RPT-576
Revision 4

Interim Closure Plan for the RWMC Active Low-Level Waste Disposal Facility at the Idaho National Laboratory Site

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Assistant Secretary for Environmental Management
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ABSTRACT

This Interim Closure Plan describes how the Radioactive Waste Management Complex Active Low-Level Waste Disposal Facility (ALLWDF) will be operationally closed to achieve long-term stability and minimize the need for active maintenance following operational closure and to ensure compliance with the requirements of DOE O 435.1 Chg 1, "Radioactive Waste Management," and DOE O 458.1 Chg 2, "Radiation Protection of the Public and the Environment."

The ALLWDF stopped disposals of contact- and remote-handled waste September 30, 2008, in the open pit areas of the facility. Remote-handled waste continues to be disposed of in concrete vaults and these remote-handled operations are planned to continue through the year 2020 (*Phase 1 Remedial Design/Remedial Action Work Plan for Operable Unit 7-13/14,* DOE/ID-11389). The disposal facility is located within Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Operable Unit 7-13/14, which is currently in the remedial design/remedial action phase. The ALLWDF will be closed under the remedial action, which includes a final cover as specified in the Record of Decision for Operable Unit 7-13/14 (DOE/ID-11359). Since the facility will be closed under CERCLA, DOE O 435.1 Chg 1 requirements will be applied until the end of operations and CERCLA requirements will apply thereafter. The emphasis of this Interim Closure Plan is on the interim closure during operations. The design assumptions for the final cover are consistent with the assumptions made in the performance assessment (*Performance Assessment for the RWMC Active Low-Level Waste Disposal Facility at the Idaho National Laboratory Site*, DOE/NE-ID-11243) and subsequent documentation in the annual reports.

Revision 4 of this document (a) updates the waste characteristics with radionuclide inventory and volumes updated through Fiscal Year 2015 and projected remote-handled LLW disposals through closure, (b) presents an updated disposal closure schedule through the year 2020, (c) presents a summary of refined plans for the final closure, and (d) presents October 2010 and October 2014 aerial surveys of the ALLWDF, including the interim cover that has been placed over the closed portions of the facility.

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ACRONYMS

ALLWDF	Active Low Level Waste Disposal Facility
CA	composite analysis
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
DOE	Department of Energy
FY	fiscal year
INL	Idaho National Laboratory
LLW	low-level waste
OU	operable unit
PA	performance assessment
ROD	record of decision
RWMC	Radioactive Waste Management Complex
SDA	Subsurface Disposal Area
SVR	soil vault row
WAG	waste area group

Interim Closure Plan for the RWMC Active Low-Level Waste Disposal Facility at the Idaho National Laboratory Site

1. INTRODUCTION

This Interim Closure Plan is written for the Idaho National Laboratory (INL) Active Low-Level Waste Disposal Facility (ALLWDF). This plan describes how the ALLWDF will be closed to ensure compliance with the requirements of DOE O 435.1 Chg 1, "Radioactive Waste Management," and DOE O 458.1 Chg 2, "Radiation Protection of the Public and the Environment." The report has been developed to comply with the applicable requirements of DOE M 435.1-1 Chg 2 and the Disposal Authorization Statement (Marcinowski 2008) for the facility.

The ALLWDF is part of the Waste Area Group (WAG) 7 Operable Unit (OU) 7-13/14, which is the designation for the Radioactive Waste Management Complex (RWMC) under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) (42 USC § 9601 et seq.). OU 7-13/14 is currently in the remedial design/remedial action phase. At the RWMC, the Subsurface Disposal Area (SDA), which contains the ALLWDF, will be closed under the remedial action specified in the Record of Decision (ROD) for OU 7-13/14 (DOE-ID 2008a). Since final closure of the ALLWDF will occur under CERCLA, DOE O 435.1 Chg 1 requirements will be applied until the end of operations and CERCLA requirements will apply thereafter.

The purpose of the Interim Closure Plan is to define the approach for ensuring the long-term protection of the public and the environment from the disposal of low-level radioactive wastes in accordance with DOE O 435.1 Chg 1. Specific construction plans for the interim closure of the ALLWDF are presented in this plan because the interim closure will occur during and immediately following the end of ALLWDF operations.

Updates to this revision of the Interim Closure Plan include:

- Updated inventories and waste disposal volumes through Fiscal Year (FY) 2015 and projected through ALLWDF closure.
- New operational and interim closure dates for the disposal of remote-handled waste.
- Refined final closure plans per the ROD for OU (OU) 7-13/14 (DOE-ID 2008a) and implementation under the CERCLA program.
- October 2010 and October 2014 aerial surveys of the ALLWDF, including the interim cover that has been placed over the closed portions of the facility:
  - The October 2010 aerial survey shows the elevations of the interim cover as completed in September 2010.
  - The October 2014 aerial survey shows the elevations of the interim cover as of the latest aerial survey.

This introduction describes the general facility, land-use restrictions, and the CERCLA activities. The remaining sections provide background information, the technical approach to closure, and the closure schedule.

1.1 General Facility Description

The INL Site is a U.S. Department of Energy (DOE) facility occupying approximately 2,305 km^2 (890 mi^2) of mostly undeveloped, high-desert terrain in southeastern Idaho (see Figure 1-1). The RWMC is located in the southwestern portion of the INL Site and encompasses 177 acres (Figure 1-2) divided into the Administrative and Operations Area (22 acres), Transuranic Storage Area (58 acres), and SDA (97 acres).

A contoured earthen berm surrounds the SDA to isolate it from the surrounding land in order to control intermittent storm water and snowmelt and confine the contamination to the area of the SDA. Within the SDA, the ALLWDF covers an area of roughly 7.76 acres[a] (31,400 m^2) and is subject to DOE O 435.1 Chg 1 requirements. The total area within the boundaries of Pits 17-20 (Figure 1-3) is roughly 5.76 acres (23,300 m^2) based on Drawing 416511 and a geographical information system application (ESRI 2013).

The waste management mission of the RWMC is to manage, in a safe and environmentally sound manner, the disposal of low-level waste (LLW). Several thousand cubic meters of LLW have been disposed of at the facility each year. Mixed waste materials have been buried in the SDA from 1952 until late 1983. From 1984 to the present, only LLW has been disposed of.

As previously stated, the ALLWDF is contained within SDA at the RWMC. By definition, the ALLWDF includes waste disposed from 1984 until the present in a large contiguous subsurface area delineated into Pits 17 through 20, the Soil Vault Rows (SVRs) 14 through 21, and the concrete vaults located in the southwest portion of Pit 20 (Figure 1-3).

Disposals to the ALLWDF open pits consisted primarily of contact-handled waste with a relatively small volume of remote-handled waste. Pits 17 through 20 were constructed to a total depth of approximately 9 m (30 ft), and the exposed basalt at the base of the pit was covered with 0.6 m (2 ft) of soil. The contact-handled LLW was stacked in the open pit using forklifts and cranes. The stack height was limited by the self-supporting strength of the containers and by administrative controls (maximum stack height is 7.3 m [24 ft]).

SVRs 14 through 21 (Figure 1-3) were used for the disposal of remote-handled LLW prior to construction of the concrete vaults. The soil vaults comprise unlined holes bored directly in the native soil with a diameter of 0.4 m to 2.0 m (1.3 to 6.5 ft) and are 5.2 to 7.6 m (17 to 25 ft) deep. Typically, soil vaults were covered with several feet of soil.[b] Each vault is separated from the previous vault by a minimum distance of 0.6 m (2 ft). There have been no disposals to SVRs 14 through 21 since August 1995.

Two hundred concrete vaults are located in the southwest corner of Pit 20 (Figure 1-3). The concrete vaults are designed to receive remote-handled radioactive waste, conserve space within the ALLWDF, and provide a rigid structure for operational safety. Constructed of precast reinforced concrete manhole sections resting on an integral base plate and capped with a concrete plug, the vaults are configured in honeycomb arrays. The vaults are surrounded by soil for additional shielding and seismic

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a. The area was estimated in the original Performance Assessment (PA) (Maheras et al. 1994, p. 3-31) for the ALLWDF. The area of the ALLWDF was assumed to be represented by a 122- × 257-m or 31,400-m^2 area.

b. Two inactive soil vaults covered with shield plugs in SVR 21 have not been covered with an interim soil cover. An interim soil cover will be placed over these two soil vaults when remote-handled LLW disposals cease in 2020.

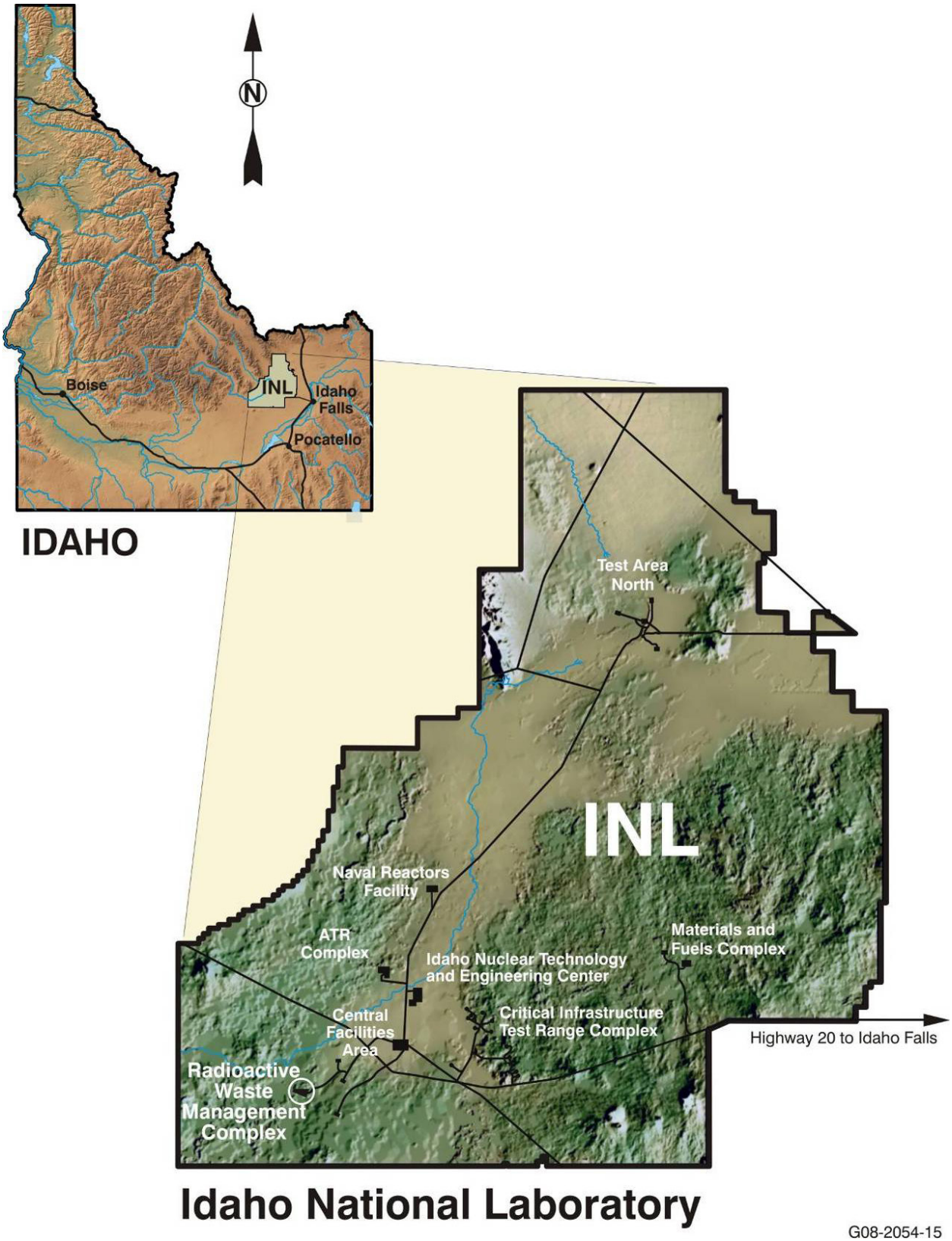

Figure 1-1. Map of the Idaho National Laboratory Site showing locations of the Radioactive Waste Management Complex and other Site facilities.

