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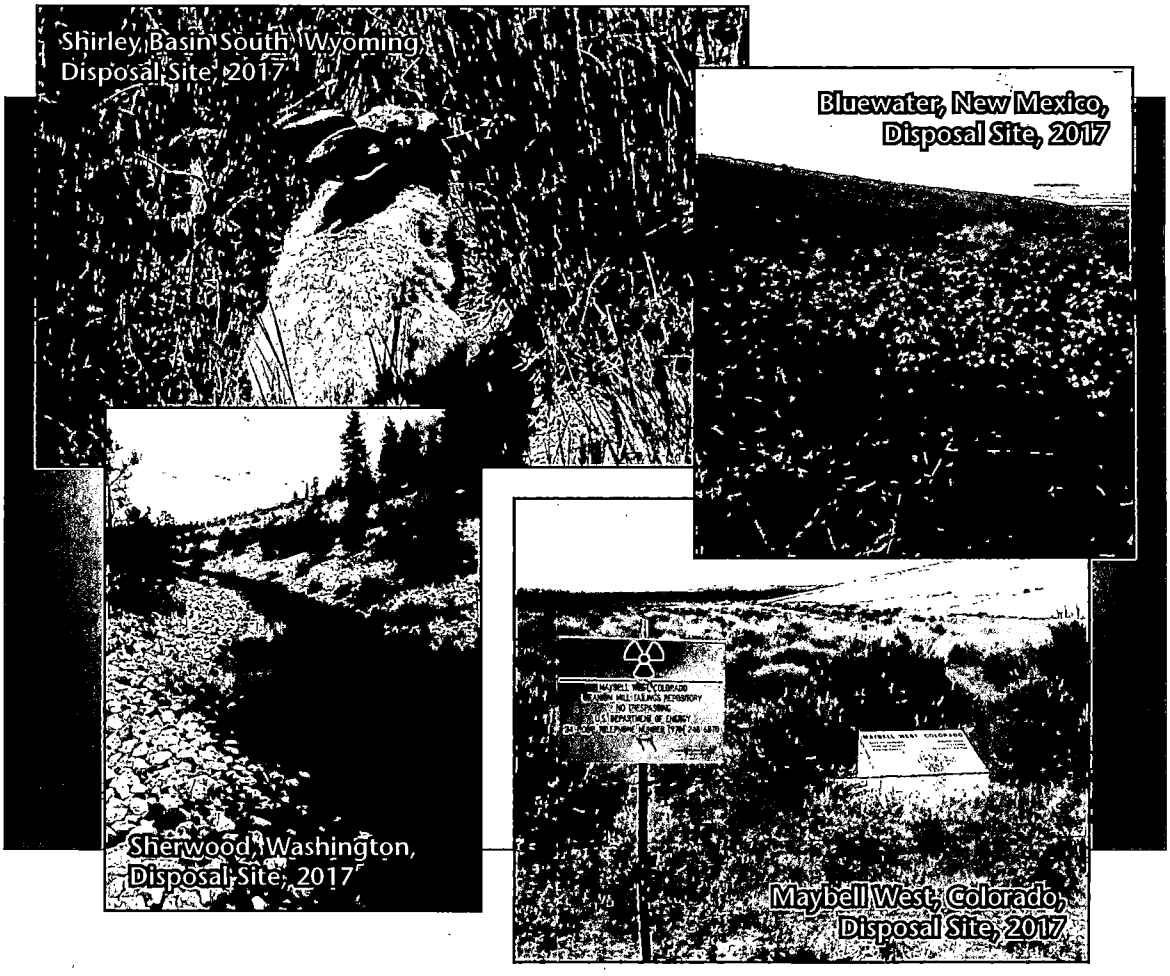
U.S. DEPARTMENT OF
ENERGY

Legacy
Management

2017 Annual Site Inspection and Monitoring Report for Uranium Mill Tailings Radiation Control Act Title II Disposal Sites

December 2017



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Abbreviations

AAS	alternate abatement standard
ACL	alternate concentration limit
BIA	Bureau of Indian Affairs
BLM	U.S. Bureau of Land Management
CFR	*Code of Federal Regulations*
DOE	U.S. Department of Energy
EMP	erosion monitoring program
GPS	global positioning system
IC	institutional control
LIDAR	light detection and ranging
LMS	Legacy Management Support
LTSP	Long-Term Surveillance Plan
MCL	maximum concentration limit
mg/L	milligrams per liter
NMED	New Mexico Environment Department
NRC	U.S. Nuclear Regulatory Commission
PCB	polychlorinated biphenyl
PL	photograph location
PMF	probable maximum flood
POC	point of compliance
POE	point of exposure
^{226}Ra	radium-226
^{228}Ra	radium-228
SMK	site marker
TDS	total dissolved solids
UMTRCA	Uranium Mill Tailings Radiation Control Act of 1978 (Title 42 *United States Code* Section 7901 [42 USC 7901])
USC	*United States Code*
WDEQ	Wyoming Department of Environmental Quality

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Executive Summary

This report, in fulfillment of a license requirement, presents the results of long-term surveillance and maintenance activities conducted by the U.S. Department of Energy (DOE) Office of Legacy Management in 2017 at six uranium mill tailings disposal sites reclaimed under Title II of the Uranium Mill Tailings Radiation Control Act of 1978 (UMTRCA). These activities verified that the UMTRCA Title II disposal sites remain in compliance with license requirements. Long-Term Surveillance Plans (LTSPs) and site compliance reports are available on the Internet at https://energy.gov/lm/sites/lm-sites.

DOE manages six UMTRCA Title II disposal sites under a general license established by the U.S. Nuclear Regulatory Commission (NRC) in Title 10 *Code of Federal Regulations* Section 40.28 (10 CFR 40.28). Reclamation and site transition activities continue at other sites, and DOE anticipates managing 30 Title II disposal sites.

Long-term surveillance and maintenance activities and services for these disposal sites include inspecting and maintaining the sites; monitoring environmental media and institutional controls; conducting any necessary corrective action; and performing administrative, records, stakeholder relations, and other regulatory stewardship functions.

Annual site inspections and monitoring are conducted in accordance with site-specific LTSPs and procedures established by DOE to comply with license requirements. Each site inspection is performed to verify the integrity of visible features at the site; to identify changes or new conditions that might affect the long-term performance of the site; and to determine the need, if any, for maintenance, follow-up inspections, or corrective action in accordance with the LTSP.

All of the sites require some degree of routine monitoring and maintenance, which can include groundwater and surface water monitoring, minor erosion control, vegetation management, fence and gate repairs, sign replacement, and minor trash removal. The following nonroutine activities[1] occurred in 2017:

- **Bluewater, New Mexico:** Uranium concentrations continued to exceed the UMTRCA maximum concentration limit and New Mexico drinking water standard in both aquifers at the site. Site-derived uranium contamination is not expected to impact the local municipal water supplies. DOE is evaluating options to address the contaminant plumes.
- **Bluewater, New Mexico:** DOE operated a siphon in March and October 2017 to dewater ponds that developed in depressions on the top slope of the main tailings disposal cell. DOE is evaluating options to prevent ponding of precipitation runoff water on the cell top slope.
- **Sherwood, Washington:** An erosion feature is present at the toe of the tailings dam, and a forest fire in August 2016 impacted portions of the site. The erosion feature was determined to be in an area below the actual embankment and thus poses no danger to the disposal cell embankment. No further erosion was noted during the May 2017 inspection.
- **Shirley Basin South, Wyoming:** Concentrations of radium-226 and radium-228 continued to exceed their respective alternate concentration limits at three wells. NRC concluded that

[1] Nonroutine activities are activities implemented in response to changes in site conditions, the regulatory setting, or the management structure following an extraordinary event or regulatory compliance review.

there is no current risk to human health and the environment. Groundwater monitoring will continue in accordance with the LTSP.

- **Shirley Basin South, Wyoming:** Field investigations for a joint NRC/DOE radon study were conducted to investigate the effects of soil-forming processes on disposal cell cover engineering properties.

Results of the annual site inspections, maintenance, and monitoring activities are reported in the site-specific chapters that follow. Significant actions and issues at each site are summarized in Table ES-1.

Table ES-1. 2017 Summary of UMTRCA Title II Site Issues and Actions

Site	Chapter	Page	Issues and Actions
Bluewater, New Mexico	1	1-6	Operated pond dewatering siphon on cell.
		1-9	Conducted groundwater monitoring.
		1-12	Alluvial aquifer groundwater with elevated uranium concentrations leaving the site.
		1-14	Bedrock aquifer groundwater with elevated uranium concentrations leaving the site.
		1-16	Site-derived uranium contamination is not expected to impact municipal water supplies.
Edgemont, South Dakota	2	2-2	Repaired broken fence strand.
		2-2	The grazing licensee will remove the unmaintained interior fence.
		2-6	No groundwater monitoring is required by the LTSP.
L-Bar, New Mexico	3	3-2	Repaired cut fence strands.
		3-8	Conducted groundwater monitoring.
Maybell West, Colorado	4	4-2	Conducted perimeter fence repairs.
		4-5	Replaced missing perimeter sign P9.
		4-5	Continued to observe small depression with no changes.
		4-5	Continued to observe second small depression with no changes.
		4-7	No groundwater monitoring is required by the LTSP.
Sherwood, Washington	5	5-6	Conducted dam safety inspection.
		5-8	Determined that erosion feature near the toe of the disposal cell embankment does not impact the embankment.
		5-9	Determined only impact of August 2016 forest was scorched but legible perimeter sign.
		5-9	Conducted groundwater monitoring.
Shirley Basin South, Wyoming	6	6-5	Conducted field investigations for a joint NRC/DOE radon study.
		6-7	Conducted groundwater monitoring.
		6-10	Continued to exceed ACLs for radium-226 and radium-228.
		6-14	Concluded that elevated radium concentrations pose no risk to human health and the environment.

1.0 Bluewater, New Mexico, Disposal Site

1.1 Compliance Summary

The Bluewater, New Mexico, Uranium Mill Tailings Radiation Control Act (UMTRCA) Title II Disposal Site (site) was inspected on September 13, 2017. No changes were observed on the main tailings disposal cell, although depressions and resultant ponding continue to be observed on the top slope. A siphon is operated to remove the runoff water that accumulates in the depressions. Measures to eliminate ponding and ensure positive drainage from the top slope are being evaluated. A small area of settlement was observed on the soil cover of Disposal Area No. 1. This feature, which is not above tailings, will be repaired in 2018. Tamarisk shrubs and other noxious weeds scattered across the site were treated with herbicide during the inspection. Loose fence strands near perimeter sign P7 were repaired after the inspection. Inspectors identified no other maintenance needs or cause for a follow-up inspection.

Groundwater was sampled in November 2016 and May 2017. Analytical results indicate that alternate concentration limits (ACLs) were not exceeded. However, groundwater leaving the site in both the alluvial and bedrock aquifers has uranium concentrations exceeding the UMTRCA maximum concentration limit (MCL) and the New Mexico drinking water standard. No known domestic wells within the contaminant plumes have uranium concentrations exceeding the drinking water standard, and the plumes are not expected to impact local municipal water supplies. The extent of the plumes and potential impacts to existing wells will be reevaluated in 2018.

1.2 Compliance Requirements

Requirements for the long-term surveillance and maintenance of the site are specified in the site-specific U.S. Department of Energy (DOE) Long-Term Surveillance Plan (LTSP) (DOE 1997) and in procedures that DOE established to comply with requirements of Title 10 *Code of Federal Regulations* Section 40.28 (10 CFR 40.28). Table 1-1 lists these requirements.

Table 1-1. License Requirements for the Bluewater, New Mexico, Disposal Site

Requirement	LTSP	This Report	10 CFR 40.28
Annual Inspection and Report	Sections 3.3 and 3.4	Section 1.4	(b)(3)
Follow-up Inspections	Section 3.5	Section 1.5	(b)(4)
Routine Maintenance and Emergency Measures	Section 3.6	Section 1.6	(b)(5)
Environmental Monitoring	Section 3.7	Section 1.7	(b)(3)

1.3 Institutional Controls

The 3300-acre site, identified by the property boundary shown in Figures 1-1 and 1-2, is owned by the United States and was accepted under the U.S. Nuclear Regulatory Commission (NRC) general license (10 CFR 40.28) in 1997. DOE is the licensee and, in accordance with the requirements for UMTRCA Title II sites, 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

cells, disposal areas, dumps, entrance gate and sign, perimeter fence and signs, a site marker, boundary monuments, and monitoring wellhead protectors.

1.4 Inspection Results

The site, located approximately 9 miles northwest of Grants, New Mexico, was inspected on September 13, 2017. The inspection was conducted by R. Johnson and A. Kuhlman of the Legacy Management Support (LMS) contractor to the DOE Office of Legacy Management (LM). B. Tsosie (DOE site manager), W. Pearson and A. Rheubottom (New Mexico Environment Department [NMED]), and N. Gordon (LMS) attended the inspection. The purposes of the inspection were to confirm the integrity of the visible features at the site, to identify changes in conditions that might affect conformance with the LTSP, and to determine the need, if any, for maintenance or additional inspection and monitoring.

1.4.1 Site Surveillance Features

Figures 1-1 and 1-2 show the locations of site features in black, including the surveillance features and inspection areas. Site features that are present but not required by the LTSP to be inspected are shown in italic font. Observations from previous inspections that are currently monitored are shown in blue text, and new observations identified in the 2017 annual inspection are shown in red. Inspection results and recommended maintenance activities associated with site surveillance features are included in the following subsections. Photographs to support specific observations are identified in the text and in Figures 1-1 and 1-2 by photograph location (PL) numbers. The photographs and photograph log are presented in Section 1.9.

1.4.1.1 Site Access, Entrance Gate, and Interior Roads

Access to the site is directly off gravel-surfaced Cibola County Road 63 (a.k.a., Anaconda Road); no private property is crossed to gain site access. The entrance gate is a tubular steel, double-swing gate. The gate is secured by a chain and locks belonging to DOE and the various utility companies that have rights-of-way across the site. The site access road is surfaced with crushed basalt and extends northward along a narrow strip of DOE property for approximately 1700 feet from the entrance gate to the main site access road gate. Two culverts allow drainage of surface runoff under the road.

Interior roads used to access DOE assets consist of a dirt track covered at places with crushed basalt. The roads are susceptible to erosion and are repaired when they become impassable; minor repairs were conducted in August 2017. All roads were passable at the time of the inspection. No maintenance needs were identified.

1.4.1.2 Perimeter Fence and Signs

A four-strand barbed-wire fence encloses the site to facilitate land management by DOE, which retained a local subcontractor to periodically check the site perimeter fence and to remove trespassing cattle. Minor fence repairs are conducted as needed. Numerous sections of the fence are in remote areas of the site and cannot be observed from site access roads. The entire perimeter fence was inspected in spring 2016, and no maintenance needs were identified at that time. Loose strands were observed during the inspection near perimeter sign P7 (PL-1) and were repaired after the inspection.

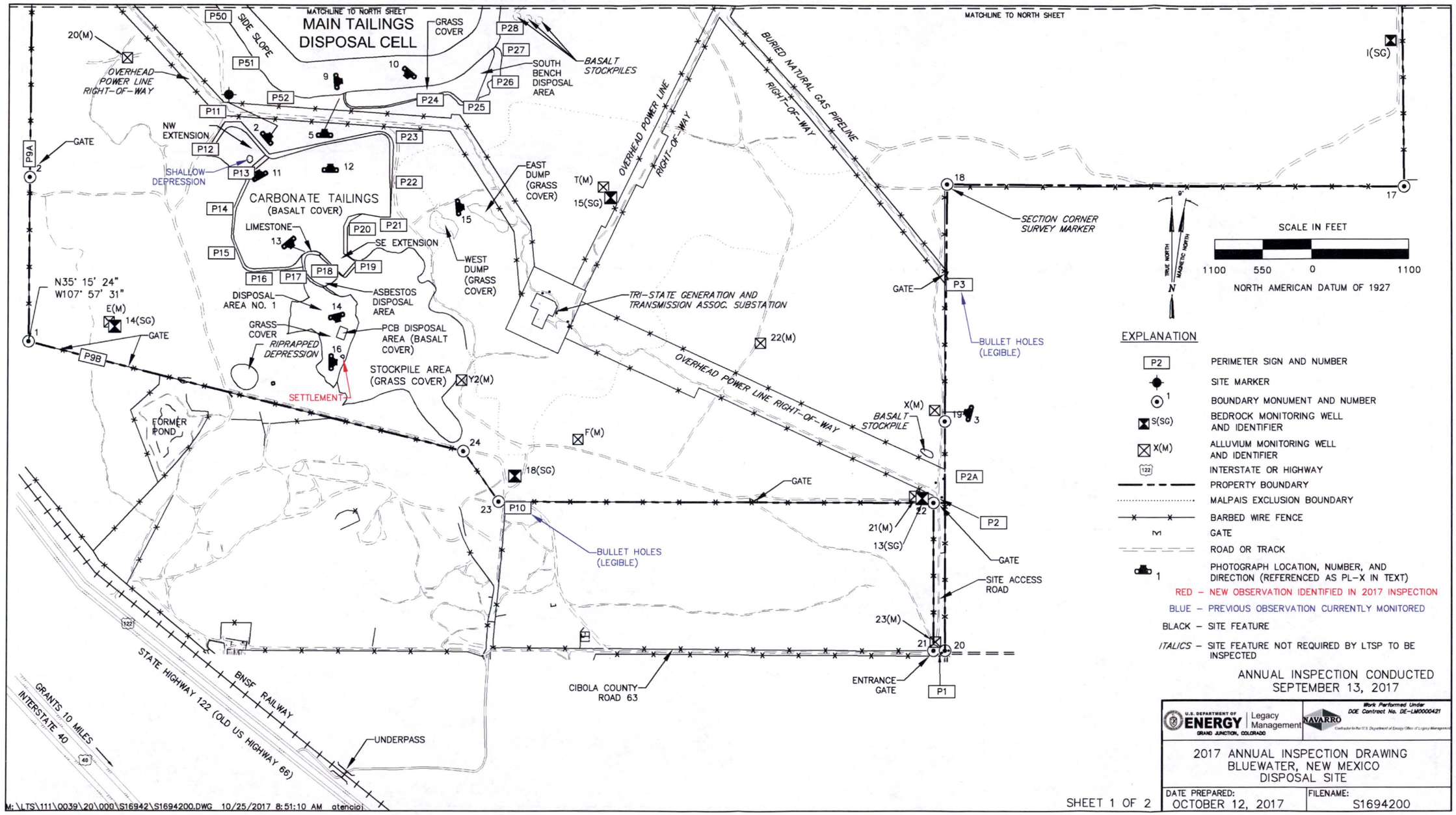


Figure 1-1. 2017 Annual Inspection Drawing for the Bluewater, New Mexico, Disposal Site (South Area)

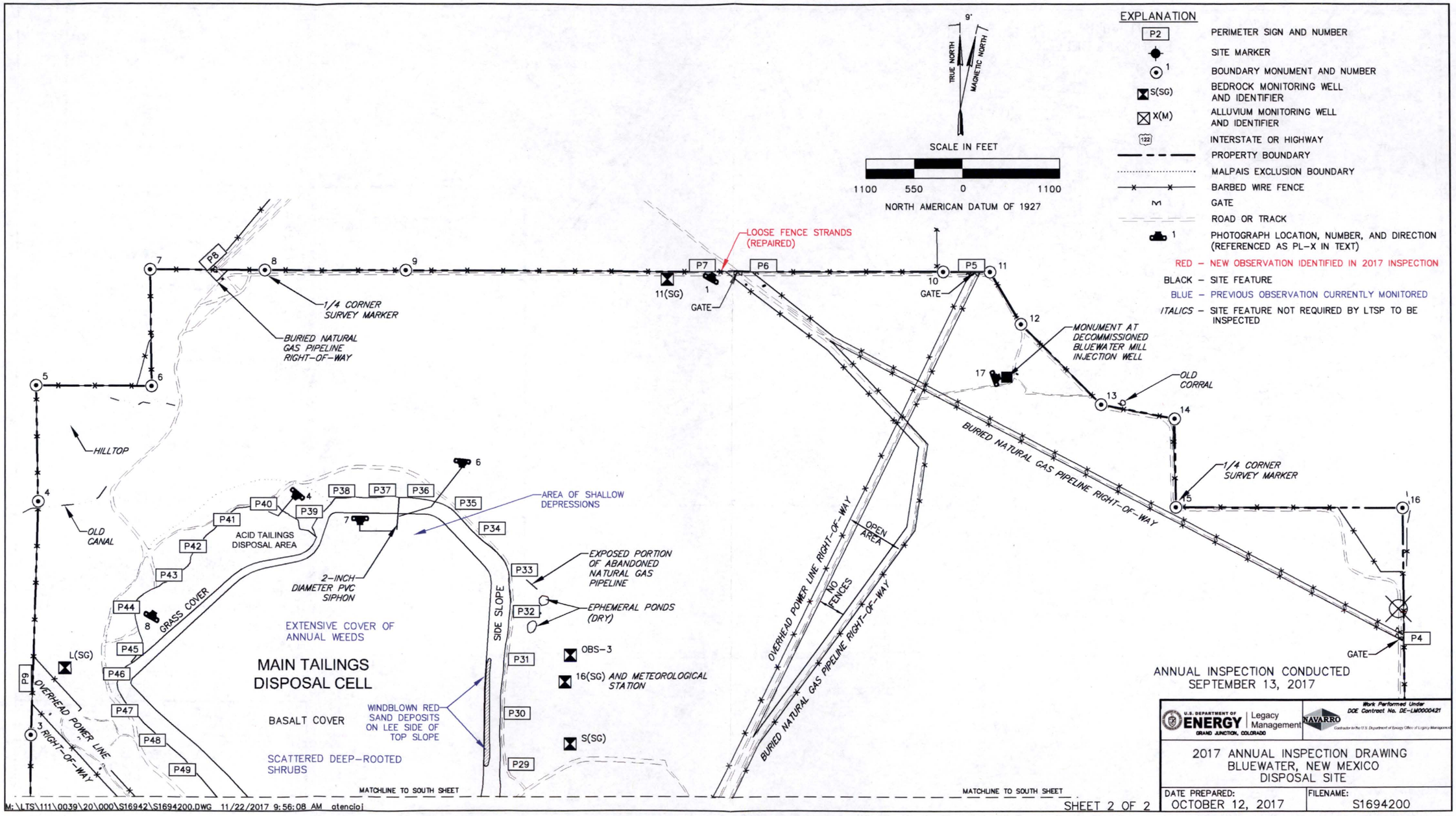


Figure 1-2. 2017 Annual Inspection Drawing for the Bluewater, New Mexico, Disposal Site (North Area)

Fifty-five perimeter signs (warning and no-trespassing signs) are mounted on steel posts along the site boundary and around the main and carbonate tailings disposal cells. Perimeter signs P3 and P10 have gunshot damage but are still legible. No maintenance needs were identified.

1.4.1.3 Site Marker

The site has one granite site marker between the southwest corner of the main tailings disposal cell and the northwest corner of the carbonate tailings disposal cell (PL-2). No maintenance needs were identified.

1.4.1.4 Boundary Monuments

Twenty-four boundary monuments define the site boundary. These monuments are typically inside the perimeter fence and several feet inside the true corner or boundary line. Some monuments tend to get covered by drifting sand, and metal T-posts have been driven at those locations to help inspectors find them. Other monuments are in remote locations of the site and cannot be observed from site access roads. All of the boundary monuments were inspected and photographed in spring 2016; covering sand was removed to expose several monuments. No maintenance needs were identified.

1.4.1.5 Monitoring Wells

The site groundwater monitoring network consisted of nine wells when the site was transferred to DOE. Two additional wells were installed in summer 2011, and eight more wells were installed in summer 2012 in response to elevated uranium concentrations in the two aquifers at the site. The onsite groundwater monitoring network now consists of 19 monitoring wells. Several wells have telemetry towers to transmit groundwater level and weather data to the LM office in Grand Junction, Colorado. The wellhead protectors (PL-3) and telemetry towers were undamaged and locked. No maintenance needs were identified.

1.4.2 Inspection Areas

In accordance with the LTSP, the site is divided into four inspection areas (referred to as "transects" in the LTSP) to ensure a thorough and efficient inspection. The inspection areas are (1) the main tailings disposal cell, including the acid tailings and south bench disposal areas; (2) the carbonate tailings disposal cell, including the asbestos disposal area, the polychlorinated biphenyl (PCB) disposal area, and associated disposal areas and dumps; (3) the region between the disposal structures and the site perimeter; and (4) the site perimeter and outlying area. Inspectors examined the 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.

1.4.2.1 Main Tailings Disposal Cell and the Acid Tailings and South Bench Disposal Areas

The 354-acre contiguous main tailings disposal cell, acid tailings, and south bench disposal areas constitute one large disposal area. The top slope of the main tailings disposal cell is covered with basalt riprap and was designed to shed runoff water over the north edge of the top slope. The top slope grade is 3% to 4% at the south end and decreases to less than 0.5% at the north end. The

top slopes of the acid tailings (PL-4) and south bench disposal areas are nearly flat and covered by healthy grass. Basalt riprap protects the side slopes of the disposal areas.

Plant encroachment (annual weeds, perennial grasses and forbs, and scattered perennial shrubs) continues on the main tailings disposal cell top and side slopes (PL-5). Siberian elm saplings on the top slope are managed to prevent the establishment of trees that could damage the main tailings disposal cell cover materials; none were observed during the inspection.

Several depressions exist on the north end of the top slope of the main tailings disposal cell and along the east and northwest edges of the top slope. This portion of the top slope overlies predominantly clay-rich tailings referred to as "slimes." Although the former licensee attempted to dewater the slimes to consolidate them, that portion of the top slope continued to settle after the site transitioned to DOE. Annual inspections indicated that the depressions enlarged in area and depth over time. DOE, therefore, conducted high-resolution topographic mapping using the light detection and ranging (LIDAR) method in 2012 and 2016 to determine if settlement continues and to gauge its magnitude (DOE 2017). The 2016 LIDAR results, when compared to the 2012 LIDAR results and the original topographic map developed in 1997, demonstrated that settlement, as much as 4 feet in some locations, continues. However, the rate of settlement since 2012 is much less than the rate before 2012. Another LIDAR survey is scheduled for 2019.

Ponds often develop in the depressions after rainfall events and occasionally coalesce into one large pond after a series of rainfall events. The area of depressions is monitored continuously using a remotely operated webcam to detect the presence of ponded water. The top slope was dry at the time of the inspection. The largest pond to date held approximately 4.3 million gallons of runoff water. Although the top slope was designed to shed runoff water, this has never occurred because all of the runoff water collects in the depressions.

A 2-inch-diameter siphon was installed in fall 2015 to dewater as much of the ponded water as possible (PL-6). The siphon is manually started when the webcam indicates that a large pond has developed. The intent is to avoid potential erosion of the main tailings disposal cell cover materials if the pond surface reaches an elevation high enough to spill over the north side slope of the disposal cell. Water would start to spill at the lowest point along the north edge of the top slope, and that could initiate erosion at that location. DOE is evaluating measures to eliminate ponding and to ensure positive drainage from the top slope.

The siphon is operated at least once a year and it successfully removes nearly all the water; all of the water cannot drain from one location due to the unevenness of the depressions. The siphon was operated twice in 2017. On March 29, 2017, the siphon began dewatering a 2.9-acre pond containing approximately 313,000 gallons, and on October 4, 2017, the siphon began dewatering a 4.1-acre pond containing approximately 540,100 gallons (the pond developed after the annual inspection). The siphon discharges water, at a rate of approximately 100 gallons per minute, at the toe of the north side slope where runoff water was intended to discharge. The discharged water ponds over a large area north of the main tailings disposal cell and eventually dissipates through infiltration into soil and through evaporation. The discharged water does not flow off the site.

NRC requested that DOE evaluate the performance of the radon barrier because of a concern that the ponded water could be degrading the main tailings disposal cell performance (i.e., releasing

radon and allowing percolation of water through the cover materials and into the encapsulated tailings). Radon flux measurements were collected in July 2013 on top of the radon barrier in the area of depressions. All radon measurements were below the detection limit, indicating that the radon barrier in that portion of the main tailings disposal cell was performing as designed. Based on the integrity of the radon barrier and the persistence of ponded water, dissipation of the ponded water was determined to be most likely due to evaporation rather than percolation through the cover materials.

The site is currently part of a joint NRC/DOE radon study investigating the effects of soil-forming processes on disposal cell cover properties (DOE 2016). In addition to measuring radon flux through the radon barrier, analysis of soil properties will help determine the permeability and other soil properties of the radon barrier materials. Field research conducted in June 2016 included exposing the radon barrier for radon measurements, excavating samples of the radon barrier for field and laboratory analysis of soil properties, and exposing the surface immediately under the radon barrier to measure radon flux. Thirteen test pits were dug and sampled on the top slope of the main tailings disposal cell, and two more were dug on the acid tailings disposal area. The test pits were reclaimed after completion of field investigations, and the locations were observed and photographed during the annual inspection. No indications of settlement or erosion were visible (PL-7 and PL-8), as was also noted during the 2016 annual inspection; therefore, annual inspections of the reclaimed tests pits will be discontinued. Results of the disposal cell cover investigations will be used to determine, in consultation with NRC, if additional monitoring, removal of the ponded water, or cover enhancements are necessary. Until conclusions are drawn from the disposal cell cover investigations, DOE will continue to monitor top slope settlement and plans to conduct another high-resolution topographic survey in 2019.

The side slopes and toe of the main tailings disposal cell were inspected for signs of erosion or sediment deposition. No abnormal irregularities were observed on the side slopes (PL-9), and no sediment deposits were present along the toe. No maintenance needs for the side slopes or acid tailings and south bench disposal areas were identified.

1.4.2.2 Carbonate Tailings Disposal Cell, Other Disposal Areas, and Dumps

The 54-acre carbonate tailings disposal cell is south of the main tailings disposal cell (PL-10). Basalt riprap covers the top and side slopes of the carbonate tailings disposal cell. The top, for the most part, slopes gently eastward. The carbonate tailings disposal cell includes extensions to the northwest and southeast. A very shallow depression exists on the northwest extension, and rainfall runoff occasionally ponds at this location; the location was dry at the time of the inspection (PL-11). This depression does not appear to be enlarging, but will continue to be inspected and will be evaluated using periodic LIDAR survey results. Annual weeds, perennial grasses, and scattered woody shrubs were present on the carbonate tailings disposal cell and its extensions. Siberian elm saplings are periodically treated with herbicide; no saplings were observed during the inspection. No maintenance needs were identified.

Two test pits were dug and sampled on the top slope of the carbonate tailings disposal cell as part of the NRC/DOE radon study. The test pits were reclaimed after completion of field investigations, and the locations were observed and photographed during the annual inspection. No indications of settlement or erosion were visible (PL-12), as was also noted during the 2016 annual inspection; therefore, annual inspections of the reclaimed tests pits will be discontinued.

The 2-acre asbestos disposal area is a bowl-like feature just south of the carbonate tailings disposal cell (PL-13). The north, west, and south side slopes of this feature are covered by limestone riprap; the bottom of the bowl (the asbestos cell cover) is grass-covered. Several small depressions are present around the perimeter of the disposal area where relocated clean soil (placed for slope grading) and small-diameter riprap has filtered down through basalt joints and fractures. These depressions do not affect the integrity of the disposal area, but will be filled with riprap (crushed basalt) during other site maintenance activities. No other maintenance needs were identified.

There is an 11-acre grass-covered disposal area south of the asbestos disposal area. A small riprap-covered PCB cell (less than 1 acre) is located within the disposal area (PL-14). Two grass-covered dumps, totaling about 2 acres, are east of the carbonate tailings disposal cell (PL-15). The disposal areas and dumps were inspected. A small area of settlement was observed on the soil cover of Disposal Area No. 1, which does not contain mill tailings (PL-16); the settlement area will be repaired in 2018. No other maintenance needs were identified.

1.4.2.3 Area Between the Disposal Cells and the Site Perimeter

Other areas inside the site were inspected by driving the site perimeter road and other roads and tracks. Much of the southern and western portions of the site are inaccessible by vehicle because they are covered by basalt flows.

Small ponds often form in an area along the east side of the main tailings disposal cell and in other low spots following storm events. The areas of ponding are far enough from the main tailings disposal cell to not impact it. No ponded water was present onsite at the time of the inspection.

Scattered tamarisk shrubs and other plants listed as noxious weeds in the state of New Mexico are present onsite. Observed noxious weeds were sprayed with herbicide by LMS staff at the time of the inspection.

A monument consisting of a steel well casing set in concrete is located at the decommissioned mill process fluid injection well near the northeast corner of the site (PL-17). Information pertaining to the well is welded onto the monument.

Several utility companies have rights-of-way that cross the site. These rights-of-way are bordered by stock fences with locked gates where the rights-of-way cross the site boundary. Roads along the rights-of-way typically are covered with crushed basalt to provide the utility companies with all-weather access. DOE is not responsible for maintaining the right-of-way roads or fences. An electric power substation, enclosed by a security fence, is located near the center of the site. Utility company personnel visit the substation frequently. DOE is not responsible for maintaining the substation or its security fence and access road.

1.4.2.4 Site Perimeter and Outlying Areas

Surrounding land is used for livestock grazing and wildlife habitat. The area beyond the site boundary for 0.25 mile was visually observed for erosion, development, changes in land use, or other phenomena that might affect conformance with LTSP requirements. No such changes were observed.

1.5 Follow-up Inspections

DOE 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) DOE is notified by a citizen or outside agency that conditions at the site are substantially changed. No need for a follow-up inspection was identified during the inspection.

1.6 Routine Maintenance and Emergency Measures

Loose fence strands were repaired. Scattered tamarisk shrubs and other noxious weeds were treated with herbicide. Small depressions near the perimeter of the asbestos disposal area and a small settlement area on Disposal Area No. 1 will be repaired in 2018. No other maintenance needs were identified.

Emergency measures are corrective actions that DOE will take in response to unusual damage or disruption that threatens or compromises site health and safety, security, integrity, or compliance with 40 CFR 192. No emergency measures were identified.

