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U.S. DEPARTMENT OF ENERGY

Legacy Management

2016 Annual Site Inspection and Monitoring Report for Uranium Mill Tailings Radiation Control Act Title II Disposal Sites

November 2016

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Contents

Abbreviations iii
Executive Summary v
Bluewater, New Mexico, Disposal Site 1-1
Edgemont, South Dakota, Disposal Site 2-1
L-Bar, New Mexico, Disposal Site 3-1
Maybell West, Colorado, Disposal Site 4-1
Sherwood, Washington, Disposal Site 5-1
Shirley Basin South, Wyoming, Disposal Site 6-1

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Abbreviations

ACL	alternate concentration limit
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
LiDAR	light detection and ranging
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
SMK	site marker
TDS	total dissolved solids
UMTRCA	Uranium Mill Tailings Radiation Control Act of 1978 (Title 42 *United States Code* Section 7901, et seq.)
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 (LM) in 2016 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 http://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) Title 10 *Code of Federal Regulations* Section 40.28. Reclamation and site transition activities continue at other sites, and DOE ultimately expects to manage 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 2016:

- **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. NRC is reviewing a groundwater conceptual model prepared by DOE. A joint NRC/DOE radon study is being conducted at the site to investigate the effects of soil-forming processes on disposal cell cover engineering properties.
- **Bluewater, New Mexico:** A LiDAR topographic survey was conducted to evaluate changes in disposal cell cover depressions. Results of the survey indicate the disposal cell cover continues to settle.
- **Edgemont, South Dakota:** A follow-up inspection was performed after a wildfire spread across the site five days after the annual inspection. Minor damage to a small section of the perimeter fence occurred during firefighting efforts and has been repaired. The fire did not impact the integrity of the disposal cell. DOE will study and monitor the effects of wildfires on the vegetative cover of the cell and the surrounding areas.

[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.

- **L-Bar, New Mexico:** Culvert installation was completed at a site access road to prevent further damage from an erosional gully. The section of fence along the east site access road was re-aligned to address impacts from erosion.
- **Sherwood, Washington:** An erosion feature is present at the toe of the tailings dam, and a forest fire on August 2016 impacted portions of the site. A follow-up inspection is planned for late 2016.
- **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 there is no current risk to human health and the environment. Groundwater monitoring will continue in accordance with the LTSP.

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. 2016 Summary of UMTRCA Title II Site Issues and Actions

Site	Chapter	Page	Issues and Actions
Bluewater, New Mexico	1	1-6	Conducted radon study at site in conjunction with NRC.
		1-6	Restarted pond dewatering siphon on cell.
		1-8	Conducted groundwater monitoring.
		1-11	Alluvial aquifer groundwater with elevated uranium concentrations leaving the site.
		1-13	Bedrock aquifer groundwater with elevated uranium concentrations leaving the site.
		1-14	Site-derived uranium contamination is not expected to impact municipal water supplies.
Edgemont, South Dakota	2	2-6	Follow-up inspection was conducted due to a wildfire.
		2-6	No groundwater monitoring is required by the LTSP.
L-Bar, New Mexico	3	3-2	Re-aligned fence due to erosion.
		3-6	Installed culverts to control erosion near access road.
		3-8	Measured cell cover erosion and vegetation.
Maybell West, Colorado	4	4-5	Continued to observe small depression with no changes.
		4-5	Observed second small depression.
		4-7	No groundwater monitoring is required by the LTSP.
Sherwood, Washington	5	5-5	Observed erosion feature at the toe of tailings dam.
		5-6	Conducted dam safety inspection.
		5-7	Follow-up inspection will occur in late 2016 due to an erosion feature and a forest fire.
		5-8	Conducted groundwater monitoring.
Shirley Basin South, Wyoming	6	6-7	Conducted groundwater monitoring.
		6-8	Continued to exceed ACLs for radium-226 and radium-228.
		6-9	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 August 24, 2016. There was a significant pond on the top slope of the main tailings disposal cell cover in an area where there are depressions. A siphon installed after the 2015 inspection to dewater ponds was started on August 22 and the depression were nearly dry when checked again on September 18. Siberian elm saplings present on the main tailings disposal cell and tamarisk shrubs scattered across the site were treated with herbicide during the inspection. Inspectors identified no other maintenance needs or cause for a follow-up inspection.

Groundwater was sampled in December 2015 and May 2016. Monitoring results indicate alternate concentration limits (ACLs) were not exceeded. Groundwater leaving the site however has concentrations exceeding the UMTRCA maximum concentration limit (MCL) and the State of New Mexico drinking water standard. Based on downgradient samples and the groundwater conceptual model, uranium contamination from the site will not exceed drinking water standards and is not expected to impact local municipal water supplies.

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	Long-Term Surveillance Plan	This Report
Annual Inspection and Report	Sections 3.3 and 3.4	Section 1.4
Follow-up Inspections	Section 3.5	Section 1.5
Routine Maintenance and Emergency Measures	Section 3.6	Section 1.6
Environmental Monitoring	Section 3.7	Section 1.7

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 of America 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. Physical institutional controls at the site that are inspected annually consist of the disposal cells and landfills, entrance gate, perimeter fence, perimeter signs, 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 August 24, 2016. The inspection was conducted by R. Johnson and T. Jasso of the DOE Legacy Management Support (LMS) contractor. A. Ortelli of the New Mexico Environment Department

(NMED) 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 site integrity, and to determine the need, if any, for maintenance or additional inspection and monitoring.

1.4.1 Site Surveillance Features

Figure 1-1 and Figure 1-2 show the locations of the site surveillance features. 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 on the figures by photograph location (PL) numbers.

1.4.1.1 Site Access, Entrance Gate, and Interior Roads

Access to the site is directly off gravel-surfaced Cibola County Road 63; 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. No maintenance needs were identified.

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. No maintenance needs were identified.

Interior tertiary 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. All roads were passable except for a location that was covered by a large ephemeral pond (PL-1).

1.4.1.2 Fence and Perimeter Signs

A four-strand barbed-wire fence encompasses the site to facilitate land management by DOE. DOE retained a local subcontractor to periodically check the site perimeter fence and to remove trespassing cattle. Minor fence repairs are conducted as needed. The entire perimeter fence was inspected in spring 2016, and no maintenance needs were identified.

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 (PL-2). Perimeter signs P3 and P10 have gunshot damage but are still legible. No maintenance needs were identified.

1.4.1.3 Site Marker and Boundary Monuments

A granite site marker is between the southwest corner of the main tailings disposal cell and the northwest corner of the carbonate tailings disposal cell (PL-3). No maintenance needs were identified.

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. All of the boundary monuments were inspected in spring 2016; covering sand was removed to expose several monuments. No maintenance needs were identified.

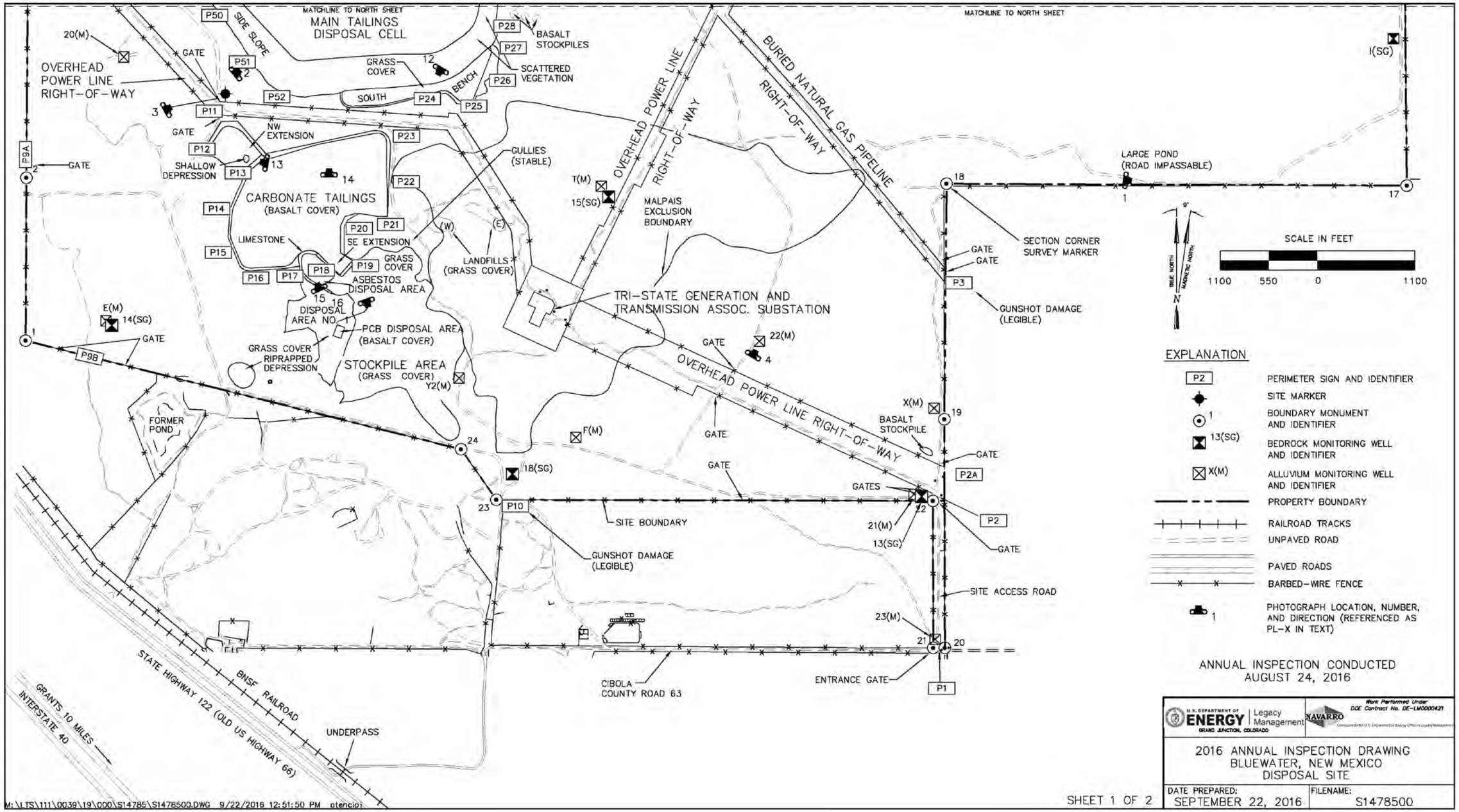


Figure 1-1. 2016 Annual Inspection Drawing for the Bluewater, New Mexico, Disposal Site (South Area)

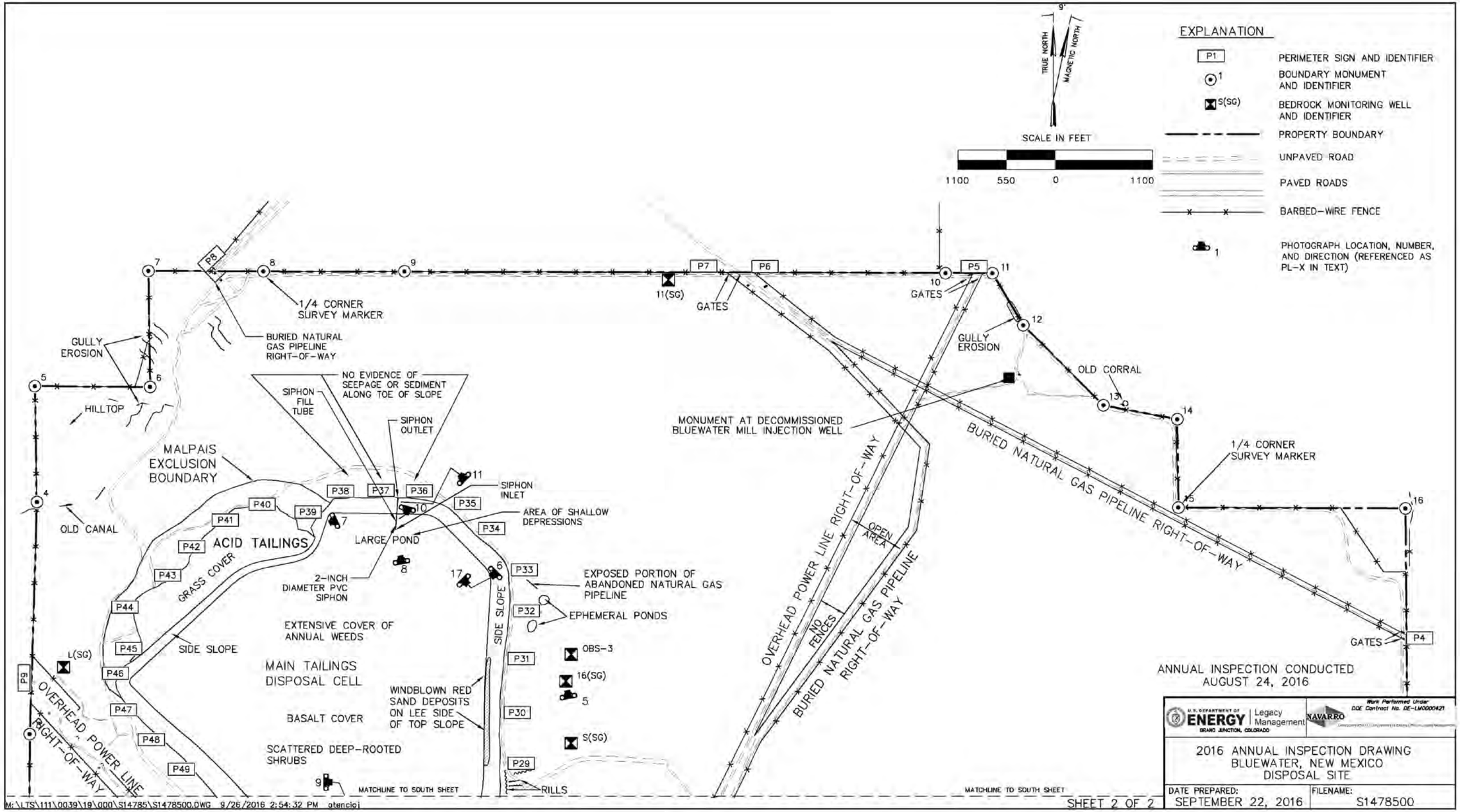


Figure 1-1. 2016 Annual Inspection Drawing for the Bluewater, New Mexico, Disposal Site (North Area)

1.4.1.4 Monitoring Wells

The 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 DOE office in Grand Junction, Colorado (PL-4 and PL-5). The wellhead protectors 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 disposal area and the south bench; (2) the carbonate tailings disposal cell, including the asbestos disposal area, the polychlorinated biphenyl (PCB) disposal area, and associated landfills; (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 disturbances that might affect the site's integrity, protectiveness, or long-term performance.

1.4.2.1 Main Tailings Disposal Cell, the Acid Tailings Disposal Area, and the South Bench Disposal Area

The main tailings disposal cell and the acid tailings and south bench disposal areas are contiguous, and together they constitute one large disposal area of approximately 354 acres. The top slope of the main tailings disposal cell is covered with basalt riprap (PL-6) 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-7) and south bench disposal areas are nearly flat and covered by healthy grass. Basalt riprap protects the side slopes of the three disposal areas.

Plant encroachment (annual weeds, perennial grasses and forbs, and scattered perennial shrubs) continues on the cell top and side slopes. Siberian elm saplings on the top slope are managed to prevent the establishment of trees that could damage the cell cover materials; several saplings were treated with herbicide by LMS staff on the same day as 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 the magnitude of settlement and to determine if settlement is still occurring. 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, is continuing. However, the rate of settlement since 2012 is much less than the rate before 2012.

Ponds often develop in the depressions after rainfall events and occasionally coalesce into one large pond after a series of rainfall events. The presence of ponded water is monitored continuously using a remotely operated camera system (PL-8). The top slope was dry in July, but rain events in August totaling 5.74 inches of precipitation resulted in one large pond holding approximately 2.1 million gallons of runoff water at the time of the inspection (calculated based on the surface elevation of the pond and LiDAR-generated topography of the top slope surface). 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.

NRC requested that DOE evaluate the performance of the radon barrier because of a concern that the ponded water could be degrading disposal cell performance (i.e., releasing radon and allowing percolation of water through the cover materials and into the encapsulated tailings). Radon flux measurements on top of the radon barrier in the area of depressions were collected in July 2013. All radon measurements were below the detection limit, indicating that the radon barrier in that portion of the 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 located on the acid tailings bench. The test pits were reclaimed after completion of field investigations, and the locations (except two that were under water) were observed and photographed during the annual inspection. Reclamation appeared to be successful at every test pit location; no settlement or erosion was visible (PL-9). Results of the 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 cell cover investigations, DOE will continue to monitor top slope settlement and plans to conduct another high-resolution topographic survey in 2019. Also, a 2-inch-diameter siphon was installed in fall 2015 to dewater as much of the ponded water as possible. The intent is to avoid potential erosion of the 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, which could initiate erosion at that location.

The siphon successfully removed nearly all the water when operated in fall 2015; all of the water cannot drain from one location due to the unevenness of the depressions. The remaining shallow ponds dried up by March 2016. The siphon was restarted on August 22 to dewater the pond present at the time of the inspection (PL-10 and PL-11); the ponded water was siphoned off in less than four weeks. The siphon discharges water 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 disposal cell and eventually dissipates through infiltration into soil and through evaporation. The discharged water does not flow off of the site.

1.4.2.2 Carbonate Tailings Disposal Cell, Asbestos and PCB Disposal Areas, and Landfills

The 54-acre carbonate tailings disposal cell is south of the main tailings disposal cell (PL-12). Basalt riprap covers the top and side slopes of the disposal cell. The top, for the most part, slopes gently eastward. The 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; some standing water was present at the time of the inspection (PL-13). Annual weeds, perennial grasses, and scattered woody shrubs were present on the cell and its extensions. Siberian elm saplings are periodically treated with herbicide; no saplings were observed during the inspection.

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. Reclamation appeared to be successful at both test pit locations; no settlement or erosion was visible (PL-14).

The 2-acre asbestos disposal area is a bowl-like feature just south of the carbonate tailings disposal cell (PL-15). 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) has filtered down through basalt joints and fractures. These depressions do not affect the integrity of the disposal area. No maintenance needs were identified.

There is an 11-acre grass-covered disposal area south of the asbestos disposal area. A small riprap-covered polychlorinated biphenyl (PCB) cell is located within the disposal area (PL-16). Two grass-covered landfills, totaling about 2 acres, are east of the carbonate tailings disposal cell. The disposal areas and landfills were inspected, and no 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 disposal cell and in other low spots following storm events and were present at the time of the inspection (PL-17). The areas of ponding are far enough from the cell to not impact it.

Isolated tamarisk shrubs, listed as noxious weeds in the state of New Mexico, are present on the site. Accessible shrubs 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. 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, fences, or associated gates.

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 outside the site boundary for 0.25 mile was visually inspected for erosion, development, changes in land use, or other phenomena that might affect the long-term integrity of the site. No such impacts 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

Elm saplings on the main tailings disposal cell cover and tamarisk shrubs scattered across the site were treated with herbicide. A siphon was activated to dewater the large pond on the main tailings disposal cell top slope. 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 Bluewater site. The 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 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 (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. The monitoring network, including new wells installed in 2011 and 2012, is described in Table 1-2. ACLs are listed in Table 1-3.

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 Bluewater site were migrating offsite and contaminating the regional groundwater. In response to NMED's concerns, DOE reinitiated annual sampling at all of the site wells in fall 2008, including the POE wells. Semiannual sampling was initiated in 2011 in response to an ACL exceedance. 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 disposal cell performance, and developed a groundwater conceptual model to address uranium contamination issues. NRC is reviewing the model.

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	Analyte	ACL (mg/L)
Alluvial Aquifer Wells F(M) and T(M)	Molybdenum Selenium Uranium	0.10 0.05 0.44
Bedrock Aquifer Wells OBS-3 and S(SG)	Selenium Uranium	0.05 2.15

Abbreviations:
mg/L = milligrams per liter

1.7.1 Alluvial Aquifer

Water-bearing alluvium underlies the southern portion of the Bluewater 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 disposal cell and comes in contact with a mineralized zone that formed beneath the tailing impoundments. Calculations performed by the former licensee indicate that as many as 2.7 billion gallons of processing fluids seeped from the tailings ponds 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 impoundments before the cells were 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 out of solution. 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.

