5.0 Falls City, Texas, Disposal Site

5.1 Compliance Summary

The Falls City, Texas, Uranium Mill Tailings Radiation Control Act (UMTRCA) Title I Disposal Site was inspected on May 23, 2023. No changes were observed in the disposal cell or associated drainage features, and personnel found no cause for a follow-up inspection.

The U.S. Department of Energy (DOE) Office of Legacy Management (LM) conducts annual groundwater monitoring as a best management practice. LM conducts two types of groundwater monitoring at the Falls City site: disposal cell performance monitoring and groundwater compliance monitoring. In the original Long-Term Surveillance Plan (DOE 1997b) (1997 LTSP), DOE committed to 5 years of disposal cell performance monitoring for changes in groundwater quality over the initial ambient conditions. In the original Groundwater Compliance Action Plan (DOE 1998), DOE proposed a compliance strategy of no groundwater remediation and application of supplemental standards because site-related contamination in the uppermost aquifer poses no risk to human health as it is not used for human consumption and is classified as limited use. The limited use classification was due to widespread ambient contamination not due to milling and that could not be cleaned up with methods reasonably employed by public water systems. Therefore, no concentration limits or points of compliance have been established.

In 2008, DOE issued an updated LTSP, the *Long-Term Surveillance Plan for the U.S. Department of Energy Falls City Uranium Mill Tailings Disposal Site, Falls City, Texas* (DOE 2008) (2008 LTSP) that states that DOE has fulfilled the monitoring requirements for disposal cell performance and groundwater compliance. DOE committed to continue annual groundwater monitoring as a best management practice. DOE submitted the *Groundwater Monitoring Assessment, Falls City, Texas, Disposal Site* (DOE 2010) to the U.S. Nuclear Regulatory Commission (NRC) in 2010. In the 2010 report, DOE evaluated groundwater monitoring results from 2006 to 2010 and compared them to previous results. DOE recommended termination of the monitoring program based on the requirements specified in the 2008 LTSP and requested concurrence from NRC for groundwater monitoring activities to be discontinued at the site (Dayvault 2010). Because DOE has not received concurrence from NRC regarding the request, annual best management practice groundwater monitoring continues to be conducted. The most recent sampling event occurred in February 2023.

5.2 Compliance Requirements

Requirements for the long-term surveillance and maintenance of the site are specified in the site-specific 2008 LTSP in accordance with procedures established to comply with the requirements of the NRC general license at Title 10 *Code of Federal Regulations* Section 40.27 (10 CFR 40.27). Table 5-1 lists these requirements.

Table 5-1. License Requirements for the Falls City, Texas, Disposal Site

Requirement	LTSP	This Report	10 CFR 40.27
Annual Inspection and Report	Section 3.3	Section 5.4	(b)(3)
Follow-Up Inspections	Section 3.4	Section 5.5	(b)(4)
Maintenance	Section 3.5	Section 5.6	(b)(5)
Emergency Response	Section 3.6	Section 5.7	(b)(5)
Environmental Monitoring	Section 3.7	Section 5.8	(b)(2)

5.3 Institutional Controls

The 231-acre site, identified by the property boundary shown in Figure 5-1, is owned by the United States and was accepted under the NRC general license in 1997. DOE is the licensee and, in accordance with the requirements for UMTRCA Title I sites, LM is responsible for the custody and long-term care of the site. Institutional controls (ICs) at the site include federal ownership of the property, administrative controls, and the following physical ICs that are inspected annually: the disposal cell and associated drainage structures, entrance gate and sign, perimeter fence and signs, site markers, survey and boundary monuments, and wellhead protectors.

An adjacent 513-acre offsite property was sold by the State of Texas to Alamo Funding Group in 2005. The state initially acquired this land as part of the designated processing site, but this portion of the processing site was not incorporated into the final DOE-owned site. The warranty deed stipulates that the new owners agree not to use any groundwater underlying the property for commercial or industrial uses in accordance with requirements for parcel transfers stipulated in UMTRCA. No human habitation structures will be constructed on the property, and nothing may be done to affect groundwater quality or interfere with UMTRCA groundwater remediation activities. Permission must be obtained from the Texas Commission on Environmental Quality and LM before (1) constructing wells or otherwise exposing groundwater to the surface; (2) performing construction, excavation, or soil removal of any kind; or (3) selling the property. Alamo Funding Group subdivided the land and sold it to two parties in 2011 and 2012. LM confirmed that the deed restrictions remained in recorded real property documents. The two landowners will seek approval from LM and the state for any future construction.

