

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 June 9, 2021. The disposal cell, containment dam, and associated drainage features were functioning as designed. Inspectors identified one missing perimeter sign, which was replaced during the subsequent groundwater sampling event in July 2021. 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 criteria (250 milligrams per liter [mg/L]) was exceeded at monitoring well 4 in 2017 (260 mg/L) but was met in 2018 (250 mg/L) based on the 2018 sampling event. 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 July 2021, 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 accordance with procedures 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 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 June 9, 2021. The inspection was conducted by B. Mays and D. Ravelojaona of the Legacy Management Support contractor. K. Kreie (LM site manager); B. Stasney (Washington Department of Health [WDOH]); and J. Caruso and W. McCart (Stevens County) attended the inspection. The purposes of the inspection were to confirm the integrity of visible features at the site, identify changes in conditions that might affect conformance with the LTSP, and evaluate whether maintenance or additional inspection and monitoring are needed.

5.4.1 Site Surveillance Features

Figure 5-1 shows the locations of site features, including site surveillance features and inspection areas, in black and gray font. 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 type, and new observations identified in the 2021 annual inspection are shown in red type. 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. Road maintenance activities were occurring at the time of the inspection. 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 P2 was missing and was replaced during the subsequent groundwater sampling event in July 2021. 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.

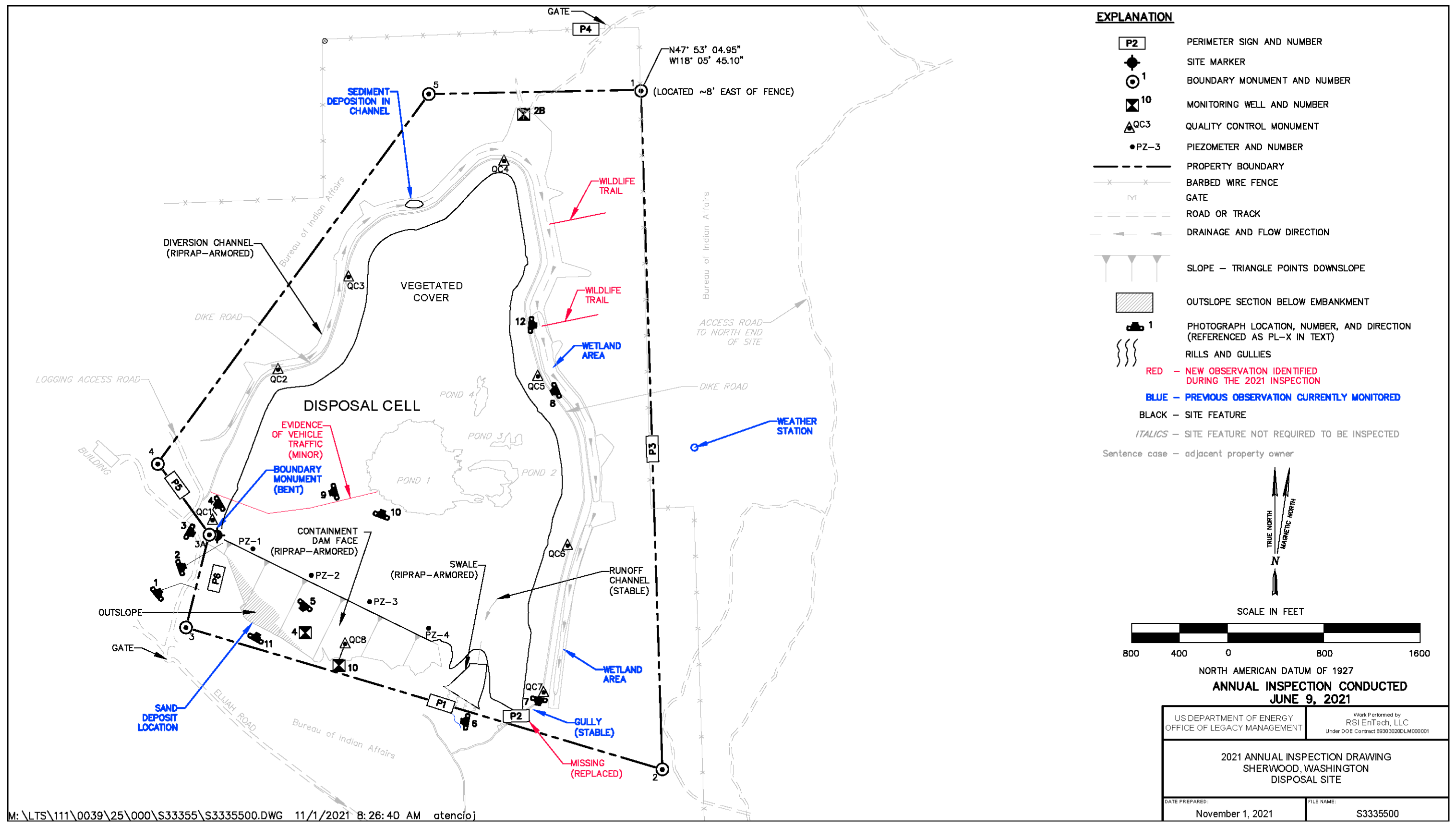


Figure 5-1. 2021 Annual Inspection Drawing for the Sherwood, Washington, Disposal Site

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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 2021 inspection (PL-4). A baseline aerial survey was conducted in October 2021. 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