Alluvial aquifer analytical results from sampling events in December 2015 and in May 2016 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 milligram per liter (mg/L) exceeded the ACL of 0.44 mg/L (Figure 1-3). 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. Concentrations for the other analytes 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 December 2015 and in May 2016 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)	0.00075, 0.00054	ND, ND	0.00005, 0.00003
F(M)	0.0014, 0.00100	0.0016, 0.00092	0.007, 0.00720
T(M)	NS	NS	NS
X(M)	0.001, 0.00078	0.0064, 0.00670	0.110, 0.11
Y2(M)	0.0017, ND	0.0013, 0.00120	0.0053, 0.00460
20(M)	0.0021, 0.00200	0.0057, 0.00400	0.011, 0.01
21(M)	0.0016, 0.0009	0.015, 0.01	0.120, 0.13
22(M)	0.0014, 0.0019	0.0038, 0.00330	0.300, 0.36
23(M)	0.0063, 0.00440	0.0025, 0.00290	0.017, 0.02

Notes:
December 2015 results are first, and May 2016 results are second in each pair of results.

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

Alluvium well 21(M), installed in 2011, is adjacent to the southern site boundary, where the estimated deepest part of the ancestral Rio San Jose channel coursed before being buried by basalt lava flows. Alluvium well 22(M), also installed in 2011, is approximately halfway between POC well T(M) and 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 on

Figure 1-3, 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.

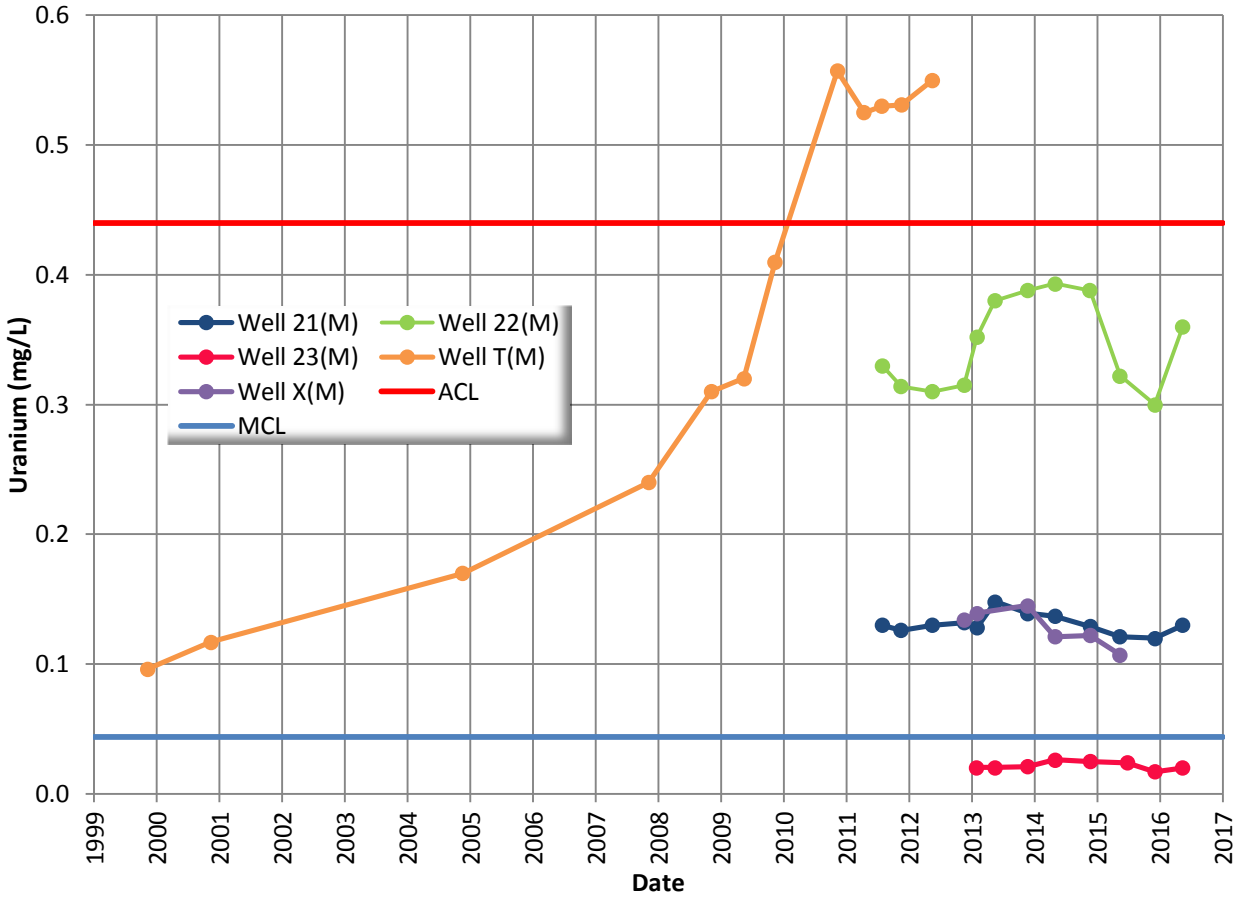


Figure 1-3. Uranium Concentrations in Alluvial Aquifer POC Well T(M) and Downgradient Wells at the Bluewater, New Mexico, Disposal Site

NRC requested that DOE evaluate the performance of the main tailings disposal cell to see if there is a correlation between cell performance and the elevated uranium concentrations in POC well T(M) (see Figure 1-3). A cell cover and water balance evaluation of the 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 disposal cell performance; no surge of tailings fluids from the 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 contaminated weathered Chinle Formation material at the bottom of the well screen.

The extent of contamination in the alluvial aquifer has been evaluated as part of the groundwater conceptual model. Approximately 1 mile downgradient of the Bluewater 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 Bluewater 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.

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 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, sample results from wells OBS-3 and S(SG) are not considered to be representative of aquifer conditions, but they continue to be sampled in accordance with the LTSP.

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 aquifer. All of the new San Andres aquifer wells, except well 16(SG), are screened in the upper 50 feet of the San Andres Limestone, as are most San Andres 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 aquifer groundwater with uranium concentration exceeding the drinking water standard is leaving the site. The 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 aquifer are shown on Figure 1-4. Uranium concentrations in well I(SG) before 2013 were erroneously low because of an incorrect sampling depth in the well. Uranium concentrations at POC wells OBS-3 and S(SG) are not shown in Figure 1-4 because the well screens are encrusted with iron scale that has resulted in erroneously low uranium concentrations.

Table 1-5. Bedrock Aquifer Monitoring Results for December 2015 and May 2016 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)	0.0023, ND	0.010, 0.01
13(SG)	0.0084, 0.00680	0.100, 0.10
14(SG)	0.00032, 0.00066	0.057, 0.06
15(SG)	ND, ND	0.076, 0.07
16(SG)	0.014,0.01	1.300, 1.30
18(SG)	0.0054, 0.00570	0.190, 0.22
I(SG)[a]	0.0071, 0.00830	0.320, 0.32
L(SG)	0.00043, ND	0.0033, 0.00350
OBS-3	0.00058, 0.00190	0.0064, 0.18
S(SG)	0.0082, 0.01	0.580, 0.59
HMC-951	0.0078, 0.0057	0.03, 0.027

Notes:
December 2015 results are first, and May 2016 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.

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

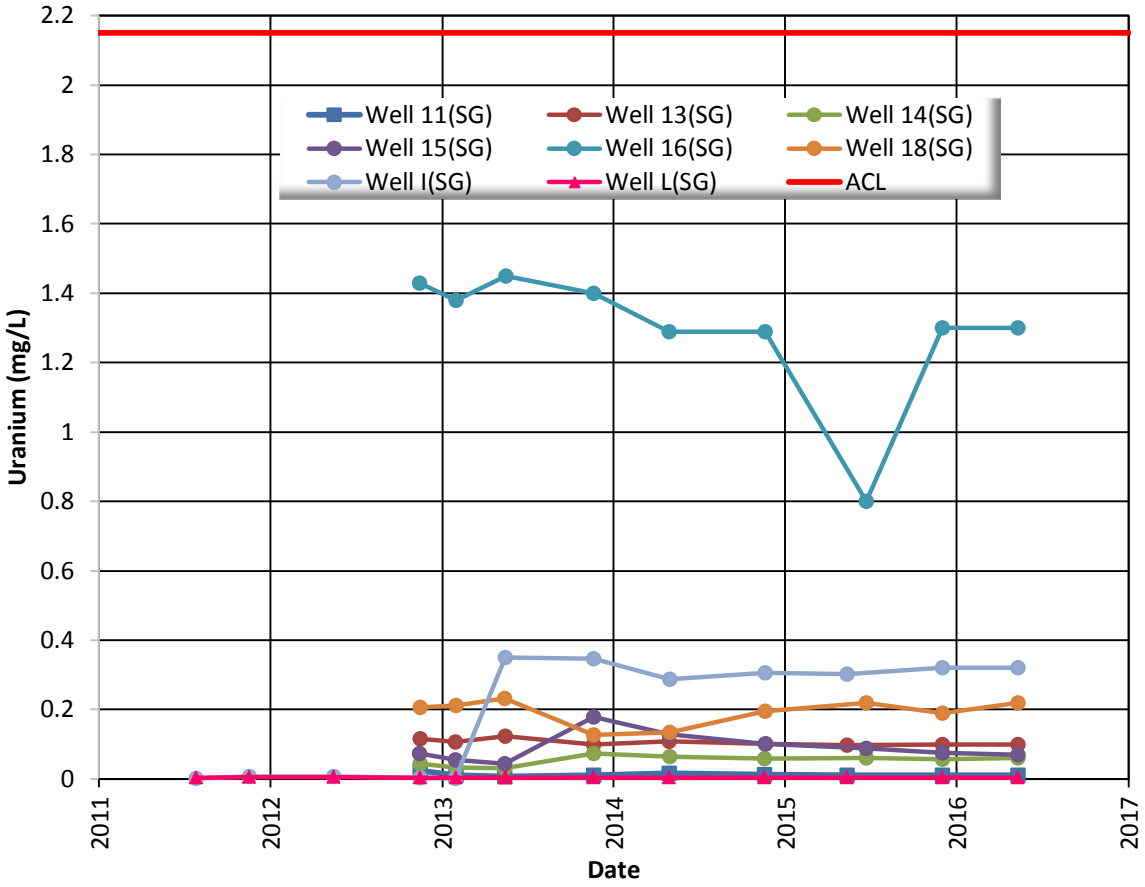


Figure 1-4. Uranium Concentrations in the San Andres Aquifer at the Bluewater, New Mexico, Disposal Site

To evaluate the extent of contamination, DOE sampled private wells near the Bluewater site in 2013. Most of the private wells near the site are completed in the San Andres 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 drinking water standard but below limits considered safe for livestock consumption. All other private San Andres wells sampled by DOE, whether permitted for drinking water or agricultural use, had uranium concentrations below the drinking water standard. The nearest downgradient municipal wells, operated by Milan, produce from the San Andres aquifer and do not have elevated uranium concentrations or show upward trends.

The extent of uranium contamination in the San Andres aquifer and the potential risk to downgradient groundwater users was evaluated in DOE's groundwater conceptual model. Evaluation of previous groundwater studies in the region and available groundwater data indicated that the flow path of the aquifer from the Bluewater site is in the east-southeast direction. The groundwater from the site passes under the Homestake mill site and continues through an area north of the community of Grants. The flow path from the Bluewater site is substantially north of the Milan and Grants municipal wells (Figure 1-5).

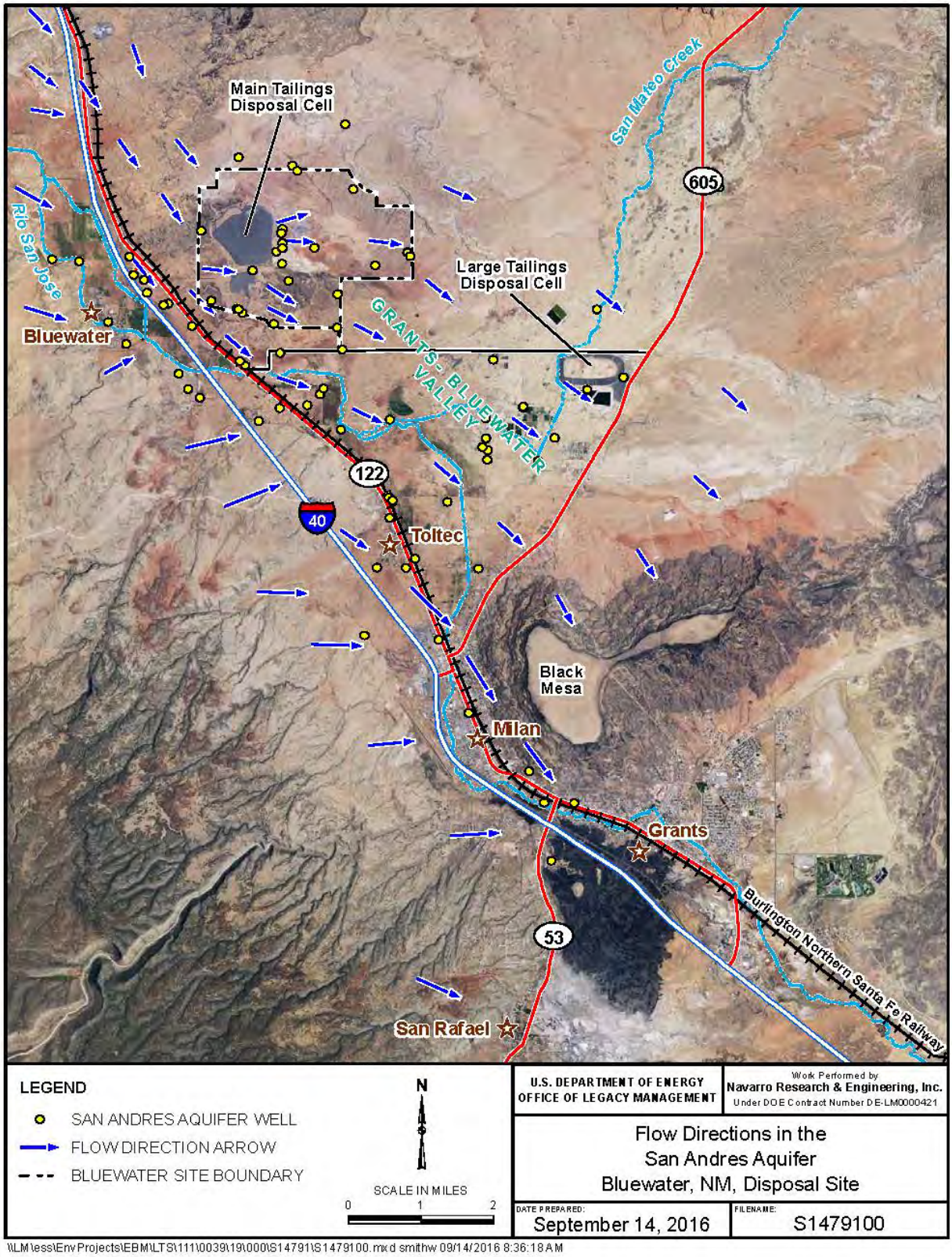


Figure 1-5. Groundwater Flow Directions in the San Andres Aquifer at the Bluewater, New Mexico, Disposal Site

The uranium plume follows the groundwater flow path, and the leading portion is in the vicinity of the Homestake site. 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 Bluewater site primarily through dispersion. No known drinking water wells are completed within the uranium plume, and Bluewater site-derived uranium contamination in the San Andres aquifer is not expected to impact the Milan or Grants municipal water supplies.

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.

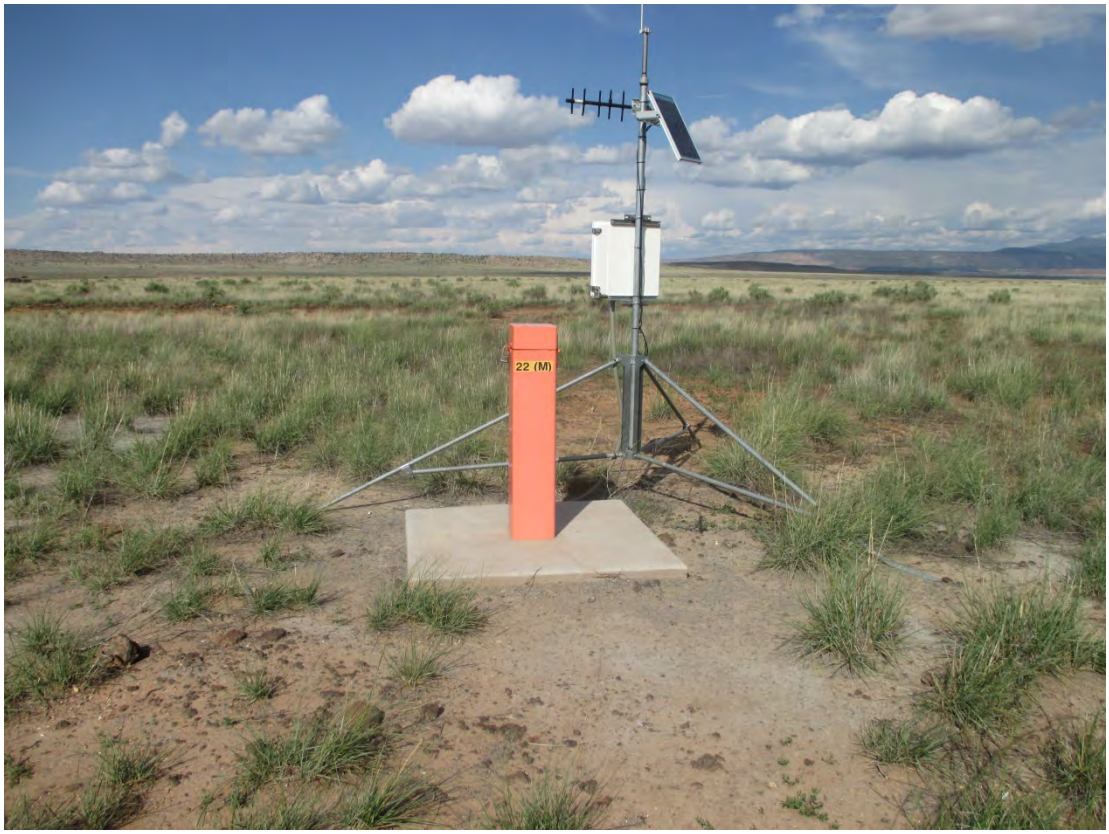
1.9 Photographs

Photograph Location Number	Azimuth	Photograph Description
PL-1	95	Large Ephemeral Pond in East Portion of Site
PL-2	50	Perimeter Sign P51
PL-3	60	Site Marker and South End of Main Tailings Disposal Cell
PL-4	30	Monitoring Well 22(M)
PL-5	350	Weather Station and Precipitation Gauge at Monitoring Well 16(SG)
PL-6	225	View Southwest Across Main Tailings Disposal Cell Top Slope
PL-7	245	Acid Tailings Bench of Main Tailings Disposal Cell
PL-8	350	Web Camera on Main Tailings Disposal Cell
PL-9	90	Reclaimed Test Pit 6
PL-10	195	Pond Dewatering Siphon on Main Tailings Disposal Cell
PL-11	315	Outlet of Operating Siphon on Main Tailings Disposal Cell
PL-12	210	Carbonate Tailings Disposal Cell
PL-13	280	Ponded Water on Northwest Extension of Carbonate Tailings Disposal Cell
PL-14	0	Reclaimed Test Pit 7
PL-15	335	Asbestos Disposal Area
PL-16	160	PCB Disposal Area
PL-17	135	Ephemeral Ponds Near East Side of Main Tailings Disposal Cell

PL-1. Large Ephemeral Pond in East Portion of Site

PL-2. Perimeter Sign P51

PL-3. Site Marker and South End of Main Tailings Disposal Cell



PL-4. Monitoring Well 22(M)

