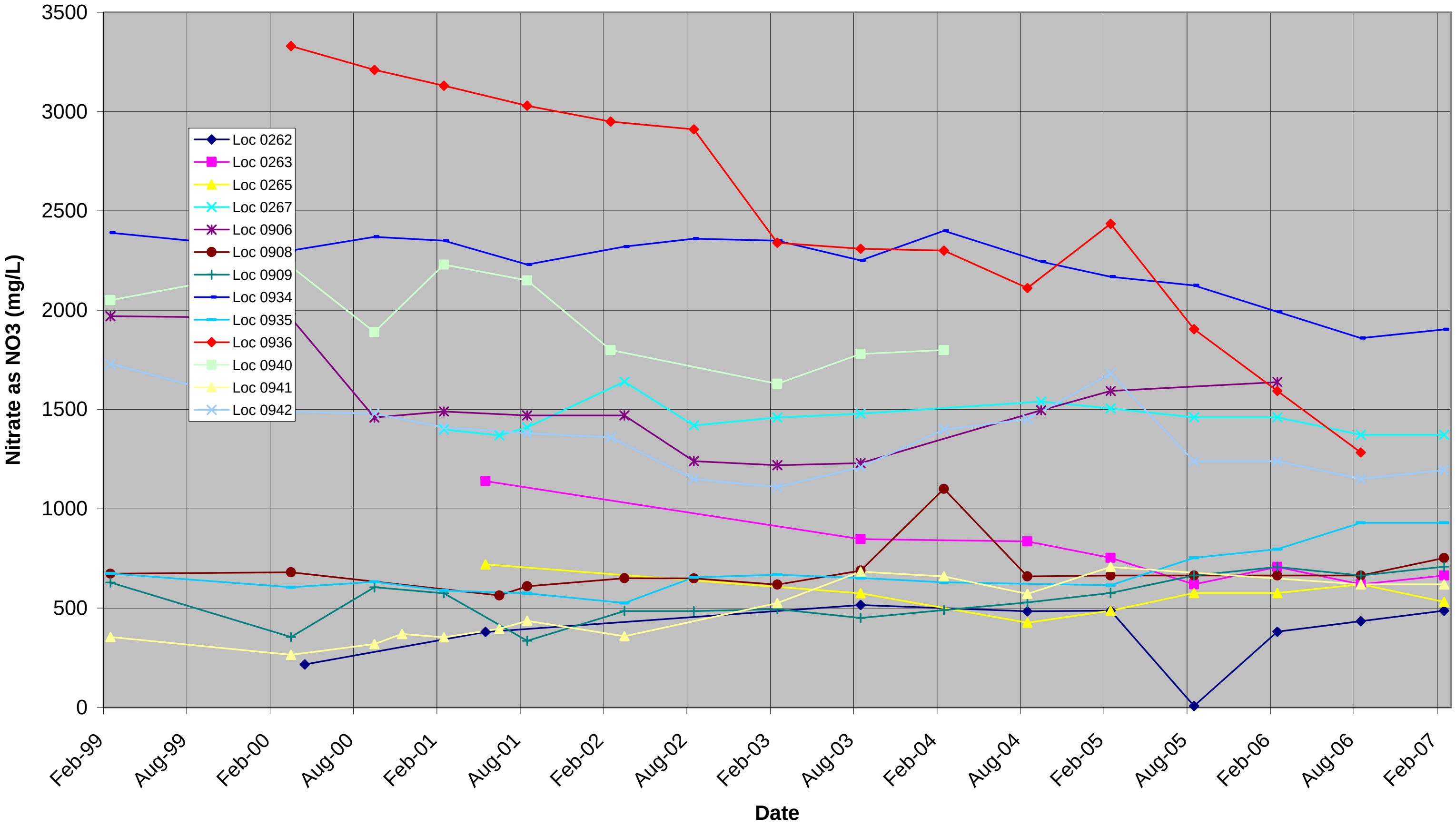

Figure E−1. Horizons A and B Monitor Wells, Nitrate as $N0_3$ Concentration

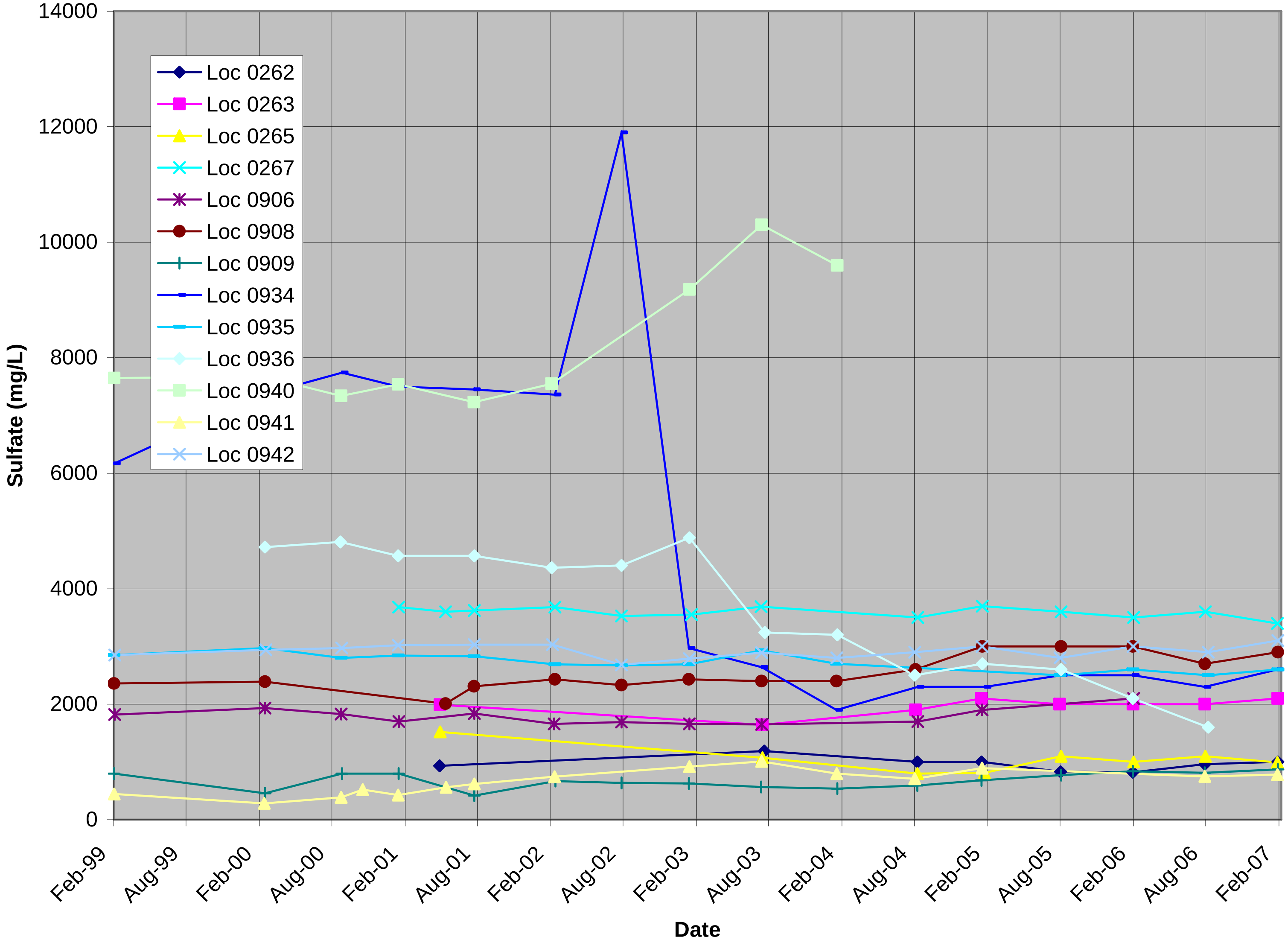

Figure E−2. Horizons A and B Monitor Wells, Sulfate Concentration

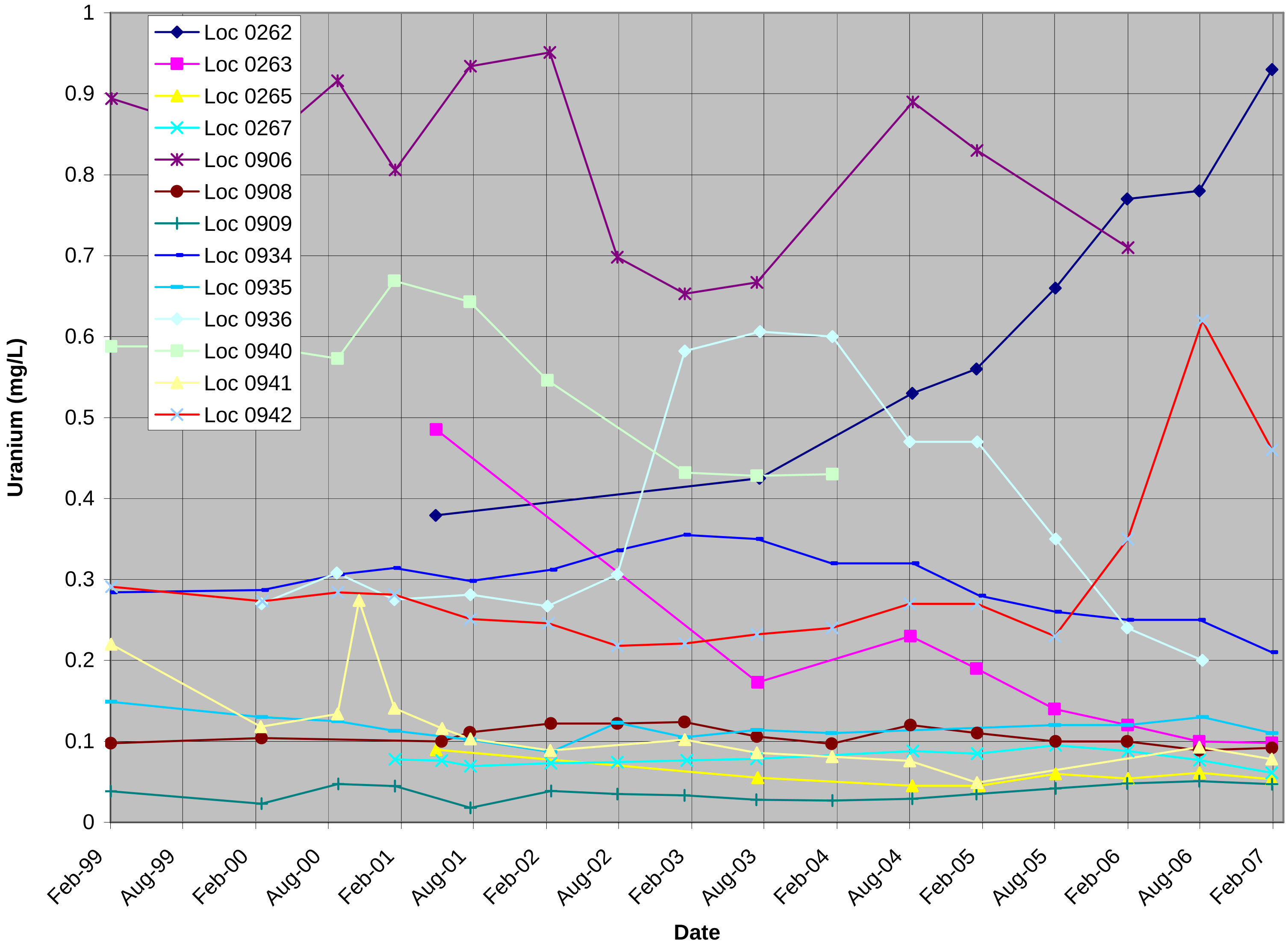

Figure E−3. Horizons A and B Monitor Wells, Uranium Concentration

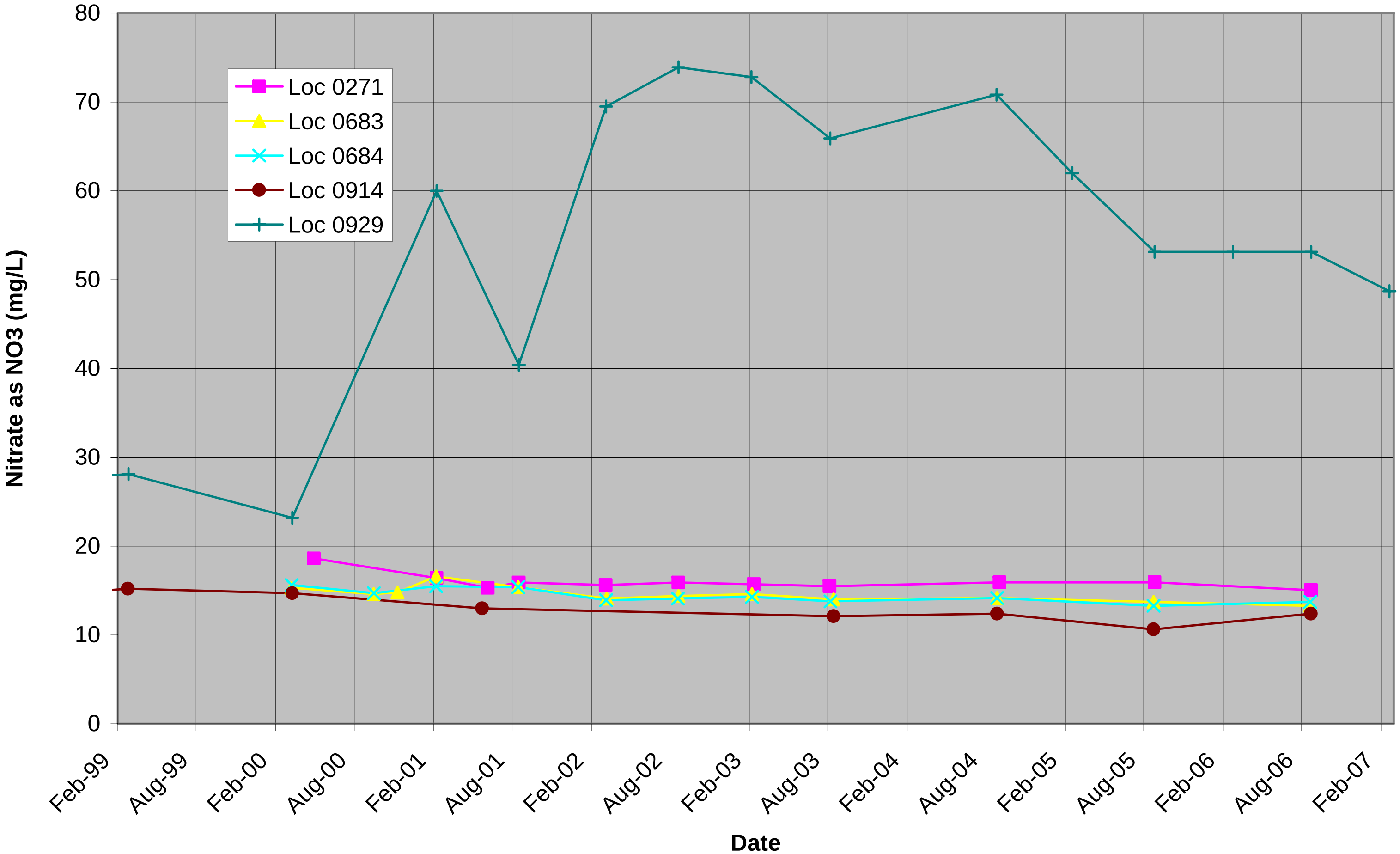

Figure E−4. Horizons A and B Sentinel Wells, Nitrate as NO_3 Concentration

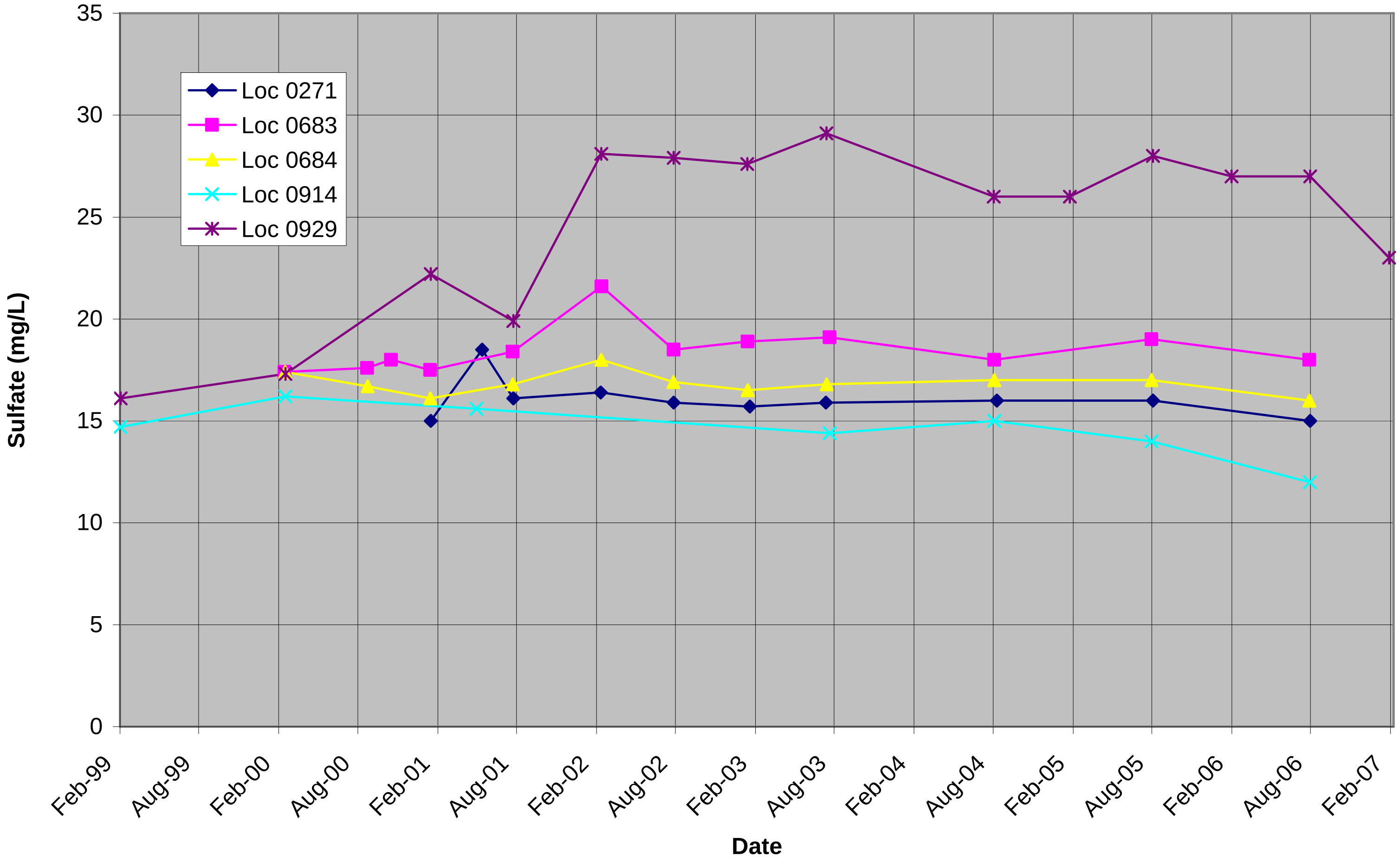

Figure E−5. Horizons A and B Sentinel Wells, Sulfate Concentration

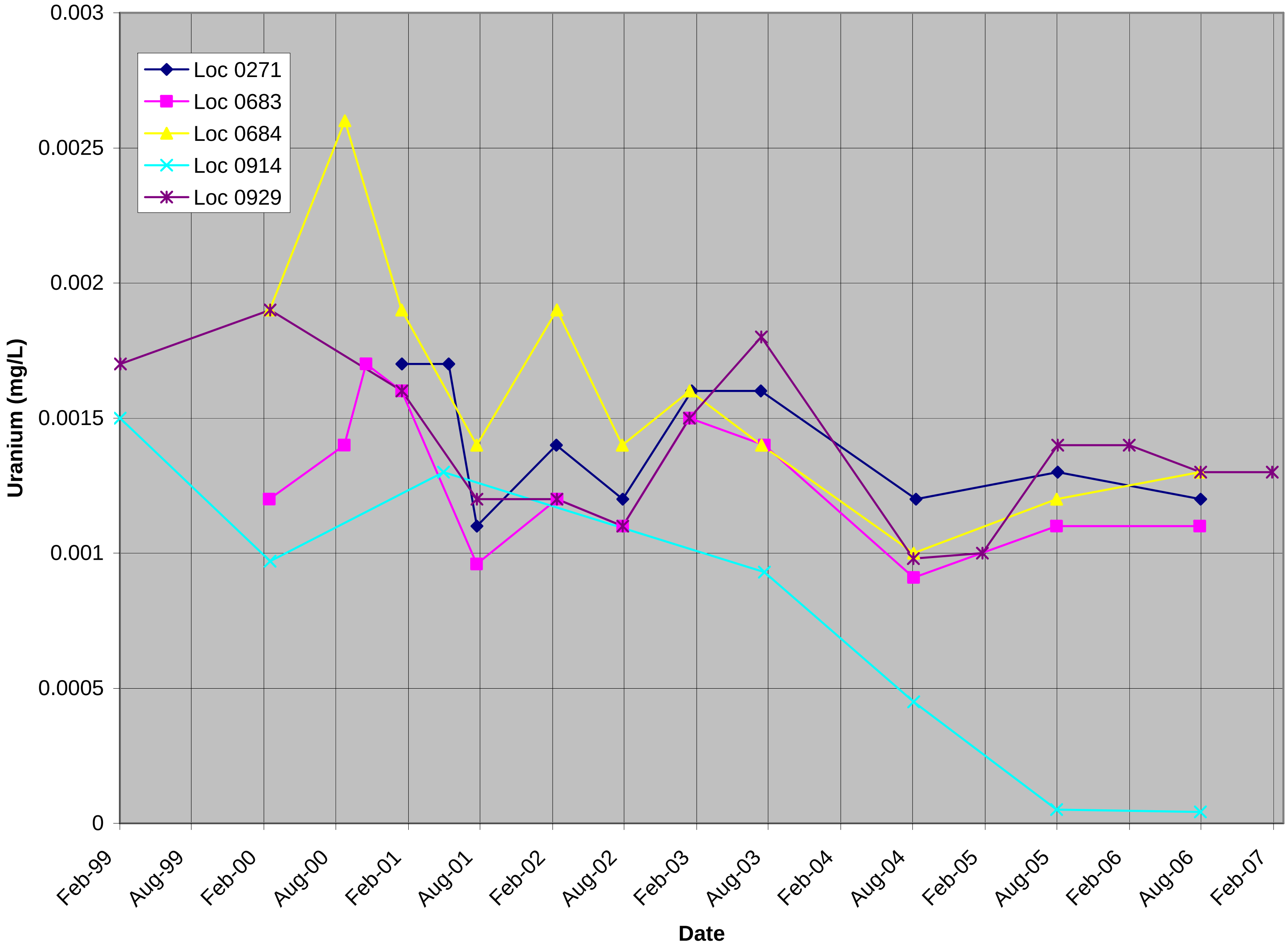

Figure E−6. Horizons A and B Sentinel Wells, Uranium Concentration