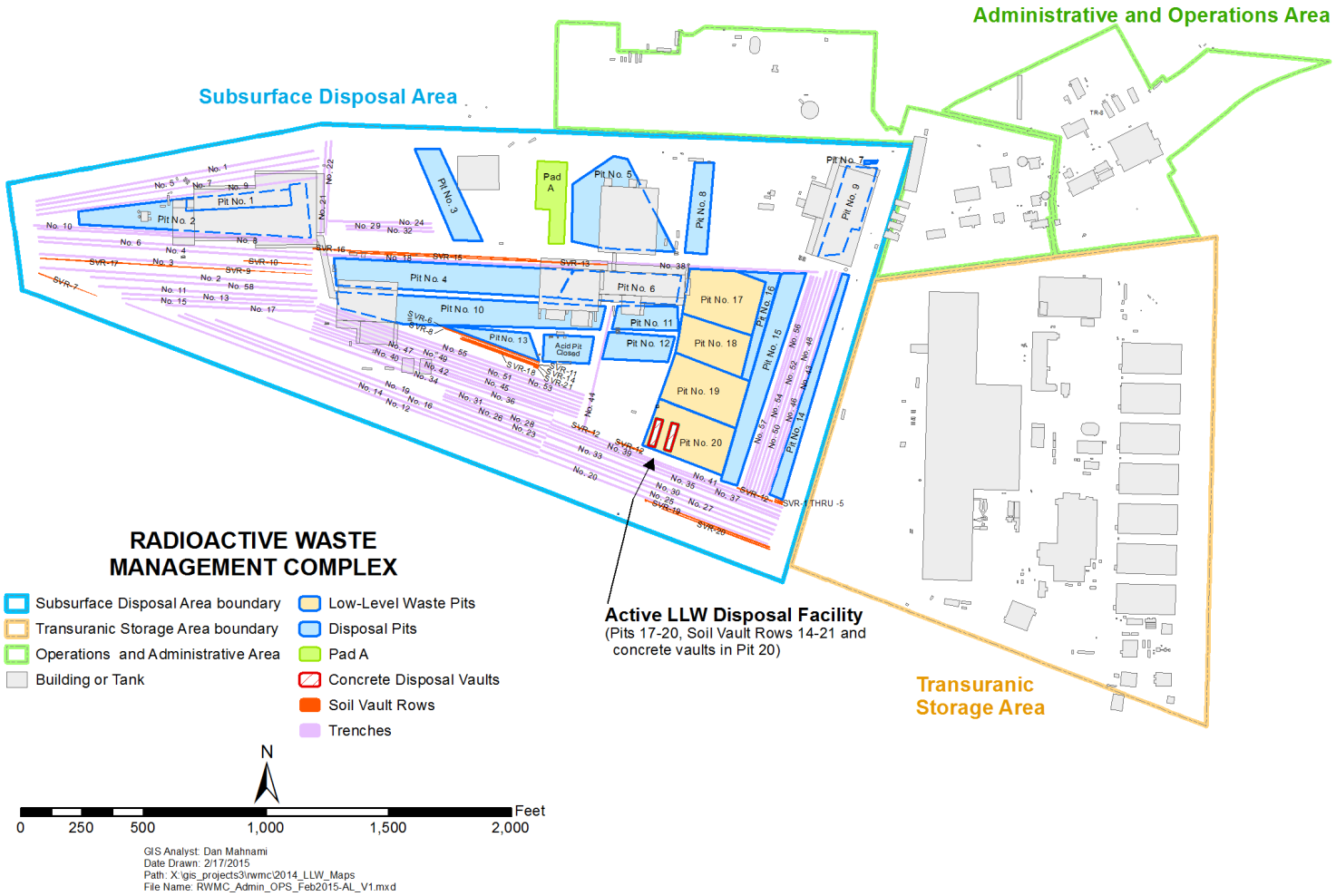

Figure 1-2. Map of the Radioactive Waste Management Complex.

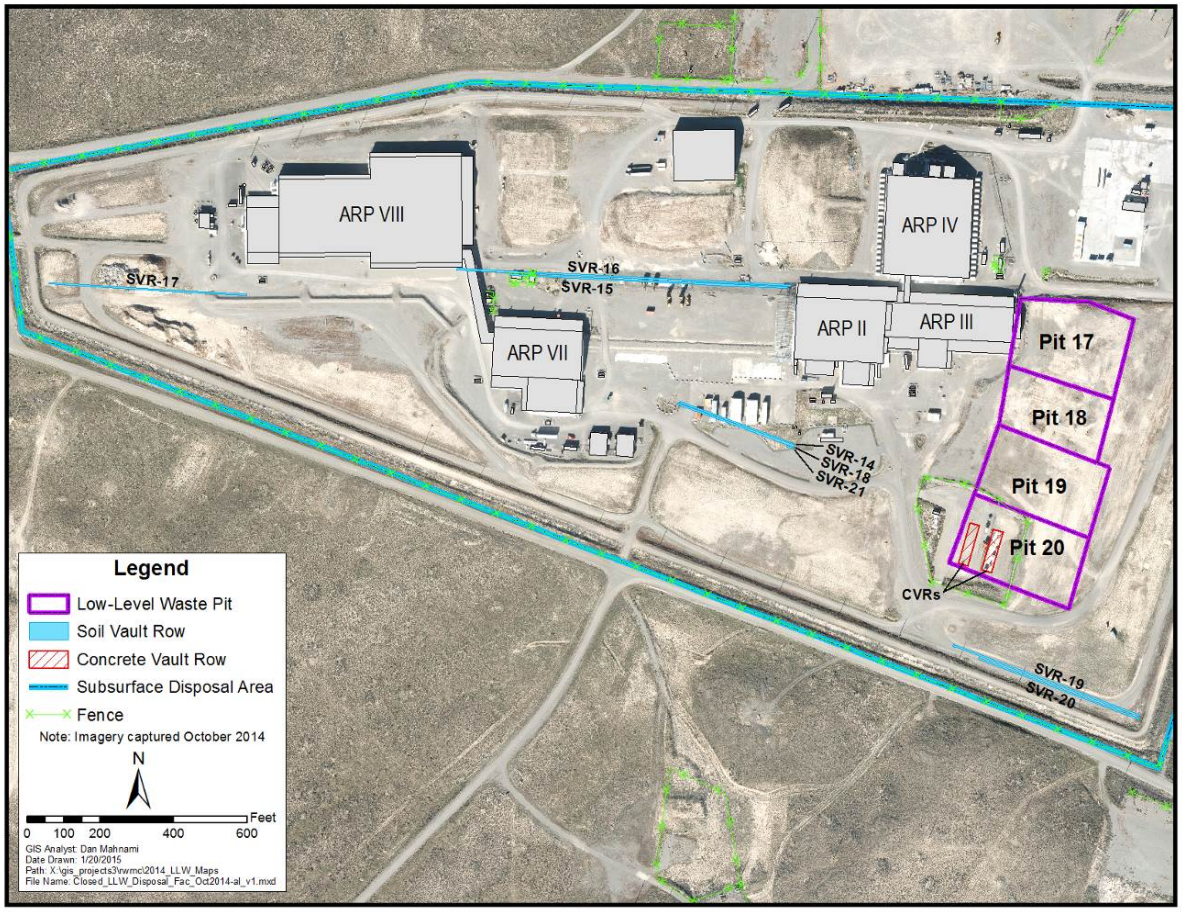

Figure 1-3. Radioactive Waste Management Complex Active Low-Level Waste Disposal Facility within the Subsurface Disposal Area (October 2014).

stability, and the void spaces between the vaults in each array are filled with sand. On August 2, 1994, disposals began of remote-handled LLW in concrete vaults, and the concrete vaults remain an active disposal site. Most remote-handled wastes disposed of in the concrete vaults are packaged in specialized containers such as the 55-ton shipping cask liner inserts. The Naval Reactors Facility is the main waste generator of the remote-handled LLW. For more details regarding remote-handled waste disposal to the concrete vaults, refer to TPR-1757, "55-Ton Cask Discharge to RH LLW Concrete-Lined Vaults." Waste disposal constraints for the ALLWDF are defined in *Radioactive Waste Management Complex Active Low-Level Waste Disposal Facility Waste Acceptance Criteria* (DOE-ID 2015a).

1.2 Land-Use Restrictions

The *Idaho National Laboratory Comprehensive Land Use and Environmental Stewardship Report* (INL 2011) describes land use and activities being undertaken at the INL Site. Land use at the Site is government-controlled industrial use. The primary use of INL Site land is to support facility and program operations dedicated to nuclear energy research, spent nuclear fuel management, hazardous and mixed waste management and minimization, cultural resources preservation, and environmental remediation. A security force is used to limit access to approved personnel and visitors. The distance from the RWMC to the Site southern boundary is roughly 5,500 m (3.4 mi).

Future land use during the 1,000-year compliance period for performance assessment is: (1) the Site will remain under government control for the foreseeable future and (2) no new major private developments (residential or nonresidential) are expected in areas adjacent to the Site. The INL land use is expected to be a research facility within the Site boundaries and agriculture and open land surrounding the Site.

Consistent with DOE orders and policy, DOE will maintain control of the land at the RWMC and land within a sufficient surrounding area to further ensure protection of human health and the environment. Specific long-term land-use restrictions for the RWMC are implemented under CERCLA as specified in the ROD for OU 7-13/14 (DOE-ID 2008a) and the INL Site-Wide Institutional Controls Plan (DOE-ID 2015b).

1.3 Related CERCLA Activities

The ALLWDF is located within CERCLA OU 7-13/14, which includes historical mixed waste disposals in older pits, trenches, and SVRs within the SDA. As stated in the OU 7-13/14 Phase 3 Remedial Design Work Plan (Meagher and Holdren 2013), "DOE intends to transfer management of the Active Low-Level Waste Disposal Facility, including the remote-handled concrete vault, to regulation and management under CERCLA by 2023." Final closure of the ALLWDF will be implemented through the CERCLA process as specified in the ROD for OU 7-13/14 (DOE-ID 2008a).

Active coordination is in place between those organizations working on the CERCLA process (Environmental Restoration) and those involved with operation of the ALLWDF (Waste Management) in the SDA. This cooperation is to ensure that these activities can proceed concurrently in compliance with applicable DOE and other regulatory requirements.

1.4 Closure Approach

Closure of the ALLWDF will be conducted in the following three stages:

- Interim closure will be implemented as described in this report.
- Final closure will be implemented through the CERCLA process as specified in the ROD for OU 7-13/14 (DOE-ID 2008a) and will include emplacement of a final cover over the entire SDA.
- Long-term institutional control will also be implemented through the CERCLA process as specified in the OU 7-13/14 ROD (DOE-ID 2008a) and the INL Site-Wide Institutional Controls Plan (DOE-ID 2015b).

Monitoring and maintenance of the ALLWDF will continue as specified in the Monitoring Program (Parsons 2015) and Maintenance Plan (Parsons, McCarthy, and Koslow 2010) until the transfer to CERCLA is complete.

Long-term institutional controls, maintenance, and monitoring will be implemented as specified in the ROD for OU 7-13/14 (DOE-ID 2008a) and the INL Site-Wide Institutional Controls Plan (DOE-ID 2015b). Establishing and maintaining long-term surveillance, maintenance, monitoring, and institutional controls will preserve the integrity of the surface barrier, limit access, and enforce land-use restrictions to ensure continued effectiveness of the remedy. DOE will maintain control of the site with land-use restrictions and will conduct 5-year reviews to assess the effectiveness of the remedy.

2. BACKGROUND

This section describes the RWMC environmental setting, LLW characteristics, and compliance with performance objectives and other requirements.

2.1 Environmental Setting

The natural environment and demographics around the RWMC play a critical role in determining the performance of the ALLWDF. The PA (DOE-NE-ID 2007) describes in detail the geography, demography, meteorology, climatology, ecology, geology, seismology, volcanology, hydrology, geochemistry, natural resources, and natural background radiation in the vicinity of the RWMC. The remainder of this section is an overview of this information.

The INL Site is located in the Eastern Snake River Plain, the largest continuous physiographic feature in southern Idaho (Figure 1-1). This large topographic depression extends from the Oregon border across Idaho to Yellowstone National Park and northwestern Wyoming. The surface of the INL Site is a relatively flat, semiarid, sagebrush desert. The INL Site is located entirely on the northern side of the Eastern Snake River Plain and adjoins the Lost River, Lemhi, and Beaverhead mountain ranges to the northwest, which compose the northern boundary of the plain. The INL Site boundary is over 5 km (3 mi) south of the RWMC. No permanent residents are within an 8-km (5-mi) radius of the RWMC. Regionally, the INL Site is nearest to the cities of Idaho Falls and Pocatello to the east and the town of Arco to the west.

The average annual precipitation in the area is 21.4 cm (8.4 in.). Snowfall is a substantial contributor to total annual precipitation and ranges from 17 to 152 cm/year (6.7 to 60 in./year), with an annual average of 70 cm (28 in.).