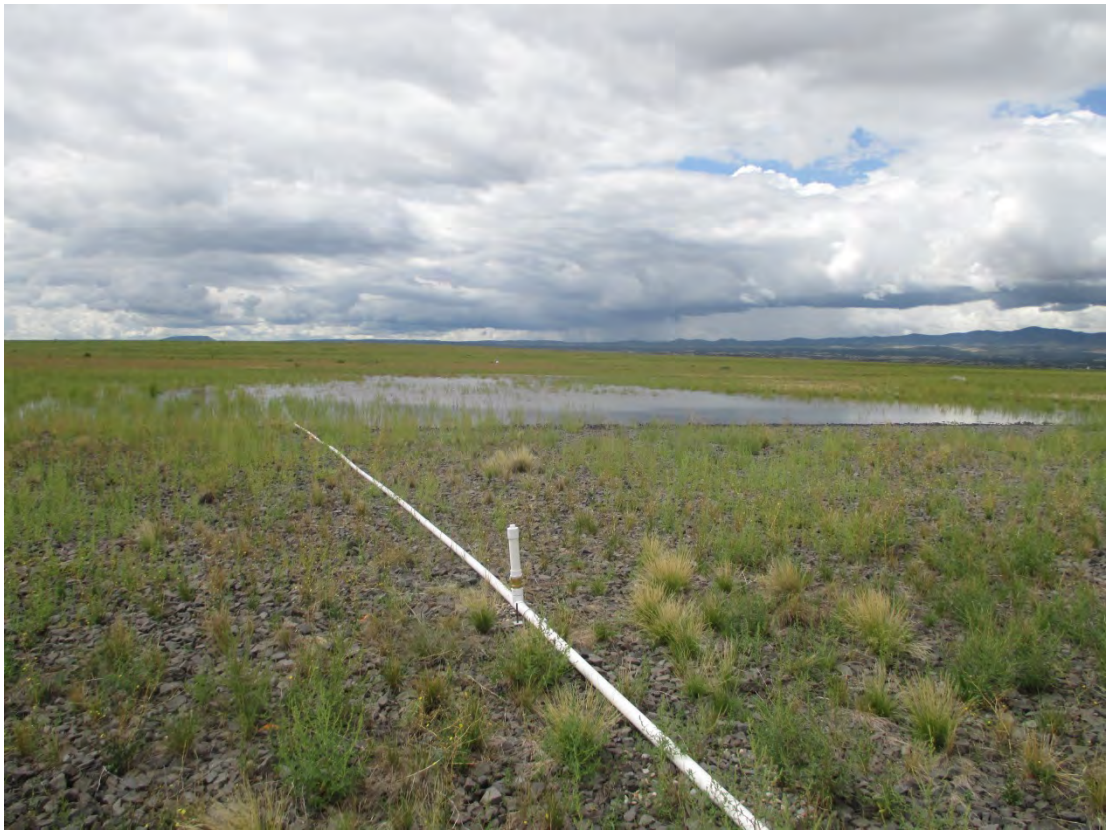
PL-5. Weather Station and Precipitation Gauge at Monitoring Well 16(SG)

PL-6. View Southwest Across Main Tailings Disposal Cell Top Slope

PL-7. Acid Tailings Bench of Main Tailings Disposal Cell

PL-8. Web Camera on Main Tailings Disposal Cell

PL-9. Reclaimed Test Pit 6



PL-10. Pond Dewatering Siphon on Main Tailings Disposal Cell

PL-11. Outlet of Operating Siphon on Main Tailings Disposal Cell

PL-12. Carbonate Tailings Disposal Cell

PL-13. Ponded Water on Northwest Extension of Carbonate Tailings Disposal Cell

PL-14. Reclaimed Test Pit 7

PL-15. Asbestos Disposal Area

PL-16. PCB Disposal Area

PL-17. Ephemeral Ponds Near East Side of Main Tailings Disposal Cell

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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 12, 2016. There were no observed changes in the disposal cell or site surveillance features. Inspectors identified no maintenance needs or cause for a follow-up inspection. On July 17, 2016 a natural wildfire burned most of the vegetation across the site. DOE conducted a follow-up inspection of the site on July 22, 2016 to access the damage and verify that the disposal cell remained protective. Only two features were damaged enough to require repairs: the site entrance sign and a 12-foot wide section of fence near the main entrance. These features were damaged when a bulldozer was driven through the fence in an attempt to construct a firebreak. The firebreak was not within or near the actual tailings containment cell but the bulldozer scraped vegetation from the surface for approximately 150 yards. The area of the firebreak required regrading and reseeding to knock down the berms and start vegetation. DOE completed this work in September 2016 during a planned noxious weed control visit to 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	Long-Term Surveillance Plan	This Report
Annual Inspection and Report	Sections 3.3 and 3.4	Section 2.4
Follow-up Inspections	Section 3.5	Section 2.5
Routine Maintenance and Emergency Measures	Section 3.6	Section 2.6
Environmental Monitoring	Section 3.7	Section 2.7

2.3 Institutional Controls

The 360-acre site, identified by the property boundary shown in Figure 2-1, is owned by the United States of America and was accepted under the U.S. Nuclear Regulatory Commission (NRC) 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. Physical institutional controls at the site that are inspected annually consist of the disposal cell, the entrance gate, the perimeter fence, entrance and perimeter signs, a site marker, boundary monuments, and access gates.

2.4 Inspection Results

The site is approximately 2 miles south of the town of Edgemont in Fall River County near the southwestern corner of South Dakota. It was inspected on July 12, 2016. The inspection was conducted by D. Traub, R. Johnson, S. Hall, and T. Jasso of the DOE Legacy Management Support contractor. The purposes of the inspection were to confirm the integrity of visible

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

2.4.1 Site Surveillance Features

Figure 2-1 shows the locations of site surveillance features. 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 on Figure 2-1 by photograph location (PL) numbers.

2.4.1.1 Site Access, Entrance Sign, and Gates

Access to the Edgemont site is immediately off Fall River County Road 6N. No private property is crossed to gain access. The entrance sign was updated with a decal to include the new DOE website address. However, the entrance sign was knocked over during firefighting efforts following the initial inspection. The entrance sign was attached to the nearby perimeter fence and was still legible. It was slightly bent and will be replaced after the post has been reset by the grazing licensee.

A tubular metal entrance gate was secured by a locked chain and was intact. Three 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. No maintenance needs were identified.

2.4.1.2 Perimeter Fence and Perimeter Signs

A four-strand barbed-wire fence was installed in 1999 along the site perimeter to demarcate DOE property and to control grazing on the property. The fence truncates the southeast corner to allow livestock access to a preexisting stock pond. The fence was intact. The two warning or perimeter signs, located next to access gates, were present and legible (PL-1). A grazing license granted by DOE allows a local rancher to graze his cattle on the site; in return, the rancher monitors site security and maintains the perimeter fence.

During the follow-up inspection after the wildfire, the contractor site lead met with the grazing licensee and discussed conditions. A 12-foot section of fence near the main entrance had been damaged during the firefighting efforts. The licensee had no concerns and stated he would reset the entrance signpost and repair the fence damage near the sign.

2.4.1.3 Site Marker

The granite site marker identifying the site is just inside the entrance gate and was stable and legible (PL-2, PL-3).

2.4.1.4 Boundary Monuments

Boundary monuments are at each of the four corners of the property. The observed monuments were present and stable. During the post-fire inspection, all monuments were inspected (except the northeast corner) and were in stable condition.

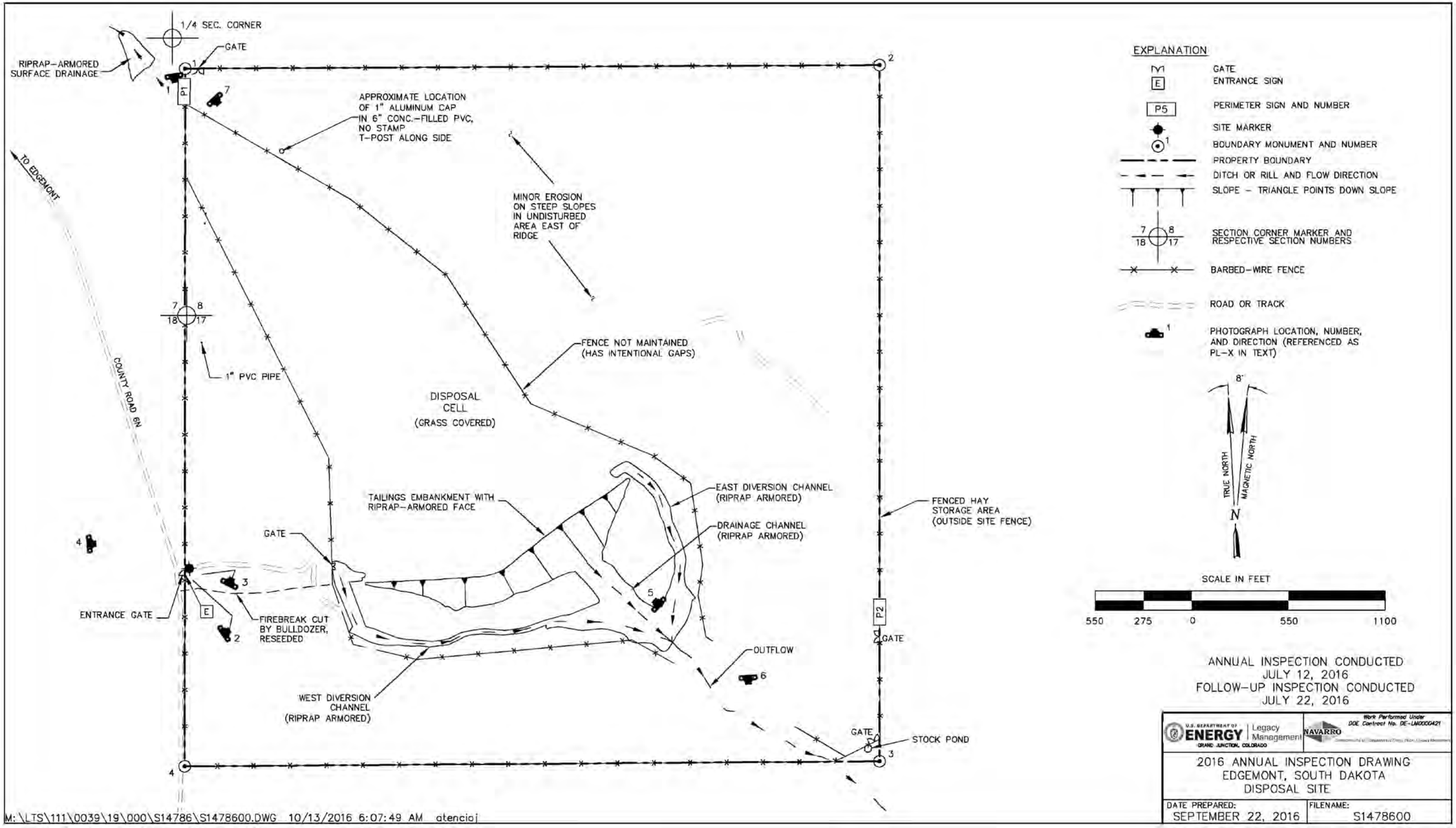

Figure 2-1. 2016 Annual Inspection Drawing for the Edgemont, South Dakota, Disposal Site

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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 tailings impoundment; (2) the containment dam and diversion channels; (3) the region between the disposal cell and the site perimeter, and the outlying area.

Within each area, inspectors examined the specific site surveillance features. Inspectors also looked for evidence of erosion, settling, slumping, or other disturbances that might affect the site's integrity, protectiveness, or long-term performance.

2.4.2.1 Cover of the Tailings Impoundment

The 100-acre top of the disposal cell, completed in 1989, is grass-covered and was stable and functional before the wildfire. No signs of erosion, settling, or other modifying processes that might affect the integrity of the cell were noted.

After the wildfire, which burned most of the vegetation except for the areas within the riprap diversion channels (PL-4), the ground was examined to determine the depth of fire damage. In all areas examined, the roots appeared healthy, indicating the fire had moved very rapidly. The rancher agreed with this observation, stating that it was a very fast-moving fire due to the wind.

2.4.2.2 Containment Dam and Diversion Channels

The tailings embankment face, the steepest man-made slope onsite, is covered with riprap and was intact and stable (PL-5). The riprap showed no signs of degradation. Scattered plants, mostly grass and annual weeds, grow in the riprap. These plants do not threaten the stability or function of the embankment face.

Diversion and drainage channels are normally 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. The grass-covered swales burned off, but vegetation between the rock embankment and the diversion channels was protected by the riprap, which acted as a firebreak. The drainage channels were intact and stable. 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. Precipitation runoff is pooling, and wetland vegetation is present at the base of the diversion channels.

2.4.2.3 Region Between the Disposal Cell and the Site Perimeter, and Outlying Areas

The area between the disposal cell and the site perimeter 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.

The site is surrounded by private land used primarily for grazing and wildlife habitat. The area approximately 0.25 mile beyond the site boundary was inspected from within the boundary fence. A surface drainage area just outside the northwest corner of the property is riprap-armored to prevent headward erosion onto the site; it was stable and in good condition. There was no evidence of activity or changes in land use that could affect the site.

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.

DOE was notified of the fire by the grazing licensee on July 19, a follow-up inspection was conducted at the site on July 22, following the July 17 wildfire. Conversations with the licensee indicated site features such as fencing and signage may have been damaged, and construction of the firebreak may have damaged site features. During the site visit on July 22, numerous photographs were taken to document the condition of the site, and a portion of the embankment and perimeter were hiked to verify that the engineered structures were indeed intact. A summary report of the follow-up inspection was transmitted to the NRC project manager.

The steel wire perimeter fence was not damaged except for a short section near the entrance gate, which was repaired by the grazing licensee. The perimeter signs mounted on the fence were undamaged. The only fire-related damage requiring repair was caused by construction of the firebreak. The firebreak is approximately 20 feet wide and extends from the entrance gate to the inner fence near the west drainage channel, but it does not go east of the inner fence, as noted on Figure 2-1. This section was reseeded and regraded by the licensee. The entrance signpost was knocked over and will be reset by the licensee, with a new sign installed. All engineered structures, such as the embankment and diversion channels, were undamaged.

Wildfires are a normal part of the prairie ecology and are beneficial in maintaining a healthy level of vegetation (PL-6). New vegetation was sprouting when ecologists visited the site in September 2016 (PL-7). The areas affected by this wildfire will be monitored, mainly for possible soil erosion, and evaluated to determine what types of plants respond quickly for a complete recovery.

2.6 Routine Maintenance and Emergency Measures

No maintenance needs were identified during the annual inspection. Several items resulting from the wildfire, as noted above, will be repaired by the grazing licensee. An ecology visit was conducted in September that focused on the reseeding and regrading efforts rather than the noxious weed control that was planned.

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 there is a 300- to 700-foot-thick layer of competent shale bedrock lying 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. The vegetation across the site was stable during the annual inspection and will be monitored for recovery from the fire. There were approximately 100 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	Description
PL-1	175	Wire Gate and Perimeter Sign P1 Near Northwest Corner of Site, July 22, 2016
PL-2	60	Granite Site Marker July 12, 2016
PL-3	30	Granite Site Marker July 22, 2016
PL-4	90	Tailings Embankment and Diversion Channels, Looking East, July 22, 2016
PL-5	315	Drainage Channel and Embankment, July 12, 2016
PL-6	180	Jackrabbit Observed on July 22, 2016
PL-7	180	Vegetation Regrowth Observed on September 6, 2016

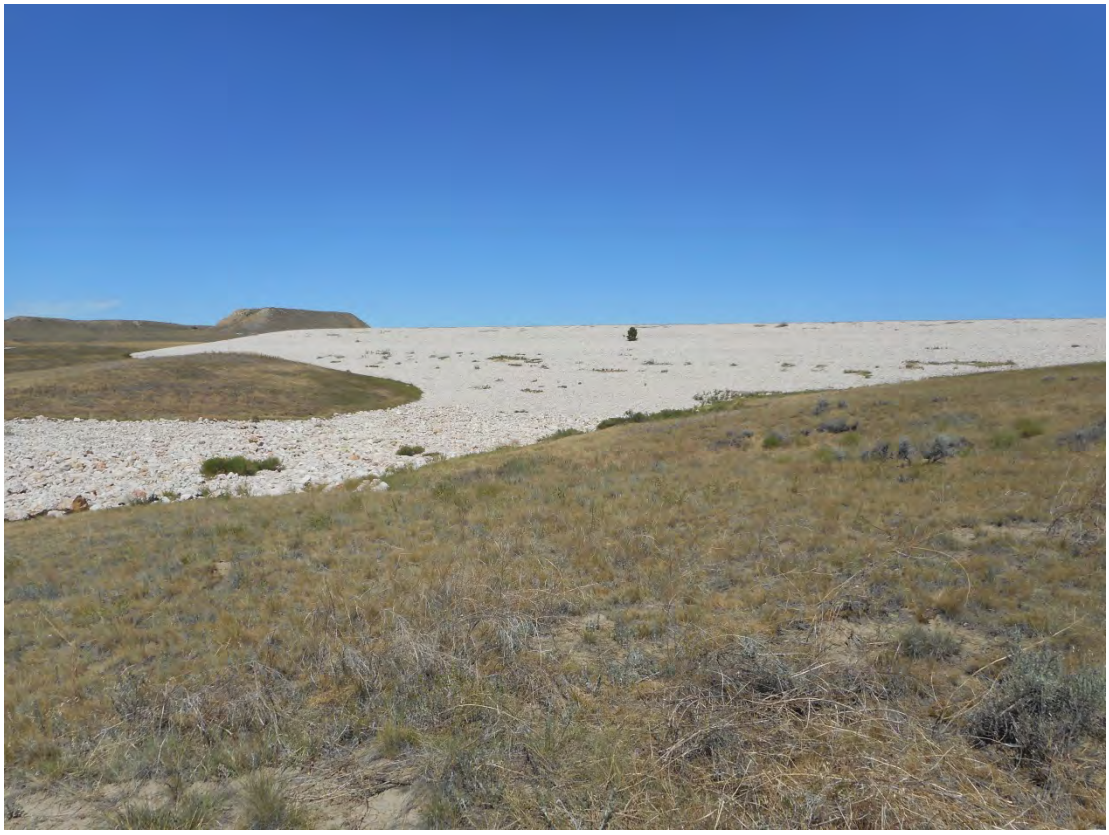
This report includes photos taken during the annual inspection on July 12, during a July 22 follow-up inspection after a July 17 wildfire had burned off most of the site's vegetation, and during the September 6 ecological site visit.

PL-1. Wire Gate and Perimeter Sign P1 Near Northwest Corner of Site, July 22, 2016

PL-2. Granite Site Marker July 12, 2016

PL-3. Granite Site Marker July 22, 2016

PL-4. Tailings Embankment and Diversion Channels, Looking East, July 22, 2016



PL-5. Drainage Channel and Embankment, July 12, 2016

PL-6. Jackrabbit Observed on July 22, 2016

PL-7. Vegetation Regrowth Observed on September 6, 2016

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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 August 23, 2016. There were no observed changes in the disposal cell or associated surface water diversion structures. 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 decreased slightly since 2015 due to a drier growing season in 2016. Groundwater was sampled in late 2016 and results will be reported and discussed in the 2017 site annual compliance report.

A broken fence strand was repaired during the inspection. Above-average rainfall during summer and fall 2015 resulted in substantial gully erosion along some sections of perimeter fence and next to an access road. The perimeter fence was realigned at two locations in September 2016 to avoid being damaged by further gully erosion. Culvert installation and road grading were conducted in September 2016 to avoid damage to the access road. Inspectors identified no other maintenance needs or cause for a follow-up inspection.

3.2 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 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	Long-Term Surveillance Plan	This Report
Annual Inspection and Report	Section 3.3 and 3.4	Section 3.4
Follow-up Inspections	Section 3.5	Section 3.5
Routine Maintenance and Emergency Measures	Section 3.6	Section 3.6
Environmental Monitoring	Section 3.7	Section 3.7

3.3 Institutional Controls

The 738-acre site, identified by the property boundary shown in Figure 3-1, is owned by the United States of America 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. Physical institutional controls at the site that are inspected annually consist of the disposal cell and associated diversion channels, the entrance gate, the perimeter fence, entrance and perimeter 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 August 23, 2016. The inspection was conducted by R. Johnson, T. Jasso, M. Kastens, and D. Marshall of the DOE Legacy Management Support contractor. 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 site integrity, 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 surveillance features. 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 on Figure 3-1 by photograph location (PL) numbers.

3.4.1.1 Site Access and Entrance Gate

The site is accessed via 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 for 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 (PL-1). No maintenance needs were identified.

3.4.1.2 Fence and Perimeter Signs

A barbed-wire stock fence encompasses the disposal cell and associated drainage structures and is intended to prohibit trespassing and livestock intrusion on the disposal cell structures. 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.