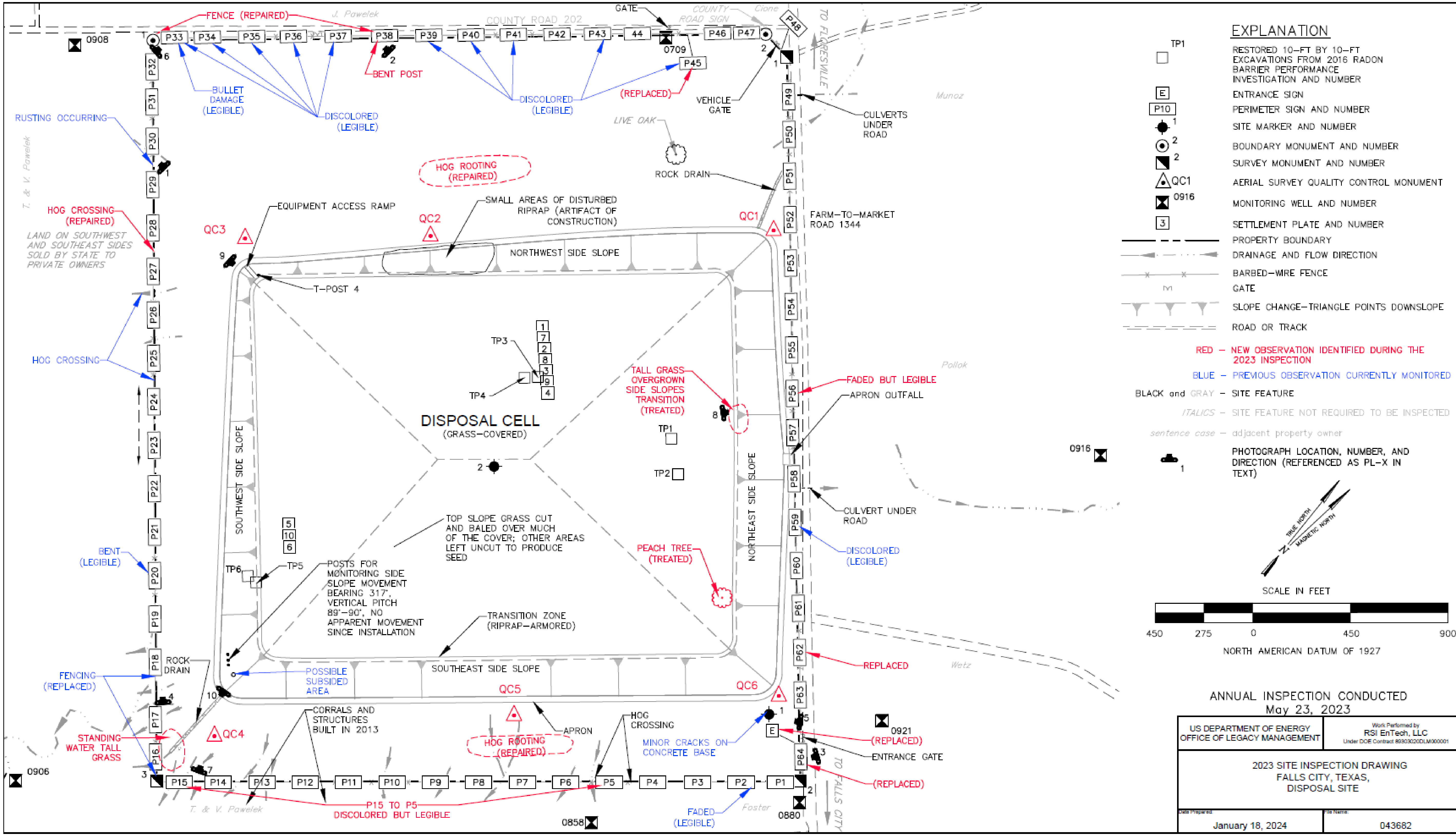


Figure 5-1. 2023 Annual Inspection Drawing for the Falls City, Texas, Disposal Site

5.4 Inspection Results

The site, 8 miles southwest of Falls City, Texas, was inspected on May 23, 2023, by D. Marshall, J. Graham, S. Daly, and L. Martin of the Legacy Management Support (LMS) contractor. C. Boger (LM site manager) and R. Lyssy (LMS maintenance subcontractor) attended the inspection. T. Johnson and S. Anderson (NRC) also attended the inspection. The purposes of the inspection were to confirm the integrity of visible features at the site, identify changes in conditions that might affect conformance with the 2008 LTSP, and evaluate whether maintenance or follow-up inspection and monitoring are needed.

5.4.1 Site Surveillance Features

Figure 5-1 shows the locations of site features, including site surveillance features and inspection areas, in black and gray font. Some site features that are present but not required to be inspected are shown in italic font. Observations from previous inspections that are currently monitored are shown in blue, and new observations identified during the 2023 annual inspection are shown in red. Inspection results and recommended maintenance activities associated with site surveillance features are described in the following subsections. Photographs to support specific observations are noted in the text and in Figure 5-1 by photograph location (PL) numbers. The photographs and photograph log are presented in Section 5.10.

5.4.1.1 Site Access, Entrance Gate, and Entrance Sign

Access to the site is from Farm-to-Market Road 1344. The entrance gate at the east corner of the site and the vehicle gate at the north corner were locked and functional. There are two entrance signs on each entrance gate. One sign is on the north entrance, and one sign is on the east entrance. The east entrance sign was illegible and was replaced following the inspection. No other maintenance needs were identified.

5.4.1.2 Perimeter Fence and Signs

A five-strand barbed-wire perimeter fence encloses the site. As noted in previous inspections, perimeter fence strands and posts are beginning to rust except along the northwest side where the fence was replaced in 2006. The fence on the southwest side, between perimeter signs P33 and P38, showed signs of rust and damage and was repaired following the inspection. The rusting occurring between perimeter signs P29 and P32 will continue to be monitored (PL-1). The post at perimeter sign P38 is bent but functional (PL-2).

Wild hogs dig under the perimeter fence line in some areas. Their crossings are filled in by the LMS maintenance subcontractor, as these crossings can potentially compromise the integrity of the perimeter fence or damage haying equipment.

There are 64 perimeter signs attached to steel posts set in concrete and positioned along the property boundary and set back 5 feet (ft). Perimeter sign P64 (PL-3) was brittle and was replaced following the inspection, along with perimeter sign P62. Perimeter sign P45 was illegible and was replaced following the inspection. Perimeter sign P33 has bullet damage but remains legible. Additional perimeter signs are fading but remain legible. Replacement of the perimeter fence between perimeter sign P18 and survey monument SM-3 was completed following the 2022 inspection (PL-4). No other maintenance needs were identified.

5.4.1.3 Site Markers

The site has two site markers. Site marker SMK-1 is just inside the entrance gate (PL-5). The corners of the concrete base around the marker are cracked. The cracks are unchanged since the last inspection, and repairs are not needed. Site marker SMK-2 is on the top slope of the disposal cell. No maintenance needs were identified.

5.4.1.4 Survey and Boundary Monuments

Three survey monuments and two boundary monuments delineate the corners of the property (PL-6).

5.4.1.5 Aerial Survey Quality Controls Monuments

Six aerial survey quality control monuments were installed in February 2023 (PL-7). All monuments were in good condition during the inspection. No maintenance needs were identified.

5.4.1.6 Monitoring Wells

There is one monitoring well onsite; 11 monitoring wells are offsite. All monitoring wells were inspected during the February 2023 sampling event, and wellhead protectors were undamaged and locked. No maintenance needs were identified.

5.4.2 Inspection Areas

In accordance with the 2008 LTSP, the site is divided into three inspection areas (referred to as “transects” in the LTSP) to ensure a thorough and efficient inspection. The inspection areas are (1) the top and side slopes of the disposal cell, apron outfall, and rock drains; (2) the region between the apron at the toe of the side slopes and the site perimeter; and (3) the outlying area. Inspectors examined specific site surveillance features within each area and looked for evidence of erosion, settling, slumping, or other modifying processes that might affect the site’s conformance with LTSP requirements.

5.4.2.1 Top and Side Slopes of the Disposal Cell, Apron Outfall, and Rock Drains

The disposal cell, completed in 1994, occupies 127 acres. Its vegetated cover consists primarily of well-established coastal Bermudagrass and kleingrass, with other species interspersed. The site, including the disposal cell, is managed for hay production, which ensures that turf vitality is maintained. The LMS maintenance subcontractor can take as many as three cuttings of hay each year from the site. The LMS maintenance subcontractor spot-sprays woody vegetation distributed in the uncut grass. At the time of the May 2023 inspection, hay bales were present on the property.

The previously observed desiccation cracks were no longer present in the soil on the top of the disposal cell. There was no evidence of erosion, settling, slumping, or other modifying processes that might affect the integrity of the disposal cell. No areas of ponded water or areas of settlement were observed on top of the disposal cell during the 2023 inspection.

On the northwest side slope, there was tall grass overgrown at the transition point from the top of the side slope to the riprap side slope that was treated following the inspection (PL-8). LM has also monitored several small depressions on the northwest side slope of the disposal cell since 2010. These depressions do not compromise the protectiveness of the riprap side slope, and no changes have been observed since 2010. Inspectors will continue to monitor these areas.

Fractured riprap has been observed on the disposal cell side slopes since it was completed. Pieces of riprap are fractured in place, indicating that the fracturing occurred after placement. Fracturing is likely a consequence of mechanical placement or thermal expansion and contraction; the riprap condition appears stable.

An equipment access ramp to the top of the disposal cell is at the west corner of the side slope (PL-9). The ramp was installed in 2006 using clean, angular riprap of progressively smaller rock sizes to provide a free-draining and stable driving surface that does not encourage vegetation encroachment. Some displacement of smaller rock has occurred, as would be expected from use, but the ramp continues to provide a stable driving surface.