The potential annual evaporation from saturated ground at the INL Site is approximately 109 cm (43 in.), with 80% of the evaporation occurring between May and October. Little evaporation occurs between November and April. Actual evaporation rates are much lower than potential rates because the ground surface is rarely saturated. Transpiration by the native vegetation of the Snake River Plain is estimated at 15 to 23 cm/year (6 to 9 in./year). The most likely time for water to infiltrate into the ground is from late winter to spring because of the low evapotranspiration rates (Mundorff, Crosthwaite, and Kilburn 1964).

Geology at the INL Site consists of a sequence of Tertiary and Quaternary volcanic rocks and sedimentary interbeds. Hundreds of basalt flows, basalt-flow groups, and sedimentary interbeds underlie the INL Site. Basalt makes up about 85% of the volume of deposits in most areas. The basalt flows are locally interbedded with scoria and thin layers of sediment. Sedimentary interbeds are as thick as 15 m (50 ft) and consist of well-sorted to poorly sorted deposits of clay, silt, sand, and gravel.

The vadose zone thickness near the RWMC is approximately 180 to 186 m (590 to 610 ft). Perched water in the subsurface forms as discontinuous saturated lenses with unsaturated conditions existing both above and below the lenses. Perched water bodies are formed by vertical and, to a lesser extent, lateral migration of water moving away from a source until an impeding sedimentary layer is encountered. Perched water bodies have been identified at two depth intervals at the RWMC, approximately 24 to 27 m (80 to 90 ft) and 61 to 67 m (200 to 220 ft), corresponding to the B-C and C-D sedimentary interbeds, respectively. Perched water typically occurs in fractured basalt above the interbeds.

The Snake River Plain Aquifer, which underlies the INL Site, was classified as a sole-source aquifer by the Environmental Protection Agency in 1991 (56 FR 50634). This aquifer consists of saturated basalt and sediments, and it is one of the largest aquifers in the United States (Irving 1993). Generally, groundwater flows from the northeast to the southwest.

2.2 Waste Characteristics

Waste placed in the ALLWDF was classified as remote-handled or contact-handled LLW, depending on whether radiation levels at 1 m (3.3 ft) from the package surface are greater than or less than 500 mR/hour, respectively. Contact-handled LLW generated at the INL Site consisted primarily of contaminated or potentially contaminated protective clothing, paper, rags, packing material, glassware, tubing, and other general-use items. Contaminated equipment (such as glove boxes and ventilation ducts) and process waste (such as filter cartridges and sludges) were also disposed of. These materials were either surface-contaminated with radionuclides or were activated from nuclear reactions. A variety of different waste packages, including wooden and metal boxes; drums; soft-sided, reinforced containers; and other specialized containers, were used for specific contact-handled waste disposal.

For disposal in the open pit areas, the ALLWDF stopped receiving disposals of contact- and remote-handled waste on September 30, 2008. During the last years of waste disposal to the open pits, the focus changed to disposal of wastes resulting from deactivation, decontamination, and decommissioning activities on the Site, which included much more contaminated debris, consisting typically of large volumes with lower radioactivity. Remote-handled waste continues to be disposed of in concrete vaults at the ALLWDF, and these remote-handled operations are planned to continue through 2020 (DOE-ID 2013).

The following sections discuss the waste volumes, radionuclide inventories, waste forms, and release mechanisms for the LLW disposed of to the ALLWDF.

2.2.1 Waste Volumes

As previously explained, the waste in the ALLWDF is defined as all waste disposed of after January 1, 1984, to the following disposal units:

- Open pits – a single contiguous open pit shown on maps in this report as Pits 17, 18, 19, and a portion of Pit 20
- Soil Vault Rows 14 through 21
- Concrete vaults – contained within the southwest corner of Pit 20.

Pit 17 contains some waste disposed of prior to January 1, 1984, which is not included in the definition of the ALLWDF. The waste disposal volume defined as the ALLWDF and the waste volume disposed of to Pit 17 prior to January 1, 1984, are shown in Table 2-1. As shown in the table, the volume of waste disposed of to Pits 17 through 20 (including the concrete vaults) and SVRs 14 through 21 is approximately:

- 8.50E+04 m^3 from 1984 through September 2015 and defined as the LLW disposals to the ALLWDF
- 9.12E+04 m^3 from 1982 through September 2015.[c]

The Interim Closure Plan includes a cover over all of Pit 17 regardless of whether the waste is defined as part of the ALLWDF. Therefore, the ALLWDF closure is over a total of 9.12E+04 m^3 of waste, but only 8.50E+04 m^3 of the waste is defined as LLW and regulated under DOE O 435.1 Chg 1.

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c. Although not included in the RWMC PA (DOE-NE-ID 2007), disposals to Pit 17 from May 1982 through December 1983 were included in the RWMC Composite Analysis (CA) (DOE-NE-ID 2008) and represent less than 1% of the total PA inventory for the radionuclides that contribute significantly to the PA radiological dose (Appendix C in Parsons et al. 2008). If the Pit 17 disposals were included in the RWMC PA, they would have little impact on the results and no impact on the conclusions.

Table 2-1. Waste volumes disposed of at the Active Low-Level Waste Disposal Facility and in Pit 17 prior to January 1, 1984.

Disposal Location	Disposal Period		Volume Disposed Of[a] (m^3)
	Beginning	End	
ALLWDF waste disposals (January 1984 through September 2015)			
Open pits – Pits 17, 18, 19, and portion of Pit 20	Jan. 1984	Sep. 2008	8.36E+04
Concrete vaults – southwest corner of Pit 20[b]	Jan. 1994	Sep. 2015	7.67E+02
Soil Vault Rows 14 through 21	Jan. 1984	Aug. 1995	6.57E+02
Total ALLWDF waste disposals (January 1984 - September 2015)			**8.50E+04**
Pre-ALLWDF disposals (prior to January 1984)			
Open pit - Pit 17	May 1982	Dec. 1983	6.22E+03
ALLWDF disposals plus disposals prior to January 1994 (May 1982 through September 2015)			
Total waste disposals (May 1982 – September 2015)			**9.12E+04**

a. Waste disposal volumes were obtained from the WILD and IWTS databases. Data were compiled by Kirk Green (CWI) on December 15, 2015.

b. Each concrete vault can receive two disposals and each disposal is approximately 2.66 m^3. The total volume of waste received in the concrete vaults of 767 m^3 is slightly smaller than the volume available in 157 vaults (835 m^3) assuming 5.32 m^3 per vault because not all the vaults have received a constant volume of 5.32 m^3 of waste.

ALLWDF Active Low-Level Waste Disposal Facility
CWI CH2M-WG Idaho, LLC
IWTS Integrated Waste Tracking System
WILD Waste Information and Location Database

Future waste disposals to the ALLWDF will only be to the concrete vaults. Of the 200 concrete vaults built at the ALLWDF, 157 have been filled and one is out-of-service. Figure 2-1 shows the actual vault usage from January 1998 through September 2015 and the projected usage through 2020 of the remaining 42 vaults (McCarthy, Parsons, and Bowser 2016).

Figure 2-1. Remote-handled low-level waste vault usage at the Active Low-Level Waste Disposal Facility from 1998 to 2020 (actuals and projected). (Note: The year 2020 includes October – December of 2020 in addition to FY 2020.)

2.2.2 Radioactive Waste Inventories

The ALLWDF inventory of all radionuclides evaluated in the RWMC PA (DOE-NE-ID 2007) is shown and discussed in detail in the PA. Additional details on disposals are documented in *Waste Information and Location Database for the OU 7-13/14 Project* (McKenzie et al. 2005).

Beginning in FY 2009, the suite of radionuclides disposed of at the ALLWDF is different (i.e., activated metal and resins), compared with previous years when disposals were a combination of both contact- and remote-handled LLW to the open pits and remote-handled LLW to the soil and concrete vaults. Disposals since 2009 have been limited to 55-ton shipping cask liner inserts from the Naval Reactors Facility Expended Core Facility. Waste placed in the inserts comprises non-fuel-bearing highly activated metal upper and lower structures removed during processing of depleted naval nuclear core fuel modules.

Table 2-2 provides documented inventories in the ALLWDF through FY 2015, inventory projections through calendar year 2020, and an estimated total inventory at closure. These data were compiled from the Waste Information and Location Database and Integrated Waste Tracking System (i.e., two different CH2M-WG Idaho, LLC, [CWI] databases). The inventory presented is limited to radionuclides with greater than 5-year radioactive decay half-lives.

2.2.3 Waste Forms and Release Mechanisms

Waste was buried at the ALLWDF in containers such as metal drums; metal, concrete, and wooden boxes; soft-sided containers; and a variety of specialized containers. Waste forms evaluated in the PA (DOE-NE-ID 2007) include resins, activated metals, beryllium blocks, fuel-like materials, and miscellaneous waste. When the containers fail, the radionuclides are assumed to be released over time by either surface wash or dissolution.

Table 2-2. For all radionuclides with greater than a 5-year radioactive decay half-life, the inventory (Ci) disposed of and projected for disposal at the Active Low-Level Waste Disposal Facility.

Nuclide	Half-Life	Total Inventory Disposed Of January 1984 – FY 2015[a]	Projected Inventory FY 2016 – FY 2020[a]	Total Inventory Disposed Of Plus Projected Inventory January 1984 – FY 2020
Ac-227	2.18E+01	9.70E-04	—	9.70E-04
Ag-108m	4.18E+02	1.47E-01	—	1.47E-01
Al-26	7.17E+05	3.35E-03	—	3.35E-03
Am-241	4.32E+02	3.68E+00	3.57E-01	4.03E+00
Am-242m	1.41E+02	3.19E-03	5.30E-03	8.48E-03
Am-243	7.37E+03	2.61E-02	2.93E-03	2.91E-02
Ba-133	1.05E+01	3.93E-03	—	3.93E-03
Be-10	1.51E+06	3.52E+00	—	3.52E+00
Bi-207	3.29E+01	1.00E-11	—	1.00E-11
C-14	5.70E+03	1.55E+02	4.87E+01	2.04E+02
Ca-41	1.03E+05	1.31E+00	—	1.31E+00
Cd-113	7.70E+15	9.92E-05	—	9.92E-05
CD-113M	1.41E+01	4.43E-02	—	4.43E-02
Cf-249	3.51E+02	2.24E-04	—	2.24E-04
Cf-251	8.98E+02	8.88E-04	—	8.88E-04

Table 2-2. (continued).

Nuclide	Half-Life	Total Inventory Disposed Of January 1984 – FY 2015[a]	Projected Inventory FY 2016 – FY 2020[a]	Total Inventory Disposed Of Plus Projected Inventory January 1984 – FY 2020
Cl-36	3.01E+05	3.53E-01	1.41E-01	4.94E-01
Cm-243	2.91E+01	4.96E-03	2.45E-03	7.40E-03
Cm-244	1.81E+01	9.97E+00	3.94E-01	1.04E+01
Cm-245	8.50E+03	2.28E-03	—	2.28E-03
Cm-246	4.76E+03	2.14E-03	1.35E-04	2.28E-03
Cm-247	1.56E+07	1.68E-04	—	1.68E-04
Cm-248	3.48E+05	2.35E-07	—	2.35E-07
Co-60	5.27E+00	9.62E+05	1.22E+04	9.74E+05
Cs-135	2.30E+06	1.11E-02	—	1.11E-02
Cs-137	3.01E+01	7.62E+03	1.05E+01	7.63E+03
Eu-152	1.35E+01	1.48E+02	—	1.48E+02
Eu-154	8.59E+00	1.63E+02	—	1.63E+02
Fe-60	1.50E+06	3.75E-18	—	3.75E-18
Gd-152	1.08E+14	6.32E-06	—	6.32E-06
H-3	1.23E+01	2.76E+05	5.06E+01	2.76E+05
Hf-178m	3.10E+01	1.73E+00	2.88E+00	4.61E+00
Ho-166m	1.20E+03	1.69E-04	—	1.69E-04
I-129	1.57E+07	5.58E-02	1.12E-05	5.58E-02
K-40	1.27E+09	2.02E-03	—	2.02E-03
Kr-85	1.08E+01	1.74E-01	—	1.74E-01
Mn-53	3.74E+06	8.41E-10	—	8.41E-10
Mo-93	4.00E+03	4.69E-03	—	4.69E-03
Nb-92	3.47E+07	9.42E-12	—	9.42E-12
Nb-93m	1.61E+01	4.01E-01	—	4.01E-01
Nb-94	2.03E+04	2.59E+01	9.20E+00	3.51E+01
Nd-144	2.29E+15	3.80E-04	—	3.80E-04
Ni-59	7.60E+04	5.14E+03	7.50E+02	5.89E+03
Ni-63	1.00E+02	6.12E+05	5.37E+04	6.65E+05
Np-237	2.14E+06	2.24E-02	—	2.24E-02
Os-194	6.00E+00	1.55E-06	—	1.55E-06
Pa-231	3.28E+04	5.43E-03	—	5.43E-03
Pb-205	1.53E+07	2.52E-13	—	2.52E-13
Pb-210	2.23E+01	4.20E-01	—	4.20E-01
Pd-107	6.50E+06	3.41E-05	—	3.41E-05
Pm-146	5.53E+00	2.78E-06	—	2.78E-06
Pu-238	8.77E+01	5.17E+00	5.96E-01	5.77E+00
Pu-239	2.41E+04	8.44E+01	6.83E-02	8.45E+01
Pu-240	6.56E+03	3.27E+00	3.41E-02	3.30E+00
Pu-241	1.43E+01	8.41E+01	8.79E+00	9.29E+01

Table 2-2. (continued).

