LMS/TUB/S06397

# Annual Groundwater Report April 2009 through March 2010 Tuba City, Arizona, Disposal Site

July 2010

U.S. DEPARTMENT OF ENERGY | Legacy Management

**LMS/TUB/S06397**

# Annual Groundwater Report
# April 2009 through March 2010
# Tuba City, Arizona, Disposal Site

**July 2010**

This page intentionally left blank

# Contents



# Figures

# Tables



# Appendixes

This page intentionally left blank

# 1.0 Introduction

## 1.1 Background Information

This report evaluates the performance of the groundwater remediation system at the U.S. Department of Energy (DOE) Office of Legacy Management site near Tuba City, Arizona, for the period April 2009 through March 2010, and cumulatively. The site is located in Coconino County, Arizona, within the Navajo Nation and near Hopi Reservation land (Figure 1). A former uranium-ore processing mill operated at the site from 1956 until 1966. DOE conducted surface remedial actions, consisting of encapsulating all solid waste within an on-site engineered disposal cell, between 1988 and 1990. A remnant plume of groundwater contamination, presumed to have originated from evaporation ponds and slurry-emplaced tailings during mill operation, extends off site to the south and southeast in the underlying bedrock sandstone aquifer. The primary site contaminants in groundwater are nitrate, uranium, and sulfate. DOE constructed a pump-and-treat remediation system, operational by mid-2002, to remove contamination from the aquifer and restore groundwater quality. The progress of water quality restoration is evaluated and reported annually.

## 1.2 Groundwater Remediation System

The groundwater 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 treatment plant, where it is mechanically distilled following ion exchange softener pretreatment. An engineered solar evaporation pond receives the waste liquid (brine) and softener regeneration waste, and an infiltration trench located upgradient of the contaminant plume receives the treated water (distillate), where it is returned to the aquifer to promote the restoration process. Six injection wells (wells 1003 through 1008), originally intended to create a hydraulic barrier at the downgradient limit of contamination by injecting a portion of the treated water, 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, 936, 938, and 942, used formerly for monitoring purposes only, were converted to extraction use in summer 2005. Numerous other groundwater monitoring wells used to track water quality and water level trends are situated within and surrounding the network of extraction wells. Figures 2a through 2c depict the locations of extraction and monitoring wells and the primary features of the site. Figure 2a shows all well locations, Figure 2b shows monitoring wells only, and Figure 2c shows treatment system wells only. (These figures are referred to collectively hereafter as Figure 2.) Corresponding well completion information is provided in Appendix A.

## 1.3 Groundwater Compliance Strategy

The groundwater 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 consist of 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).

Groundwater contaminants requiring active remediation at the site are molybdenum, nitrate, selenium, sulfate, and uranium (DOE 1999). The focus of the figures and data analyses presented in this report are nitrate, uranium, and sulfate, because these contaminants are most widespread and contribute most to potential risk. For all constituents except sulfate, restoration standards correspond to a maximum concentration limit in groundwater established in Table 1 of Subpart A of 40 CFR 192 (see Table 1). Sulfate is not regulated by 40 CFR 192; however, a restoration standard was adopted for this constituent because it is present in groundwater at the site at concentrations that cause excess potential risk (DOE 1999).

*Table 1. Groundwater Remediation Targets*
*(Source: DOE 1999)*

| Constituent/Property | Cleanup Level | Baseline Concentrations in Plume |
|---|---|---|
| Nitrate[a] as $NO_3$ | 44 mg/L as $NO_3$ | 840–1,500 mg/L as $NO_3$ |
| 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 |
| Total Dissolved Solids (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
mg/L = milligrams per liter
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, partly on the basis of groundwater monitoring conducted in August and February of each year. During these events, samples are collected at monitoring 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. Most of the extraction wells are sampled only during the August events (exceptions this period were wells 935, 938, and 942). This is also the case for several distal and lower terrace wells that have no history of contamination (these, too, are only sampled during the August events).

Other information used in evaluating the effectiveness of the groundwater remediation system includes the monitoring data collected during routine operation of the treatment plant, such as (1) continuous flow metering for each extraction well, (2) continuous flow metering of the bulk influent and all outflow streams, (3) approximately weekly determination of bulk inflow and distillate composition through composite sampling, and (4) approximately monthly analysis of groundwater composition at each extraction well.

## 1.5 Hydrogeologic Setting

### 1.5.1 Site Conceptual Model and Groundwater Flow

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. The terraces are composed of thin (≤20 feet [ft]) surface deposits of coarse, semi-indurated, Quaternary alluvium. Loose dune sand and silt mantle the terraces at most locations. The terrace and dune deposits unconformably overlie the regionally extensive Navajo Sandstone, a massively cross-bedded, friable, fine-grained to very fine grained sandstone and siltstone of Jurassic age. Escarpments that separate the terraces are formed by cliffs of the Navajo Sandstone. The regional dip of the bedrock is about 1 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, which are relict playa lakes, are interspersed throughout both the classic and intertonguing intervals. The Kayenta Formation consists primarily of 100 ft or more of less-resistant, thin-bedded, red silt and fine sand and lacks the characteristic cross-beds of the Navajo Sandstone. Figure A−1 in Appendix A depicts a conceptual model of the site hydrogeology to illustrate the relationship of surface topography, subsurface geology, and groundwater flow.

Groundwater 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 composition of the Kayenta Formation locally, it is not water bearing and is considered the base of the N-aquifer in this area. The local water table occurs within the Navajo Sandstone; the terrace and dune deposits in the site area are not saturated. Groundwater saturation extends from the water table, about 50 to 60 ft below ground surface on the upper and middle terraces, to the contact with the Kayenta Formation, accounting for a saturated thickness on the order of 500 ft. Except for the local effects of groundwater withdrawal at the site, groundwater flow is south to 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 groundwater from higher in the formation occurs in some areas, as evidenced by scattered bands of desert phreatophytes that typically occur 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.

### 1.5.2 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 for evaluating the site hydrogeology and depth of contamination. Ground surface of the middle terrace, nominally 5,050 ft in elevation, marks the top of the uppermost horizon, Horizon A (Figure A–1). 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. Contamination of the aquifer is limited in depth; therefore, groundwater 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 of Appendix A. In Figure 2, color-coding identifies the corresponding horizon in which the midpoint of the screen of each well is located for extraction wells (round symbols) and monitoring 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 of Appendix A includes additional well completion information such as screen length and elevations.

# 2.0 Treatment and Extraction Systems

## 2.1 Bulk Treatment Parameters

During the current review period of April 2009 through March 2010, the treatment plant operated for 235 of 365 total days[1], for a net on-stream factor of 64 percent. This on-stream percentage has decreased from 87 percent (318 operational days) reported for 2008–2009. The decrease in the net on-stream factor is due to a number of factors, the primary one being continued problems with fouling in the evaporator vessel. Power failures and scheduled maintenance requiring plant shutdowns accounted for the remainder of the downtime.

About 31.7 million gallons of water were treated during this period, resulting in an average operating rate of 94 gallons per minute (gpm). The effective rate (downtime included) was 60 gpm, about half of the 120 gpm treatment plant capacity. Aquifer yield generally limits the extraction rate to about 90 to 100 gpm. Corresponding values reported for 2008–2009 were 40.6 million gallons treated, and average operating and effective rates of 89 gpm and 77 gpm, respectively.

Total groundwater treatment as of April 1, 2010, was approximately 338.4 million gallons, equivalent to about 28.2 percent of the total estimated volume of uranium-contaminated groundwater prior to remedial action (see Section 4.0 for discussion of contaminant removal rates). Corresponding values reported for 2008–2009 were 306.7 million gallons (cumulative treated volume), corresponding to 25.6 percent of the total contaminated groundwater volume.

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 that, on average, the bulk extraction rate (represented by inflow) continues to decrease slightly over time. However, the weekly inflows sometimes vary considerably. This figure also indicates relatively stable concentrations of nitrate and sulfate entering the treatment system at typical inflows.

[1] Operational days include only the days when the plant was fully in service and returning treated water to the aquifer. The plant is not considered to be operational on startup days, when equipment is bringing the plant up to operating conditions and is not treating water for reinjection.

As shown in Figure 4, uranium concentrations in the bulk feed show a slight downward trend over the same period. 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 105,088 pounds (lbs), 282,908 lbs, and 71 lbs, respectively (Table 2).

*Table 2. Treatment System Performance Summary, April 2009−March 2010*

| Contaminant | Mass Removed During Review Period (lbs) | Typical Feed Concentration (mg/L) | Average Distillate Concentration (mg/L) |
|---|---|---|---|
| Nitrate (as $NO_3$) | 105,088 | 409 | 3.8 |
| Sulfate | 282,908 | 1,158 | 13.2 |
| Uranium | 71 | 0.29 | 0.002 |

mg/L = milligrams per liter

## 2.2 Distillate Quality

Figure 5 plots average weekly concentrations of nitrate, sulfate, uranium, chloride, and total dissolved solids (TDS) in the distillate ranged over time. Except for increases in 2007 and 2008[2], distillate quality has remained relatively stable since 2005. During this review period, concentrations of nitrate, sulfate, and uranium in the distillate averaged 3.8, 13.2, and 0.002 milligrams per liter (mg/L), respectively (Table 2).

During this review, TDS concentrations in the distillate ranged from 10 to 110 mg/L (28 mg/L average), and chloride concentrations ranged from 0.5 to 21.6 mg/L (2.1 mg/L average). These results indicate highly effective contaminant removal and a quality of water returned to the aquifer generally well below the remediation targets listed in Table 1.

## 2.3 Treatment System Water Budget

Consistent with the last reporting period, about 29 million gallons (91 percent) of the total feed to the treatment system was returned to the aquifer at the infiltration trench over the past year. This percentage is consistent with previous years of plant operation and is consistent with system design parameters. Treatment system wastewater sent to the evaporation pond comprised about 5 percent of the total inflow as brine and about 4 percent as loss for softener regeneration. Water levels in the evaporation pond continue to remain safely below the maximum operating level.

## 2.4 Extraction Well System Description

In Figure 2c, 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 fills 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 a

[2] As addressed in the last annual report, the increases in contaminant concentrations in the distillate observed in 2007 and 2008 were attributable to the need for replacement of the treatment system heat exchanger bags. Bags were replaced in May 2008.

depth 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 monitoring 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. Refer also to Table A–1 and Figure A–2 in Appendix A.

# 3.0 Groundwater Capture Analysis

## 3.1 Extent of Groundwater Contamination

Figures 6a through 14a illustrate the concentrations of nitrate (as $NO_3$), sulfate, and uranium in groundwater in the respective aquifer horizons before the start of remediation (baseline period). Figures 6b through 14b show contaminant distributions in August 2009 or February 2010 for the respective contaminant and aquifer horizon. Corresponding analytical results are tabulated in Appendix B for August 2009, February 2010, and the baseline period. Most of the baseline period data are from sample collection in March 2002, but data for some locations are from 1999 or 2001. In addition to the primary contaminants, Appendix B also documents analytical results for molybdenum and selenium.

To facilitate review of Figures 6 through 14, although each well location sampled for the respective period is shown, a concentration value is posted only where the applicable remediation goal or standard (Table 1) was exceeded. In comparing the "a" series figures (representing baseline conditions) with the "b" series counterparts (plotting the most recent results), the area of contamination in the various horizons does not appear significantly different from that established for baseline conditions, indicating no lateral spreading of the contaminant plume (additional information regarding contaminant concentration trends is provided in Section 4.1).

The depth of groundwater contamination is generally limited to Horizons A, B, and C beneath the middle terrace. Contamination of Horizon D is confined to the disposal cell and evaporation pond area where groundwater extraction is most focused (Figures 7b, 10b, and 13b). Apparent contamination in Horizon D in these areas may be an effect of downward migration of contaminated groundwater from upper horizons in response to groundwater withdrawal at nearby extraction wells. Contamination in Horizon E (see Figures 8b, 11b, and 14b) is still limited to the occurrence of nitrate in well 268, presently at 75 mg/L. Contamination is absent in the deeper horizon. (Refer to Section 4.0 for a discussion of corresponding time trends.)

In general, contamination of lower terrace wells is absent—with few exceptions, constituent concentrations in these wells continue to be below remediation goals. However, nitrate continues to exceed the 44 mg/L (as $NO_3$) restoration standard at several locations (Figures 7a and 7b), currently at concentrations between 53 and 290 mg/L as $NO_3$. The maximum concentrations (290 and 230 mg/L) were measured respectively at Horizon C well 0691 and paired well 1003 (Horizon D). These paired wells are the only locations on the lower terrace where the sulfate restoration goal is presently exceeded (Figure 10b). In recent years (since the start of remediation), sulfate concentrations had decreased to levels below the restoration goal of 250 mg/L at all lower terrace locations.

Prior to 2005, uranium was present at several lower terrace wells (e.g., 0691) at concentrations that exceeded the 0.044 mg/L restoration standard. Uranium concentrations had remained less than this standard at all lower terrace locations until February 2010, when uranium was detected at 0.47 mg/L at well 0691. Historically, contaminant trends in wells 0691 and 1003 have not been stable (see Section 4.1 for additional trending information).

Figures C−1, C−2, and C−3 in Appendix C show the distributions of nitrate, sulfate, and uranium during the current period of review. The contours shown in the figures were computer-generated using the natural neighbor interpolation method based on the posted concentration values. This method yields continuous 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. As has been the case for the last several reporting periods, the plume geometry and magnitude of the contour intervals has not changed significantly—for all constituents, contamination is still generally confined to the middle terrace.

## 3.2 Water Table Configuration

### 3.2.1 Water Table Contours

Figure 15 shows the estimated water table for the baseline period (August 2001) using water levels in Horizons A and B monitoring wells for the middle terrace and Horizon C wells for the lower terrace. On the middle terrace, water levels at 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 within the area of interest. The horizontal direction of groundwater flow was predominantly south during the baseline period. A steeper hydraulic gradient at the escarpment (Figure 15) mimics ground surface topography.

Figure 16 shows the estimated water table for February 2010. The monitoring wells and corresponding water table elevations used to generate the water table contours are identified in the figure. The computer-generated, grid-based contours were computed using the natural neighbor interpolation method. Additional output of the contouring application (SURFER) includes vector analysis of the groundwater capture zone, as described in Section 3.4.

Comparison of Figures 15 and 16 indicates that operation of the extraction wells has significantly depressed the water table within the central regions of extraction to the south and east of the disposal cell. Also evident in Figure 16 is the development of an elongate groundwater mound and increased hydraulic gradients along the north edge of the disposal cell caused by infiltrating distillate at the trench. Additional analysis of water table drawdown, groundwater flow direction, and groundwater capture, as influenced by groundwater extraction, is provided in Sections 3.3, 3.4, and 3.5.

### 3.2.2 Infiltration Trench

The infiltration trench is constructed into bedrock along the north side of the site (see Figure 2). Distillate enters at the midpoint of the trench and flows toward each end in perforated pipe that is embedded in a 3-ft-thick gravel pack. Through mid-2003, nonuniform infiltration caused greater than 20 ft of groundwater mounding beneath the southwest section of the trench, but only about 1 ft of mounding beneath the northeast section. The groundwater mound progressively became more symmetrical after November 2003 when flow valves were installed and all inflowing water was diverted to the northeast section of the trench. In April 2005, a small amount of flow was redirected back to the southwest section of the trench, which again resulted in comparatively greater mounding in that section. Water levels at well 946, located near the southwest section of the trench, reached historical maximums in 2007 but have since decreased slightly. The groundwater mound at the infiltration trench currently appears to be symmetrical in shape from the point of water entry to the trench.

Wells 284 and 285 are paired with wells 946 and 943, respectively, to monitor water table conditions at the contact between the terrace deposits and the Navajo Sandstone immediately downgradient of the trench (see Figure 2b). Wells 284 and 285, completed with screen intakes that straddle the alluvium/sandstone contact, have remained dry since installation in 2004, indicating that mounding has not over-topped the trench to saturate the alluvium. Current water levels are closest to alluvium/sandstone contact at well 946, where the water table is within about 6 feet of that contact. Water level hydrographs for wells completed in the aquifer in the area of the trench are presented as Figure D−1 in Appendix D.

## 3.3 Water Level Drawdown

Figure 17 illustrates the effect of groundwater extraction and infiltration by showing the difference in water levels in Horizons A and B between the baseline period and February 2010. Figures 18 and 19 plot the water level differences between the same periods for the deeper horizons. Positive values identify locations where the water level in February 2010 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 groundwater extraction, the pattern of water level drawdown illustrated in Figures 17 through 19 reflects three-dimensional converging flow to the extraction wells. The greatest drawdown (as much as 70 ft) is observed at the monitoring wells closest to or within the east and south areas of extraction and which are screened in the same horizons spanned by the extraction well intakes (Horizon C, D, or E). Drawdown is observed to decrease with vertical and horizontal distance from the extraction well intakes. Well hydrographs in Appendix D provide an additional view of water level variation over time at selected monitoring wells. The predominantly downward trend in groundwater levels indicates that the capture zone continues to expand. Recent increases in water levels at several locations (0906 for example) may reflect the increased periods of plant downtime discussed in Section 2.1.

## 3.4 Horizontal Capture

Figure 20 depicts the estimated zone of groundwater capture in lateral extent in Horizons A and B, where the bulk of contamination resides. In this depiction, all groundwater within the blue line, the approximate extent of plume capture, is predicted to ultimately flow to an extraction well. This prediction is based on slope analysis of the water table depicted in Figure 16. Using the computer program SURFER, the analysis calculates a vector that describes the direction and magnitude of the water table slope within each user-specified grid cell used in computing the water table contours. The capture line in Figure 20 corresponds to a horizontal flow divide between the vectors that converge on the extraction wells and those that do not.

The slope analysis indicates that the full width of the contaminant plume along the south edge of the disposal cell is within the capture zone, suggesting that flow of contaminated groundwater from the site has been eliminated. The capture zone encompasses the region of greatest contamination; however, much of the area encompassing extraction wells 1126 through 1129 apparently escapes capture. Water level drawdown in this area is significant (Figures 17 and 18) and generally continues to increase (Figures D−4, D−5, and D−6 in Appendix D). These data indicate an expanding cone of depression and expanding capture zone in this area. Contamination in this area is limited in vertical extent to Horizons A and B and is generally at lower concentrations than within the primary capture zone shown in Figure 20.

## 3.5 Vertical Capture

Hydrographs included in Appendix D for selected sets of co-located monitoring 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 groundwater remediation. With few exceptions, vertical flow potentials were downward during the baseline period. Since that time, the magnitude of downward flow in Horizons A, B, and C has generally increased, as exemplified by the greater vertical separation in the hydrographs for the respective locations of well pairs 263/264, 265/266, 909/932, and 908/912 since about mid-2002 (see Figures D−4 through D−7 in Appendix D). In the main region of contamination, these increased gradients likely imply capture of groundwater 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 in response to groundwater extraction. For example, the vertical flow potentials 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 trend for Horizons E and I is apparent at the location of wells 251/252 (see Figure D−9). A downward flow potential remained between Horizon I and M into 2005 at paired wells 254/255 (Figure D−10; wells 254 and 255 were decommissioned in August 2005). Groundwater elevation data for well 273, installed in August 2004 near the location of former wells 254 and 255, implies vertically upward flow from Horizon I to D under the current pumping condition and downward flow from Horizons A and B (Figure D−10). Groundwater extraction has reduced but not reversed the downward flow gradient between Horizons D and G at wells 915 and 916 (Figure D−11); however, this region of the aquifer is not contaminated.

Because the observed vertical influence of the extraction wells extends 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. Downward flow potentials in lower terrace groundwater remain strongly downward, extending possibly through Horizon I, as indicted at the lower terrace well cluster identified in Figure D−12. The effect of pumping at that location has been to increase the downward hydraulic gradient between Horizons C and E and decrease the potential between Horizons E and I (Figure D−10). Despite the downward flow potential remaining on the lower terrace, the slight amount of contamination in lower terrace groundwater is limited primarily to Horizon C.

# 4.0 Remediation Progress

## 4.1 Contaminant Concentration Trends at Monitoring Wells

Appendix E contains time series graphs of nitrate, sulfate, and uranium concentrations in groundwater at selected monitoring wells located throughout the project area. In the main region of groundwater contamination, nitrate and sulfate concentrations have risen since the baseline period (see Figures E–1 and E–2). Similar trending is not apparent for uranium, for which consistent trending is generally absent (Figure E–3). Movement of more highly contaminated groundwater to less contaminated areas of the aquifer should be expected at some locations in response to groundwater withdrawal. The opposite effect should also be expected. In general, persistent and widespread trending, upward or downward, is not evident.

Toward the downgradient (south) margin of the plume, contaminant concentrations are relatively stable and generally consistent with baseline concentrations (see Figures E−4 through E−6). Horizon A, B, and C wells 271, 683, 684, 914, and 929 are located beyond but near the downgradient or crossgradient extent of contamination. At most of these “sentinel” wells (271, 683, 684, and 914), groundwater has not been contaminated since monitoring began in 1999. Minor nitrate contamination of about 1.5 times the remediation standard remains at well 929 (before and since the start of remediation). These findings indicate that the contaminant plume has not expanded laterally.

On the middle terrace, contaminant concentrations remain stable and below remediation standards in Horizons C and D, as indicated at wells 264, 266, 914, 915, and 932 (Figures E−7 through E−9). These results indicate that the plume is not expanding southward at this depth in the aquifer. In Figures E−7 and E−8, elevated nitrate and sulfate concentrations at well 912 (Horizon C) have trended downward over time, which also indicates that contamination is not spreading farther downgradient to the south of the disposal cell.

As presented in Section 3.1, groundwater contamination beneath the lower terrace is sparse and limited to concentrations that do not greatly exceed the remediation standards. Figures E–10 through E–12 show time-series plots for nitrate, sulfate, and uranium at selected lower-terrace wells. Concentrations of these constituents are shown to be relatively stable before and after the start of groundwater remediation, except at paired well 691 and 1003, where contaminant concentrations are highly erratic. For example, nitrate, sulfate, and uranium concentrations decreased significantly from preremediation conditions to at or below cleanup levels through about 2007. Concentrations of these constituents have increased significantly at this location to again exceed (if only marginally) the remediation standards.

Contaminant concentrations at monitoring wells screened below Horizon D on both the middle and lower terrace remain stable and below remediation standards, except at well 268 (refer to Appendix E, Figures E−13 through E−15). At well 268 (Horizon E), located in an area of extensive water level drawdown (see Figures 16 and 19), contaminant concentrations have increased, presumably in response to groundwater withdrawal associated with the remediation system. The trend has stabilized at this location since about 2005, and only nitrate has exceeded the remediation standard. The rise in contaminant concentrations at well 268 may be explained by the downward movement of contaminated groundwater from upper horizons to deeper horizons intercepted by the nearby extraction wells. Well 268 is in an area of pronounced drawdown.

## 4.2 Breakthrough from the Infiltration Trench

The arrival of water from the infiltration trench to the extraction wells may eventually be important in evaluating the flushing process and time requirement for restoration of the aquifer. Breakthrough of clean water from the infiltration trench is expected to be evident as a relatively abrupt decline in contaminant concentration at monitoring and extraction wells nearest the downgradient side of the disposal cell. Such trending is not yet apparent. Darcy's Law predicts a travel time from the infiltration trench to well 940 of about 17 years, based on the observed water table gradient (Figure 16), a hydraulic conductivity of 1 ft per day (from DOE 1998), and 25 percent porosity. This amount of time exceeds the cumulative remediation period to date, so breakthrough of the distillate is not yet expected. DOE may evaluate other possible geochemical indicators of distillate breakthrough downgradient of the disposal cell as remediation progresses.

## 4.3 Contaminant Concentration Trends at Extraction Wells

Figures 21 to 23 illustrate concentration trends at the extraction wells for nitrate, sulfate, and uranium. Each figure comprises three separate time series plots to show the trends in different areas of the extraction well field. The well field is separated into the area east of the disposal cell (figure "a"), the area immediately south of the disposal cell (figure "b"), and the area encompassing the southernmost portion of the plume (figure "c").

Figures 21a, 22a, and 23a show that concentration trending is generally downward in the eastern area of the extraction well field for each contaminant. Concentration trending is much more variable in the area immediately south of the disposal cell (Figures 21b, 22b, and 23b). In this area, concentrations at some wells are observed to be static over time, while at other wells, trends may be slightly upward or downward. Nitrate and sulfate concentrations rose slightly in the southernmost portion of the extraction field at the onset of remediation. Concentrations have since been relatively stable. Uranium concentrations did not show a similar rise at the onset of remediation, and concentrations remain relatively stable.

Appendix F provides times series plots of nitrate, sulfate, and uranium for each extraction well based on monthly monitoring conducted by treatment plant operators. Monthly monitoring is conducted to provide greater accuracy in evaluating and maintaining treatment system performance than can be accomplished by the separate semiannual monitoring program. Some of the figures in Appendix F are plotted twice at different scales of the *y* axis to show greater resolution of trending and comparison to remediation standards at lower-magnitude concentrations.

Table 3 was prepared on the basis of Figures 21 to 23 and the times series plots in Appendix F to list the extraction wells where a primary contaminant concentration was below the remediation standard in the extract during this reporting period.

*Table 3. Pumping Wells Where a Contaminant Concentration is Below the Remediation Standard in the Extract, as of February 2010*

| Extraction Well[a] | Nitrate[b] | Sulfate[c] | Uranium[b] |
|---|---|---|---|
| 1112 | | X | |
| 1113 | | X | X |
| 1116 | | | X |
| 1117 | | | X |
| 1125 | | X | X |
| 1133 | | X | |

[a] Only those extraction wells where the remediation standard was not exceeded for at least one contaminant are listed above.
[b] Results for nitrate and uranium are the same as those reported for 2008–2009. Nitrate continues to exceed the remediation standard in all extraction wells.
[c] Results for sulfate differ slightly when compared with the last reporting period (sulfate levels in well 1112 exceeded the standard last year, whereas those in well 1116 did not).

As reported in previous years, there was no extraction well where all three primary contaminants were below remediation standards during this review period. The lowest nitrate concentration in an extraction well was 49 mg/L (well 1125). Sulfate and uranium concentrations in the extracted groundwater are below the remediation standards at wells 1113 and 1125. Although the extraction well samples are likely composites of groundwater from several horizons of variable contamination, the region of the aquifer east of the evaporation pond and encompassing well 1125 is approaching cleanup goals. As has been the case for the last several years, nitrate concentrations during this period exceeded the 44 mg/L standard (as $NO_3$) in all extraction wells.

DOE expects to develop and implement a protocol to evaluate contaminant rebound at extraction well 1125 as an effect of alternating periods of pumping and nonpumping of that well. Other wells where contaminant concentrations are approaching remediation standards may also be targeted for such evaluation. Evaluating the contaminant rebounding effect may be useful in ultimately determining when remediation is complete and pumping can be permanently discontinued in specific regions of the aquifer.

## 4.4 Contaminant Inventory and Removal Rates

### 4.4.1 Contaminant Mass Removal Rate Projections

Table 4 lists the cumulative amounts of nitrate, sulfate, and uranium removed from the aquifer through March 2010, about 8 years into full-scale groundwater extraction and treatment. 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 of initial contaminant mass are provided in Appendix G as Calculation Set 1. An estimate of the initial volume of contaminated groundwater is also presented in Table 4 based on Calculation 1 in Appendix G.

These results are plotted in Figure 24, which shows that although cleanup is progressing (more rapidly for uranium), cumulative masses removed for all constituents are not close to the initial mass estimates. Based on the calculations in Appendix G (Calculation Set 2), at the current nitrate mass recovery rate of 1.5 percent per year, the nitrate remediation standard may be attained in 65 years. By the same analysis, at a mass removal rate of 4 percent per year, the uranium standard may be attained in 25 years. Sulfate restoration would be complete in about 50 years.

*Table 4. Summary of Cumulative Mass and Volume Recovery as of April 1, 2010*

| Contaminant | Initial Mass (lbs) | Cumulative Mass Removed (lbs)[b] | Cumulative Percent Mass Reduction | Initial Volume (gal)[a] | Volume Treated (gal) | Percent Plume Volume Reduction |
|---|---|---|---|---|---|---|
| Nitrate | 9,500,000 | 1,136,000 | 12.0 | $1.2 \times 10^9$ | $3.4 \times 10^8$ | 28.2 |
| Sulfate | 20,150,000 | 2,860,000 | 14.2 | $1.2 \times 10^9$ | $3.4 \times 10^8$ | 28.2 |
| Uranium | 2,300 | 700 | 31.3 | $1.2 \times 10^9$ | $3.4 \times 10^8$ | 28.2 |

Source: Appendix G.
Masses rounded, but percent mass reduction and plume volume reduction calculations used nonrounded values.
For the preceding review period (ending April 1, 2009), cumulative mass reductions were 10.8, 12.8, and 28.3 percent for nitrate, sulfate, and uranium. The volume treated was $3.1 \times 10^8$ gallons, and the percent plume volume reduction was 25.6 percent.

The corresponding volume of groundwater extracted at 25 years, assuming constant withdrawal of 85 gpm (equivalent to about a 3.6 percent reduction in plume volume per year), is 1 billion gallons, or approximately one estimated pore volume of the contaminant plume.

### 4.4.2 Aquifer Restoration Indices

An alternative approach of estimating the restoration period to that presented in Section 4.4.1 is based on concentration trending over time and is independent of mass and volume estimates of the initial contaminant plumes. With this approach, the geometric mean concentration of a contaminant is computed for each sampling event from a selected group of monitoring wells. The composition of the groundwater plume is thus represented by a single concentration value, or index, for a given contaminant and time. A time series plot of the index can then provide a measure of bulk trending and restoration progress. Figures 25 and 26 illustrate how the sulfate and uranium indices vary since the start of active remediation. The selected monitoring wells in this analysis are located throughout the contaminant plume and are 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 25 and 26 depict a developing trend suggesting that remediation is effective in reducing the bulk concentration of uranium and sulfate (nitrate results have not yet been analyzed using this method). Linear projection of the sulfate and uranium indices, which disregards possible concentration tailing effects, predicts restoration times of about 30 and 60 years, respectively, since the inception of active remediation in mid-2002. This compares to an estimated 28 years to remove one pore volume of the initial contaminant plume at the current cumulative extraction rate of about 3.6 percent per year by volume (Appendix G, Figure G–2).

Linear projections of contaminant removal rates as indicators of the aquifer restoration period must be regarded with caution, because such projections ignore geochemical and matrix effects known to prolong water quality improvement (see EPA 1994). Examples of such effects are kinetically controlled desorption of a contaminant from aquifer substrate grains and diffusion-controlled transport of a contaminant within dual-domain porosity settings. These effects can lead to concentration tailing, whereby the rate of contaminant release from the substrate decreases with time, or to concentration rebounding following periods of reduced or inactive pumping. Either effect will eventually cause a departure from linear concentration trending and to a longer restoration period than predicted by linear projection.

### 4.4.3 Summary of Restoration Progress

The projections discussed in Sections 4.4.1 and 4.4.2 based on mass and volume removal rates, and bulk concentration trending, predict a wide range of projected cleanup times, ranging from about 25 to 65 years. However, such forecasts ignore the matrix and geochemical effects discussed above. These effects could explain why—despite the measureable progress in groundwater treatment discussed herein (see Section 2.1 and Table 4)—after 8 years of active groundwater treatment, persistent and significant downward trending in contaminant concentrations at site monitoring wells is not obvious.

# 5.0 Year in Review Summary

During the current review period of April 2009 through March 2010, close to 32 million gallons of contaminated groundwater were treated, yielding a total cumulative treatment volume of 338 million gallons, or 28 percent of the total estimated volume of uranium-contaminated groundwater prior to remedial action. Major findings are summarized below:

- Although occasional problems with fouling accounted for some decline in plant efficiency, as indicated below, overall the treatment plant is operating effectively and as intended.
  - Distillate quality meets or exceeds design objectives.
  - Return flow to the aquifer as a percentage of extracted water meets design objectives.
  - Infiltration capacity of the infiltration trench and groundwater mounding meets design objectives.
- The current configuration and operation of the extraction system effectively captures the lateral region of maximum groundwater contamination and the full vertical extent. Plume expansion into uncontaminated regions is not significant on either the middle or lower terrace.
- Cumulative contaminant mass and volume extraction, and bulk concentration trends indicate measurable progress in water quality restoration; however, significant and widespread decreases in contaminant concentrations are not obvious.

- Contamination of lower terrace wells (off site and farther downgradient) is generally absent; with few exceptions, constituent concentrations in these wells continue to be below remediation goals.
- Restoration projections documented in this report predict a wide range of cleanup times, ranging from about 25 to 65 years. These forecasts are interpreted with caution, however, because they ignore important geochemical and matrix effects that could explain why—despite the measureable progress in groundwater treatment—after 8 years of full-scale groundwater extraction and treatment, significant and widespread decreases in contaminant concentrations are not obvious.
- Although there is no extraction well where all three primary contaminants are below remediation standards, contaminant concentrations are approaching remediation standards at well 1125 (east of the evaporation pond). DOE expects to develop and implement a protocol to evaluate contaminant rebound at this well as an effect of alternating periods of pumping and nonpumping of that well. Other wells where contaminant concentrations are approaching remediation standards may also be evaluated. Such an evaluation may be useful in ultimately determining when remediation is complete and pumping can be permanently discontinued in specific regions of the aquifer.

# 6.0 References

Cooley, M.E., J.W. Harshbarger, J.P. Akers, and W.F. Hardt, 1969. *Regional Hydrogeology of the Navajo and Hopi Indian Reservations, Arizona, New Mexico, and Utah*, U.S. Geological Survey Professional Paper 521-A.

DOE (U.S. Department of Energy), 1998. *Final Site Observational Work Plan for the UMTRA Project Site Near Tuba City, Arizona,* MAC-GWTUB1.1, U.S. Department of Energy Grand Junction Office, Grand Junction, Colorado, September.

DOE (U.S. Department of Energy), 1999. *Phase I Ground Water Compliance Action Plan for the Tuba City, Arizona, UMTRA Site,* GJO−99−99−TAR. U.S. Department of Energy Grand Junction Office, Grand Junction, Colorado, June.

DOE (U.S. Department of Energy), 2003. *Tuba City UMTRA Site Baseline Performance Evaluation*, GJO−2002−370−TAC, GJO-GWTUB 30.13.2-1. U.S. Department of Energy Grand Junction Office, Grand Junction, Colorado, May.

EPA (U.S. Environmental Protection Agency), 1994. *Methods for Monitoring Pump-and-Treat Performance*, EPA/600/R-94/123, June.

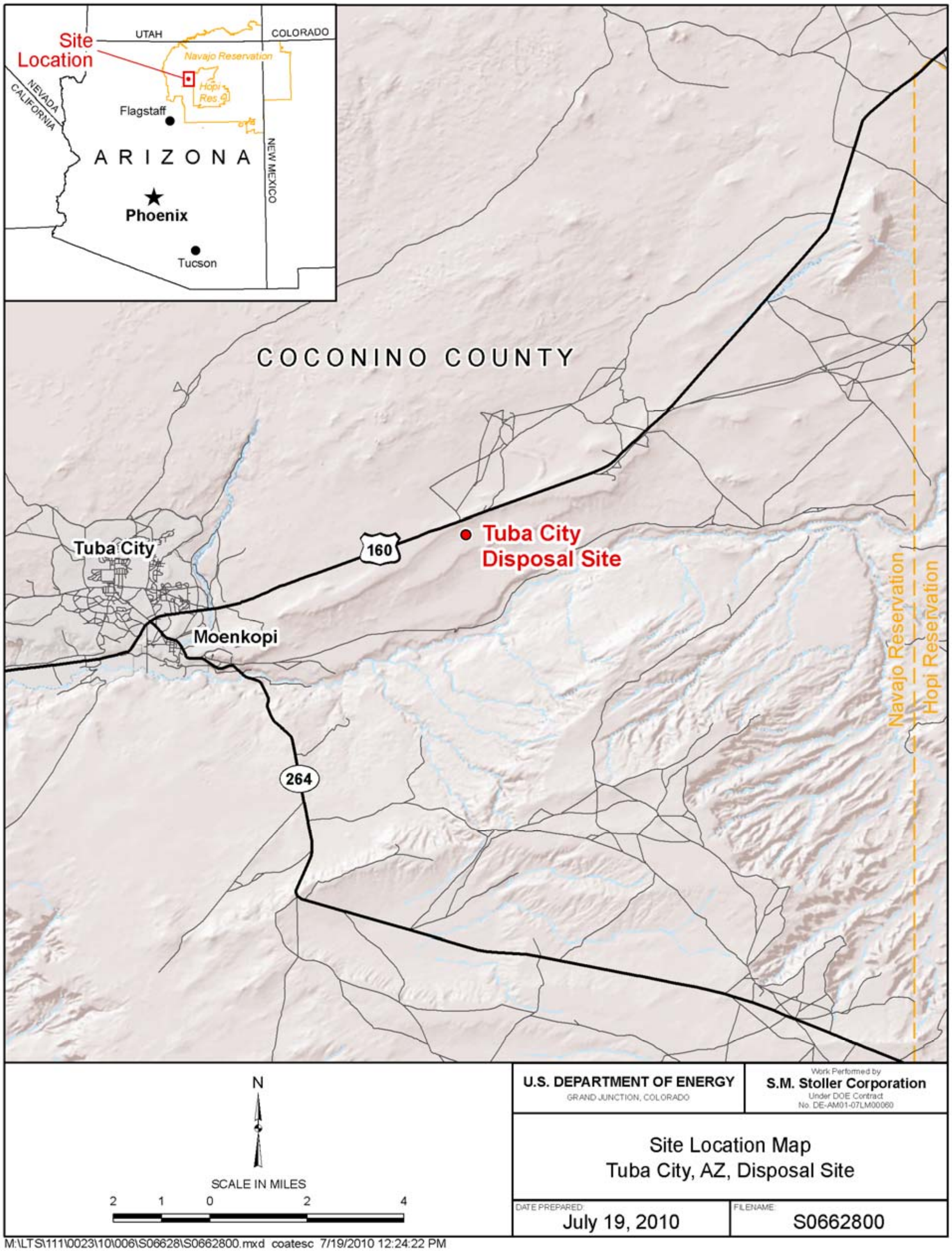



*Figure 1. Tuba City Site Location*

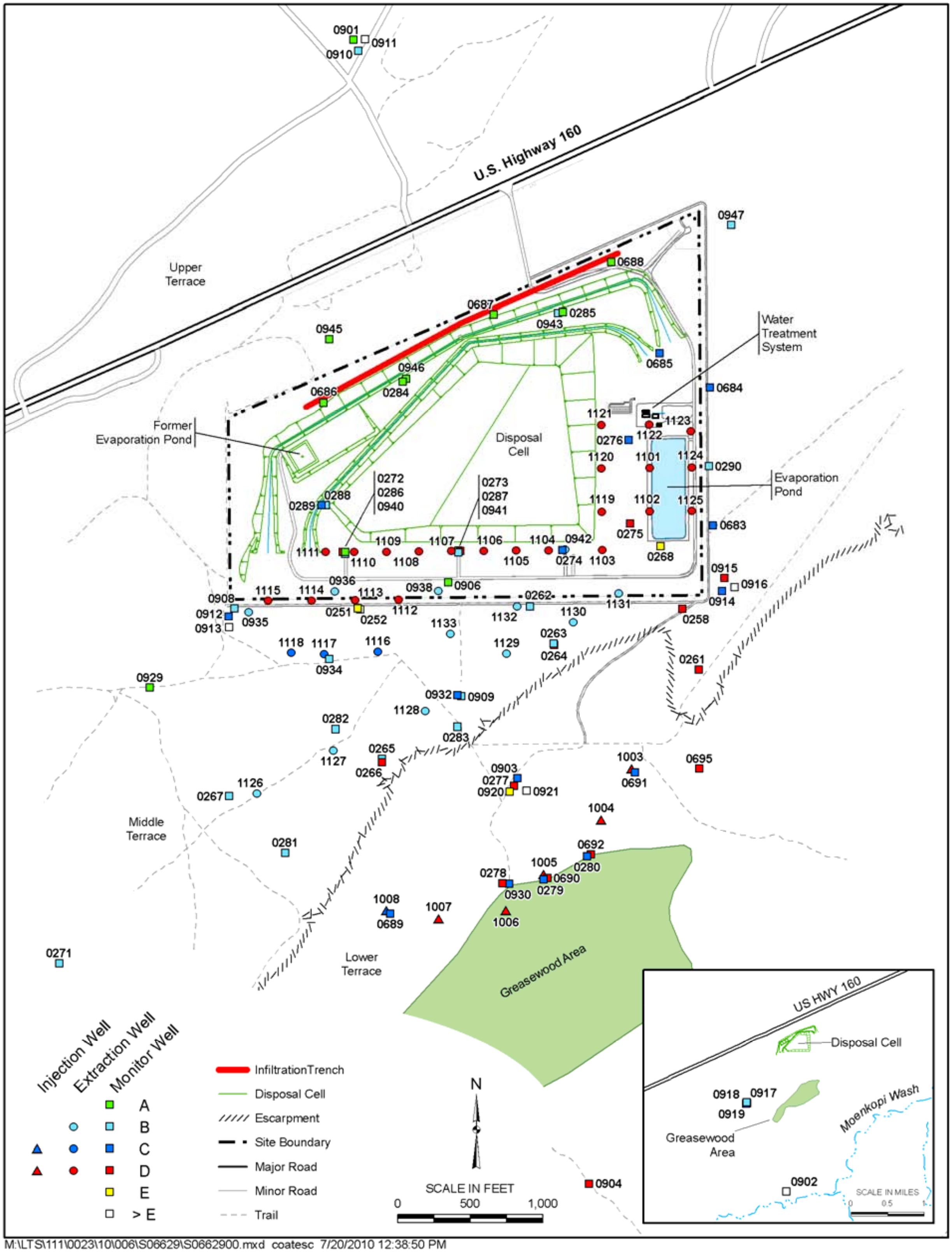
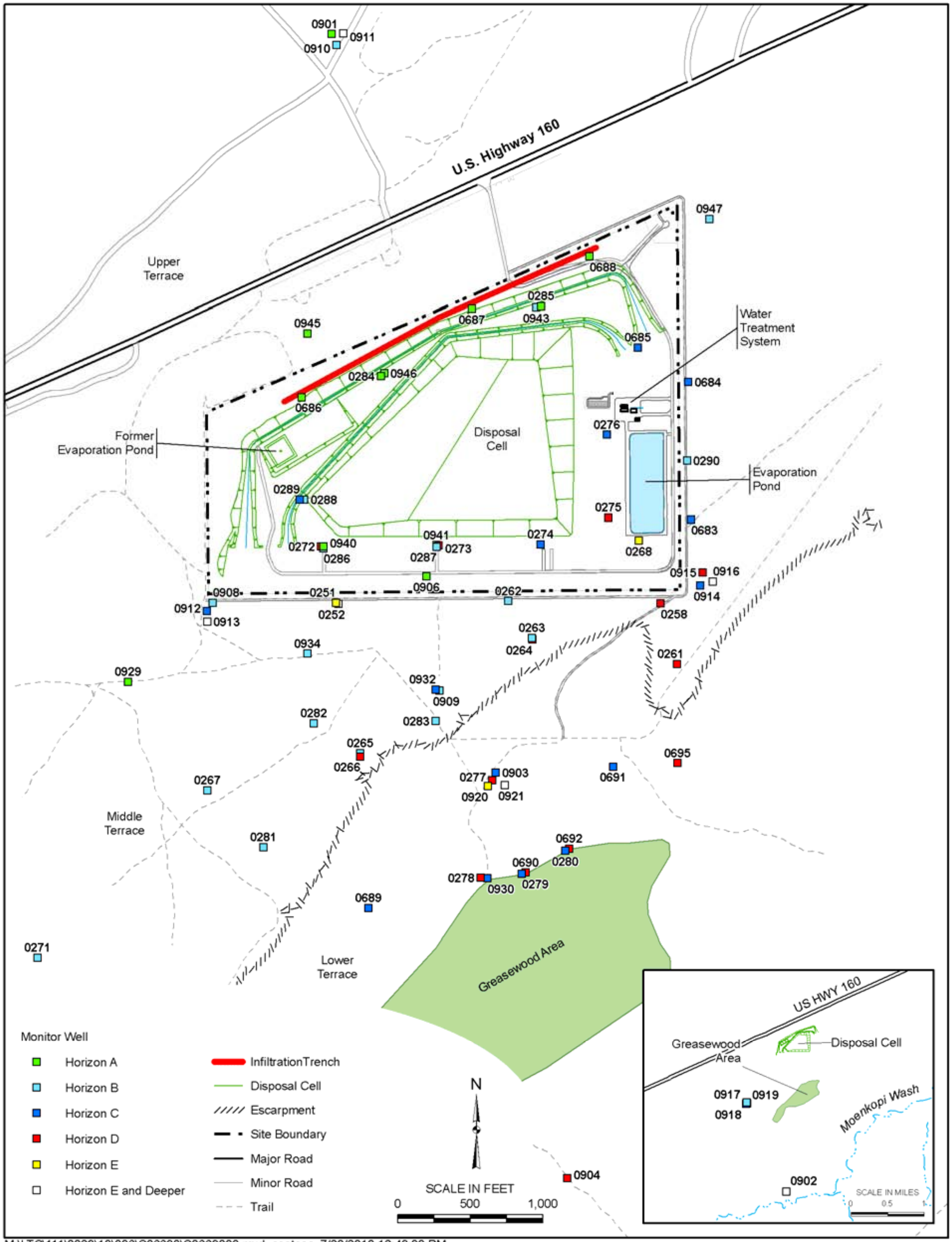
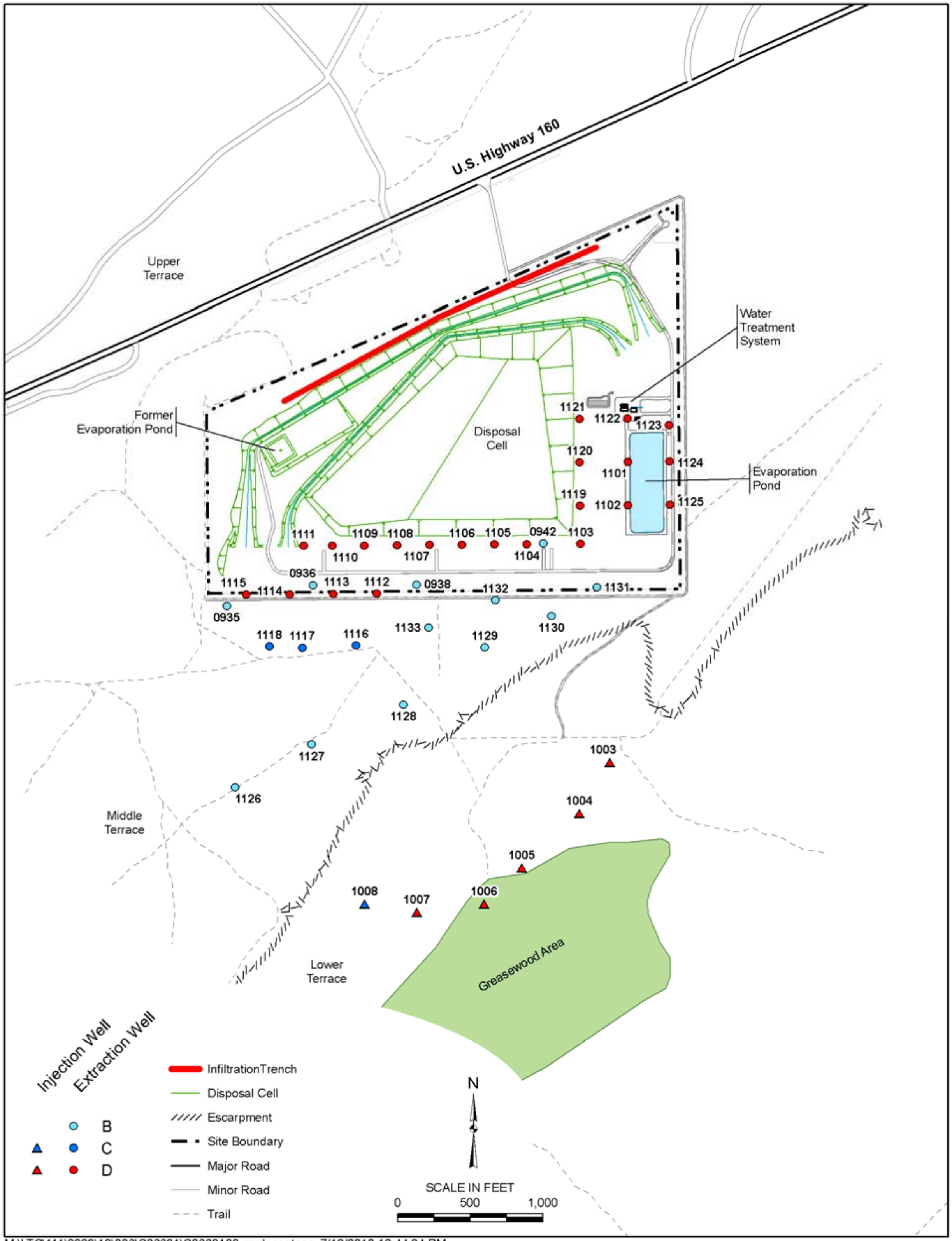



*Figure 2a. Tuba City Site Features and Well Locations*




M:\LTS\111\0023\10\006\S06630\S0663000.mxd coatesc 7/20/2010 12:43:00 PM

*Figure 2b. Tuba City Site Features and Well Locations—Monitoring Wells Only*



M:\LTS\111\0023\10\006\S06631\S0663100.mxd coatesc 7/19/2010 12:44:34 PM

*Figure 2c. Tuba City Site Features and Well Locations—Treatment System Wells Only*

