Department of Energy
Washington, DC 20585

November 18, 2013

U.S. Nuclear Regulatory Commission
Attn: Document Control Desk
Deputy Director
Mail Stop T8F5
Washington, DC 20555-0001

Subject: 2013 Annual Site Inspection and Monitoring Report for Uranium Mill Tailings Radiation Control Act Title II Disposal Sites

To Whom It May Concern:

Enclosed are four copies of the *2013 Annual Inspection and Monitoring Report for Uranium Mill Tailings Radiation Control Act Title II Disposal Sites*. The report covers the annual inspections of the six Title II disposal sites managed by the U.S. Department of Energy.

This report is submitted in compliance with the reporting requirements set forth in 10 CFR 40.28, and each inspection was conducted in accordance with the inspection and monitoring requirements contained in the Long-Term Surveillance Plan for each site.

Please call me at (970)248-6020 if you have any questions. Please send any correspondence to:

U.S. Department of Energy
Office of Legacy Management
2597 Legacy Way
Grand Junction, CO 81503

Sincerely,

April Gil, Ph.D.
Environmental Team Lead

Enclosures

cc w/enclosures:
P. Brandt, NRC
J. Buckley, NRC
K. Conway, NRC
D. Orlando, NRC

cc w/o enclosures:
R. Bush, DOE–LM (e)
D. Johnson, Stoller (e)
File: ADM 535.10(A) (rc grand junction)

FSME20

Printed with soy ink on recycled paper

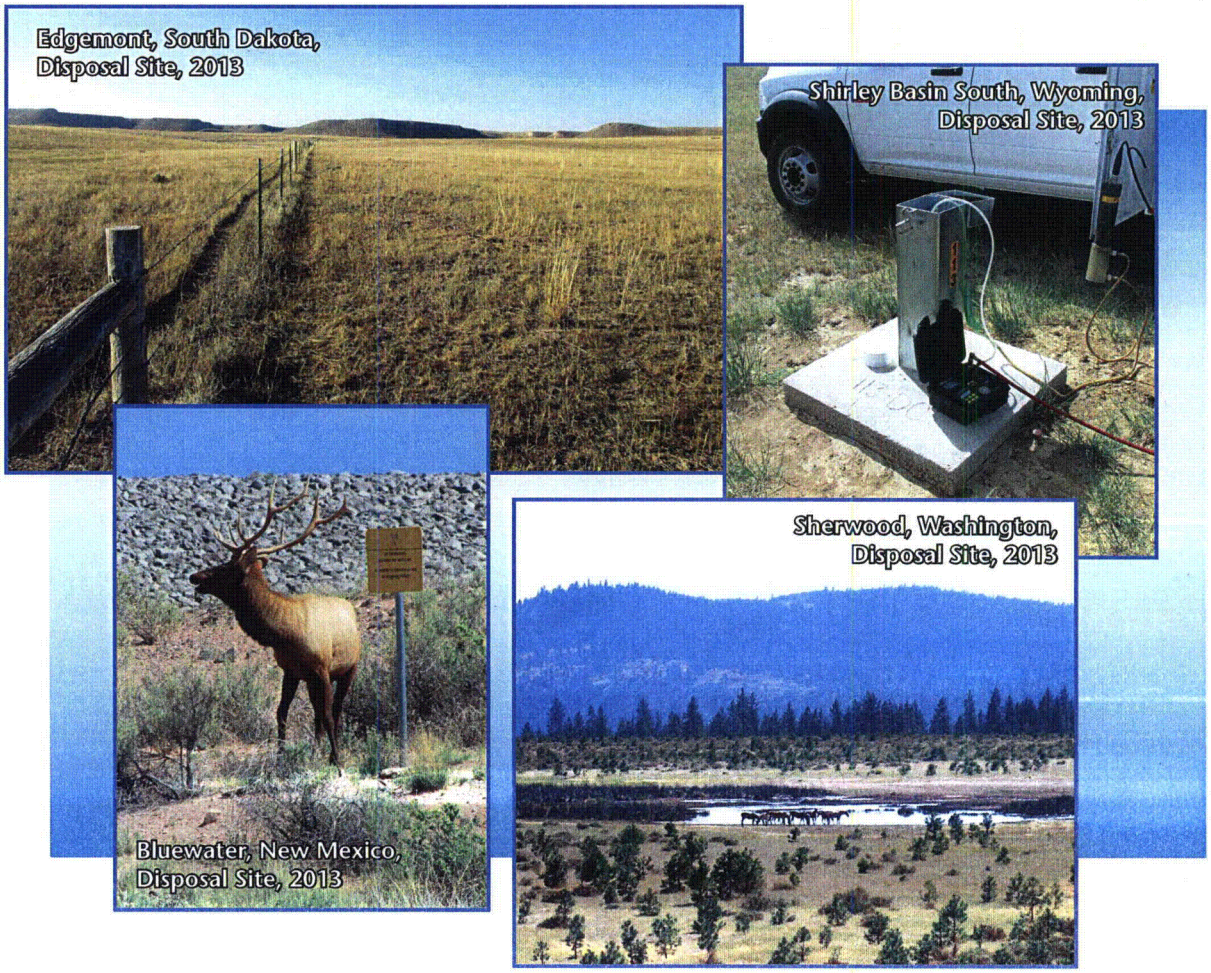
LMS/S10652

U.S. DEPARTMENT OF ENERGY

Legacy Management

2013 Annual Site Inspection and Monitoring Report for Uranium Mill Tailings Radiation Control Act Title II Disposal Sites

November 2013



This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed in this report, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

LMS/S10652

U.S. Department of Energy
Office of Legacy Management

2013 Annual Site Inspection and Monitoring Report for Uranium Mill Tailings Radiation Control Act Title II Disposal Sites

November 2013

This page intentionally left blank

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

This page intentionally left blank

Abbreviations

AAS	alternate abatement standard
ACL	alternate concentration limit
BIA	U.S. Bureau of Indian Affairs
BLM	U.S. Bureau of Land Management
CFR	*Code of Federal Regulations*
DOE	U.S. Department of Energy
EMP	erosion monitoring program
LTSP	long-term surveillance plan
MCL	maximum concentration limit
mg/L	milligram(s) per liter
NMED	New Mexico Environment Department
NRC	U.S. Nuclear Regulatory Commission
PCB	polychlorinated biphenyl
pCi/L	picocurie(s) per liter
PL	photo location
PMF	probable maximum flood
POC	point of compliance
POE	point of exposure
Stoller	S.M. Stoller Corporation
TDS	total dissolved solids
UMTRCA	Uranium Mill Tailings Radiation Control Act of 1978 (88 USC 7901, et seq.)
WDEQ	Wyoming Department of Environmental Quality

This page intentionally left blank

Executive Summary

This report, in fulfillment of a license requirement, presents the results of long-term surveillance and maintenance activities conducted by the U.S. Department of Energy (DOE) Office of Legacy Management in 2013 at six uranium mill tailings disposal sites reclaimed under Title II of the Uranium Mill Tailings Radiation Control Act (UMTRCA) of 1978. These activities verified that the UMTRCA Title II disposal sites remain in compliance with license requirements.

DOE manages six UMTRCA Title II disposal sites under a general license granted by the U.S. Nuclear Regulatory Commission (NRC) established at Title 10 *Code of Federal Regulations* Part 40.28. Reclamation and site transition activities continue at other sites, and DOE ultimately expects to manage approximately 27 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 services, and other regulatory functions.

Annual site inspections and monitoring are conducted in accordance with site-specific long-term surveillance plans (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 may affect the long-term performance of the site; and to determine the need, if any, for maintenance, follow-up inspections, or corrective action. LTSPs and site compliance reports are available online at http://www.lm.doe.gov.

DOE performed routine activities in 2013, including groundwater monitoring, erosion and vegetation monitoring, and noxious weed control. The following nonroutine activities[1] occurred in 2013:

- Bluewater, New Mexico—Uranium concentrations continued to exceed the UMTRCA maximum concentration limit for uranium in both aquifers at the site. DOE began sampling offsite private wells to help determine the extent of contamination. DOE continues to evaluate the cause and risk of contaminated groundwater.
- Bluewater, New Mexico—Radon flux measurements collected in the area of depressions on the main tailings disposal cell cover indicated that the radon barrier is performing as designed.
- Shirley Basin South, Wyoming—Concentrations of radium-226 and radium-228 continued to exceed their respective alternate concentration limits at three wells. The cause of the elevated concentrations is attributed to natural mineralization of the aquifers. DOE submitted monitoring recommendations to NRC for review and concurrence.

[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.

Results of the annual site inspection, 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. The table includes an index number for each item, which can be found in the left margin next to the corresponding text in the respective site chapter.

Table ES-1. 2013 Summary of UMTRCA Title II Site Issues and Actions

Site	Chapter	Page	Index No.	Issues and Actions
Bluewater, New Mexico	1	1-2	1A	Modified portion of perimeter fence.
		1-5	1B	Evaluation of cell performance.
		1-9	1C	Alluvial aquifer groundwater with elevated uranium concentrations leaving the site.
		1-9	1D	Conducted radon flux measurements on disposal cell cover.
		1-11	1E	Conducted downhole conductivity measurements in two bedrock aquifer monitoring wells.
		1-11	1F	Bedrock aquifer groundwater with elevated uranium concentrations leaving the site.
		1-11	1G	Sampled offsite private wells.
Edgemont, South Dakota	2			None.
L-Bar, New Mexico	3	3-9	3A	Measured cell cover erosion and vegetation.
Maybell West, Colorado	4			None.
Sherwood, Washington	5	5-6	5A	Conducted dam safety inspection.
		5-7	5B	Conducted groundwater best management practice monitoring.
Shirley Basin South, Wyoming	6	6-7	6A	Provided groundwater monitoring recommendations to NRC.
		6-9	6B	Continued to exceed the ACLs for radium-226 and radium-228.
		6-9	6C	Elevated concentrations attributed to natural mineralization in the aquifers.

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 was inspected on August 21 and 22, 2013. Several shallow depressions that exist on the main tailings disposal cell cover were dry at the time of the inspection; disposal cell performance is being evaluated to determine if additional monitoring or cover enhancement is necessary. A portion of the north perimeter fence was modified to prevent intrusion by cattle. Small elm tree saplings growing the main tailings disposal cell cover were treated with herbicide. No maintenance needs or cause for a follow-up inspection were identified.

1.2 Compliance Requirements

Requirements for the long-term surveillance and maintenance of the Bluewater site are specified in the *Long-Term Surveillance Plan for the DOE Bluewater (UMTRCA Title II) Disposal Site Near Grants, New Mexico* (U.S. Department of Energy [DOE], Grand Junction, Colorado, July 1997) and in procedures established by DOE to comply with requirements of Title 10 *Code of Federal Regulations* Part 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 3,300-acre site 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. Institutional controls at the site include federal ownership of the property and the following features that are inspected annually: a site marker, boundary monuments, and warning/no trespassing signs.

1.4 Inspection Results

The site, located approximately 9 miles northwest of Grants, New Mexico, was inspected on August 21 and 22, 2013. Results of the inspection are described below. R. Johnson and D. Traub of S.M. Stoller Corporation, the Legacy Management Support contractor at the DOE office in Grand, Junction, Colorado, conducted the inspection. D. Barr, the DOE Office of Legacy Management site manager, 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 may affect site integrity, and to determine the need, if any, for maintenance or additional inspection and monitoring. Numbers in the left margin of this report refer to items summarized in Table ES-1 of the Executive Summary.

1.4.1 Site Surveillance Features

The locations of site surveillance features are shown on Figure 1-1 (south area) and Figure 1-2 (north area). 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 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 site access road is surfaced with crushed basalt and extends northward along a narrow strip of DOE property for approximately 1,700 feet from the entrance gate to the main site access gate. The access road was in good condition.

Interior tertiary roads used to access DOE assets consist of a dirt track covered at places with crushed basalt. Portions of the road are susceptible to erosion, and the road is repaired when it becomes impassable. All roads used during the inspection were in good condition.

1.4.1.2 Perimeter Signs and Boundary Monuments

Fifty-five warning signs, referred to as perimeter signs, are mounted on steel posts along the site boundary and around the main and carbonate tailings disposal cells. Perimeter signs P3 and P10 have gunshot damage but are still legible. All other observed signs were in good condition.

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. Not all of the boundary monuments were verified during the 2013 inspection, but the monuments observed were in good condition. Some monuments tend to get covered by drifting sand, and metal t-posts have been driven at those locations to help inspectors find them.

1.4.1.3 Perimeter Fence

A four-strand barbed-wire fence encompasses the site to facilitate land management by DOE. The fence was in good condition. Sand had drifted to near the top of a portion of the north perimeter fence allowing site intrusion by cattle. The fence in this drift-prone area was modified
1A by installing taller fence posts and additional strands of wire (PL-1).

The entrance gate is a tubular steel, double-swing gate. The gate is secured by a chain and locks belonging to DOE and the various utility companies that have rights-of-way across the site. The gate was locked and in good condition.

1.4.1.4 Site Marker

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. The marker was in excellent condition (PL-2).

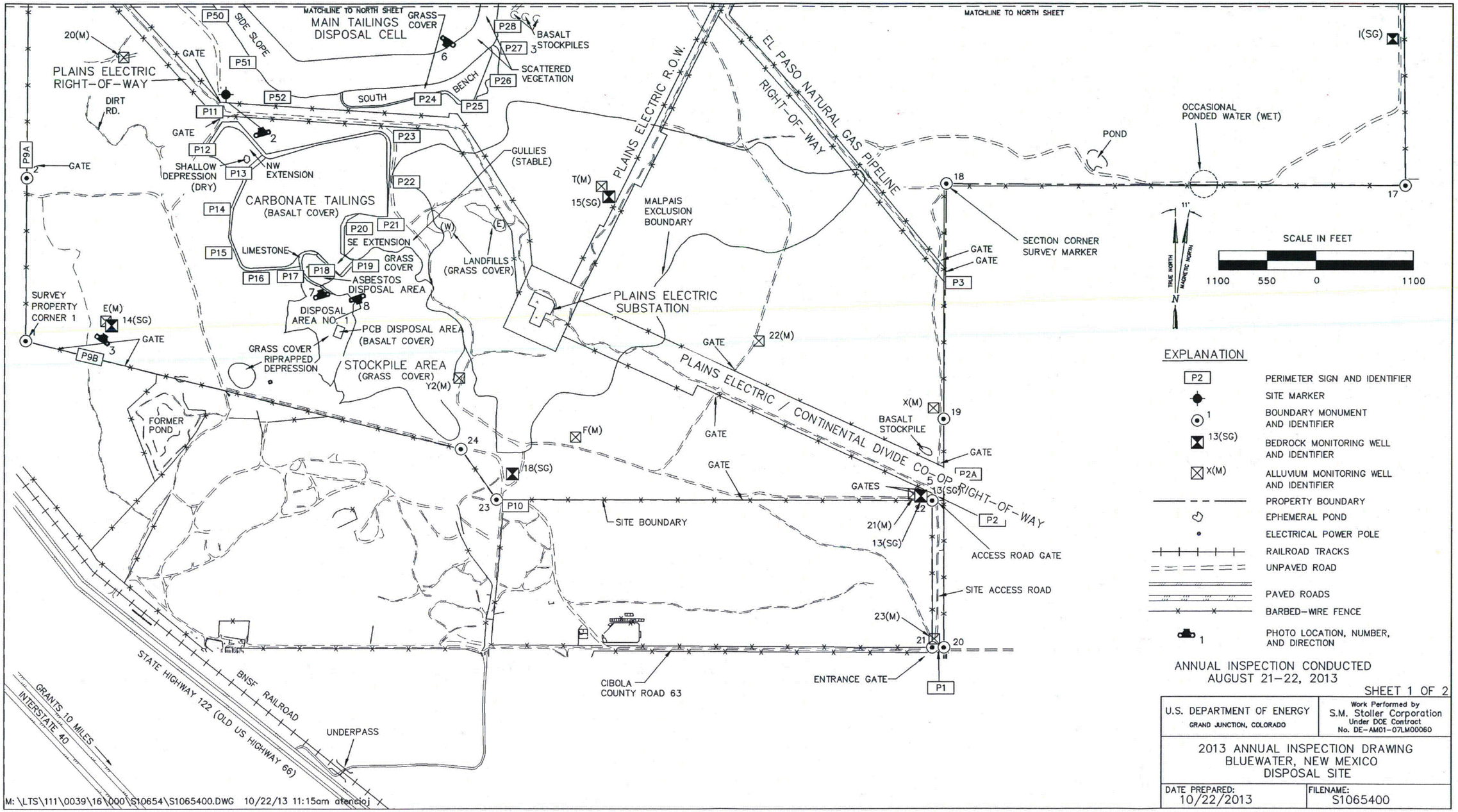


Figure 1-1. 2013 Annual Compliance Drawing for the Bluewater, New Mexico, Disposal Site (South Area)

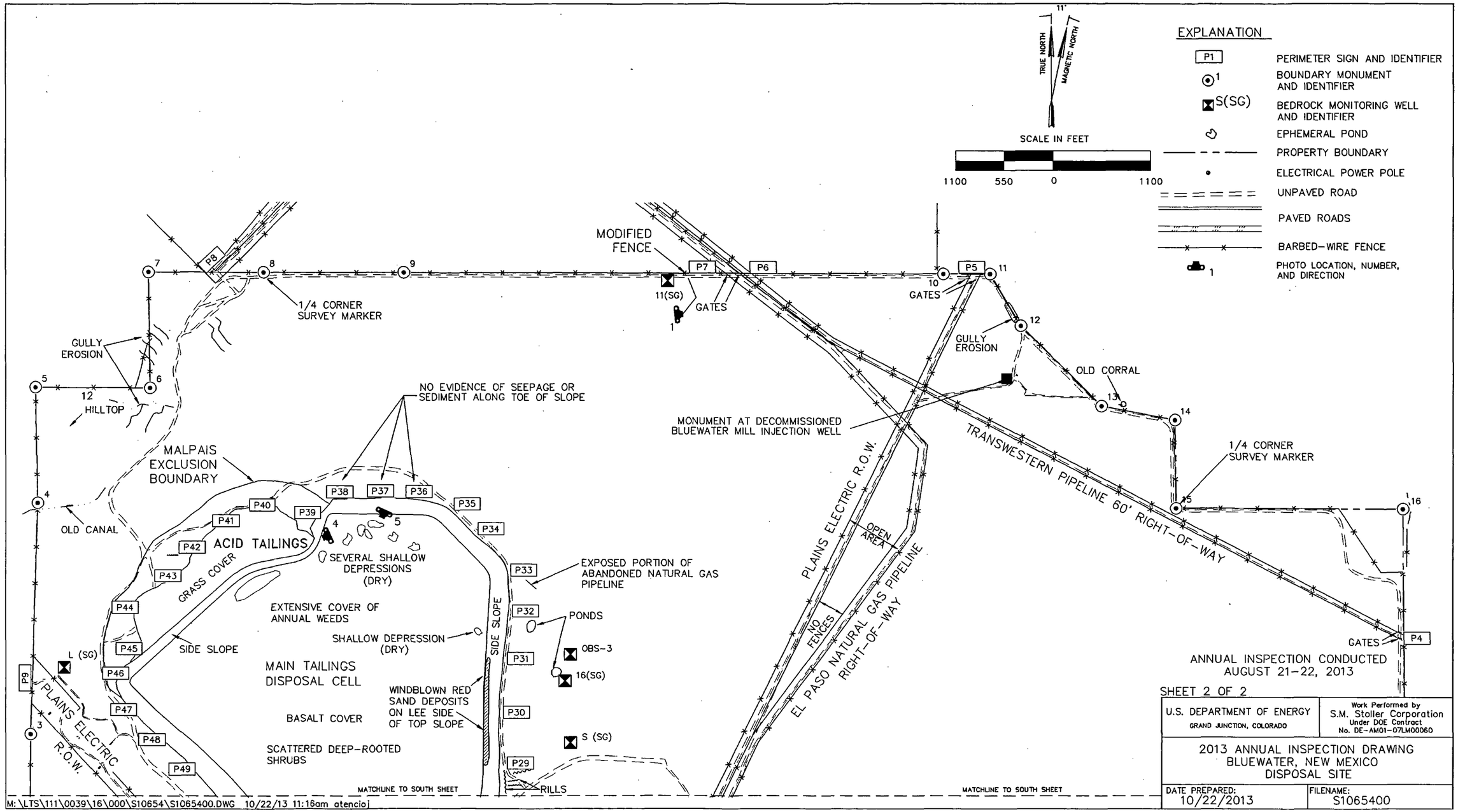


Figure 1-2. 2013 Annual Compliance Drawing for the Bluewater, New Mexico, Disposal Site (North Area)

1.4.1.5 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.

Nine wells are screened in Rio San Jose alluvium underlying basalt lava flows and are identified as E(M), F(M), T(M), X(M), Y2(M), 20(M), 21(M), 22(M), and 23(M). The other 10 wells are completed in the San Andres Limestone-Glorieta Sandstone hydrogeologic unit, which is the uppermost bedrock aquifer at the site. The bedrock wells are I(SG), L(SG), OBS-3, S(SG), 11(SG), 13 (SG), 14(SG), 15(SG), 16(SG), and 18(SG). Several wells have transducers to obtain continuous water level measurements, and the data are transmitted to the DOE office in Grand Junction. The wells and their associated telemetry towers were secure and in excellent condition (PL-3).

1.4.2 Inspection Areas

In accordance with the Long-Term Surveillance Plan (LTSP), the site is divided into four inspection areas (referred to as "transects" in the LTSP) to ensure a thorough and efficient inspection: (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.