Nuclide	Half-Life	Total Inventory Disposed Of January 1984 – FY 2015[a]	Projected Inventory FY 2016 – FY 2020[a]	Total Inventory Disposed Of Plus Projected Inventory January 1984 – FY 2020
Pu-242	3.73E+05	2.67E-03	3.00E-04	2.97E-03
Pu-244	8.00E+07	1.26E-05	—	1.26E-05
Ra-226	1.60E+03	2.72E+00	—	2.72E+00
Ra-228	5.75E+00	1.08E-05	—	1.08E-05
Re-187	4.35E+10	1.56E-01	—	1.56E-01
Se-79	1.10E+06	2.39E-05	—	2.39E-05
Si-32	1.72E+02	2.96E-08	—	2.96E-08
Sm-147	1.06E+11	6.72E-13	—	6.72E-13
Sm-151	9.00E+01	2.40E+00	—	2.40E+00
Sn-121m	5.50E+01	7.71E-02	1.27E-01	2.04E-01
Sn-126	1.00E+05	1.38E-03	—	1.38E-03
Sr-90	2.88E+01	5.36E+03	8.23E+00	5.37E+03
Tc-99	2.11E+05	1.02E+01	3.47E-01	1.06E+01
Th-229	7.34E+03	8.81E-06	—	8.81E-06
Th-230	7.54E+04	4.47E-01	—	4.47E-01
Th-232	1.41E+10	1.13E-02	—	1.13E-02
U-232	6.89E+01	2.22E+00	—	2.22E+00
U-233	1.59E+05	3.12E+00	—	3.12E+00
U-234	2.46E+05	3.52E+00	—	3.52E+00
U-235	7.04E+08	1.77E-01	—	1.77E-01
U-236	2.34E+07	5.31E-02	—	5.31E-02
U-238	4.47E+09	3.30E+00	—	3.30E+00
Zr-93	1.53E+06	2.46E-03	—	2.46E-03

Note: The annual disposal activity for each radionuclide is the sum of the activity from all containers for the waste disposed of in that year of each specific waste stream for which the waste profile included that radionuclide. The activity concentration identified in each waste profile was either derived concentration based on waste characterization studies and documented in the associated IWTS Material Profile or calculated by a radiological engineer based on documented waste stream source term considerations and reported in a source term document. The activity listed does not reflect changes in activity due to radioactive decay or ingrowth between the time of waste characterization and the time of disposal nor the time from disposal until this report was issued. For radionuclides with short half-lives, the activity listed could be significantly larger than the actual activity at the time of disposal or the timeframe in which this report was issued. The Total Inventory Disposed Of column (column three) is the sum of the annual activities for the waste stream at the time of characterization and may significantly overestimate the activity for short-lived radionuclides. Accounting for decay and ingrowth to the present time is not required for this report as decay and ingrowth are inherently part of the PA processes.

a. From *Annual Performance Assessment and Composite Analysis Review for the Active Low-Level Waste Disposal Facility at the RWMC FY 2015* (McCarthy, Parsons, and Bowser 2016).

— no data
FY fiscal year
IWTS Integrated Waste Treatment System
PA performance assessment

2.3 Compliance with Performance Objectives and Other Requirements

As previously discussed, the RWMC PA considered waste disposals to the ALLWDF from 1984 through 2009 (DOE-NE-ID 2007). The PA compared the projected performance of the disposal facility, during interim closure and after final closure, with the performance objectives identified in DOE O 435.1 Chg 1 as well as other relevant requirements. The PA addressed the all-pathways dose, air pathway, radon flux at the surface, inadvertent intruder, groundwater protection, and biotic pathway.

Table 2-3 is a copy of the comparison of the performance objectives and ALLWDF PA results from the PA (DOE-NE-ID 2007). The results show that for the 100-year institutional control period and compliance period out 1,000 years, the all-pathways, atmospheric, inadvertent intruder, and groundwater protection performance objectives are all easily met.

For final closure of the SDA, the ROD (DOE-ID 2008a) specifies a design performance goal to reduce net infiltration through the surface barrier to less than 1 cm/year on average for the evapotranspiration surface barrier. In the PA, the base-case infiltration rate was assumed to be 0.1 cm/year (DOE-NE-ID 2007). A sensitivity case was run using all other base-case assumptions to evaluate the all-pathways dose if the cover performance was set at the previous value of 1 cm/year. The impact of increasing the infiltration rate to 1 cm/year was a shift in the time of the peak doses and an increase in the magnitude of the peaks. Assuming the higher infiltration rate, the peak doses were still well below the 25-mrem/year objective.

Table 2-4 is a copy from the PA (DOE-NE-ID 2007) of the comparison of groundwater results to groundwater protection criteria for the State of Idaho "Ground Water Quality Rule" (IDAPA 58.01.11). Groundwater protection is evaluated by comparing predicted concentrations in groundwater 100 m downgradient from the ALLWDF during the 100-year institutional control period with the groundwater performance measures. The beta-gamma effective dose equivalent sum of ratios, gross alpha activity, and Ra-226/Ra-228 concentrations are all much smaller than the performance measures. The H-3 concentration is 17,200 pCi/L, which is below the 20,000-pCi/L limit and was conservatively modeled (DOE-NE-ID 2007). All of the groundwater protection performance objectives are below the standards, which provide confidence that a reasonable expectation of compliance with the groundwater protection performance objectives can be achieved.

Although biotic transport of radionuclides can occur at the INL Site and was evaluated in the RWMC PA (DOE-NE-ID 2007), biointrusion at the ALLWDF is not expected because one of the requirements of the CERCLA ROD (DOE-ID 2008a) is to inhibit biotic transport to the surface. The final barrier design will satisfy this requirement through overall thickness of the final cover or through some other means (e.g., incorporation of a biobarrier component).

The final barrier design, overall cover thickness, net average infiltration rate of less than 1 cm/year for the evapotranspiration surface barrier, long-term institutional controls, groundwater use, and drilling restrictions, all implemented under CERCLA per the ROD (DOE-ID 2008a), will provide continued assurance the groundwater protection requirement will be met. No additional closure activities or design features are needed with respect to this performance objective.

Table 2-3. Comparison of performance objectives and Active Low-Level Waste Disposal Facility performance assessment results (from Table ES-1 of DOE-NE-ID 2007).

Performance Objective	Standard	Performance Assessment Results	
		100-Year Institutional Control Period[a] (5,500 m downgradient, INL Site boundary)	Compliance Period (100 m downgradient of ALLWDF)
All-pathways (DOE O 435.1 Chg 1)	25 mrem/yr EDE	0.04 mrem/yr	0.5 mrem/yr
Atmospheric (40 CFR 61 Subpart H)	10 mrem/yr EDE (entire INL Site)	0.003 mrem/yr	0.07 mrem/yr
Atmospheric (40 CFR 61 Subpart Q)	20 $pCi \cdot m^{-2} \cdot s^{-1}$ radon flux (at surface of ALLWDF)	1.2 $pCi \cdot m^{-2} \cdot s^{-1}$	1.3E-01 $pCi \cdot m^{-2} \cdot s^{-1}$
Acute inadvertent intruder (DOE O 435.1 Chg 1)	500 mrem EDE	NA	1.7 mrem at ALLWDF
Chronic inadvertent intruder (DOE O 435.1 Chg 1)	100 mrem/yr EDE	NA	1.0 mrem/yr at ALLWDF
Groundwater protection (40 CFR 141) (IDAPA 58.01.08)	Beta-gamma sum of ratios between concentration and MCL ≤1.0	0.02	0.3
	MCL of 5 pCi/L for Ra-226 and Ra-228	0	1E-11 pCi/L
	MCL of 15 pCi/L for gross alpha	0	2E-05 pCi/L
	MCL of 30 μg/L for uranium	0	2E-03 μg/L
	MCL of 8 pCi/L for Sr-90	NA[b]	NA[b]
	MCL of 20,000 pCi/L for H-3	290 pCi/L	940 pCi/L

a. The performance assessment assumed a 100-year institutional control period; however, the CERCLA Record of Decision (DOE-ID 2008a) indicates that DOE will maintain control indefinitely or will transfer the property in accordance with CERCLA requirements.

b. Not applicable; Sr-90 is not a contaminant of concern at the ALLWDF.

ALLWDF Active Low-Level Waste Disposal Facility
CERCLA Comprehensive Environmental Response, Compensation, and Liability Act
DOE Department of Energy
EDE effective dose equivalent
INL Idaho National Laboratory
MCL maximum contaminant level
NA not applicable

Table 2-4. Comparison of groundwater results to groundwater protection criteria for the State of Idaho "Ground Water Quality Rule." (from Table 4-5 of DOE-NE-ID 2007).

Groundwater Performance Measure	100-Year Institutional Control Period[a] (100 m Downgradient of ALLWDF) 2010–2110	Comments
Beta-gamma sum of the ratios between concentration and 4 mrem/yr EDE ≤1.0	0.2	H-3 accounts for about 99% of the ratio
Gross alpha activity ≤15 pCi/L	5E-08 pCi/L	—
Ra-226/Ra-228 concentration ≤5 pCi/L	2E-17 pCi/L	Ingrowth from U-238, U-234, and Th-232 parents
Sr-90 ≤8 pCi/L	NA	Screened out
H-3 concentration ≤20,000 pCi/L	17,200 pCi/L	—

a. The performance assessment assumed a 100-year institutional control period; however, the CERCLA Record of Decision (DOE-ID 2008a) indicates that DOE will maintain control indefinitely or will transfer the property in accordance with CERCLA requirements.

ALLWDF Active Low-Level Waste Disposal Facility
CERCLA Comprehensive Environmental Response, Compensation, and Liability Act
DOE Department of Energy
EDE effective dose equivalent
NA not applicable

3. TECHNICAL APPROACH TO CLOSURE

The ALLWDF will be closed in three stages. Waste Management will implement the first stage, interim closure, which includes placement of a thick layer of soil over the waste packages. Waste Management will maintain the interim cover to address subsidence, drainage, and other operational and safety concerns. The second stage, final closure, will be implemented through the CERCLA process, as specified in the ROD (DOE-ID 2008a). The third stage, long-term management, will also be implemented through the CERCLA process, as specified in the ROD (DOE-ID 2008a). Activities related to the closure of the ALLWDF include environmental monitoring. This section describes the plans for each activity.

3.1 Operational/Interim Closure of the ALLWDF

Interim closure of the ALLWDF is being completed in two phases. The first phase of interim closure was completed in September 2010 after the open pit portion of the ALLWDF was closed and an interim cover completed. The second phase of interim closure will be completed after 2020 when disposal of remote-handled LLW to the concrete vaults in the southwest corner of Pit 20 is complete. At that time, the two inactive soil vaults in SVR 21 will also be closed and covered.

Interim closure includes placement of a minimum 0.9-m (3-ft) -thick layer of soil over the waste packages. Placement, compaction, and contouring of the interim cover were designed for surface water drainage and subsidence control. As a result of the contouring for drainage, in many areas, the interim cover over the waste is much thicker than the required 0.9 m (3 ft). The interim cover will be maintained to address minimum thickness of fill over the waste, subsidence, drainage, and other operational and safety concerns.

