5.0 Sherwood, Washington, Disposal Site

5.1 Compliance Summary

The Sherwood, Washington, Uranium Mill Tailings Radiation Control Act (UMTRCA) Title II Disposal Site (site) was inspected on August 19, 2020. The disposal cell, containment dam, and associated drainage features were functioning as designed. Inspectors replaced one missing perimeter sign. No additional maintenance needs or cause for a follow-up inspection were identified.

Groundwater monitoring is not required at the site. However, the U.S. Department of Energy (DOE) Office of Legacy Management (LM) conducts groundwater monitoring at three wells as a best management practice in accordance with the site-specific Long-Term Surveillance Plan (LTSP) (DOE 2001). The sulfate action level (250 milligrams per liter [mg/L]) was exceeded at monitoring well 4 in 2017 (260 mg/L) but was met in 2018 based on the 2018 sampling event (250 mg/L). In 2019, the well was redeveloped, and the bladder pump was raised slightly so it would not be buried in possible debris. The well was sampled before and after development, and analytical results for sulfate were similar for both samples (54 mg/L before and 62 mg/L after development). The most recent sampling event occurred in August 2020, and the sulfate concentration (14 mg/L) remained below the action level criteria.

5.2 Compliance Requirements

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

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

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

5.3 Institutional Controls

The 380-acre site, identified by the property boundary shown in Figure 5-1, is owned by the United States in trust for the Spokane Tribe of Indians. 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 to convey the property rights to DOE. However, an agreement was executed between the U.S. Bureau of Indian Affairs (BIA), the Spokane Tribe, NRC, and DOE for permanent right of access, which allows LM to fulfill its long-term surveillance and maintenance custodial responsibilities. Institutional controls (ICs) at the site include federal ownership of the property, administrative

controls, and the following physical ICs that are inspected annually: disposal cell, perimeter signs, site marker, boundary monuments, and monitoring wellhead protection.

5.4 Inspection Results

The site, approximately 5 miles west of Wellpinit, Washington, and 35 miles northwest of Spokane, Washington, was inspected on August 19, 2020. The inspection was conducted by B. Mays and D. Traub of the Legacy Management Support contractor. The purposes of the inspection were to confirm the integrity of visible features at the site, identify changes in conditions that might affect conformance with the LTSP, and determine the need, if any, for maintenance or additional inspection and monitoring.

5.4.1 Site Surveillance Features

Figure 5-1 shows the locations of site features in black and gray font, including site surveillance features and inspection areas. Site features that are present but not required to be inspected are shown in italic font. Observations from previous inspections that are currently monitored are shown in blue text, and new observations identified in the 2020 annual inspection are shown in red. Inspection results and recommended maintenance activities associated with site surveillance features are included in the following subsections. Photographs to support specific observations are identified in the text and in Figure 5-1 by photograph location (PL) numbers. The photographs and photograph log are presented in Section 5.9.

5.4.1.1 Site Access and Entrance Gates

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

5.4.1.2 Perimeter Signs

There are six warning or perimeter signs, attached to steel posts set in concrete, positioned along the site boundary at likely access points around the site (PL-1). Perimeter sign P6 was missing and was replaced during the inspection. No additional maintenance needs were identified.

