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# ***Central Facilities Area Landfills I, II, and III Five-Year Review Supporting Documentation***



Idaho National Engineering and Environmental Laboratory

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**November 2002**

**Prepared for the  
U.S. Department of Energy  
Idaho Operations Office**

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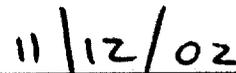
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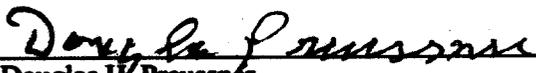
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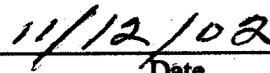
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## ABSTRACT

This report summarizes the documentation submitted in support of the 5-year review of the remedial action for Central Facilities Area (CFA) Landfills I, II, and III. The remedial action was conducted pursuant to the requirements delineated in the *Record of Decision Declaration for Central Facilities Area Landfills I, II, and III (Operable Unit 4-12), and No Action Sites (Operable Unit 4-03)*. The remedy included the installation of a native soil cover over each landfill to mitigate infiltration of surface water, implementation of administrative controls to prevent unauthorized access to the site, and environmental monitoring to ensure the effectiveness of the remedy. Routine inspections and maintenance of the covers are performed to ensure their integrity, and institutional controls have been implemented to restrict access.

The major components of the remedial action included the emplacement of a native soil cover over the landfills and the implementation of administrative controls and routine monitoring to ensure the effectiveness of the remedial action. The installation of the soil covers and time-domain reflectometry arrays was completed in 1997, with new deep, time-domain reflectometry arrays installed in 2000. Monitoring of the groundwater commenced in 1996, and monitoring of the time-domain reflectometry arrays, soil gas, and neutron-probe access tubes began in 1997. Groundwater monitoring was conducted on a quarterly basis for the first year and annually thereafter. Data collection from the neutron-probe access tubes occurred from December 1996 through August 1998 and October 2000 to the present. For the time-domain reflectometry arrays, the shallow arrays were monitored from March 1997 through September 1998, and data were collected from the deep arrays from October 2000 to the present. Soil gas samples were collected semiannually from December 1996 through July 1998 and from August 2000 to July 2001.

The implementation of institutional controls coincided with the installation of the landfill covers. In accordance with Section 6 of the *Remedial Design/Remedial Action Work Plan for Central Facilities Area Landfills I, II, and III Native Soil Cover Project Operable Unit 4-12*, it was established that the 5-year review of the CFA landfills' remedial action would take place 5 years following the commencement of landfill monitoring efforts. Based upon cover infiltration monitoring commencing in the spring of 1997, the 5-year review would take place in the spring of 2002.

The 5-year review includes a review of the past site inspections and monitoring data collected in support of the remedial action. Specific data assessments include soil gas monitoring and results, groundwater monitoring, and landfill moisture monitoring. The landfill moisture monitoring consisted of neutron-probe monitoring data and time-domain reflectometer data analysis. The

technical analysis addresses the issues of whether the remedy is functioning as intended; whether the assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time are still valid; and whether any other information has come to light that could affect the protectiveness of the remedy.

From the review of the analytical data and the technical assessment thereof, it is recommended that annual inspections of the institutional controls be continued and the soil gas and groundwater monitoring be continued on an annual basis.

For the past 5 years since the remedial action, precipitation levels have been less than normal. These dry conditions do not allow for an adequate review of the landfill moisture-monitoring efforts. It is recommended that moisture monitoring be continued for 2002 and 2003 through September 2003. Modeling of the infiltration will be performed based upon the moisture-monitoring data obtained. Based on this modeling, a decision on whether to continue moisture infiltration monitoring or to perform an “artificial rain” infiltration test will be made by September 2003. The written results of the moisture infiltration modeling will be included in the FY 2003 monitoring report. Based upon the information presented herein, the determination as to whether the remedy for the CFA Landfills I, II, and III is expected to remain protective of human health and the environment has been deferred until the recommendations in this report are implemented. These recommendations include moisture infiltration monitoring and data modeling as previously discussed, performance of digital gyroscopic deviation surveys of some groundwater wells and redrawing of the groundwater contour maps using this information, re-evaluation of the need for another groundwater monitoring well, and re-evaluation of the source of nitrates in the groundwater. The next 5-year review is scheduled for 2006.

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## ACRONYMS

BBWI	Bechtel BWXT Idaho, LLC
BLM	Bureau of Land Management
bls	below land surface
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFA	Central Facilities Area
CFR	Code of Federal Regulations
COCA	Consent Order and Compliance Agreement
DOE	U.S. Department of Energy
DOE-ID	U.S. Department of Energy Idaho Operations Office
EG&G	Edgerton, Germeshausen, and Grier
EPA	U.S. Environmental Protection Agency
ET	evapotranspiration
FFA/CO	Federal Facility Agreement and Consent Order
FR	Federal Register
FSP	field sampling plan
FY	fiscal year
IDAPA	Idaho Administrative Procedures Act
IDEQ	Idaho Department of Environmental Quality
INEEL	Idaho National Engineering and Environmental Laboratory
INEL	Idaho National Engineering Laboratory
INTEC	Idaho Nuclear Technology and Engineering Center
MCL	maximum contaminant level
NA	not applicable
NAT	neutron-probe access tube
ND	not detected

NEPA	National Environmental Policy Act
NOAA	National Oceanic and Atmospheric Administration
NPL	National Priorities List
O&M	operations and maintenance
OU	operable unit
ROD	Record of Decision
SMCL	secondary maximum contaminant level
SRPA	Snake River Plain Aquifer
USGS	United States Geological Survey
USC	United States Code
VOC	volatile organic compound
WAG	Waste Area Group

# Central Facilities Area Landfills I, II, and III Five-Year Review Supporting Documentation

## 1. INTRODUCTION

In accordance with the *Federal Facility Agreement and Consent Order for the Idaho National Engineering Laboratory* (DOE-ID 1991) between the U.S. Department of Energy (DOE), the U.S. Environmental Protection Agency (EPA), and the Idaho Department of Environmental Quality (IDEQ), hereafter referred to as the Agencies, DOE submits this supporting documentation for the 5-year review for the Central Facilities Area (CFA) Landfills I, II, and III. Under the current remediation management strategy outlined in the Federal Facility Agreement and Consent Order (FFA/CO) (DOE-ID 1991), the location identified for the remedial action is designated as Waste Area Group (WAG) 4, Operable Unit (OU) 4-12 at the Idaho National Engineering and Environmental Laboratory (INEEL), as shown in Figure 1-1. This report documents the review period covering from 1996 when the remedial action began and from 1997 when all landfill monitoring activities commenced through the summer of 2002.

The remedial action objectives outlined in the *Record of Decision Declaration for Central Facilities Area Landfills I, II, and III (Operable Unit 4-12), and No Action Sites (Operable Unit 4-03)* (DOE-ID 1995) are (1) prevent direct contact with the landfill contents, (2) minimize the potential for erosion and infiltration at the surface, and (3) ensure that the migration of contaminants in the landfills does not cause drinking water standards to be exceeded in the Snake River Plain Aquifer (SRPA). The scope of the remedial action was detailed in the *Remedial Design/Remedial Action Work Plan for Central Facilities Area Landfills I, II, and III Native Soil Cover Project Operable Unit 4-12* (DOE-ID 1996). The major components of the remedial action included the following:

- A native soil cover (in combination with the existing soil cover) was placed over the landfills to a minimum depth of 0.6 m (2 ft). The cover was compacted and graded to minimize erosion and infiltration by controlling surface water run-on and run-off resulting from seasonal precipitation.
- Administrative controls on future land use are implemented, including the posting of signs.
- Groundwater, infiltration, and/or vadose-zone monitoring are conducted to monitor the effectiveness of the remedial action.
- The cover is periodically inspected and routinely maintained to ensure its integrity.
- The institutional controls are maintained, including signs, postings, and land use restrictions.