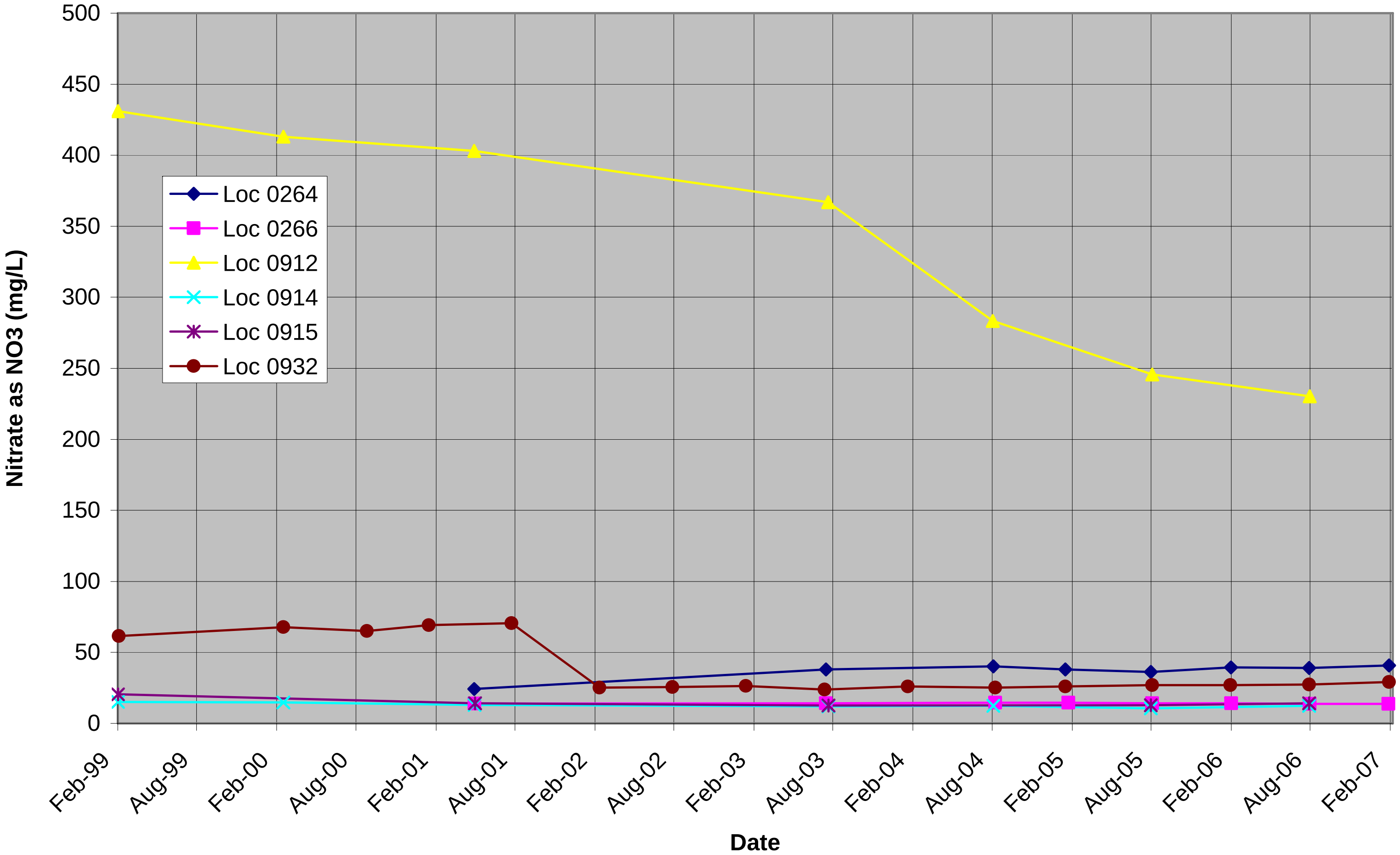

Figure E−7. Horizons C and D Monitor Wells, Nitrate as NO_3 Concentration

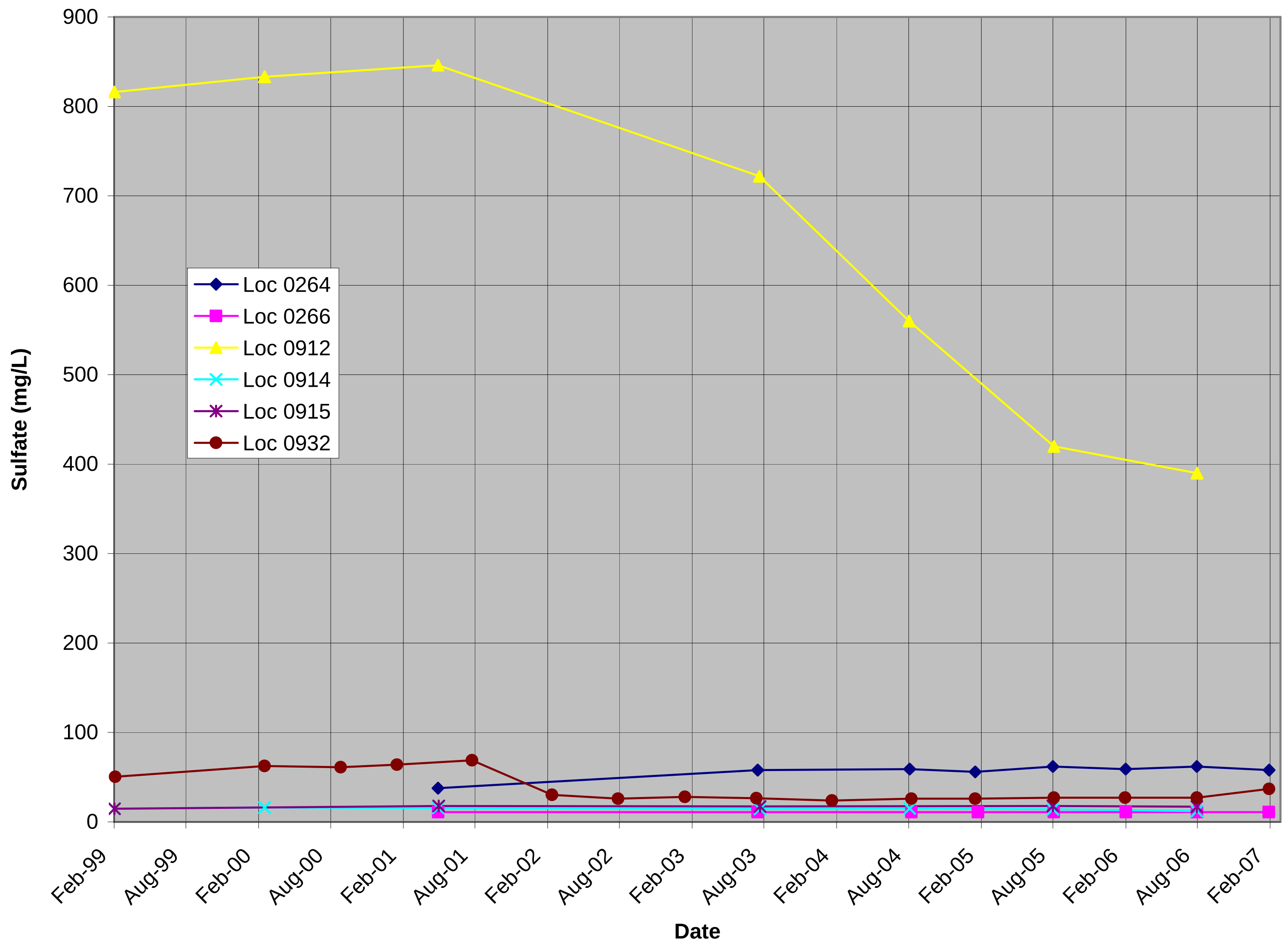

Figure E−8. Horizons C and D Monitor Wells, Sulfate Concentration

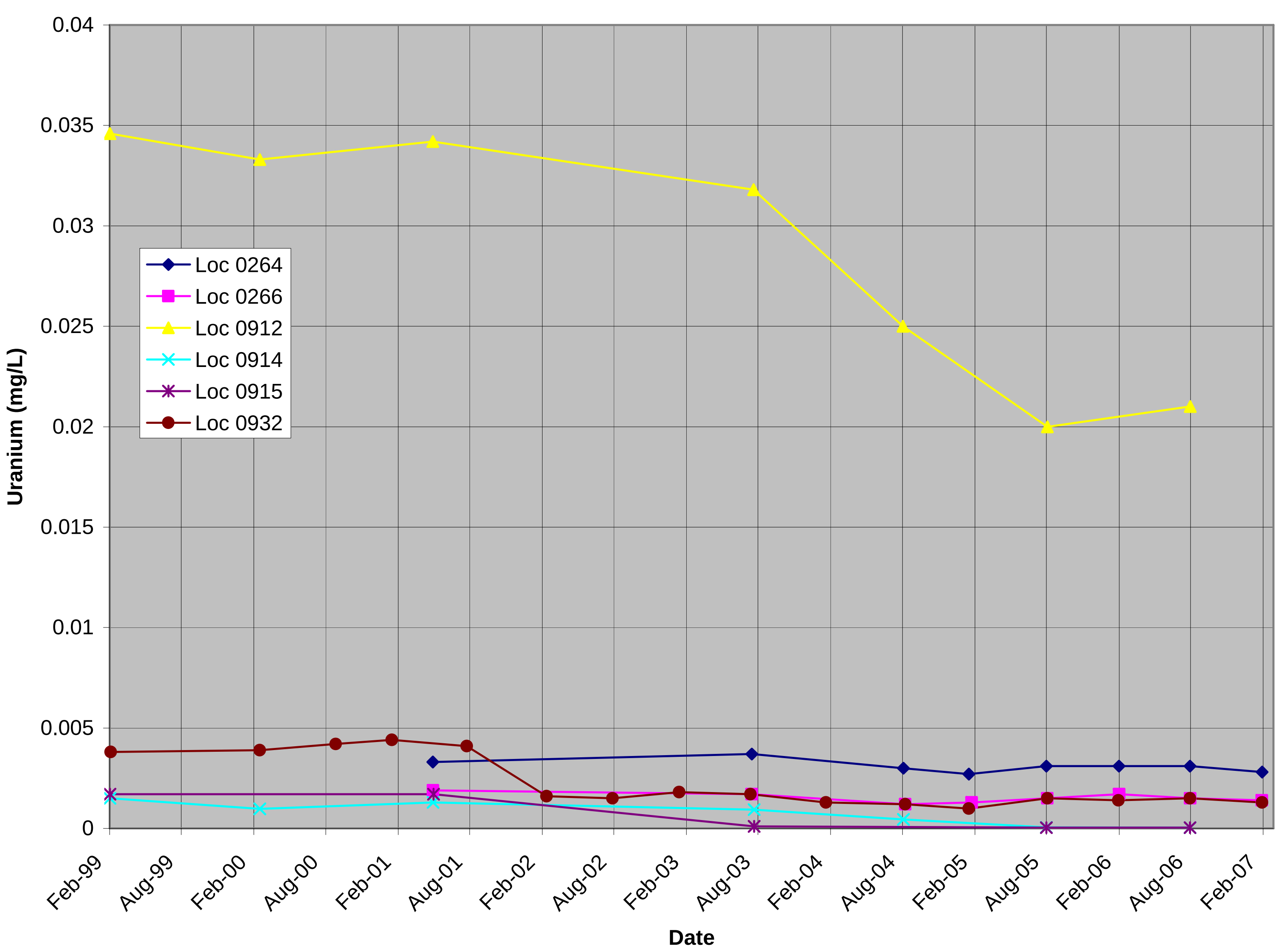

Figure E−9. Horizons C and D Monitor Wells, Uranium Concentration

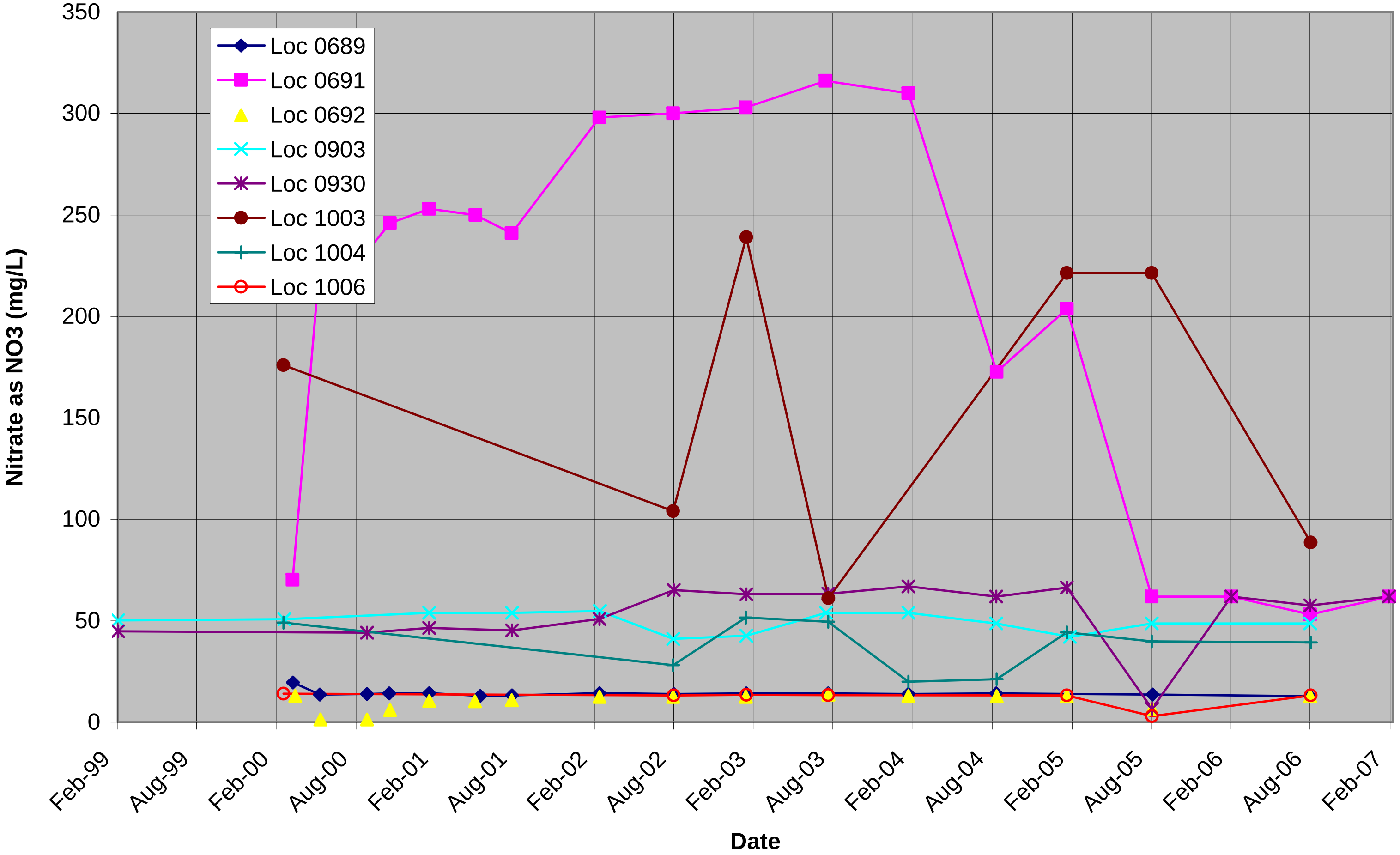

Figure E−10. Lower Terrace Monitor Wells, Nitrate as NO_3 Concentration

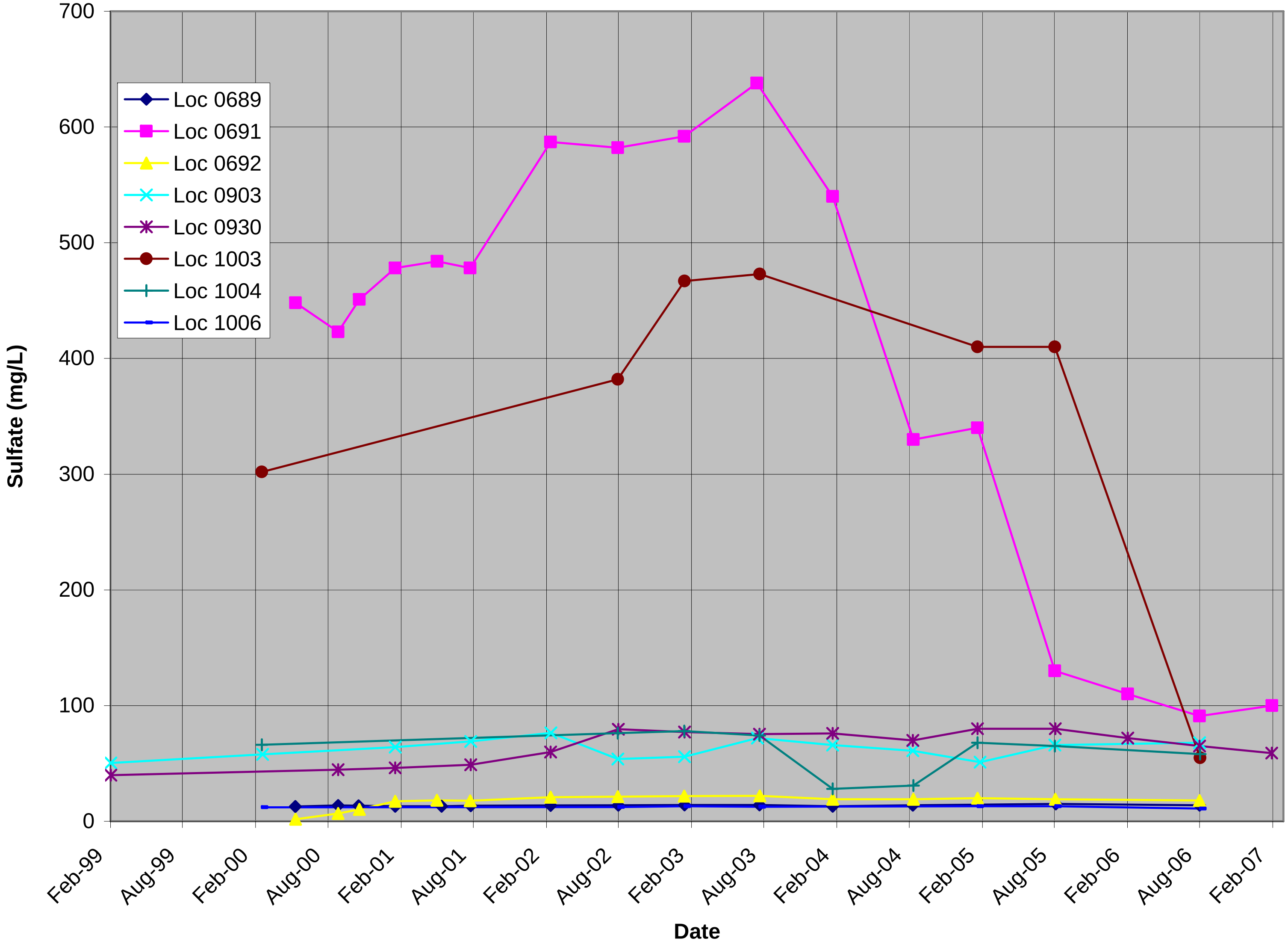

Figure E−11. Lower Terrace Monitor Wells, Sulfate Concentration

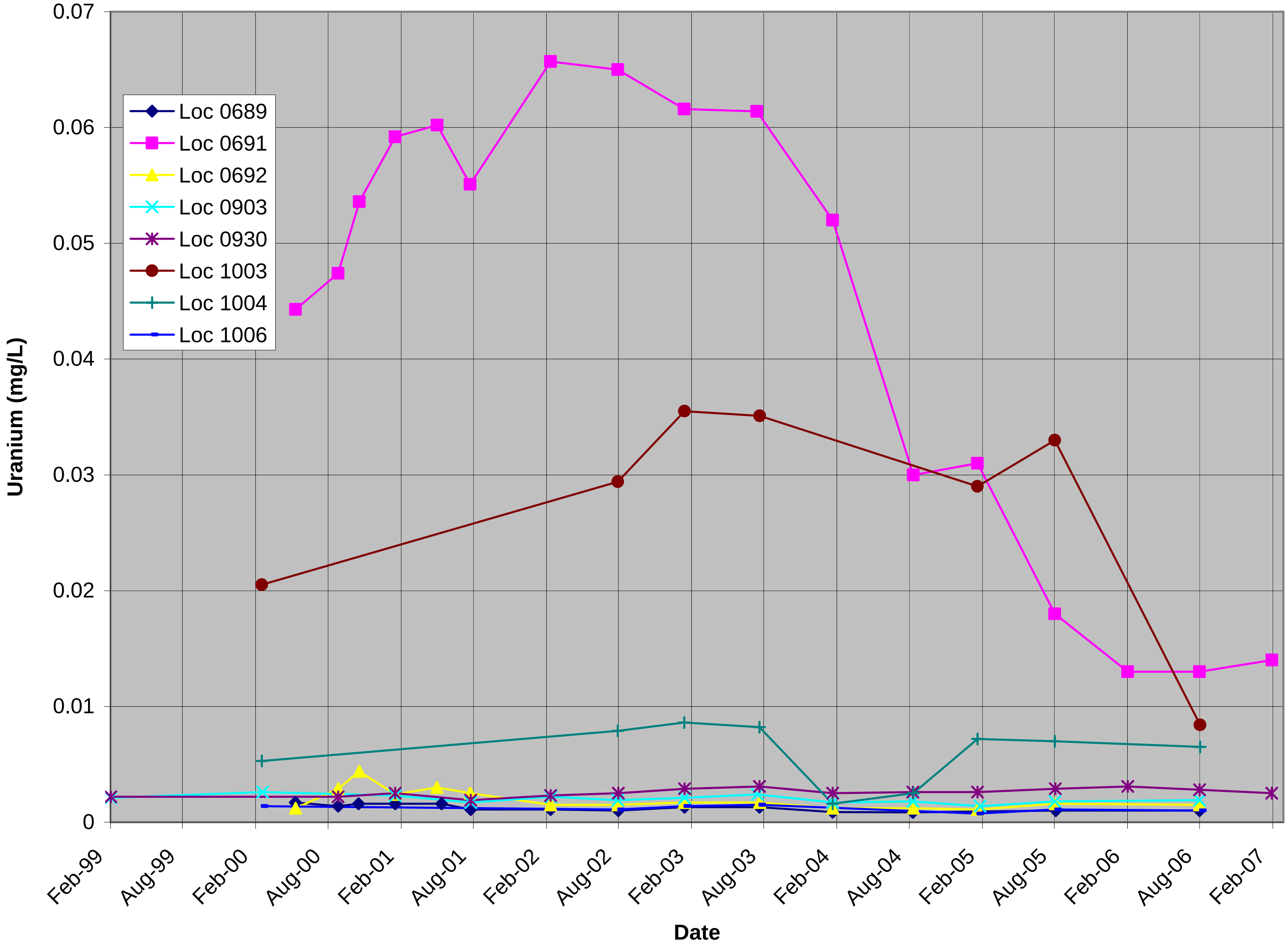

Figure E−12. Lower Terrace Monitor Wells, Uranium Concentration

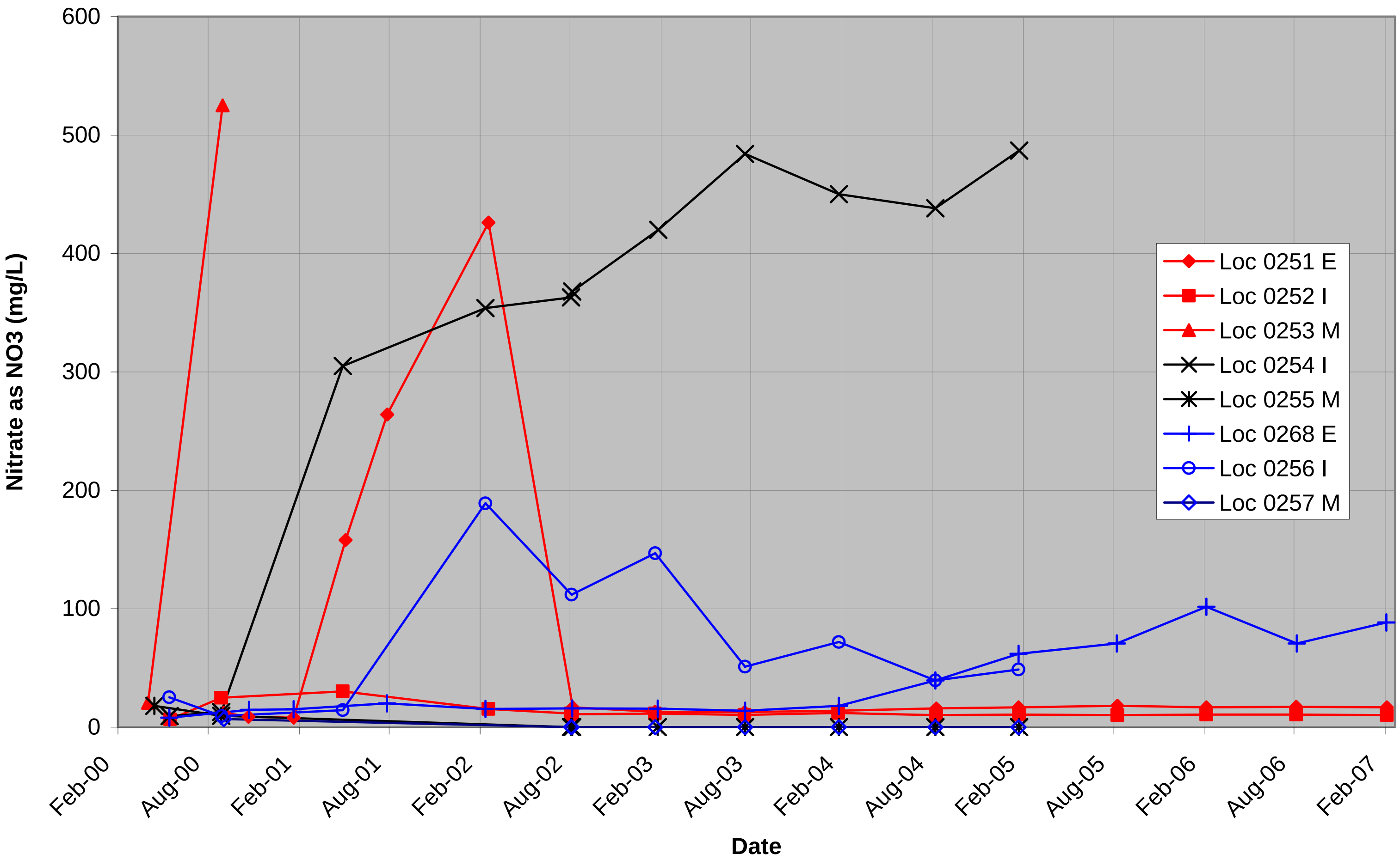