A ponderosa pine forest constitutes most of the area outside of 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. Large boulders line the east side of Elijah Road to the southwest of the disposal cell outside of the site boundary. These boulders keep vehicle traffic on the road and prevent unnecessary vehicle access to the cell. Inspectors noticed boulders had been moved near boundary monument BM-3A, but no evidence of vehicle access was identified in that area. The boulders are not part of the cell design, but the area will continue to be monitored to ensure that vehicle traffic does not increase on the site.

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, the gully is not impacting site features or access but will continue to be monitored. Additionally, minor erosion was identified during the 2021 inspection adjacent the two-track on the southeast side of the cell near perimeter sign P2 (PL-7). The erosion areas are not impacting site features or access and 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-8).

A small, shallow channel developed by runoff from the top slope of the disposal cell is 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.

Evidence of vehicle travel was identified on the southwest side of the disposal cell. Minor vehicle tracks were observed from the road intersection near perimeter sign P5 to the edge of Pond 1 (PL-9). The area will continue to be monitored, and strategies to prevent unnecessary vehicle traffic on the cell will be evaluated in consultation with Spokane tribal leadership.

Designers of the disposal cell predicted that some settlement would continue after the uncompacted cover was put in place. As explained on pages 2–14 of the LTSP, the cover was designed to be self-stabilizing 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-10). 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. Baseline aerial remote sensing surveys to collect high-resolution topographic data were conducted in October 2021 to monitor the surface of the disposal cell, and data are currently being processed. Data will be reviewed in 2022 and a summary of the survey findings will be included in the 2022 inspection report. No maintenance needs were identified.

5.4.2.3 Containment Dam and Diversion Channel

The tailings embankment on the 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 July 13, 2021—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. Based on the recent water levels observed in the piezometers and monitoring wells, the containment dam is considered to be unsaturated.