The results of the remedial action are summarized in the *Remedial Action Report CFA Landfills I, II, and III Native Soil Cover Project Operable Unit 4-12* (DOE-ID 1997). The procedures required to maintain the CFA landfills are outlined in the *Operations and Maintenance Plan for the Central Facilities Area Landfills I, II, and III Native Soil Cover Project Operable Unit 4-12* (INEL 1997a), which is provided in Appendix J to the Remedial Action Report (DOE-ID 1997). This Operations and Maintenance (O&M) Plan was superseded by the *Operations and Maintenance Plan for the Final Selected Remedies and Institutional Controls at Central Facilities Area, Operable Unit 4-13* (DOE-ID 2002a). Post-remedial action monitoring required by the Record of Decision (ROD) (DOE-ID 1995) is being carried out per the *Post Record of Decision Monitoring Work Plan Central Facilities Area Landfills I, II, and III Operable Unit 4-12* (INEL 1997b) and the *Field Sampling Plan for the Post Record of Decision Monitoring Central Facilities Area Landfills I, II, and III Operable Unit 4-12* (INEL 1997c).

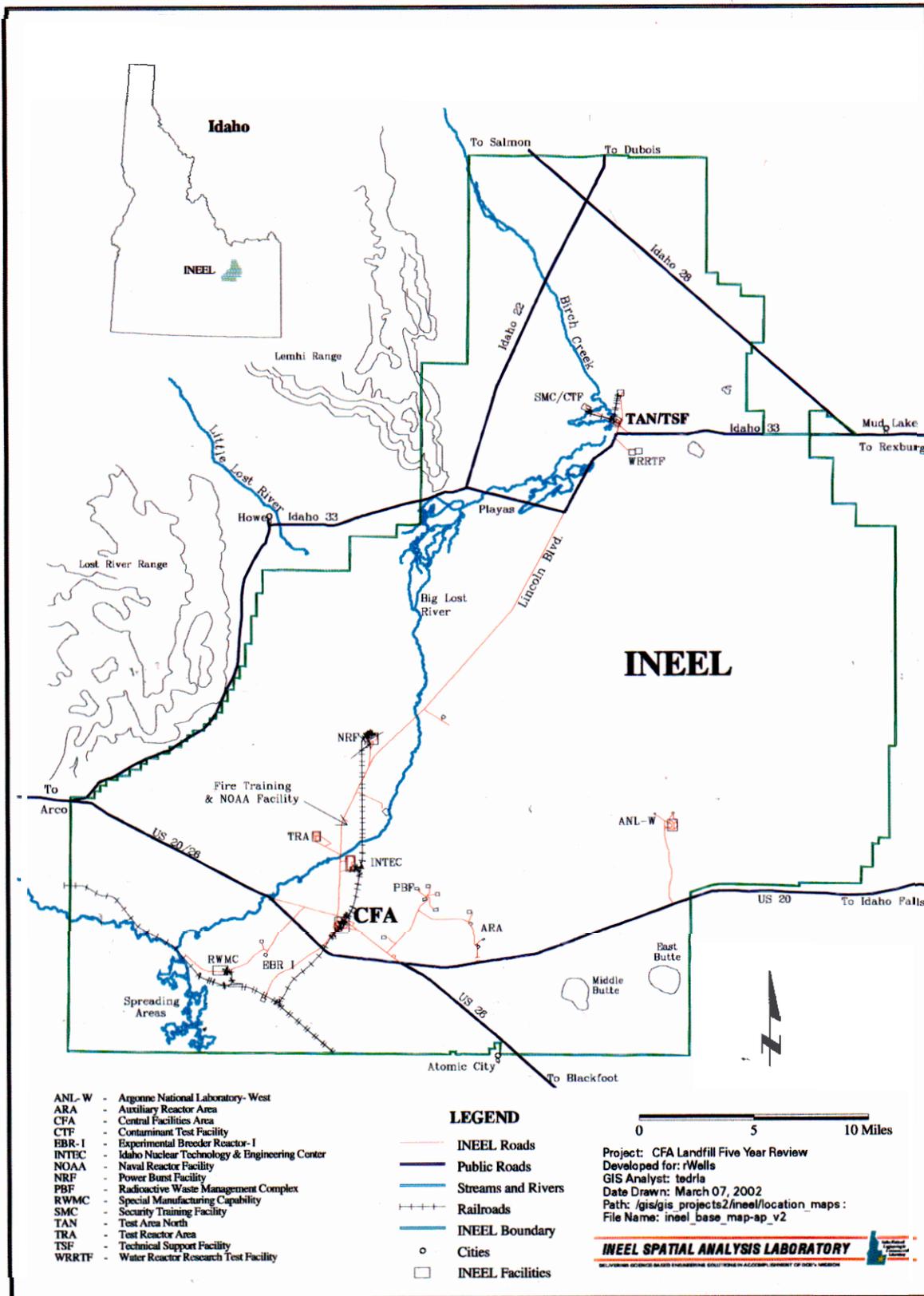


Figure 1-1. Location of Waste Area Group 4 at the Idaho National Engineering and Environmental Laboratory.

## 1.1 Purpose

The purpose of this 5-year review is to ensure that the remedy prescribed by the ROD (DOE-ID 1995) remains protective of human health and the environment. The 5-year review is being conducted in accordance with the requirements delineated in Section 121(c) of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) as provided in Title 42 of the *United States Code* (USC), Chapter 103, Subchapter I, Section 9621 and is considered a statutory review. As delegated to DOE for the INEEL site under Section 2(d) of Executive Order 12580, pursuant to the President's authority to delegate conferred by Section 115 of CERCLA, DOE has the duty and authority, by law, to conduct the 5-year reviews. Furthermore, the "National Oil and Hazardous Substances Pollution Contingency Plan" as promulgated in the *Code of Federal Regulations* (CFR) recognizes at 40 CFR 300.5, "Definitions," that DOE will be the lead agency for the INEEL with regard to conducting 5-year reviews.

Given the stipulation that DOE is required and has the authority to conduct 5-year reviews at sites remediated at the INEEL, the U.S. Department of Energy Idaho Operations Office (DOE-ID) initiated the 5-year review of the remedial action conducted at the CFA landfills in January 2002. Upon agreement between DOE-ID, IDEQ, and EPA, this document is being submitted as supporting documentation for the 5-year review with the EPA providing the final 5-year review report for the CFA landfills following concurrence of IDEQ and DOE-ID. The review is being conducted in accordance with the guidance provided in the EPA document, *Comprehensive Five-Year Review Guidance* (EPA 2001). The results of the review will become final with the completion of this report. This review covers the period from 1996 when the remedial action commenced and 1997 when all monitoring activities were implemented through the spring of 2002. It represents the first 5-year review of the CFA landfills' remedial action.