1.7 Environmental Monitoring

Groundwater monitoring is required at the site. The monitoring well network acquired by DOE at the time of site transition and that was included in the LTSP consisted of wells E(M), F(M), T(M), Y2(M), X(M), L(SG), OBS-3, S(SG), and I(SG). The LTSP requires annual sampling for PCBs (for 20 years beginning in 1998) and triennial sampling for molybdenum, selenium, and uranium in the alluvial aquifer background and point-of-compliance (POC) wells. The LTSP also requires triennial sampling of the San Andres/Glorieta (bedrock) aquifer background and POC wells for selenium and uranium. Alluvial aquifer well X(M) and bedrock aquifer well I(SG)—point-of-exposure (POE) wells located along the east property boundary—are to be sampled only if specified ACLs are exceeded at POC wells. Currently, PCBs are monitored annually in accordance with the LTSP, and all of the site wells (including POE wells) are sampled semiannually for an expanded list of constituents as described in the following sections. The groundwater monitoring network is described in Figure 1-3 and Table 1-2. ACLs are listed in Table 1-3.

In 2008 NMED requested DOE's assistance in investigating and evaluating regional groundwater contamination associated with the former Grants Mineral Belt uranium mining industry. NMED suspected that contaminants from the site had migrated offsite. In response to NMED's concerns, DOE reinitiated annual sampling at all onsite monitoring wells in fall 2008, including the POE wells. Semiannual sampling was initiated in 2011 in response to an ACL exceedance for uranium in well T(M). DOE also began evaluating the hydrogeology and groundwater quality at the site in 2009 and started analyzing a larger suite of constituents than what is required by the LTSP to characterize the site aquifers and to support NMED's regional groundwater investigation. In consultation with NRC, DOE installed additional monitoring wells in 2011 and 2012, evaluated the main tailings disposal cell performance, and developed a groundwater conceptual model to address uranium contamination concerns (DOE 2014).

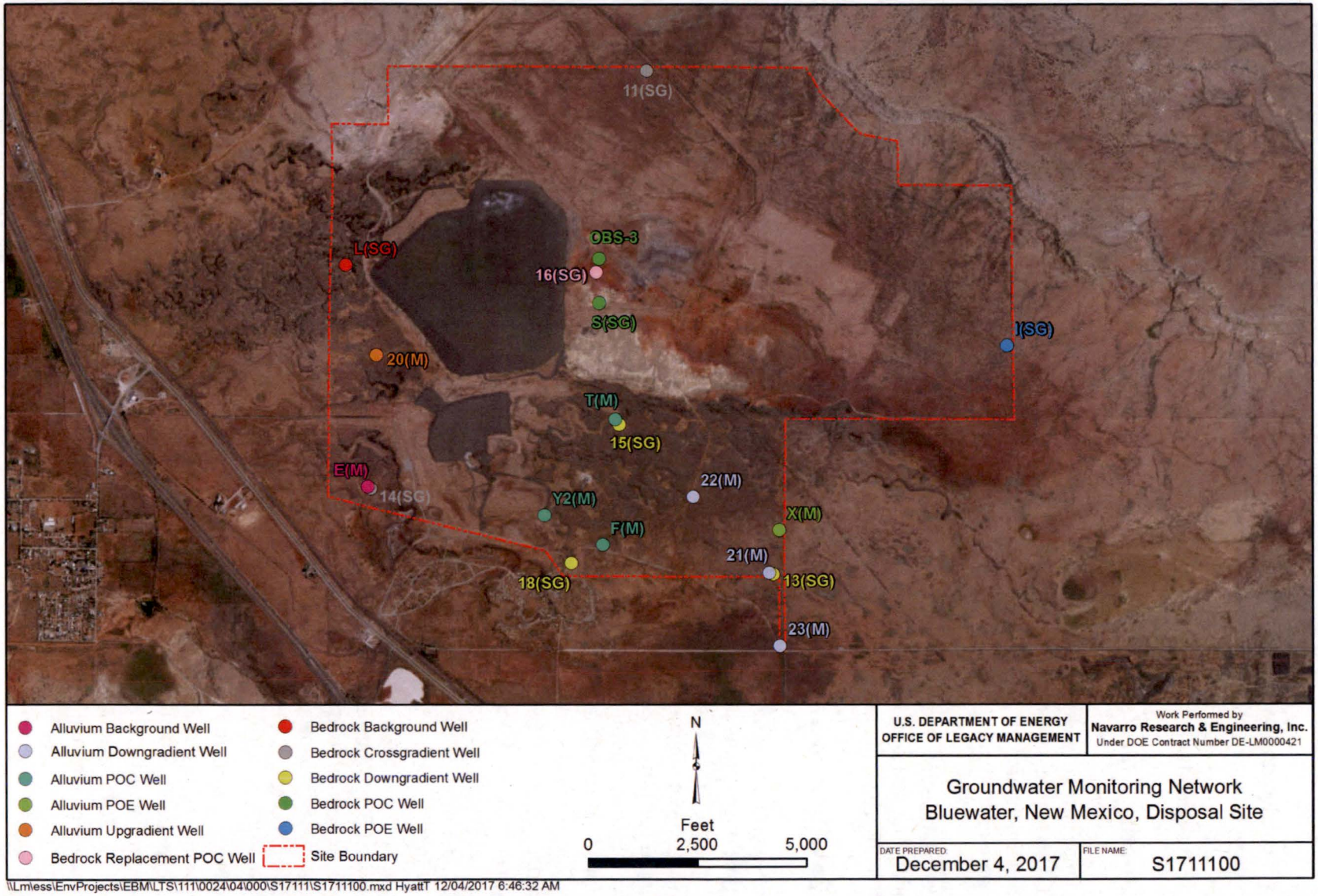


Figure 1-3. Groundwater Monitoring Network at Bluewater, New Mexico, Disposal Site

Table 1-2. Groundwater Monitoring Network at the Bluewater, New Mexico, Disposal Site

Monitoring Well	Network Application
E(M)	Alluvium background well
F(M)	Alluvium POC well
T(M)	Alluvium POC well
X(M)	Alluvium POE well
Y2(M)	Alluvium POC well
20(M)	Alluvium upgradient well
21(M)	Alluvium downgradient well
22(M)	Alluvium downgradient well
23(M)	Alluvium downgradient well
I(SG)	Bedrock POE well
L(SG)	Bedrock background well
OBS-3	Bedrock POC well
S(SG)	Bedrock POC well
11(SG)	Bedrock crossgradient well
13(SG)	Bedrock downgradient well
14(SG)	Bedrock crossgradient well
15(SG)	Bedrock downgradient well
16(SG)	Bedrock replacement POC well
18(SG)	Bedrock downgradient well

Table 1-3. Groundwater ACLs for the Bluewater, New Mexico, Disposal Site

POC Well	Constituent	ACL (mg/L)
Alluvial aquifer wells F(M) and T(M)	Molybdenum	0.10
	Selenium	0.05
	Uranium	0.44
Bedrock aquifer wells OBS-3 and S(SG)	Selenium	0.05
	Uranium	2.15

1.7.1 Alluvial Aquifer

Water-bearing alluvium underlies the southern portion of the site. The alluvium, along the course of the ancestral Rio San Jose, is covered by basalt lava flows. The alluvium consists of coarse sands and gravels in the main channel and finer-grained floodplain deposits outside the channel. Groundwater in the alluvium is in hydraulic communication with the deeper bedrock aquifer along fault lines and where the alluvium overlies bedrock.

Groundwater in the alluvial aquifer is contaminated with uranium as it passes beneath the southeast portion of the main tailings disposal cell and comes in contact with a presumed

mineralized zone that likely formed beneath the tailing impoundments (DOE 2014). Calculations performed by the former licensee indicate that as many as 2.7 billion gallons of processing fluids seeped from the main tailings impoundment before excess water was decanted and disposed of in a deep injection well starting in 1960, and a total of 5.7 billion gallons of tailings fluids seeped from the tailings impoundment before the cell was closed in 1995. The mineralized zone is the result of the acidic seepage water from the impoundments becoming neutralized as it contacted formation materials and dissolved constituents precipitated. Groundwater in the aquifer is oxidized, and adsorption of dissolved uranium does not occur. However, uranium concentrations reduce with distance from the site due to dispersion (DOE 2014).

Alluvial aquifer analytical results from sampling events in November 2016 and in May 2017 are provided in Table 1-4. Alluvial aquifer POC well T(M) was not sampled because it is dry. The uranium concentration in well T(M) trended upward since DOE began monitoring the well in 1999, and the November 2010 concentration of 0.557 mg/L exceeded the ACL of 0.44 mg/L (Figure 1-4). DOE notified NRC of the exceedance upon receiving the results from the laboratory. Uranium concentrations in the well continued to exceed the ACL and remained steady in four subsequent samples until the well dried up after the May 2012 sampling event due to a drop in the water table as a result of drought; the well remains dry. Concentrations for the other constituents in all of the wells remain less than their respective ACLs. PCBs have never been detected in the wells at the site.

Table 1-4. Alluvial Aquifer Monitoring Results in November 2016 and May 2017 at the Bluewater, New Mexico, Disposal Site

Well	Molybdenum (mg/L) ACL = 0.10 mg/L	Selenium (mg/L) ACL = 0.05 mg/L	Uranium (mg/L) ACL = 0.44 mg/L
E(M)	0.00032, 0.00052	0.00066, 0.00200	0.00007, 0.00007
F(M)	0.00083, 0.00097	0.00096, 0.00200	0.00660, 0.00678
T(M)	NS	NS	NS
X(M)	0.00069, 0.00073	0.00670, 0.00816	0.100, 0.112
Y2(M)	0.00140, 0.00146	0.0011, 0.0020	0.0044, 0.0044
20(M)	0.00180, 0.00204	0.00440, 0.00512	0.0110, 0.0118
21(M)	0.00082, 0.00088	0.0130, 0.0138	0.110, 0.116
22(M)	0.00320, 0.00376	0.00340, 0.00453	0.350, 0.364
23(M)	0.00290, 0.00316	0.00310, 0.00288	0.024, 0.0232

Note:
November 2016 results are first, and May 2017 results are second in each pair of results.

Abbreviations:
ND = not detected (below method detection limit)
NS = not sampled

Downgradient well 21(M), installed in 2011, is adjacent to the southern site boundary, where the thickness of the alluvium in this area is estimated to be greatest due to deep incisement associated with channel development of the ancestral Rio San Jose before the river was buried by basalt lava flows. Downgradient well 22(M), also installed in 2011, is approximately halfway between POC well T(M) and downgradient well 21(M). The uranium concentrations in these two newer wells are less than the ACL (Table 1-4). However, the uranium concentrations in both

wells, shown in Figure 1-4, continue to exceed the UMTRCA MCL of 0.044 mg/L (40 CFR 192, Table 1) and the State of New Mexico drinking water standard of 0.03 mg/L. The elevated uranium concentrations in well 21(M) and POE well X(M) indicate that alluvial groundwater with uranium concentrations exceeding the drinking water standard is leaving the site.

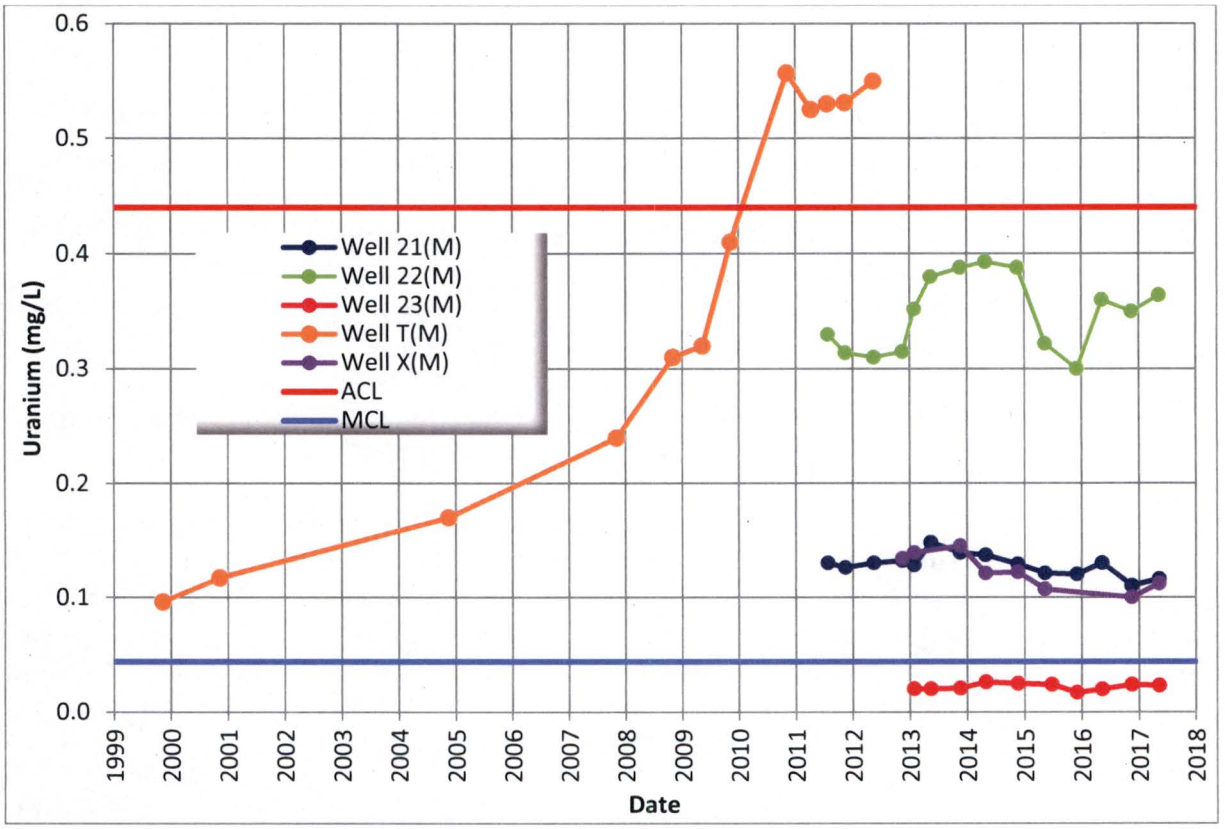


Figure 1-4. Uranium Concentrations in Alluvial Aquifer POC Well T(M) and Downgradient Wells at the Bluewater, New Mexico, Disposal Site

NRC requested that DOE evaluate the performance of the main tailings disposal cell to see if there is a correlation between the main tailings disposal cell performance and the elevated uranium concentrations in POC well T(M) (see Figure 1-4). A disposal cell cover and water balance evaluation of the main tailings disposal cell (including the 2013 radon study referred to in Section 1.4.2.1) concluded that the increase in uranium concentrations in well T(M) cannot be attributed to a reduction in the main tailings disposal cell performance; no surge of tailings fluids from the main tailings cell has occurred since it was closed (DOE 2014). The increase in uranium concentration is apparently related to the declining water level at the well location and the influence of groundwater from weathered Chinle Formation material at the bottom of the well screen that was contaminated by the alluvial groundwater.

The extent of contamination in the alluvial aquifer was evaluated as part of the groundwater conceptual model (DOE 2014). Approximately 1 mile downgradient of the site, the alluvial groundwater flow from the site merges with contaminated alluvial groundwater flow from the Homestake mill site. The combined alluvial groundwater flows southeast toward the Village of

Milan. Although some non-DOE alluvial aquifer monitoring wells downgradient of the site have uranium concentrations exceeding the New Mexico drinking water standard, samples from the nearest downgradient drinking water well had uranium concentrations below the drinking water standard. DOE will reevaluate the extent of the contaminant plume in 2018.

1.7.2 Bedrock Aquifer

Bedrock wells 11(SG), 13(SG), 14(SG), 15(SG), 16(SG), and 18(SG) were installed in summer 2012 to gain a better understanding of the hydrogeological characteristics of the San Andres/Glorieta aquifer at the site and because a nearby offsite private well (HMC-951) completed in the same aquifer had elevated uranium concentrations. There were no bedrock wells in the south portion of the site before this well construction project. Wells 11(SG) and 14(SG) are crossgradient of the groundwater flowing beneath the disposal cells, and all of the other new wells are downgradient of the cells. Well 16(SG) was installed between POC wells OBS-3 and S(SG) because their well screens are highly corroded and their uranium concentrations seemed to be anomalously low. Because of the poor well conditions and unsuccessful rehabilitation efforts, sample results from wells OBS-3 and S(SG) are not considered to be representative of aquifer conditions; however, they continue to be sampled in accordance with the LTSP until decommissioning is approved by NRC.

Bedrock wells I(SG) and L(SG) were completed with open-borehole construction through the entire thickness of the San Andres Limestone and Glorieta Sandstone formations, which comprise the San Andres/Glorieta aquifer (the formations are hydraulically connected). All of the new San Andres/Glorieta aquifer wells, except well 16(SG), are screened in the upper 50 feet of the San Andres Limestone, as are most San Andres/Glorieta aquifer wells in the region, because this is the most productive zone of the aquifer. Well 16(SG) is screened in the Glorieta Sandstone because the San Andres Limestone is dry at that location.

In response to NMED questions about the possibility of stratification of contamination within the aquifer, downhole conductivity was measured in wells I(SG) and L(SG) in spring 2013. No change in conductivity with depth was observed in background well L(SG). However, three zones of different conductivities were noted in POE well I(SG); conductivity was lowest in the water within the well casing, higher in the upper portion of the open borehole, and highest in the lower portion of the open borehole. In 2013, low-flow samples collected in each zone in well I(SG) demonstrated that uranium concentrations increased with conductivity: 0.005 mg/L within the well casing, 0.15 mg/L in the upper portion of the open borehole, and 0.34 mg/L in the lower portion of the open borehole. Well L(SG) was also sampled at three depths for comparison purposes, and all results were 0.003 mg/L. Samples are collected at the depth of greatest uranium concentrations.

Analytical results for the required constituents in bedrock wells are provided in Table 1-5. The selenium and uranium concentrations did not exceed ACLs in the POC wells. However, the uranium concentrations in downgradient wells 13(SG), 18(SG), and I(SG), located along the site boundary, exceed the UMTRCA MCL of 0.044 mg/L and the New Mexico drinking water standard. This indicates that San Andres/Glorieta aquifer groundwater with uranium concentrations exceeding the drinking water standard is leaving the site. The May 2017 uranium concentration in private well HMC-951, used for monitoring purposes only, did not exceed the New Mexico drinking water standard.

Uranium concentrations in the San Andres/Glorieta aquifer are shown in Figure 1-5. Uranium concentrations in well I(SG) before 2013 are not shown because they were erroneously low due to an incorrect sampling depth in the well. Uranium concentrations at POC wells OBS-3 and S(SG) are not shown in Figure 1-5 because the well screens are encrusted with iron scale that has resulted in erroneously low uranium concentrations since DOE began sampling the wells.

Table 1-5. Bedrock Aquifer Monitoring Results for November 2016 and May 2017 at the Bluewater, New Mexico, Disposal Site

Well	Selenium (mg/L) ACL = 0.05 mg/L	Uranium (mg/L) ACL = 2.15 mg/L
11(SG)	0.00066, 0.00200	0.0100, 0.0101
13(SG)	0.00680, 0.00739	0.0960, 0.0906
14(SG)	0.0032, 0.0020	0.1200, 0.0989
15(SG)	0.00066, 0.00200	0.0610, 0.0555
16(SG)	0.0150, 0.0165	1.20, 1.21
18(SG)	0.00670, 0.00665	0.190, 0.201
I(SG)[a]	0.00700, 0.00811	0.290, 0.305
L(SG)	0.00066, 0.00200	0.00300, 0.00308
OBS-3	0.00066, 0.00200	0.00750, 0.00381
S(SG)	0.0070, 0.0116	0.410, 0.501
HMC-951	0.00580, 0.00632	0.0320, 0.0275

Notes:
November 2016 results are first, and May 2017 results are second, in each pair of results.
[a] Sample collected at 265 feet below the top of the casing at the depth of highest conductivity.

Abbreviation:
ND = not detected (below method detection limit)

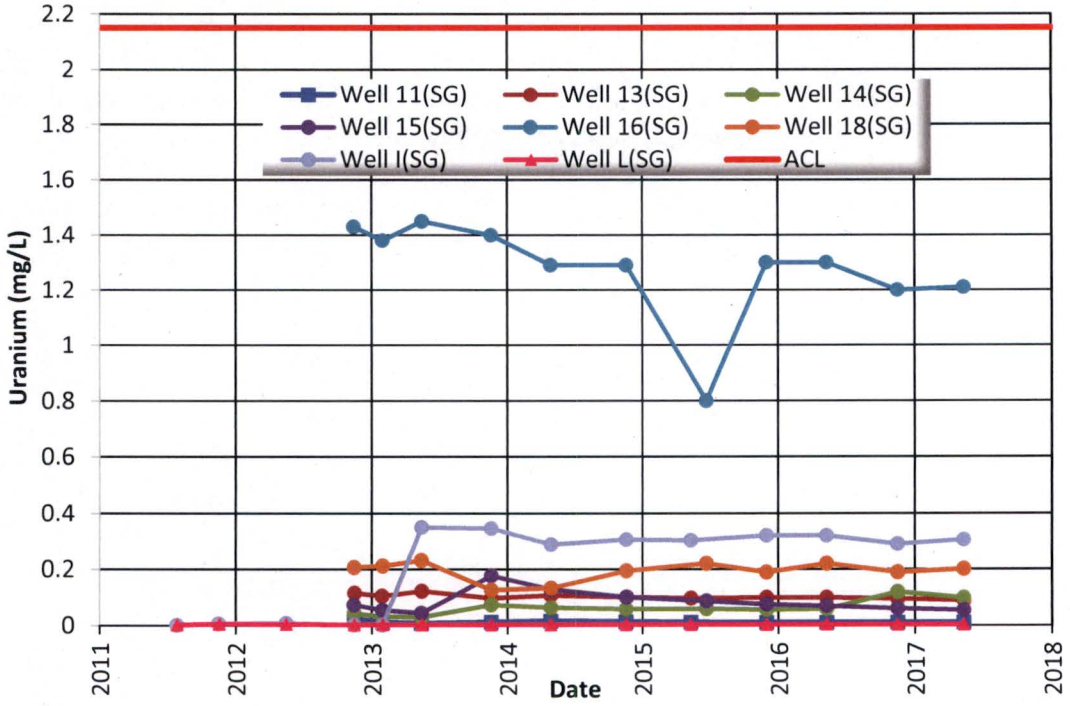


Figure 1-5. Uranium Concentrations in the San Andres/Glorieta Aquifer at the Bluewater, New Mexico, Disposal Site

To evaluate the extent of contamination, DOE sampled private wells near the site in 2013. Most of the private wells near the site are completed in the San Andres/Glorieta aquifer because of the limited extent of the alluvial aquifer near the site. A stock well near the south boundary of the site, which had been a production well for the Bluewater mill, had a uranium concentration above the New Mexico drinking water standard but below limits considered safe for livestock consumption. All other private San Andres/Glorieta wells sampled by DOE, whether permitted for drinking water or agricultural use, had uranium concentrations below the New Mexico drinking water standard. The nearest downgradient municipal wells are located along the New Mexico State Highway 122 corridor and are operated by the Village of Milan. They produce from the San Andres/Glorieta aquifer (Figure 1-6). Municipal sampling results have not had uranium concentrations exceeding the drinking water standard or shown upward trends.

The extent of uranium contamination in the San Andres/Glorieta aquifer and the potential risk to downgradient groundwater users was evaluated in DOE's groundwater conceptual model (DOE 2014). Evaluation of previous groundwater studies in the region and available groundwater data indicated that the flow path of the groundwater in the aquifer from the site is to the east-southeast. The groundwater from the site passes under the Homestake mill site and turns south toward Grants due to the influence of a major fault that passes under Grants (San Rafael Fault). The flow path from the site is substantially north of the Milan municipal wells (Figure 1-6).

The estimated extent of the uranium plume, described in the conceptual groundwater model (DOE 2014), is shown in Figure 1-7. The uranium plume follows the groundwater flow path, and the leading portion is near the Homestake site. The blue area on the figure represents impacted groundwater with uranium concentrations between the site background concentration of 0.01 mg/L and the New Mexico drinking water standard of 0.03 mg/L. Groundwater monitoring results obtained by various entities over the last several decades indicate that uranium contamination from Bluewater mill operations reached the Homestake site by 1980 and that the plume has essentially stabilized. Uranium concentrations attenuate with distance from the site primarily through dispersion instead of chemical reduction because of the absence of a reducing environment in the aquifer formations (DOE 2014). No known drinking water wells are completed within the uranium plume, and site-derived uranium contamination in the San Andres/Glorieta aquifer is not expected to impact the Milan or Grants municipal water supplies. The extent of the plume and potential impacts to existing wells will be reevaluated in 2018.

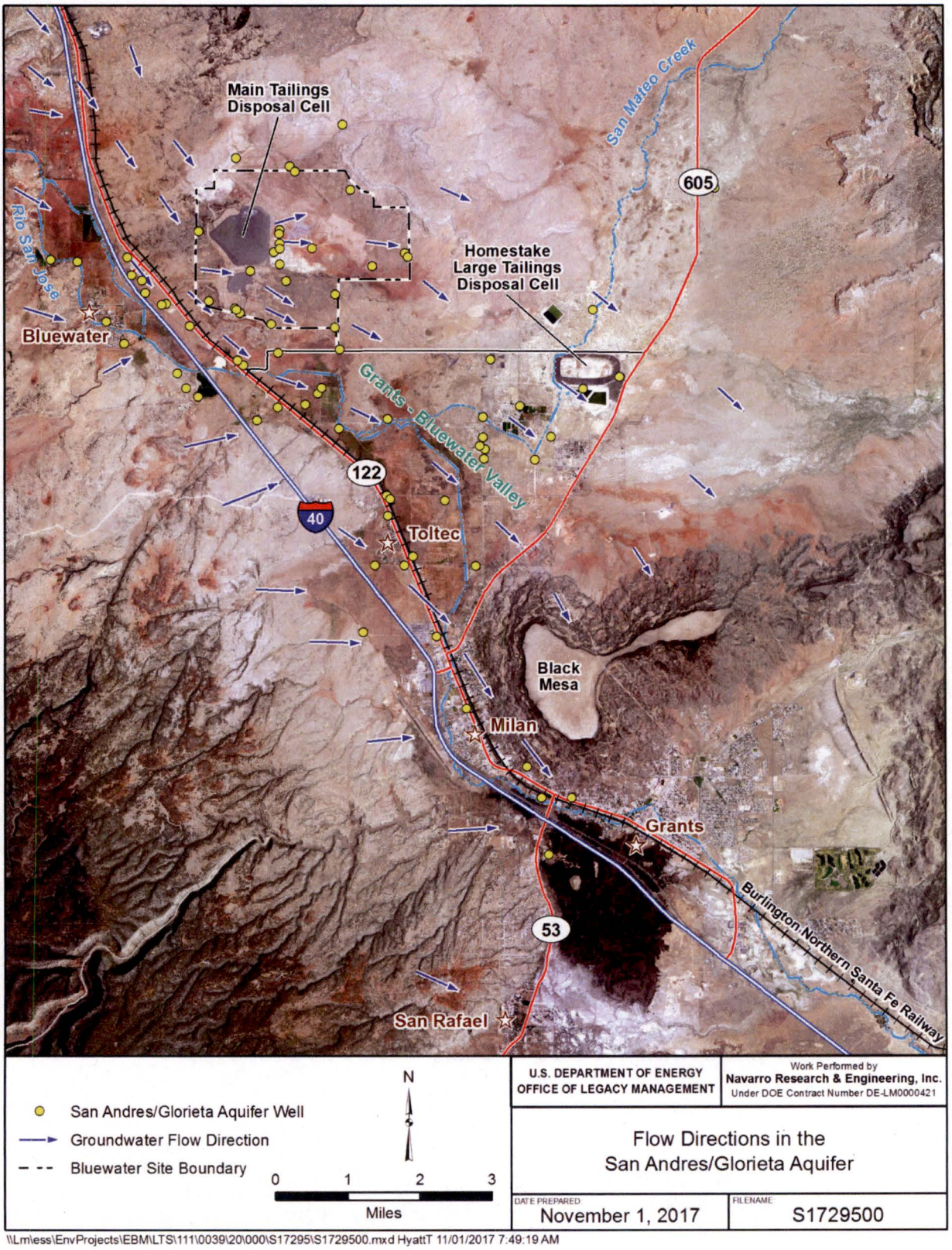


Figure 1-6. Groundwater Flow Directions in the San Andres/Glorieta Aquifer at the Bluewater, New Mexico, Disposal Site

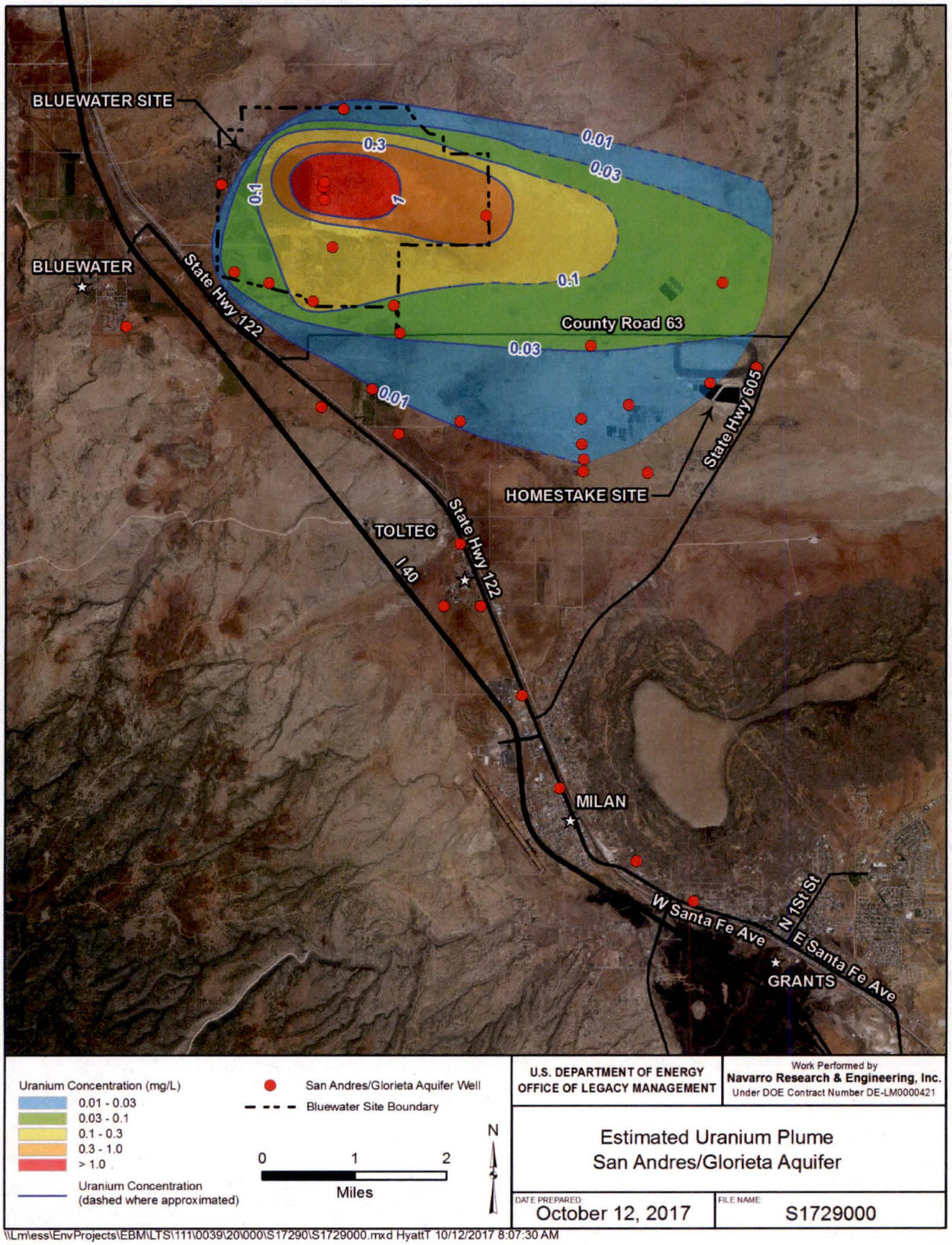


Figure 1-7. 2014 Estimated Uranium Plume in the San Andres/Glorieta Aquifer (DOE 2014)

1.8 References

DOE (U.S. Department of Energy), 1997. *Long-Term Surveillance Plan for the DOE Bluewater (UMTRCA Title II) Disposal Site Near Grants, New Mexico*, LTSM003407, July.

DOE (U.S. Department of Energy), 2014. *Site Status Report: Groundwater Flow and Contaminant Transport in the Vicinity of the Bluewater, New Mexico, Disposal Site*, LMS/BLU/S11381, November.