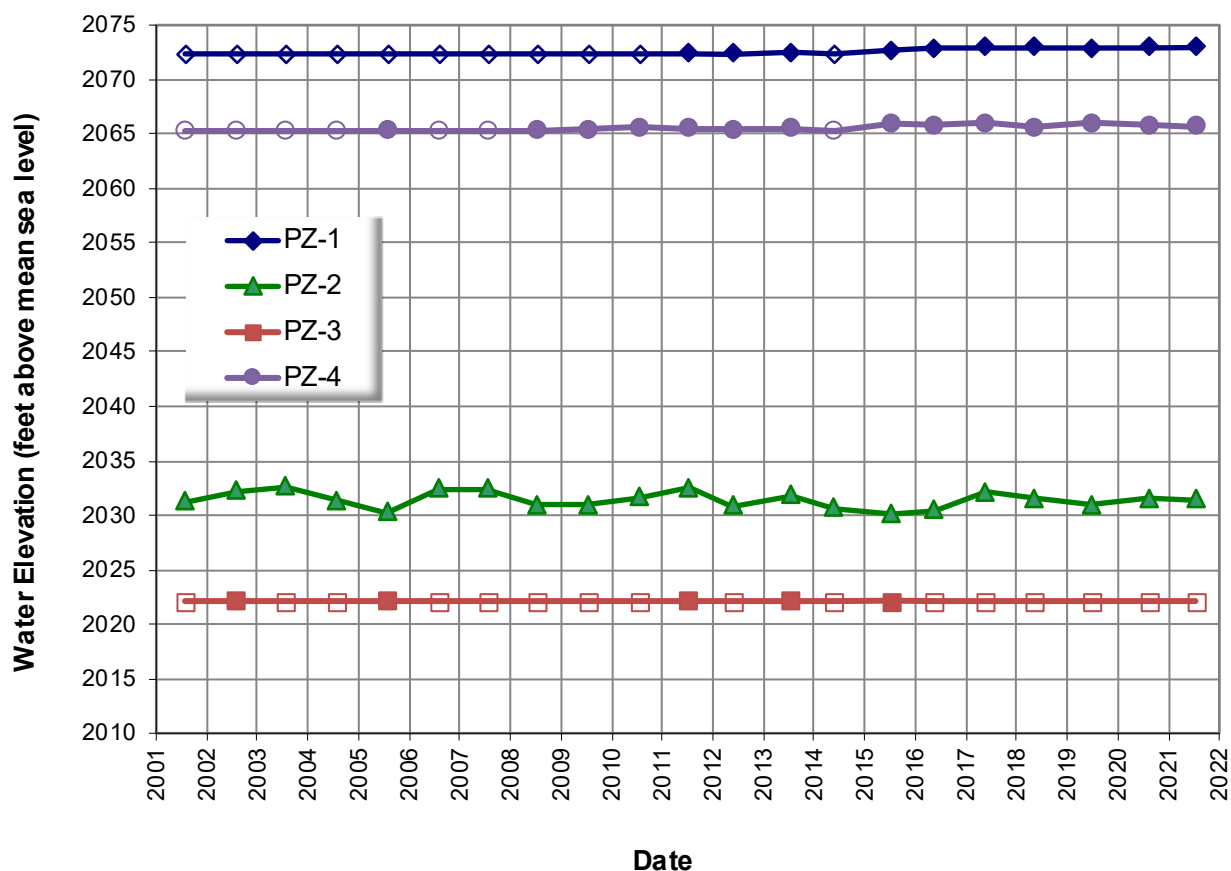
Table 5-2. 2021 Sherwood, Washington, Disposal Site Piezometer Water Depths

Piezometer	Total Depth of Piezometer (ft) ^{a,b}	Water Level (ft) ^a	Depth of Water (ft)
PZ-1	22.55	21.81	0.70
PZ-2	63.07	60.88	2.32
PZ-3	67.62	Dry	Dry
PZ-4	22.70	22.10	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, Washington, Disposal Site Piezometer Water Elevations

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.

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-11). 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-12). 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 P2 was identified as missing and was replaced during the subsequent groundwater sampling event in July 2021. 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 quality results for the July 2021 sampling event are in Table 5-3. Groundwater constituent concentrations continue to be less than the action level criteria for confirmatory sampling in monitoring wells 2B, 4, and 10. Should the concentration of chloride or sulfate exceed the action level criteria (state of Washington water quality criteria value of 250 mg/L), 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.