Vegetation management is conducted on the top of the disposal cell and on the side slopes. Much of the vegetation observed on the side slopes was dead or dormant grass. The grass does not affect disposal cell performance. Because deep roots of woody vegetation could penetrate the radon barrier, woody vegetation is controlled annually through cutting and applying herbicide. A peach tree was observed growing on top of the disposal cell and was treated following the inspection. No additional maintenance concerns were noted on the top and side slopes of the disposal cell.

LM participated in a project sponsored by NRC to investigate the effect of soil-forming processes on the performance of the radon barrier on UMTRCA disposal cells. In April 2016, researchers excavated through the cover materials (cover soil and underlying radon barrier) at six locations to measure radon flux and document soil structure (Figure 5-1). Although significant soil structure was developing, radon flux did not exceed the U.S. Environmental Protection Agency (EPA) standard. LM will continue to monitor these locations to confirm that positive drainage is preserved and vegetation continues to thrive at the grass-covered test pits.

There was water slowly flowing in the south rock drain during the inspection (PL-10) with water ponding on the south corner noted on the inspection map. Willows that grow along the south drain are periodically removed by the LMS maintenance subcontractor. No water was observed in the north rock drain. Vegetation is left uncut at the outlets of the rock drains to help dissipate the energy of stormwater runoff and reduce soil erosion. No maintenance needs were identified.

5.4.2.2 Region Between the Apron at the Toe of the Side Slopes and the Site Perimeter

The area between the perimeter fence and the apron at the toe of the disposal cell side slopes is covered with well-established grass, which is primarily kleingrass with some coastal Bermudagrass. The grass is cut and baled 1 to 3 times annually, depending on precipitation. It is usually left uncut along the fence, along rock drains, and around some surveillance features, such as survey monuments that cannot be accessed with conventional farming equipment. No maintenance needs were identified.

5.4.2.3 Outlying Area

The area 0.25 mile beyond the site boundary was visually observed for erosion, changes in land use, or other phenomena that might affect the long-term integrity of the site. No such impacts were observed.

A portion of the site has been sold to another owner who is using the area for occasional livestock grazing. The new owners have removed some of the brush on their property to facilitate grazing.

Karnes County Road 202 runs along the northwest side of the property boundary. Public access to the road was restricted by a locked gate before 2011. The road has been open since then, but this has not led to increased vandalism or trespassing at the site.

5.5 Follow-Up Inspections

LM will conduct follow-up inspections if (1) a condition is identified during the annual inspection or other site visit that requires a return to the site to evaluate the condition or (2) LM is notified by a citizen or outside agency that conditions at the site are substantially changed. No need for a follow-up inspection was observed.

5.6 Maintenance

Six aerial survey quality control monuments were installed before the site inspection. Inspectors noted the following minor maintenance items that were completed following the inspection:

- Replacement of perimeter signs P45, P62, and P64
- Replacement of the entrance sign on the northeast gate between perimeter signs P64 and P63
- Repair of the perimeter fence between perimeter signs P33 and P38
- Repair of the hog crossing between perimeter signs P27 and P28
- Repair of the hog rootings on the northwest and southeast outlying areas
- Removal of the tall grass and vegetation on the northeast side slope transition

No other maintenance needs were identified.

5.7 Emergency Response

An emergency response is action LM will take in response to unusual damage or disruption that threatens or compromises site safety, security, or integrity in compliance with 10 CFR 40 Appendix A Criterion 12. No need for an emergency response was found.

5.8 Environmental Monitoring

5.8.1 Groundwater Monitoring

In accordance with the 2008 LTSP, annual groundwater monitoring is conducted as a best management practice. The most recent sampling event occurred in February 2023. The compliance strategy for groundwater protection at the site is no further remediation and application of supplemental standards in accordance with 40 CFR 192.21(g). Because supplemental standards apply to the uppermost aquifer at the site, no concentration limits or point of compliance locations have been established. Groundwater in the uppermost aquifer beneath the site meets the EPA definition of limited use (Class III) because it is not currently or potentially a source of drinking water due to widespread ambient contamination that cannot be remediated using methods reasonably employed by public water supply systems (40 CFR 192.11[e]).

As prescribed in the LTSP, the site groundwater monitoring program has the following purposes:

- Disposal cell performance monitoring
- Groundwater compliance monitoring to demonstrate that potential users of groundwater downgradient of the site are not exposed to contamination related to the former processing site

Two hydraulically connected groundwater units comprise the uppermost aquifer beneath the site. The shallower of the two units consists of the Deweesville Sandstone, which is underlain by the Conquista Clay of the Whitsett Formation. Groundwater flow in the Conquista Clay occurs mainly in the middle sandstone subunit with clay subunits above and below, though continuously low permeability strata have not been identified (DOE 1997a). Thus, these two units together are often referred to as the Deweesville/Conquista aquifer. The Dilworth Sandstone of the Whitsett Formation is below the Conquista Clay. A downward hydraulic gradient occurs between the Deweesville/Conquista aquifer to the Dilworth aquifer, but the main communication between the two occurs through past mining company boreholes that were not abandoned properly (DOE 1997a). With this, the Dilworth is included as part of the uppermost aquifer. The 2008 LTSP states that the Dilworth Sandstone is underlain by the Manning Clay, a 300-foot-thick aquitard that isolates the uppermost aquifer from higher-quality groundwater in deeper aquifers. Samples are collected from the Deweesville/Conquista and the Dilworth groundwater units.

Table 5-2 and Figure 5-2 describe and illustrate the groundwater monitoring network at the site, which includes the groundwater compliance monitoring wells and the disposal cell performance monitoring wells. The disposal cell performance monitoring wells are near the disposal cell and are all completed in the Deweesville and Conquista units. The groundwater compliance monitoring wells are downgradient of the site and completed in the Deweesville and Conquista units and the Dilworth unit.

Table 5-2. Groundwater Monitoring Network for the Falls City, Texas, Disposal Site

Groundwater Monitoring Purpose	Monitoring Wells	Comments
Disposal cell performance monitoring	0709, 0858, 0880, 0906, 0908, 0916, and 0921	Well 0880 is completed in the Deweesville unit; remaining disposal cell performance wells are completed in the Conquista unit. Wells 0908 and 0916 have been dry since 1987.
Groundwater compliance monitoring	0862, 0886, 0891, 0924, and 0963	Well 0886 is completed in the Deweesville unit and is considered a sentinel well for groundwater flow toward the Conquista site. Wells 0924 and 0963 are completed in the Conquista unit, and wells 0862 and 0891 are completed in the underlying Dilworth unit. Wells 0924 and 0891 are considered sentinel wells for the Conquista and Dilworth units, respectively (DOE 1997a).

Groundwater is sampled annually for total uranium and field measurements of water level, temperature, pH, conductivity, turbidity, alkalinity, dissolved oxygen, and oxidation-reduction potential. Of particular interest are total uranium, pH, and water levels. The *Final Site Observational Work Plan for the UMTRA Project Site at Falls City, Texas* (DOE 1997a) identifies low pH in groundwater as an indicator of the extent and movement of the tailings-derived groundwater plumes. However, in the 2008 LTSP, subsequent monitoring results indicate that pH is not always an indicator of contaminant concentrations at the site. Therefore, increasing uranium concentrations at a monitoring well without an attendant drop in pH might still indicate movement of processing-related contamination.