## 2. SITE CHRONOLOGY

### 2.1 History of the Idaho National Engineering and Environmental Laboratory

The INEEL, originally established in 1949 as the National Reactor Testing Station, is a DOE-managed reservation that historically has been devoted to energy research and related activities. The National Reactor Testing Station was re-designated as the Idaho National Engineering Laboratory (INEL) in 1974 to reflect the broad scope of engineering activities that were being conducted at various laboratory facilities. In 1997, the INEL was re-designated as the INEEL in keeping with contemporary emphasis on environmental research.

Historically, facilities at the INEEL were dedicated to the development and testing of peaceful applications for nuclear power. Throughout the 50 years of INEEL operations, disposal practices have been implemented in compliance with state and federal regulations and with policies established by DOE and its predecessors. Some of these practices are unacceptable by contemporary standards and have been discontinued. Contaminated structures and environmental media such as soil and water are the legacy of some historical disposals. Occasional accidental releases have also occurred over time. In keeping with the contemporary emphasis on environmental issues, INEEL research is now focused on environmental restoration to address these contaminated media and on waste management issues to minimize additional contamination from current and future operations. As described in the *INEEL Comprehensive Facility and Land Use Plan* (DOE-ID 2001a), the emphasis of work at the INEEL is moving toward management of radiological and hazardous waste, restoration of the environment, development of environmental cleanup technologies, preservation of national security, and development of nuclear technologies and applications.

### 2.2 Regulatory Background

On July 28, 1986, the DOE-ID entered into a *Consent Order and Compliance Agreement (COCA)* with Region 10 of the EPA and the United States Geological Survey (USGS) (DOE-ID 1986). The agreement called for implementing an action plan to remediate active and inactive waste disposal sites at the INEEL under the authority of the Resource Conservation and Recovery Act (42 USC 6901 et seq.), which regulates the generation, transportation, treatment, storage, and disposal of hazardous waste. The sites identified for further evaluation during the INEEL installation assessment (EG&G 1986), including those located within WAG 4, were covered by the COCA. Under the COCA, the CFA landfills were identified as Hazardous Waste Land Disposal Units.

On November 15, 1989, the EPA added the INEEL to the National Priorities List (NPL) under CERCLA (42 USC 9601 et seq.), also known as the Superfund Act. The NPL identifies high-priority sites for investigation and remediation. The Superfund Act also requires that the public be provided with opportunities to participate in the decision-making process. The decision to add the INEEL to the NPL was based on the detection of contaminants in the environment at INEEL sites.

The FFA/CO and its associated action plan (DOE-ID 1991) were negotiated and signed by DOE-ID, EPA, and the Idaho Department of Health and Welfare in December 1991 to implement the remediation of the INEEL under CERCLA. Effective December 9, 1991, the FFA/CO superseded the COCA. The FFA/CO (DOE-ID 1991) established the procedural framework and schedule for developing, prioritizing, implementing, and monitoring response actions at the INEEL in accordance with CERCLA and Resource Conservation and Recovery Act legislation and the Idaho Hazardous Waste Management Act. The FFA/CO (DOE-ID 1991) is consistent with a general approach approved by the EPA and DOE in which agreements with states as full partners would allow site investigation and cleanup to proceed

using a single road map to minimize conflicting requirements and maximize limited remediation resources. For management purposes, the FFA/CO (DOE-ID 1991) divided the INEEL into 10 WAGs.

### 2.3 Waste Area Group 4 Overview

Three time-critical removal actions, four non-time-critical removal actions, and three RODs have been or are being performed at WAG 4. The three time-critical removal actions were performed at WAG 4 for the CFA-04 Pond, CFA-06 and CFA-43 Lead Sites, and CFA-42 Tank Farm Spills. Three non-time-critical removal actions were performed in 1997 at CFA-13, CFA-15, and CFA-17/47. A fourth non-time-critical removal action was performed for sites CFA-17 and CFA-47, bermed fire pits and associated asphalt pad, and an adjacent fire station chemical disposal area.

The first ROD for WAG 4 was for the OU 4-11 Motor Pool Pond—*Record of Decision, Central Facilities Area Motor Pool Pond, Operable Unit 4-11, Waste Area Group 4*—and was signed on December 31, 1992 (DOE-ID 1992). This ROD resulted in no action, with further evaluation of potential risk via the groundwater pathway to be conducted in the *Comprehensive Remedial Investigation/Feasibility Study for the Central Facilities Area Operable Unit 4-13 at the Idaho National Engineering and Environmental Laboratory* (DOE-ID 2000a).

The second ROD—issued on October 10, 1995—addressed the OU 4-03 Underground Storage Tank sites and OU 4-12 Landfills I, II, and III (DOE-ID 1995), which are the subject of this review. This ROD (DOE-ID 1995) resulted in 19 No Further Action determinations for the underground storage tanks and installation of compacted native soil covers over the three landfills as a presumptive remedy. The ROD (DOE-ID 1995) also called for cover and groundwater monitoring along with institutional controls. Groundwater monitoring wells were installed in 1995 and 1996. The landfill covers and monitoring systems were emplaced in 1997. Groundwater monitoring at WAG 4 is being carried out under the OU 4-12 Post Record of Decision Monitoring Work Plan (INEL 1997b). The monitoring commenced in 1996 and will continue until it is determined during a 5-year review that some or all of the monitoring activities can cease. The *Post-Record of Decision Monitoring Report from 1996–1998 at Operable Unit 4-12, Central Facilities Area Landfills I, II, and III (CFA-01, CFA-02, and CFA-03)* (INEEL 2000) summarizes data from the first 2 years of monitoring. This report summarizes the results of the first 5-year review being conducted in accordance with the FFA/CO (DOE-ID 1991).

The third ROD for WAG 4 is the *Final Comprehensive Record of Decision for Central Facilities Area Operable Unit 4-13* (DOE-ID 2000b), which was signed in July 2000. Remediation of sites and establishment of institutional controls, as defined by this ROD, are ongoing. The locations of the WAG 4 CERCLA sites, including the CFA Landfills I, II, and III, are shown in Figure 2-1.