5.4.1.3 Site Marker

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

5.4.1.4 Boundary Monuments

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

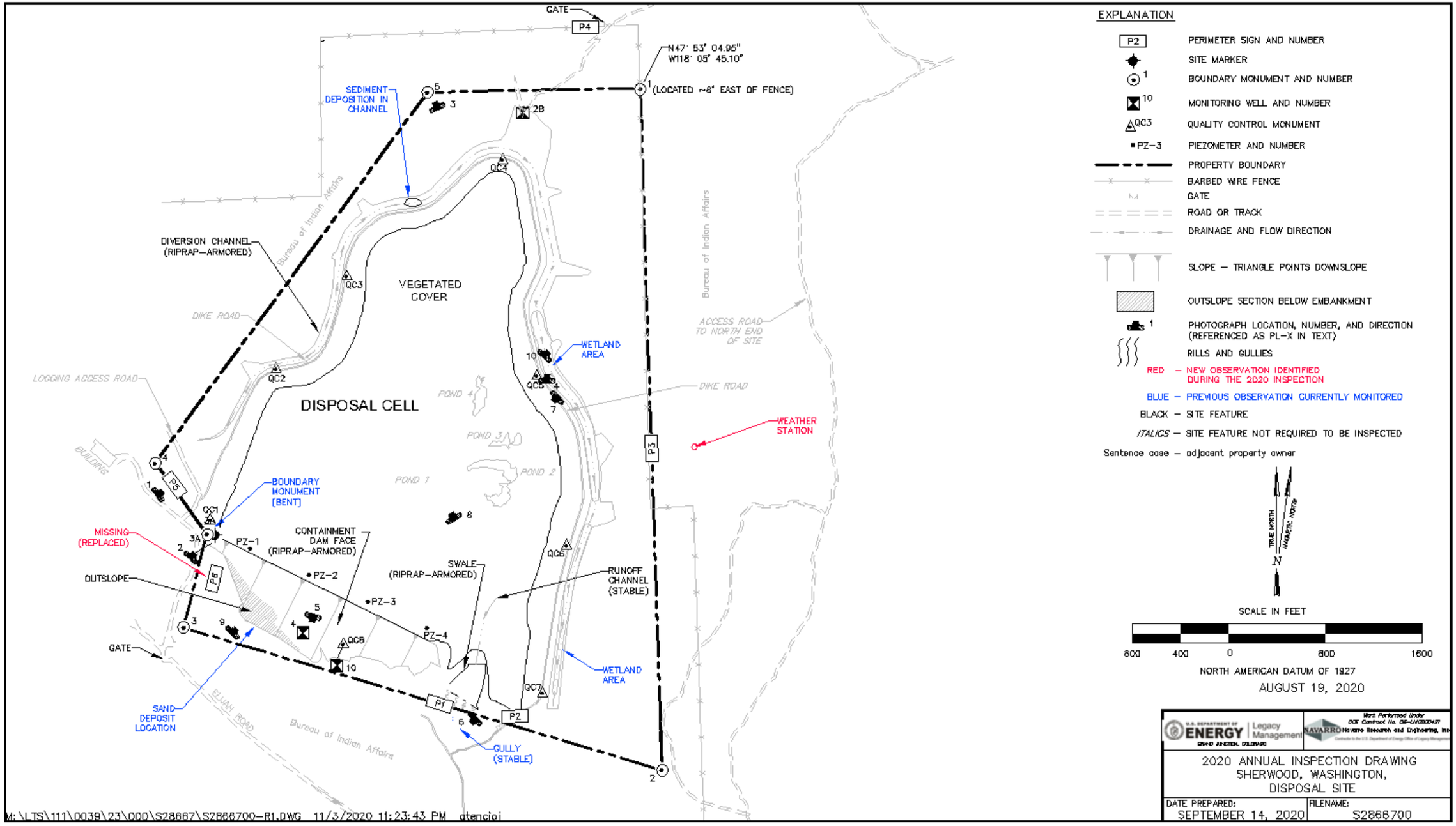

Figure 5-1. 2020 Annual Inspection Drawing for the Sherwood, Washington, Disposal Site

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5.4.1.5 Aerial Survey Quality Control Monuments

Eight aerial survey quality control (QC) monuments, installed in 2019, were inspected during the 2020 inspection (PL-4). No maintenance needs were identified.

5.4.1.6 Monitoring Wells and Piezometers

The site groundwater monitoring network consists of monitoring wells 2B, 4, and 10 (PL-5). As part of the dam safety inspection program, four piezometers, designated piezometers PZ-1 through PZ-4, were installed in November 2000 along the crest of the containment dam at a depth equivalent to the base of the dam. All piezometers and wellhead protectors were undamaged and locked. No maintenance needs were identified.

5.4.2 Inspection Areas

In accordance with the LTSP, the site is divided into three inspection areas (referred to as "transects" in the LTSP) to ensure a thorough and efficient inspection. The inspection areas are (1) the site perimeter, outlying areas, and balance of site; (2) the cover of the disposal cell (tailings impoundment); and (3) the containment dam and diversion channel. Inspectors examined specific site surveillance features within each area and looked for evidence of erosion, settling, slumping, or other modifying processes that might affect the site's conformance with LTSP requirements.

5.4.2.1 Site Perimeter, Outlying Areas, and Balance of Site

Ponderosa pine forest constitutes most of the area outside the diversion channel that encircles the disposal cell. The surrounding lands are part of the Spokane Indian Reservation and are used for timber harvesting and wildlife habitat. The area approximately 0.25 mile beyond the site boundary was visually observed for erosion, changes in land use, or other phenomena that might affect the long-term integrity of the site. No such changes were identified. A vacant metal building, left in place from earlier mining operations, is about 500 feet (ft) west of the western site boundary. A weather station was identified during the 2020 inspection approximately 400 ft east of the eastern site boundary on BIA property. The weather station is not an LM asset. No new development was evident east of the site along Elijah Road.

A gully offsite, downgradient of the riprap-armored swale near perimeter sign P1, was first observed in 2009. The gully is photographed periodically to monitor its development (PL-6). Although erosion continues to occur because of site drainage effects, the gully appears to be stabilizing as its grade reaches equilibrium with the surrounding topography. The gully is not impacting site features or access but will continue to be monitored. No maintenance needs were identified.

5.4.2.2 Cover of Disposal Cell

The disposal cell, completed in 1996, occupies 100 acres. The cover consists of 12 to 20 ft of uncompacted soils. During site reclamation, the surface was seeded and planted with native shrubs, forbs, grasses, and trees (PL-7).

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

Designers of the disposal cell predicted that some settlement would continue after the uncompacted cover was put in place. As explained on page 2-14 of the LTSP, the cover was designed to be self-healing with regard to impacts from freezing and thawing, biointrusion, and settlement (DOE 2001). The largest area of settlement is referred to as Pond 1 (PL-8). The plant species present indicate the presence of year-round moisture below the surface of the pond area. Other minor depressions—designated as Ponds 2, 3, and 4—were dry at the time of inspection. An evaluation of topographic surveys conducted in 2016 and 2017 indicated that up to 4.4 ft of settlement has occurred near the ponds since construction of the disposal cell. The cover was designed to withstand up to 10 ft of settlement (DOE 2018a). The shallow ponds are considered favorable features on the disposal cell cover, but LM will continue to monitor the surface for unusual settlement features to verify the cover's integrity and ensure that the disposal cell is performing as designed. Periodic aerial remote sensing surveys to collect high-resolution topographic data are anticipated to begin in 2021 to monitor the surface of the disposal cell. No maintenance needs were identified.