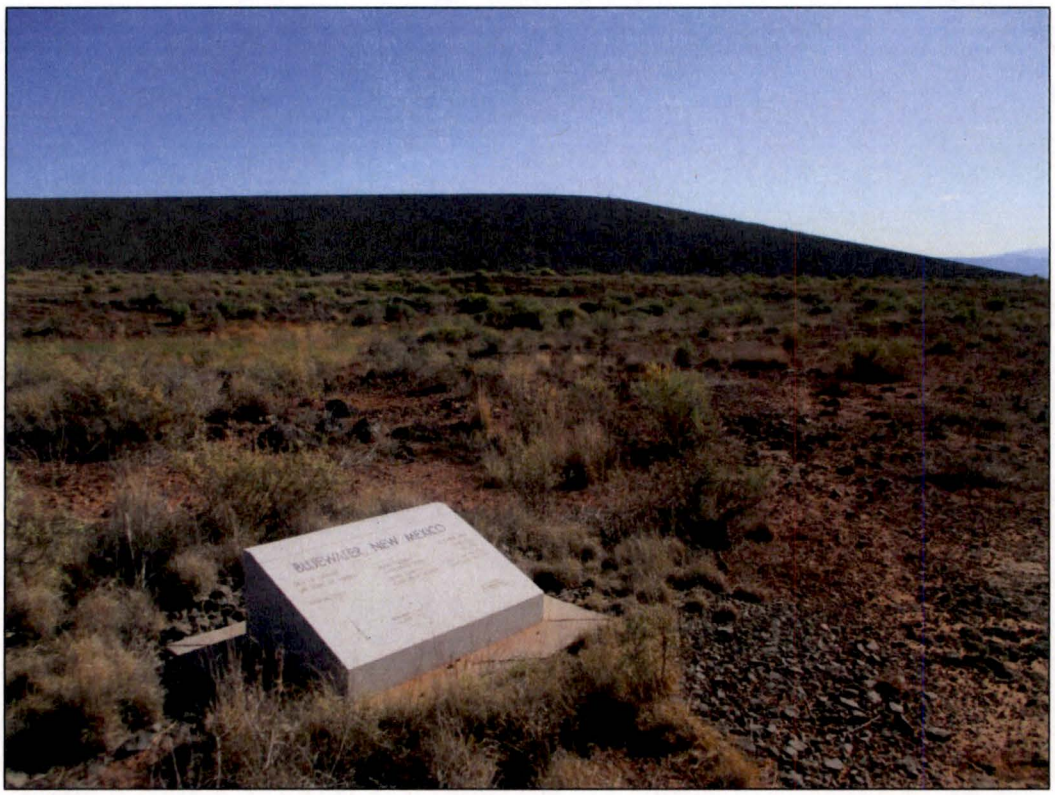
DOE (U.S. Department of Energy), 2016. *Effects of Soil-Forming Processes on Cover Engineering Properties, Field Work Plan, Bluewater Disposal Site, New Mexico*, LMS/BLU/S13276, February.

DOE (U.S. Department of Energy), 2017. *Evaluation of Disposal Cell Topography Using LiDAR Surveys, Bluewater, New Mexico, Disposal Site*, LMS/BLU/S14703, April.

1.9 Photographs

Photograph Location Number	Azimuth	Photograph Description
PL-1	30	Loose Fence Strands Near Perimeter Sign P7
PL-2	50	Site Marker and Main Tailings Disposal Cell
PL-3	285	Monitoring Well X(M)
PL-4	220	Acid Tailings Disposal Area of Main Tailings Disposal Cell
PL-5	0	Vegetation on South Side Slope of Main Tailings Disposal Cell
PL-6	185	Siphon on Main Tailings Disposal Cell Top Slope
PL-7	180	Reclaimed Test Pit 1A on Main Tailings Disposal Cell Top Slope
PL-8	30	Reclaimed Test Pit 9A on Acid Tailings Disposal Area of Main Tailings Disposal Cell
PL-9	85	South Side Slope of Main Tailings Disposal Cell
PL-10	220	Carbonate Tailings Disposal Cell
PL-11	330	Northwest Extension of Carbonate Tailings Disposal Cell
PL-12	0	Reclaimed Test Pit 8 on Carbonate Tailings Disposal Cell Top Slope
PL-13	140	Asbestos Disposal Area
PL-14	165	PCB Disposal Area
PL-15	85	East Dump
PL-16	90	Settlement on Soil Cover of Disposal Area 1
PL-17	70	Bluewater Injection Well Monument

PL-1. Loose Fence Strands Near Perimeter Sign P7

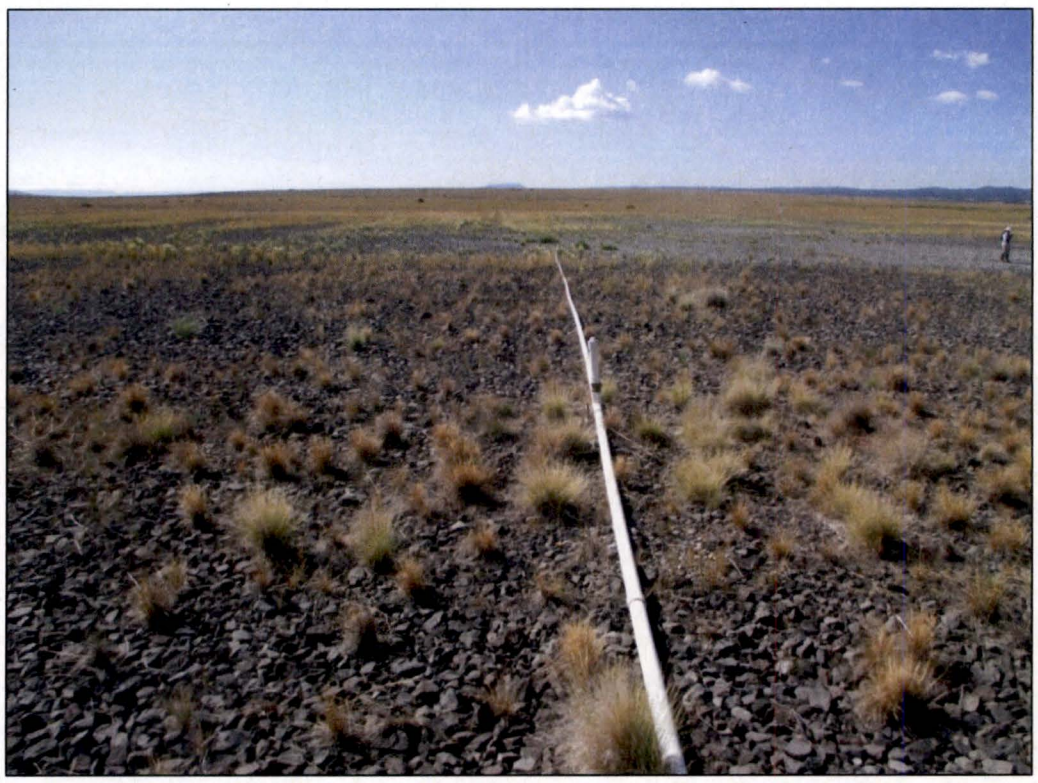


PL-2. Site Marker and Main Tailings Disposal Cell

PL-3. Monitoring Well X(M)

PL-4. Acid Tailings Disposal Area of Main Tailings Disposal Cell

PL-5. Vegetation on South Side Slope of Main Tailings Disposal Cell



PL-6. Siphon on Main Tailings Disposal Cell Top Slope

PL-7. Reclaimed Test Pit 1A on Main Tailings Disposal Cell Top Slope (Water Bottle Provided for Scale)

PL-8. Reclaimed Test Pit 9A on Acid Tailings Disposal Area of Main Tailings Disposal Cell (Water Bottle Provided for Scale)

PL-9. South Side Slope of Main Tailings Disposal Cell

PL-10. Carbonate Tailings Disposal Cell

PL-11. Northwest Extension of Carbonate Tailings Disposal Cell

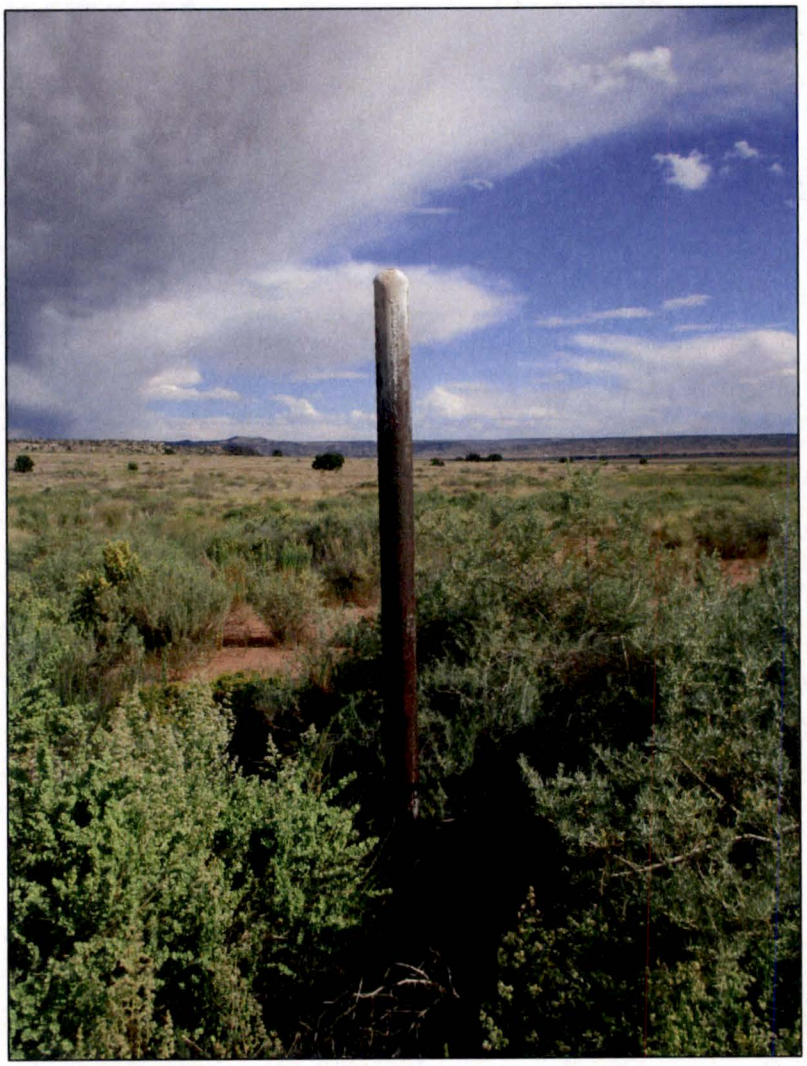
PL-12. Reclaimed Test Pit 8 on Carbonate Tailings Disposal Cell Top Slope

PL-13. Asbestos Disposal Area

PL-14. PCB Disposal Area

PL-15. East Dump

PL-16. Settlement on Soil Cover of Disposal Area 1



PL-17. Bluewater Injection Well Monument

2.0 Edgemont, South Dakota, Disposal Site

2.1 Compliance Summary

The Edgemont, South Dakota, Uranium Mill Tailings Radiation Control Act (UMTRCA) Title II Disposal Site (site) was inspected on July 25, 2017. No changes were observed on the disposal cell or in associated drainage features. A perimeter fence strand was broken in one location and was repaired by the grazing licensee. The grazing licensee will remove the unmaintained interior fence prior to the next annual inspection. Inspectors identified no other maintenance needs or cause for a follow-up inspection. Groundwater monitoring is not required at the site.

2.2 Compliance Requirements

Requirements for the long-term surveillance and maintenance of the site are specified in the site-specific U.S. Department of Energy (DOE) Long-Term Surveillance Plan (LTSP) (DOE 1996) and in procedures DOE established to comply with the requirements of Title 10 *Code of Federal Regulations* Section 40.28 (10 CFR 40.28). Table 2-1 lists these requirements.

Table 2-1. License Requirements for the Edgemont, South Dakota, Disposal Site

Requirement	LTSP	This Report	10 CFR 40.28
Annual Inspection and Report	Sections 3.3 and 3.4	Section 2.4	(b)(3)
Follow-up Inspections	Section 3.5	Section 2.5	(b)(4)
Routine Maintenance and Emergency Measures	Section 3.6	Section 2.6	(b)(5)
Environmental Monitoring	Section 3.7	Section 2.7	(b)(3)

2.3 Institutional Controls

The 360-acre site, identified by the property boundary shown in Figure 2-1, is owned by the United States and was accepted under the U.S. Nuclear Regulatory Commission general license (10 CFR 40.28) in 1996. DOE is the licensee and, in accordance with the requirements for UMTRCA Title II sites, 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, the entrance gate and sign, the perimeter fence and signs, a site marker, and boundary monuments.

2.4 Inspection Results

The site, located approximately 2 miles south of Edgemont, South Dakota, was inspected on July 25, 2017. The inspection was conducted by C. Boger, D. Traub, and R. Johnson of the Legacy Management Support (LMS) contractor to the DOE Office of Legacy Management. T. Jasso (DOE site manager), K. Kreie, P. Robinson, and K. Kiilehua (DOE) attended the inspection. The purposes of the inspection were to confirm the integrity of visible features at the site, to identify changes in conditions that might affect conformance with the LTSP, and to determine the need, if any, for maintenance or additional inspection and monitoring.

A grazing license granted by DOE allows a local rancher to graze his cattle on the site. The DOE and LMS site managers met with the grazing licensee before the inspection to discuss any issues or concerns. As discussed in Section 2.4.1.2, the grazing licensee will remove the unmaintained interior fence from the site. No other concerns were identified by the grazing licensee.

2.4.1 Site Surveillance Features

Figure 2-1 shows the locations of site features in black, including site surveillance features and inspection areas. Site features that are present but not required by the LTSP to be inspected are shown in italic font. Observations from previous inspections that are currently monitored are shown in blue text, and new observations identified in the 2017 annual inspection are shown in red. Inspection results and recommended maintenance activities associated with site surveillance features are included in the following subsections. Photographs to support specific observations are identified in the text and in Figure 2-1 by photograph location (PL) numbers. The photographs and photograph log are presented in Section 2.9.

2.4.1.1 Site Access and Entrance Gate

Access to the site is from County Road 6N. On July 17, 2016, a natural wildfire occurred on the site. The entrance sign was knocked over and bent during firefighting efforts. The post was reset by the grazing licensee, and the entrance sign has been replaced. The entrance sign was updated with the new DOE website address (PL-1).

A tubular metal entrance gate was secured by a locked chain and was intact. Three additional wire gates are along the perimeter fence: at the northwest corner of the property, approximately 700 feet north of the southeast corner, and at the southeast corner of the site. All gates were closed and intact (PL-2 and PL-3). No maintenance needs were identified.

2.4.1.2 Perimeter Fence and Signs

A four-strand barbed-wire fence encloses the site, truncating at the southeast corner to allow livestock access to a preexisting stock pond. The fence was intact except for a broken fence strand at one location that was repaired by the grazing licensee following the inspection. Two perimeter signs are attached to the perimeter fence. Both perimeter signs were present and legible. The grazing licensee monitors site security and maintains the perimeter fence. The licensee proposed to remove the unmaintained interior fence later in 2017 (PL-4). It was installed to prevent grazing during vegetation establishment following closure of the disposal cell. The DOE site manager concurred with this approach as this fence is no longer required.

2.4.1.3 Site Marker

The site has one granite site marker just inside the site entrance gate (PL-5). No maintenance needs were identified.

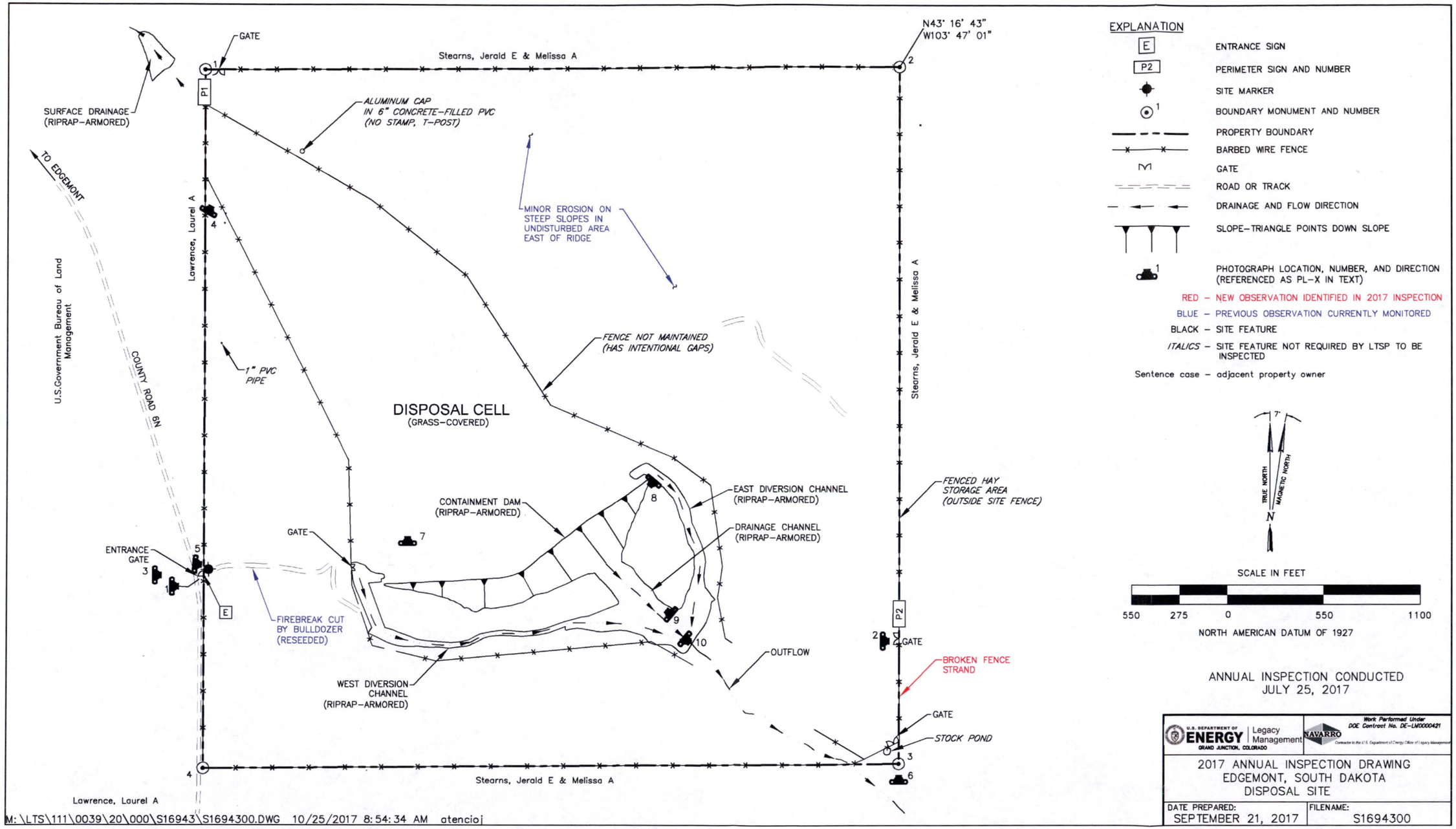


Figure 2-1. 2017 Annual Inspection Drawing for the Edgemont, South Dakota, Disposal Site

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2.4.1.4 Boundary Monuments

There are four boundary monuments, each at a corner of the property (PL-6). All boundary monuments were inspected (except the northeast corner), and no maintenance needs were identified.

2.4.2 Inspection Areas

In accordance with the 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 cover of the disposal cell, (2) the containment dam and diversion channels, (3) the site perimeter, outlying areas, and balance of the site. 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.

2.4.2.1 Cover of the Disposal Cell

The grass-covered disposal cell, completed in 1989, occupies 100 acres. It showed no signs of erosion, settling, or other modifying processes that might affect its integrity.

The 2016 wildfire burned most of the vegetation on the site except for the areas within the riprap diversion channels. Across the site vegetation has recovered (PL-7), and few effects of the fire were evident during the 2017 annual inspection. No maintenance needs were identified.

2.4.2.2 Containment Dam and Diversion Channels

The face of the containment dam, the steepest man-made slope onsite, is covered with riprap and showed no evidence of erosion, settling, slumping, or other modifying processes (PL-8). Scattered plants, mostly grass and annual weeds, grow in the riprap. These plants do not threaten the stability or function of the containment dam.

The diversion and drainage channels are grass-covered on their upslope portions (these are gentle swales on each side of the disposal cell) and riprap-armored on their downslope portions and on steeper slopes (PL-9). Minor amounts of vegetation are present in the riprap. The vegetation helps to stabilize these areas and does not impair the function of the channels. Wetland vegetation is present at the base of the diversion channels (PL-10). No maintenance needs were identified.

2.4.2.3 Site Perimeter, Outlying Areas, and Balance of the Site

The firebreak at the site perimeter created in 2016 is approximately 20 feet wide and extends from the entrance gate to the interior fence near the west drainage channel. This section was regraded by the grazing licensee, and vegetation is recovering.

The site is surrounded by private land used primarily for grazing and wildlife habitat. The area approximately 0.25 mile beyond the site boundary, including a surface drainage area just outside the northwest corner of the property that is riprap-armored to prevent headward erosion onto the site, was visually observed for erosion, changes in land use, or other phenomena that might affect the long-term integrity of the site. No such changes were identified.

The balance of the site consists of undisturbed areas covered with native shrubs, grasses, and forbs and formerly disturbed areas covered primarily with seeded grasses and annual weeds. Some minor erosional features are present on steep slopes in an area isolated from the disposal cell; these features were stable. No maintenance needs were identified.

2.5 Follow-up Inspections

DOE 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) DOE is notified by a citizen or outside agency that conditions at the site are substantially changed. No need for a follow-up inspection was identified.

2.6 Routine Maintenance and Emergency Measures

A broken strand of barbed wire was identified in one section of the perimeter fence, and it was repaired by the grazing licensee. The grazing licensee will also remove the unmaintained interior fence. No other maintenance needs were identified.

Emergency measures are corrective actions that DOE will take in response to unusual damage or disruption that threatens or compromises site health and safety, security, integrity, or compliance with 40 CFR 192. No emergency measures were identified.

2.7 Environmental Monitoring

In accordance with the LTSP, groundwater monitoring is not required at this site because a 300- to 700-foot-thick layer of competent shale bedrock lies between the encapsulated tailings and the uppermost confined aquifer. Additionally, clay liners were constructed to isolate the tailings from the shallower, unconfined, perched groundwater that is present as a result of local precipitation. There is no evidence of any direct hydraulic connection between the perched groundwater and the underlying confined bedrock aquifer.

An annual visual inspection of vegetation conditions at the site is required by the LTSP. Vegetation burned by the 2016 wildfire has recovered across the site, and few effects of the fire were evident. No vegetation management is required. There were no cattle grazing on the site during the inspection.

2.8 Reference

DOE (U.S. Department of Energy), 1996. *Long-Term Surveillance Plan for the DOE Tennessee Valley Authority (UMTRCA Title II) Disposal Site, Edgemont, South Dakota,* June.

2.9 Photographs

Photograph Location Number	Azimuth	Photograph Description
PL-1	90	Entrance Sign
PL-2	90	Locked Gate Near Southeast Corner of Site
PL-3	90	Locked Entrance Gate
PL-4	30	Interior Fence (Will Be Removed by Grazing Licensee)
PL-5	95	Site Marker
PL-6	0	Boundary Monument BM-3
PL-7	0	Disposal Cell Cover (Recovered Vegetation After 2016 Wildfire)
PL-8	220	East Portion of Containment Dam
PL-9	310	Riprap-Armored Drainage Channel Below Containment Dam
PL-10	130	Wetland Vegetation at Outlet of Riprap-Armored Diversion Channel

PL-1. Entrance Sign

PL-2. Locked Gate Near Southeast Corner of Site

PL-3. Locked Entrance Gate

PL-4. Interior Fence (Will Be Removed by Grazing Licensee)

PL-5. Site Marker

PL-6. Boundary Monument BM-3

PL-7. Disposal Cell Cover (Recovered Vegetation After 2016 Wildfire)

PL-8. East Portion of Containment Dam

PL-9. Riprap-Armored Drainage Channel Below Containment Dam

PL-10. Wetland Vegetation at Outlet of Riprap-Armored Diversion Channel

3.0 L-Bar, New Mexico, Disposal Site

3.1 Compliance Summary

The L-Bar, New Mexico, Uranium Mill Tailings Radiation Control Act (UMTRCA) Title II Disposal Site (site) was inspected on September 12, 2017. No changes were observed on the disposal cell or in associated drainage structures. Cut fence strands were identified and repaired during the inspection. Loose wooden brace posts along the southeast watershed fence line at two locations need to be replaced. Gaps under the fence at several locations, caused by gully erosion, need to be blocked by installing additional fence posts to prevent potential intrusion by livestock. Faded trefoil decals on many of the perimeter signs need to be replaced. A broken T-post at an erosion monitoring point on the disposal cell cover needs to be replaced. These maintenance needs will be addressed before the 2018 annual site inspection. Inspectors identified no other maintenance needs or cause for a follow-up inspection.

Erosion and vegetation measurements to monitor the condition of the disposal cell top slope indicated that no erosion is occurring, and perennial vegetation foliar cover at the measurement plots was similar to 2016 measurements. The success criterion of 20% foliar cover in more than half of the measurement plots has not been achieved. Groundwater is monitored triennially in accordance with the site-specific U.S. Department of Energy (DOE) Long-Term Surveillance Plan (LTSP) (DOE 2004). Groundwater sampling was last conducted in November 2016. There are no trends that suggest a compliance limit or standard will be exceeded.

3.2 Compliance Requirements

Requirements for the long-term surveillance and maintenance of the site are specified in the LTSP (DOE 2004) and in procedures that DOE established to comply with the requirements of Title 10 *Code of Federal Regulations* Section 40.28 (10 CFR 40.28). Table 3-1 lists these requirements.

Table 3-1. License Requirements for the L-Bar, New Mexico, Disposal Site

Requirement	LTSP	This Report	10 CFR 40.28
Annual Inspection and Report	Sections 3.3 and 3.4	Section 3.4	(b)(3)
Follow-up Inspections	Section 3.5	Section 3.5	(b)(4)
Routine Maintenance and Emergency Measures	Section 3.6	Section 3.6	(b)(5)
Environmental Monitoring	Section 3.7	Section 3.7	(b)(3)

3.3 Institutional Controls

The 738-acre site, identified by the property boundary shown in Figure 3-1, is owned by the United States and was accepted under the U.S. Nuclear Regulatory Commission (NRC) general license (10 CFR 40.28) in 2004. DOE is the licensee and, in accordance with the requirements for UMTRCA Title II sites, 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, the

entrance gate and sign, the perimeter fence and signs, a site marker, boundary monuments, and monitoring wellhead protectors.

3.4 Inspection Results

The site, located approximately 15 miles north of Laguna, New Mexico, was inspected on September 12, 2017. The inspection was conducted by R. Johnson, A. Kuhlman, M. Kastens, and T. Thoele of the Legacy Management Support (LMS) contractor to the DOE Office of Legacy Management. W. Frazier (DOE site manager), W. Pearson and A. Rheubottom (New Mexico Environment Department), and N. Gordon (LMS) attended the inspection. The purposes of the inspection were to confirm the integrity of the visible features at the site, to identify changes in conditions that might affect conformance with the LTSP, and to determine the need, if any, for maintenance or additional inspection and monitoring.

3.4.1 Site Surveillance Features

Figure 3-1 shows the locations of site features in black, including the surveillance features and inspection areas. Site features that are present but not required by the LTSP to be inspected are shown in italic font. Observations from previous inspections that are currently monitored are shown in blue text, and new observations identified in the 2017 inspection are shown in red. Inspection results and recommended maintenance activities associated with site surveillance features are included in the following subsections. Photographs to support specific observations are identified in the text and in Figure 3-1 by photograph location (PL) numbers. The photograph log and photographs are presented in Section 3.9.

3.4.1.1 Site Access and Entrance Gate

Access to the site is from a public gravel road (Cibola County Road 1). Approximately 300 feet of Cebolleta Land Grant property is crossed to enter the site, and access is provided and described in the warranty and quitclaim deed for the site. The entrance gate is a tubular-steel gate in the stock fence that surrounds the disposal cell features. The gate was secured with a locked chain. No maintenance needs were identified.

3.4.1.2 Fence and Perimeter Signs

A barbed-wire fence encloses the disposal cell and associated drainage structures and is intended to prohibit trespassing and livestock intrusion on the disposal cell structures (livestock trails would initiate gully erosion). The fence is located as much as 3300 feet inside the property boundary, and the area between the fence and the boundary is grazed in accordance with a DOE grazing license with the Cebolleta Land Grant that owns the surrounding property. Cut fence strands near perimeter sign P20 were identified and repaired during the inspection (PL-1). Two sets of wooden brace posts along the fence line near perimeter P33 were loose and need to be replaced by steel posts set in concrete. At several locations, gullies under the fence could be large enough to allow intrusion by calves; the gaps at these locations will be obstructed by installing additional fence posts (metal T-posts). No other maintenance needs were identified.

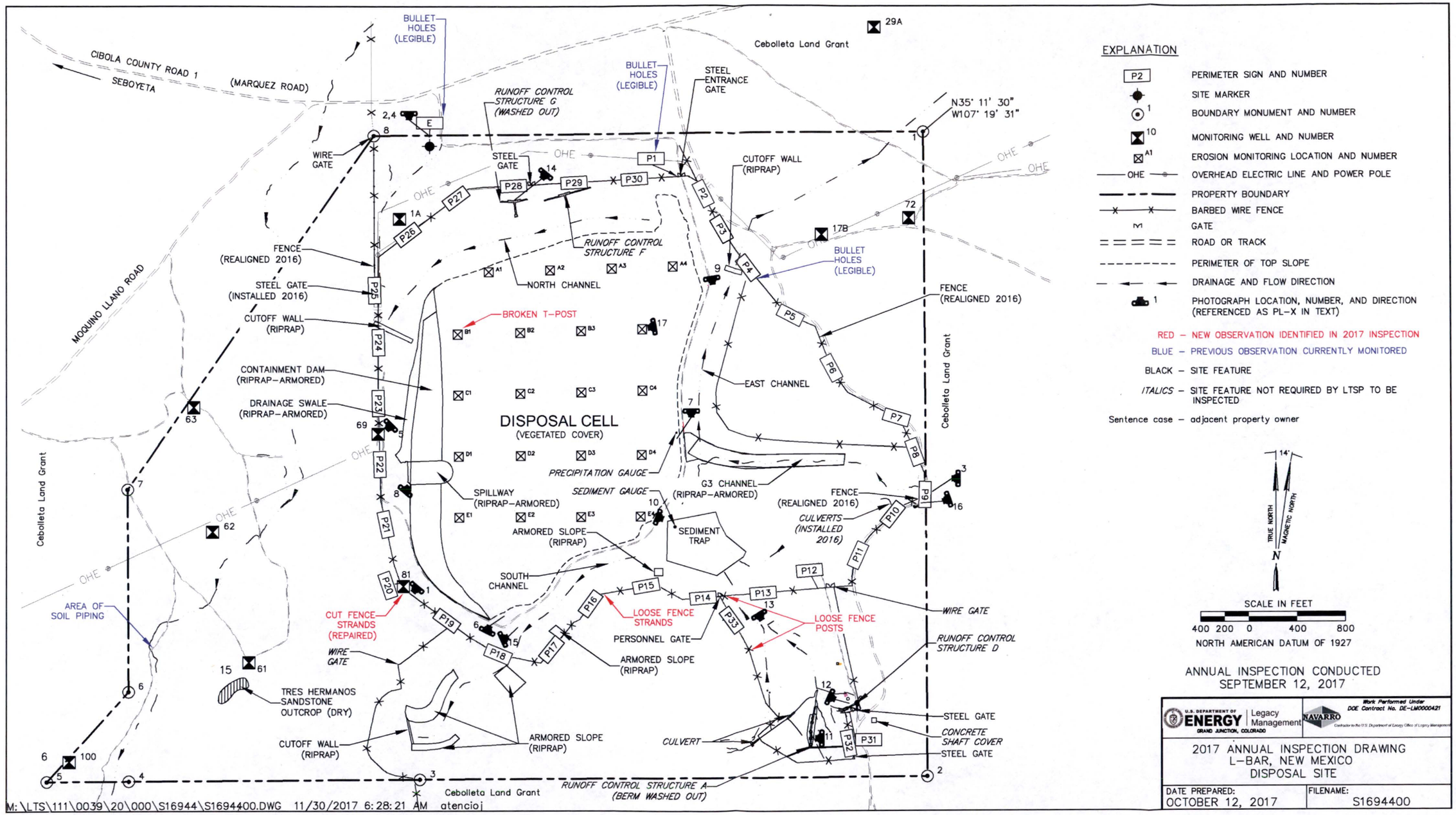

Figure 3-1. 2017 Annual Inspection Drawing for the L-Bar, New Mexico, Disposal Site

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The entrance sign is located on the main site access road near the site marker. It has several bullet holes but was legible (PL-2). Thirty-three warning or perimeter signs are attached to the barbed-wire fence that surrounds the disposal site structures and an area of excessive gully erosion in the southeast portion of the site (PL-3). The decals on many of the perimeter signs are faded and will be replaced during subsequent site visits. No other maintenance needs were identified.

3.4.1.3 Site Marker

The site has one granite site marker located north of the disposal cell adjacent to the site access road (PL-4). No maintenance needs were identified.

3.4.1.4 Boundary Monuments

There are eight boundary monuments defining the site boundary. Due to the size of the site and the remote locations of many of the property corners, not all of the boundary monuments are typically observed during the annual inspection, and this was the case during the 2017 annual inspection. However, all of the boundary monuments were inspected and photographed in spring 2016. No maintenance needs were identified.

3.4.1.5 Monitoring Wells

The site groundwater monitoring network consists of 10 wells. Nine of the wells are on DOE property; monitoring well 29A is outside the northeast corner of the site. The wellhead protectors observed during the inspection were undamaged and locked (PL-5). No maintenance needs were identified.

3.4.2 Inspection Areas

In accordance with the LTSP, the site is divided into four inspection areas (referred to as "transects" in the LTSP) to ensure a thorough and efficient inspection. The inspection areas are (1) the cover of the disposal cell, (2) the containment dam, (3) the diversion channels, and (4) the site perimeter, outlying areas, and balance of the site. Inspectors examined the 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.

3.4.2.1 Cover of the Disposal Cell

The soil-covered disposal cell, completed in 2000, occupies approximately 100 acres. Its top slope surface is minimally sloped to the west toward the central portion of the containment dam to promote drainage and minimize runoff water velocities and the potential for erosion. Although the top slope was not seeded because plant growth was not expected to be successful, vegetation is occurring naturally with native species (PL-6). Vegetation was slow to establish in the southeast portion of the top slope, so a native seed mix was applied in 2009. This area also has successfully vegetated (PL-7). The establishment and maturing of vegetation is expected to reduce wind and water erosion of the surface and help prevent precipitation from percolating into the tailings.

Cracks are usually present in the surface soil of the disposal cell top slope. They are confined to the upper couple of feet of the cover soil and appear to result from drying of the gypsum-rich soil after precipitation events. The cracks tend to heal as they fill with windblown and precipitation runoff–borne sediment and as perennial vegetation continues to establish. The cover of the disposal cell showed no signs of erosion, settling, or other modifying processes that might affect the integrity of the disposal cell. No maintenance needs were identified. In accordance with the LTSP, erosion and vegetation are monitored on the disposal cell top slope. Section 3.7.2 describes the monitoring program and presents the results to date.

