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ENCLOSURE

North Site and Well 98A
Investigation Report

(excluding the CD referenced in Appendix G)

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North Site and Well 98A Investigation Report

NFS Facility
Erwin, Tennessee

March 2013

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ARCADIS

North Site and Well 98A Investigation Report

NFS Facility
Erwin, Tennessee

William M. Bailey
Staff Scientist

Paul M. Preston, PE
Project Manager

Berny D. Ilgner, PG
Principal In Charge

Prepared for:
Nuclear Fuel Services, Inc.

Prepared by:
ARCADIS
114 Lovell Road
Suite 202
Knoxville
Tennessee 37934
Tel 865.675.6700
Fax 865.675.6712

Our Ref.:
TNNFS126.NSAM

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Acronyms

ALS	ALS Laboratory Group
bgs	below ground surface
BSB	Banner Spring Branch
$CaCO_3$	calcium carbonate
CSM	conceptual site model
DCE	dichloroethene
DO	dissolved oxygen
ft	feet
gpm	gallons per minute
MCL	maximum contaminant level
µg/L	micrograms per liter
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
mS/cm	millisiemens per centimeter
NFS	Nuclear Fuel Services, Inc.
North Site	North Site Burial Grounds
ORP	oxidation reduction potential
PCBs	polychlorinated biphenyls
PCE	tetrachloroethene
pCi/L	picocuries per liter
PVC	polyvinyl chloride
SPLP	Synthetic Precipitation Leaching Procedure
TCE	trichloroethene
TDS	total dissolved solids
USEPA	U.S. Environmental Protection Agency
VC	vinyl chloride
VOCs	volatile organic compounds

1. Introduction

ARCADIS was retained by Nuclear Fuel Services, Inc. (NFS) to perform site investigation activities associated with dissolved uranium concentrations in the area of the North Site Burial Grounds (North Site). The study area is located in the northwest portion of the NFS facility in Erwin, Tennessee. The objectives of this investigation were to establish background soil conditions and occurrence of uranium in groundwater. Concentrations of dissolved uranium have been detected at wells 98A and 68 above the U.S. Environmental Protection Agency (USEPA) maximum contaminant level (MCL) of 30 micrograms per liter (µg/L). These concentrations indicated an increasing trend through July 2012 and have steadily declined to below the MCL as of December 2012. As a result of these fluctuations in concentrations, additional groundwater monitor wells were installed and monitored. The objective of this report is to provide the findings and conclusions of the investigation and provide a recommended path forward.

2. Conceptual Site Model

The conceptual site model (CSM) describes site conditions and includes data collected during the North Site 98A area investigation activities.

2.1 Site Description

NFS is a nuclear fuel fabrication and uranium recovery facility that has been operational since the late 1950s and is located in the mountainous region of east Tennessee, east of the Nolichucky River and adjacent to the CSX Railroad (Figure 2-1). The NFS Erwin site, located in Unicoi County, is within the city limits of Erwin and is immediately west of the community of Banner Hill. The site is situated in a narrow valley surrounded by rugged mountains, and occupies a relatively level area approximately 20 to 30 feet (ft) above the elevation of the Nolichucky River. To the west, east, and south, the mountains rise to elevations of 3,500 to 5,000 ft within a few miles of the site.

2.2 Geology and Hydrogeology

The site is underlain by alluvial deposits and clayey residuum which overlie Cambrian sedimentary rocks that have been folded and thrust faulted. No faults have been mapped through or adjacent to the plant site (EcoTek, Inc. 1994). Descriptions of bedrock samples collected during borehole drilling provide a more complete interpretation of the lithology of upper bedrock at the North Site. Although significant variability has been observed, rock types generally ranged from shaley dolomite and dolomitic limestone to thin-bedded shale. Coring at the site has shown that the Rome Formation dips at steep angles, to nearly vertical, and contains highly-weathered zones. No laterally extensive limestone beds have been identified on site. Instead, the upper bedrock consists of rapidly alternating, steeply dipping, and thinly-bedded sequences of shale, shaley dolomite, and dolomitic limestone.

The site is located within the Nolichucky River floodplain and, over time, the meandering river has migrated across the valley floor across various bedrock geologic units, near vertically dipping, eroding bedrock and depositing fluvial materials. In response to periodic episodes of increased streamflow, the channel has incised the underlying bedrock at different rates depending on the bedrock composition and amount of fracturing. The Nolichucky River alluvial deposits encountered during drilling at the site generally consist of a cobble zone ranging in thickness from 1 to 26.5 ft, when present (Figure 2-2).

In order to target groundwater within the transmissive portion of the cobble zone, 23 out of 24 wells installed during this North Site and 98A Investigation were

installed to the top of bedrock (Rome Formation). Measured well depths were then used to refine the understanding of bedrock surface elevations across the site (Figure 2-3).

The aquifer underlying the NFS site is composed of two principal hydrostratigraphic units: an unconsolidated unit (cobble zone) and a bedrock unit (Rome Formation). The unconsolidated aquifer occurs in the surficial sediments, which are predominantly alluvial in origin with the exception of excavated materials from the North Site. This alluvial aquifer is limited in aerial extent and is located mainly in the low-lying areas. Even though the alluvial aquifer is of greater permeability than the bedrock aquifer, regional groundwater flow patterns exist in the bedrock aquifer beneath the site to a depth of at least 350 ft. Groundwater originating in the upland areas flows through the Rome Formation, Shady Dolomite, and Honaker Dolomite before exiting the groundwater flow system as surface water in the valley. Previous investigations have determined that water in the Rome Formation in the area occurs under weak artesian conditions for the range of depths investigated.

The water table is present in the alluvium from where it intersects the land surface to more than 18 ft below ground surface (bgs) in the southwestern area of the plant. Water-level data is available throughout the site and indicates a groundwater flow direction to the north-northwest (Figure 2-4). Water-level data from monitor well clusters (wells located adjacent to each other and screened at different depths) indicate that consistent upward vertical hydraulic gradients exist in at least the northwest area of the site. This upward gradient is most likely due to regional discharge of groundwater (typically from the mountains) to large discharge features like the Nolichucky River.

Given the number of newly-installed wells in the northwest corner of the North Site associated with the well 98A Investigation, two cross-sections were constructed to help refine the unconsolidated zone above bedrock. The two transects (Figures 2-5 and 2-6) trend in the direction of bedrock strike from southwest to northeast (A-A') and perpendicular to strike from northwest to southeast (B-B'). In general, the A-A' section indicates an unconsolidated zone consisting of transmissive sand and gravel. Silt and clay are present in thin layers located above the estimated water table. This cross-section also depicts a deep depression at well 154A with corresponding thick unit of cobbles above this depression. The B-B' section highlights the discontinuous nature of clay and silt layers in the northwest corner of the North Site, with the only clay occurring near well 98A.

2.3 Groundwater Conditions

Since 2000, NFS has conducted extensive decommissioning activities and many source areas have been removed or remediated. Recent groundwater monitoring has indicated that low concentrations of dissolved uranium are still present in shallow groundwater at the North Site area, particularly at well 98A, located near the north perimeter of the site. Dissolved uranium concentrations at well 98A have fluctuated above the USEPA MCL (30 µg/L) from July 2007 (59.10 µg/L) through September 2012, with a maximum concentration of 99.78 µg/L, and have subsequently decreased to 11.76 µg/L as of December 6, 2012. Similar fluctuations in uranium concentrations were observed during 2012 at well 68, located approximately 100 ft upgradient and south of well 98A. At well 68, dissolved uranium exceeded the MCL in May 2012 at a concentration of 34.45 µg/L and remained elevated above the USEPA MCL for approximately 2 months. Uranium concentrations in samples from well 68 have been below the USEPA MCL since July 25, 2012 (Appendix A).

Data collected in the fall of 2012 indicate that groundwater uranium concentrations at the North Site have decreased from levels observed in the summer months at wells 98A and 68. Concentrations may have fluctuated due to several factors, as described below.

- The increase in uranium levels may have been influenced by precipitation events and/or changes to geochemical conditions from the newly-installed backfill materials. Two of three monthly rain events since 2005 that produced over 8.0 inches of rain (Figure 2-7), coincide with dissolved uranium concentrations at well 98A.
- Results of groundwater sampling from several of the new 98A Investigation wells indicated reducing groundwater conditions may exist in the area. Reducing conditions are indicated by negative oxidation reduction potential (ORP), low dissolved oxygen (DO), and elevated dissolved concentrations of iron and manganese. Under reducing conditions, uranium has the potential to form stable solid phases, such as uraninite and coffinite.
- A number of utility corridors are present in the areas of wells 98A and 68. Utility corridors often have the potential to serve as preferential groundwater flow and contaminant migration pathways due to the increased porosity within the utility trench lines and potential for breaches in the utility lines themselves.
- During construction of a concrete weir in a nearby ditch, a concrete truck was parked near well 98A and during the course of construction, some cement spilled on top of the well cover at well 98A.

2.4 Surface-Water Features

There are four surface-water bodies in the vicinity of the NFS Erwin site: Banner Spring Branch (BSB), Martin Creek, the Nolichucky River, and the North Site ponds. BSB, re-routed during site remediation, was a small (1.5 to 3.0 ft wide) spring-fed stream lying entirely within the NFS Erwin plant boundaries. BSB originates on NFS property at Banner Spring, which flows at a rate of about 300 gallons per minute (gpm) and flows underground within concrete piping around the east and north of the site until it empties into Martin Creek at the northwest corner of the site, approximately 1,200 ft from the source. The former BSB was confined to a straight, incised channel which flowed between Ponds 1, 2, and 3, which were also removed during site remediation activities. These ponds were created to hold wastewater discharge prior to the construction of the on-site wastewater treatment facility. Prior to creation, the Ponds Area were marshy with the Banner Spring channel exiting the area along its western boundary. The former BSB was generally a gaining stream in its upper man-made reaches and was a losing stream west of the Ponds Area until its confluence with Martin Creek.

Martin Creek, fed by mountain springs, groundwater, and runoff, is located nearly parallel to the northern property line of the site, crossing the property at the northwest corner. The width of Martin Creek varies from 8 to 15 ft, with depth varying from a few inches to pools of 3 to 4 ft deep. The flow rate varies seasonally from 1,000 to 5,000 gpm.

The Nolichucky River is a major stream draining the Blue Ridge Mountains of western North Carolina and east Tennessee. Monthly stage data for the Nolichucky River were obtained from the United States Geological Survey at the gauging station near Embreeville, roughly 2.5 miles northwest of the site. Based on this data, the average river stage is approximately 1,521 ft above National Geodetic Vertical Datum 1929 (United States Geological Survey 2009).

2.5 Utility Corridor Locations

Based on the most current utility information provided by NFS, there are multiple utility corridors at the NFS facility for the purpose of managing stormwater, fire protection, sanitary wastewater, and drinking water. These utilities were installed during various phases and consist of a multitude of construction and backfill materials (e.g., reinforced concrete, cast iron, etc.). Utility corridors often have the potential to serve as preferential groundwater flow and contaminant migration pathways due to the increased porosity within the utility trench lines and potential for breaches in the utility lines themselves. In general, specific utility construction as-built drawings and information related to bedding, backfill, and construction are limited due to the age of the facility. Additional information

is being sought and updates to the currently understood locations, depths, and construction details will be included as the CSM is refined.

The sanitary sewer line for the facility runs parallel along the northwest property boundary and exits at the same location as Martin Creek. Several wells are located adjacent to the sewer line including well 68. A water line is also present in the area of the investigation and crosses the sewer line near well 155A and exits the property just south of well 98A.

3. Investigation Activities

Boring locations for the investigation activities were selected in August 2012 following consideration of project objectives, known site hydrology, potential pathways, and review of pertinent information. Prior to commencement of subsurface activities, but after the initial selection of proposed boring locations, a third party survey was conducted under ARCADIS oversight to identify subsurface utilities that could affect placement of the proposed boring locations. This survey included the use of ground penetrating radar, review of applicable site drawings, and site inspection.

3.1 Drilling Method

Sonic drilling was selected for well installation due to its ability to address the difficulty associated with cobbles within the subsurface at the North Site. Sonic drilling uses high frequency mechanical oscillations developed in the drill head to transmit resonant vibrations and rotary power through the drilling tools to the drill bit. These oscillations allow the bit to achieve exceptional drilling penetration rates without the need for drilling fluids or air.

3.2 Soil Sampling

The sonic drilling process provides continuous core recovery from which samples can be collected with significant spatial accuracy. Because the core is continuous, it can also provide a precise and detailed stratigraphic profile of any overburden condition including dry or wet/saturated sands and gravels, cobbles and boulders, clays, silts, and hard tills. Recovery of a sample interval is typically high. Photographs of select intervals from the core recovery can be viewed in Appendix B. Soil core descriptions from this investigation can be found on the Borehole and Well Construction Logs located in Appendix C. Two soil samples were generally collected at each boring depending on subsurface conditions: one from the surface interval (approximately 0.0 to 2.0 ft), and one immediately above the water table (typically between 5.0 to 10.0 ft). In some cases, soil samples were collected from deeper intervals. A discussion of the sampling results can be found in Sections 4.3 and 4.4.

3.3 Well Construction

A total of 24 wells were installed (Table 3-1) as part of multiple phases of well installation activities at the North Site. Each well is generally categorized as a North Site Perimeter well or 98A Investigation well, depending upon its location and purpose. In December 2011, six wells were installed along the southwest and south boundary of

the North Site (North Site Perimeter) to assess and monitor groundwater conditions. The next two phases were conducted concurrent with each other and included the installation of 18 monitor wells during August/September of 2012. Eight of the wells (North Site Perimeter) were installed as replacement wells for wells removed during excavation activities.

Of the 14 North Site Perimeter wells, ten of the wells were completed as 2-inch monitor wells and the remaining four wells were completed as 4-inch monitor wells (Table 3-1). Well materials for the 2-inch monitor wells consisted of 2-inch Schedule 40 polyvinyl chloride (PVC) riser with 10-slot, machine-cut screens, a filter pack of 20/30-grade silica sand placed around the screen from the bottom of the borehole to approximately 2 ft above top of screen, and a 2-ft thick seal of hydrated bentonite chips with a grout mixture to complete the well to the surface. The well materials for the four 4-inch monitor wells consisted of 4-inch Schedule 40 PVC riser with 20-slot stainless-steel wire-wrapped screens, a filter pack of 6/20-grade silica sand placed around the screen from the bottom of the borehole to approximately 2 ft above top of screen, and a 2-ft thick seal of hydrated bentonite chips with a grout mixture tremmied to complete the well to the surface.

All North Site Perimeter 2-inch monitor wells were completed as stick-up well vaults with a 2-ft by 2-ft by 6-inch thick concrete pad. The 4-inch monitor wells were completed using flush-mount well vaults. All well pads were equipped with a permanent well marker with the well identification number.

For the 98A Investigation wells, four of the wells were completed as 2-inch monitor wells and the remaining six wells were completed as 4-inch monitor wells (Table 3-1). Well materials for the 2-inch monitor wells consisted of 2-inch Schedule 40 PVC riser with 10-slot, machine-cut screens, a filter pack of 20/30-grade silica sand placed around the screen from the bottom of the borehole to approximately 2 ft above top of screen, and a 2-ft thick seal of hydrated bentonite chips with a grout mixture to complete the well to the surface. The well materials for the six remaining monitor wells consisted of 4-inch Schedule 40 PVC riser with 20-slot stainless-steel wire wrapped screens, a filter pack of 6/20-grade silica sand placed around the screen from the bottom of the borehole to approximately 2 ft above top of screen, and a 2-ft thick seal of fine sand with a cement/bentonite grout mixture tremmied to complete the well to the surface.

Depending upon the location, 98A Investigation wells were either completed with stick-up well vaults with a 2-ft by 2-ft by 6-inch thick concrete pad or flush mount, with a permanent well marker set in the well pad with the well identification number.

3.4 Well Development

The newly-installed wells were developed to remove the residual materials remaining in the wells after installations were completed and to re-establish the natural hydraulic flow conditions of the formations which may have been disturbed by well construction. The new wells were developed using a submersible pump and developed until the columns of water in the wells were free of visible sediment and the pH, temperature, turbidity, and specific conductivity had stabilized. Purge rates during well development were typically between 1.5 and 3 gpm. In cases where a well was not able to sustain continuous flow at these flow rates, the well was repeatedly purged dry and allowed to recharge until the water column was free of visible sediment. Once that condition was met, development was completed using a peristaltic pump with a purge rate of about 0.25 gpm until pH, temperature, turbidity, and specific conductivity had stabilized. Well development forms and purge logs can be found in Appendix D.

3.5 Groundwater Sampling

Following well development activities, ARCADIS conducted baseline sampling of the newly-installed wells. Pre-sampling activities included equipment calibration, preparation of the sample containers and cooler, monitor well identification to ensure proper identification of each monitor well, and water-level collection. Once these activities were completed, each well was purged until the pH, temperature, turbidity, and specific conductivity had stabilized (Appendix D). Once the field parameters were stabilized, groundwater samples were collected using low-flow techniques and reverse-flow method for volatile organic compounds (VOCs) (Appendix D). A discussion of the sampling results are located in Sections 4.3 and 4.4.

Quality assurance/quality control samples including one matrix spike, one matrix spike duplicate, one field blank, and one blind field duplicate sample were collected for both North Site Perimeter and 98A Investigation wells. The labeled sample containers were stored in coolers on ice, with chain-of-custody documentation and shipped to ALS Laboratory Group (ALS) in Fort Collins, Colorado for analysis. The purge water generated during the monitoring event was containerized in on-site containers per NFS direction pending disposal by NFS.

4. Results

Results from the activities associated with these previously discussed scopes of work are summarized in the following sub-sections.

4.1 Field Parameters

Field parameters including pH, specific conductivity, temperature, DO, ORP, turbidity, and total dissolved solids (TDS) were collected as part of the groundwater sampling activities (Table 4-1). Field data indicate that groundwater pH varies across the north site area, ranging from 4.52 at well 137A to 7.96 at well 135A. Specific conductivity at the site is typically below 1 millisiemens per centimeter (mS/cm), with the exception of well 133A, which has a conductivity of 8.821 mS/cm and well 135A, which has a conductivity of 1.699 mS/cm. DO and ORP vary across the site; however, wells in the 98A Investigation area are typically reducing, as indicated by low concentrations of DO (average of 0.4 milligrams per liter [mg/L]) and negative ORP (average of -100 millivolts).

4.2 Groundwater Flow

Water levels were collected from monitor wells on September 20, 2012 (Table 4-2). This data set was used to generate a potentiometric surface map for the project area (Figure 2-4), which indicate groundwater flow toward the north-northwest, and is consistent with historical data.

The amount of rainfall influences groundwater elevations and flow direction and the transition from drought conditions to average rainfall amounts has the potential to alter groundwater flow directions. The annual average rainfall for Erwin is 54 inches (Unicoi County Chamber of Commerce 2012). Historical rainfall data since 2005 (Figure 2-7 and Appendix E) indicate that area rainfall has been below the annual average except for 2009 when 55.12 inches of rain was recorded. During this timeframe from 2005 through 2012, the 3 months with the highest rainfall totals were June 2007 with 7.94 inches, August 2010 with 8.81 inches, and July 2012 with 9.8 inches. During 2007, a total of 33.45 inches of rainfall was recorded, while through December 31, 2012, 52.47 inches of rain has been recorded.

4.3 Non-Radiological Data

Soil samples were collected across the North Site and analyzed for VOCs [tetrachloroethene (PCE) plus daughter products], polychlorinated biphenyls (PCBs),

total metals, inorganics, sulfate, and fluoride (Table 4-3). Notable, arsenic occurs throughout the North Site in concentrations as high as 11 milligrams per kilogram (mg/kg) and is likely naturally-occurring. Background concentrations of arsenic reported in Tennessee soils range from 0.1 to 120 mg/kg, with an estimated naturally-occurring background level of approximately 10 mg/kg (Kopp 2001). This concentration was observed in the upper 1 ft of soil at wells 140A and 147A. No PCBs were detected. VOCs were generally not detected, although low concentrations were observed at depths greater than 23 ft bgs at wells 132A and 134A.

Analytical laboratory results for groundwater samples (Table 4-4) consist of VOCs (i.e., PCE and daughter products), inorganics, PCBs, sulfate, fluoride, total phosphorus, total suspended solids, and metals (total and dissolved). Reducing conditions in the well 98A Investigation area are demonstrated by the high concentrations of dissolved iron and dissolved manganese. Dissolved iron concentrations are at or above 1 mg/L at wells 141A, 144A, 139A, 152A, 153A, 154A, and 155A. The maximum dissolved iron concentration of 14 mg/L was reported for a groundwater sample from well 153A, and dissolved manganese is also elevated with a concentration of 2.3 mg/L. As previously described, reducing conditions were also indicated by field data (low DO and negative ORP).

Groundwater in the North Site area typically has total alkalinity in the range of approximately 100 to 330 mg/L as calcium carbonate ($CaCO_3$). Two wells (136A and 137A) have exceptional low alkalinities of 18 and 9.6 mg/L as $CaCO_3$, respectively. These wells also have low pH values of 5.76 standard units at well 136A and 4.52 standard units at well 137A (Table 4-4 and Appendix D). Well 133A is also an exception to the typical alkalinity range having a high alkalinity of 780 mg/L as $CaCO_3$. Well 133A also has a relatively high conductivity of 8.821 mS/cm, TDS of 5.735 grams per liter (Table 4-1), sulfate of 810 mg/L, and high major cation concentrations.

PCE was detected in groundwater in 13 of the North Site Perimeter wells (wells 132A, 133A, 134A, 135A, 136A, 137A, 140A, 141A, 144A, 145A, 146A, 147A, and 150AW), with the highest concentration of 0.94 mg/L reported for a groundwater sample from well 134A, located to the southwest of the North Site. Wells 137A and 144A detections of PCE were flagged as less than the laboratory reporting limit during the validation process. PCE concentrations exceed the USEPA MCL of 0.005 mg/L at seven of these wells: wells 132A, 133A, 134A, and 135A, which are located adjacent to the site buildings on the west portion of the north site area, and wells 145A, 146A, and 147A, which are located on the south and southeast portions of the North Site area (Figure 4-1). Several of the wells with PCE detections are located in the upgradient (southeast) portion of the North Site area (wells 145A, 136A, and 146A). One of more

daughter products of PCE [trichloroethene (TCE), cis-1,2-dichlorotehene (cis-1,2-DCE), trans-1,2-DCE, and vinyl chloride (VC)] were detected above their respective USEPA MCLs (0.005 mg/L for TCE and trans-1,2-DCE, 0.07 mg/L for cis-1,2-DCE, and 0.002 mg/L for VC) at three wells (wells 132A, 134A, and 135A). Figures presenting the concentrations in groundwater for TCE, cis-1,2-DCE, and VC are located on Figures 4-2, 4-3, and 4-4, respectively. PCBs were not detected in the groundwater samples collected from the North Site area.

4.4 Radiological Data

Since 2000, NFS has undergone extensive decommissioning activities and source areas have been removed or remediated. Leachate extracted from soil collected (Table 4-5) as part of the well installation process and analyzed via Synthetic Precipitation Leaching Procedure indicated that total uranium mass activities range from near zero across much of the sampled area to 5.81 picocuries per liter (pCi/L) at sample 144A (0-1 ft). The activity in leachate obtained from soil at 144A (0-1 ft), which represents the maximum activity observed during sampling, corresponds to an equivalent uranium concentration of approximately 0.002 mg/L. These data suggest that soil in the North Site area is not leaching uranium at concentrations greater than the USEPA MCL (Appendix F).

Groundwater results for uranium isotopes are presented in Table 4-6 along with uranium mass concentrations in Figure 4-5. Activities were converted to mass concentration using the specific activity for each isotope. For U-233/234, the pCi/L value is divided by 6,210 to obtain the mass concentration in µg/L; for U-235/236 divide by 2.16, and for U-238 divide by 0.336, respectively. Concentrations for the North Site Perimeter wells and 98A Investigation wells are below the USEPA MCL of 0.03 mg/L. The highest total concentration for the North Site Perimeter wells is 0.0088 mg/L, this was detected at well 135A, located on the southwest portion of the North Site area. The highest concentration for the 98A Investigation wells is 0.01 mg/L, detected at well 152A. Analytical laboratory results have been included in Appendix G (on CD).

5. Conclusions and Recommendations

ARCADIS has completed an investigation of groundwater quality conditions at the North Site, with a particular focus on the well 98A area where uranium concentrations were above the MCL during the first three quarters of 2012 and have subsequently reduced to below the MCL by the fourth quarter of 2012. This investigation included the installation of additional monitor wells, a focused evaluation of wells 98A and 68, redevelopment of monitor wells in the vicinity of 98A, and sampling at an increased frequency during the investigation. A total of 24 wells were installed and sampled for target constituents in close proximity of the 98A area, including upgradient of 98A and along preferential pathways in the area of well 98A.

In general, well 98A uranium concentrations have fluctuated from 2007 through 2012, and peaked during July 2012. Since the peak in July, uranium concentrations have had steady decline to below the MCL for the October 2012 sampling event and have continued a steadily decreasing trend through the end of 2012. Uranium concentrations at upgradient well 68 have also fluctuated around the MCL. Beginning in May 2012 through July 18, 2012, uranium concentrations were above the MCL at well 68, but have remained below the MCL since July 25, 2012 and for the subsequent sampling events through the end of 2012.

As a part of the investigation activities, the newly-installed wells were sampled for soil and groundwater. The laboratory analytical results for uranium from the newly installed wells in the proximity of wells 68 and 98A indicated that groundwater concentrations were below the MCL. Laboratory results also indicated that the upgradient wells and wells along potential preferential pathways were also below the MCL for uranium. Additionally, soil samples were collected from 17 boreholes and submitted to the laboratory for various analyses, including laboratory testing to evaluate the potential for uranium concentrations leaching from the soil. Laboratory data from the leachate testing indicated that the maximum detected uranium mass concentration reported was 0.002 mg/L, which is consistent with background concentrations at the Site. This data suggests that the soils at the North Site are not leaching to groundwater at concentrations above the MCL.

Since 2000, NFS has conducted extensive decommissioning activities and many source areas have been removed or remediated. The findings from the 24 wells installed as part of this investigation indicates that the previous remediation efforts in the area of the North Site were successful. This investigation of the North Site and the well 98A area was unable to identify any point source uranium contamination as a contributor to the temporary increase in well 98A uranium concentration.

Based on the data included herein, ARCADIS recommends continued monitoring at the North Site and off-site locations (Figure 5-1). The monitoring program should continue the aggressive monitoring/sampling approach at upgradient well 68 and well 98A at the current monthly frequency through the remainder of 2013. Additionally, ARCADIS recommends the continued monitoring/sampling of existing wells and the 24 new wells installed at the North Site on a semi-annual basis. Upon analysis of supplemental data collected during 2013, the results of the monitoring program should be presented to Tennessee Department of Environment and Conservation at the Annual Facility Action Plan Meeting held at the end of 2013.