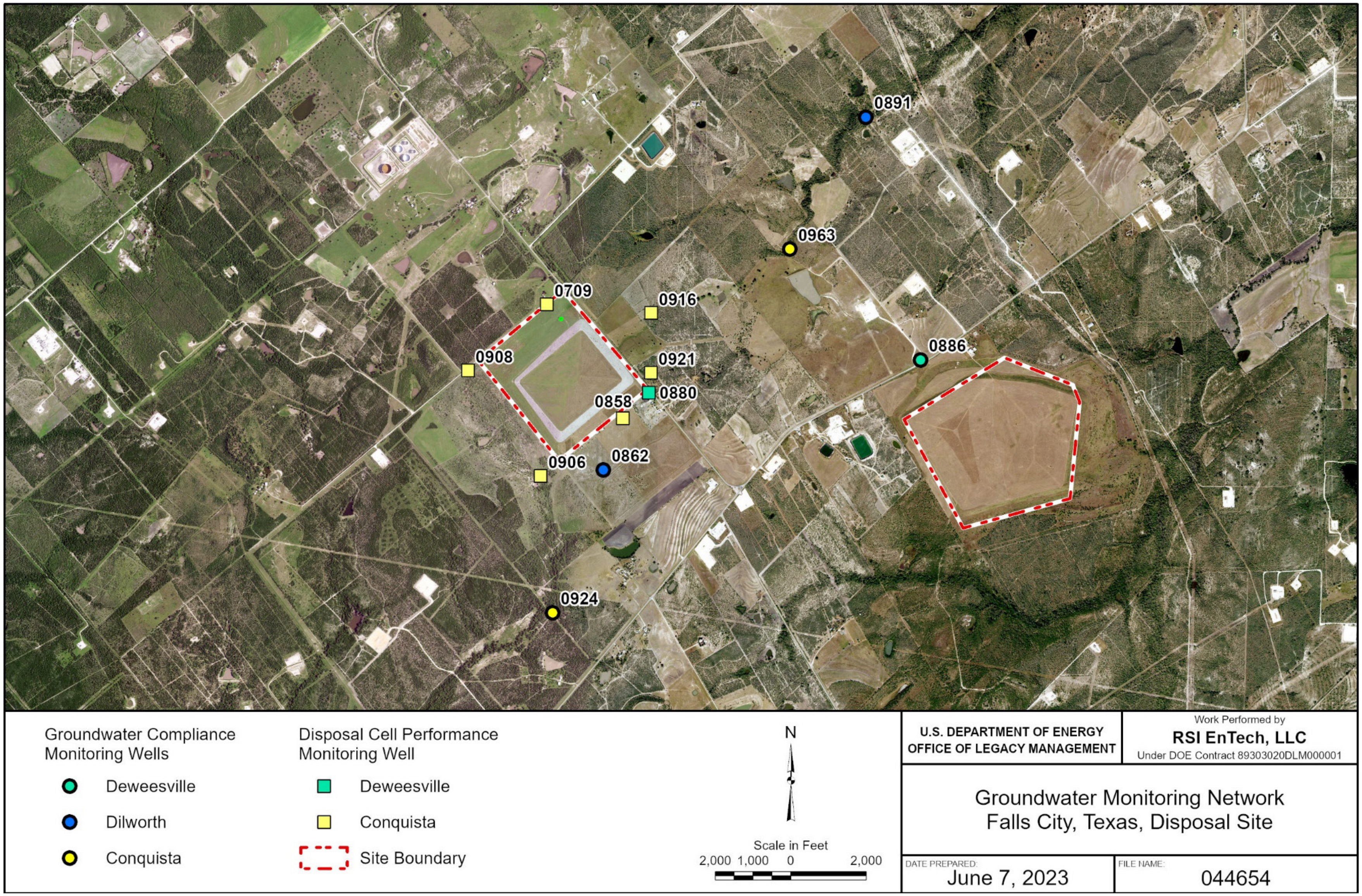


Figure 5-2. Groundwater Monitoring Well Network at the Falls City, Texas, Disposal Site

The following sections (Sections 5.8.2 and 5.8.3) present monitoring results for groundwater levels and groundwater quality (pH and uranium), respectively. To support these discussions, Figure 5-3 through Figure 5-8 use a faceting approach, whereby data are partitioned into a matrix of panels, with each panel plotting data for a single well. In each facet plot, a nonparametric smoothing method—locally estimated scatterplot smoothing (LOESS)—is used. The surrounding shaded area represents the 95% pointwise confidence interval. Using this approach, overall trends in the data are more apparent and not obscured by "noise" or random variation. Because of the wide range in uranium contaminant concentrations measured in site wells (0.0003–14 milligrams per liter [mg/L]), a semilogarithmic scale is used.

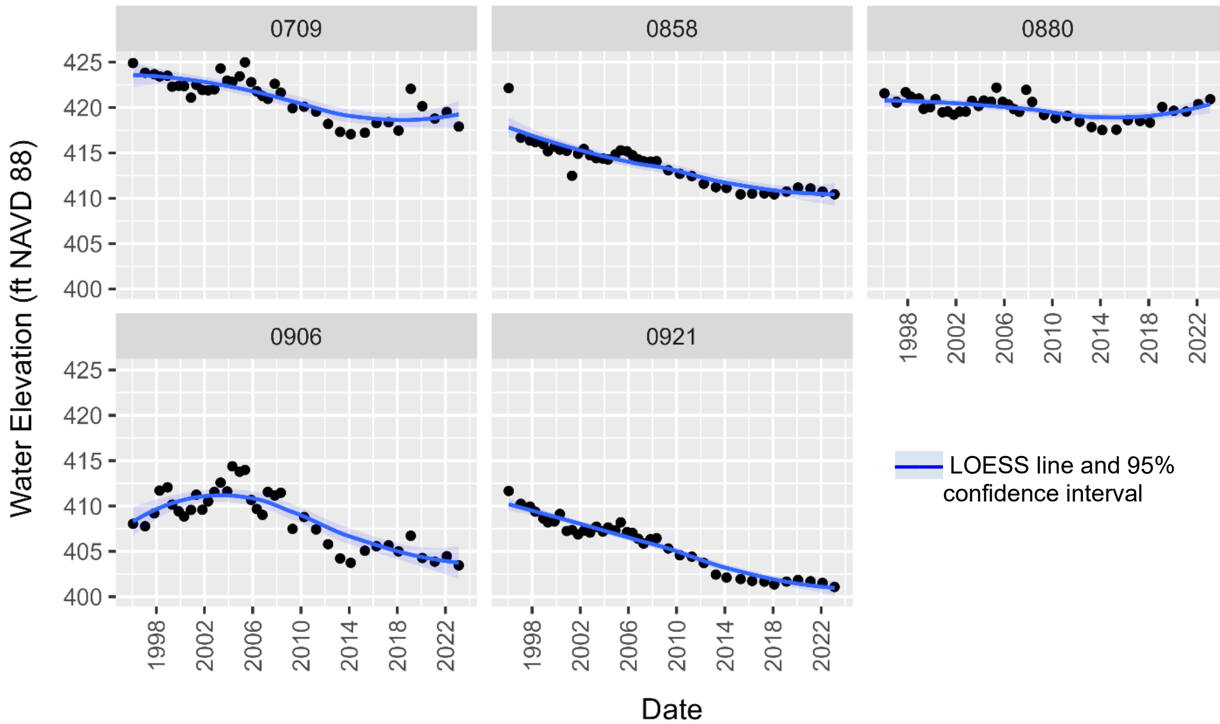
Figure 5-3 through Figure 5-8 were developed using R, version 4.3.0 (The R Foundation 2023), and the ggplot2 package, version 3.4.2 (Wickham 2016), one of a collection of packages included in the tidyverse (version 2.0.0) (Wickham et al. 2019). To support interpretation of these figures, Mann-Kendall trend analysis was performed for each well-parameter combination to assess whether trends in water levels, pH, or uranium are upward, stable (no trend), or declining. Detailed Mann-Kendall trend test results are documented at the end of this section (Table 5-3).