3.4.2.2 Containment Dam

The disposal cell was constructed during mill operations by damming the head of a natural drainage basin. The face of the earthen containment dam has a 20% slope and is riprap-armored to prevent erosion and degradation. Large-diameter riprap was used to protect the spillway in the central portion of the containment dam where precipitation runoff would discharge from the disposal cell cover (PL-8). Native vegetation is well established on the face, which is desirable for increasing the erosion protection of the surface. There were no indications of erosion, settlement, seeps, or other modifying processes that might affect the integrity of the containment dam. No maintenance needs were identified.

3.4.2.3 Diversion Channels

The surface water diversion system consists primarily of the east, north, and south channels that divert runoff water away from the disposal cell. The system is designed to accommodate probable maximum flood discharges. Runoff from an upgradient watershed east of the disposal cell is designed to be conveyed away from the site to a northeastward-flowing drainage via the east channel. The east channel is separated from the disposal cell by a dike that serves as an onsite access road. Gullies are present along the east slope of the east channel, but the erosion and sediment deposition are not impairing the function of the east channel. The east channel was dry at the time of the inspection (PL-9).

A tributary channel, the G3 channel, was constructed to divert runoff from a smaller watershed into the east channel. Gullies have formed along the side slopes of the G3 channel. The erosion and sediment deposition are not impairing the function of the channel.

Some erosion was expected to occur in a watershed that encompasses the southeast portion of the site and adjacent property. Storm runoff from this watershed discharges into a sediment trap, where the sediment load settles out. If a runoff event overtops the sediment trap, the flow is diverted to the east channel. The sediment trap was dry at the time of the inspection (PL-10).

Multiple high-intensity storm events since the completion of site reclamation have caused deep gullies to form in the highly erodible soils and fill materials upgradient of the sediment trap. Construction of runoff control structures to reduce the rate of erosion in the area and prevent headward migration of gullies into adjoining private property was completed in December 2009. Runoff from a storm event in September 2011 overtopped an earthen runoff control berm of Runoff Control Structure A and caused substantial damage to the berm. Subsequent runoff events have caused erosion adjacent to gabion drop structures associated with Runoff Control Structure A and nearby Runoff Control Structure D (PL-11 and PL-12). Repairs to these

structures and the addition of other structures in the watershed are being evaluated due to excessive erosion (PL-13).

Runoff water from the area north of the disposal cell is captured by the north channel. The water is diverted away from the site to the west. Deep gullies had formed in the alluvium and weathered shale along a portion of the north bank of the channel, and headward erosion was rapidly migrating to the north toward the site access road and property boundary. The eroded channel bank was restored to its original design configuration, and two runoff control structures were constructed in 2009 to reduce erosion and sedimentation. The east structure (Runoff Control Structure F) was stable and functional at the time of the inspection. The west structure (Runoff Control Structure G), however, suffered severe erosion during runoff events in August and September 2011 and continues to erode (PL-14). Repairs and modifications to these structures are being evaluated.

The south channel diverts storm runoff from the higher terrain immediately south of the disposal cell toward the channel outlet to the west (PL-15). Three riprap structures are present on the north-facing slope (south bank) to inhibit erosion along natural drainage swales. Erosion is occurring on the unprotected slope surfaces, resulting in sediment accumulation in the south channel. The erosion and sediment deposition are not impairing the function of the south channel.

3.4.2.4 Site Perimeter, Outlying Areas, and Balance of the Site

The site is surrounded by open private land that is used primarily for grazing. Uranium exploration activities, mine reclamation activities, and associated access road construction have occurred in recent years in areas adjacent to the site. These activities have not been detrimental to site security.

A gully that formed on a side slope of G3 channel had encroached on the east site access road. Culverts were installed along the access road in 2016 to prevent washout of the road and to control erosion. The culverts were functioning as designed, and no maintenance needs were identified (PL-16).

The access road to monitoring well 100, located in the southwest corner of the site, is damaged by subsurface erosion (soil piping) near the head of an arroyo. The affected area has been mapped, metal fence posts have been installed next to soil collapse features, and the information is shown on the inspection and sampling maps to prevent injury or vehicle damage. Consequently, well 100 is accessed by foot or by all-terrain vehicle.

A Tres Hermanos Sandstone unit of the Mancos Shale crops out in the southwest corner of the site. This unit is hydraulically connected to contaminated groundwater under the disposal cell, and the outcrop is considered a potential evapotranspiration area. The outcrop was not observed during the inspection but was dry when visited in August 2017. This location will continue to be monitored for seepage and recommended for sampling if seep water is present.

Several legacy features, including concrete pads (a large pad covers the mine shaft) and abandoned sewer manholes, are near the southeast corner of the site. These features will be monitored to ensure that they continue to prevent access to the underground mine structures.

3.5 Follow-up Inspections

DOE 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) DOE is notified by a citizen or outside agency that conditions at the site are substantially changed. No need for a follow-up inspection was identified during the inspection.

3.6 Routine Maintenance and Emergency Measures

Cut fence strands were identified and repaired during the inspection. Loose wooden brace posts need to be replaced, gaps where the fence crosses gullies need to be blocked, and faded trefoil decals on many of the perimeter signs need to be replaced. A broken T-post at an erosion monitoring point on the disposal cell cover needs to be replaced. These maintenance needs will be addressed before the 2018 annual inspection. No other maintenance needs were identified during the inspection.

Emergency measures are corrective actions that DOE will take in response to unusual damage or disruption that threatens or compromises site health and safety, security, integrity, or compliance with 40 CFR 192. No emergency measures were identified.

3.7 Environmental Monitoring

3.7.1 Groundwater Monitoring

In accordance with the LTSP, groundwater monitoring is required at the site. The monitoring network consists of 10 DOE wells on or adjacent to the site and two Moquino Water Users Association wells approximately 2 miles west of the site in the village of Moquino. Table 3-2 lists the wells that are in the monitoring network, and they are shown in Figure 3-2. Samples are collected triennially and are analyzed for chloride, nitrate, selenium, sulfate, total dissolved solids (TDS), and uranium. Analytical results are compared to the LTSP-required concentration limits listed in Table 3-3 that consist of alternate concentration limits (ACLs) granted by NRC and alternate abatement standards (AASs) stipulated by the New Mexico Environment Department.

If an ACL or AAS is exceeded in any monitoring well (Table 3-3), DOE will inform NRC of the exceedance and conduct confirmatory sampling. If confirmatory sampling verifies the exceedance, DOE will develop an evaluative monitoring work plan and submit that plan to NRC for review prior to initiating the evaluative monitoring program. Results of the evaluative monitoring program will be used, in consultation with NRC, to determine if corrective action is necessary.

Table 3-2. Groundwater Monitoring Network for the L-Bar, New Mexico, Disposal Site

Monitoring Well	Network Application
1A	POC source zone well
17B	POC source zone well
29A	Background well
61	Seepage indicator well
62	Seepage affected area indicator well
63	POE seepage indicator well
69	POC source zone well
72	POE well on east property boundary
81	POC source zone well
100	POE well on west property boundary
Moquino New	Public water supply well in Moquino
Moquino Old	Backup public water supply well in Moquino

Abbreviations:
POC = point of compliance
POE = point of exposure

Table 3-3. Groundwater Alternate Concentration Limits and Alternate Abatement Standards for the L-Bar, New Mexico, Disposal Site

Analyte	New Mexico Standard	ACL (Wells 1A, 17B, 69, 81)	AAS Source Zone (Wells 1A, 17B, 69, 81)	AAS Affected Area (Well 62)
Chloride (mg/L)	250	NA	1127	NA
Nitrate (mg/L)	10.0	NA	1180	NA
Selenium (mg/L)	0.05	2.0	2.0	NA
Sulfate (mg/L)	4000[a]	NA	13,110	5185
TDS (mg/L)	5880[a]	NA	20,165	7846
Uranium (mg/L)	0.03[b]	13.0	13.0	NA

Notes:
[a] Background value approved by the State of New Mexico for L-Bar.
[b] LTSP listed the former State of New Mexico standard of 5.0 mg/L.

Abbreviations:
mg/L = milligrams per liter
NA = not applicable

As stipulated in the LTSP, the requirements for annual groundwater monitoring were met in 2007. Consequently, the sampling frequency changed to once every 3 years beginning in fall 2010 in accordance with the LTSP. Groundwater monitoring will continue as long as a New Mexico standard (Table 3-3) is exceeded in any monitoring well.

Groundwater monitoring was conducted in November 2016, and the results are provided in Table 3-4. Access to the Moquino wells was not provided by the owner, so those wells could not be sampled. The next sampling event will occur in 2019.

Table 3-4. November 2016 Groundwater Monitoring Results for the L-Bar, New Mexico, Disposal Site

Monitoring Well	Analyte (mg/L)[a,b]					
	Chloride	Nitrate[c]	Selenium	Sulfate	TDS	Uranium
1A	***400***	0.25	ND	***4300***	***6600***	0.0061
17B	***360***	***790***	0.2	***4700***	***9400***	0.027
29A	170	0.01	ND	***4500***	***6400***	0.0001
61	100	0.027	ND	3200	4700	0.00027
62	46	ND	ND	550	1600	0.00005
63	46	ND	ND	520	1600	0.0001
63[d]	49	ND	ND	570	1600	0.00011
69	***730***	ND	ND	***10,000***	***13,000***	***1.6***
72	220	8	0.013	***4500***	5800	0.016
81	170	***16***	0.049	***4800***	***6400***	0.019
100	31	0.55	ND	2300	3400	0.0011
Moquino New	NS	NS	NS	NS	NS	NS
Moquino Old	NS	NS	NS	NS	NS	NS

Notes:
[a] Significant digits are reported by the laboratory and are based on detection limits.
[b] ***Bold italicized*** results exceed a New Mexico standard.
[c] Nitrate plus nitrite as nitrogen (NO_3 + NO_2 as N).
[d] Duplicate result from laboratory.

Abbreviations:
mg/L = milligrams per liter
ND = not detected (below laboratory detection limit)
NS = not sampled

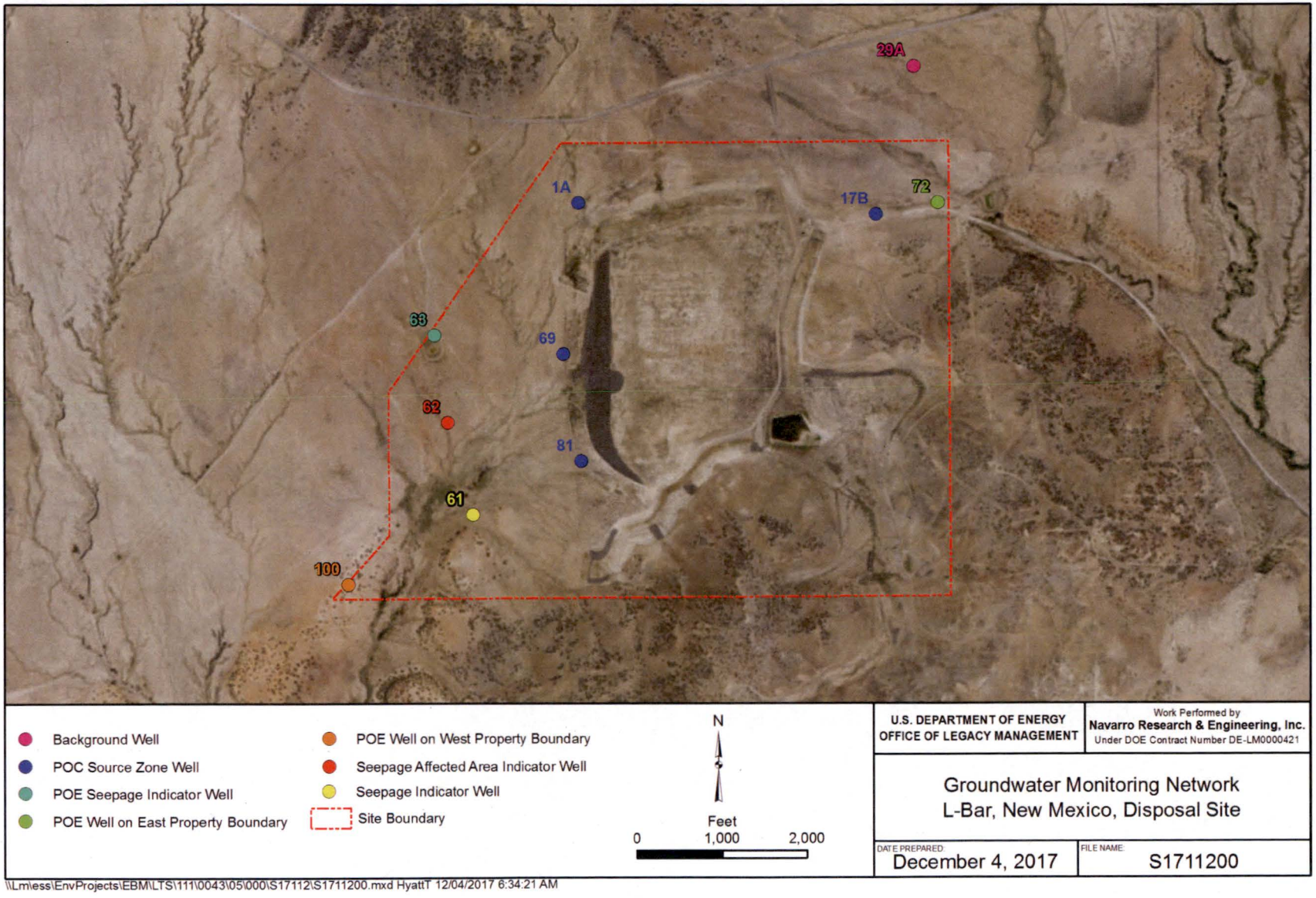


Figure 3-2. Groundwater Monitoring Network at L-Bar, New Mexico, Disposal Site

Since sampling commenced in 2005, no ACL or AAS Source Zone levels have been exceeded in any of the POC wells, and no AAS Affected Area levels have been exceeded in monitoring well 62. Therefore, groundwater at the site is in compliance with the LTSP requirements. Results from the 2016 sampling event are consistent with historical results. Increases in chloride and nitrate concentrations occurred in well 69 and 17B, respectively, but there are no trends that suggest that an ACL, AAS Source Zone, or AAS Affected Area concentration will be exceeded (Figure 3-3, Figure 3-4). Selenium concentration decreased or remained stable in all POC wells (Figure 3-5), and sulfate concentration remained stable in both AAS Source Zone wells and the AAS Affected Area well (Figure 3-6, Figure 3-7). TDS concentration decreased in all AAS Source Zone wells (Figure 3-8) and remained stable in the AAS Affected Area well (Figure 3-9).

Uranium concentration decreased or remained stable in all POC wells (Figure 3-10). At least one New Mexico standard is exceeded in six of the DOE wells, including background well 29A (sulfate and total dissolved solids).

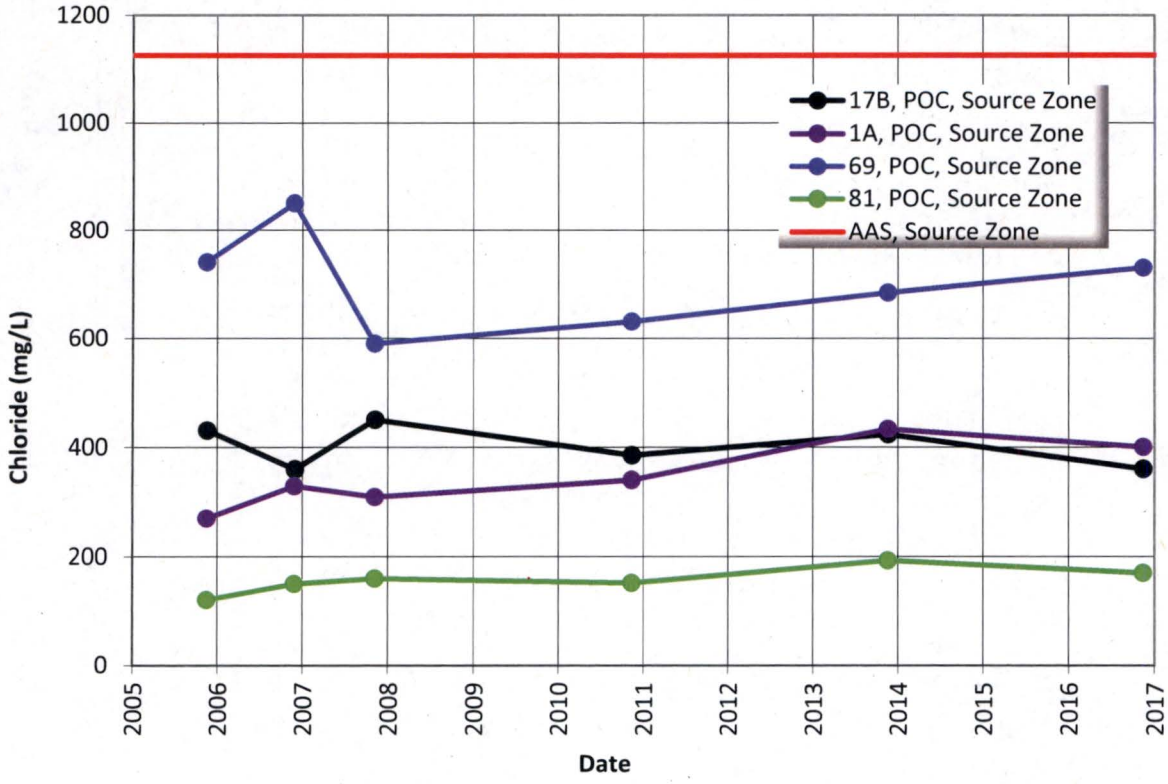


Figure 3-3. Time Concentration Plots of Chloride in Groundwater at the L-Bar Disposal Site

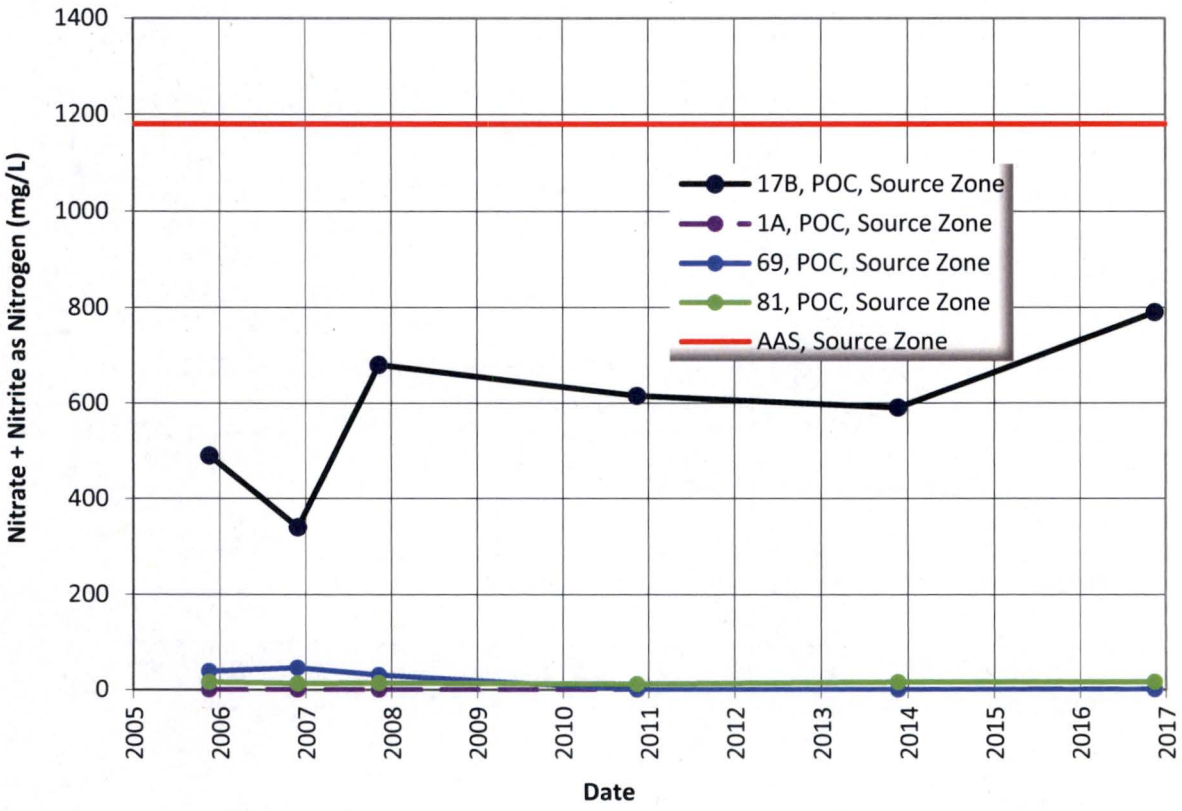


Figure 3-4. Time Concentration Plots of Nitrate in Groundwater at the L-Bar Disposal Site

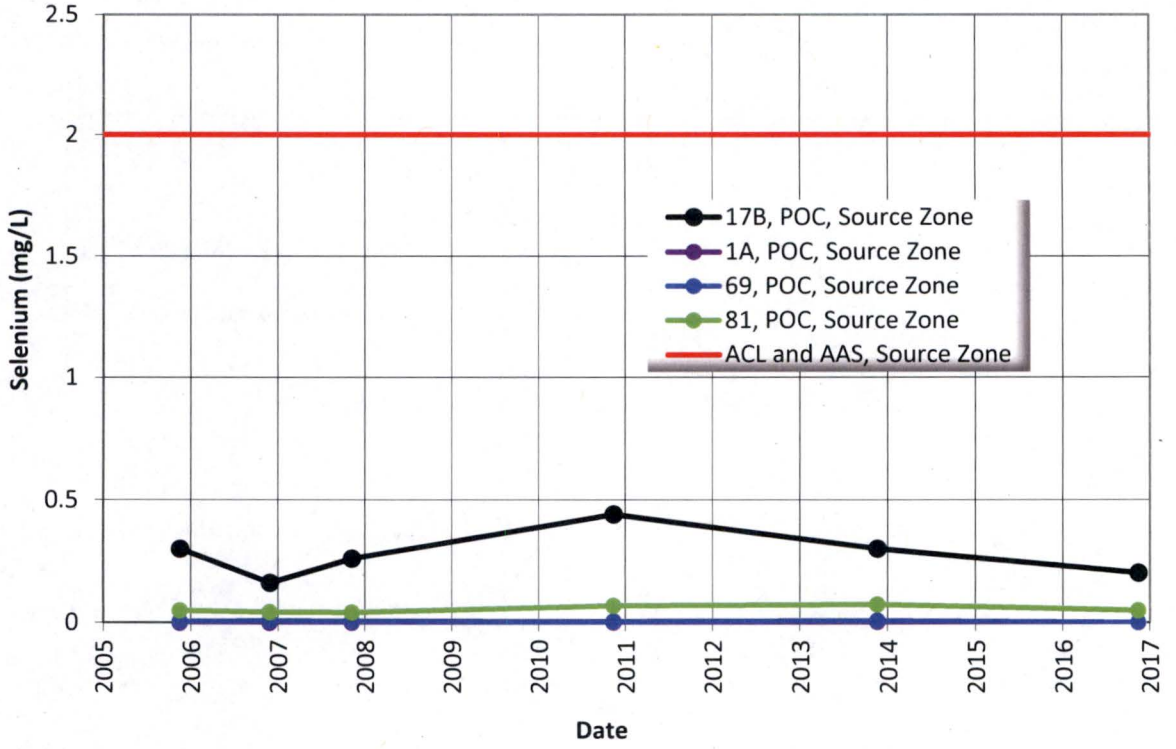


Figure 3-5. Time Concentration Plots of Selenium in Groundwater at the L-Bar Disposal Site

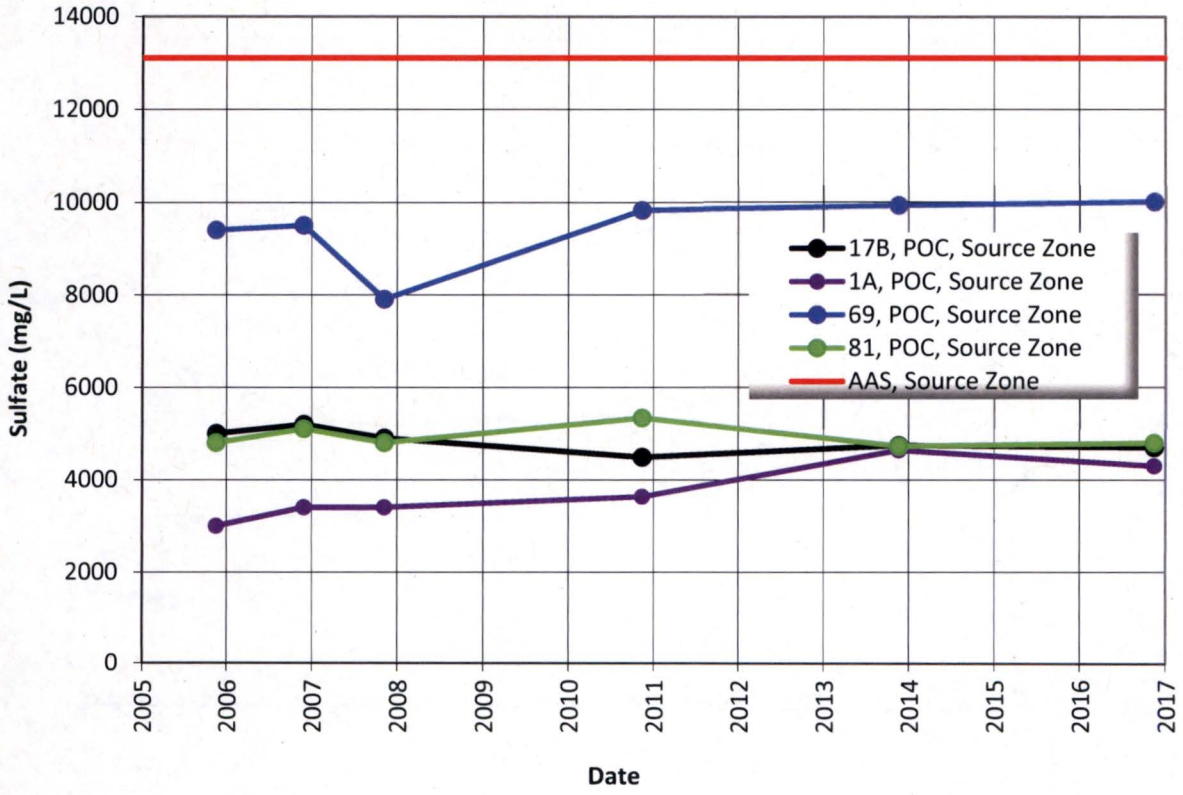


Figure 3-6. Time Concentration Plots of Sulfate in Groundwater at the L-Bar Disposal Site (Source Zone Wells)

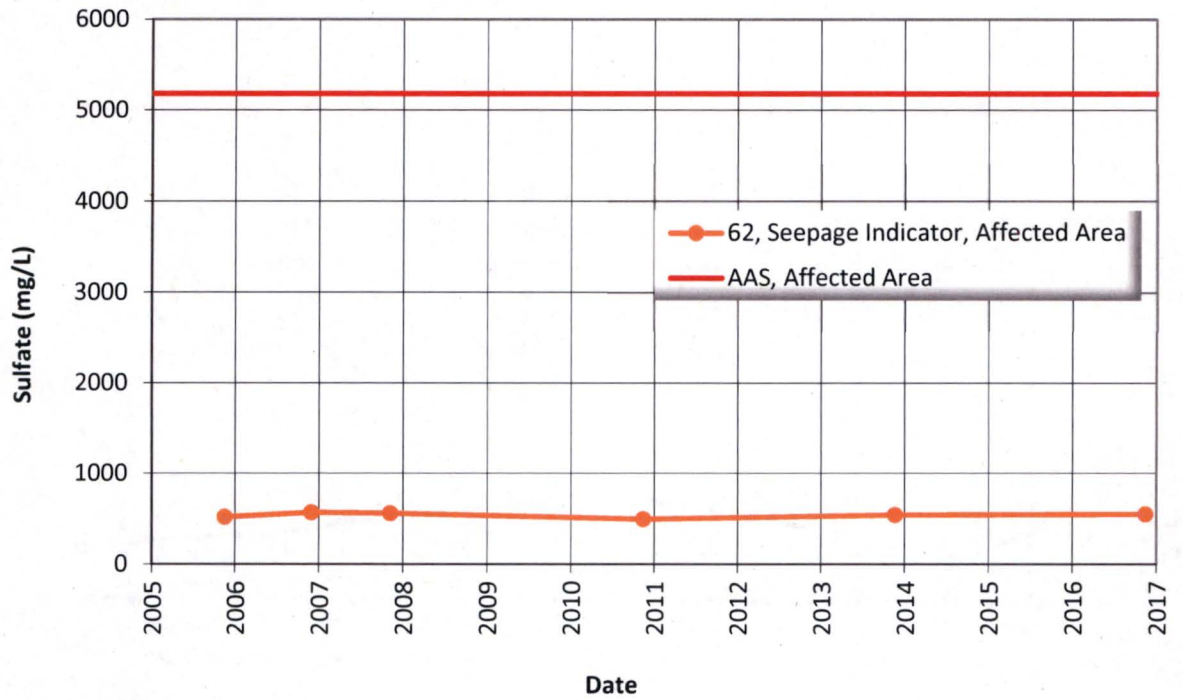


Figure 3-7. Time Concentration Plots of Sulfate in Groundwater at the L-Bar Disposal Site (Affected Area Wells)

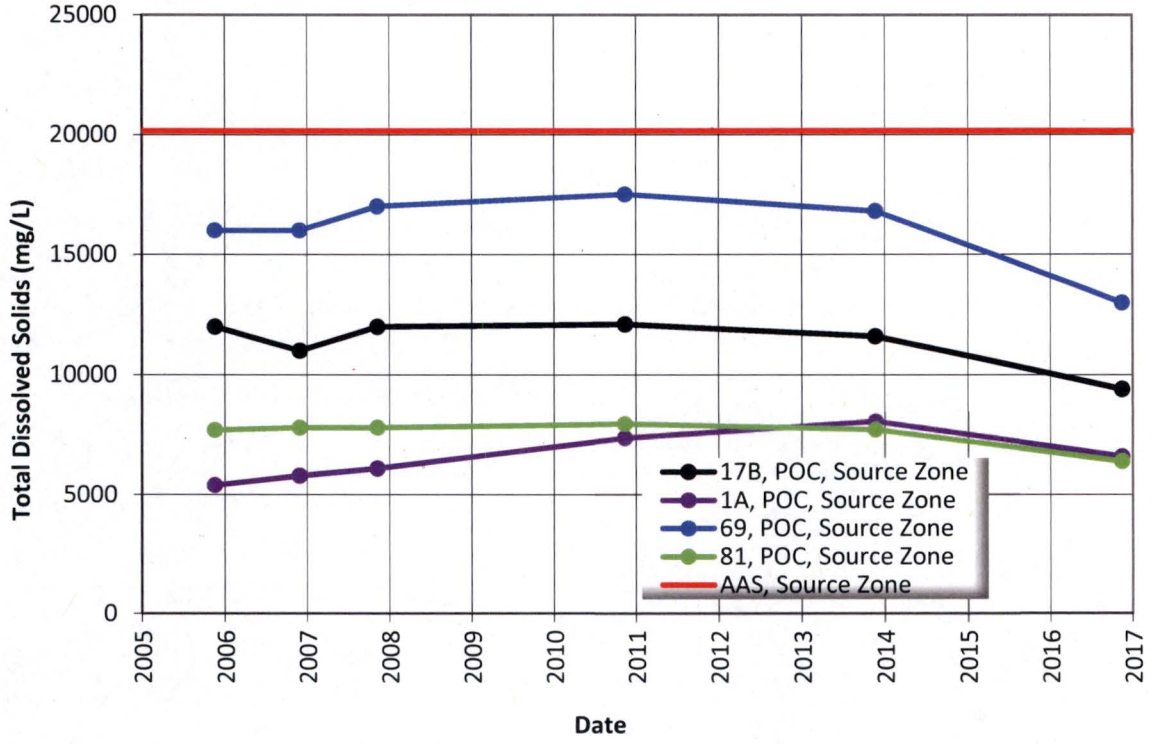


Figure 3-8. Time Concentration Plots of Total Dissolved Solids in Groundwater at the L-Bar Disposal Site (Source Zone Wells)