Figure E−13. Deep Monitor Wells, Nitrate as NO_3 Concentration

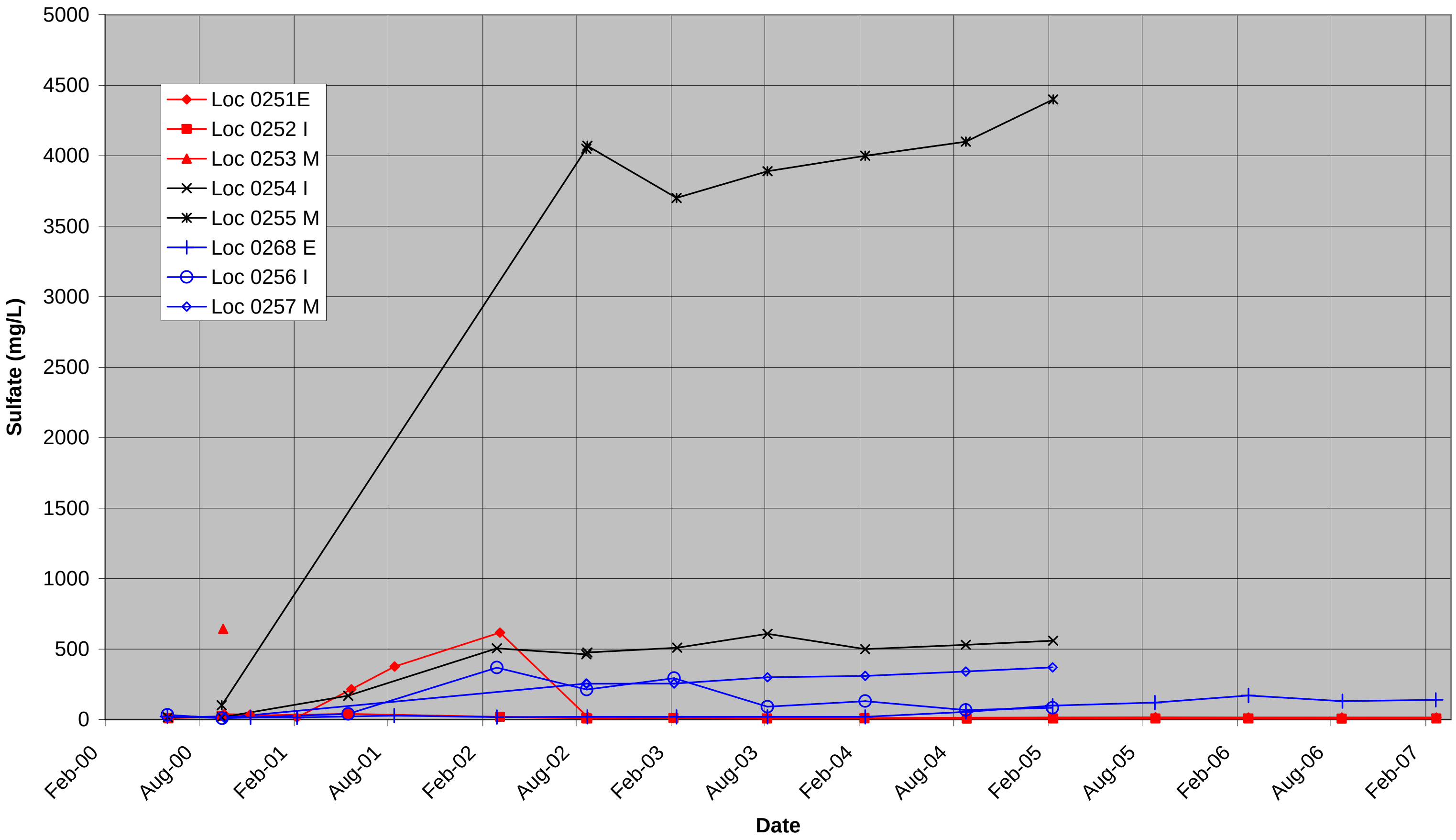

Figure E−14. Deep Monitor Wells, Sulfate Concentration

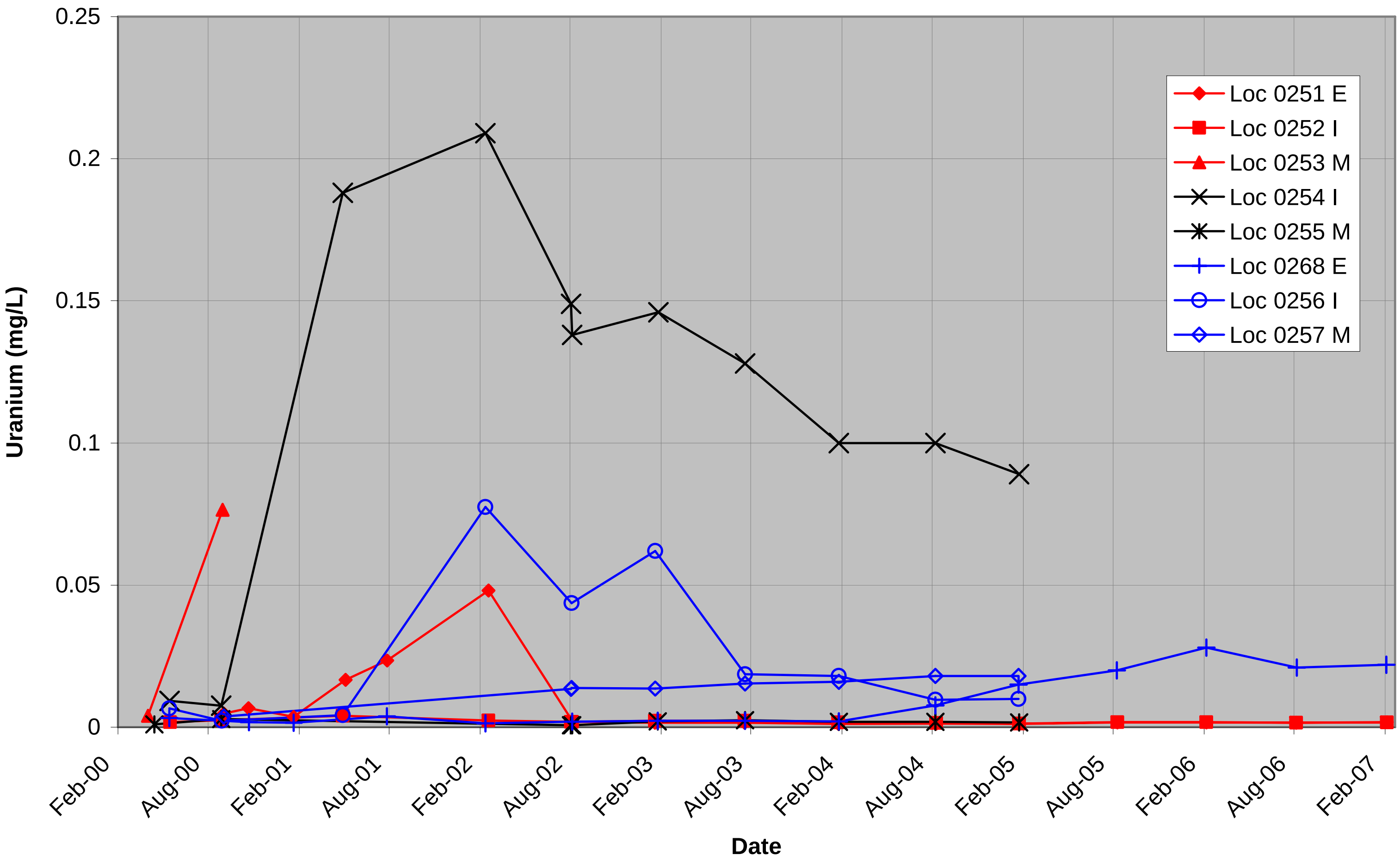

Figure E–15. Deep Monitor Wells, Uranium Concentration

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Appendix F

Contaminant Concentrations at Extraction Wells

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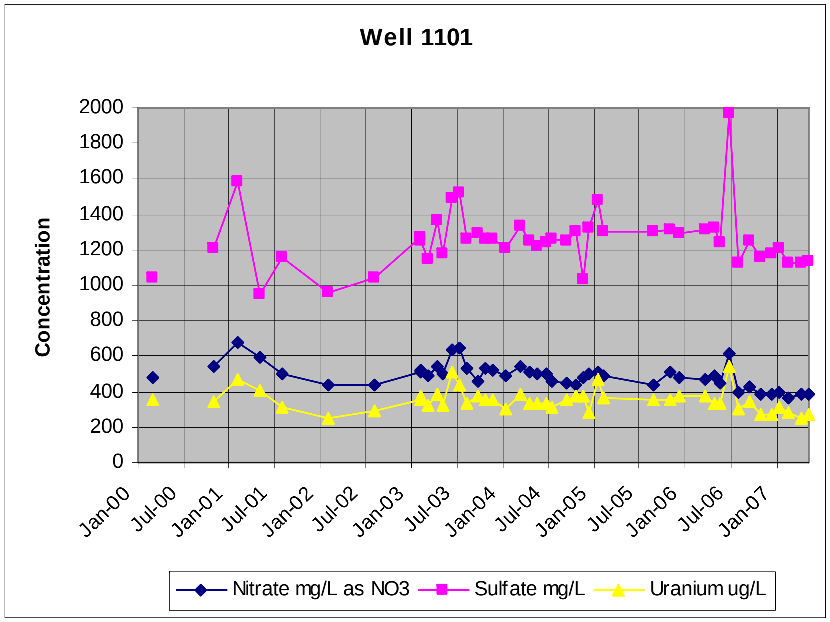
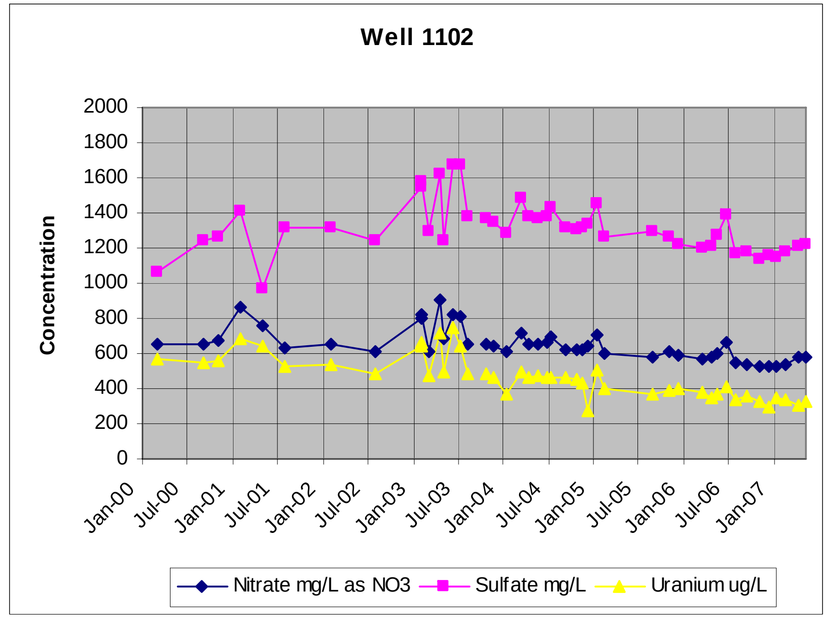
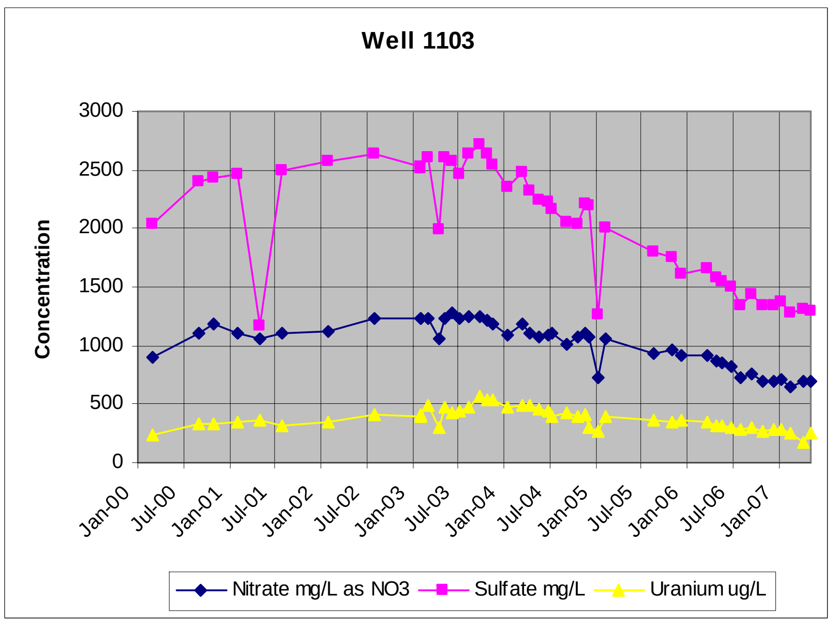
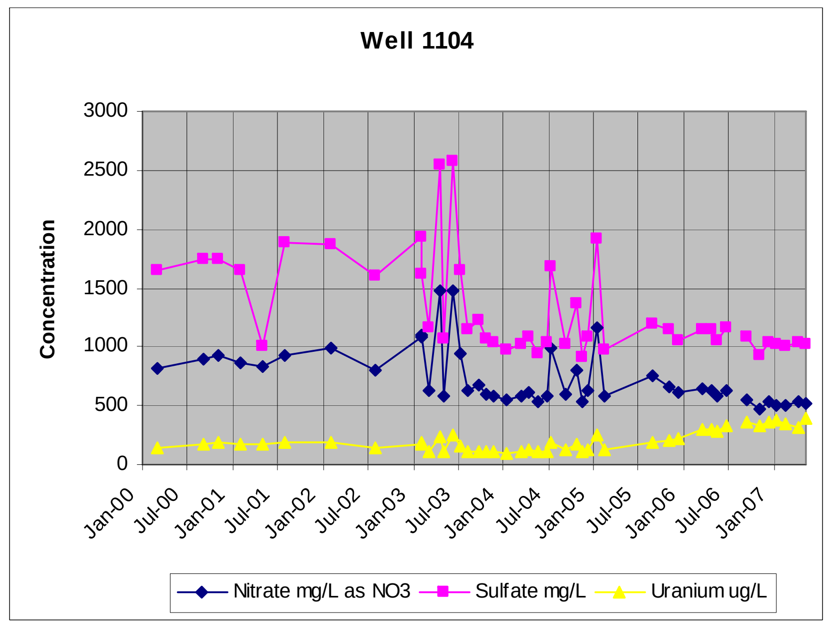
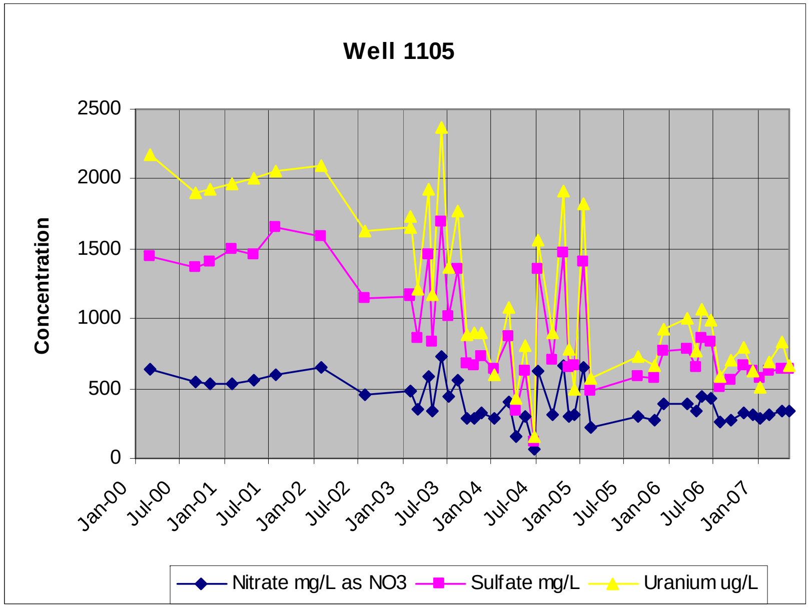
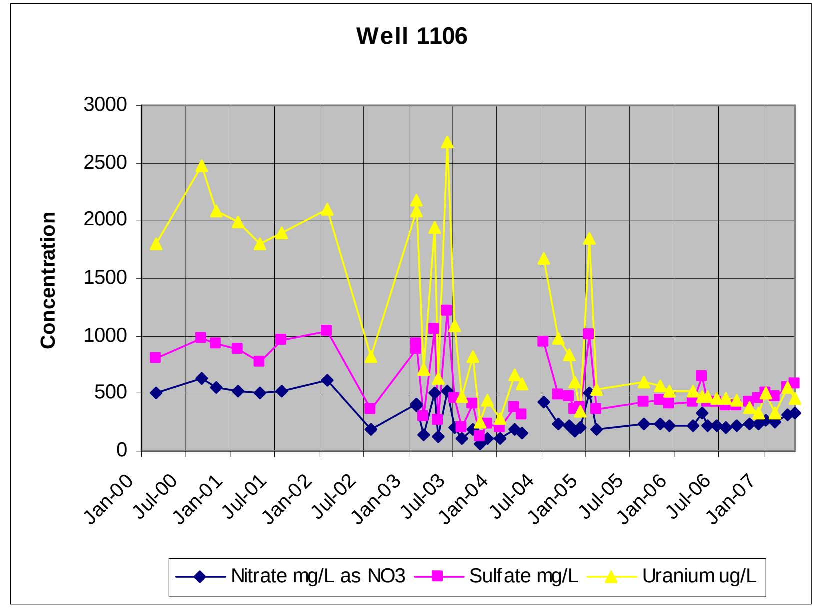