A broken fence strand near perimeter sign P19 was repaired during the inspection (PL-2). The section of fence between perimeter signs P3 and P10 is affected by deep gullies and areas of sediment accumulation, potentially providing access points for livestock to enter the site. This section of fence was difficult to maintain because of continuing erosion and steep terrain, so the fence was realigned along the east site access road in September 2016 (PL-3). Another section of fence near perimeter sign P25 was also be realigned in September 2016 to avoid an active gully at that location. No other maintenance needs were identified.

The entrance sign is located on the main site access road near the site marker. It has several bullet holes but was legible (PL-4). Thirty-four warning or perimeter signs are attached to the barbed-wire fence that surrounds the disposal site structures. No maintenance needs were identified.

3.4.1.3 Site Marker and Boundary Monuments

The site has one granite site marker, which is located north of the disposal cell adjacent to the site access road (PL-5). No maintenance needs were identified.

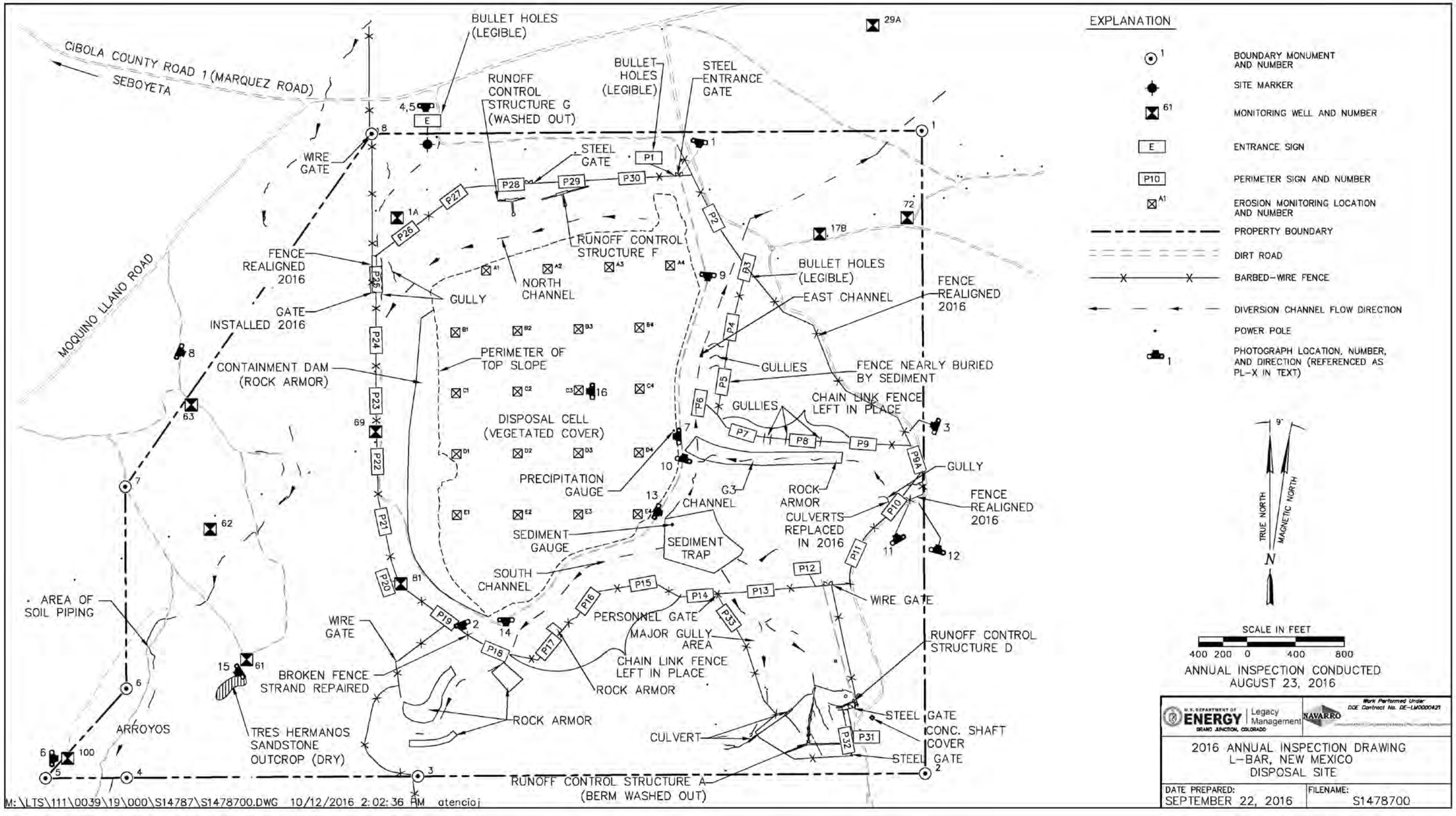

Figure 3-1. 2016 Annual Inspection Drawing for the L-Bar, New Mexico, Disposal Site

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Eight flush-mounted boundary monuments define the site boundary; some are set in concrete, and some consist of aluminum caps on rebar driven into the ground. All of the boundary monuments were inspected in spring 2016. No maintenance needs were identified.

3.4.1.4 Monitoring Wells

The site groundwater-monitoring network consists of 10 wells. Nine of the wells are located on DOE property; monitoring well 29A is located outside the northeast corner of the site. The wellhead protectors were undamaged and locked (PL-6). 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 tailings impoundment (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 also looked for evidence of erosion, settling, slumping, or other disturbances that might affect the site's integrity, protectiveness, or long-term performance.

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. 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 sediment and as perennial vegetation continues to establish.

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 tailings impoundment during mill operations was constructed by damming the head of a natural drainage basin. The face of the earthen containment dam has a 20% slope and is rock-armored to prevent erosion and degradation. Large-diameter rock was used to protect the central portion of the containment dam where runoff from the disposal cell surface would spill (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 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 diversion channel. The east channel is separated from the disposal cell by a dike that serves as an onsite access road (PL-9). Gullies are present along the east slope of the east channel, but the erosion and sediment deposition are not impairing the function of the channel. The east channel was dry at the time of the inspection (PL-10).

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 is not impairing the function of the channel, but a gully developed in 2015 that had encroached to the edge of the east site access road (PL-11). In September 2016, DOE installed new culverts and regraded the road to control erosion of the access road (PL-12).

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-13).

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 January 2010. Runoff from a storm event in September 2011 overtopped an earthen runoff control berm and caused substantial damage to the berm. Repairs are not planned at this time because erosion from this area is not impacting the integrity of the disposal cell.

Runoff water from the area north of the disposal cell is captured by the north diversion 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 January 2010 to reduce erosion and sedimentation. The east structure (Structure F) was stable and functional at the time of the inspection. The west structure (Structure G), however, suffered severe erosion during runoff events in August and September 2011 and continues to erode. Repairs are not planned at this time because erosion from this area is not currently impairing the function of the diversion channel or the integrity of the disposal cell.

The south diversion channel diverts storm runoff from the higher terrain immediately south of the disposal cell toward the channel outlet to the west. Two riprap aprons are present on the north-facing slope (south bank) to inhibit erosion along natural drainage paths (PL-14). Minor erosion is occurring on the unprotected slope surfaces, resulting in sediment accumulation in the channel. The erosion and sediment deposition are not impairing the function of the 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 are occurring on properties adjacent to the site. These activities have not been detrimental to site security.

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 impoundment, and the outcrop is considered a potential evapotranspiration area. There was no indication of seepage or evaporation at the outcrop (PL-15). 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 mine structures.

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.

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

A broken fence strand was repaired during the inspection. Sections of fence impacted by gully erosion were realigned in September 2016. Culvert installation and road grading was conducted on a site access road in September 2016 to avoid damage caused by gully encroachment. 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

Groundwater monitoring at the site occurs every three years and is scheduled for late 2016. At the time of this report the groundwater sampling had not yet occurred. Results of the 2016 sampling event will be provided in the 2017 annual compliance report. Monitoring well protectors are inspected to confirm they are undamaged and locked.

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 alternate abatement standards for groundwater at the site.

The cover of the disposal cell consists of a 4.1-foot-thick (minimum) compacted layer of clay to function as a radon barrier, which 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 annual site inspection on August 23, 2016.

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 on Figure 3-1. The locations were initially measured in December 2003 to establish a baseline data set.

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 such 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.

Erosion measurement is accomplished by placing a 4-foot-long level centered at the base of the rebar such 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. 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.

Results of the 2016 measurements are presented in Table 3-2. 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 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 3-2. Surface Elevation Changes on the L-Bar, New Mexico, Disposal Cell Cover Between 2003 and 2016

Monitoring Location	Length of Rebar Above Surface (inches)				Change in Surface Elevation[a] Baseline to Present (decimal inches)
	2003 (Baseline)		2016		
	(fraction)	(decimal)	(fraction)	(decimal)	
A1	12 10/16	12.625	10 15/16	10.938	1.687
A2	12 7/16	12.438	12 0/16	12.000	0.438
A3	12 15/16	12.938	11 15/16	11.938	1.000
A4	12 6/16	12.375	11 8/16	11.500	0.875
B1	12 10/16	12.625	10 15/16	10.938	1.687
B2	12 8/16	12.500	12 1/16	12.063	0.437
B3	13 0/16	13.000	12 8/16	12.500	0.500
B4	12 15/16	12.938	12 0/16	12.000	0.938
C1	12 8/16	12.500	10 15/16	10.938	1.562
C2	13 1/16	13.063	12 7/16	12.438	0.625
C3	12 2/16	12.125	11 2/16	11.125	1.000
C4	12 6/16	12.375	11 10/16	11.625	0.750
D1	12 7/16	12.438	11 12/16	11.750	0.688
D2	12 12/16	12.750	11 9/16	11.563	1.187
D3	12 3/16	12.188	11 1/16	11.063	1.125
D4	12 12/16	12.750	12 8/16	12.500	0.250
E1	13 1/16	13.063	12 3/16	12.188	0.875
E2	12 14/16	12.875	12 4/16	12.250	0.625
E3	12 9/16	12.563	11 12/16	11.750	0.813
E4	12 15/16	12.938	12 9/16	12.563	0.375

Notes:

[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. 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 (PL-16).

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;

then, 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 2016 measurements, compared with the 2013, 2014, and 2015 measurements, are presented in Table 3-3. Four of the 10 plots contained more than 20% perennial foliar cover in 2016 (five plots contained more than 20% perennial foliar cover in 2015). The overall slight decrease in plant cover from 2015 to 2016 is likely due to the drier growing season in 2016. Annual vegetation monitoring will continue until six or more plots meet or exceed the 20% foliar cover requirement.

Table 3-3. Comparison of Perennial Plant Cover on the L-Bar, New Mexico, Disposal Cell Cover from 2013 Through 2016

Plot Location	Percent Perennial Plant Cover in 100-feet^2 Plots			
	2013	2014	2015	2016
A1	12	10	30	34
A3	7	8	11	10
B2	0	0	0	0
B4	13	8	21	20
C1	7	16	27	20
C3	2	1	2	2
D2	9	7	1	0
D4	1	3	14	18
E1	5	25	34	65
E3	6	5	23	15

In addition to estimating the cover of live plants, litter (organic detritus often consisting of dead annual plants), rock, bare ground, and plant species also were recorded. Perennial plant species that have been observed within the monitoring plots include broom snakeweed (*Gutierrezia sarothrae*), rubber rabbitbrush (*Ericameria nauseosa*), fourwing saltbush (*Atriplex canescens*), Indian rice grass (*Achnatherum hymenoides*), bottlebrush squirreltail (*Elymus elymoides*), James' galleta grass (*Pleuraphis jamesii*), Nelson's globemallow (*Sphaeralcea parvifolia*), Bigelow's tansyaster (*Machaeranthera bigelovii*), silverleaf nightshade (*Solanum elaeagnifolium*), white heath aster (*Symphyotrichum ericoides*), spreading fleabane (*Erigeron divergens*), and goosefoot (*Chenopodium sp*.).

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	190	Entrance Gate
PL-2	160	Repaired Fence
PL-3	290	New Fence Along East Site Access Road
PL-4	180	Entrance Sign
PL-5	180	Site Marker
PL-6	90	Monitoring Well 100
PL-7	270	Vegetation on Disposal Cell Cover (Revegetated Area in Foreground)
PL-8	115	Containment Dam (Spillway in Center)
PL-9	185	Dike Road Along East Channel
PL-10	15	East Channel (Dry)
PL-11	330	Encroaching Gully Along East Access Road
PL-12	15	New Culvert Across East Site Access Road
PL-13	110	Sediment Trap (Dry)
PL-14	180	Rock-Armored Slope Along South Channel
PL-15	240	Potential Seep Area at Tres Hermanos Sandstone Outcrop
PL-16	270	Erosion Monitoring Plot and Vegetation Plot C3

PL–1. Entrance Gate

PL–2. Repaired Fence

PL–3. New Fence Along East Site Access Road

PL–4. Entrance Sign

PL–5. Site Marker

PL–6. Monitoring Well 100

PL–7. Vegetation on Disposal Cell Cover (Revegetated Area in Foreground)

PL–8. Containment Dam (Spillway in Center)

PL–9. Dike Road Along East Channel

PL–10. East Channel (Dry)

PL–11. Encroaching Gully Along East Access Road

PL–12. New Culvert Across East Site Access Road

PL–13. Sediment Trap (Dry)

PL–14. Rock-Armored Slope Along South Channel

PL–15. Potential Seep Area at Tres Hermanos Sandstone Outcrop

PL–16. Erosion Monitoring Plot and Vegetation Plot C3

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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 18, 2016. The small, shallow depression (Depression No. 1) on top of the disposal cell remains approximately the same size (approximately 25 feet long, 15 feet wide, and 1 foot deep). A second smaller depression (Depression No. 2) appears to be developing just west of the first. Neither depression currently threatens the integrity or performance of the cell; monitoring of the depressions will continue. Minor damage to the perimeter fence was noted; however, the fence remains functional. Perimeter sign 9 was missing and will be replaced. Boundary monuments BM-3 and BM-6 could not be located; further investigation is needed to determine if these two monuments, which help to define the 20-foot offsets that occur along both the north and south boundaries, actually exist. Noxious weeds present on the site were treated with herbicide. Inspectors identified no other maintenance needs or cause for a follow-up inspection.

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 that 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	Long-Term Surveillance Plan	This Report
Annual Inspection and Report	Sections 3.3 and 3.4	Section 4.4
Follow-up Inspections	Section 3.5	Section 4.5
Routine Maintenance and Emergency Measures	Section 3.6	Section 4.6
Environmental Monitoring	Section 3.7	Section 4.7

4.3 Institutional Controls

The 180-acre site, identified by the property boundary shown in Figure 4-1, is owned by the United States of America 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. Physical institutional controls at the site that are inspected annually consist of the disposal cell, the entrance gate, a site marker, the perimeter fence, entrance and perimeter signs, and boundary monuments.

4.4 Inspection Results

The site, approximately 4 miles north-northeast of the town of Maybell in Moffat County in northwestern Colorado, was inspected on August 18, 2016. The inspection was conducted by S. Hall and T. Jasso of the DOE Legacy Management Support contractor. J. Nguyen (DOE Site Manager) and M. Cosby (Colorado Department of Public Health and Environment) participated in 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 site integrity, and to determine the need, if any, for maintenance or additional inspections and monitoring.

4.4.1 Site Surveillance Features

The locations of site surveillance features are shown on Figure 4-1. 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 on Figure 4-1 by photograph location (PL) numbers.

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 past an abandoned open pit uranium mine known as Rob Pit for approximately 0.5 mile, 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 Maybell West UMTRCA Title II disposal site.

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. The gate was locked, and no maintenance needs were identified. There are no other gates at the site.

4.4.1.2 Fence, Entrance and Perimeter Signs

A standard four-strand barbed-wire stock fence surrounds 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. With the exceptions of a damaged fence post and the associated loose fence strands (PL-1) and erosion occurring along a short portion of the fence line, no maintenance needs were identified. Those fence repairs will be made when more significant repairs are needed; the fence remained functional. The entrance sign is mounted on a perimeter fence metal t-post directly south of the entrance gate (PL-2). The entrance sign remains legible. Ten warning or perimeter signs are mounted on perimeter fence metal t-posts around the site. Perimeter sign 9 was missing and will be replaced. The remaining perimeter signs remain legible.

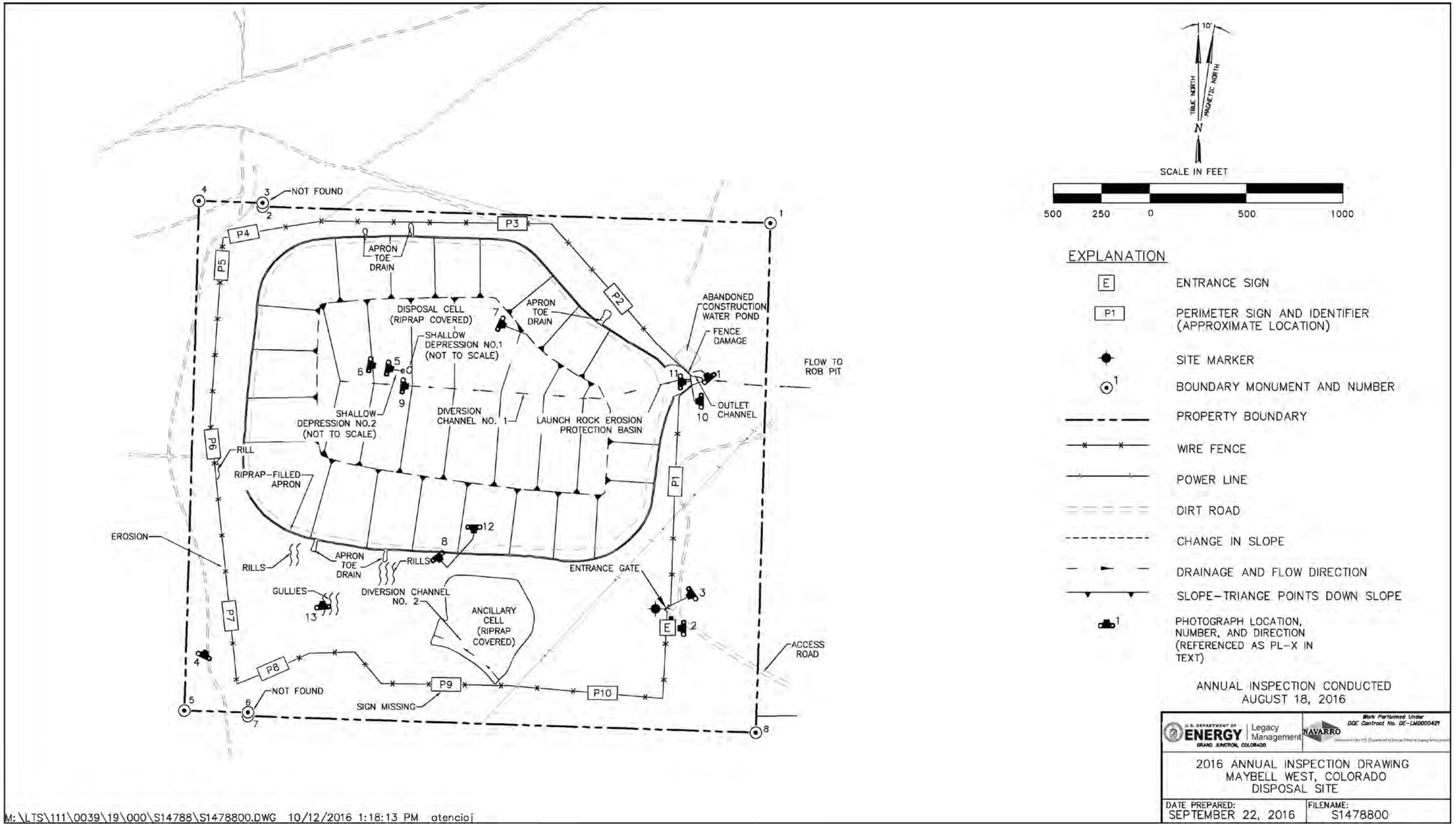

Figure 4-1. 2016 Annual Inspection Drawing for the Maybell West, Colorado, Disposal Site

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4.4.1.3 Site Marker and Boundary Monuments

One granite site marker is on the site near the entrance gate (PL-3). The site marker remains legible. Eight boundary monuments are on the site boundary outside of the fenced area. Four of the monuments are at the property corners, and the others define a 20-foot offset that occurs along both the north and south boundaries where the private land DOE acquired in fee adjoins the BLM withdrawal area on the western portion of the site. All of the boundary monuments were checked during the inspection with the exception of BM-3 and BM-6, which could not be located; further investigation is needed to determine if these two monuments, which assist in defining the 20-foot offsets, were installed. (Note: Preliminary review of as-built drawings and survey information indicates that a capped piece of rebar was installed at these two locations rather than standard boundary monuments; however, field verification is needed.)