Within each area, inspectors examined the specific site surveillance features and 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 main tailings disposal cell is covered with basalt riprap and slopes northward. The top slope grade is 3 to 4 percent at the south end and decreases to less than 0.5 percent at the north end. The top slopes of the acid tailings (PL-4) and the south bench disposal areas are essentially flat and covered by healthy grass. Basalt riprap protects the side slopes of the three disposal areas. The riprap was in excellent condition.

Plant encroachment (annual weeds, perennial grasses and forbs, and scattered perennial shrubs) continues on the cell cover and side slopes. Saplings of Siberian elm have been present on the cell cover and are periodically cut and their stumps are treated with herbicide; several saplings were observed during the inspection and later were treated with herbicide.

Several shallow depressions exist on the relatively flat north end of the top slope of the main tailings disposal cell and along the east and northwest edges of the cover. Although ponds often
1B develop in the depressions after rainfall events, the depressions were dry at the time of the inspection (PL-5). DOE is evaluating disposal cell performance as it relates to groundwater

contamination at the site. Results of the investigation will be used to determine, in consultation with NRC, if additional monitoring or cover enhancements are necessary.

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-6). The cell was in excellent condition except for a shallow depression on the northwest extension of the cell that was dry at the time of the inspection. Basalt riprap covers the top and side slopes of the disposal cell. The top, for the most part, slopes gently eastward. The small northwest and southeast extensions slope in their respective directions. Annual weeds, perennial grasses, and scattered woody shrubs were present on the cell and its extensions. Saplings of Siberian elm have been present on the cell cover and are periodically cut, and their stumps are treated with herbicide; no saplings were observed during the inspection.

The 2-acre asbestos disposal area is a bowl-like feature just south of the carbonate tailings disposal cell (PL-7). 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. The asbestos disposal area was in excellent condition.

The 11-acre grass-covered disposal area south of the asbestos disposal area was in excellent condition, as was the small riprap-covered PCB cell located within the disposal area (PL-8). The two grass-covered landfills east of the carbonate tailings disposal cell, totaling about 2 acres, were in excellent condition.

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. The areas of ponding are far enough from the cell to not impact it.

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 enclosed by stock fences with gates where the rights-of-way intersect one another, cross the site boundary, or cross the perimeter road. 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

A local subcontractor has been retained to periodically check the site perimeter fence and to remove trespassing cattle. Minor fence repairs are conducted as needed.

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

A portion of the north perimeter fence was modified to prevent intrusion by cattle. Elm saplings on the main tailings disposal cell cover were treated with herbicide. 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

1.7.1 Groundwater Monitoring

Groundwater monitoring is required at the Bluewater site. The well network acquired by DOE at the time of site transition and 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 alluvium aquifer background and point-of-compliance (POC) wells (Table 1-2). The LTSP also requires triennial sampling of the San Andres-Glorieta (bedrock) aquifer background and POC wells for selenium and uranium. Alluvium aquifer well X(M) and bedrock aquifer well I(SG)—point-of-exposure (POE) wells located along the east property boundary—were to be sampled only if specified alternate concentration limits (ACLs) are exceeded. The monitoring network, including new wells installed in 2011 and 2012, is provided in Table 1-2. ACLs are listed in Table 1-3.

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

Key: POC = point-of-compliance; POE = point-of-exposure

Table 1-3. Groundwater Alternate Concentration Limits for the Bluewater, New Mexico, Disposal Site

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

Key: ACL = alternate concentration limit; mg/L = milligrams per liter; POC = point-of-compliance

The New Mexico Environment Department (NMED) requested DOE's assistance in investigating and evaluating regional groundwater contamination associated with the former Grants Mineral Belt uranium 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 at NMED's request in response to an ACL exceedance. Also at NMED's request, DOE analyzes a larger suite of constituents than required by the LTSP. DOE also began evaluating the hydrogeology and groundwater quality at the site in 2009. Additional wells have been installed at the site to support DOE's site groundwater evaluation and NMED's regional investigation.

1.7.2 Alluvial Aquifer

Alluvial aquifer analytical results from the most recent sampling event in May 2013 are provided in Table 1-4. Alluvium POC well T(M) and POE well X(M) were not sampled because they were dry. The uranium concentration in alluvium POC 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. DOE notified NRC of the exceedance upon receiving the results from the laboratory. Uranium concentrations in the well continued to exceed the ACL and had remained steady in four subsequent samples until the well dried up. As required by the LTSP, an evaluative monitoring work plan was submitted to NRC in August 2011 for review; DOE and NRC continue to discuss the proposed plan. Concentrations for the other analytes in all of the wells remain below their respective ACLs. PCBs have never been detected in any of the wells at the site.

Table 1-4. May 2013 Alluvium Aquifer Monitoring Results

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
20(M)	0.0020	0.0055	0.016
21(M)	0.0009	0.0120	0.148
22(M)	0.0007	0.0060	0.380
23(M)	0.0084	0.0069	0.020
E(M)	0.0003	ND	ND
F(M)	0.0009	0.0018	0.008
T(M)	Not Sampled	Not Sampled	Not Sampled
X(M)	Not Sampled	Not Sampled	Not Sampled
Y2(M)	0.0018	0.0022	0.005

Key: mg/L = milligrams per liter; ND = not detected (below method detection limit)

Alluvium well 21(M) is located adjacent to the southern site boundary where the estimated deepest part of the former Rio San Jose channel coursed prior to being buried by basalt lava flows. Alluvium well 22(M) is located approximately halfway between POC well T(M) and well 21(M). The uranium concentrations in the new wells are below the ACL (Table 1-4). However, the uranium concentrations in both wells, shown in Figure 1-3, continue to exceed the
1C UMTRCA maximum concentration limit (MCL) of 0.044 mg/L (40 CFR 192, Table 1). Based on the elevated uranium concentration in well 21(M), alluvial groundwater with elevated uranium is leaving the site. The extent of contamination in the alluvial aquifer is not known at this time. However, the uranium concentration in well 23(M), located about 1,600 feet downgradient of well 21(M), was 0.020 mg/L.

NRC requested DOE to 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 the alluvium wells. DOE conducted radon flux measurements in July 2013 on top of the radon barrier in the area of depressions on the cell cover. All radon results were below the detection limit, indicating that the radon barrier in that portion of the disposal cell is performing as
1D designed. Additionally, DOE is evaluating the water balance of the disposal cell to see if elevated uranium concentrations can be attributed to continued leakage from the cell. Preliminary observations suggest that the uranium concentrations in the site groundwater

monitoring network are the result of seepage of tailings fluids during milling operations and do not reflect a change in performance of the disposal cell.

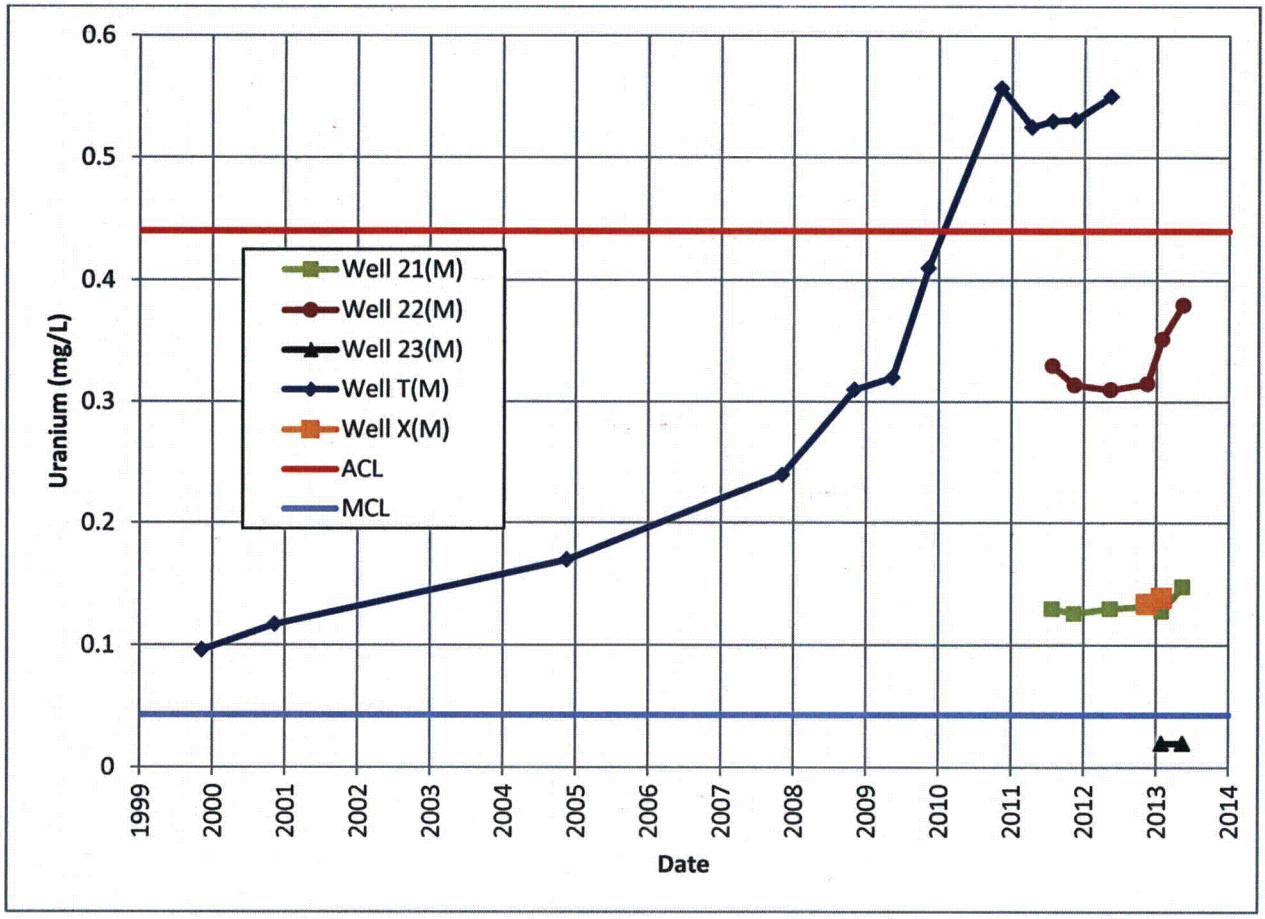


Figure 1-3. Uranium Concentrations in Alluvium POC Well T(M) and Downgradient Wells

1.7.3 Bedrock Aquifer

Bedrock wells 11(SG), 13(SG), 14(SG), 15(SG), 16(SG), and 18(SG) were installed in summer 2012 to gain a better understanding of the hydrogeological characteristics of the San Andres/ Glorieta aquifer at the site, and because a nearby offsite private well (HMC-951) completed in the same aquifer indicated elevated uranium concentrations. There were no bedrock wells in the south portion of the site prior to this well construction project. Wells 11(SG) and 14(SG) are considered to be crossgradient of 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 of the poor condition of those wells (their well screens are highly corroded). Wells OBS-3 and S(SG) continue to be sampled.

Bedrock wells I(SG) and L(SG) were completed with open-hole construction through the entire thickness of the San Andres Limestone and Glorieta Sandstone formations. All of the new San Andres/Glorieta aquifer wells onsite, except well 16(SG), are screened in the upper 50 feet of the San Andres Limestone as are most San Andres/Glorieta aquifer wells in the region because this

is the most productive zone of the aquifer. Well 16(SG) is screened in the Glorieta Sandstone because the San Andres Limestone is dry at that location.

1E In response to questions by NMED 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). Low-flow samples were collected in each zone in well I(SG) to see if the changes in conductivity corresponded with changes in uranium concentrations. Well L(SG) was also sampled at three depths for comparison purposes.

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. Therefore, San Andres/Glorieta aquifer groundwater
1F with elevated uranium is leaving the site; this occurrence is being evaluated by DOE in consultation with NRC

Table 1-5. May 2013 Bedrock Aquifer Monitoring Results

Well	Selenium (mg/L) ACL = 0.05 mg/L	Uranium (mg/L) ACL = 0.44 mg/L
11(SG)	ND	0.007
13(SG)	0.0068	0.123
14(SG)	ND	0.031
15(SG)	ND	0.045
16(SG)	0.0181	1.450
18(SG)	0.0059	0.232
I(SG)[a]	0.0095	0.350
L(SG)	ND	0.003
OBS-3	0.0083	0.228
S(SG)	0.0137	0.639

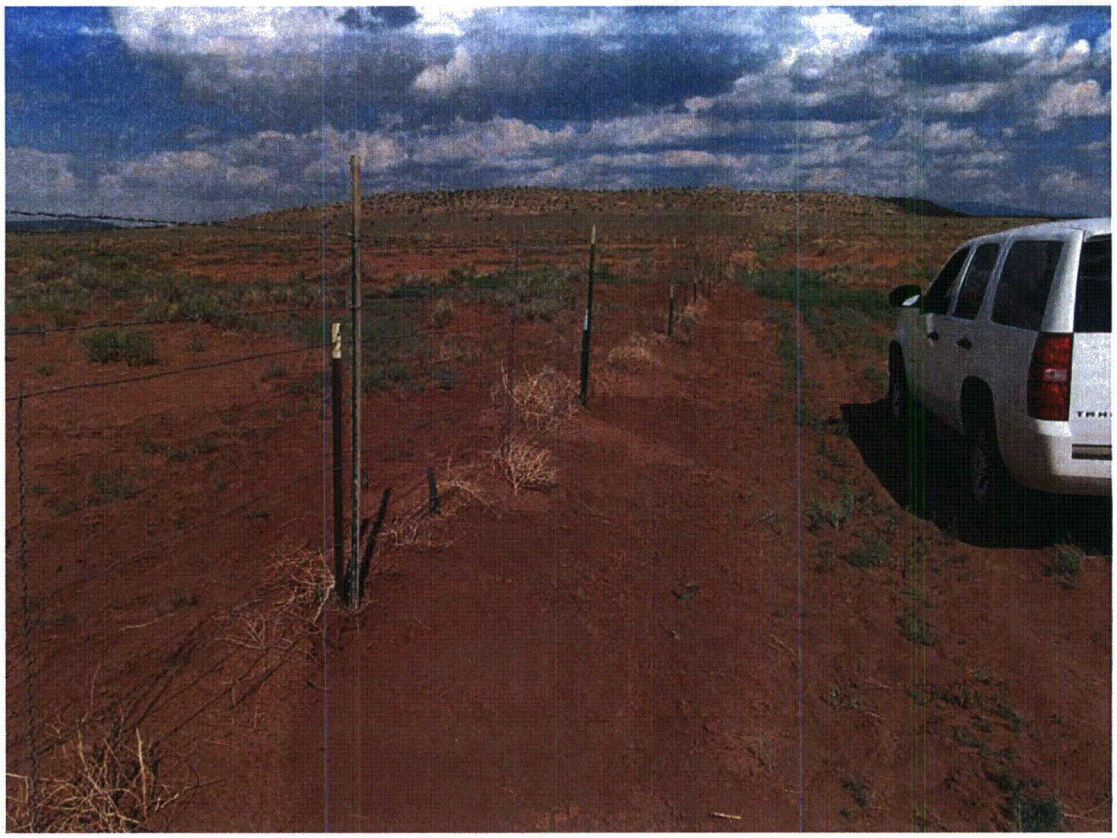
Key: mg/L = milligrams per liter; ND = not detected (below method detection limit)
[a]Sample collected at the depth of highest conductivity

The multiple-depth samples from background well L(SG) were well below standards and did not show a change in uranium concentration with depth. However, although the upper sample in well I(SG)—which is the normal sampling depth for that well—continued to have a uranium concentration well below the MCL (0.005 mg/L), uranium in the samples at the lower depths exceeds the MCL. It appears that there is a correlation between conductivity and uranium concentration and that there is geochemical stratification within the aquifer at this location; this occurrence is under evaluation by DOE.

1G To evaluate the extent of contamination, DOE has begun sampling private wells near the Bluewater site. Most of the private wells near the site are completed in the San Andres/Glorieta aquifer because of the limited extent of the alluvial aquifer near the site. Results from these wells will be used to develop plume maps and to evaluate potential risk to the users. The nearest downgradient municipal wells (village of Milan) produce from the San Andres/Glorieta aquifer and do not have elevated uranium concentrations or show upwards trends.

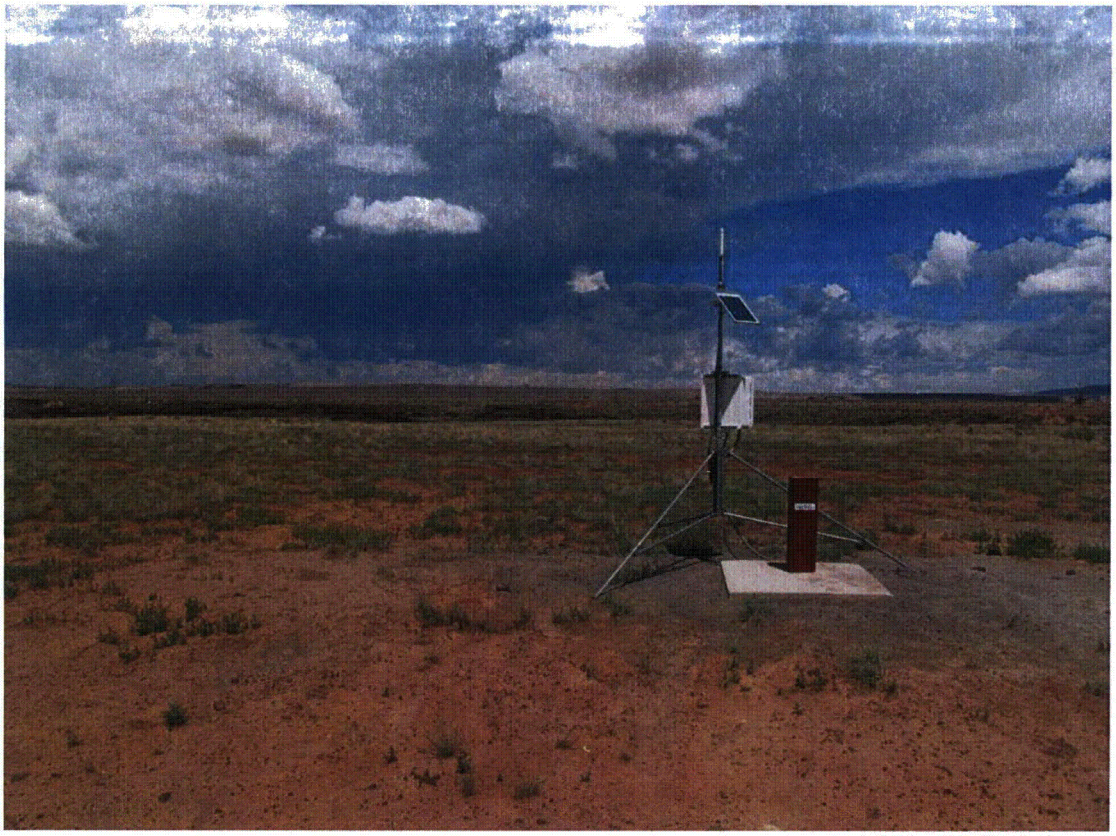
1.8 Photographs

Photograph Location Number	Azimuth	Photograph Description
PL-1	85	Modified fence along north property boundary.
PL-2	345	Site marker.
PL-3	35	Monitoring well 14(SG).
PL-4	245	Acid tailings portion of main tailings disposal cell.
PL-5	205	Dry depressions on north end of main tailings disposal cell top slope.
PL-6	215	Carbonate tailings disposal cell.
PL-7	345	Asbestos disposal area.
PL-8	160	PCB disposal area (rock-covered area in center of photo).



BLU 8/2013. PL-1. Modified fence along north property boundary.

BLU 8/2013. PL-2. Site marker.



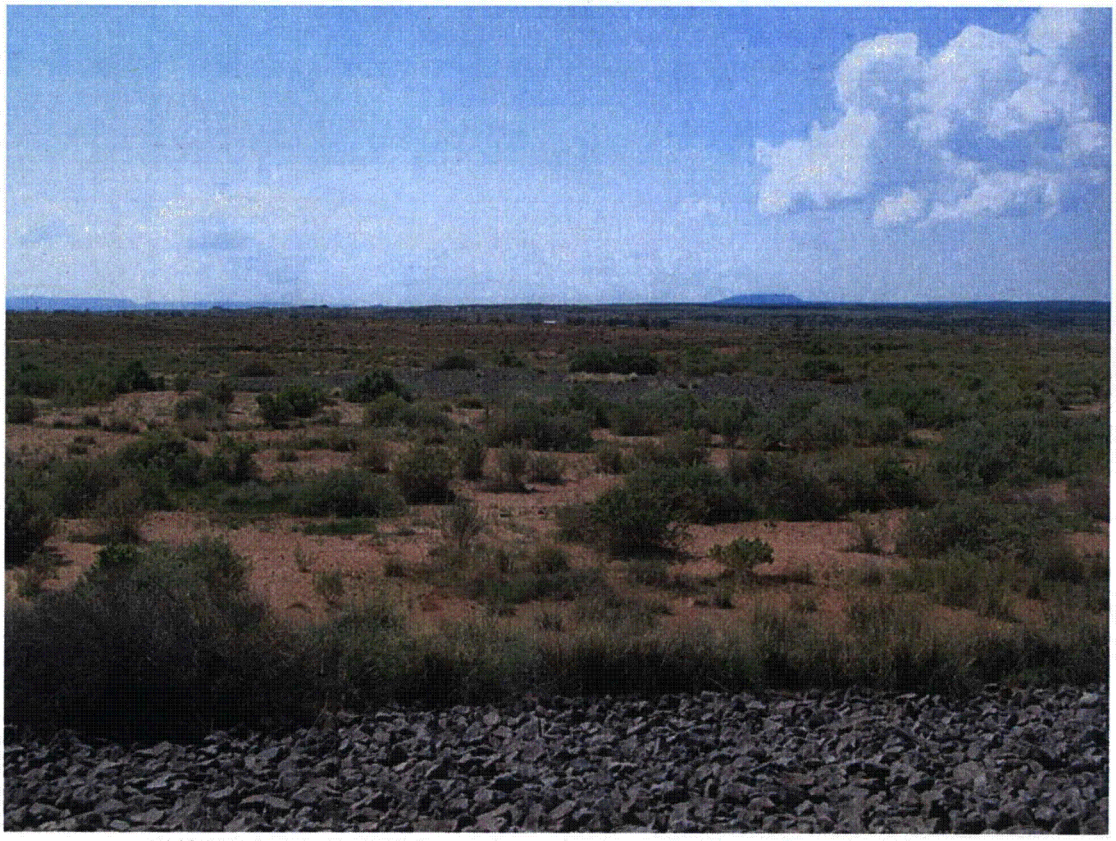
BLU 8/2013. PL-3. Monitoring well 14(SG).