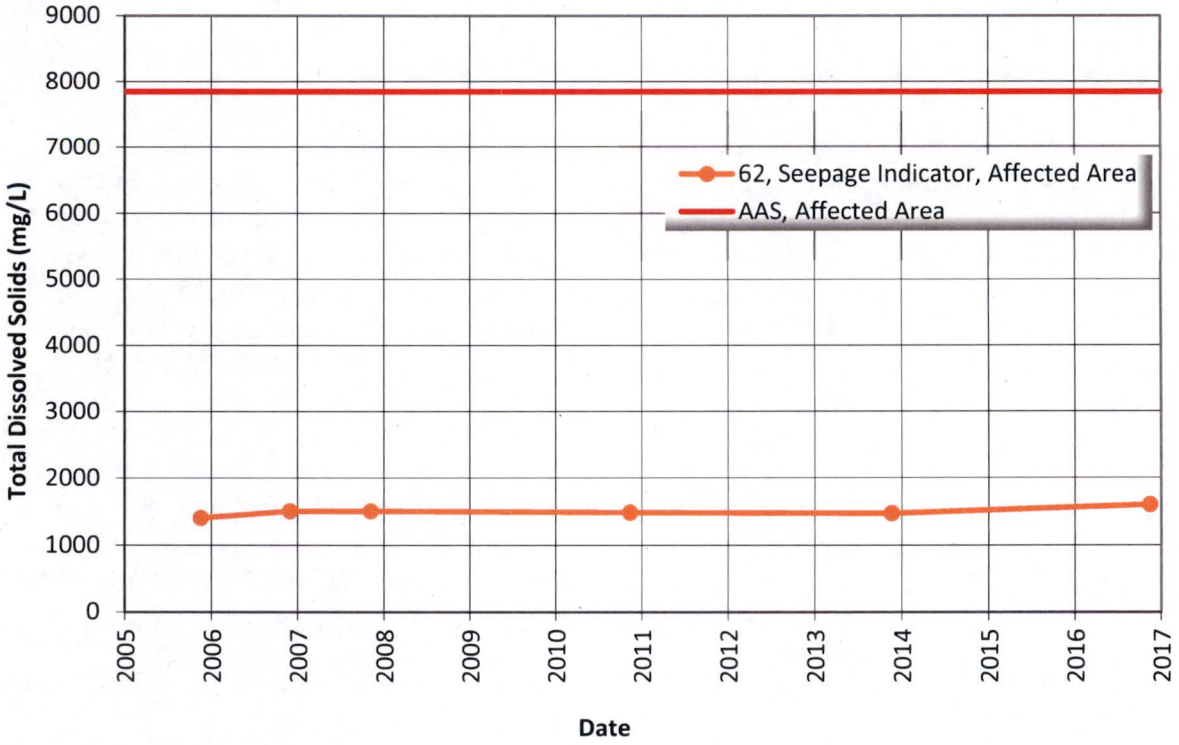


Figure 3-9. Time Concentration Plots of Total Dissolved Solids in Groundwater at the L-Bar Disposal Site (Affected Area Wells)

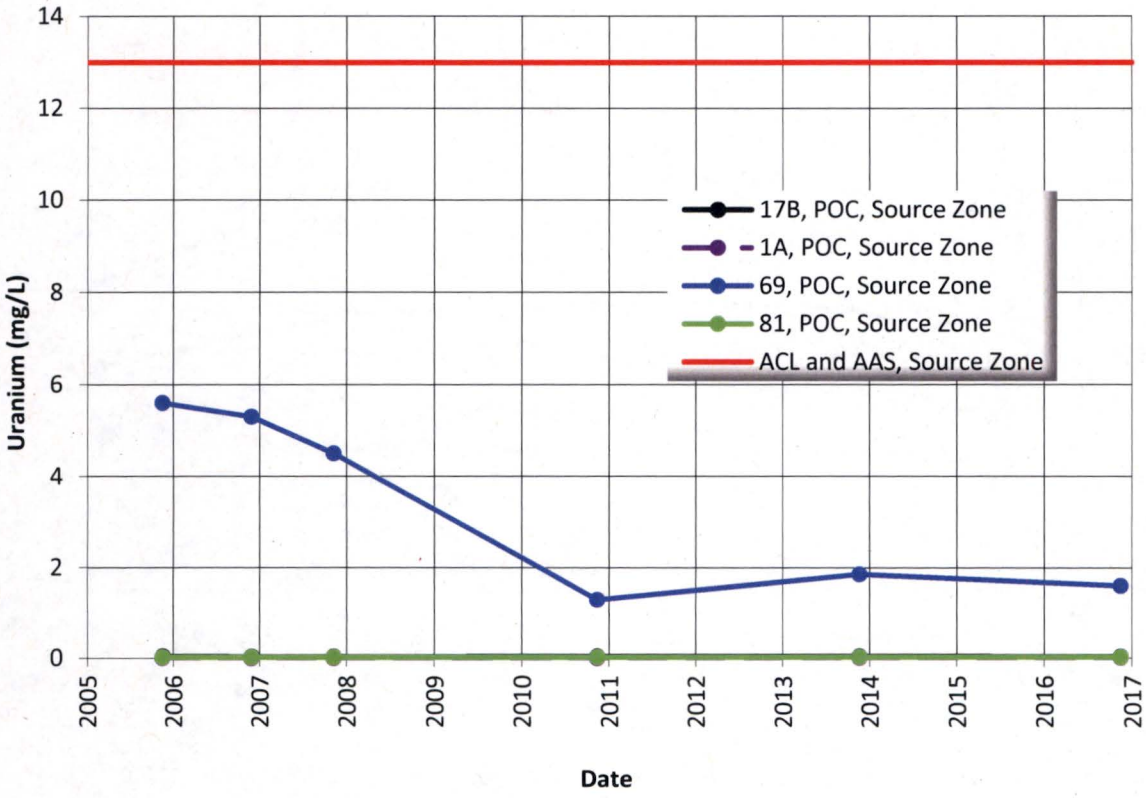


Figure 3-10. Time Concentration Plots of Uranium in Groundwater at the L-Bar Disposal Site

3.7.2 Erosion Monitoring Program

An erosion monitoring program (EMP) was developed to address potential erosion of the disposal cell cover over time and was incorporated as an LTSP requirement. Sohio Western Mining Company developed the plan at the request of the New Mexico Water Quality Control Commission as a condition for granting AASs for groundwater at the site. In accordance with Appendix C of the LTSP, erosion measurements will be performed annually for 20 years (through 2024) and once every 10 years for the following 80 years. Erosion will be considered excessive when 2 feet of erosion is noted at more than half of the monitoring locations. If this occurs, DOE will initiate discussions with NRC to assess likely remedial scenarios and develop an appropriate mitigation protocol, if required.

The cover of the disposal cell consists of a 4.1-foot-thick (minimum) compacted layer of clay to function as a radon barrier; it is overlain by clay-rich soil materials. Total thickness of the cover ranges from 6 to 10 feet. The EMP has two parts: (1) measuring erosion and (2) measuring the progress of revegetation. Measurements were made during the 2017 annual site inspection on September 12, 2017.

3.7.2.1 Erosion Monitoring

In accordance with the EMP, the former licensee installed a grid of 20 evenly spaced monitoring locations on the cover in November 2003. These locations are shown in Figure 3-1. The locations were initially measured in December 2003 to establish a baseline dataset.

Each monitoring location consists of a 5-foot length of half-inch-diameter, epoxy-coated rebar surrounded by three metal T-posts that were installed to help locate the rebar and provide orientation for the measurements. The rebar was driven at each location so that approximately 1 foot remained above the cover surface. Each rebar has a metal tag indicating the location number. The T-posts are set approximately 6 feet from the rebar and form an equilateral triangle, with one point of the triangle due east of the rebar. An 8-foot length of PVC pipe was installed over the east T-post at each monitoring location in spring 2016 to aid in finding the monitoring locations in the increasingly tall vegetation. A T-post at erosion monitoring point B1 was broken and will be replaced prior to the 2018 annual site inspection.

Erosion measurement is accomplished by placing a 4-foot-long level centered at the base of the rebar so that the east end of the level points to the easternmost T-post. The height of the rebar is measured from the base of the level to the top of the rebar and is recorded to the nearest 1/16 inch, using the method established during baseline measurements in 2003.

Results of the 2017 measurements are presented in Table 3-5. Baseline measurements are included for comparison. The surface elevation has increased at all of the monitoring locations when compared to the baseline measurements. These results indicate that the surface of the disposal cell is accreting instead of eroding. Accretion is likely due to the increasing vegetation density on the disposal cell cover, which in turn raises the surface elevation through underground root growth, organic matter accumulation in and on the surface soil, and sediment (derived from locations upwind of the disposal cell) deposition around the plants' foliage and stems.

Table 3-5. Surface Elevation Changes on the L-Bar, New Mexico, Disposal Cell Cover Between 2003 and 2017

Monitoring Location	Length of Rebar Above Surface (inches)				Change in Surface Elevation[a] Baseline to Present (decimal inches)
	2003 (Baseline)		2017		
	(fraction)	(decimal)	(fraction)	(decimal)	
A1	12 10/16	12.625	11 0/16	11.000	1.625
A2	12 7/16	12.438	11 10/16	11.625	0.813
A3	12 15/16	12.938	11 15/16	11.938	1.000
A4	12 6/16	12.375	11 5/16	11.313	1.062
B1	12 10/16	12.625	11 2/16	11.125	1.500
B2	12 8/16	12.500	12 3/16	12.188	0.312
B3	13 0/16	13.000	12 6/16	12.375	0.625
B4	12 15/16	12.938	11 6/16	11.375	1.563
C1	12 8/16	12.500	11 0/16	11.000	1.500
C2	13 1/16	13.063	12 9/16	12.563	0.500
C3	12 2/16	12.125	11 6/16	11.375	0.750
C4	12 6/16	12.375	11 9/16	11.563	0.812
D1	12 7/16	12.438	11 10/16	11.625	0.813
D2	12 12/16	12.750	12 3/16	12.188	0.562
D3	12 3/16	12.188	10 15/16	10.938	1.250
D4	12 12/16	12.750	12 9/16	12.563	0.187
E1	13 1/16	13.063	11 15/16	11.938	1.125
E2	12 14/16	12.875	12 6/16	12.375	0.500
E3	12 9/16	12.563	11 10/16	11.625	0.938
E4	12 15/16	12.938	12 6/16	12.375	0.563

Note:
[a] A positive change indicates that the surface elevation at that monitoring point increased; a negative change indicates that the surface elevation at that location decreased.

3.7.2.2 Vegetation Monitoring

DOE established 10 vegetation monitoring plots to measure the progress of revegetation over time (PL-17). Plots were established at existing erosion monitoring locations to streamline measurement activities at the site (monitoring locations A1, A3, B2, B4, C1, C3, D2, D4, E1, and E3). At each plot, three T-posts were used to form three corners of the plot; the fourth point was projected south of the three T-posts to form a parallelogram covering approximately 100 square feet.

The primary vegetation monitoring requirement is to measure the percentage of the foliar cover (canopy) of all live vegetation within the plot. Percent foliar cover represents the approximate total area under the maximum circumference of each of the live plants within the plot. The average foliar cover of live vegetation in the vicinity of the site, according to the U.S. Department of Agriculture and estimated from observation, is approximately 25%.

The predominant vegetation in the area consists of perennial grasses, forbs, and shrubs. In accordance with the EMP, DOE will perform annual vegetation monitoring until at least 20% foliar cover is achieved, and this criterion will be satisfied when more than half of the monitoring plots exceed 20% cover. Because annual and biennial plants do not necessarily germinate each year, and their germination is highly dependent upon weather conditions, it is assumed that this criterion is based on perennial plant cover. Once the success criterion is met, annual monitoring will not be required unless a significant reduction in plant density is noted during an annual site inspection; in that case, vegetation cover in the plots will be measured again. Annual vegetation monitoring will continue until the success criterion has again been satisfied.

Results of the 2017 vegetation monitoring, compared with those from selected previous years, are presented in Table 3-6. Four of the 10 plots contained more than 20% perennial foliar cover in 2017, the same as in 2016. Large increases and decreases in perennial cover from year to year are mostly attributable to new growth and dieback in the shrub species (broom snakeweed, rubber rabbitbrush, and fourwing saltbush), which likely occur in response to wet and drought years, respectively. Perennial foliar cover in Plot D4 has noticeably improved since it was seeded in 2009. Annual vegetation monitoring will continue until six or more plots meet or exceed the 20% foliar cover requirement.

Table 3-6. Comparison of Perennial Plant Cover on the L-Bar, New Mexico, Disposal Cell Cover

Plot Location	Percent Perennial Plant Cover in 100-feet^2 Plots					
	2005	2009	2013	2015	2016	2017
A1	57	74	12	30	34	35
A3	11	15	7	11	10	8
B2	0	0	0	0	0	0
B4	20	48	13	21	20	28
C1	22	20	7	27	20	25
C3	0	2	2	2	2	8
D2	2	6	9	1	0	4
D4	0	0	1	14	18	18
E1	2	16	5	34	65	22
E3	8	10	6	23	15	13

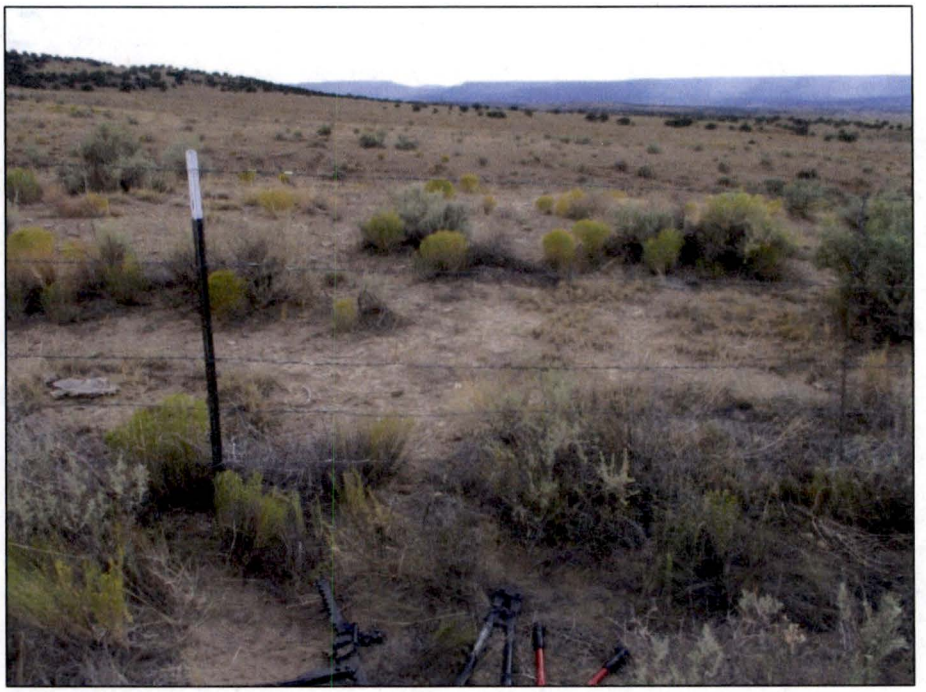
Perennial plant species that have been observed within the monitoring plots include broom snakeweed, rubber rabbitbrush, fourwing saltbush, dropseed, bottlebrush squirreltail, James' galleta grass, tumblegrass, Nelson globemallow, Bigelow's tansyaster, silverleaf nightshade, white heath aster, spreading fleabane, and goosefoot. Rubber rabbitbrush and fourwing saltbush are deep-rooted woody shrubs.

3.8 Reference

DOE (U.S. Department of Energy), 2004. *Long-Term Surveillance Plan for the U.S. Department of Energy L-Bar, New Mexico (UMTRCA Title II) Disposal Site, Seboyeta, New Mexico,* DOE–LM/GJ709–2004, September.

3.9 Photographs

Photograph Location Number	Azimuth	Photograph Description
PL-1	220	Repaired Cut Perimeter Fence Near Perimeter Sign P20
PL-2	180	Entrance Sign
PL-3	270	Perimeter Sign P9
PL-4	180	Site Marker
PL-5	225	Monitoring Well 69
PL-6	25	Disposal Cell Top Slope
PL-7	190	Southeast Portion of Disposal Cell Top Slope Seeded in 2009
PL-8	40	Containment Dam Spillway
PL-9	170	East Channel
PL-10	110	Sediment Trap
PL-11	270	Soil Piping Along Runoff Control Structure A Channel
PL-12	115	Gully Below Runoff Control Structure D
PL-13	150	Gullies Upgradient of Sediment Trap
PL-14	220	Damaged Runoff Control Structure G
PL-15	65	South Channel
PL-16	250	Culverts Constructed in 2016
PL-17	260	Erosion Monitoring Point and Vegetation Plot B4



PL-1. Repaired Cut Perimeter Fence Near Perimeter Sign P20

PL-2. Entrance Sign

PL-3. Perimeter Sign P9

PL-4. Site Marker

PL-5. Monitoring Well 69

PL-6. Disposal Cell Top Slope

PL-7. Southeast Portion of Disposal Cell Top Slope Seeded in 2009

PL-8. Containment Dam Spillway

PL-9. East Channel

PL-10. Sediment Trap

PL-11. Soil Piping Along Runoff Control Structure A Channel

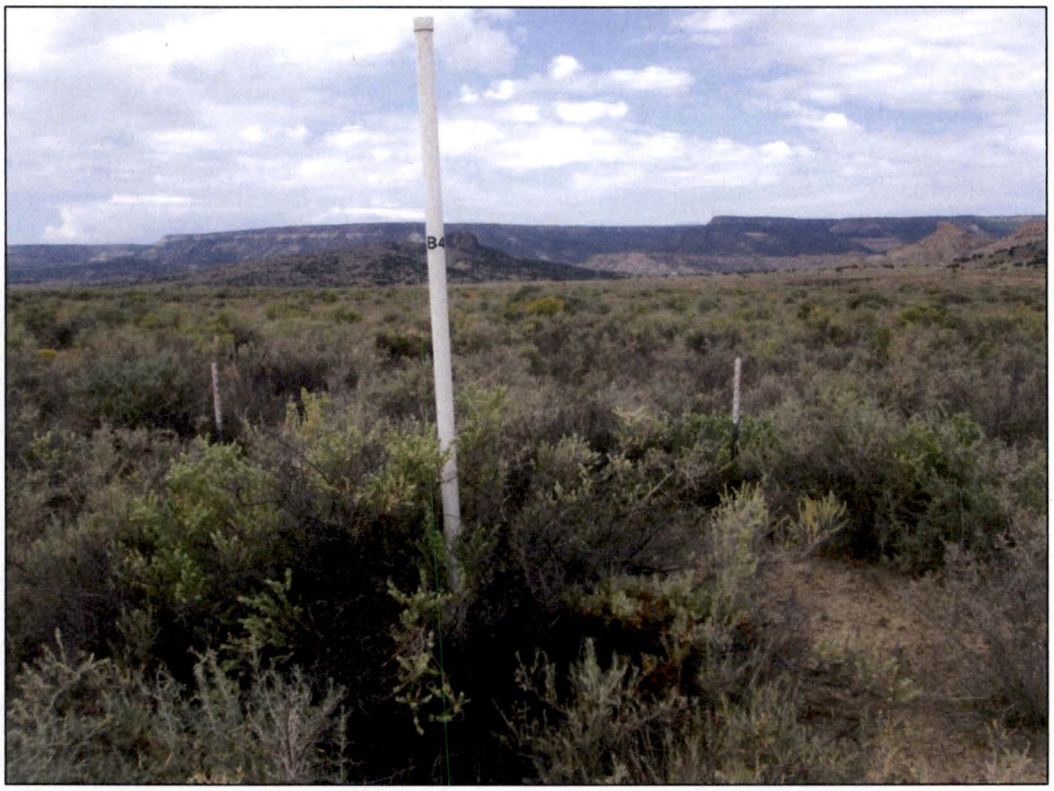
PL-12. Gully Below Runoff Control Structure D

PL-13. Gullies Upgradient of Sediment Trap

PL-14. Damaged Runoff Control Structure G

PL-15. South Channel

PL-16. Culverts Constructed in 2016



PL-17. Erosion Monitoring Point and Vegetation Plot B4

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4.0 Maybell West, Colorado, Disposal Site

4.1 Compliance Summary

The Maybell West, Colorado, Uranium Mill Tailings Radiation Control Act (UMTRCA) Title II Disposal Site (site) was inspected on August 8, 2017. The small, shallow depression (Depression No. 1) on top of the disposal cell remains the same size (approximately 25 feet long, 15 feet wide, and 1 foot deep). The second, smaller depression (Depression No. 2) just west of the first remains unchanged (10 feet long, 5 feet wide, and less than 6 inches deep). Neither depression currently threatens the integrity or performance of the disposal cell; monitoring of the depressions will continue. No changes were observed in associated drainage features. Minor damage to the perimeter fence was noted, and perimeter sign P9 was missing. The fence was repaired and the sign replaced on October 11, 2017. Inspectors identified no other maintenance needs or cause for a follow-up inspection. Groundwater monitoring is not required at the site.

4.2 Compliance Requirements

Requirements for the long-term surveillance and maintenance of the site are specified in the site-specific U.S. Department of Energy (DOE) Long-Term Surveillance Plan (LTSP) (DOE 2010) and in procedures DOE established to comply with the requirements of Title 10 *Code of Federal Regulations* Section 40.28 (10 CFR 40.28). Table 4-1 lists these requirements.

Table 4-1. License Requirements for the Maybell West, Colorado, Disposal Site

Requirement	LTSP	This Report	10 CFR 40.28
Annual Inspection and Report	Sections 3.3 and 3.4	Section 4.4	(b)(3)
Follow-up Inspections	Section 3.5	Section 4.5	(b)(4)
Routine Maintenance and Emergency Measures	Section 3.6	Section 4.6	(b)(5)
Environmental Monitoring	Section 3.7	Section 4.7	(b)(3)

4.3 Institutional Controls

The 180-acre site, identified by the property boundary shown in Figure 4-1, is owned by the United States and was accepted under the U.S. Nuclear Regulatory Commission general license (10 CFR 40.28) in 2010. DOE is the licensee and, in accordance with the requirements for UMTRCA Title II sites, is responsible for the custody and long-term care of the site. Institutional controls (ICs) at the site include federal ownership of the property and the following physical ICs that are inspected annually: the disposal cells, entrance gate and sign, perimeter fence and signs, site marker, and boundary monuments.

4.4 Inspection Results

The site, located approximately 4 miles north-northeast of Maybell, Colorado, was inspected on August 8, 2017. The inspection was conducted by S. Hall and A. Kuhlman of the Legacy Management Support (LMS) contractor to the DOE Office of Legacy Management. J. Nguyen (DOE site manager) and J. Doebele (Colorado Department of Public Health and Environment) attended the inspection. The purposes of the inspection were to confirm the integrity of visible

features at the site, to identify changes in conditions that might affect conformance with the LTSP, and to determine the need, if any, for maintenance or additional inspections and monitoring.

4.4.1 Site Surveillance Features

Figure 4-1 shows the locations of site features in black, including site surveillance features and inspection areas. Site features that are present but not required by the LTSP to be inspected are shown in italic font. Observations from previous inspections that are currently monitored are shown in blue text, and new observations identified in the 2017 inspection are shown in red. Inspection results and recommended maintenance activities associated with site surveillance features are included in the following subsections. Photographs to support specific observations are identified in the text and in Figure 4-1 by photograph location (PL) numbers. The photographs and photograph log are presented in Section 4.9.

4.4.1.1 Site Access and Entrance Gate

Access to the site is via Moffat County Road 53, which runs north from U.S. Highway 40 approximately 8 miles east of Maybell, Colorado. County Road 53 ends at an unlocked gate near the northeast corner of the Maybell UMTRCA Title I disposal site (approximately 3 miles from U.S. Highway 40).

From that point the access road continues west as a dirt two-track road on U.S. Bureau of Land Management (BLM) property and through a second unlocked gate. Just past the second gate, the access road turns south and continues for approximately 0.5 mile past an abandoned open pit uranium mine known as Rob Pit, where it meets the former haul road for the Maybell West site. The access road continues north on the former haul road for approximately 0.25 mile to the site, ending at the site entrance gate.

Because the portion of the access road that leads to the Maybell UMTRCA Title I disposal site is a county road, maintenance up to that point is performed by Moffat County. Beyond that point (i.e., the unlocked gate near the northeast corner of the Maybell UMTRCA Title I disposal site), DOE is responsible for maintenance of the access road under a BLM right-of-way permit. The access road was passable, and no maintenance needs were identified.

The entrance gate, a standard tubular metal stock gate, is near the southeast corner of the site (PL-1). The gate was locked, and no maintenance needs were identified.

4.4.1.2 Perimeter Fence and Signs

A four-strand barbed-wire fence encloses the disposal cell, the ancillary cell, the drainage structures, and much of the site. The fence facilitates land management by DOE, because the site is in wintering grounds frequented by big game animals (primarily pronghorn, deer, and elk) and is also surrounded by open range land used for cattle grazing. As a result, minor damage to the perimeter fence occurs periodically. Fence damage identified during the 2016 annual inspection consisted of a bent fence post and associated loose fence strands (PL-2). Minor erosion was also observed between two fence posts, but this erosion does not currently threaten the fence (PL-3). Observation of this erosion will continue. Another broken fence strand was identified during the 2017 annual inspection. All fence maintenance was performed on October 11, 2017.

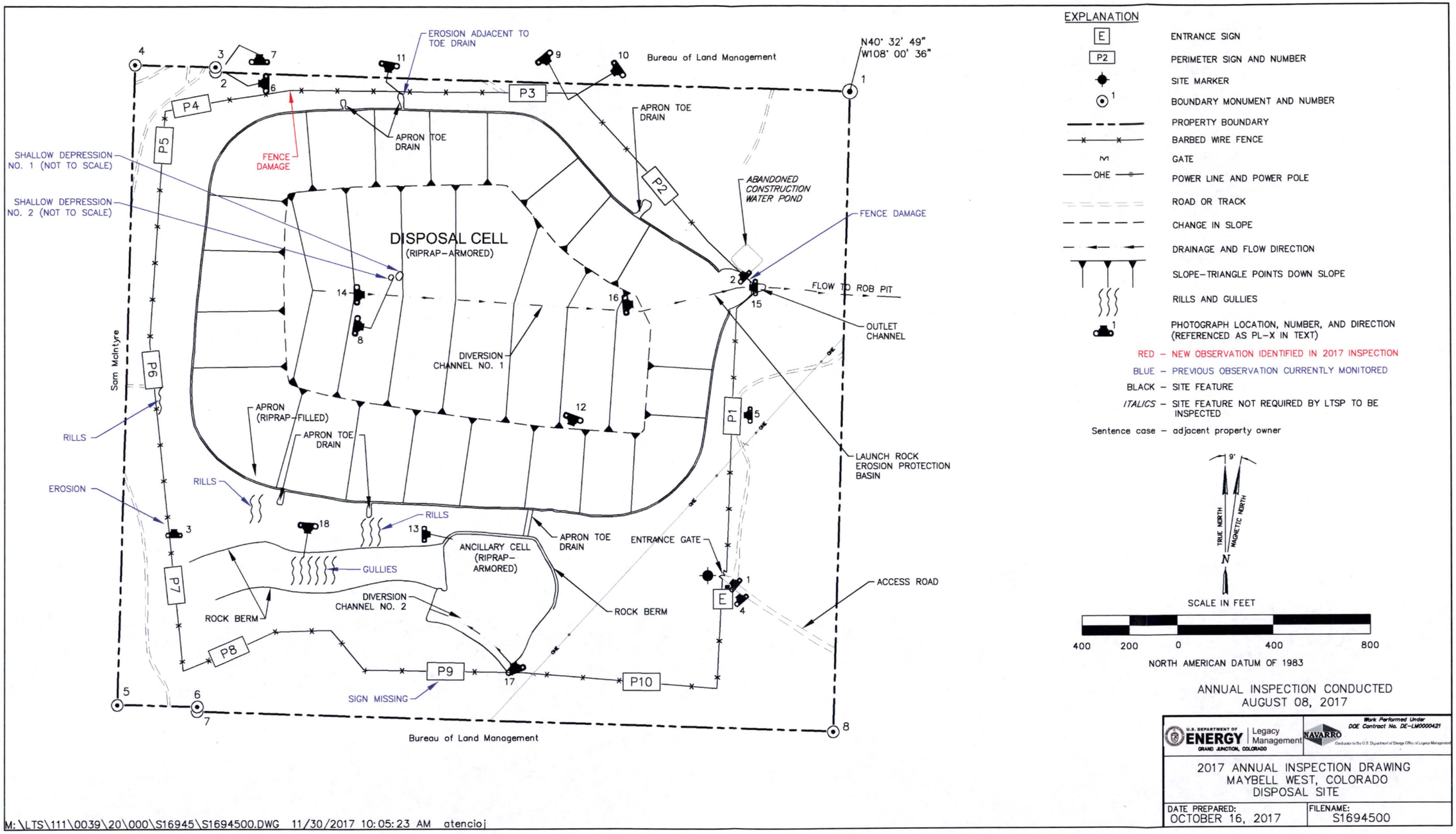

Figure 4-1. 2017 Annual Inspection Drawing for the Maybell West, Colorado, Disposal Site

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The entrance sign is mounted on a perimeter fence metal T-post directly south of the entrance gate (PL-4). Ten warning or perimeter signs are mounted on perimeter fence metal T-posts around the site (PL-5). All perimeter signs, with the exception of perimeter sign P9, were present and legible. Perimeter sign P9 was identified as missing during the 2016 inspection and was replaced on October 11, 2017. No other maintenance needs were identified.

4.4.1.3 Site Marker

The site has one granite site marker near the entrance gate (PL-4). No maintenance needs were identified.

4.4.1.4 Boundary Monuments

Eight boundary monuments are on the site boundary outside the fenced area (PL-6). Four of the monuments are at the property corners, and the others define an approximate 20-foot offset that occurs along both the north and south boundaries where the private land that DOE acquired in fee adjoins the BLM withdrawal area on the western portion of the site. Boundary monuments BM-3 and BM-7 define the two 20-foot offsets and consist of a capped piece of rebar. All of the boundary monuments were inspected. Boundary monument BM-3 is bent (PL-7) and will be straightened during the 2018 annual inspection. No other maintenance needs were identified.

4.4.2 Inspection Areas

In accordance with the LTSP, the site is divided into five inspection areas (referred to as "transects" in the LTSP) to ensure a thorough and efficient inspection. The inspection areas are (1) the top slope of the disposal cell, (2) the side slopes of the disposal cell, (3) the ancillary cell, (4) the diversion and drainage channels, and (5) the site perimeter and balance of the site.

4.4.2.1 Top Slope of the Disposal Cell

The top slope of the riprap-armored disposal cell, a reclaimed former heap leach area, occupies about 60 acres of the site. The top of the disposal cell showed no signs of erosion, settling, or other modifying processes that might affect the integrity of the disposal cell. However, a small shallow depression (Depression No. 1) was observed just north of Diversion Channel No. 1 during the initial annual inspection in 2010 (PL-8). This depression—approximately 25 feet long, 15 feet wide, and 1 foot deep in the center—appears to be the result of settlement of the underlying materials since completion of the disposal cell. It is approximately the same size as noted during the 2016 annual inspection. A second smaller and shallower depression (Depression No. 2)—approximately 10 feet long, 5 feet wide, and less than 6 inches deep in the center—was first noted during the 2016 annual inspection just west of the first depression. Depression No. 2 also appeared to be approximately the same size as previously observed. Measurements of both depressions will continue to be performed during annual inspections to determine if additional, more significant, settlement is occurring. No standing water was observed in either depression; however, evidence of standing water (in the form of evaporites) was observed. The depressions currently do not threaten the integrity or performance of the disposal cell. No maintenance needs were identified.

While various species of plants were present on the top slope of the disposal cell, no deep-rooted vegetation was observed. If encroachment of deep-rooted vegetation is observed, an evaluation will be conducted as required by the LTSP to determine if any action is necessary. Noxious weeds are controlled in accordance with the LTSP.

4.4.2.2 Side Slopes of the Disposal Cell

The disposal cell was designed to control surface water runoff resulting from a probable maximum flood event. The side slopes of the disposal cell were constructed with a 20% slope grade and are covered with a 1-foot-thick layer of riprap (PL-9 and PL-10). Surface water runoff from the side slopes is conveyed by an apron at the toe of the slope to six riprap-armored toe drains at low points in the apron. The apron and toe drains are constructed channels filled with riprap. Minor erosion has occurred adjacent to a toe drain along the north side of the disposal cell (PL-11), but that has not impacted the performance of the toe drain. No maintenance needs were identified.

4.4.2.3 Ancillary Cell

The ancillary cell (PL-12) was constructed to contain waste materials associated with the reclaimed evaporation pond area. A heap drainage storage pond that was constructed below grade and adjacent to the heap leach repository was used as the footprint for this cell. At the close of reclamation activities for the main disposal cell, the synthetic pond liner material, evaporation pond material, and other contaminated debris remaining on the site were compacted in the ancillary cell. The ancillary cell slopes gently toward the southwest. A rock berm wraps around the eastern and northern sides of the ancillary cell to provide protection from surface water runoff (PL-13). Various species of plants were present on the top slope of the ancillary cell (PL-12 and PL-13). Noxious weeds are controlled in accordance with the LTSP. No maintenance needs were identified.

4.4.2.4 Diversion and Drainage Channels

Final surface conditions at the site include a combination of rock armoring and contouring to achieve the surface water drainage control and erosion protection necessary to satisfy the design longevity requirements. The top slope of the disposal cell was designed to drain surface water runoff to the center and into riprap-armored Diversion Channel No. 1 (PL-14), which is graded toward and then down the east side slope of the disposal cell (PL-15). Surface water runoff ultimately discharges into Rob Pit east of the site (PL-16). An erosion protection structure, referred to as the Launch Rock Erosion Protection Basin (PL-15 and PL-16), was constructed at the outfall of Diversion Channel No. 1 to protect the disposal cell from head-cutting that may occur from the deep channel that runs into Rob Pit. Diversion Channel No. 2 runs along the south side of the ancillary cell to convey surface water runoff away from the ancillary cell (PL-17). The diversion channels and outlet channel of the Launch Rock Erosion Protection Basin remain functioning as designed.

The rock berm that runs along the northern edge of the ancillary cell continues west across the slope south of the disposal cell to provide protection against erosion. Several gullies and rills have developed on this south slope but do not threaten the integrity of the disposal cell (PL-18). They will continue to be monitored and repaired as needed. This erosion is expected to stabilize

over time as site vegetation improves. The rock berm effectively controls head-cutting from these gullies and provides protection to the disposal cell. No maintenance needs were identified.

4.4.2.5 Site Perimeter and Balance of the Site

Reclaimed surfaces at the site were planted with a mixture of native and adaptive grasses to provide soil stability, and the vegetation continues to improve. Noxious weeds are controlled (treated with herbicide) in accordance with the LTSP.

During each site inspection, the area surrounding the site is checked to ensure that changes in land or water use do not affect site protectiveness. The area beyond the site boundary for a distance of 0.25 mile was visually observed for erosion, changes in land use, or other phenomena that might affect the long-term integrity of the site. No such changes were identified.

4.5 Follow-up Inspections

DOE 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) DOE is notified by a citizen or outside agency that conditions at the site are substantially changed. No need for a follow-up inspection was identified.

4.6 Routine Maintenance and Emergency Measures

Noxious weeds are treated with herbicide. Minor damage to the perimeter fence was noted in the 2016 and 2017 annual inspections, and perimeter sign P9 was identified as missing. The fence was repaired and the sign replaced on October 11, 2017. No other maintenance needs were identified.