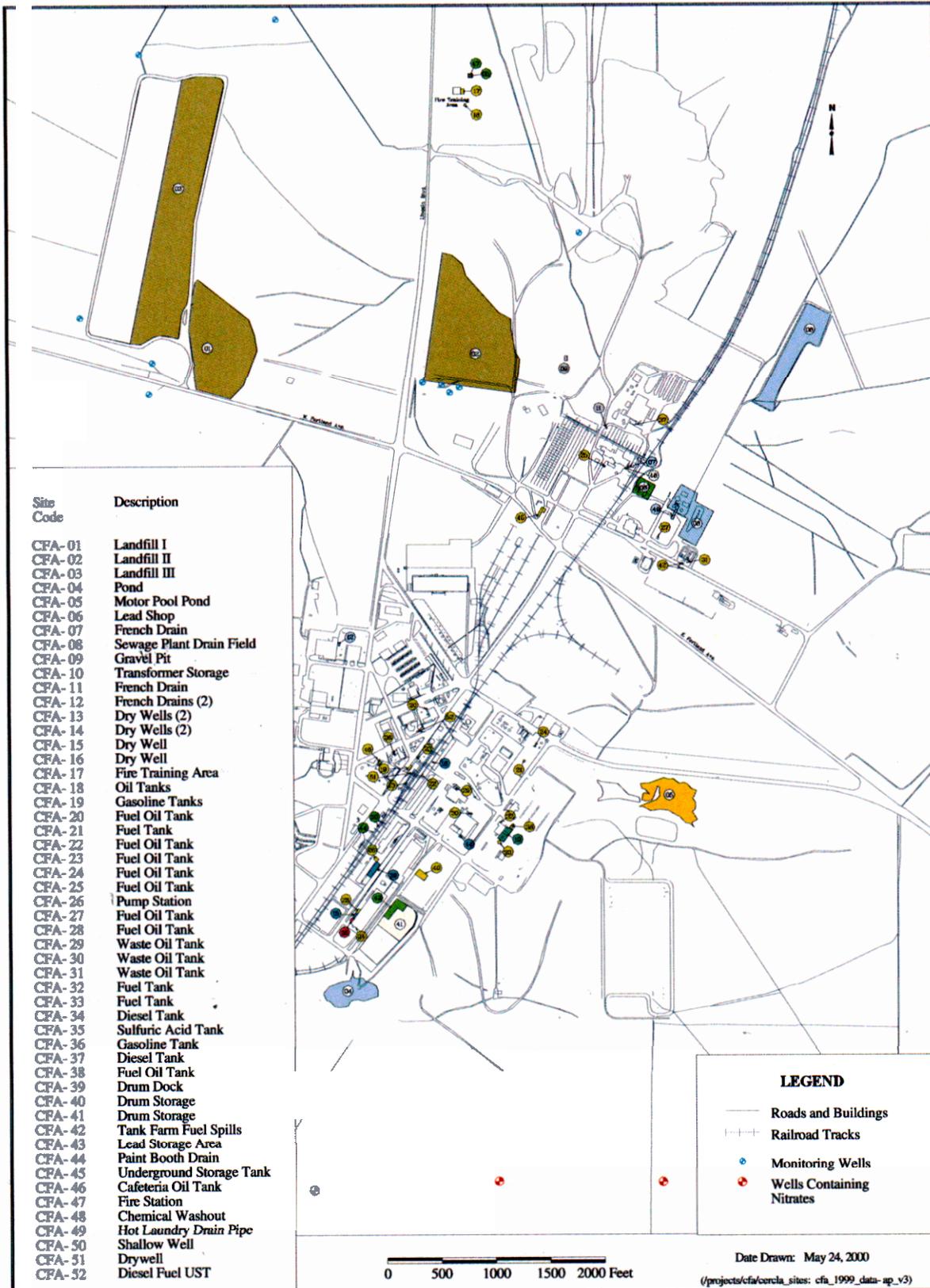


Figure 2-1. Waste Area Group 4 Comprehensive Environmental Response, Compensation, and Liability Act sites.

### 3. BACKGROUND

This section provides a summary of the physical characteristics of the CFA landfills, a description of the land and resource use, a summary of the contaminants present in various media associated with the landfills, a summary of the initial responses conducted at the landfills, and a summary of the basis for the remedial action conducted at the landfills.

#### 3.1 Physical Characteristics

The CFA landfills are located on the Eastern Snake River Plain in Big Lost River alluvial deposits overlying basalt bedrock. The sediments composing these deposits are primarily sands and gravels and contain very few fine-grained materials. In some places, however, a clay-rich layer (0 to 2.7 m [0 to 9 ft] thick) exists above the bedrock. Depth to basalt at these landfills ranges from 3.0 to 11.2 m (10 to 37 ft). The vadose zone, that portion of the subsurface that extends from the land surface down through the subsurface to the water table, at the CFA landfills is approximately 146 m (480 ft) thick. It is composed of a relatively thin layer of surface sediments, in which the wastes are disposed of, and thick sequences of interfingering basalt flows containing interbedded sediments. As a result of the relatively low annual precipitation, high potential evapotranspiration, and deep water table, vadose zone soils at the landfills tend to be relatively dry during most of the year. The spring snowmelt event provides the greatest source of water available for infiltration into the landfills. The SRPA, one of the largest and most productive groundwater resources in the United States, underlies the CFA landfills. The aquifer is listed as a Class I aquifer, and the EPA has designated it as a sole-source aquifer. The SRPA consists of a series of saturated basalt flows and interlayered pyroclastic and sedimentary materials that underlie the Eastern Snake River Plain. The depth to water at the CFA landfills varies from about 145 m (476 ft) to just over 150 m (495 ft). The direction of groundwater flow in this general vicinity is in a south to southwesterly direction. Additional information pertaining to the CFA landfills can be found in the *Remedial Investigation/Feasibility Study for Operable Unit 4-12: Central Facilities Area Landfills I, II, and III at the Idaho National Engineering Laboratory* (INEL 1995a).

##### 3.1.1 Landfill I

Landfill I occupied a total surface area of approximately 33,400 m<sup>2</sup> (8.25 acres) and consisted of three subunits: the rubble landfill, western waste trench, and northern waste trench. The rubble landfill originated as a gravel quarry that was operated by the U.S. Navy from 1942 to 1949. The quarry was used as a disposal area for Sitewide waste disposal sometime after 1949. Wastes were discarded in the landfill from the 1950s up to 1984. The surface area of the rubble landfill was estimated to be 22,300 m<sup>2</sup> (5.5 acres), and its depth was estimated to be 3.7 to 4.6 m (12 to 15 ft). The rubble landfill was covered with approximately 0.3 to 1.2 m (1 to 5 ft) of soil overlain with a layer of gravel. The surface of the western waste trench was approximately 8,100 m<sup>2</sup> (2 acres) and consisted of smaller waste trenches, each excavated to a size of 2.4 m (8 ft) wide by 3 m (10 ft) deep by 15 m (50 ft) long. Each of the smaller trenches was separated from the other by 4.6 m (15 ft) of undisturbed soil. Filled trenches were covered with 0.3 to 1.5 m (1 to 5 ft) of soil. The western trench is west of the present-day road separating Landfill I and Landfill III and is actually covered by the Landfill III cap. The northern waste trench was identified from aerial photographs and has a surface area of approximately 3,000 m<sup>2</sup> (0.75 acres). Information pertaining to its true dimensions was limited. It was covered with soil and was not discernible at the surface.

##### 3.1.2 Landfill II

Landfill II encompassed approximately 60,700 m<sup>2</sup> (15 acres) and was located in the southwest corner of an abandoned gravel pit. It received waste from September 1970 until it was closed in

September 1982. Depth to basalt at the landfill varied from 4.6 to 11.3 m (15 to 37 ft), based on a seismic refraction survey and a subsurface borehole drilling investigation. The landfill waste profile, however, was estimated to range in depth from 3.7 to 8.5 m (12 to 28 ft), because the pit probably was not excavated beyond the base of the gravel-bearing unit and into the clay material. Hand augering at 60 sampling sites indicated that the original Landfill II soil cover ranged in thickness from 0.1 to 1.0 m (0.33 to 3.17 ft), with an overall mean of 0.47 m (1.5 ft). The landfill surface was gently undulating due to differential settling of the waste and maintained a stand of crested wheatgrass.