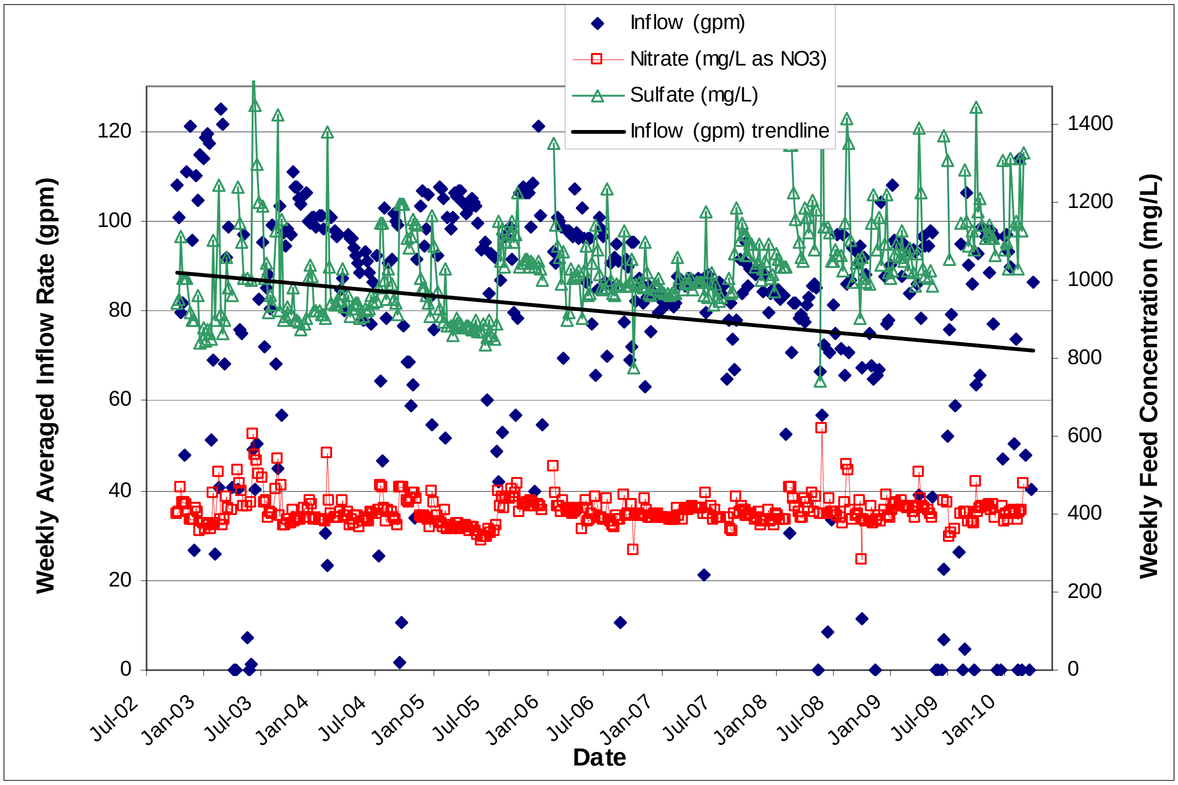



*Figure 3. Treatment Plant Inflow Rate and Nitrate and Sulfate Concentrations*

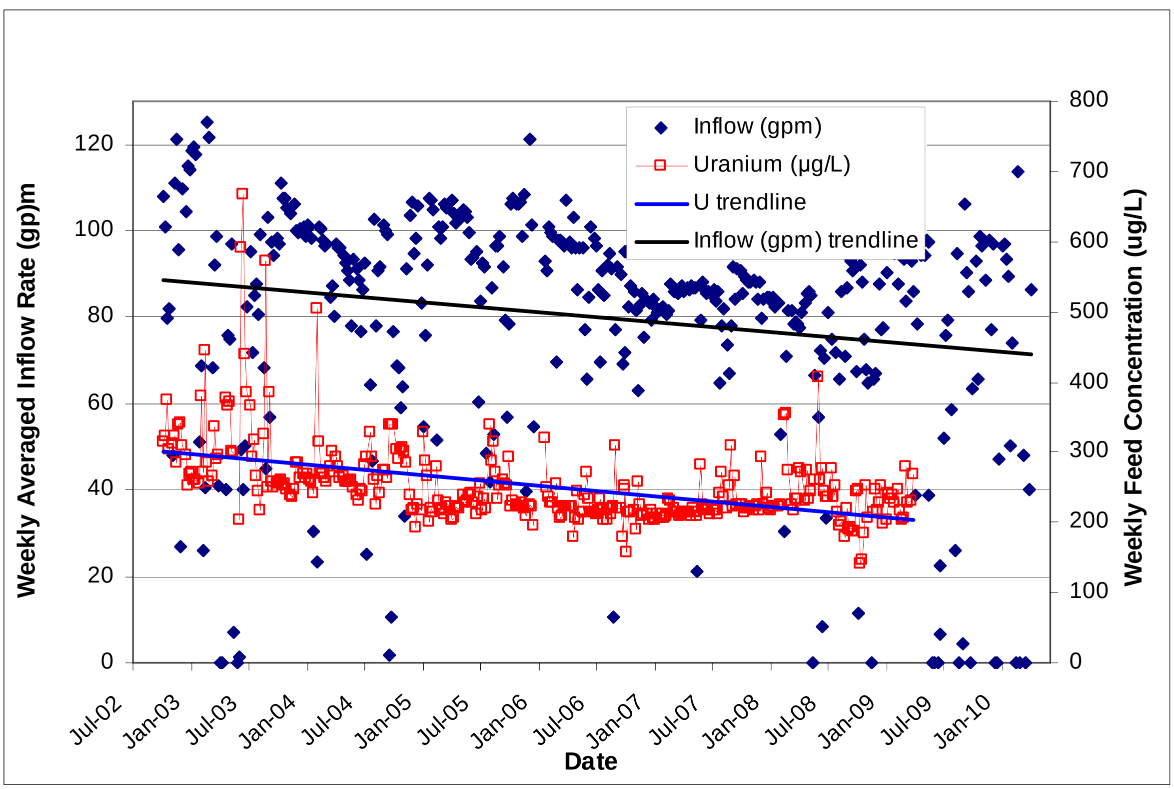



*Figure 4. Treatment Plant Inflow Rate and Uranium Concentration*

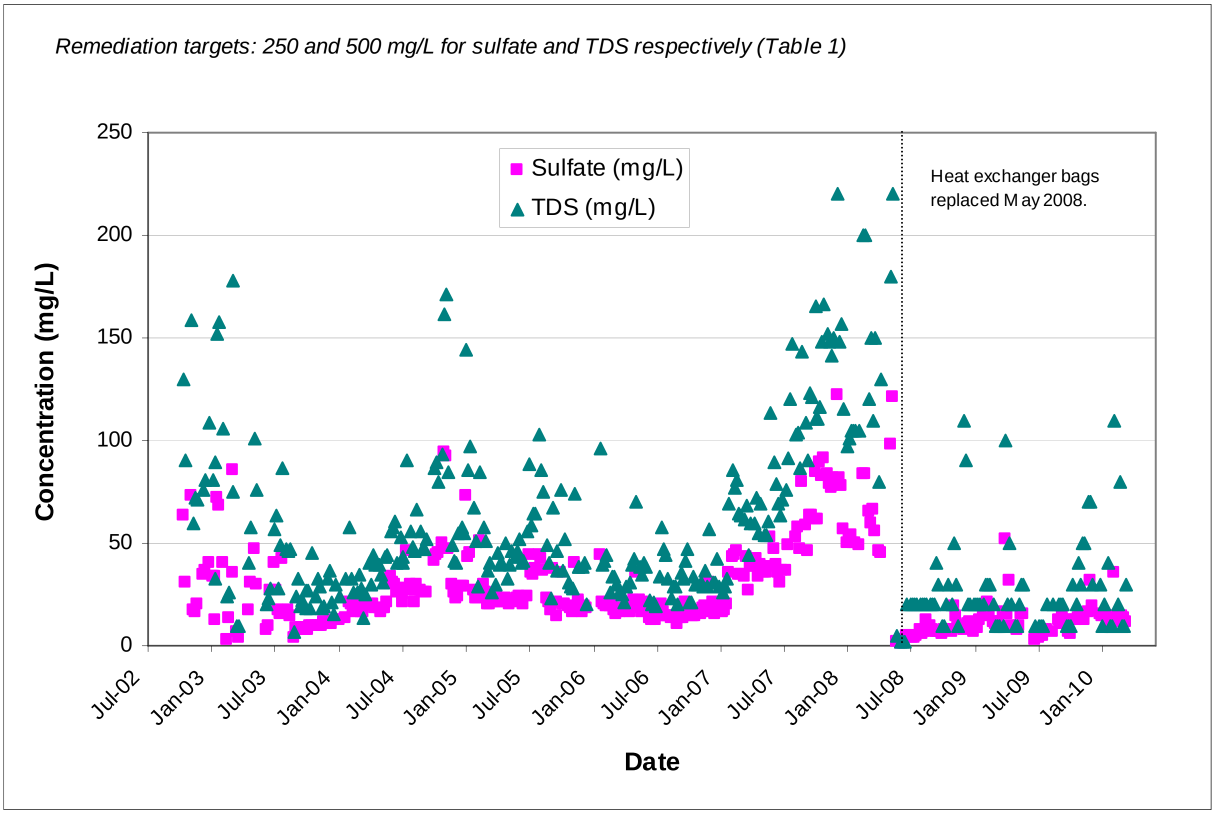



*Figure 5a. Treatment Plant Distillate Quality—Sulfate and TDS*

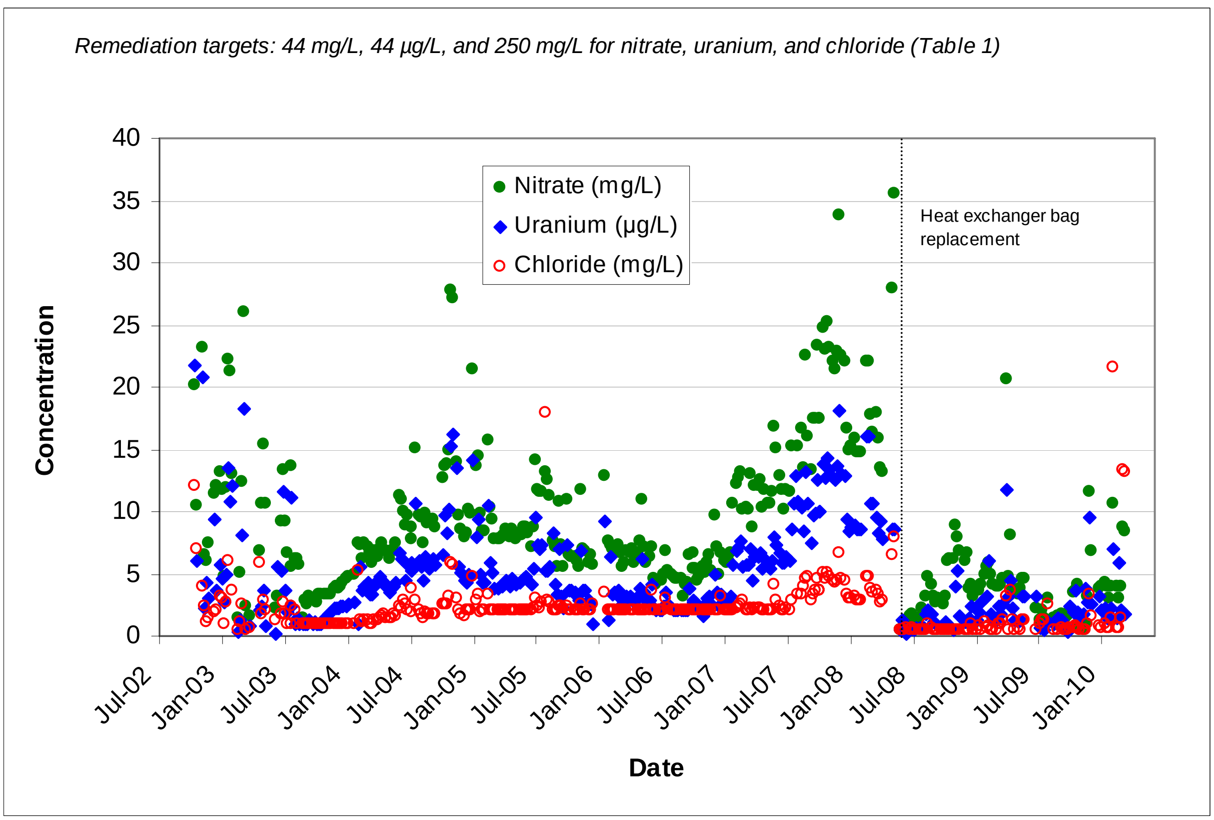



*Figure 5b. Treatment Plant Distillate Quality—Nitrate, Uranium, and Chloride*

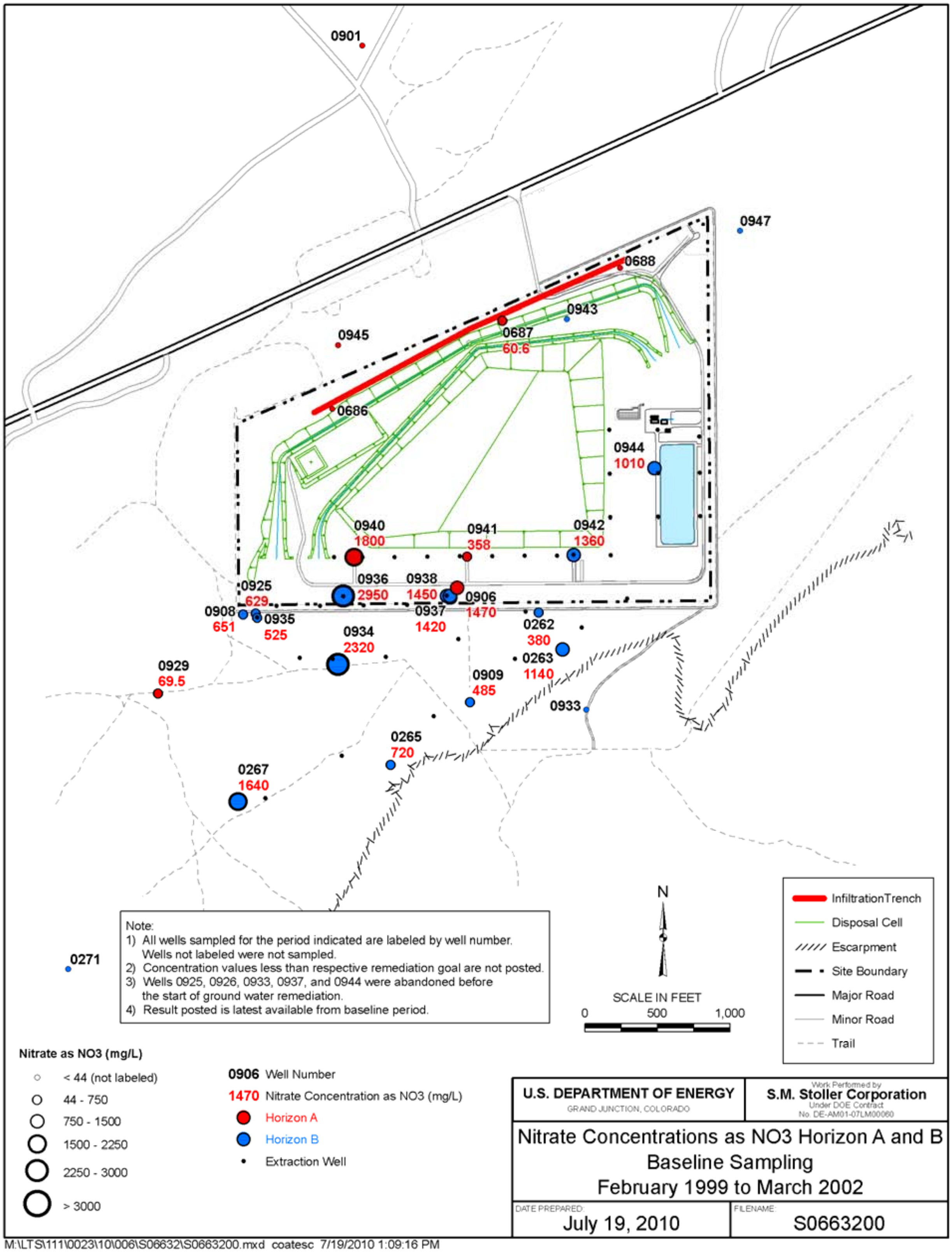



*Figure 6a. Nitrate Concentrations as $NO_3$, Horizons A and B, Baseline Period*

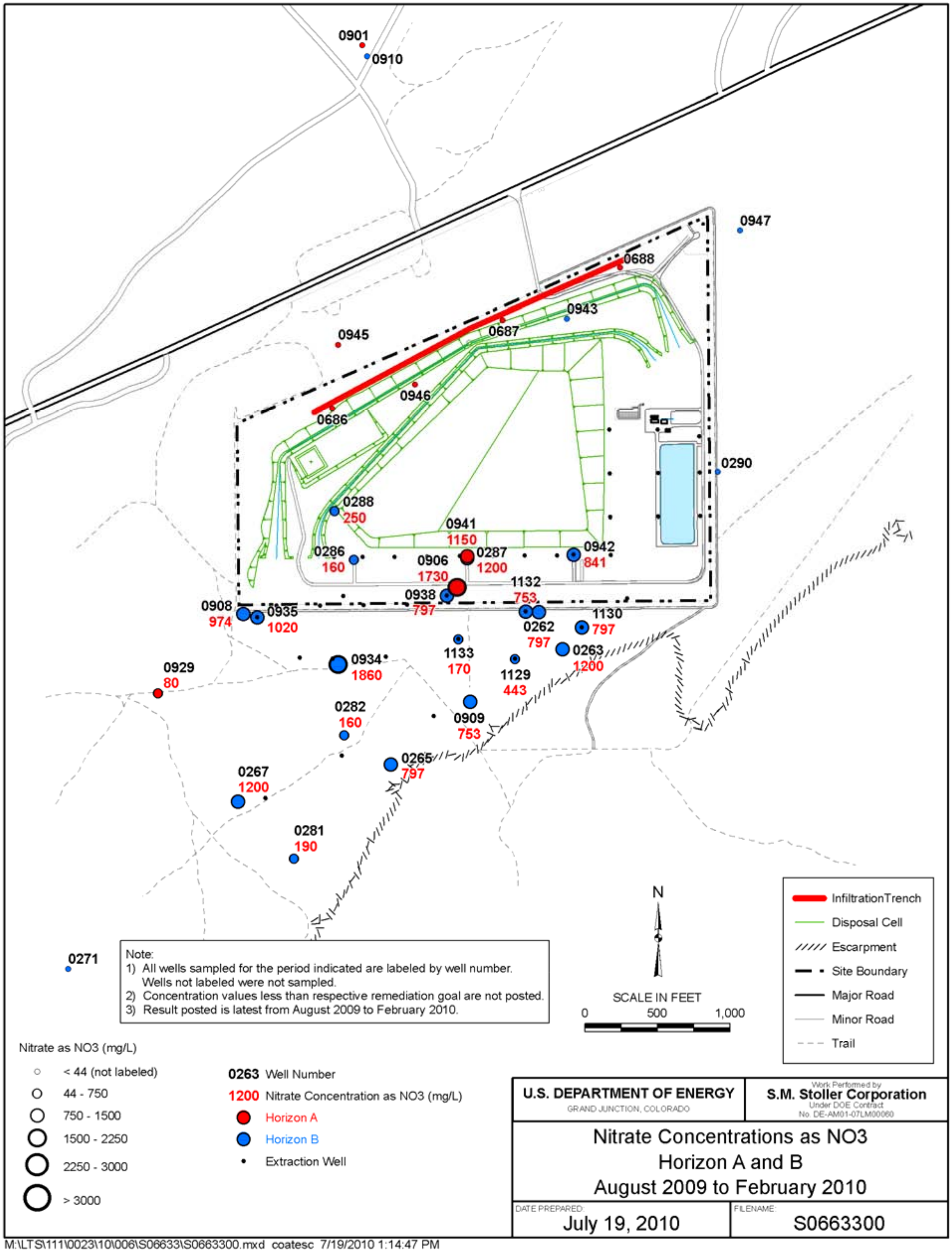



*Figure 6b. Nitrate Concentrations as $NO_3$, Horizons A and B, February 2010*

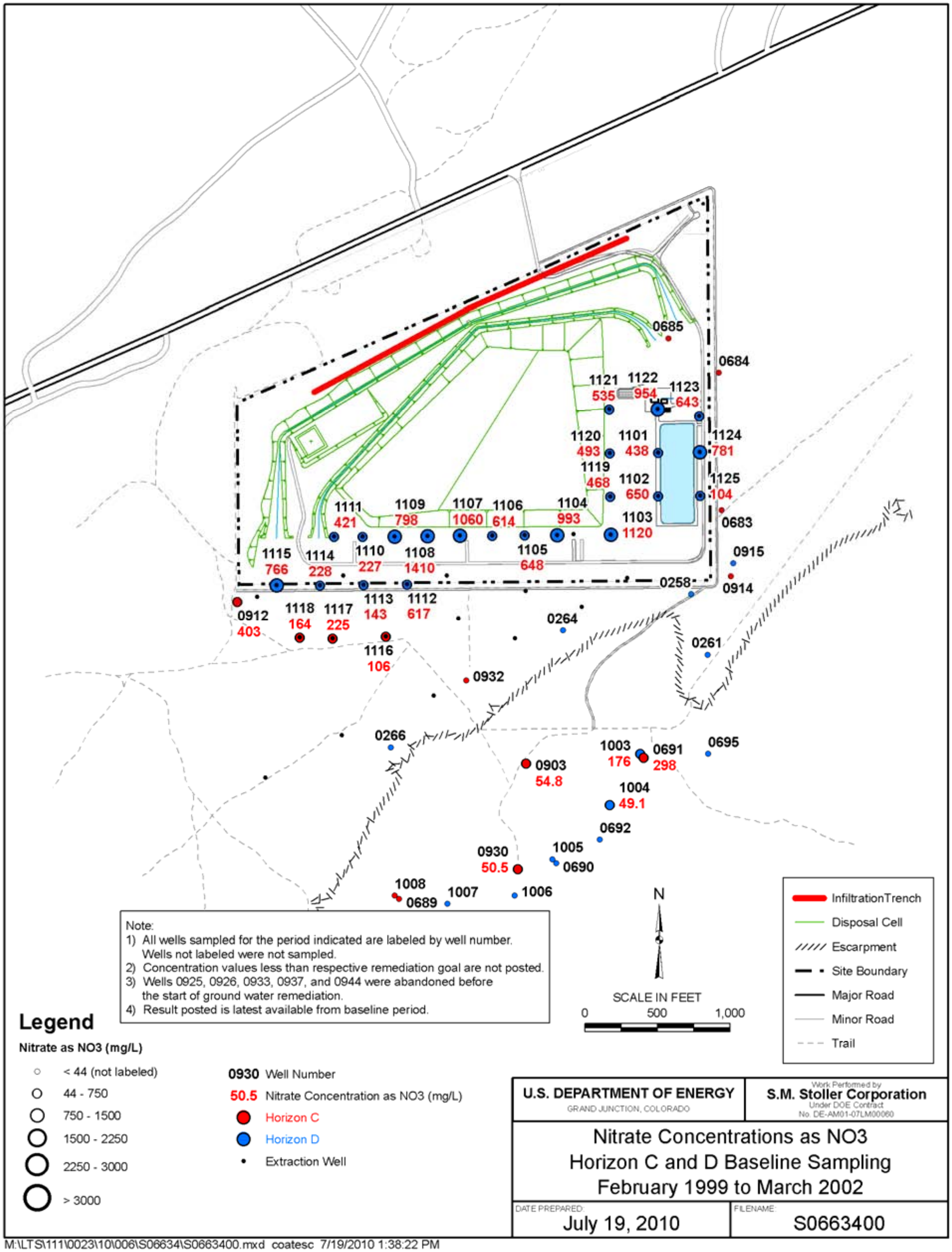



*Figure 7a. Nitrate Concentrations as $NO_3$, Horizons C and D, Baseline Period*

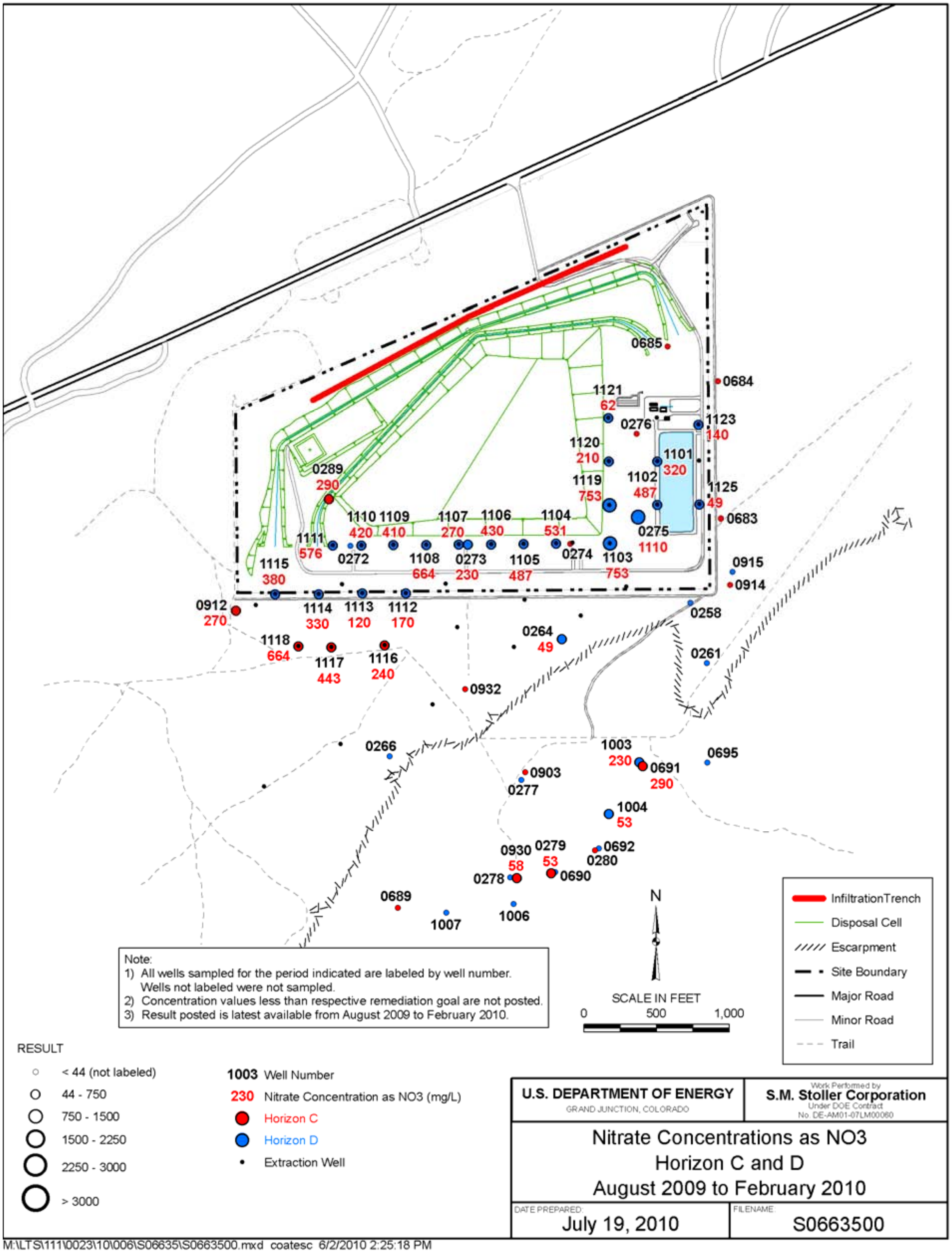



*Figure 7b. Nitrate Concentrations as $NO_3$, Horizons C and D, February 2010*

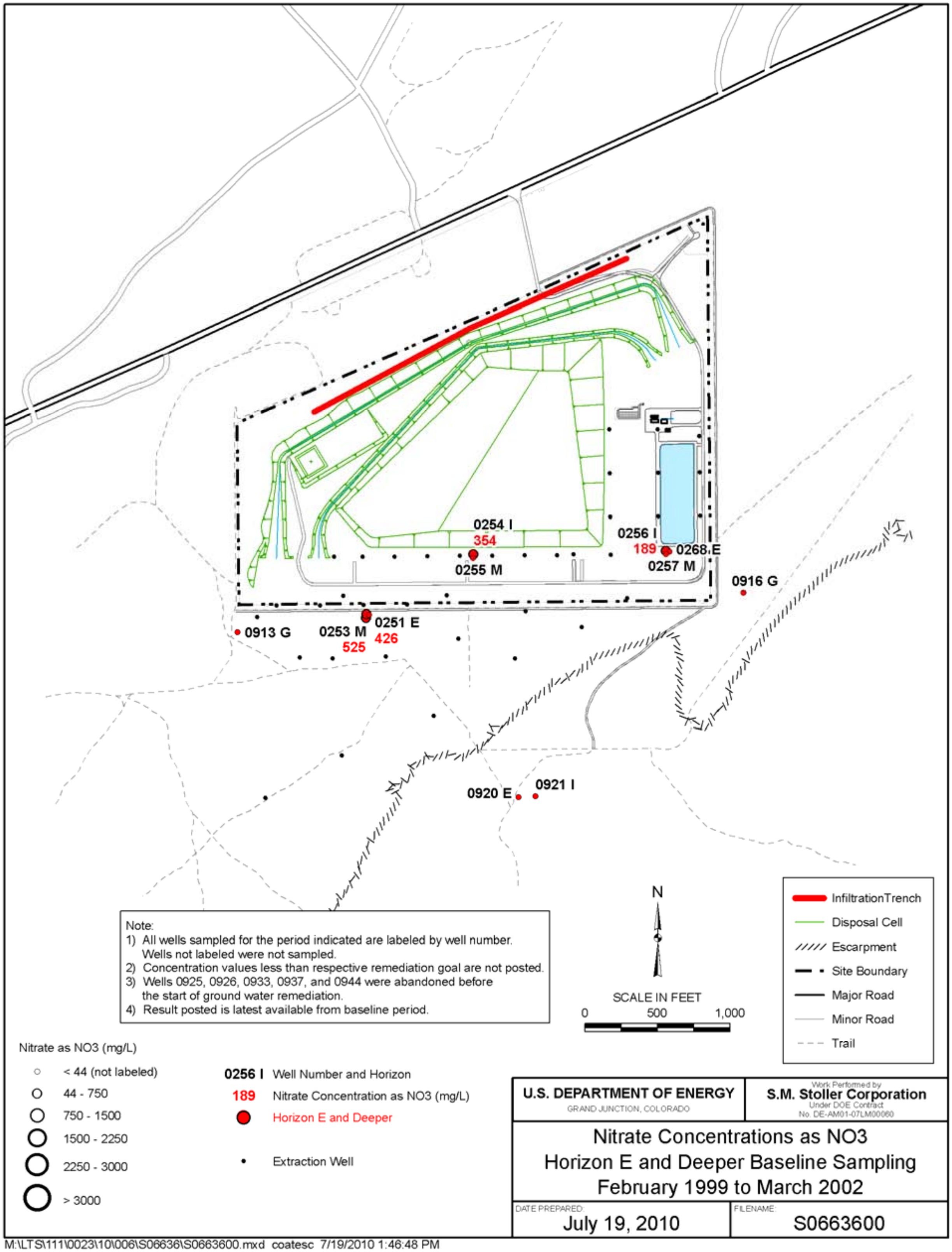



*Figure 8a. Nitrate Concentrations as $NO_3$, Horizons E and Deeper, Baseline Period*

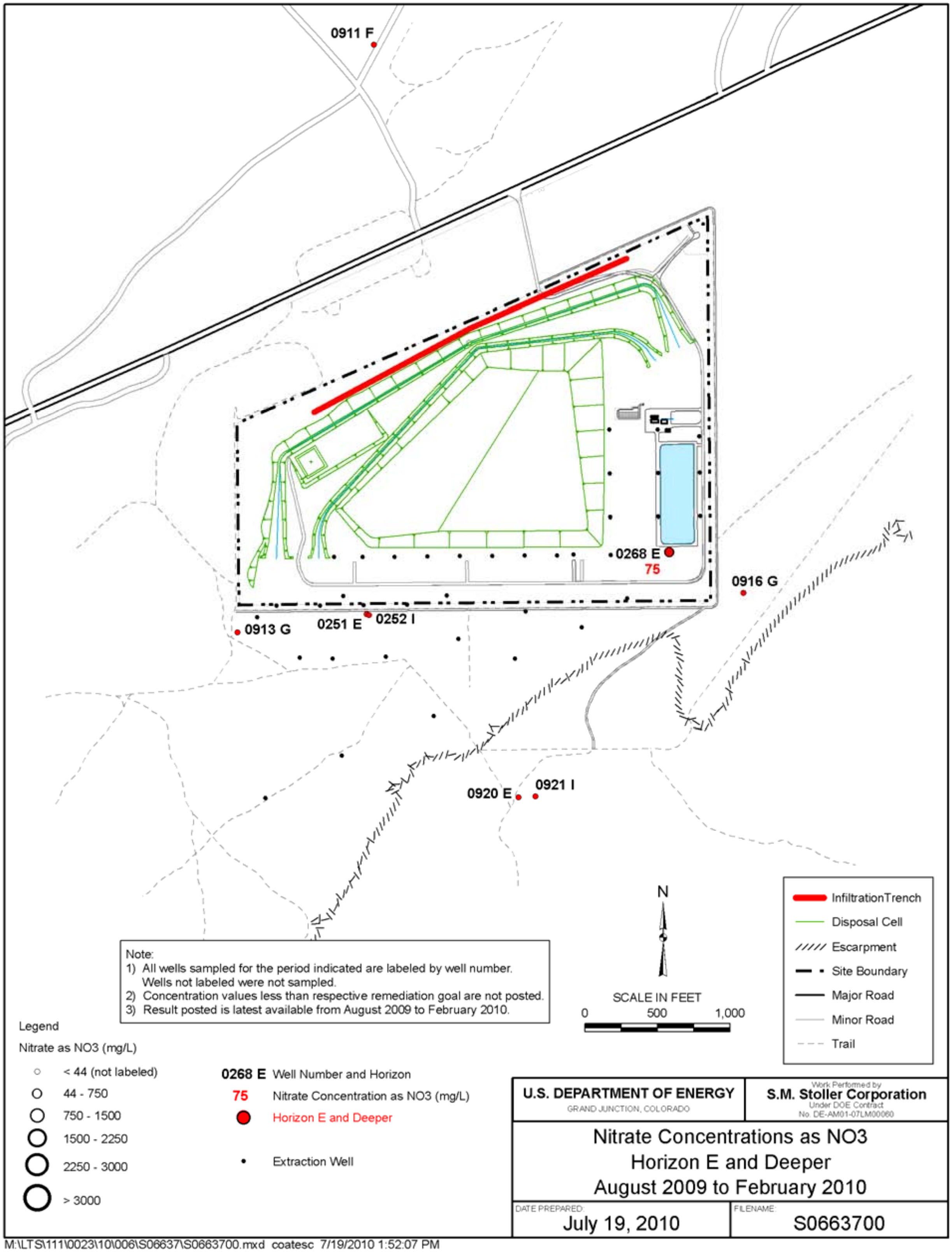



*Figure 8b. Nitrate Concentrations as $NO_3$, Horizons E and Deeper, February 2010*

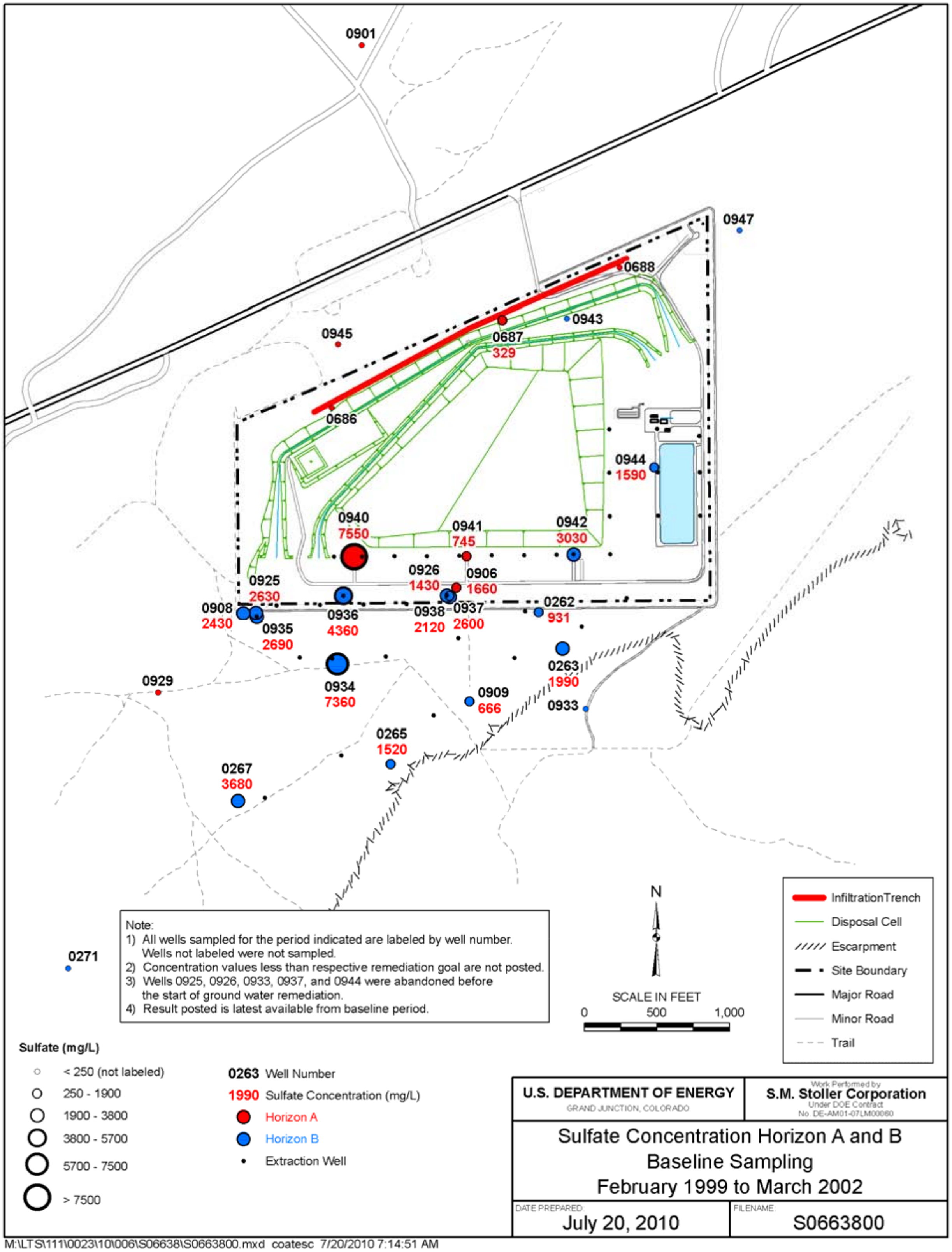



*Figure 9a. Sulfate Concentrations in Groundwater, Horizons A and B, Baseline Period*

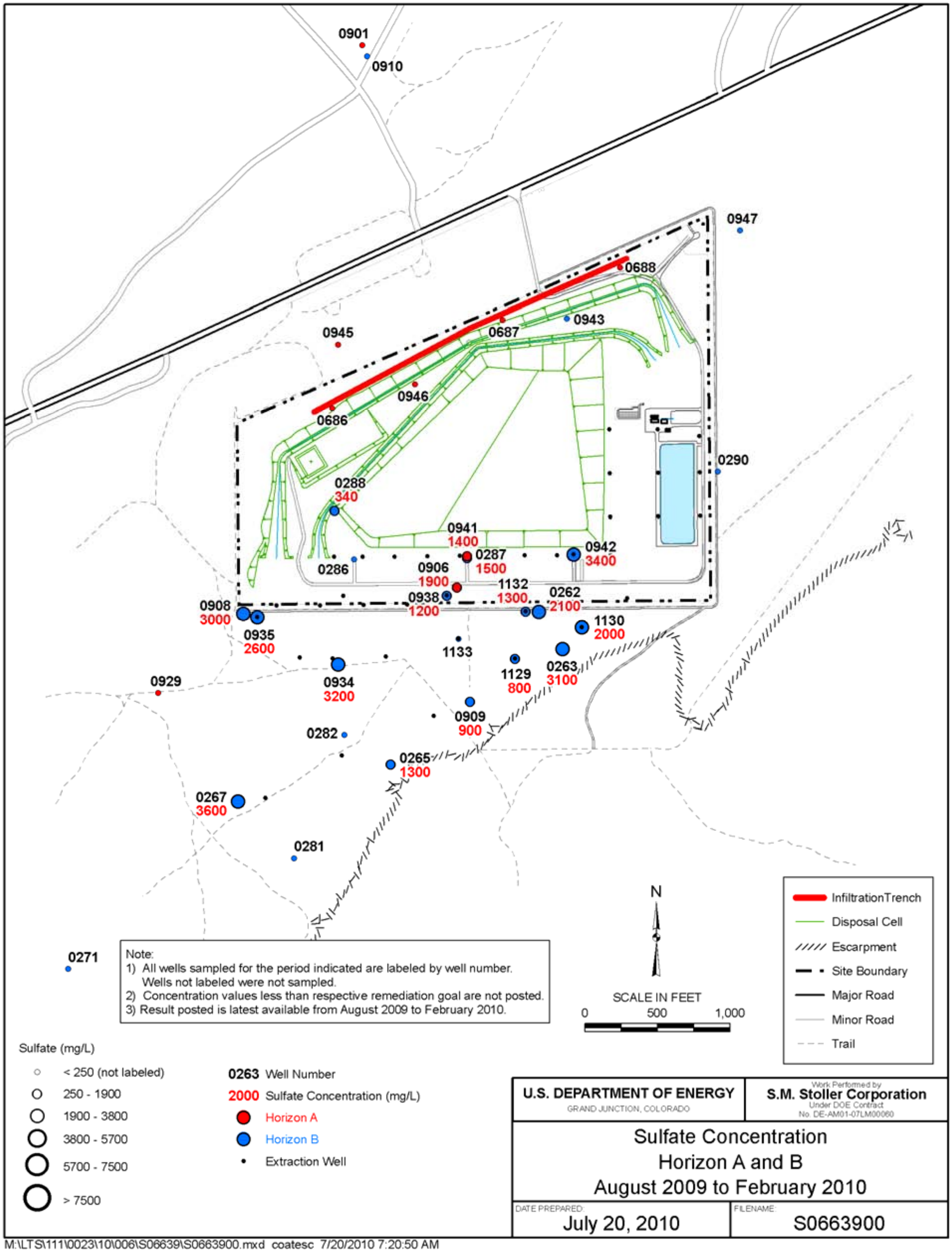
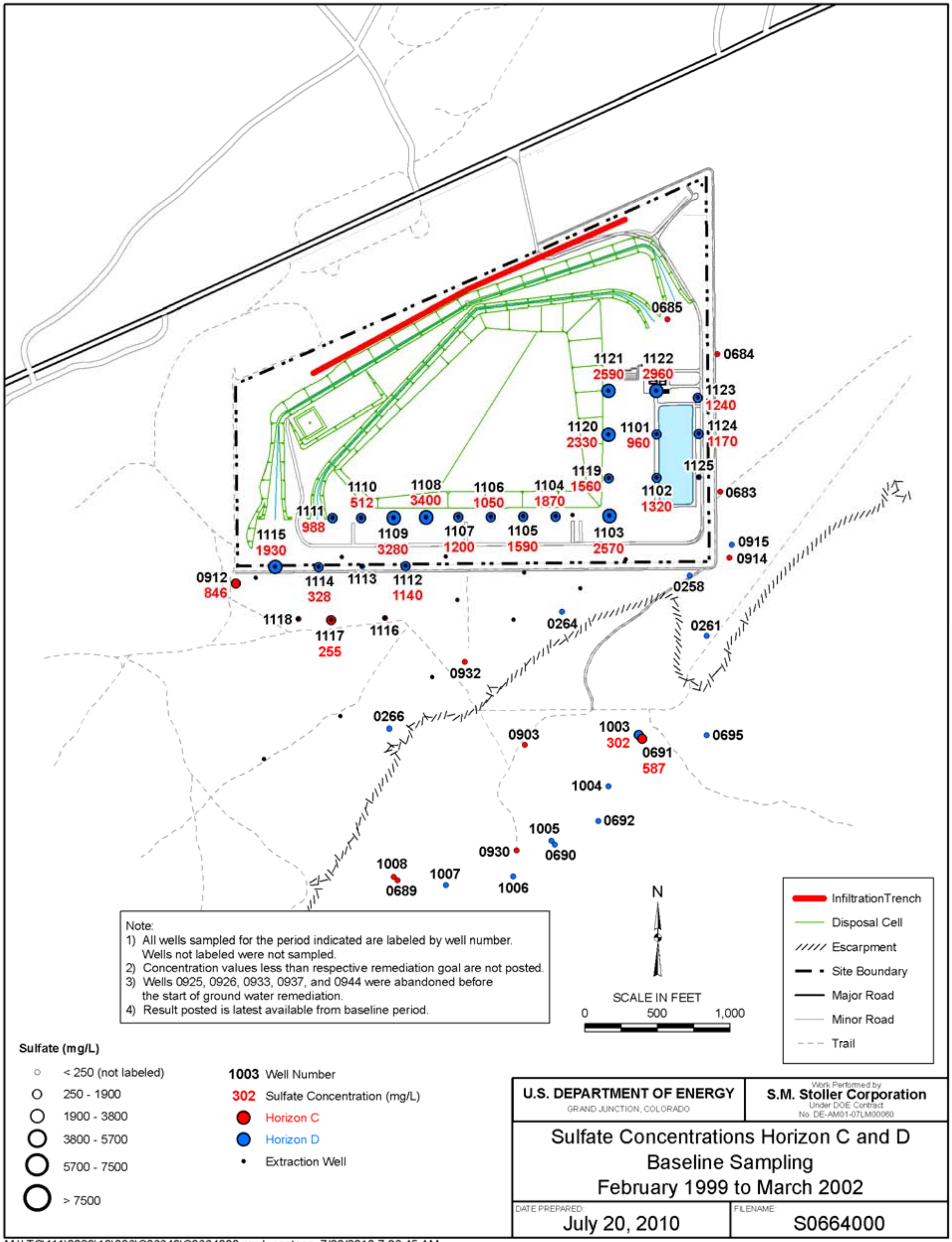



*Figure 9b. Sulfate Concentrations in Groundwater, Horizons A and B, February 2010*




M:\LTS\111\0023\10\006\S06640\S0664000.mxd coatesc 7/20/2010 7:36:45 AM

*Figure 10a. Sulfate Concentrations in Groundwater, Horizons C and D, Baseline Period*

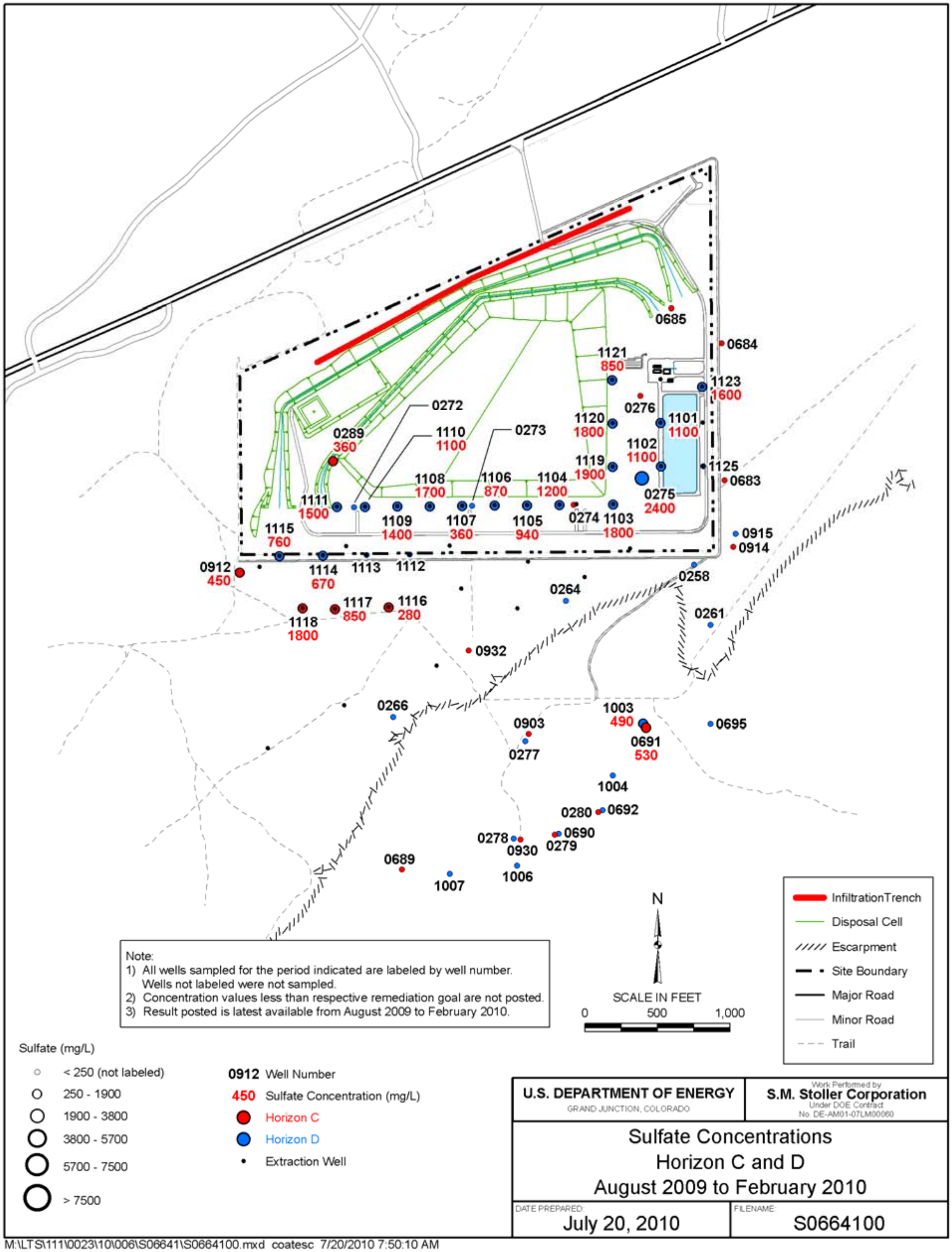



*Figure 10b. Sulfate Concentrations in Groundwater, Horizons C and D, February 2010*

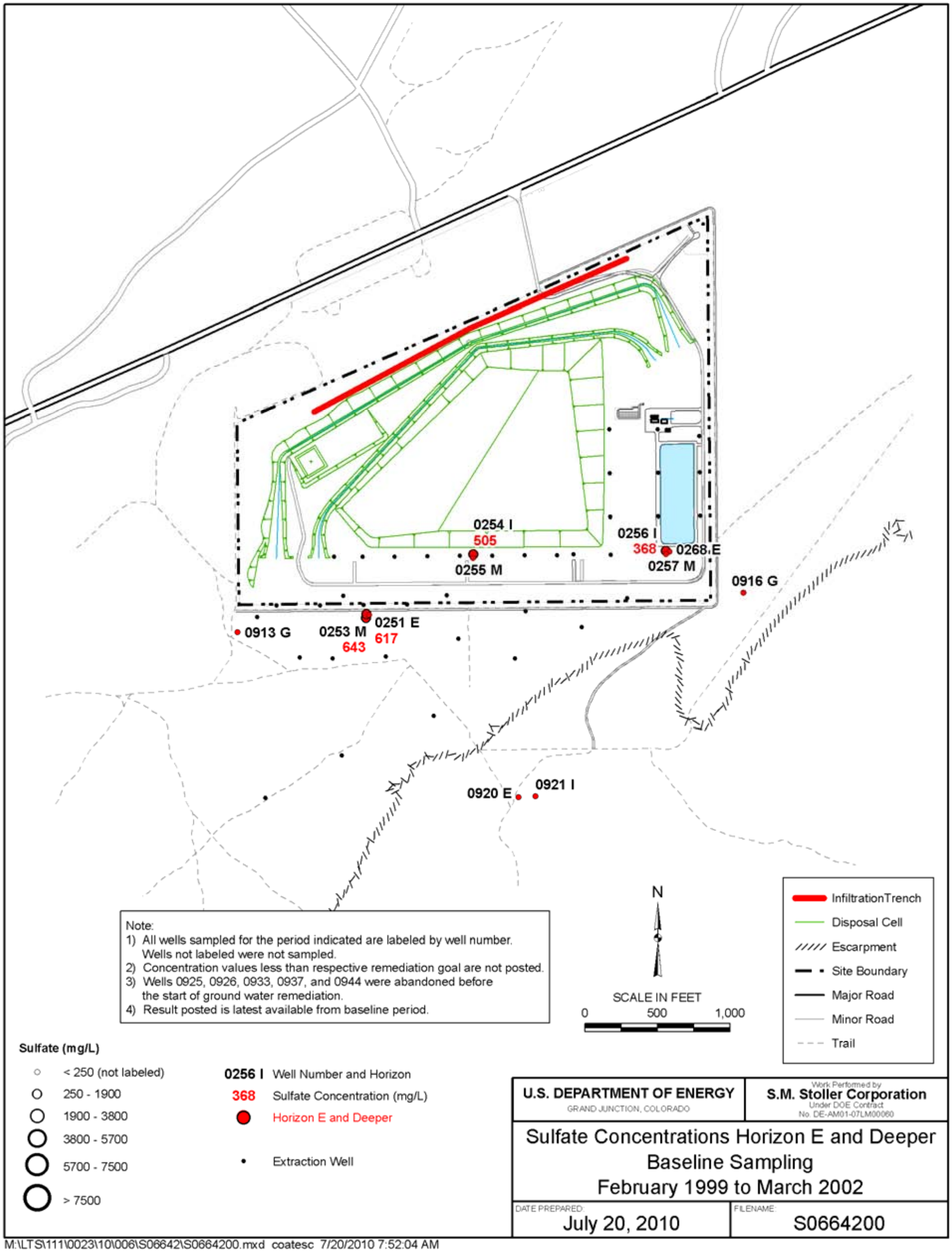



*Figure 11a. Sulfate Concentrations in Groundwater, Horizons E and Deeper, Baseline Period*

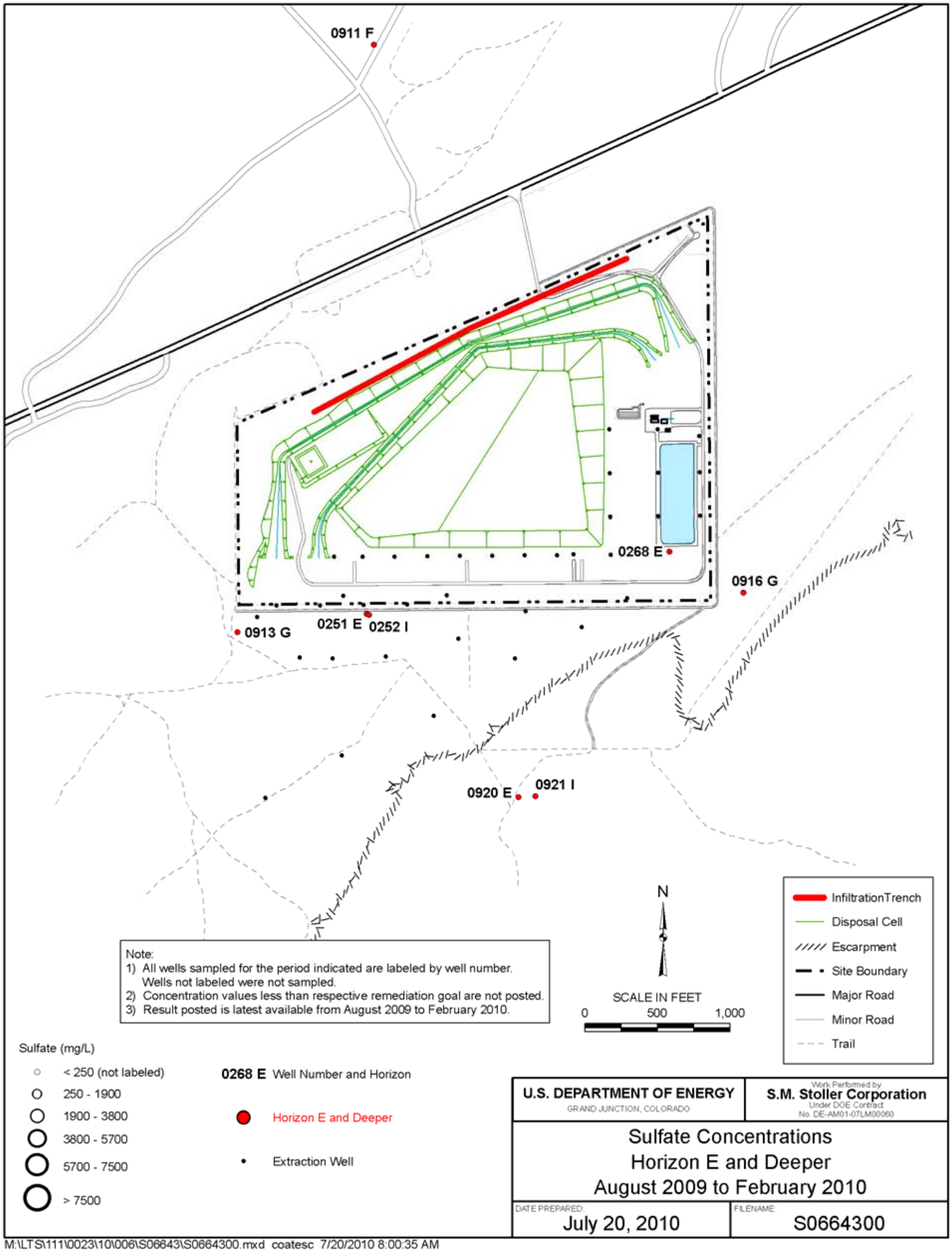



*Figure 11b. Sulfate Concentrations in Groundwater, Horizons E and Deeper, February 2010*

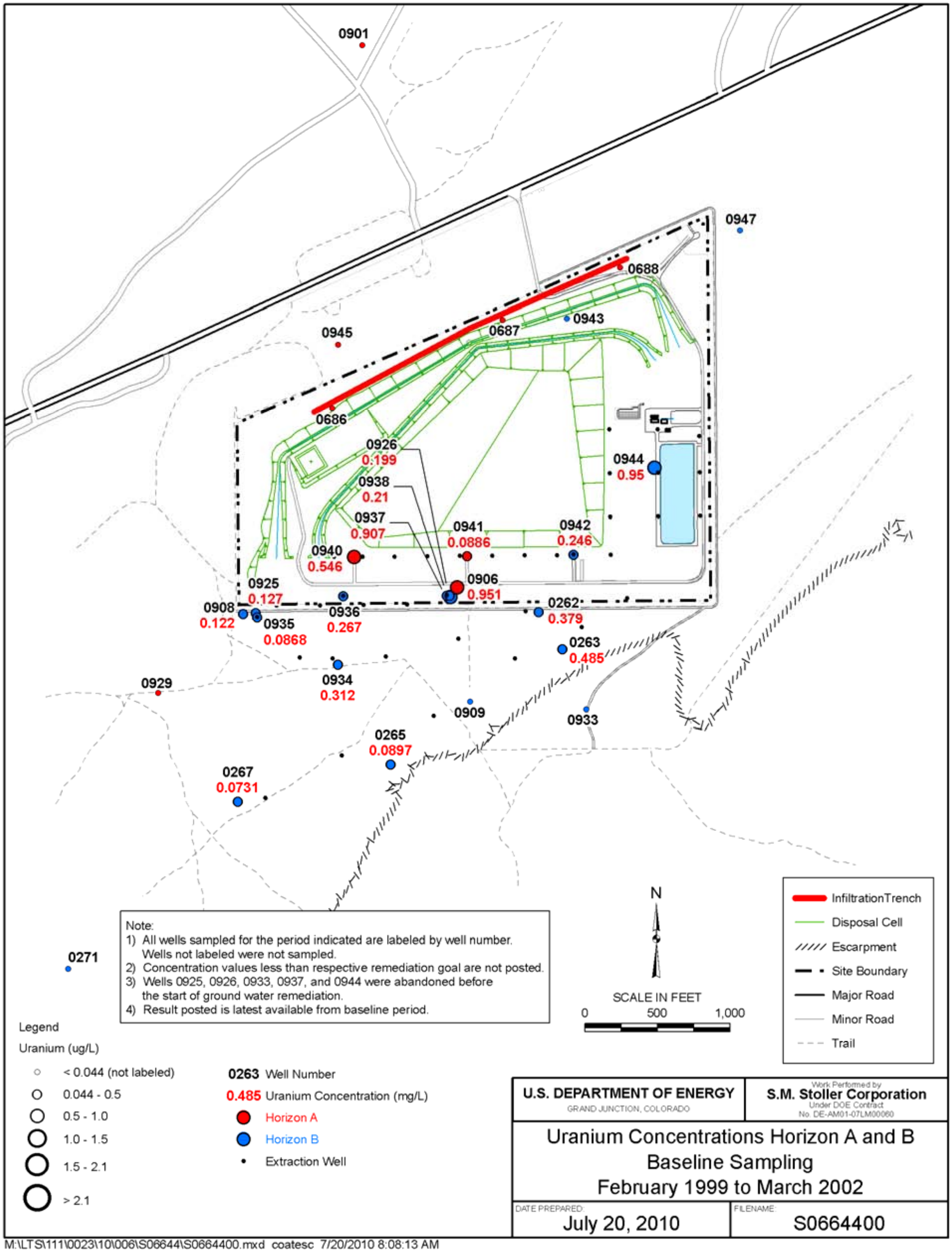



*Figure 12a. Uranium Concentrations in Groundwater, Horizons A and B, Baseline Period*

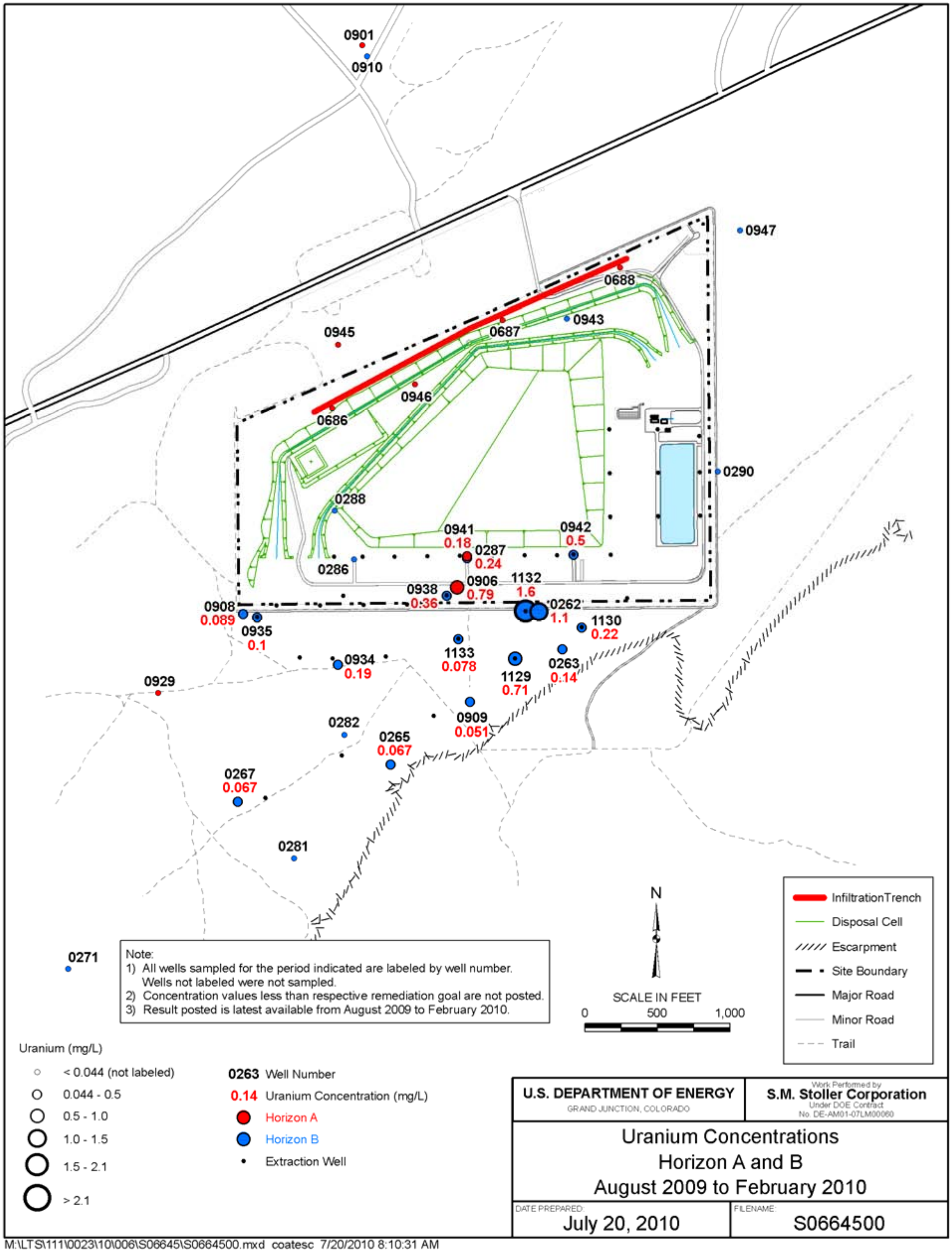
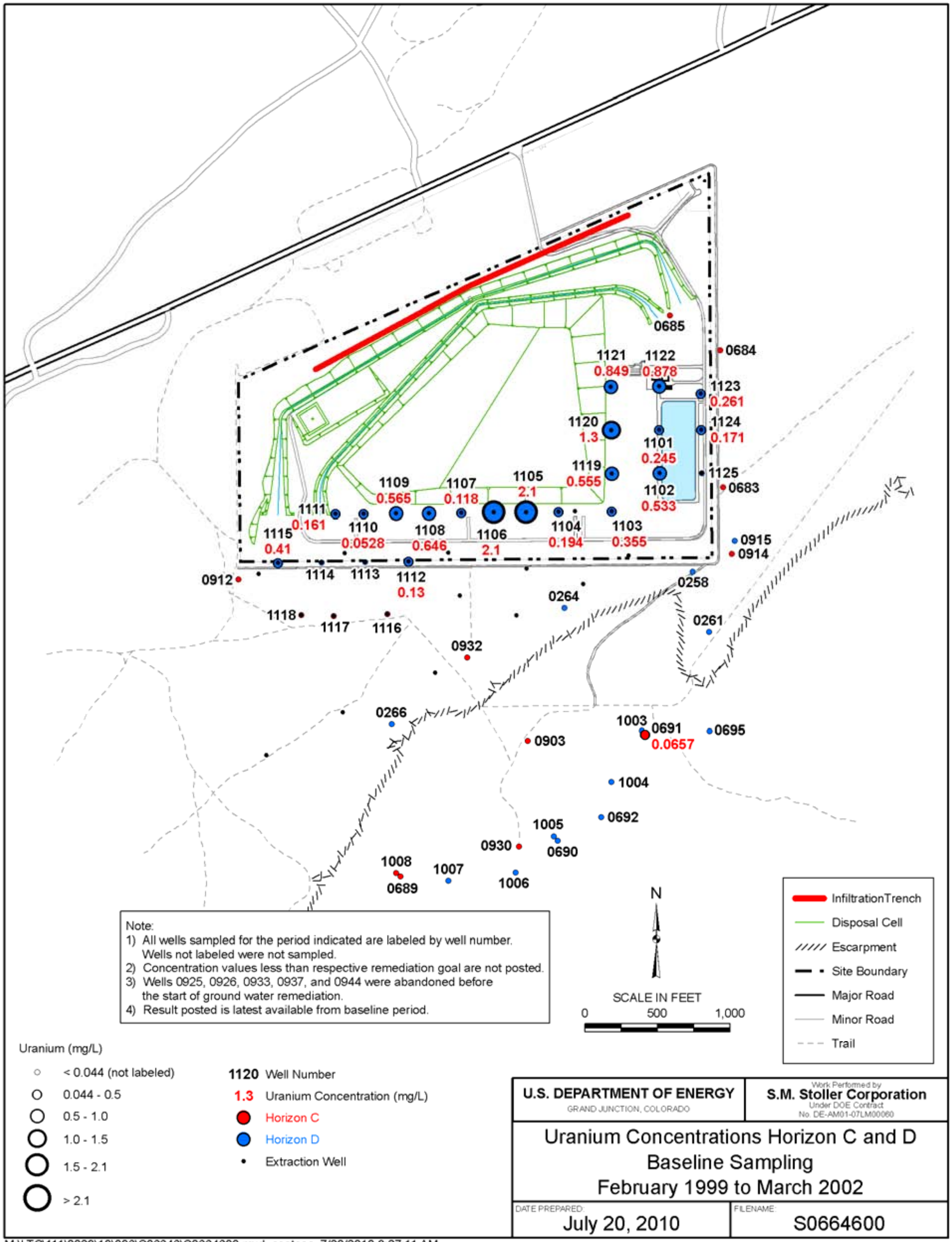



*Figure 12b. Uranium Concentrations in Groundwater, Horizons A and B, February 2010*




M:\LTS\111\0023\10\006\S06646\S0664600.mxd coatesc 7/20/2010 8:27:11 AM

*Figure 13a. Uranium Concentrations in Groundwater, Horizons C and D, Baseline Period*

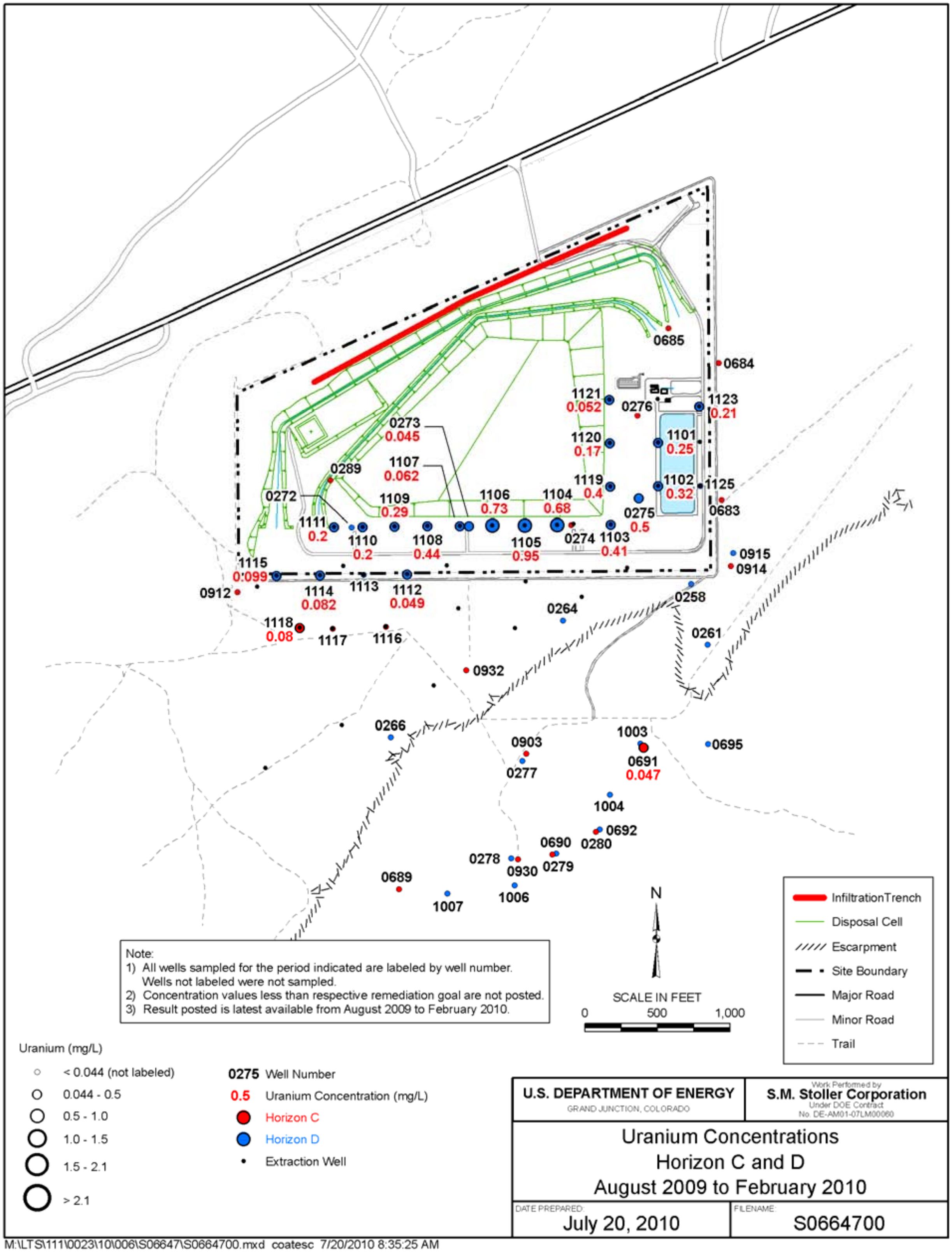



*Figure 13b. Uranium Concentrations in Groundwater, Horizons C and D, February 2010*

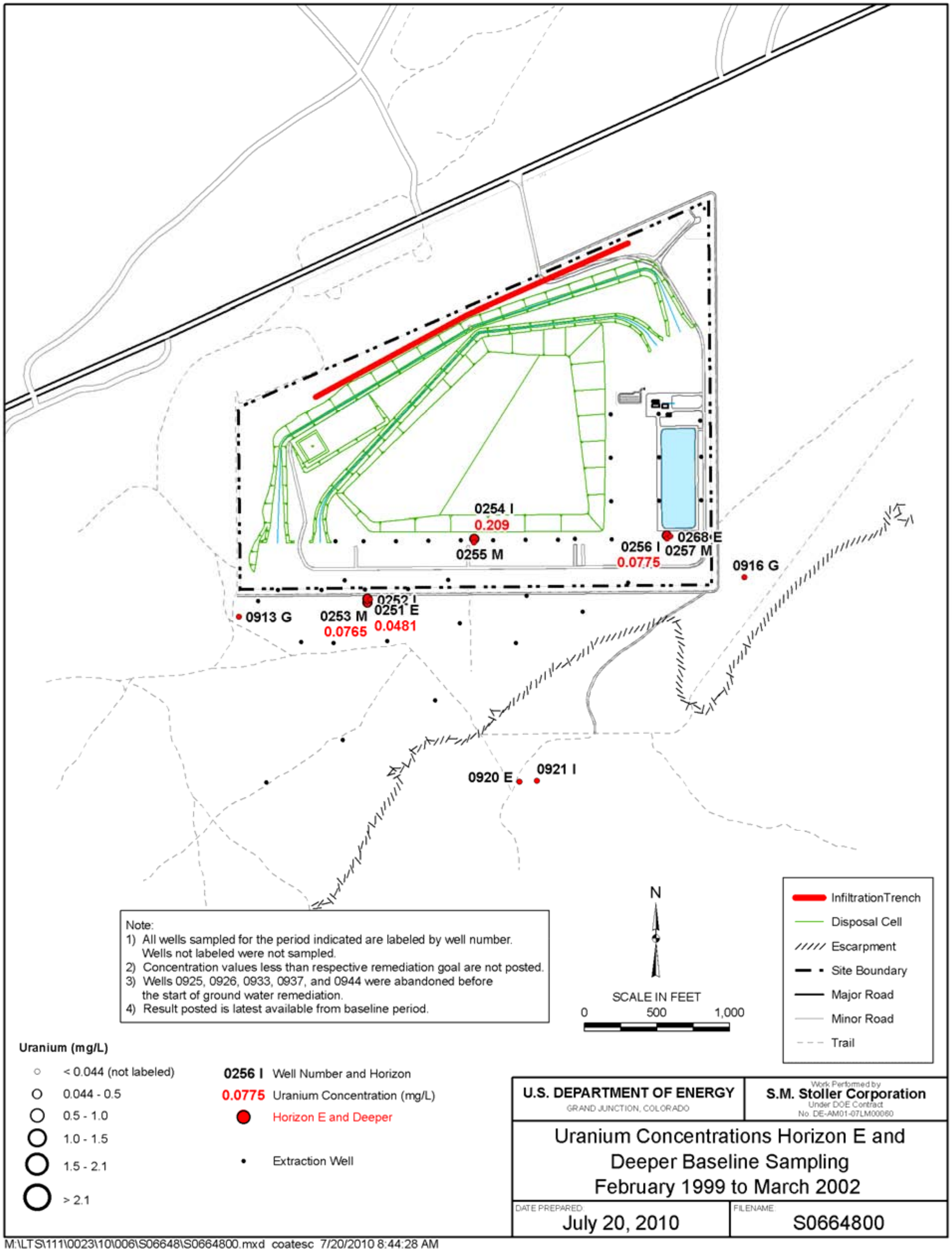



*Figure 14a. Uranium Concentrations in Groundwater, Horizons E and Deeper, Baseline Period*

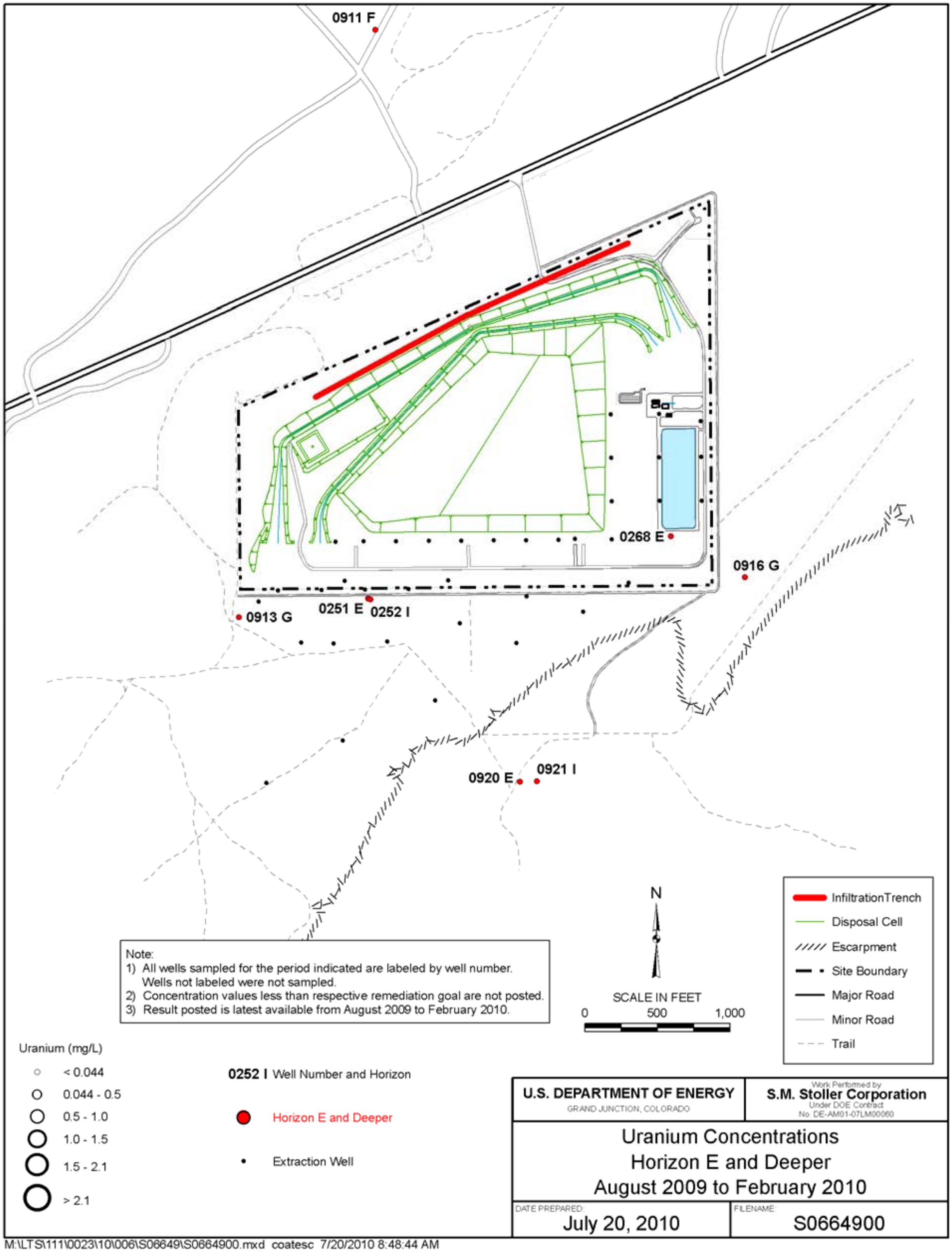



*Figure 14b. Uranium Concentrations in Groundwater, Horizons E and Deeper, February 2010*