Well 1101
Concentration
0
200
400
600
800
1000
1200
1400
1600
1800
2000
Jan-00
Jul-00
Jan-01
Jul-01
Jan-02
Jul-02
Jan-03
Jul-03
Jan-04
Jul-04
Jan-05
Jul-05
Jan-06
Jul-06
Jan-07
Nitrate mg/L as NO3
Sulfate mg/L
Uranium ug/L

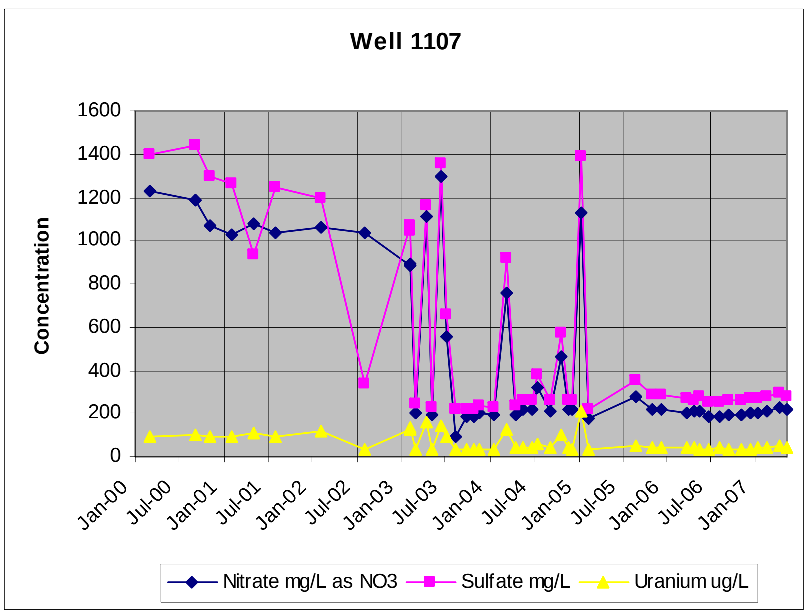

Well 1102
Concentration
0
200
400
600
800
1000
1200
1400
1600
1800
2000
Jan-00
Jul-00
Jan-01
Jul-01
Jan-02
Jul-02
Jan-03
Jul-03
Jan-04
Jul-04
Jan-05
Jul-05
Jan-06
Jul-06
Jan-07
Nitrate mg/L as NO3
Sulfate mg/L
Uranium ug/L

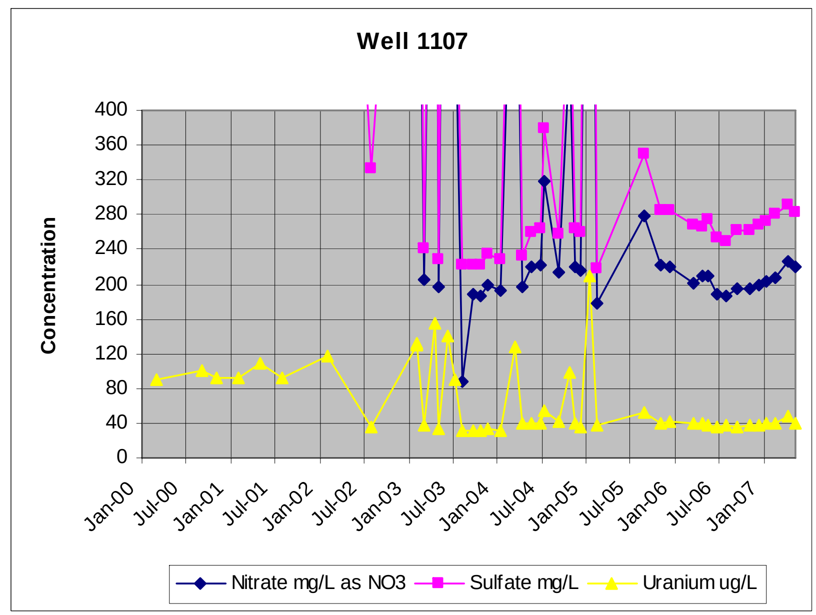

Well 1103
Concentration
0
500
1000
1500
2000
2500
3000
Jan-00
Jul-00
Jan-01
Jul-01
Jan-02
Jul-02
Jan-03
Jul-03
Jan-04
Jul-04
Jan-05
Jul-05
Jan-06
Jul-06
Jan-07
Nitrate mg/L as NO3
Sulfate mg/L
Uranium ug/L

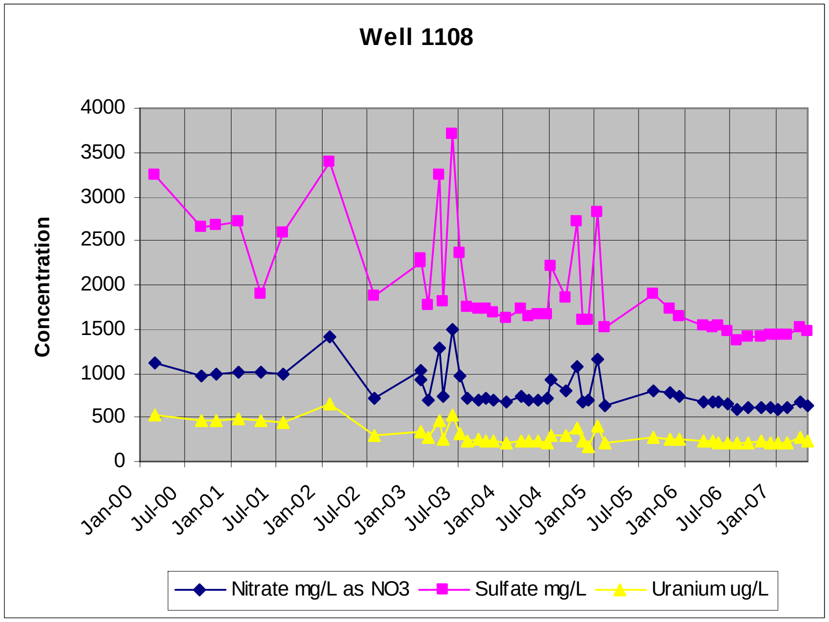

Well 1104
Concentration
0
500
1000
1500
2000
2500
3000
Jan-00
Jul-00
Jan-01
Jul-01
Jan-02
Jul-02
Jan-03
Jul-03
Jan-04
Jul-04
Jan-05
Jul-05
Jan-06
Jul-06
Jan-07
Nitrate mg/L as NO3
Sulfate mg/L
Uranium ug/L

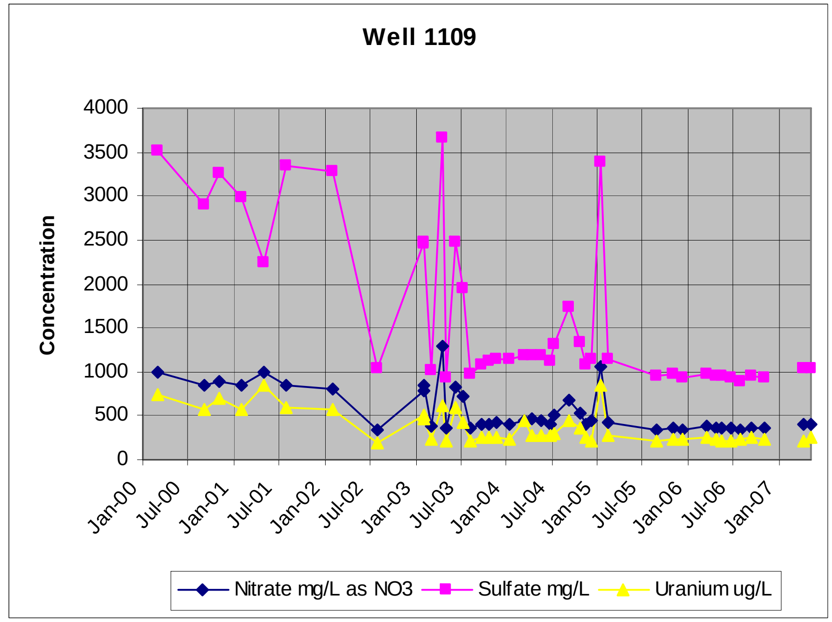

Well 1105
Concentration
2500
2000
1500
1000
500
0
Jan-00
Jul-00
Jan-01
Jul-01
Jan-02
Jul-02
Jan-03
Jul-03
Jan-04
Jul-04
Jan-05
Jul-05
Jan-06
Jul-06
Jan-07
Nitrate mg/L as NO3
Sulfate mg/L
Uranium ug/L

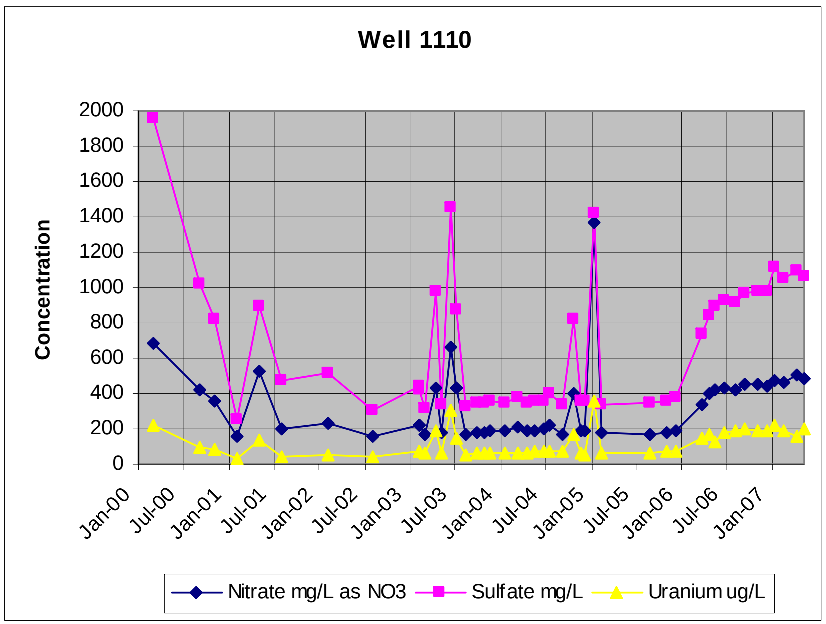

Well 1106
Concentration
3000
2500
2000
1500
1000
500
0
Jan-00
Jul-00
Jan-01
Jul-01
Jan-02
Jul-02
Jan-03
Jul-03
Jan-04
Jul-04
Jan-05
Jul-05
Jan-06
Jul-06
Jan-07
Nitrate mg/L as NO3
Sulfate mg/L
Uranium ug/L

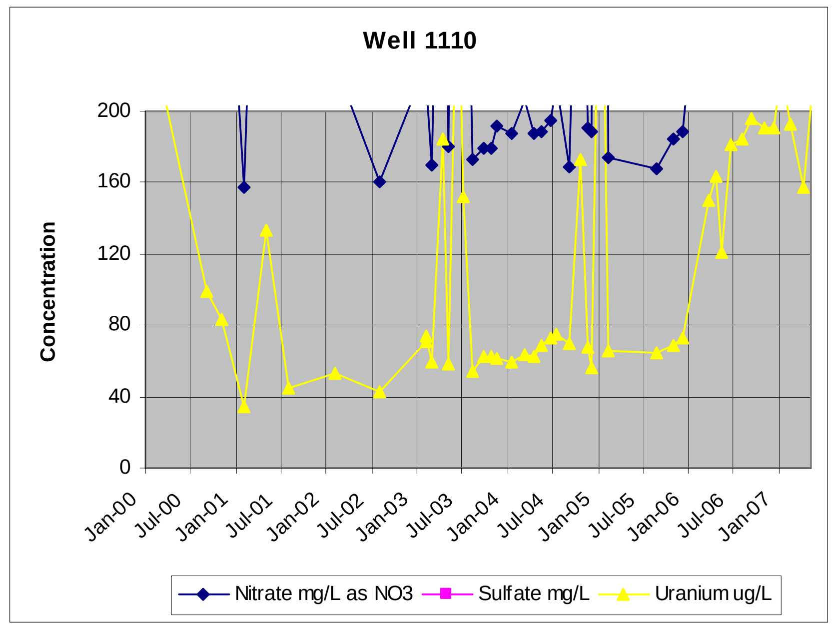

Well 1107
Concentration
1600
1400
1200
1000
800
600
400
200
0
Jan-00
Jul-00
Jan-01
Jul-01
Jan-02
Jul-02
Jan-03
Jul-03
Jan-04
Jul-04
Jan-05
Jul-05
Jan-06
Jul-06
Jan-07
Nitrate mg/L as NO3
Sulfate mg/L
Uranium ug/L

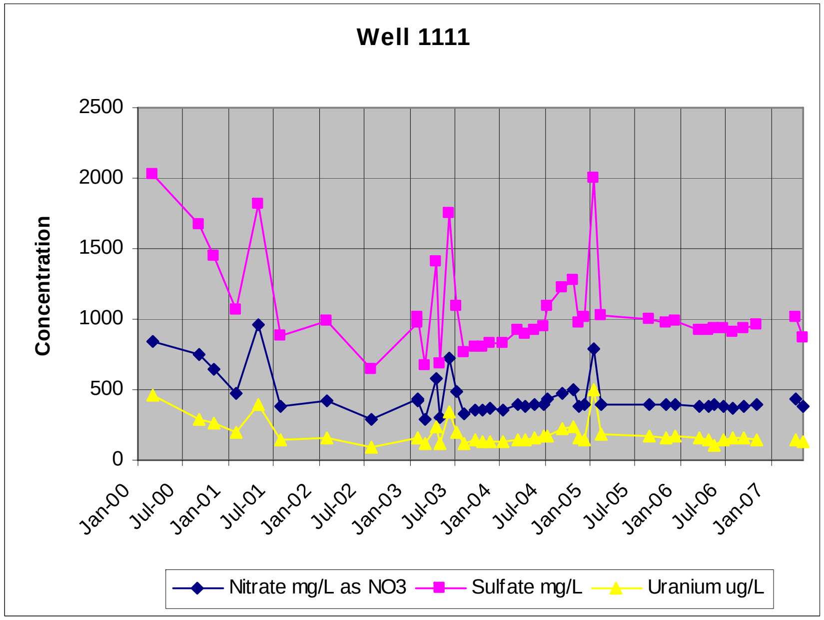

Well 1107
Concentration
400
360
320
280
240
200
160
120
80
40
0
Jan-00
Jul-00
Jan-01
Jul-01
Jan-02
Jul-02
Jan-03
Jul-03
Jan-04
Jul-04
Jan-05
Jul-05
Jan-06
Jul-06
Jan-07
Nitrate mg/L as NO3
Sulfate mg/L
Uranium ug/L

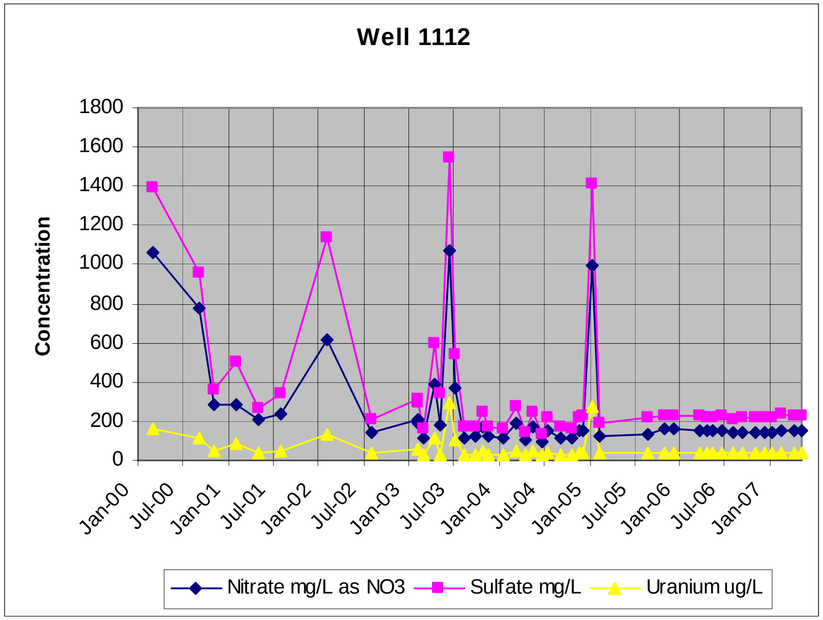

Well 1108
Concentration
4000
3500
3000
2500
2000
1500
1000
500
0
Jan-00
Jul-00
Jan-01
Jul-01
Jan-02
Jul-02
Jan-03
Jul-03
Jan-04
Jul-04
Jan-05
Jul-05
Jan-06
Jul-06
Jan-07
Nitrate mg/L as NO3
Sulfate mg/L
Uranium ug/L

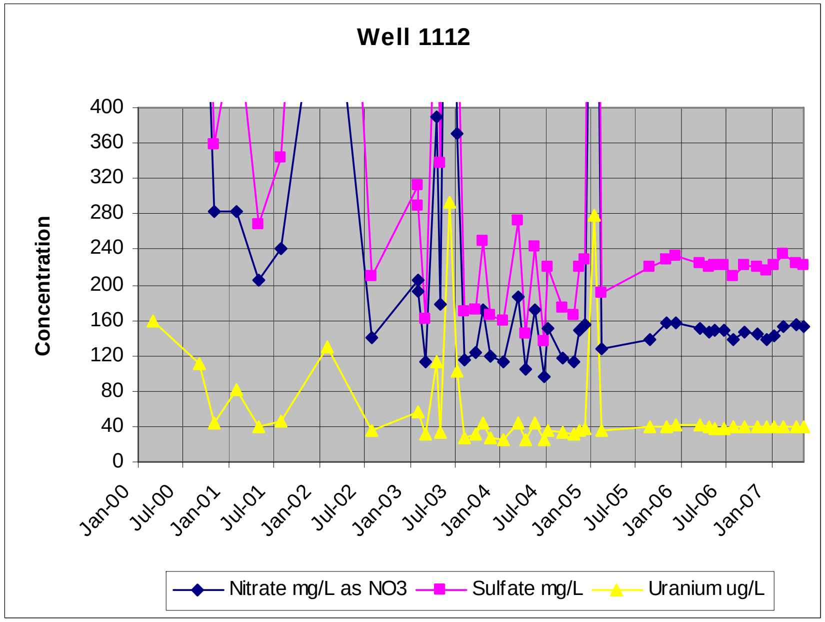

Well 1109
Concentration
4000
3500
3000
2500
2000
1500
1000
500
0
Jan-00
Jul-00
Jan-01
Jul-01
Jan-02
Jul-02
Jan-03
Jul-03
Jan-04
Jul-04
Jan-05
Jul-05
Jan-06
Jul-06
Jan-07
Nitrate mg/L as NO3
Sulfate mg/L
Uranium ug/L