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, balance of the site, and outlying area.

4.4.2.1 Top Slope of the Disposal Cell

The rock-covered disposal cell, a reclaimed former heap leach area that occupies about 60 acres of the site, rises to a maximum height of approximately 75 feet above the surrounding landscape (PL-4). No evidence of slumping, erosion, or rock degradation was observed. However, a small shallow depression (Depression No.1) is present just north of Diversion Channel No. 1 (PL-5). 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 cell. The depression was approximately the same size as noted during the last annual inspection, although a second smaller and shallower depression (Depression No.2) appears to be developing just west of the first (PL-6). 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 within either depression. The depressions currently do not cause significant ponding of water, prevent positive drainage of the cover, or threaten the integrity or performance of the disposal cell.

Various species of plants were present on the cell top. DOE will evaluate whether deep-rooted vegetation needs to be controlled on the cell cover. 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 covered with a 1-foot-thick layer of riprap (PL-7). Surface-water runoff from the side slopes is conveyed by an apron at the toe of the slope to five riprap-armored toe drains at low points in the apron. The apron and toe drains are constructed channels with a minimum depth of 2 feet and filled with riprap that has a minimum 12-inch-diameter rock size. Minor erosion has

occurred adjacent to a toe drain along the north side of the disposal cell, but that has not impacted the performance of the toe drain.

4.4.2.3 Ancillary Cell

The ancillary cell (PL-8) 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-8).

Various species of plants were present on the ancillary cell top (PL-8). Noxious weeds are controlled in accordance with the LTSP.

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 necessary surface-water drainage control and erosion protection necessary to satisfy the design longevity requirements.

The top slope of the cell was designed to drain surface-water runoff to the center and into riprap-armored Diversion Channel No. 1 (PL-9), which is graded toward and then down the east side slope of the cell (PL-10). Surface-water runoff ultimately discharges into Rob Pit east of the site (PL-11). An erosion protection structure, referred to as the launch rock erosion protection basin (PL-10), 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 (PL-11). Diversion Channel No. 2 runs along the south side of the ancillary cell to convey surface-water runoff away from the cell (PL-12). 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 main disposal cell to provide protection against erosion. Several gullies and rills have developed below this south slope but do not threaten the integrity of the disposal cell (PL-13). 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 appears to be effective at controlling head-cutting from these gullies and providing protection to the disposal cell.

4.4.2.5 Site Perimeter and Balance of the Site

Reclaimed surfaces at the site were planted with a mix of native and adaptive grasses to provide soil stability, and the vegetation continues to improve. Noxious weeds are controlled 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. For example, a resurgence of interest in uranium mining and processing or oil and gas exploration could lead to increased activity near

the site and an increased potential for site disturbance. The area outside the site boundary for 0.25 mile was visually inspected for erosion, development, changes in land use, or other phenomena that might affect the long-term integrity of the site. No such impacts were observed.

4.5 Follow-up Inspections

DOE will conduct follow-up inspections if (1) an annual inspection or other site visit reveals a condition that must be reevaluated during a return to the site, or (2) a citizen or outside agency notifies DOE that conditions at the site are substantially changed. No need for a follow-up inspection was identified during the inspection.

4.6 Routine Maintenance and Emergency Measures

Noxious weeds were treated with herbicide. Minor repairs to the perimeter fence will be made when more significant repairs are needed; the fence remains functional. Perimeter sign 9 was missing and will be replaced. 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 required.

4.7 Environmental Monitoring

Groundwater monitoring is not required at the site because 30 years of historical monitoring performed at the site by the former licensee indicated that groundwater has not been contaminated by site-related activities. Of the 30 years of monitoring, 23 were after mill operations ceased, and 10 years 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

Photo Location Number	Azimuth	Photograph Description
PL-1	320	Fence Damage East of Disposal Cell
PL-2	270	Entrance Sign
PL-3	235	Site Marker
PL-4	25	Southwestern Portion of Disposal Cell
PL-5	100	Measuring Depression No.1
PL-6	100	Depression No. 1 and No. 2 Marked by Pin Flags
PL-7	115	North Side Slope of Disposal Cell
PL-8	140	Top Slope of Ancillary Cell; Rock Berm South of Disposal Cell in Foreground
PL-9	95	Diversion Channel No. 1 on Top of Disposal Cell; View Downslope
PL-10	270	Launch Rock Erosion Protection Basin on East Side Slope of Cell
PL-11	90	Launch Rock Erosion Protection Basin Outlet; Rob Pit in Background
PL-12	180	Interface of Top and West Side Slope of Ancillary Cell; Outlet of Diversion Channel No. 2 in Background
PL-13	355	Gully Southwest of Disposal Cell; Looking Upslope

PL-1. Fence Damage East of Disposal Cell

PL-2. Entrance Sign

PL-3. Site Marker

PL-4. Southwestern Portion of Disposal Cell

PL-5. Measuring Depression No.1

PL-6. Depression No. 1 and No. 2 Marked by Pin Flags

PL-7. North Side Slope of Disposal Cell

PL-8. Top Slope of Ancillary Cell; Rock Berm South of Disposal Cell in Foreground

PL-9. Diversion Channel No. 1 on Top of Disposal Cell; View Downslope

PL-10. Launch Rock Erosion Protection Basin on East Side Slope of Cell

PL-11. Launch Rock Erosion Protection Basin Outlet; Rob Pit in Background

PL-12. Interface of Top and West Side Slope of Ancillary Cell; Outlet of Diversion Channel No. 2 in Background

PL-13. Gully Southwest of Disposal Cell; Looking Upslope

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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 18, 2016. There were no observed changes in disposal cell or site surveillance features except for one location at the base of the embankment. At that location, sand is washing out from under the protective rock cover and has created a small (2 feet wide × 8- to 12-inch deep) rill that extends approximately 50 feet back up the slope of the dam. The dam inspection and associated piezometer water-level measurements verified that the tailings dam is functioning as designed. Inspectors identified no other maintenance needs.

A follow-up inspection with engineering staff was performed on October 4 and 5, 2016, to further evaluate the observed erosion features. Both Washington Department of Health and Bureau of Indian Affairs participated in the follow-up inspection. Upon completion of the engineering evaluation, a report will be transmitted to the NRC detailing a summary of findings and if required, the proposed remedy for NRC approval. The follow-up inspection also assessed impacts from the August 22, 2015, forest fire which burned over a portion of the southeast section of the site. The fire did not spread over the disposal cell and only minor damage to a perimeter sign was observed.

During the 2015 inspection the U.S. Nuclear Regulatory Commission (NRC) inspector posed a question regarding the amount of settlement on the disposal cell. In response, following the May 2016 annual inspection, a survey team collected global positioning system (GPS) elevation data for locations on the surface of the disposal cell. Additional GPS data was collected in October 2016 which verified the May GPS data. Upon complete data evaluation, a report providing elevation values will be transmitted to the NRC. Initial data evaluation indicated either minor or no settlement has occurred on the disposal cell.

5.2 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 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	Long-Term Surveillance Plan	This Report
Annual Inspection and Report	Sections 3.3 and 3.4	Section 5.4
Follow-up Inspections	Section 3.5	Section 5.5
Routine Maintenance and Emergency Measures	Section 3.6	Section 5.6
Environmental Monitoring	Section 3.7	Section 5.7

5.3 Institutional Controls

The 380-acre site, identified by the property boundary shown in Figure 5-1, is owned by the United States of America, in trust for the Spokane Tribe of Indians. The site was accepted under the 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 for permanent right-of-access and long-term surveillance and maintenance, which lets DOE fulfill its custodial responsibilities required for UMTRCA Title II sites, was executed between the Tribe and DOE. Physical institutional controls at the site that are inspected annually consist of the disposal cell and drainage features, entrance and perimeter signs, site marker, boundary monuments, and monitoring wellhead protection.

5.4 Inspection Results

The site, near Wellpinit, Washington, was inspected on May 18, 2016. The inspection was conducted by D. Traub and L. Sheader of the DOE Legacy Management Support contractor. Support contractor D. Marshall and Spokane Tribal representatives R. Stephens and D. Wood 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 site integrity, 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 surveillance features. Inspection results and recommended maintenance activities associated with site surveillance features are presented in the following subsections. Photographs to support specific observations are identified in the text and on Figure 5-1 by photograph location (PL) numbers.

5.4.1.1 Site Access and Entrance Gates

The site and adjacent lands are part of the Spokane Indian Reservation. The U.S. Bureau of Indian Affairs maintains Elijah Road, the all-weather site road over which DOE has permanent right-of-access. Two double-swing steel gates across the road control access to the disposal site and the nearby Sherwood mill area and Tribe-owned facilities. Both gates were open at the time of the inspection.

5.4.1.2 Perimeter Signs

Six warning or perimeter signs, designated P1 through P6, are along the site boundary at likely access points around the site. The signs are attached to steel posts set in concrete. Vandalism of signs commonly occurs, including removal of signs or bullet damage. Text on signs may become illegible due to fading or bullet damage. Missing or illegible signs are replaced as necessary. All of the signs were present and legible, and no maintenance needs were identified (PL-1).

5.4.1.3 Site Marker and Boundary Monuments

One granite site marker is present on the southwest side of the site where the access road lies closest to the site boundary. Site marker was stable and legible. No maintenance needs were identified (PL-2).

Six boundary monuments set in concrete define the site boundary (PL-3). Boundary monument BM-3A, near the granite site marker, is bent but does not need to be repaired. Because surrounding vegetation had made it difficult to locate some of the monuments, metal t-posts were installed at each monument location. All boundary monuments were verified to be present and stable during the 2016 inspection (PL-3).

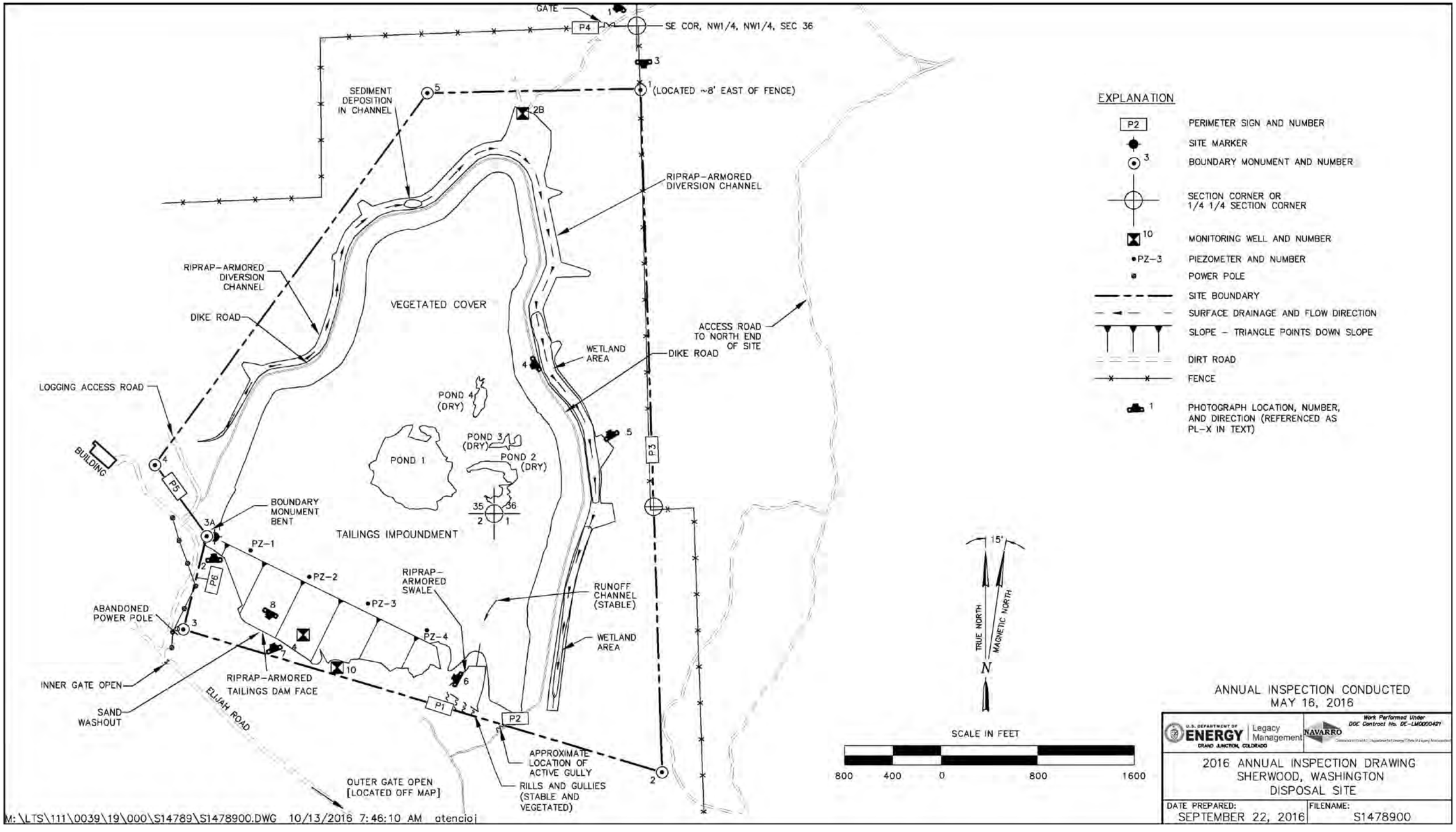

Figure 5-1. 2016 Annual Inspection Drawing for the Sherwood, Washington, Disposal Site

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5.4.1.4 Monitoring Wells and Piezometers

Three monitoring wells are on the site and are designated as MW-2B, MW-4, and MW-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 tailings dam at a depth equivalent to the base of the dam. All piezometer and monitoring wellhead protectors were undamaged and locked. No maintenance needs were identified.

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 cover of the tailings impoundment, (2) the containment dam and diversion channel, and (3) the site perimeter and outlying areas. Inspectors examined the specific site surveillance features within each area and also looked for evidence of erosion, settling, slumping, or other disturbances that might affect the site's integrity, protectiveness, or long-term performance.

5.4.2.1 Cover of the Tailings Impoundment

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

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

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 2015.

Designers of the 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 reclamation cover was designed to withstand up to 10 feet of settlement. The largest area of settlement is referred to as Pond 1. 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, were dry during the 2016 inspection. The shallow ponds are considered to be favorable features on the impoundment cover, but DOE will continue to monitor the surface for unusual settlement features to verify the cover's integrity and ensure that the impoundment is performing as designed.

During its inspection of the site in 2015, NRC requested a ground-level elevation survey to determine actual settlement values, rather than subjective evaluations. Following the May 2016 inspection, a survey team collected GPS elevation data for locations on the surface of the disposal cell. Additional GPS data was collected in October 2016 and was used to further confirm elevation data collected in May. Initial evaluation of the data indicates little to no

settlement has occurred on the disposal cell. Upon complete data evaluation, a report providing elevation values will be transmitted to the NRC. Initial evaluation of the data indicates only minor to no settlement has occurred on the disposal cell.

5.4.2.2 Containment Dam and Diversion Channel

A riprap-armored diversion channel surrounds the tailings impoundment and diverts runoff away from the cell surface. The channel was designed to allow trees to grow and stabilize the surfaces, and their presence in the channel is not expected to hinder the channel's ability to convey design flows (PL-5). The intrusion of volunteer plants, including trees, within the diversion channel is evident in most areas of the channel. Sediment deposition is found in places on the west leg of the diversion channel but does not interfere with the channel's design function. Upslope areas that have contributed to the sedimentation have stabilized with vegetation. Two permanent wetland areas have formed along the bottom of the east side of the channel due to seeps that are present in those areas. Wildlife, buffalo, and horse trails cross the 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 tailings impoundment.

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

Measurements of water levels in four piezometers atop the dam were obtained in May 2016, 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 dam. Steadily increasing water levels in any of the piezometers could indicate a potential problem with the performance of the dam. Measurements collected in May 2016 are provided in the Dam Inspection Checklist at the end of this report and do not indicate a steady 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. The lateral extent of the lens is unknown, but more than 200 feet of unsaturated material is beneath the PZ-2 perched zone. On the basis of the 2016 piezometer measurements, the tailings dam is considered to be in an unsaturated condition.

Table 5-2. 2016 Piezometer Water Depths

Piezometer	Total Depth of Piezometer (feet)[a]	Water Level (feet)[a]	Depth of Water (feet)
PZ-1	22.47	21.92	0.55
PZ-2	62.95	61.83	1.12
PZ-3	67.53	Dry	Dry
PZ-4	22.62	22.00	0.62

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

The tailings 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 prevent erosion. Consequently, the presence of this vegetation does not harm the function of the dam, and the dam will not be compromised if the rock cover eventually degrades. The dam face is thickly vegetated (PL-6).

During the 2016 annual inspection, one area at the base of the rock-covered dam face was found to have a fan of sand that had washed out from underneath the rock cover (PL-7, PL-8). A small rill could be traced from the 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 return visit to the site was performed on October 4 and 5 to evaluate the cause, extent, and repair of the erosion, if required. A report will be transmitted to the NRC upon completion of the engineering evaluation.

5.4.2.3 Site Perimeter and Outlying Areas

Ponderosa pine forest constitutes most of the area outside of the diversion channel. 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, a forest fire (Cayuse Mountain Fire), which covered more than 18,000 acres, occurred near the site. DOE confirmed the presence of the fire near the site and maintained communication with the State during the event. A report by the Washington Department of Health stated that the area surrounding Elijah Road, the access road to the site, was being heavily impacted by the fire, which had also spread up the eastern side of the site. It was later confirmed that the fire had burned the southeast corner of the site and a portion of the site east of the disposal cell. Although the fire posed no risk to the integrity of the disposal cell, concerns are focused on any maintenance activities, such as replacing damaged perimeter signs. A major concern with fires is the possibility that heavy rains afterward could wash burned trees, debris, or mudflows into diversion channels, creating blockages that cause flow patterns to change and allow water to flow onto the cell surface.

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 inspection with engineering staff on October 4 and 5, 2016, to evaluate the sand washout erosional feature. The tailings closest to the washout are approximately 800 feet away. This engineering evaluation by specialists was required to provide information needed to select a remedy. An engineering evaluation report is being completed and will be transmitted to the NRC detailing the summary of findings and if required, the proposed remedy for NRC approval. DOE also assessed impact from the August 22 forest fire which burned over portions of the southeast section of the site. The fire did not burn over the disposal cell and the only damage observed was a scorched perimeter sign which remained legible.

5.6 Routine Maintenance and Emergency Measures

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 required.

5.7 Environmental Monitoring

5.7.1 Groundwater Monitoring

Groundwater compliance monitoring is not required at the Sherwood 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 MW-2B north of the tailings impoundment and from downgradient wells MW-4 and MW-10 near the base of the tailings dam. Samples are analyzed for sulfate, chloride, and total dissolved solids. Sulfate and chloride are the primary indicator parameters.

Groundwater sampling was conducted on May 19, 2016, and the results are presented in Table 5-3. Groundwater constituent concentrations continue to be less than the action levels for confirmatory sampling, and no upward trends are apparent. These results demonstrate that leachate from the tailings impoundment has not entered site groundwater.

Table 5-3. 2016 Groundwater Quality Results for the Sherwood, Washington, Disposal Site

Constituent	Water Quality Criterion[a]	Background MW-2B	Downgradient MW-4	Downgradient MW-10
Chloride, mg/L	250	1.8	32	1.2
Sulfate, mg/L	250	3.4	140	32
TDS, mg/L	N/A	240	650	610

Notes:
[a] State of Washington water quality criteria used as action levels.

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

5.7.2 Vegetation Monitoring

The LTSP requires annual visual inspections of the cell's vegetated cover to ensure that it satisfies erosional stability criteria and is self-sustaining. Vegetation on the cell cover includes trees (primarily ponderosa pine), shrubs, and a mixture of native and introduced grasses and forbs. Herds of bison and horses are often managed onsite by the Spokane Tribe of Indians. No areas of concern, such as patterns of dead vegetation or erosional features, were identified during the 2016 annual inspection.

As in 2015, inspectors met with tribal ecologists 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.