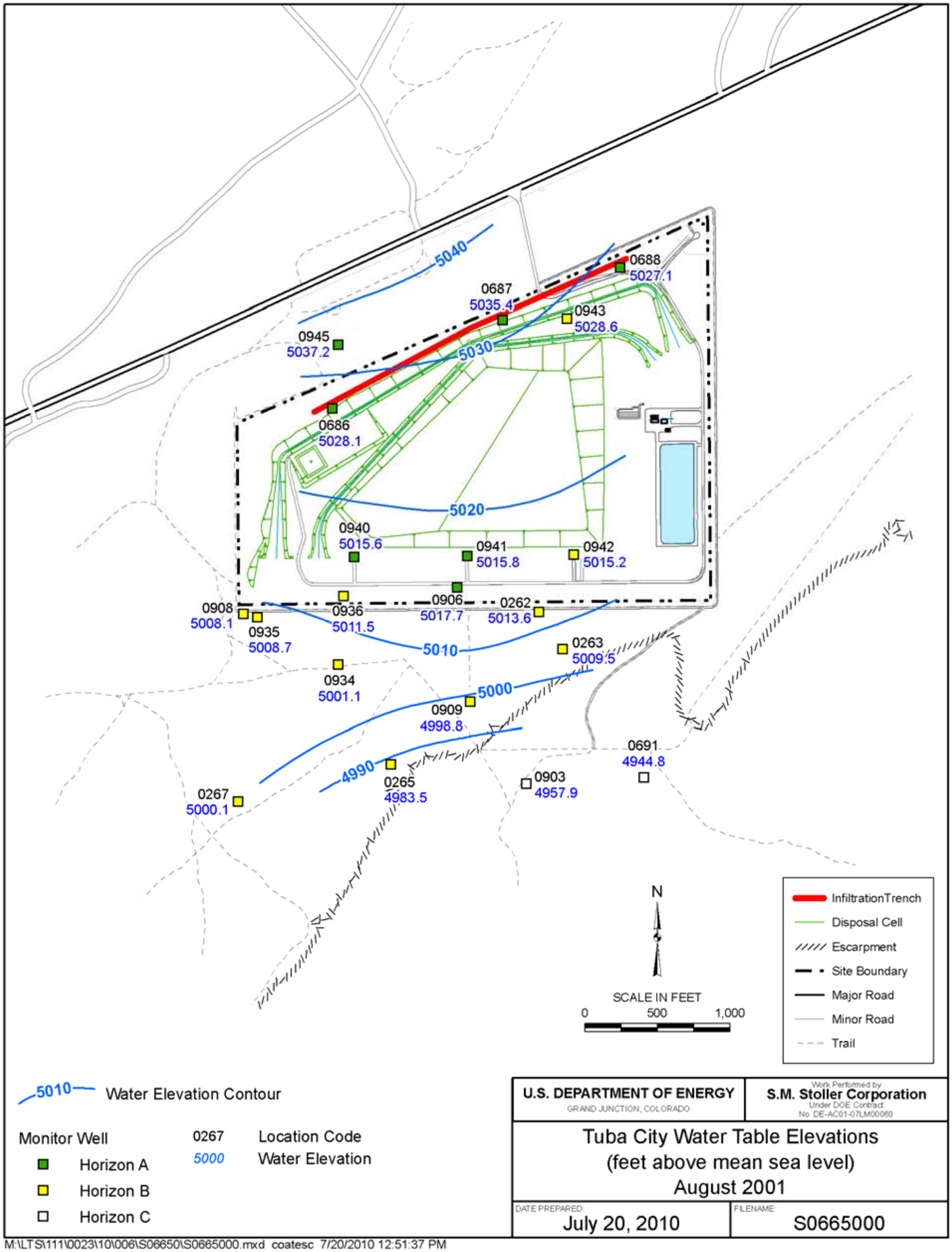
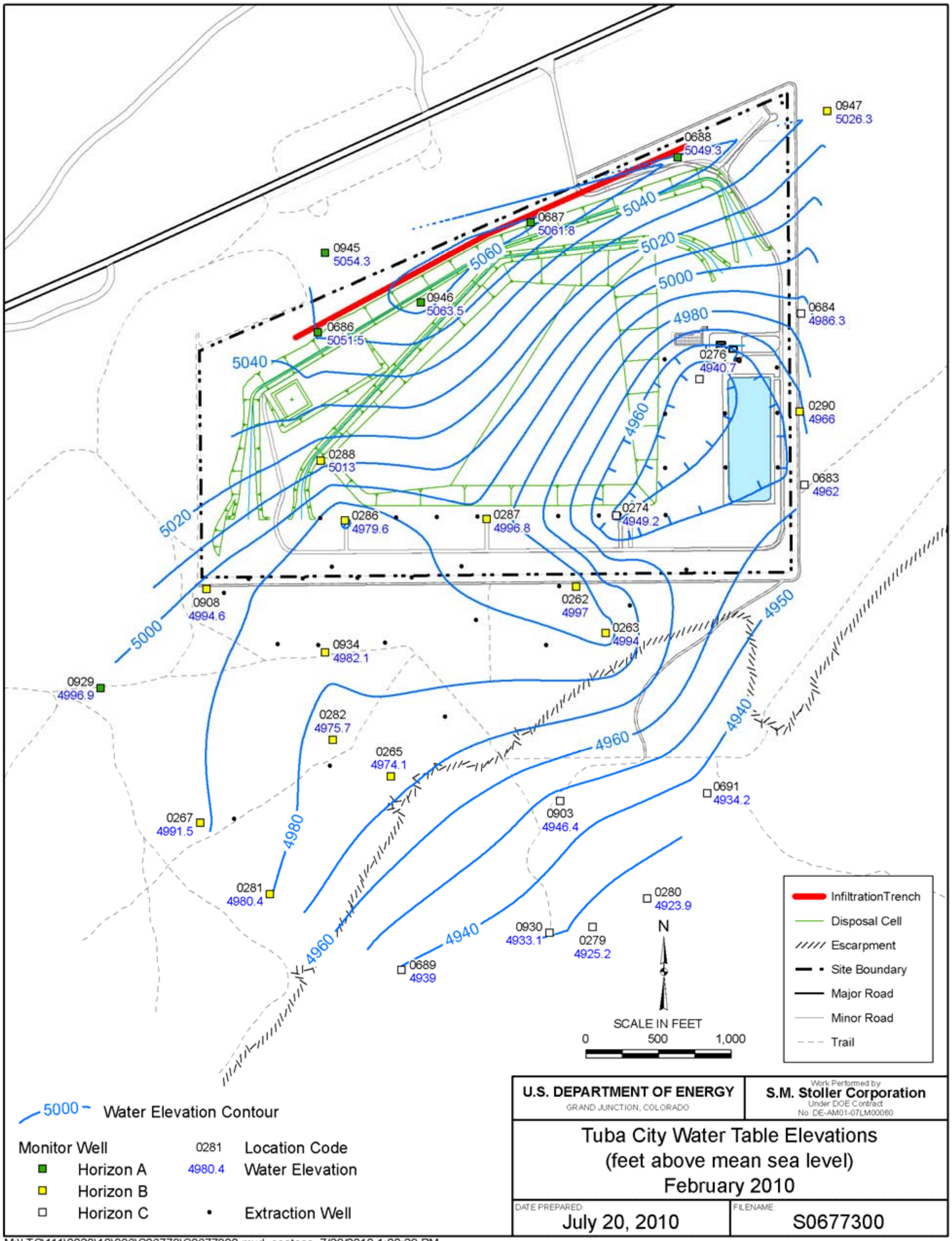



*Figure 15. Water Table Elevations (Feet above Mean Sea Level), Tuba City Site, August 2001*




M:\LTS\111\0023\10\006\S06773\S0677300.mxd coatesc 7/20/2010 1:00:29 PM

*Figure 16. Water Table Contour Map, Tuba City Site, February 2010*

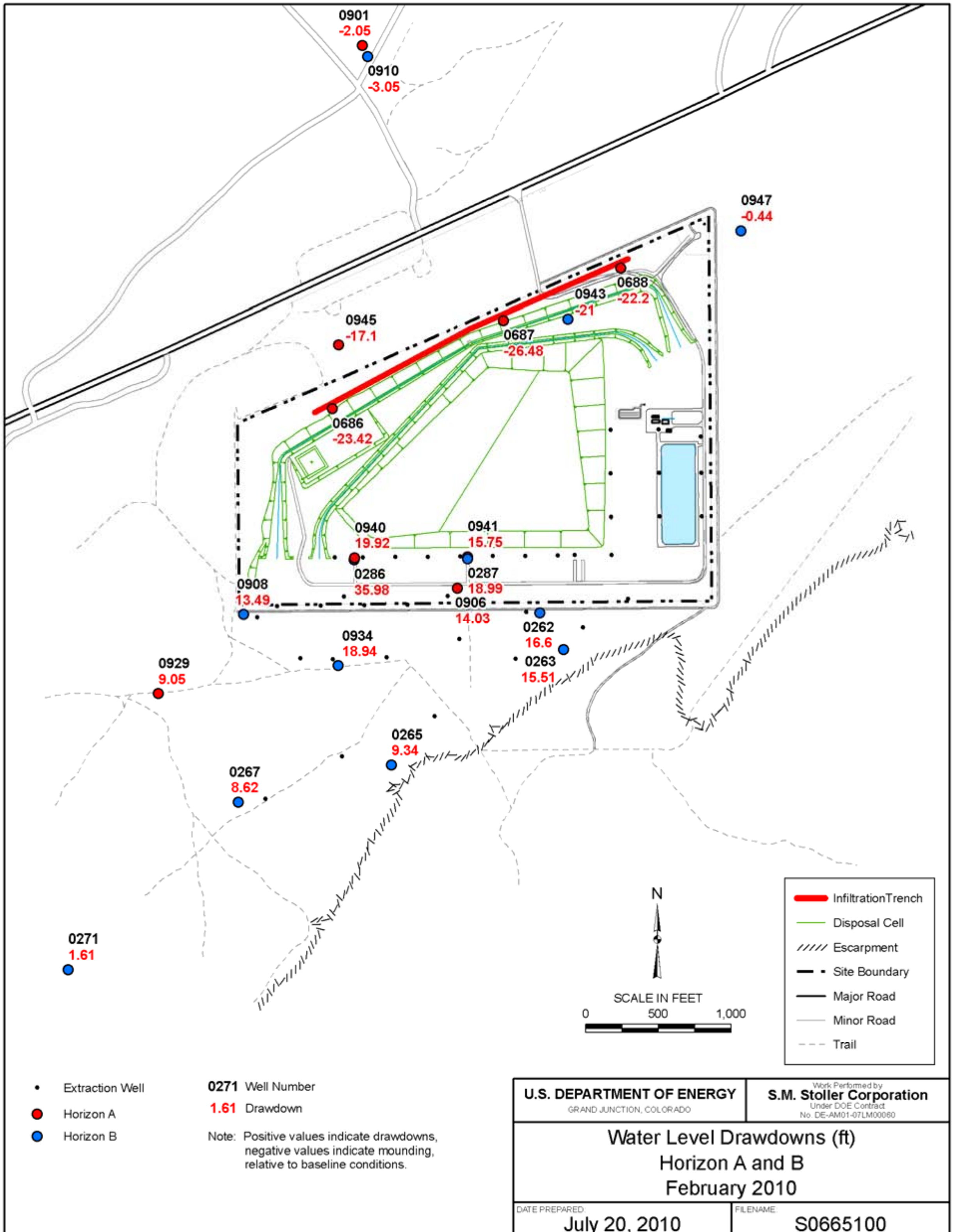



*Figure 17. Water Level Drawdowns (Feet), Horizons A and B, February 2010*

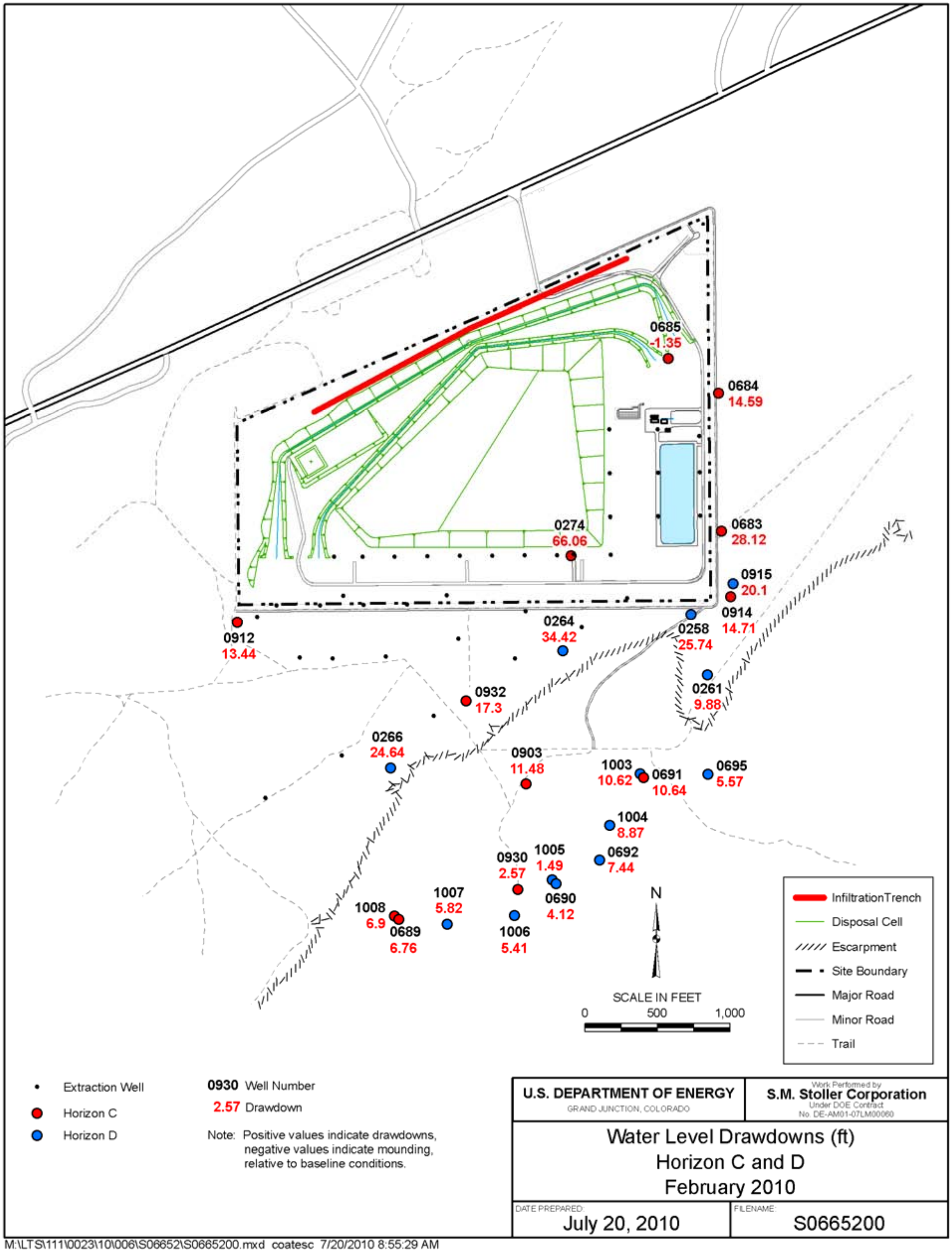



*Figure 18. Water Level Drawdowns (Feet), Horizons C and D, February 2010*

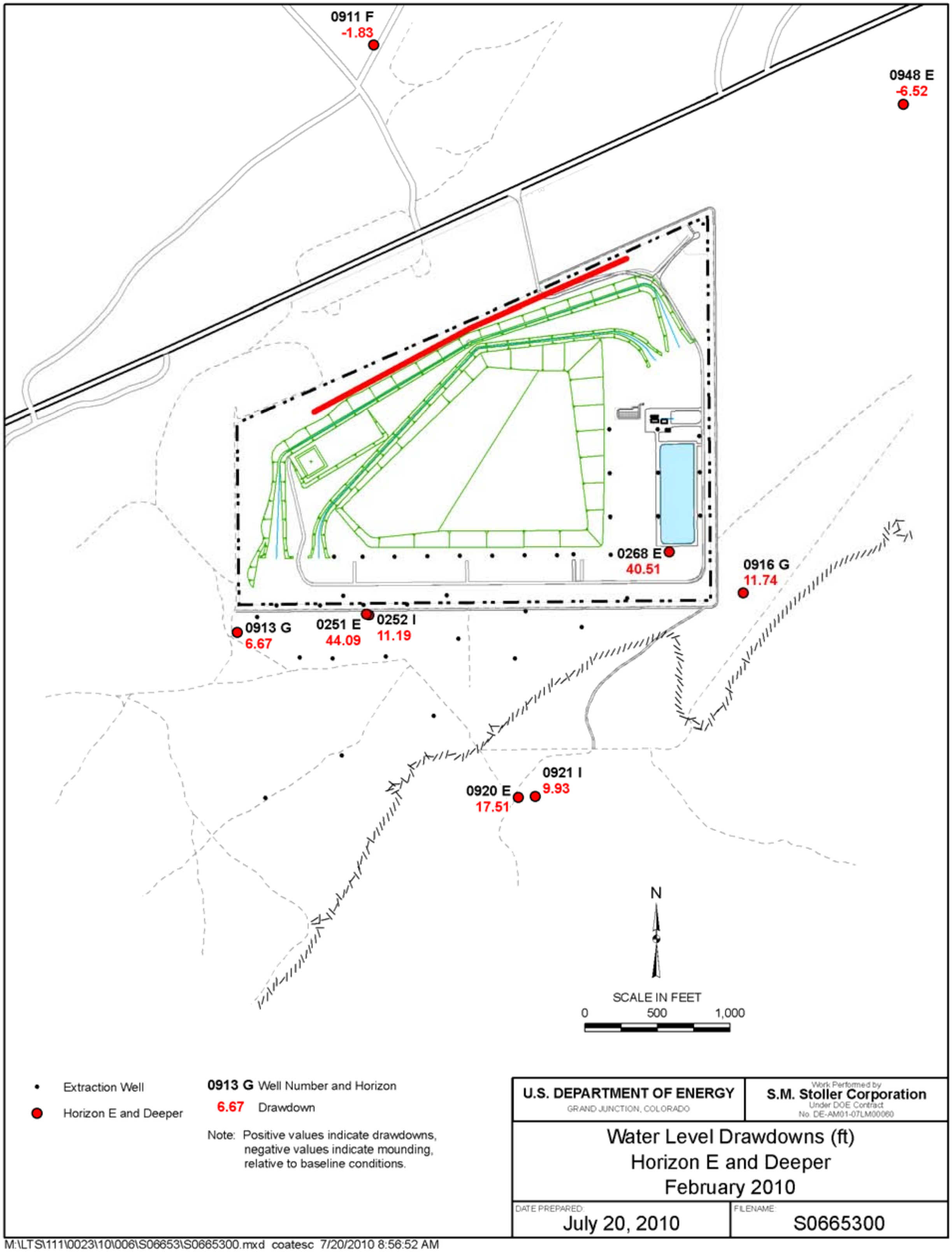
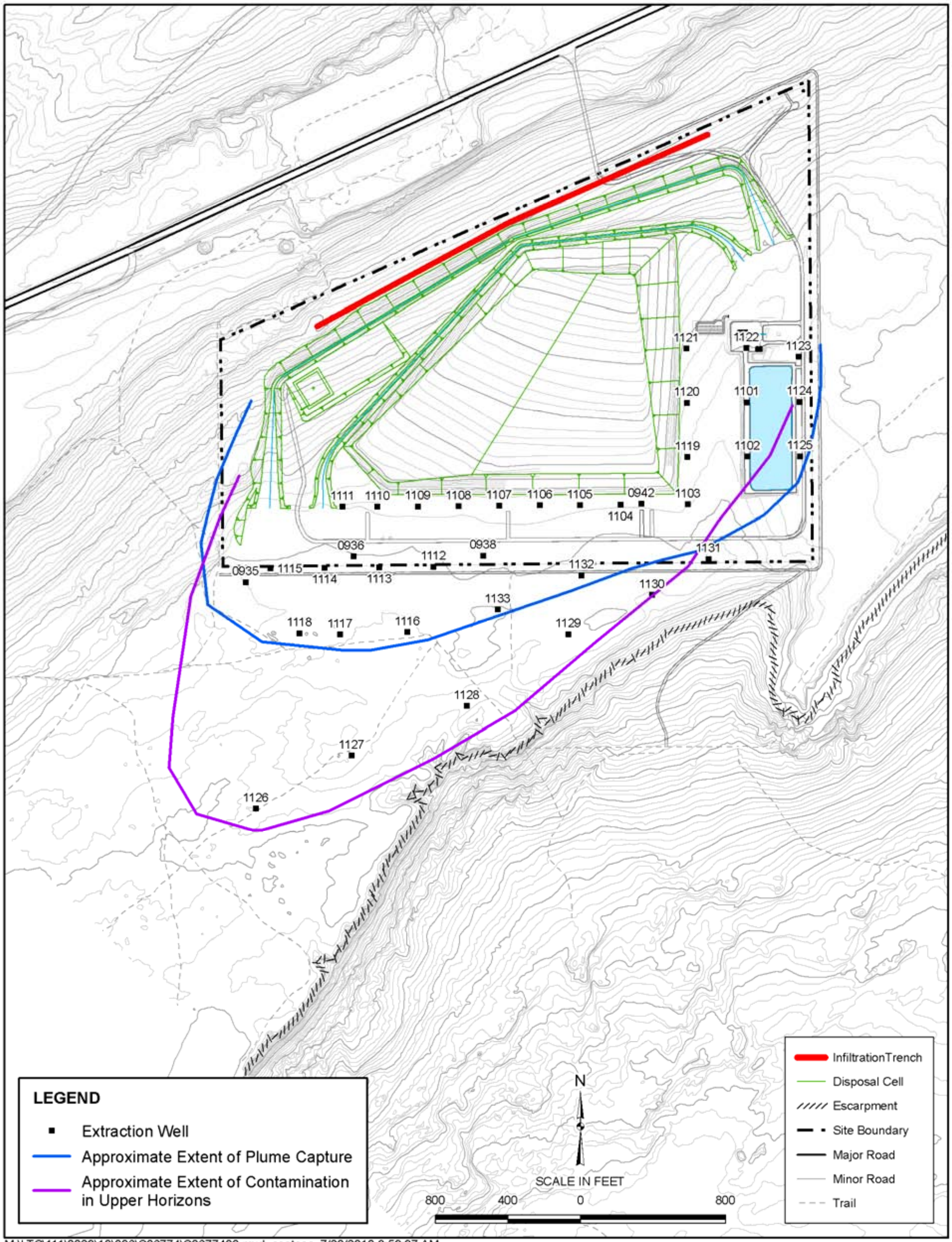



*Figure 19. Water Level Drawdowns (Feet), Horizons E, F, G, I, and M, February 2010*




M:\LTS\111\0023\10\006\S06774\S0677400.mxd coatesc 7/20/2010 8:59:37 AM

*Figure 20. Approximate Extent of Groundwater Contamination and Extraction System Capture Zone, Horizons A and B*

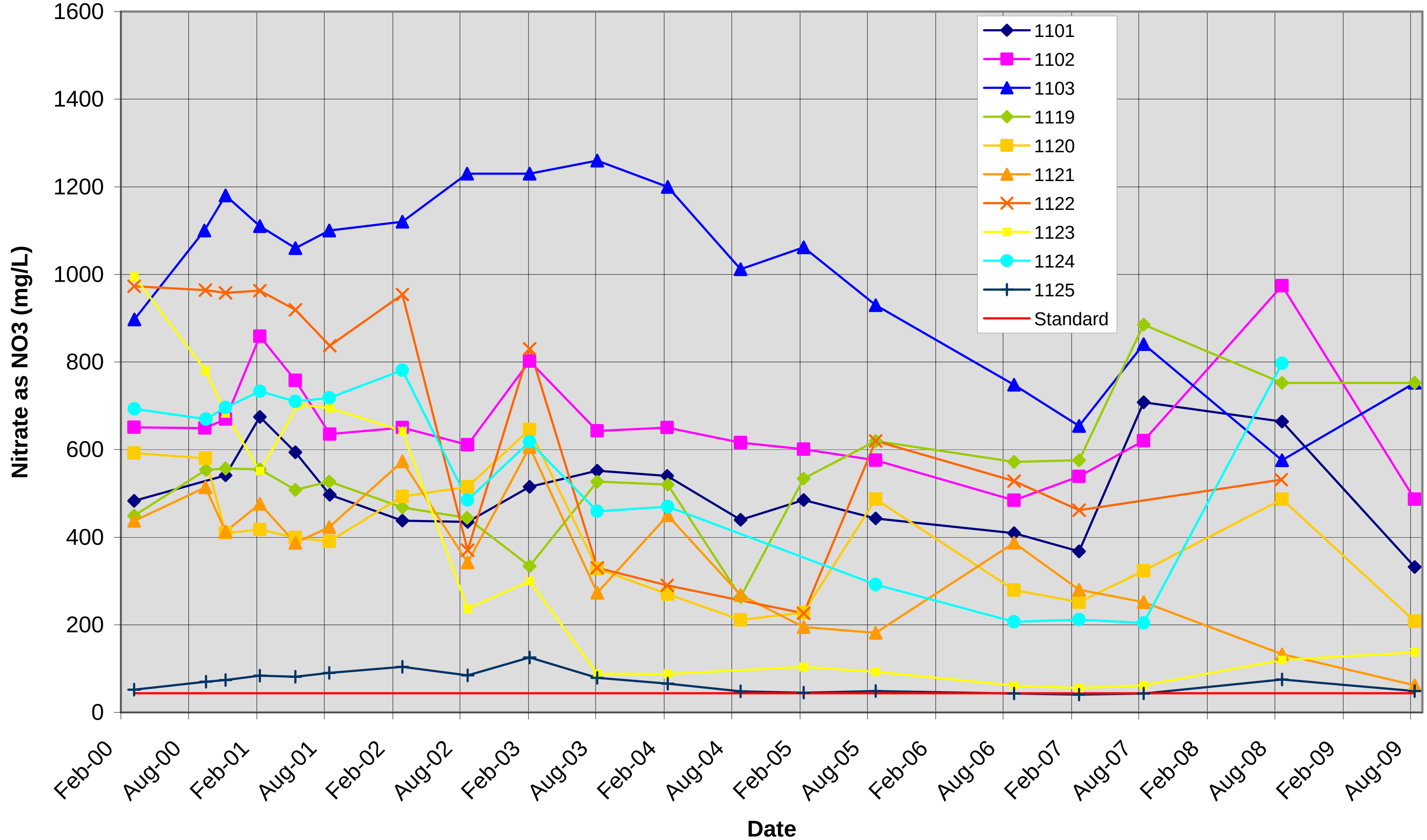



*Figure 21a. Nitrate Concentration Trends at Extraction Wells 1101–1103, 1119–1125 (East of Disposal Cell)*

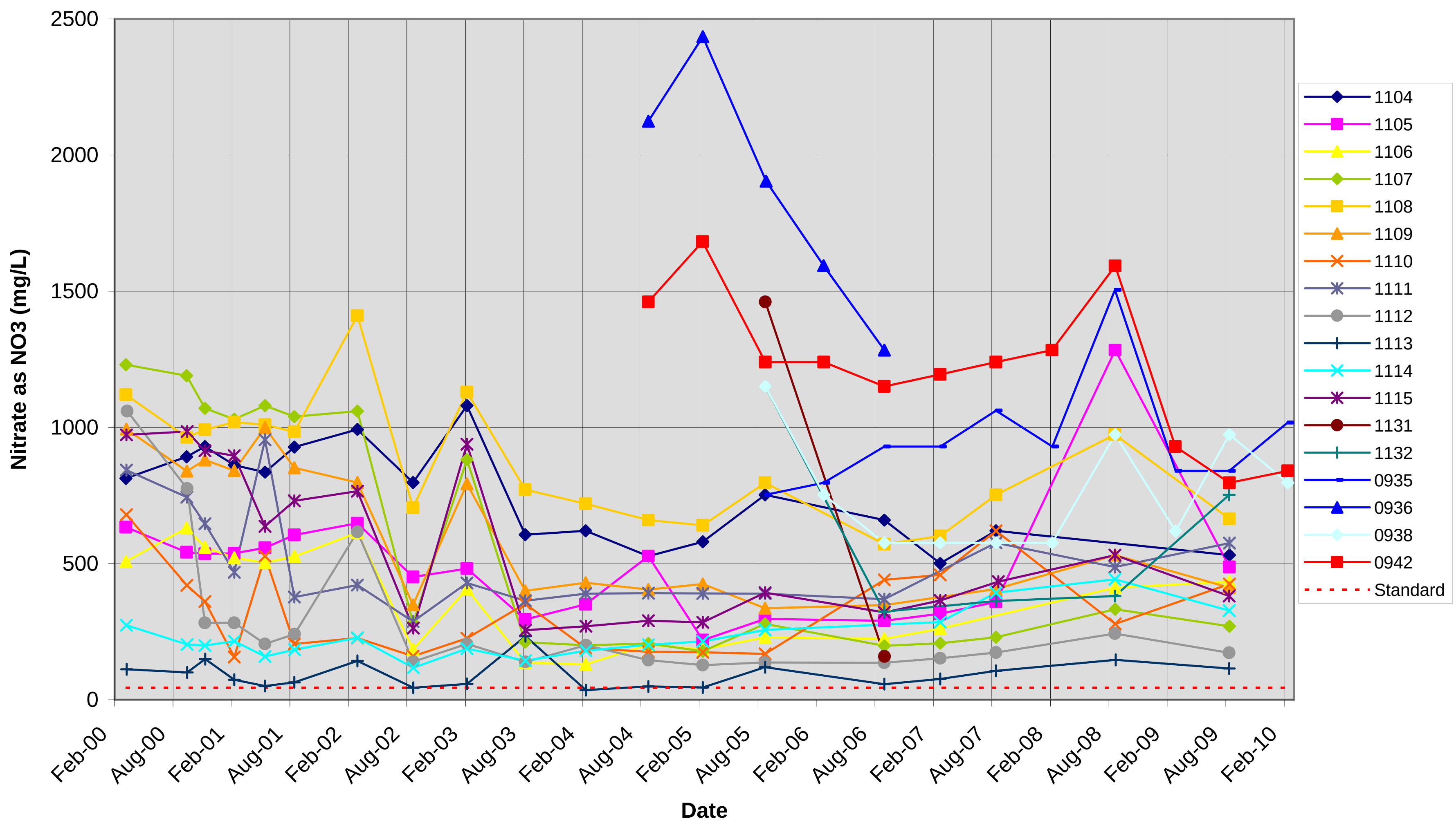



*Figure 21b. Nitrate Concentration Trends at Extraction Wells 1104–1115, 1131–1132, 935, 936, 938, 942 (South of Disposal Cell at or within Site Boundary)*

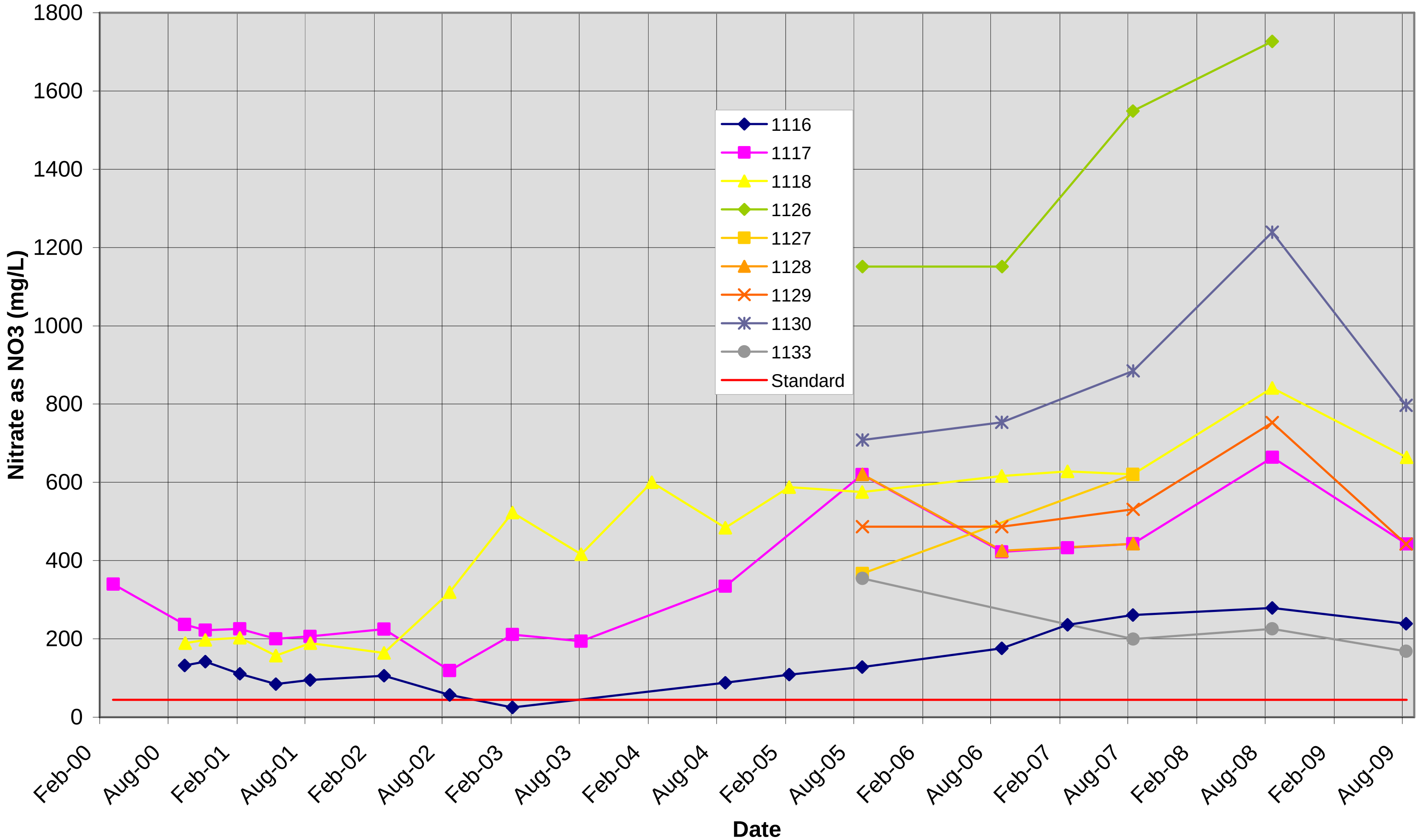



*Figure 21c. Nitrate Concentration Trends at Southernmost Extraction Wells 1116–1118, 1126–1130, 1133*

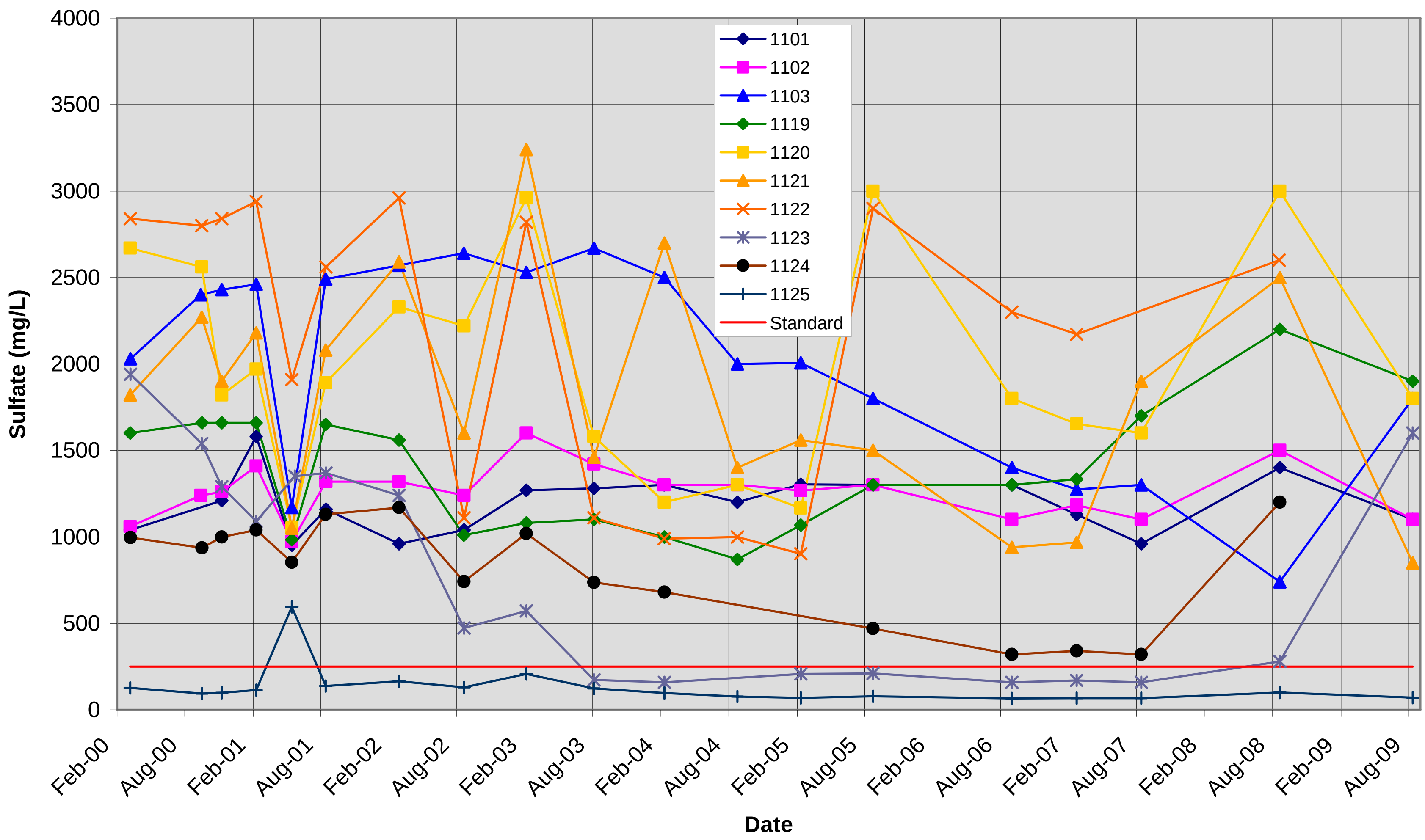



*Figure 22a. Sulfate Concentration Trends at Extraction Wells 1101–1103, 1119–1125*
*(East of Disposal Cell)*

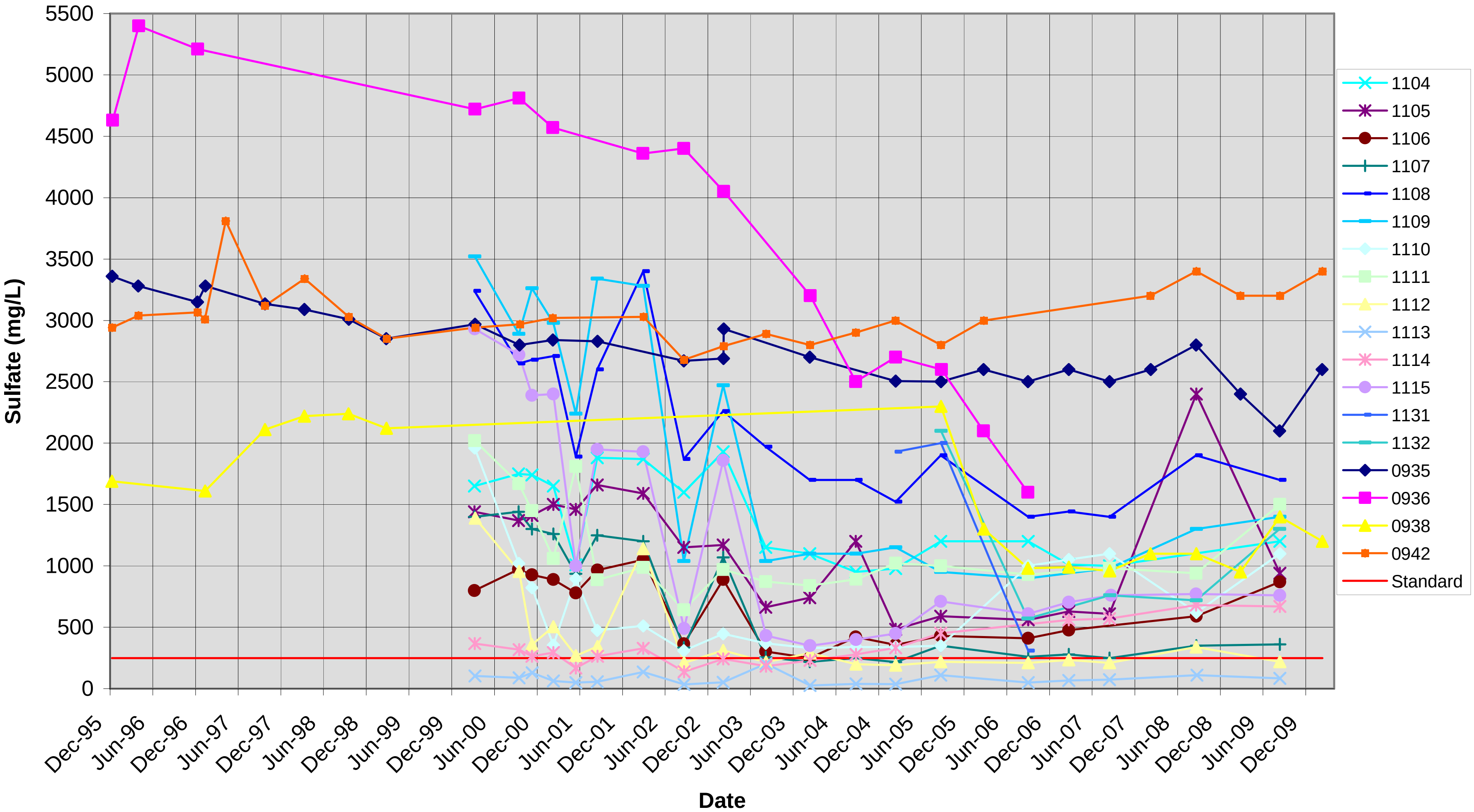



*Figure 22b. Sulfate Concentration Trends at Extraction Wells 1104–1115, 1131−1132, 935, 936, 938, 942 (South of Disposal Cell at or within Site Boundary)*

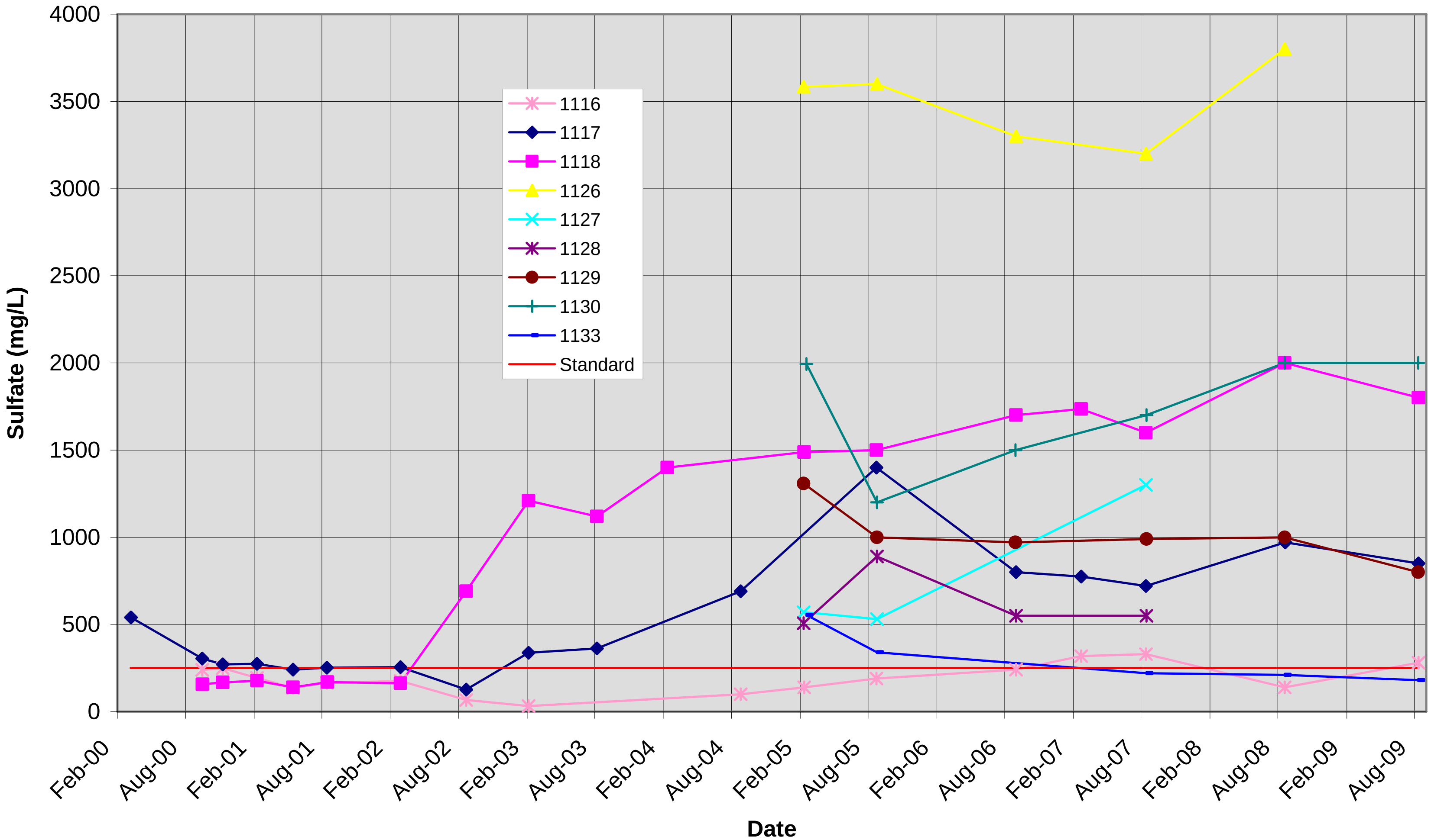



*Figure 22c. Sulfate Concentration Trends at Southernmost Extraction Wells 1116–1118, 1126–1130, 1133*

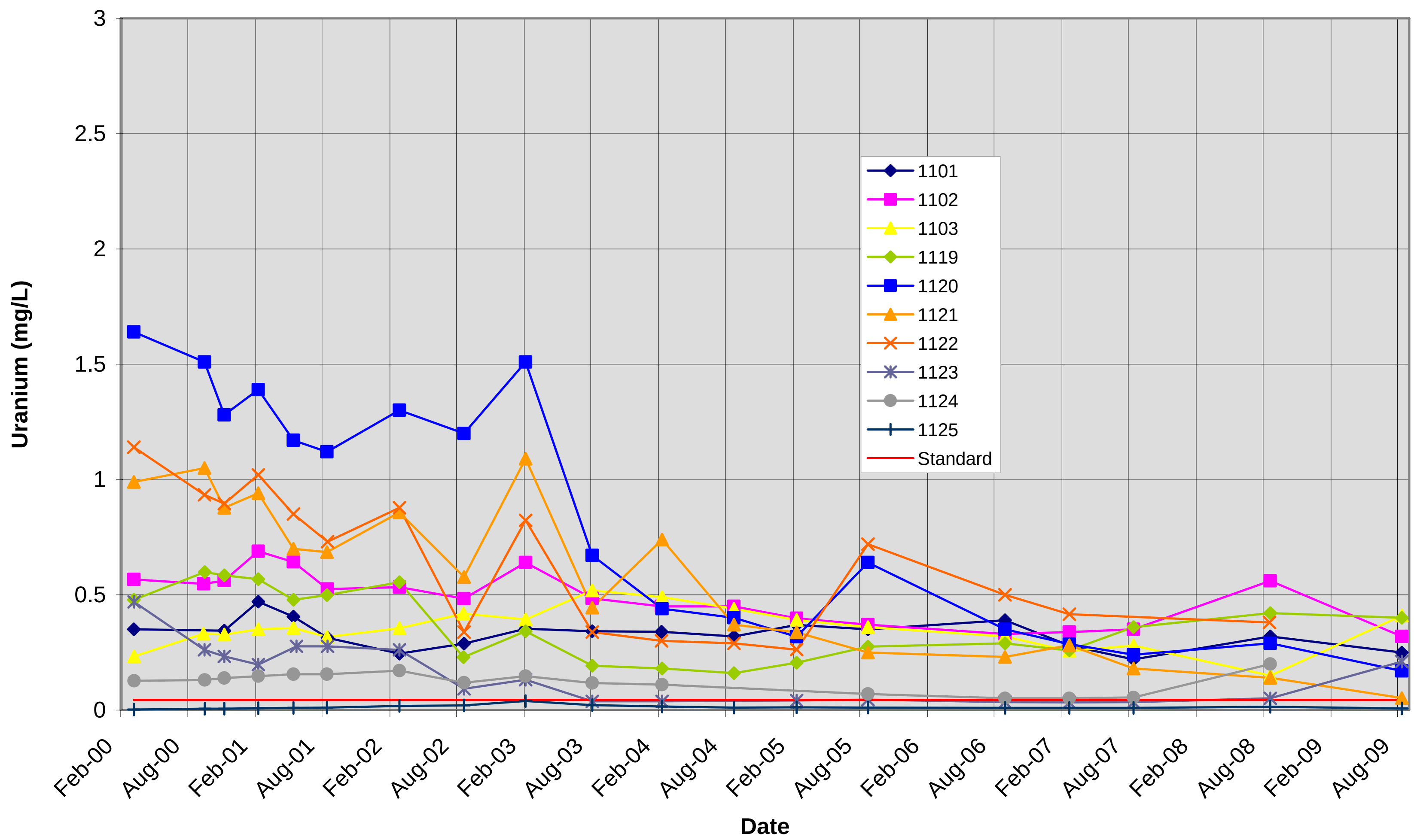



*Figure 23a. Uranium Concentration Trends at Extraction Wells 1101–1103, 1119–1125 (East of Disposal Cell)*

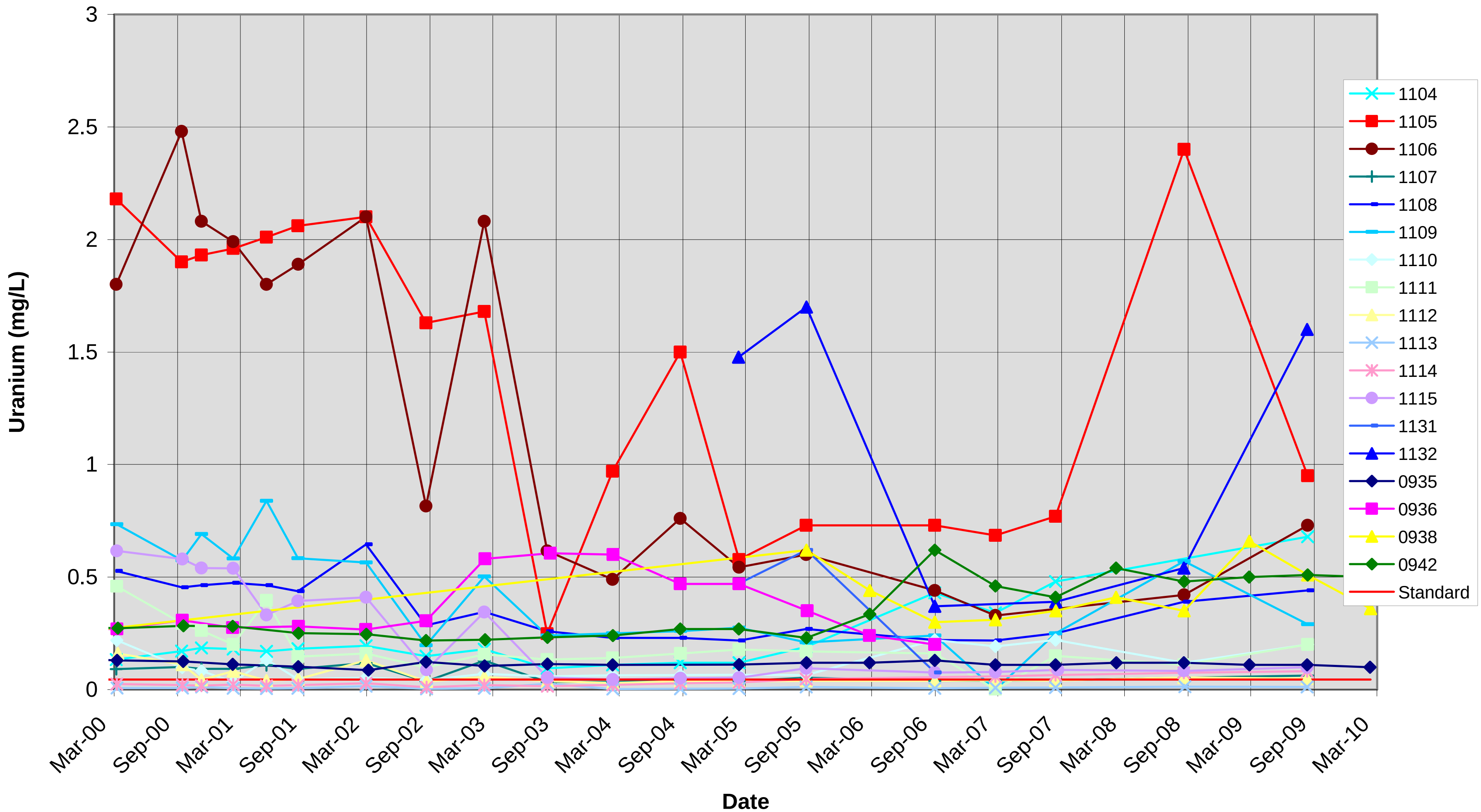



*Figure 23b. Uranium Concentration Trends at Extraction Wells 1104–1115, 1131−1132, 935, 936, 938, 942*
*(South of Disposal Cell at or within Site Boundary)*

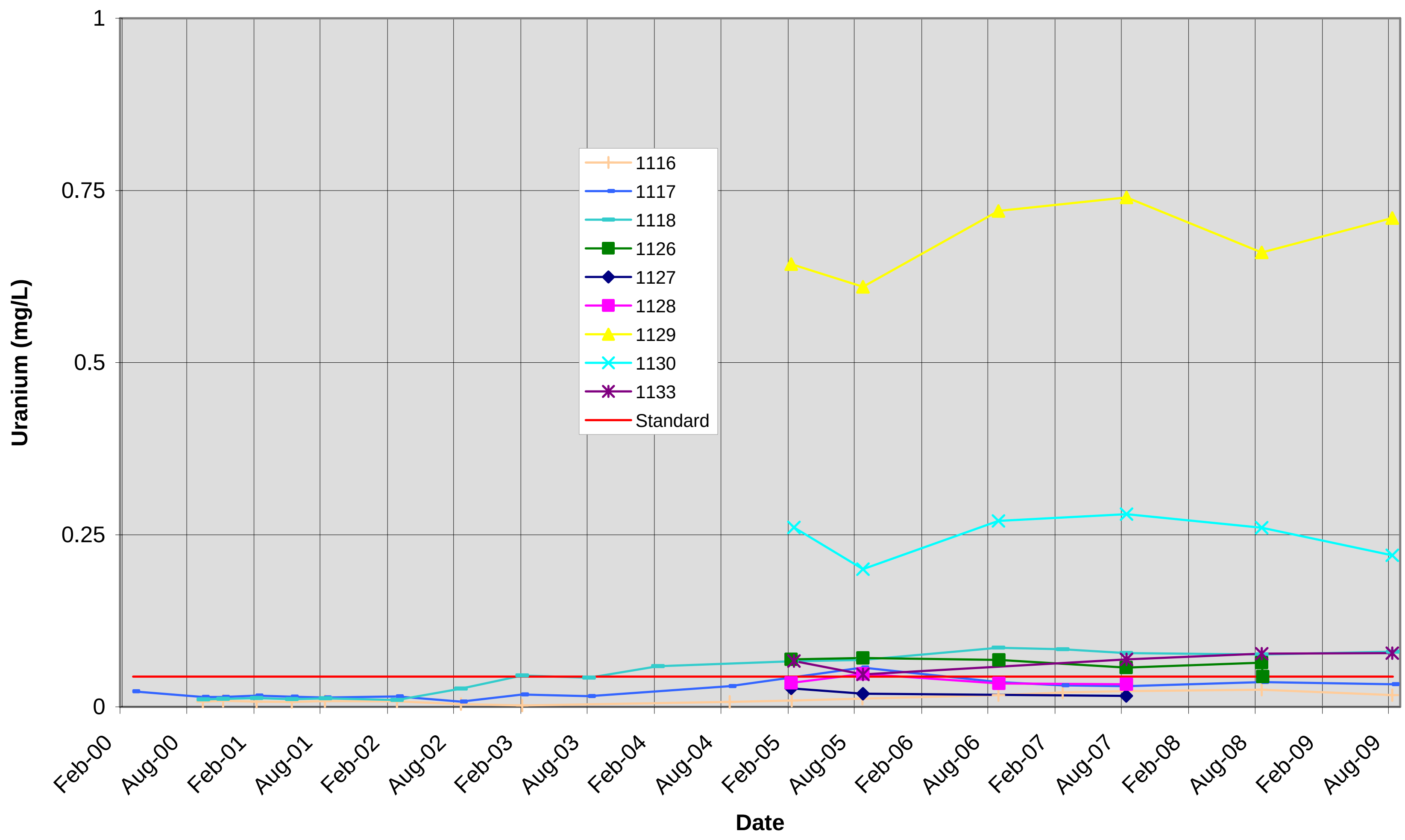



*Figure 23c. Uranium Concentration Trends at Southernmost Extraction Wells 1116–1118, 1126–1130, 1133*