All groundwater monitoring results presented in the following sections are reported and published on the LM Geospatial Environmental Mapping System (GEMS) website (https://gems.lm.doe.gov/#site=FCT).

5.8.2 Groundwater Level Monitoring Results

Figure 5-3 and Figure 5-4 plot groundwater elevations measured between 1996 and 2023 in disposal cell performance and groundwater compliance monitoring wells, respectively. The data plotted in these figures are referenced to the North American Vertical Datum of 1988 (NAVD 88). Water levels in all disposal cell performance wells have statistically significant decreasing trends from 1996 to 2023 based on Mann-Kendall trend analyses (Table 5-3). The greatest water-level declines have occurred in wells 0709, 0921, and 0858, with decreases of 7.0, 10.6, and 11.7 ft, respectively.

Groundwater compliance wells 0862, 0886, and 0963 have statistically significant increasing water-level trends since 1996 (5–7 ft increases). Although water levels in well 0891 have increased 3.3 ft since 1996 (Figure 5-4), the trend is not significant (Table 5-3). In contrast, a statistically significant decreasing trend was identified for well 0924, where water levels have declined 1.6 ft since 1996.



Note: Disposal cell performance monitoring wells 0908 and 0916 have been dry since 1987.

Figure 5-3. Water-Level Measurements at Disposal Cell Performance Monitoring Wells at the Falls City, Texas, Disposal Site

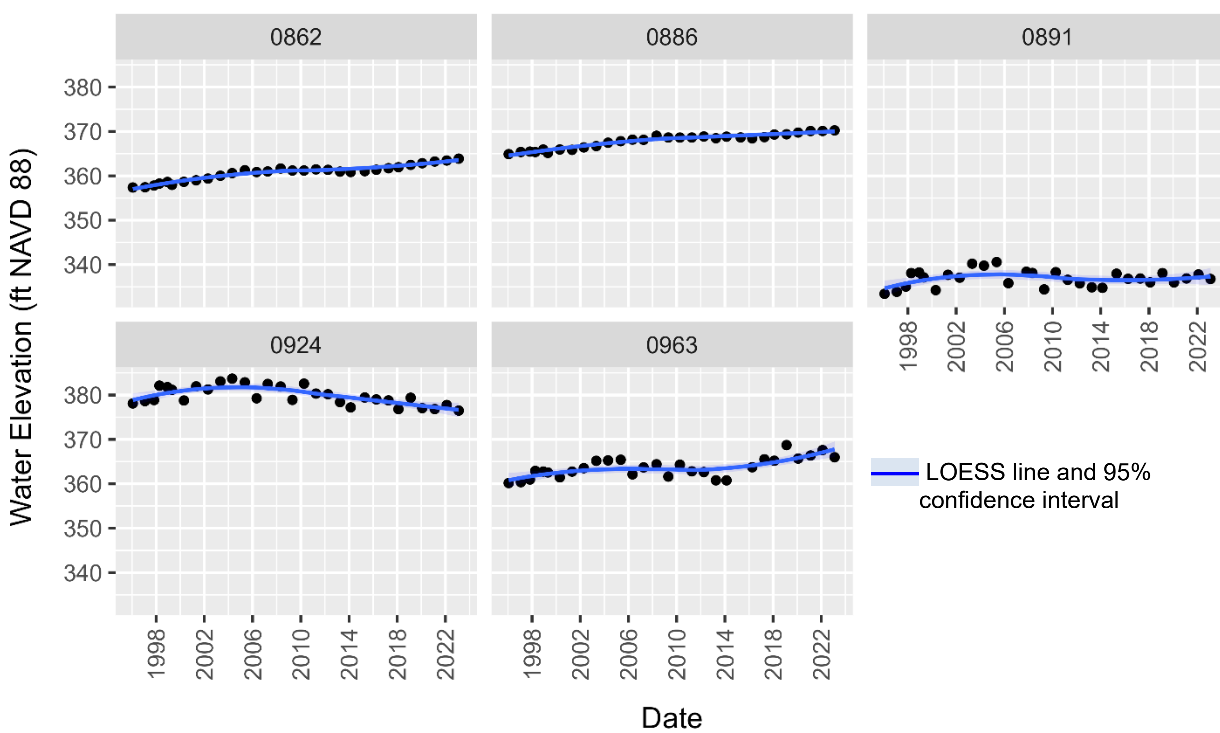
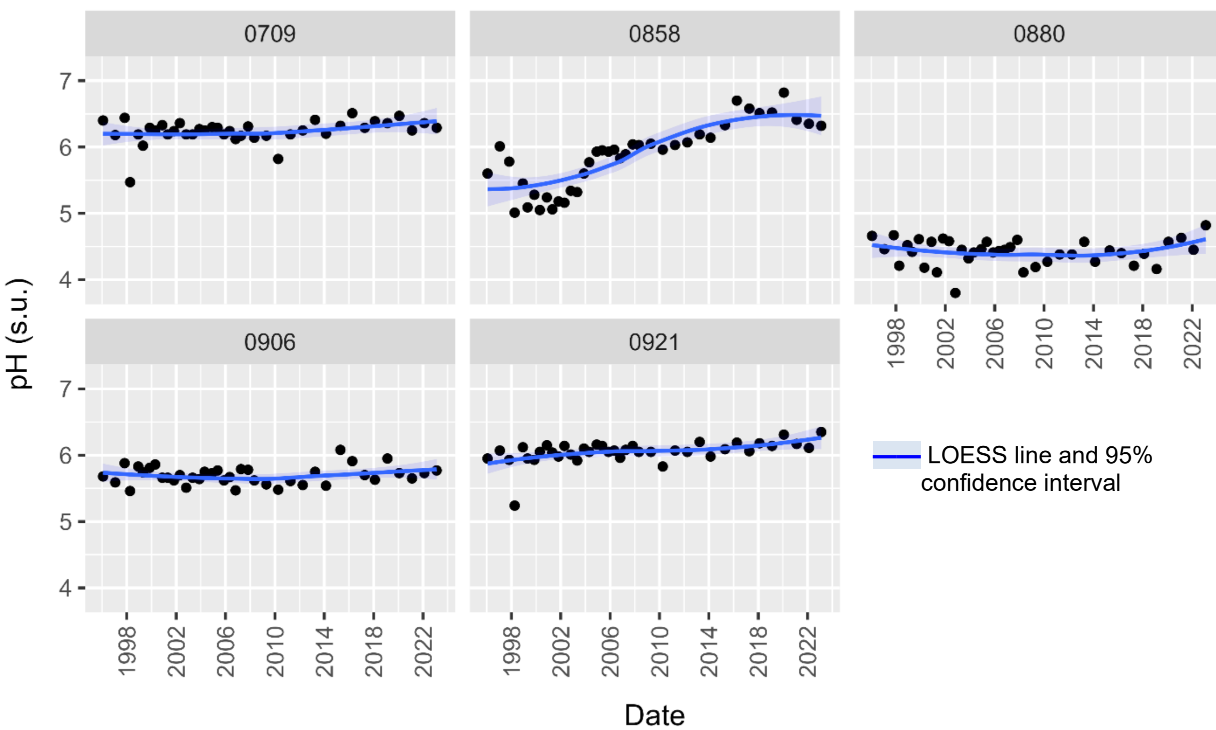