3.1.1 Interim Closure of the Open Pit Portion of the ALLWDF

The first phase of interim closure and the grading plan used to construct the interim cover are described in this subsection. After disposal to the ALLWDF open pits was completed in September 2008, the interim cover was placed over Pits 17–19 and the open pit portion of Pit 20. This portion of the interim cover was completed in September 2010 and constructed according to the plans provided in an earlier revision of this report (Koslow 2010) and PLN-2258, "Active LLW Disposal Facility Pits 17, 18, 19, and 20 Cover Fill Plan." TPR-1703, "SDA Soil Cover Operations," describes the procedure for placement of intermediate soil cover material over waste.

Figure 3-1 shows the ALLWDF and the plan for the first phase of the interim cover. Interim cover placement consisted of placing at least 0.9 m (3 ft) of clean soil and fill material over the waste in the closed portions of the ALLWDF. The maximum elevation of the interim cover is 1,529.2 m (5,017 ft) above mean sea level (vertical datum NGVD-29) near the southwestern corner. The overburden was contoured to direct run-off away from the LLW pits, with the general direction of run-off ultimately going to the ditch to the east of the ALLWDF.

The drainage ditch along the east side of the interim cover directs flow that drains off the interim cover away from the facility and prevents adjacent flow from entering the facility (Figure 3-2, Section A). A berm was placed around the east and north side of the remote-handled LLW concrete vaults in Pit 20, separating the two disposal units and preventing surface water drainage from the interim cover flowing into the remote-handled LLW disposal unit (Figure 3-2, Section B).

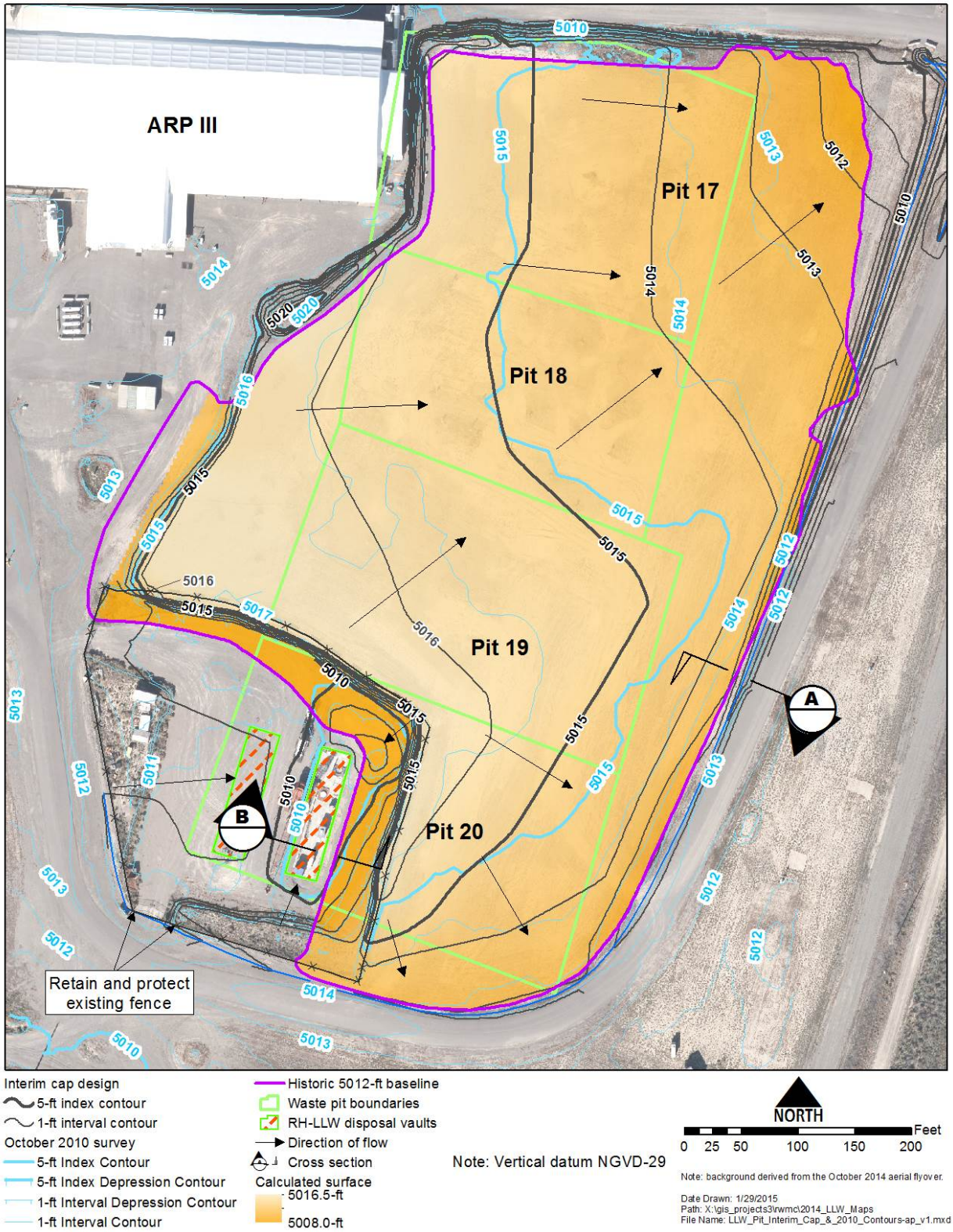
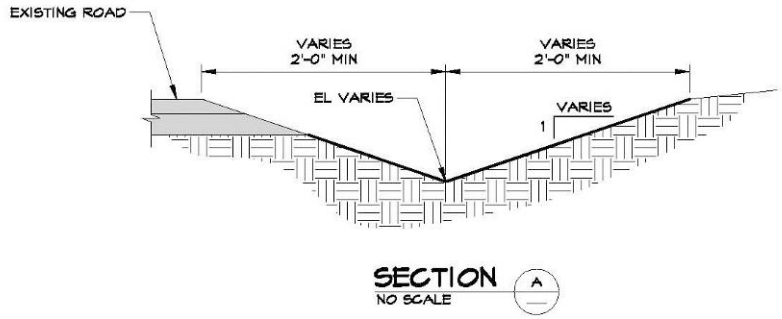


Figure 3-1. Topographic map of the interim cover plan (black contours) and the October 2010 ground levels after cover construction (blue contours) for the open pit portion of the low-level waste disposal units.



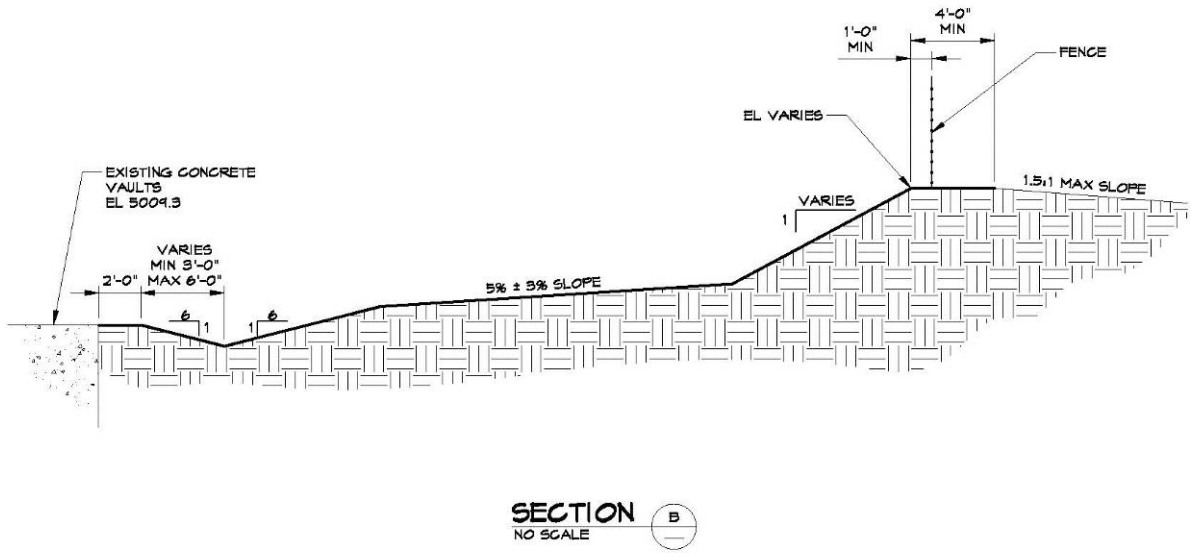


Figure 3-2. Cross section of drainage ditch and berm for drainage control of the interim cover.

There are two sets of contours in Figure 3-1:

- Topographic contours for the interim cover grading plan[d] - The interim cover plan used to construct the cover over Pits 17–19 and the open pit portion of Pit 20. The topographic contours for the first phase of the interim cover plan are based on Drawing 766880, "RWMC WMF-730 Low Level Waste Pit Interim Grading Plan" (Appendix A).
- Topographic contours for the ground surface after construction of the interim cover - The ground contours after construction of the cover are based on an aerial survey of the ALLWDF in October 2010 (EDF-9997) and represent the as-built interim cover.

d. Cover plan contours shown in Figure 3-1 were drawn using contours from Drawing 766880. The contours in Drawing 766880 are based on vertical datum NAVD-88, and the contours in Figure 3-1 are based on vertical datum NGVD-29. In order to convert the contours in NAVD-88 to contours in NGVD-29, 3.48 ft has to be subtracted. Historically, NGVD-29 has been used as the vertical datum for the ALLWDF drawings, and NAVD-88 vertical datum is used for the SDA construction drawings.

A comparison of the plan contours and the contours after construction indicates that the ground elevations of the constructed cover were similar to the cover plan and meet the intent of the interim cover placement criteria.

The soil and fill material used for the cover were obtained from areas in the vicinity of the RWMC. Soil was placed as fill in the voids around the waste containers as part of the interim cover. Most of the soil for the cover came from T-12 (a borrow area west of the SDA) and the Boiling-Water Reactor Experiment pit located on Adams Blvd., with other soil sources from the Accelerated Retrieval Project clean overburden soils. The sources of fill material include the Lockheed Martin Advanced Environmental Systems rubble pile, fire-water trench cuttings, and asphalt and concrete from deactivation, decontamination, and decommissioning of the Intermediate-Level Transuranic Storage Facility. The volume of material used for the cover was approximately:

- 7.65E+04 m^3 (1.00E+05 yd^3) of soil and fill material to bring the interim cover to elevation 5,012 ft msl (vertical datum NGVD-29)
- 2.51E+04 m^3 (3.28E+04 yd^3) of clean soil to bring the interim cover to a maximum elevation of 5,017 ft msl (vertical datum NGVD-29) in the southwestern portion of the interim cover.

3.1.2 Completion Plan for the Interim Closure of the ALLWDF

Remote-handled LLW continues to be disposed of in concrete vaults in the southwestern corner of Pit 20. After a concrete vault is filled, interim closure includes the placement of a 1.2-m (4-ft) -thick reinforced concrete plug over the vault. The seams between adjacent plug caps of filled vaults are sealed with acrylic caulk at the surface of the vault array, and a silicone sealant is placed at the interface between the vault plug and the vault wall to inhibit moisture infiltration into the vault. When remote-handled LLW disposals to the concrete vaults cease in 2020, an interim soil cover will be placed over the vaults, which will complete the interim cover over the ALLWDF except for the two inactive soil vaults in SVR 21.

The CERCLA program grouted portions of SVRs 17 and 20 (Lopez et al. 2005) and SVR 14 (Jessmore, Meagher, and Holdren 2011). Under Waste Management's interim closure of the ALLWDF, two inactive soil vaults in SVR 21 will be grouted and/or filled with appropriate materials, and an interim cover will be placed over the vaults when the interim cover is placed over the concrete vaults.

Figure 3-3 shows the grading plan for the completion of the interim cover (vertical datum NGVD-29) after closure of the concrete vaults in 2020. The topographic contours shown in Figure 3-3[e] are based on Drawing 766881, "RWMC WMF-730 Low Level Waste Pit Final Grading Plan" (Appendix A). The grading plan starts with the plan shown in Figure 3-1 (or Drawing 766880) and completes the cover over the currently operating concrete vaults.

Two general requirements govern the thickness of the soil cover that is applied over the remote-handled LLW: (a) the soil must be at least 0.9 m (3 ft) thick and (b) the exposure rate above the covered vault must be less than 1 mR/hour at the soil surface.

Consistent with the intent of the first phase of the interim cover, the placement, compaction, and contouring of the completed interim cover are designed for surface water drainage and subsidence control. The overburden will be contoured to direct run-off away from the LLW pits, with the general direction of run-off ultimately going to the ditches adjacent to the ALLWDF.

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e. Cover plan contours shown in Figure 3-3 were drawn using contours from Drawing 766881. The contours in Drawing 766881 are based on vertical datum NAVD-88, and the contours in Figure 3-3 are based on vertical datum NGVD-29. In order to convert the contours in NAVD-88 to contours in NGVD-29, 3.48-ft has to be subtracted.