Emergency measures are corrective actions that DOE will take in response to unusual damage or disruption that threatens or compromises site health and safety, security, integrity, or compliance with 40 CFR 192. No emergency measures were identified.

4.7 Environmental Monitoring

In accordance with the LTSP, groundwater monitoring is not required at the site because 30 years of historical monitoring performed at the site by the former licensee (20 years before reclamation, 10 years after reclamation) indicated that groundwater was not contaminated by site-related activities. The final 10 years of monitoring were after site reclamation was completed.

4.8 Reference

DOE (U.S. Department of Energy), 2010. *Long-Term Surveillance Plan for the Maybell West (UMTRCA Title II) Disposal Site, Moffat County, Colorado*, LMS/MAW/S01879, February.

4.9 Photographs

Photograph Location Number	Azimuth	Photograph Description
PL-1	310	Entrance Gate; Disposal Cell in Background
PL-2	315	Perimeter Fence Damage
PL-3	350	Erosion Along Perimeter Fence
PL-4	320	Entrance Sign; Site Marker and Disposal Cell in Background
PL-5	270	Perimeter Sign P1 with Disposal Cell in Background
PL-6	270	Boundary Monument BM-2
PL-7	0	Damaged Boundary Monument BM-3
PL-8	100	Depression No. 1 on Disposal Cell Top Slope
PL-9	140	Northeast Side Slope of Disposal Cell
PL-10	235	North Side Slope of Disposal Cell
PL-11	190	Erosion Downslope of Disposal Cell Toe Drain
PL-12	200	Ancillary Cell from Disposal Cell Top Slope
PL-13	90	Rock Berm Upslope of Ancillary Cell
PL-14	90	Diversion Channel No. 1 on Disposal Cell Top Slope
PL-15	270	Diversion Channel No. 1 Outlet on East Side Slope; Launch Rock Erosion Protection Basin in Foreground
PL-16	85	Diversion Channel No. 1 Outlet on East Side Slope; Launch Rock Erosion Protection Basin and Rob Pit in Background
PL-17	340	Diversion Channel No. 2
PL-18	185	Erosion Downslope of Disposal Cell

PL-1. Entrance Gate; Disposal Cell in Background

PL-2. Perimeter Fence Damage

PL-3. Erosion Along Perimeter Fence

PL-4. Entrance Sign; Site Marker and Disposal Cell in Background

PL-5. Perimeter Sign P1 with Disposal Cell in Background

PL-6. Boundary Monument BM-2

PL-7. Damaged Boundary Monument BM-3

PL-8. Depression No. 1 on Disposal Cell Top Slope

PL-9. Northeast Side Slope of Disposal Cell

PL-10. North Side Slope of Disposal Cell

PL-11. Erosion Downslope of Disposal Cell Toe Drain

PL-12. Ancillary Cell from Disposal Cell Top Slope

PL-13. Rock Berm Upslope of Ancillary Cell

PL-14. Diversion Channel No. 1 on Disposal Cell Top Slope

PL-15. Diversion Channel No. 1 Outlet on East Side Slope;
Launch Rock Erosion Protection Basin in Foreground

PL-16. Diversion Channel No. 1 Outlet on East Side Slope;
Launch Rock Erosion Protection Basin and Rob Pit in Background

PL-17. Diversion Channel No. 2

PL-18. Erosion Downslope of Disposal Cell

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5.0 Sherwood, Washington, Disposal Site

5.1 Compliance Summary

The Sherwood, Washington, Uranium Mill Tailings Radiation Control Act (UMTRCA) Title II Disposal Site (site) was inspected on May 17, 2017. No changes were observed on the disposal cell or in the containment dam and associated drainage features. Inspectors identified no maintenance needs or cause for a follow-up inspection. Groundwater monitoring is not required at the site. However, the U.S. Department of Energy (DOE) Office of Legacy Management conducts groundwater monitoring at three wells as a best management practice in accordance with the site-specific Long-Term Surveillance Plan (LTSP) (DOE 2001). The action level (State of Washington water quality criteria) for sulfate was exceeded in one monitoring well. DOE will conduct confirmatory sampling during the 2018 sampling event and evaluate well conditions.

5.2 Compliance Requirements

Requirements for the long-term surveillance and maintenance of the site are specified in the LTSP (DOE 2001) and in procedures DOE established to comply with the requirements of Title 10 *Code of Federal Regulations* Section 40.28 (10 CFR 40.28). Table 5-1 lists these requirements.

Table 5-1. License Requirements for the Sherwood, Washington, Disposal Site

Requirement	LTSP	This Report	10 CFR 40.28
Annual Inspection and Report	Sections 3.3 and 3.4	Section 5.4	(b)(3)
Follow-up Inspections	Section 3.5	Section 5.5	(b)(4)
Routine Maintenance and Emergency Measures	Section 3.6	Section 5.6	(b)(5)
Environmental Monitoring	Section 3.7	Section 5.7	(b)(3)

5.3 Institutional Controls

The 380-acre site, identified by the property boundary shown in Figure 5-1, is owned by the United States in trust for the Spokane Tribe of Indians (Spokane Tribe). The site was accepted under the U.S. Nuclear Regulatory Commission (NRC) general license (10 CFR 40.28) in 2001. Because the site is on the Spokane Indian Reservation, no agreement of transfer was necessary for conveying the property rights to DOE. However, an agreement was executed between the Bureau of Indian Affairs (BIA), Spokane Tribe, NRC, and DOE for permanent right-of-access, which allows DOE to fulfill its long-term surveillance and maintenance custodial responsibilities. 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, entrance sign, perimeter signs, a site marker, boundary monuments, and monitoring wellhead protection.

5.4 Inspection Results

The site, located approximately 8 miles west of Wellpinit, Washington, was inspected on May 17, 2017. The inspection was conducted by D. Traub, D. Johnson, and D. Marshall of

the DOE Legacy Management Support contractor. K. Kreie (DOE site manager); B. Stasney, S. Pachernegg, and K. Schwab of the Washington State Department of Health; and J. Turner and T. Freeman of the Spokane Tribe attended the inspection. The purposes of the inspection were to confirm the integrity of the visible features at the site, to identify changes in conditions that might affect conformance with the LTSP, and to determine the need, if any, for maintenance or additional inspection and monitoring.

5.4.1 Site Surveillance Features

Figure 5-1 shows the locations of site features in black, including site surveillance features and inspection areas. Site features that are present but not required by the LTSP to be inspected are shown in italic font. Observations from previous inspections that are currently monitored are shown in blue text, and new observations identified in the 2017 inspection are shown in red. Inspection results and recommended maintenance activities associated with site surveillance features are included in the following subsections. Photographs to support specific observations are identified in the text and in Figure 5-1 by photograph location (PL) numbers. The photographs and photograph log are presented in Section 5.9.

5.4.1.1 Site Access and Entrance Gates

Access to the site is from Elijah Road, an all-weather, BIA-maintained road over which DOE has permanent right-of-access. The site and adjacent lands are part of the Spokane Indian Reservation. The entrance gates are no longer used and allow open access to the site.

5.4.1.2 Perimeter Signs

There are six warning or perimeter signs, attached to steel posts set in concrete, positioned along the site boundary at likely access points around the site. Signs have been vandalized in the past (including bullet damage) and text on signs may become illegible due to fading or bullet damage. Sign P2 was scorched by an August 2016 forest fire but remains legible (PL-1). No maintenance needs were identified.

5.4.1.3 Site Marker

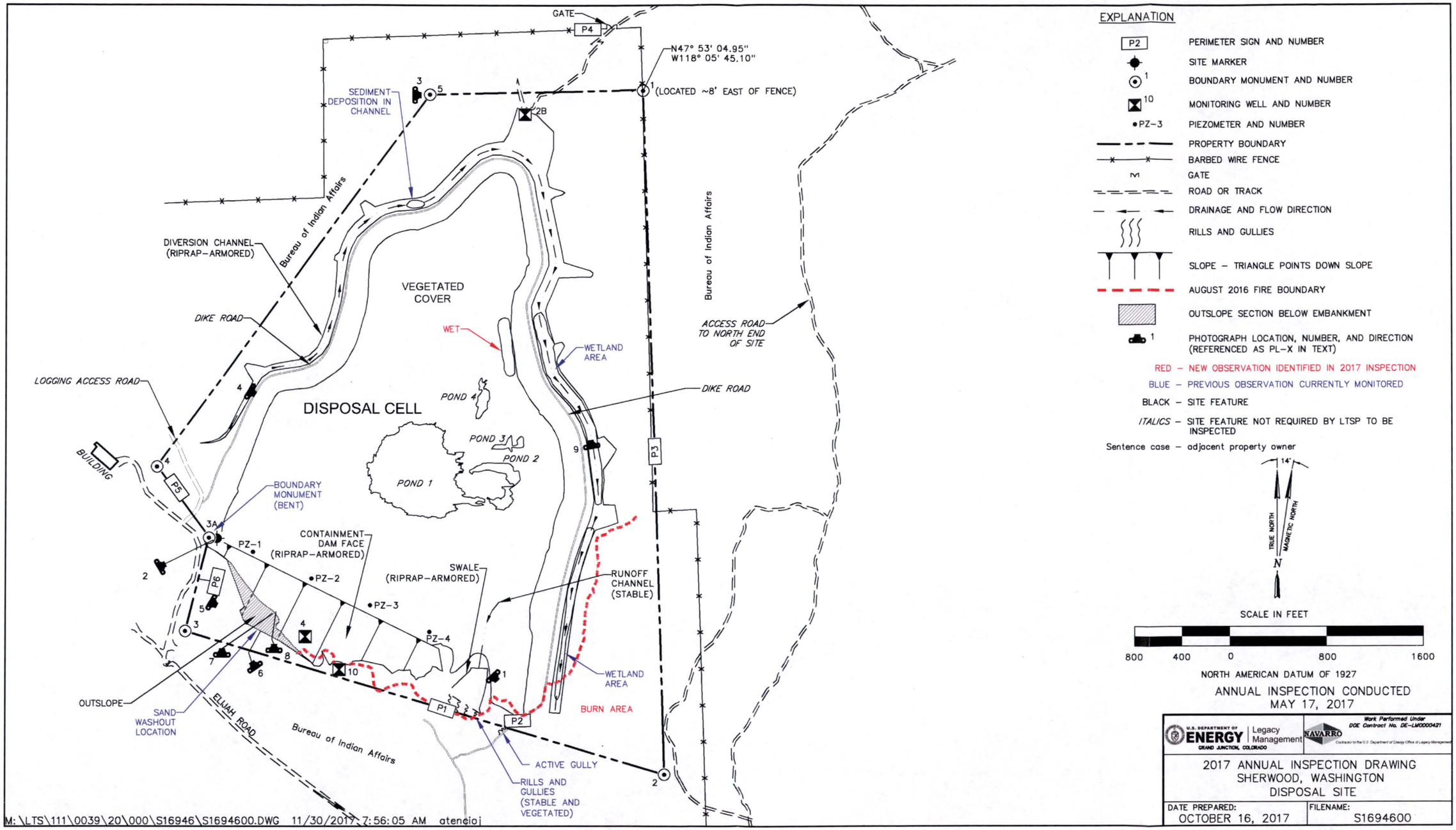
There is one granite site marker on the southwest side of the site where the access road lies closest to the site boundary. No maintenance needs were identified (PL-2).

5.4.1.4 Boundary Monuments

Six boundary monuments set in concrete define the site boundary. Because surrounding vegetation has made it difficult to locate some of the monuments, metal T-posts were installed at each monument location. All boundary monuments were inspected (PL-3). No maintenance needs were identified.

5.4.1.5 Monitoring Wells and Piezometers

The site groundwater monitoring network consists of three monitoring wells designated as 2B, 4, and 10. As part of the dam safety inspection program, four piezometers, designated PZ-1 through PZ-4, were installed in November 2000 along the crest of the containment dam at a depth equivalent to the base of the dam. All piezometer and wellhead protectors were undamaged and locked. No maintenance needs were identified.



EXPLANATION

- P2 — PERIMETER SIGN AND NUMBER
- SITE MARKER
- 1 — BOUNDARY MONUMENT AND NUMBER
- 10 — MONITORING WELL AND NUMBER
- •PZ-3 — PIEZOMETER AND NUMBER
- PROPERTY BOUNDARY
- BARBED WIRE FENCE
- GATE
- ROAD OR TRACK
- DRAINAGE AND FLOW DIRECTION
- RILLS AND GULLIES
- SLOPE – TRIANGLE POINTS DOWN SLOPE
- AUGUST 2016 FIRE BOUNDARY
- OUTSLOPE SECTION BELOW EMBANKMENT
- 1 — PHOTOGRAPH LOCATION, NUMBER, AND DIRECTION (REFERENCED AS PL-X IN TEXT)

RED – NEW OBSERVATION IDENTIFIED IN 2017 INSPECTION

BLUE – PREVIOUS OBSERVATION CURRENTLY MONITORED

BLACK – SITE FEATURE

ITALICS – SITE FEATURE NOT REQUIRED BY LTSP TO BE INSPECTED

Sentence case – adjacent property owner

14°

TRUE NORTH

MAGNETIC NORTH

N

SCALE IN FEET

800 400 0 800 1600

NORTH AMERICAN DATUM OF 1927

ANNUAL INSPECTION CONDUCTED MAY 17, 2017

U.S. DEPARTMENT OF ENERGY | Legacy Management
GRAND JUNCTION, COLORADO

Work Performed Under DOE Contract No. DE-LM0000421

NAVARRO
Contractor to the U.S. Department of Energy Office of Legacy Management

2017 ANNUAL INSPECTION DRAWING
SHERWOOD, WASHINGTON
DISPOSAL SITE

DATE PREPARED: OCTOBER 16, 2017

FILENAME: S1694600

Figure 5-1. 2017 Annual Inspection Drawing for the Sherwood, Washington, Disposal Site

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5.4.2 Inspection Areas

In accordance with the 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 site perimeter, outlying areas, and balance of site; (2) the cover of the disposal cell (tailings impoundment); and (3) the containment dam and diversion channel. Inspectors examined specific site surveillance features within each area and also 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 Site Perimeter, Outlying Areas, and Balance of Site

Ponderosa pine forest constitutes most of the area outside the diversion channel that encircles the disposal cell. The surrounding lands are part of the Spokane Indian Reservation and are used for timber harvesting and wildlife habitat. No residences are within 0.25 mile of the site boundary. A vacant metal building, left in place from earlier mining operations, is about 500 feet west of the western site boundary. No new development was evident east of the site along Elijah Road.

In late August 2016, the 18,000-acre Cayuse Mountain Fire occurred near the site. A follow-up inspection (detailed in the 2016 Title II Annual Compliance Report) confirmed that the fire had burned a corner of the site south and east of the disposal cell (Figure 5-1) and posed no risk to the disposal cell. No maintenance needs were identified.

A gully has formed along a site road near perimeter sign P2. This erosion is not impacting site features or access but will continue to be monitored. The gully is photographed periodically and has not increased in size since the last inspection in May 2016.

5.4.2.2 Cover of Disposal Cell

The disposal cell, completed in 1996, occupies 100 acres. The cover consists of 12 to 20 feet of uncompacted soils. During site reclamation, the surface was seeded and planted with native shrubs, forbs, grasses, and trees (PL-4).

A small, shallow channel developed by runoff from the top slope of the disposal cell is present near the southeast corner of the disposal cell. Runoff has scoured the channel down to the quartz monzonite bedrock and discharges into a riprap-armored swale east of the containment dam. The channel is stable and is not above an area containing tailings; however, it will continue to be monitored to ensure that it does not affect the integrity of the disposal cell.

Designers of the disposal cell predicted that some settlement would continue after the uncompacted cover was put in place. As explained on page 2-14 of the LTSP, the cover was designed to be self-healing with regard to impacts from freezing and thawing, biointrusion, and settlement (DOE 2001). The cover was designed to withstand up to 10 feet of settlement. The largest area of settlement is referred to as Pond 1. Due to the unusually wet winter, the pond was larger in extent than normally observed and was estimated to be 10.6 acres using a GPS system. The plant species present indicate that there is year-round moisture below the surface of the pond area. Other minor depressions—designated as Ponds 2, 3, and 4—normally are dry but contained water during the 2017 annual inspection. The shallow ponds are considered to be favorable features on the disposal cell cover, but DOE will continue to monitor the surface for unusual

settlement features to verify the cover's integrity and ensure that the disposal cell is performing as designed. No maintenance needs were identified.

During the 2015 annual site inspection, a ground-level elevation survey was requested to determine actual settlement values (opposed to estimated values) to verify that settlement is within the allowance of the disposal cell design. A survey team collected GPS elevation data for locations on the surface of the disposal cell at the time of the 2016 annual inspection. Evaluation of the data indicates some settlement has occurred on the disposal cell; the settlement is estimated at 2 to 3 feet near the ponds, which is less than the 10 feet of settlement allowed for in the LTSP (Figure 5-2). Comparisons between the as-built survey and the 2016 survey were not exact since the 2016 data were not collected in the same locations. During the data-evaluation process, it was noted that the surface elevations presented in the 2001 LTSP were incorrect (LTSP Figure 2-11). The incorrect LTSP values, the correct as-built values, and the 2016 recent survey values for the cover elevations are shown in Figure 5-2.

5.4.2.3 Containment Dam and Diversion Channel

The tailings embankment on this site is classified as a containment dam because of the saturated condition of the impoundment. Therefore, an annual dam safety inspection is required by the LTSP to ensure continued compliance with the National Dam Safety Program Act. The containment dam face was inspected in accordance with the Dam Inspection Checklist, which is included at the end of this report.

Measurements of water levels in four piezometers atop the containment dam were obtained in May 2017 during the annual groundwater sampling event. These annual measurements (Table 5-2), collected since the piezometers were installed in 2000, provide a direct means of determining moisture conditions in the containment dam. Steadily increasing water levels in any of the piezometers could indicate a potential problem with the performance of the containment dam. Measurements collected in May 2017 are provided in the Dam Inspection Checklist at the end of this report and do not indicate an increase in water levels. Variations in the amount of water in the four piezometers are thought to be due to seasonal responses to precipitation. The minor amount of water in PZ-2 is the result of a small, perched lens of water that exists because of localized differences in permeability. While the lateral extent of the lens is unknown, based on water levels in PZ-2 and monitoring wells 4 and 10, it is estimated that more than 200 feet of unsaturated material is beneath the PZ-2 perched zone. On the basis of the recent water levels observed in the piezometers and monitoring wells, the containment dam is considered to be in an unsaturated condition.

The containment dam face has a rock cover consisting primarily of highly durable quartz monzonite. The face was designed to allow a vegetated cover, including mature trees, to establish and stabilize the surface and mitigate erosion. Consequently, the presence of this vegetation does not harm the function of the containment dam. The containment dam face is thickly vegetated (PL-5). No maintenance needs were identified.

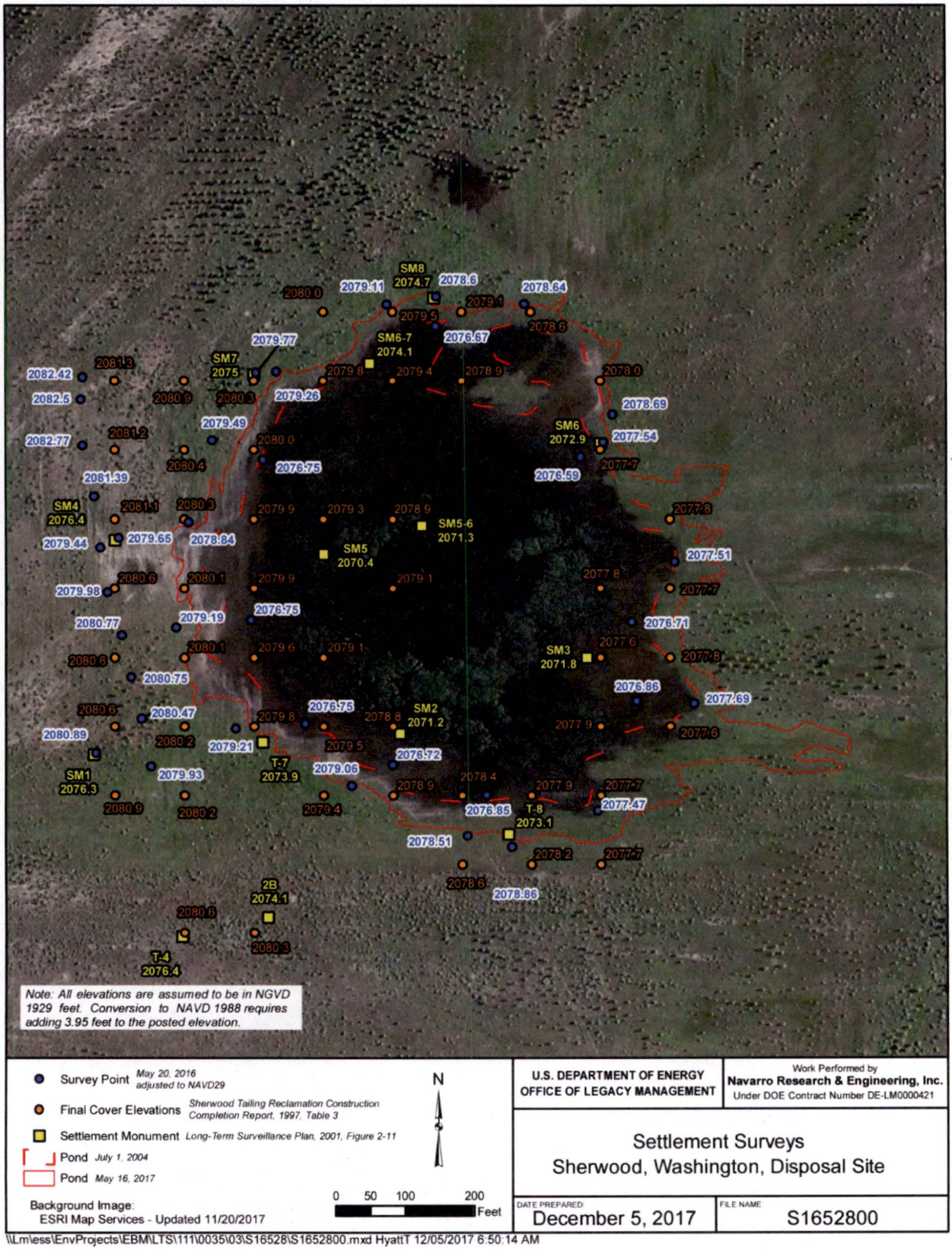

Figure 5-2. Settlement Surveys Sherwood, Washington, Disposal Site

Table 5-2. 2017 Piezometer Water Depths

Piezometer	Total Depth of Piezometer (feet)[a]	Water Level (feet)[a]	Depth of Water (feet)
PZ-1	22.47	21.84	0.63
PZ-2	62.95	60.20	2.75
PZ-3	67.53	Dry	Dry
PZ-4	22.62	21.83	0.79

Note:
[a] Measured from the top of the inner casing.

During the 2016 annual inspection, one area at the base of the rock-covered containment dam face was found to have a fan of sand that had washed out from underneath the rock cover (PL-6). A small rill could be traced from the containment dam base up approximately 50 feet under the cover. The rill ranged from 1 to 2 feet wide and 8 to 12 inches deep. A follow-up inspection was performed on October 4 and 5, 2016, to evaluate the cause, extent, and repair method of the erosion, if required. A report will be transmitted to NRC upon completion of the resulting engineering evaluation. This area was closely examined during the 2017 annual inspection, and several small holes were dug upslope to determine the edge of the actual embankment (PL-7, PL-8). It was determined that the washout area was in a portion of the containment dam defined as the outslope (Figure 5-1). This area, which consisted of a native sand formation, was graded, and protective rock was placed over the surface. The sandy material is not comparable to the compacted material used in the actual embankment. The sand deposit has not increased since October 2016, and the associated erosion does not threaten the containment dam. This area will be closely monitored during future inspections.

A riprap-armored diversion channel surrounds the disposal cell and diverts runoff away from the disposal cell surface. The diversion channel (PL-9) was designed to allow trees to grow and stabilize the surfaces, and their presence in the diversion channel is not expected to hinder the diversion channel's ability to convey design flows. The intrusion of volunteer plants, including trees, within the diversion channel is evident in most areas of the diversion channel. Sediment deposition is found in places on the west leg of the diversion channel but does not interfere with the diversion channel's design function. Upslope areas that have contributed to the sedimentation have stabilized with vegetation. Wildlife, buffalo, and horse trails cross the diversion channel at numerous locations and have caused displacement of the diversion channel riprap in several places. These disturbances will be visually monitored for erosion but are not in areas that would impact the disposal cell.

5.5 Follow-up Inspections

DOE 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) DOE is notified by a citizen or outside agency that conditions at the site are substantially changed.

DOE conducted a follow-up to the 2016 annual inspection with engineering staff on October 4 and 5, 2016, to evaluate the sand washout erosional feature and assess the impact

from the August forest fire. The washout was determined to be in an area below the actual embankment and posed no danger to the disposal cell embankment. No further erosion was noted during the May 2017 inspection. The area will continue to be monitored during annual inspections and repaired if erosion continues. The fire did not burn over the disposal cell and the only damage observed was a scorched perimeter sign that remained legible. No need for a follow-up inspection was identified.

5.6 Routine Maintenance and Emergency Measures

No maintenance needs were identified. Emergency measures are corrective actions that DOE will take in response to unusual damage or disruption that threatens or compromises site health and safety, security, integrity, or compliance with 40 CFR 192. No emergency measures were identified.

5.1 Environmental Monitoring

5.1.1 Groundwater Monitoring

Groundwater compliance monitoring is not required at the site. However, as a best management practice stipulated in the LTSP, DOE conducts limited groundwater monitoring for several indicator parameters. Samples are collected annually from background well 2B north of the disposal cell and from downgradient wells 4 and 10 near the base of the containment dam (Figure 5-3). Samples are analyzed for chloride, sulfate (primary indicator parameters), and total dissolved solids. Should the concentration of chloride or sulfate exceed the Washington water quality criteria value of 250 milligrams per liter for either parameter, DOE would conduct confirmatory sampling. If the confirmatory sampling verifies the exceedance, the DOE will develop an evaluative monitoring work plan, in consultation with the Spokane Tribe and BIA, and submit that plan to the NRC for review prior to initiating the evaluative monitoring program. Results of an evaluative monitoring program would be used to determine if corrective action is necessary.

Groundwater sampling was conducted on May 17, 2017, and the results are presented in Table 5-3. Groundwater constituent concentrations continue to be less than the action levels for confirmatory sampling in monitoring wells 2B and 10; however, the action level for sulfate was exceeded in monitoring well 4. DOE will conduct confirmatory sampling during the 2018 sampling event and evaluate well conditions.

Table 5-3. 2017 Groundwater Quality Results for the Sherwood, Washington, Disposal Site

Constituent	Water Quality Criterion[a]	Well[b]		
		Background Well 2B	Downgradient Well 4	Downgradient Well 10
Chloride, mg/L	250	1.8	57	0.2
Sulfate, mg/L	250	3.2	***260***	29
TDS, mg/L	N/A	180	890	640

Notes:
[a] State of Washington water quality criteria used as action levels.
[b] ***Bold italicized*** results indicate an exceedance of an action level.

Abbreviations:
mg/L = milligrams per liter; N/A = not applicable; TDS = total dissolved solids

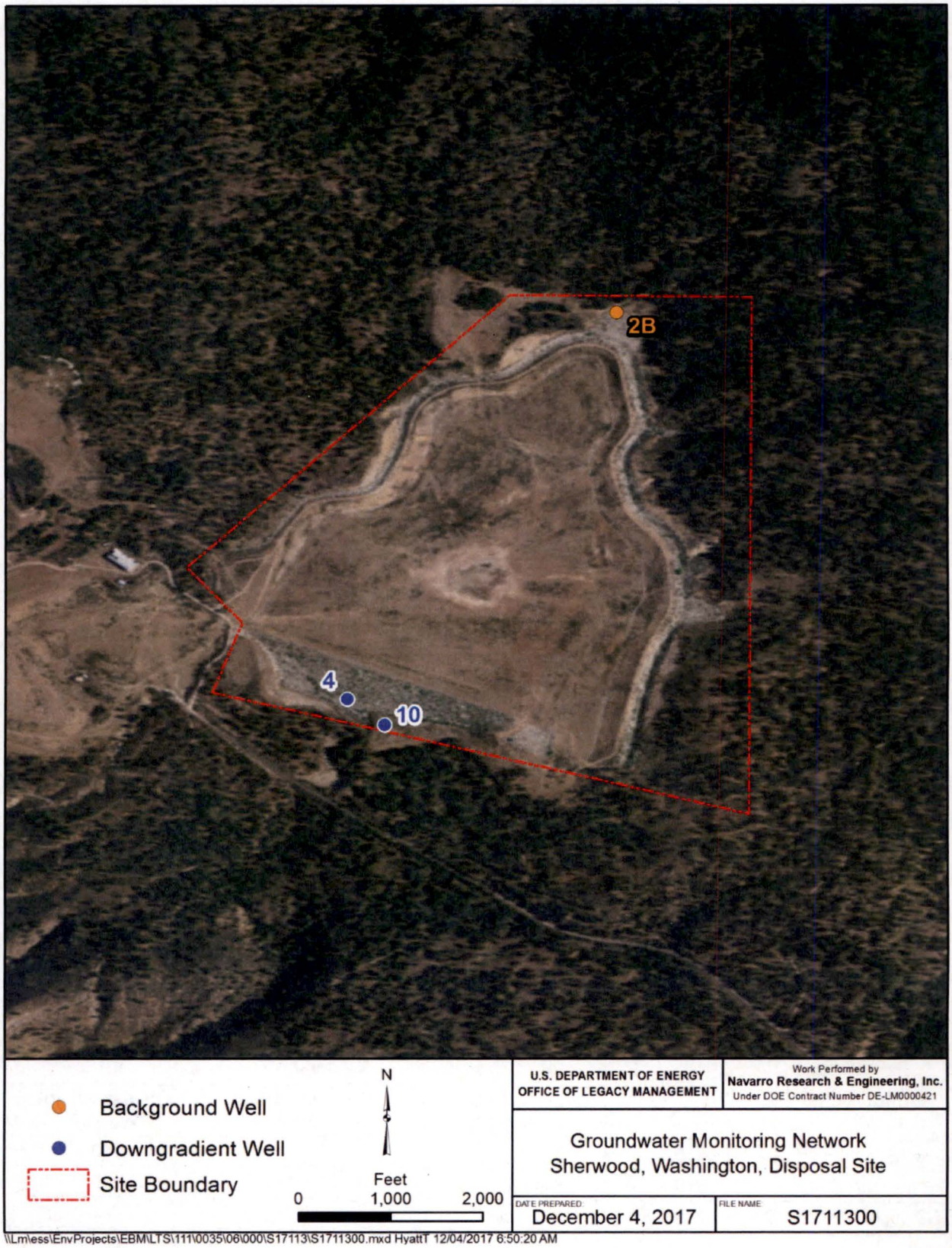

Figure 5-3. Groundwater Monitoring Network at Sherwood, Washington, Disposal Site

5.1.2 Vegetation Monitoring

The LTSP requires annual visual inspections of the disposal cell's vegetated cover to ensure that it satisfies erosional stability criteria and is self-sustaining. Vegetation on the disposal cell cover includes trees (primarily ponderosa pine), shrubs, and a mixture of native and introduced grasses and forbs. No areas of concern, such as patterns of dead vegetation or erosional features, were identified during the 2017 annual inspection.

Inspectors met with tribal ecologists during the inspection to discuss noxious weed control at the site. Seven species of State-listed noxious weeds historically have been found, six of which are "List B" species and, by law, must be controlled. No "List A" species, which must be eradicated, have been found at the site. DOE has released various biological control insects in the past and periodically treats weed infestations with herbicide.

5.7 Reference

DOE (U.S. Department of Energy), 2001. *Long-Term Surveillance Plan for the DOE Sherwood Project (UMTRCA Title II) Reclamation Cell, Wellpinit, Washington*, S00204, February.

5.8 Photographs

Photograph Location Number	Azimuth	Photograph Description
PL-1	120	Perimeter Sign P2, Scorched by August 2016 Fire
PL-2	60	Site Marker
PL-3	90	Boundary Monument BM-5
PL-4	120	Disposal Cell Cover and Pond 1 Viewed from Dike Road
PL-5	120	Face of Containment Dam and Outslope Area
PL-6	325	Sand Deposition at Base of Outslope Area
PL-7	0	Test Hole in Outslope Material Above Washout Area
PL-8	0	Test Hole in Embankment Material Above Washout Area
PL-9	350	Diversion Channel with Ponded Water

PL-1. Perimeter Sign P2, Scorched by August 2016 Fire

PL-2. Site Marker

PL-3. Boundary Monument BM-5

PL-4. Disposal Cell Cover and Pond 1 Viewed from Dike Road

PL-5. Face of Containment Dam and Outslope Area

PL-6. Sand Deposition at Base of Outslope Area

PL-7. Test Hole in Outslope Material Above Washout Area

PL-8. Test Hole in Embankment Material Above Washout Area

PL-9. Diversion Channel with Ponded Water

Dam Inspection Checklist
Sherwood, Washington, UMTRCA Title II Disposal Site

Date of Inspection May 17, 2017

Inspector David Traub Organization Navarro

Piezometer water levels measured during groundwater monitoring event May 17, 2017.
* All depths in feet. TOC is Top of Casing.

Piezometer PZ-1 fluid level (TOC to top of fluid): 21.84 Fluid amount: 0.63
Total depth 22.47

Piezometer PZ-2 fluid level (TOC to top of fluid) 60.20 Fluid Amount: 2.75
Total depth 62.95

Piezometer PZ-3 fluid level (TOC to top of fluid) Dry Fluid Amount:
Total depth 67.53

Piezometer PZ-4 fluid level (TOC to top of fluid) 21.83 Fluid Amount: 0.79
Total depth 22.62

Was evidence of significant seepage observed on the dam face? ***No***
If yes discuss in report.