BLU 8/2013. PL-4. Acid tailings portion of main tailings disposal cell.

BLU 8/2013. PL-5. Dry depressions on north end of main tailings disposal cell top slope.

BLU 8/2013. PL-6. Carbonate tailings disposal cell.

BLU 8/2013. PL-7. Asbestos disposal area.



BLU 8/2013. PL-8. PCB disposal area (rock-covered area in center of photo).

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 was inspected on June 25, 2013. The disposal cell and all associated surface water diversion and drainage structures were in excellent condition and functioning as designed. No maintenance needs or cause for a follow-up inspection were identified.

2.2 Compliance Requirements

Requirements for the long-term surveillance and maintenance of the Edgemont site are specified in the *Long-Term Surveillance Plan for the DOE Tennessee Valley Authority (UMTRCA Title II) Disposal Site, Edgemont, South Dakota,* (U.S. Department of Energy [DOE], Grand Junction, Colorado, June 1996) and procedures established by DOE to comply with the requirements of Title 10 *Code of Federal Regulations* Part 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 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 1996. DOE is the licensee and, in accordance with the requirements for UMTRCA Title II sites, is responsible for the custody and long-term care of the site. Institutional controls at the site include federal ownership of the property and the following features that are inspected annually: a site marker, boundary monuments, warning/no trespassing signs, and a perimeter fence and its access gates.

2.4 Inspection Results

The site, located approximately 2 miles south of the town of Edgemont in Fall River County near the southwestern corner of South Dakota, was inspected on June 25, 2013. R. Johnson and D. Traub of S.M. Stoller Corporation, the Legacy Management Support contractor at the DOE office in Grand Junction, Colorado, conducted 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 may affect site integrity, and to determine the need, if any, for maintenance or additional inspection and monitoring. Numbers in the left margin of this report refer to items summarized in Table ES-1 of the Executive Summary.

2.4.1 Site Surveillance Features

The locations of site surveillance features are shown on Figure 2-1. 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 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 County Road 6N. No private property is crossed to gain access. The entrance sign was in excellent condition (PL-1).

A tubular metal entrance gate is secured by a locked chain and was in excellent condition (PL-2). 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 in good condition.

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. 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. The fence was in excellent condition (PL-3). The two warning or perimeter signs, located next to access gates, were in excellent condition.

2.4.1.3 Site Marker

One granite site marker identifying the site is just inside the entrance gate and was in excellent condition (PL-4).

2.4.1.4 Boundary Monuments

Four boundary monuments—one at each corner of the property—were in excellent condition (PL-5).

2.4.2 Inspection Areas

In accordance with the Long-Term Surveillance Plan (LTSP), the site is divided into four inspection areas (referred to as "transects" in the LTSP) to ensure a thorough and efficient inspection: (1) the grass-covered disposal cell top; (2) the riprap-covered embankment face and associated drainage and diversion channels; (3) the region between the disposal cell and the site perimeter; and (4) the outlying area.

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

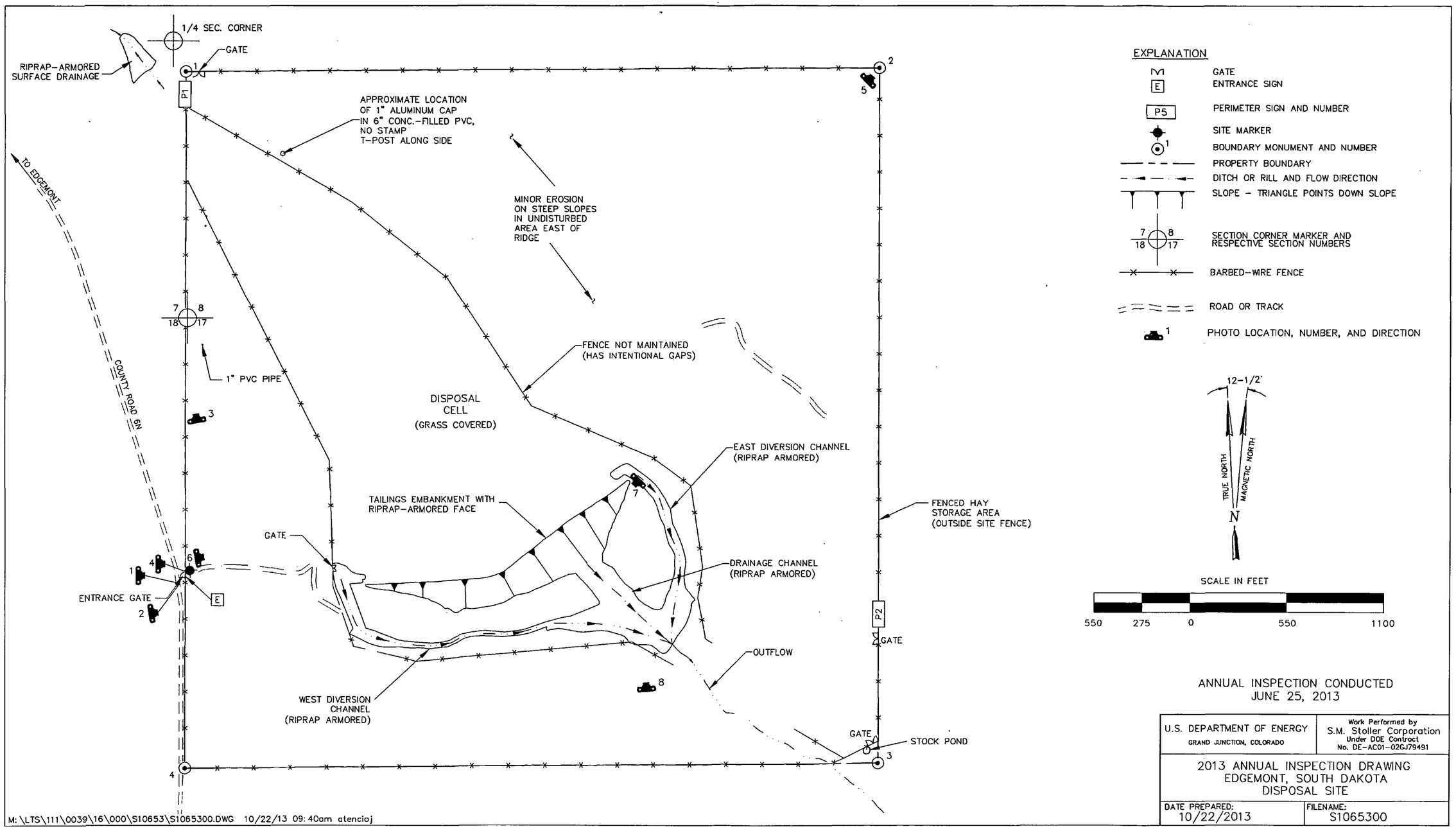


Figure 2-1. 2013 Annual Compliance Drawing for the Edgemont, South Dakota, Disposal Site

This page intentionally left blank

2.4.2.1 Top of the Disposal Cell

The 100-acre top of the disposal cell, completed in 1989, is grass-covered and was in good condition (PL-6). Although numerous cattle trails are present on the cell, no signs of erosion, settling, or other modifying processes that might affect the integrity of the cell were noted.

2.4.2.2 Embankment Face and Drainage and Diversion Channels

The tailings embankment face, the steepest manmade slope onsite, is covered with riprap, and was in excellent condition (PL-7). The slope is stable, and 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 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. These structures were in excellent condition (PL-8). Grass in the vegetated portions of the channels upgradient of the tailings embankment was in good condition, and there was no evidence of erosion. 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 pooling and wetland vegetation are present at the base of the diversion channels.

2.4.2.3 Region Between the Disposal Cell and the Site Perimeter

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.

2.4.2.4 Outlying Area

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, riprap-armored to prevent headward erosion onto the site, was stable and in good condition. The town of Edgemont operates a municipal landfill north-northwest of the site, and minor amounts of windblown trash have been observed onsite or along the fences; however, landfill trash was insignificant at the site this year. 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. No need for a follow-up inspection was identified during the inspection.

2.6 Routine Site Maintenance and Emergency Measures

No maintenance needs were identified.

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

2.7 Environmental Monitoring

2.7.1 Groundwater Monitoring

In accordance with the LTSP, groundwater monitoring is not required at this site due to the presence of a 300- to 700-foot-thick layer of competent, unweathered 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 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.

2.7.2 Vegetation Monitoring

Vegetation monitoring is required by the LTSP as an annual visual inspection. The vegetation was stressed due to dry conditions. In 2008 it was noted that a significant percentage of the plant cover was composed of non-noxious weedy species. It was not known whether the range condition has improved, deteriorated, or stayed about the same since cattle began grazing the site. A vegetation monitoring program began in 2009 to monitor the effects of grazing. Annual monitoring data will be evaluated to manage the grazing as needed to maintain healthy ecological conditions at the site.

2.8 Photographs

Photograph Location Number	Azimuth	Description
PL-1	90	Site entrance sign.
PL-2	80	Site entrance gate.
PL-3	350	West perimeter fence.
PL-4	90	Site marker.
PL-5	45	Boundary monument BM-2.
PL-6	80	Southeast portion of disposal cell cover.
PL-7	225	Northeast portion of tailings embankment.
PL-8	355	Tailings embankment, drainage channel, and east diversion channel.

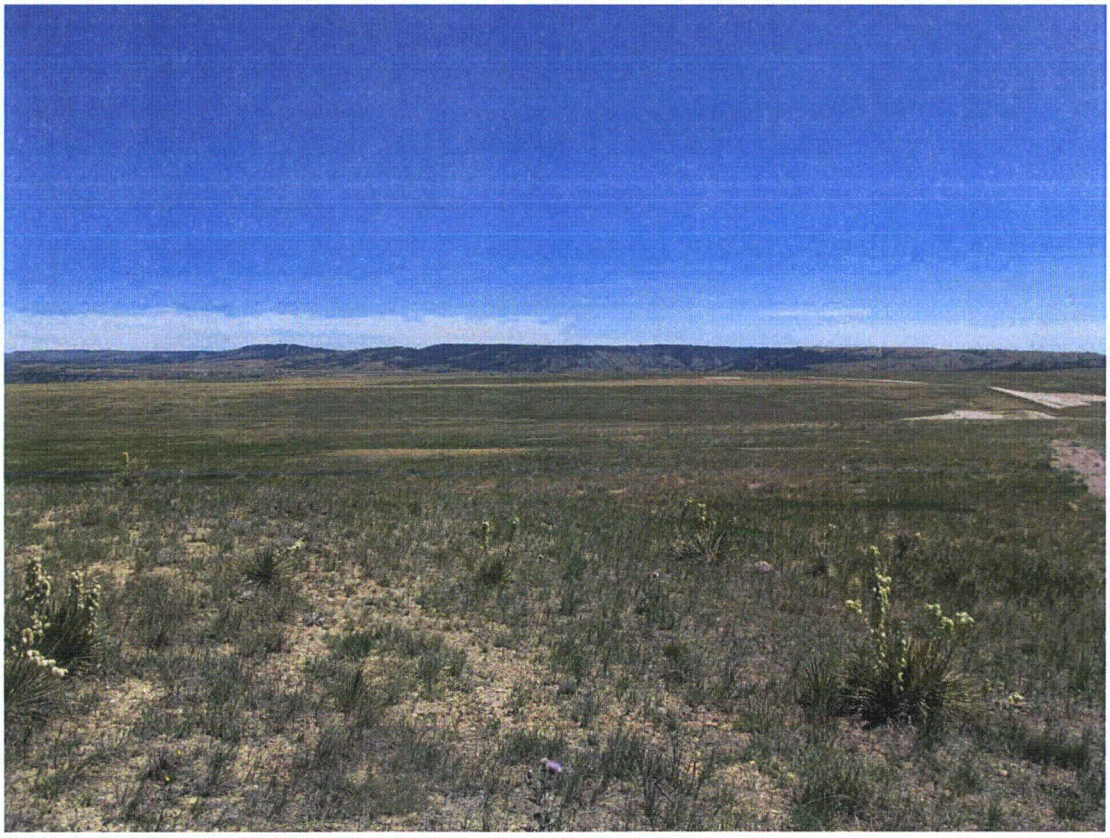
EDG 6/2013. PL-1. Site entrance sign.

EDG 6/2013. PL-2. Site entrance gate.

EDG 6/2013. PL-3. West perimeter fence.

EDG 6/2013. PL-4. Site marker.

EDG 6/2013. PL-5. Boundary monument BM-2.



EDG 6/2013. PL-6. Southeast portion of disposal cell cover.

EDG 6/2013. PL-7. Northeast portion of tailings embankment.

EDG 6/2013. PL-8. Tailings embankment, drainage channel, and east diversion channel.

3.0 L-Bar, New Mexico, Disposal Site

3.1 Compliance Summary

The L-Bar, New Mexico, Uranium Mill Tailings Radiation Control Act (UMTRCA) Title II disposal site was inspected on August 20, 2013. The tailings impoundment was in excellent condition. Erosion and vegetation measurements to monitor the condition of the impoundment cover indicate that no erosion is occurring, and foliar cover of the vegetation has decreased since the 2012 inspection due to continuing drought conditions. No cause for a follow-up inspection was identified.

3.2 Compliance Requirements

Requirements for the long-term surveillance and maintenance of the L-Bar site are specified in the *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 2004) and procedures established by the U.S. Department of Energy (DOE) to comply with the requirements of Title 10 *Code of Federal Regulations* Part 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 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. Institutional controls at the site include federal ownership of the property and the following features that are inspected annually: a site marker, boundary monuments, and warning/no trespassing signs.

3.4 Inspection Results

The site, located approximately 15 miles north of Laguna, New Mexico, and 2 miles east of Seboyeta, New Mexico, was inspected on August 20, 2013. R. Johnson, D. Traub, and M. Kastens of S.M. Stoller Corporation, the Legacy Management Support contractor at the DOE office in Grand, Junction, Colorado, conducted the inspection. D. Barr, the DOE Office of Legacy Management site manager, 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 may affect site integrity, and to determine the need, if any, for maintenance or additional inspection and monitoring. Numbers in the left margin of this report refer to items summarized in Table ES-1 of the Executive Summary.

3.4.1 Site Surveillance Features

The locations of site surveillance features are shown in Figure 3-1. 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 in Figure 3-1 by photograph location (PL) numbers.

3.4.1.1 Site Access and Interior Roads

Access to the L-Bar site is 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 access road was in good condition.

Interior tertiary dirt roads and tracks are present to access DOE assets. Portions of the roads are susceptible to erosion and are repaired when they become impassable. All roads used during the inspection were in good condition.

3.4.1.2 Signs and Boundary Monuments

Entrance signs installed on metal posts are located at three access points to the site. Entrance signs E1 (main site entrance) and E2 (along the east access road) have several bullet holes but are legible (PL-1). Thirty-four warning or perimeter signs are attached to a barbed-wire fence that surrounds the disposal site structures. The perimeter signs were in good condition.

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. The boundary monuments observed during the inspection were in excellent condition.

3.4.1.3 Fence and Gates

A barbed-wire stock fence encompasses the tailings impoundment and associated drainage structures and is intended to prohibit trespassing and livestock intrusion on the tailings impoundment structures. The fence is located as much as 3,300 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. Three wire gates with DOE locks allow vehicle access through the fence (PL-2). The fence and gates were in excellent condition.

3.4.1.4 Site Marker

A granite site marker is located north of the disposal cell adjacent to the site access road. The marker was in excellent condition (PL-3).

3.4.1.5 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. All of the wells were locked and in good condition (PL-4). Some well locations do not have established access roads or tracks but are accessible by 4-wheel drive vehicle as long as the ground is dry.

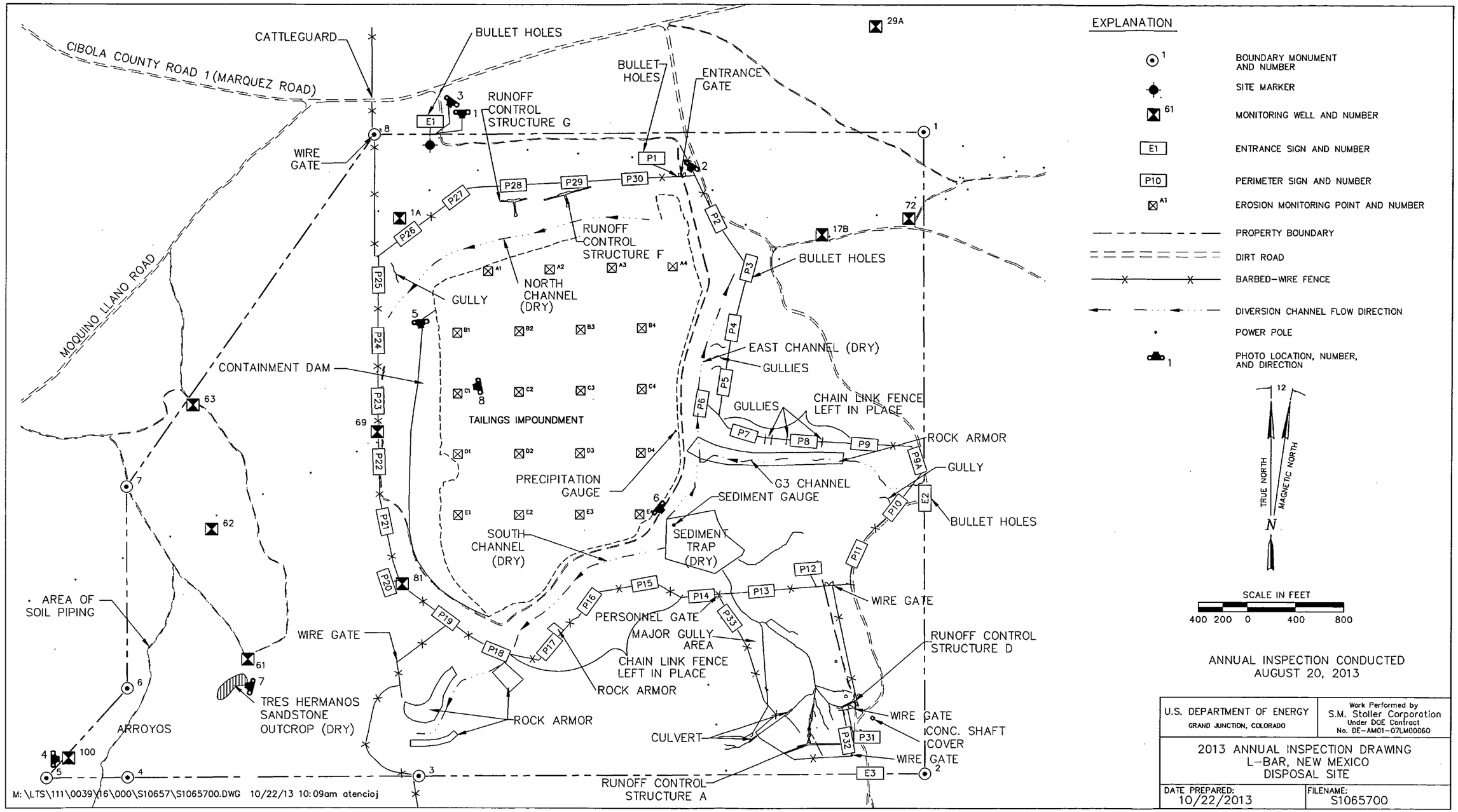


Figure 3-1. 2013 Annual Compliance Drawing for the L-Bar, New Mexico, Disposal Site

This page intentionally left blank

3.4.2 Inspection Areas

In accordance with the Long-Term Surveillance Plan (LTSP), the site is divided into four inspection areas (referred to as "transects" in the LTSP) to ensure a thorough and efficient inspection: (1) the cover of the tailings impoundment; (2) the containment dam; (3) the diversion channels; and (4) the site perimeter, outlying areas, and balance of the site.

Within each area, inspectors examined the specific site surveillance features and 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 Tailings Impoundment

The soil-covered tailings impoundment, completed in 2000, occupies approximately 100 acres. Its 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 cover was not seeded because plant growth was not expected to be successful, revegetation is occurring naturally with native species. The establishment and maturing of vegetation is expected to reduce wind and water erosion of the surface and help to prevent precipitation from infiltrating into the tailings.