5.4.2.3 Containment Dam and Diversion Channel

The tailings embankment on this site is classified as a containment dam because of the saturated condition of the impoundment. Therefore, an annual dam safety inspection is required by the LTSP to ensure continued compliance with the National Dam Safety Program Act. The containment dam face was inspected in accordance with the *Dam Inspection Checklist*, which is included at the end of this chapter. No concerns were observed.

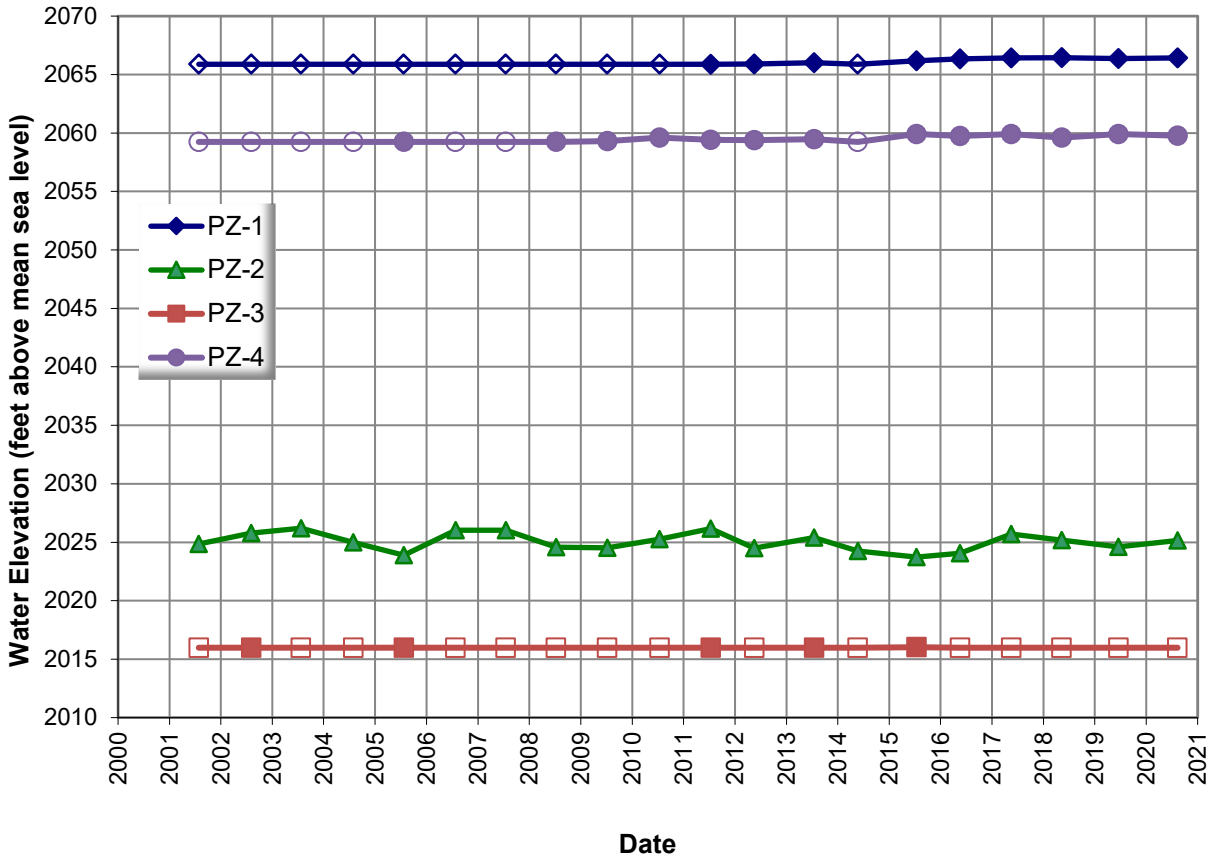
Measurements of water levels in four piezometers atop the containment dam are collected during the annual groundwater sampling events as part of the annual dam inspection. These annual measurements, collected since the piezometers were installed in 2000, provide a direct means of determining moisture conditions in the containment dam. Steadily increasing water levels in any of the piezometers could indicate a potential problem with the dam's performance. Measurements collected on August 11, 2020—provided in Table 5-2, Figure 5-2, and the attached *Dam Inspection Checklist*—do not indicate an increase in water levels. Variations in the amount of water in the four piezometers are thought to be seasonal responses to precipitation. The minor amount of water in piezometer PZ-2 is the result of a small, perched lens of water that exists because of localized differences in permeability. While the lateral extent of the lens is unknown, it is estimated, based on water levels in piezometer PZ-2 and monitoring wells 4 and 10, that more than 200 ft of unsaturated material is beneath the piezometer PZ-2 perched zone. On the basis of the recent water levels observed in the piezometers and monitoring wells, the containment dam is considered to be unsaturated.

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

Table 5-2. 2020 Piezometer Water Depths

Piezometer	Total Depth of Piezometer (ft)[a,b]	Water Level (ft)[a]	Depth of Water (ft)
PZ-1	22.55	21.85	0.70
PZ-2	63.07	60.75	2.32
PZ-3	67.62	Dry	Dry
PZ-4	22.70	21.97	0.73

Notes:
[a] Measured from the top of the inner casing.
[b] Total depths were adjusted based on measurements collected during the 2019 sampling event.



Note:
Hollow symbols indicate dry water level measurement events.