Was evidence of significant slumping observed on the dam? ***No***
If yes discuss in report.

Was evidence of significant erosion observed on the dam? ***No, however, minor erosion was observed below the embankment. No erosion was noted on the embankment.***
If yes discuss in report.

Was vegetative growth that could compromise dam stability observed? ***No***
If yes discuss in report.

Was any condition that presents an imminent hazard to human health and safety or to the environment observed? ***No***
If yes immediately contact the following:

DOE Site Manager: Ken Kreie (970) 248-6073
NRC Operations Center: (301) 951-0550
Spokane Tribal Police/Sheriff: (509) 258-4400
State Department of Ecology—Dam Safety Office: (360) 407-6625

Following completion of the inspection, this Dam Inspection Checklist is to be sent to:
James DeMay, 360) 407-6603, jade461@ecy.wa.gov Washington Department of Ecology, Dam Safety Office

Inspector Signature: David Traub Date: 6-21-17

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6.0 Shirley Basin South, Wyoming, Disposal Site

6.1 Compliance Summary

The Shirley Basin South, Wyoming, Uranium Mill Tailings Radiation Control Act (UMTRCA) Title II Disposal Site (site) was inspected on June 27, 2017. No changes were observed on the disposal cell or in associated drainage features. Inspectors identified no maintenance needs or cause for a follow-up inspection. Groundwater is monitored annually in accordance with the site's Long-Term Surveillance Plan (LTSP). Alternate concentration limits (ACLs) continue to be exceeded for radium-226 (^{226}Ra) and radium-228 (^{228}Ra). No risks to human health and the environment were identified.

6.2 Compliance Requirements

Requirements for the long-term surveillance and maintenance of the site are specified in the site-specific U.S. Department of Energy (DOE) LTSP (DOE 2004) and in procedures that DOE established to comply with requirements of Title 10 *Code of Federal Regulations* Section 40.28 (10 CFR 40.28). Table 6-1 lists these requirements.

Table 6-1. License Requirements for the Shirley Basin South, Wyoming, Disposal Site

Requirement	LTSP	This Report	10 CFR 40.28
Annual Inspection and Report	Sections 3.3 and 3.4	Section 6.4	(b)(3)
Follow-up Inspections	Section 3.5	Section 6.5	(b)(4)
Routine Maintenance and Emergency Measures	Section 3.6	Section 6.6	(b)(5)
Environmental Monitoring	Section 3.7	Section 6.7	(b)(3)

6.3 Institutional Controls

The 1512-acre site, identified by the property boundary shown in Figure 6-1, is owned by the United States and was accepted under the U.S. Nuclear Regulatory Commission (NRC) general license (10 CFR 40.28) in 2005. DOE is the licensee and, in accordance with the requirements for UMTRCA Title II sites, 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, the entrance gate and sign, the perimeter fence and signs, a site marker, boundary monuments, and monitoring wellhead protectors.

6.4 Inspection Results

The site, approximately 60 miles south of Casper, Wyoming, was inspected on June 27, 2017. The inspection was conducted by R. Johnson, J. Price, and C. Boger of the DOE Legacy Management Support (LMS) contractor to the DOE Office of Legacy Management. B. Frazier (DOE site manager) and A. Ranalli (LMS) attended the inspection. The purposes of the inspection were to confirm the integrity of the visible features at the site, to identify changes in

conditions that might affect conformance with the LTSP, and to determine the need, if any, for maintenance or additional inspection and monitoring.

6.4.1 Site Surveillance Features

Figure 6-1 shows the locations of site features in black, including site surveillance features and inspection areas. Site features that are present but not required by the LTSP to be inspected are shown in italic font. Observations from previous inspections that are currently monitored are shown in blue text and new observations identified in the 2017 inspection are shown in red. Inspection results and recommended maintenance activities associated with site surveillance features are included in the following subsections. Photographs to support specific observations are identified in the text and in Figure 6-1 by photograph location (PL) numbers. The photographs and photograph log are presented in Section 6.9.

6.4.1.1 Site Access and Entrance Gate

Access to the site is immediately off Carbon County Road 2E. The entrance gate is a barbed-wire gate in the perimeter fence that surrounds the site. The gate, along the south portion of the perimeter fence, was secured by a locked chain (PL-1). No maintenance needs were identified.

6.4.1.2 Perimeter Fence and Signs

A four-strand barbed-wire fence encloses the site. A grazing license granted by DOE to a local rancher allows the rancher to graze his livestock on the site in exchange for maintaining the perimeter fence. Sections along the north perimeter are secured with a temporary wire fence. Ur-Energy, the adjacent landowner, uses these sections to reach a topsoil stockpile area on the site.

The grazing licensee, in cooperation with the adjacent property owner, erected a new four-strand barbed-wire fence around the north rim of Pit 4 in 2017 to bypass a damaged section of fence not maintained because of steep slopes and recurring snow damage. This also provides cattle access to each side of the pit.

The entrance sign is located on the main site access road near the site marker (PL-2).
Nine perimeter signs (warning and no-trespassing signs) are posted along the site perimeter at potential points of access, and another 25 signs are positioned around the disposal cell. Perimeter signs P1, P2, and P33 have bullet holes in them but remain legible. No maintenance needs were identified.

6.4.1.3 Site Marker

The site has one granite site marker near the site entrance gate (PL-3). No maintenance needs were identified.

6.4.1.4 Boundary Monuments

There are 26 boundary monuments delineating the site property boundary (PL-4). All boundary monuments were inspected. No maintenance needs were identified.

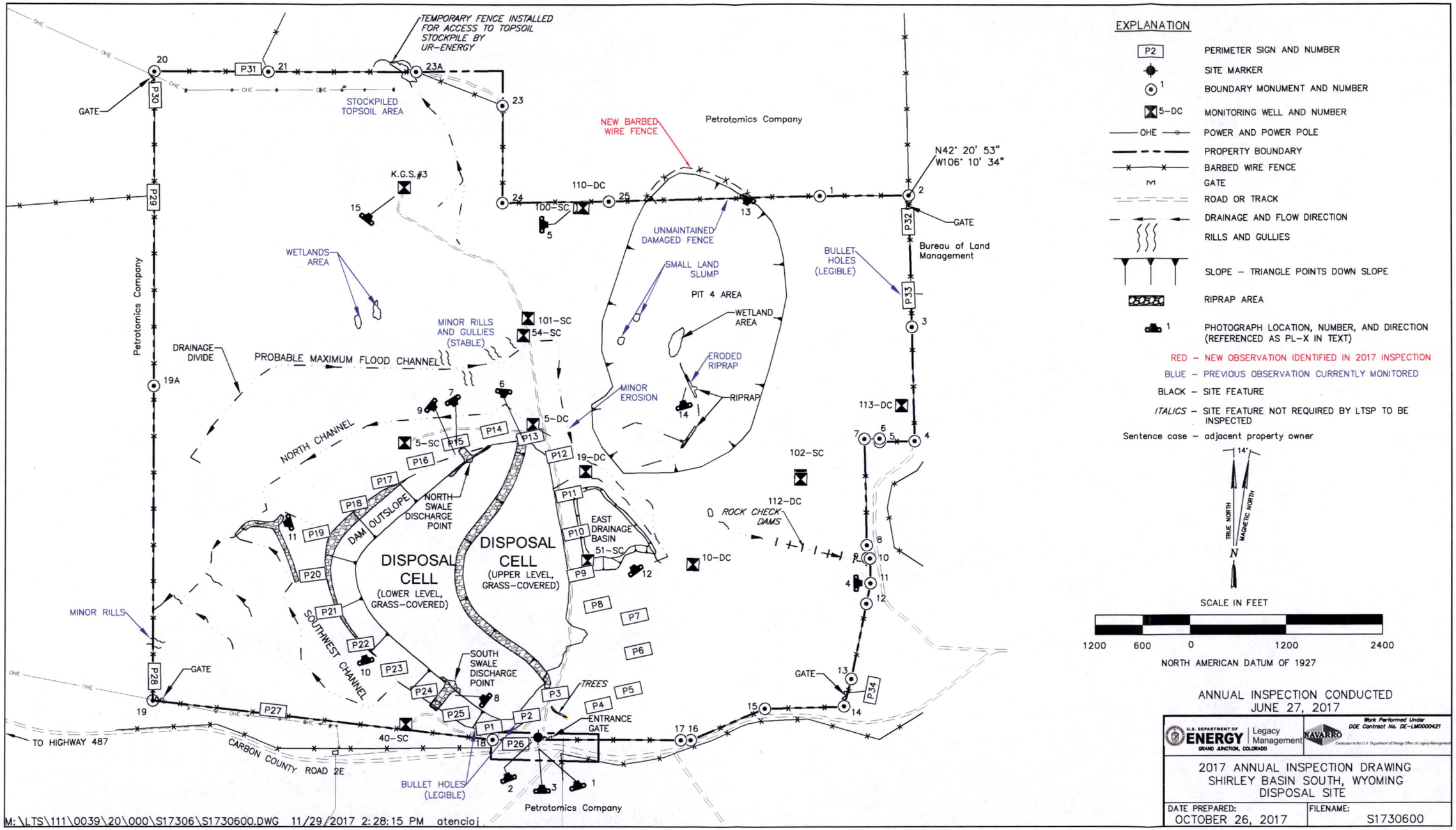

Figure 6-1. 2017 Annual Inspection Drawing for the Shirley Basin South, Wyoming, Disposal Site

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6.4.1.5 Monitoring Wells

The site groundwater monitoring network consists of 14 wells. The wellhead protectors were undamaged and locked (PL-5). No maintenance needs were identified.

6.4.2 Inspection Areas

In accordance with the 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 cover of the disposal cell, (2) the containment dam and diversion channels, and (3) the site perimeter and balance of the site. Inspectors examined specific site surveillance features within each area and also looked for evidence of erosion, settling, slumping, or other modifying processes that might affect the site's conformance with LTSP requirements.

6.4.2.1 Cover of the Disposal Cell

The disposal cell, completed in 2000, occupies 142 acres. It has a soil cover and was revegetated primarily with native grasses. The vegetation on the disposal cell and throughout the site is managed through the grazing license. The disposal cell surface is constructed at two elevations—the upper (eastern) surface and the lower (western) surface, which are separated by a riprap-armored slope (PL-6). There were no signs of erosion, settlement, or other modifying processes on the disposal cell cover or side slopes that might affect the integrity of the disposal cell.

Windblown sediment is accumulating in the riprap on the slope that separates the two elevations, and this has led to gradual vegetation encroachment. The establishment of perennial vegetation enhances the slope's stability. Wetland vegetation is establishing in areas at the toe of the slope that accumulate snowmelt runoff and summer precipitation.

The upper surface is contoured to drain into a basin east of the cell and west over the riprap-protected slope to the lower surface. The lower surface is contoured to drain to the north and south at riprap-armored swale discharge points (PL-7 and PL-8). The riprap dissipation basins of the discharge points usually hold precipitation runoff water in spring and early summer (PL-9). No maintenance needs were identified.

In October 2017, field investigations for a joint NRC/DOE radon study were conducted to investigate the effects of soil-forming processes on disposal cell cover engineering properties.

6.4.2.2 Containment Dam and Diversion Channels

The tailings pile was reclaimed in place and was contained behind a horseshoe-shaped earthen dam. The containment dam is predominantly grass-covered, but the steeper portion (5:1 slope) of the dam outslope is protected by riprap (PL-10). There were no signs of erosion, settlement, or other modifying processes that might affect the integrity of the dam. Encroaching vegetation on the riprap surfaces enhances the stability of the slope. No maintenance needs were identified.

The surface water diversion system consists of a combination of diversion channels, drainage basins, and contoured surfaces. Riprap armor was placed on the steeper slopes and flow

concentration points where design flow velocities could erode surfaces and impact the disposal cell (PL-11). A probable maximum flood (PMF) channel was constructed north of the disposal cell along the side of the reclaimed mine overburden spoil pile. Part of the PMF channel drains to the southwest through the north and southwest channels and discharges to a small closed basin. The portion of the PMF channel that flows eastward and discharges into the east drainage basin captures storm water from a larger drainage area (PL-12). The east basin was dry at the time of the inspection. These drainage basins are large enough to accommodate PMF water volumes. No maintenance needs were identified.

6.4.2.3 Site Perimeter and Balance of Site

The other major feature on the site is the reclaimed Pit 4 Area, which is in the northeast portion of the site. Reclamation activities included rounding the side slopes, partially backfilling the pit to an elevation above the local water table, revegetating the surfaces, and protecting against potential erosion areas with riprap. Vegetation is well established, and a wetland area has formed at the bottom of the pit where standing water from runoff is often present (PL-13); the surface of this area tends to dry out later in the summer. Some minor slumps and displacement features are present on the west side slope of the pit, but they do not represent a significant slope stability concern. A riprap-armored drainage channel near the bottom of the pit has eroded (PL-14). Repair of the displaced riprap armor is not necessary at this time, because potential erosion in that portion of the pit will not cut deeper than the floor of the pit and is not expected to impact slope stability.

Public land administered by the U.S. Bureau of Land Management and private land surround the site. Land on three sides is used primarily for livestock grazing. Ur-Energy is the property owner north of the site and can access and use stockpiled topsoil on the site. This access is in accordance with an agreement originally established between Petrotomics Company, the former licensee of the site, and Pathfinder Mines Corporation, which was acquired by Ur-Energy. DOE is the successor to Petrotomics, and the terms of the agreement remain in effect. The Wyoming Department of Environmental Quality (WDEQ) extended Pathfinder's mine area permit to include the soil stockpile area. In accordance with the permit, Ur-Energy will be required to reclaim the disturbed area, including replacing fences, when it has finished removing topsoil from the stockpile. No stockpiled topsoil has been removed.

Monitoring well K.G.S. #3 is completed in a deep formation that is not affected by processing related groundwater contamination or naturally occurring contamination from uranium mineralization. The grazing license allows the rancher to pump water from K.G.S. #3 for livestock watering purposes and to install watering facilities and solar-powered electric fences to manage the livestock (PL-15).

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

6.5 Follow-up Inspections

DOE 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) DOE is notified by a citizen or outside agency that conditions at the site are substantially changed. No need for a follow-up inspection was identified.

6.6 Routine Maintenance and Emergency Measures

No maintenance needs were identified. Emergency measures are corrective actions that DOE will take in response to unusual damage or disruption that threatens or compromises site health and safety, security, integrity, or compliance with 40 CFR 192. No emergency measures were identified.

6.7 Environmental Monitoring

In accordance with the LTSP, annual groundwater monitoring is required at the site. The monitoring network described in the LTSP (DOE 2004) comprises eight wells in the site's uppermost aquifer. The uppermost aquifer consists of two sand units in the Wind River Formation. A third, lower sand aquifer is hydraulically isolated from the site's uppermost aquifer. In consultation with NRC, DOE installed six additional monitoring wells in fall 2008 to provide a better understanding of the groundwater chemistry and flow direction in the sand units. The current monitoring network is described in Table 6-2 and shown in Figure 6-2. Although no wells are designated as points of exposure, groundwater chemistry at downgradient wells 100-SC, 102-SC, 110-DC, and 113-DC represent groundwater quality (for groundwater flowing offsite) in the upper and main sands.

Table 6-2. Groundwater Monitoring Network at the Shirley Basin South, Wyoming, Disposal Site

Monitoring Well	Network Application
5-SC	POC well; upper sand aquifer
40-SC	Upgradient well; upper sand aquifer
51-SC	POC well; upper sand aquifer
54-SC	Downgradient well; upper/main sand aquifer
100-SC	Downgradient well; upper sand aquifer
101-SC	Downgradient well; upper sand aquifer
102-SC	Downgradient well; upper sand aquifer
5-DC	POC well; main sand aquifer
10-DC	Downgradient well; main sand aquifer
19-DC	POC well; main sand aquifer
110-DC	Downgradient well; main sand aquifer
112-DC	Downgradient well; main sand aquifer
113-DC	Downgradient well; main sand aquifer
K.G.S. #3	Lower sand aquifer

Abbreviation:
POC = point of compliance

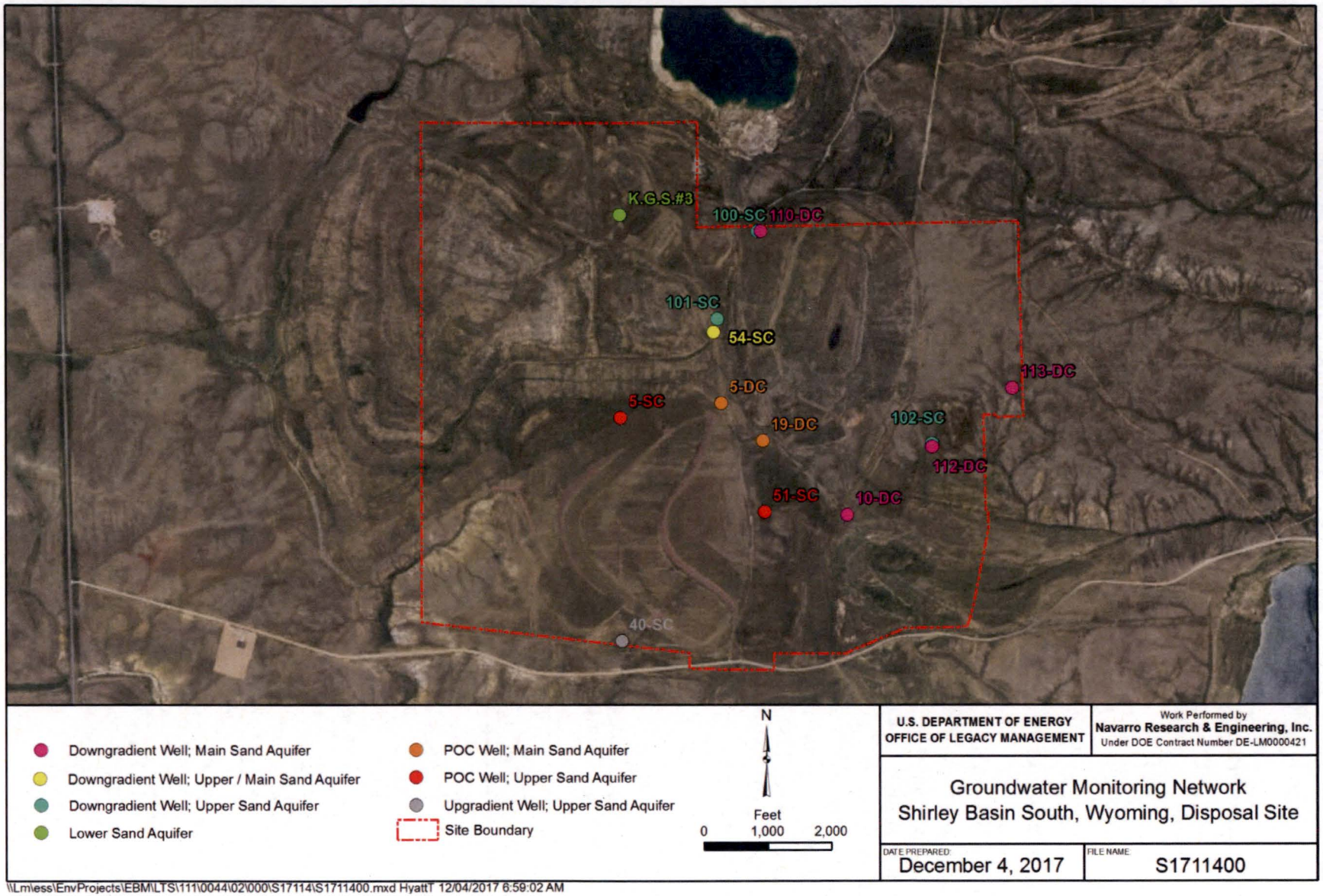

Figure 6-2. Groundwater Monitoring Network at Shirley Basin South, Wyoming, Disposal Site

Water level, pH, and electrical conductivity are measured at the time of sampling, and samples are analyzed for cadmium, chloride, chromium, lead, nickel, nitrate, ^{226}Ra, ^{228}Ra, selenium, sulfate, thorium-230, total dissolved solids (TDS), and uranium. Analytical results are compared to the ACLs and Wyoming Class III groundwater protection standards provided in Table 6-3. Nitrate is not included in Table 6-3 because there are no applicable limits or standards for nitrate at this site. However, nitrate is included as a sampled analyte (see Table 6-4) because it can be an indicator of contaminant migration. Water-level elevations are measured at the monitoring wells to evaluate flow direction as the upper aquifers recover from mining and reclamation activities.

Table 6-3. Alternate Concentration Limits and Groundwater Protection Standards for the Shirley Basin South, Wyoming, Disposal Site

Analyte	ACL	Groundwater Protection Standard[a]
Cadmium (mg/L)	0.079	NA
Chloride (mg/L)	NA	2000
Chromium (mg/L)	1.83	NA
Lead (mg/L)	0.05	NA
Nickel (mg/L)	6.15	NA
Radium-226 (pCi/L)	91.3	NA
Radium-228 (pCi/L)	25.7	NA
Selenium (mg/L)	0.12	NA
Sulfate (mg/L)	NA	3000
Thorium-230 (pCi/L)	2409	NA
TDS (mg/L)	NA	5000
Uranium (mg/L)	9.2	NA

Note:
[a] This column shows Wyoming Class III Groundwater Protection Standard values for livestock use, which apply to this site.

Abbreviations:
mg/L = milligrams per liter
NA = not applicable
pCi/L = picocuries per liter

The intent of annual groundwater quality monitoring is to verify that the ACLs are not exceeded at point of compliance (POC) wells and to verify continued compliance with applicable groundwater protection standards.

The results for cadmium in POC well 5-SC and ^{228}Ra in POC well 5-DC exceed their respective ACLs in DOE's initial sampling in July 2005. The 2005 ^{228}Ra concentration in non-POC well 54-SC also was substantially above the ACL. When compared with historical results provided by the previous site licensee, the results for cadmium in well 5-SC and for ^{228}Ra in wells 5-DC and 54-SC were within the range of historical measurements. NRC and WDEQ were notified of the exceedances.

The second sampling event after installation of the new monitoring wells was conducted in July 2009. It indicated that ^{226}Ra exceeded the ACL in new downgradient well 110-DC near the north site boundary. NRC and WDEQ were notified of the exceedance, and DOE evaluated the cause of the exceedance. DOE has determined that the elevated concentrations do not represent a

contaminant plume migrating offsite; rather, they are attributed to natural conditions within the ore-bearing sand unit as aquifer recovery continues.

Analytical results for the July 2017 sampling event are provided in Table 6-4 (upper sand aquifer) and Table 6-5 (main sand aquifer). Samples could not be collected in wells 51-SC and 101-SC because they continue to be dry.

Table 6-4. 2017 Groundwater Monitoring Results in the Upper Sand Aquifer Wells at the Shirley Basin South, Wyoming, Disposal Site

Analyte (Limit or Standard)	Well[a]						
	5-SC (POC)	40-SC	51-SC (POC)	54-SC	100-SC	101-SC	102-SC
Cadmium (0.079 mg/L)	0.033	0.00007	NS	0.00043	0.00012	NS	0.00011
Chloride (2000 mg/L)	370	27	NS	390	210	NS	140
Chromium (1.83 mg/L)	0.25	0.0031	NS	0.24	ND	NS	0.0028
Lead (0.05 mg/L)	ND	ND	NS	0.00017	ND	NS	ND
Nickel (6.15 mg/L)	2.8	0.0093	NS	2.3	0.0037	NS	0.0012
Nitrate/Nitrite as N (mg/L)[b]	ND	1.3	NS	ND	0.013	NS	0.76
Radium-226 (91.3 pCi/L)	4.93	0.255	NS	15.7	5.88	NS	2.27
Radium-228 (25.7 pCi/L)	2.45	0.754	NS	***85.3***[c]	5.12	NS	2.37
Selenium (0.12 mg/L)	0.1	0.0048	NS	0.062	ND	NS	0.0058
Sulfate (3000 mg/L)	***12,000***[d]	1400	NS	***8400***[d]	1300	NS	940
Thorium-230 (2409 pCi/L)	459	ND	NS	9.21	-0.0302	NS	ND
TDS (5000 mg/L)	***18,000***[d]	2100	NS	***13,000***[d]	2300	NS	1600
Uranium (9.2 mg/L)	2.9	0.00015	NS	0.01	0.0027	NS	0.018

Notes:
[a] ***Bold italicized*** results exceed a standard.
[b] No designated limit or standard.
[c] Result exceeds an ACL.
[d] Result exceeds a Wyoming Class III groundwater protection standard.

Abbreviations:
mg/L = milligrams per liter
ND = not detected (below method detection limit)
NS = no sample collected (dry)
pCi/L = picocuries per liter

Table 6-5. 2017 Groundwater Monitoring Results in the Main Sand Aquifer Wells at the Shirley Basin South, Wyoming, Disposal Site

Analyte (Limit or Standard)	Well[a]					
	5-DC (POC)	10-DC	19-DC (POC)	110-DC	112-DC	113-DC
Cadmium (0.079 mg/L)	0.00014	ND	ND	0.00006	ND	ND
Chloride (2000 mg/L)	310	65	73	240	29	7.5
Chromium (1.83 mg/L)	ND	0.0023	ND	0.0016	0.0046	ND
Lead (0.05 mg/L)	ND	ND	ND	ND	0.00021	ND
Nickel (6.15 mg/L)	2.7	ND	0.39	0.0014	0.001	ND
Nitrate/Nitrite as N (mg/L)[b]	ND	ND	ND	ND	ND	0.078
Radium-226 (91.3 pCi/L)	5.54	19.2	5.25	***165***[c]	9.9	2.98
Radium-228 (25.7 pCi/L)	17.3	4.71	5.18	8.25	5.82	2.93
Selenium (0.12 mg/L)	0.01	ND	ND	ND	ND	ND
Sulfate (3000 mg/L)	***14,000***[d]	1100	2500	1900	1100	640
Thorium-230 (2409 pCi/L)	0.774	ND	ND	ND	ND	ND
TDS (5000 mg/L)	***22,000***[d]	1800	3700	3000	1700	1100
Uranium (9.2 mg/L)	0.064	0.012	0.00015	0.01	0.0085	0.00083

Notes:
[a] ***Bold italicized*** results exceed a standard.
[b] No designated limit or standard.
[c] Result exceeds an ACL.
[d] Result exceeds a Wyoming Class III groundwater protection standard.

Abbreviations:
mg/L = milligrams per liter
ND = not detected (below method detection limit)
pCi/L = picocuries per liter

The concentration of cadmium in well 5-SC remained less than the ACL as it has since 2005. Radium-228 continued to exceed the ACL in well 54-SC but dropped below the ACL in well 5-DC (Figure 6-3). Additionally, the ACL for ^{226}Ra continues to be exceeded in well 110-DC (Figure 6-4).

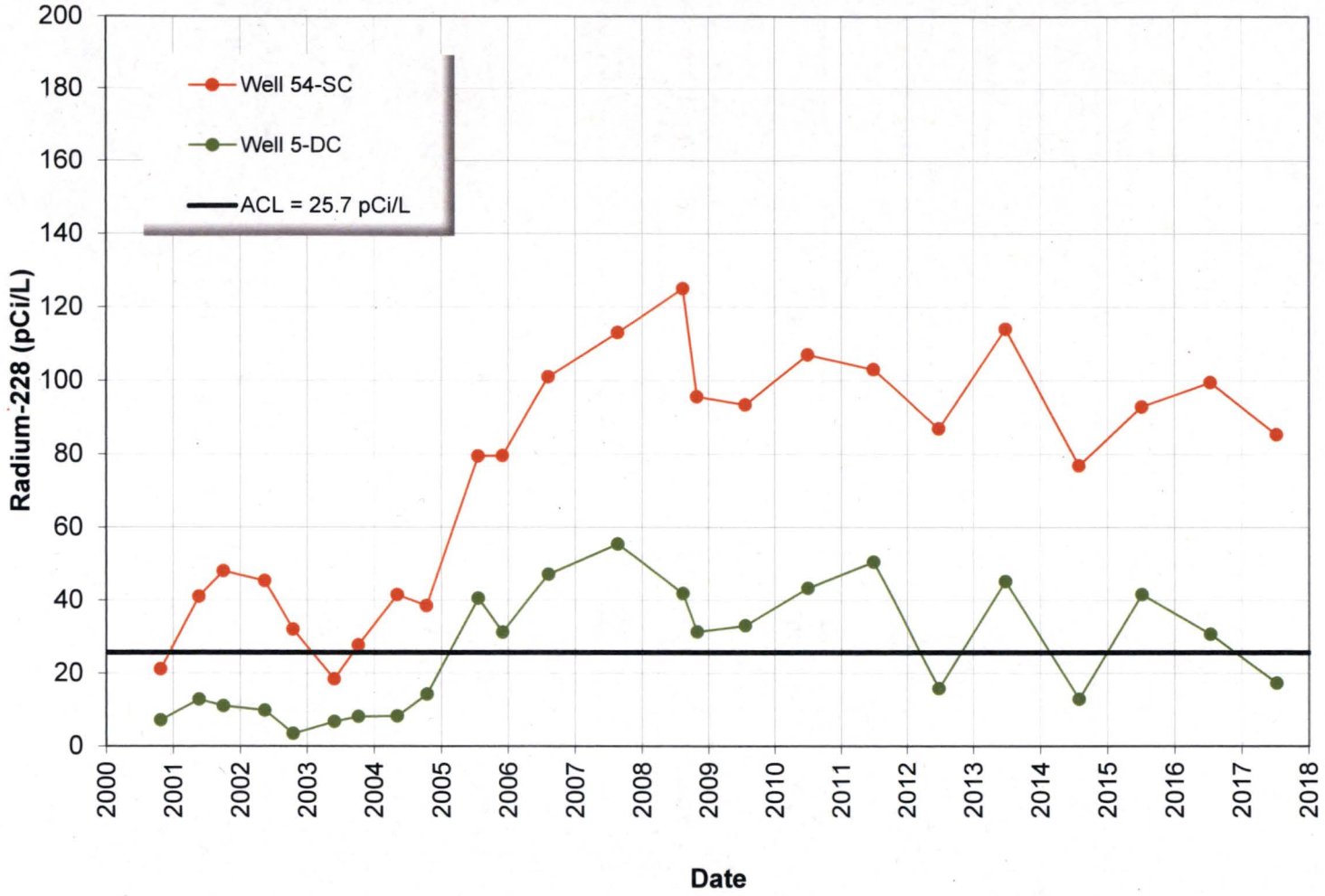

Figure 6-3. Radium-228 Concentrations in Wells 5-DC and 54-SC Since Completion of the Disposal Cell at the Shirley Basin South, Wyoming, Disposal Site

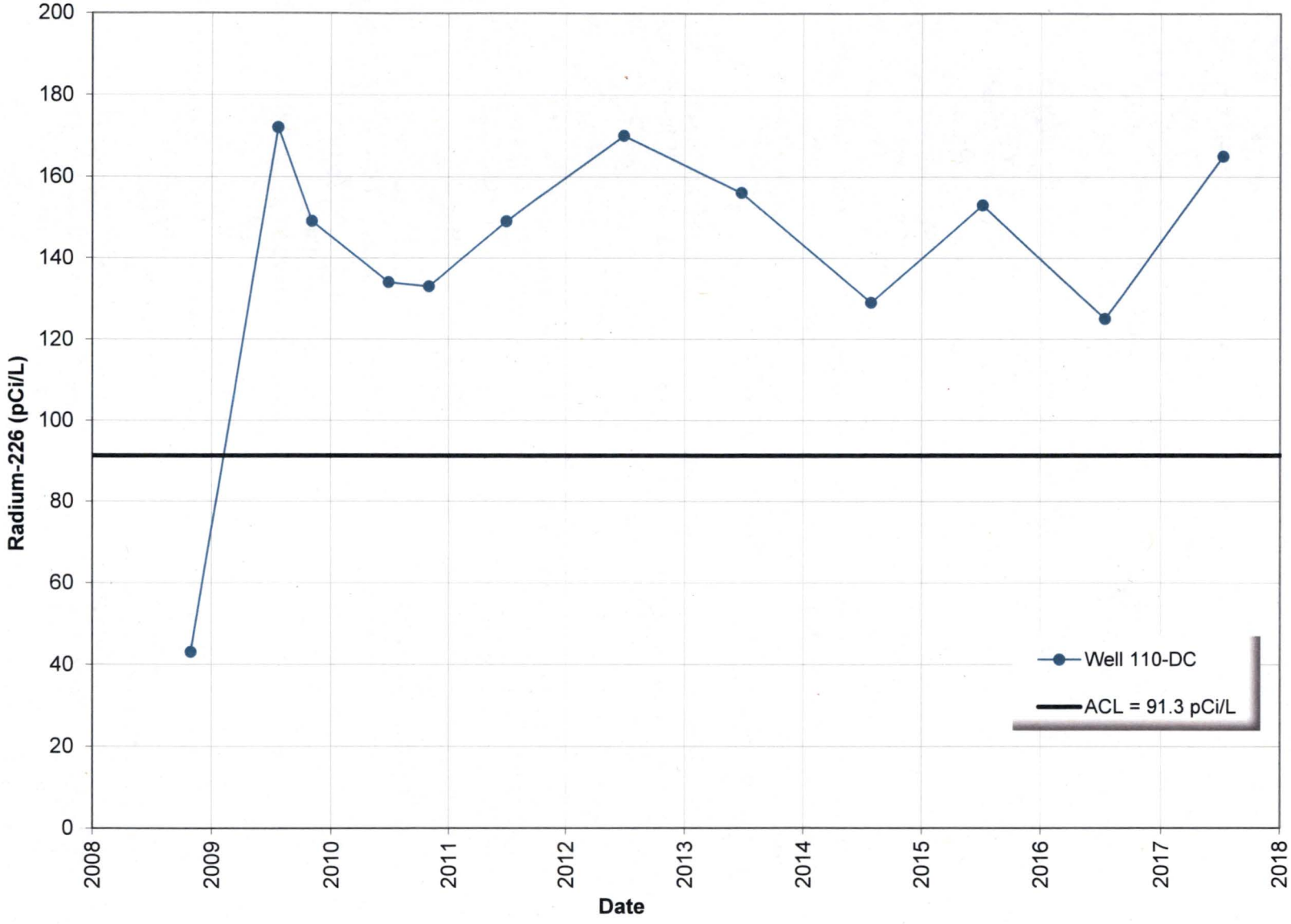

Figure 6-4. Radium-226 Concentrations in Well 110-DC at the Shirley Basin South, Wyoming, Disposal Site

Although ^{228}Ra concentration is elevated in 54-SC, it is less than the highest concentration measured in this well in the early 1990s during site groundwater remediation activities. Radium-228 is a decay product of thorium-232 (^{232}Th), which is highly immobile. Because the half-life of ^{228}Ra is relatively short, ^{232}Th sources must be near monitoring wells 5-DC and 54-SC. DOE attributes the cause of elevated ^{226}Ra and ^{228}Ra in the site wells to natural mineralization in the aquifers, rather than concluding it is evidence of diminished disposal cell performance or contaminant plumes migrating offsite. Both of the aquifers at the site were dewatered during mining and remediation and are still in the process of recovering; therefore, as the sand units are resaturating, groundwater may be coming back into contact with thorium and other minerals in the ore body, and the quality is returning to preremediation concentrations.