6. References

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7. Certification

I certify under penalty of law, including but not limited to penalties for perjury, that the information contained in this *North Site and Well 98A Investigation Report* for the Nuclear Fuel Services, Inc. facility in Erwin, Tennessee, and on any attachment is true, accurate, and complete to the best of my knowledge, information, and belief. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for intentional violation.

Berny D. Ilgner, PG
PG (Print Name)

Signature

3/5/13
Date

TN000250
Tennessee Registration #

Paul M. Preston, PE
PE (Print Name)

Signature

3/6/2013
Date

TN109506
Tennessee Registration #

STATE OF TENNESSEE COUNTY OF KNOX

Sworn to and subscribed before me by Berny D. Ilgner

and Paul M. Preston on this date March 5, 2013.

My commission expires March 1, 2015

Benita A. Ferrell
Notary Public (Print Name)

Benita A. Ferrell
Signature

Table 3-1.
North Site Well Construction Summary

North Site and Well 98A Investigation Report
Nuclear Fuel Services, Inc.
Erwin, Tennessee

Well ID	Date Well Installed	Well Reference Point Elevation * (ft msl)	Ground Surface Elevation (ft msl)	Depth of Well (ft bls)	Top of Screen (ft msl)	Bottom of Screen (ft msl)	Diameter (inches)	Well Type
North Site Perimeter								
132A	12/13/2011	1640.43	1640.36	27	1628.36	1613.36	4	Flushmount
133A	12/14/2011	1640.43	1640.37	21	1629.37	1619.37	4	Flushmount
134A	12/15/2011	1640.12	1640.02	25	1630.02	1615.02	4	Flushmount
135A	12/15/2011	1639.51	1639.41	25	1629.41	1614.41	4	Flushmount
136A	12/19/2011	1648.27	1645.07	21	1636.07	1626.07	2	Stickup
137A	12/20/2011	1650.26	1646.96	20	1636.96	1626.96	2	Stickup
140A	8/22/2012	1638.33	1635.22	15	1630.22	1620.22	2	Stickup
141A	8/23/2012	1639.98	1636.52	18	1628.52	1618.52	2	Stickup
144A	8/28/2012	1635.78	1632.75	14.75	1628	1618	2	Stickup
145A	8/29/2012	1643.68	1640.34	40	1615.34	1600.34	2	Stickup
146A	8/30/2012	1645.16	1641.84	30	1626.84	1611.84	2	Stickup
147A	9/5/2012	1654.37	1651.02	33	1633.02	1618.02	2	Stickup
148A	9/6/2012	1648.71	1645.52	21	1634.52	1624.52	2	Stickup
150AW	9/6/2012	1640.82	1637.41	15	1627.41	1622.41	2	Stickup
98A Investigation								
138A	8/21/2012	1635.1	1635.03	19	1626.03	1616.03	2	Flushmount
139A	8/22/2012	1639.43	1636.03	17	1629.03	1619.03	2	Stickup
142A	8/27/2012	1639.86	1636.51	20	1626.51	1616.51	2	Stickup
143A	8/28/2012	1638.16	1634.72	19	1625.72	1615.72	2	Stickup
149A	9/6/2012	1634.84	1634.64	16	1623.64	1618.64	4	Flushmount
151A	9/12/2012	1636.07	1636	19	1627	1617	4	Flushmount
152A	9/12/2012	1635.94	1635.9	12	1628.9	1623.9	4	Flushmount
153A	9/11/2012	1636.5	1636.35	17	1629.35	1619.35	4	Flushmount
154A	9/11/2012	1634.05	1633.99	27	1621.99	1606.99	4	Flushmount
155A	9/12/2012	1634.58	1634.48	16	1623.48	1618.48	4	Flushmount

Acronyms and Abbreviations:
* = well reference point elevation is top of lid
btoc = below top of casing
ft = feet
msl = mean sea level

Source:
Survey data from Glenn Allen, Shellnut Land Surveyor (December 2011 and September 2012).

Table 4-1.
Well Field Parameters

North Site and Well 98A Investigation Report
Nuclear Fuel Services, Inc.
Erwin, Tennessee

Well ID	Date	pH (SU)	Specific Conductivity (mS/cm)	Temperature (°C)	Turbidity (NTU)	ORP (mV)	TDS (g/L)	DO (mg/L)
North Site Perimeter								
132A	9/7/2012	6.20	0.872	20.21	8.00	-65.1	0.567	0.30
133A	8/28/2012	6.26	8.821	18.00	130	142.6	5.735	1.86
134A	8/28/2012	7.47	0.775	19.19	1.86	53.8	0.503	2.43
135A	8/28/2012	7.96	1.699	19.43	4.22	-3.9	1.107	0.30
136A	9/7/2012	5.76	0.111	18.83	10.30	128.7	0.072	6.45
137A	9/6/2012	4.52	0.036	19.58	28.9	-36.2	0.023	8.26
140A	8/27/2012	6.88	0.437	23.04	0.49	18.6	0.285	0.62
141A	8/27/2012	6.59	0.668	22.74	8.90	-50.7	0.434	0.28
144A	8/30/2012	6.42	0.370	22.66	3.29	-57.5	0.240	0.71
145A	9/6/2012	7.56	0.238	17.64	19.9	-5.9	0.155	2.60
146A	9/5/2012	7.30	0.200	20.17	4.33	52.0	0.130	6.87
147A	9/20/2012	7.13	0.265	16.07	2.68	-93.9	0.172	4.62
148A	9/12/2012	7.32	0.343	19.20	0.81	99.4	0.243	1.57
150AW	9/20/2012	6.41	0.310	23.57	1.83	-69.3	0.202	3.93
98A Investigation								
138A	8/23/2012	6.52	0.298	22.55	17.5	-6.0	0.194	0.42
139A	8/27/2012	6.93	0.618	21.53	0.78	-43.4	0.402	0.26
142A	8/30/2012	6.30	0.407	21.17	7.69	-8.6	0.264	0.17
143A	8/30/2012	6.57	0.433	22.37	9.24	-111.6	0.281	0.85
149A	9/18/2012	6.63	0.417	20.63	2.35	-25.9	0.271	0.70
151A	9/19/2012	7.77	0.426	21.93	23.1	-251.7	0.277	0.19
152A	9/18/2012	6.41	0.687	21.30	1.59	-69.7	0.446	0.55
153A	9/18/2012	6.66	0.673	21.92	2.22	-110.3	0.439	0.31
154A	9/19/2012	6.57	0.434	20.93	5.54	-173.7	0.282	0.42
155A	9/19/2012	6.90	0.489	21.69	6.55	-174.9	0.318	0.40

Acronyms and Abbreviations:

°C = degrees Celsius
DO = dissolved oxygen
g/L = grams per liter
mg/L = milligrams per liter
mS/cm = millisiemens per centimeter
mV = millivolts
NTU = nephelometric turbidity units
ORP = oxidation reduction potential
SU = standard units
TDS = total dissolved solids

Table 4-2.
Water-Table Elevations

North Site and Well 98A Investigation Report
Nuclear Fuel Services, Inc.
Erwin, Tennessee

Well ID	Date Collected	Well Reference Point Elevation* (ft msl)	Depth to Water (ft bmp)	Water-Table Elevation (ft msl)
North Site Perimeter				
132A	9/20/2012	1640.43	8.48	1631.95
133A	9/20/2012	1640.43	8.55	1631.88
134A	9/20/2012	1640.12	8.10	1632.02
135A	9/20/2012	1639.51	6.65	1632.86
136A	9/20/2012	1648.27	10.96	1637.31
137A	9/20/2012	1650.26	9.66	1640.60
140A	9/20/2012	1638.33	7.15	1631.18
141A	9/20/2012	1639.98	8.06	1631.92
144A	9/20/2012	1635.78	5.22	1630.56
145A	9/20/2012	1643.68	8.30	1635.38
146A	9/20/2012	1645.16	8.06	1637.10
147A	9/20/2012	1654.37	18.98	1635.39
148A	9/20/2012	1648.71	14.48	1634.23
150AW	9/20/2012	1640.82	8.38	1632.44
98A Investigation				
138A	9/20/2012	1635.1	4.00	1631.10
139A	9/20/2012	1639.43	8.20	1631.23
142A	9/20/2012	1639.86	8.01	1631.85
143A	9/20/2012	1638.16	6.90	1631.26
149A	9/20/2012	1634.84	4.14	1630.70
151A	9/20/2012	1636.07	5.34	1630.73
152A	9/20/2012	1635.94	5.01	1630.93
153A	9/20/2012	1636.5	5.59	1630.91
154A	9/20/2012	1634.05	4.65	1629.40
155A	9/20/2012	1634.58	3.91	1630.67

Acronyms and Abbreviations:
* = well reference point elevation is top of lid
bmp = below measuring point
ft = feet
msl = mean sea level

Table 4-3.
Summary of Non-Radiological Data for Soil

North Site and Well 98A Investigation Report
Nuclear Fuel Services, Inc.
Erwin, Tennessee

Analyte	Well ID: / Date: / Units	North Site Perimeter Wells					
		132A (8-10) 12/13/2011 Total	132A (25-27) 12/13/2011 Total	133A (8-10) 12/14/2011 Total	133A (20-21) 12/14/2011 Total	134A (8-10) 12/14/2011 Total	134A (23-25) 12/14/2011 Total
Metals							
Aluminum	mg/kg	17000	16000	14000	15000	18000	13000
Antimony	mg/kg	0.46J	2.5 U	2.4 U	2.7 U	2.4 U	2.3 U
Arsenic	mg/kg	4.3	0.99 J	0.93 J	0.62 J	2.9	0.82 J
Barium	mg/kg	50	14	43	50	39	110
Beryllium	mg/kg	1.7	0.93	1.6	10	1.7	0.79
Cadmium	mg/kg	0.1 J	0.047 J	0.12 J	0.13 J	0.14 J	0.076 J
Calcium	mg/kg	260	59000	430	560	7700	1100
Chromium	mg/kg	33	21	58	46	42	25
Cobalt	mg/kg	15	5.2	8.4	17	14	11
Copper	mg/kg	25	10	16	40	22	16
Iron	mg/kg	40000	22000	37000	41000	41000	22000
Lead	mg/kg	10	2.5	3.6	6.5	8.3	4.8
Magnesium	mg/kg	4100	67000	4700	7500	5900	5400
Manganese	mg/kg	560	1500	260	66	460	62
Mercury	mg/kg	0.15	0.043 U	0.04 U	0.046 U	0.046	0.039 U
Molybdenum	mg/kg	NA	NA	NA	NA	NA	NA
Nickel	mg/kg	37	17	29	110	35	19
Potassium	mg/kg	2000	7300	3400	3200	3200	1900
Selenium	mg/kg	6.3 U	0.62 U	5.9 U	6.7 U	5.9 U	0.39 J
Silver	mg/kg	1.3 U	1.2 U	1.2 U	1.3 U	1.2 U	1.2 U
Sodium	mg/kg	7.7 J	88 J	12 J	230	28 J	58 J
Thallium	mg/kg	13 U	12 U	7.3 J	13 U	12 U	0.57 J
Uranium	mg/kg	NA	NA	NA	NA	NA	NA
Vanadium	mg/kg	44	24	40	59	37	27
Zinc	mg/kg	77	27	53	220	64	44
Volatile Organic Compounds							
cis-1,2-Dichloroethene	mg/kg	0.0064 U	0.022	0.0061 U	0.007 U	0.006 U	0.012
Tetrachloroethene	mg/kg	0.0064 U	0.017	0.0061 U	0.003 J	0.006 U	0.14
trans-1,2-Dichloroethene	mg/kg	0.0064 U	0.0064 U	0.0061 U	0.007 U	0.006 U	0.0059 U
Trichloroethene	mg/kg	0.0064 U	0.0073	0.0061 U	0.007 U	0.006 U	0.089
Vinyl Chloride	mg/kg	0.0064 U	0.0064 U	0.0061 U	0.007 U	0.006 U	0.0059 U
Inorganics							
Alkalinity as CaCO3 (Total)	mg/kg	64 U	920	110	82	520	77
Bicarbonate as CaCO3	mg/kg	64 U	790	110	82	520	77
Carbonate as CaCO3	mg/kg	64 U	130	61 U	70 U	60 U	59 U
pH	SU	6.55	8.05	7.27	7.12	7.81	7.02
TOC	mg/kg	320 U	440	300 U	350 U	300 U	290 U
PCBs							
AROCLOR-1016	mg/kg	0.021 U	0.021 U	0.02 U	0.023 U	0.019 U	0.02 U
AROCLOR-1221	mg/kg	0.021 U	0.021 U	0.02 U	0.023 U	0.019 U	0.02 U
AROCLOR-1232	mg/kg	0.021 U	0.021 U	0.02 U	0.023 U	0.019 U	0.02 U
AROCLOR-1242	mg/kg	0.021 U	0.021 U	0.02 U	0.023 U	0.019 U	0.02 U
AROCLOR-1248	mg/kg	0.021 U	0.021 U	0.02 U	0.023 U	0.019 U	0.02 U
AROCLOR-1254	mg/kg	0.021 U	0.021 U	0.02 U	0.023 U	0.019 U	0.02 U
AROCLOR-1260	mg/kg	0.021 U	0.021 U	0.02 U	0.023 U	0.019 U	0.02 U
Total PCB	mg/kg	0.021 U	0.021 U	0.02 U	0.023 U	0.019 U	0.02 U
Other							
Sulfate	mg/kg	10 J	31	9.1 J	310	22	2.9 J
Flouride	mg/kg	2.2	3.7	4.4	0.88 J	11	0.97 J

Acronymes and Abbreviations:
CaCO3 = calcium carbonate
mg/kg = milligrams per kilogram
NA = not analyzed
NR = not reported
PCBs - polychlorinated biphenyls
SU = standard units
TOC = total organic carbon

Qualifiers:
HJ = holding time exceeded, estimated
J = result is less than the Reporting Limit but greater than or equal to the Method Detection Limit
U = result was analyzed for but not detected

Table 4-3.
Summary of Non-Radiological Data for Soil

North Site and Well 98A Investigation Report
Nuclear Fuel Services, Inc.
Erwin, Tennessee

Analyte	Well ID: / Date: / Units	North Site Perimeter Wells					
		135A (7-9) 12/15/2011 Total	135A (23-25) 12/15/2011 Total	136A (0-2) 12/19/2011 Total	136A (10-11) 12/19/2011 Total	137A (0-2) 12/20/2011 Total	137A (5-7) 12/20/2011 Total
Metals							
Aluminum	mg/kg	19000	10000	16000	19000	6300	16000
Antimony	mg/kg	2.3 U	2.6 U	2.6 U	2.5 U	2.2 U	2.4 U
Arsenic	mg/kg	3	3.6	5.6	1.3 U	1.4	3
Barium	mg/kg	44	42	380	400	290	340
Beryllium	mg/kg	1.4	0.72	0.72	0.88	0.55 U	0.6 U
Cadmium	mg/kg	0.14 J	0.089 J	0.64 U	0.63 U	0.55 U	0.6 U
Calcium	mg/kg	7600	1,300	4000	620	840	750
Chromium	mg/kg	36	43	21	36	9.7	25
Cobalt	mg/kg	15	14	12	13	2.6	2.6
Copper	mg/kg	26	20	15	12	4.1	7.3
Iron	mg/kg	38000	31000	25000	23000	9300	13000
Lead	mg/kg	10	10	32	6.3	11	12
Magnesium	mg/kg	5300	11000	1400	3000	530	610
Manganese	mg/kg	540	150	1700	200	180	91
Mercury	mg/kg	0.066	0.044 U	0.095	0.056	0.045	0.068
Molybdenum	mg/kg	NA	NA	NA	NA	NA	NA
Nickel	mg/kg	35	29	11	15	4.1	6.4
Potassium	mg/kg	2400	2,800	1100	2700	690	890
Selenium	mg/kg	5.7 U	3.3 U	3.2 U	0.63 U	0.55 U	0.6 U
Silver	mg/kg	1.1 U	1.3 U	1.3 U	1.3 U	1.1 U	1.2 U
Sodium	mg/kg	29 J	38 J	940	1100	920	1100
Thallium	mg/kg	11 U	6.5 U	6.4 U	1.3 U	1.1 U	1.2 U
Uranium	mg/kg	NA	NA	NA	NA	NA	NA
Vanadium	mg/kg	34	40	37	54	12	36
Zinc	mg/kg	66	29	740	180	180	150
Volatile Organic Compounds							
cis-1,2-Dichloroethene	mg/kg	0.006 U	0.0068 U	0.0065 U	0.0063 U	0.0056 U	0.0063 U
Tetrachloroethene	mg/kg	0.006 U	0.0068 U	0.0065 U	0.0063 U	0.0056 U	0.0063 U
trans-1,2-Dichloroethene	mg/kg	0.006 U	0.0068 U	0.0065 U	0.0063 U	0.0056 U	0.0063 U
Trichloroethene	mg/kg	0.006 U	0.0068 U	0.0065 U	0.0063 U	0.0056 U	0.0063 U
Vinyl Chloride	mg/kg	0.006 U	0.0068 U	0.0065 U	0.0063 U	0.0056 U	0.0063 U
Inorganics							
Alkalinity as CaCO3 (Total)	mg/kg	490	370	360	63 U	120	63 U
Bicarbonate as CaCO3	mg/kg	480	360	360	63 U	120	63 U
Carbonate as CaCO3	mg/kg	60 U	68 U	65 U	63 U	56 U	63 U
pH	SU	8.03	8.13	7.12	6.68	7.42	6.58
TOC	mg/kg	350	330 U	18000	400	6300	550
PCBs							
AROCLOR-1016	mg/kg	0.02 U	0.022 U	0.022 U	0.021 U	0.019 U	0.021 U
AROCLOR-1221	mg/kg	0.02 U	0.022 U	0.022 U	0.021 U	0.019 U	0.021 U
AROCLOR-1232	mg/kg	0.02 U	0.022 U	0.022 U	0.021 U	0.019 U	0.021 U
AROCLOR-1242	mg/kg	0.02 U	0.022 U	0.022 U	0.021 U	0.019 U	0.021 U
AROCLOR-1248	mg/kg	0.02 U	0.022 U	0.022 U	0.021 U	0.019 U	0.021 U
AROCLOR-1254	mg/kg	0.02 U	0.022 U	0.022 U	0.021 U	0.019 U	0.021 U
AROCLOR-1260	mg/kg	0.02 U	0.022 U	0.022 U	0.021 U	0.019 U	0.021 U
Total PCB	mg/kg	0.02 U	0.022 U	0.022 U	0.021 U	0.019 U	0.021 U
Other							
Sulfate	mg/kg	35	11 J	6.2 J	28	8.1 J	130
Flouride	mg/kg	15	34	3.8	1.2	2.7	0.5 J

Acronymes and Abbreviations:
CaCO3 = calcium carbonate
mg/kg = milligrams per kilogram
NA = not analyzed
NR = not reported
PCBs - polychlorinated biphenyls
SU = standard units
TOC = total organic carbon

Qualifiers:
HJ = holding time exceeded, estimated
J = result is less than the Reporting Limit but greater than or equal to the Method Detection Limit
U = result was analyzed for but not detected

Table 4-3.
Summary of Non-Radiological Data for Soil

North Site and Well 98A Investigation Report
Nuclear Fuel Services, Inc.
Erwin, Tennessee

Analyte	Well ID: / Date: / Units	North Site Perimeter Wells					
		140A (0-1) 8/22/2012 Total	140A (4-5) 8/22/2012 Total	141A (0-1) 8/23/2012 Total	141A (3-4) 8/23/2012 Total	144A (0-1) 8/28/2012 Total	145A (0-1) 8/29/2012 Total
Metals							
Aluminum	mg/kg	10000	1100	14000	13000	7000	18000
Antimony	mg/kg	12 U	2.1 U	12 U	12 U	0.57 J	0.95 J
Arsenic	mg/kg	11	1 U	5.3 J	5.8 U	4.5	3.3
Barium	mg/kg	250	17	71	60	40	97
Beryllium	mg/kg	2.9 J	0.13 J	0.56 J	0.56 J	0.46 J	0.67
Cadmium	mg/kg	0.29 J	0.52 U	3 U	2.9 U	0.076 J	0.05 J
Calcium	mg/kg	11000	160	83 J	51 J	11000	280
Chromium	mg/kg	18	3.8	23	26	11	21
Cobalt	mg/kg	15	1.2	16	16	8.4	9.8
Copper	mg/kg	21	0.82 J	10	7.9	18	7.7
Iron	mg/kg	96000	4000	26000	25000	18000	25000
Lead	mg/kg	54	3.6	5.9	7.1	25	7.4
Magnesium	mg/kg	5000	66 J	2700	4200	3500	2000
Manganese	mg/kg	5400	49	430	450	340	380
Mercury	mg/kg	0.14	0.035 U	0.082	0.075	0.059	0.1
Molybdenum	mg/kg	NA	NA	NA	NA	NA	NA
Nickel	mg/kg	27	1.6 J	15	16	15	13
Potassium	mg/kg	210 J	130	950	1300	400	1000
Selenium	mg/kg	8.3	0.52 U	3 U	2.9 U	1.1	2.9 U
Silver	mg/kg	5.8 U	1 U	6 U	5.8 U	1 U	1.1 U
Sodium	mg/kg	580 U	100 U	600 U	580 U	19 J	8.8 J
Thallium	mg/kg	9.4	1 U	6 U	5.8 U	1.7	5.7 U
Uranium	mg/kg	NA	NA	NA	NA	NA	NA
Vanadium	mg/kg	42	3.1	31	30	11	30
Zinc	mg/kg	130	6.5	23	29	56	24
Volatile Organic Compounds							
cis-1,2-Dichloroethene	mg/kg	0.006 U	0.0054 U	0.0063 U	0.0058 U	0.0054 U	0.0059 U
Tetrachloroethene	mg/kg	0.006 U	0.0054 U	0.0063 U	0.0058 U	0.0054 U	0.0059 U
trans-1,2-Dichloroethene	mg/kg	0.006 U	0.0054 U	0.0063 U	0.0058 U	0.0054 U	0.0059 U
Trichloroethene	mg/kg	0.006 U	0.0054 U	0.0063 U	0.0058 U	0.0054 U	0.0059 U
Vinyl Chloride	mg/kg	0.006 U	0.0054 U	0.0063 U	0.0058 U	0.0054 U	0.0059 U
Inorganics							
Alkalinity as CaCO3 (Total)	mg/kg	380	54 U	62 U	70	380	59 U
Bicarbonate as CaCO3	mg/kg	380	54 U	62 U	70	370	59 U
Carbonate as CaCO3	mg/kg	60 U	54 U	62 U	58 U	54 U	59 U
pH	SU	8.01 HJ	7.59 HJ	6.18 HJ	6.1 HJ	7.74	5.9
TOC	mg/kg	5100	740	980	970	8500	2400
PCBs							
AROCLOR-1016	mg/kg	0.02 U	0.018 U	0.021 U	0.019 U	0.018 U	0.019 U
AROCLOR-1221	mg/kg	0.02 U	0.018 U	0.021 U	0.019 U	0.018 U	0.019 U
AROCLOR-1232	mg/kg	0.02 U	0.018 U	0.021 U	0.019 U	0.018 U	0.019 U
AROCLOR-1242	mg/kg	0.02 U	0.018 U	0.021 U	0.019 U	0.018 U	0.019 U
AROCLOR-1248	mg/kg	0.02 U	0.018 U	0.021 U	0.019 U	0.018 U	0.019 U
AROCLOR-1254	mg/kg	0.02 U	0.018 U	0.021 U	0.019 U	0.018 U	0.019 U
AROCLOR-1260	mg/kg	0.02 U	0.018 U	0.021 U	0.019 U	0.018 U	0.019 U
Total PCB	mg/kg	NR	NR	NR	NR	NR	NR
Other							
Sulfate	mg/kg	NA	NA	NA	NA	NA	NA
Flouride	mg/kg	NA	NA	NA	NA	NA	NA

Acronymes and Abbreviations:
CaCO3 = calcium carbonate
mg/kg = milligrams per kilogram
NA = not analyzed
NR = not reported
PCBs - polychlorinated biphenyls
SU = standard units
TOC = total organic carbon

Qualifiers:
HJ = holding time exceeded, estimated
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Table 4-3.
Summary of Non-Radiological Data for Soil

North Site and Well 98A Investigation Report
Nuclear Fuel Services, Inc.
Erwin, Tennessee

Analyte	Well ID: / Date: / Units	North Site Perimeter Wells					
		145A (9-10) 8/29/2012 Total	146A (0-1) 8/31/2012 Total	146A (4-5) 8/31/2012 Total	147A (0-1) 9/5/2012 Total	147A (9-10) 9/5/2012 Total	148A (0-1) 9/5/2012 Total
Metals							
Aluminum	mg/kg	5000	21000	3400	14000	2900	6600
Antimony	mg/kg	2.2 U	12 U	2.8 U	1.8 J	2.1 U	0.53 J
Arsenic	mg/kg	1.1 U	3.7 J	1.4 U	11	0.6 J	3.7
Barium	mg/kg	80	75	58	78	17	27
Beryllium	mg/kg	0.21 J	0.75 J	0.22 J	1.5	0.12 J	0.24 J
Cadmium	mg/kg	0.54 U	2.9 U	0.068 J	0.18 J	0.53 U	0.53 U
Calcium	mg/kg	570	190 J	2800	1700	87 J	170
Chromium	mg/kg	15	34	6.4	22	2.5	8.8
Cobalt	mg/kg	2.1	21	0.43 J	10	2.8	2.4
Copper	mg/kg	2	14	1.7	19	1.8	3.9
Iron	mg/kg	6400	33000	1400	63000	4500	17000
Lead	mg/kg	2.5	8.3	3.6	34	2.4	6
Magnesium	mg/kg	1100	5000	450	800	90 J	260
Manganese	mg/kg	29	970	14	1300	88	73
Mercury	mg/kg	0.037 U	0.093	0.056	0.14	0.036 U	0.054
Molybdenum	mg/kg	NA	NA	NA	NA	NA	NA
Nickel	mg/kg	4	22	2 J	18	1.4 J	3.1
Potassium	mg/kg	650	2000	110 J	540	180	390
Selenium	mg/kg	0.54 U	1.8 J	0.94	6.1 U	0.53 U	0.94
Silver	mg/kg	1.1 U	5.8 U	1.4 U	1.2 U	1.1 U	1.1 U
Sodium	mg/kg	24 J	580 U	1.3 J	6.1 J	110 U	110 U
Thallium	mg/kg	1.1 U	5.8 U	1.4 U	12 U	1.1 U	1.5
Uranium	mg/kg	NA	0.92	1	3.2	0.39	0.96
Vanadium	mg/kg	8	40	7.1	46	5.4	15
Zinc	mg/kg	9.7	44	6.4	82	3	11
Volatile Organic Compounds							
cis-1,2-Dichloroethene	mg/kg	0.0056 U	0.0058 U	0.0072 U	0.0059 U	0.0054 U	0.0053 U
Tetrachloroethene	mg/kg	0.0056 U	0.0058 U	0.0072 U	0.0059 U	0.0054 U	0.0053 U
trans-1,2-Dichloroethene	mg/kg	0.0056 U	0.0058 U	0.0072 U	0.0059 U	0.0054 U	0.0053 U
Trichloroethene	mg/kg	0.0056 U	0.0058 U	0.0072 U	0.0059 U	0.0054 U	0.0053 U
Vinyl Chloride	mg/kg	0.0056 U	0.0058 U	0.0072 U	0.0059 U	0.0054 U	0.0053 U
Inorganics							
Alkalinity as CaCO3 (Total)	mg/kg	56 U	58 U	72 U	66	54 U	54 U
Bicarbonate as CaCO3	mg/kg	56 U	58 U	72 U	66	54 U	54 U
Carbonate as CaCO3	mg/kg	56 U	58 U	72 U	62 U	54 U	54 U
pH	SU	7.67	5.99 HJ	5.72 HJ	7.24 HJ	6.23 HJ	4.6
TOC	mg/kg	280 U	930	53000	2900	270 U	660
PCBs							
AROCLOR-1016	mg/kg	0.019 U	0.019 U	0.023 U	0.02 U	0.018 U	0.018 U
AROCLOR-1221	mg/kg	0.019 U	0.019 U	0.023 U	0.02 U	0.018 U	0.018 U
AROCLOR-1232	mg/kg	0.019 U	0.019 U	0.023 U	0.02 U	0.018 U	0.018 U
AROCLOR-1242	mg/kg	0.019 U	0.019 U	0.023 U	0.02 U	0.018 U	0.018 U
AROCLOR-1248	mg/kg	0.019 U	0.019 U	0.023 U	0.02 U	0.018 U	0.018 U
AROCLOR-1254	mg/kg	0.019 U	0.019 U	0.023 U	0.02 U	0.018 U	0.018 U
AROCLOR-1260	mg/kg	0.019 U	0.019 U	0.023 U	0.02 U	0.018 U	0.018 U
Total PCB	mg/kg	NR	NR	NR	NR	NR	NR
Other							
Sulfate	mg/kg	NA	NA	NA	NA	NA	NA
Flouride	mg/kg	NA	NA	NA	NA	NA	NA