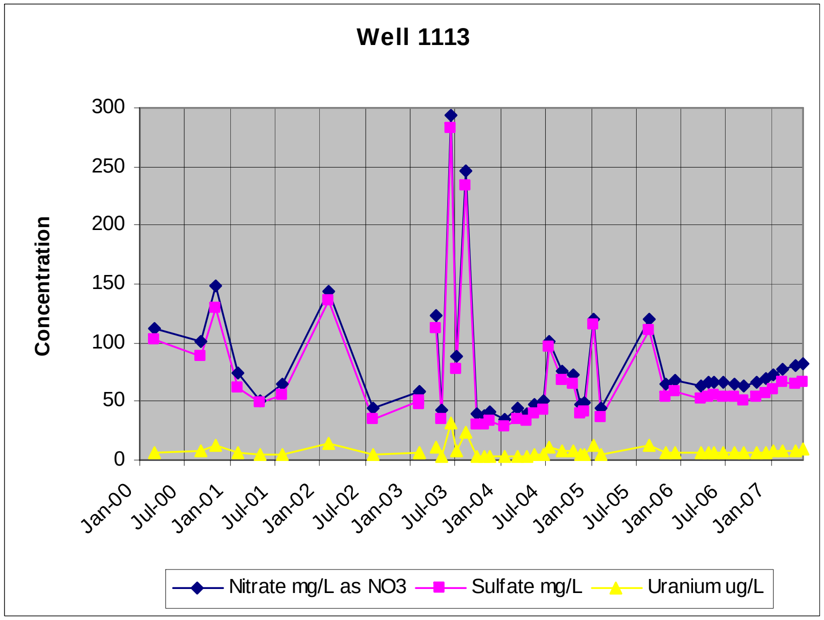

Well 1110
Concentration
2000
1800
1600
1400
1200
1000
800
600
400
200
0
Jan-00
Jul-00
Jan-01
Jul-01
Jan-02
Jul-02
Jan-03
Jul-03
Jan-04
Jul-04
Jan-05
Jul-05
Jan-06
Jul-06
Jan-07
Nitrate mg/L as NO3
Sulfate mg/L
Uranium ug/L

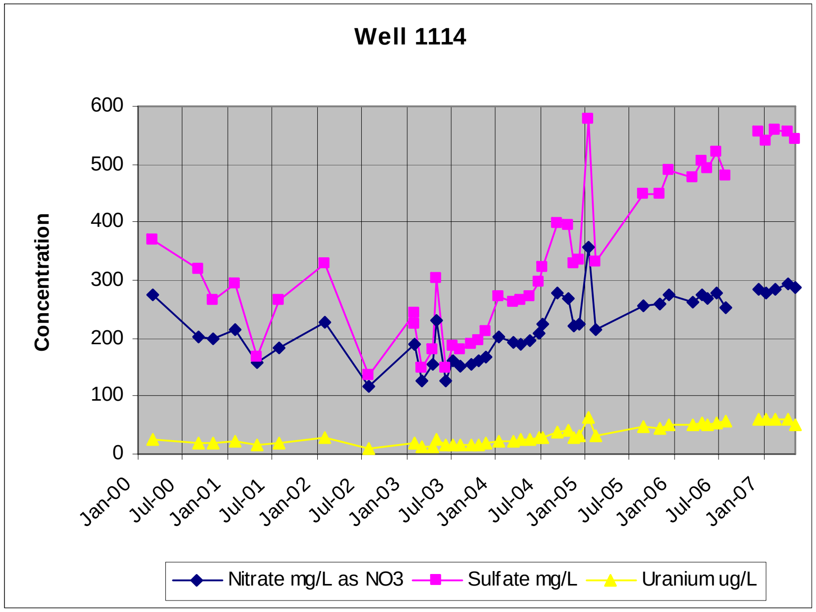

Well 1110
Concentration
200
160
120
80
40
0
Jan-00
Jul-00
Jan-01
Jul-01
Jan-02
Jul-02
Jan-03
Jul-03
Jan-04
Jul-04
Jan-05
Jul-05
Jan-06
Jul-06
Jan-07
Nitrate mg/L as NO3
Sulfate mg/L
Uranium ug/L

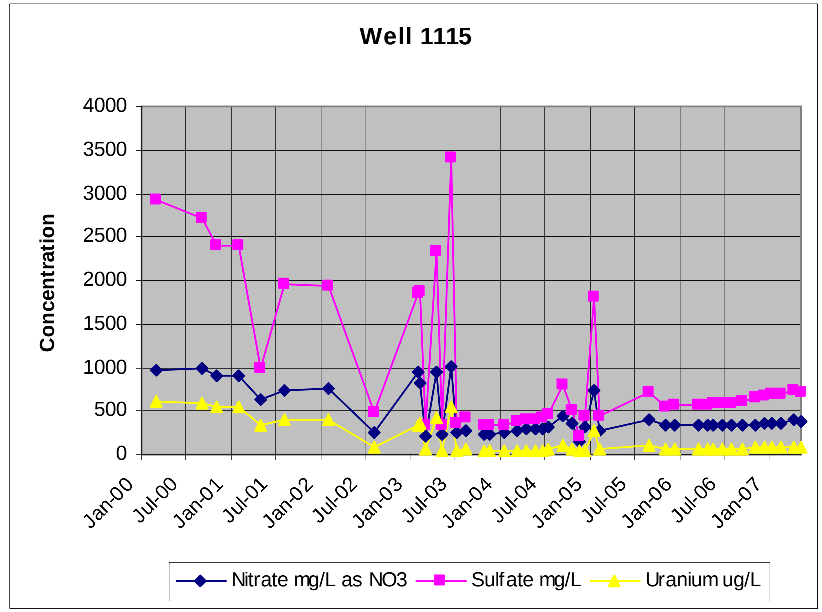

Well 1111
Concentration
0
500
1000
1500
2000
2500
Jan-00
Jul-00
Jan-01
Jul-01
Jan-02
Jul-02
Jan-03
Jul-03
Jan-04
Jul-04
Jan-05
Jul-05
Jan-06
Jul-06
Jan-07
Nitrate mg/L as NO3
Sulfate mg/L
Uranium ug/L

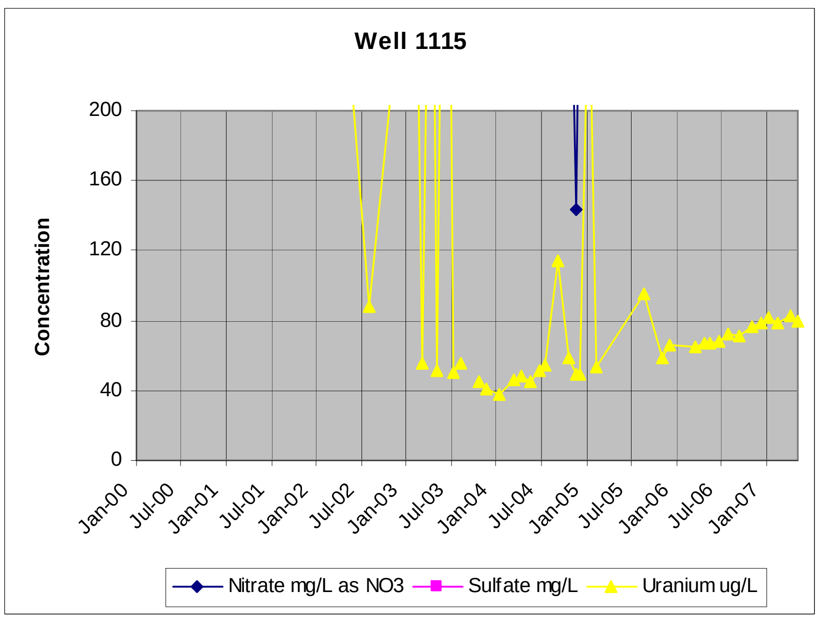

Well 1112
Concentration
0
200
400
600
800
1000
1200
1400
1600
1800
Jan-00
Jul-00
Jan-01
Jul-01
Jan-02
Jul-02
Jan-03
Jul-03
Jan-04
Jul-04
Jan-05
Jul-05
Jan-06
Jul-06
Jan-07
Nitrate mg/L as NO3
Sulfate mg/L
Uranium ug/L

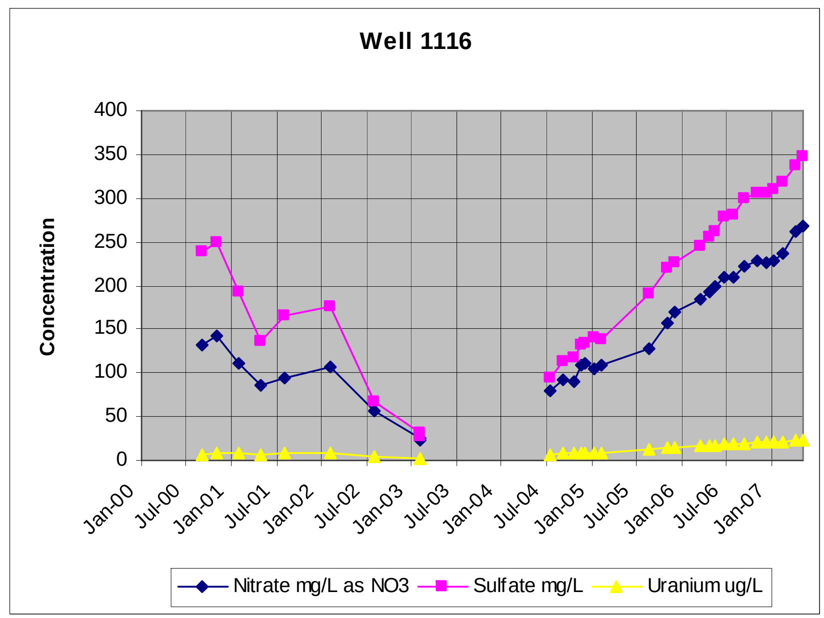

Well 1112
Concentration
0
40
80
120
160
200
240
280
320
360
400
Jan-00
Jul-00
Jan-01
Jul-01
Jan-02
Jul-02
Jan-03
Jul-03
Jan-04
Jul-04
Jan-05
Jul-05
Jan-06
Jul-06
Jan-07
Nitrate mg/L as NO3
Sulfate mg/L
Uranium ug/L

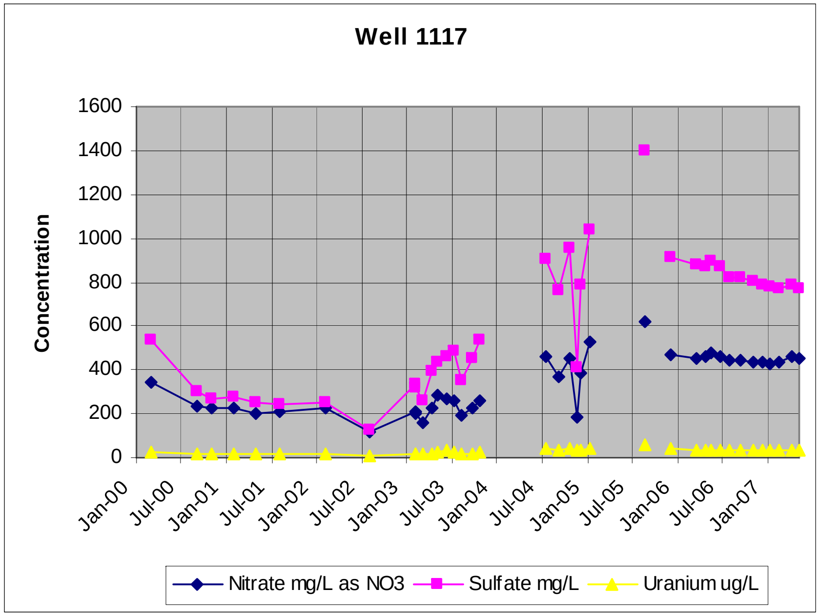

Well 1113
Concentration
0
50
100
150
200
250
300
Jan-00
Jul-00
Jan-01
Jul-01
Jan-02
Jul-02
Jan-03
Jul-03
Jan-04
Jul-04
Jan-05
Jul-05
Jan-06
Jul-06
Jan-07
Nitrate mg/L as NO3
Sulfate mg/L
Uranium ug/L


Well 1114
Concentration
600
500
400
300
200
100
0
Jan-00
Jul-00
Jan-01
Jul-01
Jan-02
Jul-02
Jan-03
Jul-03
Jan-04
Jul-04
Jan-05
Jul-05
Jan-06
Jul-06
Jan-07
Nitrate mg/L as NO3
Sulfate mg/L
Uranium ug/L


Well 1115
Concentration
4000
3500
3000
2500
2000
1500
1000
500
0
Jan-00
Jul-00
Jan-01
Jul-01
Jan-02
Jul-02
Jan-03
Jul-03
Jan-04
Jul-04
Jan-05
Jul-05
Jan-06
Jul-06
Jan-07
Nitrate mg/L as NO3
Sulfate mg/L
Uranium ug/L


Well 1115
Concentration
200
160
120
80
40
0
Jan-00
Jul-00
Jan-01
Jul-01
Jan-02
Jul-02
Jan-03
Jul-03
Jan-04
Jul-04
Jan-05
Jul-05
Jan-06
Jul-06
Jan-07
Nitrate mg/L as NO3
Sulfate mg/L
Uranium ug/L