Figure 5-4. Water-Level Measurements at Groundwater Compliance Monitoring Wells at the Falls City, Texas, Disposal Site

5.8.3 Groundwater Quality Monitoring Results

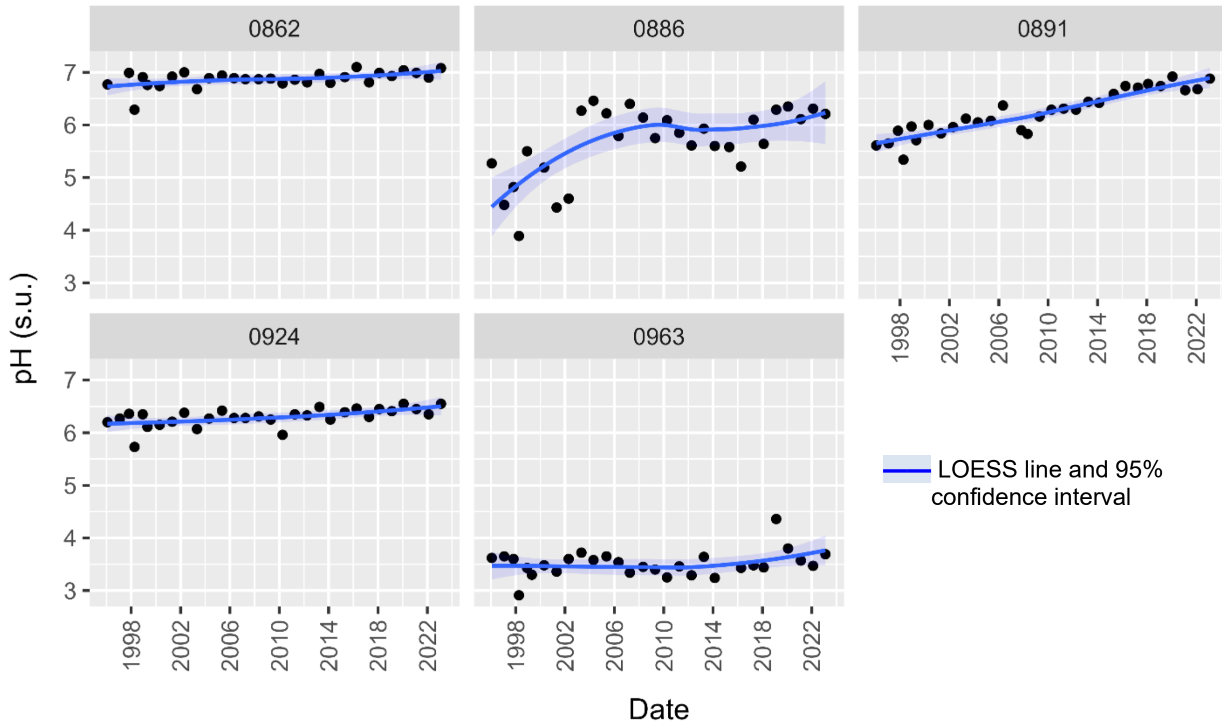
pH: Consistent with the findings in the previous annual report (DOE 2023), Mann-Kendall trend analysis indicates significant increasing trends in pH (since 1996) for wells 0858 and 0921 (Table 5-3). No significant trends were identified for the remaining disposal cell performance wells. Although pH values in all disposal cell performance wells have been greater than that measured in tailings pore fluids (pH of 2.9 [DOE 1997a]), pH levels in well 0880 remain relatively low, ranging from 3.4–5.2 historically and 3.8–4.8 for the 1996–2023 period shown in Figure 5-5. The pH values for all disposal cell performance monitoring wells do not show any recent significant changes (Figure 5-5).

For compliance monitoring wells, statistically significant increasing trends in pH have been identified in all wells except 0963 (Figure 5-6, Table 5-3). The pH values measured in 2023 were within the range of historical values for all groundwater compliance monitoring wells. The pH in monitoring well 0963 historically has been lower than at the other groundwater compliance wells (and the disposal cell performance monitoring wells), with a pH of 3.7 in 2023 compared to between 6.0–7.0 in the other wells.



Note: Disposal cell performance monitoring wells 0908 and 0916 have been dry since 1987.
Abbreviation: s.u. = standard unit

Figure 5-5. pH at Disposal Cell Performance Monitoring Wells at the Falls City, Texas, Disposal Site