Cracks are usually present in the surface soil of the tailings impoundment cover. 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 impoundment cover. Section 3.7.2 describes the erosion monitoring program (EMP) and presents the results to date.

3.4.2.2 Containment Dam

The tailings impoundment was constructed by damming the head of a natural drainage basin. The face of the earthen containment dam has a 20 percent 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 tailings impoundment surface would spill. Native vegetation is well established on the face, which is desirable for increasing the erosion protection of the surface (PL-5). There were no indications of erosion, settlement, seeps, or other modifying processes that might affect the integrity of the dam.

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 impoundment. The system is designed to accommodate probable maximum flood discharges.

Runoff from an upgradient watershed east of the tailings impoundment is designed to be conveyed away from the site to a northeastward-flowing drainage via the east channel. The east channel is separated from the impoundment by a dike. 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.

A tributary channel, the G3 channel, was constructed to divert runoff from a smaller watershed into the east channel. Gullies have formed along the north slope of the G3 channel. The erosion is not impairing the function of the channel, but gullies are encroaching on the perimeter fence in that area. This area will be monitored, and repairs will be made as needed to ensure the integrity of the fence.

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 is expected to settle out. If a runoff event overtops the sediment trap, the flow is diverted to the east channel; the sediment trap has not overtopped yet. The sediment trap was dry at the time of the inspection (PL-6).

The sediment trap was designed to function for 600 years before accumulated sediment would need to be removed. However, 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, resulting in an accelerated rate of sediment deposition in 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. Potential repairs to the berm and its associated erosion control features (Structure A), as well as repairs to a nearby structure (Structure D) are being designed.

Runoff water from the area north of the tailings impoundment is captured by the north channel. The water is diverted away from the site to the west. Deep gullies had formed in the weathered shale and alluvium along a portion of the north slope of the channel, and headward erosion was rapidly migrating to the north toward the site access road and property boundary. Sediment deposition in the diversion channel eventually would impair the function of the channel and potentially lead to erosion of the tailings impoundment. Consequently, the channel slope was restored to its original design configuration, and two runoff control structures were constructed to reduce erosion and sedimentation; construction was completed in January 2010. The east structure (Structure F) was in good condition at the time of the inspection. The west structure (Structure G), however, suffered severe erosion during runoff events in August and September 2011. Potential repairs and modifications to the structures are being designed.

The south channel diverts storm runoff from the higher terrain immediately south of the tailings impoundment toward the channel outlet to the west. Two riprap aprons are present on the north-facing slope to inhibit erosion along natural drainage paths. Minor erosion is occurring on the unprotected slope surfaces, resulting in some 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 do not appear to be 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 to be a potential evapotranspiration area. There was no indication of seepage or evaporation at the outcrop (PL-7). 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 remain in a safe condition.

The access road to monitoring well 100, located in the southwest corner of the site, is damaged by 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.

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

No 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 is required at the L-Bar site. The monitoring network consists of 10 DOE wells on or adjacent to the site and two Moquino Water Users Association wells approximately 2 miles west of the site in the village of Moquino. Table 3-2 lists the wells that are in the monitoring network. Samples are analyzed for chloride, nitrate (nitrate plus nitrite as nitrogen), selenium, sulfate, total dissolved solids, and uranium. Analytical results are compared to the alternate concentration limits (ACLs) and alternate abatement standards (AASs) provided in Table 3-3.

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

Monitoring Well	Network Application
1A	POC source zone well
17B	POC source zone well
29A	Background well
61	Seepage indicator well
62	Seepage affected area indicator well
63	POE seepage indicator well
69	POC source zone well
72	POE well on east property boundary
81	POC source zone well
100	POE well on west property boundary
Moquino Well (new)	Water users supply well in Moquino
Moquino Well (old)	Backup supply well in Moquino

Key: POC = point-of-compliance; POE = point-of-exposure

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

Analyte	New Mexico Standard[a]	ACL (Wells 1A, 17B, 69, 81)	AAS Source Zone (Wells 1A, 17B, 69, 81)	AAS Affected Area (Well 62)
Chloride (mg/L)	250	NA	1,127	NA
Nitrate (mg/L)	10.0	NA	1,180	NA
Selenium (mg/L)	0.05	2.0	2.0	NA
Sulfate (mg/L)	4,000[b]	NA	13,110	5,185
TDS (mg/L)	5,880[b]	NA	20,165	7,846
Uranium (mg/L)	0.03[c]	13.0	13.0	NA

Key: AAS = alternate abatement standard; ACL = alternate concentration limit; mg/L = milligrams per liter; NA = not applicable; TDS = total dissolved solids

[a]New Mexico Water Quality Control Commission regulation 20.6.2.3103.
[b]Background value approved for the L-Bar site and listed in the LTSP.
[c]The standard was 5.0 mg/L when the LTSP was prepared.

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

As stipulated in the LTSP, the requirements for annual groundwater monitoring were met in 2007. Consequently, the sampling frequency changed to once every 3 years beginning in fall 2010 in accordance with the LTSP. Groundwater monitoring will continue as long as a New Mexico standard (Table 3-3) is exceeded in any well. The next groundwater monitoring event is scheduled for November 2013; results will be reported in the 2014 compliance report.

3.7.2 Erosion Monitoring Program

An EMP was developed to address potential erosion of the tailings impoundment 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 impoundment consists of a 4.1-foot-thick (minimum) compacted layer of clay to function as a radon barrier, 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
3A progress of revegetation. Measurements were made during the annual site inspection on August 20, 2013.

3.7.2.1 Erosion Monitoring

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

Each monitoring point 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 point such that approximately 1 foot remained above the cover surface. Each rebar has a metal tag indicating the point 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.

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, in accordance with 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 points. 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 2013 measurements are presented in Table 3-4. Baseline measurements are included for comparison. The surface elevation has increased at all but two of the monitoring points when compared to the baseline measurements. These results indicate that the surface of the disposal cell is accreting instead of eroding. The vegetation on the cover may be raising the surface elevation through root growth, the accumulation of organic materials in the surface soil, or the trapping of windblown sediment derived from locations upwind of the tailings impoundment.

Table 3-4. Surface Elevation Changes on the L-Bar, New Mexico, Tailings Impoundment Cover Between 2003 and 2013

Monitoring Point	Length of Rebar Above Surface (inches)				Change in Surface Elevation[a] Baseline to Present (decimal inches)
	2003 (Baseline)		2013		
	(fraction)	(decimal)	(fraction)	(decimal)	
A1	12 10/16	12.625	11 0/16	11.000	1.625
A2	12 7/16	12.438	12 5/16	12.313	0.125
A3	12 15/16	12.938	11 14/16	11.875	1.063
A4	12 6/16	12.375	11 11/16	11.688	0.687
B1	12 10/16	12.625	11 6/16	11.375	1.250
B2	12 8/16	12.500	12 4/16	12.250	0.250
B3	13 0/16	13.000	12 11/16	12.688	0.312
B4	12 15/16	12.938	12 6/16	12.375	0.563
C1	12 8/16	12.500	11 10/16	11.625	0.875
C2	13 1/16	13.063	13 1/16	13.063	0.000
C3	12 2/16	12.125	11 6/16	11.375	0.750
C4	12 6/16	12.375	12 4/16	12.250	0.125
D1	12 7/16	12.438	12 1/16	12.063	0.375
D2	12 12/16	12.750	12 13/16	12.813	-0.063
D3	12 3/16	12.188	11 10/16	11.625	0.563
D4	12 12/16	12.750	12 14/16	12.875	-0.125
E1	13 1/16	13.063	12 5/16	12.313	0.750
E2	12 14/16	12.875	12 5/16	12.313	0.562
E3	12 9/16	12.563	12 3/16	12.188	0.375
E4	12 15/16	12.938	12 12/16	12.750	0.188

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

3.7.2.2 Vegetation Monitoring

DOE established 10 vegetation monitoring locations to measure the progress of revegetation over time. Plots were established at existing erosion monitoring points to streamline measurement activities at the site (monitoring points A1, A3, B2, B4, C1, C3, D2, D4, E1, and E3). At each location, 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-8).

The primary 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. 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.

The average foliar cover of live vegetation in the vicinity of the L-Bar disposal site, according to the U.S. Department of Agriculture and estimated from observation, is approximately 25 percent. The predominant vegetation in the area consists of perennial grasses, forbs, and shrubs. In accordance with the EMP, DOE will perform annual vegetation measurements until at least 20 percent foliar cover is achieved, and this criterion will be satisfied when more than half of the measurement plots exceed 20 percent 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, the plots will be measured again. Annual vegetation monitoring will continue until the success criterion has again been satisfied.

Results of the 2013 measurements, compared to the 2012 measurements, are presented in Table 3-5. Perennial plant species observed within the monitoring plots included Nelson's globemallow, silverleaf nightshade, bottlebrush squirreltail, galleta grass, broom snakeweed, rubber rabbitbrush, and fourwing saltbush. None of the plots contained more than 20 percent perennial foliar cover in 2013. When compared to the 2012 measurements, the 2013 foliar cover measurements were noticeably less in most of the plots. The primary reason for the decrease in foliar cover is most likely the continued drought that began in 2011. Annual vegetation monitoring will continue until six or more plots meet or exceed the 20 percent foliar cover requirement.

Table 3-5. Comparison of Perennial Plant Cover on the L-Bar, New Mexico, Tailings Impoundment Cover Between 2012 and 2013

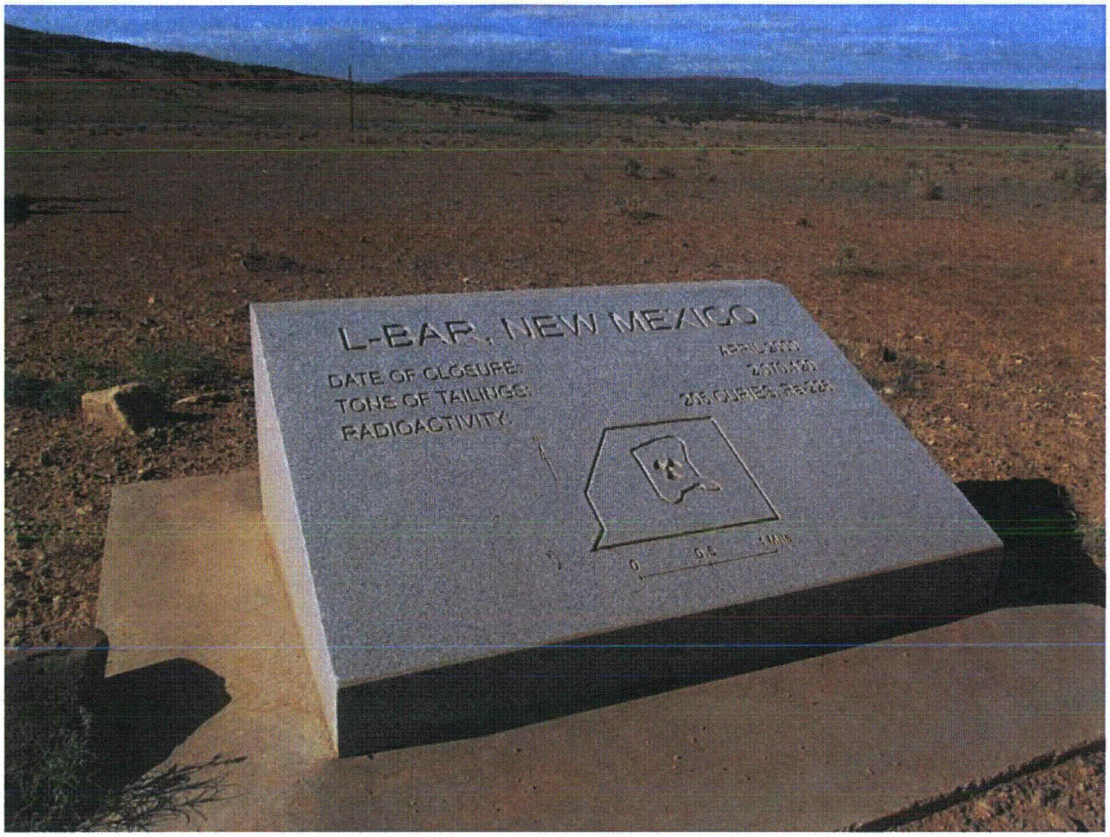
Plot Location	Percent Perennial Plant Cover in 100-foot^2 Plots	
	2012	2013
A1	28	12
A3	12	7
B2	0	0
B4	23	13
C1	24	7
C3	2	2
D2	10	9
D4	5	1
E1	25	5
E3	12	6

3.8 Photographs

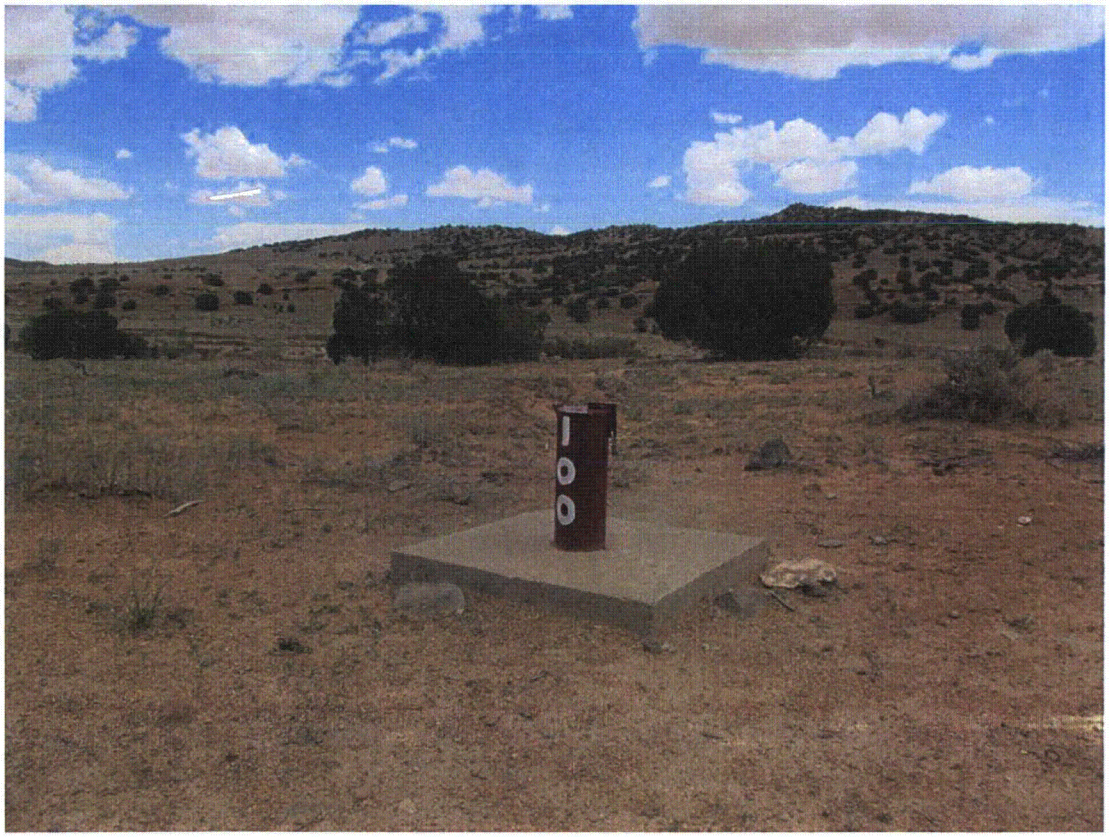
Photograph Location Number	Azimuth	Photograph Description
PL-1	180	Entrance sign and site marker.
PL-2	210	Site entrance gate.
PL-3	215	Site marker at site entrance.
PL-4	90	Monitoring well 100.
PL-5	175	Tailings containment dam.
PL-6	130	Sediment trap (dry).
PL-7	285	Tres Hermanos Sandstone outcrop (dry).
PL-8	260	Erosion monitoring point and vegetation plot C1.

BAR 8/2013. PL-1. Entrance sign and site marker.

BAR 8/2013. PL-2. Site entrance gate.



BAR 8/2013. PL-3. Site marker at site entrance.



BAR 8/2013. PL-4. Monitoring well 100.

BAR 8/2013. PL-5. Tailings containment dam.

BAR 8/2013. PL-6. Sediment trap (dry).

BAR 8/2013. PL-7. Tres Hermanos Sandstone outcrop (dry).

BAR 8/2013. PL-8. Erosion monitoring point and vegetation plot C1.

This page intentionally left blank

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 was inspected on August 6, 2013. The disposal cell, ancillary cell, and all associated surface water diversion and drainage structures were in good condition and functioning as designed. Deep-rooted plants growing on the disposal cell and noxious weeds present on the site were treated with herbicide. No maintenance needs or cause for a follow-up inspection were identified.

4.2 Compliance Requirements

Requirements for the long-term surveillance and maintenance of the Maybell West site are specified in the *Long-Term Surveillance Plan for the Maybell West (UMTRCA Title II) Disposal Site, Moffat County, Colorado,* (LMS/MAW/S01879, U.S. Department of Energy [DOE] Office of Legacy Management, February 2010) and procedures established by DOE to comply with the requirements of Title 10 *Code of Federal Regulations* Part 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 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 2010. DOE is the licensee and, in accordance with the requirements for UMTRCA Title II sites, is responsible for the custody and long-term care of the site. Institutional controls at the site include federal ownership of the property and the following features that are inspected annually: a site marker, warning/no trespassing signs, and boundary monuments.

4.4 Inspection Results

The site, located approximately 4 miles north-northeast of the town of Maybell in Moffat County in northwestern Colorado, was inspected on August 6, 2013. The inspection was conducted by S. Hall and C. Bahrke of S.M. Stoller Corporation (Stoller), the Legacy Management Support contractor at the DOE office in Grand Junction, Colorado. J. Nguyen (DOE Office of Legacy Management site manager), M. Cosby (Colorado Department of Public Health and Environment), R. Evans (NRC), and D. Ravelojaona (Stoller) attended the inspection.

The purposes of the inspection were to confirm the integrity of visible features at the site, to identify changes in conditions that may affect site integrity, and to determine the need, if any, for maintenance or additional inspections and monitoring. Numbers in the left margin of this report refer to items summarized in Table ES-1 of the Executive Summary.

4.4.1 Site Surveillance Features

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

4.4.1.1 Site Access

Access to the site is provided via County Road 53 that 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). The gravel-surfaced county road was in good condition.

From that point the access road continues west as a dirt two-track 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. The access road to the site was in good condition.

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 (identified by the first gate), DOE is responsible for maintenance of the remaining portion of the access road under a BLM right-of-way permit.

4.4.1.2 Fence and Entrance Gate

A standard four-strand barbed-wire stock fence surrounds the disposal cell, the ancillary cell, and the drainage structures to facilitate land management by DOE. The site is located in wintering grounds frequented by big game animals (primarily pronghorn, deer, and elk) and is also surrounded by open range land used for grazing by cattle. The fence was in good condition.

The entrance gate, a standard tubular metal stock gate, is located near the southeast corner of the site. The gate was locked and in good condition. There are no other gates at the site.

4.4.1.3 Signs

The entrance sign is mounted on a perimeter fence metal t-post directly south of the entrance gate. The entrance sign was in good condition.

Ten warning (perimeter) signs are mounted on perimeter fence metal t-posts around the site. The perimeter signs were in good condition.

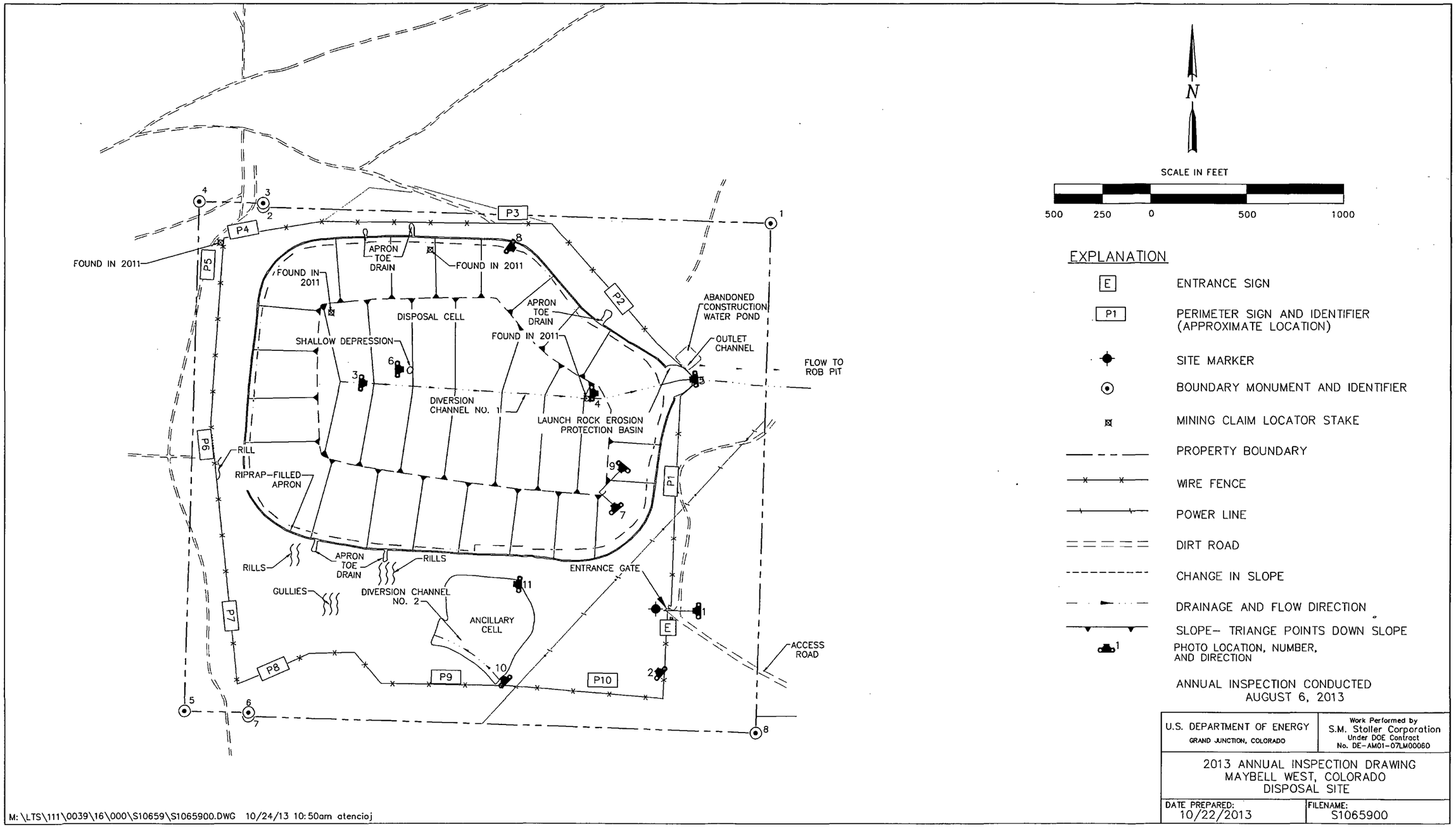


Figure 4-1. 2013 Annual Compliance Drawing for the Maybell West, Colorado, Disposal Site

This page intentionally left blank

4.4.1.4 Site Marker

One standard granite site marker is located on the site near the entrance gate (PL-1). The site marker was in good condition.