Well 1116
Concentration
400
350
300
250
200
150
100
50
0
Jan-00
Jul-00
Jan-01
Jul-01
Jan-02
Jul-02
Jan-03
Jul-03
Jan-04
Jul-04
Jan-05
Jul-05
Jan-06
Jul-06
Jan-07
Nitrate mg/L as NO3
Sulfate mg/L
Uranium ug/L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Concentration
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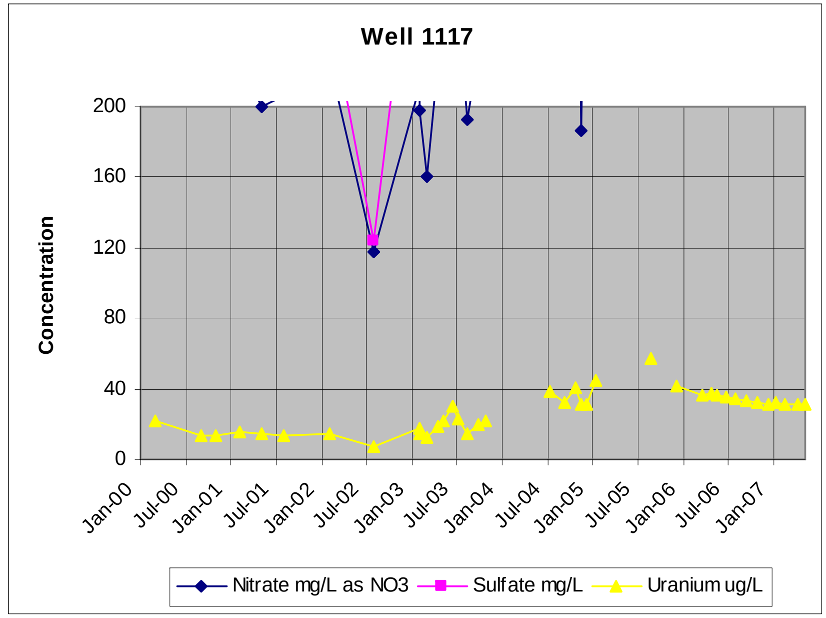
1400
1200
1000
800
600
400
200
0
Jan-00
Jul-00
Jan-01
Jul-01
Jan-02
Jul-02
Jan-03
Jul-03
Jan-04
Jul-04
Jan-05
Jul-05
Jan-06
Jul-06
Jan-07
Nitrate mg/L as NO3
Sulfate mg/L
Uranium ug/L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Concentration
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40
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Jul-00
Jan-01
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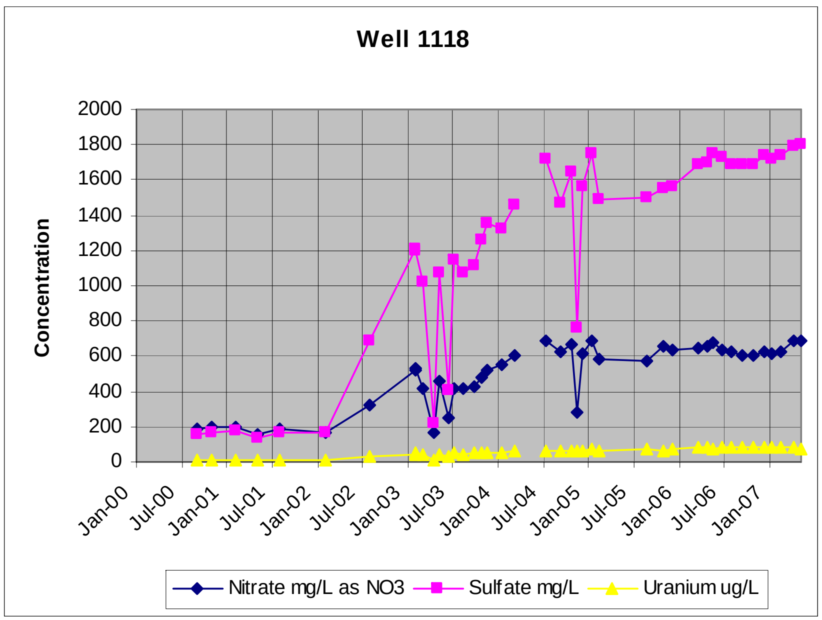
Jan-03
Jul-03
Jan-04
Jul-04
Jan-05
Jul-05
Jan-06
Jul-06
Jan-07
Nitrate mg/L as NO3
Sulfate mg/L
Uranium ug/L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800
600
400
200
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Jan-01
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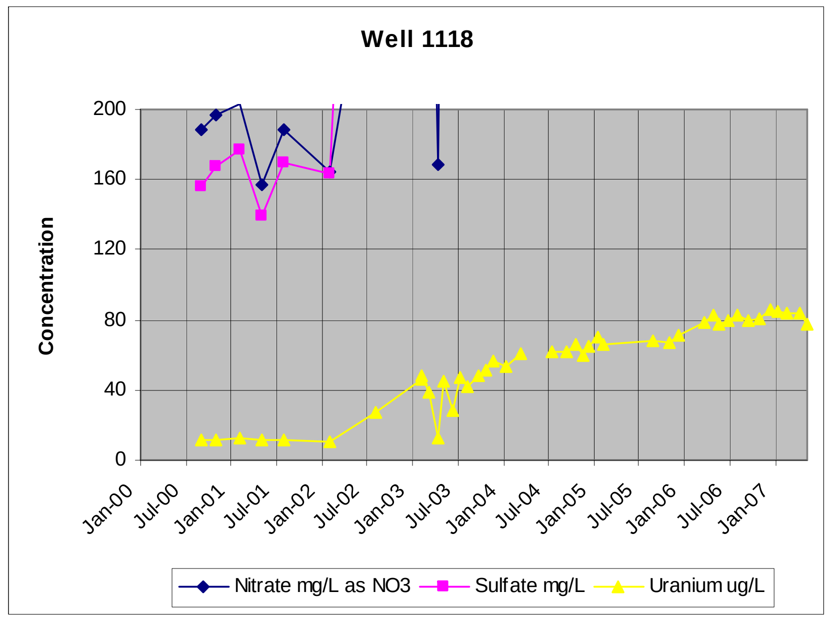
Jan-02
Jul-02
Jan-03
Jul-03
Jan-04
Jul-04
Jan-05
Jul-05
Jan-06
Jul-06
Jan-07
Nitrate mg/L as NO3
Sulfate mg/L
Uranium ug/L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Concentration
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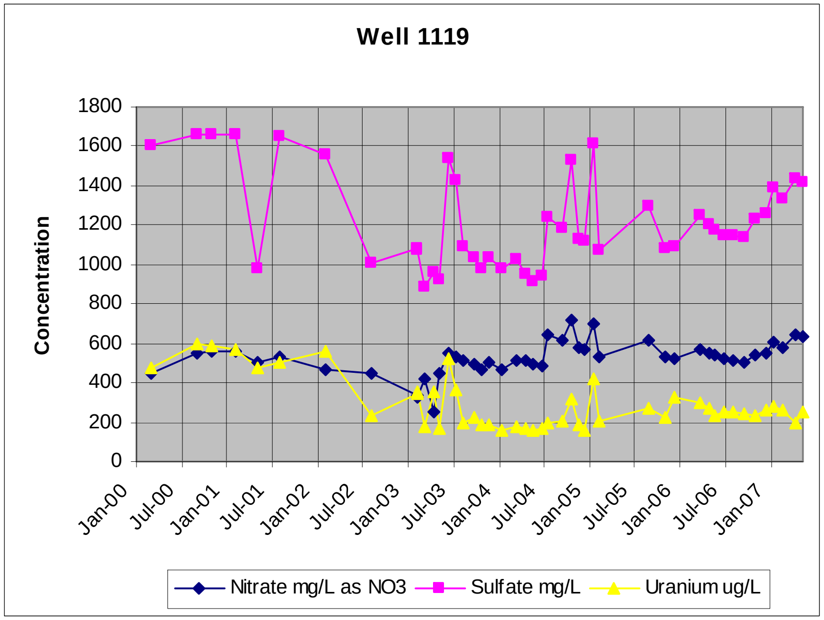
80
40
0
Jan-00
Jul-00
Jan-01
Jul-01
Jan-02
Jul-02
Jan-03
Jul-03
Jan-04
Jul-04
Jan-05
Jul-05
Jan-06
Jul-06
Jan-07
Nitrate mg/L as NO3
Sulfate mg/L
Uranium ug/L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1400
1600
1800
Jan-00
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Jan-01
Jul-01
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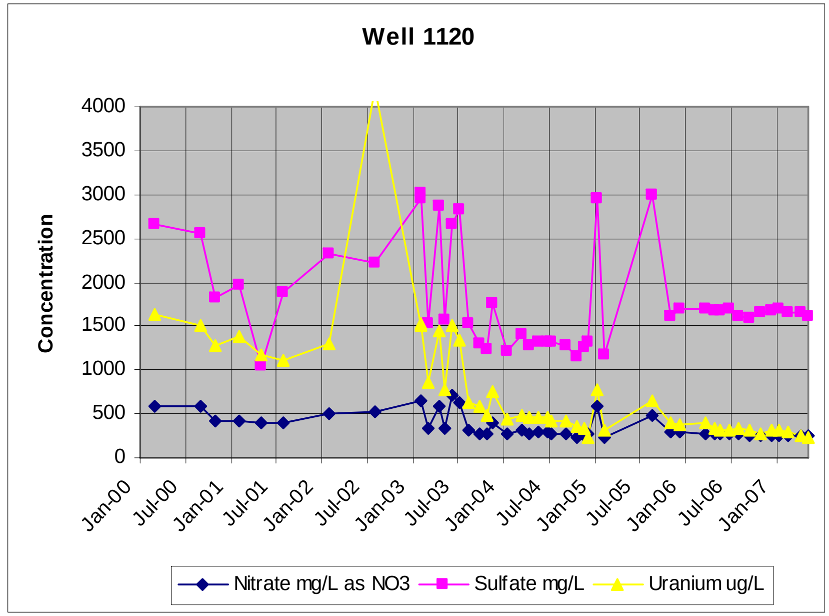
Jul-02
Jan-03
Jul-03
Jan-04
Jul-04
Jan-05
Jul-05
Jan-06
Jul-06
Jan-07
Nitrate mg/L as NO3
Sulfate mg/L
Uranium ug/L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Concentration
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2000
2500
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3500
4000
Jan-00
Jul-00
Jan-01
Jul-01
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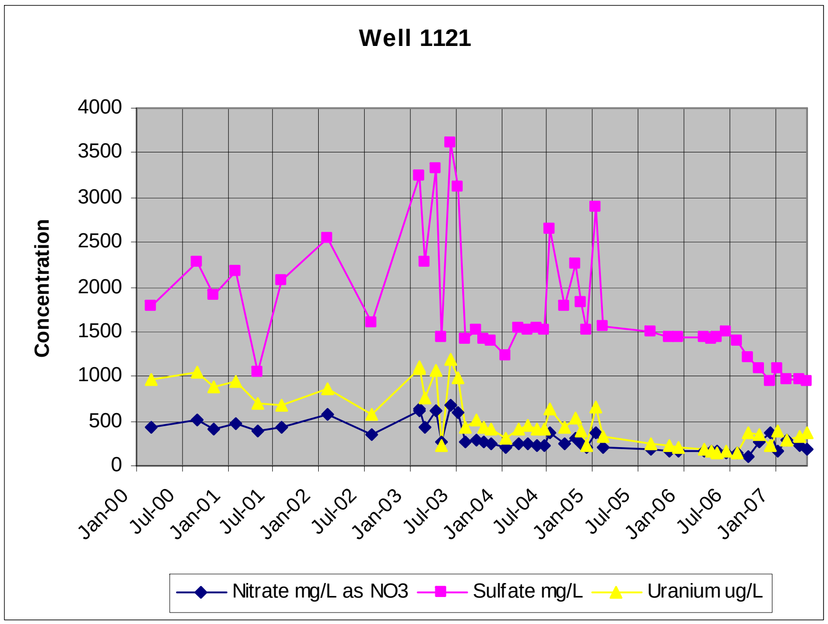
Jan-03
Jul-03
Jan-04
Jul-04
Jan-05
Jul-05
Jan-06
Jul-06
Jan-07
Nitrate mg/L as NO3
Sulfate mg/L
Uranium ug/L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Concentration
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1500
2000
2500
3000
3500
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Jan-00
Jul-00
Jan-01
Jul-01
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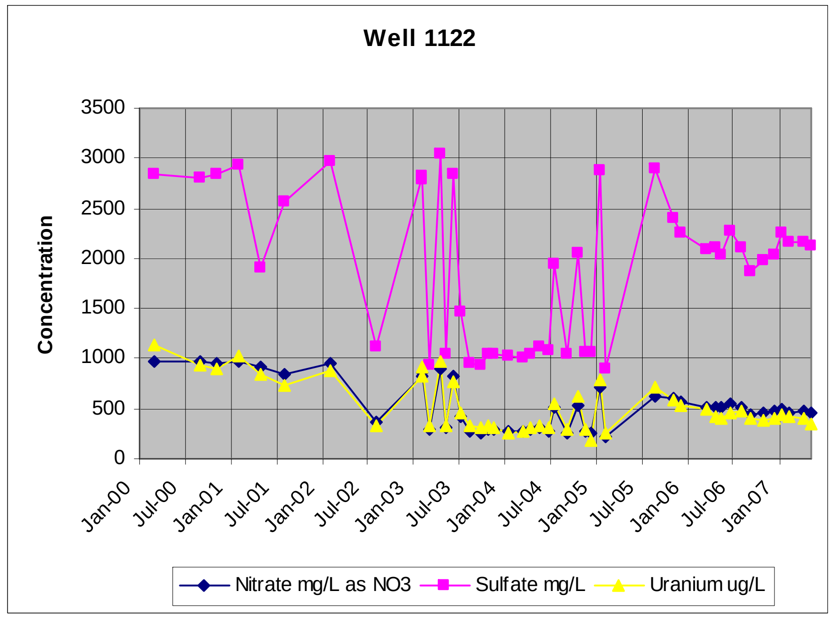
Jan-03
Jul-03
Jan-04
Jul-04
Jan-05
Jul-05
Jan-06
Jul-06
Jan-07
Nitrate mg/L as NO3
Sulfate mg/L
Uranium ug/L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Concentration
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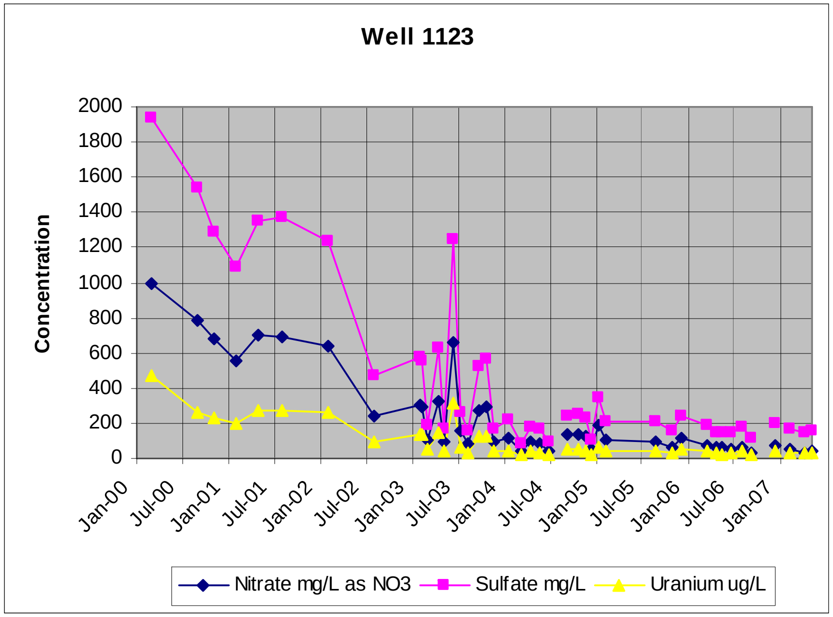
500
1000
1500
2000
2500
3000
3500
Jan-00
Jul-00
Jan-01
Jul-01
Jan-02
Jul-02
Jan-03
Jul-03
Jan-04
Jul-04
Jan-05
Jul-05
Jan-06
Jul-06
Jan-07
Nitrate mg/L as NO3
Sulfate mg/L
Uranium ug/L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1800
1600
1400
1200
1000
800
600
400
200
0
Jan-00
Jul-00
Jan-01
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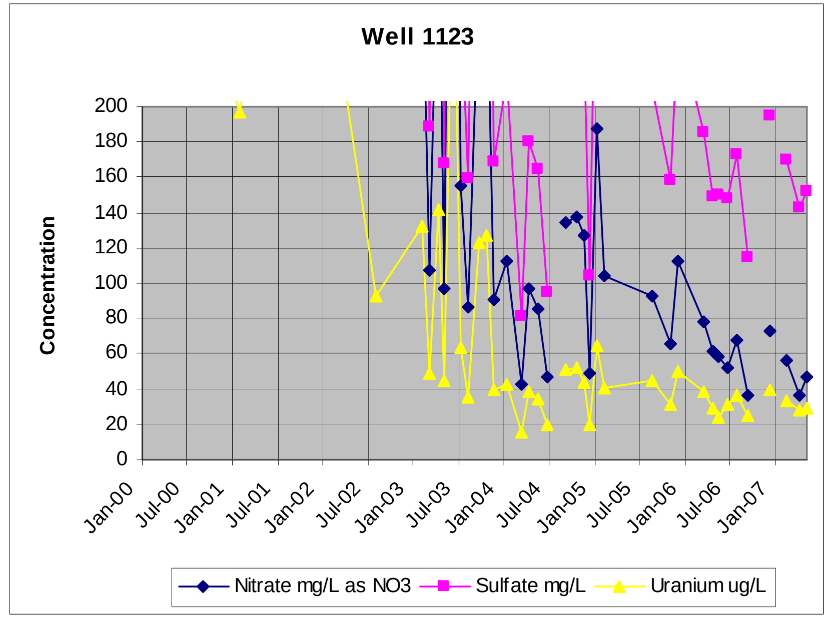
Jan-02
Jul-02
Jan-03
Jul-03
Jan-04
Jul-04
Jan-05
Jul-05
Jan-06
Jul-06
Jan-07
Nitrate mg/L as NO3
Sulfate mg/L
Uranium ug/L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Concentration
200
180
160
140
120
100
80
60
40
20
0
Jan-00
Jul-00
Jan-01
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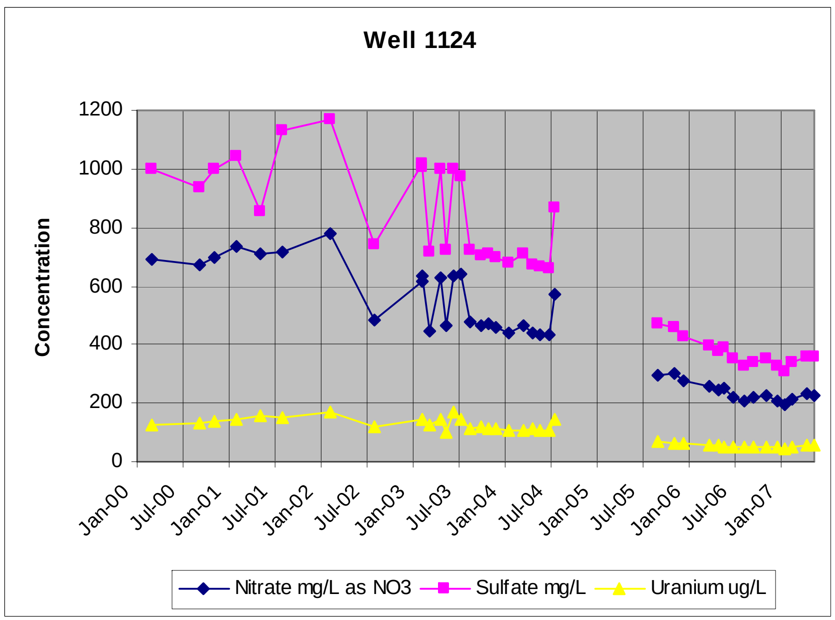
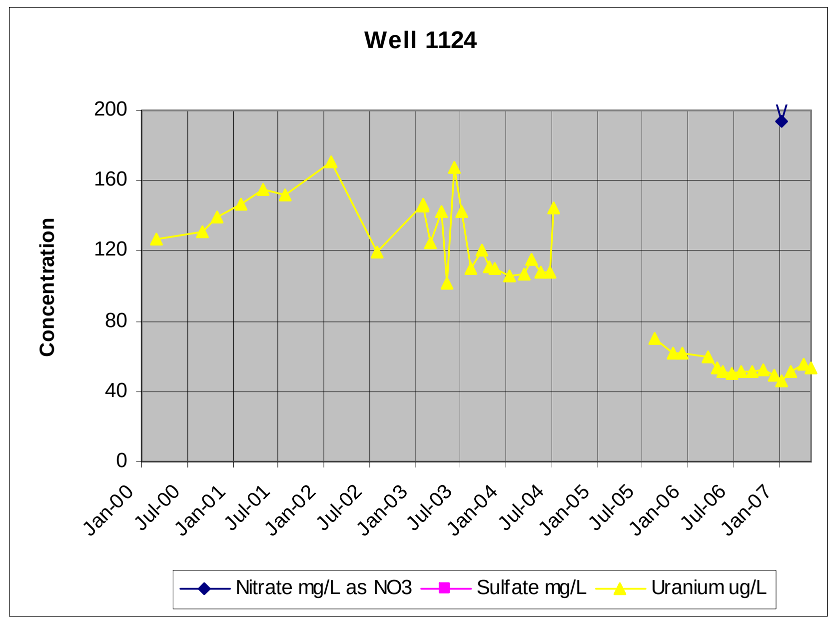
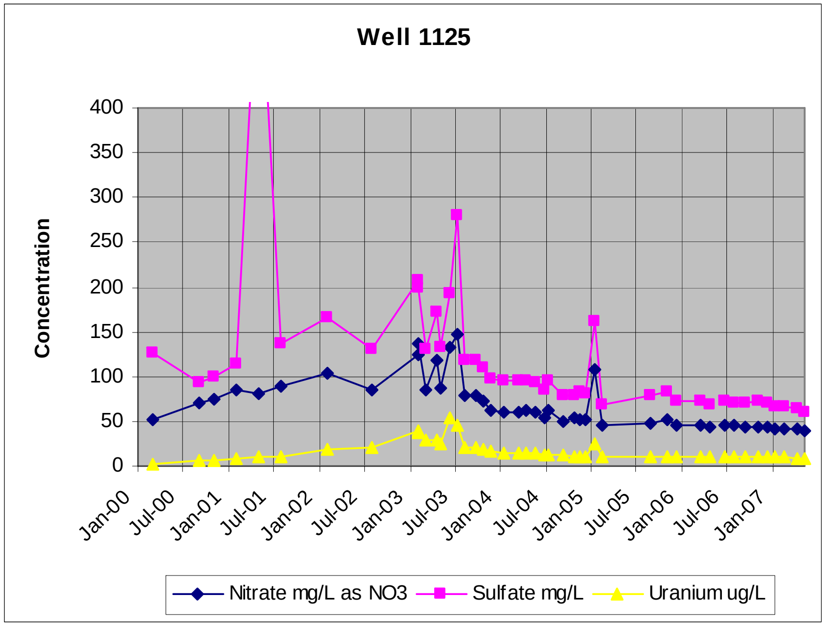
Jan-02
Jul-02
Jan-03
Jul-03
Jan-04
Jul-04
Jan-05
Jul-05
Jan-06
Jul-06
Jan-07
Nitrate mg/L as NO3
Sulfate mg/L
Uranium ug/L


Well 1124
Concentration
1200
1000
800
600
400
200
0
Jan-00
Jul-00
Jan-01
Jul-01
Jan-02
Jul-02
Jan-03
Jul-03
Jan-04
Jul-04
Jan-05
Jul-05
Jan-06
Jul-06
Jan-07
Nitrate mg/L as NO3
Sulfate mg/L
Uranium ug/L


Well 1124
Concentration
200
160
120
80
40
0
Jan-00
Jul-00
Jan-01
Jul-01
Jan-02
Jul-02
Jan-03
Jul-03
Jan-04
Jul-04
Jan-05
Jul-05
Jan-06
Jul-06
Jan-07
Nitrate mg/L as NO3
Sulfate mg/L
Uranium ug/L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Concentration
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100
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200
250
300
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400
Jan-00
Jul-00
Jan-01
Jul-01
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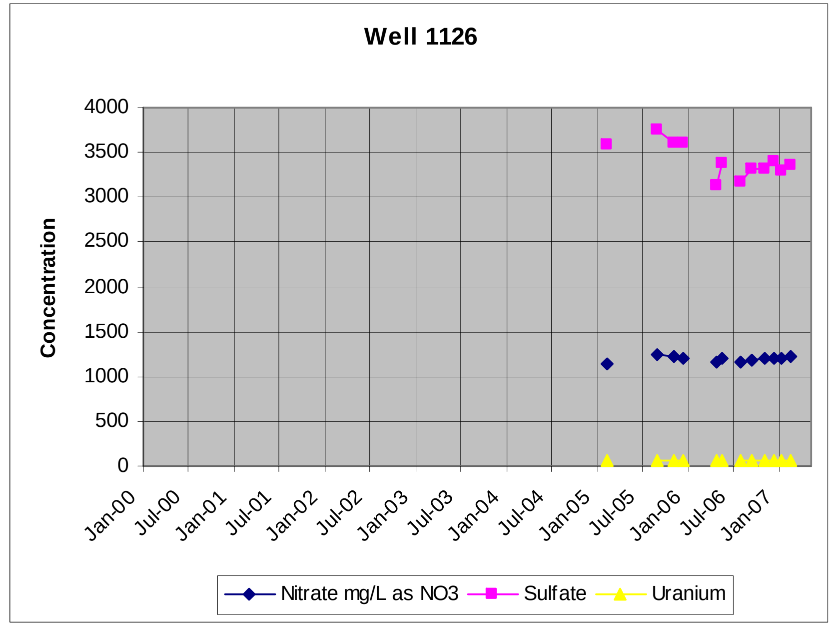
Jul-02
Jan-03
Jul-03
Jan-04
Jul-04
Jan-05
Jul-05
Jan-06
Jul-06
Jan-07
Nitrate mg/L as NO3
Sulfate mg/L
Uranium ug/L


Well 1126
Concentration
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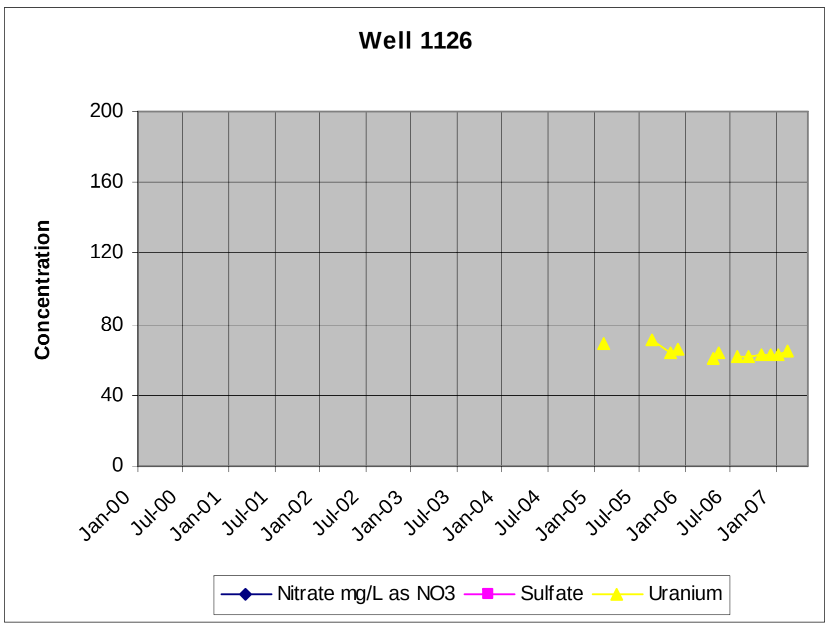
500
1000
1500
2000
2500
3000
3500
4000
Jan-00
Jul-00
Jan-01
Jul-01
Jan-02
Jul-02
Jan-03
Jul-03
Jan-04
Jul-04
Jan-05
Jul-05
Jan-06
Jul-06
Jan-07
Nitrate mg/L as NO3
Sulfate
Uranium


Well 1126
Concentration
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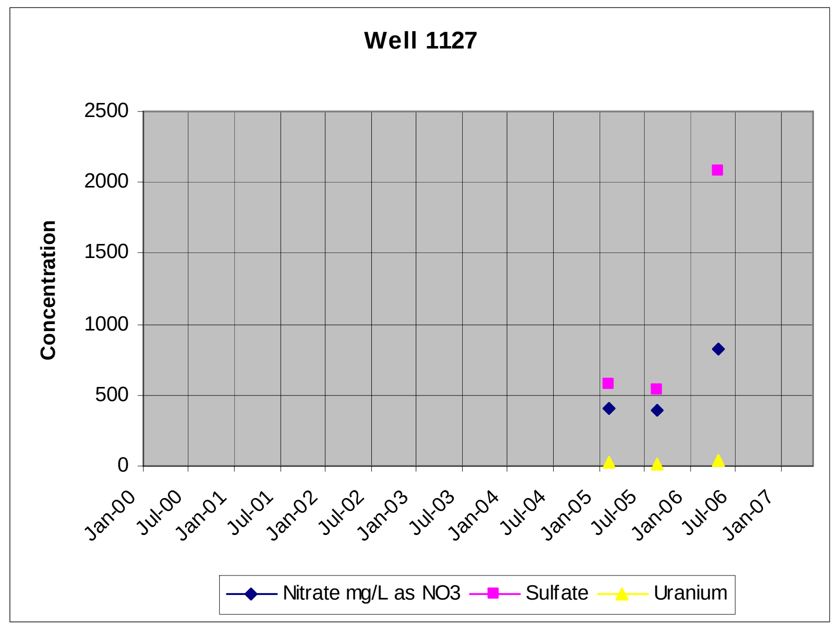
40
80
120
160
200
Jan-00
Jul-00
Jan-01
Jul-01
Jan-02
Jul-02
Jan-03
Jul-03
Jan-04
Jul-04
Jan-05
Jul-05
Jan-06
Jul-06
Jan-07
Nitrate mg/L as NO3
Sulfate
Uranium