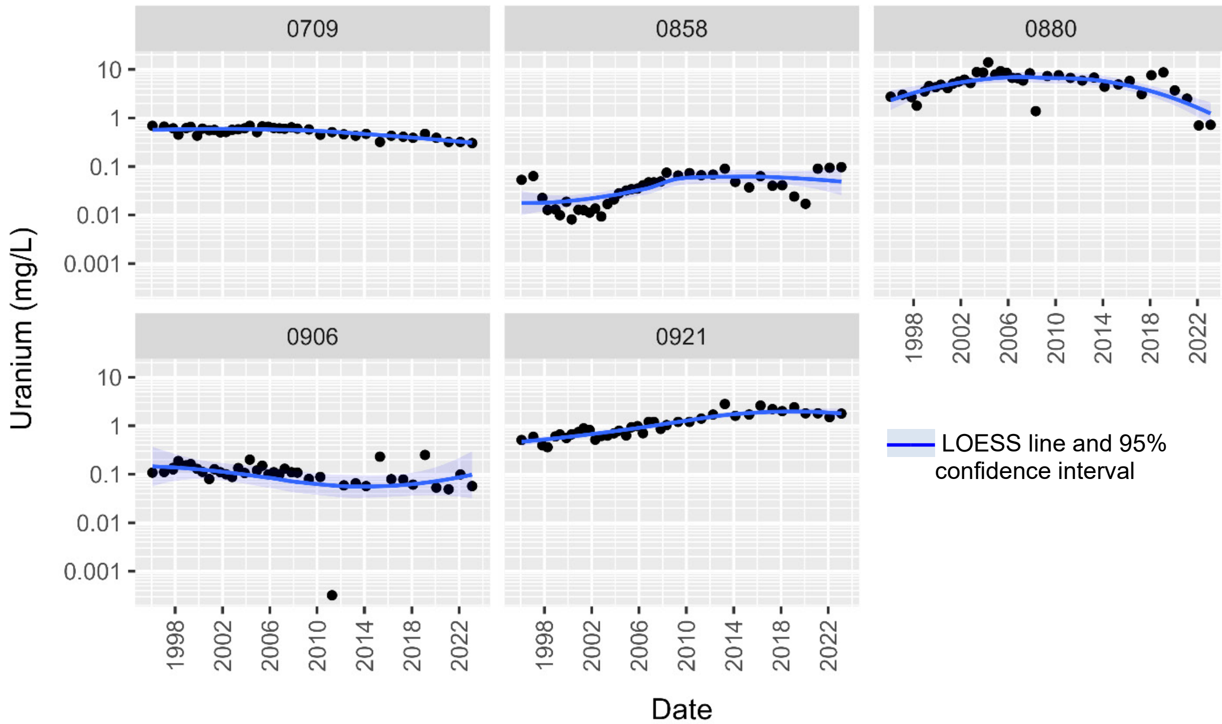


Abbreviation: s.u. = standard unit

Figure 5-6. pH at Groundwater Compliance Monitoring Wells at the Falls City, Texas, Disposal Site

Uranium: The 2023 uranium concentrations for disposal cell performance monitoring wells are similar to those reported in recent years (Figure 5-7). Using data since 1996, Mann-Kendall trend analysis identified statistically significant trends in uranium concentrations in all disposal cell performance monitoring wells except well 0880 (Table 5-3). Significant increasing trends were found for wells 0858 and 0921, while significant decreasing trends were identified for wells 0709 and 0906. Uranium concentrations in monitoring well 0880 are most variable, ranging from 0.7 mg/L (result from 2022 and 2023) to 14 mg/L in 2004, but with no significant trend.

In 2023, uranium concentrations in groundwater compliance monitoring wells were consistent with the findings reported in the previous annual report (Figure 5-8) (DOE 2023). Mann-Kendall trend analysis identified statistically significant uranium concentration trends in all wells, with increasing trends found for wells 0886, 0891, and 0924, and decreasing trends in wells 0862 (characterized by low uranium concentrations) and 0963 (Table 5-3). Although a significant increasing trend was identified for well 0924, uranium concentrations have been relatively stable since 2004, fluctuating between approximately 0.4 mg/L and 0.6 mg/L. Uranium concentrations in well 0886 have stabilized in recent years (most recent result of 0.0075 mg/L). The latter is also true for monitoring well 0891, where uranium concentrations have decreased since 2018 (Figure 5-8).



Note: Disposal cell performance monitoring wells 0908 and 0916 have been dry since 1987.

Figure 5-7. Uranium Concentrations at Disposal Cell Performance Monitoring Wells at the Falls City, Texas, Disposal Site

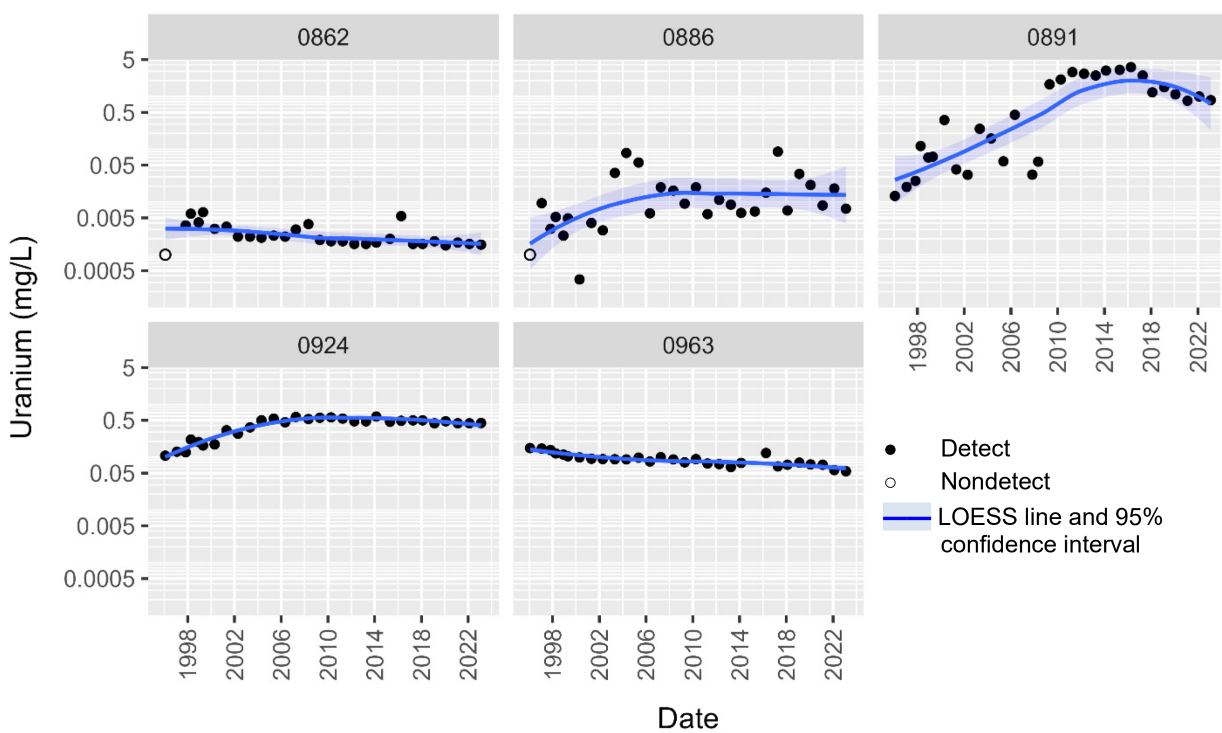


Figure 5-8. Uranium Concentrations in Groundwater Compliance Monitoring Wells at the Falls City, Texas, Disposal Site

Table 5-3. Mann-Kendall Trend Analysis Results for Falls City Site Monitoring Wells, 1996–2023