5.8 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, Office of Legacy Management, February.

5.9 Photographs

Photograph Location Number	Azimuth	Description
PL-1	225	Perimeter Sign P4
PL-2	0	Granite Site Marker
PL-3	180	Boundary Monument BM-1
PL-4	240	Disposal Cell Surface from Dike Road, View to South-Southwest
PL-5	330	Diversion Channel, East Side of Dike Road, View to Northwest
PL-6	300	Face of Tailings Dam, View to West
PL-7	340	Erosion at Base of Dam, View to Northwest
PL-8	210	Erosion at Base of Dam, View to Southwest

PL-1. Perimeter Sign P4

PL-2. Granite Site Marker

PL-3. Boundary Monument BM-1

PL-4. Disposal Cell Surface from Dike Road, View to South-Southwest

PL-5. Diversion Channel, East Side of Dike Road, View to Northwest

PL-6. Face of Tailings Dam, View to West

PL-7. Erosion at Base of Dam, View to Northwest

PL-8. Erosion at Base of Dam, View to Southwest

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

Date of Inspection May 18, 2016

Inspector David Traub Organization Navarro Research and Engineering

Piezometer water levels measured during groundwater monitoring event May 19, 2016.
* All depths in feet. TOC is Top of Casing.

Piezometer PZ-1 fluid level (TOC to top of fluid): 21.92 Fluid amount: 0.55
Total depth 22.47

Piezometer PZ-2 fluid level (TOC to top of fluid) 61.83 Fluid Amount: 1.12
Total depth 62.95

Piezometer PZ-3 fluid level (TOC to top of fluid) Dry Fluid Amount: 0
Total depth 67.53

Piezometer PZ-4 fluid level (TOC to top of fluid) 22.00 Fluid Amount: 0.62
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? *Yes*
If yes discuss in report: *Sand is washing out from under the rock armored face of the cell at one location (see photos PL-7 and PL-8 in report). A small gully can be followed 50 feet back up the face and is from 8" to 12 deep, approximately 1 ½ to 2 feet wide. The closest tailings are some 800 feet away in the cell. A second trip to the site will be made to determine the cause, extent, and possible remedy.*

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:

Emergency Notification Contacts:

DOE Site Manager: Richard Bush (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 2016.06.15 12:31:03 -06'00' Date: _____

Revised September 2015

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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 July 14, 2016. There were no observed changes in the disposal cell or associated surface-water diversion and drainage structures. Inspectors identified no maintenance needs or cause for a follow-up inspection.

Groundwater monitoring indicates alternate concertation limits (ACLs) continue to be exceeded for radium-226 and radium-228. There is no risk to human health and the environment, and groundwater monitoring will continue in accordance with the Long-Term Surveillance Plan (LTSP).

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	Long-Term Surveillance Plan	This Report
Annual Inspection and Report	Section 3.3 and 3.4	Section 6.4
Follow-up Inspections	Section 3.5	Section 6.5
Routine Maintenance and Emergency Measures	Section 3.6	Section 6.6
Environmental Monitoring	Section 3.7	Section 6.7

6.3 Institutional Controls

The 1512-acre site, identified by the property boundary shown in Figure 6-1, is owned by the United States of America 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. Physical institutional controls at the site that are inspected annually consist of the disposal cell and associated diversion channels, the entrance gate, the perimeter fence, perimeter signs, a site marker, boundary monuments, and monitoring wellhead protectors.

6.4 Inspection Results

The site, approximately 35 miles south of Casper, Wyoming, was inspected on July 14, 2016. The inspection was conducted by R. Johnson, S. Hall, T. Jasso, and D. Traub of the DOE Legacy Management Support contractor. J. O'Connor of the Wyoming Department of Environmental Quality (WDEQ) 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 site integrity, and to determine the need, if any, for maintenance or additional inspections and monitoring.

6.4.1 Site Surveillance Features

Figure 6-1 shows the locations of site surveillance features. 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.

6.4.1.1 Site Access and Entrance Gate

Access to the site is immediately off Carbon County Road 2E and is unimpaired. No private property is crossed to gain site access.

The entrance gate is a barbed-wire gate in the stock 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 Fence and Perimeter Signs

A four-strand barbed-wire perimeter fence encompasses 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.

A segment of fence crossing the north end of Pit 4 is damaged. This damaged portion is not maintained because of steep slopes and recurring snow damage. The grazing licensee, in cooperation with the adjacent property owner, erected a solar-powered electric fence around the north rim of Pit 4 in 2007 to bypass the damaged section and to give cattle access to each side of the pit. Broken strands were observed near the southeast corner of the site; the grazing licensee was notified of the damage. No other maintenance needs were identified.

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 and P2 have bullet holes in them but remain legible. No maintenance needs were identified.

6.4.1.3 Site Marker and Boundary Monuments

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

Twenty-six boundary monuments delineate the site property boundary (PL-4). All of the monuments were observed during the inspection. No maintenance needs were identified.

6.4.1.4 Monitoring Wells

The site groundwater monitoring network consists of 14 wells; six of these wells were installed downgradient of the disposal cell in the fall of 2008. The wellhead protectors were undamaged and locked (PL-5). No maintenance needs were identified.

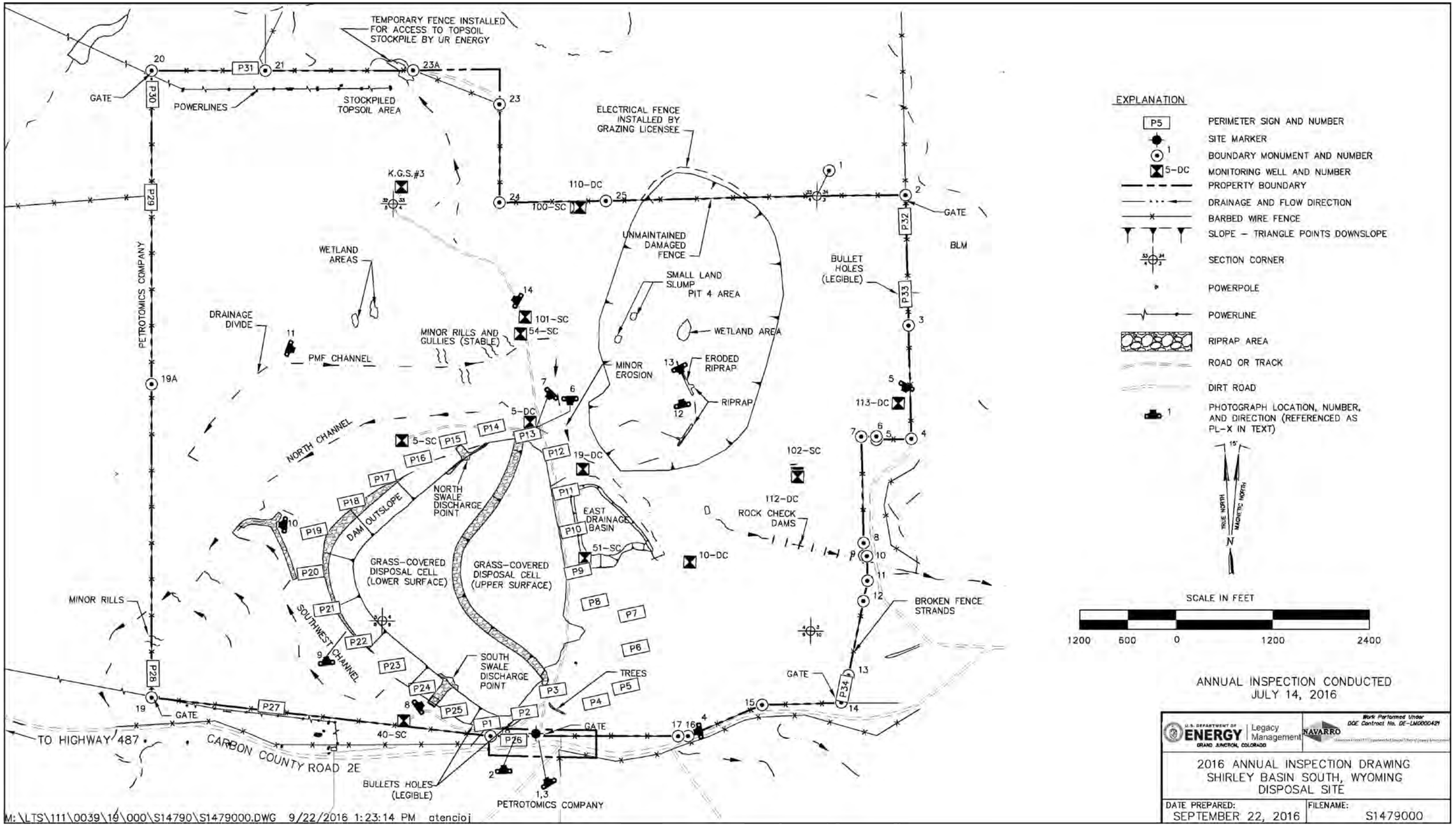

Figure 6-1. 2016 Annual Inspection Drawing for the Shirley Basin South, Wyoming, Disposal Site

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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 tailings impoundment, (2) the containment dam and diversion channels, and (3) the balance of the site and the site perimeter. Inspectors examined the specific site surveillance features within each area and also looked for evidence of erosion, settling, slumping, or other disturbances that might affect the site's integrity, protectiveness, or long-term performance.

6.4.2.1 Cover of the Tailings Impoundment

The tailings impoundment (disposal cell), completed in 2000, occupies approximately 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 surface and the lower surface—separated by a riprap-armored slope (PL-6 and PL-7). There were no indications 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, 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 eastern (upper) surface is contoured to drain into a basin east of the cell and west over the riprap-protected slope to the western (lower) surface. The lower surface is contoured to drain to the north and south at riprap-armored discharge points (PL-8). The riprap dissipation basins of the discharge points usually hold precipitation runoff water in spring and early summer. No maintenance needs were identified for the disposal cell features.

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-9). There were no indications 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 tailings dam and impoundment (PL-10). A probable maximum flood (PMF) channel was constructed north of the tailings impoundment along the side of the reclaimed mine-overburden spoil pile (PL-11). Part of the PMF channel drains to the southwest and discharges to a small closed basin. The portion of the PMF channel that flows eastward and discharges into the east drainage basin captures Stormwater from a larger drainage area. The east basin was dry at the time of the inspection. These closed drainage basins are large enough to accommodate PMF water volumes. No maintenance needs were identified.

6.4.2.3 Balance of the Site, Site Perimeter, and Outlying Area

The other major feature on the site is reclaimed Pit 4, 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-12); 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 rock-armored drainage channel near the bottom of the pit has eroded (PL-13). Repair of the displaced rock 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. 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 fence replacement, when it has finished removing topsoil from the stockpile. No stockpiled topsoil has been removed.

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 the well for livestock watering purposes and to install watering facilities and solar-powered electric fences to manage the livestock (PL-14).

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 during the inspection.

6.6 Routine Maintenance and Emergency Measures

Broken fence strands will be repaired by the grazing licensee. 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.

6.7 Environmental Monitoring

Groundwater monitoring is required at the Shirley Basin South site. The monitoring network, as described in the LTSP in 2004, consisted of eight wells in the uppermost aquifer at the site, which consists of two sand units in Wind River Formation. In consultation with NRC, DOE installed six additional monitoring wells in fall 2008 to provide a better understanding of the groundwater chemistry and flow directions of the two zones of the uppermost aquifers. DOE evaluated the monitoring requirements and sampling results and proposed revisions to the monitoring program to NRC in August 2013. NRC directed DOE to continue monitoring in accordance with the LTSP. The current monitoring network is described in Table 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

Abbreviations: POC = point of compliance

Water level, pH, and electrical conductivity are measured at the time of sampling, and the samples are analyzed for cadmium, chloride, chromium, lead, nickel, nitrate, radium-226, radium-228, 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 wells to evaluate flow direction as the upper aquifers recover from mining and reclamation activities.

The intent of the 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.

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

Notes:
[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 results for cadmium in POC well 5-SC and radium-228 in POC well 5-DC exceeded their respective ACLs in DOE's initial sampling in July 2005. The 2005 radium-228 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 radium-228 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, which occurred after installation of the new wells, was conducted in July 2009 and indicated that radium-226 exceeded the ACL in new downgradient well 110-DC near the north site boundary. NRC and WDEQ were notified of the exceedance, and DOE began to evaluate the cause of the exceedance.

Analytical results for the July 2016 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.

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 both wells 54-SC and well 5-DC (Figure 6-2). Additionally, the ACL for radium-226 continues to be exceeded in well 110-DC (Figure 6-3).

Although radium-228 concentrations are elevated in two of the wells, they are less than the peak concentrations measured in these wells in the early 1990s during site groundwater remediation activities. Radium-228 is a decay product of thorium-232, which is highly immobile. Because the half-life of radium-228 is relatively short, the thorium-232 source must be near the wells of concern. DOE attributes the cause of elevated radium-226 and radium-228 in the site wells to natural mineralization in the aquifers, rather than concluding it is evidence of diminished cell performance or contaminant plumes migrating offsite. NRC considers it possible that the

elevated radium may represent leakage from the 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 an aquifer that is not impacted by former milling operations.

Table 6-4. 2016 Groundwater Monitoring Results in the Upper Sand Aquifer Wells at the Shirley Basin South, Wyoming, Disposal Site

Analyte (Limit or Standard)	5-SC (POC)	40-SC	51-SC (POC)	54-SC	100-SC	101-SC	102-SC
Cadmium (0.079 mg/L)	0.032	0.000055	NS	0.00032	ND	NS	0.00033
Chloride (2000 mg/L)	300	24	NS	340	180	NS	150
Chromium (1.83 mg/L)	0.25	0.00051	NS	0.29	ND	NS	ND
Lead (0.05 mg/L)	0.00016	0.00013	NS	0.00025	0.00015	NS	ND
Nickel (6.15 mg/L)	2.6	0.0099	NS	2.1	0.0028	NS	ND
Nitrate/Nitrite as N (mg/L)[a]	0.035	0.98	NS	ND	ND	NS	0.51
Radium-226 (91.3 pCi/L)	5.34	0.176	NS	10.3	4.48	NS	1.75
Radium-228 (25.7 pCi/L)	3.09	1.73	NS	99.5[b]	5.94	NS	2.76
Selenium (0.12 mg/L)	0.097	0.0052	NS	0.057	ND	NS	0.0014
Sulfate (3000 mg/L)	12,000[c]	1500	NS	8500[c]	1300	NS	750
Thorium-230 (2409 pCi/L)	416	ND	NS	8.79	0.224	NS	ND
TDS (5000 mg/L)	16,000[c]	2200	NS	12,000[c]	2300	NS	1500
Uranium (9.2 mg/L)	3.5	0.00011	NS	0.013	0.0034	NS	0.014

Notes:
[a] No designated limit or standard.
[b] Result exceeds an ACL.
[c] 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 well)
pCi/L = picocuries per liter

Table 6-5. 2016 Groundwater Monitoring Results in the Main Sand Aquifer Wells at the Shirley Basin South, Wyoming, Disposal Site

Analyte (Limit or Standard)	5-DC (POC)	10-DC	19-DC (POC)	110-DC	112-DC	113-DC
Cadmium (0.079 mg/L)	ND	ND	ND	ND	ND	ND
Chloride (2000 mg/L)	240	55	56	200	33	7
Chromium (1.83 mg/L)	ND	ND	ND	ND	ND	ND
Lead (0.05 mg/L)	0.00033	ND	ND	ND	ND	ND
Nickel (6.15 mg/L)	2	ND	0.41	ND	ND	ND
Nitrate/Nitrite as N (mg/L)[a]	ND	ND	ND	ND	0.01	0.059
Radium-226 (91.3 pCi/L)	6.97	15.2	4.88	125[b]	10.5	1.74
Radium-228 (25.7 pCi/L)	30.7[b]	5.11	5.79	7.97	5.71	2.95
Selenium (0.12 mg/L)	0.0091	ND	ND	ND	ND	ND
Sulfate (3000 mg/L)	12,000[c]	1000	2300	1900	1100	640
Thorium-230 (2409 pCi/L)	0.658	0.324	ND	ND	ND	ND
TDS (5000 mg/L)	18,000[c]	1800	3500	3400	1800	1100
Uranium (9.2 mg/L)	0.14	0.012	0.00016	0.0099	0.0093	0.00095

Notes:
[a] No designated limit or standard.
[b] Result exceeds an ACL.
[c] Result exceeds a Wyoming Class III groundwater protection standard.

Abbreviations:
mg/L = milligrams per liter
pCi/L = picocuries per liter

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; for radium-228 in wells 54-SC and 5-DC; and for radium-226 in well 110-DC. The 2016 results were within the range of historical measurements for these wells. The exceedances are found in wells near the disposal cell except for the radium-226 exceedance at well 110-DC. Well 110-DC is near a uranium ore deposit and the radium-226 concentration is around 17 times that of the upgradient POC well 5-DC. Therefore, the radium-226 in well 110-DC is probably naturally occurring.

Analytical results from well K.G.S. #3 confirm that the lower sand aquifer is hydraulically isolated from the overlying main sand aquifer. This conclusion is based on substantially lower concentrations of sulfate (230 milligrams per liter [mg/L]) and TDS (530 mg/L) in the lower sand aquifer compared to those in the main sand aquifer.

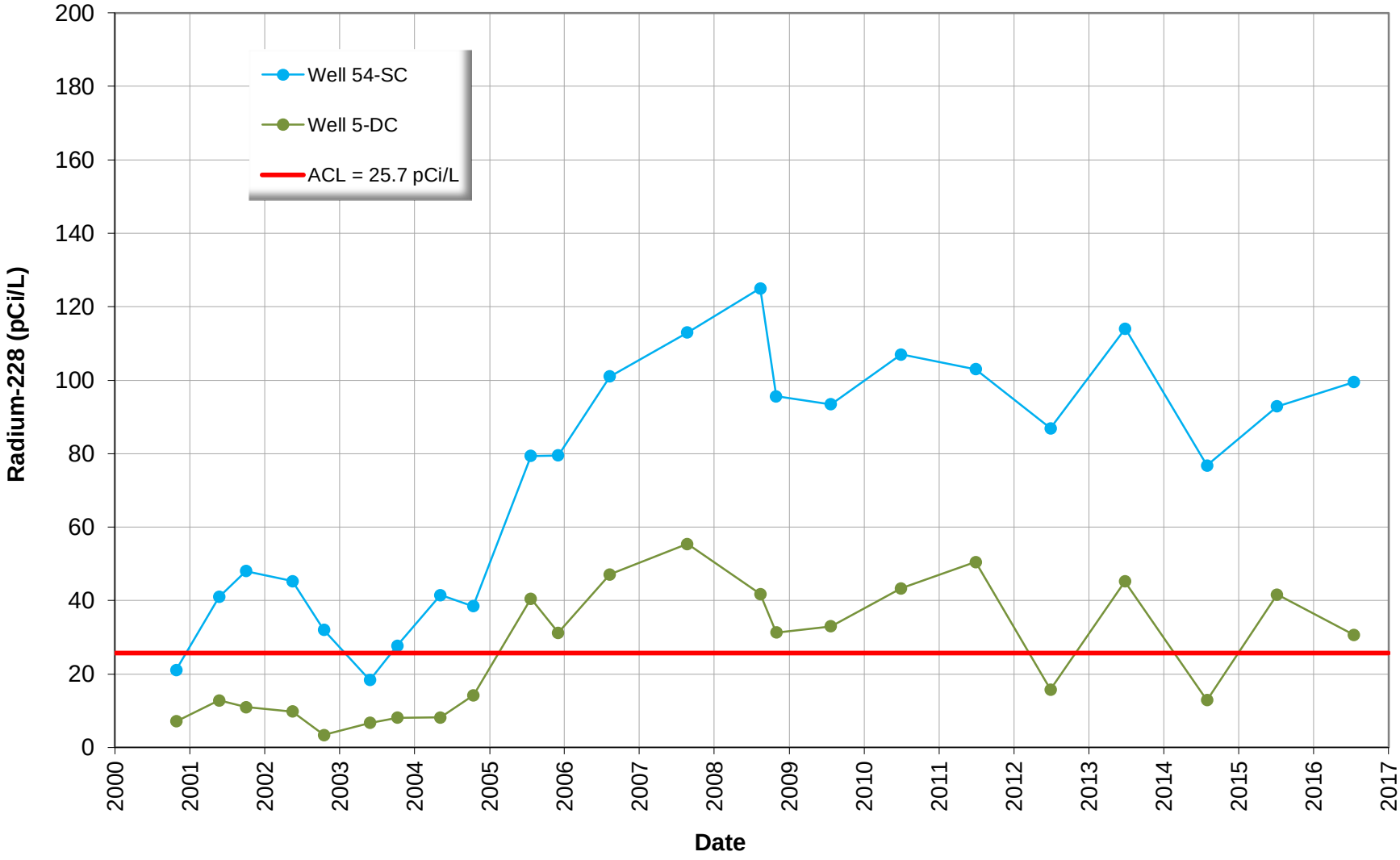


Figure 6-2. Radium-228 Concentrations in Wells 5-DC and 54-SC Since Completion of the Disposal Cell at the Shirley Basin South, Wyoming, Disposal Site