### **3.1.3 Landfill III**

Landfill III consisted of six trenches that covered approximately 48,600 m<sup>2</sup> (12 acres). It opened in October 1982 after Landfill II was closed and operated until December 1984. Depth to the underlying basalt is 3 to 10 m (10 to 33 ft) based on a seismic refraction survey. The landfill waste profile was estimated to be 4 m (13 ft) deep on average. It was common practice to excavate the landfill trenches, leaving a soil layer intact between the wastes and underlying basalt. The original Landfill III soil cover ranged in thickness from 0.3 to 2.4 m (1 to 8 ft) with an overall mean of 0.86 m (2.83 ft), based on augering results. Ground-penetrating radar measurements estimated the average original soil cover thickness to be 0.6 to 0.9 m (2 to 3 ft). The landfill surface was also gently undulating due to differential settling of the waste and maintained a stand of crested wheatgrass.

## **3.2 Land and Resource Use**

The INEEL land area consists of approximately 2,305 km<sup>2</sup> (890 mi<sup>2</sup>). Most of this land, approximately 98%, has not been disturbed by Site operations. Land use on the entire INEEL is restricted, and access to the INEEL and WAG 4 is controlled. Though public highways traverse the INEEL, public access beyond the highway right-of-way is not allowed. Access to INEEL facilities requires proper clearance, training, or an escort, and controls to limit exposures. Current and future land uses, as well as a summary of groundwater uses (including classification and basis), are discussed in the following subsections.

### **3.2.1 Current Land Use**

The Bureau of Land Management (BLM) has classified the acreage within the INEEL as industrial and mixed use (DOE-ID 2001a). Typical INEEL land use consists of wildlife management areas, government industrial operations areas, and waste management areas. No residential areas are contained within the INEEL boundaries. As shown in Figure 3-1, large tracts of land are reserved as buffer and safety zones around the boundary of the INEEL, and operations are generally restricted to the central area. Aside from the operational facilities, the remaining land within the core of the Site is largely undeveloped and is used for environmental research, ecological preservation, and sociocultural preservation. Any future construction of new facilities at the INEEL likely will occur within the preferred development corridors.

The buffer consists of 1,295 km<sup>2</sup> (500 mi<sup>2</sup>) of grazing land (DOE-ID 2001a) administered by the BLM. Grazing areas at the INEEL support cattle and sheep, especially during dry conditions. Depredation hunts of game animals managed by the Idaho Department of Fish and Game are permitted on the INEEL within the buffer zone during selected years (DOE-ID 2001a). Hunters are allowed access to an area that extends 0.8 km (0.5 mi) inside the INEEL boundary on portions of the northeastern and western borders of the Site.

-  Bureau of Land Management/grazing
-  National Forest land
-  Private land - non-cultivated
-  Private land - cultivated
-  State land
-  INEEL buffer zones, under grazing permits

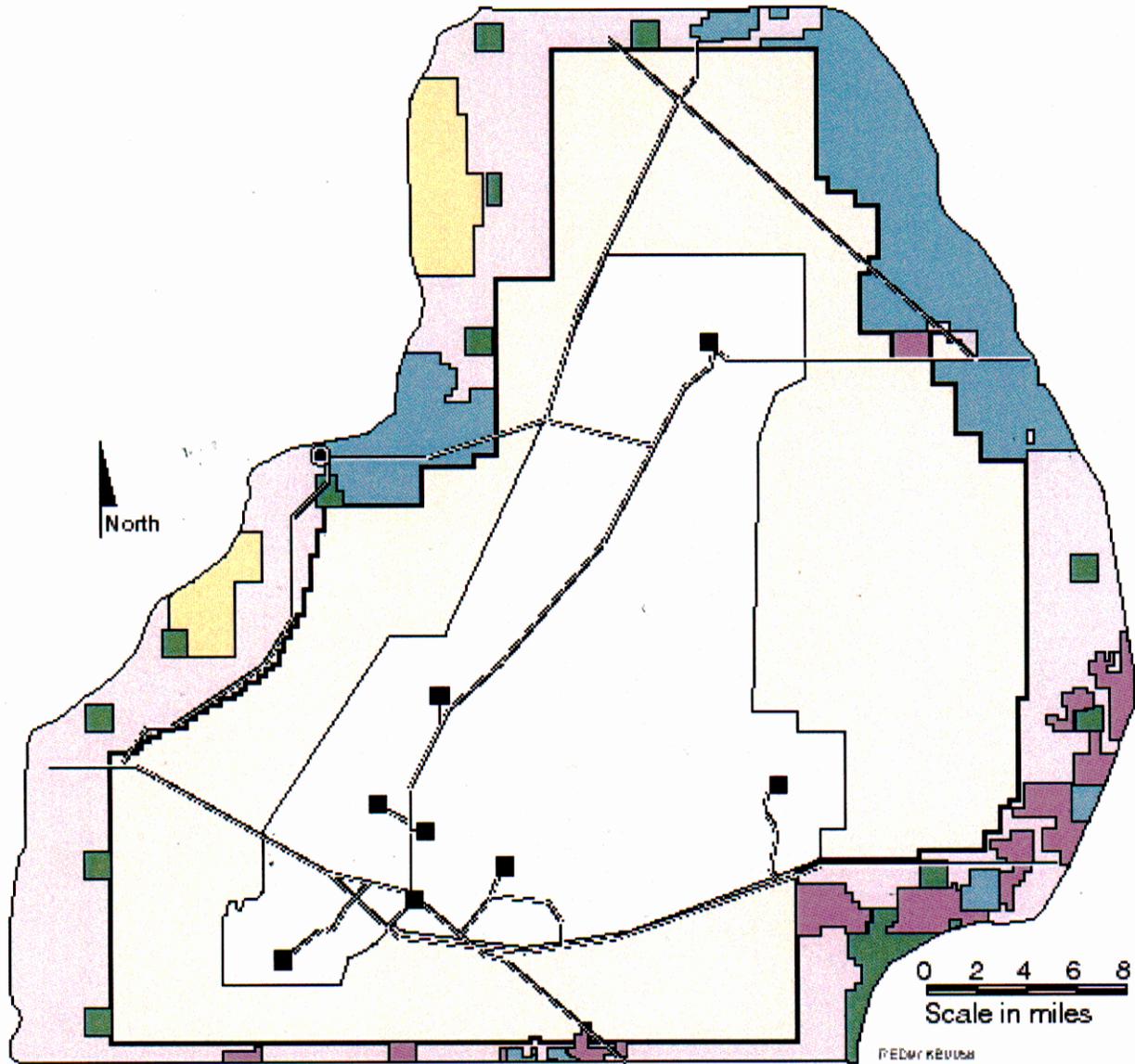


Figure 3-1. Land ownership distribution in the vicinity of the Idaho National Engineering and Environmental Laboratory.

State Highways 22, 28, and 33 cross the northeastern portion of the Site, and U.S. Highways 20 and 26 cross the southern portion (Figure 1-1). One hundred forty-five km (90 mi) of paved highways used by the general public pass through the INEEL (DOE-ID 2001a), and 23 km (14 mi) of Union Pacific Railroad tracks traverse the southern portion of the Site. A government-owned railroad passes from the Union Pacific Railroad through CFA to the Naval Reactors Facility, and a spur runs from the Union Pacific Railroad to the Radioactive Waste Management Complex.