Parameter	Well	Monitoring Purpose	Initial Trend Analysis Date[a]	Number of Samples	Mann-Kendall Trend Analysis Results[b]		
					Kendall's tau[c]	p-value[d]	Trend
Water Level	0709	Disposal Cell Performance	1/24/1996	39	−0.587	<0.0001	Decreasing
Water Level	0858	Disposal Cell Performance	1/24/1996	39	−0.804	<0.0001	Decreasing
Water Level	0880	Disposal Cell Performance	1/24/1996	40	−0.36	0.001	Decreasing
Water Level	0906	Disposal Cell Performance	1/24/1996	39	−0.435	0.0001	Decreasing
Water Level	0921	Disposal Cell Performance	1/24/1996	39	−0.859	<0.0001	Decreasing
Water Level	0862	Groundwater Compliance	1/24/1996	30	0.842	0	Increasing
Water Level	0886	Groundwater Compliance	1/24/1996	30	0.838	0	Increasing
Water Level	0891	Groundwater Compliance	1/24/1996	30	0.025	0.86	No Trend
Water Level	0924	Groundwater Compliance	1/24/1996	30	−0.347	0.007	Decreasing
Water Level	0963	Groundwater Compliance	1/24/1996	29	0.483	0.0003	Increasing
pH	0709	Disposal Cell Performance	1/30/1996	39	0.195	0.089	No Trend
pH	0858	Disposal Cell Performance	1/28/1996	39	0.710	0	Increasing
pH	0880	Disposal Cell Performance	1/25/1996	39	−0.04	0.73	No Trend
pH	0906	Disposal Cell Performance	1/30/1996	39	0.018	0.88	No Trend
pH	0921	Disposal Cell Performance	1/27/1996	39	0.390	0.0006	Increasing
pH	0862	Groundwater Compliance	1/30/1996	29	0.296	0.027	Increasing
pH	0886	Groundwater Compliance	1/25/1996	29	0.345	0.009	Increasing
pH	0891	Groundwater Compliance	1/27/1996	30	0.776	0	Increasing
pH	0924	Groundwater Compliance	1/29/1996	30	0.462	0.0004	Increasing
pH	0963	Groundwater Compliance	1/26/1996	29	0.054	0.69	No Trend
Uranium	0709	Disposal Cell Performance	1/30/1996	39	−0.509	0	Decreasing
Uranium	0858	Disposal Cell Performance	1/28/1996	39	0.487	0	Increasing
Uranium	0880	Disposal Cell Performance	1/25/1996	39	0.036	0.76	No Trend
Uranium	0906	Disposal Cell Performance	1/30/1996	40	−0.411	0.0003	Decreasing[e]
Uranium	0921	Disposal Cell Performance	1/27/1996	39	0.753	0	Increasing
Uranium	0862	Groundwater Compliance	1/30/1996	29	−0.526	0.0001	Decreasing
Uranium	0886	Groundwater Compliance	1/25/1996	30	0.304	0.019	Increasing
Uranium	0891	Groundwater Compliance	1/27/1996	30	0.483	0.0002	Increasing
Uranium	0924	Groundwater Compliance	1/29/1996	31	0.356	0.007	Increasing
Uranium	0963	Groundwater Compliance	1/26/1996	29	−0.742	0	Decreasing

Notes:

[a] For most well-parameter combinations, the final trend analysis date for this period is February 8, 2023. The only exceptions are wells 0709 and 0921, sampled on February 9, 2023.

[b] Trend tests were performed using the Kendall package in R, version 2.2.1 (McLeod 2022). Trend analyses were conducted at the 0.05 significance level using a two-sided test.

[c] The test statistic, Kendall's tau, is a measure of the strength of the association between two variables, with values always falling between −1 and +1.

[d] A calculated p-value of <0.05 indicates that the null hypothesis is rejected and a significant trend in the time series exists.

[e] The decreasing trend for uranium in well 0906 is still statistically significant if the extreme low outlier (0.00032 mg/L in April 6, 2011, sample [Figure 5-7]) is removed from the analysis. The results were nearly equivalent to those cited above, with a Kendall's tau and p-value of −0.413 and 0.00029, respectively.

5.8.4 Evaluation of Groundwater Monitoring

No change in disposal cell performance is indicated by the following data from the disposal cell performance monitoring wells: (1) overall decreasing water-level trends (Table 5-3 and Figure 5-3), and (2) no declining pH trends (Table 5-3 and Figure 5-5). These results are consistent with declining drainage rates of low-pH tailings pore water into the underlying geology. However, water levels in well 0880 have been trending higher since 2014 (Figure 5-3). Disposal cell performance wells 0858 and 0921 have statistically significant increases in uranium (Table 5-3), though the uranium increase in well 0921 occurred before 2014 (Figure 5-7). The uranium increase in well 0858 was mainly in the last 3 years (Figure 5-7).

Site-related contamination in the uppermost aquifer poses no risk to human health because groundwater from this aquifer is not used for human consumption and is designated as limited use. Potable water is produced locally from the Carrizo Sandstone that lies 2000 ft beneath the surface near the site. Additionally, a 300-foot-thick aquitard isolates the uppermost aquifer from the higher-quality groundwater in deeper aquifers.

For the groundwater compliance monitoring wells, wells 0886, 0891, and 0924 have statistically significant increasing uranium concentrations (Table 5-3), though these increases occurred before 2010 (Figure 5-8). According to DOE (1997a) and the 2008 LTSP, these results are not unexpected, as these three wells were at the downgradient edge of low-pH groundwater plumes with mill processing-derived fluids and elevated uranium concentrations. Currently, the pH values in these three wells are increasing (Figure 5-6 and Table 5-3), thereby confirming that in the longer term, the low-pH areas do not necessarily define areas with uranium contamination. This correlation was true in the past (DOE 1997a) during the continued addition of low-pH fluids from uranium processing and low-pH fluids produced from the oxidation of the tailings. Currently, these processes are no longer occurring, and uranium can continue to be mobile with increasing pH values.

The higher uranium concentrations in groundwater compliance well 0891, which increased from 1996–2016 and subsequently declined, likely reflects the passage of groundwater with elevated uranium flowing from the direction of former mill tailings (specifically tailings pile No. 3) (DOE 1997a). To maintain the protection of human health and the environment, DOE is planning on evaluating the groundwater flow and potential uranium transport downgradient of wells 0886, 0891, and 0924 to confirm that (1) groundwater quality continues to meet the groundwater class of use and (2) groundwater discharge to surface water is not an issue. Best management practice groundwater monitoring of the current monitoring well network will be continued at least through, and possibly beyond, the conclusion of this additional evaluation until concurrence for cessation is provided by NRC.

5.9 References

10 CFR 40 Appendix A. U.S. Nuclear Regulatory Commission, "Criteria Relating to the Operation of Uranium Mills and the Disposition of Tailings or Wastes Produced by the Extraction or Concentration of Source Material from Ores Processed Primarily for Their Source Material Content," *Code of Federal Regulations*.

10 CFR 40.27. U.S. Nuclear Regulatory Commission, "General License for Custody and Long-Term Care of Residual Radioactive Material Disposal Sites," *Code of Federal Regulations*.

40 CFR 192. U.S. Environmental Protection Agency, "Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings," *Code of Federal Regulations.*

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5.10 Photographs

Photograph Location Number	Azimuth	Photograph Description
PL-1	276	Rusting Fence Line
PL-2	277	Perimeter Sign P38 with Bent Post
PL-3	215	Perimeter Sign P64
PL-4	316	Repaired Fence Line Between Survey Monument SM-3 and Perimeter Sign P18
PL-5	215	Site Marker SMK-1
PL-6	—	Boundary Monument BM-1
PL-7	341	Quality Control Monument QC-4
PL-8	43	Tall Grass Overgrown on Slide Slope Transition to Riprap
PL-9	93	Equipment Access Ramp
PL-10	175	South Rock Drain

Note:
— = Photograph taken vertically from above.

PL-1. Rusting Fence Line

PL-2. Perimeter Sign P38 with Bent Post

PL-3. Perimeter Sign P64

PL-4. Repaired Fence Line Between Survey Monument SM-3 and Perimeter Sign P18

PL-5. Site Marker SMK-1

PL-6. Boundary Monument BM-1

PL-7. Quality Control Monument QC-4

PL-8. Tall Grass Overgrown on Slide Slope Transition to Riprap

PL-9. Equipment Access Ramp

PL-10. South Rock Drain