Figure 5-2. Sherwood Piezometer Water Elevations

During the 2016 annual inspection, one location at the base of the rock-covered containment dam face was found to have a deposit of sand that had washed out from underneath the rock cover, as evidenced by a shallow rock-filled erosion feature upgradient of the deposit (Figure 5-1). A subsequent follow-up inspection and evaluation identified that the sandy material was the same as natural undisturbed material nearby. During reclamation, this area of the site was used as a source for fill material used to contour the area below the toe of the containment dam. Review of

original reclamation and as-built drawings showed that the toe of the containment dam is upslope from the area of erosion, which was confirmed during the follow-up investigations. Therefore, it was concluded that the sand deposit location is in a portion of the dam defined as the outslope in the construction completion report and does not impact the containment dam (DOE 2018b).

The sand deposit location was examined during the inspection, and there was no apparent change in the deposit or the upgradient erosion feature (PL-9). The area will be visually monitored during future inspections and by periodic aerial remote sensing surveys. Repair options will be evaluated and implemented, in consultation with NRC, if the erosion area increases such that the containment dam could be affected.

A riprap-armored diversion channel surrounds the disposal cell and diverts runoff away from the disposal cell surface. The diversion channel was designed to allow trees to grow and stabilize the surfaces, and the presence of trees in the diversion channel is not expected to hinder the diversion channel's ability to convey design flows. The establishment of volunteer plants, including trees, is evident in most areas of the diversion channel. Sediment deposition is found in places on the west leg of the diversion channel but does not interfere with the diversion channel's design function. Upslope areas that have contributed to the sedimentation have stabilized with vegetation. Wildlife trails cross the diversion channel at numerous locations and have displaced the diversion channel riprap in several places (PL-10). These disturbances will be visually monitored for erosion but are not in areas that would impact the disposal cell. No evidence of erosion was observed downgradient of the diversion channel outlet. No maintenance needs were identified.

5.5 Follow-Up Inspections

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

5.6 Routine Maintenance and Emergency Measures

Perimeter sign P6 was identified as missing and was replaced during the inspection. No additional routine maintenance needs were identified.

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

5.7 Environmental Monitoring

5.7.1 Groundwater Monitoring

Groundwater compliance monitoring is not required at the site. However, as a best management practice stipulated in the LTSP, LM conducts limited groundwater monitoring for several indicator parameters. Samples are collected annually from background monitoring well 2B north of the disposal cell and from downgradient wells 4 and 10 near the base of the containment dam (Figure 5-3). Samples are analyzed for chloride and sulfate, which are primary indicator

parameters, and total dissolved solids. Should the concentration of chloride or sulfate exceed the action level (State of Washington water quality criteria value of 250 mg/L) for either parameter, LM would conduct confirmatory sampling. If the confirmatory sampling verifies the exceedance, LM will develop an evaluative monitoring work plan, in consultation with the Spokane Tribe and BIA, and submit that plan to NRC for review before initiating an evaluative monitoring program. Results of an evaluative monitoring program would be used to determine if corrective action is necessary.

An evaluative monitoring plan and consultations were not required as there was no exceedance in 2020 (24 mg/L); evaluation of the elevated sulfate values in 2017 (260 mg/L) and 2018 (250 mg/L) indicated the elevated values were related to higher-than-normal precipitation in the area, which caused higher-than-normal groundwater elevations (Kreie 2018). The issue of elevated sulfate spikes in monitoring well 4 had previously been identified by the State and documented as unrelated to the disposal cell.

Table 5-3 presents the August 2020 sampling results. Groundwater constituent concentrations continue to be less than the action levels for confirmatory sampling in monitoring wells 2B, 4, and 10.

A borehole camera was used in 2018 to evaluate conditions in the three monitoring wells, specifically to determine if any well issues could have caused the sulfate exceedance in monitoring well 4. The video showed that the inlet of the dedicated bladder pump used for low-flow sampling was buried in debris at the bottom of well 4. The well was redeveloped during the 2019 sampling event, and the debris was removed; samples were collected before and after redevelopment with similar results for sulfate (54 and 62 mg/L, respectively). After sampling, a datalogger was placed in the well to collect periodic water level, temperature, and conductivity data until removal during the 2020 sampling event. After further analysis, if the data indicate a correlation between higher water levels and increased conductivity, LM may propose to cease the best management practice annual water sampling as discussed in Kreie 2018.

Table 5-3. 2020 Groundwater Quality Results for the Sherwood, Washington, Disposal Site

Constituent	Water Quality Criterion[a]	Well		
		Background Well 2B	Downgradient Well 4	Downgradient Well 10
Chloride, mg/L	250	1.2	0.8	1.1
Sulfate, mg/L	250	1.1	14	24
TDS, mg/L	N/A	220	570	630