NRC considers it possible that the elevated radium may represent leakage from the disposal cell. However, NRC has concluded that additional evaluation of the cause of the elevated radium concentrations by DOE is not warranted at this time because there is no risk to human health and the environment. The groundwater is not a current or potential future source of drinking water, and the source of livestock water at the site is a separate aquifer that is not hydraulically connected to the aquifer of concern and is not impacted by former milling operations.

Wyoming Class III groundwater protection standards (applicable only to chloride, sulfate, and TDS) apply to water quality at the site boundary. The standards were met at the downgradient site boundary wells (100-SC, 102-SC, 110-DC, 112-DC, and 113-DC). The standards were exceeded for sulfate and TDS in wells 5-SC, 54-SC, and 5-DC.

The 2017 results were within the range of historical measurements. The exceedances are found in wells near the disposal cell except for the ^{226}Ra exceedance at well 110-DC. Well 110-DC is near a uranium ore deposit, and the ^{226}Ra concentration is around 29 times that of the upgradient POC well 5-DC. Therefore, the ^{226}Ra in well 110-DC is probably naturally occurring.

Analytical results from well K.G.S. #3 confirm that the lower sand aquifer of the Wind River Formation is hydraulically isolated from the overlying main sand aquifer. This conclusion is based on substantially lower concentrations of sulfate (220 milligrams per liter [mg/L]) and TDS (460 mg/L) in the lower sand aquifer compared to those in the main sand aquifer.

The LTSP specifies that this report provide isoconcentration maps for uranium and sulfate in each aquifer. However, the monitoring well network does not provide sufficient data points to develop these. Instead, 2017 concentrations for uranium in the two aquifers are shown in Figure 6-5 and Figure 6-6, and concentrations for sulfate are shown in Figure 6-7 and Figure 6-8. Uranium and sulfate concentrations remain less than concentrations predicted by the former licensee.

The LTSP also specifies that this report provide groundwater contour maps. However, the well network does not provide sufficient data points to develop them. Regional groundwater flows reportedly were to the north-northeast for the upper sand aquifer and to the east for the main sand aquifer before mining activities. The upper sand unit and the main sand unit coalesced and formed the main ore body at the Pit 4 location. Pit 4 was partially backfilled with overburden materials during reclamation, and the bottom of the pit was raised to an elevation above the projected recovered phreatic surface of the upper sand aquifer. The backfill operation did not re-create the hydrogeologic characteristics of the original formation, and the aquifers are no

longer confined at Pit 4. It is likely that the bottom of Pit 4 is a groundwater recharge area during periods of rainfall and snowmelt and may be an evaporation area during dry periods. Both recharge and evaporation would tend to alter groundwater chemistry. Therefore, mining and reclamation activities permanently altered the local groundwater conditions for the upper and main sand aquifers at the site.

Water-level elevations for the upper sand aquifer are shown in Figure 6-9. Water levels are increasing in wells 100-SC and 102-SC, but they are remaining constant in the other upper sand aquifer wells. The apparent flow direction is to the northeast, along the formation dip and toward Pit 4. The dry wells (51-SC and 101-SC) indicate that the upper sand aquifer has not recovered in the vicinity of Pit 4. Because the aquifer is no longer confined at the Pit 4 location, and because the flooded open-pit mine on the Ur-Energy property downgradient of the site might be a groundwater sink, aquifer water levels on the site might never recover to their premining elevations.

Main sand aquifer water elevations, shown in Figure 6-10, have been gradually rising at all wells since 2000, with an average rate of increase of approximately 0.8 foot per year since DOE began monitoring water levels in 2005 (Figure 6-11). The rising levels indicate a gradual recovery of the aquifer. However, the altered conditions at Pit 4 might prevent a return to premining elevations of the water table. Also, the water surface elevation of the downgradient pit lake on the adjacent Ur-Energy property might control the surface elevation of the aquifers on the site.

6.8 Reference

DOE (U.S. Department of Energy), 2004. *Long-Term Surveillance Plan for the U.S. Department of Energy Shirley Basin South (UMTRCA Title II) Disposal Site, Carbon County, Wyoming*, DOE–LM/GJ766–2004, December.

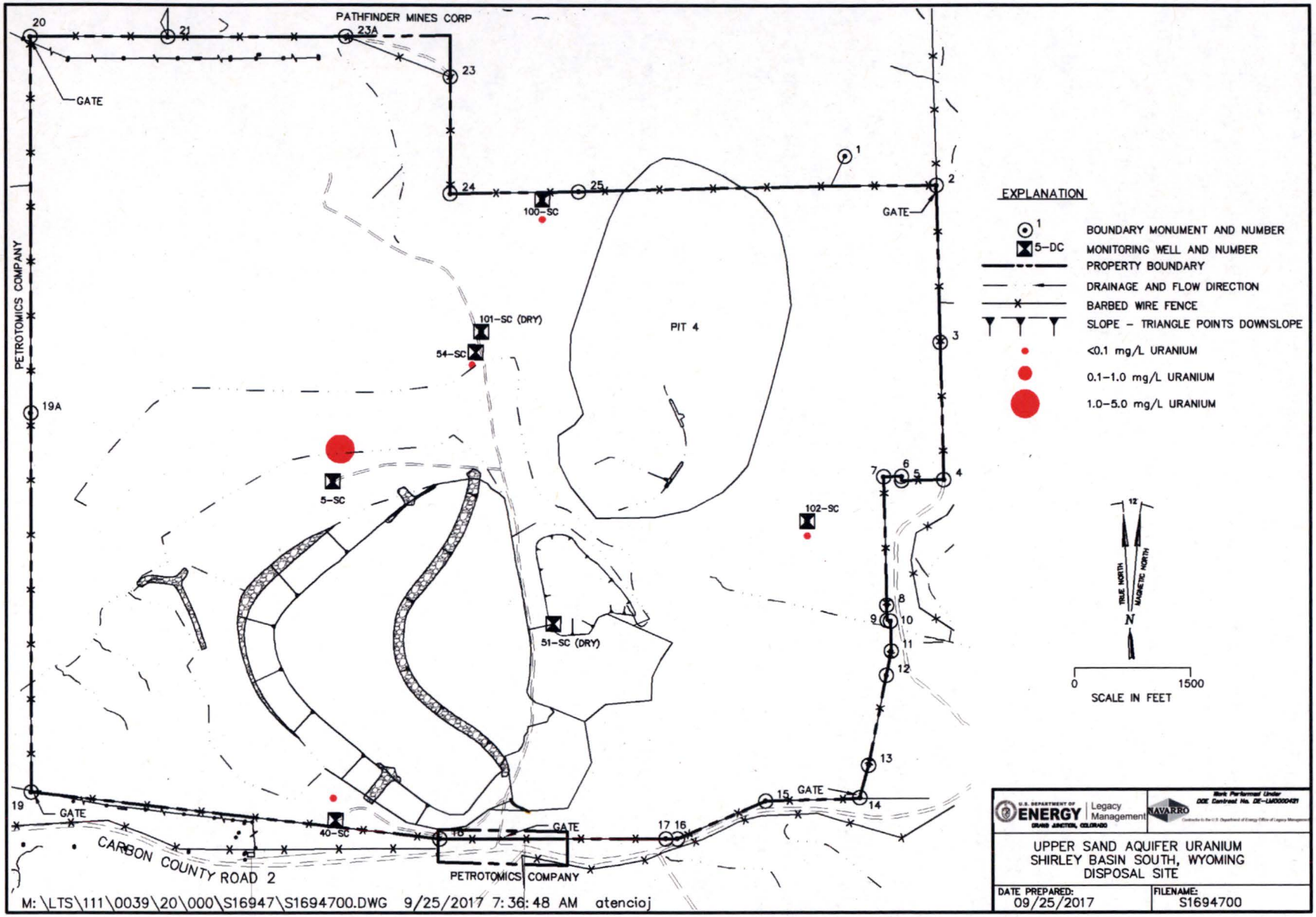

Figure 6-5. July 2017 Uranium Concentrations in the Upper Sand Aquifer at the Shirley Basin South, Wyoming, Disposal Site

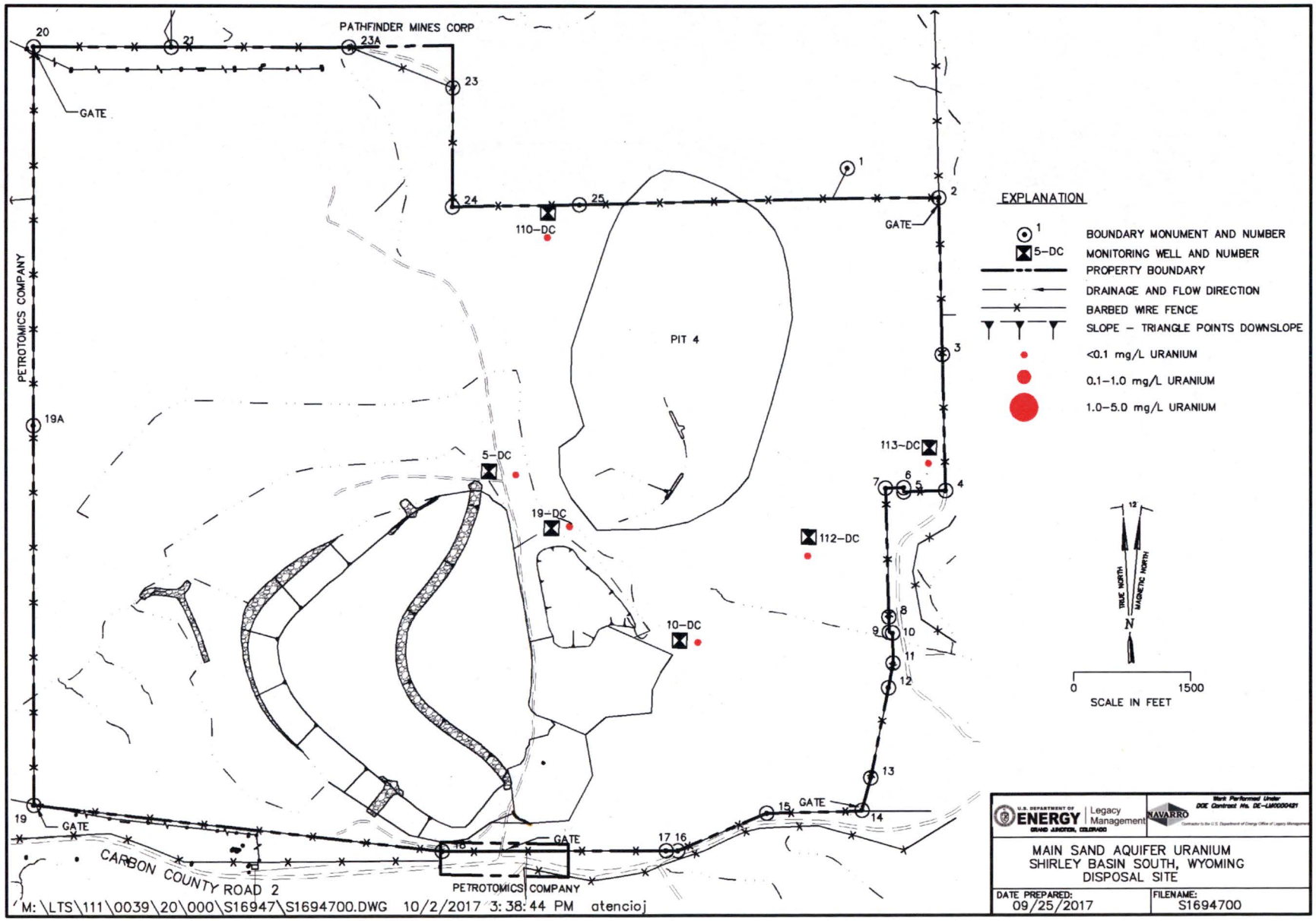

Figure 6-6. July 2017 Uranium Concentrations in the Main Sand Aquifer at the Shirley Basin South, Wyoming, Disposal Site

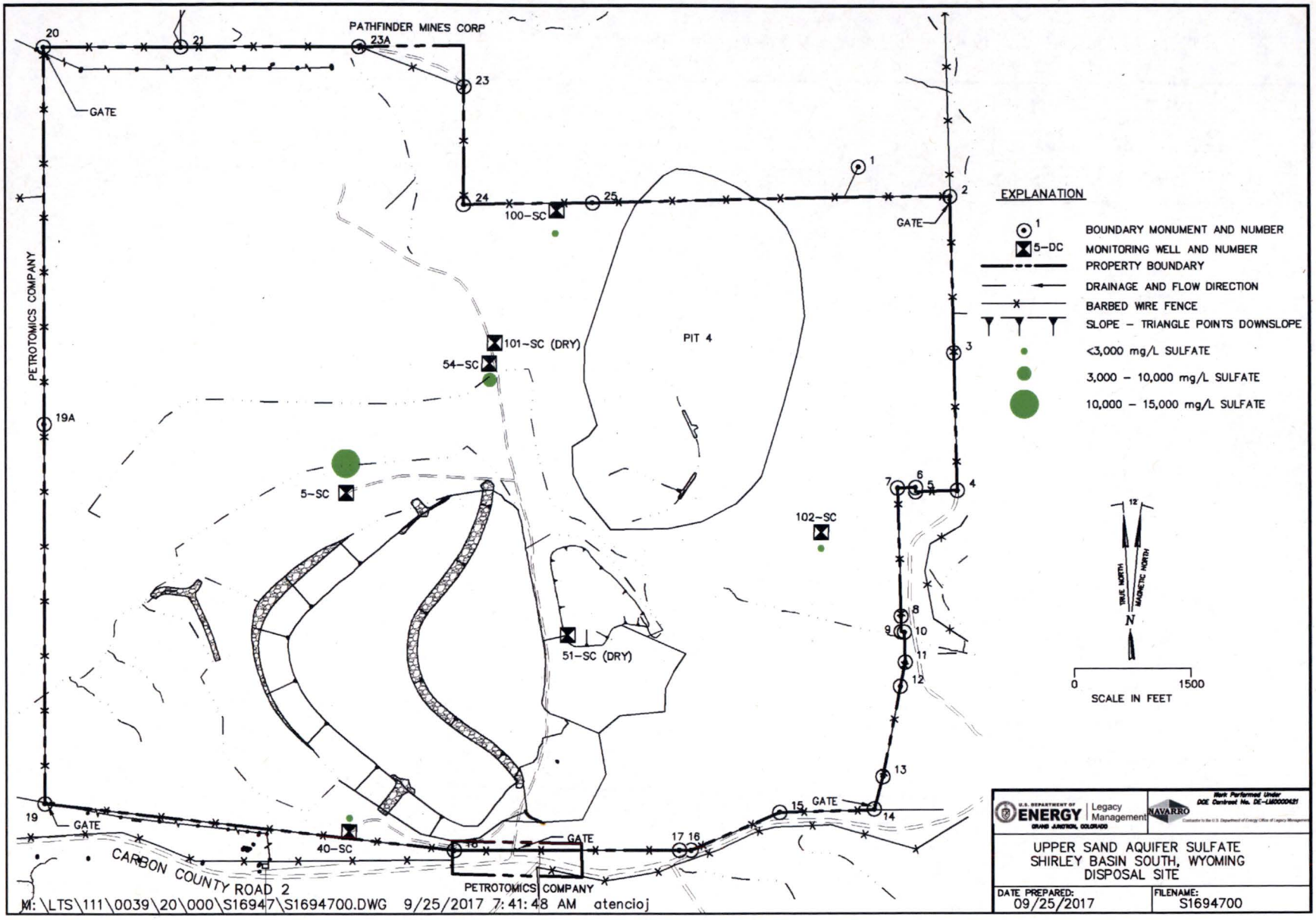

Figure 6-7. July 2017 Sulfate Concentrations in the Upper Sand Aquifer at the Shirley Basin South, Wyoming, Disposal Site

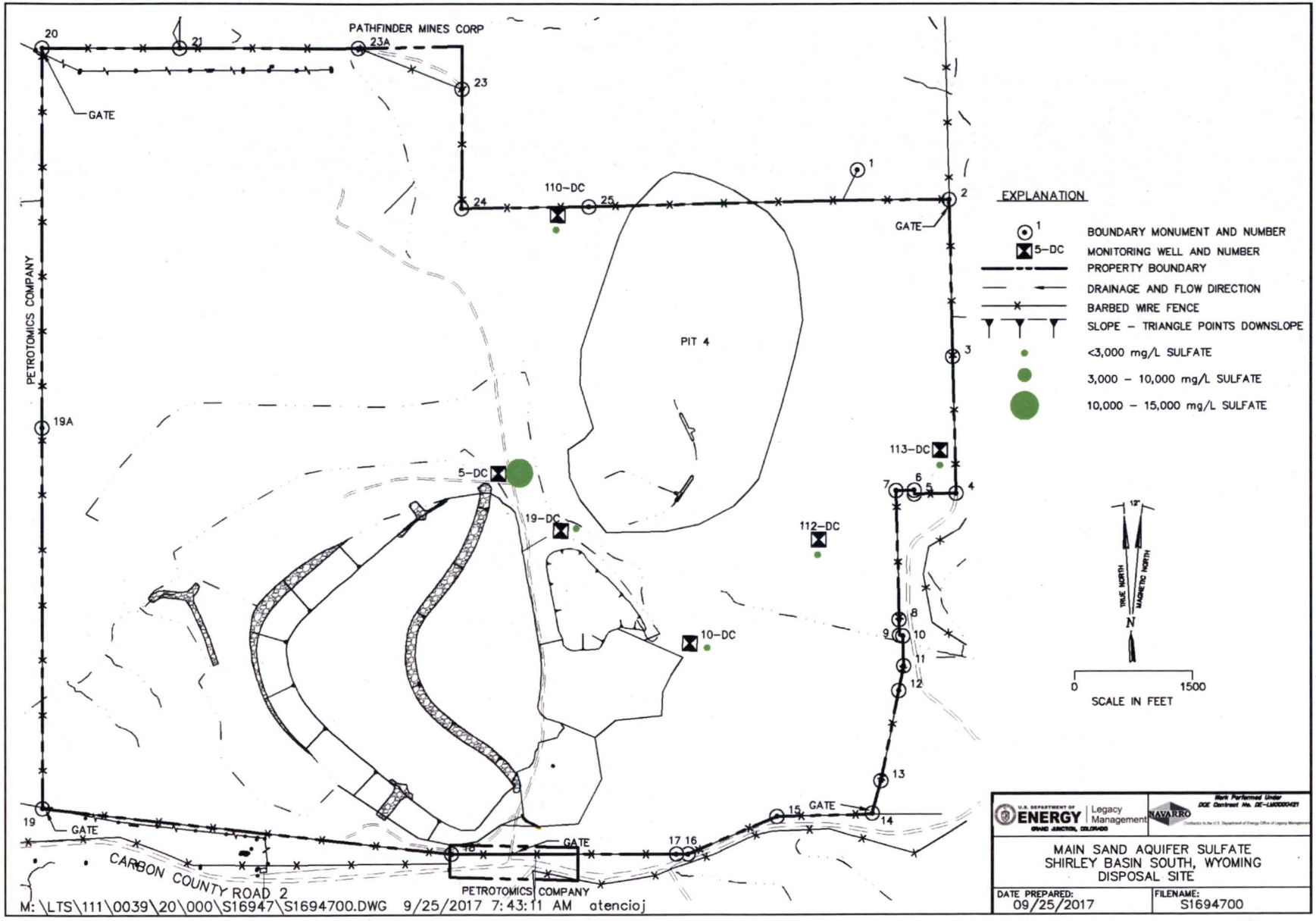

Figure 6-8. July 2017 Sulfate Concentrations in the Main Sand Aquifer at the Shirley Basin South, Wyoming, Disposal Site

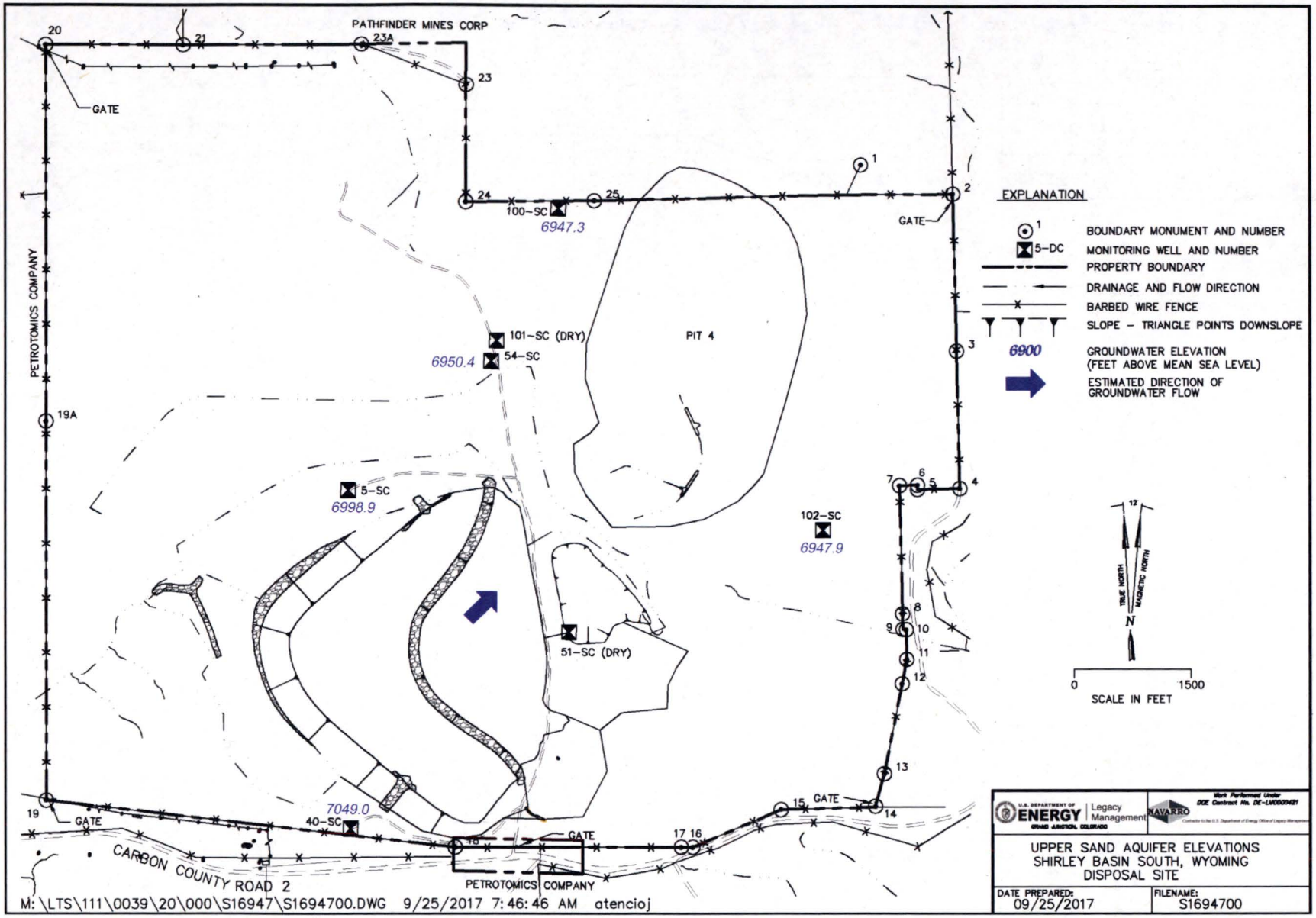

Figure 6-9. July 2017 Groundwater Elevations in the Upper Sand Aquifer at the Shirley Basin South, Wyoming, Disposal Site

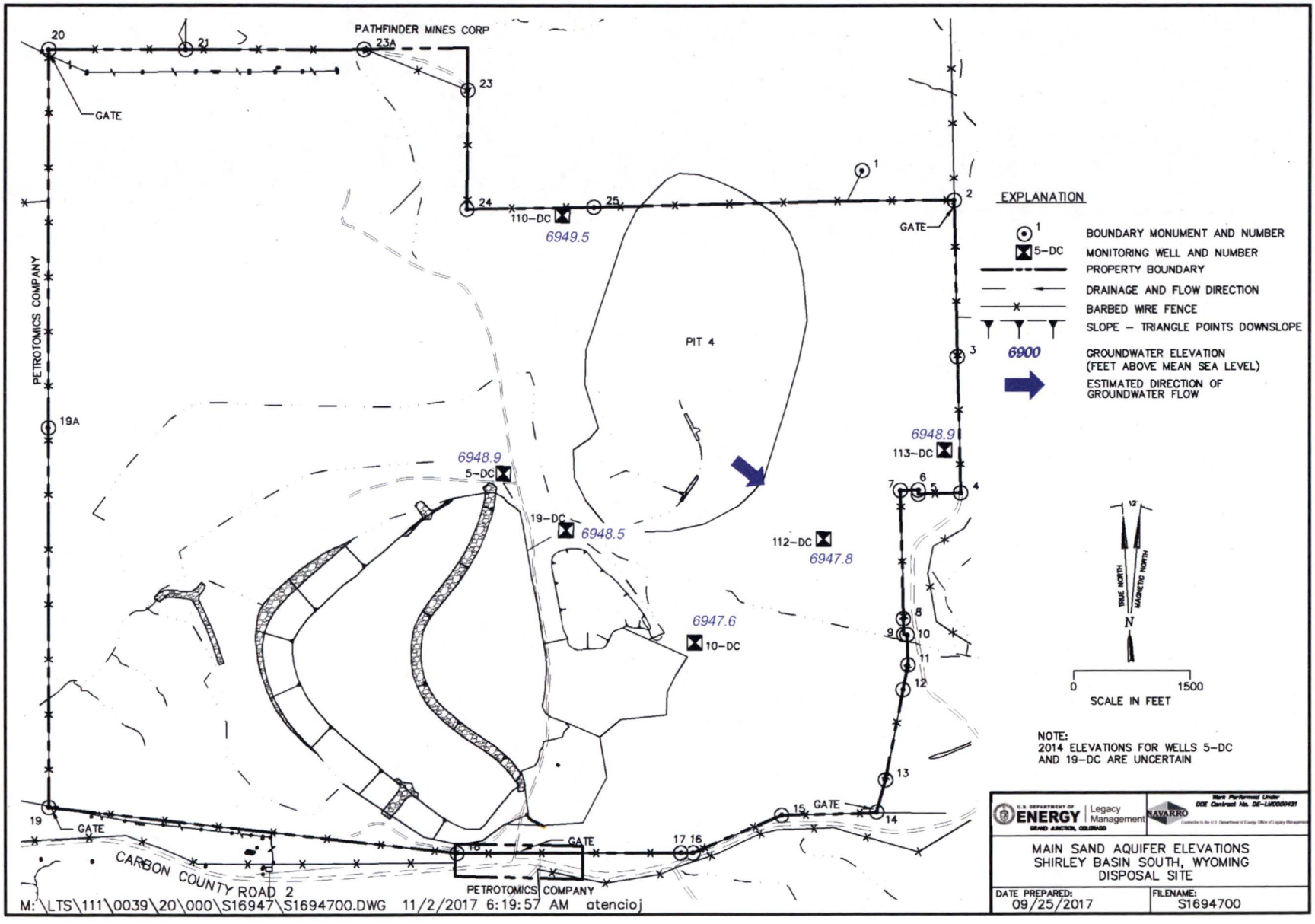

Figure 6-10. July 2017 Groundwater Elevations in the Main Sand Aquifer at the Shirley Basin South, Wyoming, Disposal Site

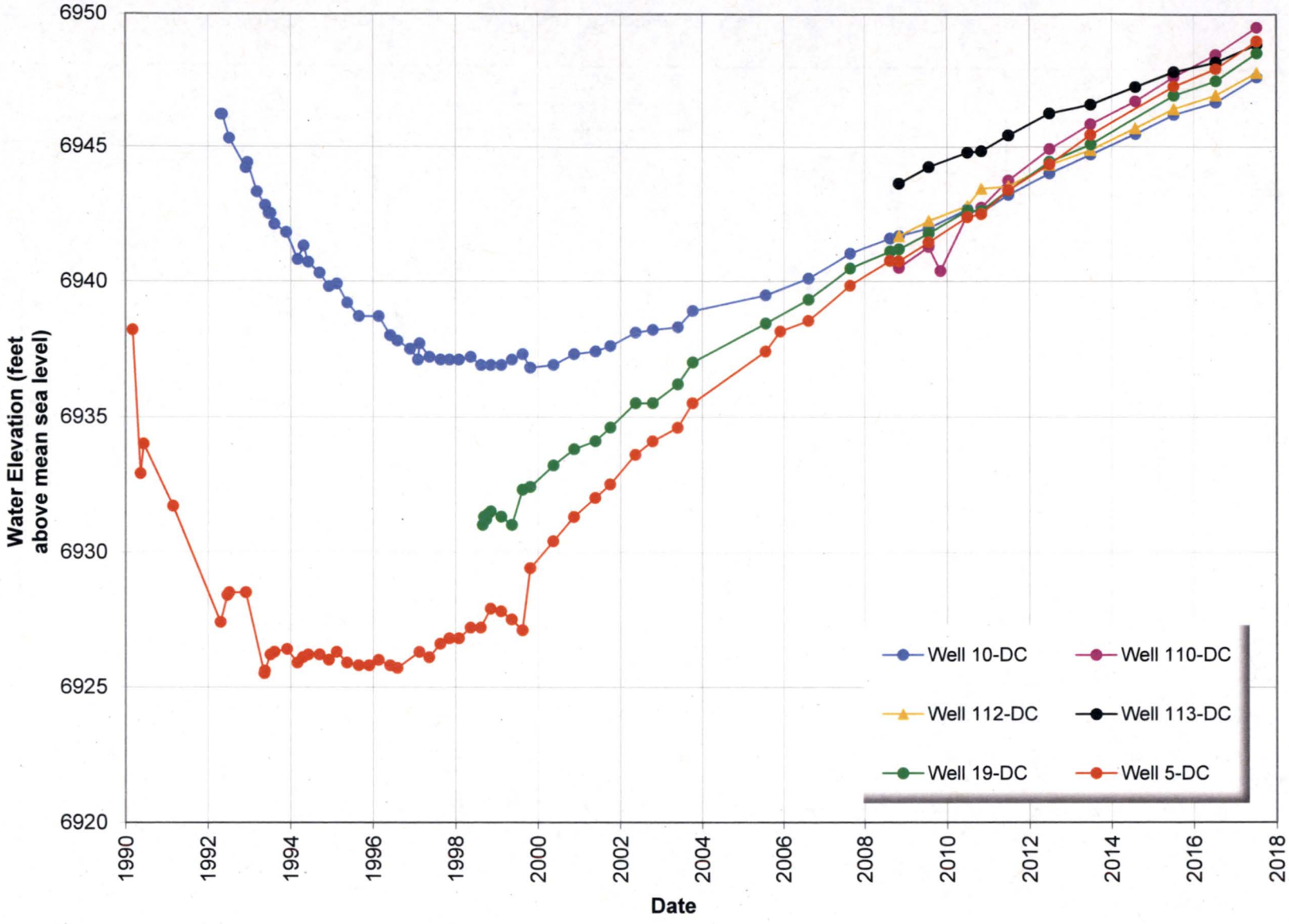

Figure 6-11. Hydrographs for Main Sand Aquifer Wells at the Shirley Basin South, Wyoming, Disposal Site

6.9 Photographs

Photograph Location Number	Azimuth	Photograph Description
PL-1	345	Entrance Gate
PL-2	340	Perimeter Sign P26 at Entrance Gate
PL-3	0	Site Marker
PL-4	90	Boundary Monument BM-11 at the Site's East Boundary
PL-5	90	Monitoring Well 110-DC
PL-6	185	Junction of Upper and Lower Surfaces of Disposal Cell
PL-7	150	North Swale Discharge Point
PL-8	310	South Swale Discharge Point
PL-9	130	Water Collected at North Swale Discharge Point
PL-10	345	Riprap-Armored Dam Outslope of Disposal Cell
PL-11	255	Downgradient View of Riprap-Armored Portion of North Channel
PL-12	325	South End of East Drainage Basin
PL-13	205	View Across Pit 4
PL-14	345	Eroded Riprap at Bottom of Pit 4
PL-15	40	Well K.G.S. #3

PL-1. Entrance Gate

PL-2. Perimeter Sign P26 at Entrance Gate

PL-3. Site Marker

PL-4. Boundary Monument BM-11 at the Site's East Boundary

PL-5. Monitoring Well 110-DC

PL-6. Junction of Upper and Lower Surfaces of Disposal Cell

PL-7. North Swale Discharge Point

PL-8. South Swale Discharge Point

PL-9. Water Collected at North Swale Discharge Point

PL-10. Riprap-Armored Dam Outslope of Disposal Cell

PL-11. Downgradient View of Riprap-Armored Portion of North Channel

PL-12. South End of East Drainage Basin

PL-13. View Across Pit 4

PL-14. Eroded Riprap at Bottom of Pit 4

PL-15. Well K.G.S. #3

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