Well 1127
Concentration
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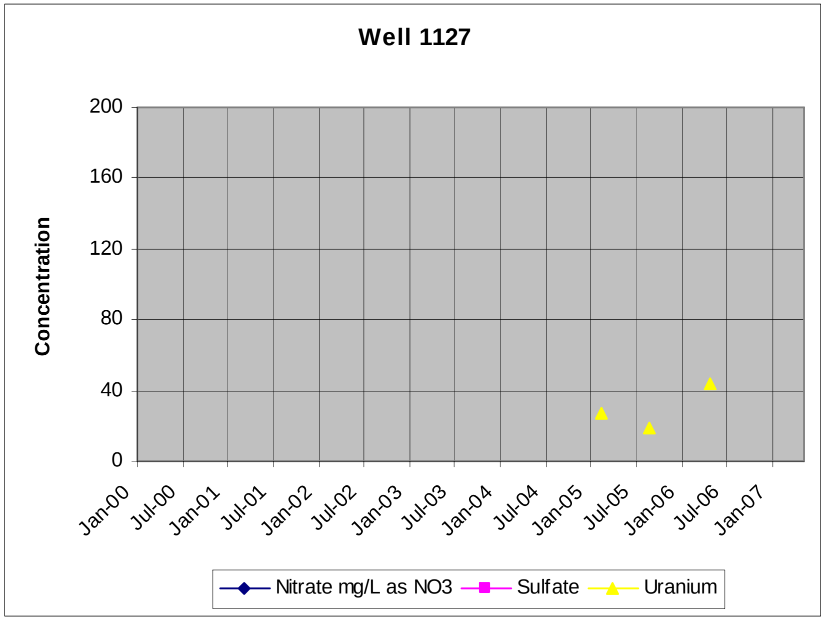
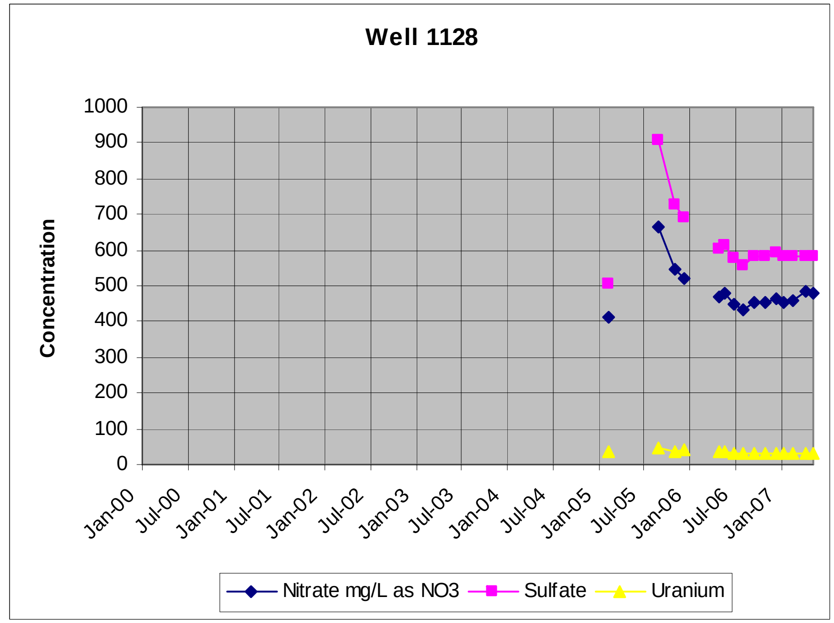
1500
2000
2500
Jan-00
Jul-00
Jan-01
Jul-01
Jan-02
Jul-02
Jan-03
Jul-03
Jan-04
Jul-04
Jan-05
Jul-05
Jan-06
Jul-06
Jan-07
Nitrate mg/L as NO3
Sulfate
Uranium


Well 1127
Concentration
200
160
120
80
40
0
Jan-00
Jul-00
Jan-01
Jul-01
Jan-02
Jul-02
Jan-03
Jul-03
Jan-04
Jul-04
Jan-05
Jul-05
Jan-06
Jul-06
Jan-07
Nitrate mg/L as NO3
Sulfate
Uranium


Well 1128
Concentration
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700
600
500
400
300
200
100
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Jul-00
Jan-01
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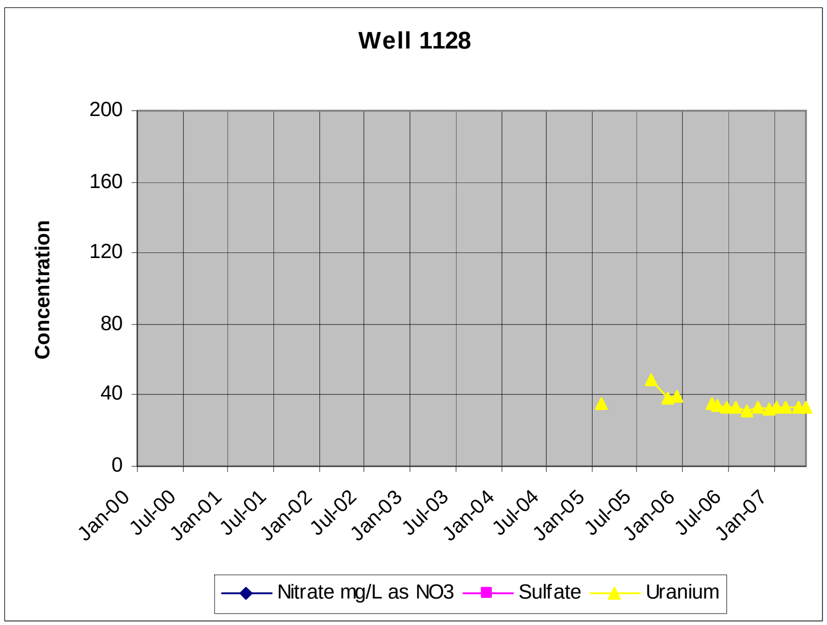
Jan-02
Jul-02
Jan-03
Jul-03
Jan-04
Jul-04
Jan-05
Jul-05
Jan-06
Jul-06
Jan-07
Nitrate mg/L as NO3
Sulfate
Uranium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Concentration
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80
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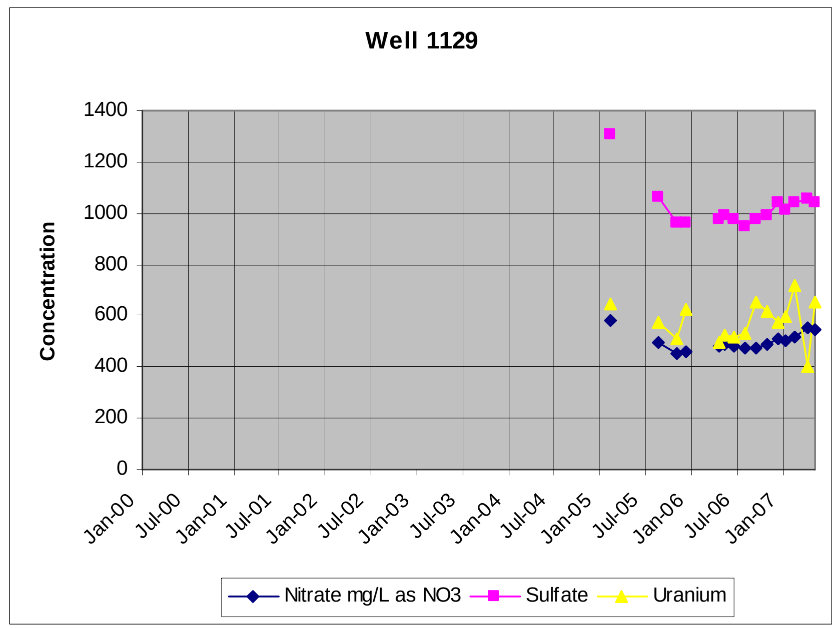
Jan-00
Jul-00
Jan-01
Jul-01
Jan-02
Jul-02
Jan-03
Jul-03
Jan-04
Jul-04
Jan-05
Jul-05
Jan-06
Jul-06
Jan-07
Nitrate mg/L as NO3
Sulfate
Uranium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800
600
400
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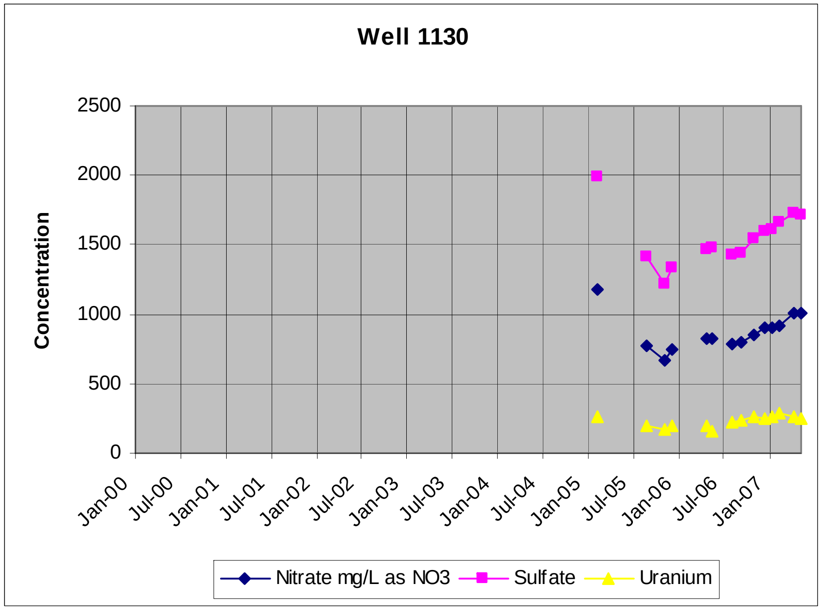
Jan-00
Jul-00
Jan-01
Jul-01
Jan-02
Jul-02
Jan-03
Jul-03
Jan-04
Jul-04
Jan-05
Jul-05
Jan-06
Jul-06
Jan-07
Nitrate mg/L as NO3
Sulfate
Uranium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Concentration
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2000
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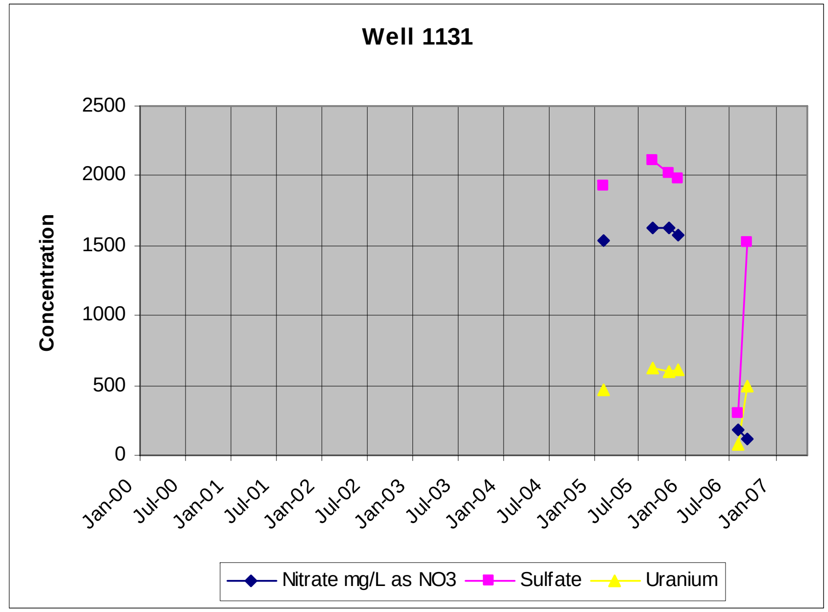
1000
500
0
Jan-00 Jul-00 Jan-01 Jul-01 Jan-02 Jul-02 Jan-03 Jul-03 Jan-04 Jul-04 Jan-05 Jul-05 Jan-06 Jul-06 Jan-07
Nitrate mg/L as NO3
Sulfate
Uranium


Well 1131
Concentration
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2000
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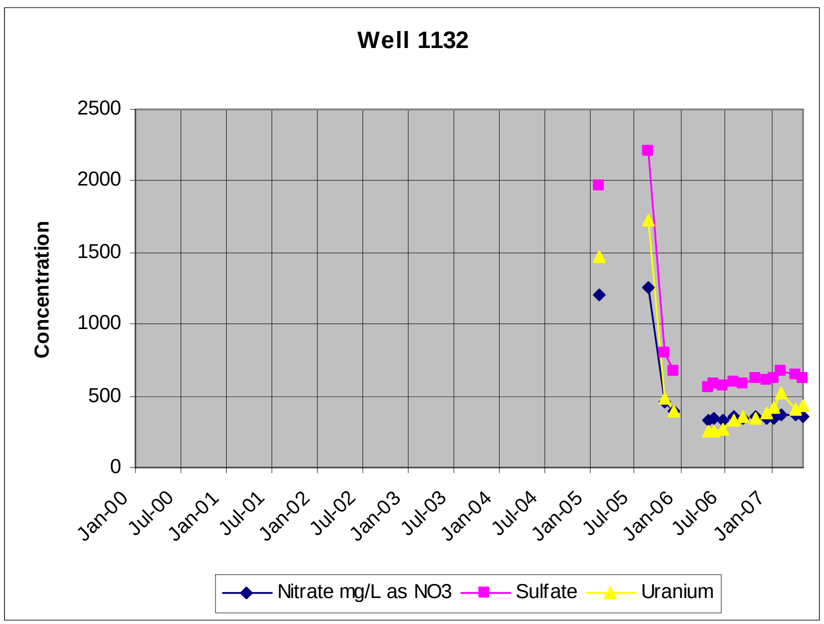
1000
500
0
Jan-00 Jul-00 Jan-01 Jul-01 Jan-02 Jul-02 Jan-03 Jul-03 Jan-04 Jul-04 Jan-05 Jul-05 Jan-06 Jul-06 Jan-07
Nitrate mg/L as NO3
Sulfate
Uranium


Well 1132
Concentration
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2000
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1000
500
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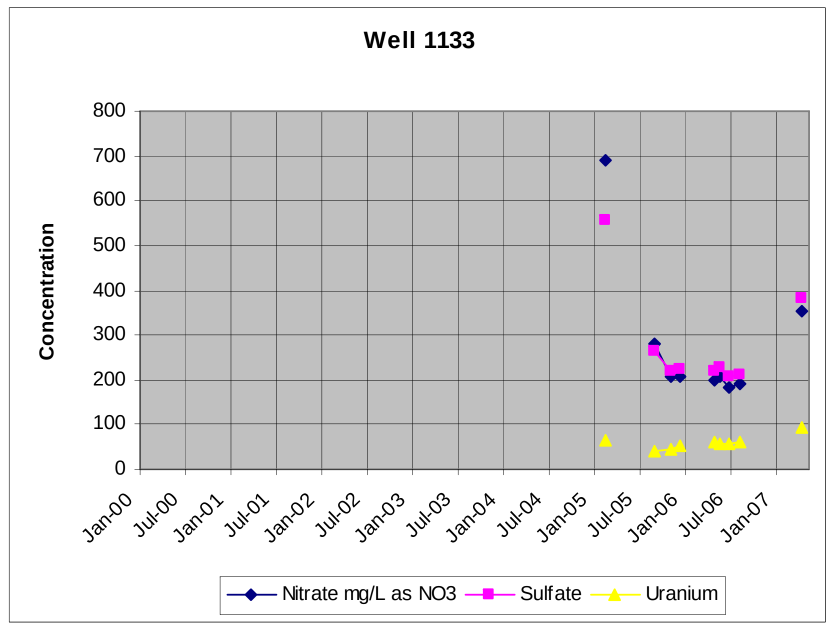
Jan-00 Jul-00 Jan-01 Jul-01 Jan-02 Jul-02 Jan-03 Jul-03 Jan-04 Jul-04 Jan-05 Jul-05 Jan-06 Jul-06 Jan-07
Nitrate mg/L as NO3
Sulfate
Uranium


Well 1133
Concentration
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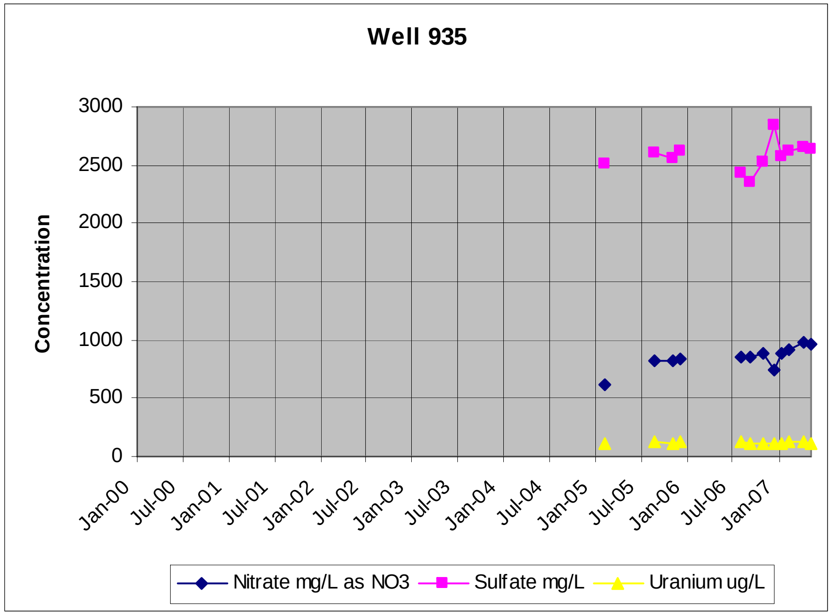
400
300
200
100
0
Jan-00 Jul-00 Jan-01 Jul-01 Jan-02 Jul-02 Jan-03 Jul-03 Jan-04 Jul-04 Jan-05 Jul-05 Jan-06 Jul-06 Jan-07
Nitrate mg/L as NO3
Sulfate
Uranium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Concentration
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1500
1000
500
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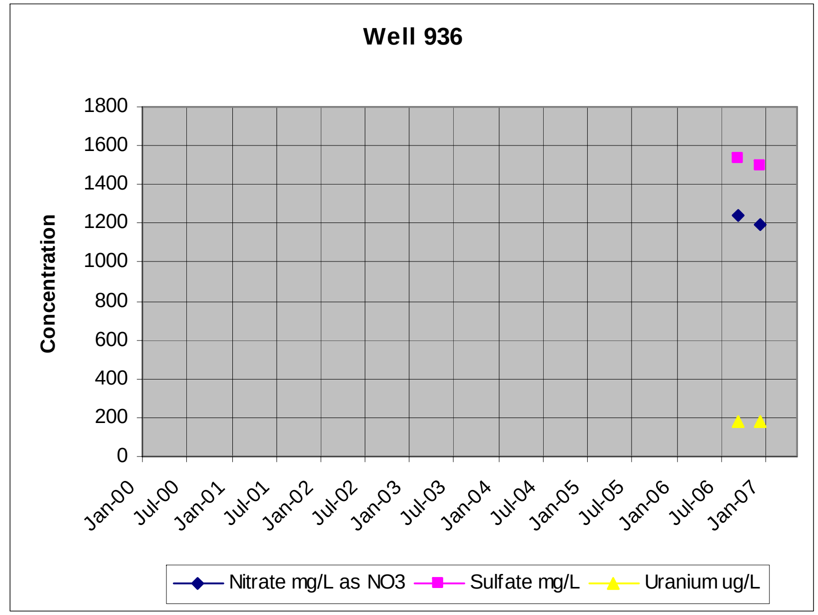
Jan-00
Jul-00
Jan-01
Jul-01
Jan-02
Jul-02
Jan-03
Jul-03
Jan-04
Jul-04
Jan-05
Jul-05
Jan-06
Jul-06
Jan-07
Nitrate mg/L as NO3
Sulfate mg/L
Uranium ug/L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Jul-00
Jan-01
Jul-01
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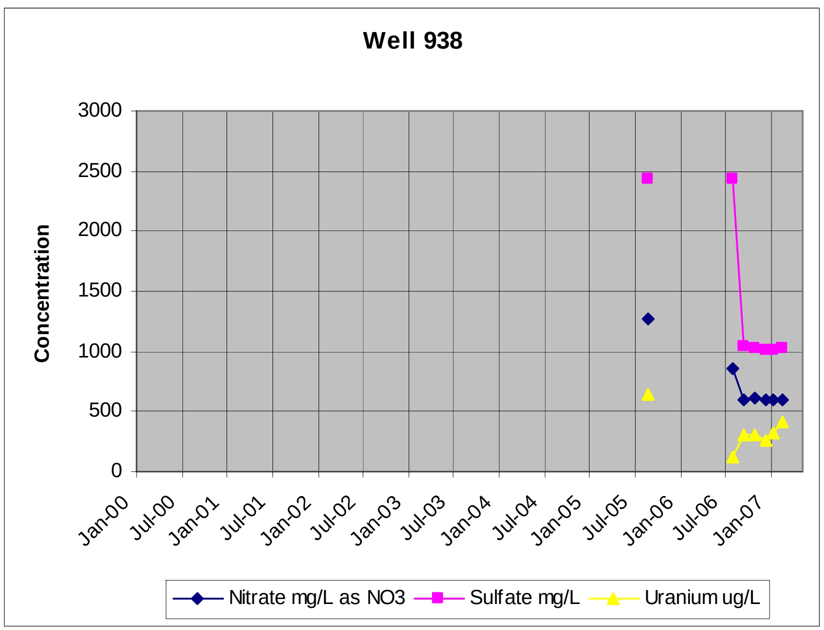
Jan-03
Jul-03
Jan-04
Jul-04
Jan-05
Jul-05
Jan-06
Jul-06
Jan-07
Nitrate mg/L as NO3
Sulfate mg/L
Uranium ug/L