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

Abbreviations:
N/A = not applicable
TDS = total dissolved solids

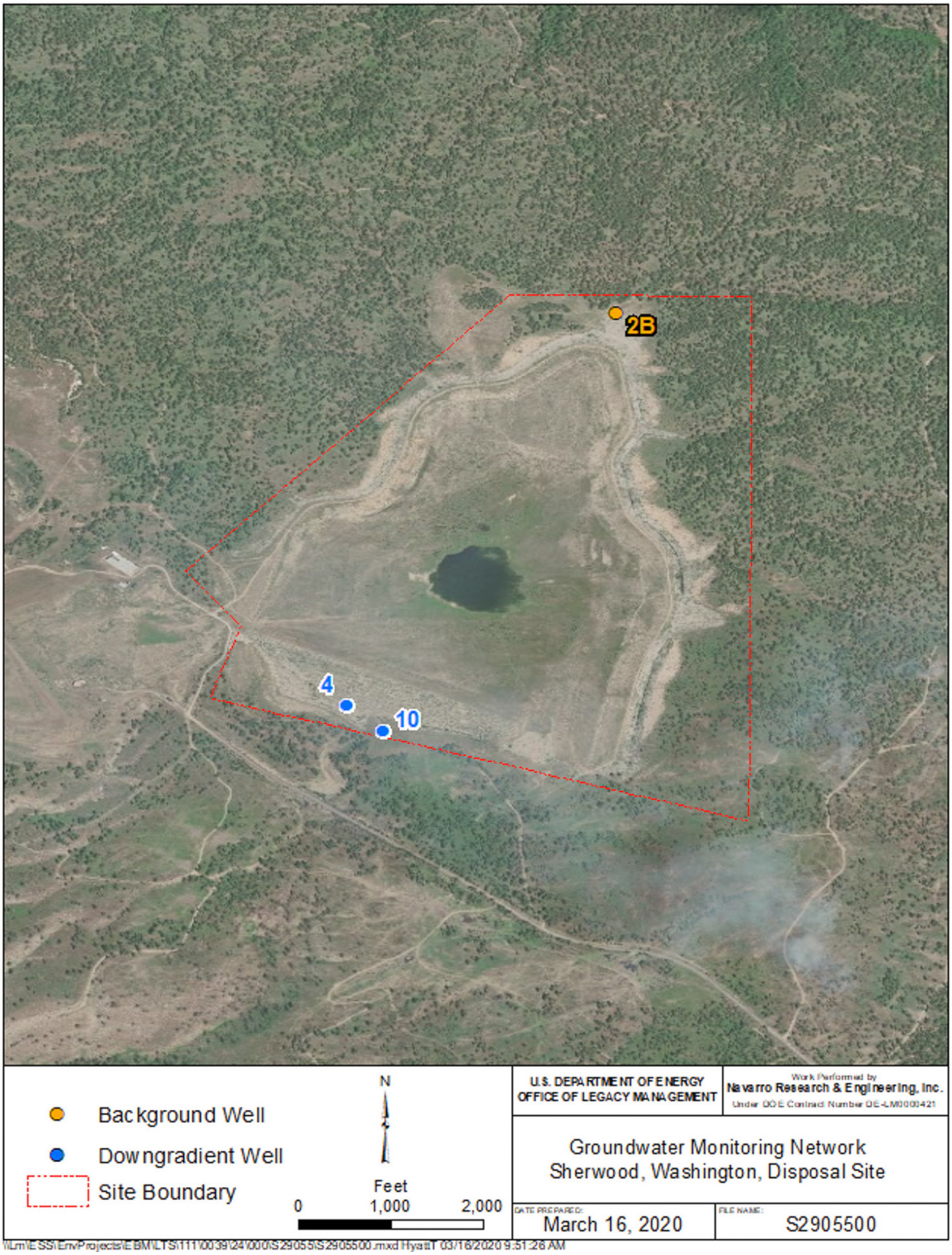


Figure 5-3. Groundwater Monitoring Network at Sherwood, Washington, Disposal Site

Figure 5-4 and Figure 5-5 show concentrations of chloride and sulfate, respectively, in the three monitoring wells since 2001. Occurrences of slightly elevated chloride levels in well 4 correspond with the higher sulfate levels measured at the same location. Water elevations for each of the monitoring wells are shown in Figure 5-6 and Figure 5-7. Groundwater occurs in two hydrostratigraphic units: (1) the alluvium that lies on top of the bedrock surface and (2) the conductive bedrock, including weathered bedrock in the upper portion and unweathered or competent bedrock below. Monitoring well 10 is completed in the alluvium, and wells 2B and 4 are completed in the bedrock.

Increases in water table height in the 2B and 4 wells correspond with the elevated levels of chloride and sulfate measured in well 4 in 2006 and 2011 and from 2016 to 2018. As noted by the Washington State Department of Health in the February 2000 *Sherwood Uranium Mill Project, Technical Evaluation Report, Monitoring and Stabilization Plan Supplement* (WDOH 2000), "One of the downgradient point-of-compliance wells, 4, has seasonal variation in water quality, represented by late spring and summer peaks that are consistent with annual infiltration and the rise in static water levels. This seasonal trend has been evaluated closely and ground water monitoring increased as established by the MSP [Monitoring and Stabilization Plan]." Annual precipitation totals measured in Spokane, Washington, show a correlation with the increased sulfate and chloride concentrations. Years with higher precipitation totals are also years with higher sulfate concentrations.

5.7.2 Vegetation Monitoring

The LTSP requires annual visual inspections of the disposal cell's vegetated cover to ensure that it satisfies erosional stability criteria and is self-sustaining. Vegetation on the disposal cell cover includes trees (primarily ponderosa pine), shrubs, and a mixture of native and introduced grasses and forbs. No areas of concern, such as patterns of dead vegetation or erosional features, were identified during the 2020 annual inspection.

Seven species of State-listed noxious weeds historically have been found, six of which are "List B" species and, by law, must be controlled. No "List A" species, which must be eradicated, have been found at the site. LM has released various biological control insects in the past and periodically treats weed infestations with herbicide. There were no herbicide applications in 2020.