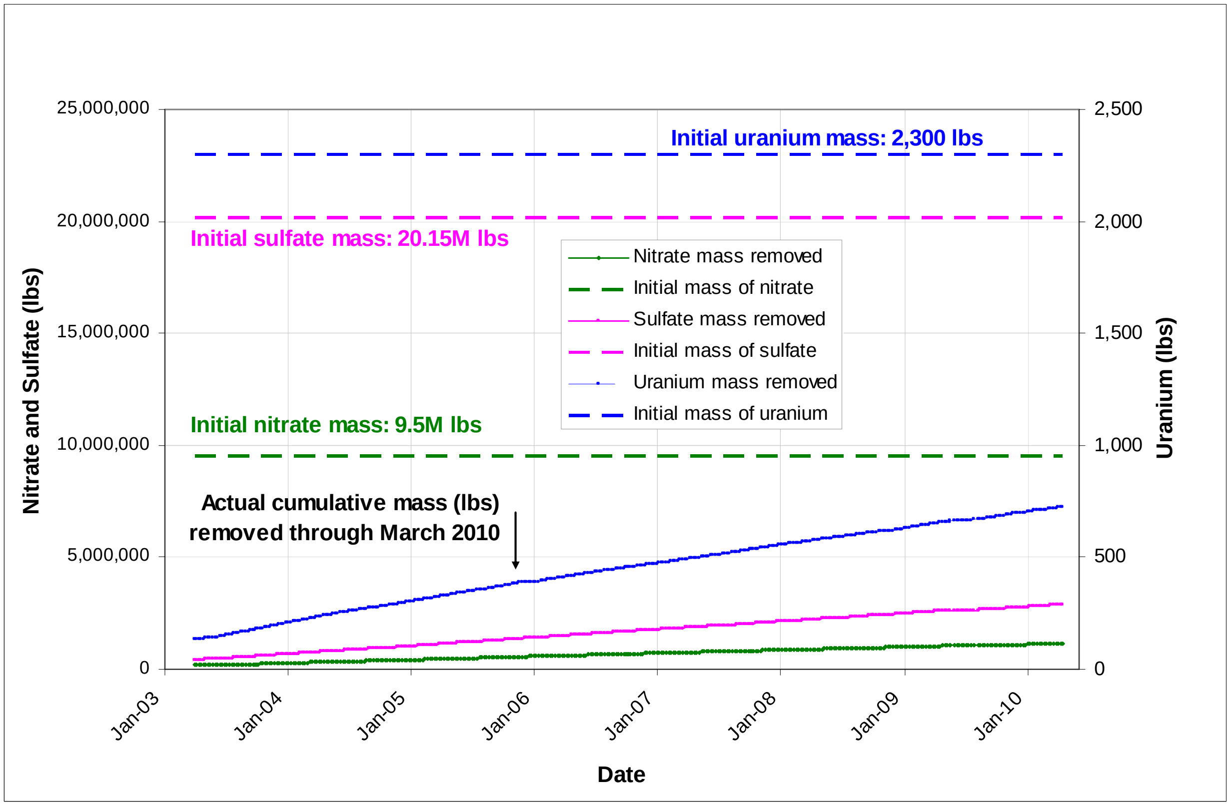



*Figure 24. Nitrate, Sulfate, and Uranium Mass Removal Rate Projections*

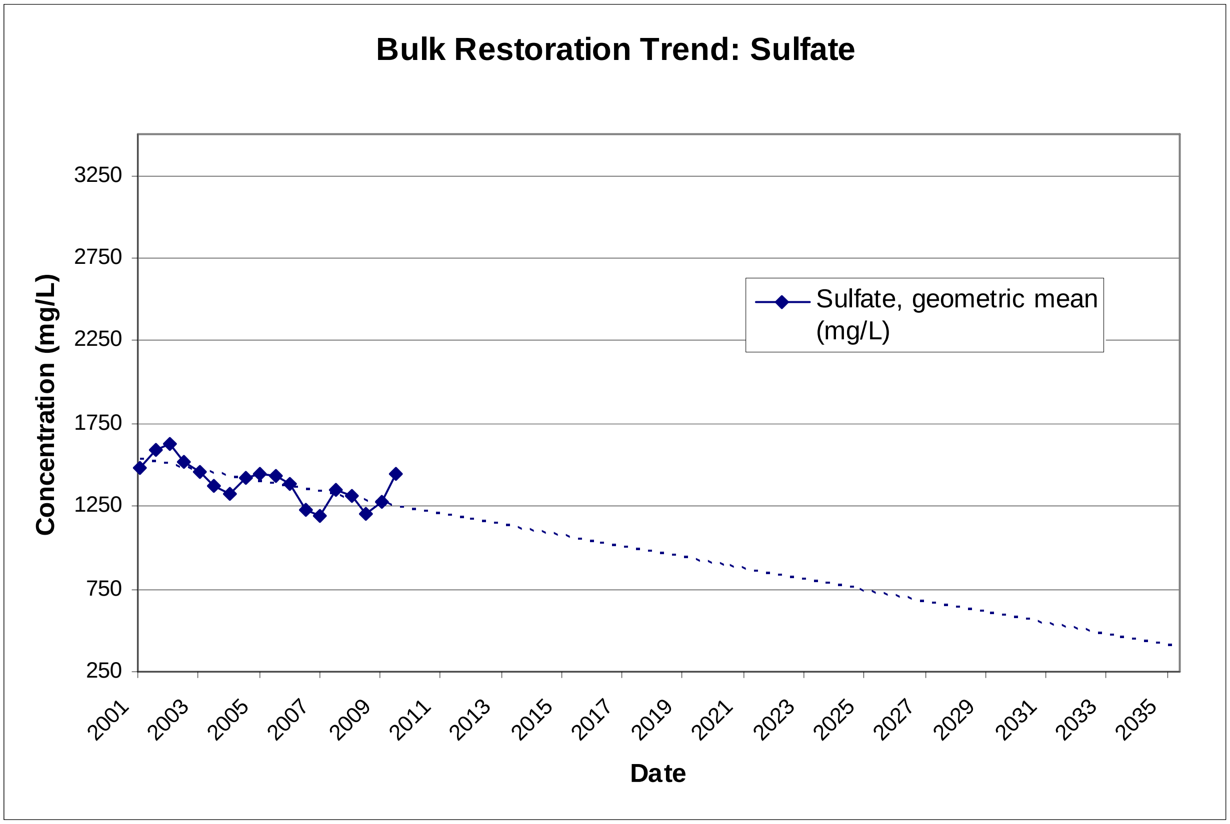



*Figure 25. Bulk Restoration Trend for Sulfate*

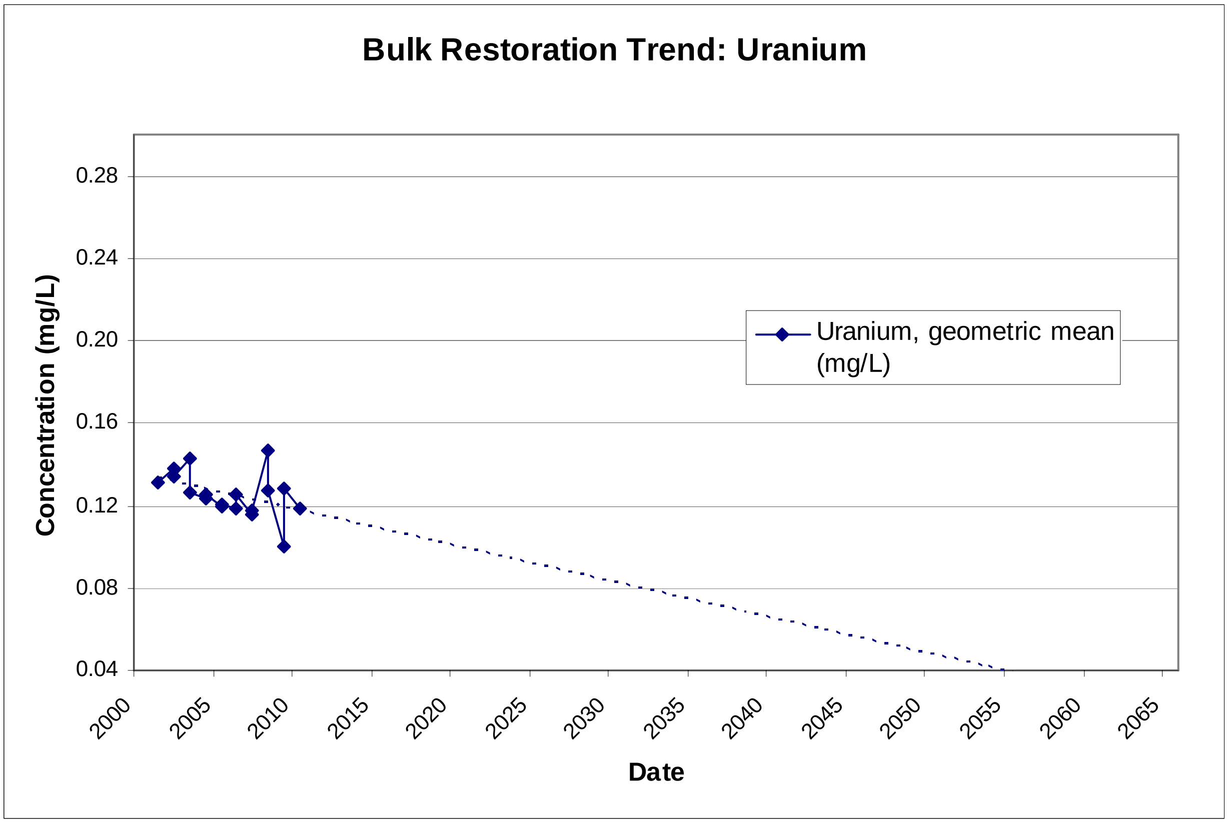



*Figure 26. Bulk Restoration Trend for Uranium*

This page intentionally left blank

# Appendix A

# Well Completion Information and Conceptual Site Model

This page intentionally left blank

# Contents

## Figures



## Table

This page intentionally left blank

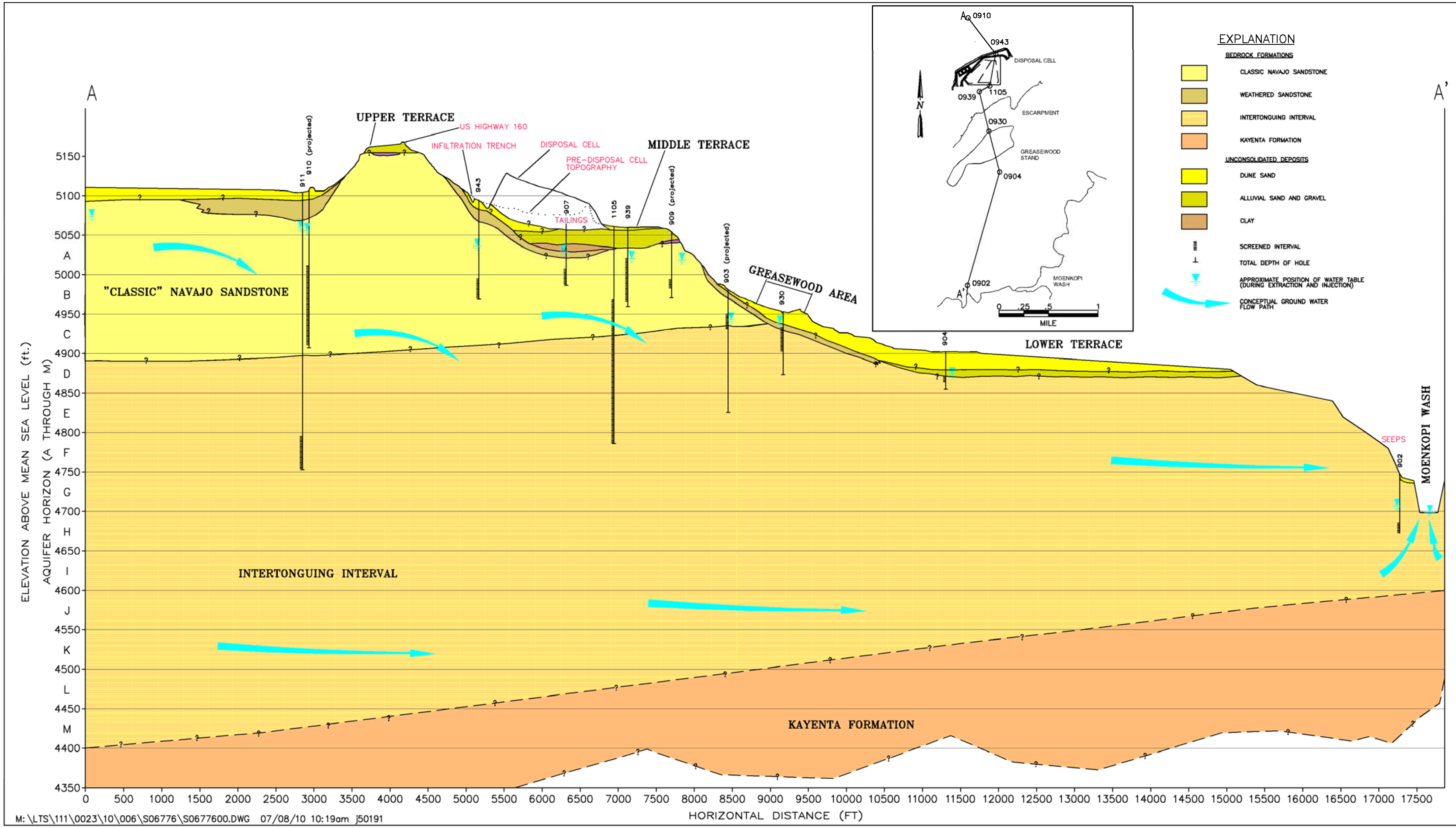



*Figure A−1. Conceptual Model of the Site Hydrogeology*

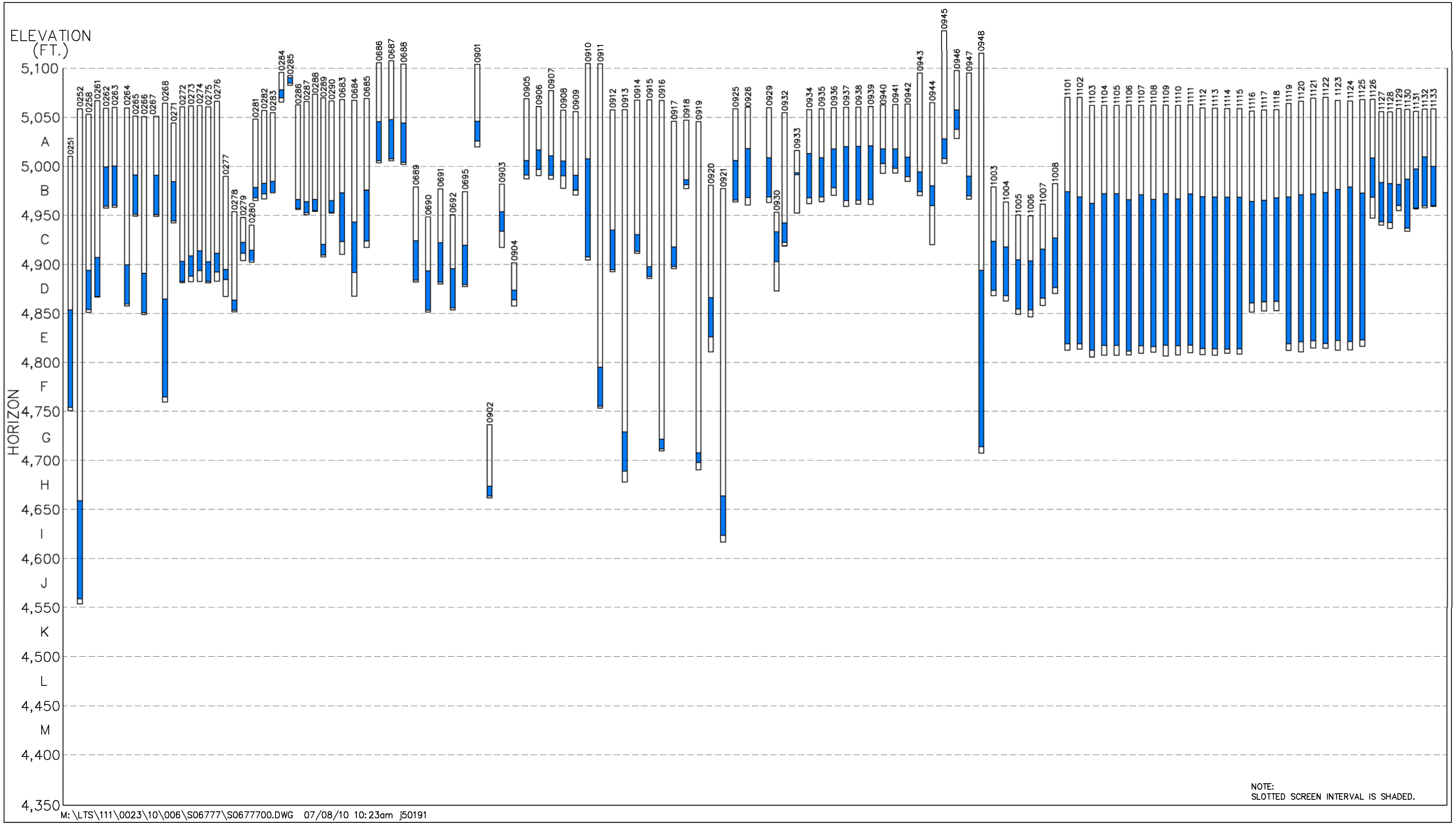



*Figure A−2. Well Completions Schematic*

*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 | Top of Casing Elev. | | Ground Elev. | | Well Diameter | Boring Started | Decommission Date | State Plane East | State Plane North |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0284 | MW | A | 5079.8 | 5074.8 | 5069.8 | 16.5 | 21.5 | 26.5 | 10.0 | 1.5 | 28.0 | 5098.72 | | 5096.3 | | 2 | 16-Aug-04 | | 730525 | 1873562 |
| 0285 | MW | A | 5090.8 | 5088.3 | 5085.8 | 3.0 | 5.5 | 8.0 | 5.0 | 0.1 | 8.1 | 5096.47 | | 5093.8 | | 2 | 16-Aug-04 | | 731629 | 1874042 |
| 0686 | MW | A | 5045.5 | 5025.5 | 5005.5 | 60.0 | 80.0 | 100.0 | 40.0 | 0.3 | 100.3 | 5107.97 | | 5105.5 | | 2 | 28-Mar-00 | | 729978 | 1873416 |
| 0687 | MW | A | 5047.6 | 5027.6 | 5007.6 | 60.0 | 80.0 | 100.0 | 40.0 | 0.3 | 100.3 | 5109.82 | | 5107.6 | | 2 | 29-Mar-00 | | 731152 | 1874024 |
| 0688 | MW | A | 5044.1 | 5024.1 | 5004.1 | 60.0 | 80.0 | 100.0 | 40.0 | 0.3 | 100.3 | 5106.98 | | 5104.1 | | 2 | 29-Mar-00 | | 731961 | 1874385 |
| 0901 | MW | A | 5045.8 | 5035.8 | 5025.8 | 58.0 | 68.0 | 78.0 | 20.0 | 2.0 | 80.0 | 5105.46 | | 5103.8 | | 2 | 16-Oct-84 | | 730185 | 1875918 |
| 0906 | MW | A | 5016.9 | 5006.9 | 4996.9 | 44.0 | 54.0 | 64.0 | 20.0 | 2.0 | 66.0 | 5062.10 | | 5060.9 | | 2 | 19-Nov-84 | | 730838 | 1872181 |
| 0907 | MW | A | 5010.7 | 5000.7 | 4990.7 | 66.5 | 76.5 | 86.5 | 20.0 | | | 5079.17 | | 5077.2 | | 2 | 30-Nov-84 | 19-Apr-88 | 731252 | 1872920 |
| 0928 | MW | A | 5022.1 | 5009.6 | 4997.1 | 30.0 | 42.5 | 55.0 | 25.0 | 3.0 | 58.0 | 5053.99 | | 5052.1 | | 4 | 20-Oct-95 | 24-May-00 | 729401 | 1870814 |
| 0929 | MW | A | 5010.4 | 4990.4 | 4970.4 | 48.2 | 68.2 | 88.2 | 40.0 | | | 5060.82 | | 5058.6 | | 4 | | | 728780 | 1871453 |
| 0940 | MW | A | 5017.9 | 5010.4 | 5002.9 | 45.0 | 52.5 | 60.0 | 15.0 | 3.0 | 68.0 | 5064.77 | | 5062.9 | | 4 | 01-Nov-95 | | 730130 | 1872391 |
| 0941 | MW | A | 5018.0 | 5008.0 | 4998.0 | 45.0 | 55.0 | 65.0 | 20.0 | 3.0 | 68.0 | 5065.97 | | 5063.0 | | 4 | 10-Nov-95 | | 730908 | 1872398 |
| 0945 | MW | A | 5028.1 | 5018.1 | 5008.1 | 110.0 | 120.0 | 130.0 | 20.0 | 3.0 | 133.0 | 5140.49 | | 5138.1 | | 4 | 11-Oct-95 | | 730019 | 1873857 |
| 0946 | MW | A | 5057.6 | 5047.6 | 5037.6 | 40.0 | 50.0 | 60.0 | 20.0 | 3.3 | 63.3 | 5100.50 | | 5097.6 | | 4 | 02-Nov-95 | | 730547 | 1873582 |
| 0262 | MW | B | 4999.2 | 4979.2 | 4959.2 | 60.0 | 80.0 | 100.0 | 40.0 | 0.3 | 100.3 | 5061.99 | | 5059.2 | | 2 | 03-Apr-00 | | 731402 | 1872012 |
| 0263 | MW | B | 5000.2 | 4980.2 | 4960.2 | 60.0 | 80.0 | 100.0 | 40.0 | 0.3 | 100.3 | 5063.10 | | 5060.2 | | 2 | 04-Apr-00 | | 731565 | 1871757 |
| 0265 | MW | B | 4991.1 | 4971.1 | 4951.1 | 60.0 | 80.0 | 100.0 | 40.0 | 0.3 | 100.3 | 5053.88 | | 5051.1 | | 2 | 16-Apr-00 | | 730382 | 1870964 |
| 0267 | MW | B | 4990.8 | 4970.8 | 4950.8 | 60.0 | 80.0 | 100.0 | 40.0 | 0.3 | 100.3 | 5053.40 | | 5050.8 | | 2 | 14-Apr-00 | | 729329 | 1870707 |
| 0271 | MW | B | 4984.0 | 4964.0 | 4944.0 | 60.0 | 80.0 | 100.0 | 40.0 | 0.3 | 100.3 | 5046.72 | | 5044.0 | | 2 | 29-Apr-00 | | 728160 | 1869555 |
| 0281 | MW | B | 4977.8 | 4972.8 | 4967.8 | 70.5 | 75.5 | 80.5 | 10.0 | 1.5 | 82.0 | 5051.00 | | 5048.3 | | 2 | 11-Aug-04 | | 729714 | 1870315 |
| 0282 | MW | B | 4983.3 | 4978.3 | 4973.3 | 74.1 | 79.1 | 84.1 | 10.0 | 1.5 | 85.6 | 5060.04 | | 5057.4 | | 2 | 10-Aug-04 | | 730062 | 1871168 |
| 0283 | MW | B | 4984.8 | 4979.8 | 4974.8 | 70.5 | 75.5 | 80.5 | 10.0 | 1.5 | 82.0 | 5057.97 | | 5055.3 | | 2 | 03-Aug-04 | | 730901 | 1871185 |
| 0286 | MW | B | 4968.84 | 4963.8 | 4958.84 | 93.2 | 98.2 | 103.2 | 10.0 | 0.4 | 103.6 | 5063.99 | | 5062.0 | | 2 | 13-Mar-07 | | 730128 | 1872377 |
| 0287 | MW | B | 4962.29 | 4957.3 | 4952.29 | 100.7 | 105.7 | 110.7 | 10.0 | 0.4 | 111.1 | 5065.65 | | 5063.0 | | 2 | 15-Mar-07 | | 730908 | 1872386 |
| 0288 | MW | B | 4965.86 | 4960.9 | 4955.86 | 104.0 | 109.0 | 114.0 | 10.0 | 0.5 | 114.5 | 5072.54 | | 5069.9 | | 2 | 18-Mar-07 | | 729995 | 1872709 |
| 0290 | MW | B | 4964.33 | 4959.3 | 4954.33 | 102.7 | 107.7 | 112.7 | 10.0 | 0.4 | 113.1 | 5068.91 | | 5067.0 | | 2 | 17-Mar-07 | | 732633 | 1872979 |
| 0905 | MW | B | 5006.0 | 4998.5 | 4991.0 | 63.0 | 70.5 | 78.0 | 15.0 | 2.0 | 80.0 | 5072.80 | | 5069.0 | | 2 | 14-Nov-84 | 24-May-00 | 732933 | 1873200 |
| 0908 | MW | B | 5005.3 | 4997.8 | 4990.3 | 52.0 | 59.5 | 67.0 | 15.0 | 2.0 | 69.0 | 5058.14 | | 5057.3 | | 2 | 17-Nov-84 | | 729366 | 1871999 |
| 0909 | MW | B | 4990.8 | 4983.3 | 4975.8 | 65.0 | 72.5 | 80.0 | 15.0 | 2.0 | 82.0 | 5057.17 | | 5055.8 | | 2 | 18-Nov-84 | | 730927 | 1871393 |
| 0910 | MW | B | 5007.6 | 4957.6 | 4907.6 | 97.0 | 147.0 | 197.0 | 100.0 | 1.0 | 198.0 | 5106.70 | | 5104.6 | | 4 | 26-Jul-85 | | 730219 | 1875840 |
| 0918 | MW | B | 4986.2 | 4983.7 | 4981.2 | 61.0 | 63.5 | 66.0 | 5.0 | 2.0 | 68.0 | 5049.63 | | 5047.2 | | 4 | 15-Aug-85 | | 727294 | 1868724 |
| 0925 | EXT | B | 5005.8 | 4985.8 | 4965.8 | 53.0 | 73.0 | 93.0 | 40.0 | 0.5 | 93.5 | 5060.87 | | 5058.8 | | 6 | 21-Oct-95 | 24-May-00 | 729452 | 1872006 |
| 0926 | EXT | B | 5018.3 | 4993.3 | 4968.3 | 42.2 | 67.2 | 92.2 | 50.0 | 3.0 | 95.2 | 5062.85 | | 5060.5 | | 6 | 25-Oct-95 | 17-May-00 | 730790 | 1872126 |
| 0933 | MW | B | 4993.3 | 4992.3 | 4991.3 | 23.0 | 24.0 | 25.0 | 2.0 | | | 5018.03 | | 5016.3 | | 4 | 18-Oct-95 | 24-May-00 | 731727 | 1871341 |
| 0934 | MW | B | 5013.0 | 4990.5 | 4968.0 | 45.0 | 67.5 | 90.0 | 45.0 | 3.0 | 93.0 | 5059.73 | | 5058.0 | | 4 | 02-Nov-95 | | 730018 | 1871649 |
| 0935 | MW/EXT | B | 5008.8 | 4988.8 | 4968.8 | 50.0 | 70.0 | 90.0 | 40.0 | 3.0 | 93.0 | 5061.50 | | 5058.8 | | 4 | 28-Oct-95 | * | 729461 | 1871978 |
| 0936 | MW/EXT | B | 5017.9 | 4997.9 | 4977.9 | 42.0 | 62.0 | 82.0 | 40.0 | 3.0 | 85.0 | 5062.30 | | 5059.9 | | 6 | 26-Oct-95 | * | 730055 | 1872121 |
| 0937 | MW | B | 5020.2 | 4992.7 | 4965.2 | 40.0 | 67.5 | 95.0 | 55.0 | 3.0 | 98.0 | 5062.80 | | 5060.2 | | 4 | 09-Nov-95 | 24-May-00 | 730790 | 1872116 |
| 0938 | MW/EXT | B | 5020.4 | 4992.9 | 4965.4 | 40.0 | 67.5 | 95.0 | 55.0 | 3.0 | 98.0 | 5063.64 | | 5060.4 | | 4 | 26-Oct-95 | * | 730769 | 1872124 |
| 0939 | EXT | B | 5021.1 | 4993.6 | 4966.1 | 40.0 | 67.5 | 95.0 | 55.0 | 3.0 | 98.0 | 5063.23 | | 5061.1 | | 6 | 23-Oct-95 | 16-May-00 | 731403 | 1872132 |
| 0942 | MW/EXT | B | 5009.5 | 4999.5 | 4989.5 | 54.0 | 64.0 | 74.0 | 20.0 | 3.0 | 77.0 | 5066.45 | | 5063.5 | | 4 | 03-Nov-95 | * | 731642 | 1872409 |

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 | Top of Casing Elev. | | Ground Elev. | | Well Diameter | Boring Started | Decommission Date | State Plane East | State Plane North |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0943 | MW | B | 4994.1 | 4984.1 | 4974.1 | 101.0 | 111.0 | 121.0 | 20.0 | 3.0 | 124.0 | 5098.05 | | 5095.1 | | 4 | 13-Oct-95 | | 731596 | 1874034 |
| 0944 | MW | B | 4979.9 | 4969.9 | 4959.9 | 85.0 | 95.0 | 105.0 | 20.0 | 2.0 | 107.0 | 5067.00 | | 5064.9 | | 4 | 04-Nov-95 | 28-Jul-99 | 732199 | 1873007 |
| 0947 | MW | B | 4990.0 | 4980.0 | 4970.0 | 105.0 | 115.0 | 125.0 | 20.0 | 3.3 | 128.3 | 5097.01 | | 5095.0 | | 4 | 03-Nov-95 | | 732786 | 1874642 |
| 1126 | EXT | B | 4991.9 | 4971.9 | 4951.9 | 60.0 | 80.0 | 100.0 | 40.0 | 3.3 | 103.3 | 5051.9 | ** | 5051.9 | ** | 4 | 09-Sep-04 | | 729517 | 1870728 |
| 1127 | EXT | B | 4984.2 | 4964.2 | 4944.2 | 72.7 | 92.7 | 112.7 | 40.0 | 3.3 | 116.0 | 5056.9 | ** | 5056.9 | ** | 4 | 11-Sep-04 | | 730044 | 1871022 |
| 1128 | EXT | B | 4982.3 | 4962.3 | 4942.3 | 72.7 | 92.7 | 112.7 | 40.0 | 3.3 | 116.0 | 5055.0 | ** | 5055.0 | ** | 4 | 12-Sep-04 | | 730679 | 1871294 |
| 1129 | EXT | B | 4990.9 | 4975.9 | 4960.9 | 68.2 | 83.2 | 98.2 | 30.0 | 3.3 | 101.5 | 5059.1 | ** | 5059.1 | ** | 4 | 30-Aug-04 | | 731237 | 1871690 |
| 1130 | EXT | B | 4987.3 | 4962.3 | 4937.3 | 71.7 | 96.7 | 121.7 | 50.0 | 3.3 | 125.0 | 5059.0 | ** | 5059.0 | ** | 4 | 29-Jul-04 | | 731699 | 1871907 |
| 1131 | EXT | B | 4998.1 | 4978.1 | 4958.1 | 59.7 | 79.7 | 99.7 | 40.0 | 3.3 | 103.0 | 5057.8 | ** | 5057.8 | ** | 4 | 08-Sep-04 | | 732011 | 1872106 |
| 1132 | EXT | B | 5009.1 | 4984.1 | 4959.1 | 49.7 | 74.7 | 99.7 | 50.0 | 3.3 | 103.0 | 5058.8 | ** | 5058.8 | ** | 4 | 31-Aug-04 | | 731310 | 1872015 |
| 1133 | EXT | B | 4999.4 | 4979.4 | 4959.4 | 59.7 | 79.7 | 99.7 | 40.0 | 3.3 | 103.0 | 5059.1 | ** | 5059.1 | ** | 4 | 02-Sep-04 | | 730850 | 1871827 |
| 0274 | MW | C | 4913.6 | 4903.6 | 4893.6 | 149.0 | 159.0 | 169.0 | 20.0 | 1.5 | 170.5 | 5064.42 | | 5062.6 | | 2 | 30-Aug-04 | | 731623 | 1872403 |
| 0276 | MW | C | 4910.0 | 4900.0 | 4890.0 | 154.5 | 164.5 | 174.5 | 20.0 | 1.5 | 176.0 | 5067.55 | | 5064.5 | | 2 | 01-Sep-04 | | 732081 | 1873158 |
| 0279 | MW | C | 4922.1 | 4917.1 | 4912.1 | 26.5 | 31.5 | 36.5 | 10.0 | 1.5 | 38.0 | 4951.04 | | 4948.6 | | 2 | 15-Aug-04 | | 731494 | 1870132 |
| 0280 | MW | C | 4922.6 | 4917.6 | 4912.6 | 26.5 | 31.5 | 36.5 | 10.0 | 1.5 | 38.0 | 4951.52 | | 4949.1 | | 2 | 15-Aug-04 | | 731794 | 1870289 |
| 0289 | MW | C | 4920.3 | 4915.3 | 4910.3 | 148.3 | 153.3 | 158.3 | 10.0 | 0.4 | 163.0 | 5070.82 | | 5068.6 | | 6 | 28-Mar-07 | | 729965 | 1872709 |
| 0683 | MW | C | 4973.2 | 4948.2 | 4923.2 | 95.0 | 120.0 | 145.0 | 50.0 | 3.0 | 148.0 | 5070.64 | | 5068.2 | | 6 | 31-Aug-99 | | 732661 | 1872574 |
| 0684 | MW | C | 4943.1 | 4917.4 | 4891.8 | 124.2 | 149.9 | 175.5 | 51.3 | 2.5 | 178.0 | 5070.05 | | 5067.3 | | 6 | 20-Aug-99 | | 732642 | 1873521 |
| 0685 | MW | C | 4975.6 | 4949.7 | 4923.8 | 93.7 | 119.6 | 145.5 | 51.8 | 2.5 | 148.0 | 5072.44 | | 5069.3 | | 6 | 19-Aug-99 | | 732295 | 1873760 |
| 0689 | MW | C | 4923.9 | 4903.9 | 4883.9 | 55.0 | 75.0 | 95.0 | 40.0 | 0.3 | 95.3 | 4981.63 | | 4978.9 | | 2 | 31-Mar-00 | | 730439 | 1869893 |
| 0691 | MW | C | 4921.9 | 4901.9 | 4881.9 | 55.0 | 75.0 | 95.0 | 40.0 | 0.3 | 95.3 | 4979.41 | | 4976.9 | | 2 | 30-Mar-00 | | 732124 | 1870872 |
| 0903 | MW | C | 4953.5 | 4943.5 | 4933.5 | 28.0 | 38.0 | 48.0 | 20.0 | 2.0 | 50.0 | 4983.33 | | 4981.5 | | 2 | 30-Oct-84 | | 731314 | 1870829 |
| 0912 | MW | C | 4934.7 | 4914.7 | 4894.7 | 123.0 | 143.0 | 163.0 | 40.0 | 2.0 | 165.0 | 5059.97 | | 5057.7 | | 4 | 12-Aug-85 | | 729324 | 1871942 |
| 0914 | MW | C | 4930.3 | 4921.8 | 4913.3 | 137.2 | 145.7 | 154.2 | 17.0 | 2.0 | 156.2 | 5070.10 | | 5067.5 | | 4 | 16-Aug-85 | | 732723 | 1872119 |
| 0917 | MW | C | 4917.8 | 4907.8 | 4897.8 | 128.0 | 138.0 | 148.0 | 20.0 | 2.0 | 150.0 | 5048.02 | | 5045.8 | | 4 | 14-Aug-85 | | 727255 | 1868642 |
| 0930 | MW | C | 4933.0 | 4918.0 | 4903.0 | 20.0 | 35.0 | 50.0 | 30.0 | 3.0 | 53.0 | 4954.96 | | 4953.0 | | 4 | 23-Oct-95 | | 731257 | 1870099 |
| 0932 | MW | C | 4942.3 | 4932.3 | 4922.3 | 112.5 | 122.5 | 132.5 | 20.0 | 2.7 | 135.2 | 5057.32 | | 5054.8 | | 4 | 29-Oct-95 | | 730900 | 1871401 |
| 1008 | INJ | C | 4926.8 | 4901.6 | 4876.4 | 55.6 | 80.8 | 106.0 | 50.4 | 2.5 | 108.5 | 4980.52 | | 4982.3 | | 6 | 23-Jul-99 | | 730410 | 1869916 |
| 1116 | EXT | C | 4964.1 | 4912.5 | 4861.0 | 92.4 | 143.9 | 195.5 | 103.1 | 2.5 | 198.0 | 5053.74 | | 5056.5 | | 6 | 08-Aug-99 | | 730350 | 1871702 |
| 1117 | EXT | C | 4965.3 | 4913.7 | 4862.1 | 92.3 | 143.9 | 195.5 | 103.2 | 2.5 | 198.0 | 5054.95 | | 5057.6 | | 6 | 11-Aug-99 | | 729981 | 1871688 |
| 1118 | EXT | C | 4967.9 | 4915.1 | 4862.3 | 89.9 | 142.7 | 195.5 | 105.6 | 2.5 | 198.0 | 5055.11 | | 5057.8 | | 6 | 12-Aug-99 | | 729756 | 1871695 |
| 0258 | MW | D | 4894.0 | 4874.0 | 4854.0 | 159.0 | 179.0 | 199.0 | 40.0 | 0.3 | 199.3 | 5055.56 | | 5053.0 | | 2 | 13-Apr-00 | | 732452 | 1871996 |
| 0261 | MW | D | 4907.0 | 4887.0 | 4867.0 | 160.0 | 180.0 | 200.0 | 40.0 | 0.3 | 200.3 | 5069.69 | | 5067.0 | | 2 | 01-Apr-00 | | 732565 | 1871578 |
| 0264 | MW | D | 4899.6 | 4879.6 | 4859.6 | 160.0 | 180.0 | 200.0 | 40.0 | 0.3 | 200.3 | 5062.19 | | 5059.6 | | 2 | 03-Apr-00 | | 731569 | 1871746 |
| 0266 | MW | D | 4890.6 | 4870.6 | 4850.6 | 160.0 | 180.0 | 200.0 | 40.0 | 0.3 | 200.3 | 5053.32 | | 5050.6 | | 2 | 15-Apr-00 | | 730380 | 1870941 |
| 0272 | MW | D | 4902.8 | 4892.8 | 4882.8 | 159.1 | 169.1 | 179.1 | 20.0 | 1.5 | 180.6 | 5064.24 | | 5061.9 | | 2 | 28-Aug-04 | | 730112 | 1872389 |
| 0273 | MW | D | 4909.4 | 4899.4 | 4889.4 | 153.0 | 163.0 | 173.0 | 20.0 | 1.5 | 174.5 | 5064.74 | | 5062.4 | | 2 | 29-Aug-04 | | 730922 | 1872397 |
| 0275 | MW | D | 4903.0 | 4893.0 | 4883.0 | 158.2 | 168.2 | 178.2 | 20.0 | 1.5 | 179.7 | 5062.64 | | 5061.2 | | 2 | 01-Sep-04 | | 732092 | 1872586 |
| 0277 | MW | D | 4884.0 | 4879.0 | 4874.0 | 95.7 | 100.7 | 105.7 | 10.0 | 1.5 | 107.2 | 4982.35 | | 4979.7 | | 2 | 12-Aug-04 | | 731290 | 1870777 |
| 0278 | MW | D | 4862.9 | 4857.9 | 4852.9 | 90.5 | 95.5 | 100.5 | 10.0 | 1.5 | 102.0 | 4956.09 | | 4953.4 | | 2 | 14-Aug-04 | | 731210 | 1870104 |

*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 | Top of Casing Elev. | | Ground Elev. | | Well Diameter | Boring Started | Decommission Date | State Plane East | State Plane North |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0690 | MW | D | 4893.3 | 4873.3 | 4853.3 | 55.0 | 75.0 | 95.0 | 40.0 | 0.3 | 95.3 | 4950.87 | | 4948.3 | | 2 | 30-Mar-00 | | 731521 | 1870140 |
| 0692 | MW | D | 4895.6 | 4875.6 | 4855.6 | 55.0 | 75.0 | 95.0 | 40.0 | 0.3 | 95.3 | 4953.31 | | 4950.6 | | 2 | 05-Apr-00 | | 731821 | 1870303 |
| 0695 | MW | D | 4919.3 | 4899.3 | 4879.3 | 55.0 | 75.0 | 95.0 | 40.0 | 0.3 | 95.3 | 4976.83 | | 4974.3 | | 2 | 06-Apr-00 | | 732566 | 1870896 |
| 0904 | MW | D | 4873.8 | 4868.8 | 4863.8 | 28.0 | 33.0 | 38.0 | 10.0 | 2.0 | 40.0 | 4904.11 | | 4901.8 | | 2 | 07-Nov-84 | | 731808 | 1868036 |
| 0915 | MW | D | 4897.8 | 4892.8 | 4887.8 | 170.0 | 175.0 | 180.0 | 10.0 | 2.0 | 182.0 | 5070.84 | | 5067.8 | | 4 | 24-Aug-85 | | 732740 | 1872209 |
| 1003 | INJ | D | 4923.4 | 4898.4 | 4873.4 | 55.5 | 80.5 | 105.5 | 50.0 | 2.5 | 108.0 | 4976.58 | | 4978.9 | | 6 | 26-Jul-99 | | 732101 | 1870898 |
| 1004 | INJ | D | 4918.1 | 4893.1 | 4868.1 | 45.5 | 70.5 | 95.5 | 50.0 | 2.5 | 98.0 | 4961.55 | | 4963.6 | | 6 | 27-Jul-99 | | 731892 | 1870544 |
| 1005 | INJ | D | 4904.7 | 4879.7 | 4854.7 | 45.5 | 70.5 | 95.5 | 50.0 | 2.5 | 98.0 | 4947.83 | | 4950.2 | | 6 | 25-Jul-99 | | 731496 | 1870168 |
| 1006 | INJ | D | 4903.7 | 4878.7 | 4853.7 | 45.7 | 70.7 | 95.7 | 50.0 | 2.5 | 98.2 | 4947.08 | | 4949.5 | | 6 | 24-Jul-99 | | 731233 | 1869918 |
| 1007 | INJ | D | 4915.6 | 4890.5 | 4865.4 | 45.8 | 70.9 | 96.0 | 50.2 | 2.5 | 98.5 | 4958.56 | | 4961.4 | | 6 | 23-Jul-99 | | 730770 | 1869861 |
| 1101 | EXT | D | 4974.2 | 4896.5 | 4818.9 | 96.1 | 173.8 | 251.5 | 155.4 | 2.5 | 254.0 | 5067.29 | | 5070.4 | | 6 | 24-Aug-99 | | 732223 | 1872970 |
| 1102 | EXT | D | 4968.8 | 4893.8 | 4818.8 | 101.5 | 176.5 | 251.5 | 150.0 | 2.5 | 254.0 | 5066.76 | | 5070.3 | | 6 | 24-Aug-99 | | 732225 | 1872670 |
| 1103 | EXT | D | 4962.3 | 4887.3 | 4812.3 | 100.0 | 175.0 | 250.0 | 150.0 | 2.5 | 252.5 | 5059.56 | | 5062.3 | | 6 | 30-Jul-99 | | 731896 | 1872407 |
| 1104 | EXT | D | 4972.3 | 4894.8 | 4817.3 | 90.0 | 167.5 | 245.0 | 155.0 | 3.0 | 248.0 | 5059.57 | | 5062.3 | | 6 | 01-Aug-99 | | 731527 | 1872404 |
| 1105 | EXT | D | 4972.1 | 4894.6 | 4817.1 | 90.0 | 167.5 | 245.0 | 155.0 | 3.0 | 248.0 | 5059.33 | | 5062.1 | | 6 | 02-Aug-99 | | 731304 | 1872401 |
| 1106 | EXT | D | 4966.0 | 4888.7 | 4811.4 | 96.5 | 173.8 | 251.1 | 154.6 | 2.9 | 254.0 | 5059.73 | | 5062.5 | | 6 | 03-Aug-99 | | 731081 | 1872400 |
| 1107 | EXT | D | 4971.2 | 4894.0 | 4816.8 | 91.1 | 168.3 | 245.5 | 154.4 | 2.5 | 248.0 | 5059.51 | | 5062.3 | | 6 | 03-Aug-99 | | 730858 | 1872398 |
| 1108 | EXT | D | 4966.1 | 4891.1 | 4816.1 | 96.3 | 171.3 | 246.3 | 150.0 | 2.5 | 248.8 | 5059.62 | | 5062.4 | | 6 | 03-Aug-99 | | 730634 | 1872396 |
| 1109 | EXT | D | 4972.1 | 4894.7 | 4817.3 | 90.3 | 167.7 | 245.1 | 154.8 | 2.9 | 248.0 | 5059.64 | | 5062.4 | | 6 | 04-Aug-99 | | 730410 | 1872394 |
| 1110 | EXT | D | 4966.8 | 4891.8 | 4816.8 | 95.5 | 170.5 | 245.5 | 150.0 | 2.5 | 248.0 | 5059.47 | | 5062.3 | | 6 | 07-Aug-99 | | 730187 | 1872392 |
| 1111 | EXT | D | 4971.9 | 4894.7 | 4817.5 | 90.7 | 167.9 | 245.1 | 154.4 | 2.5 | 247.6 | 5059.87 | | 5062.6 | | 6 | 06-Aug-99 | | 729993 | 1872392 |
| 1112 | EXT | D | 4969.1 | 4891.6 | 4814.1 | 90.5 | 168.0 | 245.5 | 155.0 | 2.5 | 248.0 | 5057.08 | | 5059.6 | | 6 | 17-Aug-99 | | 730494 | 1872064 |
| 1113 | EXT | D | 4968.7 | 4891.2 | 4813.7 | 90.5 | 168.0 | 245.5 | 155.0 | 2.5 | 248.0 | 5058.54 | | 5059.2 | | 6 | 17-Aug-99 | | 730196 | 1872061 |
| 1114 | EXT | D | 4968.5 | 4891.0 | 4813.6 | 90.6 | 168.0 | 245.5 | 154.9 | 2.5 | 248.0 | 5056.25 | | 5059.1 | | 6 | 11-Aug-99 | | 729896 | 1872057 |
| 1115 | EXT | D | 4968.6 | 4891.2 | 4813.7 | 90.5 | 168.0 | 245.5 | 155.0 | 2.5 | 248.0 | 5056.36 | | 5059.2 | | 6 | 07-Aug-99 | | 729596 | 1872055 |
| 1119 | EXT | D | 4968.7 | 4893.7 | 4818.7 | 95.3 | 170.3 | 245.3 | 150.0 | 2.5 | 247.8 | 5061.19 | | 5064.0 | | 6 | 31-Jul-99 | | 731894 | 1872667 |
| 1120 | EXT | D | 4971.0 | 4896.0 | 4821.0 | 95.5 | 170.5 | 245.5 | 150.0 | 2.5 | 248.0 | 5063.60 | | 5066.5 | | 6 | 28-Jul-99 | | 731891 | 1872967 |
| 1121 | EXT | D | 4972.0 | 4897.0 | 4822.0 | 97.5 | 172.5 | 247.5 | 150.0 | 2.5 | 250.0 | 5066.61 | | 5069.5 | | 6 | 28-Jul-99 | | 731889 | 1873267 |
| 1122 | EXT | D | 4973.4 | 4896.3 | 4819.2 | 96.9 | 174.0 | 251.1 | 154.2 | 2.9 | 254.0 | 5067.31 | | 5070.3 | | 6 | 26-Aug-99 | | 732221 | 1873269 |
| 1123 | EXT | D | 4976.2 | 4899.2 | 4822.2 | 91.0 | 168.0 | 245.0 | 154.0 | 3.0 | 248.0 | 5064.54 | | 5067.2 | | 6 | 02-Sep-99 | | 732508 | 1873222 |
| 1124 | EXT | D | 4978.7 | 4899.9 | 4821.1 | 87.9 | 166.7 | 245.5 | 157.6 | 2.5 | 248.0 | 5063.86 | | 5066.6 | | 6 | 23-Aug-99 | | 732512 | 1872972 |
| 1125 | EXT | D | 4972.8 | 4897.8 | 4822.8 | 95.5 | 170.5 | 245.5 | 150.0 | 2.5 | 248.0 | 5065.47 | | 5068.3 | | 6 | 25-Aug-99 | | 732515 | 1872671 |
| 0251 | MW | E | 4858.9 | 4808.9 | 4758.9 | 200.0 | 250.0 | 300.0 | 100.0 | 0.3 | 300.3 | 5061.25 | | 5058.9 | | 2 | 28-Apr-00 | | 730215 | 1871999 |
| 0268 | MW | E | 4864.5 | 4814.5 | 4764.5 | 200.0 | 250.0 | 300.0 | 100.0 | 0.3 | 300.3 | 5067.24 | | 5064.5 | | 2 | 15-May-00 | | 732301 | 1872430 |
| 0920 | MW | E | 4866.0 | 4846.0 | 4826.0 | 114.4 | 134.4 | 154.4 | 40.0 | 2.0 | 156.4 | 4982.97 | | 4980.4 | | 4 | 30-Jul-85 | | 731262 | 1870737 |
| 0948 | EXDS | E | 4893.9 | 4803.9 | 4713.9 | 221.5 | 311.5 | 401.5 | 180.0 | 5.0 | 406.5 | 5117.80 | | 5115.4 | | 4 | 17-Oct-95 | | 733915 | 1875516 |
| 0911 | MW | F | 4795.2 | 4775.2 | 4755.2 | 309.4 | 329.4 | 349.4 | 40.0 | 2.0 | 351.4 | 5106.96 | | 5104.6 | | 4 | 18-Jul-85 | | 730265 | 1875920 |
| 0913 | MW | G | 4729.2 | 4709.2 | 4689.2 | 328.7 | 348.7 | 368.7 | 40.0 | 2.0 | 370.7 | 5060.16 | | 5057.9 | | 4 | 02-Aug-85 | | 729327 | 1871871 |
| 0916 | MW | G | 4721.7 | 4716.7 | 4711.7 | 345.7 | 350.7 | 355.7 | 10.0 | 2.0 | 357.7 | 5070.00 | | 5067.4 | | 4 | 22-Aug-85 | | 732811 | 1872146 |
| 0919 | MW | G | 4707.9 | 4702.9 | 4697.9 | 337.7 | 342.7 | 347.7 | 10.0 | 2.0 | 349.7 | 5048.56 | | 5045.6 | | 4 | 26-Aug-85 | | 727353 | 1868654 |
| 0902 | MW | H | 4673.7 | 4668.7 | 4663.7 | 63.0 | 68.0 | 73.0 | 10.0 | 2.0 | 75.0 | 4737.42 | | 4736.7 | | 2 | 02-Dec-84 | | 730179 | 1862292 |

*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 | Top of Casing Elev. | | Ground Elev. | | Well Diameter | Boring Started | Decommission Date | State Plane East | State Plane North |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0252 | MW | I | 4658.9 | 4608.9 | 4558.9 | 400.0 | 450.0 | 500.0 | 100.0 | 0.4 | 500.4 | 5061.30 | | 5058.9 | | 4 | 26-Apr-00 | | 730232 | 1871993 |
| 0254 | MW | I | 4662.7 | 4612.7 | 4562.7 | 400.0 | 450.0 | 500.0 | 100.0 | 0.4 | 500.4 | 5065.38 | | 5062.7 | | 4 | 03-May-00 | 13-Aug-05 | 730951 | 1872411 |
| 0256 | MW | I | 4664.0 | 4614.0 | 4564.0 | 400.0 | 450.0 | 500.0 | 100.0 | 0.4 | 500.4 | 5066.58 | | 5064.0 | | 4 | 13-May-00 | 14-Aug-05 | 732277 | 1872437 |
| 0921 | MW | I | 4663.7 | 4643.7 | 4623.7 | 313.2 | 333.2 | 353.2 | 40.0 | 2.0 | 355.2 | 4979.08 | | 4976.9 | | 4 | 22-Jul-85 | | 731379 | 1870742 |
| 0253 | MW | M | 4458.8 | 4408.8 | 4358.8 | 600.0 | 650.0 | 700.0 | 100.0 | 0.4 | 700.4 | 5061.11 | | 5058.8 | | 4 | 18-Apr-00 | 11-Apr-01 | 730213 | 1871974 |
| 0255 | MW | M | 4462.3 | 4412.3 | 4362.3 | 600.0 | 650.0 | 700.0 | 100.0 | 0.4 | 700.4 | 5064.89 | | 5062.3 | | 4 | 01-May-00 | 12-Aug-05 | 730947 | 1872387 |
| 0257 | MW | M | 4463.4 | 4413.4 | 4363.4 | 600.0 | 650.0 | 700.0 | 100.0 | 0.4 | 700.4 | 5066.40 | | 5063.4 | | 4 | 11-May-00 | 11-Aug-05 | 732278 | 1872414 |
| 0968 | EXDS | NA | 5000.4 | 4699.9 | 4399.4 | 106.0 | 406.5 | 707.0 | 601.0 | 0.0 | 707.0 | 5107.00 | | 5106.4 | | 10 | 1-Feb-55 | | 730180 | 1875689 |
| 0970 | EXDS | NA | 5007.7 | 4705.2 | 4402.7 | 100.0 | 402.5 | 705.0 | 605.0 | 0.0 | 705.0 | 5109.53 | | 5107.7 | | 10 | 1-Sep-55 | | 730653 | 1876567 |
| 0971 | EXDS | NA | 4985.3 | 4693.8 | 4402.3 | 117.0 | 408.5 | 700.0 | 583.0 | 0.0 | 700.0 | 5104.00 | | 5102.3 | | 10 | 1-Nov-55 | | 731590 | 1878306 |
| 0972 | EXDS | NA | 5039.7 | 4724.7 | 4409.7 | 100.0 | 415.0 | 730.0 | 630.0 | 0.0 | 730.0 | 5141.07 | | 5139.7 | | 10 | 1-Jun-56 | | 728031 | 1877986 |

All dimensions in feet except well diameter in inches
All depths are relative to ground surface
* = Converted to extraction well in August 2005
MW = monitoring well
EXT = Groundwater remediation extraction well
INJ = Groundwater remediation injection well
EXDS = Extraction well domestic supply, completed in Navajo Sandstone. Four wells, previously owned by Rare Metals—0968, 0970, 0971, and 0972 (sampled in 1982 and 1985 only)—are located north of the site, near upgradient monitoring wells 0901, 0910, and 0911. Well 0948 (single sampling in 1995), located about 1500 ft east of the site, is used to supply the Tuba City site treatment facility with domestic non-potable water. Water levels are still measured annually at wells 0948, 0968, and 0970.
** = Approximate

# Appendix B

# Groundwater Sample Results for Contaminants of Concern: August 2009, February 2010, and the Baseline Period

This page intentionally left blank

# Contents

## Tables

This page intentionally left blank

*Table B−1. Baseline, August 2009, and February 2010 Molybdenum Concentrations*

| Well Number | Horizon | Baseline Molybdenum Concentration (mg/L) | Year Sampled, Baseline | August 2009 Molybdenum Concentration (mg/L) | February 2010 Molybdenum Concentration (mg/L) |
|---|---|---|---|---|---|
| 0686 | A | 0.0015 U | 2002 | 0.00096 B | NS |
| 0687 | A | 0.0113 | 2002 | 0.0044 | NS |
| 0688 | A | 0.0015 U | 2002 | 0.0033 | NS |
| 0901 | A | 0.00078 | 2001 | 0.00061 B | NS |
| 0906 | A | 0.0137 | 2002 | 0.0015 * | 0.0014 |
| 0929 | A | 0.0015 U | 2002 | 0.00036 BU | 0.00043 B |
| 0940 | A | 0.0015 U | 2002 | NS | NS |
| 0941 | A | 0.0284 | 2002 | 0.0029 | 0.018 |
| 0945 | A | 0.0015 U | 2002 | 0.00073 B | NS |
| 0946 | A | | | 0.0011 | NS |
| **0262** | B | **0.432** | 2001 | **1.5** | **1.3** |
| 0263 | B | **0.192** | 2001 | 0.03 | 0.024 |
| 0265 | B | 0.00046 | 2001 | 0.0002 B | 0.00025 BU |
| 0267 | B | 0.0015 U | 2002 | 0.00026 B | 0.00051 B |
| 0271 | B | 0.0015 U | 2002 | 0.00034 B | NS |
| 0281 | B | | | 0.00088 B * | 0.0012 U * |
| 0282 | B | | | 0.00067 B | 0.0006 BU * |
| 0286 | B | | | 0.00044 B | 0.00043 BU |
| 0287 | B | | | 0.048 | 0.081 |
| 0288 | B | | | 0.0002 BU | 0.00025 BU |
| 0290 | B | | | 0.00057 B * | 0.00053 B |
| 0908 | B | 0.0015 U | 2002 | 0.00099 B | 0.001 |
| 0909 | B | 0.0015 U | 2002 | 0.00025 BU* | 0.00023BU * |
| 0910 | B | | | 0.00054 BU | NS |
| 0934 | B | 0.0015 U | 2002 | 0.00026 BU | 0.00031 BU |
| 0935 | B | 0.0015 U | 2002 | 0.00031 BU | 0.000099BU |
| 0936 | B | 0.0015 U | 2002 | NS (Dry) | NS (Dry) |
| 0938 | B | 0.001 U | 1999 | 0.08 | 0.042 |
| 0942 | B | 0.021 | 2002 | 0.0065 | 0.0079 |
| 0943 | B | 0.0015 U | 2002 | 0.00085 B | NS |
| 0947 | B | 0.0015 U | 2002 | 0.00056 B | NS |
| 1129 | B | | | 0.73 | NS |
| 1130 | B | | | 0.066 | NS |
| **1132** | B | | | **1.5** | NS |
| 1133 | B | | | 0.013 | NS |
| 0274 | C | | | 0.00052 B | 0.00076 BU |
| 0276 | C | | | 0.00052 B | 0.00061 BU |
| 0279 | C | | | 0.00053 B | NS |
| 0280 | C | | | 0.00055 B | NS |
| 0289 | C | | | 0.00043 BU | 0.00072 B |
| 0683 | C | 0.0015 U | 2002 | 0.00059 B | NS |
| 0684 | C | 0.0015 U | 2002 | 0.00053 B | NS |
| 0685 | C | 0.0015 U | 2002 | 0.00043 BU | NS |
| 0689 | C | 0.0015 U | 2002 | 0.00045 B | NS |

*Table B−1 (continued). Baseline, August 2009, and February 2010 Molybdenum Concentrations*

| Well Number | Horizon | Baseline Molybdenum Concentration (mg/L) | Year Sampled, Baseline | August 2009 Molybdenum Concentration (mg/L) | February 2010 Molybdenum Concentration (mg/L) |
|---|---|---|---|---|---|
| 0691 | C | 0.0015 U | 2002 | 0.00028 B | 0.0003 BU |
| 0903 | C | 0.0015 U | 2002 | 0.00039 BU | NS |
| 0912 | C | 0.0003 U | 2001 | 0.00025 BU | NS |
| 0914 | C | 0.00081 | 2001 | 0.00095 B | NS |
| 0917 | C | 0.0013 | 2001 | NS | NS |
| 0930 | C | 0.0015 U | 2002 | 0.00028 BU | 0.00062 B |
| 0932 | C | 0.0018 U | 2002 | 0.00047 BU | 0.00063 B |
| 1008 | C | 0.0004 U | 2000 | NS | NS |
| 1116 | C | 0.0015 U | 2002 | 0.00023 BU | NS |
| 1117 | C | 0.0015 U | 2002 | 0.00026 B | NS |
| 1118 | C | 0.0015 U | 2002 | 0.00049 B | NS |
| 0258 | D | 0.00063 | 2000 | 0.00055 B | 0.00074 BU |
| 0261 | D | 0.0026 | 2001 | 0.0006 B | NS |
| 0264 | D | 0.0031 | 2001 | 0.0005 B | 0.00087 BU |
| 0266 | D | 0.00058 | 2001 | 0.00061 B | 0.00082 BU |
| 0272 | D | | | 0.00031 BU | 0.00041 BU |
| 0273 | D | | | 0.028 | 0.021 |
| 0275 | D | | | 0.0003 BU | 0.00051 BU |
| 0277 | D | | | 0.00046 B | NS |
| 0278 | D | | | 0.00073 B | NS |
| 0690 | D | 0.0015 U | 2002 | 0.0004 B | NS |
| 0692 | D | 0.0015 U | 2002 | 0.00043 B | NS |
| 0695 | D | 0.0015 U | 2002 | 0.00071 B | NS |
| 0904 | D | 0.00077 | 2001 | 0.00058 BU | NS |
| 0915 | D | 0.00054 | 2001 | 0.00069 B | NS |
| 1003 | D | 0.0004 U | 2000 | 0.00021 BU | NS |
| 1004 | D | 0.0004 U | 2000 | 0.00043 BU | NS |
| 1005 | D | 0.0004 U | 2000 | NS | NS |
| 1006 | D | 0.0004 U | 2000 | 0.0004 B | NS |
| 1007 | D | 0.0004 U | 2000 | 0.00036 B | NS |
| 1101 | D | 0.0015 U | 2002 | 0.00054 B | NS |
| 1102 | D | 0.0015 U | 2002 | 0.00033 B | NS |
| 1103 | D | 0.0015 U | 2002 | 0.0049 | NS |
| 1104 | D | 0.0916 | 2002 | 0.046 | NS |
| **1105** | D | **2.96** | 2002 | **0.5** | NS |
| **1106** | D | **1.26** | 2002 | **0.18** | NS |
| 1107 | D | **0.16** | 2002 | 0.027 | NS |
| 1108 | D | 0.0015 U | 2002 | 0.0013 | NS |
| 1109 | D | 0.0015 U | 2002 | 0.00046 B | NS |
| 1110 | D | 0.0015 U | 2002 | 0.00025 B | NS |
| 1111 | D | 0.0015 U | 2002 | 0.00033 B | NS |
| 1112 | D | 0.0015 U | 2002 | 0.00029 BU | NS |
| 1113 | D | 0.0015 U | 2002 | 0.00026 BU | NS |
| 1114 | D | 0.0027 | 2002 | 0.014 | NS |
| 1115 | D | 0.0015 U | 2002 | 0.00029 BU | NS |
| 1119 | D | 0.0053 | 2002 | 0.0069 | NS |

*Table B−1 (continued). Baseline, August 2009, and February 2010 Molybdenum Concentrations*

| Well Number | Horizon | Baseline Molybdenum Concentration (mg/L) | Year Sampled, Baseline | August 2009 Molybdenum Concentration (mg/L) | February 2010 Molybdenum Concentration (mg/L) |
|---|---|---|---|---|---|
| 1120 | D | 0.0815 | 2002 | 0.031 | NS |
| 1121 | D | **0.105** | 2002 | 0.012 | NS |
| 1122 | D | 0.0015 U | 2002 | NS | NS |
| 1123 | D | 0.0015 U | 2002 | 0.00024 BU | NS |
| 1124 | D | 0.0015 U | 2002 | NS | NS |
| 1125 | D | 0.0015 U | 2002 | 0.00042 BU | NS |
| 0251 | E | 0.0015 U | 2002 | 0.00041 BU | 0.00088 BU |
| 0268 | E | 0.0015 U | 2002 | 0.00032 BU | 0.0011 |
| 0920 | E | 0.0003 U | 2001 | 0.00038 BU | NS |
| 0911 | F | | | 0.00025 BU | NS |
| 0913 | G | 0.0003 U | 2001 | 0.00016 BU | NS |
| 0916 | G | 0.00096 | 2001 | 0.001 | NS |
| 0252 | I | 0.0015 U | 2002 | 0.00034 B | 0.00072 BU |
| 0921 | I | 0.0003 U | 2001 | 0.00022 BU | NS |

B = Result between instrument detection limit and contract required detection limit.
U = Analytical result below detection limit.
NS = Not sampled.

Values in **red** exceed the corresponding groundwater remediation target for molybdenum, 0.1 mg/L (see Table 1 of main report). Well numbers with groundwater concentrations greater than the remediation target during this reporting period are also listed in **red**.

* Denotes filtered sample. Samples are generally not filtered (as reflected above), except in cases when turbidity is greater than 10 Nephelometric Turbidity Units (NTUs).

*Table B−2. Baseline, August 2009, and February 2010 Nitrate Concentrations (as $NO_3$)*

| Well Number | Horizon | Baseline Nitrate Concentration (mg/L) | Year Sampled, Baseline | August 2009 Nitrate Concentration (mg/L) | February 2010 Nitrate Concentration (mg/L) |
|---|---|---|---|---|---|
| 0686 | A | 32.2 | 2002 | 7.5 | NS |
| 0687 | A | **60.6** | 2002 | 9 | NS |
| 0688 | A | 35.1 | 2002 | 32 | NS |
| 0901 | A | 13 | 2001 | 13 | NS |
| **0906** | A | **1470** | 2002 | **1680** * | **1730** |
| **0929** | A | **69.5** | 2002 | **53** | **80** |
| 0940 | A | **1800** | 2002 | NS | NS |
| **0941** | A | **358** | 2002 | **1020** | **1150** |
| 0945 | A | 12.7 | 2002 | 21 | NS |
| 0946 | A | | | 10 | NS |
| **0262** | B | **380** | 2001 | **753** | **797** |
| **0263** | B | **1140** | 2001 | **753** | **1200** |
| **0265** | B | **720** | 2001 | **797** | **797** |
| **0267** | B | **1640** | 2002 | **1240** | **1460** |
| 0271 | B | 15.6 | 2002 | 15 | NS |
| **0281** | B | | | **190** * | **190** * |
| **0282** | B | | | 17 | **160** * |
| **0286** | B | | | **270** | **160** |
| **0287** | B | | | **1020** | **1200** |
| **0288** | B | | | **280** | **250** |
| 0290 | B | | | 16 * | 32 |
| **0908** | B | **651** | 2002 | **841** | **974** |
| **0909** | B | **485** | 2002 | **664** * | **753** * |
| 0910 | B | | | 12 | NS |
| **0934** | B | **2320** | 2002 | **1640** | **1860** |
| **0935** | B | **525** | 2002 | **841** | **1020** |
| 0936 | B | **2950** | 2002 | NS (Dry) | NS (Dry) |
| **0938** | B | **1450** | 1999 | **974** | **797** |
| **0942** | B | **1360** | 2002 | **797** | **841** |
| 0943 | B | 22.1 | 2002 | 16 | NS |
| 0947 | B | 12.5 | 2002 | 12 | NS |
| **1129** | B | | | **443** | NS |
| **1130** | B | | | **797** | NS |
| **1132** | B | | | **753** | NS |
| **1133** | B | | | **170** | NS |
| 0274 | C | | | 14 | 15 |
| 0276 | C | | | 14 | 15 |
| 0279 | C | | | 53 | NS |
| 0280 | C | | | 12 | NS |
| **0289** | C | | | **230** | **290** |
| 0683 | C | 14.1 | 2002 | 14 | NS |
| 0684 | C | 13.9 | 2002 | 15 | NS |
| 0685 | C | 14.3 | 2002 | 14 | NS |
| 0689 | C | 14.3 | 2002 | 10 | NS |
| **0691** | C | **298** | 2002 | **230** | **290** |
| 0903 | C | **54.8** | 2002 | 10N | NS |

*Table B−2 (continued). Baseline, August 2009, and February 2010 Nitrate Concentrations (as $NO_3$)*

| Well Number | Horizon | Baseline Nitrate Concentration (mg/L) | Year Sampled, Baseline | August 2009 Nitrate Concentration (mg/L) | February 2010 Nitrate Concentration (mg/L) |
|---|---|---|---|---|---|
| **0912** | C | 403 | 2001 | **270** | NS |
| 0914 | C | 13 | 2001 | 11 | NS |
| 0917 | C | 15.7 | 2001 | NS | NS |
| **0930** | C | **50.9** | 2002 | **62** | **58** |
| 0932 | C | 25.3 | 2002 | 30 | 38 |
| 1008 | C | 15.7 | 2000 | NS | NS |
| **1116** | C | **106** | 2002 | **240** | NS |
| **1117** | C | **225** | 2002 | **443** | NS |
| **1118** | C | **164** | 2002 | **664** | NS |
| 0258 | D | 15 | 2000 | 14 | 15 |
| 0261 | D | 14 | 2001 | 14 | NS |
| **0264** | D | 24.3 | 2001 | **49** | **49** |
| 0266 | D | 14 | 2001 | 13 | 14 |
| 0272 | D | | | 15 | 16 |
| **0273** | D | | | **290** | **230** |
| **0275** | D | | | **930** | **1110** |
| 0277 | D | | | 13 | NS |
| 0278 | D | | | 12 | NS |
| 0690 | D | 12.5 | 2002 | 12 | NS |
| 0692 | D | 12.5 | 2002 | 12 | NS |
| 0695 | D | 25.4 | 2002 | 20 | NS |
| 0904 | D | 5.13 | 2001 | 4.9 | NS |
| 0915 | D | 14.1 | 2001 | 13 | NS |
| **1003** | D | **176** | 2000 | **230** | NS |
| **1004** | D | **49.1** | 2000 | **53** | NS |
| 1005 | D | 14.5 | 2000 | NS | NS |
| 1006 | D | 14.1 | 2000 | 10 | NS |
| 1007 | D | 15.3 | 2000 | 15 | NS |
| **1101** | D | **438** | 2002 | **330** | NS |
| **1102** | D | **650** | 2002 | **487** | NS |
| **1103** | D | **1120** | 2002 | **753** | NS |
| **1104** | D | **993** | 2002 | **531** | NS |
| **1105** | D | **648** | 2002 | **487** | NS |
| **1106** | D | **614** | 2002 | **430** | NS |
| **1107** | D | **1060** | 2002 | **270** | NS |
| **1108** | D | **1410** | 2002 | **664** | NS |
| **1109** | D | **798** | 2002 | **410** | NS |
| **1110** | D | **227** | 2002 | **420** | NS |
| **1111** | D | **421** | 2002 | **576** | NS |
| **1112** | D | **617** | 2002 | **170** | NS |
| **1113** | D | **143** | 2002 | **120** | NS |
| **1114** | D | **228** | 2002 | **330** | NS |
| **1115** | D | **766** | 2002 | **380** | NS |
| **1119** | D | **468** | 2002 | **753** | NS |
| **1120** | D | **493** | 2002 | **210** | NS |
| **1121** | D | **573** | 2002 | **62** | NS |

*Table B−2 (continued). Baseline, August 2009, and February 2010 Nitrate Concentrations as ($NO_3$)*

| Well Number | Horizon | Baseline Nitrate Concentration (mg/L) | Year Sampled, Baseline | August 2009 Nitrate Concentration (mg/L) | February 2010 Nitrate Concentration (mg/L) |
|---|---|---|---|---|---|
| 1122 | D | **954** | 2002 | NS | NS |
| **1123** | D | **643** | 2002 | **140** | NS |
| 1124 | D | 781 | 2002 | NS | NS |
| **1125** | D | 104 | 2002 | **49** | NS |
| 0251 | E | 426 | 2002 | 16 | 20 |
| **0268** | E | 15.4 | 2002 | **84** | **84** |
| 0920 | E | 14.8 | 2001 | 13 | NS |
| 0911 | F | | | 12 | NS |
| 0913 | G | 12.4 | 2001 | 12 | NS |
| 0916 | G | 11.6 | 2001 | 8.4 | NS |
| 0252 | I | 15.3 | 2002 | 9.7 | 10 |
| 0921 | I | 11 | 2001 | 10 | NS |

NS = Not sampled.