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). Groundwater samples are analyzed for chloride and sulfate, which are primary indicator constituents, and for total dissolved solids.

Table 5-3. 2021 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	0.24	Nondetect	Nondetect
Sulfate (mg/L)	250	1.6	14	30
TDS (mg/L)	NA	220	510	620

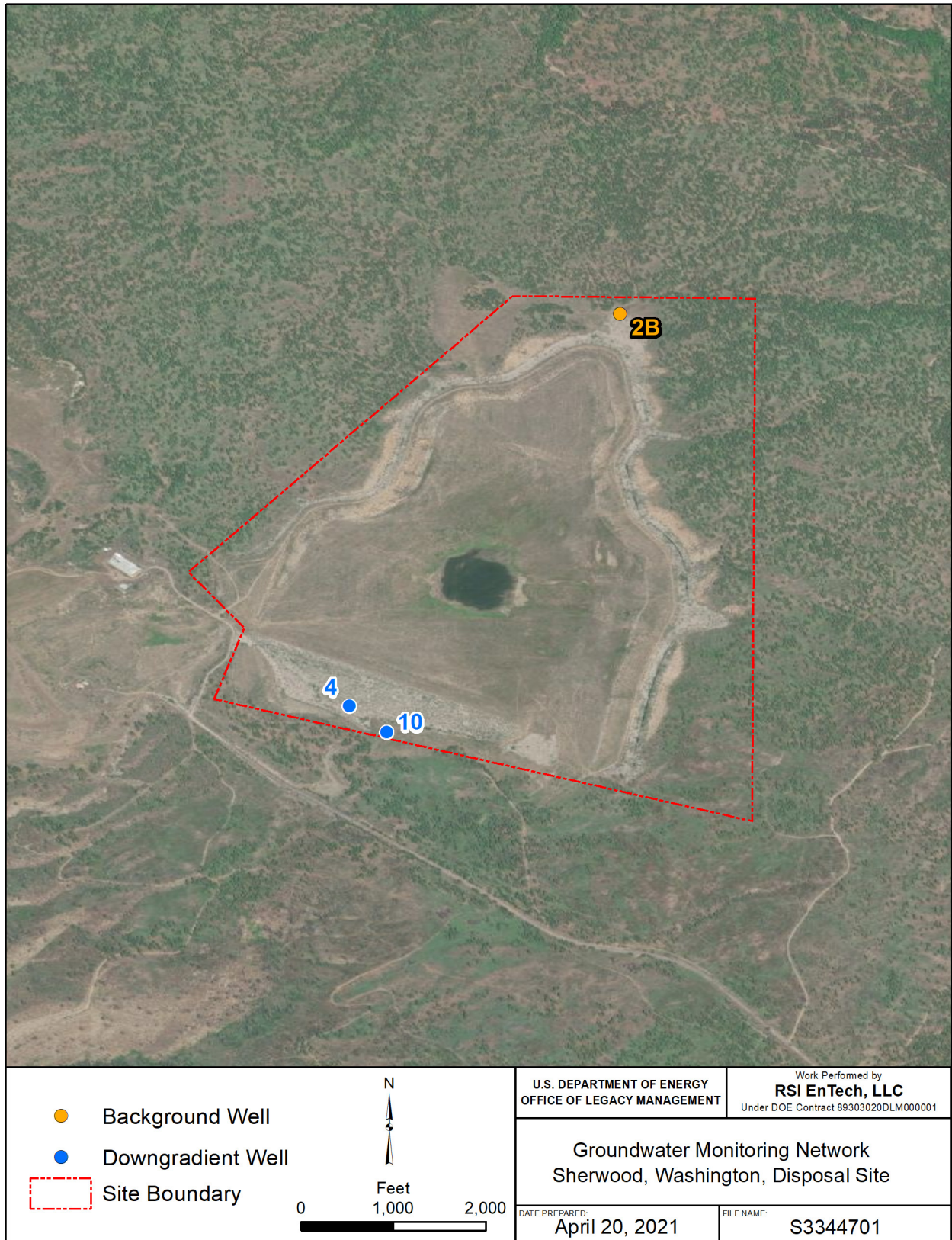
Note:

^a State of Washington water quality criteria used as action levels.