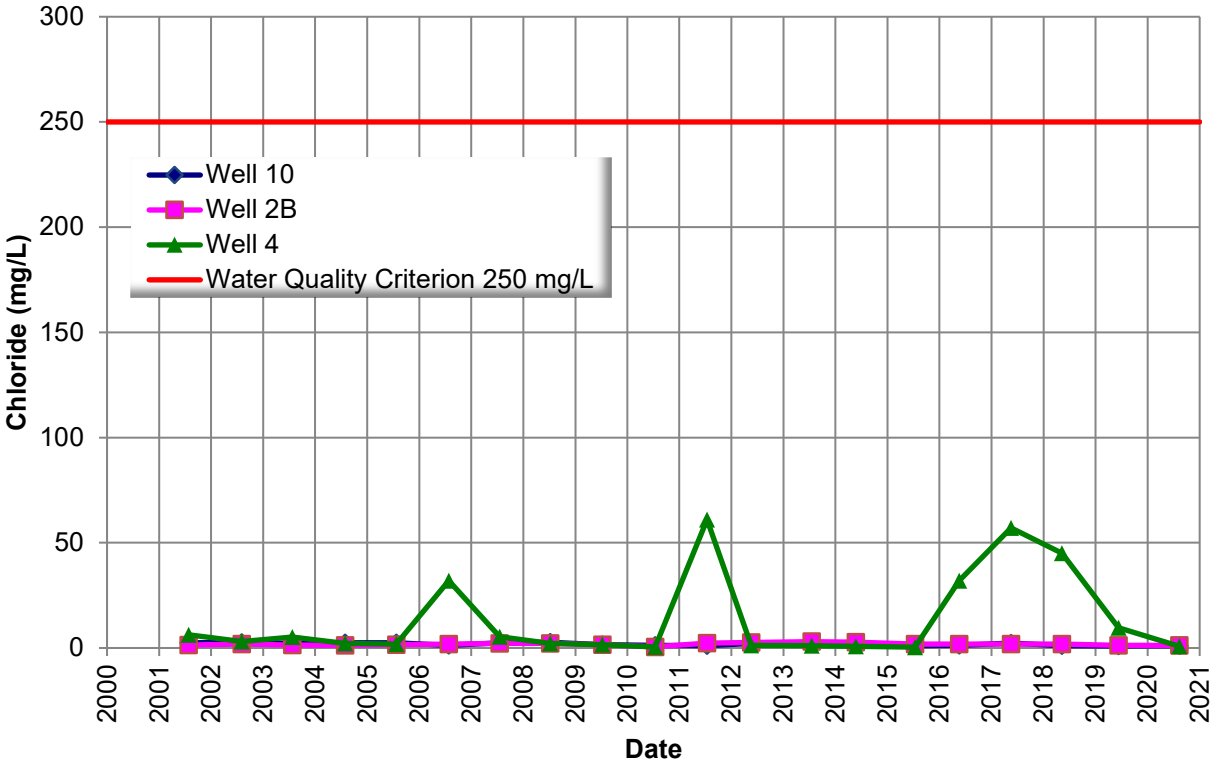


Figure 5-4. Chloride Concentrations at the Sherwood, Washington, Disposal Site

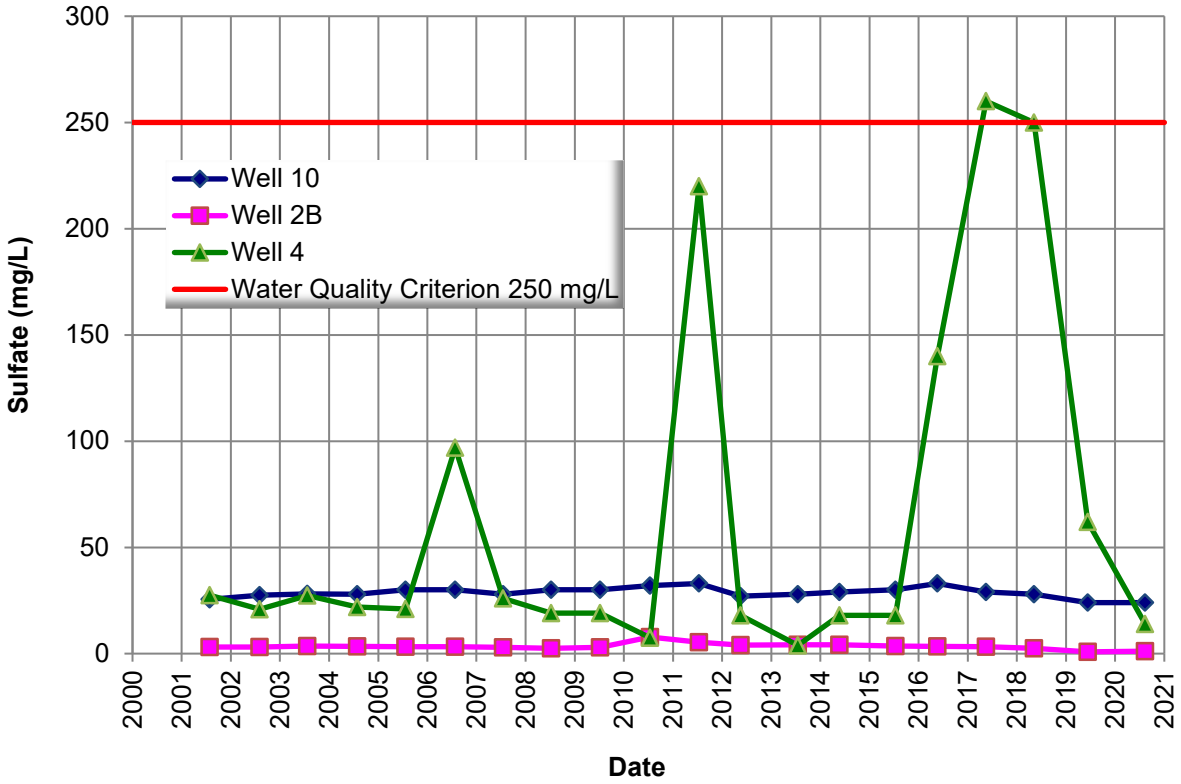