Values in **red** exceed the corresponding groundwater remediation target for nitrate (as $N0_3$), 44 mg/L (see Table 1 of main report). Well numbers with groundwater concentrations greater than the remediation target during this reporting period are also listed in **red**.

* Denotes filtered sample. Samples are generally not filtered (as reflected above), except in cases when turbidity is greater than 10 NTUs.

*Table B−3. Baseline, August 2009, and February 2010 Selenium Concentrations*

| Well Number | Horizon | Baseline Selenium Concentration (mg/L) | Year Sampled, Baseline | August 2009 Selenium Concentration (mg/L) | February 2010 Selenium Concentration (mg/L) |
|---|---|---|---|---|---|
| 0686 | A | 0.0088 | 2002 | 0.00046 | NS |
| 0687 | A | **0.0145** | 2002 | 0.00054 | NS |
| 0688 | A | 0.0033 | 2002 | 0.0089 | NS |
| 0901 | A | 0.0024 | 2001 | 0.0025 | NS |
| **0906** | A | **0.0335** | 2002 | **0.016** * | **0.021** |
| 0929 | A | 0.0028 | 2002 | 0.0018 | 0.0021 |
| 0940 | A | **0.105** | 2002 | NS | NS |
| **0941** | A | **0.0348** | 2002 | **0.082** | **0.098** |
| 0945 | A | 0.0035 | 2002 | 0.0023 | NS |
| 0946 | A | | | 0.00083 | NS |
| **0262** | B | **0.0621** | 2001 | **0.11** | **0.11** |
| **0263** | B | **0.0632** | 2001 | **0.032** | **0.036** |
| 0265 | B | 0.0071 | 2001 | 0.0057 | 0.0058 |
| **0267** | B | **0.0532** | 2002 | **0.043** | **0.044** |
| 0271 | B | 0.0016 | 2002 | 0.0013 | NS |
| 0281 | B | | | 0.0018 * | 0.0021 * |
| 0282 | B | | | 0.0013 | 0.0015 * |
| 0286 | B | | | 0.006 | 0.0035 |
| **0287** | B | | | 0.096 | **0.099** |
| 0288 | B | | | 0.0025 | 0.0028 |
| 0290 | B | | | 0.0015 * | 0.0018 |
| **0908** | B | **0.0163** | 2002 | **0.023** | **0.022** |
| **0909** | B | **0.0224** | 2002 | **0.052** * | **0.051** * |
| 0910 | B | | | 0.0013 | NS |
| **0934** | B | **0.0116** | 2002 | **0.011** | 0.0099 |
| **0935** | B | **0.0195** | 2002 | **0.018** | **0.018** |
| 0936 | B | **0.0869** | 2002 | NS (Dry) | NS (Dry) |
| **0938** | B | **0.0432** | 1999 | **0.037** | **0.029** |
| **0942** | B | **0.0348** | 2002 | **0.051** | **0.047** |
| 0943 | B | 0.0021 | 2002 | 0.00079 | NS |
| 0947 | B | 0.0019 | 2002 | 0.0014 | NS |
| **1129** | B | | | **0.057** | NS |
| **1130** | B | | | **0.026** | NS |
| **1132** | B | | | **0.11** | NS |
| **1133** | B | | | **0.013** | NS |
| 0274 | C | | | 0.0013 | 0.0015 |
| 0276 | C | | | 0.0015 | 0.0016 |
| 0279 | C | | | 0.0021 | NS |
| 0280 | C | | | 0.0018 | NS |
| 0289 | C | | | 0.0028 | 0.0031 |
| 0683 | C | 0.0022 | 2002 | 0.0015 | NS |
| 0684 | C | 0.0019 | 2002 | 0.0014 | NS |
| 0685 | C | 0.0017 | 2002 | 0.0022 | NS |
| 0689 | C | 0.0014 | 2002 | 0.0012 | NS |
| 0691 | C | 0.0046 | 2002 | 0.003 | 0.0033 |
| 0903 | C | 0.0023 | 2002 | 0.0017 | NS |

*Table B−3 (continued). Baseline, August 2009, and February 2010 Selenium Concentrations*

| Well Number | Horizon | Baseline Selenium Concentration (mg/L) | Year Sampled, Baseline | August 2009 Selenium Concentration (mg/L) | February 2010 Selenium Concentration (mg/L) |
|---|---|---|---|---|---|
| 0912 | C | **0.0137** | 2001 | 0.0061 | NS |
| 0914 | C | 0.0016 | 2001 | 0.00098 | NS |
| 0917 | C | 0.0017 | 2001 | NS | NS |
| 0930 | C | 0.002 | 2002 | 0.0016 | 0.0016E |
| 0932 | C | 0.0019 | 2002 | 0.0013 | 0.0015 |
| 1008 | C | 0.0015 | 2000 | NS | NS |
| 1116 | C | 0.0018 | 2002 | 0.0027 | NS |
| **1117** | C | 0.0028 | 2002 | **0.011** | NS |
| **1118** | C | 0.0028 | 2002 | **0.017** | NS |
| 0258 | D | 0.0018 | 2000 | 0.0014 | 0.0016 |
| 0261 | D | 0.0021 | 2001 | 0.0015 | NS |
| 0264 | D | 0.0018 | 2001 | 0.0015 | 0.0017 |
| 0266 | D | 0.0013 | 2001 | 0.00096 | 0.0012 |
| 0272 | D | | | 0.001 | 0.0012 |
| **0273** | D | | | **0.018** | **0.014** |
| **0275** | D | | | **0.02** | **0.022** |
| 0277 | D | | | 0.0012 | NS |
| 0278 | D | | | 0.0011 | NS |
| 0690 | D | 0.0014 | 2002 | 0.0012 | NS |
| 0692 | D | 0.0022 | 2002 | 0.0015 | NS |
| 0695 | D | 0.0019 | 2002 | 0.0017 | NS |
| **0904** | D | **0.0131** | 2001 | **0.018** | NS |
| 0915 | D | 0.0019 | 2001 | 0.0013 | NS |
| 1003 | D | 0.003 | 2000 | 0.0033 | NS |
| 1004 | D | 0.0021 | 2000 | 0.0017 | NS |
| 1005 | D | 0.0014 | 2000 | NS | NS |
| 1006 | D | 0.0013 | 2000 | 0.0011 | NS |
| 1007 | D | 0.0013 | 2000 | 0.0011 | NS |
| **1101** | D | **0.0188** | 2002 | **0.017** | NS |
| **1102** | D | **0.0121** | 2002 | **0.018** | NS |
| **1103** | D | **0.0613** | 2002 | **0.029** | NS |
| **1104** | D | **0.0344** | 2002 | **0.027** | NS |
| **1105** | D | **0.0871** | 2002 | **0.034** | NS |
| **1106** | D | **0.0925** | 2002 | **0.03** | NS |
| **1107** | D | **0.0903** | 2002 | **0.015** | NS |
| **1108** | D | **0.0704** | 2002 | **0.033** | NS |
| **1109** | D | **0.0372** | 2002 | **0.015** | NS |
| **1110** | D | 0.0081 | 2002 | **0.013** | NS |
| **1111** | D | **0.0172** | 2002 | **0.013** | NS |
| 1112 | D | **0.0154** | 2002 | 0.0038 | NS |
| 1113 | D | 0.0025 | 2002 | 0.0019 | NS |
| 1114 | D | 0.0035 | 2002 | 0.0087 | NS |
| **1115** | D | **0.0362** | 2002 | **0.011** | NS |
| **1119** | D | **0.029** | 2002 | **0.031** | NS |
| **1120** | D | **0.0563** | 2002 | **0.019** | NS |
| 1121 | D | **0.0455** | 2002 | 0.005 | NS |
| 1122 | D | **0.0558** | 2002 | NS | NS |

*Table B−3 (continued). Baseline, August 2009, and February 2010 Selenium Concentrations*

| Well Number | Horizon | Baseline Selenium Concentration (mg/L) | Year Sampled, Baseline | August 2009 Selenium Concentration (mg/L) | February 2010 Selenium Concentration (mg/L) |
|---|---|---|---|---|---|
| **1123** | D | **0.0449** | 2002 | **0.014** | NS |
| 1124 | D | **0.0186** | 2002 | NS | NS |
| 1125 | D | 0.0025 | 2002 | 0.0019 | NS |
| 0251 | E | 0.0035 | 2002 | 0.00082 | 0.0009 |
| 0268 | E | 0.0018 | 2002 | 0.0016 | 0.002 |
| 0920 | E | 0.0014 | 2001 | 0.0012 | NS |
| 0911 | F | | | 0.00095 | NS |
| 0913 | G | 0.00063 | 2001 | 0.00082 | NS |
| 0916 | G | 0.001 | 2001 | 0.00075 | NS |
| 0252 | I | 0.00092 | 2002 | 0.00067 | 0.00078 |
| 0921 | I | 0.00091 | 2001 | 0.00087 | NS |

E = Estimated value because of interference.
NS = Not sampled.

Values in **red** exceed the corresponding groundwater remediation target for selenium, 0.01 mg/L (see Table 1 of main report). Well numbers with groundwater concentrations greater than the remediation target during this reporting period are also listed in **red**.

* Denotes filtered sample. Samples are generally not filtered (as reflected above), except in cases when turbidity is greater than 10 NTUs.

*Table B−4. Baseline, August 2009, and February 2010 Sulfate Concentrations*

| Well Number | Horizon | Baseline Sulfate Concentration (mg/L) | Year Sampled, Baseline | August 2009 Sulfate Concentration (mg/L) | February 2010 Sulfate Concentration (mg/L) |
|---|---|---|---|---|---|
| 0686 | A | 98.6 | 2002 | 24 | NS |
| 0687 | A | **329** | 2002 | 25 | NS |
| 0688 | A | 40 | 2002 | 160 | NS |
| 0901 | A | 26.2 | 2001 | 36 | NS |
| **0906** | **A** | **1660** | 2002 | **1700** * | **1900** |
| 0929 | A | 28.1 | 2002 | 23 | 25 |
| 0940 | A | **7550** | 2002 | NS | NS |
| **0941** | A | **745** | 2002 | **1200** | **1400** |
| 0945 | A | 32.1 | 2002 | 24 | NS |
| 0946 | A | | | 45 | NS |
| **0262** | B | **931** | 2001 | **1600** | **2100** |
| **0263** | B | **1990** | 2001 | **2000** | **3100** |
| **0265** | B | **1520** | 2001 | **1300** | **1300** |
| **0267** | B | **3680** | 2002 | **3200** | **3600** |
| 0271 | B | 16.4 | 2002 | 15 | NS |
| 0281 | B | | | 140 * | 170 * |
| 0282 | B | | | 65 | 70 * |
| **0286** | B | | | **490** | 190 |
| **0287** | B | | | **1200** | **1500** |
| **0288** | B | | | **290** | **340** |
| 0290 | B | | | 19 * | 31 |
| **0908** | B | **2430** | 2002 | **2800** | **3000** |
| **0909** | B | **666** | 2002 | **910** * | **900** * |
| 0910 | B | | | 16 | |
| **0934** | B | **7360** | 2002 | **2900** | **3200** |
| **0935** | B | **2690** | 2002 | **2100 N** | **2600** |
| 0936 | B | **4360** | 2002 | NS | NS |
| **0938** | B | **2120** | 1999 | **1400** | **1200** |
| **0942** | B | **3030** | 2002 | **3200** | **3400** |
| 0943 | B | 29 | 2002 | 53 | NS |
| 0947 | B | 18.7 | 2002 | 17 | NS |
| 1129 | B | | | 800 | NS |
| **1130** | B | | | **2000 N** | NS |
| **1132** | B | | | **1300** | NS |
| 1133 | B | | | 180 | NS |
| 0274 | C | | | 14 | 16 |
| 0276 | C | | | 17 | 18 |
| 0279 | C | | | 65 | NS |
| 0280 | C | | | 21 | NS |
| **0289** | C | | | **260** | **360** |
| 0683 | C | 21.6 | 2002 | 18 | NS |
| 0684 | C | 18 | 2002 | 17 | NS |
| 0685 | C | 26.2 | 2002 | 28 | NS |
| 0689 | C | 13.7 | 2002 | 16 | NS |
| 0691 | C | **587** | 2002 | **410** | **530** |
| 0903 | C | 76.5 | 2002 | 72 | NS |

*Table B−4 (continued). Baseline, August 2009, and February 2010 Sulfate Concentrations*

| Well Number | Horizon | Baseline Sulfate Concentration (mg/L) | Year Sampled, Baseline | August 2009 Sulfate Concentration (mg/L) | February 2010 Sulfate Concentration (mg/L) |
|---|---|---|---|---|---|
| 0912 | C | **846** | 2001 | **450** | NS |
| 0914 | C | 15.6 | 2001 | 12 | NS |
| 0917 | C | 13.9 | 2001 | NS | NS |
| 0930 | C | 59.8 | 2002 | 57 | 59 |
| 0932 | C | 30.2 | 2002 | 28 | 31 |
| 1008 | C | 13 | 2000 | NS | NS |
| **1116** | C | 176 | 2002 | **280** | NS |
| 1117 | C | **255** | 2002 | 850 | NS |
| **1118** | **C** | 163 | 2002 | **1800** | NS |
| 0258 | D | 17.4 | 2000 | 17 | 19 |
| 0261 | D | 18.2 | 2001 | 21 | NS |
| 0264 | D | 37.7 | 2001 | 59 | 68 |
| 0266 | D | 10.9 | 2001 | 11 | 11 |
| 0272 | D | | | 11 | 12 |
| 0273 | D | | | 240 | 200 |
| **0275** | **D** | | | **1900** | **2400** |
| 0277 | D | | | 16 | NS |
| 0278 | D | | | 12 | NS |
| 0690 | D | 13.8 | 2002 | 12 | NS |
| 0692 | D | 20.8 | 2002 | 15 | NS |
| 0695 | D | 50.4 | 2002 | 45 | NS |
| 0904 | D | 96.5 | 2001 | 140 | NS |
| 0915 | D | 17.8 | 2001 | 17 | NS |
| **1003** | D | **302** | 2000 | **490** | NS |
| 1004 | D | 66.2 | 2000 | 67 | NS |
| 1005 | D | 12.7 | 2000 | NS | NS |
| 1006 | D | 12.2 | 2000 | 12 | NS |
| 1007 | D | 11.7 | 2000 | 12 | NS |
| **1101** | D | **960** | 2002 | **1100** | NS |
| **1102** | D | **1320** | 2002 | **1100** | NS |
| **1103** | D | **2570** | 2002 | **1800** | NS |
| **1104** | D | **1870** | 2002 | **1200** | NS |
| **1105** | D | **1590** | 2002 | **940** | NS |
| **1106** | D | **1050** | 2002 | **870** | NS |
| **1107** | D | **1200** | 2002 | **360** | NS |
| **1108** | D | **3400** | 2002 | **1700** | NS |
| **1109** | D | **3280** | 2002 | **1400** | NS |
| **1110** | D | **512** | 2002 | **1100** | NS |
| **1111** | D | **988** | 2002 | **1500** | NS |
| 1112 | D | **1140** | 2002 | 220 | NS |
| 1113 | D | 136 | 2002 | 84 | NS |
| **1114** | D | **328** | 2002 | **670** | NS |
| **1115** | D | **1930** | 2002 | **760** | NS |
| **1119** | D | **1560** | 2002 | **1900** | NS |
| **1120** | D | **2330** | 2002 | **1800** | NS |
| **1121** | D | **2590** | 2002 | **850** | NS |

*Table B−4 (continued). Baseline, August 2009, and February 2010 Sulfate Concentrations*

| Well Number | Horizon | Baseline Sulfate Concentration (mg/L) | Year Sampled, Baseline | August 2009 Sulfate Concentration (mg/L) | February 2010 Sulfate Concentration (mg/L) |
|---|---|---|---|---|---|
| 1122 | D | **2960** | 2002 | NS | NS |
| **1123** | D | **1240** | 2002 | **1600** | NS |
| 1124 | D | **1170** | 2002 | NS | NS |
| 1125 | D | 165 | 2002 | 71 | NS |
| 0251 | E | **617** | 2002 | 13 | 16 |
| 0268 | E | 17.4 | 2002 | 120 | 140 |
| 0920 | E | 12.7 | 2001 | 12 | NS |
| 0911 | F | | | 9.1 | NS |
| 0913 | G | 8.43 | 2001 | 7.6 | NS |
| 0916 | G | 13.5 | 2001 | 6.3 | NS |
| 0252 | I | 19.2 | 2002 | 6.2 | 7.1 |
| 0921 | I | 8.52 | 2001 | 8.2 | NS |

N = Spike sample recovery not within control limits.
NS = Not sampled.

Values in **red** exceed the corresponding groundwater remediation target for sulfate, 250 mg/L (see Table 1 of main report). Well numbers with groundwater concentrations greater than the remediation target during this reporting period are also listed in **red**.

* Denotes filtered sample. Samples are generally not filtered (as reflected above), except in cases when turbidity is greater than 10 NTUs.

*Table B−5. Baseline, August 2009, and February 2010 Uranium Concentrations*

| Well Number | Horizon | Baseline Uranium Concentration (mg/L) | Year Sampled, Baseline | August 2009 Uranium Concentration (mg/L) | February 2010 Uranium Concentration (mg/L) |
|---|---|---|---|---|---|
| 0686 | A | 0.0021 | 2002 | 0.00018E | NS |
| 0687 | A | 0.0208 | 2002 | 0.00024 | NS |
| 0688 | A | 0.002 | 2002 | 0.0043 | NS |
| 0901 | A | 0.0026 | 2001 | 0.0034 | NS |
| **0906** | A | **0.951** | 2002 | **0.91** * | **0.79** |
| 0929 | A | 0.0012 | 2002 | 0.0016 | 0.0015 |
| 0940 | A | **0.546** | 2002 | NS | NS |
| **0941** | A | **0.0886** | 2002 | **0.19** | **0.18** |
| 0945 | A | 0.0031 | 2002 | 0.0015 | NS |
| 0946 | A | | | 0.00014 | NS |
| **0262** | B | **0.379** | 2001 | **1.3** | **1.1** |
| **0263** | B | **0.485** | 2001 | **0.17** | **0.14** |
| **0265** | B | **0.0897** | 2001 | **0.071** | **0.067** |
| **0267** | B | **0.0731** | 2002 | **0.07** | **0.067** |
| 0271 | B | 0.0014 | 2002 | 0.0015 | NS |
| 0281 | B | | | 0.007 * | 0.0082 * |
| 0282 | B | | | 0.0044 | 0.004 * |
| **0286** | B | | | **0.093** | 0.025 |
| **0287** | B | | | **0.19** | **0.24** |
| 0288 | B | | | 0.014 | 0.016 |
| 0290 | B | | | 0.0014 * | 0.0014 |
| **0908** | B | **0.122** | 2002 | **0.096** | **0.089** |
| **0909** | B | 0.0389 | 2002 | **0.057** * | **0.051** * |
| 0910 | B | | | 0.0012 | NS |
| **0934** | B | **0.312** | 2002 | **0.19** | **0.19** |
| **0935** | B | **0.0868** | 2002 | **0.11** | **0.1** |
| 0936 | B | **0.267** | 2002 | NS (Dry) | NS (Dry) |
| **0938** | B | **0.21** | 1999 | **0.51** | **0.36** |
| **0942** | B | **0.246** | 2002 | **0.51** | **0.5** |
| 0943 | B | 0.0049 | 2002 | 0.0086 | NS |
| 0947 | B | 0.0024 | 2002 | 0.0012 | NS |
| **1129** | B | | | **0.71** | NS |
| **1130** | B | | | **0.22** | NS |
| **1132** | B | | | **1.6** | NS |
| **1133** | B | | | **0.078** | NS |
| 0274 | C | | | 0.0016 | 0.0016 |
| 0276 | C | | | 0.0015 | 0.0017 |
| 0279 | C | | | 0.0018 | NS |
| 0280 | C | | | 0.0015 | NS |
| 0289 | C | | | 0.022 | 0.024 |
| 0683 | C | 0.0012 | 2002 | 0.0013 | NS |
| 0684 | C | 0.0019 | 2002 | 0.0017 | NS |
| 0685 | C | 0.0012 | 2002 | 0.0015 | NS |
| 0689 | C | 0.0011 | 2002 | 0.0013 | NS |
| **0691** | C | **0.0657** | 2002 | 0.039 | **0.047** |
| 0903 | C | 0.0022 | 2002 | 0.0022 | NS |

*Table B−5 (continued). Baseline, August 2009, and February 2010 Uranium Concentrations*

| Well Number | Horizon | Baseline Uranium Concentration (mg/L) | Year Sampled, Baseline | August 2009 Uranium Concentration (mg/L) | February 2010 Uranium Concentration (mg/L) |
|---|---|---|---|---|---|
| 0912 | C | 0.0342 | 2001 | 0.023 | NS |
| 0914 | C | 0.0013 | 2001 | 0.000014 BU | NS |
| 0917 | C | 0.0013 | 2001 | NS | NS |
| 0930 | C | 0.0023 | 2002 | 0.0029 | 0.0028 |
| 0932 | C | 0.0016 | 2002 | 0.0016 | 0.0016 |
| 1008 | C | 0.001 | 2000 | NS | NS |
| 1116 | C | 0.0081 | 2002 | 0.017 | NS |
| 1117 | C | 0.0151 | 2002 | 0.033 | NS |
| **1118** | C | 0.0098 | 2002 | **0.08** | NS |
| 0258 | D | 0.0018 | 2000 | 0.0013 | 0.0013 |
| 0261 | D | 0.0018 | 2001 | 0.0013 | NS |
| 0264 | D | 0.0033 | 2001 | 0.0032 | 0.0037 |
| 0266 | D | 0.0019 | 2001 | 0.002 | 0.0022 |
| 0272 | D | | | 0.0014 | 0.0015 |
| **0273** | D | | | **0.068** | **0.045** |
| **0275** | D | | | **0.48** | **0.5** |
| 0277 | D | | | 0.0026 | NS |
| 0278 | D | | | 0.0013 | NS |
| 0690 | D | 0.0018 | 2002 | 0.0017 | NS |
| 0692 | D | 0.0015 | 2002 | 0.0018 | NS |
| 0695 | D | 0.002 | 2002 | 0.0022 | NS |
| 0904 | D | 0.0044 | 2001 | 0.0061 | NS |
| 0915 | D | 0.0017 | 2001 | 0.0000099 BU | NS |
| 1003 | D | 0.0205 | 2000 | 0.037 | NS |
| 1004 | D | 0.0053 | 2000 | 0.0072 | NS |
| 1005 | D | 0.0013 | 2000 | NS | NS |
| 1006 | D | 0.0014 | 2000 | 0.0012 | NS |
| 1007 | D | 0.0012 | 2000 | 0.0013 | NS |
| **1101** | D | **0.245** | 2002 | **0.25** | NS |
| **1102** | D | **0.533** | 2002 | **0.32** | NS |
| **1103** | D | **0.355** | 2002 | **0.41** | NS |
| **1104** | D | **0.194** | 2002 | **0.68** | NS |
| **1105** | D | **2.1** | 2002 | **0.95** | NS |
| **1106** | D | **2.1** | 2002 | **0.73** | NS |
| **1107** | D | **0.118** | 2002 | **0.062** | NS |
| **1108** | D | **0.646** | 2002 | **0.44** | NS |
| **1109** | D | **0.565** | 2002 | **0.29** | NS |
| **1110** | D | **0.0528** | 2002 | **0.2** | NS |
| **1111** | D | **0.161** | 2002 | **0.2** | NS |
| **1112** | D | **0.13** | 2002 | **0.049** | NS |
| 1113 | D | 0.0149 | 2002 | 0.012 | NS |
| **1114** | D | 0.0277 | 2002 | **0.082** | NS |
| **1115** | D | **0.41** | 2002 | **0.099** | NS |
| **1119** | D | **0.555** | 2002 | **0.4** | NS |
| **1120** | D | **1.3** | 2002 | **0.17** | NS |
| **1121** | D | **0.857** | 2002 | **0.052** | NS |
| 1122 | D | **0.878** | 2002 | NS | NS |

*Table B−5 (continued). Baseline, August 2009, and February 2010 Uranium Concentrations*

| Well Number | Horizon | Baseline Uranium Concentration (mg/L) | Year Sampled, Baseline | August 2009 Uranium Concentration (mg/L) | February 2010 Uranium Concentration (mg/L) |
|---|---|---|---|---|---|
| **1123** | D | **0.261** | 2002 | **0.21** | NS |
| 1124 | D | **0.171** | 2002 | NS | NS |
| 1125 | D | 0.0176 | 2002 | 0.0075 | NS |
| 0251 | E | **0.0481** | 2002 | 0.0018 E | 0.0021 |
| 0268 | E | 0.0014 | 2002 | 0.019 | 0.02 |
| 0920 | E | 0.0017 | 2001 | 0.0013 | NS |
| 0911 | F | | | 0.0012 | NS |
| 0913 | G | 0.0016 | 2001 | 0.0013 | NS |
| 0916 | G | 0.0014 | 2001 | 0.000015 BU | NS |
| 0252 | I | 0.0024 | 2002 | 0.0021 | 0.002 |
| 0921 | I | 0.0047 | 2001 | 0.0046 | NS |

B = Result between instrument detection limit and contract required detection limit.
E = Estimate value because of interference.
U = Analytical result below detection limit.
NS = Not sampled.

Values in **red** exceed the corresponding groundwater remediation target for uranium, 0.044 mg/L (see Table 1 of main report). Well numbers with groundwater concentrations greater than the remediation target during this reporting period are also listed in **red**.

* Denotes filtered sample. Samples are generally not filtered (as reflected above), except in cases when turbidity is greater than 10 NTUs.

This page intentionally left blank

# Appendix C

# Nitrate, Sulfate, and Uranium Plume Maps

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

This page intentionally left blank

# Contents

# Figures

This page intentionally left blank

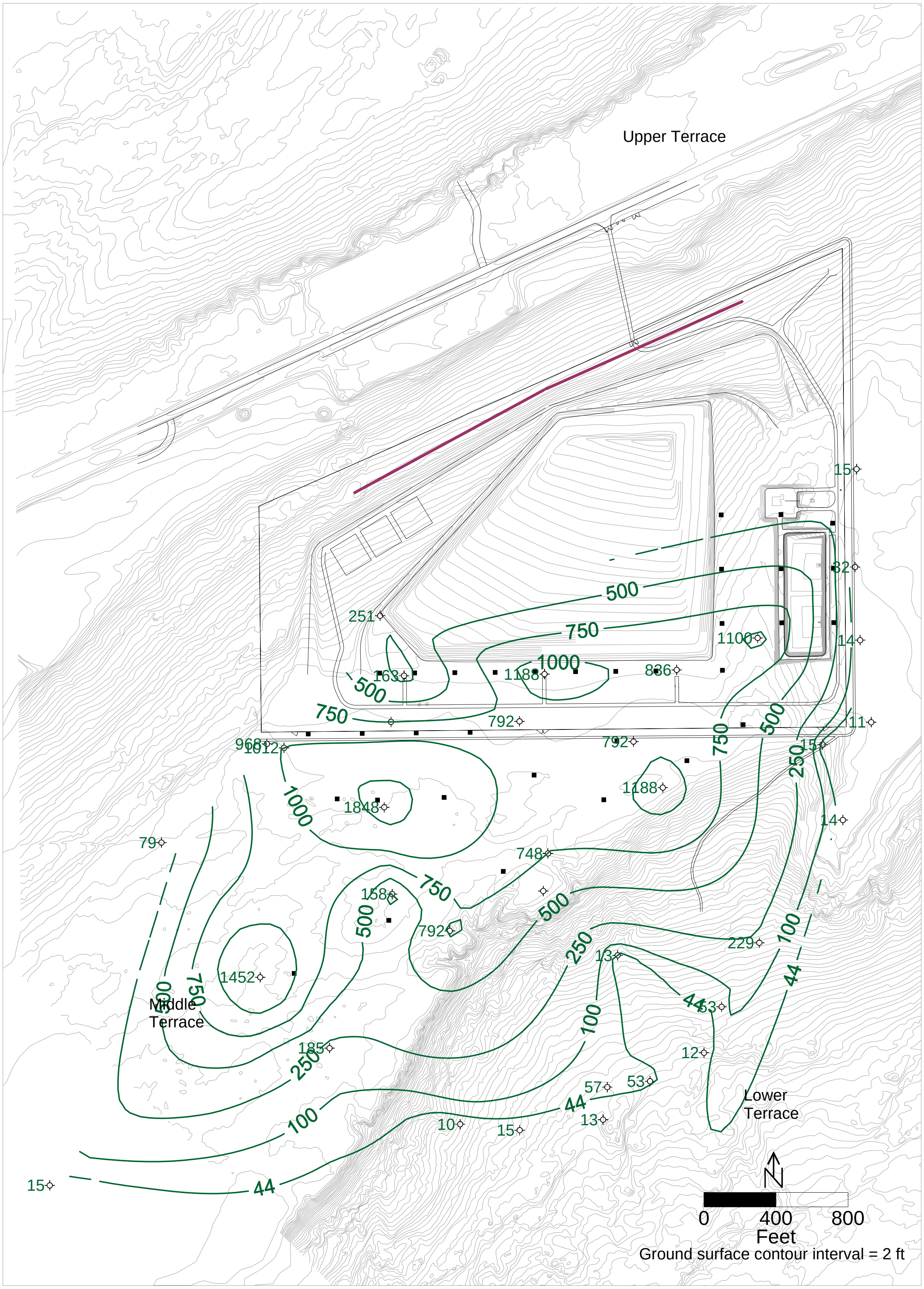



*Figure C−1. Nitrate (mg/L as $NO_3$) Plume Map: February 2010*

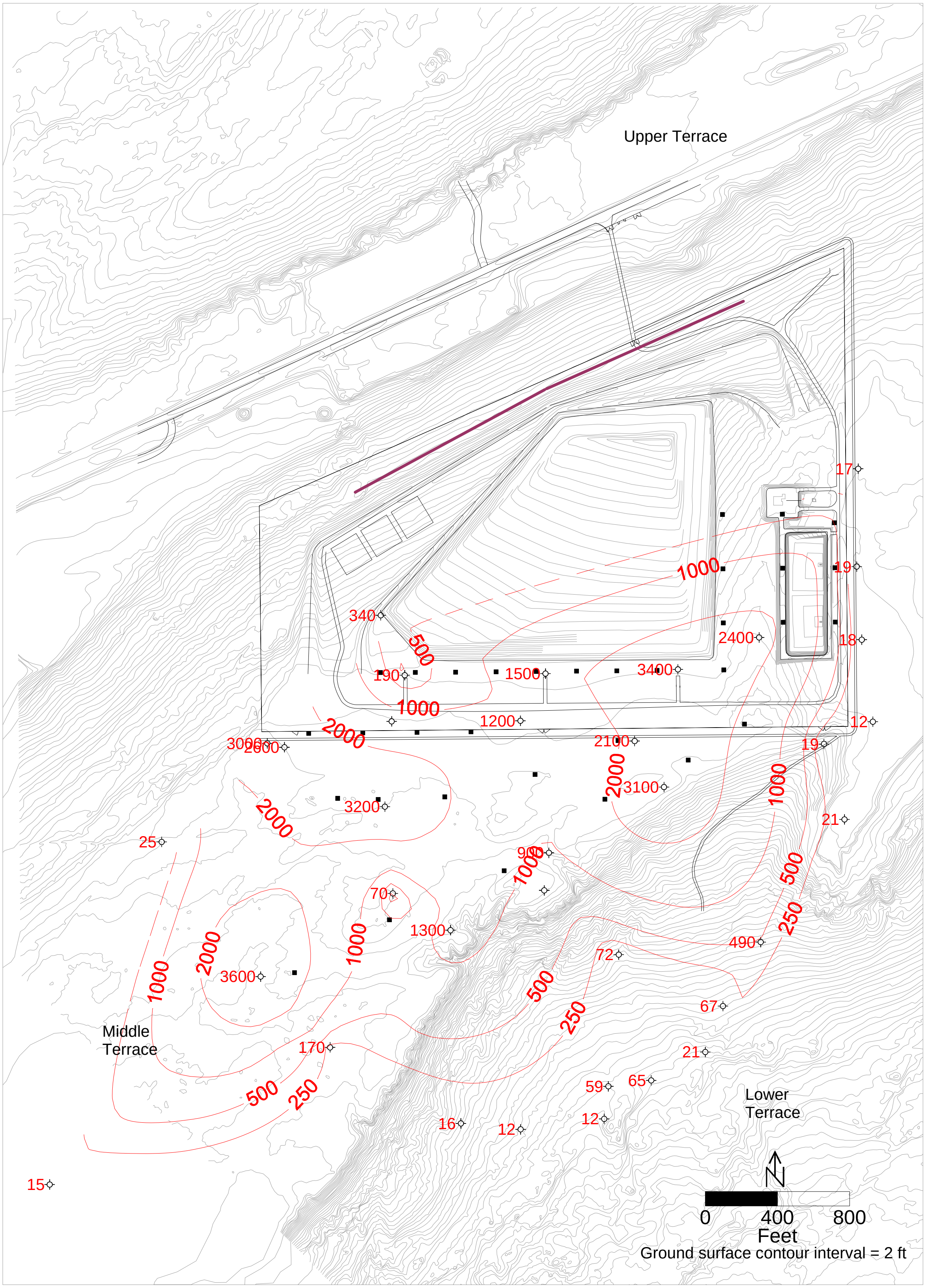



*Figure C−2. Sulfate (mg/L) Plume Map: February 2010*

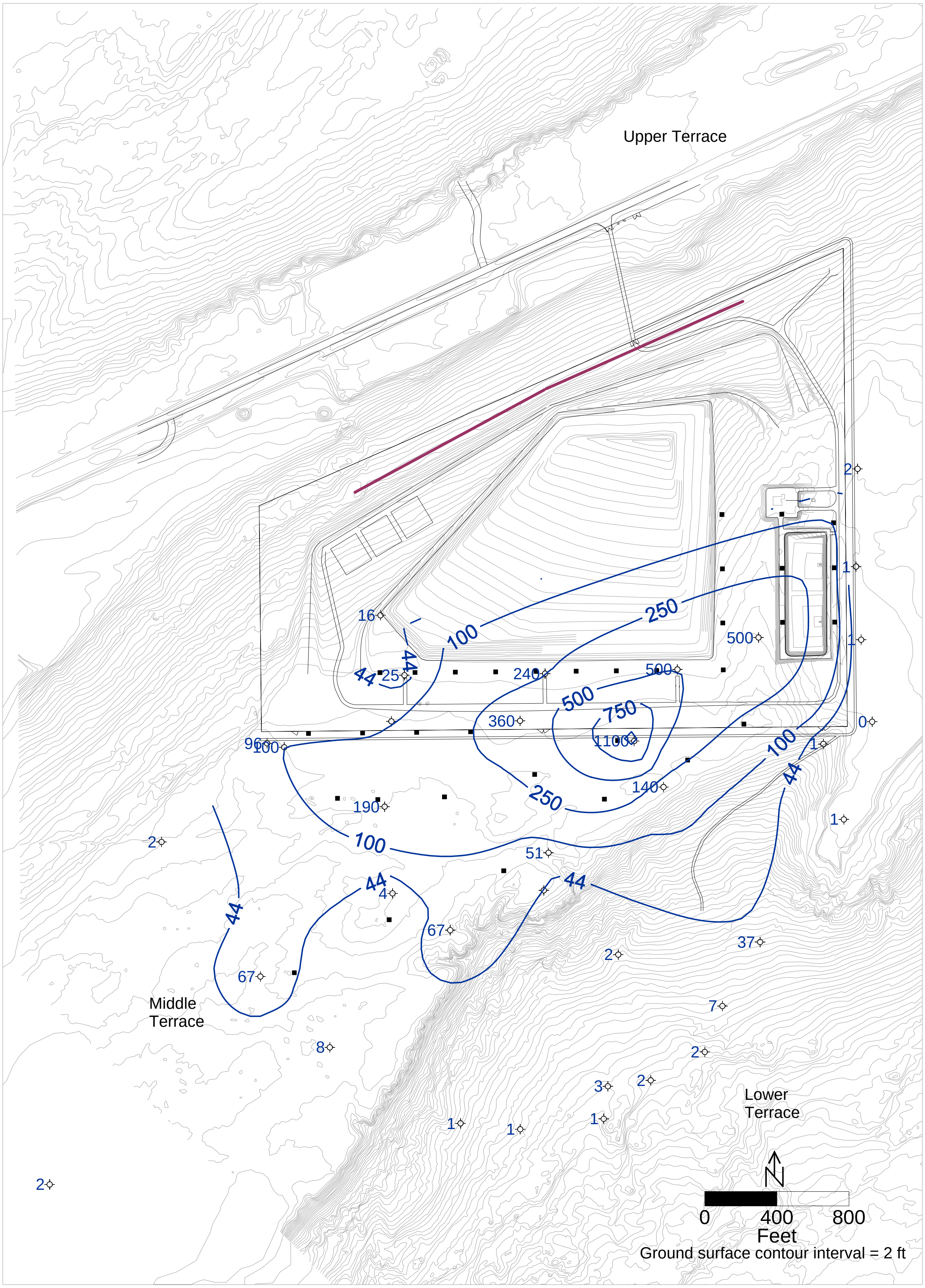



*Figure C−3. Uranium (µg/L) Plume Map: February 2010*

This page intentionally left blank

# Appendix D

# Monitoring Well Water Level Hydrographs

This page intentionally left blank

# Contents

## Figures

This page intentionally left blank

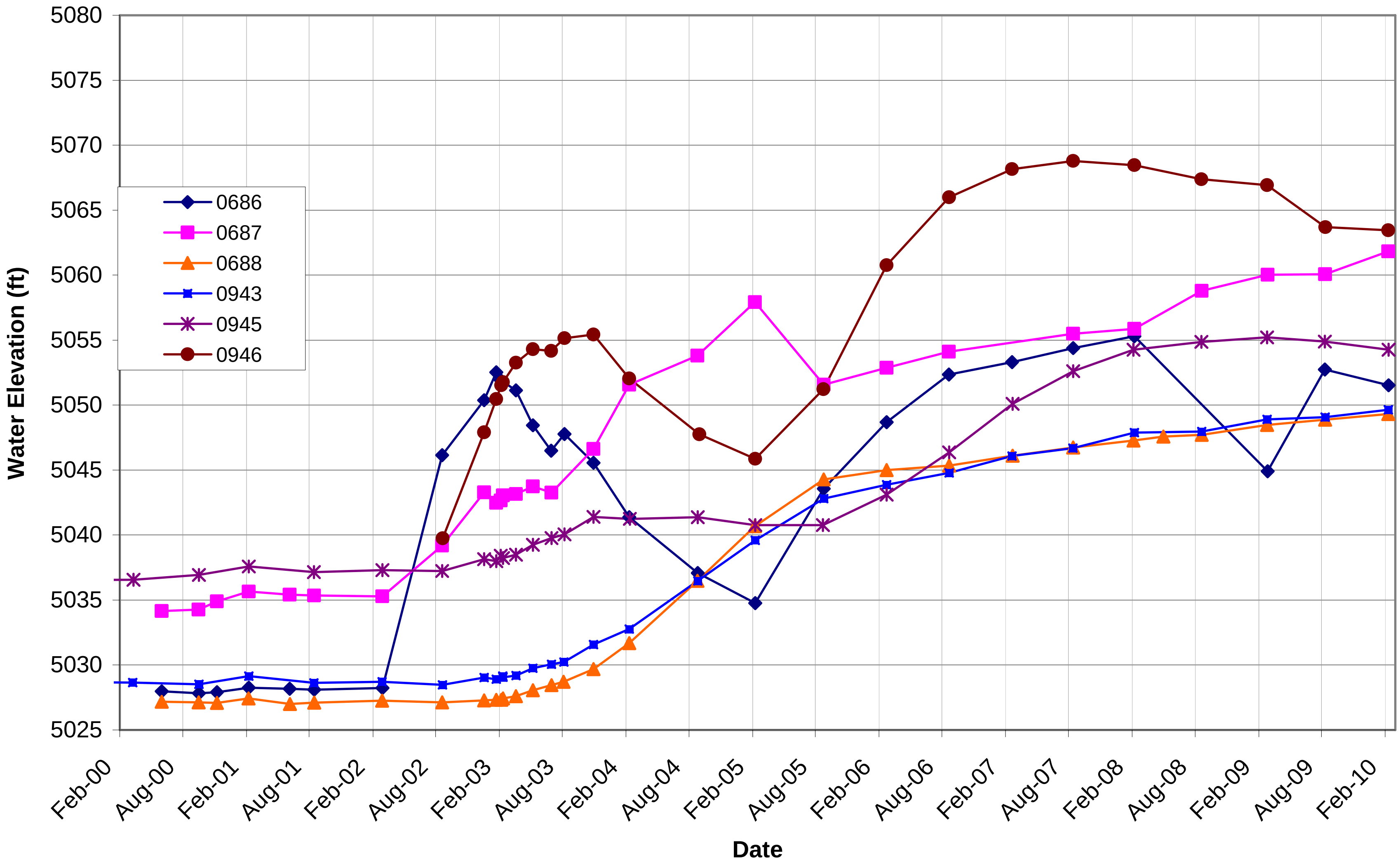



*Figure D–1. Monitoring Wells at Infiltration Trench: 0686–0688, 0943, 0945, 0946*