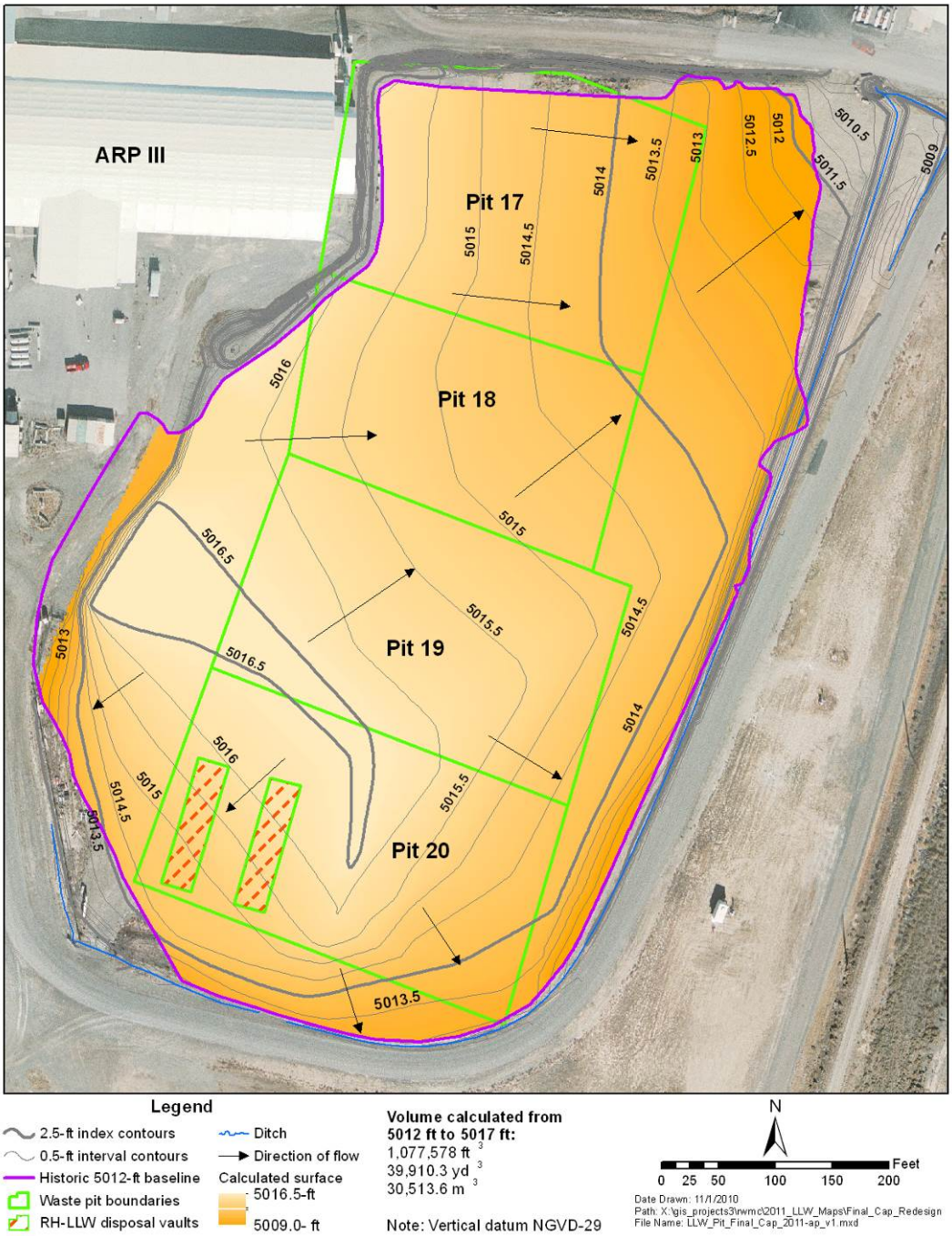

Figure 3-3. Topographic map of the planned final interim cover after disposals of waste to the concrete vaults are complete in 2020.

Like the completed portion of the interim cover, soil and fill material will be obtained from areas in the vicinity of the RWMC. An estimated additional 5.43E+03 m^3 (7.10E+03 yd^3) of clean soil (Koslow 2011) will be required to meet the topographic contours of the interim cover planned for the remote-handled LLW disposal units.

3.1.3 Maintenance of the Interim Cover

Cover erosion and subsidence has been observed at the RWMC, and the potential for cover erosion and subsidence has been evaluated. The RWMC is located in a depositional environment resulting in a very low potential for erosion (Dechert, McDaniel, and Falen 1994). Thus, erosion of the soil cover is not expected during the lifetime of the cover and is not discussed in this report. Subsidence is a common occurrence at the ALLWDF and much of the SDA. A subsidence analysis was prepared to address this concern (Keck and Seitz 2002). The subsidence analysis concluded that the potential for subsidence would need to be addressed when considering how the facility will be closed under CERCLA. Subsidence at the ALLWDF, as well as the entire SDA, is expected to be a concern for many years, and maintenance of the cover will be necessary for the foreseeable future.

Subsidence is the differential settling of waste and/or soil from an initial elevation to a lower elevation. Subsidence of a landfill cover can result in: (1) differential settlement of fill and cover, resulting in development of cracks in cover materials; (2) settlement of fill and cover, resulting in reduced drainage of water from the cover and ponding of water on the cover and/or accelerated erosion of the cover; and (3) collapse or piping of cover soils into underlying cavities in the fill, resulting in sinkhole-type depressions in the cover. The term “subsidence” has been used in previous RWMC reports to describe both localized holes and larger-scale settling. In this report, the term “subsidence hole” is used in reference to localized holes as described in Section 4.9 of PLN-1176, “RWMC Seasonal Facility Plan.”

When the waste containers fail, subsidence is caused by soil above the containers collapsing into void spaces. A surveillance and monitoring program is currently in place to repair the interim cover (as well as entire SDA) when subsidence is observed. Subsidence monitoring and control in the ALLWDF are required as long as the cover collapses into voids in the waste containers and between disposed waste containers. The interim cover will continue to settle under the weight of the overburden, natural decay of the waste containers, and the compaction of the waste and fill until the voids in the pits have been replaced with fill. As a result, the interim soil cover over Pits 17, 18, 19, and the open pit portion of Pit 20 is, and will be, in continuous need of surveillance, monitoring, and corrective maintenance to address ongoing subsidence, drainage, and other operational concerns.

The maintenance of the interim cover is necessary to meet the requirements of the interim cover to reduce the risk of exposure to waste as well as provide operator safety. As previously discussed, the interim cover should be maintained to:

- Provide waste confinement (at least 0.9 m [3 ft] of clean soil over the waste)
- Prevent precipitation over the open pit portions of the ALLWDF from flowing into the operating concrete vault disposal area until planned closure of the ALLWDF in 2020
- Minimize ponding and promote drainage towards the ditches.

Two types of subsidence need monitoring and control in the ALLWDF:

- Subsidence holes
- Surface depressions (areas of subsidence where water can pool, increasing and focusing infiltration in the areas of surface depression).

Regular maintenance of the interim cover consists of repairing areas with subsidence holes, in accordance with PLN-1176, "RWMC Seasonal Facility Plan." Subsidence holes are identified through visual inspection by the RWMC operations staff and repaired by filling with clean soil and/or grout and compacting. Periodic maintenance of the interim cover includes filling low areas to minimize water ponding over the buried waste during large rainfall or snowmelt events. Surface depressions are identified through visual inspection by the RWMC operations staff and ground or aerial surveys. The surface depressions are filled with native soils and graded level in order to minimize infiltration and the risk of surface exposure to the waste. These maintenance activities occur as a regular part of operations at the ALLWDF and throughout the RWMC and are described in PLN-1176 and JSA-1737. Subsidence monitoring and maintenance of the interim cover will continue until final closure.

Interim cover topographic contours are calculated periodically with information from ground or aerial surveys. In October 2010, an aerial flyover provided photographs of the land surface and elevation data to generate a topographic contour map (Figure 3-1) of the newly completed interim cover.
In October 2014, an aerial flyover provided photographs of the land surface and elevation data to generate a topographic contour map (Figure 3-4) of the interim cover (EDF-10709) at the end of FY 2014.
The contour maps show larger areas of settling but insufficient detail to show individual subsidence holes. Differences in the interim cover topographic contours from the periodic surveys show how the cover is changing over time as a result of subsidence and cover maintenance. The annual summaries (e.g., Parsons et al. 2015) provide the topographic contours and discuss the changes in the cover elevations over time. These contours provide part of the surveillance and monitoring information to identify areas of settling that require fill.

3.2 Final Closure of the ALLWDF Under CERCLA

Final closure of the ALLWDF will be implemented through the CERCLA process as specified in the ROD for OU 7-13/14 (DOE-ID 2008a). Before transferring responsibility for final closure to the CERCLA program under OU 7-13/14, DOE and the Idaho Cleanup Project's Waste Management organization will effect timely interim closure of the remote-handled concrete vaults in Pit 20 and the two inactive soil vaults in SVR 21 under DOE O 435.1 Chg 1.

The selected CERCLA final remedy focuses on source control of waste buried in the SDA and consists of:

- Targeted waste retrieval
- In situ grouting
- Vadose zone vapor vacuum extraction and treatment
- Evapotranspiration surface barrier
- Long-term management and control.

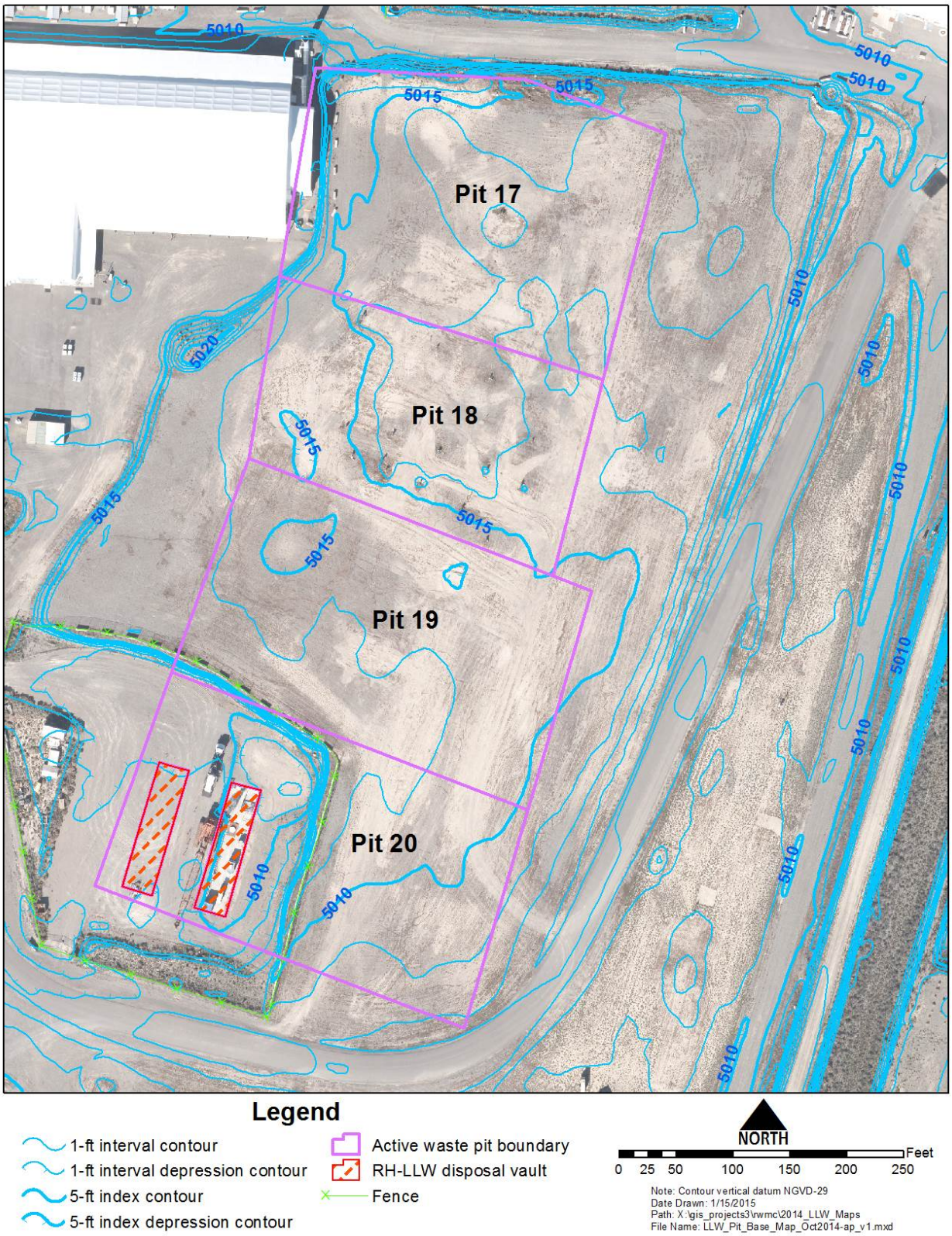

Figure 3-4. Photograph of the landfill taken during an October 2014 flyover.