Figure 5-5. Sulfate Concentrations at the Sherwood, Washington, Disposal Site

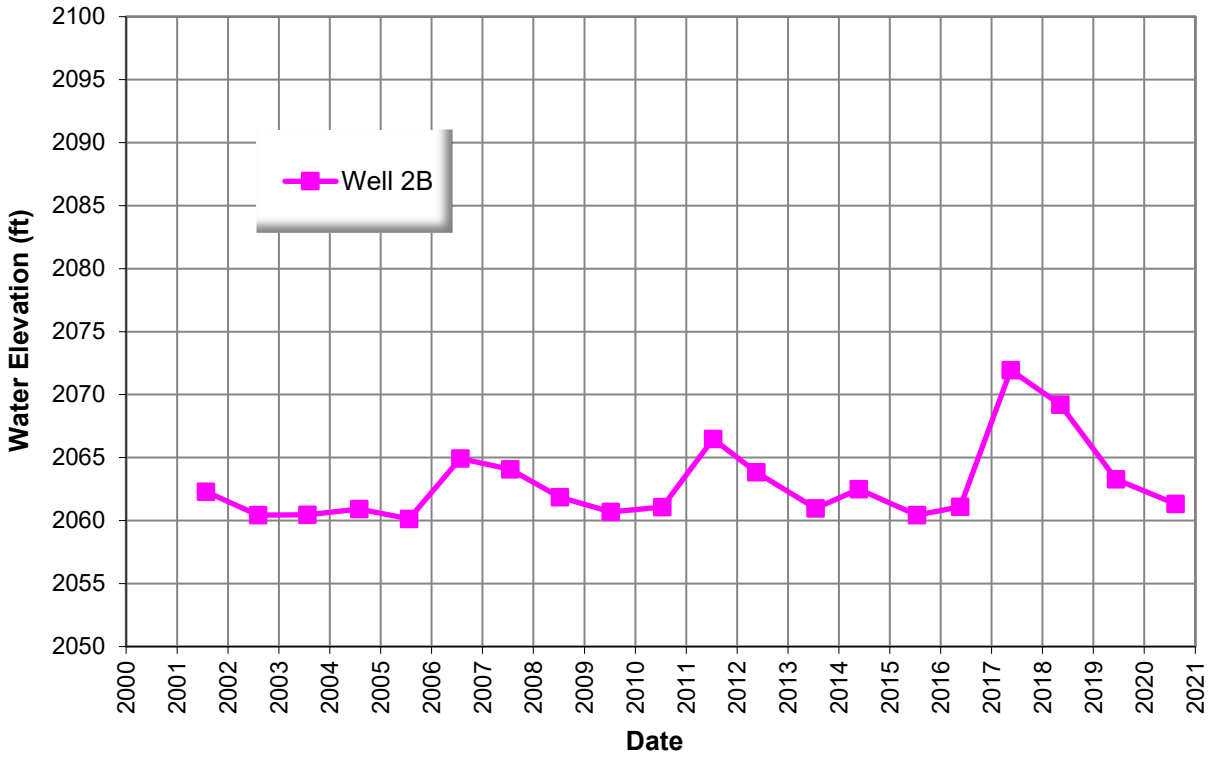


Figure 5-6. Well 2B Water Elevation Measurements at the Sherwood, Washington, Disposal Site