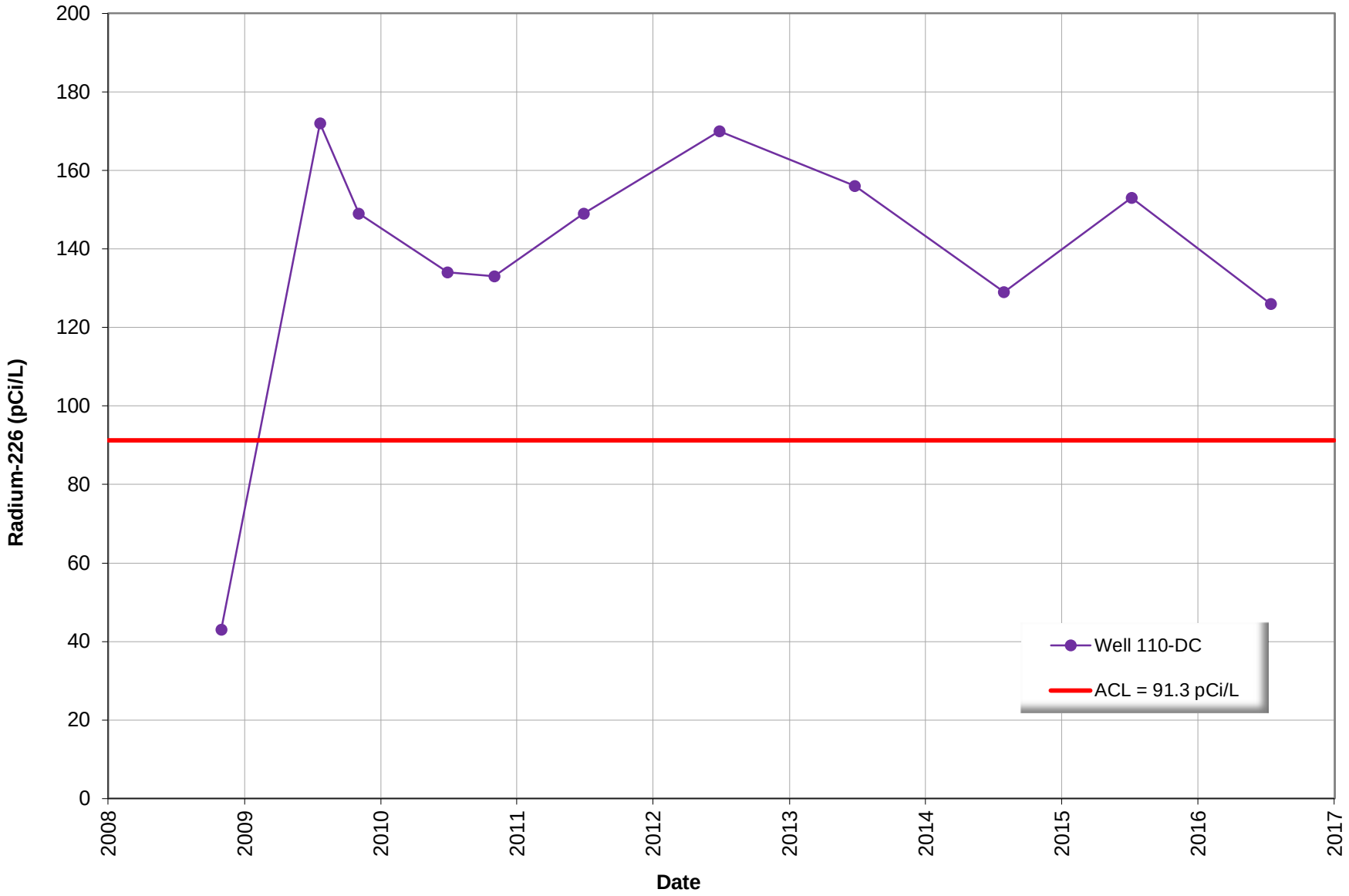


Figure 6-3. Radium-226 Concentrations in Well 110-DC at the Shirley Basin South, Wyoming, Disposal Site

The LTSP specifies that this report provide isoconcentration maps for uranium and sulfate in each aquifer. However, the well network does not provide sufficient data points to develop contour maps of the contaminant plumes. Instead, 2016 concentrations for uranium in the two aquifers are shown on Figures 6-4 and 6-5, and concentrations for sulfate are shown on Figures 6-6 and 6-7. 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 contour maps. 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, with the bottom of the pit being raised to an elevation above the projected recovered phreatic surface of the upper sand aquifer. The backfill operation did not recreate 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 on Figure 6-8. 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 Shirley Basin South site might be a groundwater sink, aquifer water levels on the Shirley Basin South site might never recover to their pre-mining elevations.

Main sand aquifer water elevations, shown on Figure 6-9, have been gradually rising at all wells since 2000, with an average rate of increase of approximately 0.7 foot per year since DOE began monitoring water levels in 2005 (Figure 6-10). The rising levels indicate a gradual recovery of the aquifer. However, the altered conditions at Pit 4 might prevent a return to pre-mining 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 Shirley Basin South site. Groundwater flow is generally toward the northeast.

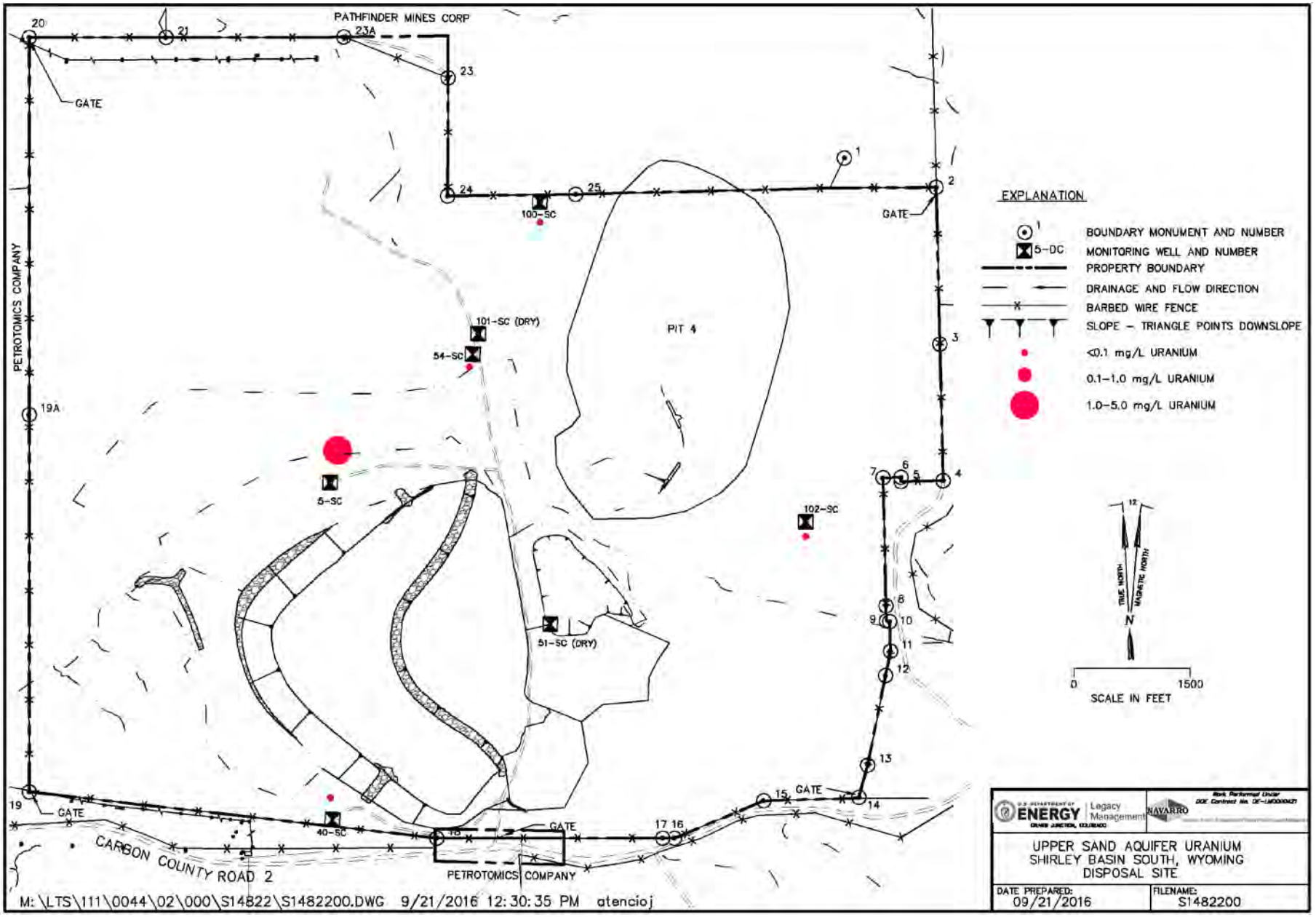


Figure 6-4. July 2016 Uranium Concentrations in the Upper Sand Aquifer at the Shirley Basin South, Wyoming, Disposal Site

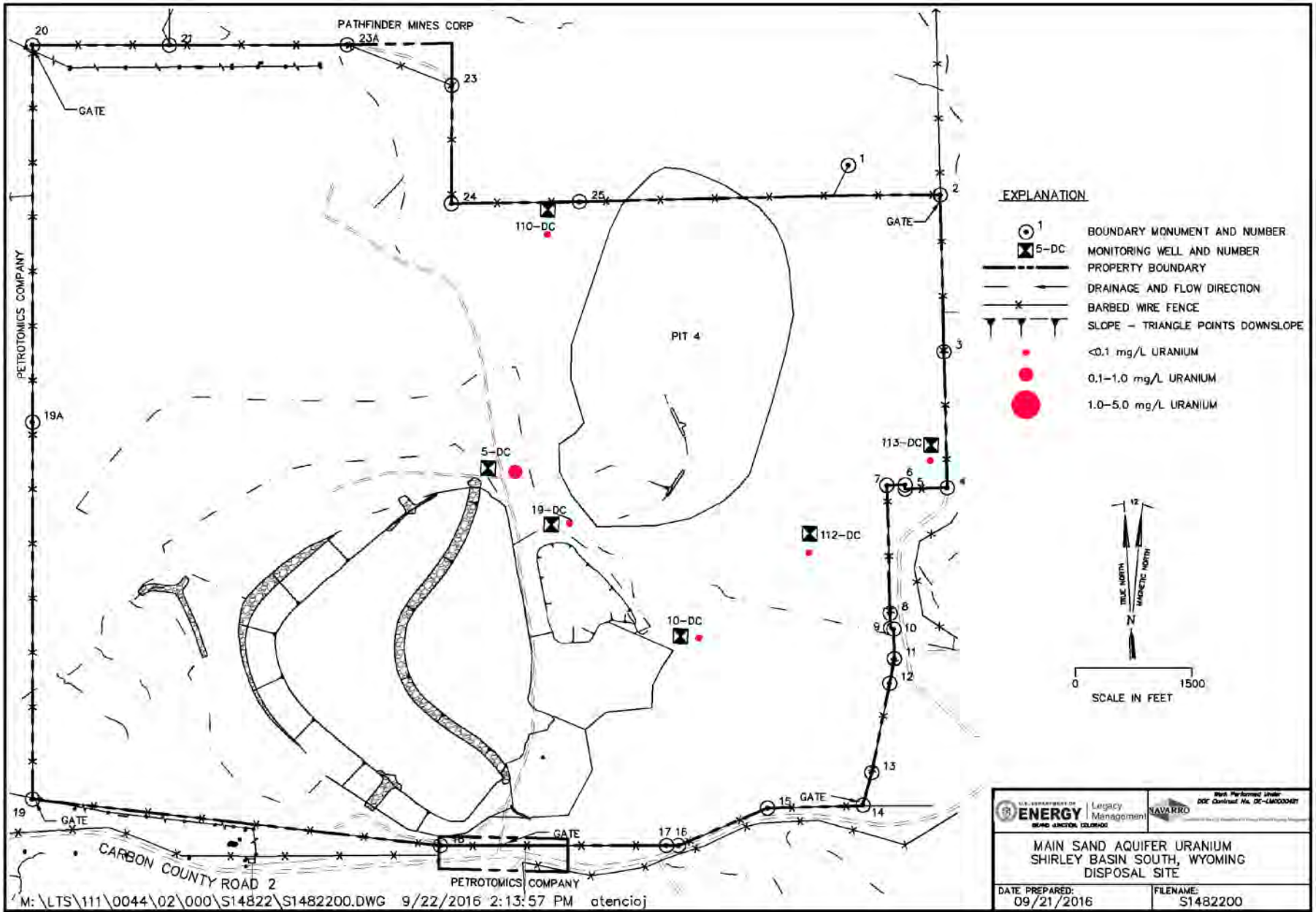


Figure 6-5. July 2016 Uranium Concentrations in the Main Sand Aquifer at the Shirley Basin South, Wyoming, Disposal Site

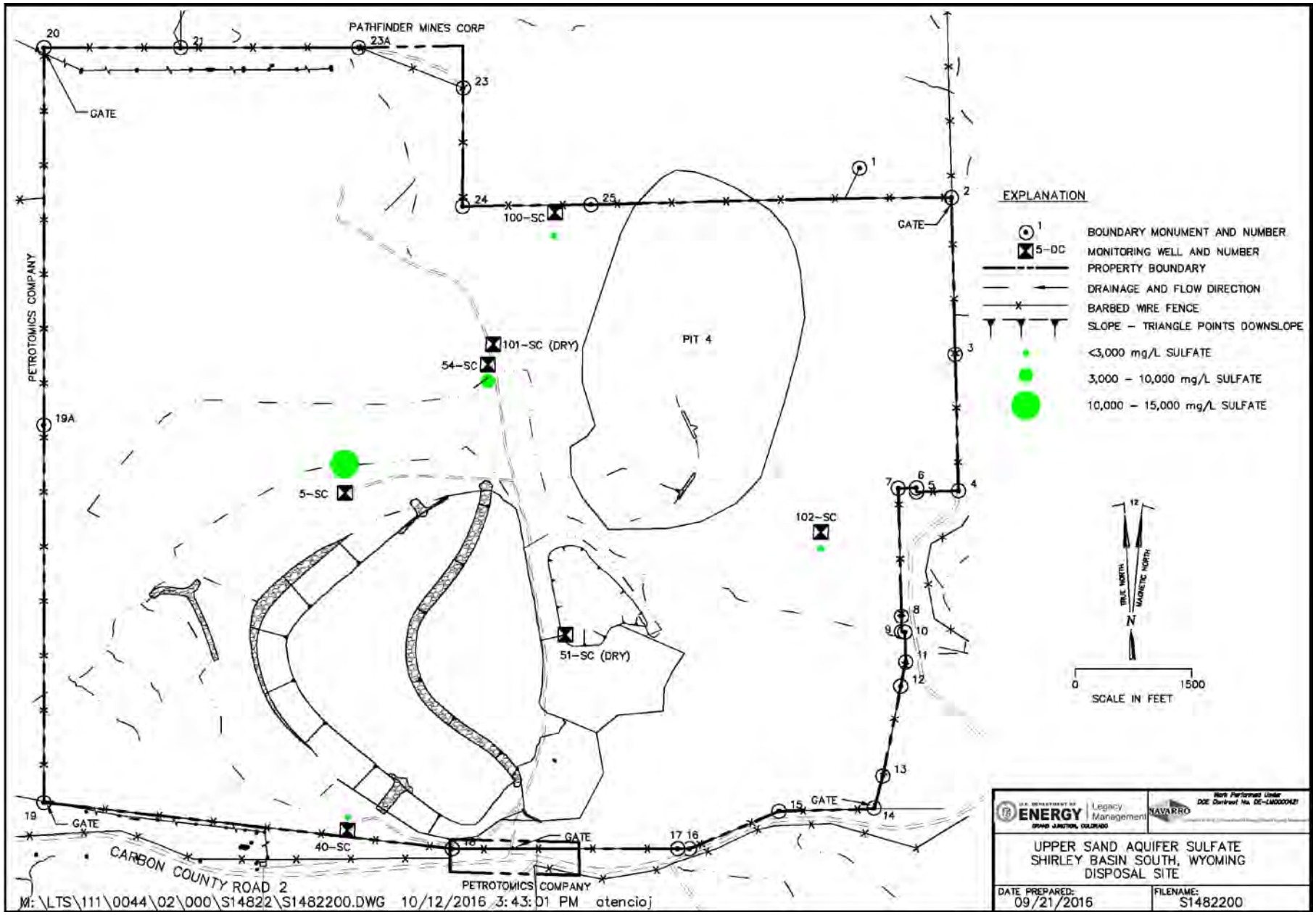


Figure 6-6. July 2016 Sulfate Concentrations in the Upper Sand Aquifer at the Shirley Basin South, Wyoming, Disposal Site

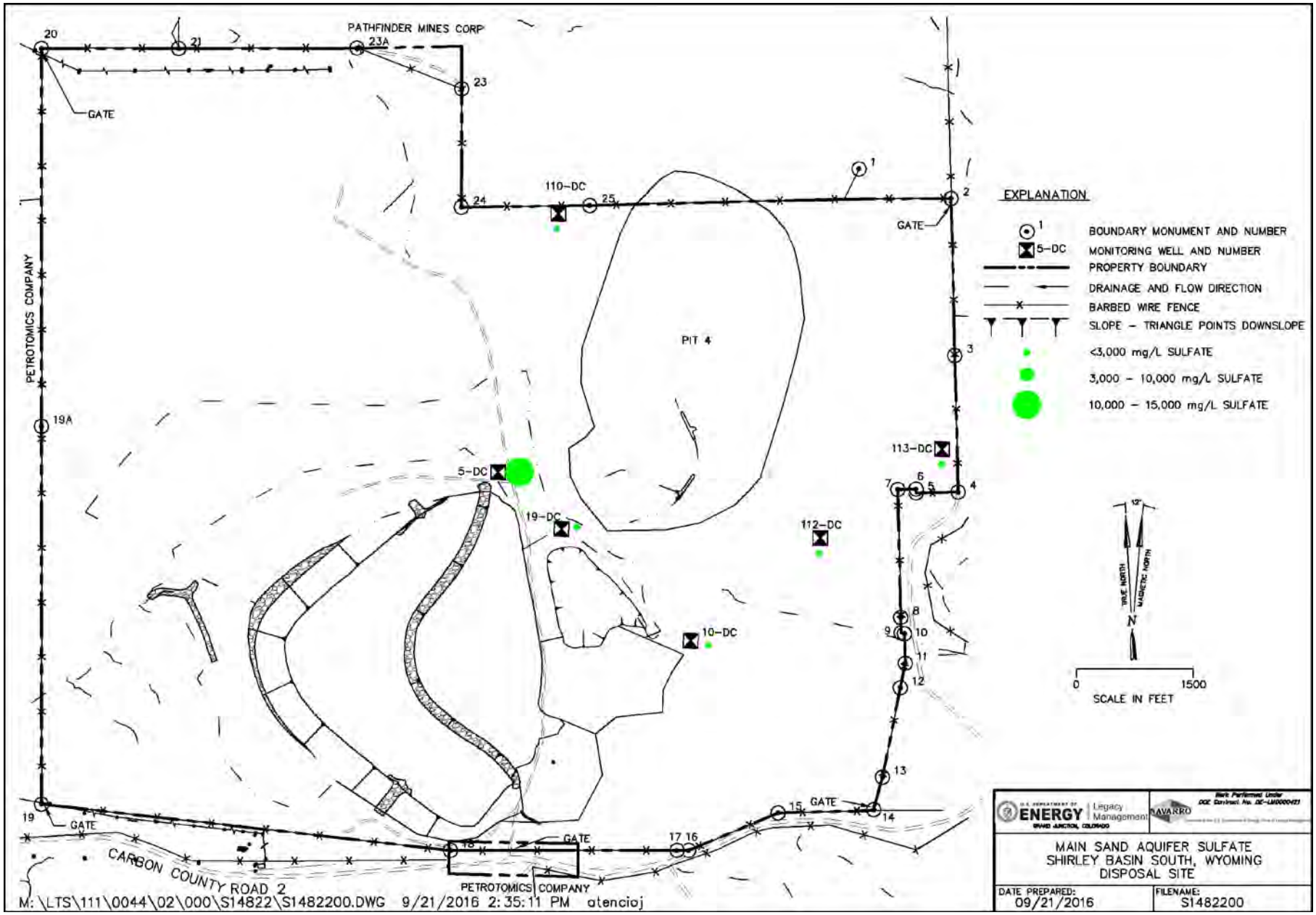


Figure 6-7. July 2016 Sulfate Concentrations in the Main Sand Aquifer at the Shirley Basin South, Wyoming, Disposal Site