In the counties surrounding the INEEL, approximately 45% of the land is used for agriculture, 45% is open land, and 10% is urban (DOE-ID 2001a). Livestock uses include the production of sheep, cattle, hogs, poultry, and dairy cattle (Bowman et al. 1984). The major crops produced on land surrounding the INEEL include wheat, alfalfa, barley, potatoes, oats, and corn. Sugar beets are grown within about 64 km (40 mi) of the INEEL in the vicinity of Rockford, Idaho, southeast of the INEEL in central Bingham County (Idaho 1996). Private individuals or the U.S. Government owns most of the land surrounding the INEEL. The BLM administers the government land on the INEEL (DOE-ID 2001a).

### **3.2.2 Future Land Use**

Land-use projections in the *INEEL Comprehensive Facility and Land Use Plan* (DOE-ID 2001a) incorporate the assumption that the INEEL will remain under government management and control for at least the next 100 years. However, implementation of this management and control becomes increasingly uncertain over this time period. Regardless of the future use of the land now occupied by the INEEL, the federal government has an obligation to provide adequate institutional controls (i.e., limit access) to areas that pose significant health or safety risks until those risks diminish to acceptable levels. Fulfillment of this obligation hinges on the continued viability of the federal government and on Congress appropriating sufficient funds to maintain the institutional controls for as long as necessary.

A mix of land uses across the INEEL is anticipated to include unrestricted industrial uses, government-controlled industrial uses, unrestricted areas, controlled areas for wildlife management and conservation, and waste management areas. No residential development will be allowed within the INEEL boundaries, and no new major private developments (residential or nonresidential) on public lands are expected in areas adjacent to the Site. Grazing will be allowed to continue in the buffer area (DOE-ID 2001a). In addition, the INEEL is currently a National Environmental Research Park and is expected to remain so for the foreseeable future.

The *INEEL Comprehensive Facility and Land Use Plan* (DOE-ID 2001a) was developed using a stakeholder process that involved a public participation forum, a public comment period, and the INEEL Citizen's Advisory Board. The public participation forum membership included members from the local counties and cities, the Shoshone-Bannock Tribes, the BLM, the DOE, the U.S. Forest Service, the U.S. National Park Service, the Idaho Department of Transportation, Idaho Fish and Game, and eight business, education, and citizen organizations. In addition, the EPA and Idaho Department of Health and Welfare participated in an ex-officio capacity. Following review and comment by the public participation forum, the document underwent a 30-day public comment period and was subsequently submitted to the INEEL Citizen's Advisory Board for review and recommendations. No recommendations for residential use of any portions of the INEEL within at least the next 100 years have been received to date. Projected non-industrial use is limited to grazing and similar activities.

Generally, future land use within the INEEL will remain essentially the same as the current use, which is the same as was in place at the time the baseline risk assessment was performed for the CFA landfills: a research facility within the INEEL boundaries and agriculture and open land surrounding the INEEL. Other potential, but less likely, land use within the INEEL includes agricultural applications and the return of the areas to their natural undeveloped states. The *INEEL Comprehensive Facility and Land*

*Use Plan* (DOE-ID 2001a) projects that improvements will be made to support performance capabilities of the CFA by upgrading its infrastructure, where needed, and productivity improvements will be implemented. Disposal of old, nonessential facilities will also continue to eliminate safety concerns and reduce surveillance and maintenance costs, although historic preservation and reuse possibilities are considered before facilities enter the demolition process.

### **3.2.3 Groundwater Uses**

Current use of groundwater from the SRPA is for drinking and irrigation. Groundwater is extracted from various production wells around the INEEL, including two located at CFA. Restrictions on groundwater use based on the impacts of WAG 4 operations on the aquifer are not anticipated. A technical assessment of the effects of the CFA landfills on the aquifer is provided in Section 7.

The CFA landfills are situated above the SRPA. The eastern portion of the aquifer was granted sole source status by the EPA on October 7, 1991 (56 FR 50634). The Idaho Ground Water Quality Rule (IDAPA 58.01.11), the Idaho Ground Water Quality Standards (IDAPA 58.01.11.200), and the Idaho Water Quality Standards and Wastewater Treatment Requirements (IDAPA 58.01.02) primarily dictate Idaho water quality standards.

Three categories of protectiveness apply to the aquifer and its associated resources under Idaho regulations: (1) Sensitive Resources, (2) General Resources, and (3) Other Resources. Because no previous action to categorize the SRPA under Idaho regulations has occurred, the aquifer defaults to the “General Resources” category. General Resource aquifers are protected to ensure that groundwater quality is not jeopardized. Idaho’s groundwater standards incorporate federal radiation exposure and drinking water standards (10 CFR 20, Appendix B, Table 2; 40 CFR 141 and 143). When the two federal standards are not in agreement, the more restrictive standard applies.

## **3.3 History of Contamination**

Contaminant sources in the CFA landfills can be generally described as solid and liquid nonradioactive materials discarded in the landfills over a period of 40 years. The predominant waste types entering the landfills were construction, office, and cafeteria waste. Review of the waste inventory records indicate that the major types of waste accepted at the landfills included trash sweepings, cafeteria garbage, wood and scrap lumber, masonry concrete, scrap metal, weeds and grass, dirt and gravel, asphalt, and asbestos. To a lesser extent, potentially hazardous wastes were also discarded in the landfills and may have included waste oil, solvents, chemicals, and paint. Landfill waste descriptions were determined from the Industrial Nonradioactive Waste Management Information System, interviews with INEEL personnel, reports, and other information related to waste disposal. Many uncertainties (especially with Landfill I) were associated with the data gathered from these sources, including lost or unreadable records, overestimation and/or underestimation of waste volumes, and inconsistency in actual disposal locations. Although the reliability of the waste descriptions may not have been very high, the waste descriptions did indicate the general categories of waste typically discarded in the landfills.

Solid nonradioactive materials discarded in the CFA landfills were generated by INEEL facilities, including Argonne National Laboratory-West, Auxiliary Reactor Area, CFA, Idaho Nuclear Technology and Engineering Center (formerly known as the Idaho Chemical Processing Plant at the time the landfills were operational), Experimental Breeder Reactor II, Naval Reactors Facility, Special Power Excursion Reactor Test, Test Area North, and Test Reactor Area. The Central Facilities Maintenance Branch of the Site Services Division collected waste material for disposal at the landfills. Demolition and construction materials were discarded in the landfill directly by subcontractors responsible for a given project. Records showed no indication of material segregation within the landfills. To a lesser extent, the disposal of liquid wastes in a sludge form (including oils, solvents, and other chemicals) did occur, usually by spreading

upon the day's collection of solid wastes followed by compaction and covering with at least 0.3 m (1 ft) of natural soil cover.

During operation of CFA Landfills II and III (1970 to 1984), screening procedures were in place to prevent radioactive wastes from being inadvertently deposited in the landfills during their operation. Screening was the responsibility of the generating facility. Before disposal of any waste material in the CFA landfills, the waste was screened by a radiological control technician for radionuclides to determine if the waste material was above radioactive background levels. However, it is acknowledged that up to one shipment per month of low-level radioactive waste may have been inadvertently disposed of to the landfills. Wastes were not screened for radioactivity at the time of disposal on a full-time basis at the INEEL landfills until 1989.