Well 938
Concentration
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1000
500
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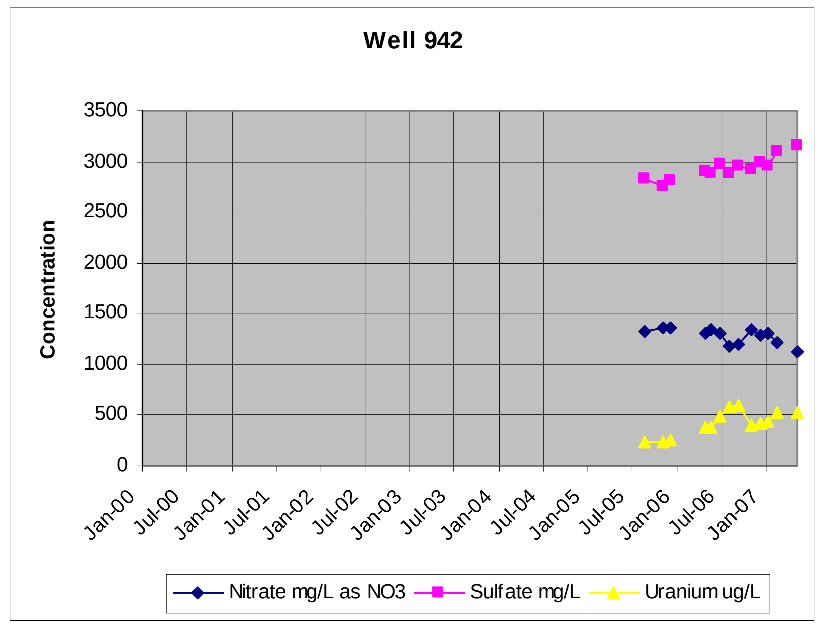
Jan-00
Jul-00
Jan-01
Jul-01
Jan-02
Jul-02
Jan-03
Jul-03
Jan-04
Jul-04
Jan-05
Jul-05
Jan-06
Jul-06
Jan-07
Nitrate mg/L as NO3
Sulfate mg/L
Uranium ug/L


Well 942
Concentration
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3000
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1500
1000
500
0
Jan-00
Jul-00
Jan-01
Jul-01
Jan-02
Jul-02
Jan-03
Jul-03
Jan-04
Jul-04
Jan-05
Jul-05
Jan-06
Jul-06
Jan-07
Nitrate mg/L as NO3
Sulfate mg/L
Uranium ug/L

Appendix G

Calculation Sets

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Calculation 1

Estimated Volume and Mass of Ground Water Contamination for the Baseline Period

Calculation Set #1: Estimated Mass and volume of ground water contamination for the baseline period (originally included in July 2005 annual report)

Tuba City, AZ, Disposal Site

Objective: estimate the baseline volume of contaminated groundwater of the Middle Terrace; estimate the baseline mass of dissolved nitrate,sulfate, and uranium in the groundwater

Method:
1) estimate the area of the plume from baseline contaminant maps separately for Horizons A and B combined and Horizons C and D combined
2) estimate the vertical thickness of contamination for Horizons A and B combined and Horizons C and D combined
3) assume 25% porosity and compute the separate plume volumes for Horizons A and B combined and Horizons C and D combined
4) compute separate concentration averages for sulfate and uranium for Horizons A and B combined and Horizons C and D combined from baseline contaminant maps
5) multiply concentration average by plume volume to determine contaminant mass for Horizons A and B combined and Horizons C and D combined
6) sum the volume and mass estimates

Calcualtion:

1) map area of contaminant plume

Horizons A and B	plume length (northeast to southwest)	4,000	ft
	plume width	1,800	ft
	area	7,200,000	ft^2
Horizons C and D	plume length (northeast to southwest)	2,500	ft
	plume width	1,800	ft
	area	4,500,000	ft^2

2) thickness of contamination

Horizons A and B			Horizons C and D		
thickness Horizon A	25	ft	thickness Horizon C	50	ft
thickness Horizon B	50	ft	thickness Horizon D	25	ft
A&B combined thickness	75	ft	C&D combined thickness	75	ft

assumptions
*approximately the upper half of Horizon A not saturated during baseline period
*Horizon B is fully saturated
*entire thickness of Horizon C contaminated
*Horizon D not contaminated at many locations, assume 50% contaminated thickness

3) plume volumes

Horizons A and B	volume of contaminated groundwater	135,000,000	ft^3	**135,000,000**	**ft^3**
		1,012,500,000	gal	**1,013,000,000**	**gal**
		3,832,312,500	L	**3,832,000,000**	**L**
Horizons C and D	volume of contaminated groundwater	28,125,000	ft^3	**28,000,000**	**ft^3**
		210,937,500	gal	**211,000,000**	**gal**
		798,398,438	L	**798,000,000**	**L**

4) baseline concentrations

Horizons A and B

well	Horizon	U mg/L	sulfate mg/L	nitrate mg/L as NO3
262	B	0.379	931	380
263	B	0.485	1990	1140
265	B	0.090	1520	720
267	B	0.073	3680	1640
906	A	0.951	1660	1470
908	B	0.122	2430	651
909	B	0.040	666	485
934	B	0.312	7360	2320
936	B	0.267	4360	2950
940	A	0.546	7550	1800
941	A	0.089	745	358
942	B	0.246	3030	1360
944	B	0.950	1590	1010
geometric mean mg/L		0.231	2174	1028

Horizons C and D

well	Horizon	U mg/L	sulfate mg/L	N mg/L as NO3
1101	D	0.245	960	438
1102	D	0.533	1320	650
1103	D	0.355	2570	1120
1104	D	0.194	1870	993
1105	D	2.100	1590	648
1106	D	2.100	1050	614
1107	D	0.118	1200	1060
1108	D	0.646	3400	1410
1109	D	0.565	3280	798
1110	D	0.053	512	227
1111	D	0.161	988	421
1112	D	0.130	1140	617
1113	D	0.053	**250**	143
1114	D	0.040	328	228
1115	D	0.410	1930	766
1116	D	0.040	250	106
1117	D	0.040	255	225
1118	D	0.040	250	164
1119	D	0.555	1560	468
1120	D	1.3	2330	493
1121	D	0.849	2590	535
1122	D	0.878	2960	954
1123	D	0.261	1240	643
1124	D	0.171	1170	781
1125	D	0.04	250	104
912	C	0.04	846	403
geometric mean mg/L		0.214	1020	464

5) mass calculation

Horizons A and B	mass uranium	884	kg
		1,949	lb
	mass sulfate	8,330,201	kg
		18,359,764	lb
	mass N as NO3	3,940,636	kg
		8,685,162	lb
Horizons C and D	mass uranium	171	kg
		377	lb
	mass sulfate	814,310	kg
		1,794,738	lb
	mass N as NO3	370,337	kg
		816,223	lb

6) total volume and masses

total volume contaminated groundwater	**163,000,000**	**ft^3**
	1,222,500,000	**gal**
	4,627,162,500	**L**
total mass uranium	**1,055**	**kg**
	2,326	**lb**
total mass sulfate	**9,144,511**	**kg**
	20,154,502	**lb**
total mass nitrate as NO3	**4,310,973**	**kg**
	9,501,384	**lb**

Figure G−1. Calculation Set, Estimated Mass and Volume of Ground Water Contamination, Tuba City, Arizona, Disposal Site

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Calculation 2

Estimated Aquifer Restoration Time Based on Mass and Volume Removal Rates

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Calculation Set #2: Estimated aquifer restoration time based on mass and volume removal rates
Tuba City Site
Annual Performance Evaluation Report
Period of Review: April 2006 through March 2007

Objective: estimate aquifer cleanup times

Method: compare mass and volume removed as of April 1, 2007 to estimates of initial contaminant inventory; predict cleanup time calculated removal rates to date

Calculation: estimate #1: initial contaminant volume and mass estimates from DOE Baseline Performance Evaluation, May 2003.
estimate #2: initial contaminant volume and mass estimates recalculated for April 2005 - March 2006 Performance Evaluation Report - see attached worksheet (Estimate of Baseline Contaminant Volume and Mass)

Estimate #1

	initial mass lb	cumulative removed lb	% removed			initial vol gal	cumulative removed gal	# pore vols removed	% plume vol removed	
Nitrate	12,400,000	757,445	6			3.40E+09	223,781,828	0.066	7	
Sulfate	17,900,000	1,862,880	10			2.70E+09	223,781,828	0.083	8	
Uranium	2,800	493	18			3.00E+09	223,781,828	0.075	7	
	mass removal rate % per yr	cleanup time, yrs	cleanup date	# yrs until cleanup			pore volume removal rate % / yr	1-pore volume cleanup time, yrs	1-pore volume cleanup date	# yrs until cleanup
Nitrate	1.3	**79**	2081	74			1.4	**73**	2075	68
Sulfate	2.2	**46**	2048	41			1.7	**58**	2060	53
Uranium	3.7	**27**	2029	22			1.6	**64**	2066	60
t1=	15-Jun-02									
t2=	01-Apr-07									
t2 - t1=	4.8	yrs								

Estimate #2

	initial mass lb	cumulative removed lb	% removed			initial vol gal	cumulative removed gal	# pore vols removed	% plume vol removed	
Nitrate	9,500,000	757,445	8			1.20E+09	223,781,828	0.186	19	
Sulfate	20,000,000	1,862,880	9			1.20E+09	223,781,828	0.186	19	
Uranium	2,300	493.036744	21			1.20E+09	223,781,828	0.186	19	
Projection	mass removal rate % per yr	cleanup time, yrs	cleanup date	# yrs until cleanup			pore volume removal rate % / yr	1-pore volume cleanup time, yrs	1-pore volume cleanup date	# yrs until cleanup
Nitrate	1.7	**60**	2062	55			3.9	**26**	2028	21
Sulfate	1.9	**52**	2054	47			3.9	**26**	2028	21
Uranium	4.5	**22**	2024	18			3.9	**26**	2028	21
t1=	15-Jun-02									
t2=	1-Apr-07									
t2 - t1=	4.8	yrs								

Figure G−2. Calculation Set 2, Estimated Aquifer Restoration Time Based on Mass and Volume Removal Rates

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Calculation 3

Calculate a Bulk Index of Aquifer Restoration for Sulfate

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Calculation Set #3: Calculate a bulk index of aquifer restoration for sulfate

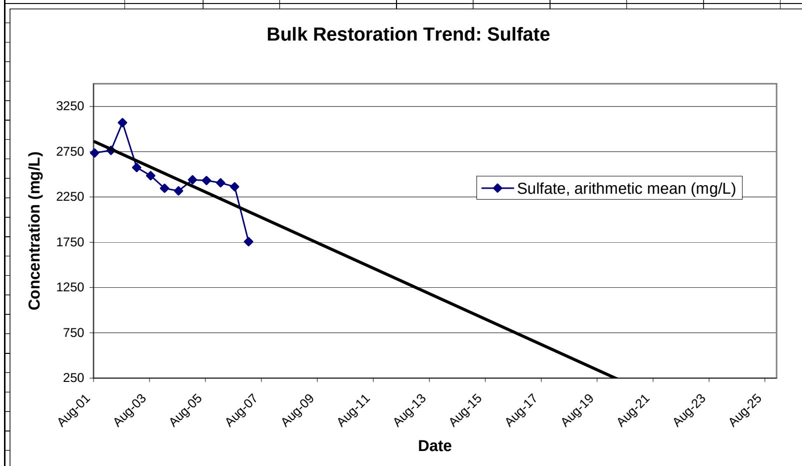
Tuba City, AZ, Disposal Site

Objective: develop a bulk concentration index for measuring restoration progress for sulfate

Method: 1) compute an average concentration of a contaminant for a given sampling date/event for a selected group of monitor wells within the contaminant plume
2) plot the computed averages over time

Calculation: the selected monitor wells below have the most comprehensive data set and are located throughout the contaminant plume in Horizons A and B;
no historical data exists for Horizons C and D within the contaminant plume
note: where data are absent in the table below, concentrations are carried forward from the previous date as shown in ***bold italic***

	Sulfate (mg/L)														**Sulfate,**	**Sulfate,**
date_sampled	**Loc 0262**	**Loc 0263**	**Loc 0265**	**Loc 0267**	**Loc 0906**	**Loc 0908**	**Loc 0909**	**Loc 0929**	**Loc 0934**	**Loc 0936**	**Loc 0940**	**Loc 0941**	**Loc 0942**		**arithmetic mean (mg/L)**	**geometric mean (mg/L)**
08/16/2001	***931***	***1990***	***1520***	3620	1840	2310	419	19.9	7450	4570	7230	620	3030	baseline	2735	1482
03/06/2002	***931***	***1990***	***1520***	3680	1660	2430	666	28.1	7360	4360	7550	745	3030	baseline	2765	1594
08/20/2002	***931***	***1990***	***1520***	3530	1690	2330	637	27.9	11900	4400	***7550***	***745***	2680		3072	1625
02/06/2003	***931***	***1990***	***1520***	3550	1660	2430	629	27.6	2970	4880	9180	920	2790		2575	1524
08/06/2003	1190	1640	1070	3690	1650	2400	564	29.1	2640	3240	10300	1010	2890		2486	1453
02/12/2004	***1190***	***1640***	***1070***	***3690***	***1650***	2400	540	***29.1***	1900	3200	9600	800	2800		2347	1375
08/31/2004	1000	1900	800	3500	1700	2600	590	26	2300	2500	***9600***	710	2900		2317	1331
02/10/2005	1000	2100	810	3700	1900	3000	680	26	2300	2700	***9600***	890	3000		2439	1426
08/31/2005	830	2000	1100	3600	***1900***	3000	770	28	2500	2600	***9600***	***890***	2800		2432	1450
02/22/2006	820	2000	1000	3500	2100	3000	840	27	2400	2100	***9600***	***890***	3000		2406	1431
08/31/2006	960	2000	1100	3600		2700	810	27	2300	1600	***9600***	750	2900		2362	1343
02/22/2007	1000	2100	990	3400		2900	870	23	2600	***1600***	1701	780	3100		1755	1176



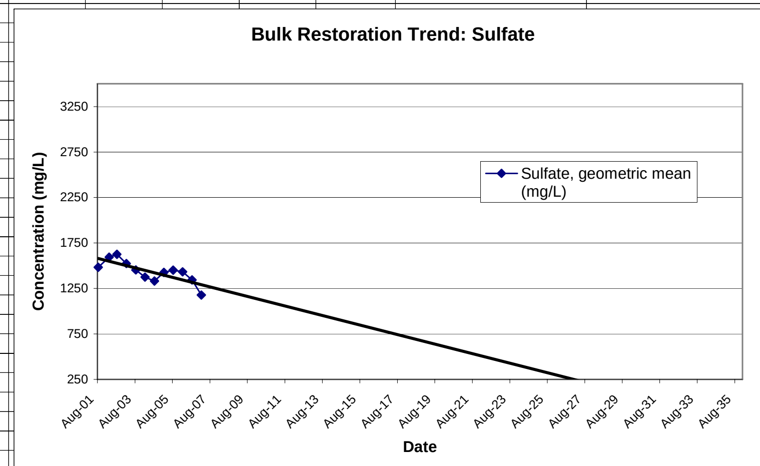


Figure 29

t1=	15-Jun-02		t1=	15-Jun-02	
t2=	1-Apr-07		t2=	1-Apr-07	
t2 - t1=	4.8	yr	t2 - t1=	4.8	yr
t3=	Aug-20	extrapolated	t3=	Aug-26	extrapolated
projected cleanup time from t1=	18	yr	projected cleanup time from t1=	24	yr
projected cleanup time from t2=	13	yr	projected cleanup time from t2=	19	yr

Figure G−3. Calculation Set 3, Calculate a Bulk Index of Aquifer Restoration for Sulfate

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Calculation 4

Calculate a Bulk Index of Aquifer Restoration for Uranium

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Calculation Set #4: Calculate a bulk index of aquifer restoration for uranium

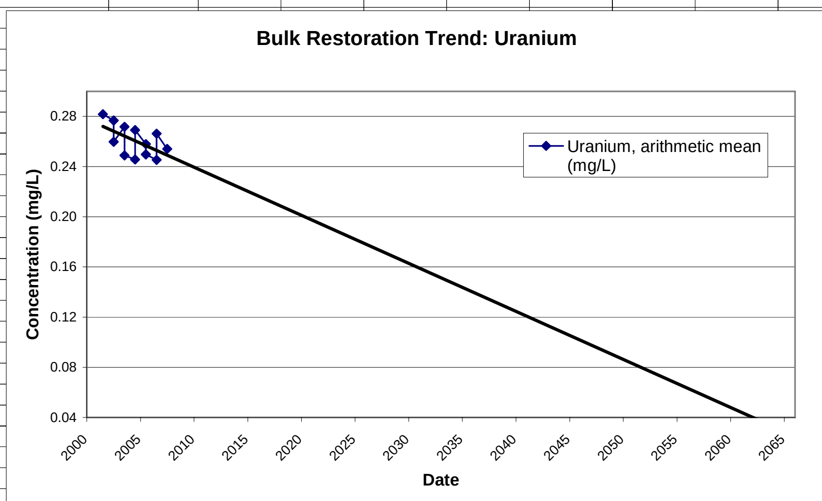
Tuba City, AZ, Disposal Site

Objective: develop a bulk concentration index for measuring restoration progress for uranium

Method: 1) compute an average concentration of a contaminant for a given sampling date/event for a selected group of monitor wells within the contaminant plume
2) compare the computed averages over time

Calculation: the selected monitor wells below have the most comprehensive data set and are located throughout the contaminant plume in Horizons A and B;
no historical data exists for Horizons C and D within the contaminant plume
note: where data are absent in the table below, concentrations are carried forward from the previous date as shown in ***bold italic***

	Uranium mg/L														**Uranium,**	**Uranium,**
date_sampled	**Loc 0262**	**Loc 0263**	**Loc 0265**	**Loc 0267**	**Loc 0906**	**Loc 0908**	**Loc 0909**	**Loc 0929**	**Loc 0934**	**Loc 0936**	**Loc 0940**	**Loc 0941**	**Loc 0942**		**arithmetic mean (mg/L)**	**geometric mean (mg/L)**
08/16/2001	***0.3790***	***0.4850***	***0.0897***	0.0696	0.9340	0.1110	0.0178	0.0012	0.2980	0.2810	0.6430	0.1030	0.2510	baseline	0.2818	0.1316
03/06/2002	***0.3790***	***0.4850***	***0.0897***	0.0731	0.9510	0.1220	0.0389	0.0012	0.3120	0.2670	0.5460	0.0886	0.2460	baseline	0.2769	0.1378
08/20/2002	***0.3790***	***0.4850***	***0.0897***	0.0742	0.6980	0.1220	0.0349	0.0011	0.3360	0.3060	***0.5460***	***0.0886***	0.2180		0.2599	0.1336
02/06/2003	***0.3790***	***0.4850***	***0.0897***	0.0765	0.6530	0.1240	0.0333	0.0015	0.3550	0.5820	0.4320	0.1020	0.2210		0.2718	0.1428
08/06/2003	0.4250	0.1730	0.0551	0.0784	0.6670	0.1060	0.0279	0.0018	0.3500	0.6060	0.4280	0.0858	0.2320		0.2489	0.1261
02/12/2004	***0.4250***	***0.1730***	***0.0551***	***0.0784***	***0.6670***	0.0970	0.0270	***0.0018***	0.3200	0.6000	0.4300	0.0810	0.2400		0.2458	0.1238
08/31/2004	0.5300	0.2300	0.0450	0.0880	0.8900	0.1200	0.0290	0.0010	0.3200	0.4700	***0.4300***	0.0760	0.2700		0.2692	0.1256
02/10/2005	0.5600	0.1900	0.0450	0.0850	0.8300	0.1100	0.0350	0.0010	0.2800	0.4700	***0.4300***	0.0490	0.2700		0.2581	0.1191
08/31/2005	0.6600	0.1400	0.0600	0.0950	***0.8300***	0.1000	0.0420	0.0014	0.2600	0.3500	***0.4300***	***0.0490***	0.2300		0.2498	0.1205
02/22/2006	0.7700	0.1200	0.0540	0.0880	0.7100	0.1000	0.0480	0.0014	0.2500	0.2400	***0.4300***	***0.0490***	0.3300		0.2454	0.1181
08/31/2006	0.7800	0.1000	0.0610	0.0770	***0.7100***	0.0890	0.0510	0.0013	0.2500	0.2000	***0.4300***	0.0930	0.6200		0.2663	0.1254
02/22/2007	0.9300	0.0980	0.0530	0.0610	***0.7100***	0.0920	0.0470	0.0013	0.2100	***0.2000***	0.3646	0.0780	0.4600		0.2542	0.1154



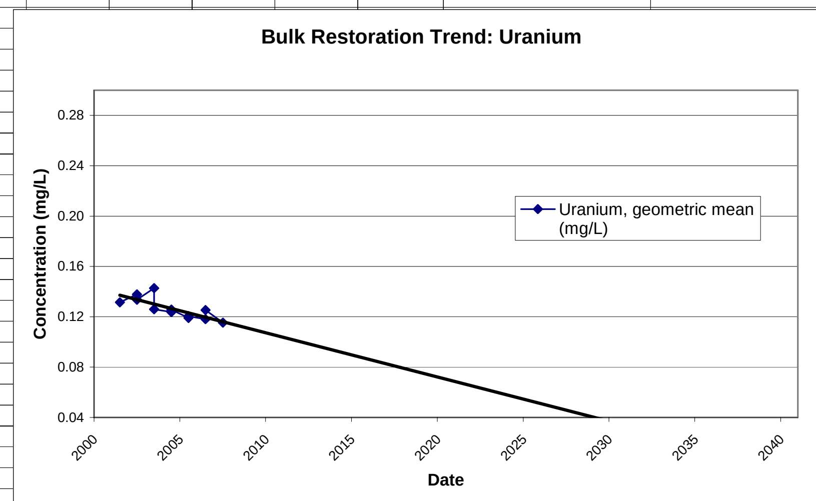


Figure 30

t1=	15-Jun-02		t1=	15-Jun-02	
t2=	1-Apr-07		t2=	1-Apr-07	
t2 - t1=	4.8	yr	t2 - t1=	4.8	yr
t3=	Aug-62	extrapolated	t3=	Aug-29	extrapolated

projected cleanup time from t1=	60	yr	projected cleanup time from t1=	27	yr
projected cleanup time from t2=	55	yr	projected cleanup time from t2=	22	yr

Figure G−4. Calculation Set 4, Calculate a Bulk Index of Aquifer Restoration for Uranium

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