The evapotranspiration surface barrier is a key component of the final remedy. The surface barrier will cover the entire SDA and consists primarily of a vegetated soil layer and underlying grading fill. The evapotranspiration barrier will be designed to store excess moisture until it evaporates or is transpired. As shown in Figure 3-5, the monolithic evapotranspiration barrier is comprised of three layers (Meagher and Holdren 2013). The total thickness of each layer, exact dimensions, and other specifications will be determined during remedial design. The three layers are:

- A base grade of uncontrolled fill materials, including pit-run gravel, fine-grained soil similar to the storage layer, decontamination and decommissioning debris, material from removal or grading of berms, and existing stockpiles
- A water storage layer consisting of fine-grained material that is able to absorb and release moisture
- A growth layer that can sustain vegetation. Topsoil will be produced by mixing available fine-grained material with organic material such as composted bark and manure. Gravel mulch, bark, or other materials may be added to reduce erosion.

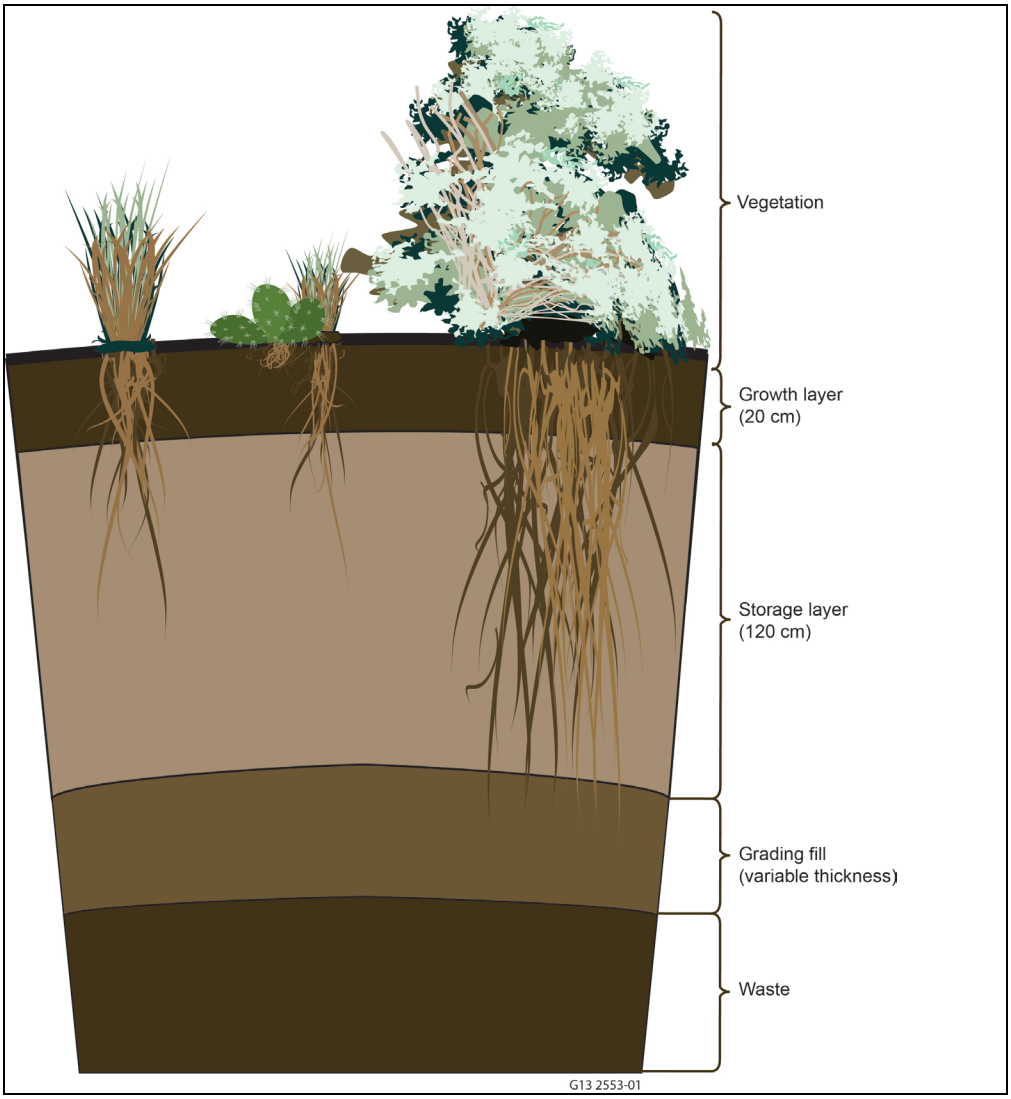

Figure 3-5. Cross section of a monolithic evapotranspiration surface barrier selected for the Subsurface Disposal Area (Meagher and Holdren 2013).

The refined final cover conceptual design (Meagher and Holdren 2013) differs from the pre-conceptual cover described in the OU 7-13/14 ROD (DOE-ID 2008a) and assumed for previous reports; however, performance objectives remain the same. The refined concept is a monolithic soil cover; whereas, the pre-conceptual cover described in the ROD included an underlying coarse rock layer. In addition, the Phase 3 Work Plan eliminated pre-treatment of the SDA for subsidence. The ALLWDF PA (DOE-NE-ID 2007) and CA (DOE-NE-ID 2008) do not simulate the details of the final cover design; therefore, this change does not impact PA and CA calculations. The final design will be documented in the 100% remedial design report in accordance with the *Operable Unit 7-13/14 Phase 3 Remedial Design Work Plan* (Meagher and Holdren 2013).

The evapotranspiration surface barrier for the SDA will be based on a design performance goal to reduce net infiltration through the surface barrier into the waste to less than 1 cm/year on average (DOE-ID 2008b). The PA and CA analyses assumption for infiltration rate through the final cover was 0.1 cm/year (1 mm/year) for the base case and 1 cm/year (10 mm/year) for a sensitivity case. For the PA, the calculated all-pathways effective-dose-equivalent doses are below the standards during the compliance and post-compliance periods, assuming both a 0.1-cm/year and 1-cm/year infiltration rate. As shown in the supplemental PA and CA simulation conducted in FY 2009—summarized in EDF-9514—the impact of the revised cover assumptions changes the dose assessment results for some radionuclides but does not change the PA and CA conclusions.

As previously discussed, final closure of the ALLWDF will be conducted under CERCLA in accordance with the ROD (DOE-ID 2008a). Closure documents will be completed during the transition from management under DOE O 435.1 Chg 1 to management under CERCLA.

A 5-year review of OU 7-13/14 is required under the CERCLA process (DOE-ID 2008a, 2015c). If a 5-year review concludes an existing remedy is not protective of human health or the environment, the Agencies may consider new technologies that were not available when the ROD (DOE-ID 2008a) was finalized. The Agencies can modify the ROD (e.g., ROD amendment) through the CERCLA process when necessary to ensure that the remedy is protective. The design assumptions for the final cover are consistent with the assumptions made in the performance assessment (DOE-NE-ID 2007) and subsequent documentation in the annual reports.

3.3 Institutional Control

Active and passive institutional controls will include access restrictions, restrictions on groundwater use (e.g., well-drilling restrictions), restrictions on land use (e.g., limit to industrial applications), and physical security. The INL Site-wide Institutional Controls Plan (DOE-ID 2015b) was updated to incorporate these requirements, as specified in the ROD (DOE-ID 2008a).

The current land-use control boundary and area of contamination have been established under CERCLA to include the area within 100 m (330 ft) of the existing fence line and can be modified in the final remedial design. The land-use institutional control area (DOE-ID 2015b) and the groundwater institutional control area at the RWMC are shown in Figure 3-6.

Following construction of the final cover, long-term surveillance, maintenance, monitoring, and institutional controls will be implemented to enforce land-use and groundwater-use restrictions and to ensure the completed final cover effectively meets all remedial action objectives. Five-year reviews will be conducted under CERCLA to assess the effectiveness of the remedy.

DOE plans to maintain control of the site indefinitely but will meet all requirements established under CERCLA for transfer of a federal facility if it is determined that another agency should assume responsibility. Release of land for public access is subject to the requirements of DOE O 458.1 Chg 2, "Radiation Protection of the Public and Environment."

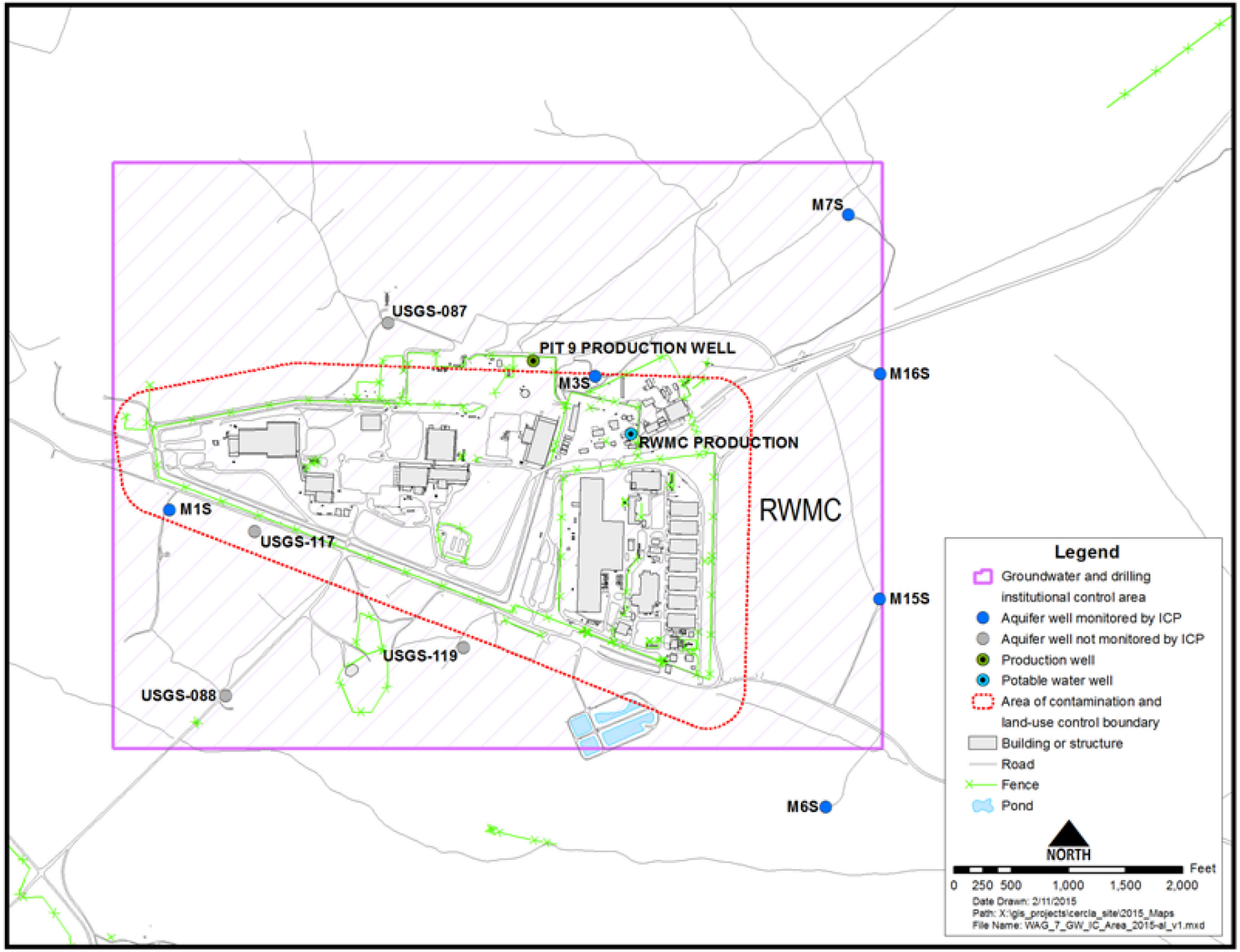

Figure 3-6. Groundwater institutional control area and land-use control boundary at the Radioactive Waste Management Complex (from DOE-ID 2015b).