Abbreviations:

NA = not applicable

TDS = total dissolved solids



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

Time-concentration plots of chloride and sulfate for the three monitoring wells are shown in Figure 5-4 and Figure 5-5, respectively. 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. Absolute values of water table elevations reported in Figure 5-6 and Figure 5-7 differ slightly from those in previous reports, but the trends are the same. The reason for the offset is the recent transformation of vertical datum from National Geodetic Vertical Datum of 1929 to North American Vertical Datum of 1988 in LM's environmental database.

Increases in water table height in wells 2B and 4 correspond with the elevated levels of chloride and sulfate measured in well 4 in 2006 and 2011 and from 2016 to 2018. As stated by WDOH 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, well 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.

A borehole camera was used in 2018 to evaluate conditions in the three monitoring wells, specifically to determine if any well issues contributed to 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 specific conductivity data until removal during the 2020 sampling event. After further analysis, if the data indicate a correlation between higher water levels and increased specific conductivity, LM may propose to cease the best management practice annual water sampling (Kreie 2018).

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 2021 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. Herbicide applications were not warranted in 2021.

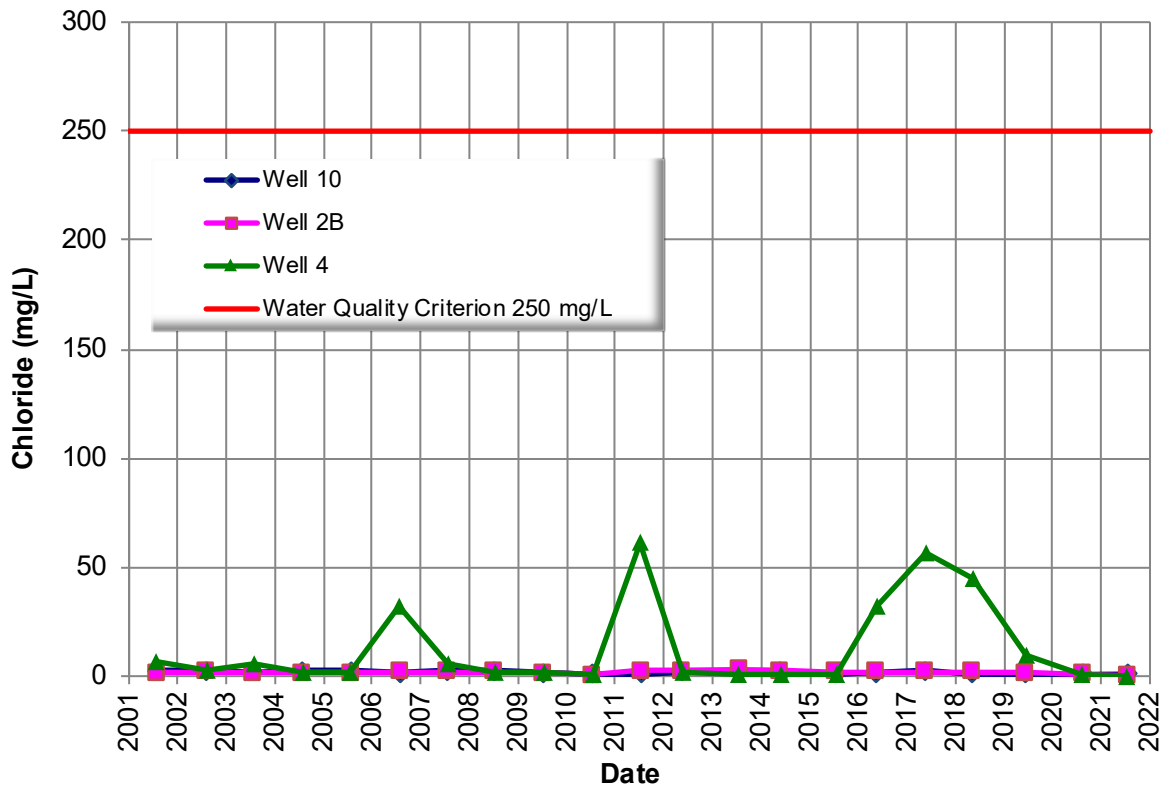


Figure 5-4. Chloride Concentrations at the Sherwood, Washington, Disposal Site

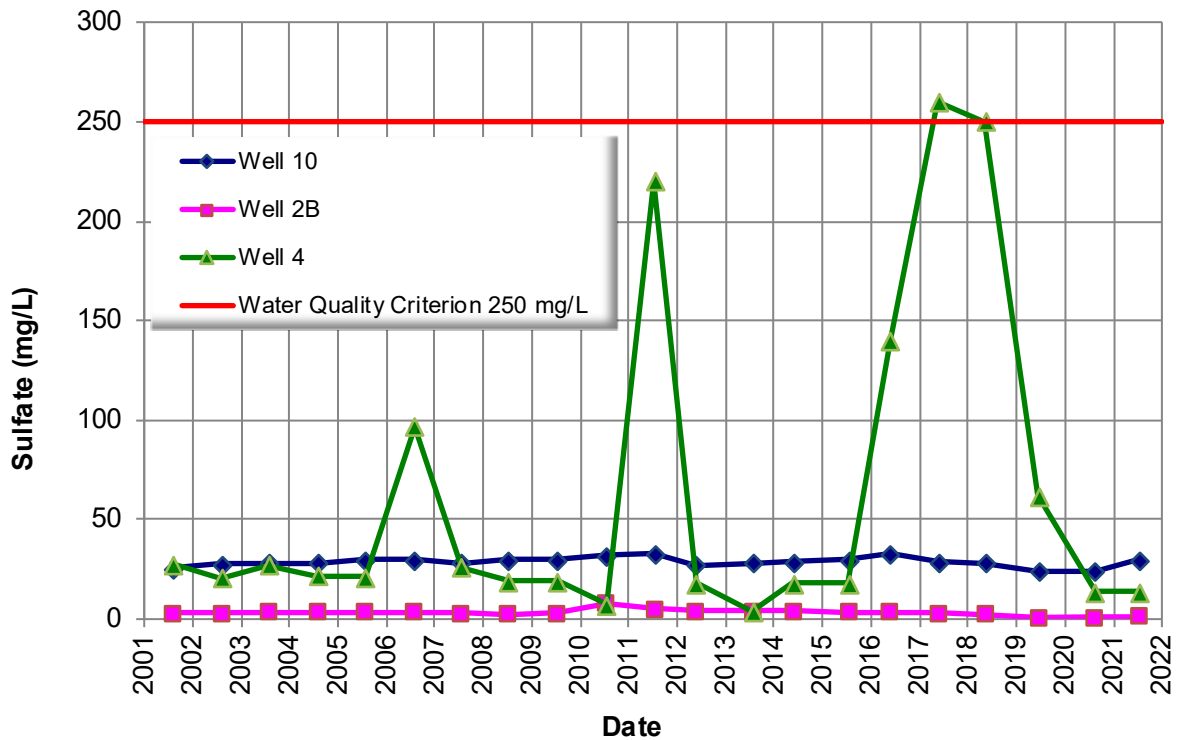


Figure 5-5. Sulfate Concentrations at the Sherwood, Washington, Disposal Site

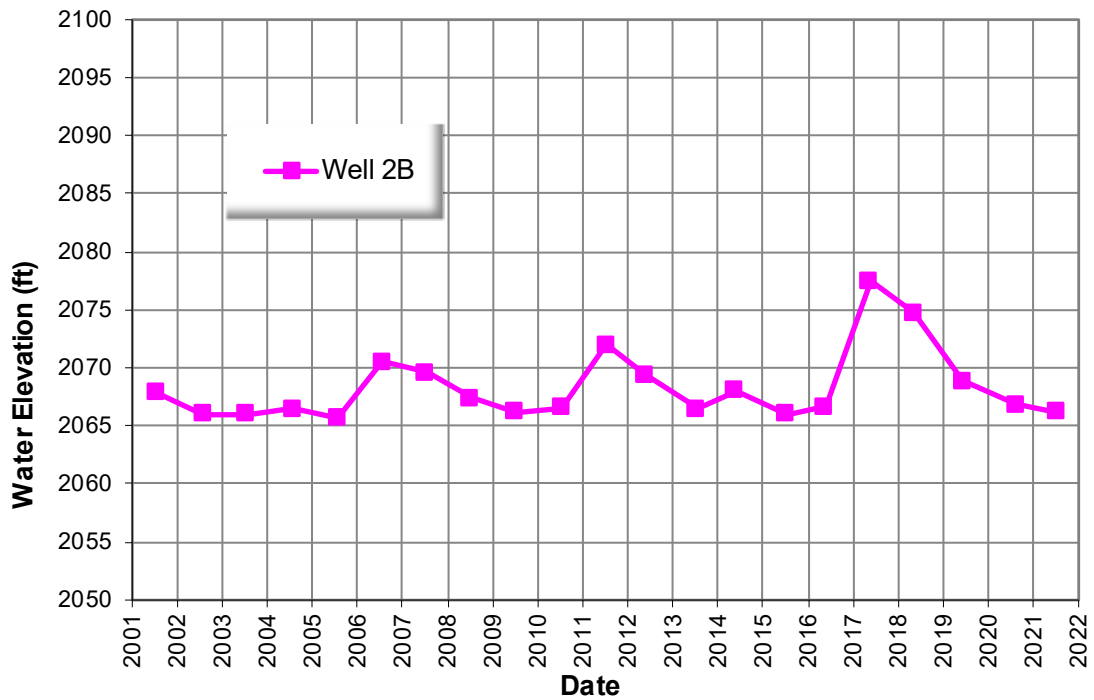


Figure 5-6. Well 2B Water Elevation Measurements at the Sherwood, Washington, Disposal Site