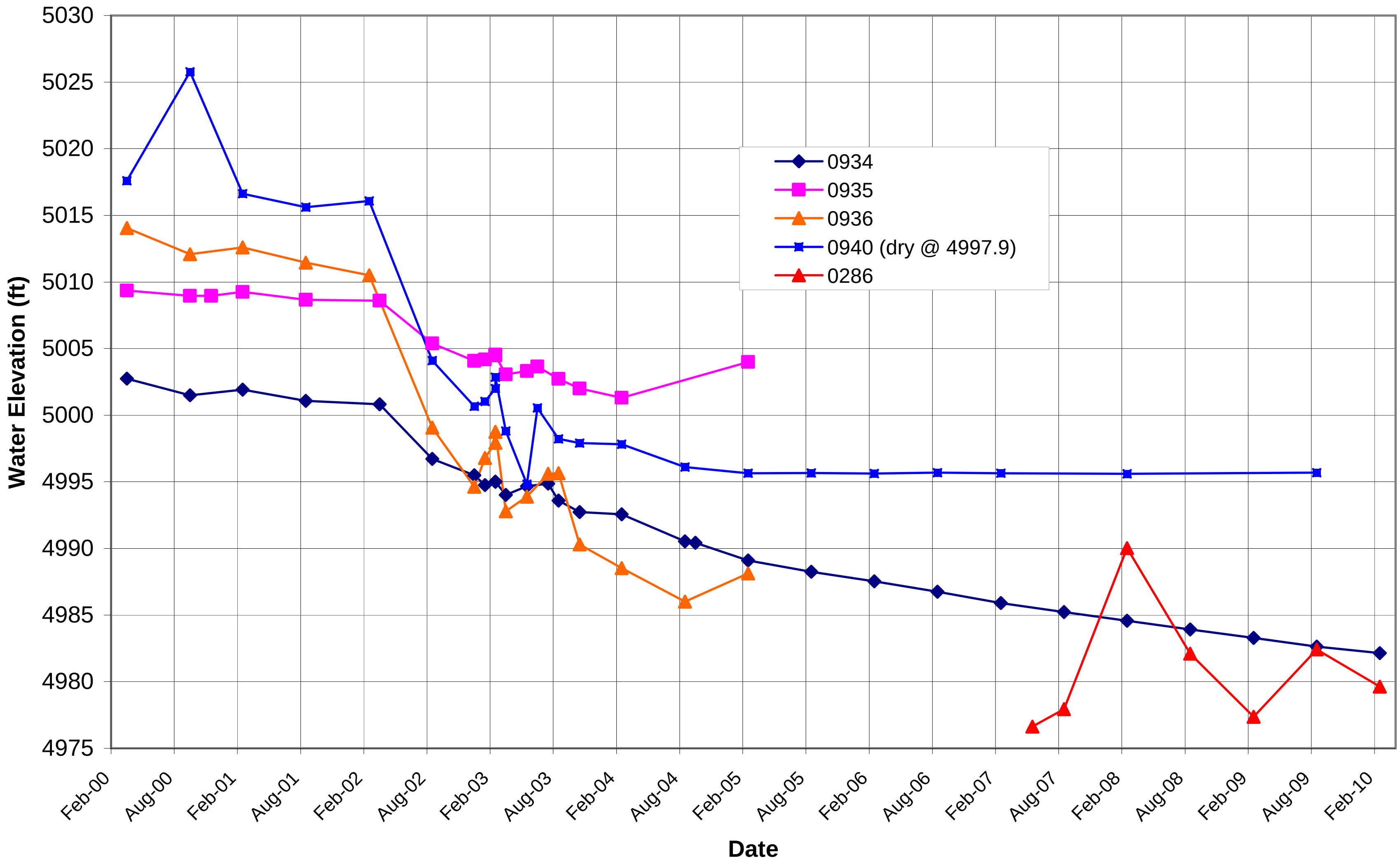



*Figure D−2. Horizon A and B Monitoring Wells 286, 934–936, 940*

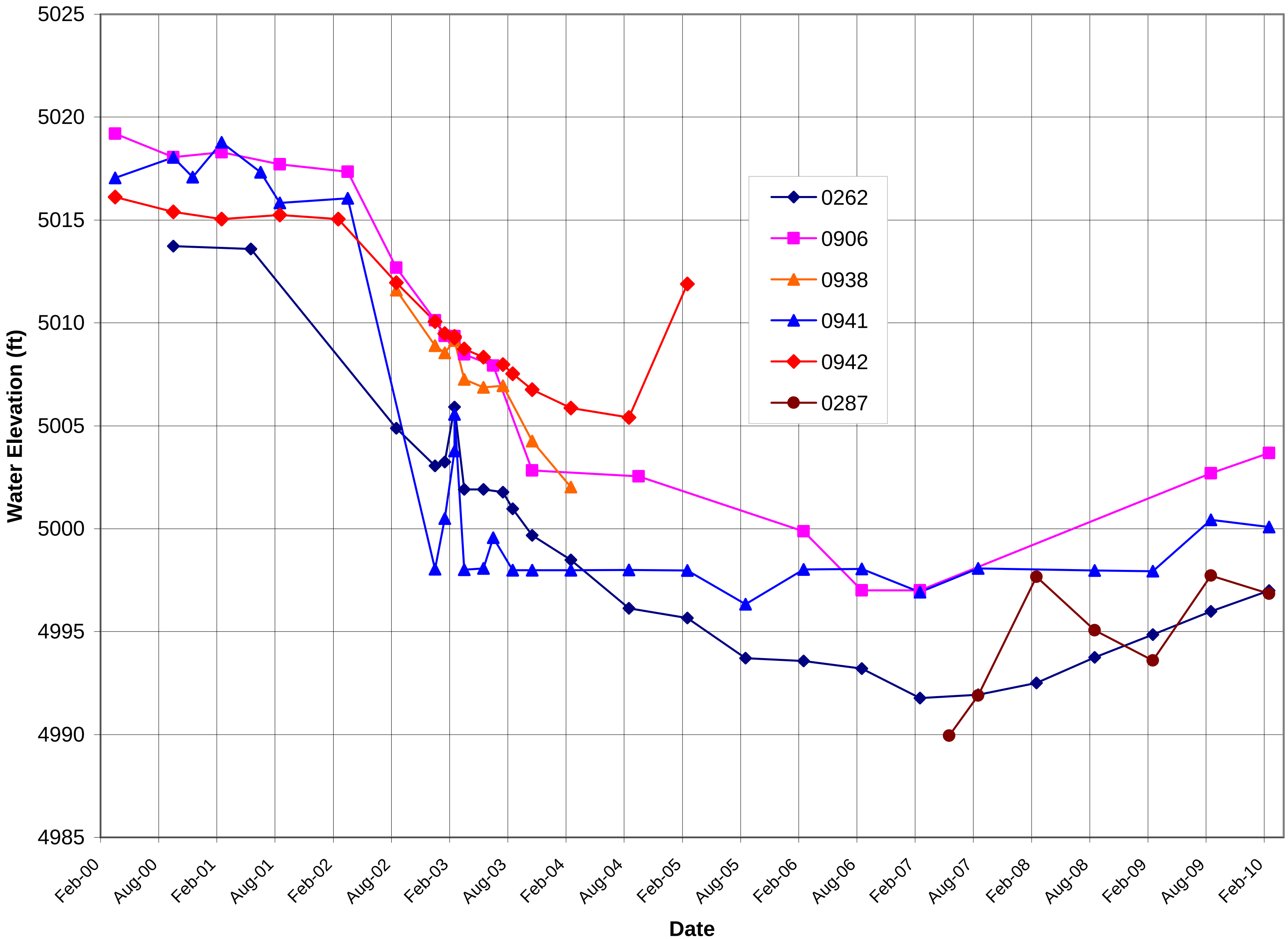



*Figure D−3. Horizon A and B Monitoring Wells 262, 287, 906, 938, 941, 942*

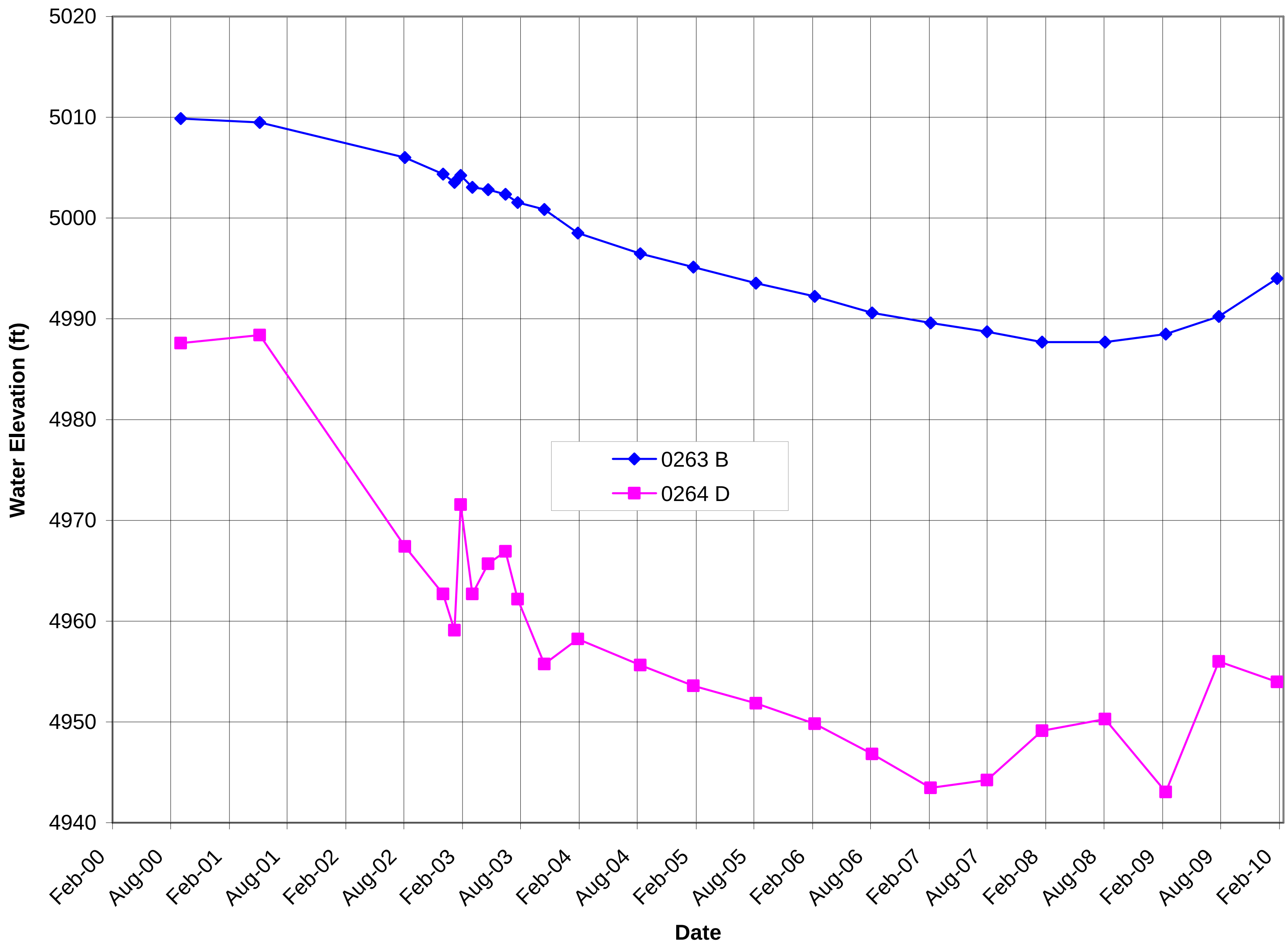



*Figure D−4. Middle Terrace Well Pair 263 and 264*

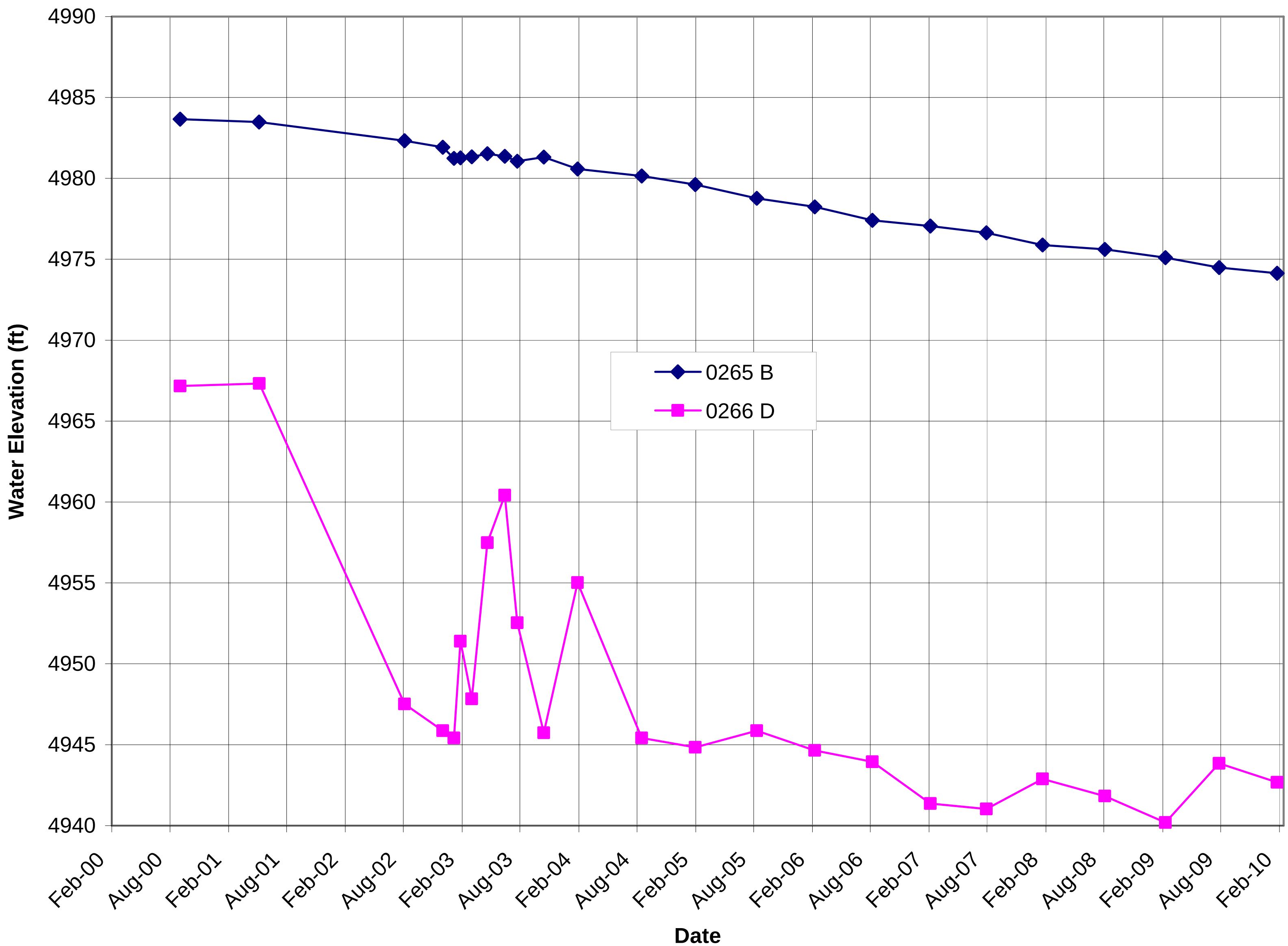



*Figure D−5. Middle Terrace Well Pair 265 and 266*

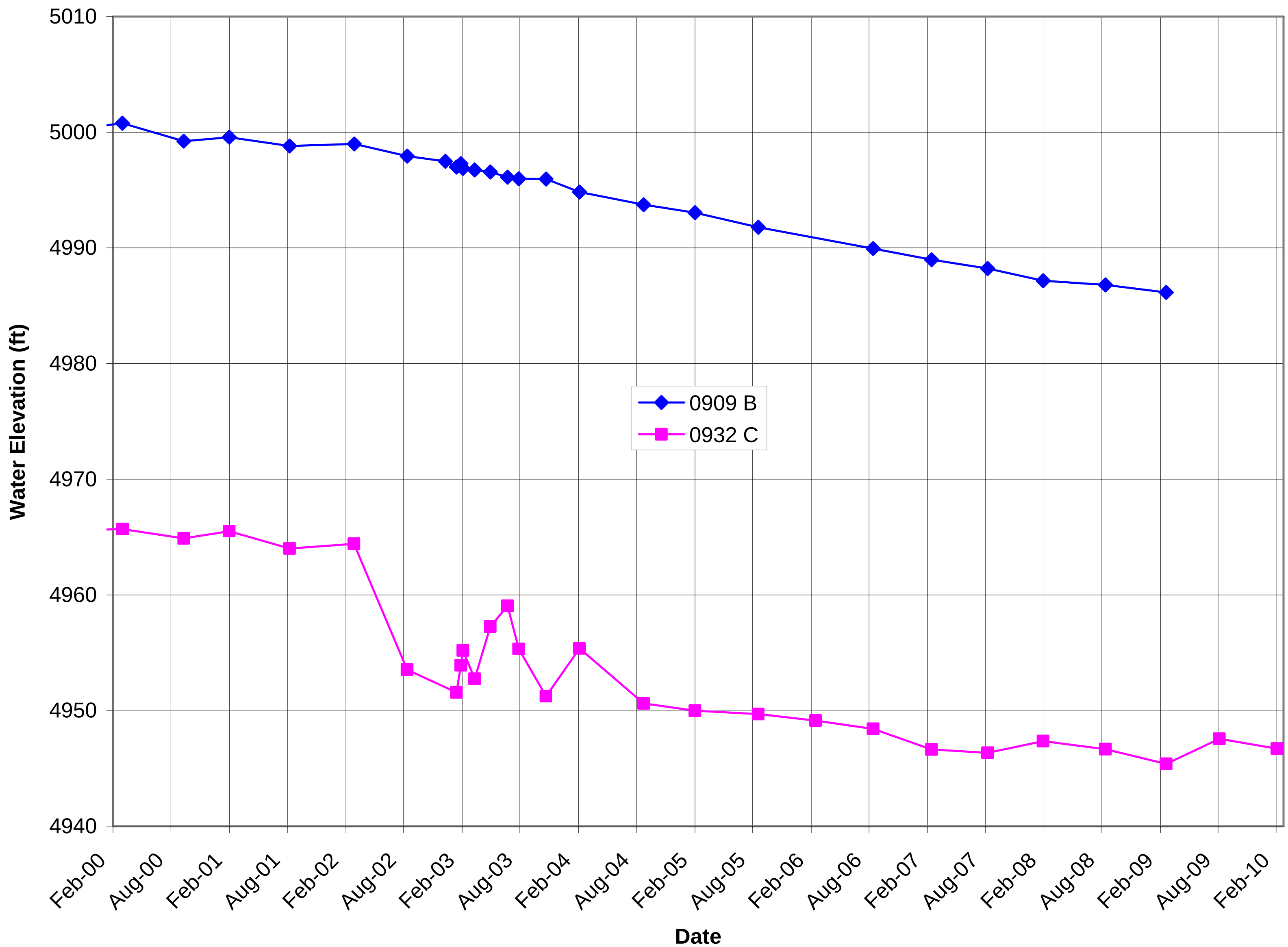



*Figure D−6. Middle Terrace Well Pair 909 and 932*

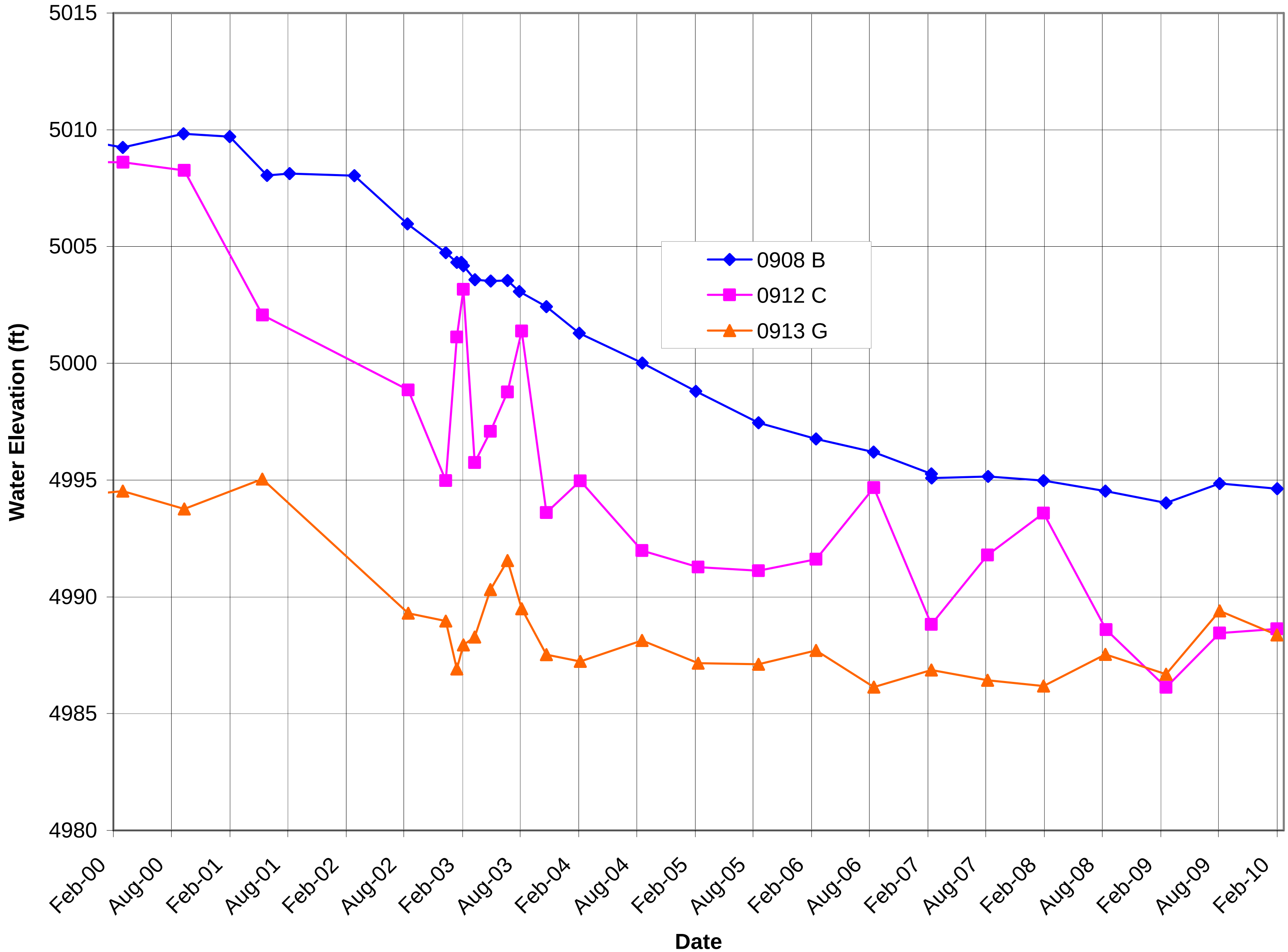



*Figure D−7. Middle Terrace Well Cluster 908, 912, and 913*

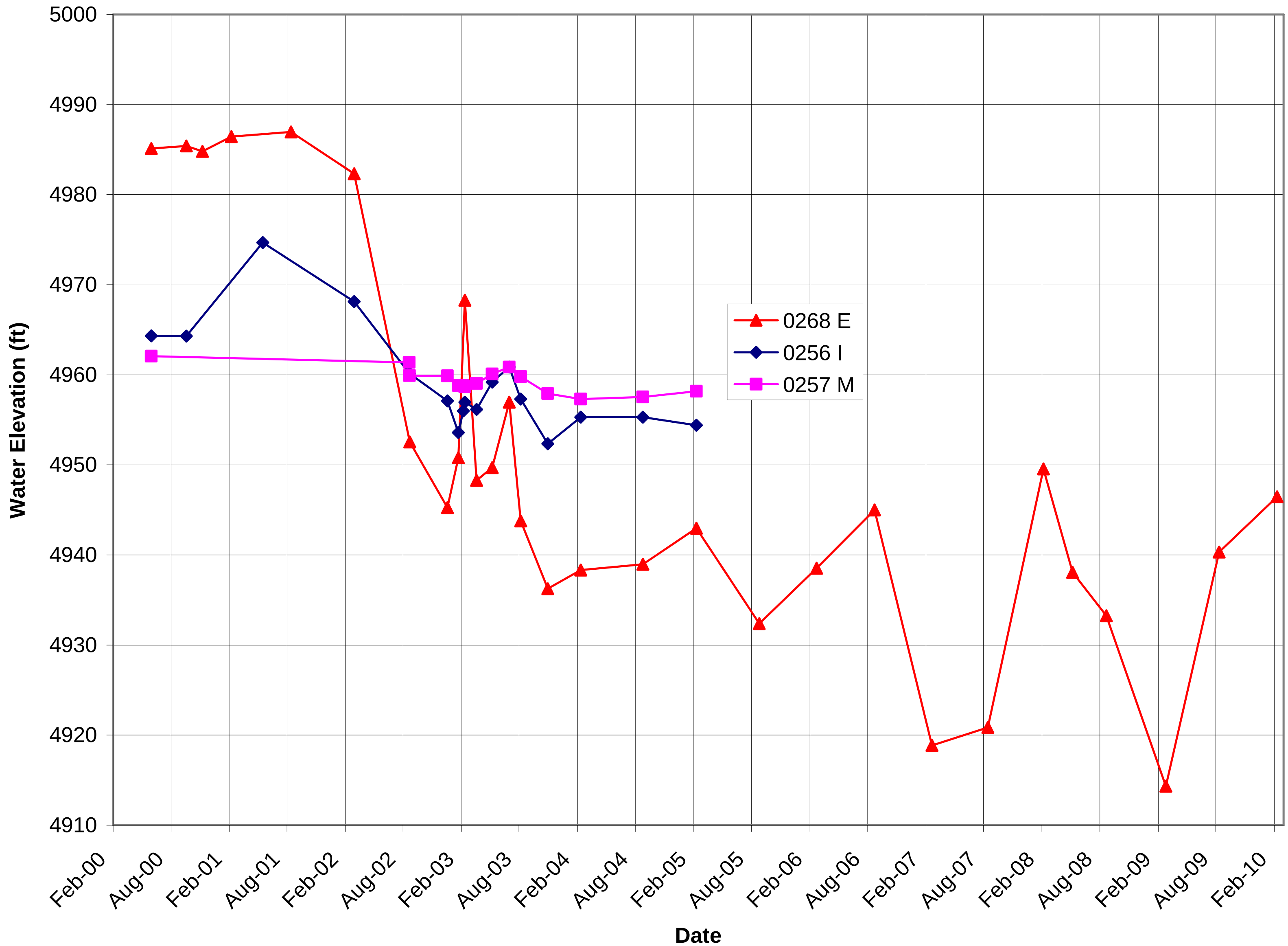



*Figure D−8. Middle Terrace Well Cluster 268, 256, and 257*

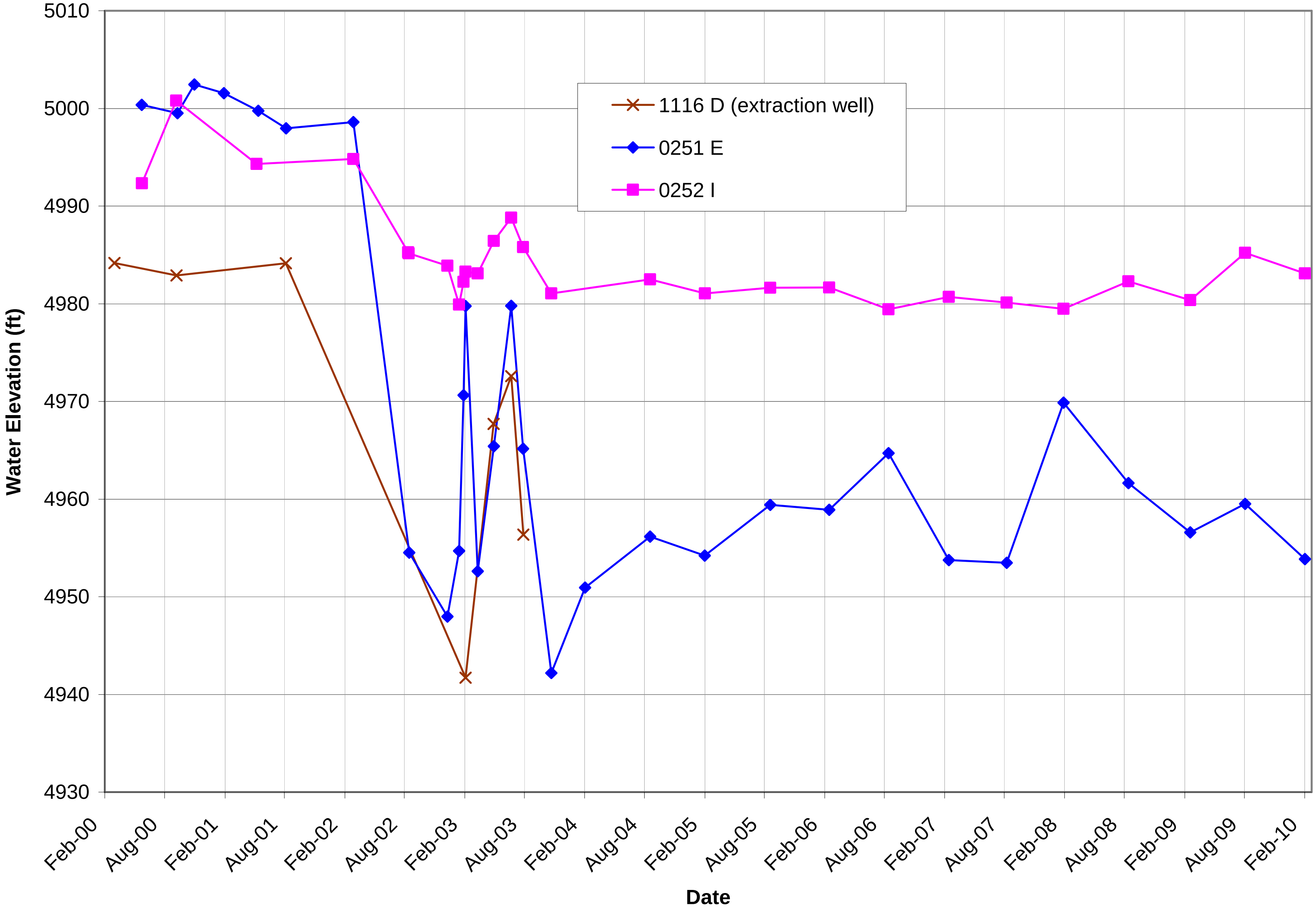



*Figure D−9. Middle Terrace Well Cluster 251, 252, and 1116*

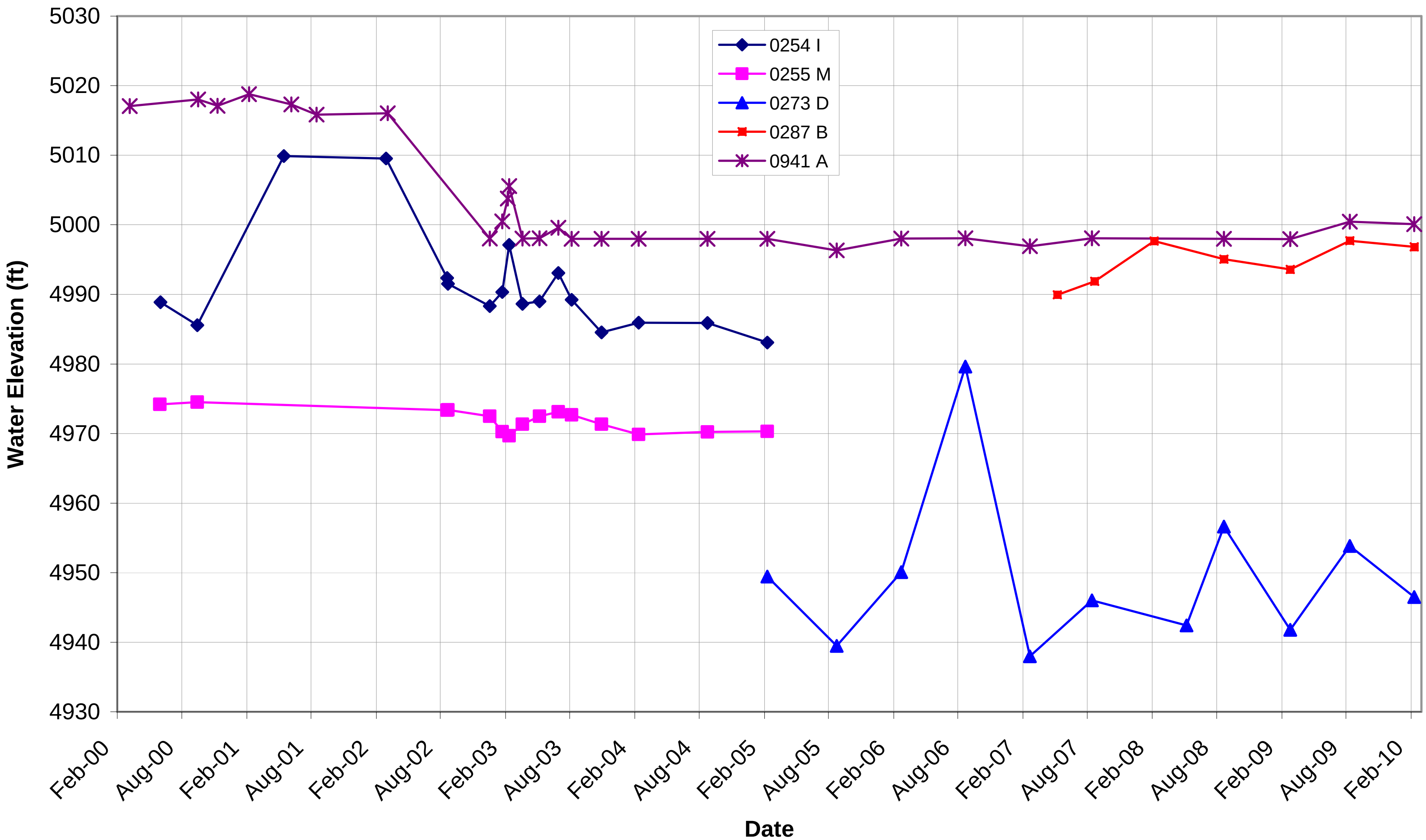



*Figure D−10. Middle Terrace Well Cluster 254, 255, 273, 287, and 941*

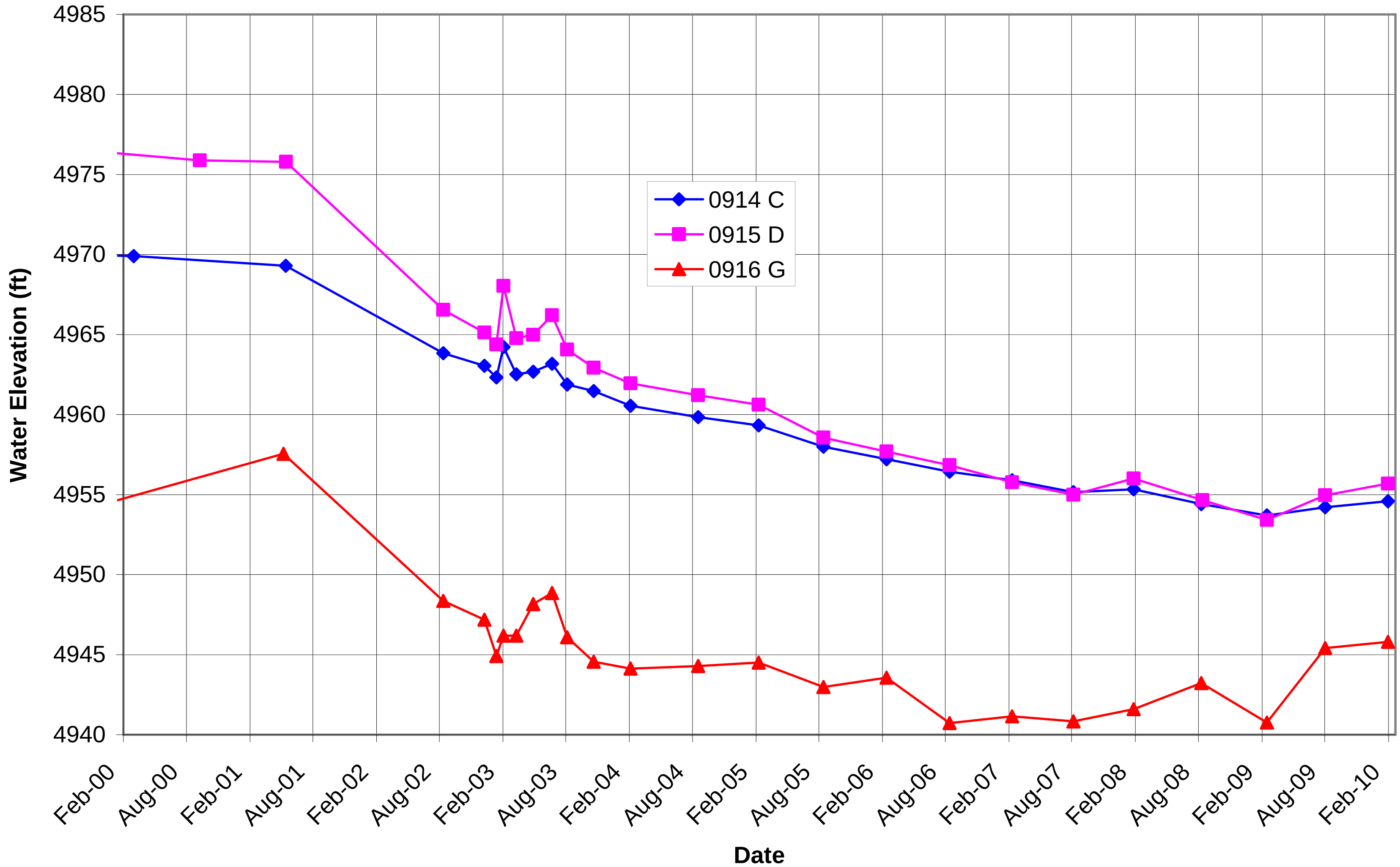



*Figure D−11. Middle Terrace Well Cluster 914, 915, and 916*

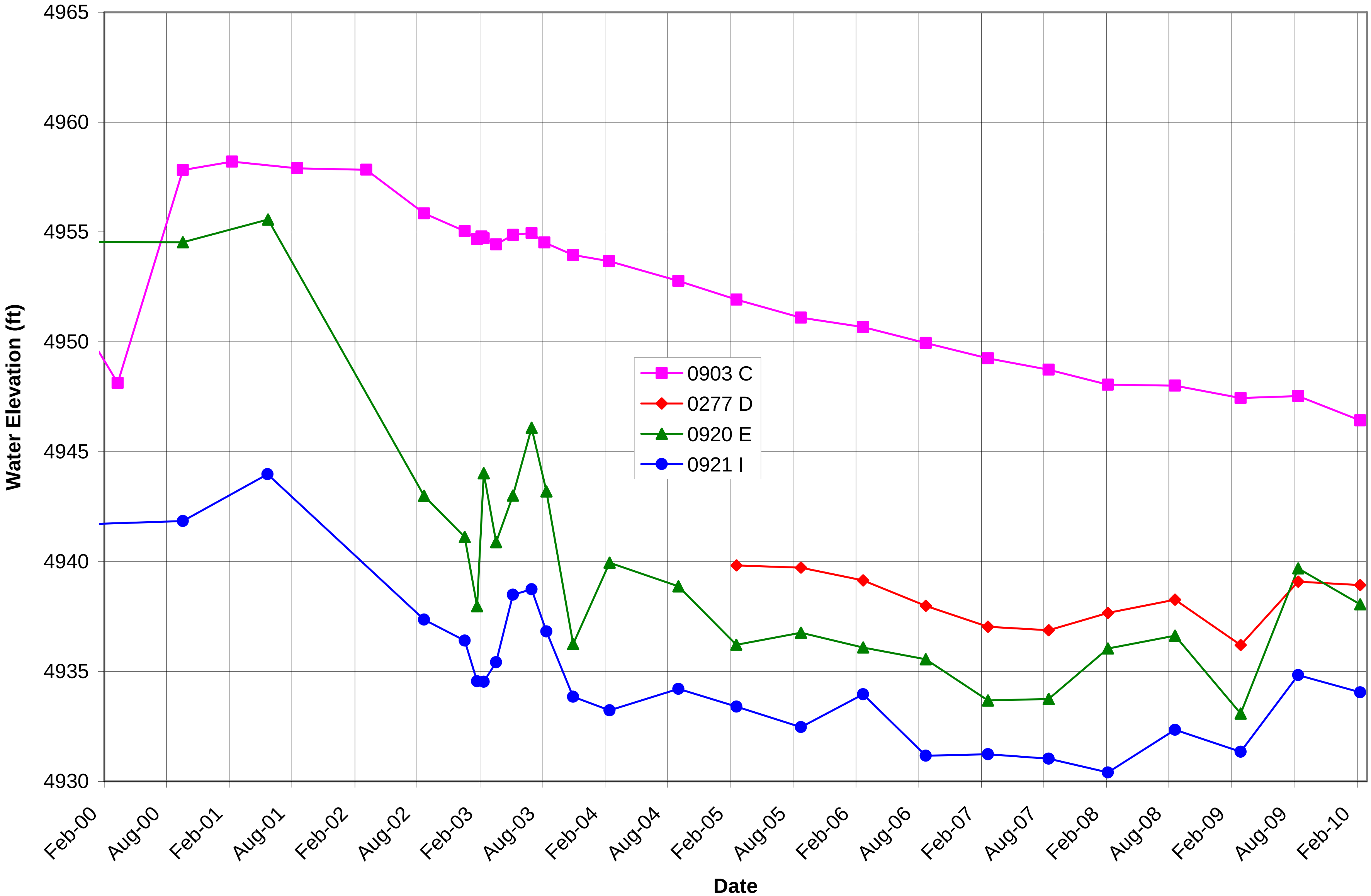



*Figure D–12. Lower Terrace Well Cluster 277, 903, 920, and 921*

# Appendix E

# Contaminant Concentration Trends at Monitoring Wells

This page intentionally left blank

# Contents

## Figures

This page intentionally left blank

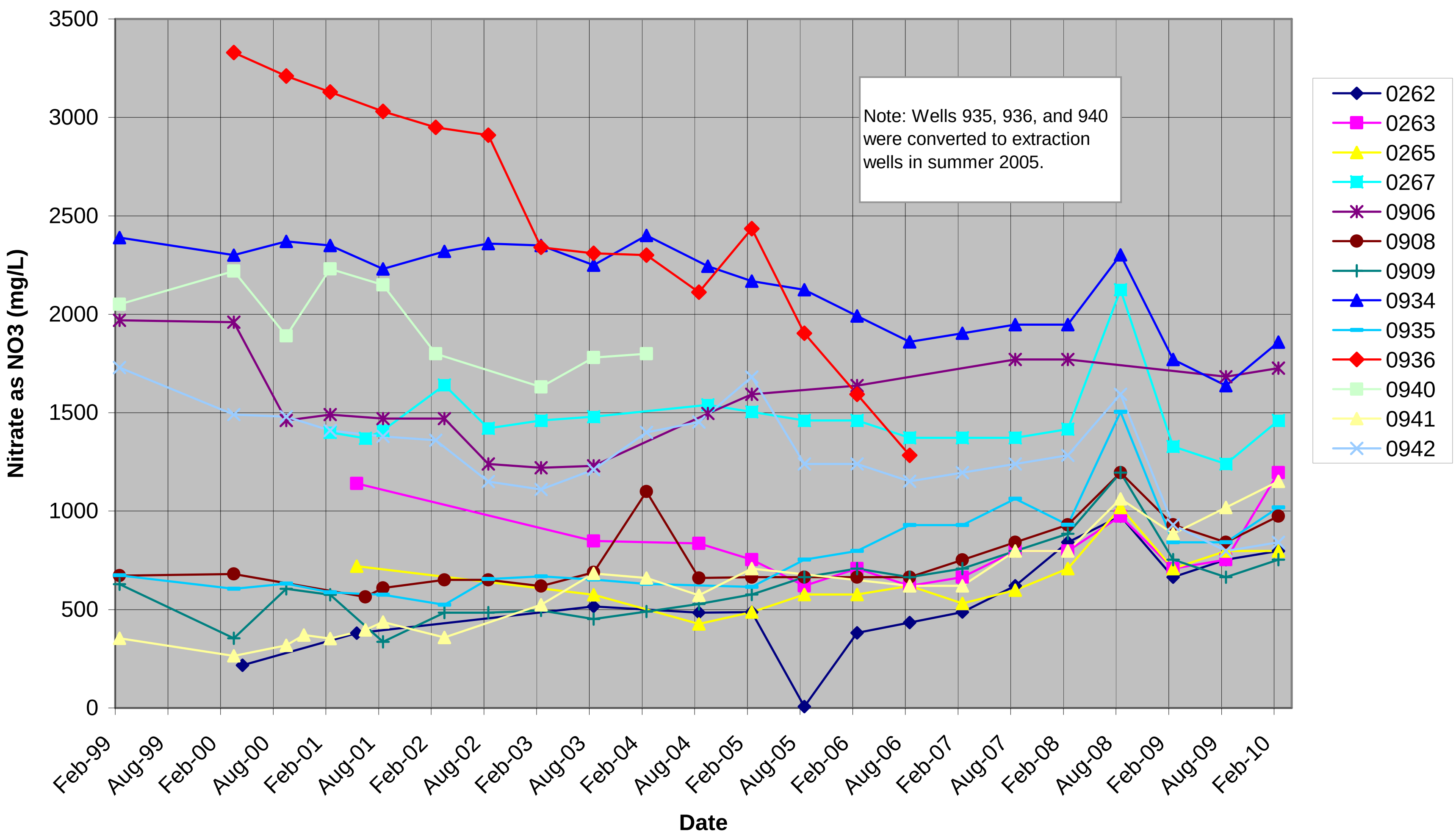



*Figure E−1. Horizons A and B Monitoring Wells, Nitrate as $NO_3$ Concentration*

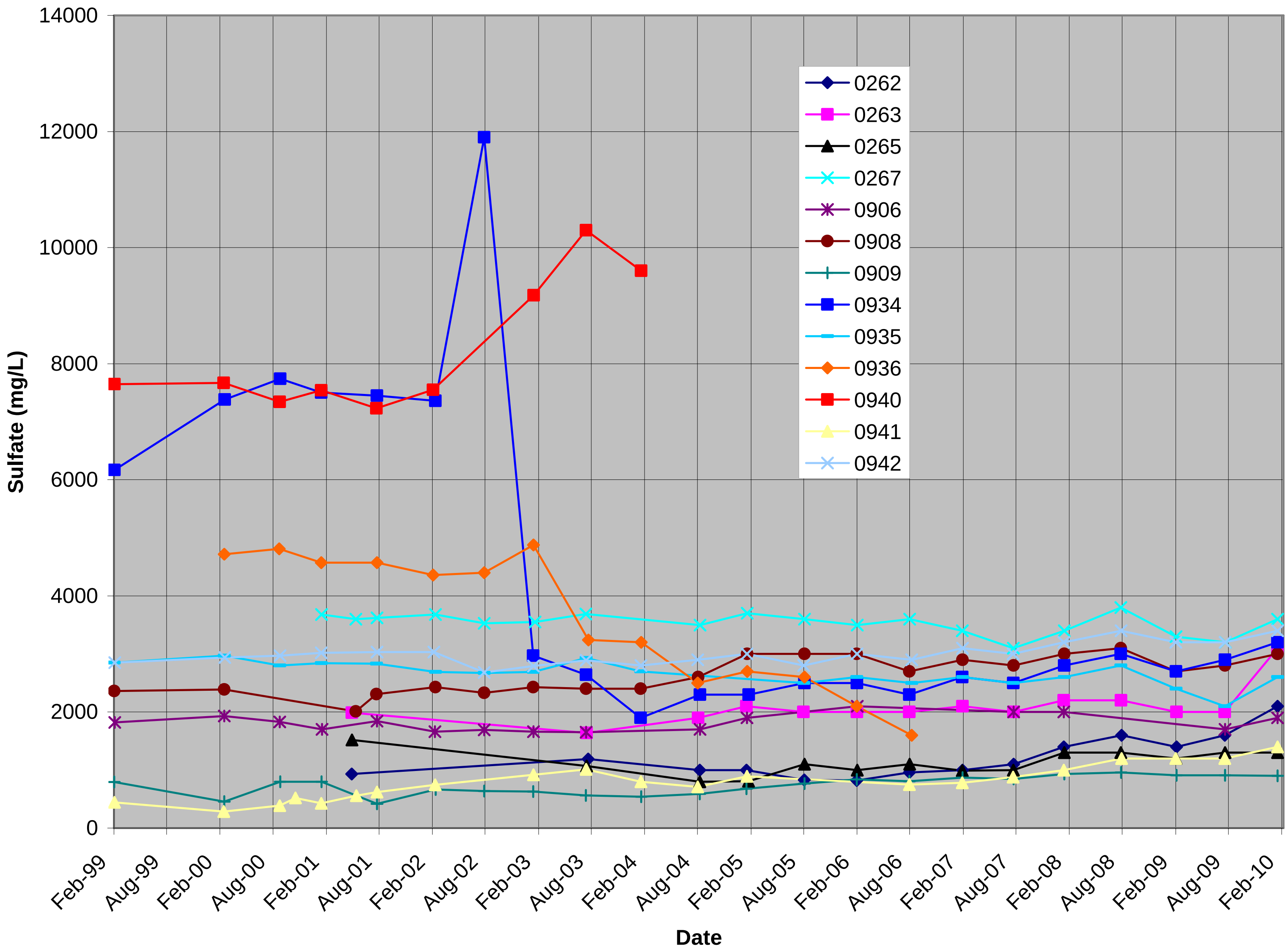



*Figure E−2. Horizons A and B Monitoring Wells, Sulfate Concentration*

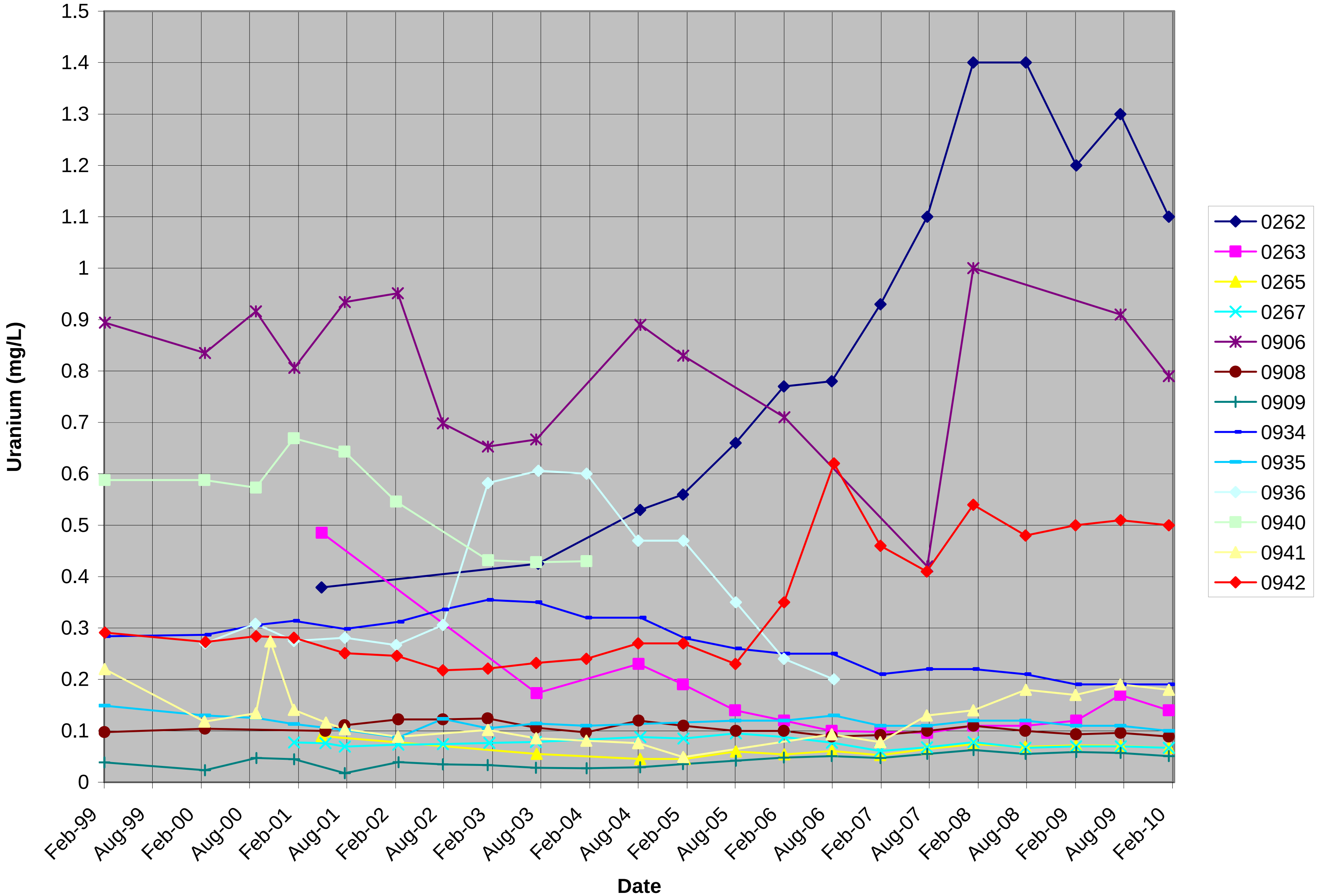



*Figure E−3. Horizons A and B Monitoring Wells, Uranium Concentration*

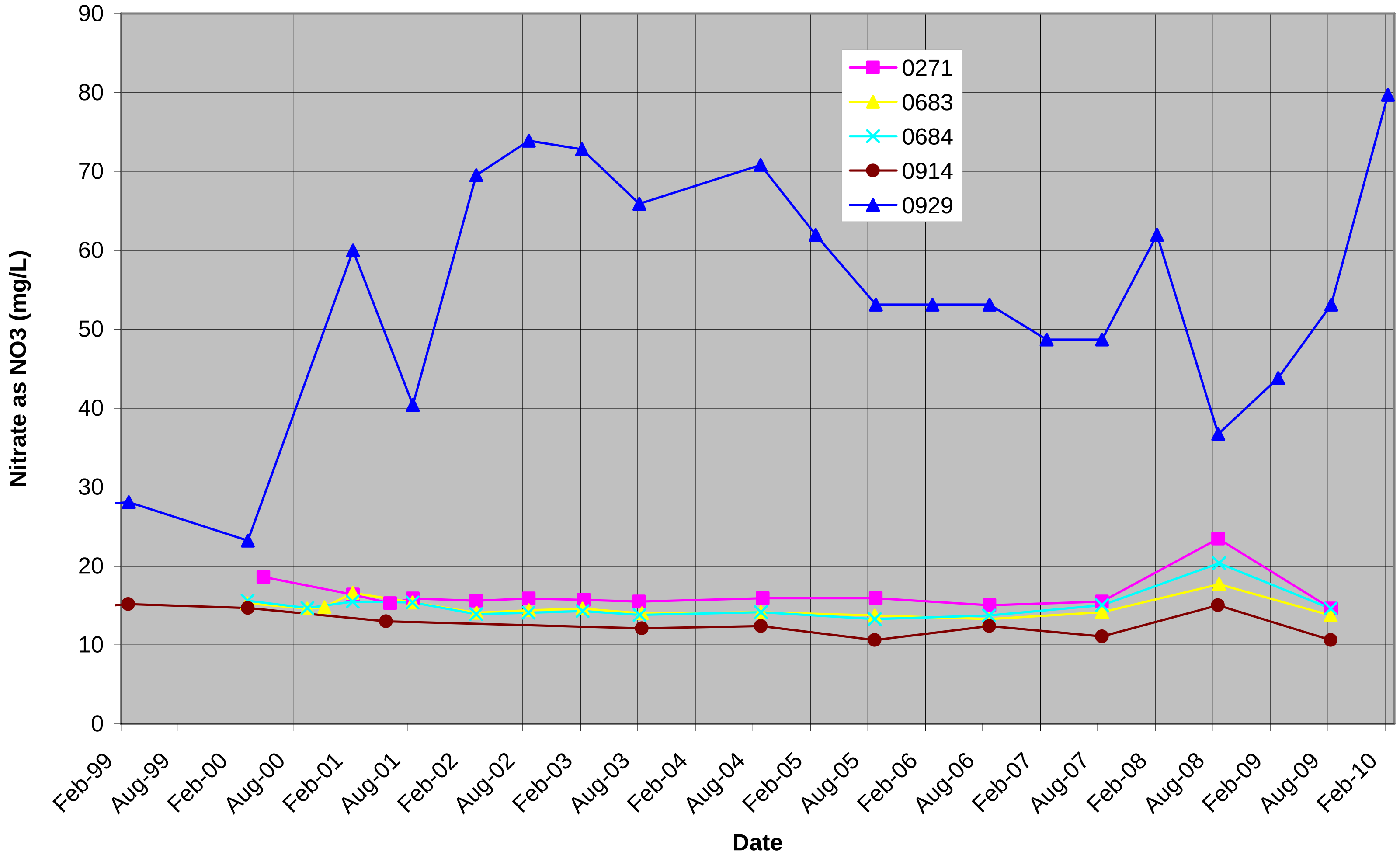



*Figure E−4. Horizons A and B Sentinel Wells, Nitrate as $NO_3$ Concentration*

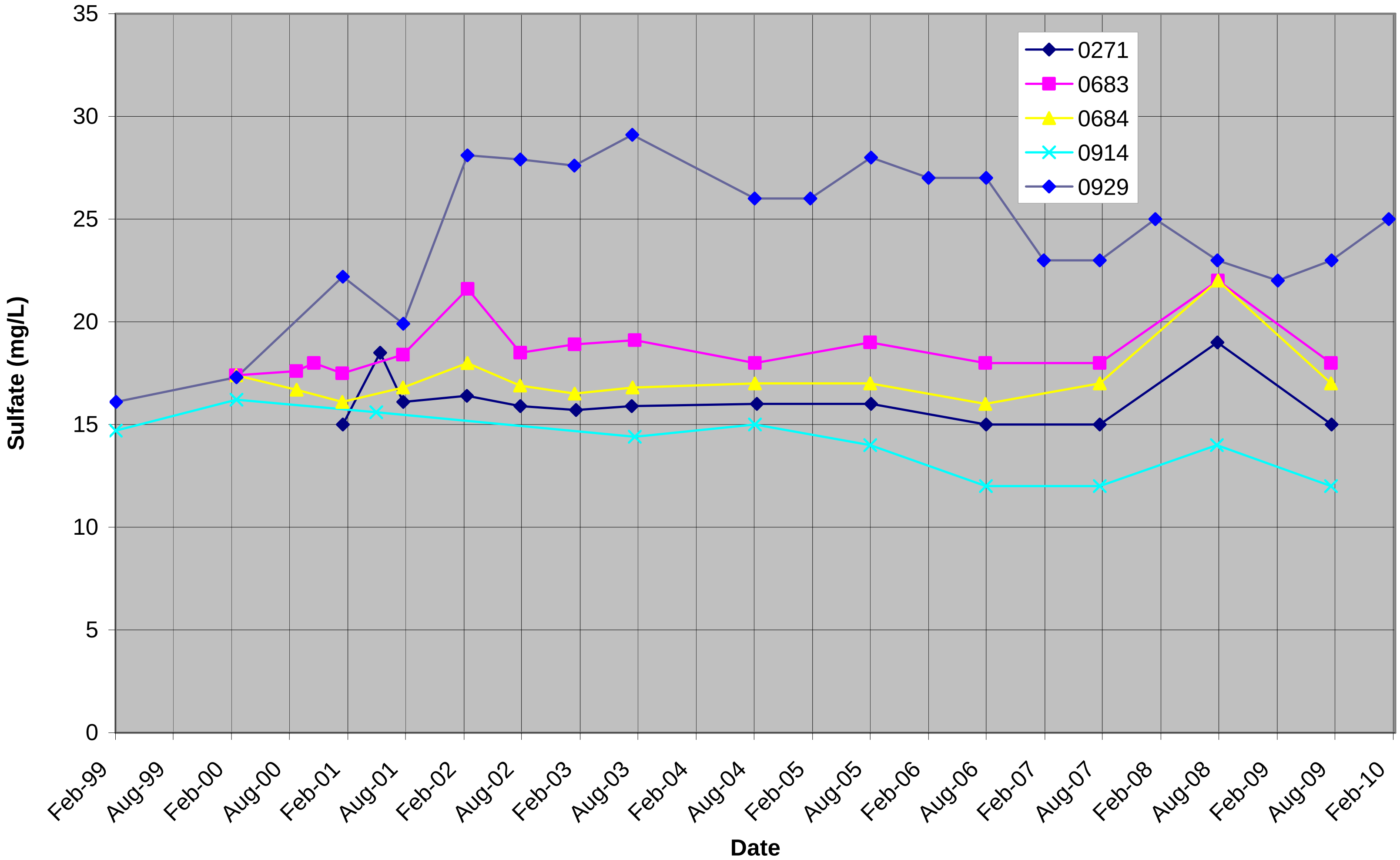



*Figure E−5. Horizons A and B Sentinel Wells, Sulfate Concentration*

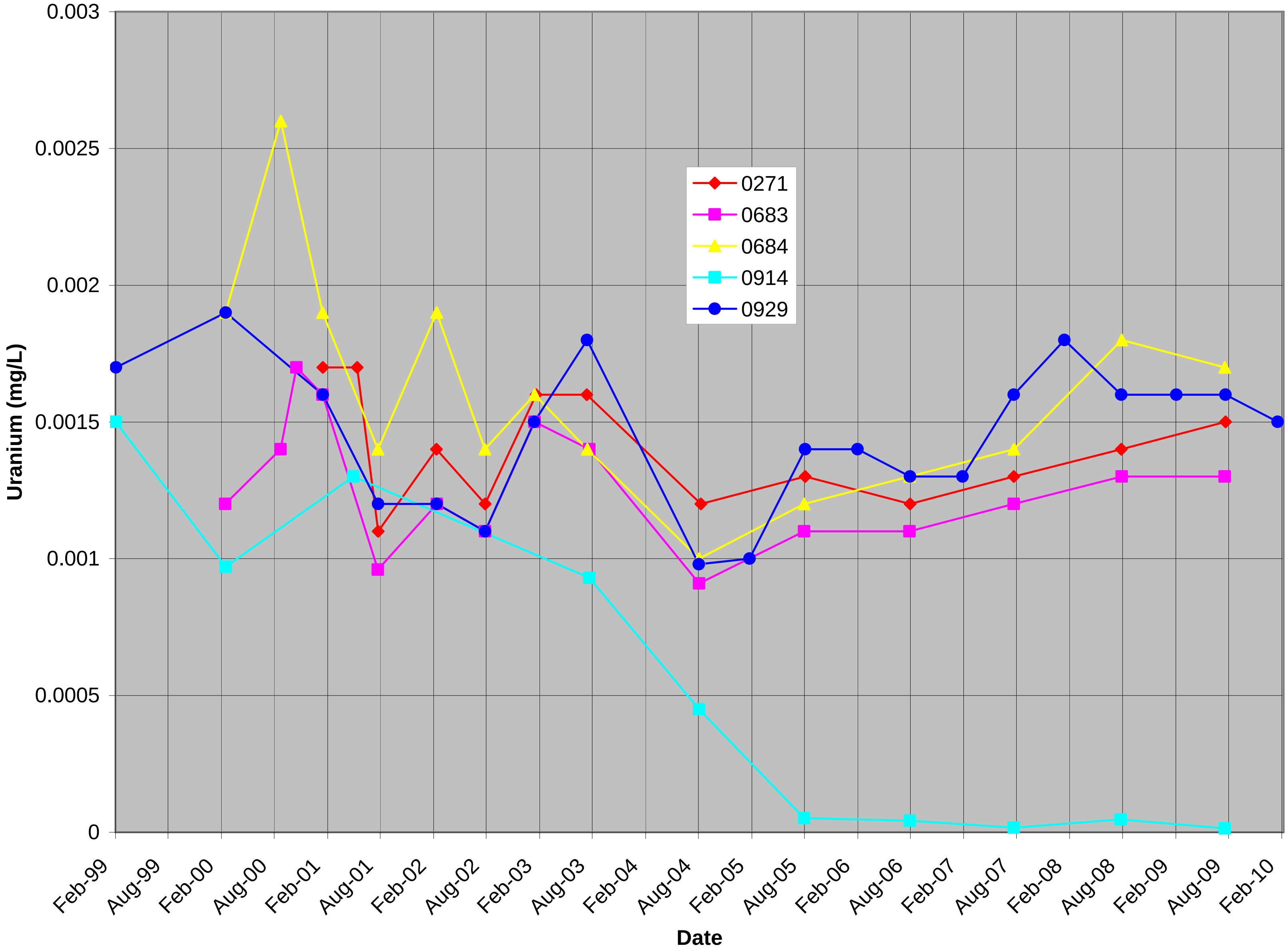



*Figure E−6. Horizons A and B Sentinel Wells, Uranium Concentration*

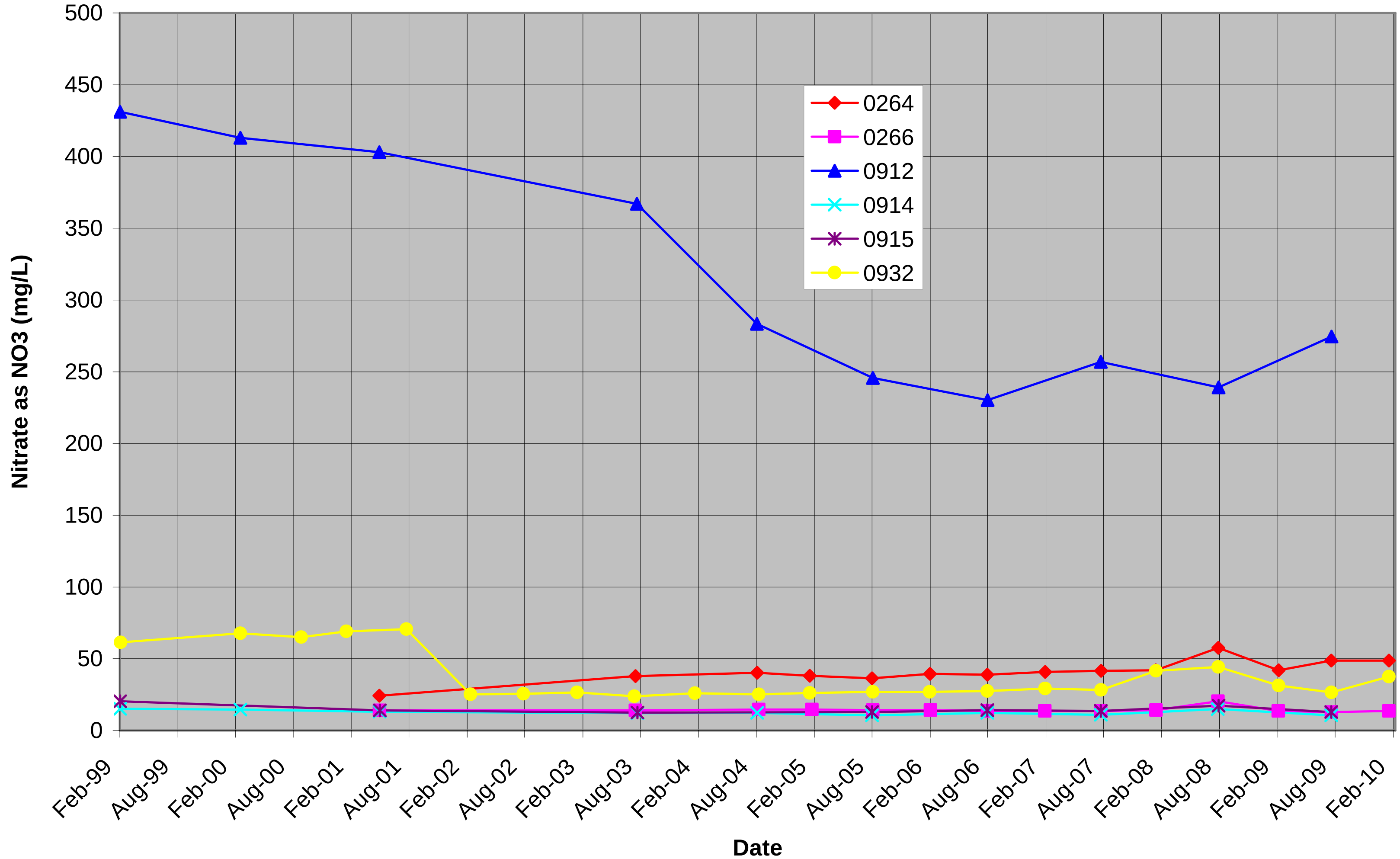



*Figure E−7. Horizons C and D Monitoring Wells, Nitrate as $NO_3$ Concentration*

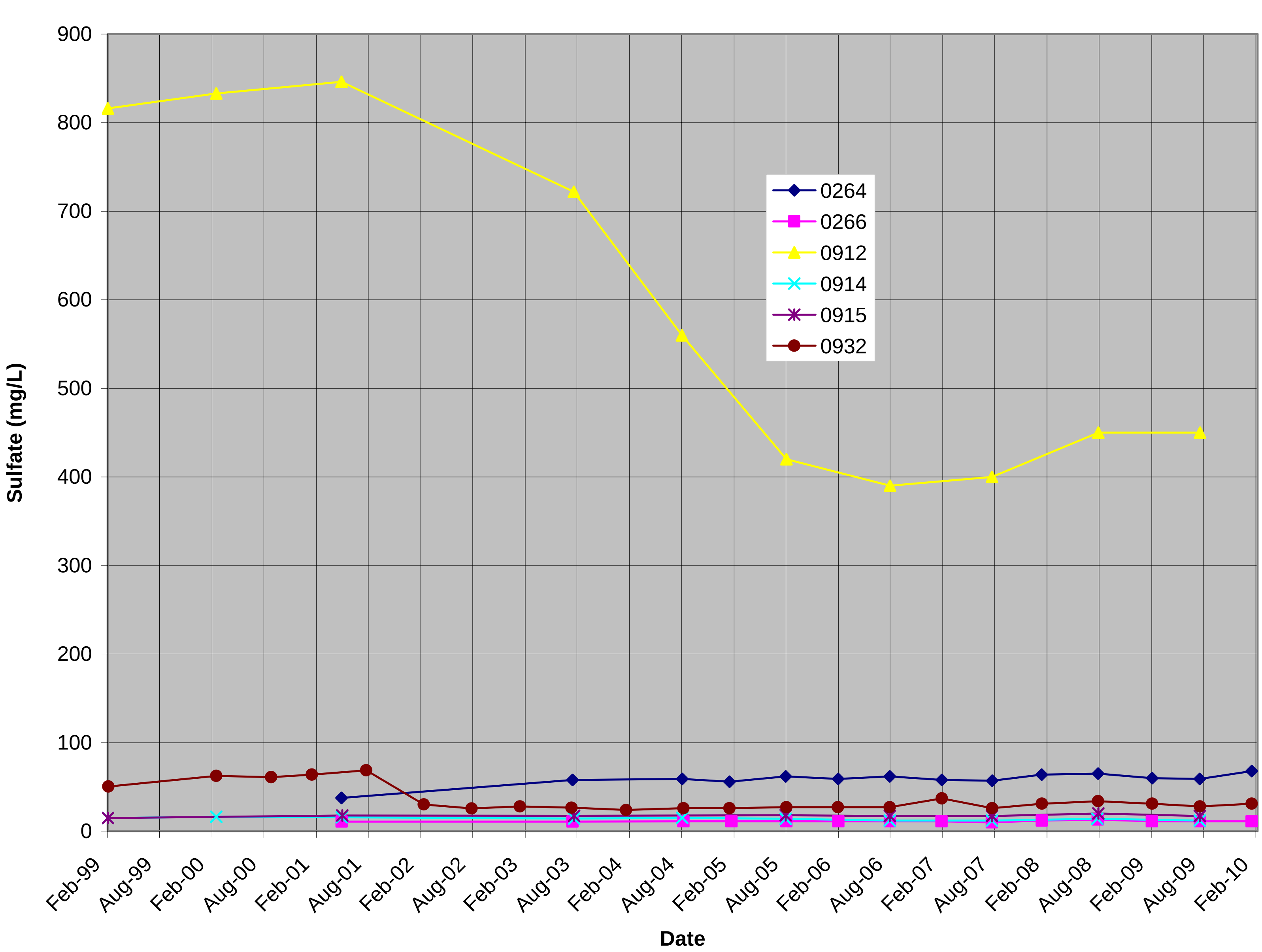



*Figure E−8. Horizons C and D Monitoring Wells, Sulfate Concentration*

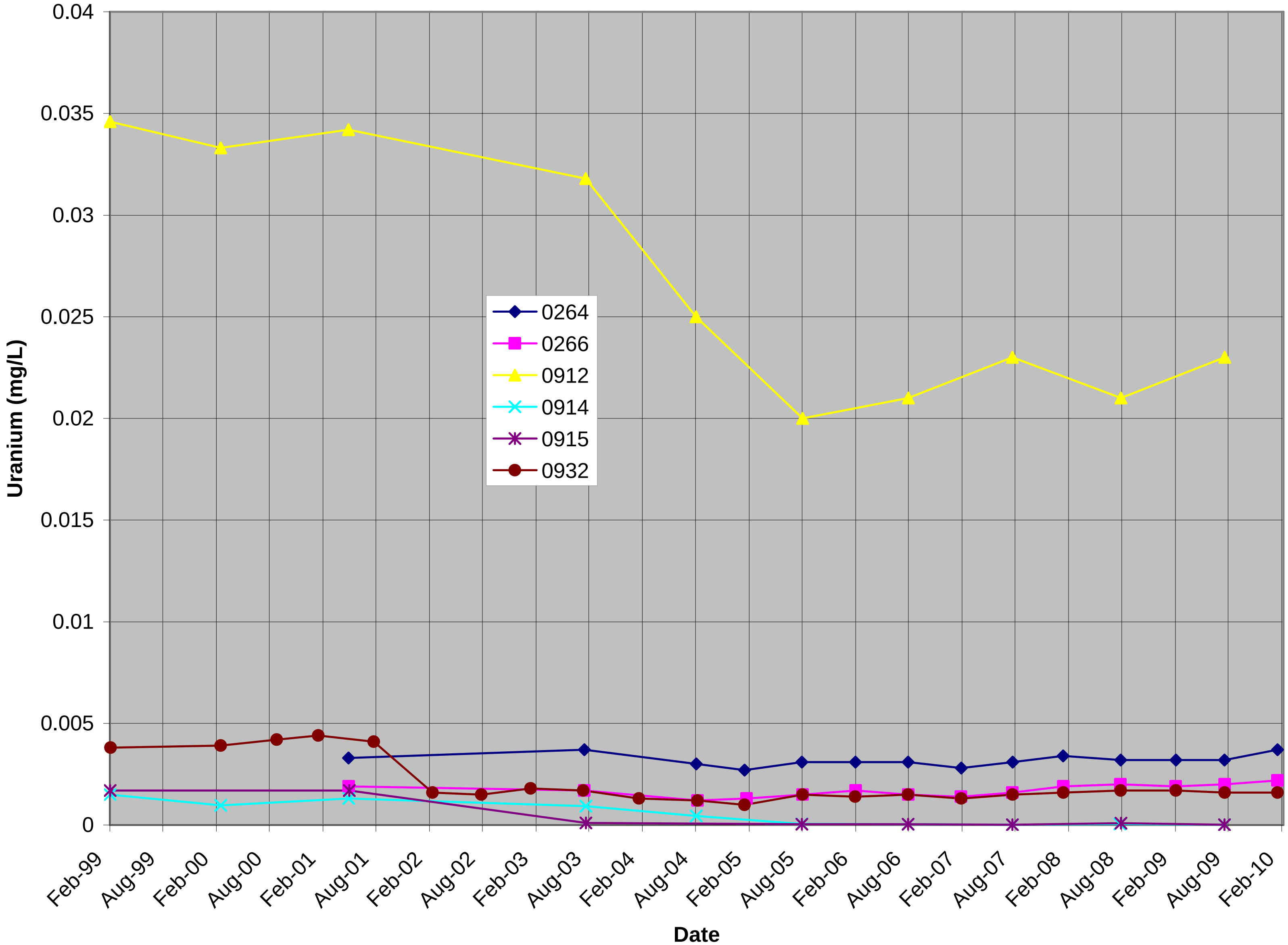



*Figure E−9. Horizons C and D Monitoring Wells, Uranium Concentration*

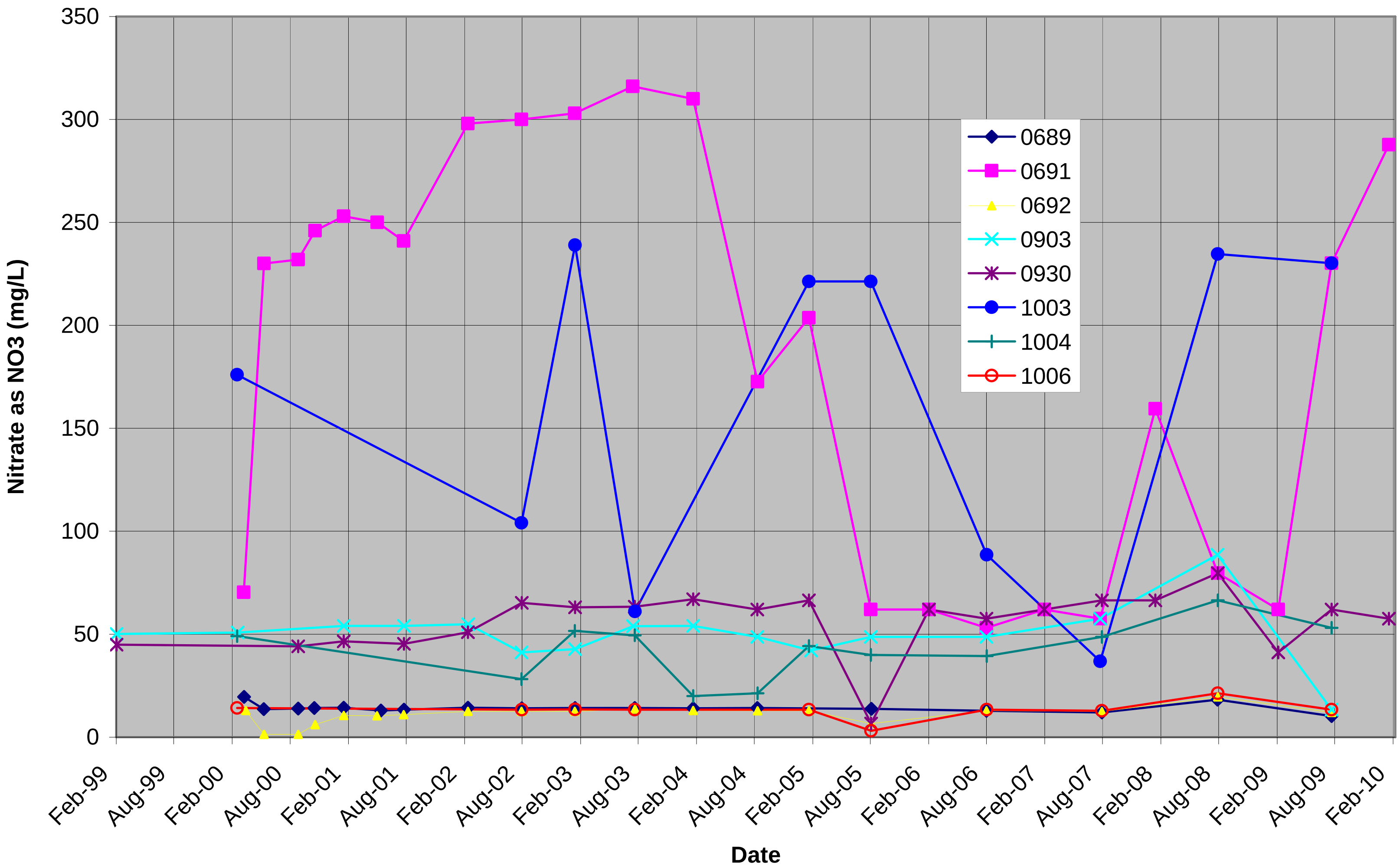



*Figure E−10. Lower Terrace Monitoring Wells, Nitrate as $NO_3$ Concentration*

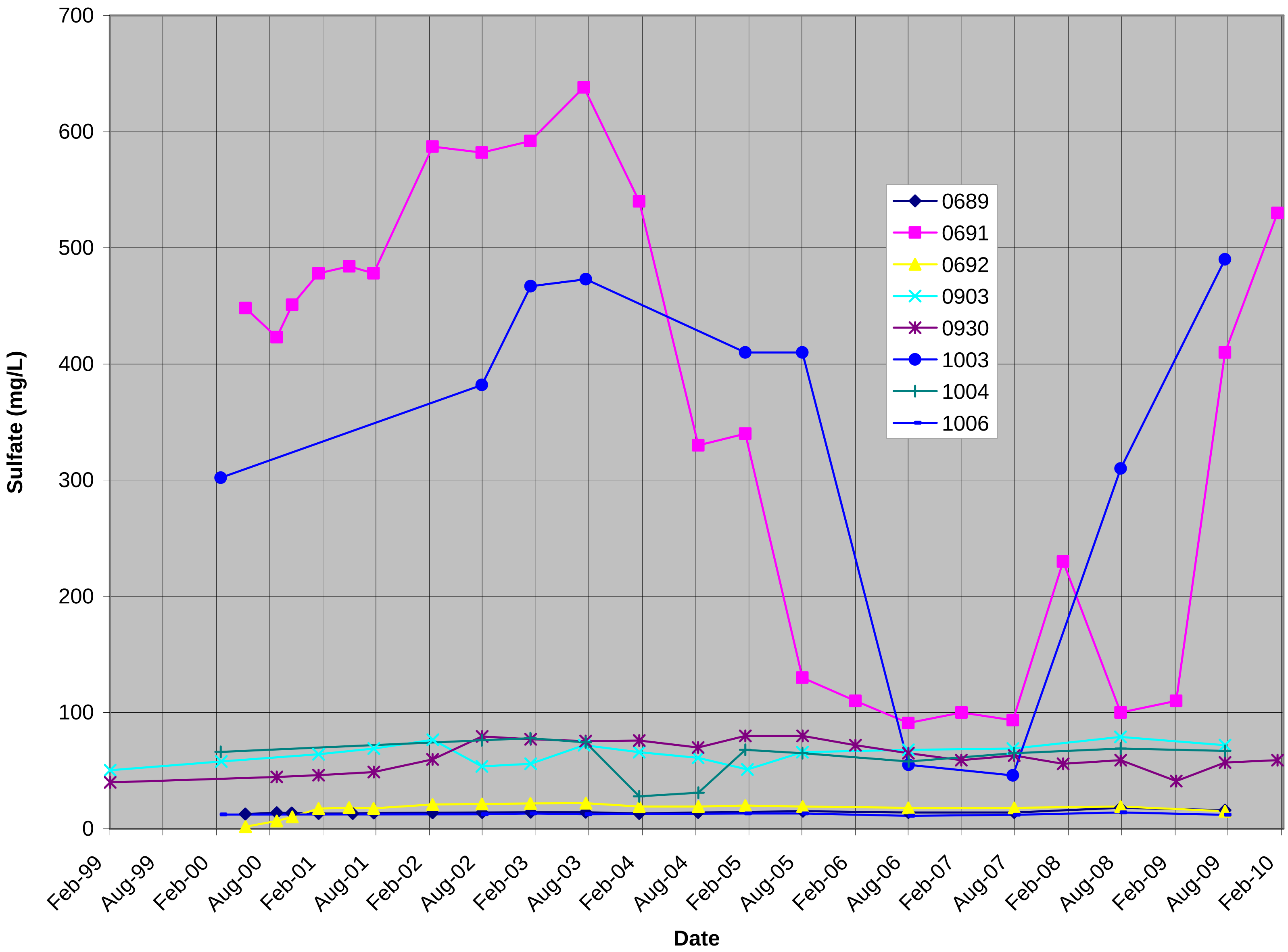



*Figure E−11. Lower Terrace Monitoring Wells, Sulfate Concentration*

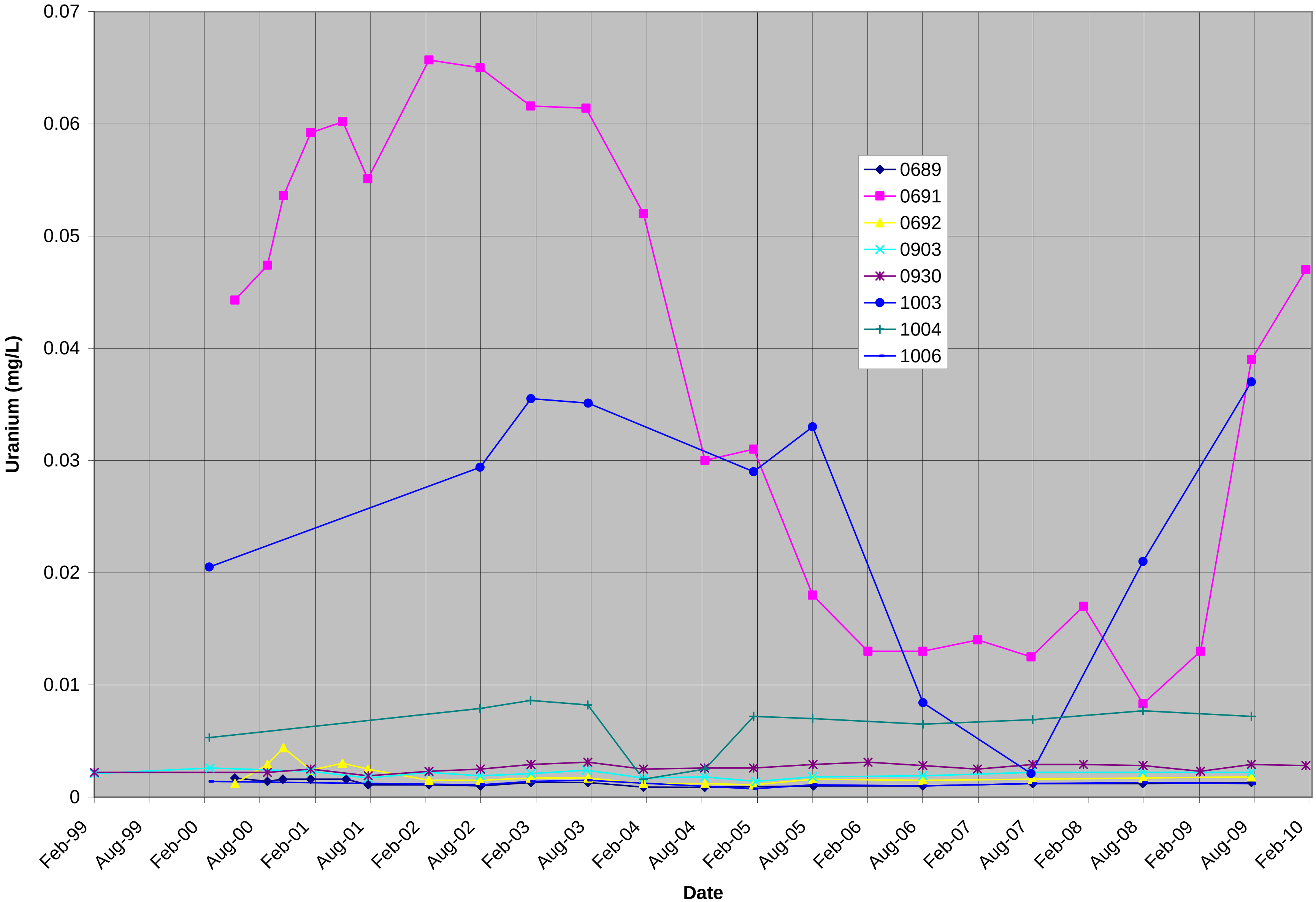



*Figure E−12. Lower Terrace Monitoring Wells, Uranium Concentration*

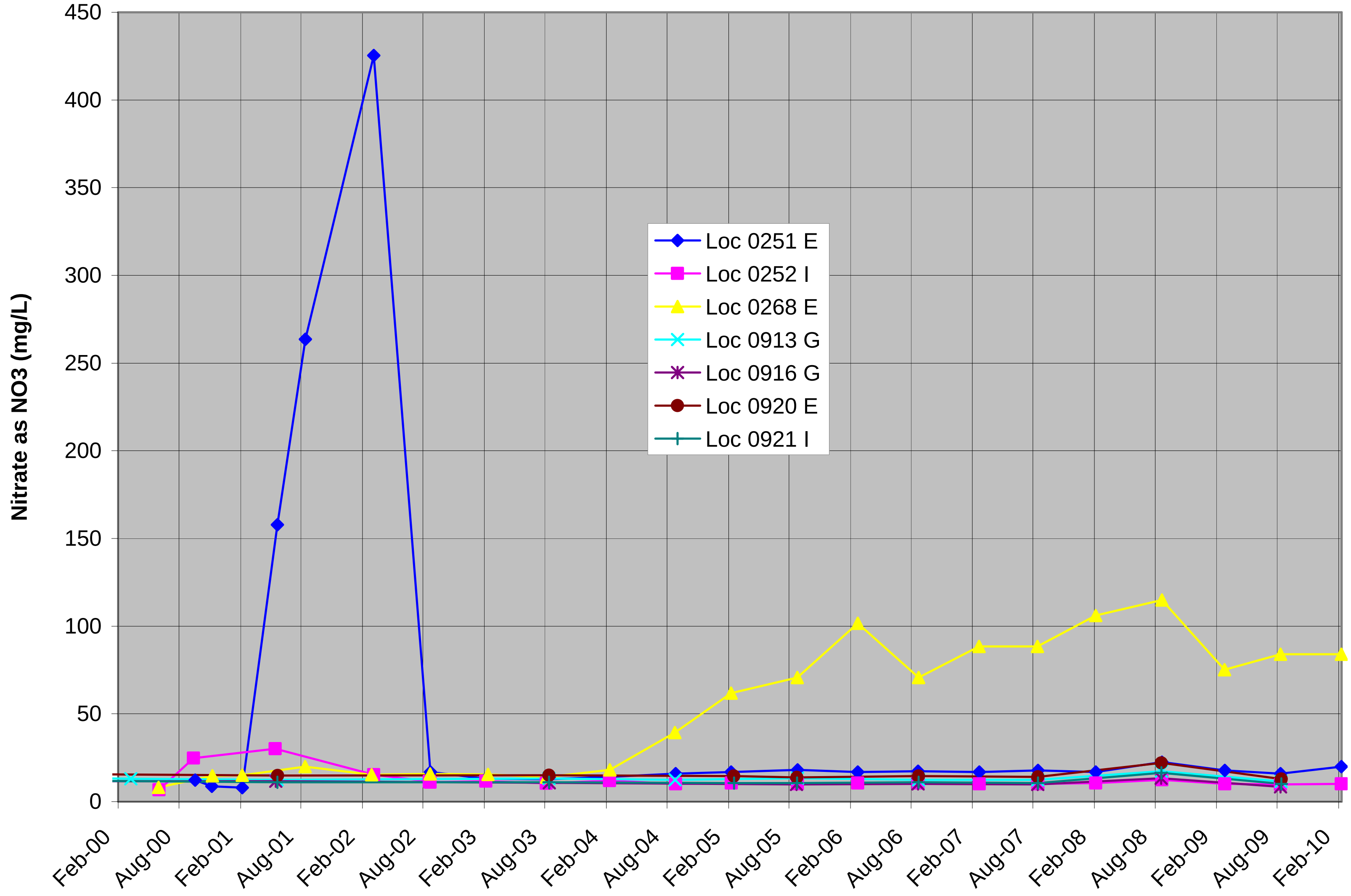



*Figure E−13. Deep Monitoring Wells, Nitrate as $NO_3$ Concentration*

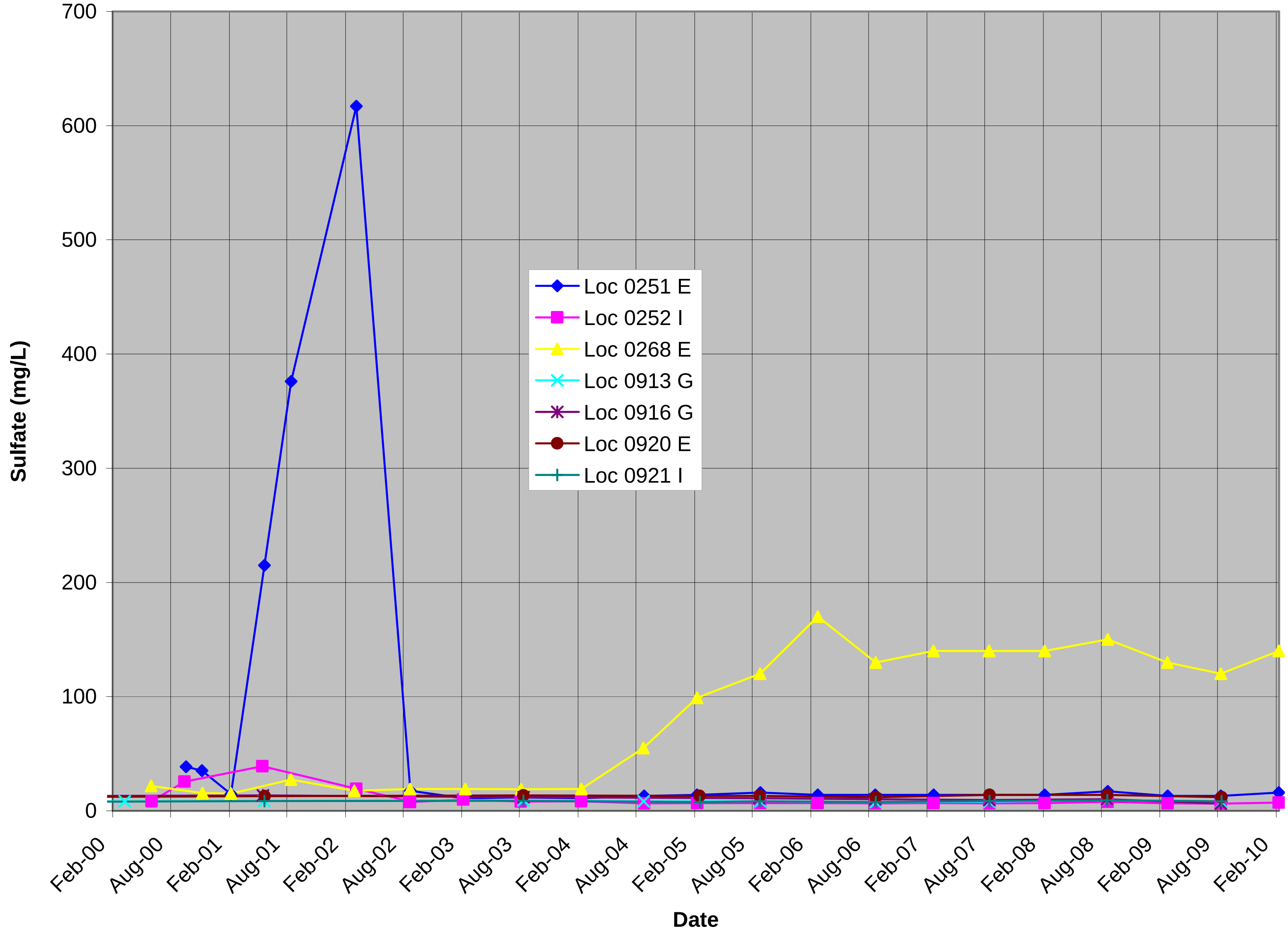



*Figure E−14. Deep Monitoring Wells, Sulfate Concentration*

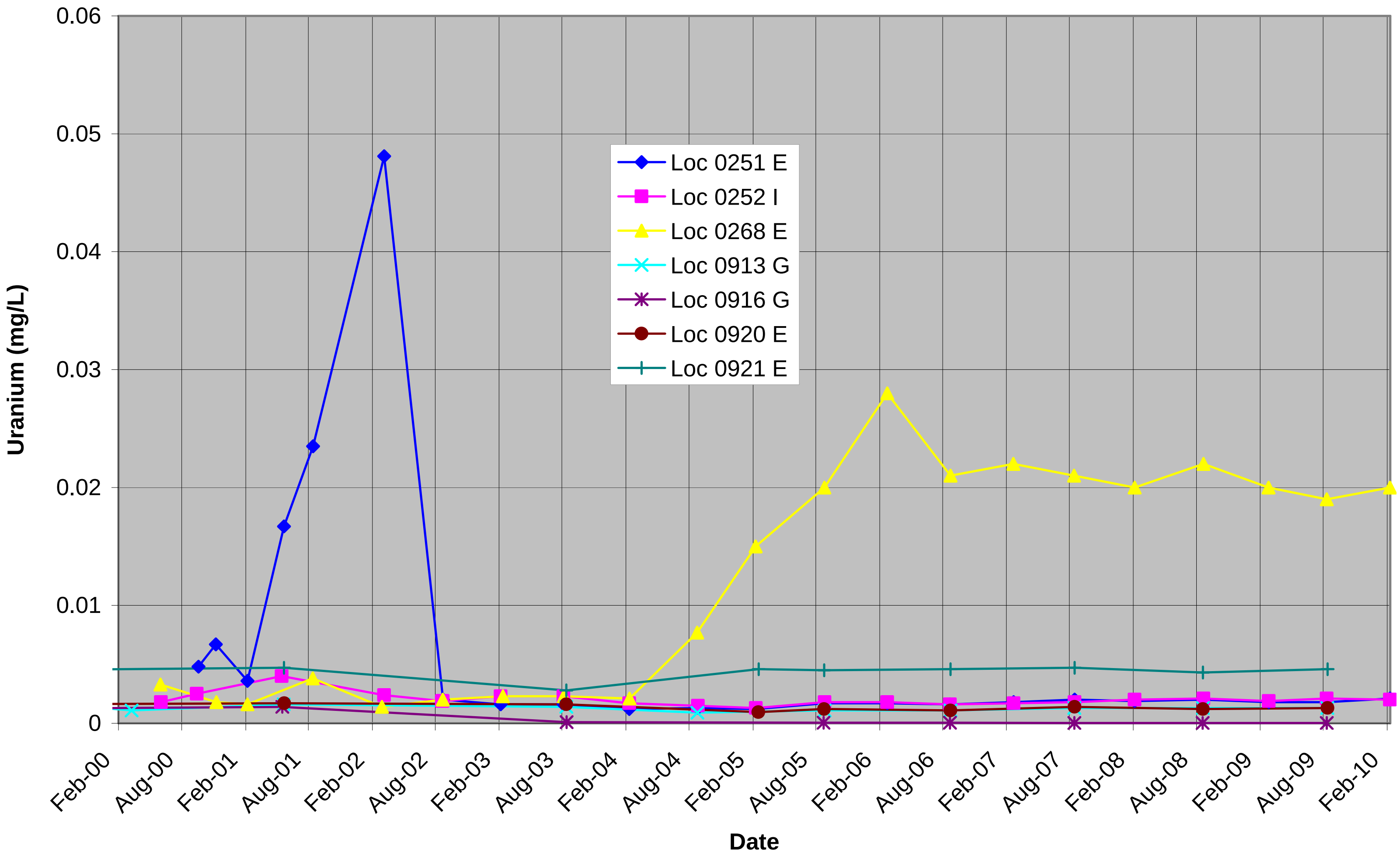



*Figure E−15. Deep Monitoring Wells, Uranium Concentration*

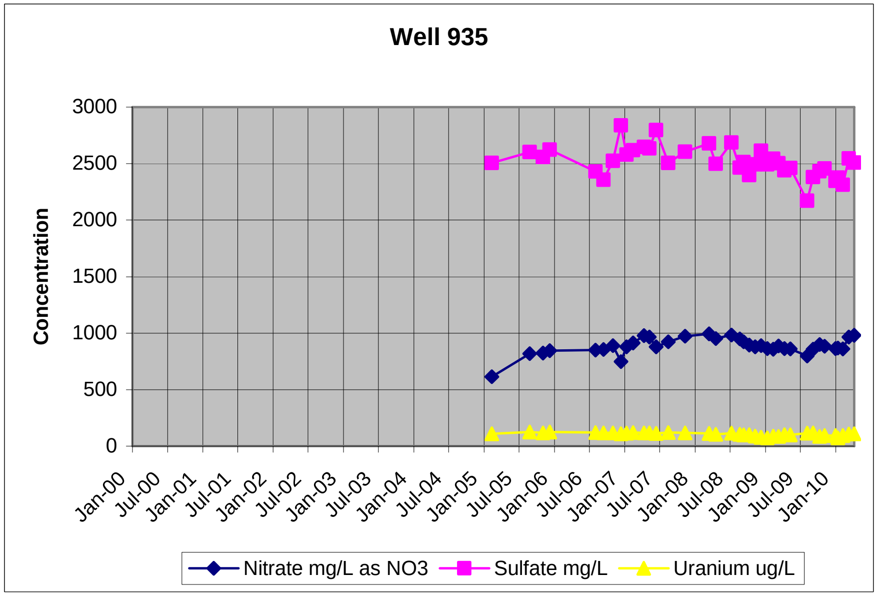
This page intentionally left blank

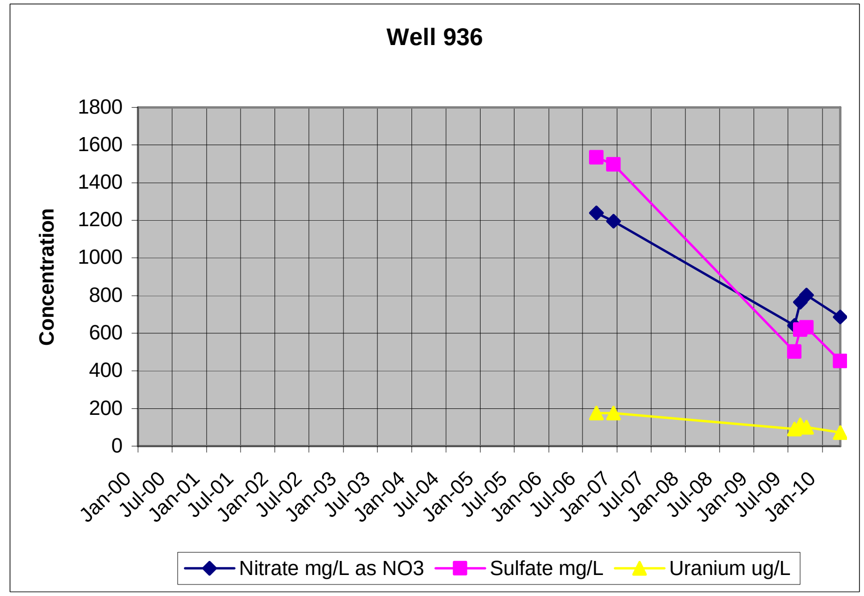
# Appendix F

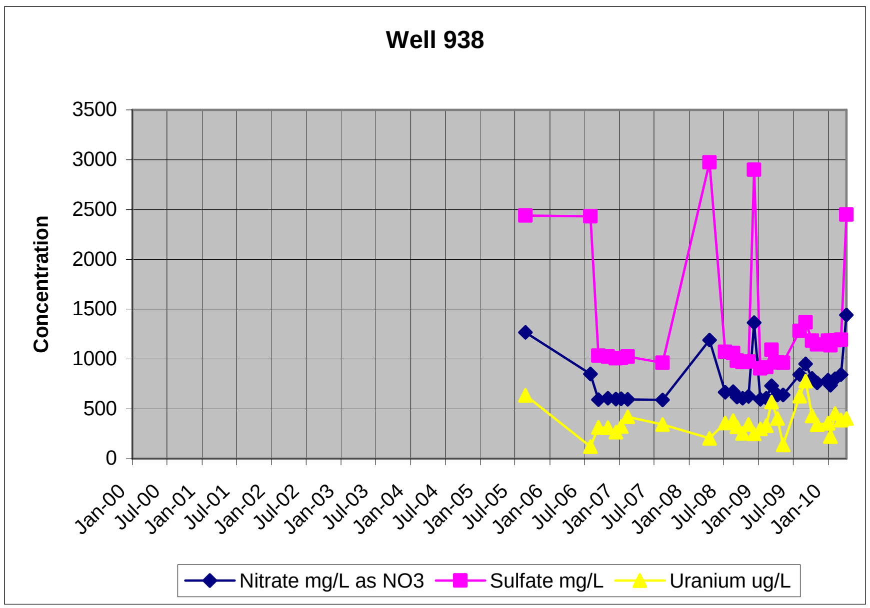
# Contaminant Concentration Trends at Extraction Wells

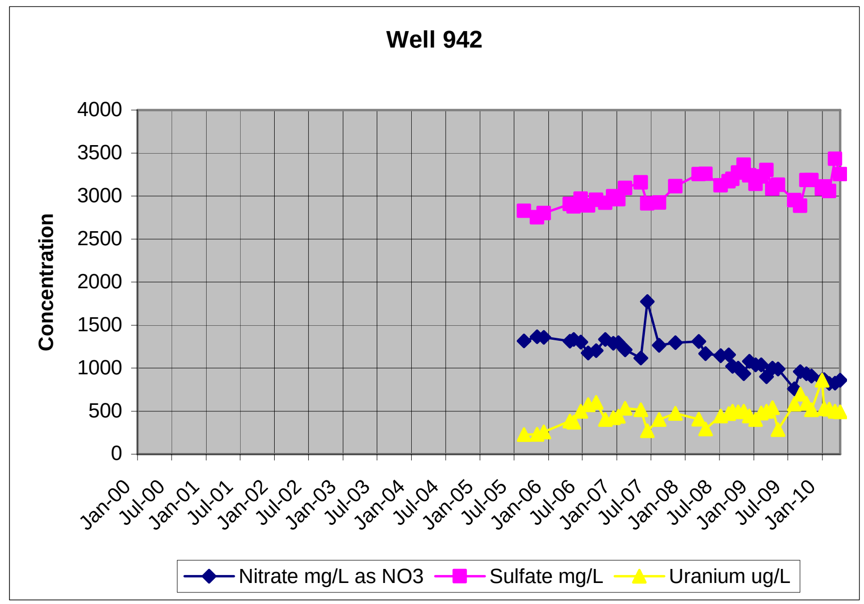
**Note:** Time-concentration graphs for wells 1107, 1110, 1112, 1115, 1117, 1118, 1123, 1124, 126, 1127, and 1128 are each plotted twice, once at a higher scale on the *y* axis to show constituents present at higher concentrations, and again at a lower scale to show the trend of a constituent with concentrations too low to be depicted at the higher scale.

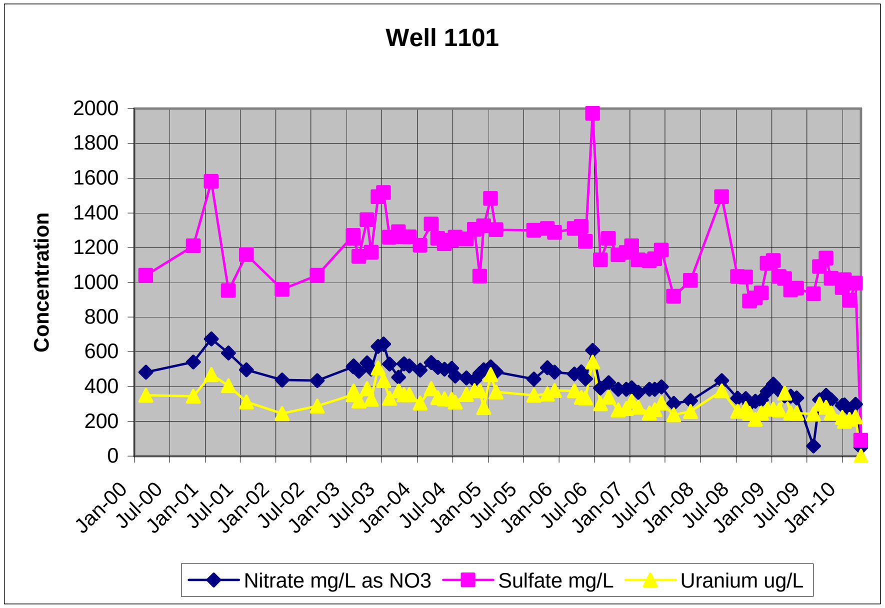
This page intentionally left blank

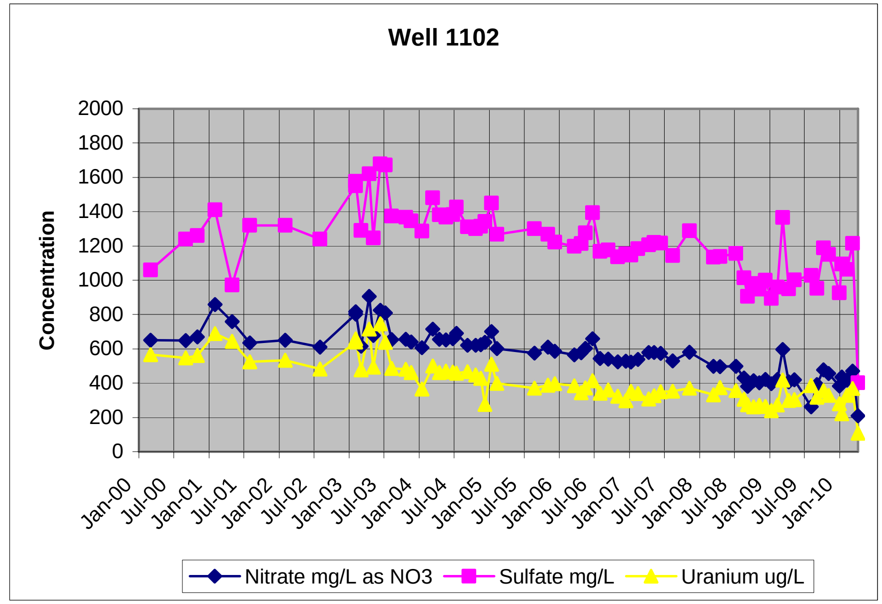

Well 935
Concentration
Nitrate mg/L as NO3
Sulfate mg/L
Uranium ug/L

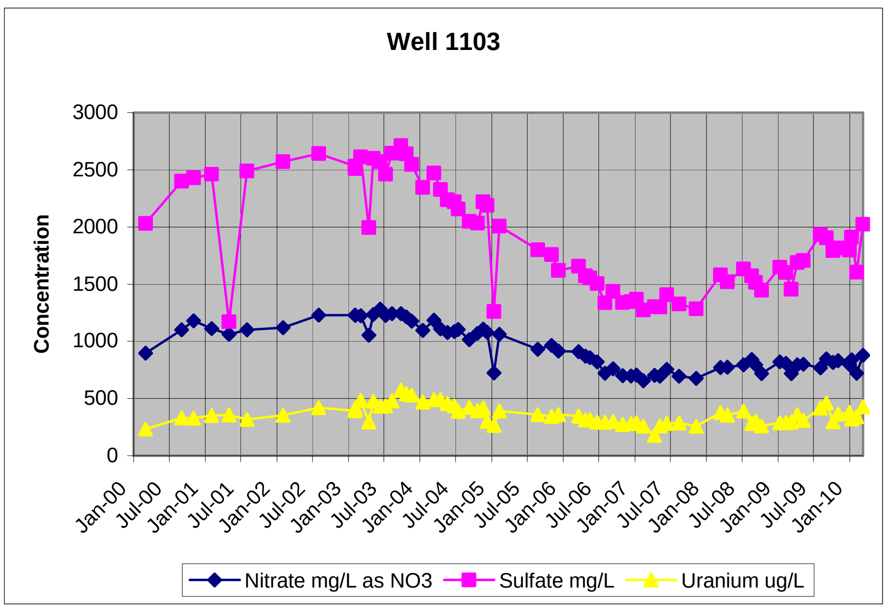

Well 936
Concentration
Nitrate mg/L as NO3
Sulfate mg/L
Uranium ug/L

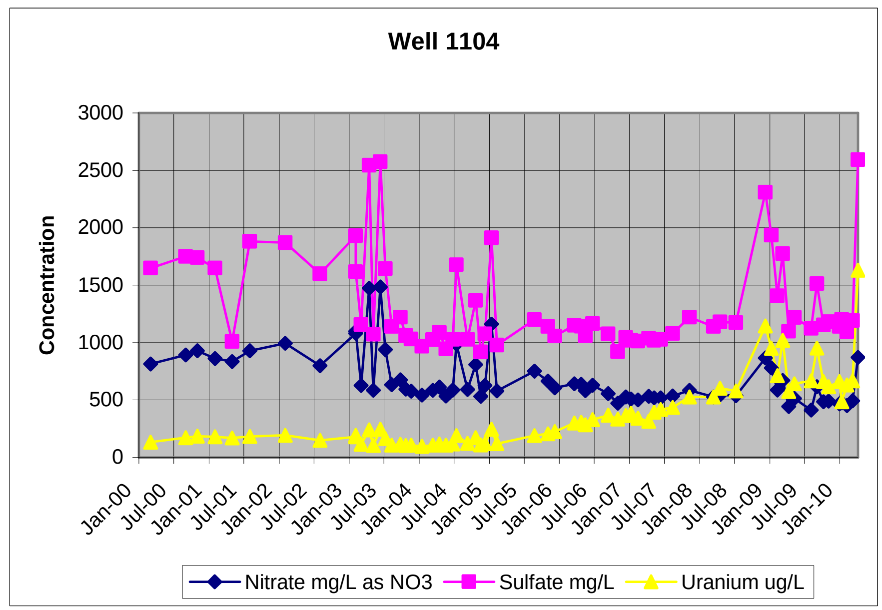

Well 938
Concentration
Nitrate mg/L as NO3
Sulfate mg/L
Uranium ug/L

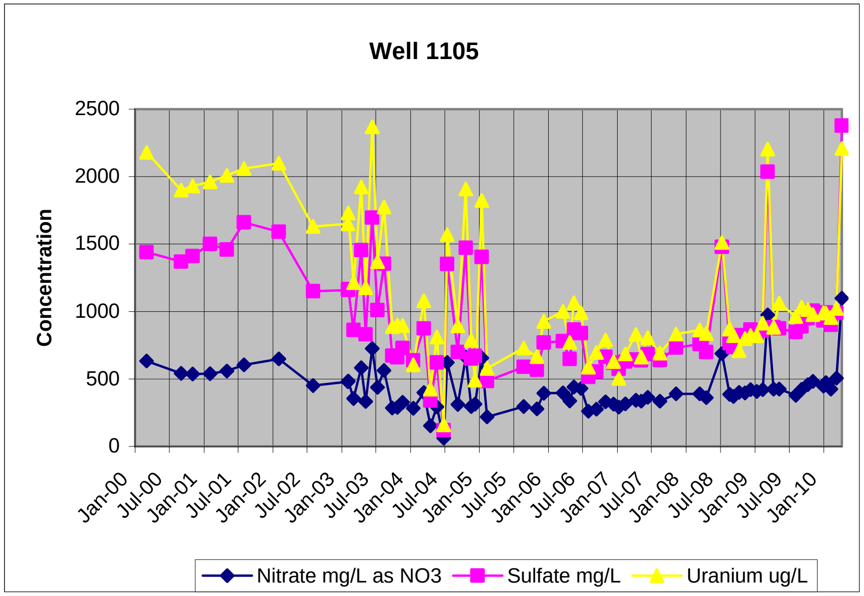

Well 942
Concentration
Nitrate mg/L as NO3
Sulfate mg/L
Uranium ug/L

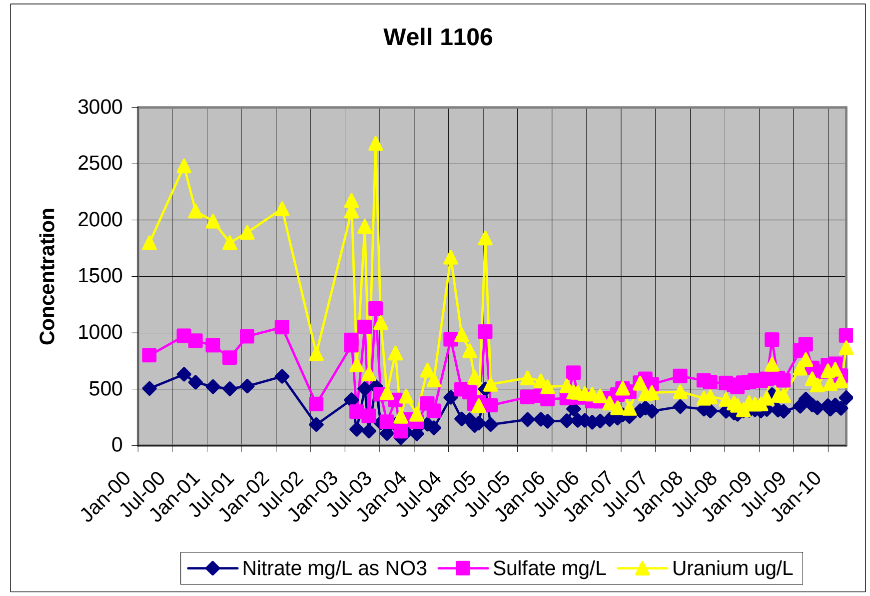

Well 1101
Concentration
0
200
400
600
800
1000
1200
1400
1600
1800
2000
Jan-00
Jul-00
Jan-01
Jul-01
Jan-02
Jul-02
Jan-03
Jul-03
Jan-04
Jul-04
Jan-05
Jul-05
Jan-06
Jul-06
Jan-07
Jul-07
Jan-08
Jul-08
Jan-09
Jul-09
Jan-10
Nitrate mg/L as NO3
Sulfate mg/L
Uranium ug/L

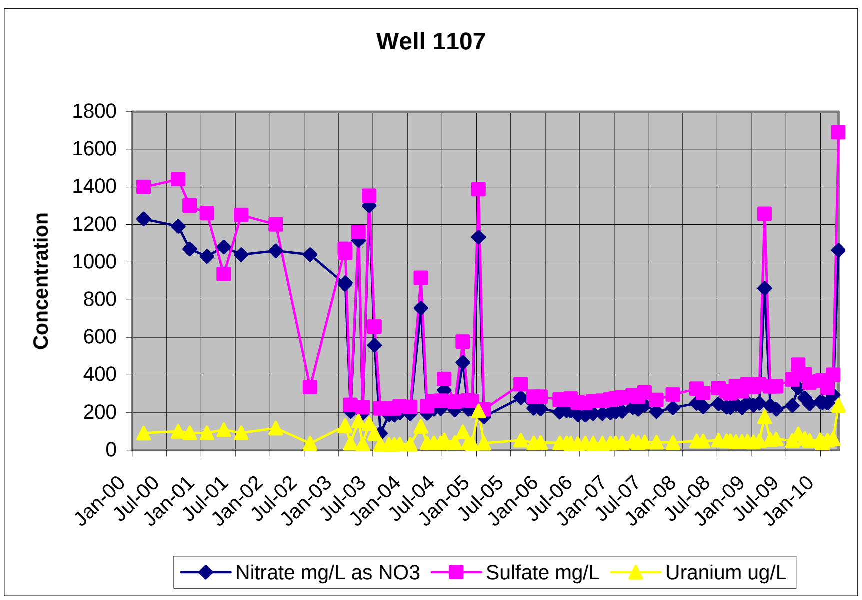

Well 1102
Concentration
0
200
400
600
800
1000