4.4.1.5 Boundary Monuments

Eight surveyed monuments are located on the site boundary outside of the fenced area. Four of the monuments are at the property corners, and the others define a slight offset that occurs along both the north and south boundaries where the fee land adjoins the BLM withdrawal area on the western portion of the site. The boundary monuments were not checked during the inspection.

4.4.2 Inspection Areas

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

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

4.4.2.1 Top Slope of the Disposal Cell

The rock-covered disposal cell (PL-2), a reclaimed former heap leach area that occupies about 60 acres of the site, was in good condition. It rises to a maximum height of approximately 75 feet above the surrounding landscape.

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-3), which is graded toward and then down the east side slope of the cell (PL-4). Surface water runoff ultimately discharges into a former open pit uranium mine (known as Rob Pit) east of the site. An erosion protection structure, referred to as the launch rock basin (PL-5), 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.

No evidence of slumping, erosion, or rock degradation was observed. However, a small shallow depression is present just north of Diversion Channel No. 1 (PL-6). This depression, approximately 25 feet long, 10 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. No significant change to the shape, size, or depth of the depression was noted during the inspection. Continued visual monitoring of this area will be performed during annual inspections to determine if additional settlement is occurring. The depression currently does not threaten the integrity or performance of the disposal cell.

Some shallow-rooted grasses and weeds were on the cell top (PL-7). Deep-rooted plants and noxious weeds are controlled in accordance with the LTSP.

Several mining claim locator stakes were observed on the site during the 2010 and 2011 inspections; no new stakes were noted during this inspection. The stakes are on the disposal cell and other portions of the site. BLM has informed DOE that these stakes are not actual claims but are lode mining claim locators, which are the precursor to a claim. Research would be needed to determine if there are valid subsurface mineral rights that pre-date the BLM withdrawal for the site. Valid third-party subsurface mineral rights exist on the fee land acquired on the west side of the site. However, in accordance with 10 CFR 40, Appendix A, Criterion 11, a notice was filed in the local public land records that indicates the land is being used for the disposal of radioactive materials and is subject to an NRC license that prohibits the disruption and disturbance of the disposed material. Should it be determined that senior subsurface rights exist that pre-date the withdrawal, protections pursuant to the NRC general license for the disposal site appear to preclude any mining activity that would jeopardize the disposal cell and its associated drainage control structures (i.e., 10 CFR 40.28[d)]).

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, constructed with a 20 percent slope grade and covered with a 1-foot-thick layer of riprap, were in good condition (PL-8). Surface water runoff from the side slopes of the disposal cell is conveyed by an apron at the toe of the cell to several appropriately spaced toe drains that lie perpendicular to, and slope away from, 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 has not impacted the performance of the toe drain.

4.4.2.3 Ancillary Cell

The ancillary cell, which was in good condition (PL-9), was constructed to contain all 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. Diversion Channel No. 2 runs along the south side of the ancillary cell to convey surface water runoff away from the cell (PL-10).

Various species of shallow-rooted plants were present on the cell top. Deep-rooted plants and noxious weeds are controlled in accordance with the LTSP.

4.4.2.4 Diversion and Drainage Channels

Final surface conditions at the site are 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 diversion channels and outlet channel of the launch rock basin were in good condition.

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 (PL-11). Several gullies and rills have developed along this slope but do not threaten the integrity of the disposal cell; however, 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

The balance of the site and the site perimeter were in good condition. 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.

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

No 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. Twenty-three of the 30 years of monitoring occurred after mill operations ceased, and 10 of those years occurred after completion of site reclamation.

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 in the vicinity of the site and an increased potential for site disturbance. There was no evidence of such activities that might affect the long-term performance or stability of the site.

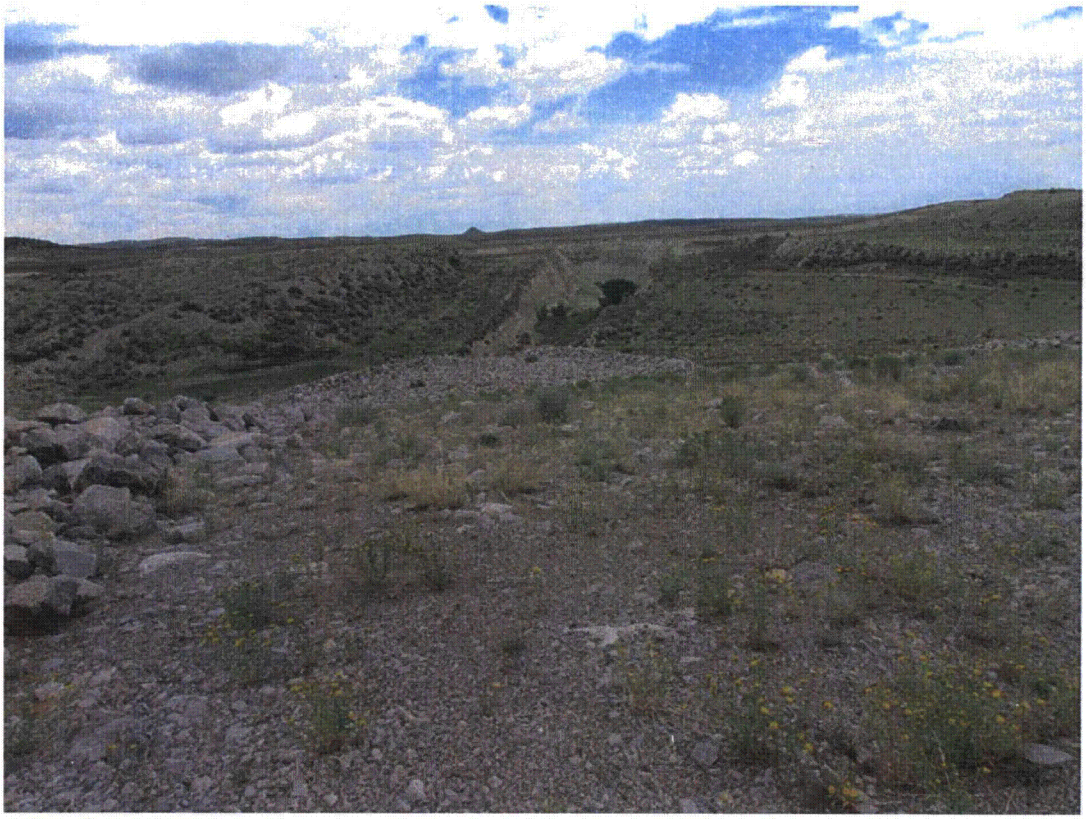
4.8 Photographs

Photo Location Number	Azimuth	Photograph Description
PL-1	270	Site marker.
PL-2	310	View of disposal cell from southeast corner of site.
PL-3	95	View downgradient in Diversion Channel No. 1 on disposal cell top slope.
PL-4	90	Diversion Channel No. 1 exiting the disposal cell top slope to east side slope (launch rock erosion protection basin and Rob Pit in background).
PL-5	265	Launch rock erosion protection basin.
PL-6	90	Small shallow depression on disposal cell top slope.
PL-7	320	Disposal cell top slope viewed from southwest corner.
PL-8	125	Northeast side slope of disposal cell.
PL-9	220	Ancillary cell.
PL-10	315	Diversion Channel No. 2 south of ancillary cell.
PL-11	275	Erosion protection berm north of ancillary cell.

MAW 8/2013. PL-1. Site marker.

MAW 8/2013. PL-2. View of disposal cell from southeast corner of site.

MAW 8/2013. PL-3. View downgradient in Diversion Channel No. 1 on disposal cell top slope.



MAW 8/2013. PL-4. Diversion Channel No. 1 exiting the disposal cell top slope to east side slope (launch rock erosion protection basin and Rob Pit in background).

MAW 8/2013. PL-5. Launch rock erosion protection basin.

MAW 8/2013. PL-6. Small shallow depression on disposal cell top slope.

MAW 8/2013. PL-7. Disposal cell top slope viewed from southwest corner.

MAW 8/2013. PL-8. Northeast side slope of disposal cell.

MAW 8/2013. PL-9. Ancillary cell.

MAW 8/2013. PL-10. Diversion Channel No. 2 south of ancillary cell.

MAW 8/2013. PL-11. Erosion protection berm north of ancillary cell.

This page intentionally left blank

5.0 Sherwood, Washington, Disposal Site

5.1 Compliance Summary

The Sherwood, Washington, Uranium Mill Tailings Radiation Control Act (UMTRCA) Title II Disposal Site was inspected on July 17, 2013. The tailings impoundment, dam, and diversion channel were in good condition. The dam inspection and associated piezometer water level measurements verified that the tailings dam is functioning as designed. No maintenance needs or cause for a follow-up inspection were identified.

5.2 Compliance Requirements

Requirements for the long-term surveillance and maintenance of the Sherwood site are specified in the *Long-Term Surveillance Plan for the DOE Sherwood Project (UMTRCA Title II) Reclamation Cell, Wellpinit, Washington* (U.S. Department of Energy [DOE], Grand Junction, Colorado, February 2001) and in procedures established by DOE to comply with the requirements of Title 10 *Code of Federal Regulations* Part 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 United States of America, in trust for the Spokane Tribe of Indians, owns the 380-acre site. The site was accepted under the U.S. Nuclear Regulatory Commission (NRC) general license (10 CFR 40.28) in 2001. Because the site is on the Spokane Indian Reservation, no agreement of transfer was necessary for conveying the property rights to DOE. However, an agreement 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. Institutional controls at the site include federal ownership of the property and the following features that are inspected annually: a site marker, boundary monuments, and warning/no trespassing signs.

5.4 Inspection Results

The site, located near Wellpinit, Washington, was inspected on July 17, 2013. The inspection was conducted by D. Traub and L. Sheader of the S.M. Stoller Corporation, the Legacy Management Support contractor at the DOE office in Grand Junction, Colorado. M. Kautsky, of the DOE Office of Legacy Management, 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 may affect site integrity, and to determine the need, if any, for

maintenance or additional inspection and monitoring. Numbers in the left margin of this report refer to items summarized in Table ES-1 of the Executive Summary.

5.4.1 Site Surveillance Features

The locations of site surveillance features are shown on Figure 5-1. 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 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 (BIA) maintains Elijah Road, the all-weather site road over which DOE has permanent right-of-access. Two double-swing steel gates across the road were intended to control access to the disposal site and the nearby Sherwood mine area and Tribe-owned facilities. Because of trespassing and vandalism concerns, BIA planned to keep the first (outer) gate locked, which also includes a DOE lock; the second gate is no longer kept closed. 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 located along the site boundary at likely access points around the site. The signs are attached to steel posts set in concrete. Missing perimeter sign P6 (PL-1) was replaced during this inspection visit. The other signs were in good condition.

5.4.1.3 Site Marker and Boundary Monuments

One inscribed granite site marker is present on the southwest side of the site where the access road lies closest to the site boundary. The marker was in excellent condition (PL-2).

Six boundary monuments set in concrete define the site boundary. Boundary monument BM-3A, located near the northwest corner of the tailings dam, 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 have been installed at each monument location (PL-3). Due to the return of the small buffalo herd and their unknown location during the day (PL-4), several of the boundary monuments were not verified during the inspection.

5.4.1.4 Monitoring Wells and Piezometers

Three monitoring wells are located on the site and are designated wells 2B, 4, and 10. The wells were secure and in good condition.

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 to a depth equivalent to the base of the dam. All piezometers were secure and in good condition.

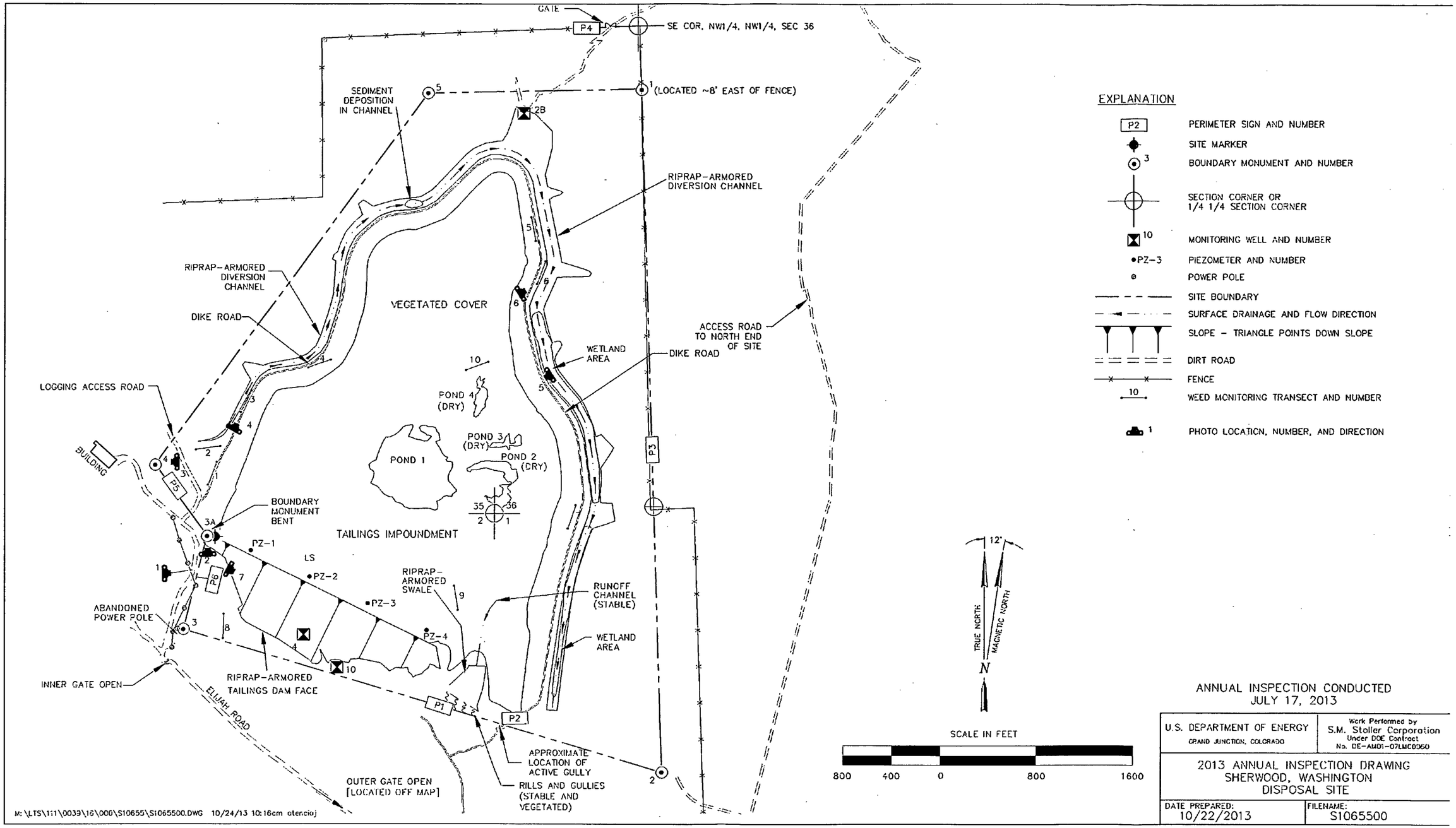


Figure 5-1. 2013 Annual Compliance Drawing for the Sherwood, Washington, Disposal Site

This page intentionally left blank

5.4.2 Inspection Areas

In accordance with the Long-Term Surveillance Plan (LTSP), the site is divided into three inspection areas (referred to as "transects" in the LTSP) to ensure a thorough and efficient inspection: (1) the cover of the tailings impoundment; (2) the diversion channel and impoundment dam face; and (3) the area between the diversion channel and site boundary, and the outlying area.

Within each area, inspectors examined the specific site surveillance features 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 Tailings Impoundment Cover

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

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 located 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.

Designers of the cell predicted that some settlement would continue after the uncompacted cover was put in place, and that the cover would be self-healing with regard to impacts from freezing and thawing, biointrusion, and settlement (LTSP, page 2-14). The largest area of settlement is referred to as Pond 1. Standing water was present in Pond 1 at the time of the inspection, and the plant species present indicate that there is year-round moisture below the surface of the pond area (PL-5). Other minor depressions, designated as Ponds 2, 3, and 4, did not contain standing water. 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, such as sinkholes or differential displacement, to verify the cover's integrity and ensure that the impoundment is performing as designed.

5.4.2.2 Diversion Channel and Impoundment Dam Face

The riprap-armored diversion channel around the tailings impoundment was in good condition. 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. Volunteer plant intrusion within the diversion channel, including trees, is evident in most areas of the channel. Sediment deposition is evident in places on the west side 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 trails cross the channel at numerous locations. Buffalo or horse movement patterns have caused displacement of the diversion channel riprap in several places (PL-6) but these are not in areas that would lead to further erosion.

5A 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 Federal Dam Safety Act. The tailings dam face was inspected in accordance with the Dam Inspection Checklist included at the end of this report. No evidence of seepage, slumping, erosion, or instability was observed.

Measurements of water levels in the four piezometers were obtained on July 17, 2013. These annual measurements, 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. Piezometers PZ-1, PZ-3, and PZ-4 had miniscule amounts of water in them, likely attributable to water collecting in the end-caps on the bottom of each piezometer. These small amounts may represent the presence of perched water in the screened zone after a significant precipitation event. Piezometer PZ-2, normally containing 1 to 3 feet of water, had 2.42 feet of water this year. 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 there is more than 200 feet of unsaturated material beneath the perched zone. On the basis of the 2013 piezometer measurements, the tailings dam is considered to be in an unsaturated condition.

The tailings dam face has a rock cover consisting primarily of highly durable quartz monzonite; the rock appeared to be in excellent condition. 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 has successfully vegetated (PL-7 and PL-8).

5.4.2.3 Area Between the Diversion Channel and Site Boundary, and Outlying Area

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 located within 0.25 mile of the site boundary. A vacant metal building, left in place from earlier mining operations, is located about 500 feet west of the western site boundary. No new development was evident east of the site along Elijah Road.

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. No need for a follow-up inspection was identified during the inspection.

5.6 Routine Maintenance and Emergency Measures

One perimeter sign that was missing was replaced during this inspection using theft-resistant hardware. 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.

5.7 Environmental Monitoring

5.7.1 Groundwater Monitoring

5B 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 designated indicator parameters. Samples are collected annually from one background well north of the tailings impoundment, identified as well 2B, and two downgradient wells near the base of the tailings dam, identified as wells 4 and 10. Samples are analyzed for sulfate, chloride, and total dissolved solids. Sulfate and chloride are the primary indicator parameters.

Monitoring results are evaluated for evidence of groundwater impact from the reclamation cell. Should the concentration of sulfate or chloride exceed the State of Washington water quality criteria values of 250 milligrams per liter for either parameter, DOE will conduct confirmatory sampling of the downgradient wells. If the confirmatory sampling verifies the exceedance, DOE will develop an evaluative monitoring work plan, in consultation with the Tribe and the U.S. Bureau of Indian Affairs, and submit that plan to NRC for review prior to initiating the evaluative monitoring program. Results of an evaluative monitoring program would be used to determine if corrective action is necessary.

Groundwater sampling was conducted on July 17, 2013, and the results are presented in Table 5-2. Groundwater constituent concentrations continue to be less than the action levels for confirmatory sampling, and no upward trends are apparent.