Acronymes and Abbreviations:
CaCO3 = calcium carbonate
mg/kg = milligrams per kilogram
NA = not analyzed
NR = not reported
PCBs - polychlorinated biphenyls
SU = standard units
TOC = total organic carbon

Qualifiers:
HJ = holding time exceeded, estimated
J = result is less than the Reporting Limit but greater than or equal to the Method Detection Limit
U = result was analyzed for but not detected

Table 4-3.
Summary of Non-Radiological Data for Soil

North Site and Well 98A Investigation Report
Nuclear Fuel Services, Inc.
Erwin, Tennessee

Analyte	Well ID: / Date: / Units	North Site Perimeter Wells			98A Investigation Wells		
		148A (9-10) 9/5/2012 Total	150AW (0-1) 9/7/2012 Total	150AW (4-5) 9/7/2012 Total	149A (11-16) 9/12/2012 Total	152A (7-12) 9/12/2012 Total	155A (11-16) 9/12/2012 Total
Metals							
Aluminum	mg/kg	33000	1200	6000	4700	5300	6200
Antimony	mg/kg	1.7 J	2.1 U	0.81 J	NA	NA	NA
Arsenic	mg/kg	1.3 U	1 U	6.5	2.3	0.7	0.610
Barium	mg/kg	280	14	94	NA	NA	NA
Beryllium	mg/kg	1.2	0.14 J	1.1	NA	NA	NA
Cadmium	mg/kg	0.15 J	0.52 U	0.2 J	NA	NA	NA
Calcium	mg/kg	500	170	140000	1300	420	610
Chromium	mg/kg	39	2.7	15	11	12	12
Cobalt	mg/kg	17	0.56 J	5.8	NA	NA	NA
Copper	mg/kg	19	0.67 J	9.4	NA	NA	NA
Iron	mg/kg	34000	3400	29000	7700	5000	7200
Lead	mg/kg	9.3	1.6	24	NA	NA	NA
Magnesium	mg/kg	5100	91 J	49000	1400	1200	1800
Manganese	mg/kg	3200	19	1000	64	26	42
Mercury	mg/kg	0.042 U	0.035 U	0.11	NA	NA	NA
Molybdenum	mg/kg	NA	NA	NA	0.53	0.250	0.360
Nickel	mg/kg	22	1.2 J	11	NA	NA	NA
Potassium	mg/kg	4,200	150	590	700	840	1100
Selenium	mg/kg	3 J	0.52 U	2.7 J	0.250	0.240	0.310
Silver	mg/kg	1.3 U	1 U	1.2 U	NA	NA	NA
Sodium	mg/kg	37 J	100 U	71 J	120 U	110 U	120 U
Thallium	mg/kg	6.3 U	1 U	5.8 U	NA	NA	NA
Uranium	mg/kg	0.9	0.33	2	0.690	0.660	0.800
Vanadium	mg/kg	100	2.3	21	NA	NA	NA
Zinc	mg/kg	66	2.9	44	NA	NA	NA
Volatile Organic Compounds							
cis-1,2-Dichloroethene	mg/kg	0.0061 U	0.0053 U	0.006 U	0.0061 U	0.0057 U	0.0061 U
Tetrachloroethene	mg/kg	0.0061 U	0.0053 U	0.006 U	0.0061 U	0.0057 U	0.0061 U
trans-1,2-Dichloroethene	mg/kg	0.0061 U	0.0053 U	0.006 U	0.0061 U	0.0057 U	0.0061 U
Trichloroethene	mg/kg	0.0061 U	0.0053 U	0.006 U	0.0061 U	0.0057 U	0.0061 U
Vinyl Chloride	mg/kg	0.0061 U	0.0053 U	0.006 U	0.0061 U	0.0057 U	0.0061 U
Inorganics							
Alkalinity as CaCO3 (Total)	mg/kg	64 U	370	60 U	250	57 U	120
Bicarbonate as CaCO3	mg/kg	64 U	350	60 U	250	57 U	120
Carbonate as CaCO3	mg/kg	64 U	53 U	60 U	61 U	57 U	61 U
pH	SU	6.34 HJ	8.21 HJ	7.88 HJ	7.9	7.27	7.37
TOC	mg/kg	320 U	950	620	NA	NA	NA
PCBs							
AROCLOR-1016	mg/kg	0.021 U	0.018 U	0.019 U	NA	NA	NA
AROCLOR-1221	mg/kg	0.021 U	0.018 U	0.019 U	NA	NA	NA
AROCLOR-1232	mg/kg	0.021 U	0.018 U	0.019 U	NA	NA	NA
AROCLOR-1242	mg/kg	0.021 U	0.018 U	0.019 U	NA	NA	NA
AROCLOR-1248	mg/kg	0.021 U	0.018 U	0.019 U	NA	NA	NA
AROCLOR-1254	mg/kg	0.021 U	0.018 U	0.019 U	NA	NA	NA
AROCLOR-1260	mg/kg	0.021 U	0.018 U	0.019 U	NA	NA	NA
Total PCB	mg/kg	NR	NR	NR	NA	NA	NA
Other							
Sulfate	mg/kg	NA	NA	NA	22	10 U	12 U
Flouride	mg/kg	NA	NA	NA	4.7	3.2	1.8

Acronymes and Abbreviations:
CaCO3 = calcium carbonate
mg/kg = milligrams per kilogram
NA = not analyzed
NR = not reported
PCBs - polychlorinated biphenyls
SU = standard units
TOC = total organic carbon

Qualifiers:
HJ = holding time exceeded, estimated
J = result is less than the Reporting Limit but greater than or equal to the Method Detection Limit
U = result was analyzed for but not detected

Table 4-4.
Summary of Non-Radiological Data for Groundwater

North Site and Well 98A Investigation Report
Nuclear Fuel Services, Inc.
Erwin, Tennessee

Analyte	Well ID: / Date: / Units	North Site Perimeter Wells							
		132A 1/5/2012		132A 9/7/2012		133A 1/6/2012		133A 8/28/2012	
		Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved
Metals									
Aluminum	mg/L	0.055 J	0.056 J	NA	NA	0.67	0.057 J	NA	NA
Antimony	mg/L	0.02 U	0.02 U	NA	NA	0.02 U	0.02 U	NA	NA
Arsenic	mg/L	0.01 U	0.01 U	NA	NA	0.01 U	0.01 U	NA	NA
Barium	mg/L	0.091 J	0.09 J	NA	NA	0.082 J	0.083 J	NA	NA
Beryllium	mg/L	0.00034 J	0.00043 J	NA	NA	0.0011 J	0.00089 J	NA	NA
Cadmium	mg/L	0.005 U	0.005 U	NA	NA	0.005 U	0.005 U	NA	NA
Calcium	mg/L	88	86	NA	NA	290	300	NA	NA
Chromium	mg/L	0.01 U	0.01 U	NA	NA	0.00071 J	0.01 U	NA	NA
Cobalt	mg/L	0.0014 J	0.001 J	NA	NA	0.037	0.036	NA	NA
Copper	mg/L	0.01 U	0.01 U	NA	NA	0.013	0.0074 J	NA	NA
Iron	mg/L	0.064 J	0.014 J	NA	NA	3.7	2.4	NA	NA
Lead	mg/L	0.003 U	0.003 U	NA	NA	0.003 U	0.003 U	NA	NA
Magnesium	mg/L	32	32	NA	NA	74	74	NA	NA
Manganese	mg/L	0.75	0.74	NA	NA	2.8	2.9	NA	NA
Mercury	mg/L	0.0002 U	0.0002 U	NA	NA	0.0002 U	0.0002 U	NA	NA
Molybdenum	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
Nickel	mg/L	0.0018 J	0.0022 J	NA	NA	0.21	0.2	NA	NA
Potassium	mg/L	25	25.00	NA	NA	230	230	NA	NA
Selenium	mg/L	0.005 U	0.005 U	NA	NA	0.0039 J	0.005 U	NA	NA
Silver	mg/L	0.01 U	0.01 U	NA	NA	0.01 U	0.01 U	NA	NA
Sodium	mg/L	11	11.00	NA	NA	390	390	NA	NA
Thallium	mg/L	0.01 U	0.01 U	NA	NA	0.01 U	0.01 U	NA	NA
Uranium	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
Vanadium	mg/L	0.01 U	0.01 U	NA	NA	0.00083 J	0.01 U	NA	NA
Zinc	mg/L	0.02 U	0.0046 J	NA	NA	0.043	0.036	NA	NA
Volatile Organic Compounds									
cis-1,2 -Dichloroethene	mg/L	0.07	NA	0.053	NA	0.0025	NA	0.0034	NA
Tetrachloroethene	mg/L	0.068	NA	0.055	NA	0.028	NA	0.031	NA
trans-1,2-Dichloroethene	mg/L	0.0013	NA	0.00093 J	NA	0.001 U	NA	0.001 U	NA
Trichloroethene	mg/L	0.03	NA	0.025	NA	0.0037	NA	0.0047	NA
Vinyl Chloride	mg/L	0.0098	NA	0.0097	NA	0.001 U	NA	0.001 U	NA
Inorganics									
Alkalinity (Total)	mg/L	330	NA	NA	NA	780	NA	NA	NA
Bicarbonate as CaCO3	mg/L	330	NA	NA	NA	780	NA	NA	NA
Carbonate as CaCO3	mg/L	20 U	NA	NA	NA	50 U	NA	NA	NA
pH	SU	6.47	NA	NA	NA	NA	NA	NA	NA
TOC	mg/L	1 U	NA	1 U	NA	10	NA	1 U	NA
PCBs									
AROCLOR-1016	mg/L	0.00051 U	NA	0.00051 U	NA	0.00048 U	NA	0.00049 U	NA
AROCLOR-1221	mg/L	0.00051 U	NA	0.00051 U	NA	0.00048 U	NA	0.00049 U	NA
AROCLOR-1232	mg/L	0.00051 U	NA	0.00051 U	NA	0.00048 U	NA	0.00049 U	NA
AROCLOR-1242	mg/L	0.00051 U	NA	0.00051 U	NA	0.00048 U	NA	0.00049 U	NA
AROCLOR-1248	mg/L	0.00051 U	NA	0.00051 U	NA	0.00048 U	NA	0.00049 U	NA
AROCLOR-1254	mg/L	0.00051 U	NA	0.00051 U	NA	0.00048 U	NA	0.00049 U	NA
AROCLOR-1260	mg/L	0.00051 U	NA	0.00051 U	NA	0.00048 U	NA	0.00049 U	NA
Total PCB	mg/L	0.05 U	NA	NR	NA	0.05 U	NA	NR	NA
Other									
Sulfate	mg/L	38	NA	NA	NA	810	NA	NA	NA
Flouride	mg/L	0.83	NA	NA	NA	0.5 U	NA	NA	NA
Total Phosphorus	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
Total Suspended Solids	mg/L	20 U	NA	NA	NA	31	NA	NA	NA

Acronyms and Abbreviations:
CaCO3 = calcium carbonate
mg/L = milligrams per liter
NA = not analyzed
NR = not reported
PCBs - polychlorinated biphenyls
SU = standard units
TOC = total organic carbon

Qualifiers:
HJ = holding time exceeded, estimated
J = result is less than the Reporting Limit but greater than or equal to the Method Detection Limit
U = result was analyzed for but not detected

Table 4-4.
Summary of Non-Radiological Data for Groundwater

North Site and Well 98A Investigation Report
Nuclear Fuel Services, Inc.
Erwin, Tennessee

Analyte	Well ID: / Date: / Units	North Site Perimeter Wells							
		134A 1/6/2012		134A 8/28/2012		135A 1/6/2012		135A 8/28/2012	
		Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved
Metals									
Aluminum	mg/L	0.28	0.065 J	NA	NA	0.19 J	0.077 J	NA	NA
Antimony	mg/L	0.02 U	0.02 U	NA	NA	0.02 U	0.02 U	NA	NA
Arsenic	mg/L	0.01 U	0.01 U	NA	NA	0.01 U	0.01 U	NA	NA
Barium	mg/L	0.31	0.12	NA	NA	0.14	0.14	NA	NA
Beryllium	mg/L	0.00047 J	0.00056 J	NA	NA	0.00055 J	0.00069 J	NA	NA
Cadmium	mg/L	0.005 U	0.005 U	NA	NA	0.005 U	0.005 U	NA	NA
Calcium	mg/L	80	43	NA	NA	23	23	NA	NA
Chromium	mg/L	0.01 U	0.01 U	NA	NA	0.01 U	0.01 U	NA	NA
Cobalt	mg/L	0.0027 J	0.01 U	NA	NA	0.01 U	0.01 U	NA	NA
Copper	mg/L	0.003 J	0.01 U	NA	NA	0.01 U	0.01 U	NA	NA
Iron	mg/L	0.33	0.1 U	NA	NA	0.062 J	0.1 U	NA	NA
Lead	mg/L	0.003 U	0.003 U	NA	NA	0.003 U	0.003 U	NA	NA
Magnesium	mg/L	13	12	NA	NA	6.3	6.1	NA	NA
Manganese	mg/L	0.53	0.14	NA	NA	0.047	0.047	NA	NA
Mercury	mg/L	0.0002 U	0.0002 U	NA	NA	0.0002 U	0.0002 U	NA	NA
Molybdenum	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
Nickel	mg/L	0.0034 J	0.02 U	NA	NA	0.02 U	0.02 U	NA	NA
Potassium	mg/L	43	15	NA	NA	120	120	NA	NA
Selenium	mg/L	0.005 U	0.005 U	NA	NA	0.005 U	0.005 U	NA	NA
Silver	mg/L	0.01 U	0.01 U	NA	NA	0.01 U	0.01 U	NA	NA
Sodium	mg/L	25	7.3	NA	NA	17	18	NA	NA
Thallium	mg/L	0.01 U	0.01 U	NA	NA	0.01 U	0.01 U	NA	NA
Uranium	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
Vanadium	mg/L	0.01 U	0.01 U	NA	NA	0.00095 J	0.00086 J	NA	NA
Zinc	mg/L	0.0017 J	0.02 U	NA	NA	0.02 U	0.02 U	NA	NA
Volatile Organic Compounds									
cis-1,2 -Dichloroethene	mg/L	0.08	NA	0.053	NA	0.073	NA	0.048	NA
Tetrachloroethene	mg/L	0.94	NA	0.47	NA	0.58	NA	0.29	NA
trans-1,2-Dichloroethene	mg/L	0.00096 J	NA	0.00062 J	NA	0.0012	NA	0.00056 J	NA
Trichloroethene	mg/L	0.58	NA	0.27	NA	0.033	NA	0.02	NA
Vinyl Chloride	mg/L	0.0087	NA	0.0044	NA	0.0066	NA	0.0043	NA
Inorganics									
Alkalinity (Total)	mg/L	340	NA	NA	NA	270	NA	NA	NA
Bicarbonate as CaCO3	mg/L	340	NA	NA	NA	270	NA	NA	NA
Carbonate as CaCO3	mg/L	20 U	NA	NA	NA	20 U	NA	NA	NA
pH	SU	NA	NA	NA	NA	NA	NA	NA	NA
TOC	mg/L	3.5	NA	1 U	NA	2.5	NA	1.8	NA
PCBs									
AROCLOR-1016	mg/L	0.00049 U	NA	0.00049 U	NA	0.00051 U	NA	0.00048 U	NA
AROCLOR-1221	mg/L	0.00049 U	NA	0.00049 U	NA	0.00051 U	NA	0.00048 U	NA
AROCLOR-1232	mg/L	0.00049 U	NA	0.00049 U	NA	0.00051 U	NA	0.00048 U	NA
AROCLOR-1242	mg/L	0.00049 U	NA	0.00049 U	NA	0.00051 U	NA	0.00048 U	NA
AROCLOR-1248	mg/L	0.00049 U	NA	0.00049 U	NA	0.00051 U	NA	0.00048 U	NA
AROCLOR-1254	mg/L	0.00049 U	NA	0.00049 U	NA	0.00051 U	NA	0.00048 U	NA
AROCLOR-1260	mg/L	0.00049 U	NA	0.00049 U	NA	0.00051 U	NA	0.00048 U	NA
Total PCB	mg/L	0.05 U	NA	NR	NA	0.05 U	NA	NR	NA
Other									
Sulfate	mg/L	38	NA	NA	NA	15	NA	NA	NA
Flouride	mg/L	0.16	NA	NA	NA	21	NA	NA	NA
Total Phosphorus	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
Total Suspended Solids	mg/L	20 U	NA	NA	NA	20 U	NA	NA	NA

Acronyms and Abbreviations:
CaCO3 = calcium carbonate
mg/L = milligrams per liter
NA = not analyzed
NR = not reported
PCBs - polychlorinated biphenyls
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Qualifiers:
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Table 4-4.
Summary of Non-Radiological Data for Groundwater

North Site and Well 98A Investigation Report
Nuclear Fuel Services, Inc.
Erwin, Tennessee

Analyte	Well ID: / Date: / Units	North Site Perimeter Wells							
		136A 1/9/2012		136A 9/7/2012		137A 1/9/2012		137A 9/6/2012	
		Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved
Metals									
Aluminum	mg/L	0.2 U	0.2 U	NA	NA	5.6	0.2 U	NA	NA
Antimony	mg/L	0.02 U	0.02 U	NA	NA	0.02 U	0.02 U	NA	NA
Arsenic	mg/L	0.01 U	0.01 U	NA	NA	0.01 U	0.01 U	NA	NA
Barium	mg/L	0.042 J	0.042 J	NA	NA	0.061 J	0.029 J	NA	NA
Beryllium	mg/L	0.005 U	0.005 U	NA	NA	0.00058 J	0.005 U	NA	NA
Cadmium	mg/L	0.005 U	0.005 U	NA	NA	0.005 U	0.005 U	NA	NA
Calcium	mg/L	6.8	7	NA	NA	1.9	1.7	NA	NA
Chromium	mg/L	0.01 U	0.01 U	NA	NA	0.017	0.01 U	NA	NA
Cobalt	mg/L	0.01 U	0.01 U	NA	NA	0.0062 J	0.0021 J	NA	NA
Copper	mg/L	0.01 U	0.01 U	NA	NA	0.016	0.01 U	NA	NA
Iron	mg/L	0.059 J	0.1 U	NA	NA	18	0.1 U	NA	NA
Lead	mg/L	0.003 U	0.003 U	NA	NA	0.0031	0.003 U	NA	NA
Magnesium	mg/L	3.6	3.7	NA	NA	2.7	1	NA	NA
Manganese	mg/L	0.088	0.076	NA	NA	0.18	0.063	NA	NA
Mercury	mg/L	0.0002 U	0.0002 U	NA	NA	0.0002 U	0.0002 U	NA	NA
Molybdenum	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
Nickel	mg/L	0.02 U	0.02 U	NA	NA	0.0094 J	0.02 U	NA	NA
Potassium	mg/L	2.8	2.8	NA	NA	3.3	2.1	NA	NA
Selenium	mg/L	0.005 U	0.005 U	NA	NA	0.005 U	0.005 U	NA	NA
Silver	mg/L	0.01 U	0.01 U	NA	NA	0.01 U	0.01 U	NA	NA
Sodium	mg/L	2.8	2.7	NA	NA	0.31 J	0.28 J	NA	NA
Thallium	mg/L	0.01 U	0.0054 J	NA	NA	0.01 U	0.01 U	NA	NA
Uranium	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
Vanadium	mg/L	0.01 U	0.01 U	NA	NA	0.023	0.01 U	NA	NA
Zinc	mg/L	0.0023 J	0.0011 J	NA	NA	0.028	0.02 U	NA	NA
Volatile Organic Compounds									
cis-1,2 -Dichloroethene	mg/L	0.001 U	NA	0.001 U	NA	0.001 U	NA	0.001 U	NA
Tetrachloroethene	mg/L	0.0021	NA	0.0014	NA	0.0007 J	NA	0.00076 J	NA
trans-1,2-Dichloroethene	mg/L	0.001 U	NA	0.001 U	NA	0.001 U	NA	0.001 U	NA
Trichloroethene	mg/L	0.001 U	NA	0.001 U	NA	0.001 U	NA	0.001 U	NA
Vinyl Chloride	mg/L	0.001 U	NA	0.001 U	NA	0.001 U	NA	0.001 U	NA
Inorganics									
Alkalinity (Total)	mg/L	18	NA	NA	NA	9.6	NA	NA	NA
Bicarbonate as CaCO3	mg/L	18	NA	NA	NA	9.6	NA	NA	NA
Carbonate as CaCO3	mg/L	5 U	NA	NA	NA	5 U	NA	NA	NA
pH	SU	NA	NA	NA	NA	NA	NA	NA	NA
TOC	mg/L	1 U	NA	1 U	NA	1 U	NA	1 U	NA
PCBs									
AROCLOR-1016	mg/L	0.00049 U	NA	0.00049 U	NA	0.0005 U	NA	0.00049 U	NA
AROCLOR-1221	mg/L	0.00049 U	NA	0.00049 U	NA	0.0005 U	NA	0.00049 U	NA
AROCLOR-1232	mg/L	0.00049 U	NA	0.00049 U	NA	0.0005 U	NA	0.00049 U	NA
AROCLOR-1242	mg/L	0.00049 U	NA	0.00049 U	NA	0.0005 U	NA	0.00049 U	NA
AROCLOR-1248	mg/L	0.00049 U	NA	0.00049 U	NA	0.0005 U	NA	0.00049 U	NA
AROCLOR-1254	mg/L	0.00049 U	NA	0.00049 U	NA	0.0005 U	NA	0.00049 U	NA
AROCLOR-1260	mg/L	0.00049 U	NA	0.00049 U	NA	0.0005 U	NA	0.00049 U	NA
Total PCB	mg/L	0.05 U	NA	NR	NA	0.05 U	NA	NR	NA
Other									
Sulfate	mg/L	1.2	NA	NA	NA	1 U	NA	NA	NA
Flouride	mg/L	0.1 U	NA	NA	NA	0.1 U	NA	NA	NA
Total Phosphorus	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
Total Suspended Solids	mg/L	20 U	NA	NA	NA	420	NA	NA	NA

Acronyms and Abbreviations:
CaCO3 = calcium carbonate
mg/L = milligrams per liter
NA = not analyzed
NR = not reported
PCBs - polychlorinated biphenyls
SU = standard units
TOC = total organic carbon

Qualifiers:
HJ = holding time exceeded, estimated
J = result is less than the Reporting Limit but greater than or equal to the Method Detection Limit
U = result was analyzed for but not detected

Table 4-4.
Summary of Non-Radiological Data for Groundwater

North Site and Well 98A Investigation Report
Nuclear Fuel Services, Inc.
Erwin, Tennessee

Analyte	Well ID: / Date: / Units	North Site Perimeter Wells							
		140A 8/27/2012		141A 8/27/2012		144A 8/31/2012		145A 9/6/2012	
		Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved
Metals									
Aluminum	mg/L	0.2 U	0.02 J	0.16 J	0.042 J	0.033 J	0.2 U	0.2 J	0.2 U
Antimony	mg/L	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U
Arsenic	mg/L	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
Barium	mg/L	0.15	0.15	0.1	0.095 J	0.076 J	0.071 J	0.051 J	0.049 J
Beryllium	mg/L	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U
Cadmium	mg/L	0.005 U	0.005 U	0.005 U	0.005 U	0.00044 J	0.005 U	0.005 U	0.005 U
Calcium	mg/L	60	60	85	84	46	44	23	23
Chromium	mg/L	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
Cobalt	mg/L	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
Copper	mg/L	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
Iron	mg/L	0.59	0.54	2.2 J	2	1 J	1	0.79 J	0.1 U
Lead	mg/L	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U
Magnesium	mg/L	13	12	29	28	14	13	12	11
Manganese	mg/L	4.3	4	1.2 J	1.3	0.72 J	0.72	0.17 J	0.17
Mercury	mg/L	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U
Molybdenum	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
Nickel	mg/L	0.02 U	0.02 U	0.02 U	0.02 U	0.0014 J	0.02 U	0.02 U	0.02 U
Potassium	mg/L	3.3	3.2	3.4	3.3	3.5	3.4	2.1	2
Selenium	mg/L	0.0065	0.005 U	0.003 J	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U
Silver	mg/L	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
Sodium	mg/L	2.1	2	3.4	3.2	2.1	2	1.6	1.5
Thallium	mg/L	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
Uranium	mg/L	0.0026 J	0.0026 J	0.0013 J	0.0014 J	0.0016 J	0.0018 J	0.00018 J	0.00017 J
Vanadium	mg/L	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.00056 J	0.01 U
Zinc	mg/L	0.02 U	0.02 U	0.02 U	0.02 U	0.0032 J	0.0034 J	0.02 U	0.02 U
Volatile Organic Compounds									
cis-1,2 -Dichloroethene	mg/L	0.001 U	NA	0.00091 J	NA	0.001 U	NA	0.001 U	NA
Tetrachloroethene	mg/L	0.002	NA	0.0011	NA	0.00054 J	NA	0.011	NA
trans-1,2-Dichloroethene	mg/L	0.001 U	NA	0.001 U	NA	0.001 U	NA	0.001 U	NA
Trichloroethene	mg/L	0.001 U	NA	0.00054 J	NA	0.001 U	NA	0.0021	NA
Vinyl Chloride	mg/L	0.001 U	NA	0.001 U	NA	0.001 U	NA	0.001 U	NA
Inorganics									
Alkalinity (Total)	mg/L	210	NA	320	NA	170	NA	92	NA
Bicarbonate as CaCO3	mg/L	210	NA	320	NA	170	NA	92	NA
Carbonate as CaCO3	mg/L	20 U	NA	20 U	NA	20 U	NA	10 U	NA
pH	SU	NA	NA	NA	NA	NA	NA	NA	NA
TOC	mg/L	1.6	NA	1.7	NA	1	NA	1 U	NA
PCBs									
AROCLOR-1016	mg/L	0.00049 U	NA	0.00049 U	NA	0.0005 U	NA	0.00049 U	NA
AROCLOR-1221	mg/L	0.00049 U	NA	0.00049 U	NA	0.0005 U	NA	0.00049 U	NA
AROCLOR-1232	mg/L	0.00049 U	NA	0.00049 U	NA	0.0005 U	NA	0.00049 U	NA
AROCLOR-1242	mg/L	0.00049 U	NA	0.00049 U	NA	0.0005 U	NA	0.00049 U	NA
AROCLOR-1248	mg/L	0.00049 U	NA	0.00049 U	NA	0.0005 U	NA	0.00049 U	NA
AROCLOR-1254	mg/L	0.00049 U	NA	0.00049 U	NA	0.0005 U	NA	0.00049 U	NA
AROCLOR-1260	mg/L	0.00049 U	NA	0.00049 U	NA	0.0005 U	NA	0.00049 U	NA
Total PCB	mg/L	NR	NA	NR	NA	NR	NA	NR	NA
Other									
Sulfate	mg/L	10	NA	11	NA	8	NA	11	NA
Flouride	mg/L	0.16	NA	0.15	NA	0.14 J	NA	0.23 J	NA
Total Phosphorus	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
Total Suspended Solids	mg/L	20 U	NA	20 U	NA	20 U	NA	20 U	NA