1200
1400
1600
1800
2000
Jan-00
Jul-00
Jan-01
Jul-01
Jan-02
Jul-02
Jan-03
Jul-03
Jan-04
Jul-04
Jan-05
Jul-05
Jan-06
Jul-06
Jan-07
Jul-07
Jan-08
Jul-08
Jan-09
Jul-09
Jan-10
Nitrate mg/L as NO3
Sulfate mg/L
Uranium ug/L

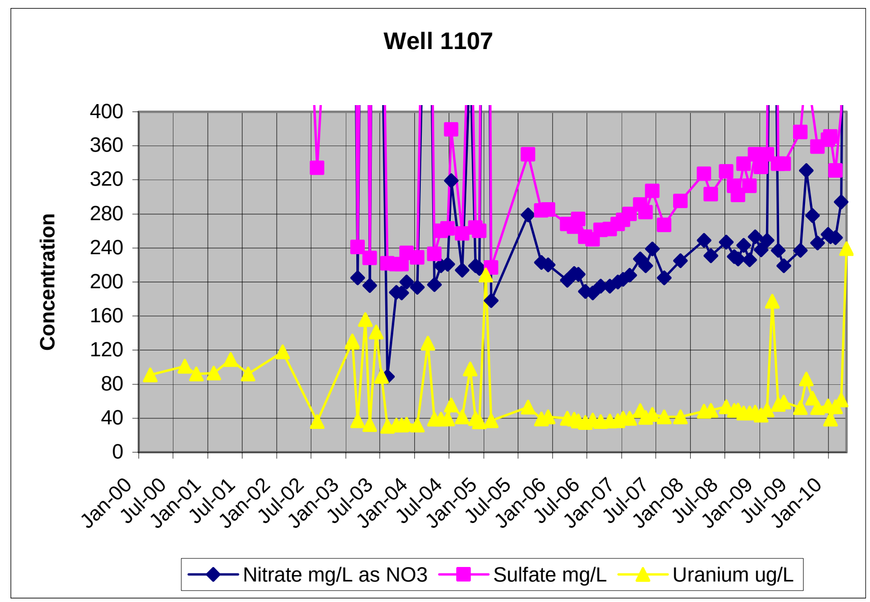

Well 1103
Concentration
0
500
1000
1500
2000
2500
3000
Jan-00
Jul-00
Jan-01
Jul-01
Jan-02
Jul-02
Jan-03
Jul-03
Jan-04
Jul-04
Jan-05
Jul-05
Jan-06
Jul-06
Jan-07
Jul-07
Jan-08
Jul-08
Jan-09
Jul-09
Jan-10
Nitrate mg/L as NO3
Sulfate mg/L
Uranium ug/L

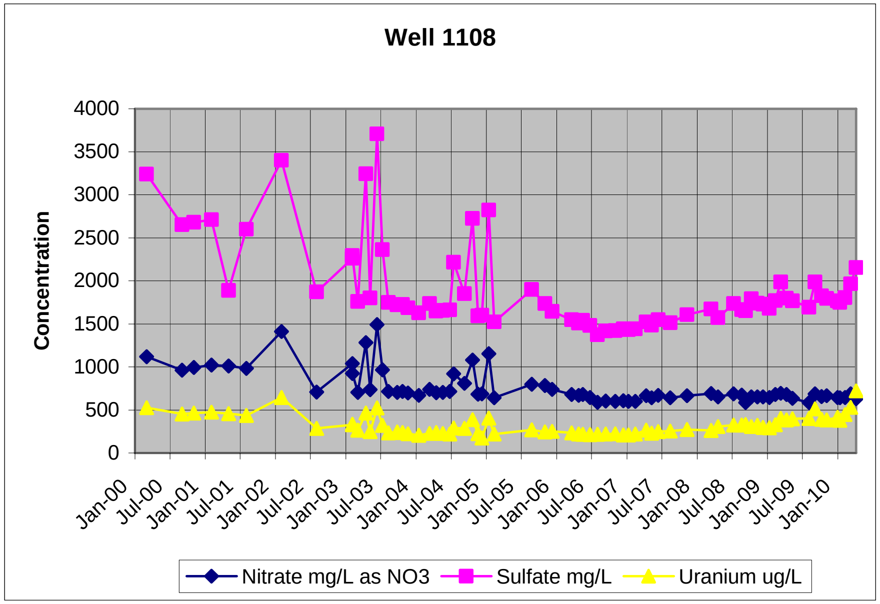

Well 1104
Concentration
0
500
1000
1500
2000
2500
3000
Jan-00
Jul-00
Jan-01
Jul-01
Jan-02
Jul-02
Jan-03
Jul-03
Jan-04
Jul-04
Jan-05
Jul-05
Jan-06
Jul-06
Jan-07
Jul-07
Jan-08
Jul-08
Jan-09
Jul-09
Jan-10
Nitrate mg/L as NO3
Sulfate mg/L
Uranium ug/L

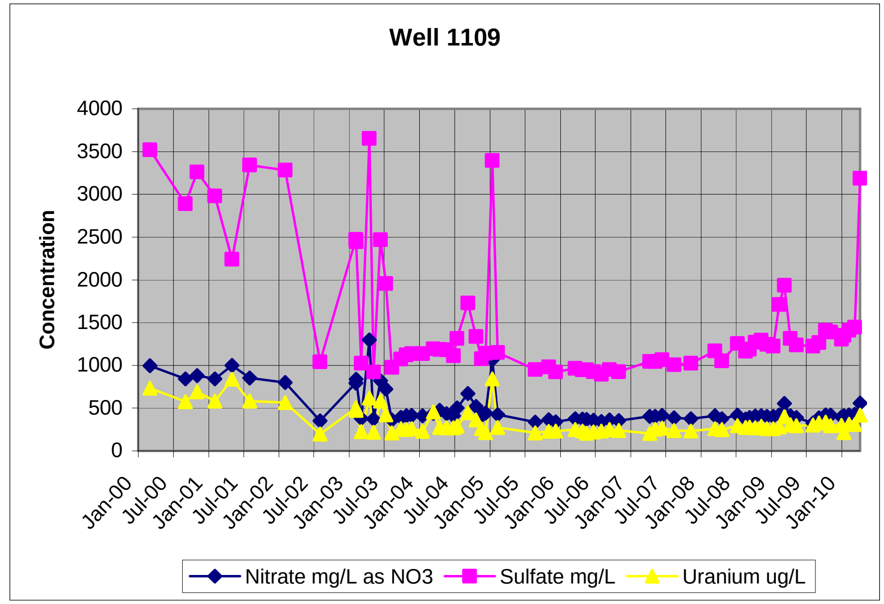

Well 1105
Concentration
2500
2000
1500
1000
500
0
Jan-00 Jul-00 Jan-01 Jul-01 Jan-02 Jul-02 Jan-03 Jul-03 Jan-04 Jul-04 Jan-05 Jul-05 Jan-06 Jul-06 Jan-07 Jul-07 Jan-08 Jul-08 Jan-09 Jul-09 Jan-10
Nitrate mg/L as NO3
Sulfate mg/L
Uranium ug/L

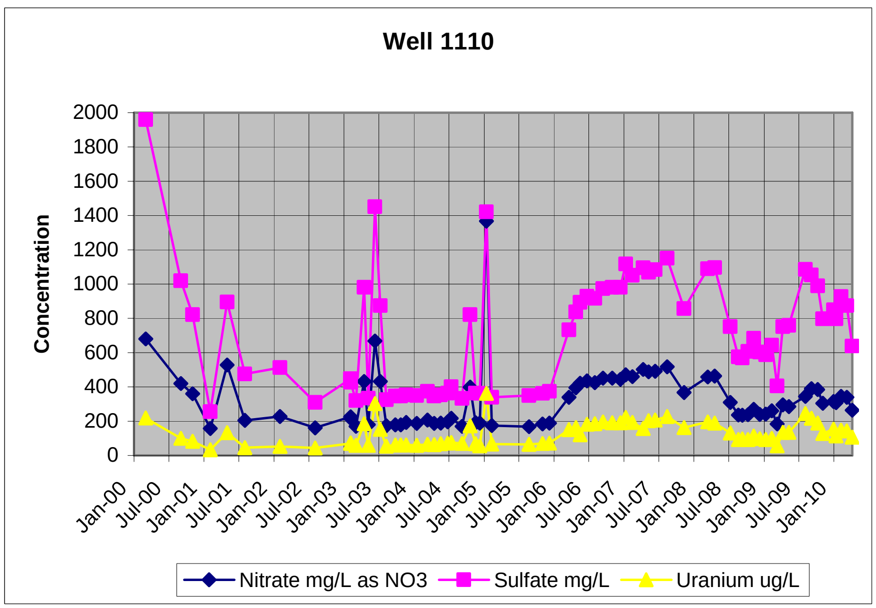

Well 1106
Concentration
3000
2500
2000
1500
1000
500
0
Jan-00 Jul-00 Jan-01 Jul-01 Jan-02 Jul-02 Jan-03 Jul-03 Jan-04 Jul-04 Jan-05 Jul-05 Jan-06 Jul-06 Jan-07 Jul-07 Jan-08 Jul-08 Jan-09 Jul-09 Jan-10
Nitrate mg/L as NO3
Sulfate mg/L
Uranium ug/L

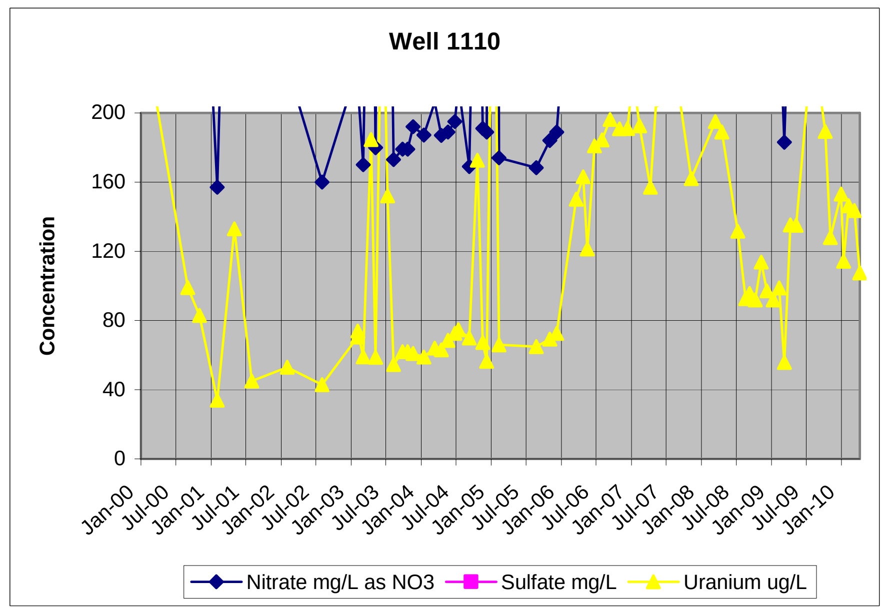

Well 1107
Concentration
1800
1600
1400
1200
1000
800
600
400
200
0
Jan-00 Jul-00 Jan-01 Jul-01 Jan-02 Jul-02 Jan-03 Jul-03 Jan-04 Jul-04 Jan-05 Jul-05 Jan-06 Jul-06 Jan-07 Jul-07 Jan-08 Jul-08 Jan-09 Jul-09 Jan-10
Nitrate mg/L as NO3
Sulfate mg/L
Uranium ug/L

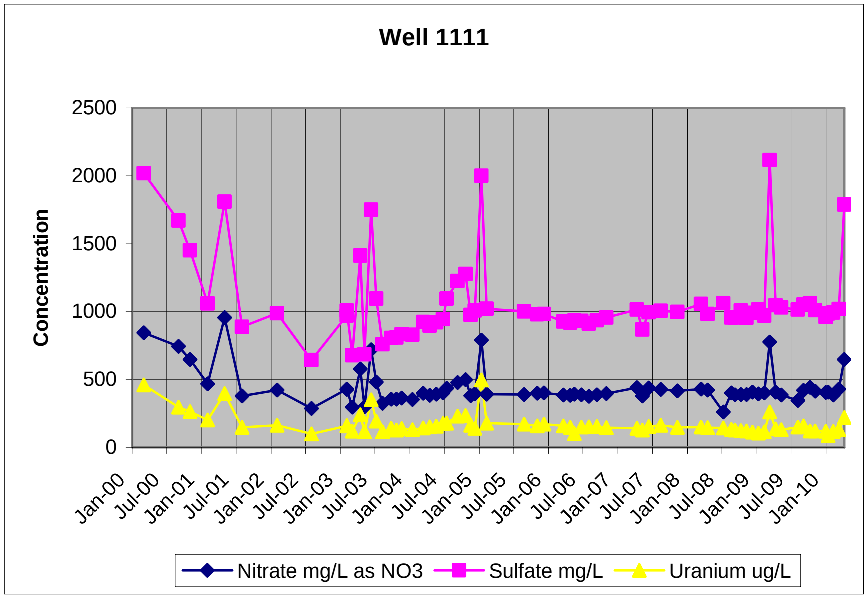

Well 1107
Concentration
400
360
320
280
240
200
160
120
80
40
0
Jan-00 Jul-00 Jan-01 Jul-01 Jan-02 Jul-02 Jan-03 Jul-03 Jan-04 Jul-04 Jan-05 Jul-05 Jan-06 Jul-06 Jan-07 Jul-07 Jan-08 Jul-08 Jan-09 Jul-09 Jan-10
Nitrate mg/L as NO3
Sulfate mg/L
Uranium ug/L

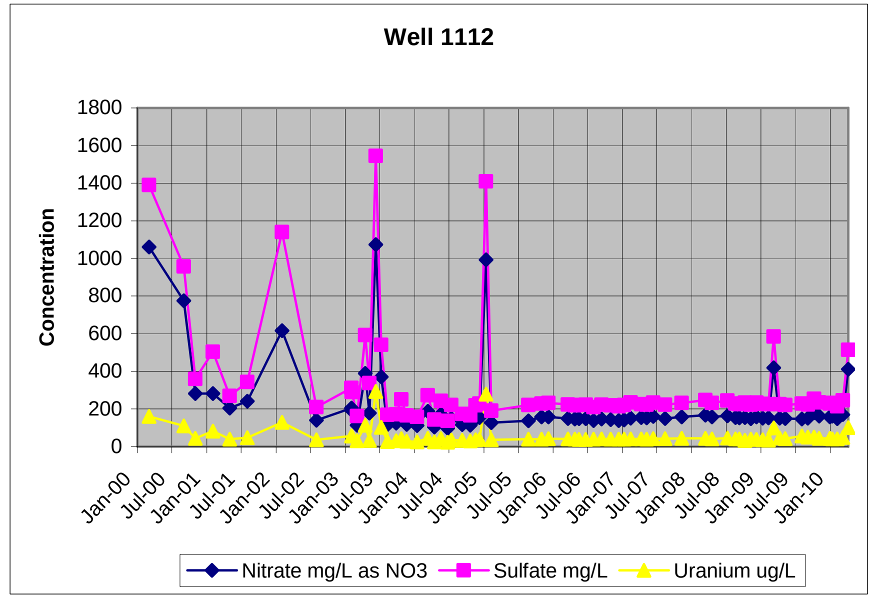

Well 1108
Concentration
4000
3500
3000
2500
2000
1500
1000
500
0
Jan-00 Jul-00 Jan-01 Jul-01 Jan-02 Jul-02 Jan-03 Jul-03 Jan-04 Jul-04 Jan-05 Jul-05 Jan-06 Jul-06 Jan-07 Jul-07 Jan-08 Jul-08 Jan-09 Jul-09 Jan-10
Nitrate mg/L as NO3
Sulfate mg/L
Uranium ug/L

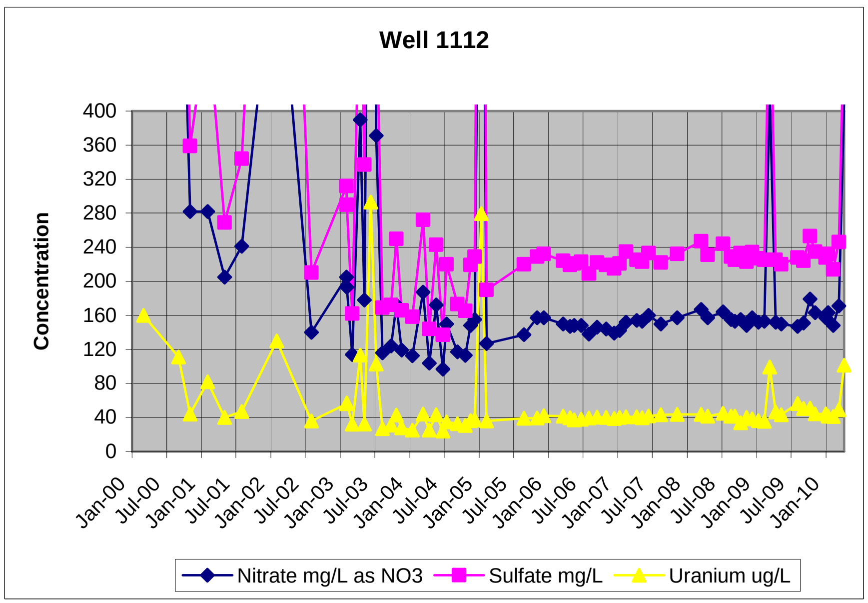

Well 1109
Concentration
4000
3500
3000
2500
2000
1500
1000
500
0
Jan-00 Jul-00 Jan-01 Jul-01 Jan-02 Jul-02 Jan-03 Jul-03 Jan-04 Jul-04 Jan-05 Jul-05 Jan-06 Jul-06 Jan-07 Jul-07 Jan-08 Jul-08 Jan-09 Jul-09 Jan-10
Nitrate mg/L as NO3
Sulfate mg/L
Uranium ug/L

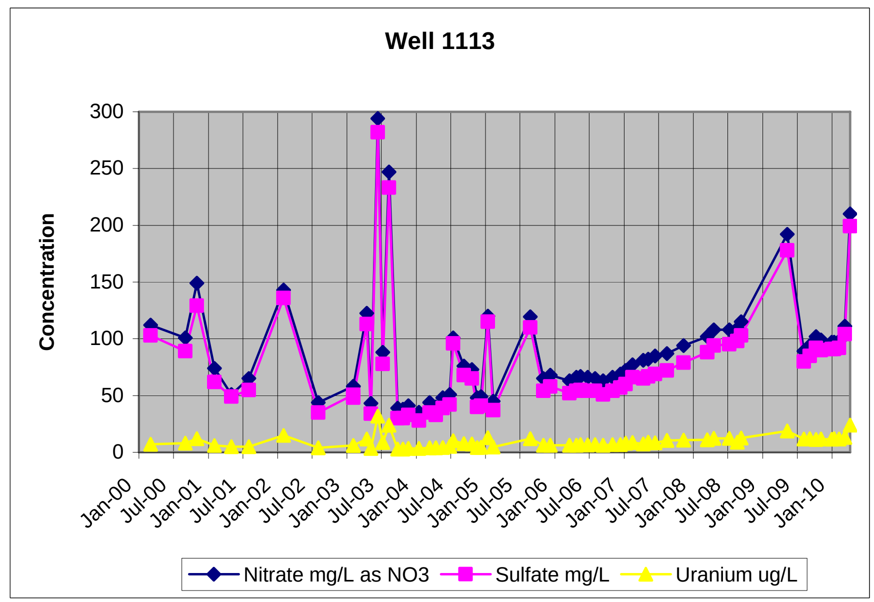

Well 1110
Concentration
2000
1800
1600
1400
1200
1000
800
600
400
200
0
Jan-00 Jul-00 Jan-01 Jul-01 Jan-02 Jul-02 Jan-03 Jul-03 Jan-04 Jul-04 Jan-05 Jul-05 Jan-06 Jul-06 Jan-07 Jul-07 Jan-08 Jul-08 Jan-09 Jul-09 Jan-10
Nitrate mg/L as NO3
Sulfate mg/L
Uranium ug/L

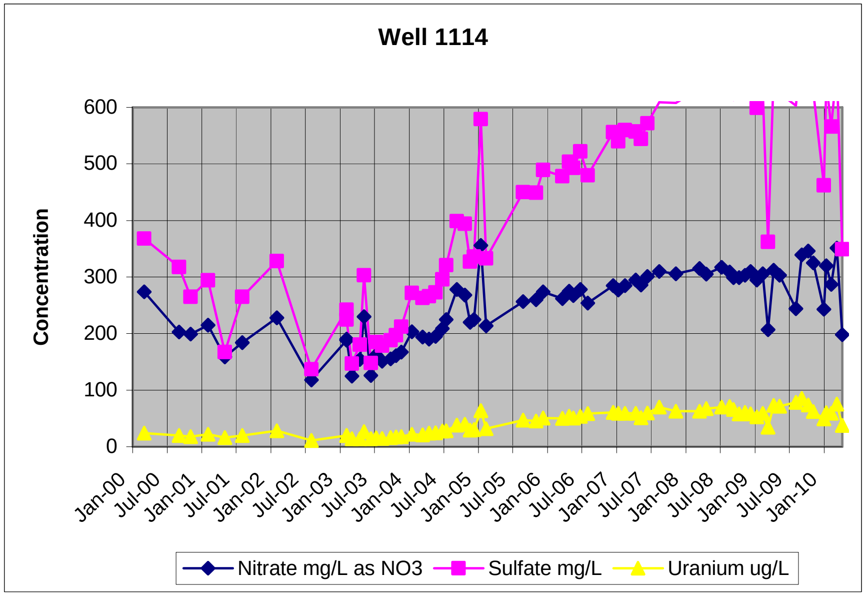

Well 1110
Concentration
200
160
120
80
40
0
Jan-00 Jul-00 Jan-01 Jul-01 Jan-02 Jul-02 Jan-03 Jul-03 Jan-04 Jul-04 Jan-05 Jul-05 Jan-06 Jul-06 Jan-07 Jul-07 Jan-08 Jul-08 Jan-09 Jul-09 Jan-10
Nitrate mg/L as NO3
Sulfate mg/L
Uranium ug/L

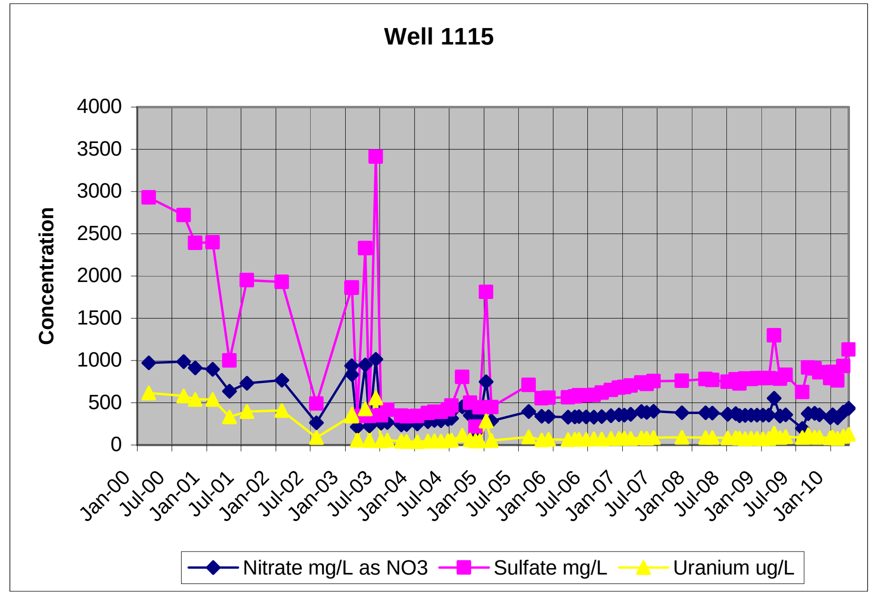

Well 1111
Concentration
2500
2000
1500
1000
500
0
Jan-00
Jul-00
Jan-01
Jul-01
Jan-02
Jul-02
Jan-03
Jul-03
Jan-04
Jul-04
Jan-05
Jul-05
Jan-06
Jul-06
Jan-07
Jul-07
Jan-08
Jul-08
Jan-09
Jul-09
Jan-10
Nitrate mg/L as NO3
Sulfate mg/L
Uranium ug/L

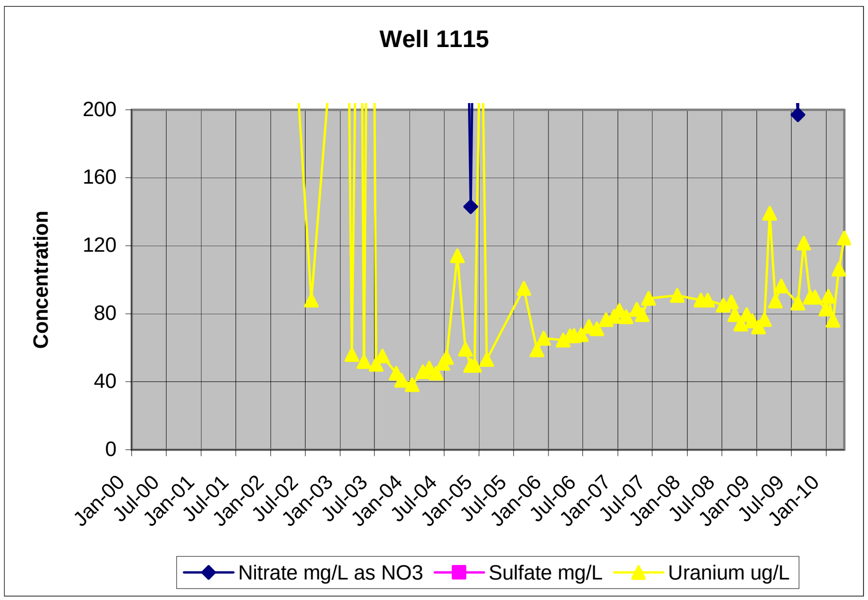

Well 1112
Concentration
1800
1600
1400
1200
1000
800
600
400
200
0
Jan-00
Jul-00
Jan-01
Jul-01
Jan-02
Jul-02
Jan-03
Jul-03
Jan-04
Jul-04
Jan-05
Jul-05
Jan-06
Jul-06
Jan-07
Jul-07
Jan-08
Jul-08
Jan-09
Jul-09
Jan-10
Nitrate mg/L as NO3
Sulfate mg/L
Uranium ug/L

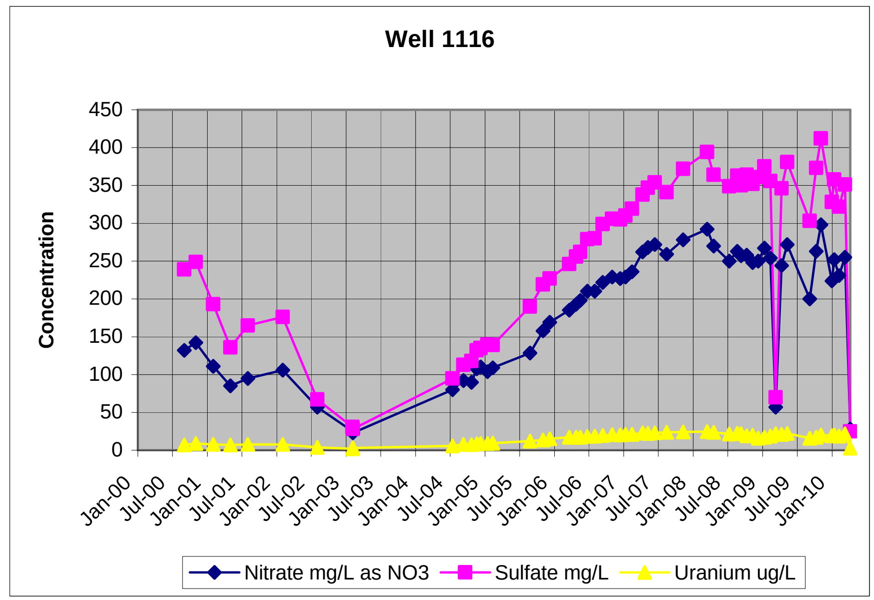

Well 1112
Concentration
400
360
320
280
240
200
160
120
80
40
0
Jan-00
Jul-00
Jan-01
Jul-01
Jan-02
Jul-02
Jan-03
Jul-03
Jan-04
Jul-04
Jan-05
Jul-05
Jan-06
Jul-06
Jan-07
Jul-07
Jan-08
Jul-08
Jan-09
Jul-09
Jan-10
Nitrate mg/L as NO3
Sulfate mg/L
Uranium ug/L

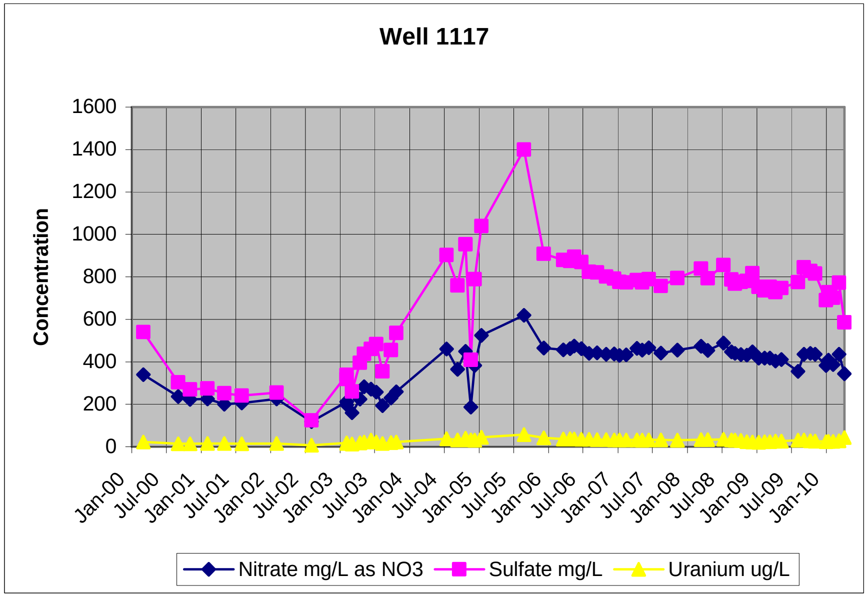

Well 1113
Concentration
300
250
200
150
100
50
0
Jan-00
Jul-00
Jan-01
Jul-01
Jan-02
Jul-02
Jan-03
Jul-03
Jan-04
Jul-04
Jan-05
Jul-05
Jan-06
Jul-06
Jan-07
Jul-07
Jan-08
Jul-08
Jan-09
Jul-09
Jan-10
Nitrate mg/L as NO3
Sulfate mg/L
Uranium ug/L

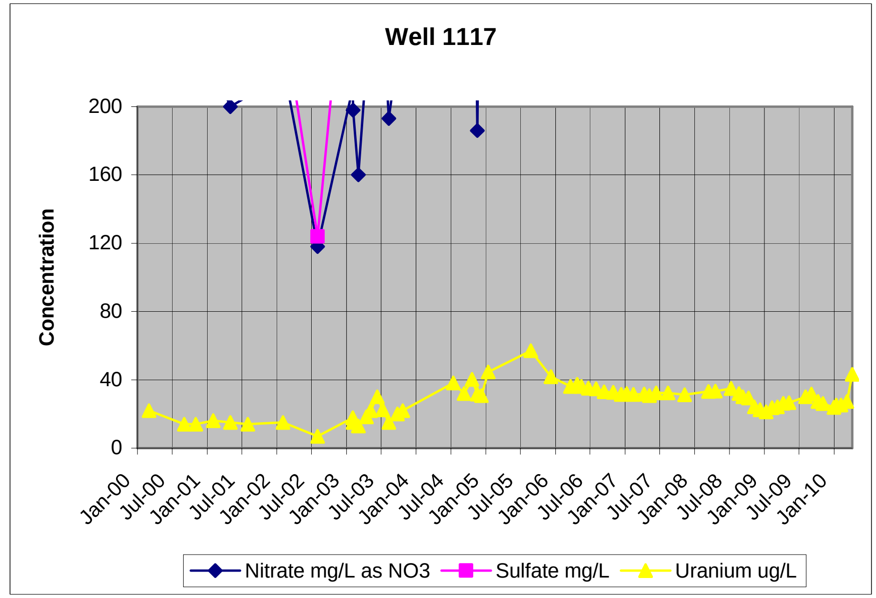

Well 1114
Concentration
0
100
200
300
400
500
600
Jan-00
Jul-00
Jan-01
Jul-01
Jan-02
Jul-02
Jan-03
Jul-03
Jan-04
Jul-04
Jan-05
Jul-05
Jan-06
Jul-06
Jan-07
Jul-07
Jan-08
Jul-08
Jan-09
Jul-09
Jan-10
Nitrate mg/L as NO3
Sulfate mg/L
Uranium ug/L