### 3.4 Previous Response Actions

A Track 2 investigation was conducted at CFA Landfill I in 1992 to collect, evaluate, and report information regarding contamination at the site. The field investigation was summarized in the *Preliminary Scoping Track 2 Summary Report for Operable Unit 4-10* (INEL 1995b) and consisted of two tasks. The first task included the collection of samples from CFA Landfill I that were analyzed for inorganic, volatile organic, semivolatile organic, and radioactive constituents. These analyses were performed to identify and characterize the contamination beneath the landfill at the soil-basalt interface by drilling and sampling the landfill waste and/or soil. The second task included the collection of soil samples for the analysis of geotechnical parameters. This was done to identify and characterize the physical properties of the existing landfill soil cover. A Track 2 risk assessment was performed for occupational and residential scenarios for the following pathways: soil ingestion, inhalation of fugitive dust, and external exposure. Based upon the Track 2 risk assessment performed at the time, no further action was recommended for the site.

In 1995, a remedial investigation was conducted at CFA Landfills I, II, and III. The results of this investigation are summarized in the *Remedial Investigation/Feasibility Study for Operable Unit 4-12: Central Facilities Area Landfills I, II, and III at the Idaho National Engineering Laboratory* (INEL 1995a). Because a Track 2 investigation had been performed previously at the CFA Landfill I, results of the investigation were incorporated into the report, and the remedial investigation concentrated on CFA Landfills II and III. Extensive field investigations and sampling of the groundwater, landfill cover soils, soil gas, and landfill emissions were conducted at these two landfills. In addition, seven boreholes were drilled through the waste to the top of the underlying basalt layer at Landfill II, and soil samples were collected within and below the waste unit.

A baseline risk assessment evaluated the potential adverse health effects to workers and potential future residents under the no-action alternative for the CFA landfills. Contaminants of concern included polyaromatic hydrocarbons detected in the cover soils of Landfill II and beryllium, cadmium, and zinc identified in the groundwater pathway. No contaminants of concern were identified for the air pathway. The potential total risk calculated for incidental ingestion of soil from CFA Landfill II was below the  $1 \times 10^{-4}$  risk for both workers and future residents. Beryllium posed a potential residential risk for the ingestion of groundwater of  $2 \times 10^{-4}$ . While the carcinogenic results indicated that there is concern for potential health effects to future residents exposed to beryllium detected in the downgradient wells, a great deal of uncertainty existed with the results, because beryllium was detected in only three of the downgradient wells and duplicate results at two of the three wells were non-detect for beryllium. The feasibility study recommended that a remedial alternative consisting of uniform containment with native soil cover, institutional controls, and monitoring be implemented at the site due to the heterogeneous nature of the landfill waste, the uncertainty of the waste inventory and disposal records, and the inability to completely characterize the landfills.

## 4. REMEDIAL ACTION

The remedial action conducted at CFA Landfills I, II, and III is protective of human health and the environment and was performed in compliance with the applicable or appropriate and relevant requirements as established in the ROD (DOE-ID 1995). Based upon cover infiltration monitoring commencing in the spring of 1997 and verbal agreement with the Agencies, it was determined that the 5-year review of the CFA landfills remedial action would take place in the spring of 2002 with submittal of the 5-year review report by the end of April 2002. The review period covers from 1996 when the remedial action began and from 1997 when all landfill monitoring activities commenced through the summer of 2002.

### 4.1 Remedy Selection

Based upon consideration of the CERCLA requirements, the detailed analysis of alternatives, and public comments, the Agencies selected uniform containment with native soil cover, institutional controls, and monitoring as the most appropriate remedy for the CFA landfills. Containment with a native soil cover is believed to be the best alternative for minimizing public risk and providing long-term protection of the SRPA.

As defined in the ROD (DOE-ID 1995) and established in the OU 4-12 Work Plan (DOE-ID 1996), there are three primary remedial action objectives associated with the CFA landfills. These include the following:

- Prevent direct contact with the landfill contents. This was accomplished by placement of the uniform native soil cover over the landfills and through the implementation of institutional controls including fences, signs, and administrative controls. Maintenance and monitoring of the institutional controls are covered by the *Operations and Maintenance Plan for the Central Facilities Area Landfills I, II, and III Native Soil Cover Project Operable Unit 4-12* (INEL 1997a) as superseded by the *Operations and Maintenance Plan for the Final Selected Remedies and Institutional Controls at Central Facilities Area, Operable Unit 4-13* (DOE-ID 2002a).
- Minimize the potential for erosion and infiltration at the landfill surface. This relied on the use of the HELP model to design a cover that would meet this goal. Requirements for the maintenance of the landfill cover are delineated in the *Operations and Maintenance Plan for the Central Facilities Area Landfills I, II, and III Native Soil Cover Project Operable Unit 4-12* (INEL 1997a) as superseded by the *Operations and Maintenance Plan for the Final Selected Remedies and Institutional Controls at Central Facilities Area, Operable Unit 4-13* (DOE-ID 2002a).
- Ensure that drinking water standards are not violated in the SRPA due to the migration of contaminants from the landfills. This relied on a landfill cover design intended to minimize infiltration as well as implementation of the Post-ROD Monitoring Work Plan (INEL 1997b). Monitoring requirements include measurement of soil moisture, soil gas, groundwater contaminants, and water level measurements to determine groundwater flow direction. Requirements in the *Final Selected Remedies and Institutional Controls at Central Facilities Area, Operable Unit 4-13* (DOE-ID 2002b) cover maintenance of landfill monitoring equipment.
  - The objective of soil moisture monitoring is to determine the landfill covers' effectiveness at minimizing infiltration into the landfill wastes. An action level was to be established for moisture infiltration rate through the landfill covers following the 2-year intensive monitoring period.

- The objective of soil gas monitoring is to provide data to evaluate potential leaching of volatile organic compounds (VOCs) from the buried landfill waste. An action level was to be established for vadose zone gas following the 2-year intensive monitoring period.
- The objective of groundwater monitoring is to provide data to evaluate potential leaching of contaminants to the aquifer, establish a baseline for contaminant concentrations in the aquifer, and monitor groundwater flow direction. The action levels for groundwater contaminant concentrations are based upon EPA-established maximum contaminant levels and risk-based concentrations.

The major components of the remedy included (1) placement of a uniform native soil cover over Landfills I, II, and III; (2) the implementation of institutional controls; and (3) the periodic monitoring of groundwater, infiltration, and/or vadose zone. The remedy is believed to be protective of human health and the environment, complies with the applicable or relevant and appropriate requirements established in the ROD (DOE-ID 1995), and is the most cost-effective of the alternatives evaluated.

As provided in the OU 4-12 Work Plan (DOE-ID 1996), the remedy ensured that a thickness of at least 0.6 m (2 ft) of a combination of existing soil cover and clean, compacted native soils covers the landfills' waste. Routine maintenance of the cover includes placement of soils (as needed) to eliminate low spots that might form due to landfill content subsidence. The cover's long-term stability has been enhanced using natural vegetation consisting of three varieties of wheatgrass (P-27 Siberian wheatgrass, "Ephraim" crested wheatgrass, and "Sodar" streambank wheatgrass) at the cover's surface. In addition to the cover, the remedy included institutional controls to ensure that future activities do not compromise the integrity of the cover (INEL 1997a). Landfill borders have been delineated through the posting of signs warning of the landfills' existence and potentially contaminated soils (INEL 1997a).

## 4.2 Remedy Implementation

The remedial action for CFA Landfills I, II, and III included placement of a native soil cover, establishment of environmental monitoring, implementation of administrative controls, inspection and maintenance of the cover, and maintenance of institutional controls. The remedial action commenced in 1996 with completion of the installation of the monitoring equipment in April 1997. A new time-domain reflectometer array was installed in 2000 and became operational in October of that year.