Acronyms and Abbreviations:
CaCO3 = calcium carbonate
mg/L = milligrams per liter
NA = not analyzed
NR = not reported
PCBs - polychlorinated biphenyls
SU = standard units
TOC = total organic carbon

Qualifiers:
HJ = holding time exceeded, estimated
J = result is less than the Reporting Limit but greater than or equal to the Method Detection Limit
U = result was analyzed for but not detected

Table 4-4.
Summary of Non-Radiological Data for Groundwater

North Site and Well 98A Investigation Report
Nuclear Fuel Services, Inc.
Erwin, Tennessee

Analyte	Well ID: / Date: / Units	North Site Perimeter Wells							
		146A 9/5/2012		147A 9/20/2012		148A 9/12/2012		150AW 9/20/2012	
		Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved
Metals									
Aluminum	mg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
Antimony	mg/L	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U
Arsenic	mg/L	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
Barium	mg/L	0.045 J	0.045 J	0.072 J	0.072 J	0.048 J	0.047 J	0.11	0.11
Beryllium	mg/L	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U
Cadmium	mg/L	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U
Calcium	mg/L	19	19	27	27	21	21	49	49
Chromium	mg/L	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
Cobalt	mg/L	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
Copper	mg/L	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
Iron	mg/L	0.041 J	0.1 U	0.018 J	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
Lead	mg/L	0.003 U	0.003 U	0.003 U	0.003 U	0.0015 J	0.003 U	0.003 U	0.003 U
Magnesium	mg/L	9.6	9.7	13	13	7.4	7.3	9.9	9.9
Manganese	mg/L	0.014 J	0.013	0.21	0.21	0.03 J	0.04	0.041 J	0.038
Mercury	mg/L	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U
Molybdenum	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
Nickel	mg/L	0.02 U	0.02 U	0.0013 J	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U
Potassium	mg/L	1.8	1.8	1.5	1.6	1.2	1.2	3.6	3.7
Selenium	mg/L	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U
Silver	mg/L	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
Sodium	mg/L	1.3	1.3	2.1	2.1	1.6	1.5	1.2	1.1
Thallium	mg/L	0.0037 J	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
Uranium	mg/L	0.00008 J	0.00009 J	NA	NA	0.00005 J	0.00004 J	0.00024 J	0.0002 J
Vanadium	mg/L	0.0008 J	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
Zinc	mg/L	0.0016 J	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U
Volatile Organic Compounds									
cis-1,2 -Dichloroethene	mg/L	0.001 U	NA	0.001 U	NA	0.001 U	NA	0.001 U	NA
Tetrachloroethene	mg/L	0.016	NA	0.0056	NA	0.001 U	NA	0.0012	NA
trans-1,2-Dichloroethene	mg/L	0.001 U	NA	0.001 U	NA	0.001 U	NA	0.001 U	NA
Trichloroethene	mg/L	0.001 U	NA	0.001 U	NA	0.001 U	NA	0.001 U	NA
Vinyl Chloride	mg/L	0.001 U	NA	0.001 U	NA	0.001 U	NA	0.001 U	NA
Inorganics									
Alkalinity (Total)	mg/L	80	NA	120	NA	88	NA	120	NA
Bicarbonate as CaCO3 -	mg/L	80	NA	120	NA	88	NA	120	NA
Carbonate as CaCO3	mg/L	10 U	NA	20 U	NA	20 U	NA	20 U	NA
pH	SU	NA	NA	NA	NA	NA	NA	NA	NA
TOC	mg/L	1 U	NA	1 U	NA	1 U	NA	1 U	NA
PCBs									
AROCLOR-1016	mg/L	0.00054 U	NA	0.00049 U	NA	0.00053 U	NA	0.00048 U	NA
AROCLOR-1221	mg/L	0.00054 U	NA	0.00049 U	NA	0.00053 U	NA	0.00048 U	NA
AROCLOR-1232	mg/L	0.00054 U	NA	0.00049 U	NA	0.00053 U	NA	0.00048 U	NA
AROCLOR-1242	mg/L	0.00054 U	NA	0.00049 U	NA	0.00053 U	NA	0.00048 U	NA
AROCLOR-1248	mg/L	0.00054 U	NA	0.00049 U	NA	0.00053 U	NA	0.00048 U	NA
AROCLOR-1254	mg/L	0.00054 U	NA	0.00049 U	NA	0.00053 U	NA	0.00048 U	NA
AROCLOR-1260	mg/L	0.00054 U	NA	0.00049 U	NA	0.00053 U	NA	0.00048 U	NA
Total PCB	mg/L	NR	NA	NR	NA	NR	NA	NR	NA
Other									
Sulfate	mg/L	7.2	NA	7	NA	6	NA	13	NA
Flouride	mg/L	0.18 J	NA	0.15 J	NA	0.2 J	NA	0.13 J	NA
Total Phosphorus	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
Total Suspended Solids	mg/L	20 U	NA	20 U	NA	20 U	NA	20 U	NA

Acronyms and Abbreviations:
CaCO3 = calcium carbonate
mg/L = milligrams per liter
NA = not analyzed
NR = not reported
PCBs - polychlorinated biphenyls
SU = standard units
TOC = total organic carbon

Qualifiers:
HJ = holding time exceeded, estimated
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U = result was analyzed for but not detected

Table 4-4.
Summary of Non-Radiological Data for Groundwater

North Site and Well 98A Investigation Report
Nuclear Fuel Services, Inc.
Erwin, Tennessee

Analyte	Well ID: / Date: / Units	98A Investigation Wells							
		138A 8/27/2012		139A 8/27/2012		142A 8/30/2012		143A 8/30/2012	
		Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved
Metals									
Aluminum	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
Antimony	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
Arsenic	mg/L	0.00037 J	0.00017 J	0.0021 J	0.0017 J	0.002 U	0.0002 J	0.00023 J	0.002 U
Barium	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
Beryllium	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
Cadmium	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
Calcium	mg/L	44	43 U	67	64 U	48	47 U	45	45 U
Chromium	mg/L	0.0023 J	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.00039 J	0.01 U
Cobalt	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
Copper	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
Iron	mg/L	2 U	0.86 U	11 U	9.5 U	0.340	0.200	0.600	0.240
Lead	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
Magnesium	mg/L	19	18	23	22	15	14	16	16
Manganese	mg/L	0.53 U	0.52 U	1.1 U	0.93 U	0.54 U	0.57 U	0.46 U	0.39 U
Mercury	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
Molybdenum	mg/L	0.0016	0.002	0.0023	0.002	0.00091 J	0.00081 J	0.0049	0.0046
Nickel	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
Potassium	mg/L	3.8	3.6	4.4	4.2	3.1	3	7.2	6.1
Selenium	mg/L	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Silver	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
Sodium	mg/L	4.1	3.9	7.4	6.7	6	6.1	6.4	5.5
Thallium	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
Uranium	mg/L	0.00044	0.00032	0.0013	0.0013	0.00051	0.0005	0.00035	0.00032
Vanadium	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
Zinc	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
Volatile Organic Compounds									
cis-1,2 -Dichloroethene	mg/L	0.001 U	NA	0.00049 J	NA	0.0009 J	NA	0.001 U	NA
Tetrachloroethene	mg/L	0.00064 J	NA	0.00082 J	NA	0.00076 J	NA	0.00041 J	NA
trans-1,2-Dichloroethene	mg/L	0.001 U	NA	0.001 U	NA	0.001 U	NA	0.001 U	NA
Trichloroethene	mg/L	0.001 U	NA	0.00034 J	NA	0.00055 J	NA	0.001 U	NA
Vinyl Chloride	mg/L	0.001 U	NA	0.001 U	NA	0.001 U	NA	0.001 U	NA
Inorganics									
Alkalinity (Total)	mg/L	180	NA	290	NA	170	NA	180	NA
Bicarbonate as CaCO3	mg/L	180	NA	290	NA	170	NA	180	NA
Carbonate as CaCO3	mg/L	20 U	NA	20 U	NA	20 U	NA	20 U	NA
pH	SU	7.17 U	NA	7.19 U	NA	7.23 HJ	NA	7.45 HJ	NA
TOC	mg/L	1 U	NA	1.7	NA	1 U	NA	1 U	NA
PCBs									
AROCLOR-1016	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
AROCLOR-1221	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
AROCLOR-1232	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
AROCLOR-1242	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
AROCLOR-1248	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
AROCLOR-1254	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
AROCLOR-1260	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
Total PCB	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
Other									
Sulfate	mg/L	19	NA	9.9	NA	24	NA	16	NA
Flouride	mg/L	0.15 U	NA	0.28	NA	0.16 U	NA	0.18	NA
Total Phosphorus	mg/L	0.016 J	NA	0.022 J	NA	0.018 J	NA	0.019 J	NA
Total Suspended Solids	mg/L	21	NA	20 U	NA	20 U	NA	20 U	NA

Acronyms and Abbreviations:
CaCO3 = calcium carbonate
mg/L = milligrams per liter
NA = not analyzed
NR = not reported
PCBs - polychlorinated biphenyls
SU = standard units
TOC = total organic carbon

Qualifiers:
HJ = holding time exceeded, estimated
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Table 4-4.
Summary of Non-Radiological Data for Groundwater

North Site and Well 98A Investigation Report
Nuclear Fuel Services, Inc.
Erwin, Tennessee

Analyte	Well ID: / Date: / Units	98A Investigation Wells							
		149A 9/18/2012		151A 9/19/2012		152A 9/18/2012		153A 9/18/2012	
		Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved
Metals									
Aluminum	mg/L	0.140	0.05 U	0.960	0.055	0.057	0.05 U	0.094	0.05 U
Antimony	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
Arsenic	mg/L	0.00033 J	0.00017 J	0.0012 J	0.00079 J	0.0032 J	0.0023 J	0.002 J	0.0024 J
Barium	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
Beryllium	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
Cadmium	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
Calcium	mg/L	43	42	44	42	75	65	78	80
Chromium	mg/L	0.01 U	0.01 U	0.0023 J	0.00037 J	0.01 U	0.01 U	0.01 U	0.01 U
Cobalt	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
Copper	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
Iron	mg/L	0.40	0.19	1.6	0.46	3.5	2	14	14
Lead	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
Magnesium	mg/L	17	16	11	12	18	15	24	24
Manganese	mg/L	0.63	0.55	1.5	1.3	0.8	0.59	2.2	2.3
Mercury	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
Molybdenum	mg/L	0.0014 U	0.001 U	0.01	0.0077	0.006	0.0057	0.0062	0.0062
Nickel	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
Potassium	mg/L	3.2	3	30	18	23	24	4.9	5.1
Selenium	mg/L	0.001 U	0.001 U	0.00038 J	0.001 U	0.0013 J	0.0011 J	0.001 U	0.001 U
Silver	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
Sodium	mg/L	3.4	3.2	6.6	5.1	20	17	3.3	3.3
Thallium	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
Uranium	mg/L	0.00048	0.00037	0.0007	0.00051	0.0091	0.0073	0.0019	0.002
Vanadium	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
Zinc	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
Volatile Organic Compounds									
cis-1,2 -Dichloroethene	mg/L	0.001 U	NA	0.00082 J	NA	0.001 U	NA	0.001 U	NA
Tetrachloroethene	mg/L	0.00062 J	NA	0.00079 J	NA	0.001 U	NA	0.00021 J	NA
trans-1,2-Dichloroethene	mg/L	0.001 U	NA	0.001 U	NA	0.001 U	NA	0.001 U	NA
Trichloroethene	mg/L	0.00031 J	NA	0.00054 J	NA	0.001 U	NA	0.001 U	NA
Vinyl Chloride	mg/L	0.001 U	NA	0.001 U	NA	0.001 U	NA	0.001 U	NA
Inorganics									
Alkalinity (Total)	mg/L	180	NA	180	NA	290	NA	330	NA
Bicarbonate as CaCO3	mg/L	180	NA	170	NA	290	NA	330	NA
Carbonate as CaCO3	mg/L	20 U	NA	20 U	NA	20 U	NA	20 U	NA
pH	SU	7.45 U	NA	8.76 U	NA	7.17	NA	7.33 U	NA
TOC	mg/L	1 U	NA	5.7	NA	2.9	NA	3.3	NA
PCBs									
AROCLOR-1016	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
AROCLOR-1221	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
AROCLOR-1232	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
AROCLOR-1242	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
AROCLOR-1248	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
AROCLOR-1254	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
AROCLOR-1260	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
Total PCB	mg/L	NA	NA	NA	NA	NA	NA	NA	NA
Other									
Sulfate	mg/L	15	NA	28	NA	34	NA	9.1	NA
Flouride	mg/L	0.1 U	NA	0.58	NA	0.21	NA	0.26	NA
Total Phosphorus	mg/L	0.03 J	NA	0.18	NA	0.036 J	NA	0.036 J	NA
Total Suspended Solids	mg/L	20 U	NA	20 U	NA	20 U	NA	25	NA

Acronyms and Abbreviations:
CaCO3 = calcium carbonate
mg/L = milligrams per liter
NA = not analyzed
NR = not reported
PCBs - polychlorinated biphenyls
SU = standard units
TOC = total organic carbon

Qualifiers:
HJ = holding time exceeded, estimated
J = result is less than the Reporting Limit but greater than or equal to the Method Detection Limit
U = result was analyzed for but not detected

Table 4-4.
Summary of Non-Radiological Data for Groundwater

North Site and Well 98A Investigation Report
Nuclear Fuel Services, Inc.
Erwin, Tennessee

Analyte	Well ID: / Date: / Units	98A Investigation Wells			
		154A 9/19/2012		155A 9/19/2012	
		Total	Dissolved	Total	Dissolved
Metals					
Aluminum	mg/L	0.11 U	0.05 U	0.26	0.05 U
Antimony	mg/L	NA	NA	NA	NA
Arsenic	mg/L	0.0014 J	0.00093 J	0.00041 J	0.00026 J
Barium	mg/L	NA	NA	NA	NA
Beryllium	mg/L	NA	NA	NA	NA
Cadmium	mg/L	NA	NA	NA	NA
Calcium	mg/L	45	45	55	56
Chromium	mg/L	0.00061 J	0.01 U	0.0022 J	0.00069 J
Cobalt	mg/L	NA	NA	NA	NA
Copper	mg/L	NA	NA	NA	NA
Iron	mg/L	2.6	1.9	3.8	3.5
Lead	mg/L	NA	NA	NA	NA
Magnesium	mg/L	17	17	20	20
Manganese	mg/L	1	0.99	0.11	0.12
Mercury	mg/L	NA	NA	NA	NA
Molybdenum	mg/L	0.0017	0.0017	0.0066	0.0073
Nickel	mg/L	NA	NA	NA	NA
Potassium	mg/L	13	10	5.6	5.7
Selenium	mg/L	0.001 U	0.001 U	0.001 U	0.001 U
Silver	mg/L	NA	NA	NA	NA
Sodium	mg/L	4.8	4.2	3.8	3.9
Thallium	mg/L	NA	NA	NA	NA
Uranium	mg/L	0.00036	0.00041	0.00027	0.0003
Vanadium	mg/L	NA	NA	NA	NA
Zinc	mg/L	NA	NA	NA	NA
Volatile Organic Compounds					
cis-1,2 -Dichloroethene	mg/L	0.001 U	NA	0.001 U	NA
Tetrachloroethene	mg/L	0.00028 J	NA	0.00047 J	NA
trans-1,2-Dichloroethene	mg/L	0.001 U	NA	0.001 U	NA
Trichloroethene	mg/L	0.001 U	NA	0.001 U	NA
Vinyl Chloride	mg/L	0.001 U	NA	0.001 U	NA
Inorganics					
Alkalinity (Total)	mg/L	200	NA	220	NA
Bicarbonate as CaCO3	mg/L	200	NA	220	NA
Carbonate as CaCO3	mg/L	20 U	NA	20 U	NA
pH	SU	7.35 U	NA	7.62 U	NA
TOC	mg/L	1.6	NA	2.9	NA
PCBs					
AROCLOR-1016	mg/L	NA	NA	NA	NA
AROCLOR-1221	mg/L	NA	NA	NA	NA
AROCLOR-1232	mg/L	NA	NA	NA	NA
AROCLOR-1242	mg/L	NA	NA	NA	NA
AROCLOR-1248	mg/L	NA	NA	NA	NA
AROCLOR-1254	mg/L	NA	NA	NA	NA
AROCLOR-1260	mg/L	NA	NA	NA	NA
Total PCB	mg/L	NA	NA	NA	NA
Other					
Sulfate	mg/L	17	NA	15	NA
Flouride	mg/L	0.17	NA	0.13 U	NA
Total Phosphorus	mg/L	0.035 J	NA	0.047 J	NA
Total Suspended Solids	mg/L	20 U	NA	20 U	NA

Acronyms and Abbreviations:
CaCO3 = calcium carbonate
mg/L = milligrams per liter
NA = not analyzed
NR = not reported
PCBs - polychlorinated biphenyls
SU = standard units
TOC = total organic carbon

Qualifiers:
HJ = holding time exceeded, estimated
J = result is less than the Reporting Limit but greater than or equal to the Method Detection Limit
U = result was analyzed for but not detected

Table 4-5.
Summary of Uranium SPLP Leachate Results

North Site and 98A Investigation Report
Nuclear Fuel Services, Inc.
Erwin, Tennessee

Well ID	Sample Date	North Site Perimeter Wells						Uranium Mass Activity (pCi/L)	Uranium Mass Concentration[a] (mg/L)
		Uranium-233/234 (pCi/L)	(µg/L)	Uranium-235/236 (pCi/L)	(µg/L)	Uranium-238 (pCi/L)	(µg/L)		
140A (0-1)	8/22/12	0.149	0.000024	0.031 U	0.014	0.104	0.31	0.28	0.00032
140A (4-5)	8/22/12	0.071	0.000011	-0.004 U	-0.0019	0.032 U	0.095	0.099	0.000093
141A (0-1)	8/23/12	0.008 U	0.0000013	0.014 U	0.0065	0.007 U	0.021	0.029	0.000027
141A (3-4)	8/23/12	0.043 U	0.0000069	0.013 U	0.006	0.01 U	0.03	0.066	0.000036
144A (0-1)	8/28/12	4.95	0.0008	0.21	0.097	0.65	1.935	5.81	0.002
145A (0-1)	8/29/12	0.03 U	0.0000048	0.001 U	0.00046	0.003 U	0.0089	0.034	0.0000094
145A (9-10)	8/29/12	0.018 U	0.0000029	-0.001 U	-0.00046	-0.012 U	-0.036	0.005	-0.000036
146A (0-1)	8/31/12	0.052 U	0.0000084	0.007 U	0.0032	0.004 U	0.012	0.063	0.000015
146A (4-5)	8/31/12	0.177	0.000029	0.011 U	0.0051	0.102	0.3	0.29	0.00031
147A (0-1)	9/5/12	0.018 U	0.0000029	0.019 U	0.0088	0 U	0	0.037	0.0000088
147A (9-10)	9/5/12	0.001 U	0.00000016	0.015 U	0.0069	0.007 U	0.021	0.023	0.000028
148A (0-1)	9/5/12	0.018 U	0.0000029	-0.016 U	-0.0074	0.003 U	0.0089	0.005	0.0000015
148A (9-10)	9/5/12	0.044 U	0.0000071	0.005 U	0.0023	0.003 U	0.0089	0.052	0.000011
149A (11-16)	9/12/12	0.115	0.000019	0.009 U	0.0042	0.046 U	0.14	0.17	0.00014
150AW (0-1)	9/7/12	0.053	0.0000085	0.018 U	0.0083	0.023 J	0.068	0.094	0.000077
150AW (4-5)	9/7/12	0.24	0.000039	-0.001 U	-0.00046	0.153	0.46	0.39	0.00045
152A (7-12)	9/12/12	0.146	0.000024	0.026 U	0.012	0.019 U	0.057	0.19	0.000069
155A (11-16)	9/12/12	0.038 U	0.0000061	-0.035 U	-0.016	-0.001 U	-0.003	0.002	-0.000019

Footnotes:

[a] = Mass concentration calculated using specific activity of each isotope and summing concentrations. Uranium 233/234 activity is 6210, Uranium-235/236 is 2.16, and Uranium-238 is 0.336.

Acronyms and Abbreviations:
µg/L = micrograms per liter
mg/g = milligrams per gram
mg/L = milligrams per liter
NR = not reported by lab
NS = not sampled
pCi/L = picocuries per liter
SPLP = Synthetic Precipitation Leaching Procedure

Qualifiers:
U = result is not detected

Table 4-6.
Summary of Total and Dissolved Uranium Concentrations in Groundwater

North Site and 98A Investigation Report
Nuclear Fuel Services, Inc.
Erwin, Tennessee

		Uranium 233/234				Uranium 235/236				Uranium 238				Uranium Mass Activity		Uranium Mass Concentration [a]	
Well ID	Sample Date	Dissolved (pCi/L)	Total (pCi/L)	Dissolved (µg/L)	Total (µg/L)	Dissolved (pCi/L)	Total (pCi/L)	Dissolved (µg/L)	Total (µg/L)	Dissolved (pCi/L)	Total (pCi/L)	Dissolved (µg/L)	Total (µg/L)	Dissolved (pCi/L)	Total (pCi/L)	Dissolved (mg/L)	Total (mg/L)
North Site Perimeter																	
132A	9/7/2012	2.52	3.05	0.00041	0.00049	0.176	0.126	0.081	0.058	1.57	1.67	4.67	4.97	4.27	4.85	0.0048	0.005
133A	8/28/2012	6.7	8.7	0.0011	0.0014	0.21	0.35	0.097	0.16	1.22	1.64	3.63	4.88	8.13	10.69	0.0037	0.005
134A	8/28/2012	4.73	5.6	0.00076	0.0009	0.23	0.27	0.11	0.13	0.74	0.94	2.2	2.8	5.7	6.81	0.0023	0.0029
135A	8/28/2012	11.1	10.8	0.0018	0.0017	0.5	0.51	0.23	0.24	2.8	2.88	8.33	8.57	14.4	14.19	0.0086	0.0088
136A	9/7/2012	0.003 U	0.049 U	0.00000048	0.0000079	-0.015 U	0.005 U	-0.0069	0.0023	0.006 U	0.009 U	0.018	0.027	-0.006	0.063	0.000011	0.000029
137A	9/6/2012	0.008 U	0.046	0.0000013	0.0000074	-0.011 U	0.007 U	-0.0051	0.0032	0.001 U	0.028	0.003	0.083	-0.002	0.081	-0.0000021	0.000087
140A	8/27/2012	0.98	1.39	0.00016	0.00022	0.054	0.028 U	0.025	0.013	0.87	0.45	2.59	1.34	1.9	1.87	0.0026	0.0014
141A	8/27/2012	0.98	1.36	0.00016	0.00022	0.036 U	0.081	0.017	0.038	0.99	0.51	2.95	1.52	2.006	1.95	0.003	0.0016
144A	8/31/2012	14.3	12.3	0.0023	0.002	0.49	0.57	0.23	0.26	0.69	0.51	2.054	1.52	15.48	13.38	0.0023	0.0018
145A	9/6/2012	0.184	0.157	0.00003	0.000025	-0.005 U	0.01 U	-0.0023	0.0046	0.034 U	0.077 U	0.1	0.23	0.21	0.24	0.0001	0.00023
146A	9/5/2012	0.099	0.127	0.000016	0.00002	0.041	0.007 U	0.019	0.0032	0.029 U	0.033	0.086	0.098	0.17	0.17	0.00011	0.0001
147A	9/20/2012	0.142	0.16	0.000023	0.000026	0.006 U	0.01 U	0.003	0.005	0.052 U	0.054 U	0.155	0.161	0.20	0.22	0.000	0.000
148A	9/12/2012	0.051 U	0.09	0.0000082	0.000014	0.005 U	0.017 U	0.0023	0.0079	0.008 U	0.021 U	0.024	0.063	0.064	0.13	0.000026	0.00007
150AW	9/17/2012	0.36	0.29	0.000058	0.000047	0.002 U	-0.003 U	0.001	-0.001	0.102	0.096	0.304	0.286	0.46	0.38	0.000	0.000
98A Investigation																	
138A	8/27/2012	0.7	0.86	0.00011	0.00014	0.008 U	0.074 U	0.0037	0.034	0.061 U	0.17	0.18	0.51	0.77	1.1	0.00019	0.00054
139A	8/27/2012	5.3	7.8	0.00085	0.0013	0.18	0.22	0.083	0.1	0.32	0.31	0.95	0.92	5.8	8.33	0.001	0.001
142A	8/30/2012	1.42	1.72	0.00023	0.00028	0.093	0.109	0.043	0.05	0.167	0.24	0.5	0.71	1.68	2.069	0.00054	0.00077
143A	8/30/2012	0.45	0.86	0.000072	0.00014	0.021 U	0.081 U	0.01	0.038	0.146	0.107	0.43	0.32	0.62	1.048	0.00044	0.00036
149A	9/18/2012	0.8	0.79	0.00013	0.00013	0.059 U	0.06	0.027	0.028	0.219	0.202	0.65	0.6	1.078	1.052	0.00068	0.00063
151A	9/19/2012	0.69	0.97	0.00011	0.00016	0.037	0.052 U	0.017	0.024	0.186	0.131	0.55	0.39	0.91	1.15	0.00057	0.00041
152A	9/18/2012	28.7	34.5	0.0046	0.0056	0.97	1.2	0.45	0.56	2.84	3.23	8.45	9.61	32.51	38.93	0.0089	0.01
153A	9/18/2012	13.1	11.8	0.0021	0.0019	0.44	0.45	0.2	0.21	0.76	0.64	2.26	1.9	14.3	12.89	0.0025	0.0021
154A	9/19/2012	0.67	0.68	0.00011	0.00011	-0.009 U	-0.001 U	-0.0042	-0.00046	0.129	0.153	0.38	0.46	0.79	0.83	0.00038	0.00046
155A	9/19/2012	0.26	0.29	0.000042	0.000047	0.014 U	0.027 U	0.0065	0.013	0.077 U	0.184	0.23	0.55	0.35	0.5	0.00024	0.00056

General Notes:
Conversion from pCi/L to µg/L carried to 1000ths (0.000).
Bold - indicates concentration above new Maximum Contaminant Level for uranium of 0.030 mg/L as of 12/8/03 (USEPA 2002).