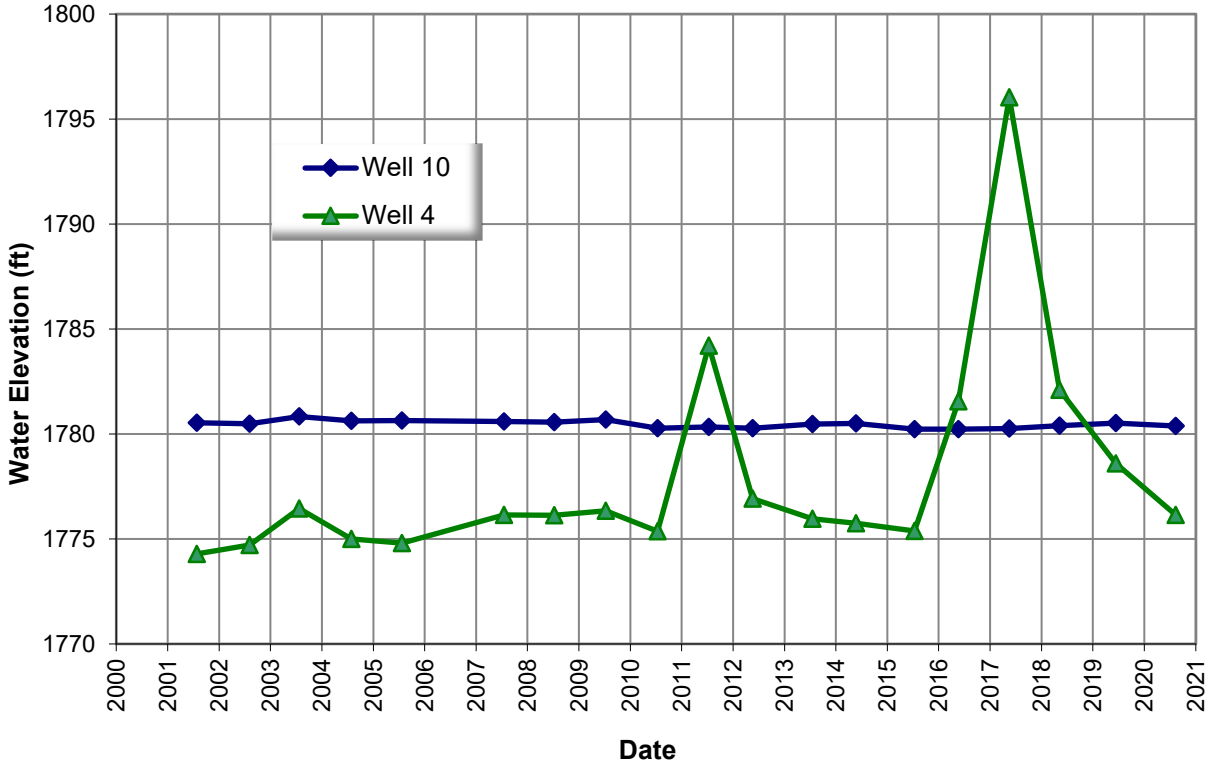


Figure 5-7. Wells 4 and 10 Water Elevation Measurements at the Sherwood, Washington, Disposal Site

5.8 References

10 CFR 40.28. U.S. Nuclear Regulatory Commission, "General License for Custody and Long-Term Care of Uranium or Thorium Byproduct Materials Disposal Sites," *Code of Federal Regulations.*

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

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

DOE (U.S. Department of Energy), 2018a. *Settlement Survey and Analysis, Sherwood, Washington, Disposal Site*, LMS/SHE/S19518, Office of Legacy Management, June.

DOE (U.S. Department of Energy), 2018b. *Follow-Up Inspection and Evaluation, Sherwood, Washington, Disposal Site*, LMS/SHE/S15417, Office of Legacy Management, March.

Kreie, 2018. Ken Kreie, site manager, Office of Legacy Management, U.S. Department of Energy, letter ("Groundwater Monitoring Results at the Sherwood, Washington, Disposal Site Indicates Elevated Sulfate Concentration in Point of Compliance Well") to deputy director, U.S. Nuclear Regulatory Commission, November 5.

WDOH (Washington State Department of Health), 2000. *Sherwood Uranium Mill Project, Technical Evaluation Report, Monitoring and Stabilization Plan Supplement*, February.

5.9 Photographs

Photograph Location Number	Azimuth	Photograph Description
PL-1	55	Perimeter Sign P5
PL-2	40	Site Marker
PL-3	335	Boundary Monument BM-5
PL-4	—	Quality Control Monument QC5
PL-5	195	Monitoring Well 4
PL-6	225	Gully Downgradient of Riprap-Armored Swale (Near Perimeter Sign P1)
PL-7	225	Disposal Cell, View Southwest
PL-8	330	Disposal Cell Pond 1, View Northwest
PL-9	45	Sand Deposit at Toe of Containment Dam Outslope
PL-10	40	Diversion Channel with Wildlife Trail

Note:
— = Photograph taken from directly above.

PL-1. Perimeter Sign P5

PL-2. Site Marker

PL-3. Boundary Monument BM-5

PL-4. Quality Control Monument QC5

PL-5. Monitoring Well 4

PL-6. Gully Downgradient of Riprap-Armored Swale (Near Perimeter Sign P1)

PL-7. Disposal Cell, View Southwest

PL-8. Disposal Cell Pond 1, View Northwest

PL-9. Sand Deposit at Toe of Containment Dam Outslope

PL-10. Diversion Channel with Wildlife Trail

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

Date of Inspection: 08/19/2020

Inspector: Brackett Mays Organization: Navarro Research and Engineering

Piezometer water levels measured during groundwater monitoring event: August 11, 2020
* All depths in feet. TOC is Top of Casing.

Piezometer PZ-1 fluid level Total depth 22.55	(TOC to top of fluid):	21.85	Fluid amount:	0.70
Piezometer PZ-2 fluid level Total depth 63.07	(TOC to top of fluid)	60.75	Fluid Amount:	2.32
Piezometer PZ-3 fluid level Total depth 67.62	(TOC to top of fluid)	Dry	Fluid Amount:	Dry
Piezometer PZ-4 fluid level Total depth 22.70	(TOC to top of fluid)	21.97	Fluid Amount:	0.73

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

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

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

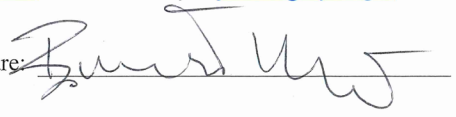
Was vegetative growth that could compromise dam stability observed? *No*
If yes discuss in report.

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

Emergency Notification Contacts:

DOE Site Manager: Ken Kreie (970) 248-6036
NRC Operations Center: (301) 951-0550
Spokane Tribal Police/Sheriff: (509) 258-4400
State Department of Ecology—Dam Safety Office: (360) 407-6625

Following completion of the inspection, this Dam Inspection Checklist is to be sent to: Gustavo Ordonez at gord461@ECY.WA.GOV and James DeMay at jade461@ecy.wa.gov Washington Department of Ecology, Dam Safety Office

Inspector Signature:  Date: 9/9/2020

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