Table 5-2. 2013 Groundwater Quality Results for the Sherwood, Washington, Disposal Site

Constituent	Water Quality Criterion[a]	Background Well 2B	Downgradient Well 4	Downgradient Well 10
Chloride, mg/L	250	3.0	1.1	2.4
Sulfate, mg/L	250	4.2	3.9	28
TDS, mg/L	N/A	220	360	640

Key: mg/L = milligrams per liter; N/A = not applicable; TDS = total dissolved solids
[a]State of Washington water quality criteria used as action levels

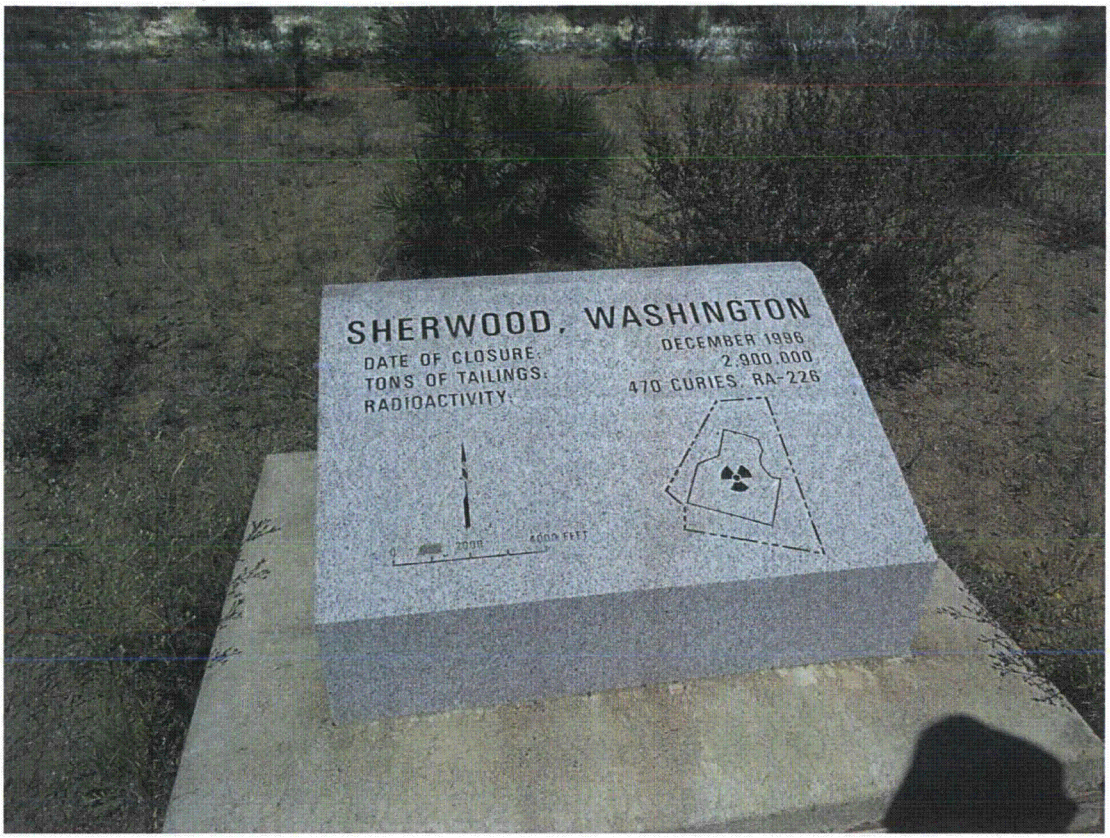
5.7.2 Vegetation Monitoring

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 native shrubs, forbs, grasses, and trees. Reclamation has been successful, as a healthy stand of vegetation has established on the cell cover and surrounding features. Noxious weeds continue to be managed through biocontrol efforts and the application of herbicide.

5.8 Photographs

Photograph Location Number	Azimuth	Description
PL-1	90	Replacement of perimeter sign P6.
PL-2	0	Site marker.
PL-3	270	Boundary monument BM-4.
PL-4	30	Return of buffalo herd to site in 2013.
PL-5	240	Pond 1 on tailings impoundment cover.
PL-6	60	Animal trail across diversion channel.
PL-7	120	Tailings dam face.

SHE 7/2013. PL-1. Replacement of perimeter sign P6.



SHE 7/2013. PL-2. Site marker.

SHE 7/2013. PL-3. Boundary monument BM-4.

SHE 7/2013. PL-4. Return of buffalo herd to site in 2013.

SHE 7/2013. PL-5. Pond 1 on tailings impoundment cover.

SHE 7/2013. PL-6. Animal trail across diversion channel.

SHE 7/2013. PL-7. Tailings dam face.

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

Date of Inspection: July 17, 2013

Inspector	Organization
D. Traub	S.M. Stoller Corp.

Piezometer PZ-1 current year water depth: (Previous year depth: 0.05 ft)	0.17
Piezometer PZ-2 current year water depth: (Previous year depth: 1.51 ft)	2.42
Piezometer PZ-3 current year water depth: (Previous year depth: dry)	0.05
Piezometer PZ-4 current year water depth: (Previous year depth: 0.21 ft)	0.27
Was evidence of significant seepage observed on the dam face? If yes discuss in report.	No
Was evidence of significant slumping observed on the dam? If yes discuss in report.	No
Was evidence of significant erosion observed on the dam? If yes discuss in report.	No
Was vegetative growth that could compromise dam stability observed? If yes discuss in report.	No
Was any condition that presents an imminent hazard to human health and safety or to the environment observed? If yes immediately contact the following:	No

DOE Grand Junction (877) 695-5322
NRC Operations Center (301) 951-0550
Spokane Tribal Police/Sheriff (509) 258-4400
State Department of Ecology—Dam Safety (360) 407-6625

Note: Piezometer water levels measured during sampling trip on July 17, 2013.

Inspector Signature: David Traub Date: 8-14-13

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 was inspected on June 26, 2013. The disposal cell and all associated surface water diversion and drainage structures were in excellent condition and functioning as designed. No maintenance needs or cause for a follow-up inspection were identified.

Groundwater monitoring indicated that the radium-228 concentration continues to exceed the alternate concentration limit (ACL) at a point-of-compliance (POC) well and a downgradient well between the disposal cell and the site boundary, and radium-226 continues to exceed the ACL in a downgradient well next to the site boundary. The cause of these elevated concentrations is attributed to natural mineralization in the aquifers.

6.2 Compliance Requirements

Requirements for the long-term surveillance and maintenance of the Shirley Basin South site are specified in the *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 2004) and in procedures established by the U.S. Department of Energy (DOE) to comply with requirements of Title 10 *Code of Federal Regulations* Part 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 1,512-acre site 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. Institutional controls at the site include federal ownership of the property and the following features that are inspected annually: a site marker, boundary monuments, and warning/no trespassing signs.

6.4 Inspection Results

The site, located approximately 35 miles south of Casper, Wyoming, was inspected on June 26, 2013. Results of the inspection are described below. R. Johnson and D. Traub of S.M. Stoller Corporation, the Legacy Management Support contractor at the DOE office in Grand Junction, Colorado, conducted the inspection. S. Surovchak, the DOE Office of Legacy

Management site manager, and D. Harris 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 may affect site integrity, and to determine the need, if any, for maintenance or additional inspection and monitoring. Numbers in the left margin of this report refer to items summarized in Table ES-1 of the Executive Summary.

6.4.1 Site Surveillance Features

The locations of site surveillance features are shown in Figure 6-1. 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 in Figure 6-1 by photograph location (PL) numbers.

6.4.1.1 Site Access and Entrance Gate

Access to the Shirley Basin South site is immediately off of Carbon County Road 2 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, located along the south portion of the perimeter fence, was secured by a padlock and chain to the adjoining post and was in good condition (PL-1).

6.4.1.2 Fence and Perimeter Signs

A four-strand barbed-wire perimeter fence encompasses the site to facilitate land management by DOE. The perimeter fence was inspected with the use of an all-terrain vehicle and, except for a damaged portion crossing the north end of Pit 4, was in excellent condition. The 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. Sections along the north perimeter are secured with a temporary wire fence. Ur Energy, the adjacent landowner, will use these sections to reach a topsoil stockpile area on the DOE site.

Nine perimeter signs (warning/no-trespassing signs) are along the site perimeter at potential points of access, and another 25 signs are positioned around the disposal cell (PL-2). Other than perimeter signs P1 and P2, which have bullet holes in them, the signs were in excellent condition.

6.4.1.3 Site Marker and Boundary Monuments

The granite site marker, which is located at the site entrance, was in excellent condition (PL-3). All 26 boundary monuments delineating DOE property were located and were in excellent condition (PL-4).

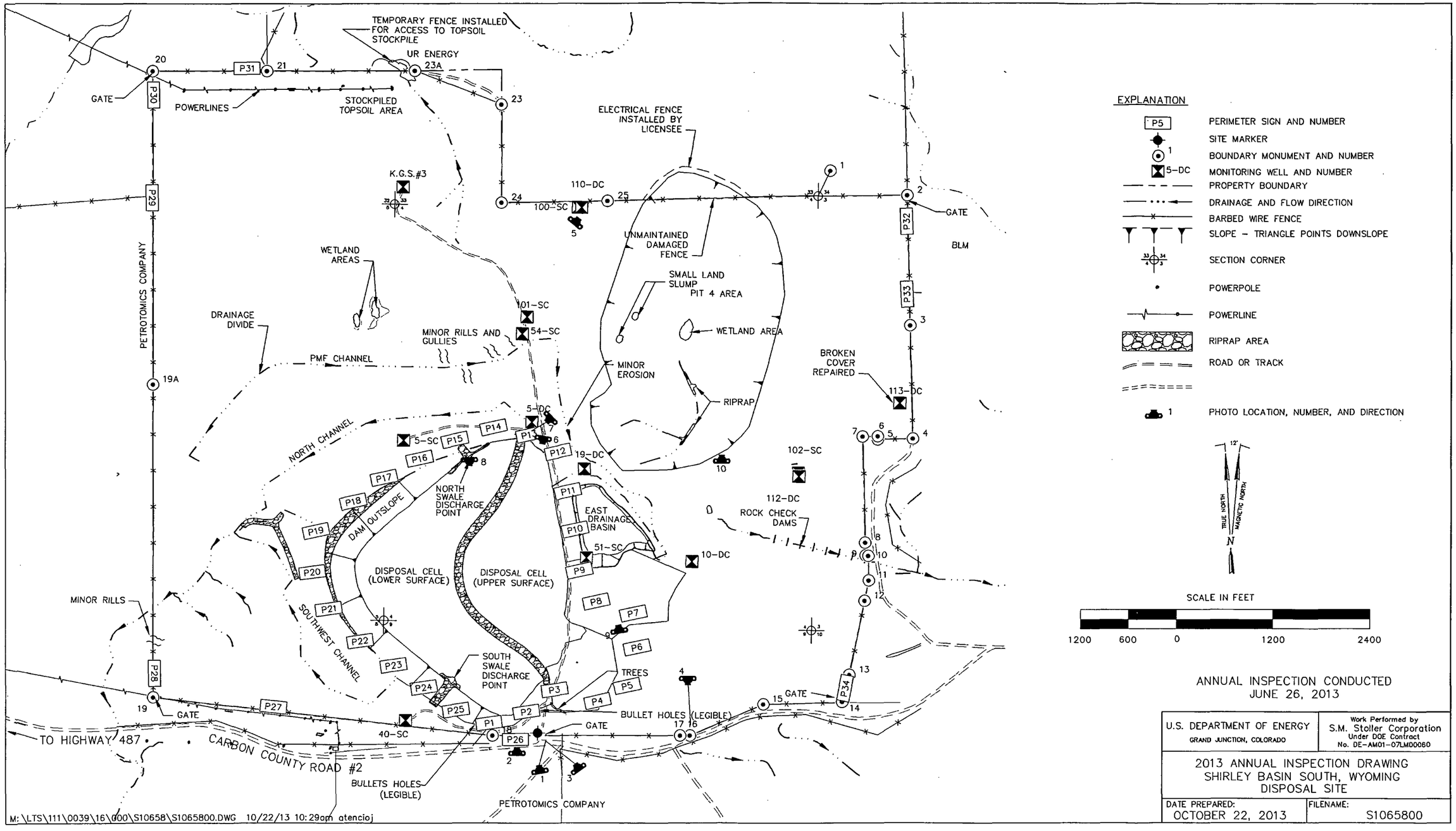


Figure 6-1. 2013 Annual Compliance Drawing for the Shirley Basin South, Wyoming, Disposal Site

This page intentionally left blank

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 during fall 2008. Each well was inspected and, except for a broken clasp on the well protection cover at well 113-DC, was in excellent condition (PL-5). The broken clasp was repaired.

6.4.2 Inspection Areas

In accordance with the Long-Term Surveillance Plan (LTSP), the site is divided into three inspection areas (referred to as "transects" in the LTSP) to ensure a thorough and efficient inspection: (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.

Within each area, inspectors examined the specific site surveillance features and 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. Although stressed due to dry conditions, the vegetation on the disposal cell and throughout the site was in good condition and is managed through a grazing license with a local rancher. The disposal cell surface is constructed at two elevations—the upper surface (PL-6) and the lower surface (PL-7)—separated by a riprap-armored slope. These features were in excellent condition; 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 cell.

Windblown sediment is accumulating in the riprap on the slope, which 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 are usually wet due to snowmelt runoff and summer precipitation. These areas were dry at the time of the inspection.

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 drains to the north and south at riprap-armored discharge points; the discharge structures were in excellent condition (PL-8). The riprap dissipation basins of the discharge points usually hold snowmelt runoff water in spring and early summer but were essentially dry at the time of the inspection.

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 is protected by riprap. The containment dam was in excellent condition; there were no indications of erosion, settlement, or other modifying processes that might affect the integrity of the dam. Vegetation is encroaching on the riprap surfaces, which enhances the stability of the slope.

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. A probable maximum flood (PMF) channel was constructed north of the tailings impoundment along the side of the reclaimed mine overburden spoil pile. 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 a larger drainage area; this basin was dry at the time of the inspection (PL-9). These closed drainage basins are large enough to accommodate the PMF water volumes. The diversion channels were in excellent condition, and no active erosion was apparent in the channels.

6.4.2.3 Balance of the Site and the Site Perimeter

The other major feature on the site is reclaimed Pit 4, in the northeast portion of the site (PL-10). Reclamation activities included rounding the side slopes, partially backfilling the pit to an elevation above the local water table, revegetating the surfaces, and protecting 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; the surface of this area tends to dry out later in the summer, but was already dry at the time of the inspection. Overall, Pit 4 was in good condition, with some minor slumps and displacement features present on the west side slope of the pit.

Private property and public land administered by the U.S. Bureau of Land Management surround the site. Land on three sides is used primarily for livestock grazing. Ur Energy is the current property owner north of the site and is in the process of reclaiming the UMTRCA Title II Shirley Basin North disposal site. Ur Energy's access to and use of stockpiled topsoil on the DOE site is in accordance with an agreement originally established between Petrotomics Company, the former licensee of the Shirley Basin South site, and Pathfinder, which was acquired by Ur Energy. In accordance with the agreement, 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 they have finished removing topsoil from the stockpile. No stockpiled topsoil has yet been removed.

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. The license also allows the rancher to pump water from well K.G.S. #3 for livestock watering purposes and to install watering facilities and solar-powered electric fences to manage the livestock. The grazing licensee has installed these features.

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

A broken clasp on a well protector was repaired. 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.

6.7 Environmental Monitoring

Groundwater monitoring is required at the Shirley Basin South site. The monitoring network, as described in the LTSP, consisted of eight DOE wells completed in aquifers of the Wind River Formation. As agreed to by DOE and NRC, DOE installed six additional monitoring wells in fall 2008 to provide a better understanding of the groundwater chemistry and flow directions of the
6A two aquifers of concern. DOE evaluated the monitoring requirements and sampling results, and provided recommended monitoring program revisions to NRC in August 2013. When NRC concurs with changes to the monitoring program, the LTSP will be revised to address the new monitoring network and sampling requirements. The current monitoring network is described in Table 6-2.

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

Key: POC = point-of-compliance

Water level, pH, and electrical conductivity are measured at the time of sampling, and the samples are analyzed for uranium, radium-226, radium-228, thorium-230, cadmium, chromium, lead, nickel, selenium, chloride, nitrate, sulfate, and total dissolved solids (TDS). Analytical results are compared to the ACLs and Wyoming Class III groundwater protection standards provided in Table 6-3. There are no applicable limits or standards for nitrate at this site. However, it is included as an analyte because it may 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.

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

Analyte	ACL	Groundwater Protection Standard[a]
Uranium (mg/L)	9.2	NA
Radium-226 (pCi/L)	91.3	NA
Radium-228 (pCi/L)	25.7	NA
Thorium-230 (pCi/L)	2,409	NA
Cadmium (mg/L)	0.079	NA
Chromium (mg/L)	1.83	NA
Lead (mg/L)	0.05	NA
Nickel (mg/L)	6.15	NA
Selenium (mg/L)	0.12	NA
Chloride (mg/L)	NA	2,000
Sulfate (mg/L)	NA	3,000
TDS (mg/L)	NA	5,000

Key: ACL = alternate concentration limit; mg/L = milligrams per liter; NA = not applicable; pCi/L = picocuries per liter; TDS = total dissolved solids
[a]Wyoming Class III Groundwater Protection Standards for livestock use are applicable to this site.

The intent of the annual groundwater quality monitoring is to verify that the ACLs are not exceeded at POC wells and to verify continued compliance with the pertinent groundwater protection standards. If an ACL is exceeded at a POC well, or if trends indicate that a groundwater protection standard may be exceeded at the site boundary, DOE will inform NRC and WDEQ of the results and conduct confirmatory sampling. If the confirmatory sampling verifies the exceedance or threat of exceedance, DOE will develop an evaluative monitoring work plan and submit that plan to NRC for review prior to initiating the evaluative monitoring program. Results of the evaluative monitoring program will be used, in consultation with NRC, to determine if corrective action is necessary.

The results for cadmium in POC well 5-SC and radium-228 in POC well 5-DC for DOE's initial sampling in July 2005 exceeded their respective ACLs. 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. To provide a better understanding of the site groundwater characteristics, DOE installed six additional monitoring wells in fall 2008.

The second sampling event after installation of the new wells was conducted in July 2009 and indicated that radium-226 exceeded the ACL in new well 110-DC. NRC and WDEQ were notified of the exceedance, and DOE began to evaluate the cause of the exceedance.

Analytical results for the June 2013 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, 101-SC, and 102-SC because they continue to be dry.

The concentration for cadmium in well 5-SC remained below the ACL and has since 2005. However, radium-228 continued to exceed the ACL in wells 5-DC and 54-SC (Figure 6-2).
6B 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 that occurred 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
6C wells of concern. The cause of elevated radium-228 in these wells is attributed to natural mineralization in the aquifer. The elevated radium-226 concentrations at well 110-DC do not represent a contaminant plume migrating offsite; rather, they are attributed to natural conditions within the ore-bearing sand unit as aquifer recovery continues.

Table 6-4. 2013 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)	0.035	ND	NS	0.0017	ND	NS	NS
Chloride (2,000 mg/L)	340	33	NS	340	160	NS	NS
Chromium (1.83 mg/L)	0.29	ND	NS	0.14	ND	NS	NS
Lead (0.05 mg/L)	ND	ND	NS	0.00062	ND	NS	NS
Nickel (6.15 mg/L)	2.7	0.0072	NS	2.8	ND	NS	NS
Nitrate/Nitrite as N (mg/L)[a]	ND	0.63	NS	ND	ND	NS	NS
Radium-226 (91.3 pCi/L)	5.54	0.376	NS	19.6	4.62	NS	NS
Radium-228 (25.7 pCi/L)	2.95	0.88	NS	**114**[b]	4.20	NS	NS
Selenium (0.12 mg/L)	0.098	0.0042	NS	0.059	0.00014	NS	NS
Sulfate (3,000 mg/L)	*12,000*[c]	1,600	NS	*6,800*[c]	1,100	NS	NS
Thorium-230 (2,409 pCi/L)	371	ND	NS	4.04	ND	NS	NS
TDS (5,000 mg/L)	*19,000*[c]	2,400	NS	*10,000*[c]	2,100	NS	NS
Uranium (9.2 mg/L)	3.0	0.00028	NS	0.054	0.0030	NS	NS

Key: mg/L = milligrams per liter; ND = not detected (below method detection limit); NS = no sample collected (dry well); pCi/L = picocuries per liter; POC = point-of-compliance; TDS = total dissolved solids
[a]No designated limit or standard.
[b]Result exceeded an ACL.
[c]Result exceeded a Wyoming Class III groundwater protection standard.

Table 6-5. 2013 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 (2,000 mg/L)	220	56	64	210	50	7.9
Chromium (1.83 mg/L)	0.011	ND	ND	ND	ND	ND
Lead (0.05 mg/L)	ND	0.0037	ND	0.0083	ND	ND
Nickel (6.15 mg/L)	1.2	ND	0.34	ND	ND	ND
Nitrate/Nitrite as N (mg/L)[a]	ND	ND	ND	ND	ND	0.027
Radium-226 (91.3 pCi/L)	11.5	14.6	4.49	**156**[b]	12.8	3.06
Radium-228 (25.7 pCi/L)	**45.2**[b]	4.65	4.50	5.75	8.66	3.05
Selenium (0.12 mg/L)	0.017	ND	ND	ND	ND	ND
Sulfate (3,000 mg/L)	*7,800*[c]	1,000	1,900	1,800	1,100	620
Thorium-230 (2,409 pCi/L)	0.651	ND	ND	ND	ND	ND
TDS (5,000 mg/L)	*12,000*[c]	1,900	3,300	3,700	2,000	1,100
Uranium (9.2 mg/L)	0.062	0.015	0.00027	0.0094	0.016	0.0011

Key: mg/L = milligrams per liter; ND = not detected (below method detection limit); pCi/L = picocuries per liter; POC = point-of-compliance; TDS = total dissolved solids
[a]No designated limit or standard.
[b]Result exceeded an ACL.
[c]Result exceeded a Wyoming Class III groundwater protection standard.