Qualifiers:
U = result is not detected

Footnotes:
[a] = Mass concentration calculated using specific activity of each isotope and summing concentrations. Uranium 233/234 activity is 6210, Uranium-235/236 is 2.16, and Uranium-238 is 0.336.

Acronyms and Abbreviations:
µg/L - micrograms per liter
mg/L - milligrams per liter
pCi/L - picocuries per liter

LEGEND

- 98A Investigation 2" Well
- 98A Investigation 4" Well
- Monitoring Well
- North Site Perimeter Well
- Sanitary Sewer
- Storm Sewer
- Water

Aerial Image: ArcGIS online Bing Maps Aerial; Accessed October 2012.
Projection: NAD 1983 State Plane Tennessee FIPS 4100 Feet
Utility Survey Data from Glenn Allen Shellnut Land Surveyor, 2012.

NUCLEAR FUEL SERVICES
ERWIN, TENNESSEE

NORTH SITE AND WELL 98A INVESTIGATION REPORT

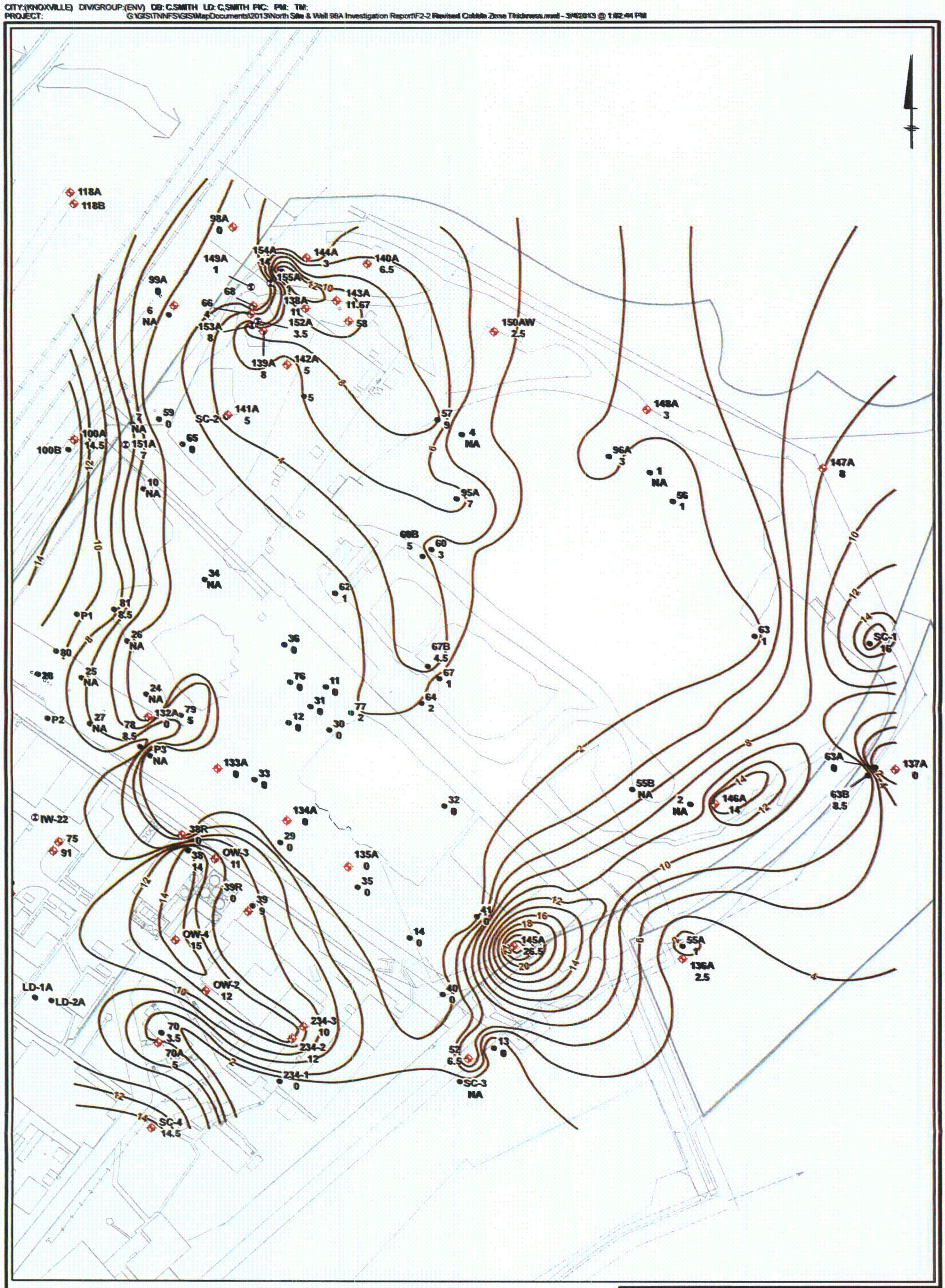
Aerial

ARCADIS

FIGURE
2-1

CITY: (KNOXVILLE) DIV/GROUP:(ENV) DB:(C.SMITH) LD:(C.SMITH) PIC:(B.ILGNER) PM:(P.PRESTON) TM:(B.BAILEY)
PROJECT: TNNFS111.WINS.00001 PATH: G:\GIS\TNNFS\GIS\MapDocuments\2013\North Site & Well 98A Investigation Report\F2-1 Aerial.mxd 3/4/2013 1:01:52 PM

CITY:(KNOXVILLE) DIV/GROUP:(ENV) DB: C.SMITH LD: C.SMITH PIC: PM: TM:
PROJECT: G:\GIS\TNNFS\GIS\MapDocuments\2013\North Site & Well 98A Investigation Report\F2-2 Revised Cobble Zone Thickness.mxd - 3/4/2013 @ 1:02:44 PM



Legend

- Abandoned Well
- Monitor Well
- Injection Well
- North Site Cobble Zone Contour

NA - Not Available

NOTE: Contours generated using Surfer program, with revisions.

0 120 240

SCALE IN FEET

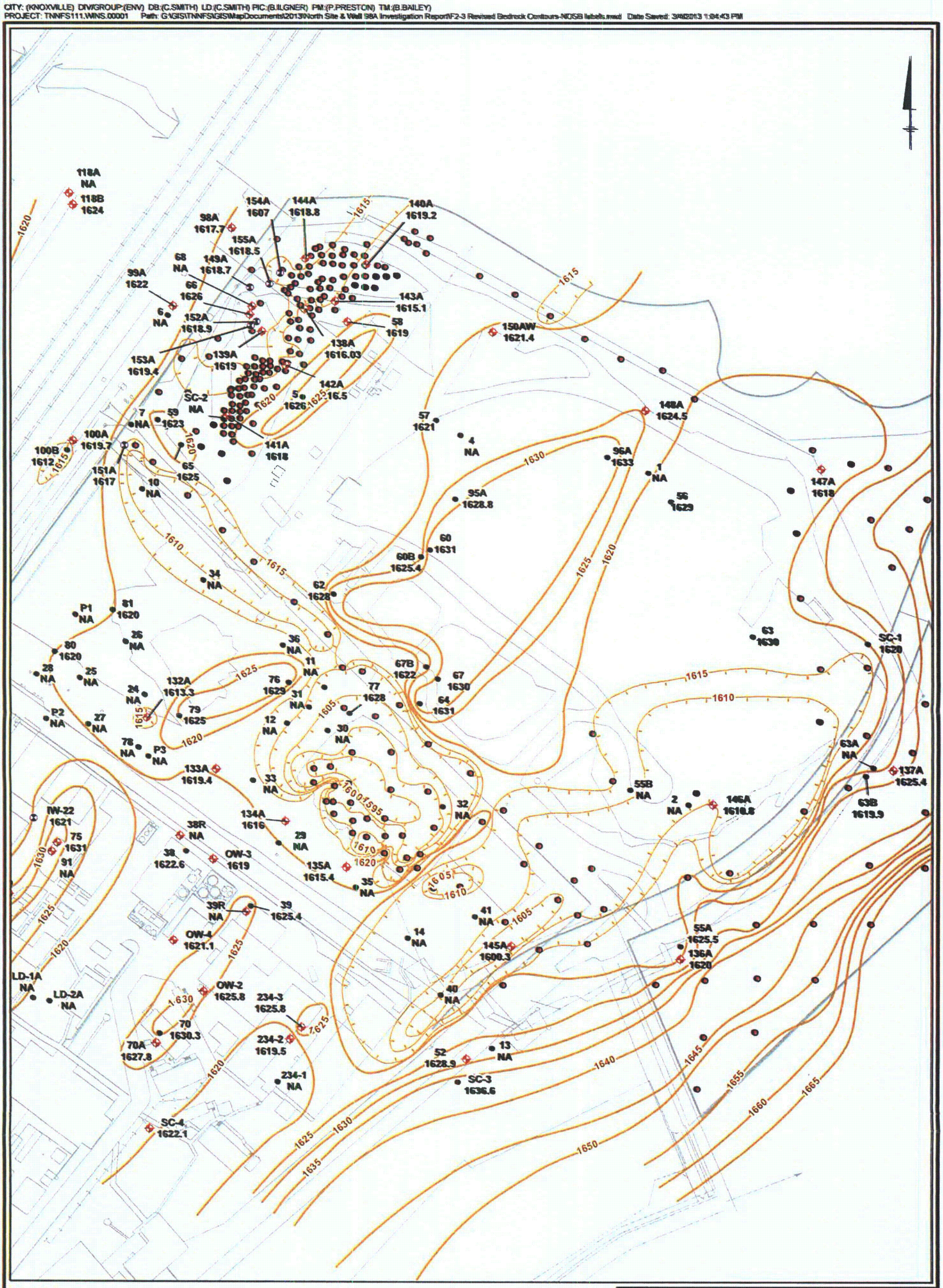
NUCLEAR FUEL SERVICES
ERWIN, TENNESSEE
NORTH SITE AND WELL 98A INVESTIGATION REPORT

General Cobble Zone Isopach

ARCADIS

FIGURE
2-2

CITY: (KNOXVILLE) DIV/GROUP:(ENV) DB:(C.SMITH) LD:(C.SMITH) PIC:(B.ILGNER) PM:(P.PRESTON) TM:(B.BAILEY)
PROJECT: TNNFS111.WINS.00001 Path: G:\GIS\TNNFS\GIS\MapDocuments\2013\North Site & Well 98A Investigation Report\F2-3 Revised Bedrock Contours-NOSB labels.mxd Date Saved: 3/4/2013 1:04:43 PM



Legend

- Abandoned Well
- Monitor Well
- Injection Well
- Soil Boring
- Bedrock Contour
- Depression

0 120 240
SCALE IN FEET

Projection: NAD 1983 State Plane Tennessee FIPS 4100 Feet

NUCLEAR FUEL SERVICES
ERWIN, TENNESSEE
North Site and Well 98A Investigation Report

Revised Bedrock Contours

ARCADIS

FIGURE
2-3

CITY: (KNOXVILLE) DIV/GROUP:(ENV) DB:(C.SMITH) LD:(C.SMITH) PIC:(B.ILLGNER) PM:(P.PRESTON) TM:(B.BAILEY)
PROJECT: TNNFS111.WINS.00001 PATH: G:\GIS\TNNFS\GIS\MapDocuments\2013\North Site & Well 98A Investigation Report\F2-4 Potentiometric Contours.mxd 3/4/2013 1:06:46 PM

LEGEND

- 98A Investigation 2" Well
- 98A Investigation 4" Well
- Monitoring Well
- North Site Perimeter Well
- Groundwater Potentiometric Contour (ft-anvd)
- Sanitary Sewer
- Storm Sewer
- Water

Aerial Image: ArcGIS online Bing Maps Aerial: Accessed July 2012.
Projection: NAD 1983 State Plane Tennessee FIPS 4100 Feet
Utility Survey Data from Glenn Allen Shellnut Land Surveyor, 2011.

NOTE:
1) Groundwater depth to water collected on September 20, 2012.
2) ft-anvd = feet above National Vertical Datum (North American 1988).
3) NM = not measured

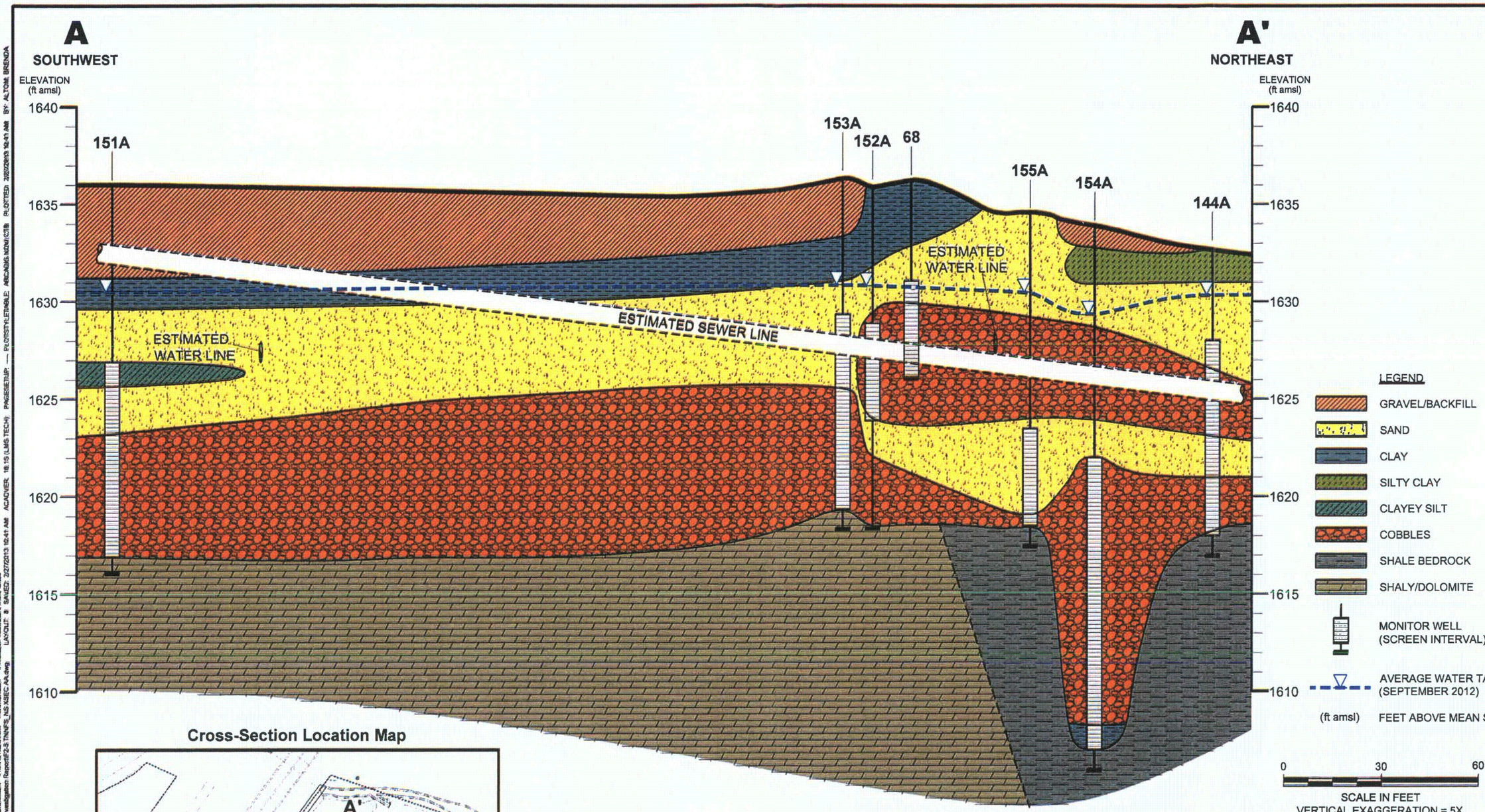
NUCLEAR FUEL SERVICES
ERWIN, TENNESSEE

NORTH SITE AND WELL 98A INVESTIGATION REPORT

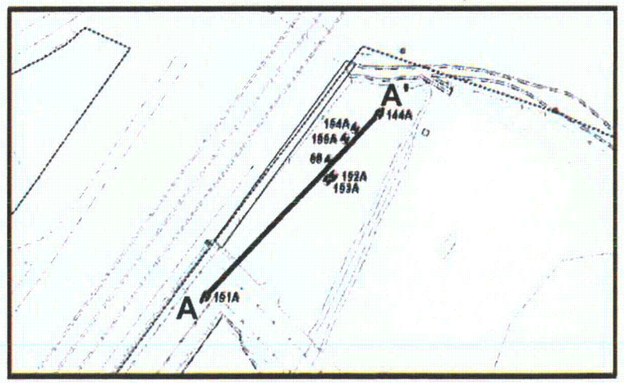
Potentiometric Contours

ARCADIS

FIGURE
2-4



Cross-Section Location Map

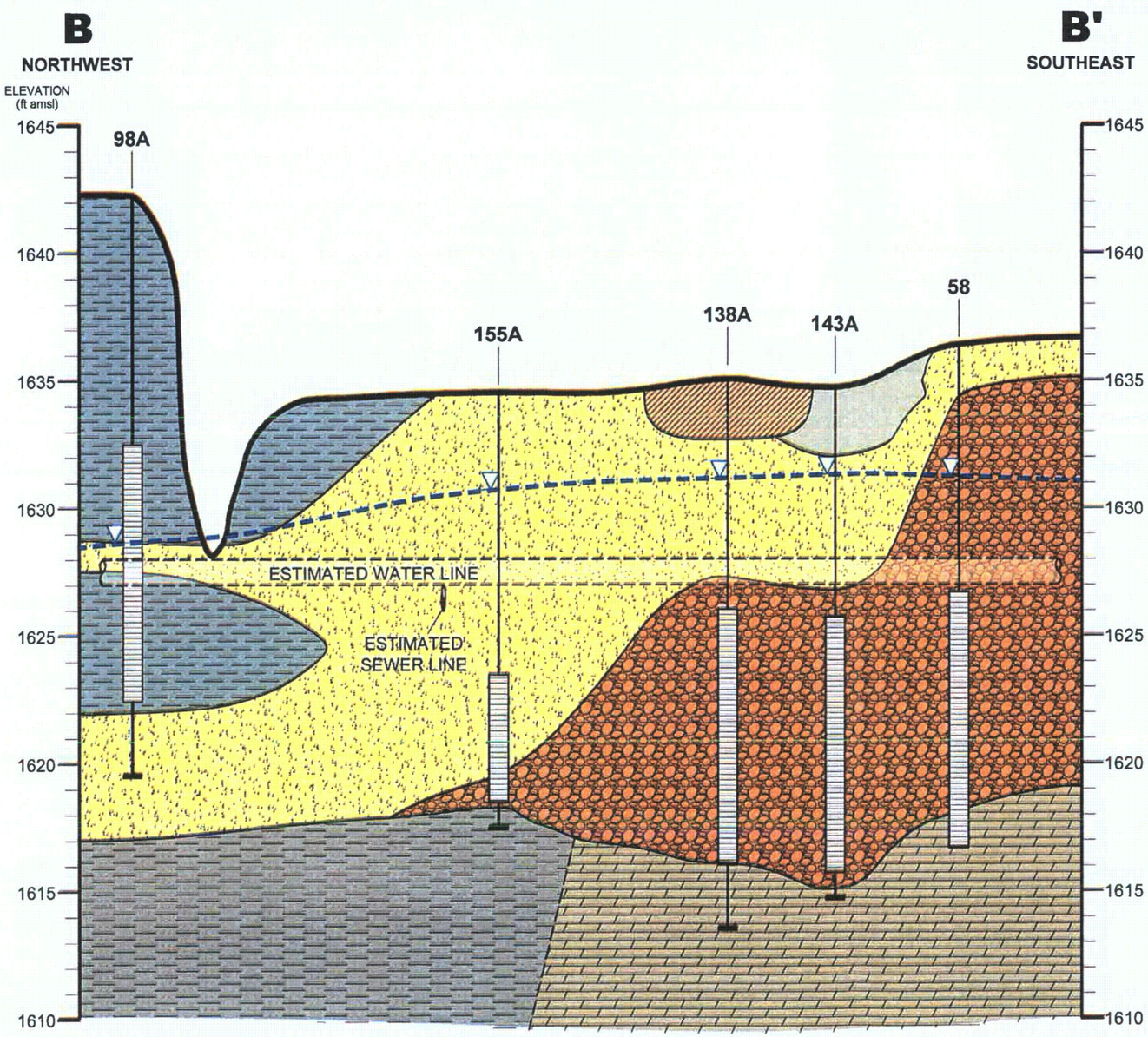


NUCLEAR FUEL SERVICES
ERWIN, TENNESSEE
NORTH SITE AND WELL 98A INVESTIGATION REPORT

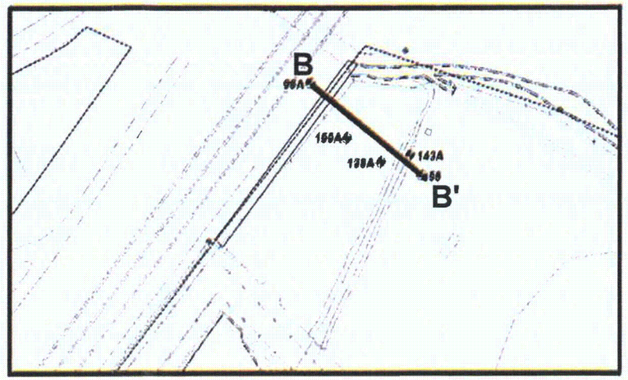
Geologic Cross-Section A-A'

ARCADIS

FIGURE
2-5



Cross-Section Location Map



LEGEND

- GRAVEL/BACKFILL
- SAND
- CLAY
- SILTY CLAY
- CLAYEY SILT
- COBBLES
- SHALE BEDROCK
- SHALY/DOLOMITE
- MONITOR WELL (SCREEN INTERVAL)
- AVERAGE WATER TABLE (SEPTEMBER 2012)
- (ft amsl) FEET ABOVE MEAN SEA LEVEL

0 30 60

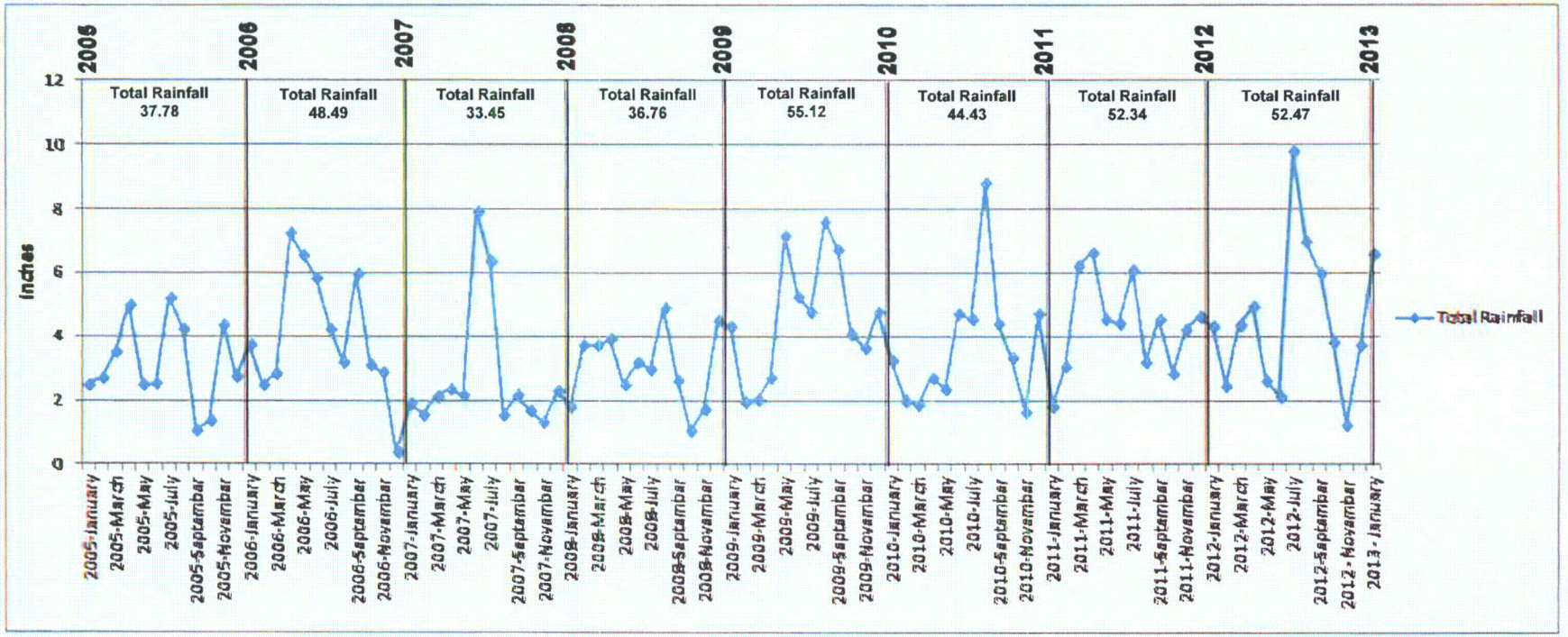
SCALE IN FEET
VERTICAL EXAGGERATION = 5X

NUCLEAR FUEL SERVICES
ERWIN, TENNESSEE
NORTH SITE AND WELL 98A INVESTIGATION REPORT

Geologic Cross-Section B-B'

ARCADIS

FIGURE
2-6



Notes:
Reference: The Weather Warehouse -
http://weather-warehouse.com/WxHubA/WxSAM12440565453_216.207.98.101/1_Erwin_1_W.html
Station Details for Erwin 1W (Unicoi County) Zip Code: 37650
Latitude: 36.1422 Longitude: -82.4261 Elevation: 524.256m (1719.995 ft)
September 2012 data gathered from the National Weather Service Monthly Climate Data (Tri-Cities Station). The Weather Warehouse had no data for 9/5/2012-9/30/2012.