The native soil cover consisted of three layers: (1) a general backfill layer that brought the existing grade up to the design slope (rough grade), (2) a compacted low-permeability soil layer, and (3) a topsoil layer that created the final grade and allows for growth of a vegetative cover. To install the cover over each landfill, the landfill was initially grubbed to remove surficial organic material in an effort to minimize void creation due to decomposition. Fill material for all three layers was obtained from Spreading Area "B" at the INEEL and placed over the landfills. The fill material was described as a lean clay with sand. The particle size analysis had 84.1% of the material passing through a No. 200 sieve (less than 0.075 mm average diameter). Both the general backfill and low-permeability soil layers were compacted to 95% of maximum dry density at 0 to +4 percentage points from optimum moisture content. The general backfill layer was emplaced with a maximum 15-cm (6-in.) compacted lift thickness. The low-permeability soil layer was placed in maximum 20-cm (8-in.) loose lifts to attain a maximum 15-cm (6-in.) compacted lift thickness. The final topsoil layer was emplaced with no compaction. In addition, for Landfill II, a riprap layer was installed at the extreme northeast face of the landfill, rather than revegetating the area, in an effort to prevent erosion due to the steepness of the slope. A detailed description of the remedial action, including the installation of the landfill covers, is provided in the *Remedial Action Report CFA Landfills I, II, and III Native Soil Cover Project Operable Unit 4-12* (DOE-ID 1997).

In accordance with the ROD (DOE-ID 1995), environmental monitoring of the site includes vadose zone, groundwater, and infiltration monitoring. Groundwater monitoring wells were previously installed in the area surrounding the CFA landfills. A total of nine soil gas-sampling points were installed in CFA Landfills II and III prior to the remedial action. These sampling ports range in depth from 3.5 to 9.4 m (11.5 to 31 ft) below land surface (bls). No sampling points were initially located near CFA Landfill I, because the sampling points at Landfills II and III were installed as part of the remedial investigation conducted for OU 4-12 of which Landfill I was not originally a part. As part of the remedial action, five new gas-sampling boreholes were installed (one adjacent to CFA Landfill I and two adjacent to both CFA Landfills II and III). Each borehole was completed with four sampling ports, two above the shallow interbed and two below. In addition to the groundwater and vadose zone monitoring capabilities, a time-domain reflectometry system was installed on Landfills I and II to monitor infiltration. Waveguide probes were installed in groups of four, with the first installed 15 cm (6 in.) above the existing grade, the second at the top of the rough grade material, the third between the first and second lift of low-permeability soil, and the fourth at the top of the low-permeability soil layer, just under the topsoil layer. Infiltration monitoring also includes the logging of the five neutron-probe access tubes (NATs) that were in place before the remedial action.

### 4.3 Operations and Maintenance

The *Operations and Maintenance Plan for the Central Facilities Area Landfills I, II, and III Native Soil Cover Project Operable Unit 4-12* (INEL 1997a) as superseded by the *Operations and Maintenance Plan for the Final Selected Remedies and Institutional Controls at Central Facilities Area, Operable Unit 4-13* (DOE-ID 2002a) describes the activities and procedures required to maintain the natural soil covers and the related systems and equipment at CFA Landfills I, II, and III. Basic elements of the O&M Plan (DOE-ID 2002a) include a description of inspection, maintenance, and repair procedures for the vegetative cover, soil cover, rock armor, and monitoring equipment. Operational and sampling procedures for the NATs and time-domain reflectometers are outlined in the *Post Record of Decision Monitoring Work Plan Central Facilities Area Landfills I, II, and III Operable Unit 4-12* (INEL 1997b). The O&M Plan (DOE-ID 2002a) outlines the requirements for the following:

- Inspection and corrective maintenance of the vegetative cover, including inspections for nongrowth areas, sparse growth areas, and weed and shrub encroachment, as well as corrective repair
- Inspection and corrective maintenance of the soil cover—including inspection of erosion areas and ponding caused by subsidence—inspections for animal intrusion, surveying for slope movement and changes in contours, and corrective repair of erosion, animal intrusion, and ponding areas
- Inspection and corrective maintenance of the rock armor, including inspections of the rock-armored slopes and corrective repair
- Inspection and corrective maintenance of NAT installations, including inspections of well components, inspections of the tubes, and corrective repair of problem areas
- Inspection and corrective maintenance of the time-domain reflectometer installations, including inspection of time-domain reflectometer components and corrective repair of problem areas
- Inspection of institutional controls, including fences and postings restricting access to the CFA landfill area by unauthorized personnel.



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### 5.3 Review Schedule

Collection of information and data pertinent to the CFA landfills' 5-year review supporting documentation is an ongoing process and includes the compilation of analytical and inspection reports that have been prepared since the completion of the remedial activity. Preparation of the 5-year review supporting documentation report commenced on January 11, 2002, with the review period expected to culminate with the finalization of the report scheduled for September 2002.

### 5.4 Document Review

In preparation for and conducting of the CFA landfill 5-year review supporting documentation, the following documents relating to the investigation and remediation of the CFA Landfills I, II, and III were reviewed:

- *Preliminary Scoping Track 2 Summary Report for Operable Unit 4-10 (INEL 1995b)*
- *Remedial Investigation/Feasibility Study for Operable Unit 4-12: Central Facilities Area Landfills I, II, and III at the Idaho National Engineering Laboratory (INEL 1995a)*
- *Record of Decision: Declaration for Central Facilities Area Landfills I, II, and III (Operable Unit 4-12), and No Action Sites (Operable Unit 4-03) (DOE-ID 1995)*
- *Remedial Design/Remedial Action Work Plan for Central Facilities Area Landfills I, II, and III Native Soil Cover Project Operable Unit 4-12 (DOE-ID 1996)*
- *Remedial Action Report CFA Landfills I, II, and III Native Soil Cover Project Operable Unit 4-12 (DOE-ID 1997)*
- *Post Record of Decision Monitoring Work Plan Central Facilities Area Landfills I, II, and III Operable Unit 4-12 (INEL 1997b)*
- *Field Sampling Plan for the Post Record of Decision Monitoring CFA Landfills I, II, and III Operable Unit 4-12 (INEL 1997c)*
- *Operations and Maintenance Plan for the Central Facilities Area Landfills I, II, and III Native Soil Cover Project Operable Unit 4-12 (INEL 1997a)*
- *Operation and Maintenance Plan for the Final Selected Remedies and Institutional Controls at Central Facilities Area, Operable Unit 4-13 (DOE-ID 2002a)*
- *Post-Record of Decision Monitoring Report from 1996–1998 at Operable Unit 4-12, Central Facilities Area Landfills I, II, and III (CFA-01, CFA-02, and CFA-03) (INEEL 2000).*

In addition to the documents listed above, the O&M inspection reports and monitoring data were reviewed. Routine inspections of the covers, rock armor, monitoring equipment, and institutional controls have been completed, and corrective maintenance has been performed as needed. The monitoring of the NATs, time-domain reflectometry arrays, gas-sampling boreholes, and groundwater has been performed, as required, in accordance with the Post-ROD Monitoring Work Plan (INEL 1997b) and the Field Sampling Plan (FSP) for the Post-ROD Monitoring (INEL 1997c). The technical assessment of the collected data is summarized in Section 7.