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 site boundary wells (100-SC, 110-DC, 112-DC, and 113-DC). The standards were exceeded for sulfate and TDS in wells 5-SC, 54-SC, and 5-DC. The 2013 results were within the range of historical measurements for these wells. Chloride concentrations were well below the standard in all wells.

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 (250 milligrams per liter [mg/L]) and TDS (550 mg/L) in the lower sand aquifer compared to those in the main sand aquifer.

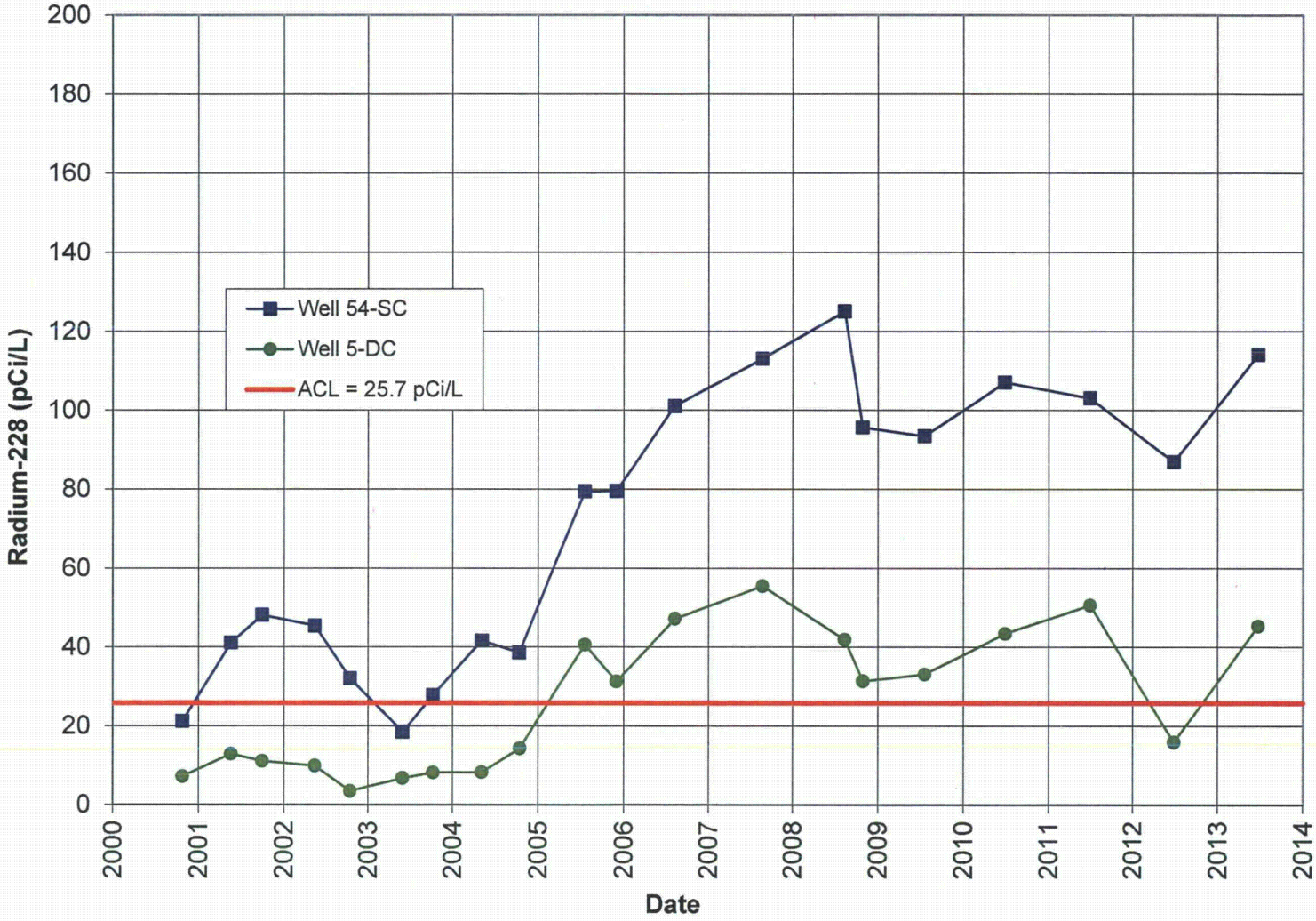


Figure 6-2. Radium-228 Concentrations in Wells 5-DC and 54-SC Since Completion of the Disposal Cell

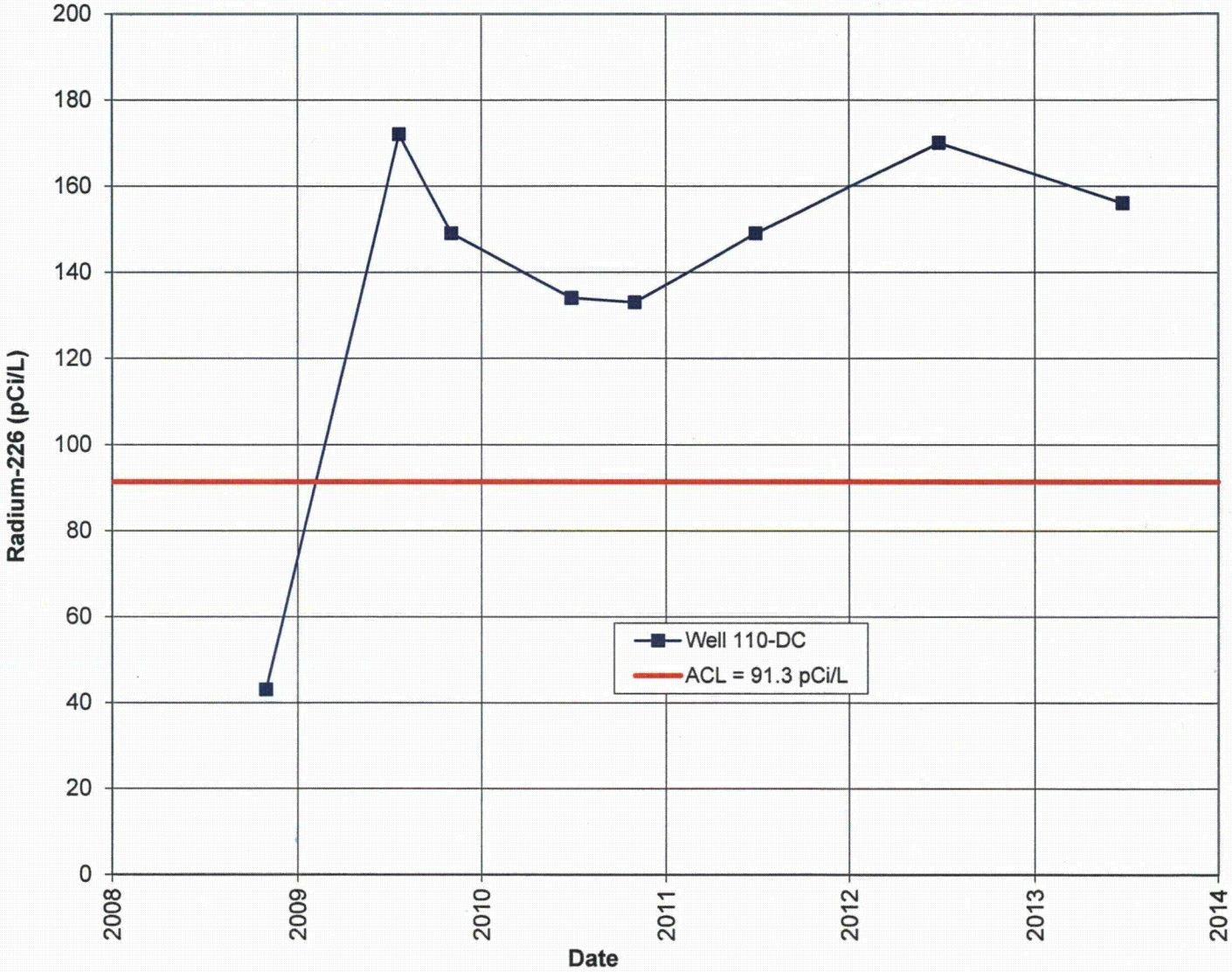


Figure 6-3. Radium-226 Concentrations in Well 110-DC

The LTSP specifies that this report provide iso-concentration 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, 2013 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 lower 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 prior to 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 surface of the upper sand aquifer. The backfill material does not represent 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. The apparent flow direction is to the northeast, along the formation dip and toward Pit 4. The dry wells (51-SC, 101-SC, and 102-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, it may never recover to its 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 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 may prevent a return to pre-mining elevations. Flow direction cannot be determined at this time because water level measurements indicate an essentially flat potentiometric surface at the site.

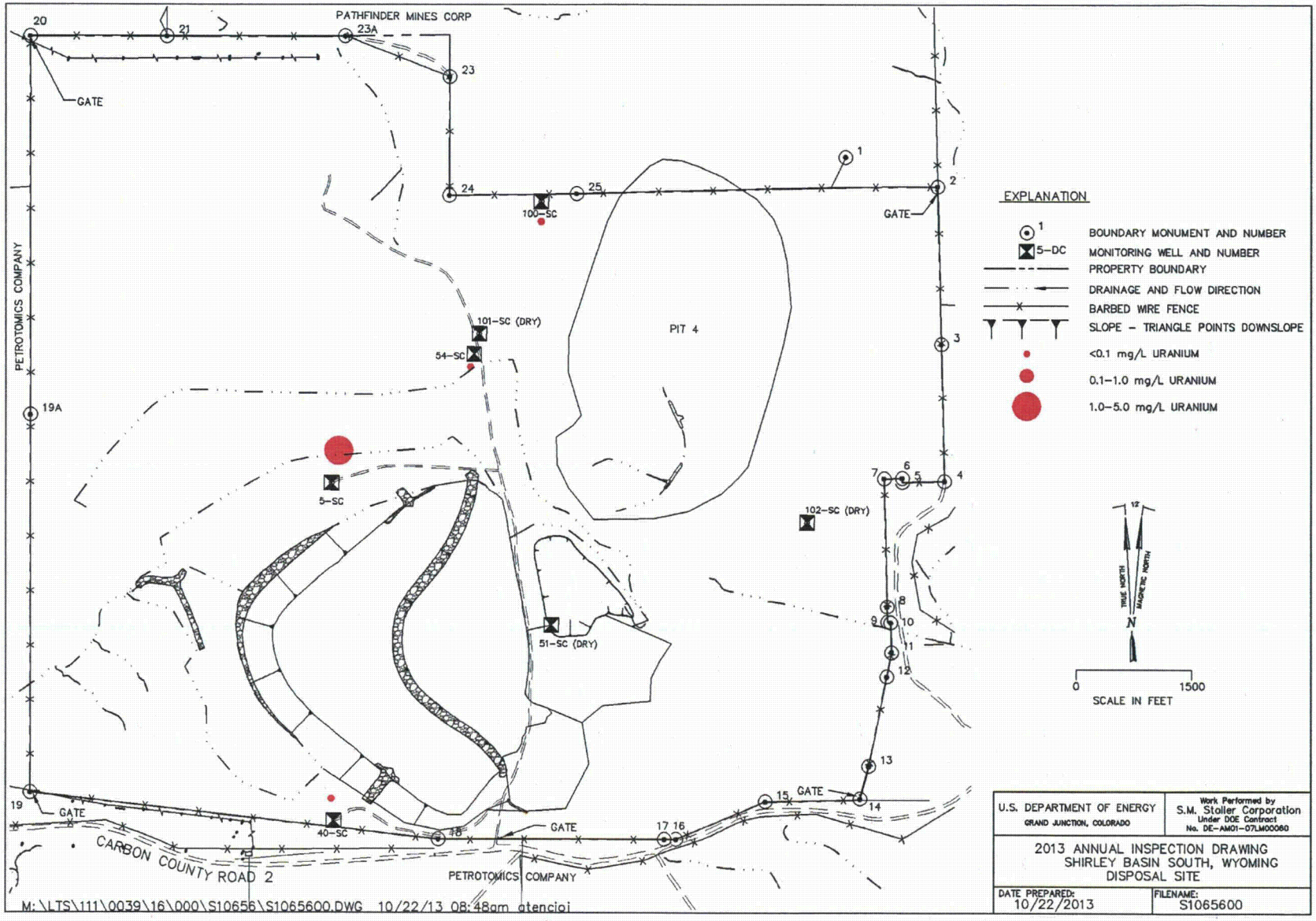


Figure 6-4. June 2013 Uranium Concentrations in the Upper Sand Aquifer at the Shirley Basin South, Wyoming, Disposal Site

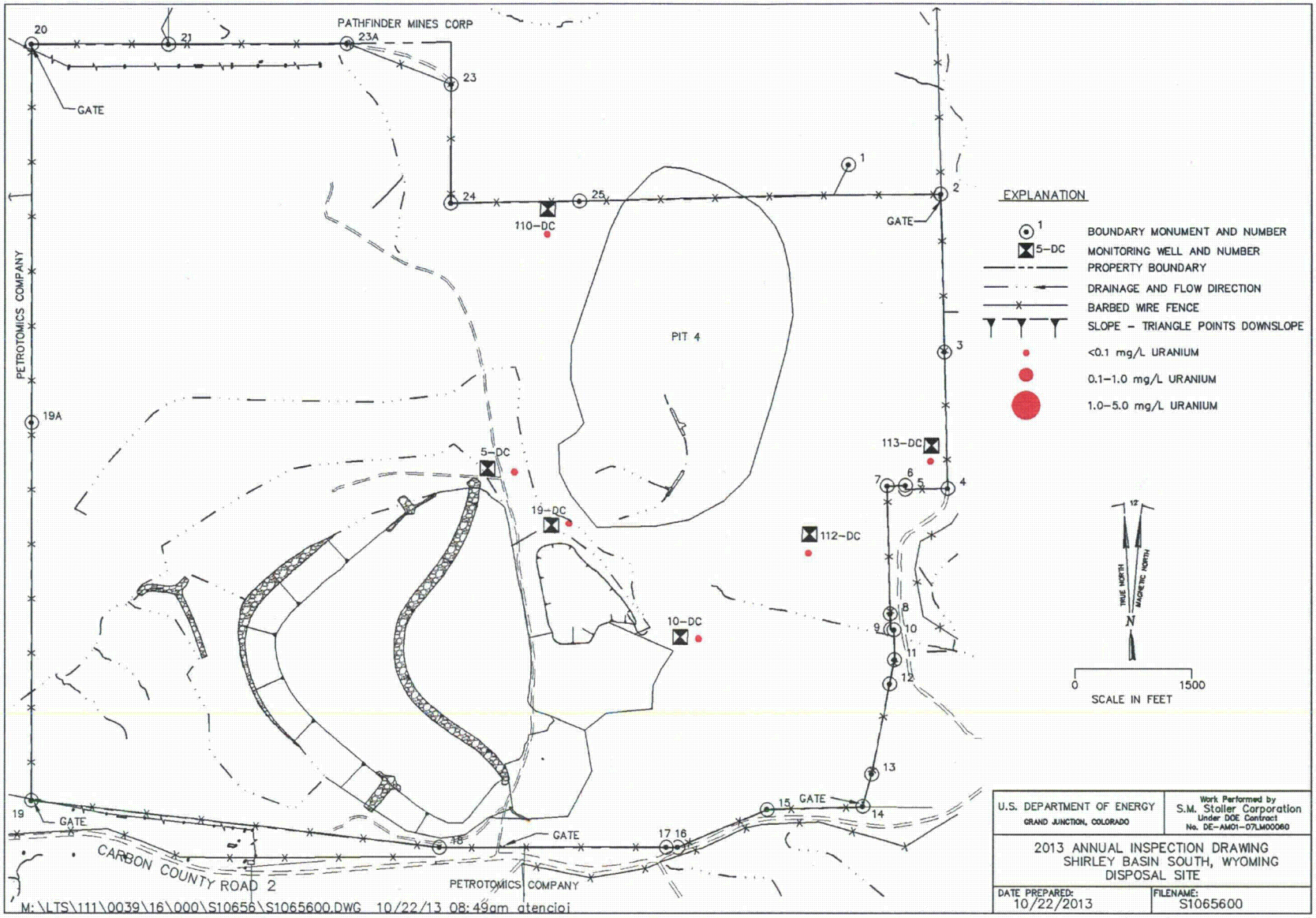


Figure 6-5. June 2013 Uranium Concentrations in the Main Sand Aquifer at the Shirley Basin South, Wyoming, Disposal Site

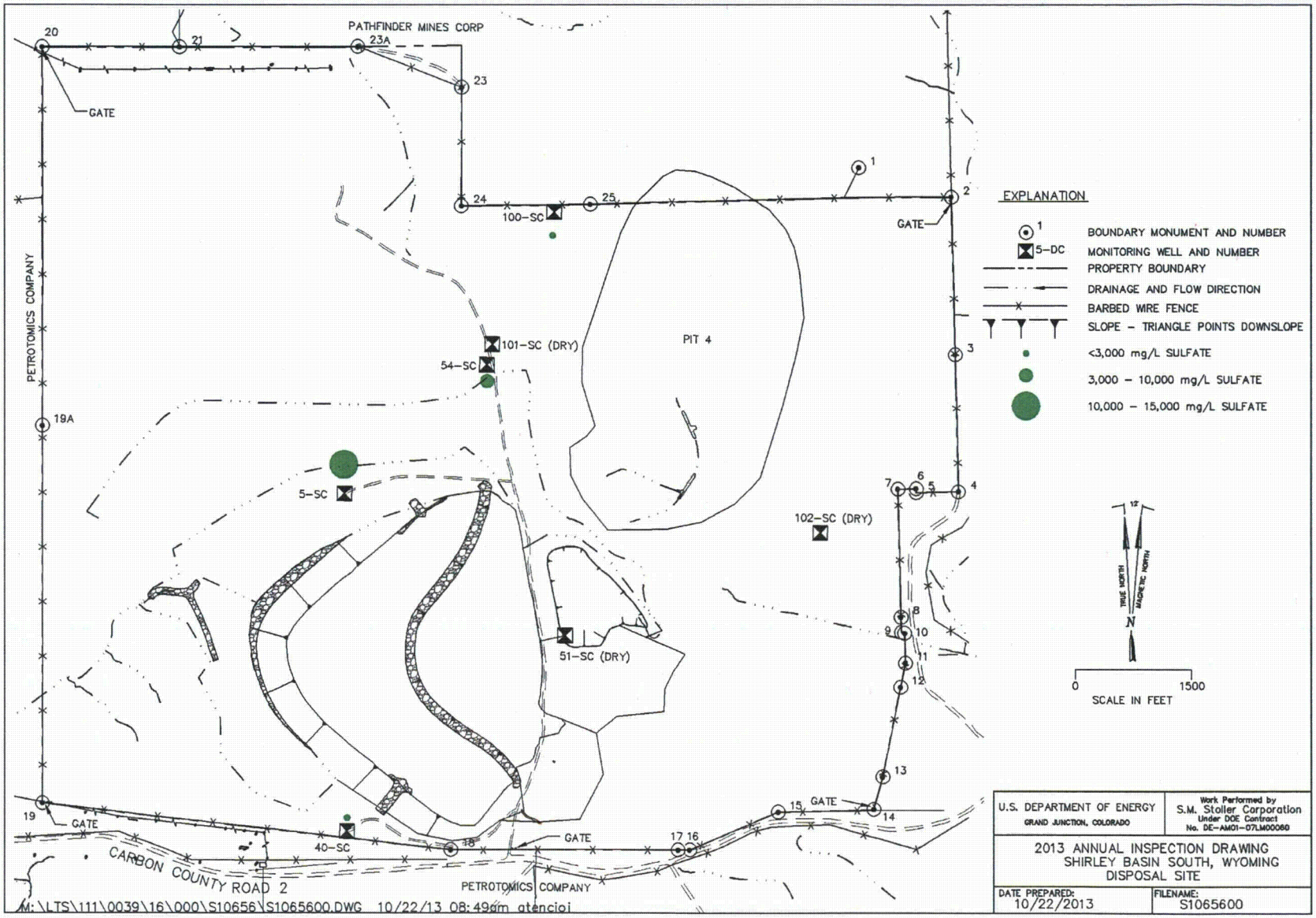


Figure 6-6. June 2013 Sulfate Concentrations in the Upper Sand Aquifer at the Shirley Basin South, Wyoming, Disposal Site