NUCLEAR FUEL SERVICES
ERWIN, TENNESSEE

NORTH SITE AND WELL 98A INVESTIGATION REPORT

Rainfall Totals

ARCADIS

Figure
2-7

LEGEND

- 98A Investigation Well 2"
- 98A Investigation Well 4"
- Monitoring Well
- North Site Perimeter Well
- -s- Sanitary Sewer
- -s- Storm Sewer
- -w- Water

Aerial Image: ArcGIS online Bing Maps Aerial: Accessed October 2012.
Projection: NAD 1983 State Plane Tennessee FIPS 4100 Feet
Utility Survey Data from Glenn Allen Shellnut Land Surveyor, 2012.

NOTES:
1) All results are reported in milligrams per liter (mg/L).

NUCLEAR FUEL SERVICES
ERWIN, TENNESSEE

NORTH SITE AND WELL 98A INVESTIGATION REPORT

Tetrachloroethene in Groundwater

ARCADIS

FIGURE
4-1

CITY: (KNOXVILLE) DIV/GROUP:(ENV) DB:(C.SMITH) LD:(C.SMITH) PIC:(B.ILGNER) PM:(P.PRESTON) TM:(B.BAILEY)
PROJECT: TNNFS111.WNIS.00001 PATH: G:\GIS\TNNFS\GIS\MapDocuments\2013\North Site & Well 98A Investigation Report\F4-1 PCE above MCL North Site.mxd 3/4/2013 1:08:42 PM

LEGEND

- 98A Investigation Well 2"
- 98A Investigation Well 4"
- Monitoring Well
- North Site Perimeter Well
- Sanitary Sewer
- Storm Sewer
- Water

Aerial Image: ArcGIS online Bing Maps Aerial: Accessed October 2012.
Projection: NAD 1983 State Plane Tennessee FIPS 4100 Feet
Utility Survey Data from Glenn Allen Shellnut Land Surveyor, 2012.

NOTES:
1) All results are reported in milligrams per liter (mg/L).

NUCLEAR FUEL SERVICES
ERWIN, TENNESSEE

NORTH SITE AND WELL 98A INVESTIGATION REPORT

Trichloroethene in Groundwater

ARCADIS

FIGURE
4-2

CITY: (KNOXVILLE) DIV/GROUP:(ENV) DB:(C.SMITH) LD:(C.SMITH) PIC:(B.LIGNER) PM:(P.PRESTON) TM:(B.BAILEY)
PROJECT: TNNFS111.WNS.00001 PATH: G:\GIS\TNNFS\GIS\MapDocuments\2013\North Site & Well 98A Investigation Report\F4-2 TCE above MCL North Site.mxd 3/4/2013 1:09:29 PM

LEGEND

- 98A Investigation Well 2"
- 98A Investigation Well 4"
- Monitoring Well
- North Site Perimeter Well
- Sanitary Sewer
- Storm Sewer
- Water

Aerial Image: ArcGIS online Bing Maps Aerial: Accessed October 2012.
Projection: NAD 1983 State Plane Tennessee FIPS 4100 Feet
Utility Survey Data from Glenn Allen Shellnut Land Surveyor, 2012.

NOTES:
1) All results are reported in milligrams per liter (mg/L).

NUCLEAR FUEL SERVICES
ERWIN, TENNESSEE

NORTH SITE AND WELL 98A INVESTIGATION REPORT

Cis-1,2-Dichloroethene in Groundwater

ARCADIS

FIGURE
4-3

CITY: (KNOXVILLE) DIV/GROUP:(ENV) DB:(C.SMITH) LD:(C.SMITH) PIC:(B.LUGNER) PM:(P.PRESTON) TM:(B.BAILEY)
PROJECT: TNNFS111.WINS.00001 PATH: G:\GIS\TNNFS\GIS\MapDocuments\2013\North Site & Well 98A Investigation Report\F4-3 DCE above MCL North Site.mxd 3/4/2013 1:30:01 PM

LEGEND

- 98A Investigation Well 2"
- 98A Investigation Well 4"
- Monitoring Well
- North Site Perimeter Well
- Sanitary Sewer
- Storm Sewer
- Water

Aerial Image: ArcGIS online Bing Maps Aerial: Accessed October 2012.
Projection: NAD 1983 State Plane Tennessee FIPS 4100 Feet
Utility Survey Data from Glenn Allen Shellnut Land Surveyor, 2012.

NOTES:
1) All results are reported in milligrams per liter (mg/L).

NUCLEAR FUEL SERVICES
ERWIN, TENNESSEE

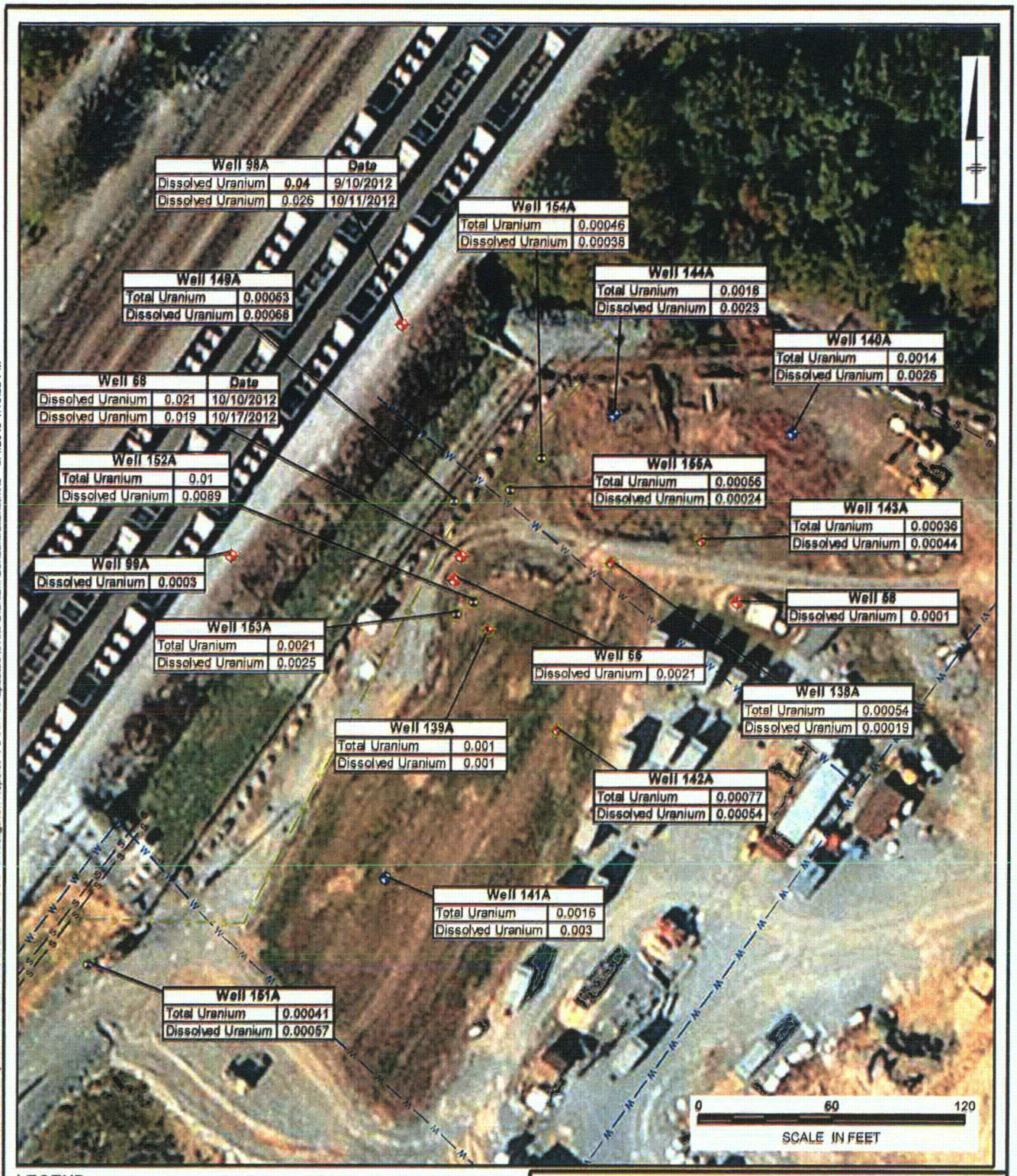
NORTH SITE AND WELL 98A INVESTIGATION REPORT

Vinyl Chloride in Groundwater

ARCADIS

FIGURE
4-4

CITY: (KNOXVILLE) DIV/GROUP:(ENV) DB:(C.SMITH) LD:(C.SMITH) PIC:(B.ILGNER) PM:(P.PRESTON) TM:(B.BAILEY)
PROJECT: TNNFS111.WINS.00001 PATH: G:\GIS\TNNFS\GIS\MapDocuments\2013\North Site & Well 98A Investigation Report\F4-4 VC above MCL North Site.mxd 3/4/2013 1:14:44 PM



CITY: (KNOXVILLE) DIVGROUP (ENV) DB: (C.SMITH) LD: (C.SMITH) PIC: (B.LIGNER) PM: (P.PRESTON) TM: (B.BAILEY)
PROJECT: TNNFS111.WINS.00001 PATH: G:\GIS\TN\NFS\GIS\MapDocuments\2013\North Site & Well 98A Investigation Report\F4-5 98A-68 updated levels Uranium Concentrations.mxd 3/4/2013 1:15:53 PM

LEGEND

- North Site Well
- 4" Well
- 2" Well
- Active Monitor Well
- s - Sanitary Sewer
- s - Storm Sewer
- w - Water

Aerial Image: ArcGIS online Bing Maps Aerial: Accessed November 2012.
Projection: NAD 1983 State Plane Tennessee FIPS 4100 Feet
Utility Survey Data from Glenn Allen Shellnut Land Surveyor, 2011.

NOTES:
1) Well locations for 138A - 155A from Shellnut survey 9/21/12.
2) All results are reported in milligrams per liter (mg/L).
3) Data for 58, 66, and 99A (collected by NFS August 2012).
4) Data for 138A - 155A (collected by Arcadis August/September 2012).
5) **BOLD** - Exceeds MCL for uranium of 0.030 mg/L
6) MCL — Maximum Contaminant Level

NUCLEAR FUEL SERVICES
ERWIN, TENNESSEE
NORTH SITE AND WELL 98A INVESTIGATION REPORT

Uranium Concentrations in Groundwater

ARCADIS

FIGURE
4-5

Legend

- 98A Investigation Well 2"
- 98A Investigation Well 4"
- Monitoring Well
- North Site Perimeter Well
- Proposed MNA Well
- — s — Sanitary Sewer
- — s — Storm Sewer
- — w — Water

Aerial Image: ArcGIS online Bing Maps Aerial: Accessed July 2012.
Projection: NAD 1983 State Plane Tennessee FIPS 4100 Feet
Utility Survey Data from Glenn Allen Shellnut Land Surveyor, 2011.

NOTE: Additional wells could be added to the monitoring network based on future well installation activities.

NUCLEAR FUEL SERVICES
ERWIN, TENNESSEE
NORTH SITE AND WELL 98A INVESTION REPORT

Proposed Monitor Well Network

ARCADIS

FIGURE
5-1

CITY: (KNOXVILLE) DIV/GROUP:(ENV) DB:(C.SMITH) LD:(C.SMITH) PIC:(B.ILGNER) PM:(P.PRESTON) TM:(B.BAILEY)
PROJECT: TNNFS111.WINS.00001 Path: G:\GIS\TNNFS\GIS\MapDocuments\2013\North Site & Well 98A Investigation Report\FS-1 Monitoring Well Network.mxd 3/4/2013 1:24:04 PM

ARCADIS

Appendix A

Analytical Graphs

Table A-1.
Summary of Radionuclide Data from Selected Wells

North Site and 98A Investigation Report
Nuclear Fuel Services, Inc.
Erwin, Tennessee

Well 98A				Well 99A				Well 100A				Well 100B				Well 116A				Well 118B				Well 68				Well 58				Well 66			
Parameter	Date Collected	Result pCi/L	Result µg/L*	Parameter	Date Collected	Result pCi/L	Result µg/L*	Parameter	Date Collected	Result pCi/L	Result µg/L*	Parameter	Date Collected	Result pCi/L	Result µg/L*	Parameter	Date Collected	Result pCi/L	Result µg/L*	Parameter	Date Collected	Result pCi/L	Result µg/L*	Parameter	Date Collected	Result pCi/L	Result µg/L*	Parameter	Date Collected	Result pCi/L	Result µg/L*	Parameter	Date Collected	Result pCi/L	Result µg/L*
U-233/234																																			
U-233/234	1/15/2004	6.293 B	0.001 B	U-233/234	9/20/2004	35.18	0.0057	U-233/234	1/19/2004	3.755 B	0.0006 B	U-233/234	1/21/2004	1.488 B	0.00024 B	U-233/234	1/19/2004	2.7	0.000041	U-233/234	1/22/2004	0.72	0.00012	U-233/234	5/2/2012	193.3	0.031	U-233/234	5/8/2012	0.09311 U	0.000015 U	U-233/234	5/17/2012	4.568	0.00074
U-233/234	2/25/2004	10.31	0.0017	U-233/234	1/4/2012	0.5496	0.000089	U-233/234	2/16/2004	1.756	0.00028	U-233/234	2/24/2004	0.9397	0.00015	U-233/234	4/19/2004	2.4	0.000036	U-233/234	4/19/2004	0.94	0.00015	U-233/234	5/7/2012	204.3	0.033	U-233/234	6/4/2012	0.04477 U	0.0000072 U	U-233/234	6/4/2012	3.803	0.00061
U-233/234	3/5/2004	7.956	0.0013	U-233/234	2/6/2012	0.3687 J	0.000059 J	U-233/234	3/16/2004	2.136	0.00034	U-233/234	3/18/2004	1.924	0.00031	U-233/234	7/16/2004	2.7	0.000041	U-233/234	7/16/2004	0.92	0.00015	U-233/234	5/16/2012	261.9	0.042	U-233/234	7/18/2012	0.275 U	0.000044 U	U-233/234	7/19/2012	3.545 J	0.00057 J
U-233/234	4/23/2004	6.011	0.00097	U-233/234	3/21/2012	0.3511 U	0.000057 U	U-233/234	4/30/2004	1.903	0.00031	U-233/234	4/29/2004	0.4094	0.000066	U-233/234	11/8/2004	1.6	0.000024	U-233/234	11/8/2004	0.78	0.00013	U-233/234	5/23/2012	358.2	0.058	U-233/234	8/6/2012	0.107 U	0.000017 U	U-233/234	8/1/2012	4.183	0.00067
U-233/234	5/25/2004	6.712	0.0011	U-233/234	4/2/2012	0.5835	0.000094	U-233/234	5/25/2004	0.6698	0.00011	U-233/234	5/28/2004	0.6411	0.0001	U-233/234	1/20/2005	2.4	0.000036	U-233/234	1/20/2005	0.57	0.000092	U-233/234	5/30/2012	315.6	0.051	U-233/234	9/5/2012	0.2536	0.000041	U-233/234	9/6/2012	2.861	0.00046
U-233/234	6/8/2004	11.57	0.0019	U-233/234	5/14/2012	0.302	0.000049	U-233/234	6/3/2004	0.594	0.000096	U-233/234	6/3/2004	0.3012	0.000049	U-233/234	4/4/2005	1.5	0.000023	U-233/234	4/4/2005	1.2	0.00019	U-233/234	6/7/2012	321	0.052								
U-233/234	7/19/2004	2.433	0.00039	U-233/234	6/11/2012	0.1991 U	0.000032 U									U-233/234	8/2/2005	2.5	0.000038	U-233/234	8/2/2005	0.87	0.00014	U-233/234	6/15/2012	311.3	0.05								
U-233/234	6/28/2006	11.47 J	0.0018 J	U-233/234	7/16/2012	0.377	0.000061									U-233/234	4/5/2006	2.33	0.000035	U-233/234	4/5/2006	0.62	0.0001	U-233/234	6/19/2012	317.4	0.051								
U-233/234	3/8/2007	4.319	0.0007	U-233/234	8/13/2012	0.2129 U	0.000034									U-233/234	10/24/2006	2.83	0.000043	U-233/234	10/24/2006	0.7	0.00011	U-233/234	6/26/2012	312.6	0.05								
U-233/234	7/4/2007	54.24 J	0.0087 J	U-233/234	9/10/2012	0.1946	0.000031									U-233/234	3/13/2007	2.98	0.000045	U-233/234	3/13/2007	0.72	0.00012	U-233/234	7/10/2012	356.8	0.057								
U-233/234	8/19/2009	26.29	0.0042													U-233/234	7/10/2007	2.47	0.000037	U-233/234	7/10/2007	0.64	0.0001	U-233/234	7/11/2012	180.4 J	0.029 J								
U-233/234	10/27/2009	56.01	0.009													U-233/234	1/4/2008	3.07	0.000046	U-233/234	1/4/2008	0.54	0.000087	U-233/234	7/18/2012	214.7	0.035								
U-233/234	3/1/2010	47.94	0.0077													U-233/234	9/8/2008	2.32	0.000035	U-233/234	9/8/2008	0.6	0.000097	U-233/234	7/25/2012	28.15 J	0.0045 J								
U-233/234	2/14/2011	49.93 J	0.008 J													U-233/234	1/21/2009	2.58	0.000039	U-233/234	1/21/2009	0.44	0.000071	U-233/234	8/1/2012	151.2	0.024								
U-233/234	5/18/2011	64.03	0.01													U-233/234	7/17/2009	2.97 J	0.000045 J	U-233/234	7/17/2009	1 J	0.00016 J	U-233/234	8/8/2012	39.31 J	0.0063 J								
U-233/234	8/17/2011	33.82	0.0054													U-233/234	3/4/2010	3.09	0.000047	U-233/234	3/4/2010	0.89	0.00014	U-233/234	8/15/2012	127.5	0.021								
U-233/234	11/17/2011	35.9	0.0058													U-233/234	8/26/2010	2.1	0.000032	U-233/234	8/26/2010	0.71	0.00011	U-233/234	8/22/2012	148.4	0.024								
U-233/234	1/4/2012	131.8	0.021													U-233/234	4/13/2011	3.39	0.000051	U-233/234	4/13/2011	1.16	0.00019	U-233/234	9/5/2012	162.9	0.026								
U-233/234	2/6/2012	93.93	0.015													U-233/234	8/31/2011	2.68	0.00004	U-233/234	8/31/2011	0.91	0.00015	U-233/234	9/12/2012	144.9	0.023								
U-233/234	3/21/2012	142.8	0.0230													U-233/234	3/22/2012	3.34	0.00005	U-233/234	3/22/2012	0.92	0.00015	U-233/234	9/19/2012	93.02	0.015								
U-233/234	4/2/2012	149.2	0.024													U-233/234	5/16/2012	3.14	0.000047	U-233/234	5/16/2012	1.01	0.00016	U-233/234	9/26/2012	138.9	0.022								
U-233/234	5/21/2012	124.2	0.02													U-233/234	8/20/2012	3.3	0.00005	U-233/234	8/20/2012	0.9	0.000014	U-233/234	10/3/2012	131.6	0.021								
U-233/234	6/11/2012	124	0.02																					U-233/234	10/10/2012	148.0	0.024								
U-233/234	7/12/2012	187.9	0.03																					U-233/234	10/17/2012	139.8	0.023								
U-233/234	8/13/2012	121.7	0.02																					U-233/234	10/23/2012	166.1	0.027								
U-233/234	9/10/2012	68.20 J	0.011 J																					U-233/234	11/1/2012	144.0	0.023								
U-233/234	10/11/2012	38.17	0.0061																					U-233/234	11/7/2012	153.9	0.025								
U-233/234	11/12/2012	19.18 J	0.0031 J																					U-233/234	11/14/2012	149.8	0.024								
U-233/234	12/6/2012	12.82 J	0.0021 J																					U-233/234	11/19/2012	163.1	0.026								
																								U-233/234	11/28/2012	183.0	0.029								
																								U-233/234	12/5/2012	191.6	0.031								
U-235/236																																			
U-235	1/15/2004	0.612	0.28	U-235/236	9/20/2004	2.533	1.17	U-235	1/19/2004	0.451	0.21	U-235	1/21/2004	0.1785 U	0.083 U	U-235/236	1/19/2004	0.44	0.2	U-235/236	1/22/2004	0.31 U	0.14 U	U-235/236	5/2/2012	6.267	2.9	U-235/236	5/8/2012	0.06892 U	0.032 U	U-235/236	5/17/2012	0.3887 J	0.18 J
U-235	2/25/2004	0.3241	0.15	U-235/236	1/4/2012	0.1758 U	0.081 U	U-235	2/16/2004	0.228 U	0.11 U	U-235	2/24/2004	0.3235	0.15	U-235/236	4/19/2004	0.12 U	0.056 U	U-235/236	4/19/2004	0.073 U	0.034 U	U-235/236	5/7/2012	7.46	3.45	U-235/236	6/4/2012	0.05523 U	0.026 U	U-235/236	6/4/2012	0.3551 U	0.16 U
U-235/236	3/5/2004	0.4572	0.21	U-235/236	2/6/2012	0.2394 J	0.11 J	U-235/236	3/16/2004	0.4392 U	0.2 U	U-235/236	3/18/2004	0.05216 U	0.024 U	U-235/236	7/16/2004	0.22	0.1	U-235/236	7/16/2004	0.19	0.088	U-235/236	5/16/2012	9.908	4.59	U-235/236	7/18/2012	0.1542 U	0.071 U	U-235/236	7/19/2012	0.8806 U	0.41 U
U-235/236	4/23/2004	0.2293 U	0.11 U	U-235/236	3/21/2012	0.1019 J	0.047 J	U-235/236	4/30/2004	1.784	0.83	U-235/236	4/29/2004	0.07216 U	0.033 U	U-235/236	11/8/2004	0 U	0 U	U-235/236	11/8/2004	0.064 U	0.03 U	U-235/236	5/23/2012	12.96	6	U-235/236	8/6/2012	0.0792 U	0.037 U	U-235/236	8/1/2012	0.3667 U	0.17 U
U-235/236	5/25/2004	0.3357	0.16	U-235/236	4/2/2012	0.04965 U	0.023 U	U-235/236	5/25/2004	0.09181 U	0.043 U	U-235/236	5/28/2004	0.102 U	0.047 U	U-235/236	1/20/2005	0.13 U	0.06 U	U-235/236	1/20/2005	0.064 U	0.03 U	U-235/236	5/30/2012	11.42	5.29	U-235/236	9/5/2012	0.1138 U	0.053 U	U-235/236	9/6/2012	0.2314 U	0.11 U
U-235/236	6/8/2004	0.8466	0.39	U-235/236	5/14/2012	0.09312 J	0.043 J	U-235/236	6/3/2004	0.1086 J	0.05 J	U-235/236	6/3/2004	0.1062 U	0.049 U	U-235/236	4/4/2005	0.19 J	0.088 J	U-235/236	4/4/2005	0.26 J	0.12 J	U-235/236	6/7/2012	10.96	5.074								
U-235/236	7/19/2004	0.1715 J	0.079 J	U-235/236	6/11/2012	0.1638 U	0.076 U									U-235/236	8/2/2005	0.082 U	0.038 U	U-235/236	8/2/2005	0.057 U	0.026 U	U-235/236	6/15/2012	11.52	5.33								
U-235/236	6/28/2006	1.118 J	0.52 J	U-235/236	7/16/2012	0.1915 U	0.089 U									U-235/236	4/5/2006	0.098	0.045	U-235/236	4/5/2006	0.024 U	0.011 U	U-235/236	6/19/2012	10.99	5.088								
U-235/236	3/8/2007	0.2131 J	0.099 J	U-235/236	8/13/2012	0.105 U	0.049 U									U-235/236	10/24/2006	0.119	0.055	U-235/236	10/24/2006	0.019 U	0.0088 U	U-235/236	6/26/2012	10.34	4.79								
U-235/236	7/4/2007	4.282 J	1.98 J	U-235/236	9/10/2012	0.1334 U	0.062 U									U-235/236	3/13/2007	0.226	0.10	U-235/236	3/13/2007	0.022 U	0.01 U	U-235/236	7/10/2012	13.26	6.14								
U-235/236	8/19/2009	1.982 J	0.92 J													U-235/236	7/10/2007	0.13	0.06	U-235/236	7/10/2007	0.057 U	0.026 U	U-235/236	7/11/2012	13.86 J	6.42 J								
U-235/236	10/27/2009	3.587 J	1.66 J													U-235/236	1/4/2008	0.026 U	0.012 U	U-235/236	1/4/2008	0 U	0 U	U-235/236	7/18/2012	10.07	4.66								
U-235/236	3/1/2010	1.688	0.78													U-235/236	9/8/2008	0.166 J	0.077 J	U-235/236	9/8/2008	0.055 U	0.025 U	U-235/236	7/25/2012	4.022 J	1.86 J								
U-235/236	2/14/2011	4.989 J	2.31 J													U-235/236	1/21/2009	0.125	0.058	U-235/236	1/21/2009	0.042 U	0.019 U	U-235/236	8/1/2012	4.776	2.21								
U-235/236	5/18/2011	2.231	1.033													U-235/236	7/17/2009	0.169 J	0.078 J	U-235/236	7/17/2009	0.042 U	0.019 U	U-235/236	8/8/2012	4.035 J	1.87 J								
U-235/236	8/17/2011	1.894	0.88													U-235/236	3/4/2010	0.069	0.032	U-235/236	3/4/2010	0.017 U	0.0079 U	U-235/236	8/15/2012	5.41	2.5								
U-235/236	11/17/2011	2.193	1.015													U-235/236	8/26/2010	0.051	0.024	U-235/236	8/26/2010	0.003 U	0.0014 U	U-235/236	8/22/2012	8.12	3.76								
U-235/236	1/4/2012	5.436	2.52													U-235/236	4/13/2011	0.046 J	0.021 J	U-235/236	4/13/2011	0.022 U	0.01 U	U-235/236	9/5/2012	6.696	3.1								
U-235/236	2/6/2012	3.701	1.71													U-235/236	8/31/2011	0.09	0.042	U-235/236	8/31/2011	0.02 U	0.0093 U	U-235/236	9/12/2012	4.964	2.30								
U-235/236	3/21/2012	6.142	2.84													U-235/236	3/22/2012	0.066	0.031	U-235/236	3/22/2012	0.03 U	0.014 U	U-235/236	9/19/2012	2.936	1.36								
U-235/236	4/2/2012	6.876	3.18													U-235/236	5/16/2012	0.035 U	0.016 U	U-235/236	5/16/2012	0.048	0.022	U-235/236	9/26/2012	8.907	4.12								
U-235/236	5/21/2012	8.142 J	3.77 J													U-235/236	8/20/2012	0.103	0.048	U-235/236	8/20/2012	0.034 U	0.016	U-235/236	10/3/2012	6.241	2.89								
U-235/236	6/11/2012	4.886	2.26																					U-235/236	10/10/2012	5.736	2.66								
U-235/236	7/12/2012	9.869	4.57																					U-235/236	10/17/2012	7.717	3.57								
U-235/236	8/13/2012	5.092	2.36																					U-235/236	10/23/2012	5.359	2.48								
U-235/236	9/10/2012	6.009 J	2.78 J																					U-235/236	11/1/2012	4.212	1.95								
U-235/236	10/11/2012	2.386 J	1.1 J																					U-235/236	11/7/2012	5.588	2.59								
U-235/236	11/12/2012	1.510 J	0.7 J																					U-235/236	11/14/2012	6.332	2.93								
U-235/236	12/6/2012	1.511 J	0.7 J																					U-235/236	11/19/2012	9.560	4.43								
																								U-235/236	11/28/2012	9.847	4.56								
																								U-235/236	12/5/2012	7.363	3.41								