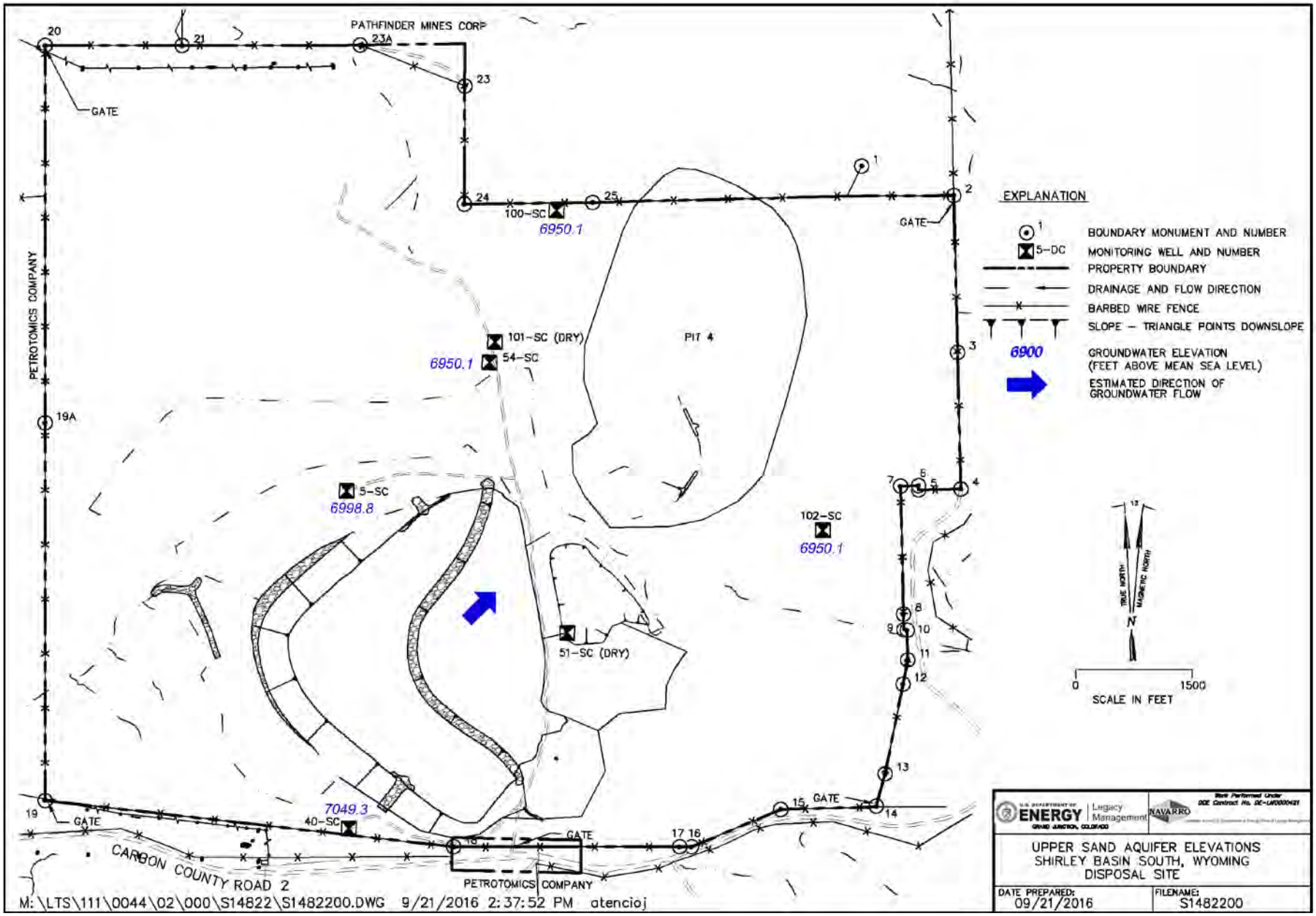


Figure 6-8. July 2016 Groundwater Elevations in the Upper Sand Aquifer at the Shirley Basin South, Wyoming, Disposal Site

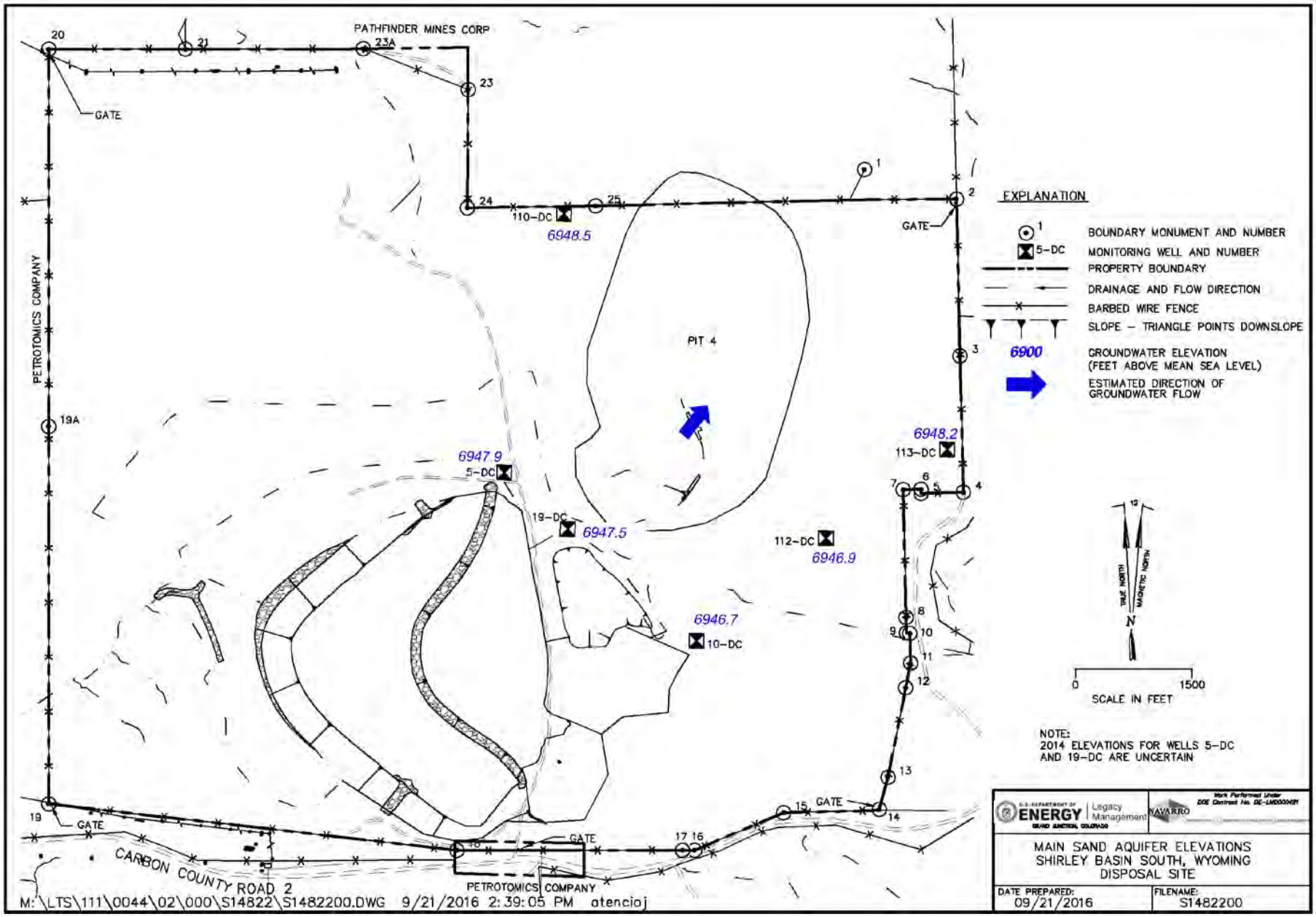


Figure 6-9. July 2016 Groundwater Elevations in the Main Sand Aquifer at the Shirley Basin South, Wyoming, Disposal Site

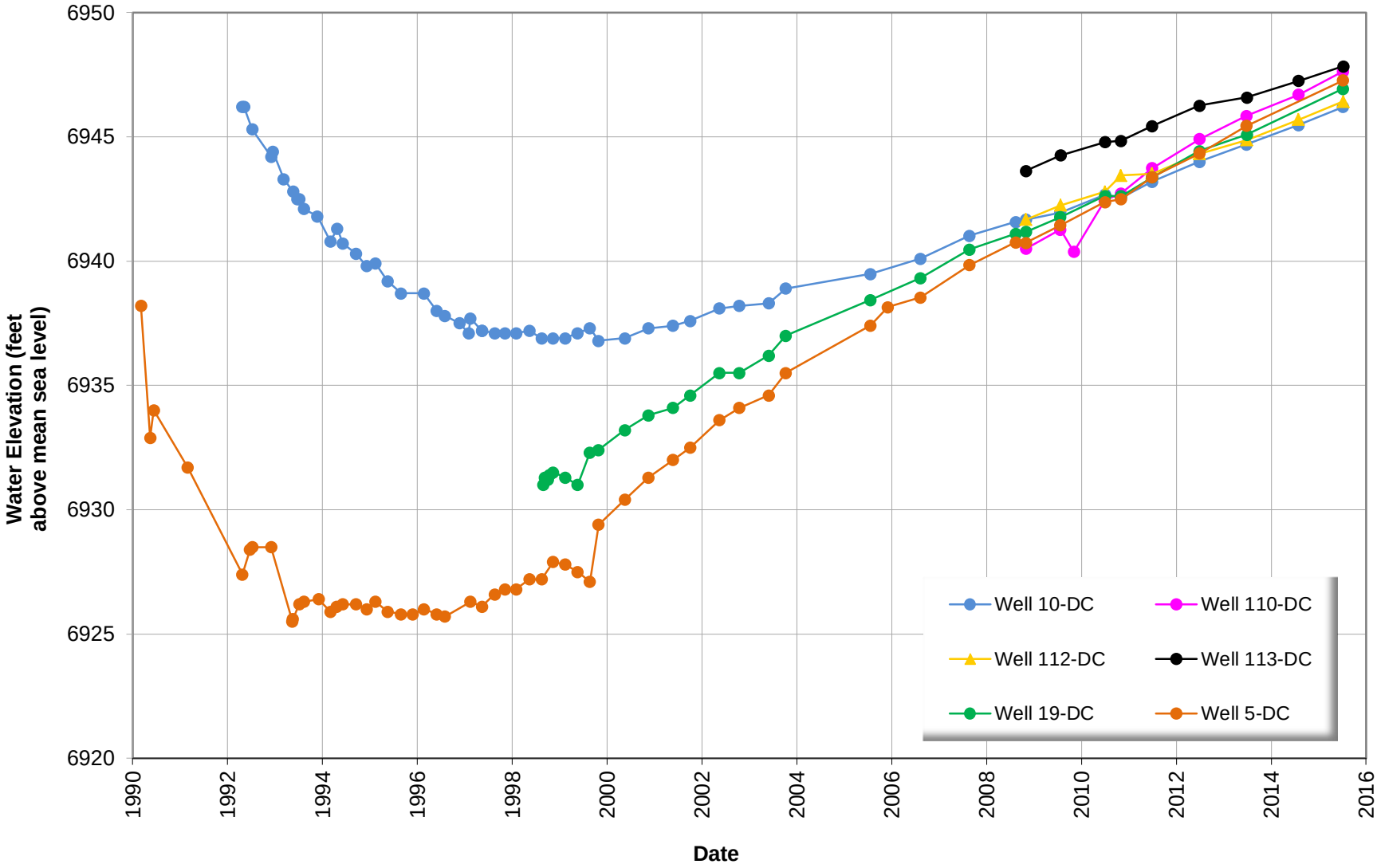


Figure 6-10. Hydrographs for Main Sand Aquifer Wells at the Shirley Basin South, Wyoming, Disposal Site

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.

6.9 Photographs

Photograph Location Number	Azimuth	Description
PL-1	330	Site Entrance Gate
PL-2	0	Perimeter Sign P26 at Site Entrance
PL-3	330	Site Marker
PL-4	260	Boundary Monument BM-16
PL-5	210	Monitoring Well 113-DC
PL-6	180	Upper Surface of Disposal Cell
PL-7	225	Lower Surface of Disposal Cell
PL-8	55	South Swale Discharge Point
PL-9	355	Toe of Riprap-Armored Dam Outslope of Disposal Cell
PL-10	275	Downgradient View of Riprap-Armored Portion of Southwest Channel
PL-11	110	PMF Channel, North Channel, and Disposal Cell (Left to Right)
PL-12	350	Wetland Area at Bottom of Pit 4
PL-13	155	Outlet of Eroded Riprap-Armored Drainage near Bottom of Pit 4
PL-14	300	Stock Water Holding Tank (Water from Well K.G.S. #3)

PL-1. Site Entrance Gate

PL-2. Perimeter Sign P26 at Site Entrance

PL-3. Site Marker

PL-4. Boundary Monument BM-16

PL-5. Monitoring Well 113-DC

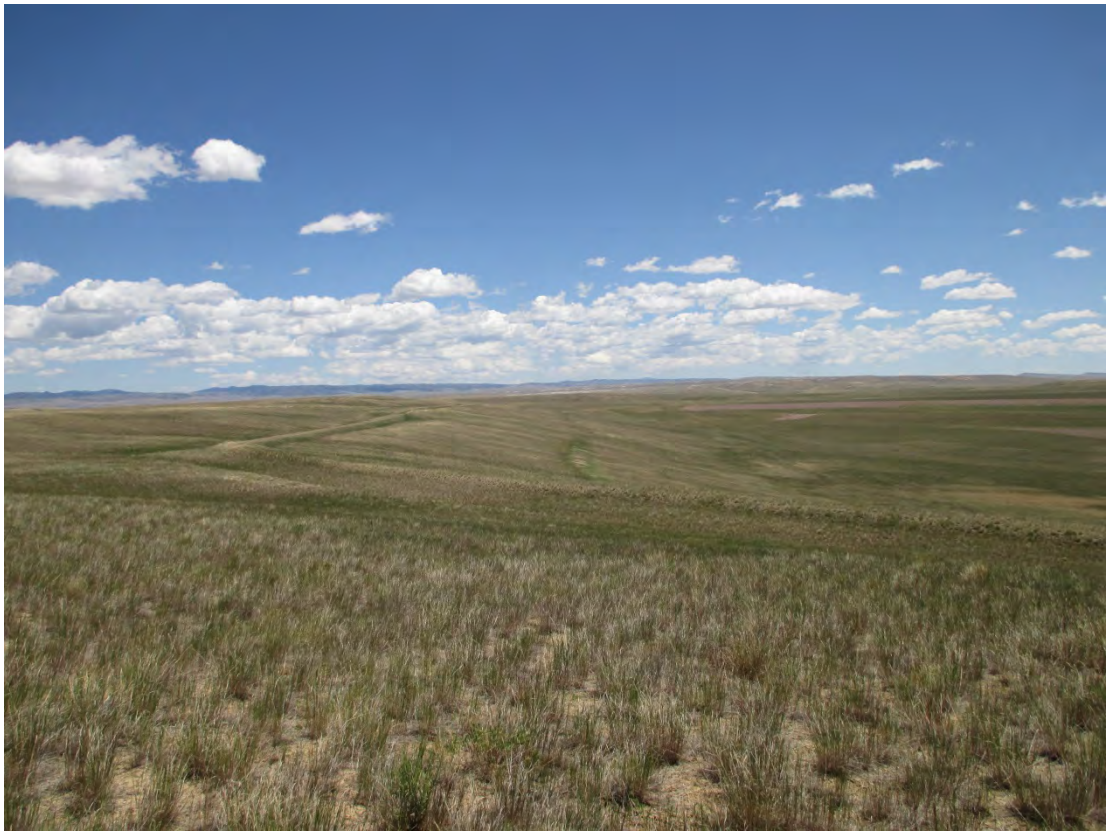
PL-6. Upper Surface of Disposal Cell

PL-7. Lower Surface of Disposal Cell

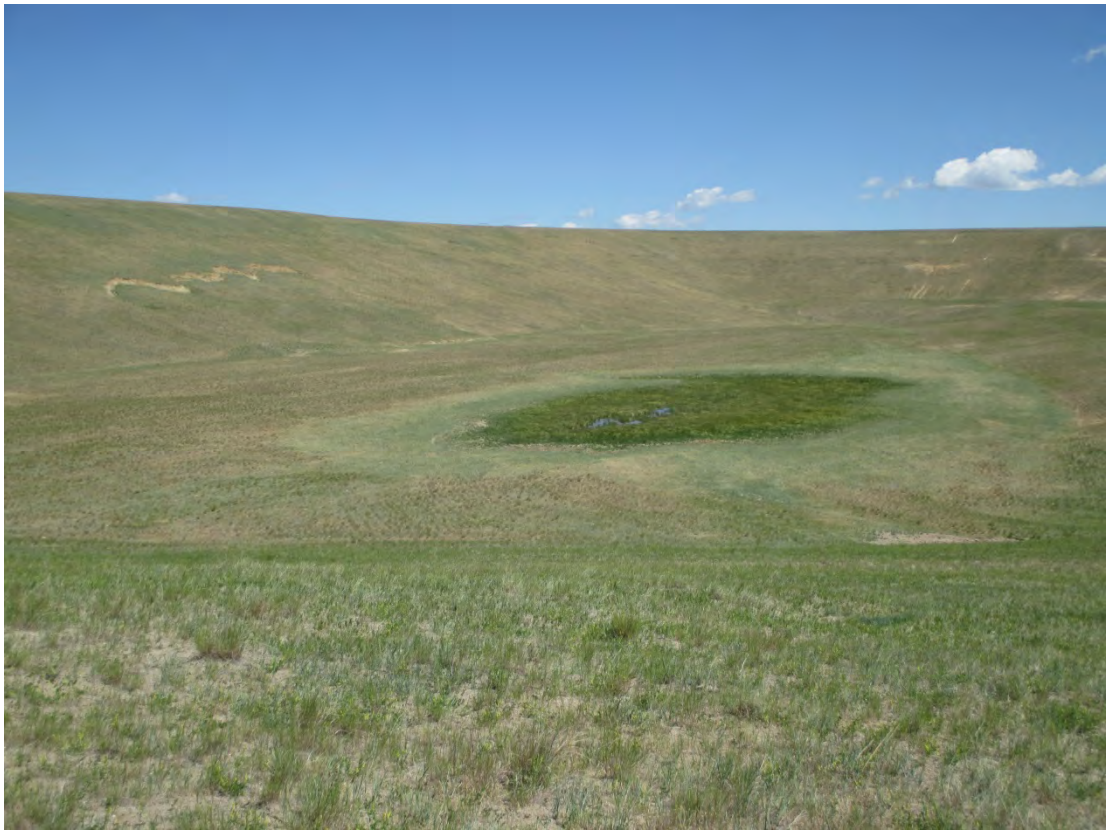
PL-8. South Swale Discharge Point

PL-9. Toe of Riprap-Armored Dam Outslope of Disposal Cell

PL-10. Downgradient View of Riprap-Armored Portion of Southwest Channel



PL-11. PMF Channel, North Channel, and Disposal Cell (Left to Right)



PL-12. Wetland Area at Bottom of Pit 4

PL-13. Outlet of Eroded Riprap-Armored Drainage near Bottom of Pit 4

PL-14. Stock Water Holding Tank (Water from Well K.G.S. #3)