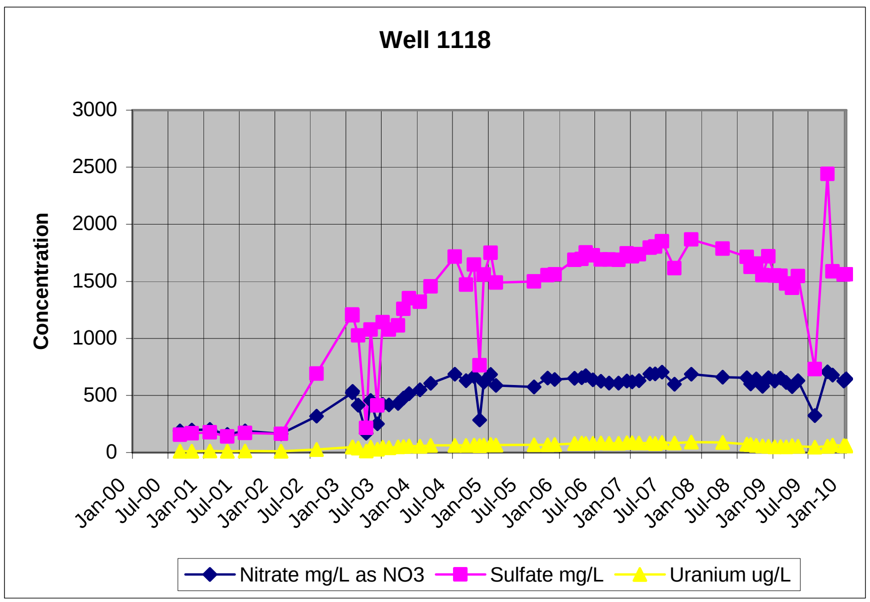

Well 1115
Concentration
0
500
1000
1500
2000
2500
3000
3500
4000
Jan-00
Jul-00
Jan-01
Jul-01
Jan-02
Jul-02
Jan-03
Jul-03
Jan-04
Jul-04
Jan-05
Jul-05
Jan-06
Jul-06
Jan-07
Jul-07
Jan-08
Jul-08
Jan-09
Jul-09
Jan-10
Nitrate mg/L as NO3
Sulfate mg/L
Uranium ug/L

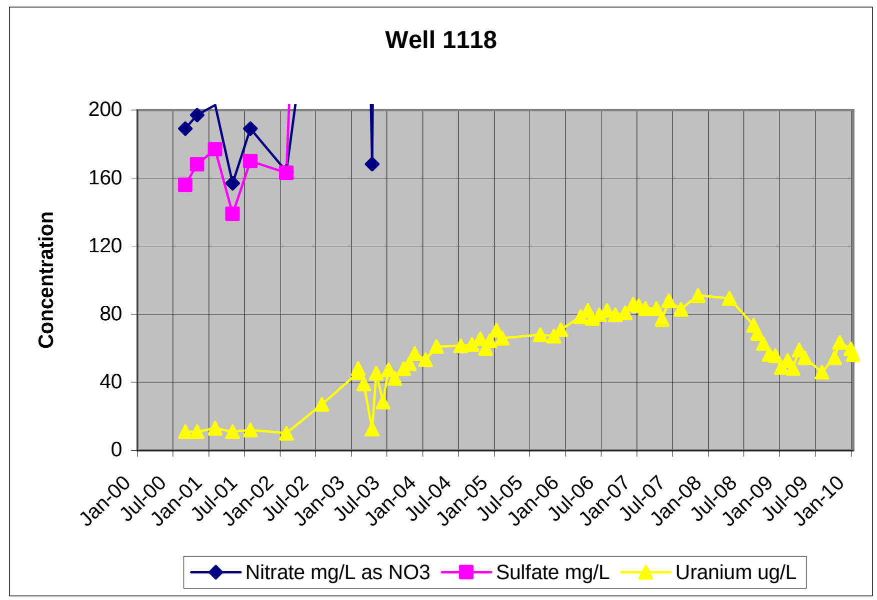

Well 1115
Concentration
0
40
80
120
160
200
Jan-00
Jul-00
Jan-01
Jul-01
Jan-02
Jul-02
Jan-03
Jul-03
Jan-04
Jul-04
Jan-05
Jul-05
Jan-06
Jul-06
Jan-07
Jul-07
Jan-08
Jul-08
Jan-09
Jul-09
Jan-10
Nitrate mg/L as NO3
Sulfate mg/L
Uranium ug/L

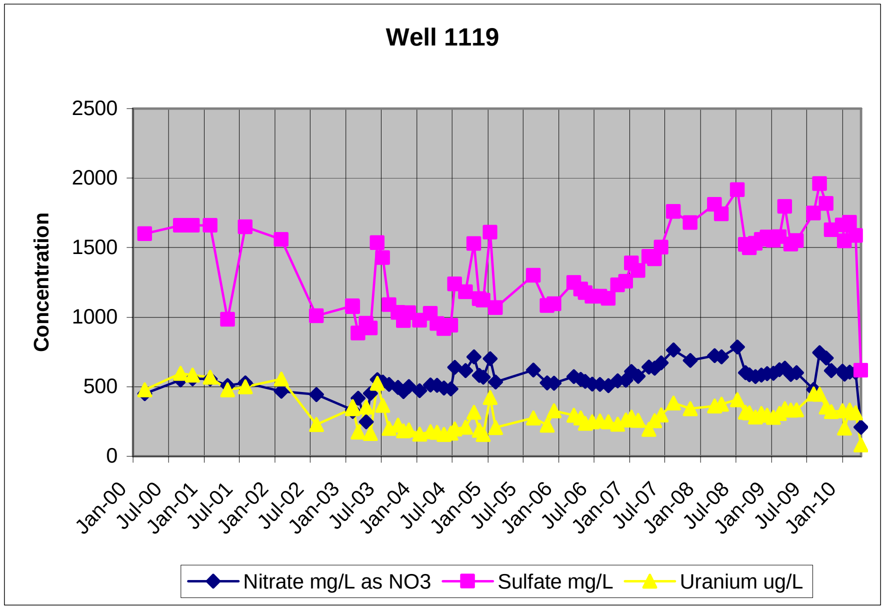

Well 1116
Concentration
0
50
100
150
200
250
300
350
400
450
Jan-00
Jul-00
Jan-01
Jul-01
Jan-02
Jul-02
Jan-03
Jul-03
Jan-04
Jul-04
Jan-05
Jul-05
Jan-06
Jul-06
Jan-07
Jul-07
Jan-08
Jul-08
Jan-09
Jul-09
Jan-10
Nitrate mg/L as NO3
Sulfate mg/L
Uranium ug/L

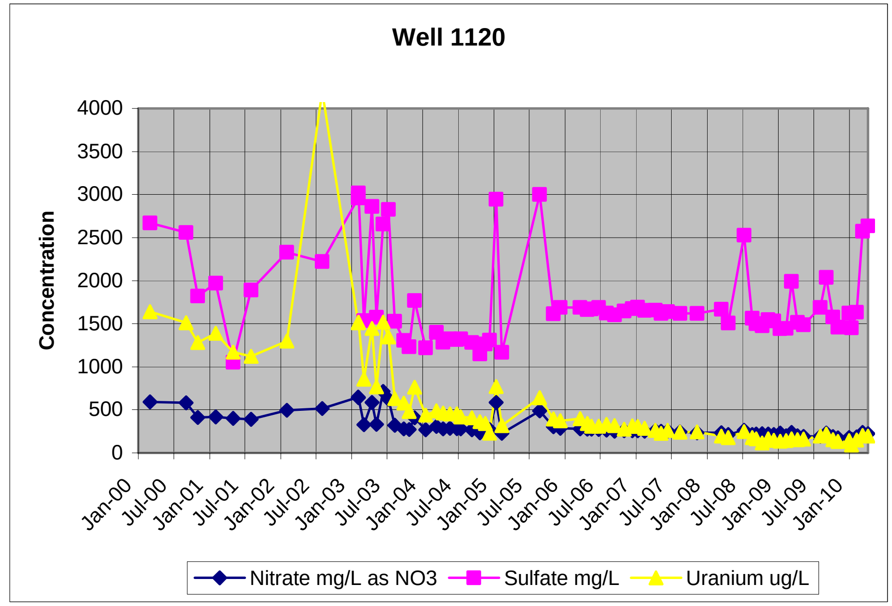

Well 1117
Concentration
0
200
400
600
800
1000
1200
1400
1600
Jan-00 Jul-00 Jan-01 Jul-01 Jan-02 Jul-02 Jan-03 Jul-03 Jan-04 Jul-04 Jan-05 Jul-05 Jan-06 Jul-06 Jan-07 Jul-07 Jan-08 Jul-08 Jan-09 Jul-09 Jan-10
Nitrate mg/L as NO3
Sulfate mg/L
Uranium ug/L

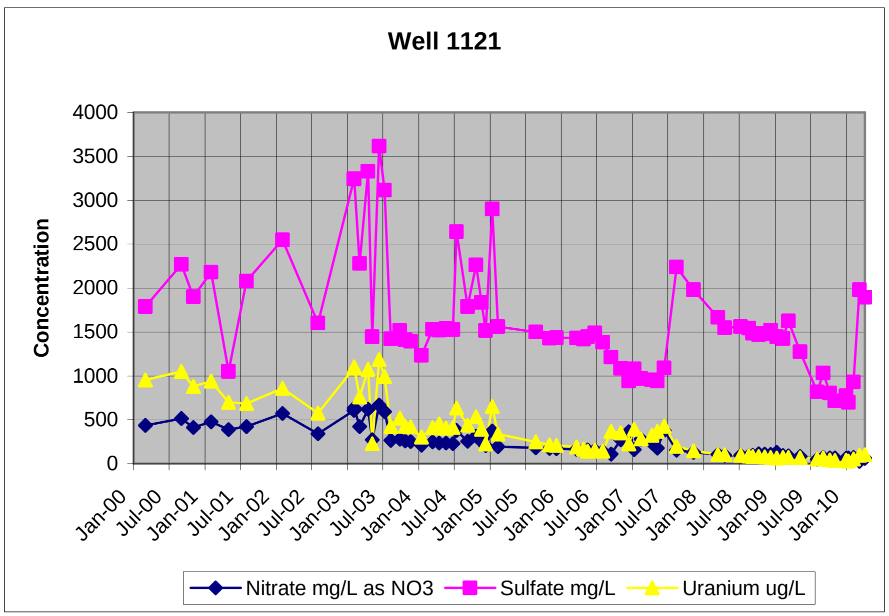

Well 1117
Concentration
0
40
80
120
160
200
Jan-00 Jul-00 Jan-01 Jul-01 Jan-02 Jul-02 Jan-03 Jul-03 Jan-04 Jul-04 Jan-05 Jul-05 Jan-06 Jul-06 Jan-07 Jul-07 Jan-08 Jul-08 Jan-09 Jul-09 Jan-10
Nitrate mg/L as NO3
Sulfate mg/L
Uranium ug/L

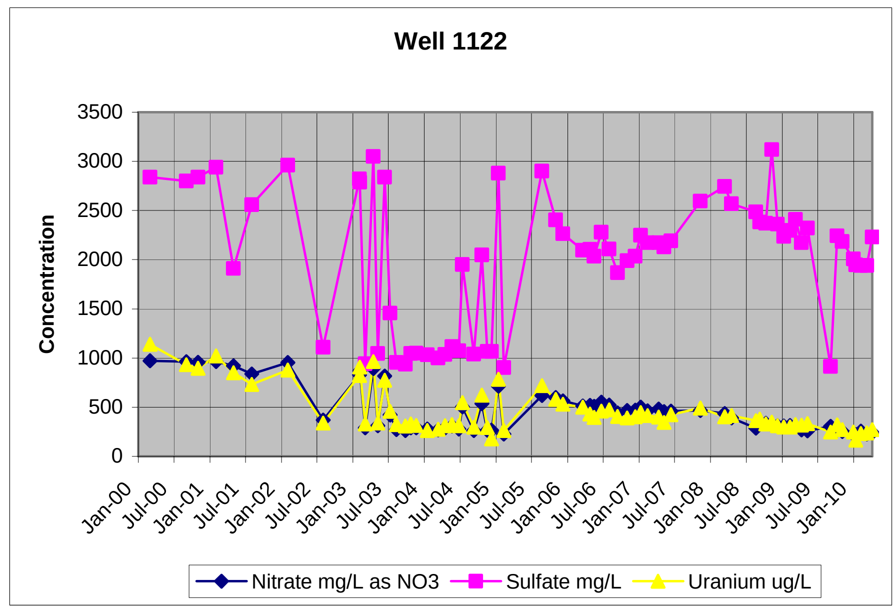

Well 1118
Concentration
0
500
1000
1500
2000
2500
3000
Jan-00 Jul-00 Jan-01 Jul-01 Jan-02 Jul-02 Jan-03 Jul-03 Jan-04 Jul-04 Jan-05 Jul-05 Jan-06 Jul-06 Jan-07 Jul-07 Jan-08 Jul-08 Jan-09 Jul-09 Jan-10
Nitrate mg/L as NO3
Sulfate mg/L
Uranium ug/L

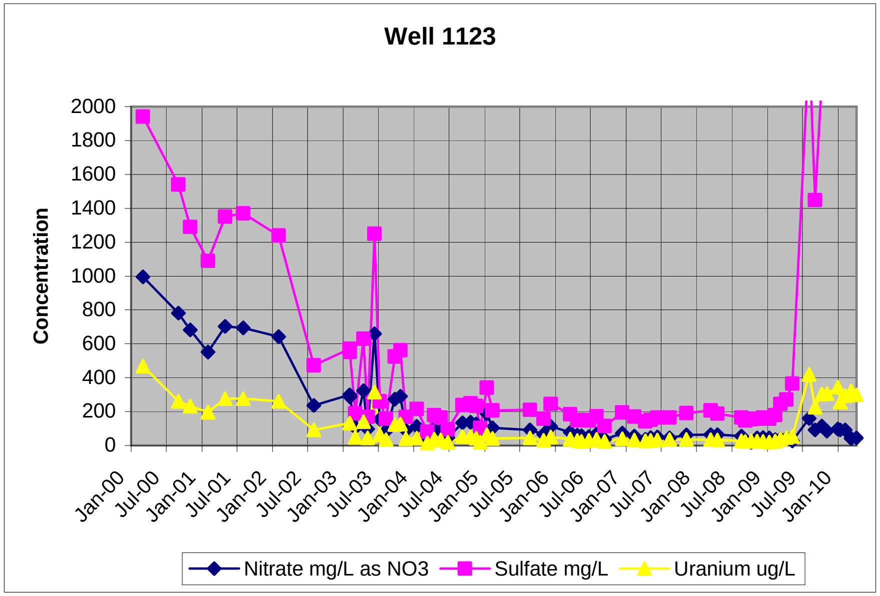

Well 1118
Concentration
0
40
80
120
160
200
Jan-00 Jul-00 Jan-01 Jul-01 Jan-02 Jul-02 Jan-03 Jul-03 Jan-04 Jul-04 Jan-05 Jul-05 Jan-06 Jul-06 Jan-07 Jul-07 Jan-08 Jul-08 Jan-09 Jul-09 Jan-10
Nitrate mg/L as NO3
Sulfate mg/L
Uranium ug/L

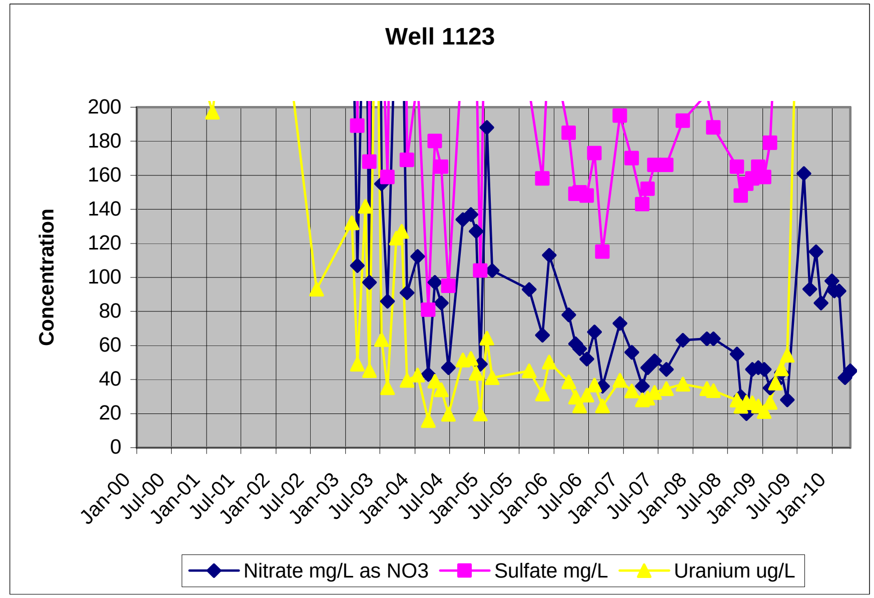

Well 1119
Concentration
0
500
1000
1500
2000
2500
Jan-00 Jul-00 Jan-01 Jul-01 Jan-02 Jul-02 Jan-03 Jul-03 Jan-04 Jul-04 Jan-05 Jul-05 Jan-06 Jul-06 Jan-07 Jul-07 Jan-08 Jul-08 Jan-09 Jul-09 Jan-10
Nitrate mg/L as NO3
Sulfate mg/L
Uranium ug/L

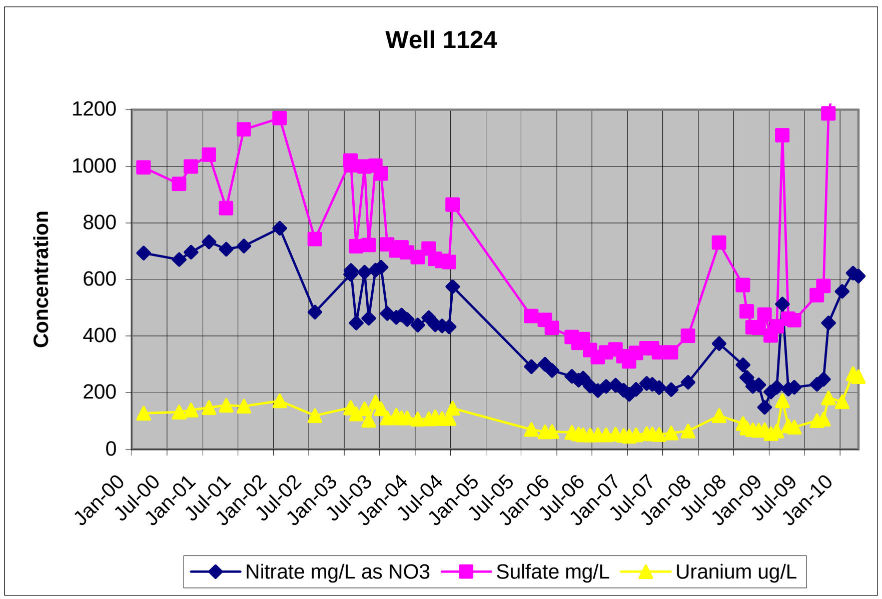

Well 1120
Concentration
0
500
1000
1500
2000
2500
3000
3500
4000
Jan-00 Jul-00 Jan-01 Jul-01 Jan-02 Jul-02 Jan-03 Jul-03 Jan-04 Jul-04 Jan-05 Jul-05 Jan-06 Jul-06 Jan-07 Jul-07 Jan-08 Jul-08 Jan-09 Jul-09 Jan-10
Nitrate mg/L as NO3
Sulfate mg/L
Uranium ug/L

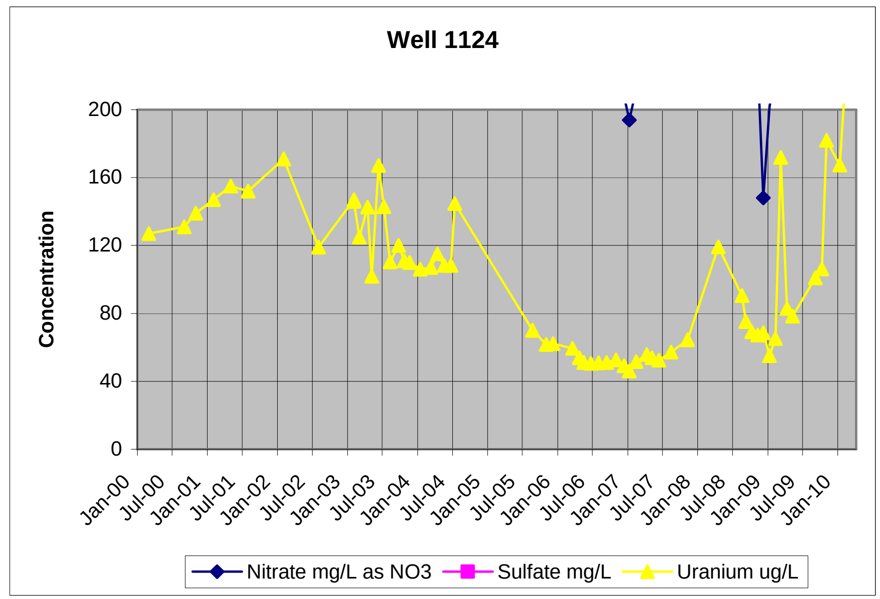

Well 1121
Concentration
0
500
1000
1500
2000
2500
3000
3500
4000
Jan-00 Jul-00 Jan-01 Jul-01 Jan-02 Jul-02 Jan-03 Jul-03 Jan-04 Jul-04 Jan-05 Jul-05 Jan-06 Jul-06 Jan-07 Jul-07 Jan-08 Jul-08 Jan-09 Jul-09 Jan-10
Nitrate mg/L as NO3
Sulfate mg/L
Uranium ug/L

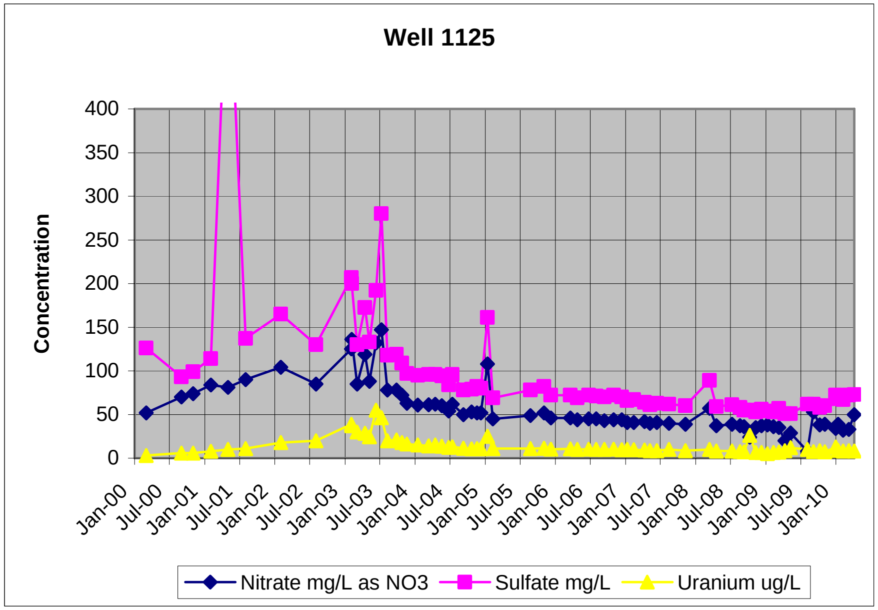

Well 1122
Concentration
0
500
1000
1500
2000
2500
3000
3500
Jan-00 Jul-00 Jan-01 Jul-01 Jan-02 Jul-02 Jan-03 Jul-03 Jan-04 Jul-04 Jan-05 Jul-05 Jan-06 Jul-06 Jan-07 Jul-07 Jan-08 Jul-08 Jan-09 Jul-09 Jan-10
Nitrate mg/L as NO3
Sulfate mg/L
Uranium ug/L

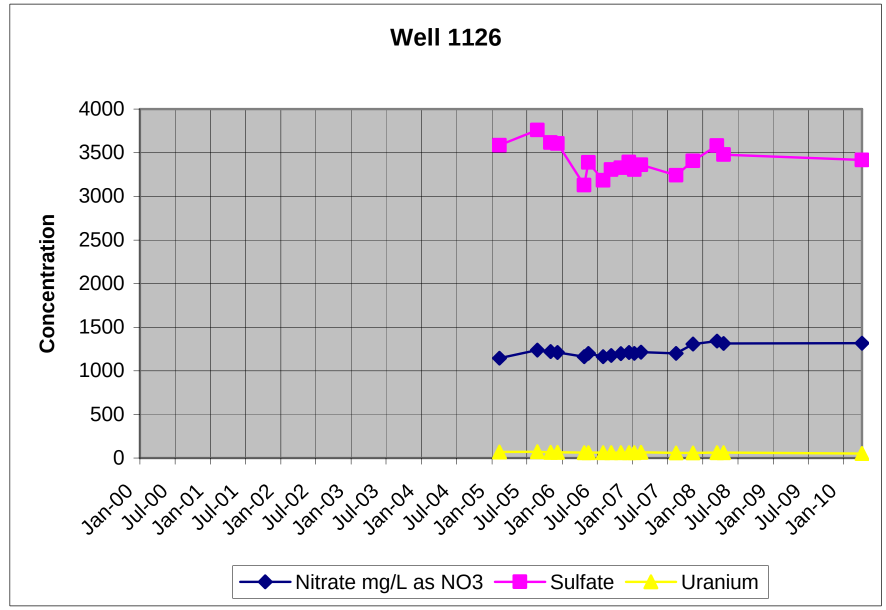

Well 1123
Concentration
2000
1800
1600
1400
1200
1000
800
600
400
200
0
Jan-00 Jul-00 Jan-01 Jul-01 Jan-02 Jul-02 Jan-03 Jul-03 Jan-04 Jul-04 Jan-05 Jul-05 Jan-06 Jul-06 Jan-07 Jul-07 Jan-08 Jul-08 Jan-09 Jul-09 Jan-10
Nitrate mg/L as NO3
Sulfate mg/L
Uranium ug/L

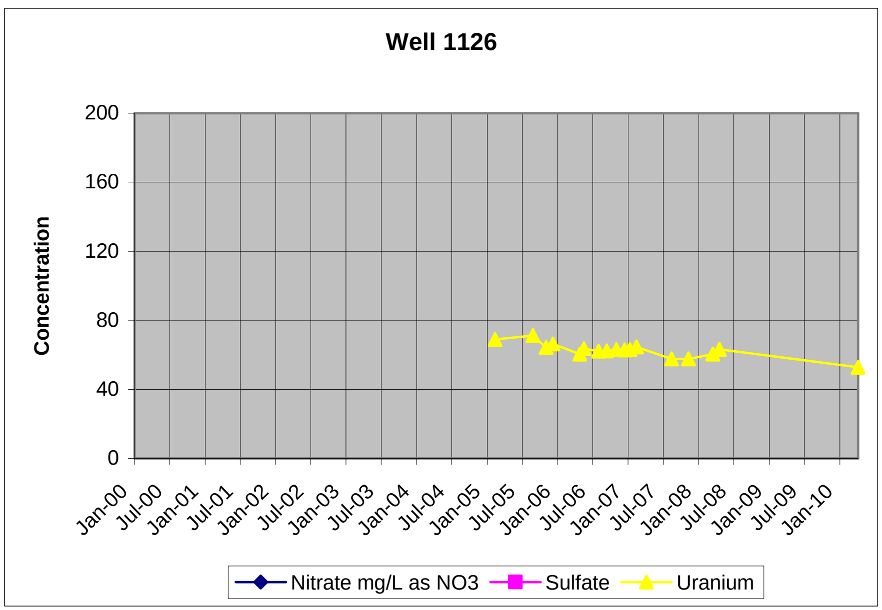

Well 1123
Concentration
200
180
160
140
120
100
80
60
40
20
0
Jan-00 Jul-00 Jan-01 Jul-01 Jan-02 Jul-02 Jan-03 Jul-03 Jan-04 Jul-04 Jan-05 Jul-05 Jan-06 Jul-06 Jan-07 Jul-07 Jan-08 Jul-08 Jan-09 Jul-09 Jan-10
Nitrate mg/L as NO3
Sulfate mg/L
Uranium ug/L

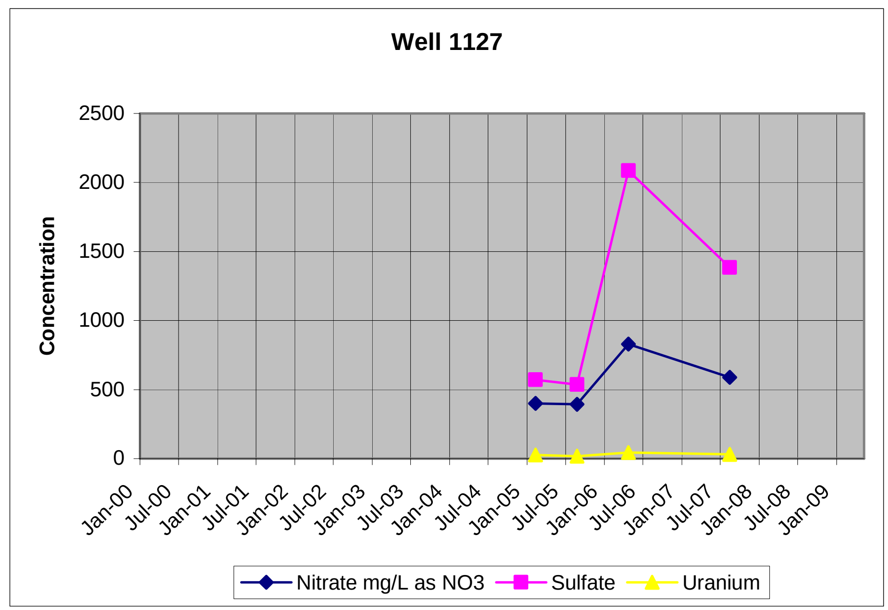

Well 1124
Concentration
1200
1000
800
600
400
200
0
Jan-00 Jul-00 Jan-01 Jul-01 Jan-02 Jul-02 Jan-03 Jul-03 Jan-04 Jul-04 Jan-05 Jul-05 Jan-06 Jul-06 Jan-07 Jul-07 Jan-08 Jul-08 Jan-09 Jul-09 Jan-10
Nitrate mg/L as NO3
Sulfate mg/L
Uranium ug/L

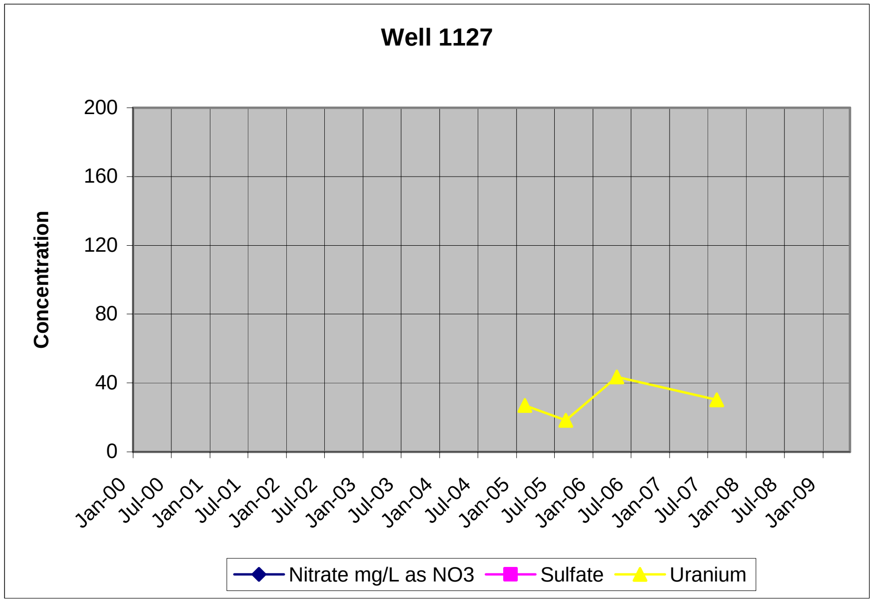

Well 1124
Concentration
200
160
120
80
40
0
Jan-00 Jul-00 Jan-01 Jul-01 Jan-02 Jul-02 Jan-03 Jul-03 Jan-04 Jul-04 Jan-05 Jul-05 Jan-06 Jul-06 Jan-07 Jul-07 Jan-08 Jul-08 Jan-09 Jul-09 Jan-10
Nitrate mg/L as NO3
Sulfate mg/L
Uranium ug/L

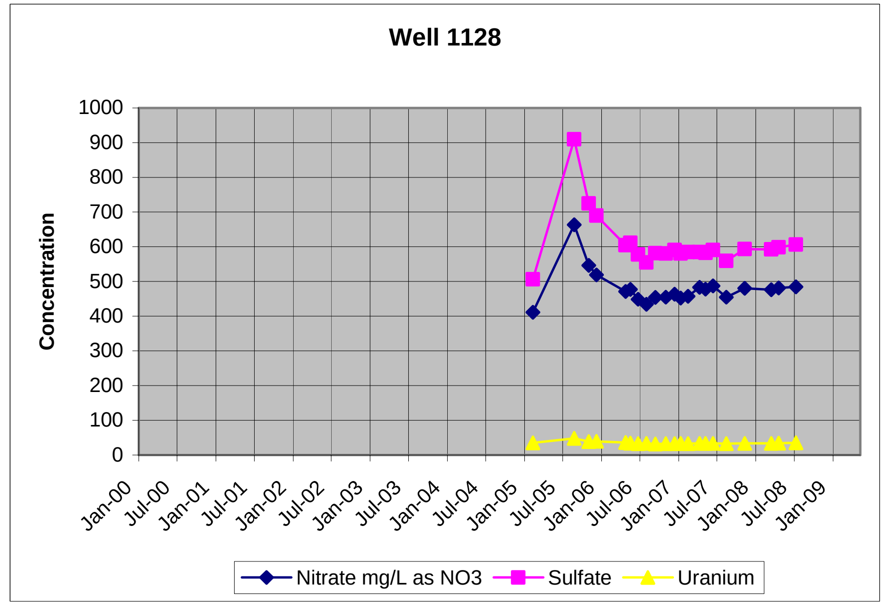

Well 1125
Concentration
400
350
300
250
200
150
100
50
0
Jan-00 Jul-00 Jan-01 Jul-01 Jan-02 Jul-02 Jan-03 Jul-03 Jan-04 Jul-04 Jan-05 Jul-05 Jan-06 Jul-06 Jan-07 Jul-07 Jan-08 Jul-08 Jan-09 Jul-09 Jan-10
Nitrate mg/L as NO3
Sulfate mg/L
Uranium ug/L

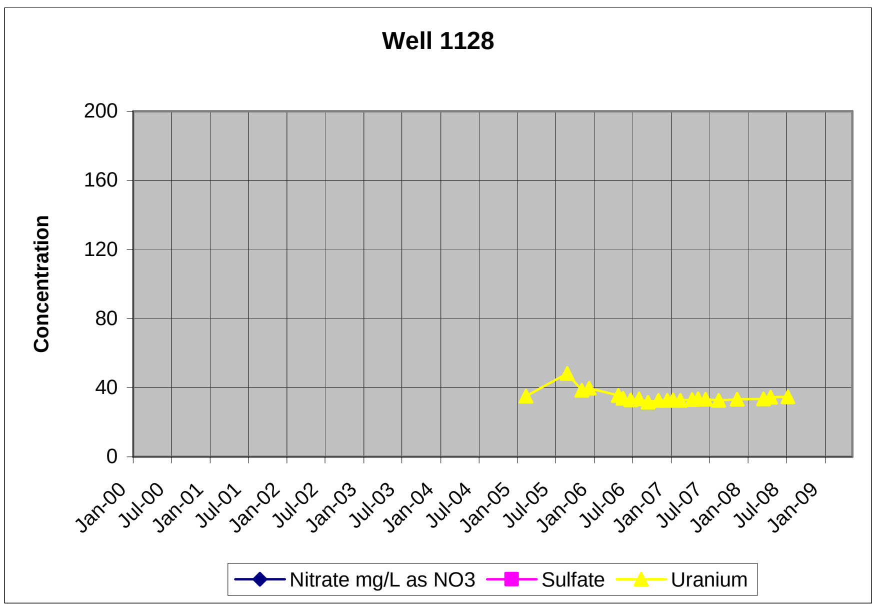

Well 1126
Concentration
4000
3500
3000
2500
2000
1500
1000
500
0
Jan-00 Jul-00 Jan-01 Jul-01 Jan-02 Jul-02 Jan-03 Jul-03 Jan-04 Jul-04 Jan-05 Jul-05 Jan-06 Jul-06 Jan-07 Jul-07 Jan-08 Jul-08 Jan-09 Jul-09 Jan-10
Nitrate mg/L as NO3
Sulfate
Uranium

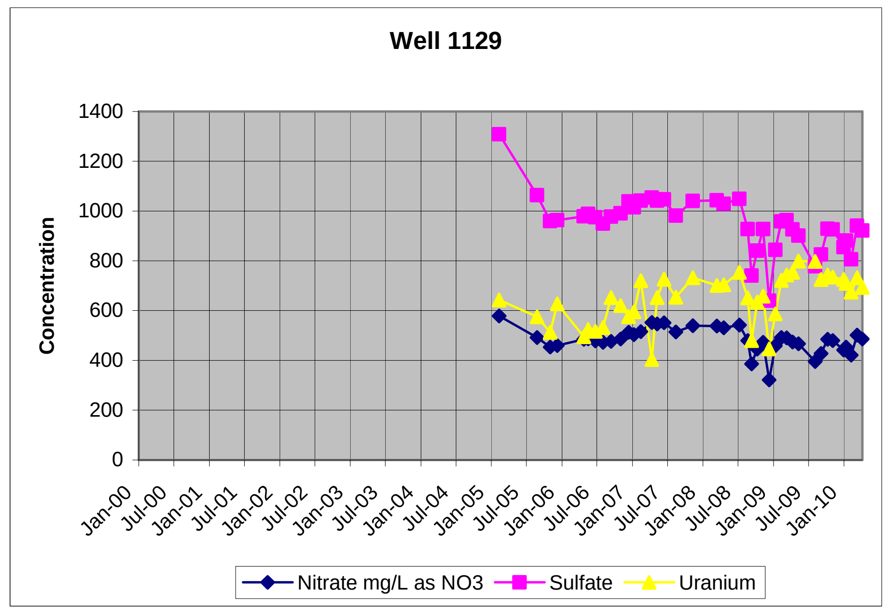

Well 1126
Concentration
200
160
120
80
40
0
Jan-00 Jul-00 Jan-01 Jul-01 Jan-02 Jul-02 Jan-03 Jul-03 Jan-04 Jul-04 Jan-05 Jul-05 Jan-06 Jul-06 Jan-07 Jul-07 Jan-08 Jul-08 Jan-09 Jul-09 Jan-10
Nitrate mg/L as NO3
Sulfate
Uranium

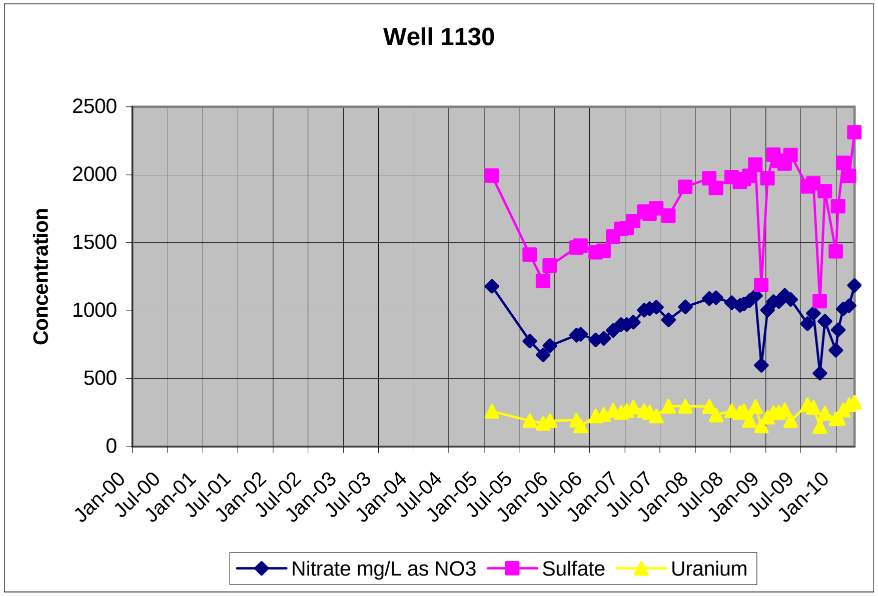

Well 1127
Concentration
2500
2000
1500
1000
500
0
Jan-00 Jul-00 Jan-01 Jul-01 Jan-02 Jul-02 Jan-03 Jul-03 Jan-04 Jul-04 Jan-05 Jul-05 Jan-06 Jul-06 Jan-07 Jul-07 Jan-08 Jul-08 Jan-09
Nitrate mg/L as NO3
Sulfate
Uranium

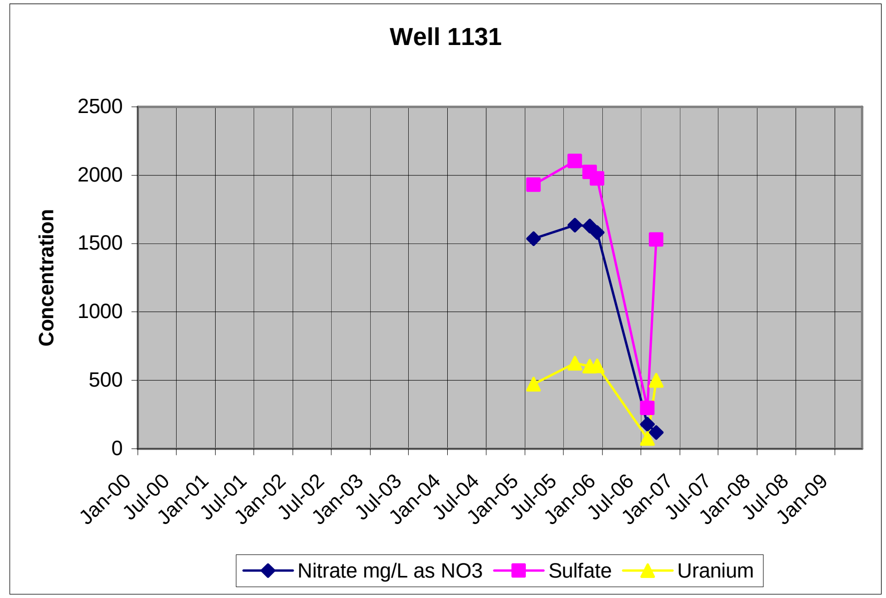

Well 1127
Concentration
200
160
120
80
40
0
Jan-00 Jul-00 Jan-01 Jul-01 Jan-02 Jul-02 Jan-03 Jul-03 Jan-04 Jul-04 Jan-05 Jul-05 Jan-06 Jul-06 Jan-07 Jul-07 Jan-08 Jul-08 Jan-09
Nitrate mg/L as NO3
Sulfate
Uranium

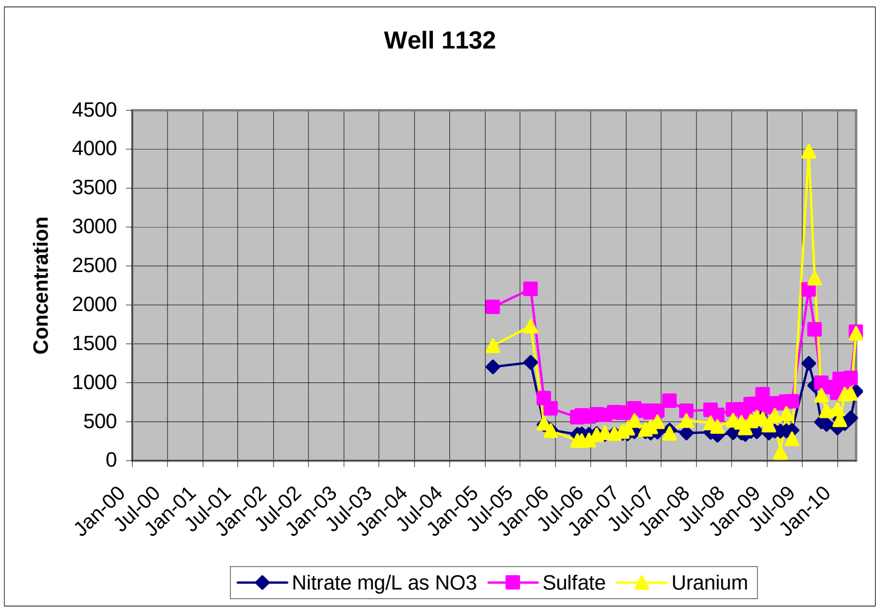

Well 1128
Concentration
1000
900
800
700
600
500
400
300
200
100
0
Jan-00 Jul-00 Jan-01 Jul-01 Jan-02 Jul-02 Jan-03 Jul-03 Jan-04 Jul-04 Jan-05 Jul-05 Jan-06 Jul-06 Jan-07 Jul-07 Jan-08 Jul-08 Jan-09
Nitrate mg/L as NO3
Sulfate
Uranium

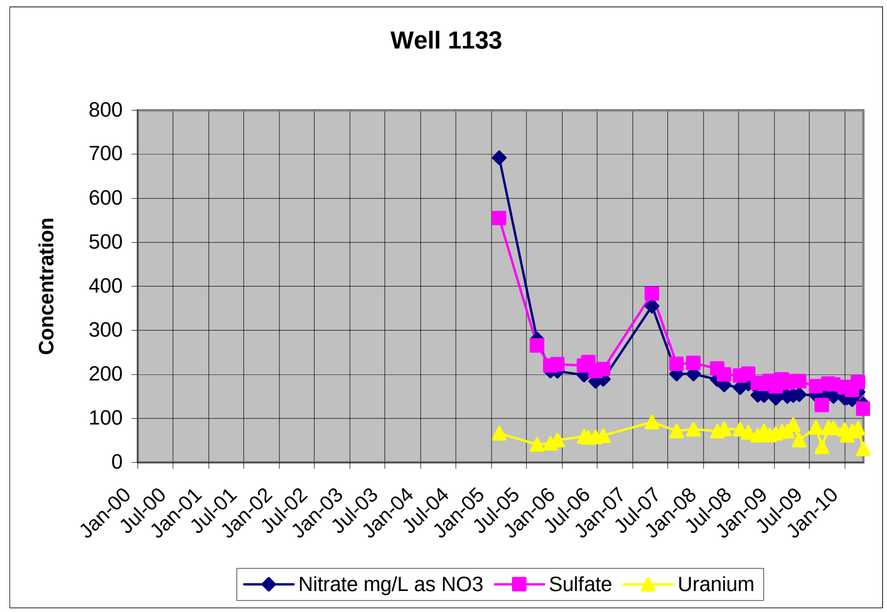

Well 1128
Concentration
200
160
120
80
40
0
Jan-00 Jul-00 Jan-01 Jul-01 Jan-02 Jul-02 Jan-03 Jul-03 Jan-04 Jul-04 Jan-05 Jul-05 Jan-06 Jul-06 Jan-07 Jul-07 Jan-08 Jul-08 Jan-09
Nitrate mg/L as NO3
Sulfate
Uranium


Well 1129
Concentration
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 Jul-07 Jan-08 Jul-08 Jan-09 Jul-09 Jan-10
Nitrate mg/L as NO3
Sulfate
Uranium


Well 1130
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 Jul-07 Jan-08 Jul-08 Jan-09 Jul-09 Jan-10
Nitrate mg/L as NO3
Sulfate
Uranium


Well 1131
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 Jul-07 Jan-08 Jul-08 Jan-09
Nitrate mg/L as NO3
Sulfate
Uranium


Well 1132
Concentration
4500
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 Jul-07 Jan-08 Jul-08 Jan-09 Jul-09 Jan-10
Nitrate mg/L as NO3
Sulfate
Uranium


Well 1133
Concentration
800
700
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 Jul-07 Jan-08 Jul-08 Jan-09 Jul-09 Jan-10
Nitrate mg/L as NO3
Sulfate
Uranium

# Appendix G

# Calculation Sets

This page intentionally left blank

# Contents

This page intentionally left blank

# Calculation 1
# Estimated Volume and Mass of Groundwater Contamination for the Baseline Period

This page intentionally left blank

**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 | | | *entire thickness of Horizon C contaminated | | |
| *Horizon B is fully saturated | | | *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*

This page intentionally left blank

# Calculation 2
# Estimated Aquifer Restoration Time
# Based on Mass and Volume Removal Rates

This page intentionally left blank

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **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 2009 through March 2010** | | | | | | | | | |
| | | | | | | | | | |
| **Objective:** | Estimate aquifer cleanup times | | | | | | | | |
| | | | | | | | | | |
| **Method:** | Compare mass and volume removed as of **April 1, 2010** 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 Calculation Set #1 | | | | | | | | |
| | | | | | | | | | |
| **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 | 1,135,649 | 9 | | 3.40E+09 | 338,423,000 | 0.100 | 10 | |
| Sulfate | 17,900,000 | 2,862,526 | 16 | | 2.70E+09 | 338,423,000 | 0.125 | 13 | |
| Uranium | 2,800 | 720.9 | 26 | | 3.00E+09 | 338,423,000 | 0.113 | 11 | |
| | | | | | | | | | |
| | | | | | | | | | |
| | mass removal | | | # yrs | | pore volume | 1-pore volume | 1-pore volume | # yrs |
| | rate % per yr | cleanup time, yrs | cleanup date | until cleanup | | removal rate % / yr | cleanup time, yrs | cleanup date | until cleanup |
| Nitrate | 1.2 | **85** | 2087 | 77 | | 1.3 | **78** | 2080 | 71 |
| Sulfate | 2.1 | **49** | 2051 | 41 | | 1.6 | **62** | 2064 | 54 |
| Uranium | 3.3 | **30** | 2032 | 22 | | 1.4 | **69** | 2071 | 61 |
| t1= | 15-Jun-02 | | | | | | | | |
| t2= | 01-Apr-10 | | | | | | | | |
| t2 - t1= | 7.8 | 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 | 1,135,649 | 12 | | 1.20E+09 | 338,423,000 | 0.282 | 28 | |
| Sulfate | 20,000,000 | 2,862,526 | 14 | | 1.20E+09 | 338,423,000 | 0.282 | 28 | |
| Uranium | 2,300 | 720.9 | 31 | | 1.20E+09 | 338,423,000 | 0.282 | 28 | |
| | | | | | | | | | |
| | mass removal | | | # yrs | | pore volume | 1-pore volume | 1-pore volume | # yrs |
| Projection | rate % per yr | cleanup time, yrs | cleanup date | until cleanup | | removal rate % / yr | cleanup time, yrs | cleanup date | until cleanup |
| Nitrate | 1.5 | **65** | 2067 | 57 | | 3.6 | **28** | 2030 | 20 |
| Sulfate | 1.8 | **54** | 2056 | 47 | | 3.6 | **28** | 2030 | 20 |
| Uranium | 4.0 | **25** | 2027 | 17 | | 3.6 | **28** | 2030 | 20 |
| t1= | 15-Jun-02 | | | | | | | | |
| t2= | 1-Apr-10 | | | | | | | | |
| t2 - t1= | 7.8 | yrs | | | | | | | |

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

This page intentionally left blank

# Calculation 3
# Calculate a Bulk Index of Aquifer Restoration for Sulfate

This page intentionally left blank

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

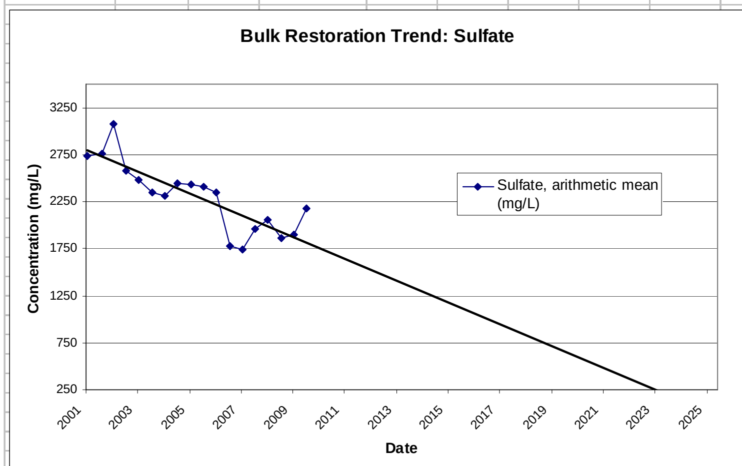
**Tuba City, AZ, Disposal Site**

**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.

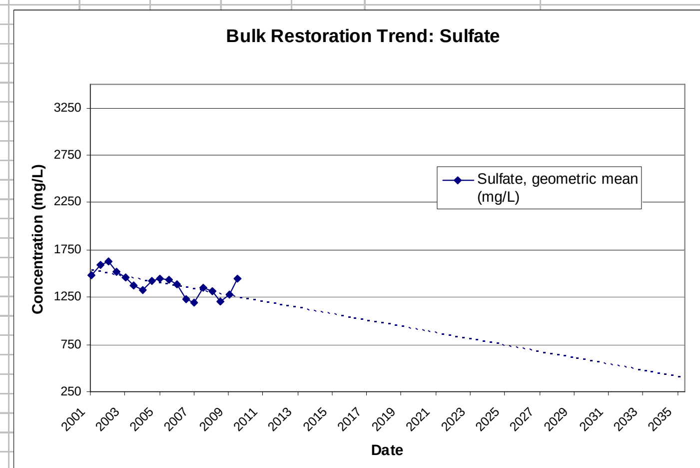
**Calculation:** The selected monitor wells below have the most comprehensive data set and are located throughout the contaminant plume in Horizons A and B.
No historical data exist for Horizons C and D within the contaminant plume.
Note: Where data are absent in the table below, concentrations are carried forward from the previous date as shown in ***bold italic.***

| | Sulfate (mg/L) | | | | | | | | | | | | | | Sulfate, | Sulfate, |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Date** | **0262** | **0263** | **0265** | **0267** | **0906** | **0908** | **0909** | **0929** | **0934** | **0936** | **0940** | **0941** | **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 | ***2100*** | 2700 | 810 | 27 | 2300 | 1600 | ***9600*** | 750 | 2900 | | 2342 | 1390 |
| 02/22/2007 | 1000 | 2100 | 990 | 3400 | ***2100*** | 2900 | 870 | 23 | 2600 | ***1600*** | 1701 | 780 | 3100 | | 1782 | 1230 |
| 8/16/2007 | 1100 | 2000 | 1000 | 3100 | 2000 | 2800 | 850 | 23 | 2500 | | 1701 | 880 | 3000 | | 1746 | 1194 |
| 2/5/2008 | 1400 | 2200 | 1300 | 3400 | 2000 | 3000 | 930 | 25 | 2800 | | 2200 | 1000 | 3200 | | 1955 | 1352 |
| 8/20/2008 | 1600 | 2200 | 1300 | 3800 | | 3100 | 960 | 23 | 3000 | | | 1200 | 3400 | | 2058 | 1307 |
| 02/25/2009 | 1400 | 2000 | 1200 | 3300 | | 2700 | 910 | 22 | 2700 | | | 1200 | 3200 | | 1863 | 1200 |
| 08/13/2009 | 1600 | 2000 | 1300 | 3200 | 1700 | 2800 | 910 | 23 | 2900 | | | 1200 | 3200 | | 1894 | 1277 |
| 02/09/2010 | 2100 | 3100 | 1300 | 3600 | 1900 | 3000 | 900 | 25 | 3200 | | | 1400 | 3400 | | 2175 | 1450 |




| | | |
|---|---|---|
| t1= | Jun-02 | |
| t2= | Feb-10 | |
| t2 - t1= | 7.6 | yr |
| t3= | Jun-18 | extrapolated |

| | | |
|---|---|---|
| projected cleanup time from t1= | 16 | yr |
| projected cleanup time from t2= | 8 | yr |




| | | |
|---|---|---|
| t1= | Jun-02 | |
| t2= | Feb-10 | |
| t2 - t1= | 7.6 | yr |
| t3= | Jun-30 | extrapolated |

| | | |
|---|---|---|
| projected cleanup time from t1= | 28 | yr |
| projected cleanup time from t2= | 20 | yr |

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

This page intentionally left blank

# Calculation 4
# Calculate a Bulk Index of Aquifer Restoration for Uranium

This page intentionally left blank

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

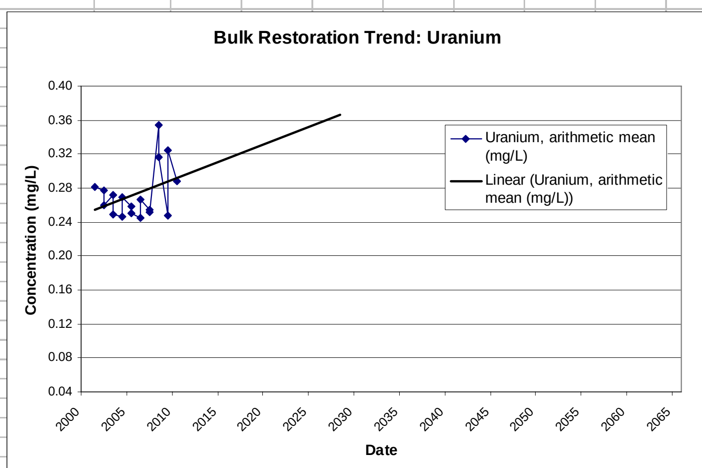
**Tuba City, AZ, Disposal Site**

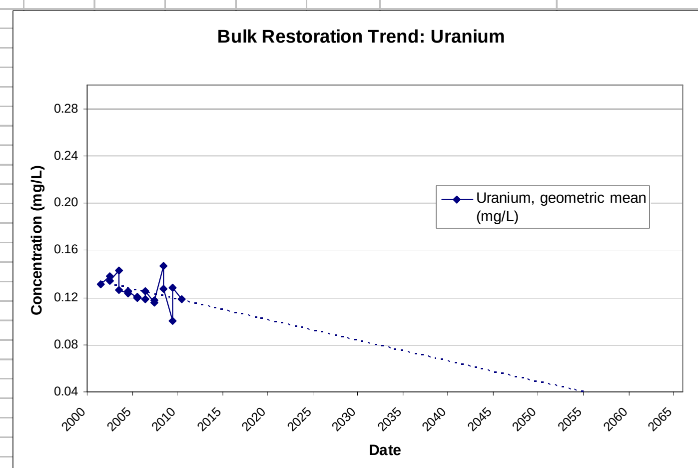
**Objective:** Develop a bulk concentration index for measuring restoration progress for uranium

**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 exist 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)** |
| 08/16/01 | ***0.379*** | ***0.485*** | ***0.090*** | 0.070 | 0.934 | 0.111 | 0.018 | 0.001 | 0.298 | 0.281 | 0.643 | 0.103 | 0.251 | baseline | 0.2818 | 0.1316 |
| 03/06/02 | ***0.379*** | ***0.485*** | ***0.090*** | 0.073 | 0.951 | 0.122 | 0.039 | 0.001 | 0.312 | 0.267 | 0.546 | 0.089 | 0.246 | baseline | 0.2769 | 0.1378 |
| 08/20/02 | ***0.379*** | ***0.485*** | ***0.090*** | 0.074 | 0.698 | 0.122 | 0.035 | 0.001 | 0.336 | 0.306 | ***0.546*** | ***0.089*** | 0.218 | | 0.2599 | 0.1336 |
| 02/06/03 | ***0.379*** | ***0.485*** | ***0.090*** | 0.077 | 0.653 | 0.124 | 0.033 | 0.002 | 0.355 | 0.582 | 0.432 | 0.102 | 0.221 | | 0.2718 | 0.1428 |
| 08/06/03 | 0.425 | 0.173 | 0.055 | 0.078 | 0.667 | 0.106 | 0.028 | 0.002 | 0.350 | 0.606 | 0.428 | 0.086 | 0.232 | | 0.2489 | 0.1261 |
| 02/12/04 | ***0.425*** | ***0.173*** | ***0.055*** | ***0.078*** | ***0.667*** | 0.097 | 0.027 | ***0.002*** | 0.320 | 0.600 | 0.430 | 0.081 | 0.240 | | 0.2458 | 0.1238 |
| 08/31/04 | 0.530 | 0.230 | 0.045 | 0.088 | 0.890 | 0.120 | 0.029 | 0.001 | 0.320 | 0.470 | ***0.430*** | 0.076 | 0.270 | | 0.2692 | 0.1256 |
| 02/10/05 | 0.560 | 0.190 | 0.045 | 0.085 | 0.830 | 0.110 | 0.035 | 0.001 | 0.280 | 0.470 | ***0.430*** | 0.049 | 0.270 | | 0.2581 | 0.1191 |
| 08/31/05 | 0.660 | 0.140 | 0.060 | 0.095 | ***0.830*** | 0.100 | 0.042 | 0.001 | 0.260 | 0.350 | ***0.430*** | ***0.049*** | 0.230 | | 0.2498 | 0.1205 |
| 02/22/06 | 0.770 | 0.120 | 0.054 | 0.088 | 0.710 | 0.100 | 0.048 | 0.001 | 0.250 | 0.240 | ***0.430*** | ***0.049*** | 0.330 | | 0.2454 | 0.1181 |
| 08/31/06 | 0.780 | 0.100 | 0.061 | 0.077 | ***0.710*** | 0.089 | 0.051 | 0.001 | 0.250 | 0.200 | ***0.430*** | 0.093 | 0.620 | | 0.2663 | 0.1254 |
| 02/22/07 | 0.930 | 0.098 | 0.053 | 0.061 | ***0.710*** | 0.092 | 0.047 | 0.001 | 0.210 | ***0.200*** | 0.365 | 0.078 | 0.460 | | 0.2542 | 0.1154 |
| 08/16/07 | 1.100 | 0.096 | 0.063 | 0.068 | 0.420 | 0.100 | 0.055 | 0.002 | 0.220 | | 0.365 | 0.130 | 0.410 | | 0.2524 | 0.1178 |
| 02/05/08 | 1.400 | 0.110 | 0.074 | 0.078 | 1.000 | 0.110 | 0.063 | 0.002 | 0.220 | | 0.520 | 0.140 | 0.540 | | 0.3547 | 0.1463 |
| 8/20/2008 | 1.400 | 0.110 | 0.069 | 0.067 | | 0.100 | 0.550 | 0.002 | 0.210 | | | 0.180 | 0.480 | | 0.3168 | 0.1275 |
| 02/25/2009 | 1.200 | 0.120 | 0.072 | 0.070 | | 0.093 | 0.059 | 0.002 | 0.190 | | | 0.170 | 0.500 | | 0.2476 | 0.1003 |
| 08/13/2009 | 1.3 | 0.17 | 0.071 | 0.07 | 0.91 | 0.096 | 0.057 | 0.0016 | 0.19 | | | 0.19 | 0.51 | | 0.3241 | 0.1287 |
| 02/09/2010 | 1.1 | 0.14 | 0.067 | 0.067 | 0.79 | 0.089 | 0.051 | 0.0015 | 0.19 | | | 0.18 | 0.5 | | 0.2887 | 0.1183 |




| | | |
|---|---|---|
| t1= | 15-Jun-02 | |
| t2= | 9-Feb-10 | |
| t2 - t1= | 7.7 | yr |
| t3= | (+) slope | extrapolated |
| projected cleanup time from t1= | N/A | yr |
| projected cleanup time from t2= | N/A | yr |

| | | |
|---|---|---|
| t1= | 15-Jun-02 | |
| t2= | 9-Feb-10 | |
| t2 - t1= | 7.7 | yr |
| t3= | Jun-65 | extrapolated |
| projected cleanup time from t1= | 63 | yr |
| projected cleanup time from t2= | 55 | yr |

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

This page intentionally left blank