Table A-1.
Summary of Radionuclide Data from Selected Wells

North Site and 98A Investigation Report
Nuclear Fuel Services, Inc.
Erwin, Tennessee

Well 98A				Well 99A				Well 100A				Well 100B				Well 118A				Well 118B				Well 66				Well 58				Well 66			
Parameter	Date Collected	Result pCi/L	Result µg/L*	Parameter	Date Collected	Result pCi/L	Result µg/L*	Parameter	Date Collected	Result pCi/L	Result µg/L*	Parameter	Date Collected	Result pCi/L	Result µg/L*	Parameter	Date Collected	Result pCi/L	Result µg/L*	Parameter	Date Collected	Result pCi/L	Result µg/L*	Parameter	Date Collected	Result pCi/L	Result µg/L*	Parameter	Date Collected	Result pCi/L	Result µg/L*	Parameter	Date Collected	Result pCi/L	Result µg/L*
U-238																																			
U-238	1/15/2004	3.409	10.15	U-238	9/20/2004	11.08	**32.98**	U-238	1/19/2004	0.987	2.94	U-238	1/21/2004	0.2469	0.73	U-238	1/19/2004	1.1	3.27	U-238	1/22/2004	0.48 U	1.43	U-238	5/2/2012	6.728	20.024	U-238	5/8/2012	0.07417 U	0.22 U	U-238	5/17/2012	0.6862	2.042
U-238	2/25/2004	5.595	16.65	U-238	1/4/2012	0.223	0.66	U-238	2/16/2004	0.4601	1.37	U-238	2/24/2004	0.1088	0.32	U-238	4/19/2004	0.96	2.86	U-238	4/19/2004	0.38	1.13	U-238	5/7/2012	7.664	22.81	U-238	6/4/2012	0.1114	0.33	U-238	6/4/2012	0.3889	1.16
U-238	3/5/2004	5.437	16.18	U-238	2/6/2012	0.1546	0.46	U-238	3/16/2004	0.709	2.11	U-238	3/18/2004	0.0421 U	0.13 U	U-238	7/16/2004	0.11	0.33	U-238	7/16/2004	0.44	1.31	U-238	5/16/2012	10.02	29.82	U-238	7/18/2012	0.09957 U	0.3 U	U-238	7/19/2012	0.5449	1.62
U-238	4/23/2004	3.126	9.30	U-238	3/21/2012	0.1645	0.49	U-238	4/30/2004	0.2021	0.6	U-238	4/29/2004	0.2038	0.61	U-238	11/8/2004	0.76	2.26	U-238	11/8/2004	0.72	2.14	U-238	5/23/2012	13.8	**41.071**	U-238	8/6/2012	0.04262 U	0.13 U	U-238	8/1/2012	0.6555	1.95
U-238	5/25/2004	5.125	15.25	U-238	4/2/2012	0.2605	0.78	U-238	5/25/2004	0.07411 J	0.22 J	U-238	5/28/2004	0.06177 J	0.18 J	U-238	1/20/2005	0.76	2.26	U-238	1/20/2005	0.47	1.40	U-238	5/30/2012	11.51	**34.26**	U-238	9/5/2012	0.06886 U	0.2 U	U-238	9/6/2012	0.2101 U	0.63 U
U-238	6/8/2004	8.177	24.34	U-238	5/14/2012	0.05637 U	0.17 U	U-238	6/3/2004	0.1095 J	0.33 J	U-238	6/3/2004	-0.02142 U	-0.064 U	U-238	4/4/2005	1.4	4.17	U-238	4/4/2005	0.46	1.37	U-238	6/7/2012	14.44	**42.98**								
U-238	7/19/2004	3.253 J	9.68 J	U-238	6/11/2012	0.1322	0.39									U-238	8/2/2005	1.2	3.57	U-238	8/2/2005	0.18 U	0.54 U	U-238	6/15/2012	12.28	**36.55**								
U-238	6/28/2006	4.116	12.25	U-238	7/16/2012	0.2429	0.72									U-238	4/5/2006	0.98	2.92	U-238	4/5/2006	0.294	0.88	U-238	6/19/2012	13.1	**38.99**								
U-238	3/8/2007	3.67	10.92	U-238	8/13/2012	0.08478 U	0.25 U									U-238	10/24/2006	1.44	4.29	U-238	10/24/2006	0.34	1.012	U-238	6/26/2012	12.24	**36.43**								
U-238	7/4/2007	19.19	57.11	U-238	9/10/2012	0.08611 J	0.26 J									U-238	3/13/2007	1.07	3.18	U-238	3/13/2007	0.25	0.74	U-238	7/10/2012	13.65	**40.63**								
U-238	8/19/2009	9.113	27.12													U-238	7/10/2007	0.91	2.71	U-238	7/10/2007	0.255	0.76	U-238	7/11/2012	7.749	23.063								
U-238	10/27/2009	16.13	48.006													U-238	1/4/2008	0.95	2.83	U-238	1/4/2008	0.193	0.57	U-238	7/18/2012	9.57	28.48								
U-238	3/1/2010	12.72	37.86													U-238	9/8/2008	0.84	2.5	U-238	9/8/2008	0.21	0.63	U-238	7/25/2012	0.8117	2.42								
U-238	2/14/2011	14.14	42.083													U-238	1/21/2009	1.07	3.18	U-238	1/21/2009	0.24	0.71	U-238	8/1/2012	5.427	16.15								
U-238	5/18/2011	13.25	39.43													U-238	7/17/2009	1.2 J	3.57 J	U-238	7/17/2009	0.25 J	0.74 J	U-238	8/8/2012	1.803	5.37								
U-238	8/17/2011	8.168	24.31													U-238	3/4/2010	1.29	3.84	U-238	3/4/2010	0.58	1.73	U-238	8/15/2012	5.064	15.071								
U-238	11/17/2011	8.36	24.88													U-238	8/26/2010	0.82	2.44	U-238	8/26/2010	0.35	1.042	U-238	8/22/2012	4.998	14.88								
U-238	1/4/2012	27.55	81.99													U-238	4/13/2011	1.17	3.48	U-238	4/13/2011	0.39	1.16	U-238	9/5/2012	5.828	17.35								
U-238	2/6/2012	18.85	56.1													U-238	8/31/2011	1.26	3.75	U-238	8/31/2011	0.54	1.61	U-238	9/12/2012	5.343	15.9								
U-238	3/21/2012	25.25	75.15													U-238	3/22/2012	1.35	4.018	U-238	3/22/2012	0.35	1.042	U-238	9/19/2012	3.451	10.27								
U-238	4/2/2012	30.99	92.23													U-238	5/16/2012	1.34	3.99	U-238	5/16/2012	0.44	1.31	U-238	9/26/2012	4.313	12.84								
U-238	5/21/2012	29.03	86.4													U-238	8/20/2012	1.42	4.23	U-238	8/20/2012	0.39	1.16	U-238	10/3/2012	4.494	13.38								
U-238	6/11/2012	27.75	82.59																					U-238	10/10/2012	6.299	18.75								
U-238	7/12/2012	31.98	95.18																					U-238	10/17/2012	5.199	15.47								
U-238	8/13/2012	26.51	78.9																					U-238	10/23/2012	5.459	16.25								
U-238	9/10/2012	12.55	37.35																					U-238	11/1/2012	5.451	16.22								
U-238	10/11/2012	8.890	26.46																					U-238	11/7/2012	5.898	17.55								
U-238	11/12/2012	5.094	15.16																					U-238	11/14/2012	5.213	15.51								
U-238	12/6/2012	3.717	11.063																					U-238	11/19/2012	5.722	17.03								
																								U-238	11/28/2012	6.925	20.61								
																								U-238	12/5/2012	5.993	17.84								
U-Total																																			
U-Total	1/15/2004		10.43 B	U-Total	9/20/2004		**34.15**	U-Total	1/19/2004		3.15 B	U-Total	1/21/2004		0.82 B	U-Total	1/19/2004		3.48	U-Total	1/22/2004		1.57	U-Total	5/2/2012		22.96	U-Total	5/8/2012		0.25	U-Total	5/17/2012		2.22
U-Total	2/25/2004		16.8	U-Total	1/4/2012		0.75	U-Total	2/16/2004		1.48	U-Total	2/24/2004		0.47	U-Total	4/19/2004		2.91	U-Total	4/19/2004		1.16	U-Total	5/7/2012		26.3	U-Total	6/4/2012		0.36	U-Total	6/4/2012		1.32
U-Total	3/5/2004		16.39	U-Total	2/6/2012		0.57	U-Total	3/16/2004		2.31	U-Total	3/18/2004		0.15	U-Total	7/16/2004		0.43	U-Total	7/16/2004		1.40	U-Total	5/16/2012		**34.45**	U-Total	7/18/2012		0.37	U-Total	7/19/2012		2.03
U-Total	4/23/2004		9.41	U-Total	3/21/2012		0.54	U-Total	4/30/2004		1.43	U-Total	4/29/2004		0.64	U-Total	11/8/2004		2.26	U-Total	11/8/2004		2.17	U-Total	5/23/2012		**47.13**	U-Total	8/6/2012		0.16	U-Total	8/1/2012		2.12
U-Total	5/25/2004		15.41	U-Total	4/2/2012		0.8	U-Total	5/25/2004		0.26 J	U-Total	5/28/2004		0.23 J	U-Total	1/20/2005		2.32	U-Total	1/20/2005		1.43	U-Total	5/30/2012		**39.59**	U-Total	9/5/2012		0.26	U-Total	9/6/2012		0.73
U-Total	6/8/2004		24.73	U-Total	5/14/2012		0.21	U-Total	6/3/2004		0.38 J	U-Total	6/3/2004		-0.015	U-Total	4/4/2005		4.25 J	U-Total	4/4/2005		1.49 J	U-Total	6/7/2012		**48.1**								
U-Total	7/19/2004		9.76 J	U-Total	6/11/2012		0.47									U-Total	8/2/2005		3.61	U-Total	8/2/2005		0.56	U-Total	6/15/2012		**41.93**								
U-Total	6/28/2006		12.77 J	U-Total	7/16/2012		0.81									U-Total	4/5/2006		2.96	U-Total	4/5/2006		0.89	U-Total	6/19/2012		**44.13**								
U-Total	3/8/2007		11.022 J	U-Total	8/13/2012		0.3									U-Total	10/24/2006		4.34	U-Total	10/24/2006		1.021	U-Total	6/26/2012		**41.27**								
U-Total	7/4/2007		**59.1** J	U-Total	9/10/2012		0.32									U-Total	3/13/2007		3.29	U-Total	3/13/2007		0.75	U-Total	7/10/2012		**46.82**								
U-Total	8/19/2009		28.044 J													U-Total	7/10/2007		2.77	U-Total	7/10/2007		0.79	U-Total	7/11/2012		29.51								
U-Total	10/27/2009		**49.68** J													U-Total	1/4/2008		2.84	U-Total	1/4/2008		0.57	U-Total	7/18/2012		**33.18**								
U-Total	3/1/2010		**38.65**													U-Total	9/8/2008		2.58 J	U-Total	9/8/2008		0.65	U-Total	7/25/2012		4.28								
U-Total	2/14/2011		**44.4** J													U-Total	1/21/2009		3.24	U-Total	1/21/2009		0.73	U-Total	8/1/2012		18.39								
U-Total	5/18/2011		**40.48**													U-Total	7/17/2009		3.65 J	U-Total	7/17/2009		0.76 J	U-Total	8/8/2012		7.24								
U-Total	8/17/2011		25.19													U-Total	3/4/2010		3.87	U-Total	3/4/2010		1.73	U-Total	8/15/2012		17.6								
U-Total	11/17/2011		25.9													U-Total	8/26/2010		2.46	U-Total	8/26/2010		1.043	U-Total	8/22/2012		18.66								
U-Total	1/4/2012		**84.53**													U-Total	4/13/2011		3.50 J	U-Total	4/13/2011		1.17	U-Total	9/5/2012		20.47								
U-Total	2/6/2012		**57.83**													U-Total	8/31/2011		3.79	U-Total	8/31/2011		1.62	U-Total	9/12/2012		18.22								
U-Total	3/21/2012		**78.015**													U-Total	3/22/2012		4.048	U-Total	3/22/2012		1.056	U-Total	9/19/2012		11.65								
U-Total	4/2/2012		**95.44**													U-Total	5/16/2012		4.0043	U-Total	5/16/2012		1.33	U-Total	9/26/2012		16.98								
U-Total	5/21/2012		**90.19**													U-Total	8/20/2012		4.27	U-Total	8/20/2012		1.18	U-Total	10/3/2012		16.29								
U-Total	6/11/2012		**84.87**																					U-Total	10/10/2012		21.43								
U-Total	7/12/2012		**99.78**																					U-Total	10/17/2012		19.069								
U-Total	8/13/2012		**81.28**																					U-Total	10/23/2012		18.76								
U-Total	9/10/2012		**40.14**																					U-Total	11/1/2012		18.20								
U-Total	10/11/2012		27.57																					U-Total	11/7/2012		20.17								
U-Total	11/12/2012		15.86																					U-Total	11/14/2012		18.47								
U-Total	12/6/2012		11.76																					U-Total	11/19/2012		21.48								
																								U-Total	11/28/2012		25.20								
																								U-Total	12/5/2012		21.28								

General Notes:
1. All reported results are dissolved.
2. Mass concentration calculated using specific activity of each isotope and assuming concentrations. The conversion activity for Uranium-233/234 is 6210, Uranium-235/236 is 2.16, and Uranium-238 is 0.336.
3. **BOLD** indicates concentration above the maximum contaminant level for uranium of 30 µg/L as of December 8, 2003 (USEPA 2002)
4. * = Where QA/QC data were available, maximum concentration was carried forward in the analysis; negative activity was considered 0 when converting to µg/L.

Acronyms and Abbreviations:
µg/L = micrograms per liter
pCi/L = picocuries per liter
QA/QC = quality assurance/quality control
USEPA = U.S. Environmental Protection Agency

Qualifiers:
B = analyte was detected in blank
J = result is estimated
U = result is not detected

CITY: KNX DIV/GROUP: ENV/GIS DB: C.SMITH PIC: B.ILGNER PM: P.PRESTON TM: B.BAILEY
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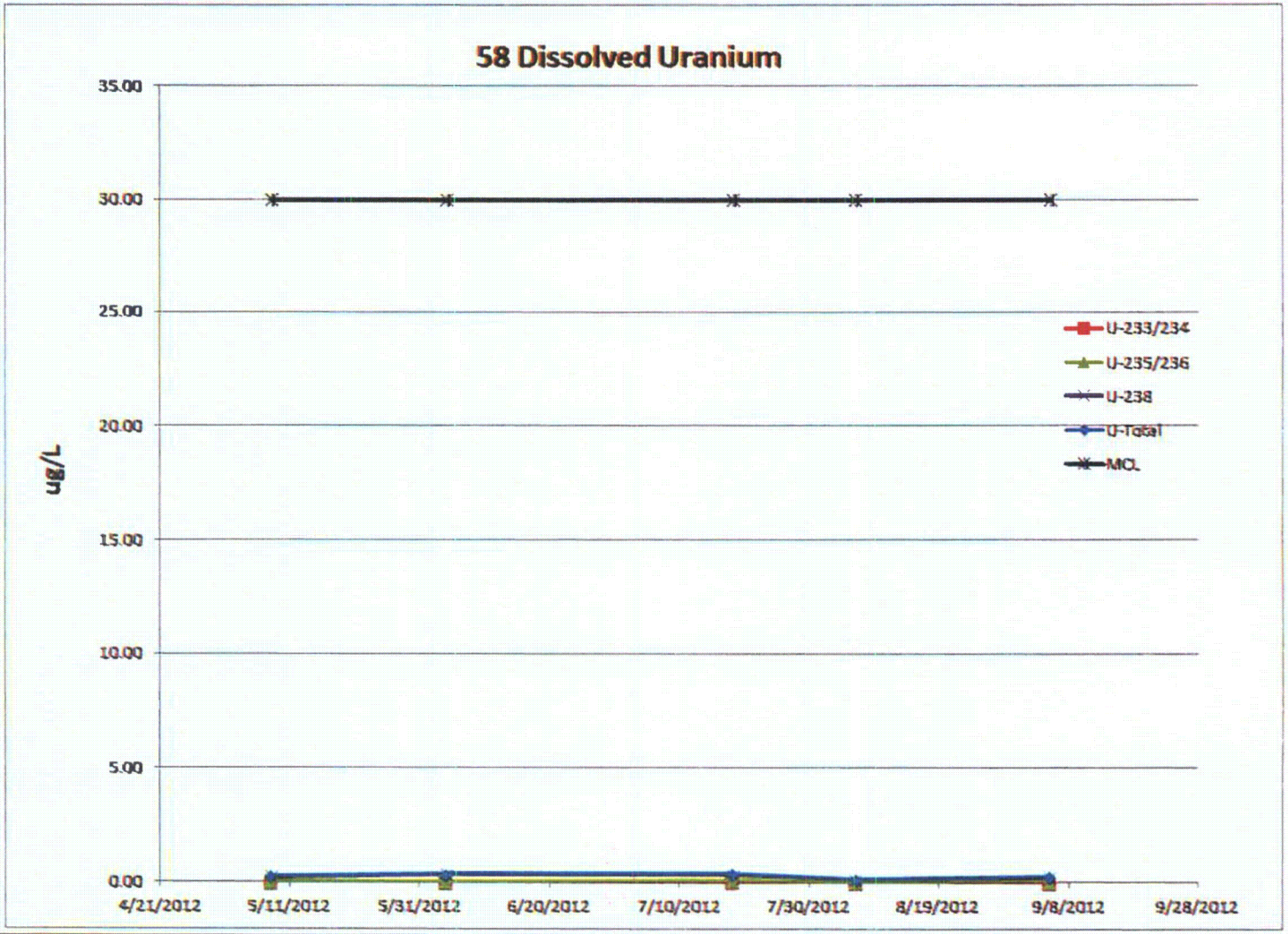

Notes:
30 ug/L – Maximum Contaminant Level for Uranium
ug/L – Micrograms per Liter

NUCLEAR FUEL SERVICES
ERWIN, TENNESSEE
NORTH SITE AND WELL 98A INVESTIGATION REPORT

Well 58

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Appendix
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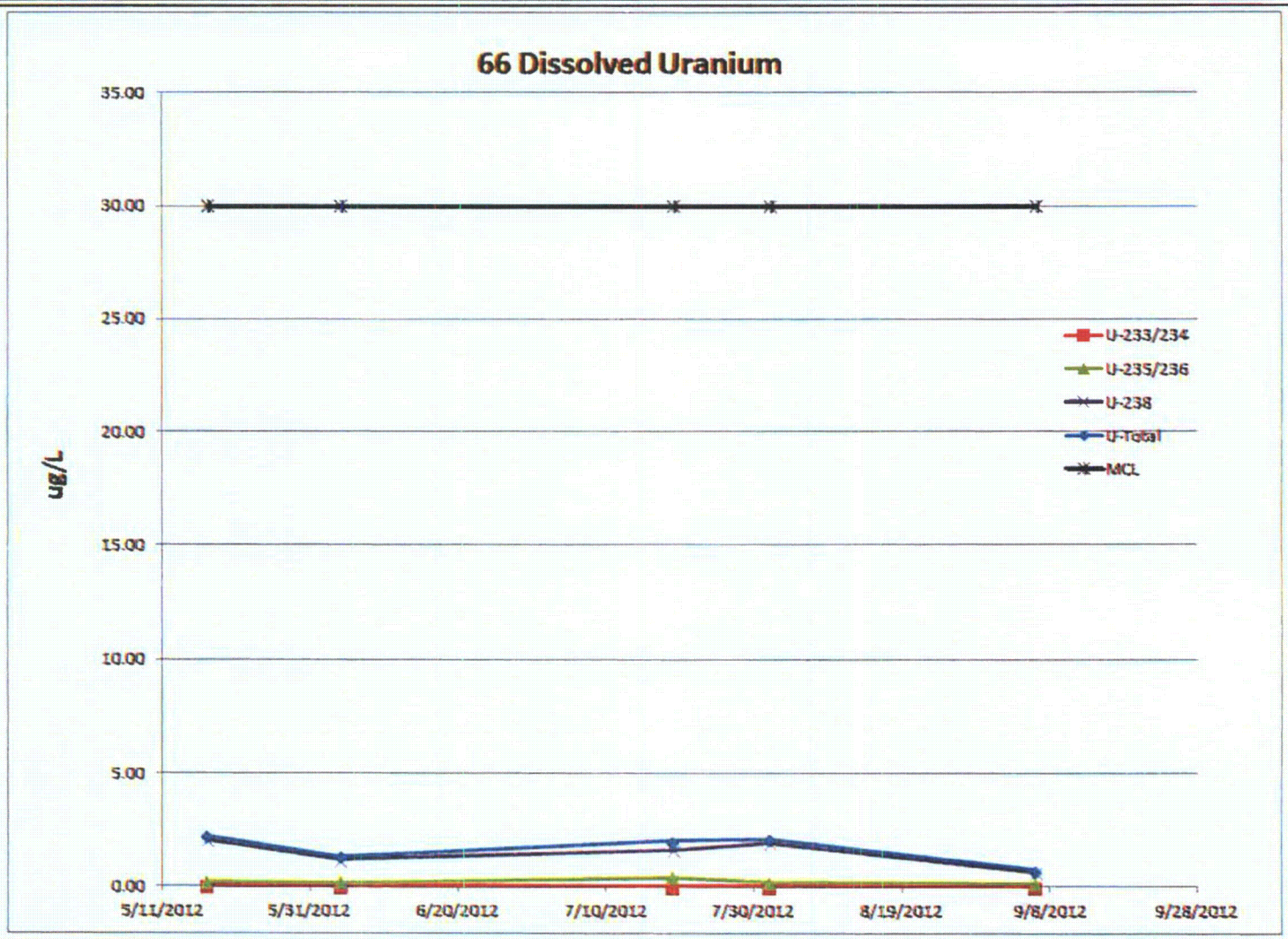
CITY: KNX DIV/GROUP: ENV/GIS DB: C.SMITH PIC: B.ILGNER PM: P.PRESTON TM: B.BAILEY
PROJECT: TNNFS123.W98A.00001 PATH: G:\GIS\TNNFS\GIS\MapDocuments\2013\North Site & Well 98A Investigation Report\A2 66.pdf



Notes:
30 ug/L – Maximum Contaminant Level for Uranium
ug/L – Micrograms per Liter

NUCLEAR FUEL SERVICES
ERWIN, TENNESSEE
NORTH SITE AND WELL 98A INVESTIGATION REPORT

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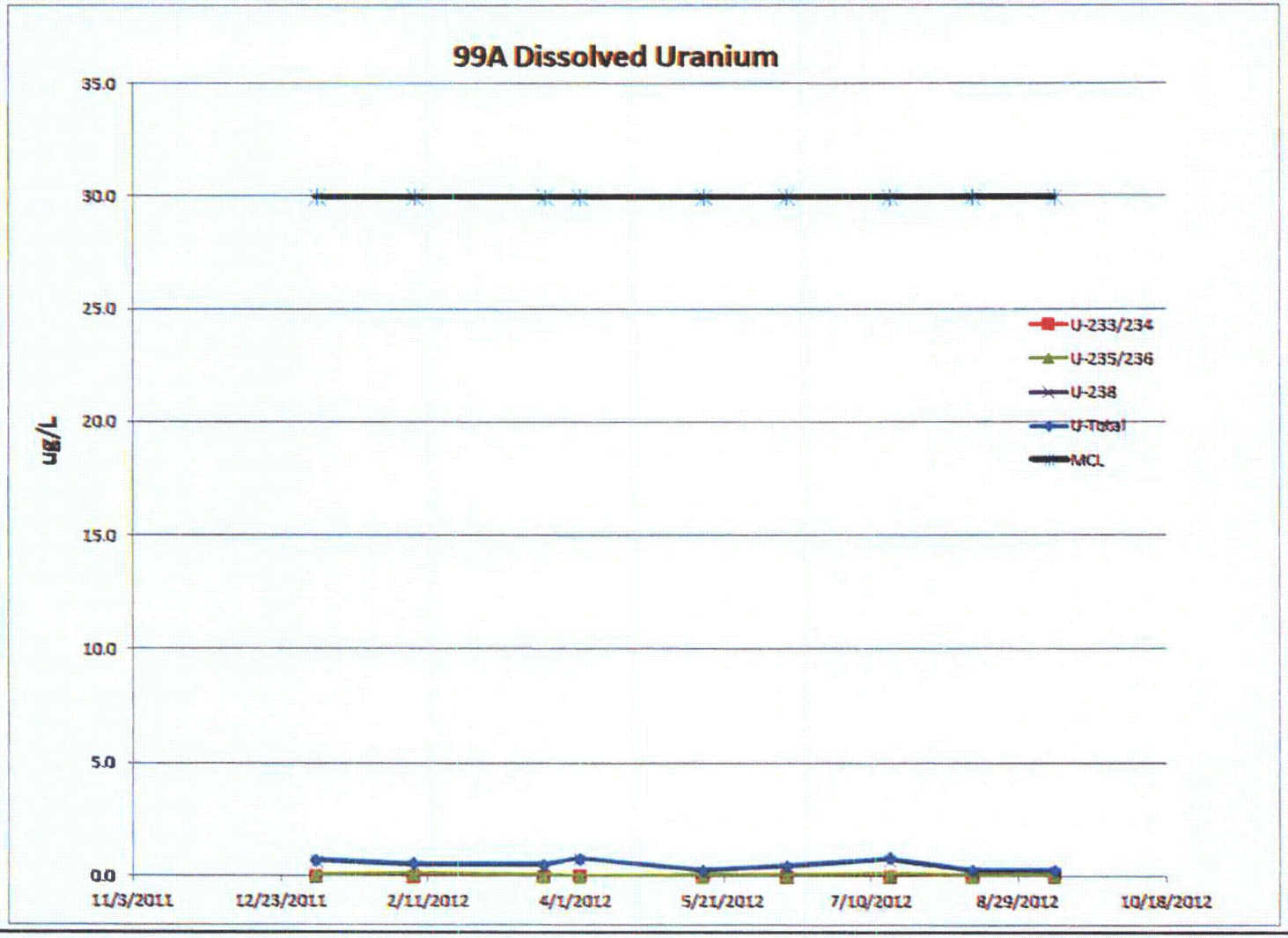
CITY: KNX DIV/GROUP: ENV/GIS DB: C.SMITH PIC: B.ILGNER PM: P.PRESTON TM: B.BAILEY
PROJECT: TNNFS123.W98A.00001 PATH: G:\GIS\TNNFS\GIS\MapDocuments\2013\North Site & Well 98A Investigation Report\A3 99A.pdf