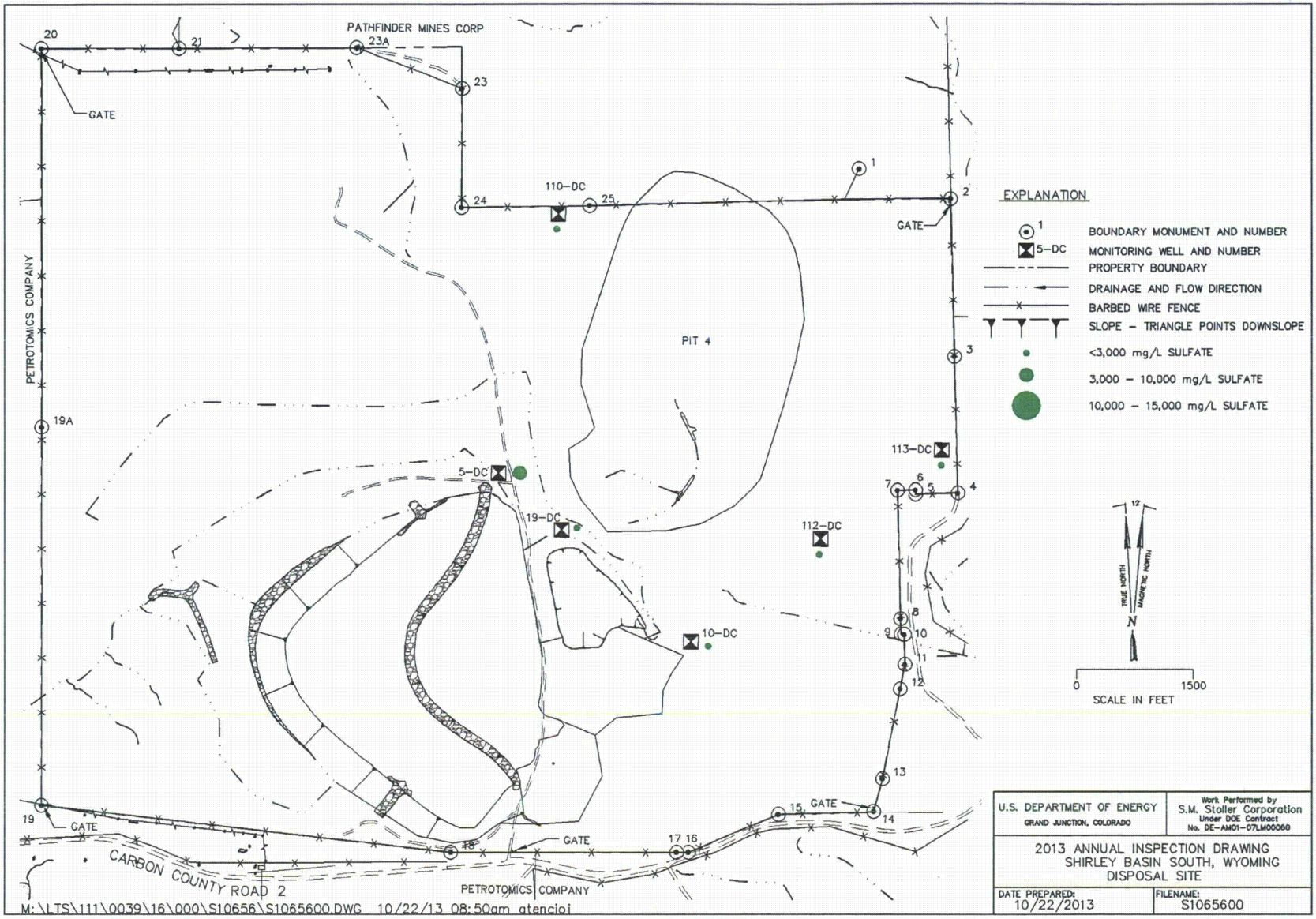


Figure 6-7. June 2013 Sulfate Concentrations in the Main Sand Aquifer at the Shirley Basin South, Wyoming, Disposal Site

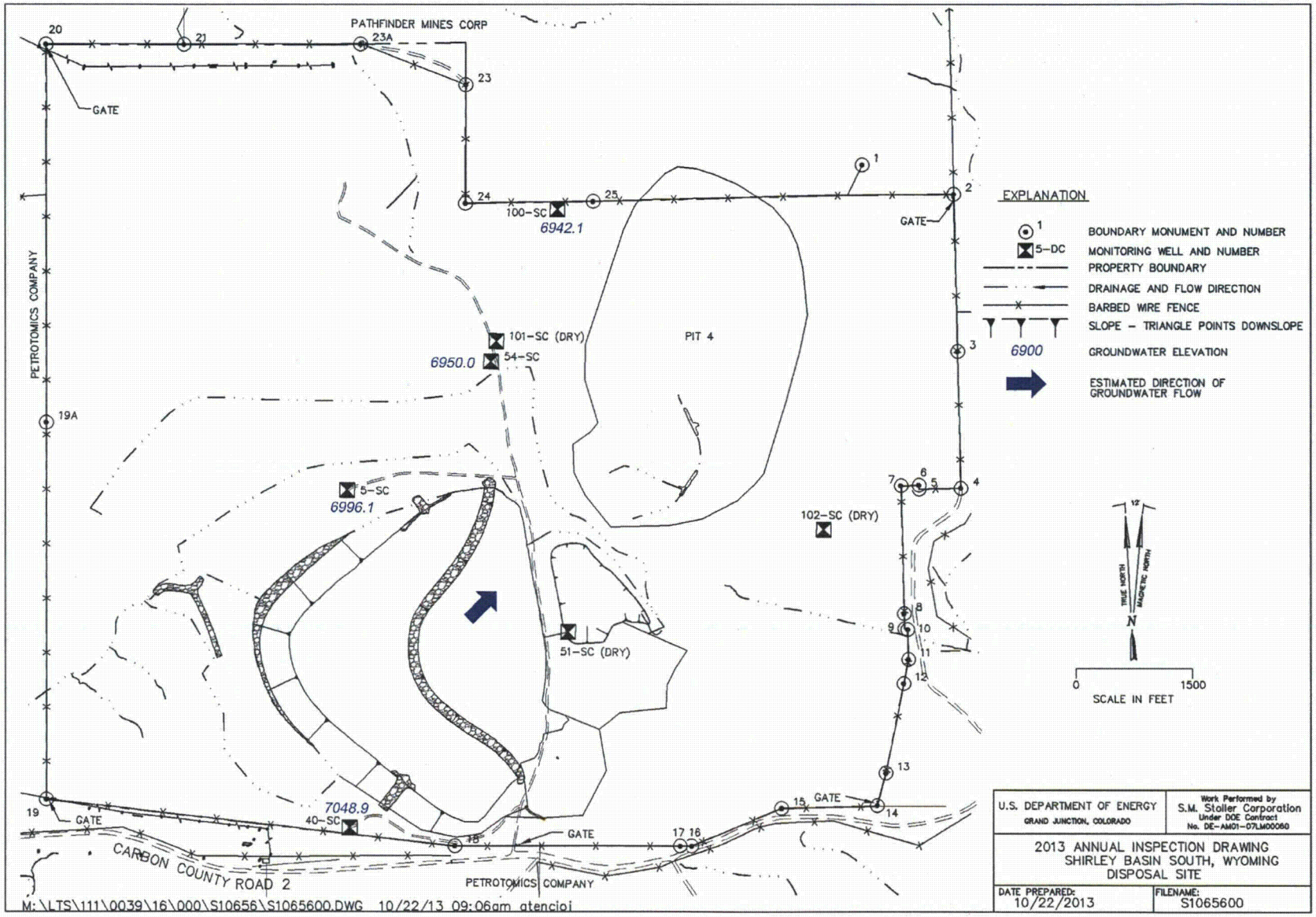


Figure 6-8. June 2013 Groundwater Elevations in the Upper Sand Aquifer at the Shirley Basin South, Wyoming, Disposal Site

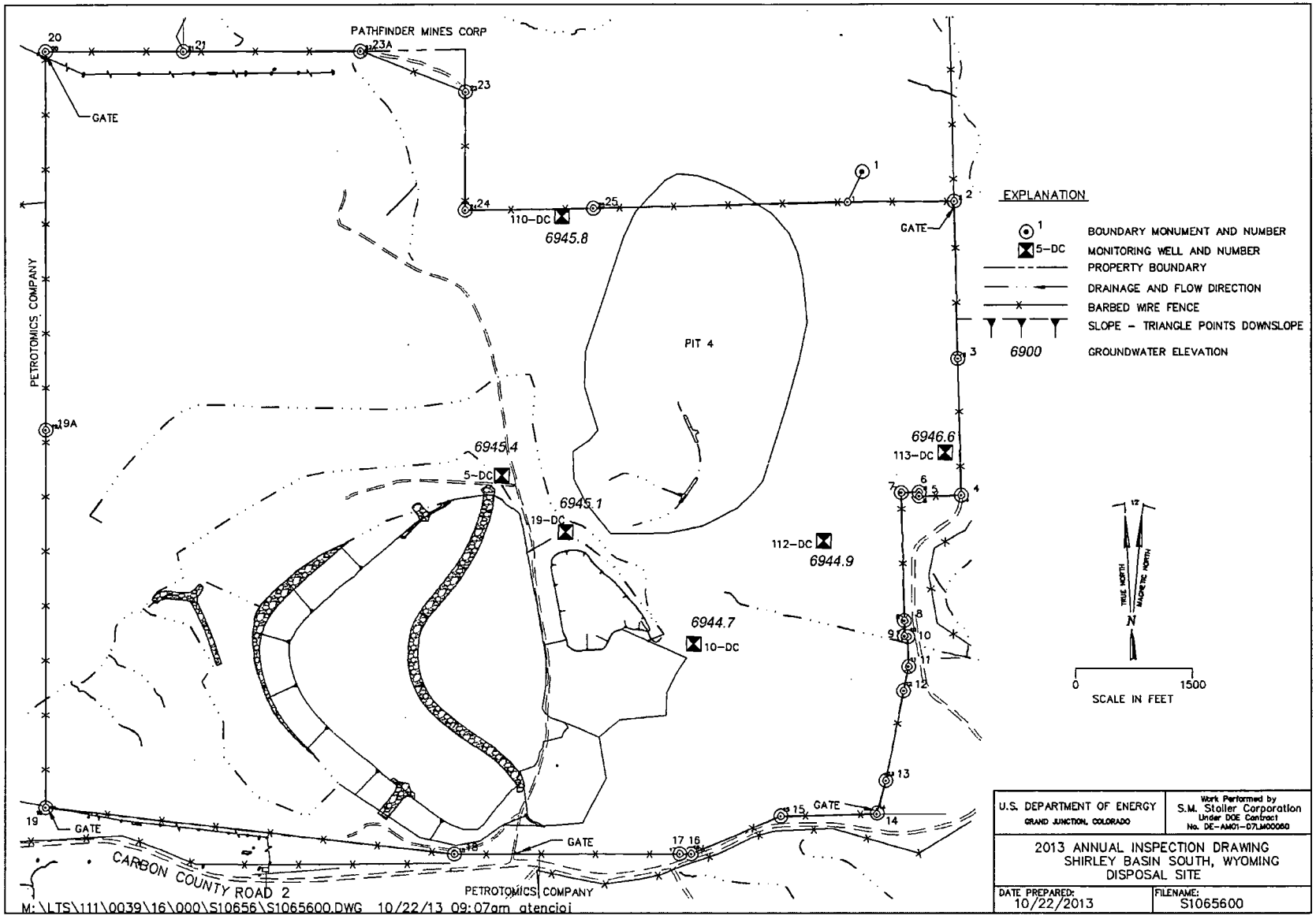


Figure 6-9. June 2013 Groundwater Elevations in the Main Sand Aquifer at the Shirley Basin South, Wyoming, Disposal Site

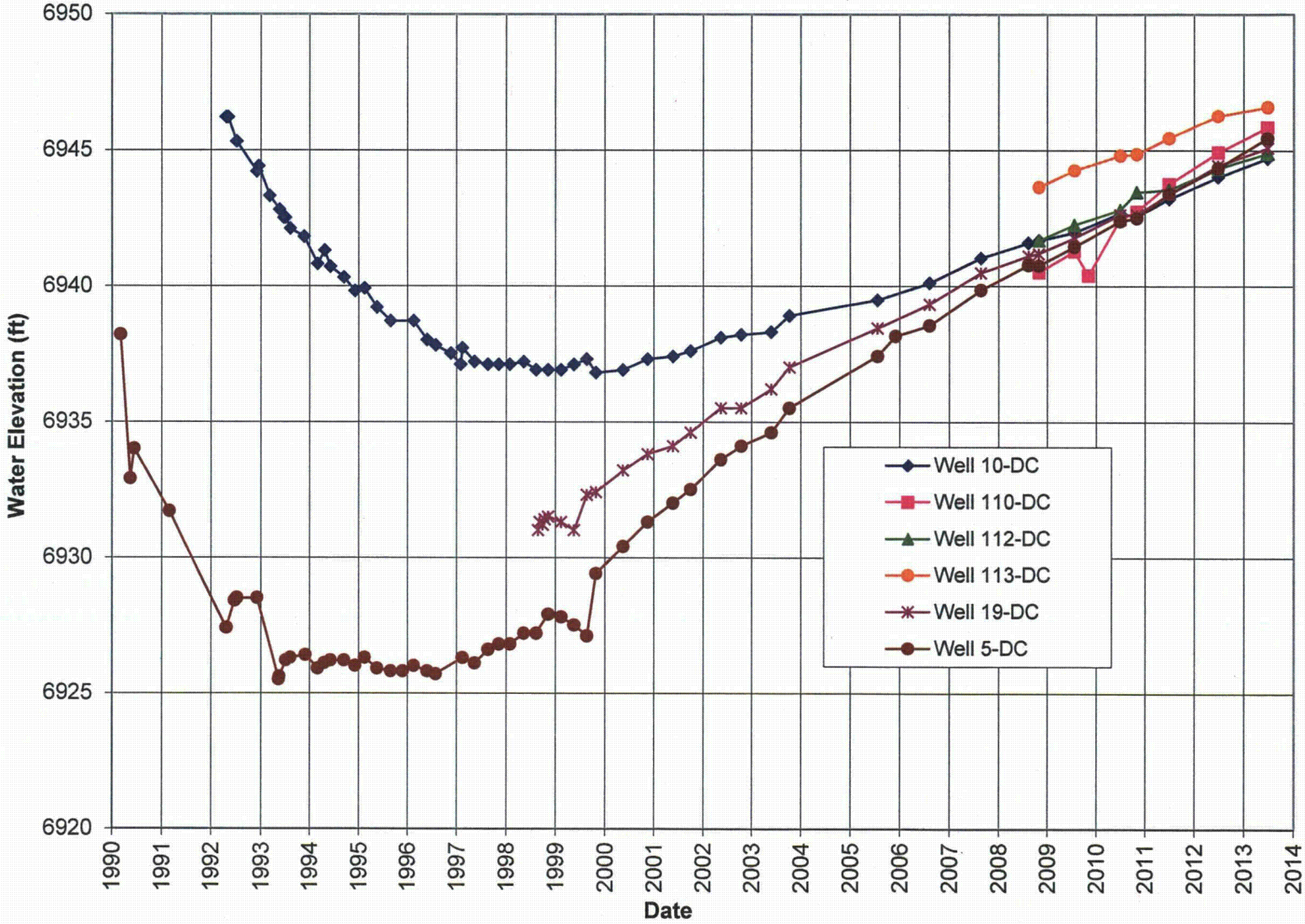
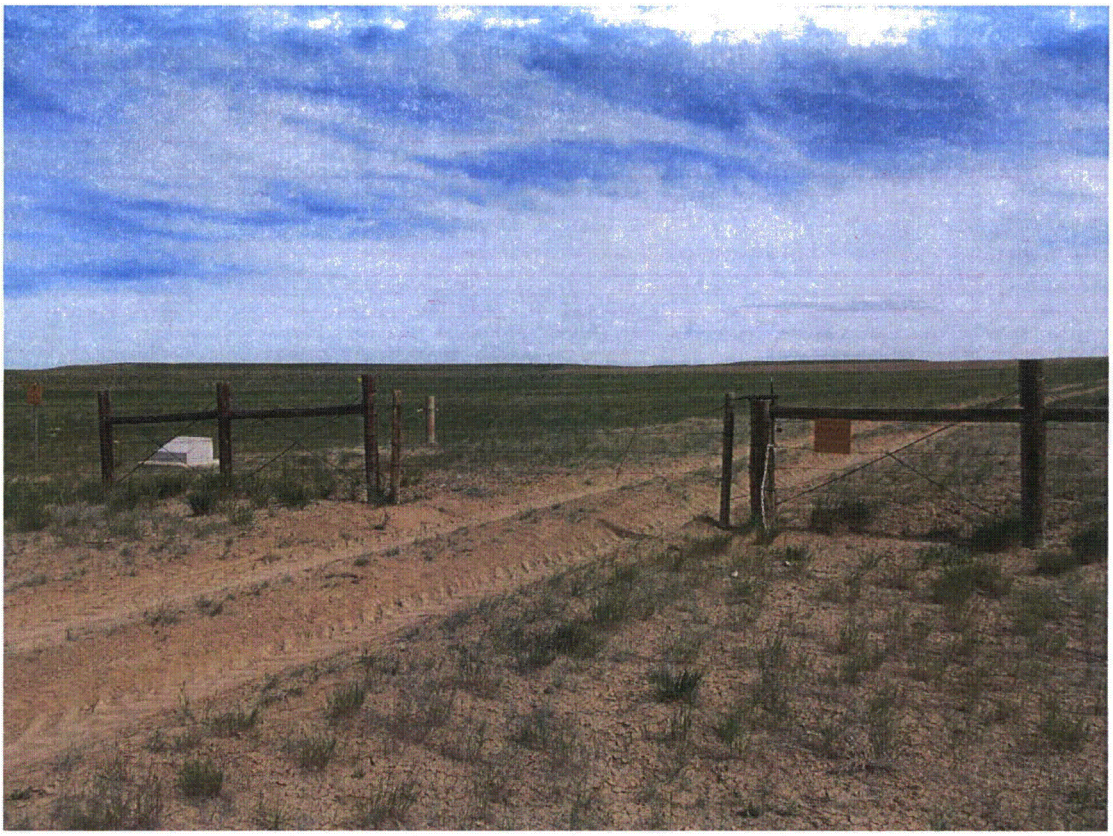


Figure 6-10. Hydrographs for Main Sand Aquifer Wells at the Shirley Basin South, Wyoming, Disposal Site

6.8 Photographs

Photograph Location Number	Azimuth	Description
PL-1	350	Site entrance gate.
PL-2	0	Perimeter sign P26 at site entrance.
PL-3	325	Site marker.
PL-4	180	Boundary monument BM-16.
PL-5	40	Monitoring well 110-DC.
PL-6	190	Upper surface of disposal cell.
PL-7	225	Lower surface of disposal cell.
PL-8	180	North swale discharge structure.
PL-9	350	Cattle in east drainage basin.
PL-10	0	North and east portions of Pit 4.

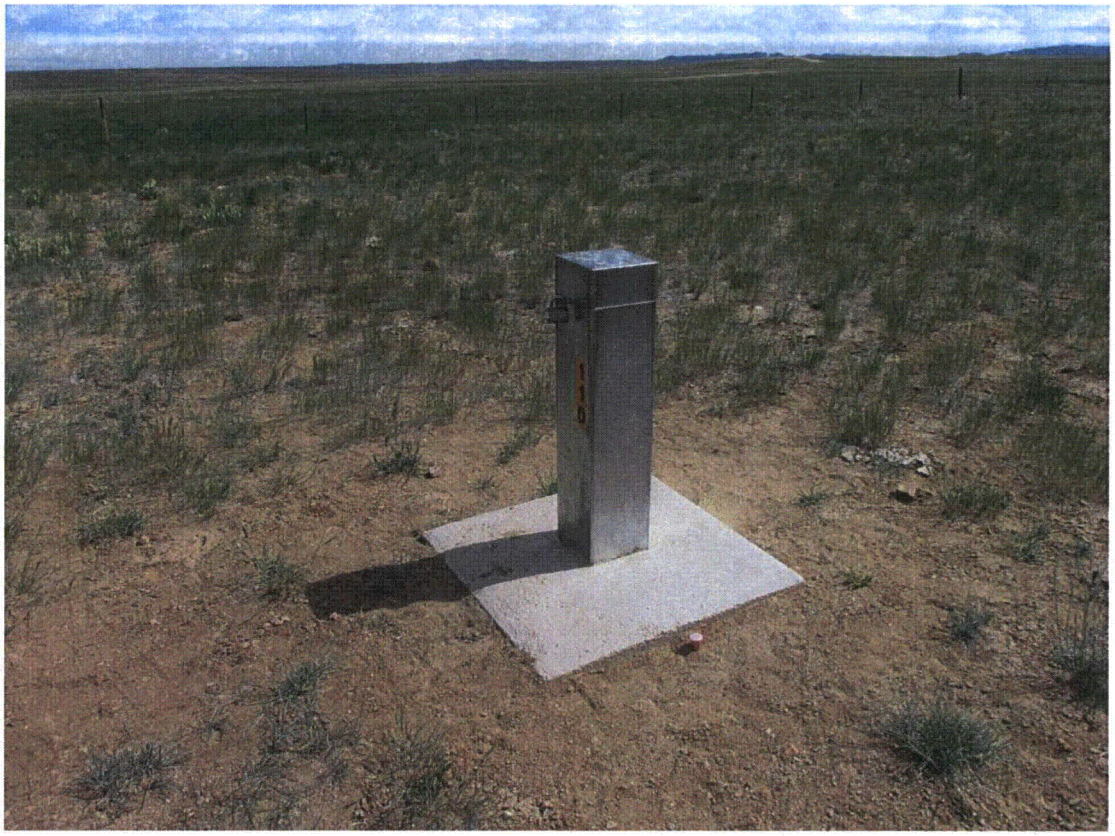


SBS 6/2013. PL-1. Site entrance gate.

SBS 6/2013. PL-2. Perimeter sign P26 at site entrance.

SBS 6/2013. PL-3. Site marker.

SBS 6/2013. PL-4. Boundary monument BM-16.



SBS 6/2013. PL-5. Monitoring well 110-DC.

SBS 6/2013. PL-6. Upper surface of disposal cell.

SBS 6/2013. PL-7. Lower surface of disposal cell.

SBS 6/2013. PL-8. North swale discharge structure.

SBS 6/2013. PL-9. Cattle in east drainage basin.

SBS 6/2013. PL-10. North and east portions of Pit 4.