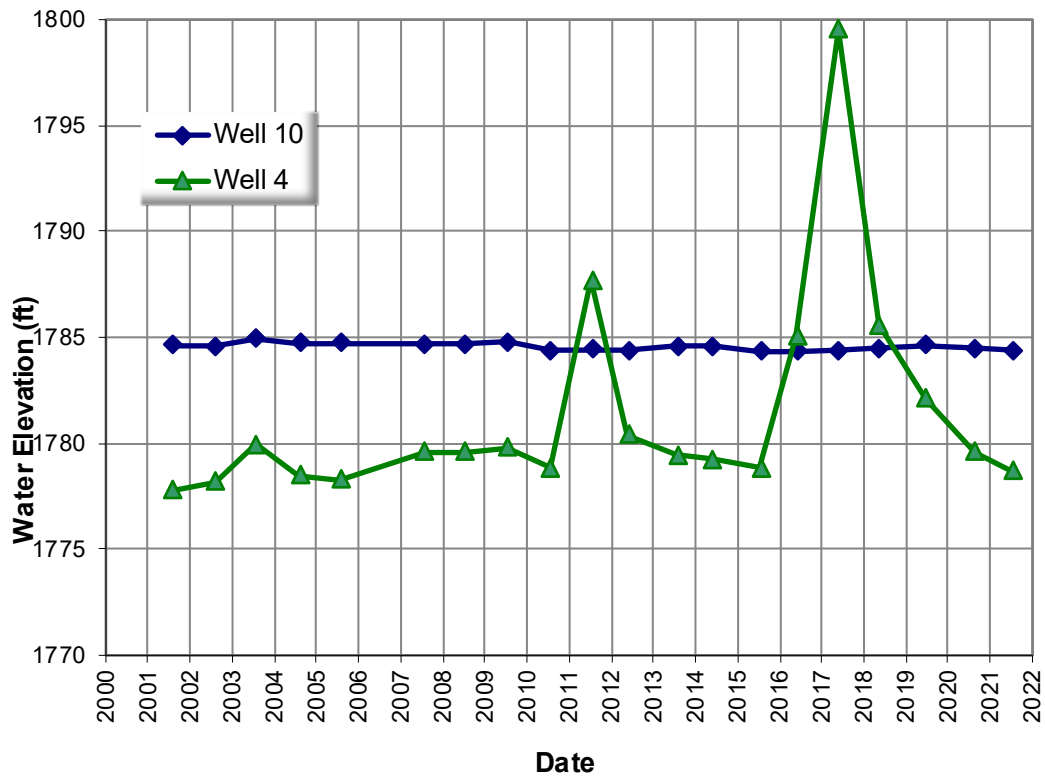


Figure 5-7. Wells 4 and 10 Water Elevation Measurements at the Sherwood, Washington, Disposal Site

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	50	Perimeter Sign P6
PL-2	70	Granite Site Marker
PL-3	120	Boundary Monument BM-3A
PL-4	240	Quality Control Monument QC-1
PL-5	220	Monitoring Well 4
PL-6	280	Gully Downgradient of Riprap-Armored Swale Near Perimeter Sign P1
PL-7	190	Gully Near Perimeter Sign P2 (Stable)
PL-8	245	Disposal Cell
PL-9	255	Evidence of Vehicle Tracks to Disposal Cell Pond 1
PL-10	20	Disposal Cell Pond 1
PL-11	30	Sand Deposit at Toe of Containment Dam Outslope
PL-12	95	Wildlife Trail Adjacent the Disposal Cell



PL-1. Perimeter Sign P6



PL-2. Granite Site Marker



PL-3. Boundary Monument BM-3A



PL-4. Quality Control Monument QC-1



PL-5. Monitoring Well 4



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



PL-7. Gully Near Perimeter Sign P2 (Stable)



PL-8. Disposal Cell



PL-9. Evidence of Vehicle Tracks to Disposal Cell Pond 1



PL-10. Disposal Cell Pond 1



PL-11. Sand Deposit at Toe of Containment Dam Outslope



PL-12. Wildlife Trail Adjacent the Disposal Cell

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

Date of Inspection: June 09, 2021

Inspector: Brackett Mays

Organization: RSI EnTech, LLC

Piezometer water levels measured during groundwater monitoring event: August 11, 2020

(All depths in feet; TOC = top of casing)

Piezometer PZ-1 fluid level (TOC to top of fluid): 21.85 Fluid amount: 0.70
Total depth: 22.55

Piezometer PZ-2 fluid level (TOC to top of fluid): 60.75 Fluid amount: 2.32
Total depth: 63.07

Piezometer PZ-3 fluid level (TOC to top of fluid): Dry Fluid amount: Dry
Total depth: 67.62

Piezometer PZ-4 fluid level (TOC to top of fluid): 21.97 Fluid amount: 0.73
Total depth: 22.70

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

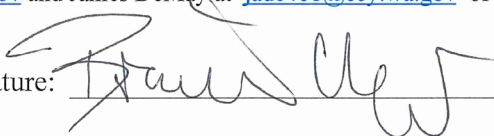
NRC Operations Center: (301) 951-0550

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 gor461@ecy.wa.gov and James DeMay at jade461@ecy.wa.gov of the Washington Department of Ecology, Dam Safety Office

Inspector Signature: _____



Date: _____

6/09/2021

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