Notes:
30 ug/L – Maximum Contaminant Level for Uranium
ug/L – Micrograms per Liter

NUCLEAR FUEL SERVICES
ERWIN, TENNESSEE
NORTH SITE AND WELL 98A INVESTIGATION REPORT

Well 99A

ARCADIS

Appendix
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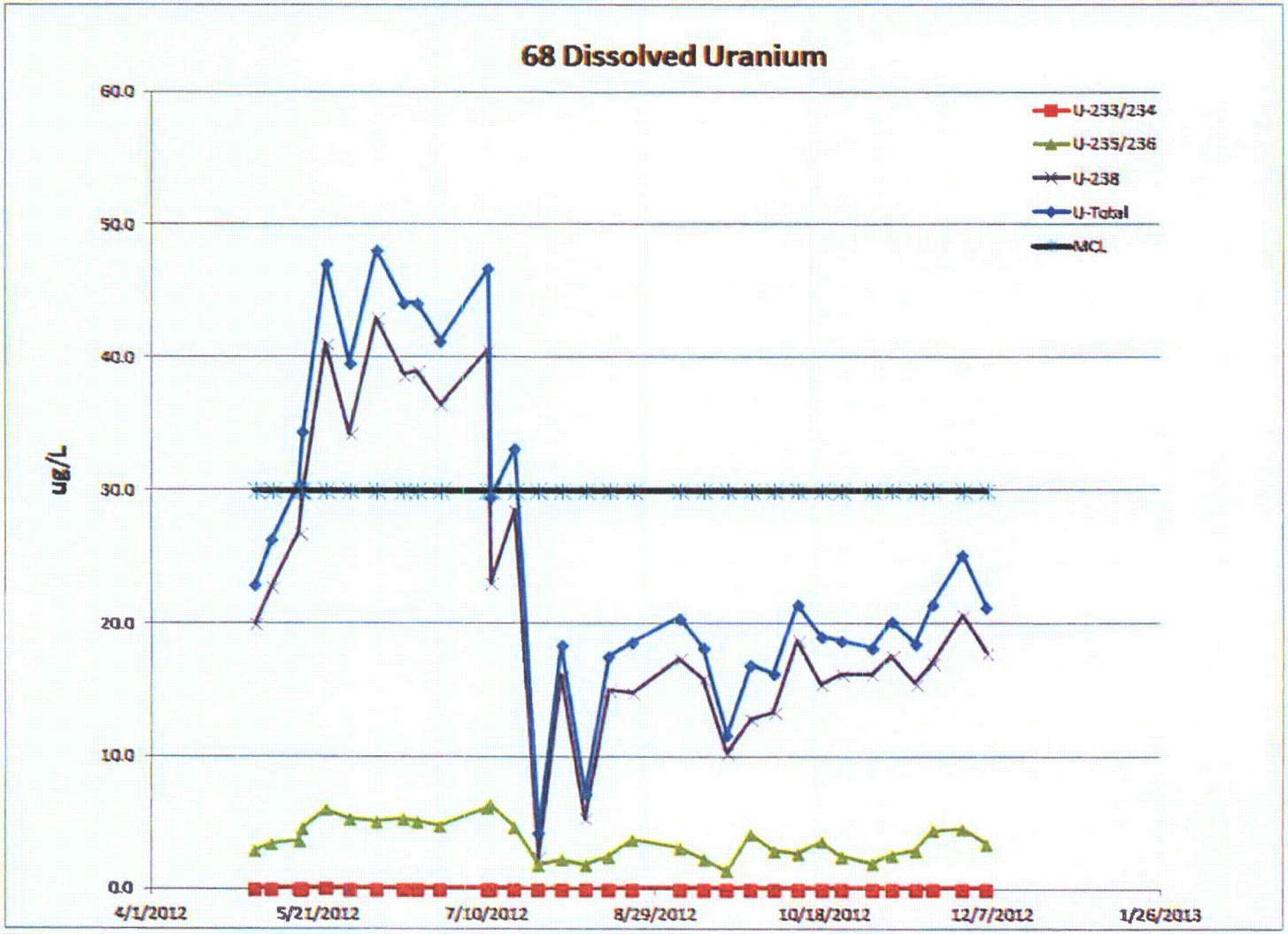

Notes:
30 ug/L – Maximum Contaminant Level for Uranium
ug/L – Micrograms per Liter

NUCLEAR FUEL SERVICES
ERWIN, TENNESSEE
NORTH SITE AND WELL 98A INVESTIGATION REPORT

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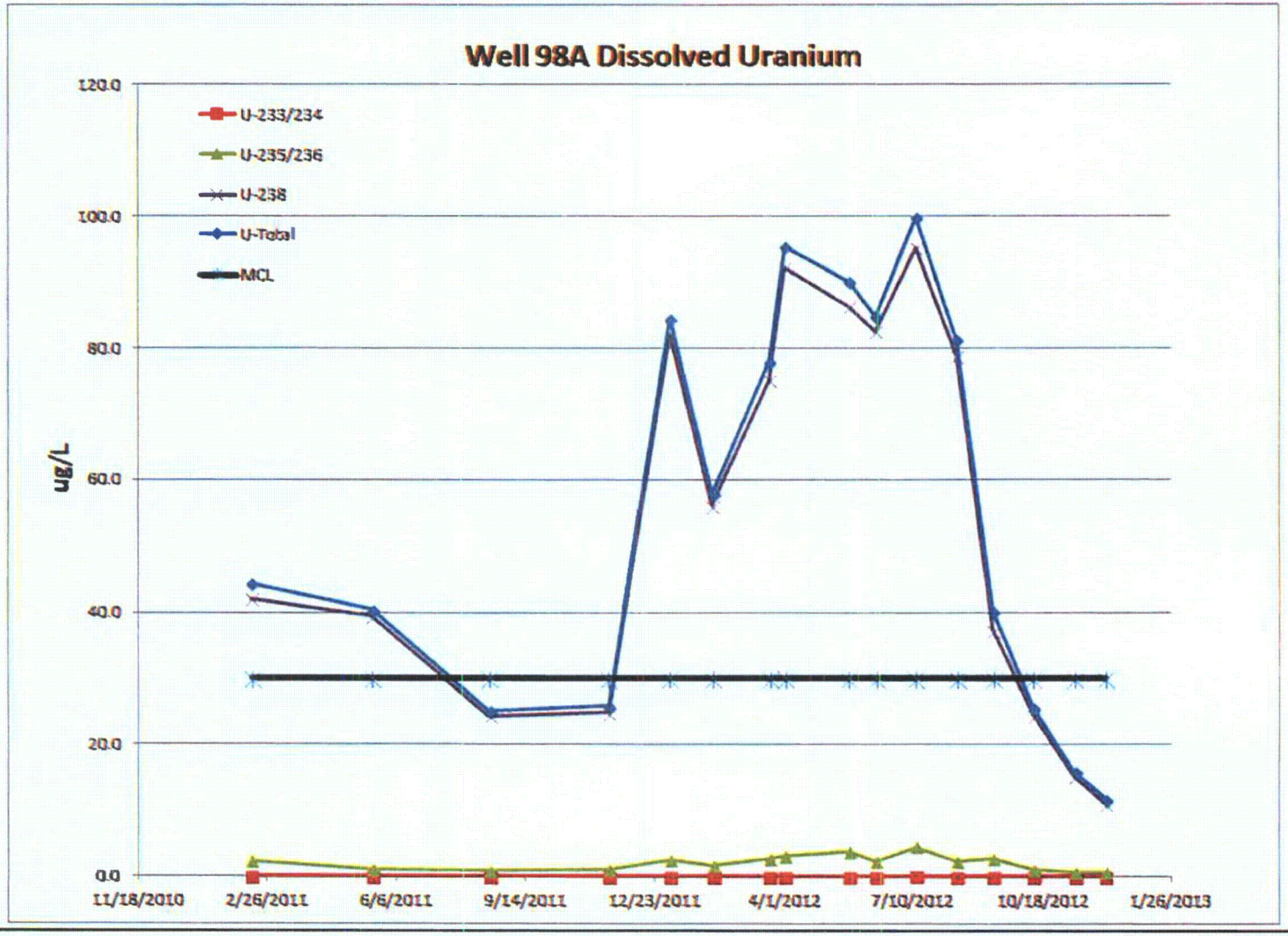
CITY: KNX DIV/GROUP: ENV/GIS DB: C.SMITH PIC: B.ILGNER PM: P.PRESTON TM: B.BAILEY
PROJECT: TNNFS123.W98A.00001 PATH: G:\GIS\TNNFS\GIS\MapDocuments\2013\North Site & Well 98A Investigation Report\A5 98A.pdf



Notes:
30 ug/L – Maximum Contaminant Level for Uranium
ug/L – Micrograms per Liter

NUCLEAR FUEL SERVICES
ERWIN, TENNESSEE
NORTH SITE AND WELL 98A INVESTIGATION REPORT

Well 98A

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Appendix
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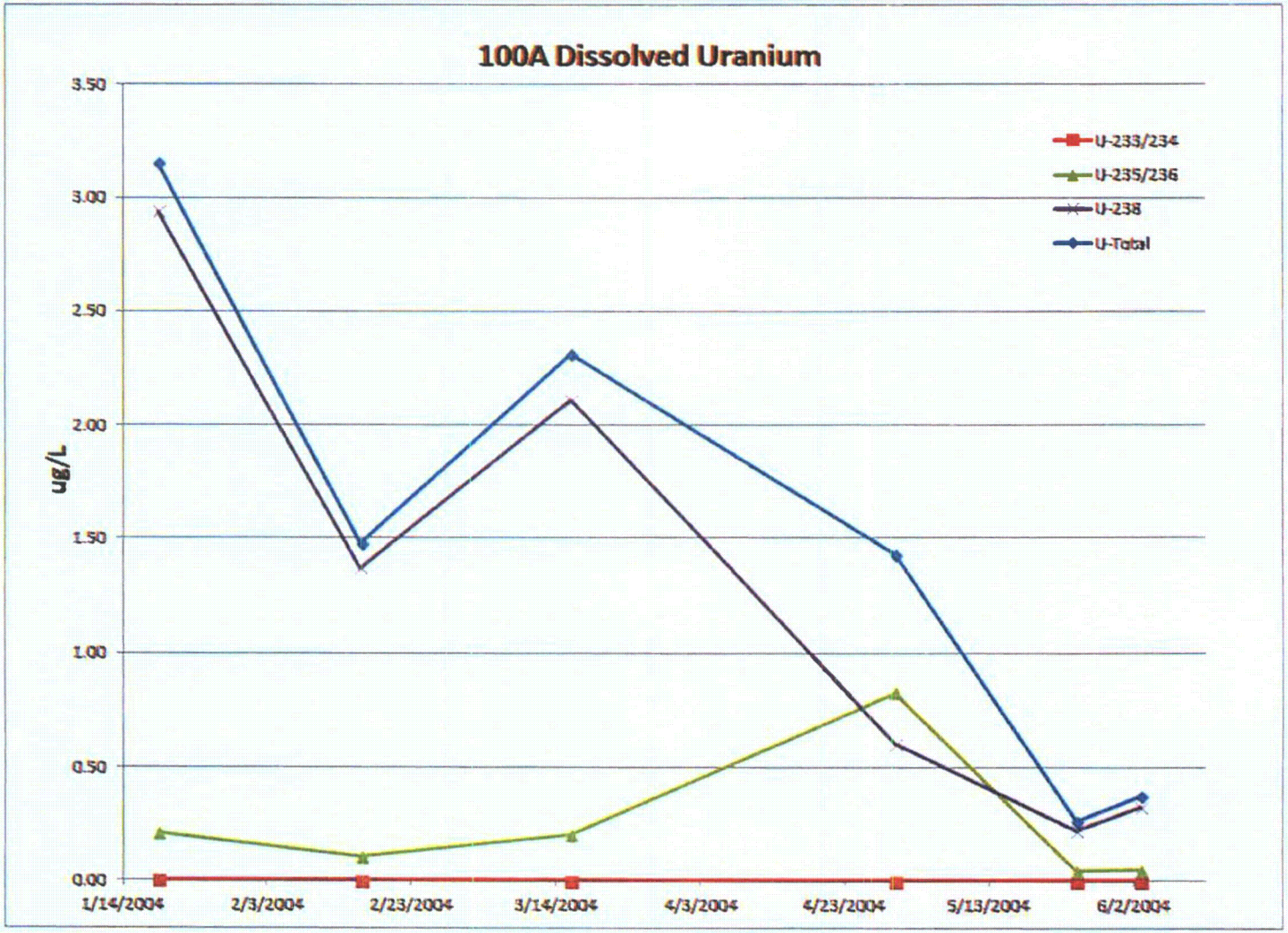
CITY: KNX DIV/GROUP: ENV/GIS DB: C.SMITH PIC: B.ILGNER PM: P.PRESTON TM: B.BAILEY
PROJECT: TNNFS123.W98A.00001 PATH: G:\GIS\TNNFS\GIS\MapDocuments\2013\North Site & Well 98A Investigation Report\A6 100A.pdf



Notes:
30 ug/L – Maximum Contaminant Level for Uranium
ug/L – Micrograms per Liter

NUCLEAR FUEL SERVICES
ERWIN, TENNESSEE
NORTH SITE AND WELL 98A INVESTIGATION REPORT

Well 100A

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Appendix
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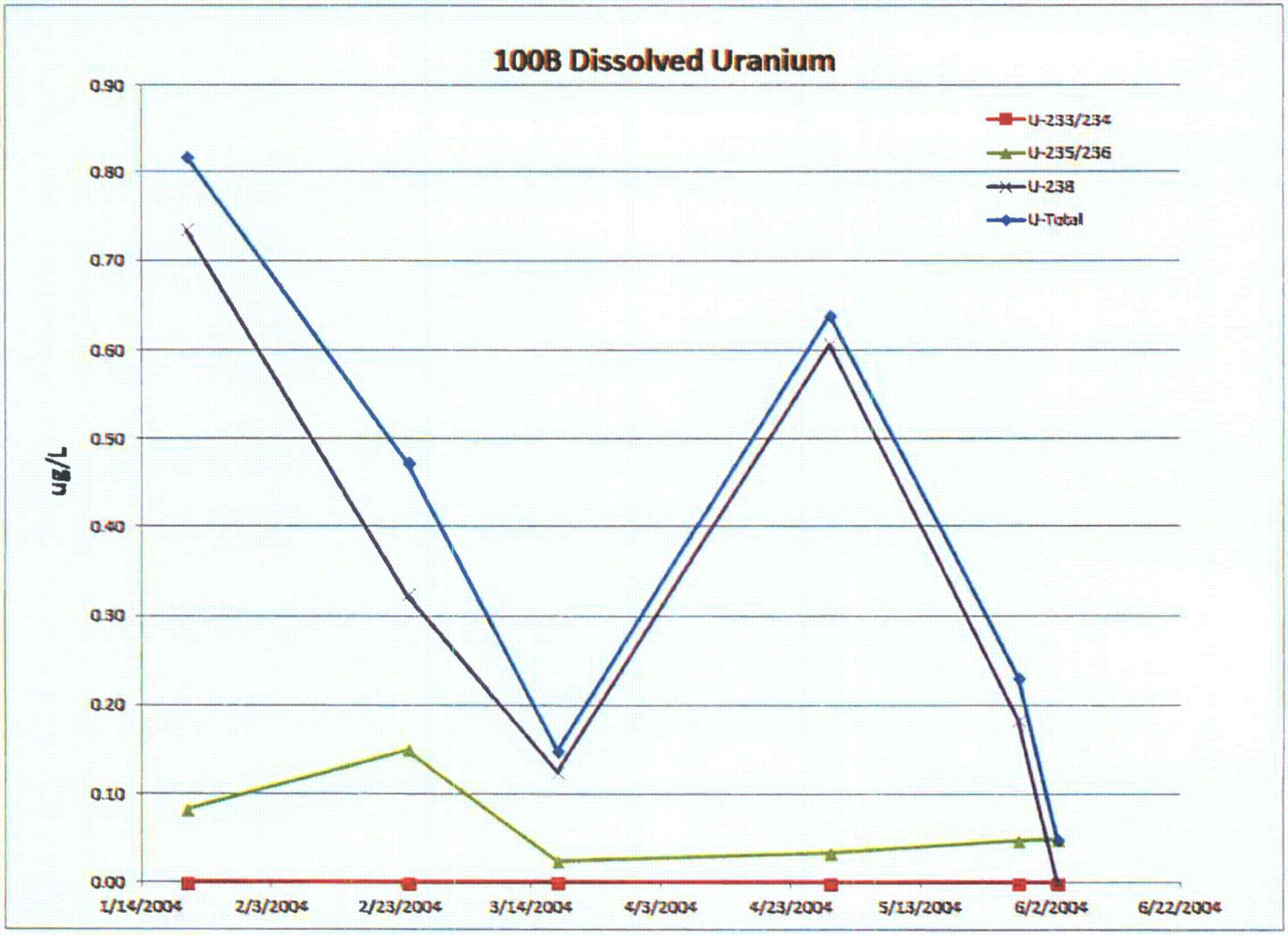
CITY: KNX DIV/GROUP: ENV/GIS DB: C.SMITH PIC: B.ILGNER PM: P.PRESTON TM: B.BAILEY
PROJECT: TNNFS123.W98A.00001 PATH: G:\GIS\TNNFS\GIS\MapDocuments\2013\North Site & Well 98A Investigation Report\A7 100B.pdf



Notes:
30 ug/L – Maximum Contaminant Level for Uranium
ug/L – Micrograms per Liter

NUCLEAR FUEL SERVICES
ERWIN, TENNESSEE
NORTH SITE AND WELL 98A INVESTIGATION REPORT

Well 100B

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Appendix
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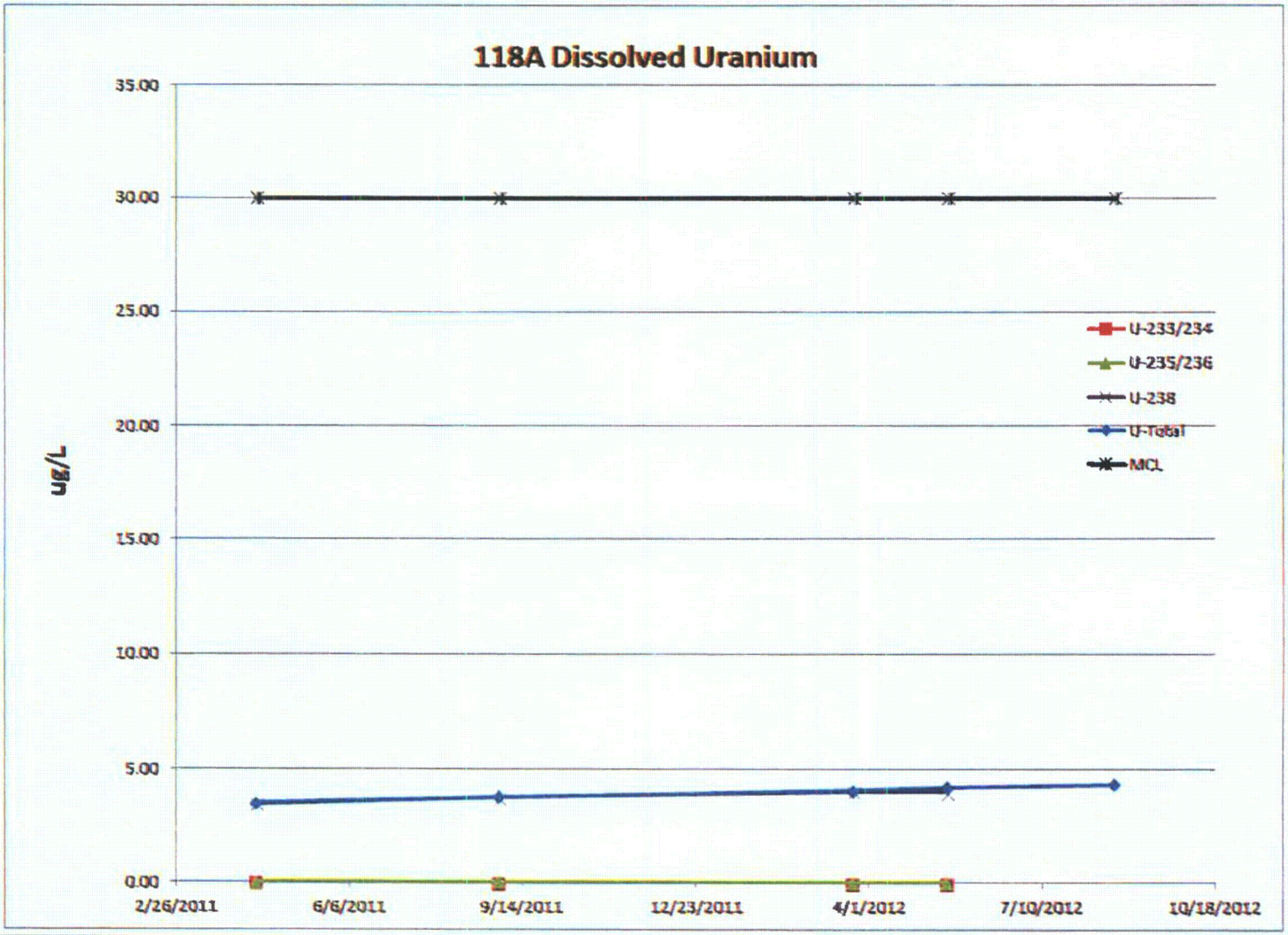
CITY: KNX DIV/GROUP: ENV/GIS DB: C.SMITH PIC: B.ILGNER PM: P.PRESTON TM: B.BAILEY
PROJECT: TNNFS123.W98A.00001 PATH: G:\GIS\TNNFS\GIS\MapDocuments\2013\North Site & Well 98A Investigation Report\A8 118A.pdf



Notes:
30 ug/L – Maximum Contaminant Level for Uranium
ug/L – Micrograms per Liter

NUCLEAR FUEL SERVICES
ERWIN, TENNESSEE
NORTH SITE AND WELL 98A INVESTIGATION REPORT

Well 118A

ARCADIS

Appendix
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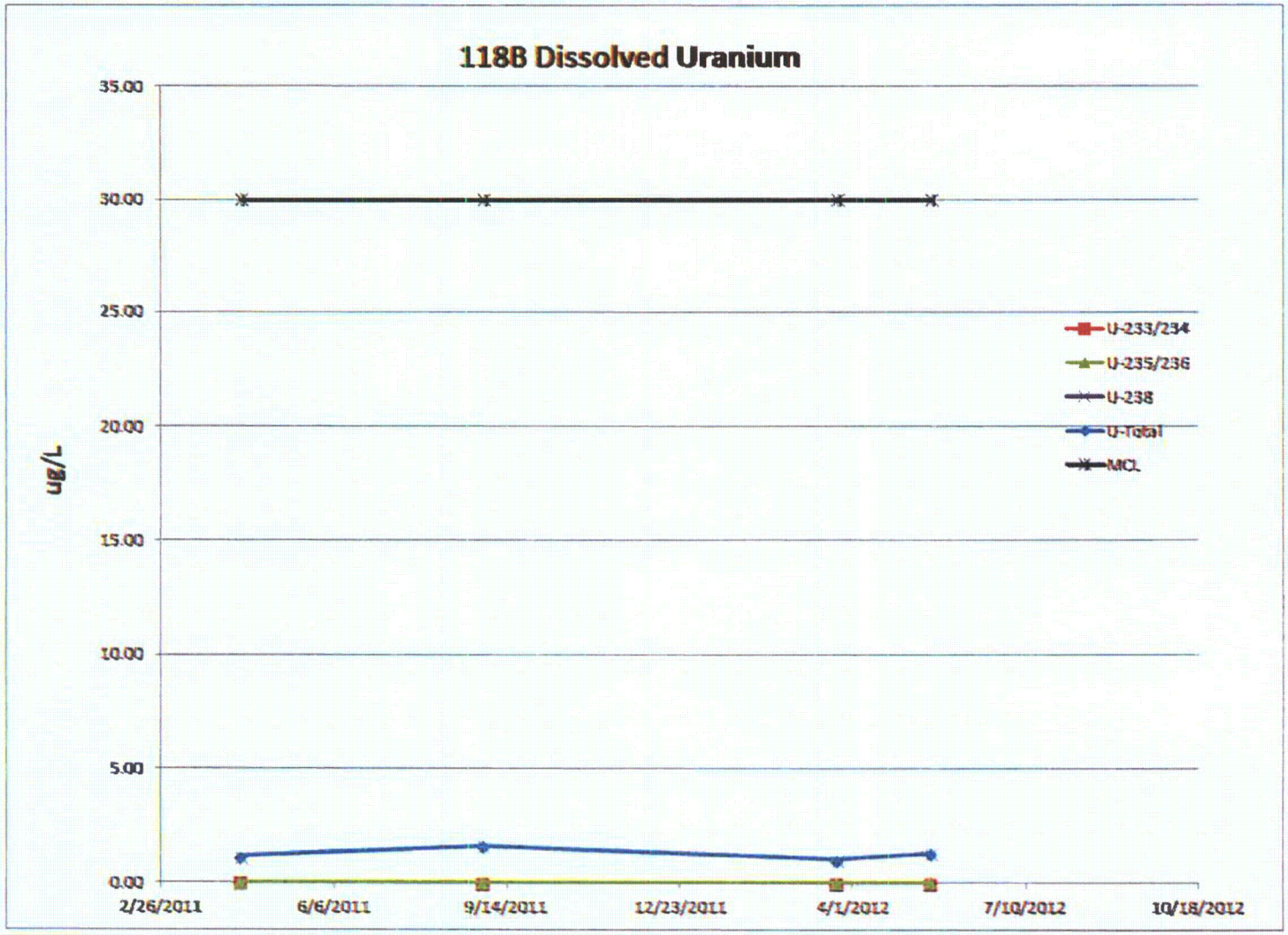
CITY: KNX DIV/GROUP: ENV/GIS DB: C.SMITH PIC: B.ILGNER PM: P.PRESTON TM: B.BAILEY
PROJECT: TNNFS123.W98A.00001 PATH: G:\GIS\TNNFS\GIS\MapDocuments\2013\North Site & Well 98A Investigation Report\A9 118B.pdf



Notes:
30 ug/L – Maximum Contaminant Level for Uranium
ug/L – Micrograms per Liter

NUCLEAR FUEL SERVICES
ERWIN, TENNESSEE
NORTH SITE AND WELL 98A INVESTIGATION REPORT

Well 118B

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Appendix
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