3.4 Environmental Monitoring

An extensive Site-wide monitoring program is in place as described in the "Environmental Surveillance Program Plan" (PLN-720) and the *Idaho National Laboratory Site Environmental Monitoring Plan* (DOE-ID 2014). Additional Site-wide monitoring at the INL is conducted by the U.S. Geological Survey.

Within and around the SDA, environmental monitoring is conducted to demonstrate acceptable performance of the ALLWDF, in accordance with the PA and CA Monitoring Program (Parsons 2015). The environmental monitoring at the SDA includes data from the following:

- Source zone (soil water, soil vapor, perched water, and changes in moisture content)
- Vadose zone monitoring (soil water and soil gas)
- Aquifer (groundwater).

Monitoring results are compared to predicted PA/CA model results and concentration thresholds to ensure appropriate monitoring data are acquired to evaluate the likelihood that assumptions made for the PA and CA are reasonable and conservative. Any impacts on the results and conclusions of the PA and CA are reported in the annual reviews.

Long-term environmental monitoring for the entire SDA (including the ALLWDF) will ultimately be managed by OU 7-13/14 under CERCLA and the Federal Facility Agreement and Consent Order (DOE-ID 1991). The long-term monitoring system will provide (1) data necessary to verify that relevant CERCLA cleanup objectives documented in the ROD (DOE-ID 2008a) are achieved and (2) data for 5-year reviews.

Monitoring activities in and around the ALLWDF are not designed to measure the performance of the interim cover and, therefore, are not further described in this report.

4. CLOSURE SCHEDULE

The ALLWDF ceased disposal of contact-handled LLW on September 30, 2008. As described in Section 3.1.1, the first phase of the interim cover was placed on the open pits portion of the ALLWDF in accordance with Revision 2 of this Interim Closure Plan (Koslow 2010) and PLN-2258. This portion of the interim cover was completed at the end of FY 2010.

Remote-handled LLW continues to be disposed of in concrete vaults in the southwest portion of Pit 20, and these disposals are planned to continue through 2020 (DOE-ID 2013). The interim cover for the concrete vaults portion of Pit 20 and the two inactive soil vaults in SVR 21 is planned to be constructed and completed after disposals cease, as described in Section 3.1.2.

Final closure of the facility will be conducted under CERCLA in accordance with the ROD (DOE-ID 2008a), as described in Section 3.2 of this report. As a basis for estimating cost, the CERCLA OU 7-13/14 selected remedy was assumed to begin in approximately 15 to 17 years from the ROD signature with a completion date of approximately 2028 (DOE-ID 2008a).

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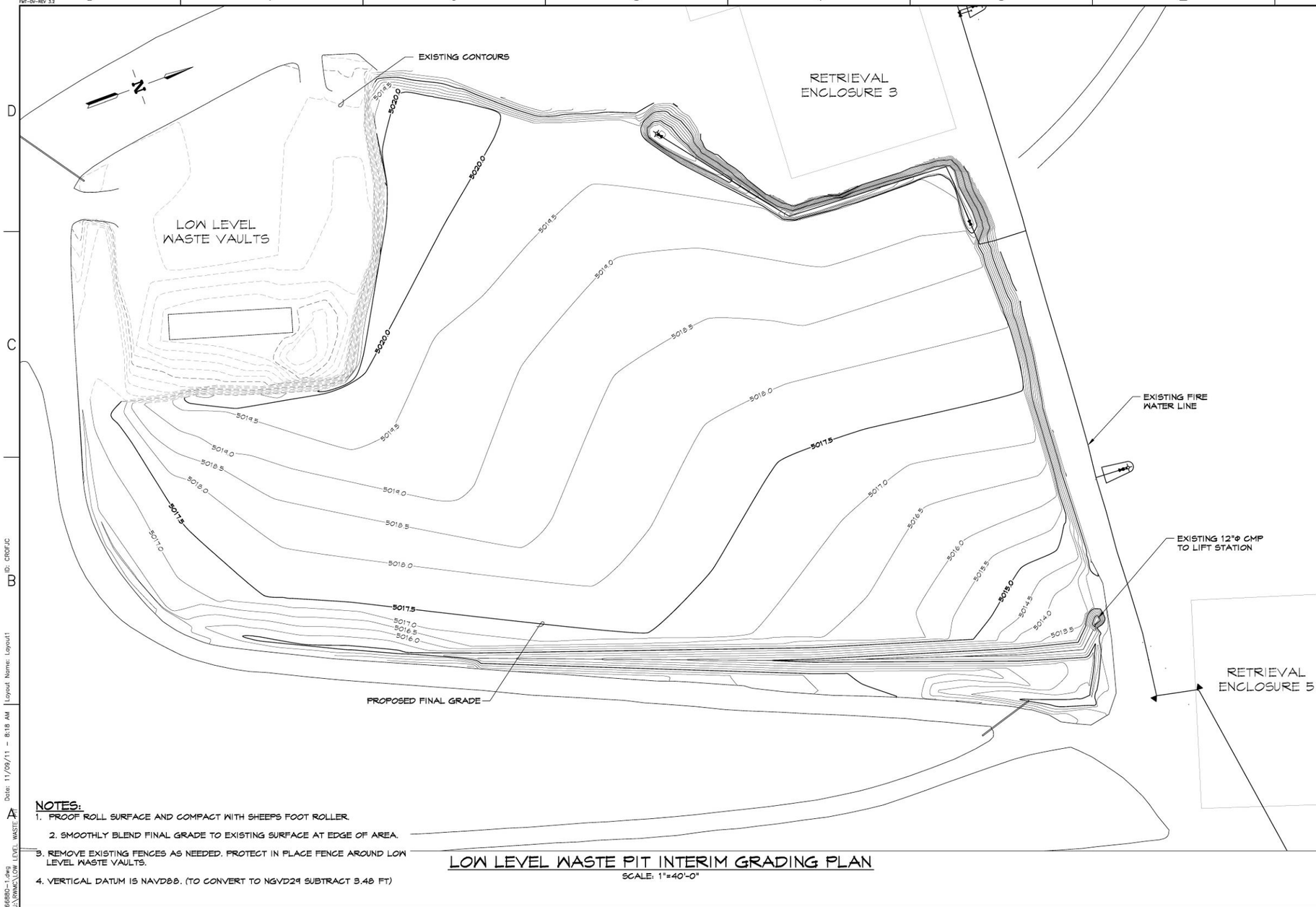
Appendix A

Interim Cover Design
Engineered in Vertical Datum NAVD-88

NOTE: *These engineered drawings are in vertical datum NAVD-88. To convert to vertical datum NGVD-29, subtract 3.48 ft.*

Appendix A

Interim Cover Design
Engineered Drawings in Vertical Datum NAVD-88



NOTES:

1. PROOF ROLL SURFACE AND COMPACT WITH SHEEPS FOOT ROLLER.
2. SMOOTHLY BLEND FINAL GRADE TO EXISTING SURFACE AT EDGE OF AREA.
3. REMOVE EXISTING FENCES AS NEEDED. PROTECT IN PLACE FENCE AROUND LOW LEVEL WASTE VAULTS.
4. VERTICAL DATUM IS NAVD88. (TO CONVERT TO NGVD29 SUBTRACT 3.48 FT)

LOW LEVEL WASTE PIT INTERIM GRADING PLAN

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	COMPLETELY REVISED

REVISION HISTORY

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VERTICAL SCALE	NA
FOR DRAWING INDEX SEE DRAWING NO.	NA

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ENG GROUP SUPERVISOR:	N.K. ROGERS, P.E.	N. Kim Rogers URS 2011.11.14 09:46:43 -07'00'
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DRAFTING CHECK/ EFFECTIVE DATE:	S. BERTHELSON	Shawn Berthelson 2011.11.14 11:05:09 -07'00'

Idaho Cleanup Project

RWMC WMF-730
LOW LEVEL WASTE PIT

INTERIM GRADING PLAN

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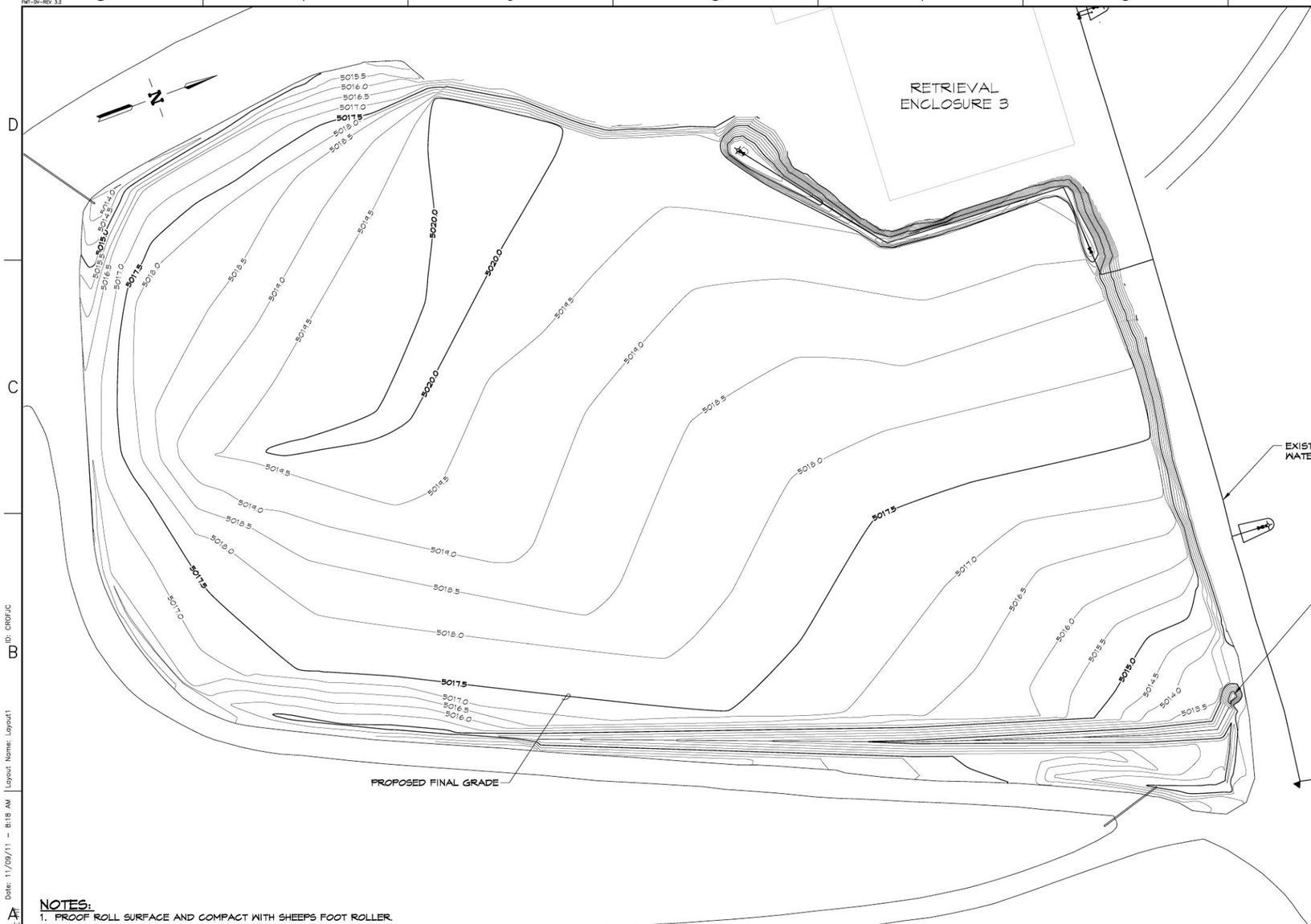

NOTES:

1. PROOF ROLL SURFACE AND COMPACT WITH SHEEPS FOOT ROLLER.
2. SMOOTHLY BLEND FINAL GRADE TO EXISTING SURFACE AT EDGE OF AREA.
3. REMOVE EXISTING FENCES AS NEEDED.
4. VERTICAL DATUM IS NAVD88. (TO CONVERT TO NGVD29 SUBTRACT 3.48 FT)

LOW LEVEL WASTE PIT FINAL GRADING PLAN

SCALE: 1"=40'-0"

REV	DESCRIPTION
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	COMPLETELY REVISED

REVISION HISTORY

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Idaho Cleanup Project

RWMC WMF-730
LOW LEVEL WASTE PIT

FINAL GRADING PLAN

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